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Appendix 5.4
Preliminary Geotechnical Report, Proposed Black Rock Geothermal Power Plant, SWC McKendry Road and Boyle Road, Calipatria, California

Geotechnical Report

Proposed Black Rock Geothermal Power Plant
SWC McKendry Road and Boyle Road
Calipatria, California

Prepared for:

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October 20, 2022

Mr. Manjot S. Bhangoo
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Preliminary Geotechnical Investigation
Proposed 81 MW Black Rock Geothermal Power Plant
SWC McKendry and Boyle Roads
Calipatria, California
LCI Report No. LE22199

Dear Mr. Bhangoo:

This preliminary geotechnical report is provided for design and construction of the proposed 81 MW Black Rock geothermal power plant located at the southwest corner of McKendry Road and Boyle Road northwest of Calipatria, California. Our preliminary geotechnical investigation was conducted in response to your request for our services. The enclosed preliminary report describes our soil engineering investigation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

Based on the geotechnical conditions encountered at the points of exploration, the project site appears suitable for the proposed construction provided the professional opinions contained in this report are considered in the design and construction of this project.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. Please provide our office with a set of the foundation plans and civil plans for review to insure that the geotechnical site constraints have been included in the design documents. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
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EXECUTIVE SUMMARY

This executive summary presents ***selected*** elements of our findings and professional opinions. This summary ***may not*** present all details needed for the proper application of our findings and professional opinions. Our findings, professional opinions, and application options are ***best related through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them. The findings of this study are summarized below:

- Clay soils (CL) of medium to high expansion (EI = 70 to 100) predominate the near surface soils at the project site.

- Soft to loose sandy clays and silt predominate the upper 40 feet of the site.

- Groundwater was encountered 3.5 to 5 feet below ground surface at this site as reported in a geotechnical report for the project site conducted by Geotechnics, Inc. of San Diego, California in February 2002 (Geotechnics Project No. 0673-002-00, dated February 5, 2002

- The site may be considered “unsuitable” for wastewater disposal due to high groundwater and a very low infiltration capacity of the surface clays. Alternate wastewater treatment and disposal systems will be required.

- The risk of liquefaction induced settlement is high. Liquefaction may occur in isolated silt and sand layers encountered at various depths between 6 and 50 feet below ground surface. Potential liquefaction induced settlements of 4¾ to 6½ inches have been estimated for the project site.

- Ground subsidence sinkholes (gloryhole) have historically occurred at an abandoned well pad south of this site.

- In order to reduce settlement in the geothermal plant structures to generally accepted limits, existing soft, compressible clays may be strengthened by soil improvement (soil mixing or replacement with sand/cement) or by use of deep foundation systems like auger cast or driven piles. These options are discussed in the report.

- The site elevation is generally 6.0 feet below the minimum building elevation established by Imperial County (Elevation -220). A flood study and protection from overland flood waters will likely be required by the County of Imperial. A storm water retention basin for 3 inch rainfall will be required.

- Subsurface agricultural tile drainage pipelines exist at this site, used to control groundwater depth and to remove excess salts from irrigation water which infiltrates the soil. The drainage pipelines will need to be abandoned by cutting and plugging at the perimeter of the facility.

- The native soil is severely corrosive to metals and contains sufficient sulfates and chlorides to require special concrete mixes (6.5 sack cement factor with a 0.45 maximum water cement ratio and Type V cement) and protection of embedded steel components (4-inch minimum concrete cover) when concrete is placed in contact with native soil. Special concrete additives for water tightness may be required. Polypropylene vapor retarders (10 to 15 mil) should be used below all slabs on grade to reduce corrosion potential of steel reinforcement

- All reinforcing bars, anchor bolts and hold down bolts shall have a minimum concrete cover of 4.0 inches and epoxy coated (ASTM D3963/A934). Hold-down straps at the foundation perimeter and pressurized water lines below or within the foundations are not allowed.

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APPENDICES

Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our preliminary geotechnical investigation for the proposed geothermal power plant located at the southwest corner of McKendry Road and Boyle Road northwest of Calipatria, California (See Vicinity Map, Plate A-1). The proposed 81 MW geothermal plant will typically include a turbine-generator structure, cooling tower, wellhead separators, crystallizer, water tanks, primary and secondary clarifier tanks, control building, office buildings, substation, pipelines and supports, various ancillary structures and associated internal roadways. Raw water ponds and perimeter flood protection embankments are planned to be constructed at the perimeters of the proposed geothermal plant site. Embankment heights are expected to be 6 to 7 feet. No geothermal wells are planned for the plant site. All geothermal fluids will be piped (above ground) to the site. A site plan for the proposed development was provided by the client at the time that this report was prepared.

The non-power generation structures (control rooms, administration buildings, etc.) are planned to consist of slab-on-grade foundations with masonry and steel-frame or panelized tilt-up concrete construction. Expected footing loads are estimated at 1 to 5 kips per lineal foot for the small structures. Expected plant components, cooling tower, clarifiers and turbine/generator columns loads range from 5 to 400 kips. The dimensions for the proposed steel clarifier tanks were not provided at the time that this report was prepared. The estimated loads imposed at ground surface by the loaded tanks are expected to range from 2,000 to 3,000 pounds per square foot.

If structural loads exceed those stated above, we should be notified so we may evaluate their impact on foundation settlement and bearing capacity. Site development will include mass grading, foundation support pad preparation, underground utility installation, water treatment plant construction, on-site sewage disposal system installation, roadway construction and concrete flatwork placement.

1.2 Purpose and Scope of Work

The purpose of this preliminary geotechnical study was to investigate the upper 100 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties. From the subsequent field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction. The scope of our services consisted of the following:

- Field exploration and in-situ testing of the site soils at selected locations and depths.
- Laboratory testing for physical and/or chemical properties of selected samples.
- Review of the available literature and publications pertaining to local geology, faulting, and seismicity.
- Engineering analysis and evaluation of the data collected.
- Preparation of this report presenting our findings, professional opinions, and recommendations for the geotechnical aspects of project design and construction.

This report addresses the following geotechnical issues:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, and site seismic design criteria
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above issues are presented for the following:

- Site grading, earthwork and embankment construction
- Building pad and foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Deep foundation alternatives
- Soil improvement alternatives
- Concrete slabs-on-grade
- Lateral earth pressures
- Excavation conditions and buried utility installations
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters
- Pavement structural sections
- Onsite Wastewater Treatment/Disposal

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions, stormwater infiltration, on-site wastewater soil percolation rates, groundwater mounding, or landscape suitability of the soil.

1.3 Authorization

BHE Renewables, LLC provided authorization by Purchase Order No. 160007 to proceed with our work on September 26, 2022. We conducted our work according to our written proposal dated September 12, 2022.

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Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on September 28, 2022 using Kehoe Testing and Engineering, Inc. of Huntington Beach, California to advance four (4) electric cone penetrometer (CPT) soundings to approximate depths of 50 to 100 feet below existing ground surface. The soundings were made at the locations shown on the Site and Exploration Plan (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernible site features.

CPT soundings provide a continuous profile of the soil stratigraphy with readings every 2.5cm (1 inch) in depth. Direct sampling for visual and physical confirmation of soil properties has been used by our firm to establish direct correlations with CPT exploration in this geographical region.

The CPT exploration was conducted by hydraulically advancing an instrumented 15cm^2 conical probe into the ground at a rate of 2cm per second using a 30-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were then applied to the data to give a continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (ϕ) angle (soil friction angle), undrained shear strength (S_u) of clays and over-consolidation ratio (OCR). These correlations may then be used to evaluate vertical and lateral soil bearing capacities and consolidation characteristics of the subsurface soil.

Shear wave velocity was determined for the subsurface soils to a depth of 100 feet at CPT-1. Shear wave velocities averaged (600 ft/sec) for the upper 100 feet. The site soils have been classified as Site Class D (stiff soil profile).

Additional subsurface exploration was performed on September 27 and 28, 2022 using 2R Drilling of Chino, California to advance three (3) borings to depths of 25 to 75 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 75 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers.

The approximate boring locations were established in the field and plotted on the site map by sighting to discernible site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

A senior soil technician observed the drilling operations and maintained logs of the soil encountered with sampling depths. Soils were classified during drilling according to the Unified Soil Classification System using the visual-manual procedure in accordance with ASTM D2488. Relatively undisturbed and bulk samples of the subsurface materials were obtained at selected intervals. The relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler lined with 6-inch stainless-steel sleeves. In addition, Standard Penetration Tests (SPT) were performed in accordance with ASTM D1586 and ASTM D6066. The samples were obtained by driving the samplers ahead of the auger tip at selected depths using a 140-pound CME automatic hammer with a 30-inch drop. The number of blows required to drive the samplers the last 12 inches of an 18-inch drive depth into the soil is recorded on the boring logs as "blows per foot". Blow counts (N values) reported on the boring logs represent the field blow counts. No corrections have been applied to the blow counts shown on the boring logs for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter. Pocket penetrometer readings were also obtained to evaluate the stiffness of cohesive soils retrieved from sampler barrels.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

Interpretive logs of the CPT soundings and logs of the test borings and test pits were produced after review of field and laboratory test data and are presented on Plates B-1 through B-6 in Appendix B of this report. Keys to the interpretation of CPT soundings, logs of test borings and test pits are presented on Plate B-7 and B-8. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

2.2 Field Electrical Resistivity Testing

Wenner 4-pin field resistivity testing was conducted by RF Yeager Engineering of Lakeside, California under sub-contract to Landmark at two (2) locations around the project site in accordance with ASTM G57 standards. Tests were conducted with both a north-south and east-west pin orientations. The tests were conducted at pin spacings of 2.5, 5, 10, 15, 20 and 40 feet. Additionally, two (2) near surface soil samples (upper 3 feet) were obtained for laboratory soil corrosivity testing at the select location. The results of the electrical resistivity and soil corrosivity testing are presented in Appendix H.

2.3 Thermal Resistivity Testing

On-site field soil thermal resistivity testing was conducted by RF Yeager Engineering at two (2) locations located at the northwest and south sides of the substation. The tests were conducted at the same locations where TR-1 and TR-2 soundings were performed. The testing were conducted in accordance with ASTM D5344. A hole was hand dug at each location to a depth of about 3 feet for each test. The results of the thermal resistivity testing are presented in Appendix H.

2.4 Laboratory Testing

Laboratory tests were conducted on selected bulk (auger cuttings) and relatively undisturbed soil samples obtained from the soil borings to aid in classification and evaluation of selected engineering properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Plasticity Index (ASTM D4318)
- Particle Size Analyses (ASTM D6913/D7928)
- Unit Dry Densities (ASTM D2937)
- Moisture Contents (ASTM D2216)
- One Dimensional Consolidation (ASTM D2435)
- Moisture-Density Relationship (ASTM D1557)
- Direct Shear (ASTM D3080)
- Unconfined Compression (ASTM D2166)
- R Value (CAL 301)
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods)

The laboratory test results are presented on the subsurface logs (Appendix B) and in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were obtained from the field and laboratory testing program.

Section 3
DISCUSSION

3.1 Site Conditions

The project site is located at the southwest corner of McKendry Road and Boyle Road approximately 7 miles northwest of Calipatria, California. The project site is located in an active agricultural field currently in bermuda grass crop. The project site is bounded on the east by a concrete lined irrigation water delivery canal (Imperial Irrigation District) and Boyle Road (dirt) and the north by McKendry Road (gravel). Agricultural fields are located to the south, west, north and east of the site. The Vulcan and Hoch Geothermal Power Plants are located adjacent to the southeast corner of the project site. The Salton Sea is located northwest of the project site and has an approximately 8 foot high embankment (levee) separating the sea from the project site.

The project site lies at an elevation of approximately 232 feet below mean sea level (MSL) (El. 768 local datum) in the Imperial Valley region of the California low desert. ***In general, Imperial County regulations require all structures to be constructed above the Elevation 220 contour or to be protected from flooding by placing berms to the Elevation 220 contour.***

The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water to an elevation of 43± feet above MSL. Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures above 100 ^{o}F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Salton Trough region of the Colorado Desert physiographic province of southeastern California. The Salton Trough is a topographic and geologic structural depression resulting extending from the San Gorgonio Pass to the Gulf of California (Norris & Webb, 1990). The Salton Trough is bounded on the northeast by the San Andreas fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone.

The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments deposited since the Miocene Epoch (Morton, 1977). Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The Imperial Valley is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The Late Pleistocene to Holocene (present) lake deposits are probably less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake (Lake Cahuilla). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 - 20,000 feet.

3.3 Subsurface Soil

The USDA Natural Resources Conservation Service "Web Soil Survey" (USDA, 2022) website indicates that surficial deposits at the project site consist predominantly of silty clay loams overlying fine sands of the Imperial-Glenbar and Holtville soil groups (see Plate A-3). These loams are formed in sediment and alluvium of mixed origin (Colorado River overflows and fresh-water lake-bed sediments).

The subsurface soils encountered during the field exploration conducted on September 27 and 28, 2022 consist of approximately 5 feet of near surface silty clays. Interbedded medium dense silty sands, silts and silty clays were encountered from about 5 to 35 feet below ground surface with a dense sand layer at about 3 to 45 feet. Stiff clays with thin silty sand and silt layers are encountered at a depth of 45 to 100 feet, the maximum depth of exploration. The subsurface logs (Plates B-1 through B-6) depict the stratigraphic relationships of the various soil types.

Variations in subsurface stratigraphy may occur between the points of exploration. The stratification lines shown on the subsurface log represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

The native surface clays likely exhibit high swell potential (Expansion Index, EI = 110 to 132) when correlated to Plasticity Index tests (ASTM D4318) performed on the native soils.

The clay is expansive when wetted and can shrink with moisture loss (drying). Development of building foundations and concrete flatwork should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil. Causes for soil saturation include landscape irrigation, broken utility lines, or capillary rise in moisture upon sealing the ground surface to evaporation. Moisture losses can occur with lack of landscape watering, close proximity of structures to downslopes and root system moisture extraction from deep rooted shrubs and trees placed near the foundations. The design structural engineer (foundations) should consider the effects of non-uniform moisture conditions around the entire foundation when selecting design criteria for the foundations.

Typical measures used for industrial projects to remediate expansive soil include:

- capping silt/clay soil with a non-expansive sand layer of sufficient thickness (typically 3 to 4 feet) to reduce the effects of soil shrink/swell,

3.4 Groundwater

Groundwater was encountered in the borings at about 6 feet at the time of exploration, but may rise with time to approximately 3.5 to 5 feet below ground surface at this site as reported in a geotechnical report for the project site conducted by Geotechnics, Inc. of San Diego, California in February 2002 (Geotechnics Project No. 0673-002-00, dated February 5, 2002). There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, removal of the subsurface tile drainage pipeline, level of the Salton Sea and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition. Our work scope did not include a groundwater surface mounding study resulting from applied landscape water.

Soils encountered below 2 to 3 feet are likely to pump under construction wheel loads. Light earthmoving equipment should be anticipated for use in these areas.

Subsurface agricultural tile drainage pipelines (4-inch diameter plastic or clay perforated pipelines encapsulated by sand/gravel envelopes) exist at a depth of 5 to 7 feet below this site and are used to remove salts accumulating from agricultural irrigation and crop production. Abandoning and plugging the subsurface drainage pipelines can allow groundwater levels to rise variably across the site. Cutting the subsurface tile drain pipelines with utility trenches will likely result in some localized trench flooding. Base line collectors (6 or 8 inch diameter) should be crushed in-place and trench backfill compacted (85-90%). The 4-inch lateral pipeline drains are not required to be removed or crushed in-place. The pipelines should be plugged at the perimeter of the facility. Copies of the tile drainage system plats (TD-1373) as obtained from Imperial Irrigation District records are provided in Appendix G.

3.5 Faulting

The project site is located in the seismically active Imperial Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. The San Andreas Fault System is comprised of the San Andreas, San Jacinto, and Elsinore Fault Zones in southern California. The Imperial fault represents a transition from the more continuous San Andreas fault to a more nearly echelon pattern characteristic of the faults under the Gulf of California. We have performed a computer-aided search of known faults or seismic zones that lie within a 45 mile radius of the project site (Table 1: Appendices).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along Holocene-active or pre-Holocene faults (CGS, 2022b). Earthquake Fault Zones are regulatory zones that address the hazard of surface fault rupture. A Holocene-active fault is one that has ruptured during Holocene time (within the last 11,700 years). A pre-Holocene fault is a fault that has not ruptured in the last 11,700 years. Pre-Holocene faults may still be capable of surface rupture in the future, but are not regulated by the Alquist-Priolo Act (AP).

Review of the current Earthquake Fault Zone maps (CGS, 2022a) indicates that the nearest zoned fault is the Elmore Ranch fault located approximately 4.4 miles west of the project site.

The project site lies within the Brawley Seismic Zone (BSZ), a pull-apart basin between the southern terminus of the San Andreas fault and the northern trace of the Imperial fault. The BSZ is composed of numerous cross-cutting high angle normal faults. The BSZ extends northward beyond the termination of the mapped Imperial/Brawley faults to beneath the Salton Sea, where it terminates upon intersecting the San Andreas fault near Bombay Beach. The Brawley Seismic Zone was the source of the 1981 5.9M_W Westmorland earthquake sequence that involved activity on at least seven distinct fault planes within the zone. An earthquake swarm with eleven (11) earthquakes above magnitude 4.0 (the largest being 5.5$M_{w)}$ occurred approximately 2 miles northwest of Brawley, California between August 26-28, 2012. Although there was no evidence of surface rupture associated with this event, numerous structures in Brawley were damaged.

The faults in the Brawley Seismic Zone are considered to be short enough that earthquakes much larger than 6-6.5M_W are unlikely. The California Geological Survey considers the Brawley Seismic Zone to have a maximum magnitude of 6.4Mw, with a very short 24-year average return interval, and a geologic slip rate of 25 mm/year.

3.6 General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

<u>2019 CBC General Ground Motion Parameters:</u> The California Building Code (CBC) requires that a site-specific ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 11.4.8 (ASCE, 2016) for structures on Site Class D and E sites with S_1 greater than or equal to 0.2 and Site Class E sites with S_s greater than or equal to 1.0 (CBC, 2019). **This project site has been classified as Site Class D (Table 3 Appendices) and has a S_1 value of 0.6, which would require a site-specific ground motion hazard analysis**. However, ASCE 7-16 Section 11.4.8 provides three exceptions which permit the use of conservative values of design parameters for certain conditions for Site Class D and E sites in lieu of a site specific hazard analysis. The exceptions are:

- Exception 1: Structures on Site Class E sites with S_s greater than or equal to 1.0, provided the site coefficient F_a is taken as equal to that of Site Class C.
- Exception 2: Structures on Site Class D sites with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient C_s is determined by Equations 12.8-2 for values of $T \leq 1.5T_S$ and taken as equal to 1.5 times the value computed in accordance with either Equation 12.8-3 for $T_L \geq T > 1.5T_S$ or Equation 12.8-4 for $T > T_L$.
- Exception 3: Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_S and the equivalent static force procedure is used for design.

Based on our understanding of the proposed development, the seismic design parameters presented in Table 2 were calculated assuming that one of the exceptions listed above applies to the proposed structures at this site. **However, the structural engineer should verify that one of the exceptions is applicable to the proposed structures.** If none of the exceptions apply, our office should be consulted to perform a site-specific ground motion hazard analysis. A site-specific ground motion hazard analysis may produce lower $PGA_{M.}$

The 2019 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2022) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value to be used for liquefaction and seismic settlement analysis in accordance with 2019 CBC Section 1803.5.12 ($PGA_M = F_{PGA}$*PGA) is estimated at 0.61g for the project site. **Design earthquake ground motion parameters are provided in Table 2 (Appendices).**

3.7 Seismic and Other Hazards

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Elmore Ranch, San Andreas, and Brawley Seismic Zone faults.

- **Surface Rupture.** The California Geological Survey (2022b) has established Earthquake Fault Zones in accordance with the 1972 Alquist-Priolo Earthquake Fault Zone Act. The Earthquake Fault Zones consists of boundary zones surrounding well defined, active faults or fault segments. The project site does not lie within a currently mapped A-P Earthquake Fault Zone; therefore, surface fault rupture is considered to be low at the project site.
- **Liquefaction and lateral spreading.** Liquefaction is a potential design consideration because of underlying saturated sandy substrata. Although the Imperial Valley has not yet been evaluated for seismic hazards by the California Geological Survey seismic hazards zonation program, liquefaction is well documented in the Imperial Valley after strong seismic events (McCrink, et al, 2011 and Rymer et al, 2011). The potential for liquefaction at the site is discussed in more detail in Section 3.8. Liquefaction induced lateral spreading is not expected to occur at this site due to the planar topography.

<u>Other Potential Geologic Hazards.</u>

- **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps, aerial photographs and topographic maps of the region and no indications of landslides were observed during our site investigation.
- **Volcanic hazards.** The site is located in close proximity (1 to 2 miles) to a known volcanically active area (Obsidian Buttes and Red Hill). The risk of volcanic hazards is considered low. The domes erupted about 1,800 to 2,500 years ago (Wright et al, 2015). The subsurface brine fluids around the domes have a high heat flow and are currently being utilized to produce geothermal energy.
- **Tsunamis and seiches.** Tsunamis are giant ocean waves created by strong underwater seismic events, asteroid impact, or large landslides. Seiches are large waves generated in enclosed bodies of water in response to strong ground shaking. The site lies adjacent to the Salton Sea, so the threat of seiches or other seismically-induced flooding is considered possible.
- **Flooding.** Based on our review of Federal Emergency Management Agency (FEMA) FIRM Panel 06025C0725C which encompasses the project site, the project site is located in Flood Zone A, an area to be within a special flood hazard area subject to inundation by the 1% annual chance flood (100-year flood) (FEMA, 2008). No base flood elevations have been determined. A site specific flood study will likely be required.
- **Collapsible soils.** Collapsible soil generally consists of dry, loose, low-density material that have the potential collapse and compact (decrease in volume) when subjected to the addition of water or excessive loading.

Soils found to be most susceptible to collapse include loess (fine grained wind-blown soils), young alluvium fan deposits in semi-arid to arid climates, debris flow deposits and residual soil deposits. Due to the cohesive nature of the subsurface soils and shallow groundwater, the potential for hydro-collapse of the subsurface soils at this project site is considered very low.

- **Expansive soils.** Surficial silty clays and clays which are moderate to highly expansive exist at this site. The expansive soil conditions are discussed in more detail in Section 3.3.

3.8 Liquefaction

Liquefaction occurs when granular soils below the water table are subjected to vibratory motions, such as those produced by earthquakes. With strong ground shaking, the pore water pressure increases as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations. Four conditions are generally required for liquefaction to occur:

(1) the soil must be saturated (relatively shallow groundwater);
(2) the soil must be loosely packed (low to medium relative density);
(3) the soil must be relatively cohesionless (not clayey); and
(4) groundshaking of sufficient intensity must occur to function as a trigger mechanism.

All of these conditions exist to some degree at this site.

<u>Methods of Analysis:</u> The computer program CLiq (Version 2.2.0.32, Geologismiki, 2017) was utilized for liquefaction assessment at the project site. The estimated settlements have been adjusted for transition zones between layers. Computer printouts of the liquefaction analyses are provided in Appendix D.

The liquefaction potential at the project site was evaluated using the 1997 NCEER Liquefaction Workshop (NCEER, 1997 and Youd, et.al., 2001). The 1997 NCEER methods utilize CPT cone readings from site exploration and earthquake magnitude/PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio (CSR) versus a corrected tip pressures $Q_{tn,cs}$. The analysis was performed using a PGA_M value of 0.61g was used in the analysis with a 6-foot groundwater depth and a threshold factor of safety (FS) of 1.3.

The fines content of the liquefiable sands and silts increases their liquefaction resistance in that more ground motion cycles are required to fully develop the increased pore pressures. The CPT tip pressures (Qc) were adjusted to an equivalent clean sand pressure ($Q_{tn,cs}$) in accordance with NCEER (1997).

The soils encountered at the points of exploration included saturated silts and silty sands that could liquefy during a Maximum Considered Earthquake. Liquefaction can occur within several isolated silt and sand layers between depths of 8.5 to 50 feet. The likely triggering mechanism for liquefaction appears to be strong groundshaking associated with the rupture of the Elmore and San Andreas faults. The analysis is summarized in the table below.

Summary of Liquefaction Analysis

Boring Location	Depth To First Liquefiable Zone (ft)	Potential Induced Settlement (in)
CPT-1	6.5	4¾
CPT-2	8.0	5¾
CPT-3	6.0	6½

Liquefaction Induced Settlements: ***Based on empirical relationships, total induced settlements are estimated to be about 4¾ to 6½ inches should liquefaction occur.*** Differential settlement is estimated at be one-half of the total potential settlement (Martin and Lew, 1999). Accordingly, there is a potential for approximately 2 inches of liquefaction induced differential settlement at the project site.

Liquefaction Induced Ground Failure: Based on research from Ishihara (1985) and Youd and Garris (1995) small ground fissure or sand boil formation is possible because of the relatively thin layer of the overlying unliquefiable soil. Sand boils are conical piles of sand derived from the upward flow of groundwater caused by excess porewater pressures created during strong ground shaking. Sand boils are not inherently damaging by themselves, but are an indication that liquefaction occurred at depth (Jones, 2003). Liquefaction induced lateral spreading is not expected to occur at this site due to the planar topography. According to Youd (2005), if the liquefiable layer lies at a depth greater that about twice the height of a free face, lateral spread is not likely to develop. No slopes or free faces occur at this site.

Mitigation: Ground improvement methods are available to mitigate liquefaction such as deep soil mixing (cement), vibro-compaction, vibro-replacement, geopiers, stone columns, compaction grouting, or deep dynamic compaction. Some other means to mitigate liquefaction damage include either a deep foundation system or rigid mat foundations and grade-beam reinforced foundations that can withstand the differential movement or tilting, but will not protect fracturing of buried utilities from damage (CGS, 2008).

Because of the potential for differential settlement due to liquefaction, the designer should consider the following options for design of the structure:

1) Structural flat-plate mats.
2) Deep foundations (drilled piers or auger cast piles) founded at a minimum depth of 40 feet.
3) Soil improvement by soil-cement mixing or soil replacement to create non-liquefying soils (35 feet minimum depth).

Section 4
RECOMMENDATIONS

4.1 Site Preparation and Backfill

Clearing and Grubbing: All surface improvements, crop or vegetation including grass, brush, and weeds on the site at the time of construction should be removed from the construction area. The crop may be stripped by cutting with a blade or earthmover to 1 inch below ground surface. Organic strippings should not be used as fill within plant structural areas. ***The agricultural subsurface tile drainage system shall be abandoned by cutting and plugging laterals at the boundary of the plant site (see Tile Drainage Maps – Appendix G).*** Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Site Mass Grading: Prior to placing any fills, the surface 12 inches of soil should be uniformly moisture conditioned by discing and wetting to a minimum of optimum plus 2% and recompacted to a minimum of 90% of ASTM D1557 maximum density. Onsite native clays placed as engineer fill should be uniformly moisture conditioned by discing and wetting or drying to optimum plus 2 to 8% and compacted in 6 inch maximum lifts to a minimum of 90% relative compaction. Clods shall be reduced by discing to a maximum dimension of 1.0 inch prior to being placed as fill.

4.2 Building Pad Preparation and Foundations for Lightly Loaded Structures

Building Pad Preparation: The existing surface soil within the administration office, control rooms, and light buildings foundation areas should be removed to 36 inches below the building pad elevation or existing grade (whichever is lower) extending five feet beyond all exterior wall/column lines (including adjacent concreted areas). Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 5 to 10% above optimum moisture content and recompacted to 85 to 90% of the maximum density determined in accordance with ASTM D1557 methods.

A geotextile separation fabric and geogrid layer should be placed over the graded surface and a minimum of 12 inches of aggregate base placed over the geotextile and geogrids prior to allowing any construction equipment onto the building pad. The surface of the aggregate base shall be compacted to a minimum of 90% of ASTM D1557 maximum density prior to placing a subsequent 6 inch lift of aggregate base. The geotextile shall a 6 oz. non-woven fabric equivalent to Mirafi 160N or Propex 4506. Geogrids shall be either Tensar TriAx 5 or Tenax MS330. The 6 inch lift of aggregate base shall be compacted to at least 95% of ASTM D1557 maximum density.

An engineered building support pad consisting a minimum of 3.0 feet of granular soil, placed in maximum 8-inch lifts (loose), compacted to a minimum of 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture, should be placed below the control building and warehouse slabs.

Imported fill soil shall be non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to a minimum of 95% of ASTM D1557 maximum dry density at optimum moisture ±2%.

<u>Concrete Hardscape Areas:</u> In areas other than the basin backfill which are to receive housekeeping slabs or area concrete slabs, the ground surface should be presaturated (20% minimum moisture content) to a minimum depth of 24 inches and then scarified to 8 inches, moisture conditioned to a minimum of 5% over optimum, and recompacted to a minimum of 85 to 90 % of ASTM D1557 maximum density just prior to concrete placement.

<u>Moisture Control and Drainage:</u> Adequate site drainage is essential to future performance of the project. Infiltration of excess irrigation water and stormwaters can adversely affect the performance of the subsurface soil at the site.

Positive drainage should be maintained away from all structures (5% for 10 feet minimum across unpaved areas) to prevent ponding and subsequent saturation of the native clay soil. Gutters and downspouts may be considered as a means to convey water away from foundations. If landscape irrigation is allowed next to the building, drip irrigation systems or lined planter boxes should be used. The subgrade soil should be maintained in a moist, but not saturated state, and not allowed to dry out. Drainage should be maintained without ponding. Trees should be set back from foundations equal to their anticipated height.

Foundations: Shallow spread footings and continuous wall footings are suitable to support the building structures associated with offices, control rooms and warehouse. The bottoms of footings shall be founded on at least 18 inches of properly prepared and compacted granular soil as described in Section 4.1. The foundations shall be designed for an allowable soil bearing pressure of 2,000 psf when foundations are supported on 18 inches of granular soil. The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events.

4.3 Structural Mats Foundations for Cooling Tower

Structural Mat Foundations for Cooling Tower: The relatively light cooling tower structure that covers large area may use soil unloading as a means to control settlement. The general, in-situ soil load is approximately 120 pcf and by removing 3 feet of soil, 360 psf of foundation loading can be offset (e.g. a 500 psf foundation load can be reduced to 140 psf net soil loading).

Soil Improvements and Underlayment: A technique to improve soft and compressible ground condition is through mixing of the subsurface soil with cement (or replacement of the clay with a sand/cement slurry). Soil-cement mixing is accomplished by augering 48-inch diameter holes (20% minimum area replacement ratio) to a minimum depth of 25 feet below ground surface and mixing the soil with cement, creating a soil-cement column. The deep soil mixing serves to reduce settlement by replacing the compressible clay soils below the structures with very stiff soil-cement columns, creating a stiffer composite soil matrix. Soil-cement design should be provided by a licensed specialty contractor.

The table below is for preliminary use, complete settlement data will need to be performed by a licensed specialty contractor. It is unlikely that significant differential settlement will occur on foundations supported by improved soil.

**Estimated Settlement - 135 ft. x 420 ft. Foundation
Overlaying Soil Mixed Columns**

Treatment Depth (ft)	Load (psf)	Settlement Estimates (in)
No Treatment	750	3.0
10	750	2.2
20	750	2.0
30	750	1.7
*35	750	1.5

* Minimum depth required to reduce liquefaction settlement to 1.5 inches.

4.4 Clarifier Tank Soil Preparation, Foundations and Settlements

Clarifier tanks that are not sensitive to settlements may be supported by mat foundations bearing on reinforced structural fill or deep soil improvement.

<u>Excavation</u>: The surface soils should be excavated from the foundation area (including 10 feet beyond foundation lines) to 3 feet below the planned tank sump floor bottom elevation (estimated 12 feet below tank finish grade). Sidewalls of the excavation should be sloped back at a minimum of 1.5(H):1(V) due to groundwater presence.

Perimeter Drain: A minimum 1 ft. deep by 1.5 ft. wide trench can be excavated at the toe of the excavated slope with placement of a 6-inch corrugated drainage pipe (ADS or equal) and drainage filter sock or sand envelope. The filter sand should consist of tiling sand as specified for agricultural tile drainage pipelines by the U.S. Soil Conservation Service. Filter sand should be placed to the top of the perimeter drain trench. The purpose of the perimeter drain is to assist in dewatering the excavation and provide porewater pressure relief of groundwater rising to the drainage blanket during strong groundshaking resulting in soil liquefaction. The drainage pipe should be connected to riser pipes or manholes, spread not greater than 100 feet apart.

Drainage Blanket: The bottom of the subexcavation should be covered with a geotextile filter fabric (Mirafi 180N, Supac 8NP, or equivalent) extending over the perimeter drain and lapped at sides/ends in accordance with the manufacturer's installation guidelines (2 ft minimum). The fabric should be placed as the excavation progresses to minimize the time of groundwater intrusion into the subgrade.

A 1.5 foot thick layer of drainage rock (conforming to gradation limits of ASTM C33, Size 57 or 467) should be end dumped onto the filter fabric and spread evenly by excavators or dozers. Upon completing placement of the drainage rock, a small vibratory compactor (walk-behind or equivalent) should be used to densify the crushed rock layer. Following densification of the drainage rock, a second layer of filter fabric should be placed over the rock prior to placement of the reinforced structural engineered fill.

Reinforced Structural Fill: Structural fill should consist of 1.5 ft of crushed aggregate base with 2 geogrid layers as described herein. The first lift of aggregate base should be end dumped and spread in a 0.5 ft. thick uniform layer over the drainage blanket filter fabric before compacting. After the aggregate base has been placed and spread, the base material should be wetted within 2% of optimum moisture and compacted to a minimum of 90% of ASTM D1557 maximum density. After completion of compacting, a geogrid reinforcing mesh (Tensar TX5 Triaxial geogrid or Greenbook Type S2 bi-axial geogrid) should be placed over the first layer of base material and lapped at sides/ends (1 ft. minimum) in conformance with manufacturer's installation instructions.

A second lift of aggregate base should be end dumped and spread in a 1 ft. thick uniform layer over the geogrid. This layer may be placed in two lifts, wetted within 2% of optimum moisture and compacted to a minimum of 95% of ASTM D1557 maximum density. After compacting a second layer of geogrid mesh should be placed over the base material and covered by a 0.5 ft. thick layer of aggregate base that should be compacted to a minimum to a minimum 95% of ASTM D1557 maximum density within 2% of optimum moisture placed over the existing 5 ft. thick reinforced structural fill.

Following completion of the aggregate base reinforced structural fill, the remaining excavation area (from the clarifier sump bottom foundation it to the tank finish grade) may be backfilled with imported fill (sand) placed in lifts no greater than 8 inches in loose thickness and compacted to a minimum of 95% of ASTM D1557 maximum dry density at optimum moisture ±2% to the bottom of the sloped tank foundation.

The imported soils should meet the USCS classifications SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and no less than 5% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to a minimum of 95% of ASTM D1557 maximum dry density at optimum moisture ±2%.

Deep Ground Improvement: In lieu of reinforced structural fill as described above, the steel tanks may be placed on a deep ground improvement option. Deep ground improvement may be considered to reduce static and liquefaction settlements and to potentially reduce de-watering needs for backfilling the reinforced structural fill section.

Flat Plate Structural Mats: Structural mats may be used for the steel clarifier tanks and associated catwalk tower and shall have a minimum thickness of 14 inches. Structural mats may be designed for a modulus of subgrade reaction (Ks) of 300 pci when placed on 3 feet of imported fill sand and/or aggregate base as described above.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf to resist lateral loadings. The top one foot of embedment may be considered in computing passive resistance due to the adjacent area being confined by concrete pavement. An allowable friction coefficient of 0.35 may also be used at the base of the slab to resist lateral loading.

The tanks may be designed using an allowable soil bearing pressure of 3,000 pounds per square foot (psf) when placed on the reinforced structural fill as described above. The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events. Deep ground improvements may increase the allowable design soil pressures. Bearing values shall be provided by the specialty contractor.

Estimated Tank Settlements: The subsurface clays are saturated and overconsolidated in their natural state. Imposed foundations loads can consolidate the soils by reducing the void ratio through pore water expulsion. The amount of vertical settlement that occurs as a result of soil compression varies with applied loads, foundation shape and width.

The tanks should be hydrotested by staged filling with water and held to monitor the settlement and performance of the tank. Settlement readings should be taken until movement, in the opinion of the geotechnical engineer, has sufficiently stabilized.

The settlement measuring methods, loading sequence, and records of settlement should be reviewed by the geotechnical engineer prior to initial loading. Flexible connections such as “Flex-Tend” expansion joints should be used to connect exterior piping with the tank. It may be necessary to readjust piping connections after the loading sequence.

Estimated settlements were calculated using the consolidation and field data test data for the clay strata and Schmertman's analysis for the granular strata using the CPT data correlations. The soils to a depth of the diameter of the tanks (80, 100 and 120 feet) may be significantly stressed to contribute to the overall settlement. The estimated settlement for several typical tank diameters with an imposed pressure load of 1,500 and 2,000 psf are as follow:

Settlement Estimates (inches)

Diameter (ft)	Load (psf)	*Settlement Estimates (in)
80	1,500	3.1
	2,000	3.9
100	1,500	3.6
	2,000	4.4
120	1,500	4.0
	2,000	4.9

*The settlement estimate is approximate and field measured settlements may be half to twice the value given. Settlements when using deep ground improvement may be reduced from the values given above.

Edge settlements should be about 60% of the estimated center settlements for the tanks. Since the settlements are deep seated, little is gained by further excavation and replacement of compacted granular fill to reduce settlements. The differential settlement from the outer edge to the middle of the tank will result in stretching the bottom of the tanks and any liner placed imparting tensile stresses as the stretching occurs. The fill may be crowned 2 to 3 inches to allow for differential movement between the tank perimeter and center.

4.4 Deep Soil Improvement

The use of soil improvement (soil mixing with cement, stone columns or geopiers) or by the placement of a deep foundation system, like drilled piers or driven piles, is recommended in order to reduce settlement to tolerable limits.

Structural mat foundations placed over the improved soil (soil mixing with cement, stone columns or geopiers) or placed over a deep foundation system, like piles or drilled piers, are anticipated to be used to support various structural elements of the plant. Mats should be underlain by 36 inches of crushed aggregate base (reinforced structural fill).

If soil improvement or deep foundation system are extended to a minimum depth of 35 feet below ground surface, liquefaction settlements are expected to be about 1½-inch. A dense sand layer below 40 feet will likely yield optimal support for structures.

A. Soil-Cement Mixing

A technique to improve soft and compressible ground condition is through mixing of the subsurface soil with cement. Soil-cement mixing is accomplished by augering 36 to 48-inch diameter holes to a minimum depth of 35 feet below ground surface and mixing the soil with cement, creating a soil-cement column. The deep soil mixing serves to reduce settlement by replacing the compressible clay soils below the structures with very stiff soil-cement columns, creating a stiffer composite soil matrix.

Soil-cement design should be provided by a licensed specialty contractor. The specialty contractor should also provide allowable soil bearing capacity and associated settlement.

The use of soil improvement like soil mixing with cement or soil replacement (sand/cement) may be used to reduce settlement to tolerable limits.

Structural mat foundations placed over the improved soil are anticipated to be used to support the various structural elements of the plant. Mats overlaying soil mixed columns should be underlain by 3.0 feet of crushed aggregate base (Caltrans Class 2, 1-½" or ¾" grading).

B. Stone Columns

Stone columns consisting of gravel stones that are placed in underground columns by a vibro-replacement method are effective in mitigating the settlement hazard related to highly compressible soil layers. They have been used frequently in Southern California.

For preliminary design purposes, the stone columns should be extended to a dense, non-compressible layer, spaced on approximately 6-foot on centers, and have an effective diameter of approximately 30-36 inches. The vibro-replacement method densifies the soil around the column. Settlement potential of the soil is greatly reduced by densification, drainage, and increased stiffness of the soil within the treated area. The stone columns should extend to a depth determined by engineering design based on settlement risks, but should, as a minimum, be founded at depths greater than 35 feet.

A 36-inch thick aggregate base layer (reinforced structural fill) should overlie the stone column treated area beneath the foundation to spread transmitted loads to the stone columns.

The above data for stone columns is presented as preliminary information only. A specialty contractor should be consulted for the actual design and construction of stone columns. The specialty contract should also provide allowable soil bearing capacity and associated settlement.

All of the stone column installation operations should be conducted under the observation of the geotechnical engineer's representative.

C. Geopiers (Rammed Piers)

Another technique to improve soft and compressible ground condition is through placement of geopiers. Geopiers are constructed by augering 18 to 36-inch diameter holes to a depth greater than 35 feet below the base of the footings and backfilling the holes with thin lifts of compacted aggregates. Compaction densifies the aggregate and increases lateral stress in the soil matrix. The system serves to reduce settlement by replacing the compressible clay soils below the structures with very stiff aggregate piers, creating a stiffer composite soil matrix.

Geopier design should be provided by a licensed specialty contractor. The specialty contractor should also provide allowable soil bearing capacity and associated settlement. One demonstration pier should be installed with the contractor's standard procedures and then load –tested to determine the soil modulus.

The load testing setup and procedures should be selected by the geopier contractor and submitted for review to the project geotechnical engineer. The demonstration pier should be installed at the foundation grade level. All of the Geopier element installation operations should be conducted under the observation of the geotechnical engineer's representative.

4.5 Deep Foundations

A. Drilled Piers or Auger Cast Piles

Drilled piers or auger cast piles (cast-in-place grout with steel cage reinforcement) have been used successfully to provide deep foundations for heavily loaded and critical elements of geothermal power plants. Capacities for 24, 30 and 36 inch diameter shafts are provided below.

<u>Vertical Capacity:</u> Vertical capacity for 24, 30 and 36 inch diameter shafts are shown on Plate E-1. Capacities for other shaft sizes can be determined in direct proportion to shaft diameters. End bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5. The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil. The structural capacity of the piers should be verified by the structural engineer. Drilled pier or auger cast piles which are extended to a minimum depth of 40 feet within a medium dense to very dense sand layer will reduce liquefaction settlements to about 1¼ inch or less.

<u>Lateral Capacity:</u> The allowable lateral capacity for 24, 30 and 36 inch diameter shafts are given in the Table 8. The allowable horizontal deflection at the shaft head has been assumed to be one-half inch (0.50 inch).

Lateral Capacities – Drilled Piers / Auger Cast Piles

Shaft Diameter (in.)	**24**		**30**		**36**	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Length (ft.)	**40**	**40**	**40**	**40**	**40**	**40**
Lateral Capacity (kips)	21.6	52.4	33.4	79.5	46.4	113
Maximum Moment (foot-kips)	116.7	-333.3	209.2	-585	326.7	-933.3
@Depth from Pier Head (ft.)	9.0	0	10.3	0	11.7	0
Length (ft.)	**50**	**50**	**50**	**50**	**50**	**50**
Lateral Capacity (kips)	22	53	33.7	80.5	47	114.2
Maximum Moment (foot-kips)	118.3	-335	209.2	-588.3	328.3	-941.7
@Depth from Pier Head (ft.)	9.0	0	10.3	0	11.7	0

(*) Fixed head is defined when there is no rotation in the pile head (eg. concrete foundation surrounding the pile heads).

Settlement: Total static (non-seismic) settlements of less than ¼ inch are anticipated for single piles designed according to the preceding recommendations.

Axial Load Group Effect: If pier/pile spacing is a least 2.5 pier/pile diameters center-to-center, no reduction in axial load capacity is considered necessary for group effect.

Uplift Capacity: Pier capacity in tension should be taken as 50% of the compression capacity.

Soil Parameters: Interpretive engineering soil parameters of the subsurface soil for Allpile Computer Program are presented in the table below. Since the subsurface soils at the project site may experience liquefaction settlements at depths between 6 to 50 feet below ground surface, a deep foundation system like drilled piers founded at a minimum depth of 40 feet below ground surface is estimated to reduce settlements to approximately 1¼ inch. The drilled pier foundation vertical and lateral capacities from the resettled loose liquefied soils can be calculated using the following interpretive engineering soil parameters determined using the California Department of Transportation (Caltrans) Geotechnical Manual method for pier foundations subjected to liquefaction:

Soil Strength Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Lateral Soil Modulus, k (pci)	Strain Factor, E50 o Dr (%)
CL-ML	0 to 5	125	0°	0.50	50	1.60
(*) ML-SM	5 to 13	115	25°	0	25	25
ML-CL	13 to 17	120	24°	0.30	100	1.33
(*) SP-SM	17 to 27	115	30°	0	30	35
CL	27 to 34	125	0°	0.75	135	1.15
(*) SM-ML	34 to 37	115	30°	0	25	25
(*) SP-SM	37 to 47	115	30°	0	75	55
CH	47 to 53	125	0°	1.00	225	1.00
SM-ML	53 to 62	115	34°	0	50	45
CL	62 to 70	125	0°	0.75	135	1.15

(*) Liquefiable soils layers

The drilled pier foundations vertical and lateral capacities from the resettled lose liquefied soils can be calculated using the following values:

- C=0 and ϕ = 30º for coarse-grained liquefied soil (e.g. SW, SP, SM) or,
- C=0 and ϕ = 25º for fine-grained liquefied soil (e.g. ML)

Note: Soil strength parameters obtained from field data and laboratory testing program were modified (reduced) based on our engineering judgment and our previous experience in the general site vicinity.

Installation: The drilled pier shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. The bottom of the excavation for piers should be reasonably free of loose or slough material. A tremie pipe should be used to pour concrete from the bottom up and to ensure less than five feet of free fall. All drilled piers extending below groundwater (about 6.0 feet deep) shall be cased to prevent caving or lateral deformation. Steel reinforcement and concrete shall be placed immediately after drilling. Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

B. Driven Piles

Precast, prestressed concrete piles are often used in the corrosive soil environments of the Imperial Valley. Selection of pile type may be based on drivability and cost comparisons. Allowable axial and lateral capacities for a 12x12 and 14x14 precast, prestressed concrete piles embedded to a depth of 40, 50 and 60 feet from the existing ground surface are given in the tables below.

Allowable Axial and Lateral Capacities
Precast, Prestressed Square Concrete Pile

Pile Size (in)	12x12		12x12		12x12	
Specified Tip Depth (ft)	40		50		60	
Allowable Axial Capacity (kips)	48.2		62.4		75.2	
Allowable Deflection (in)	¼		¼		¼	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Lateral Capacity (kips)	7.2	18.6	7.3	18.8	7.2	18.4
Maximum Moments (kips – foot)	28.5	-80.3	28.8	-80.8	28.6	-79.6
Depth of Maximum Moment (ft)	6	0	6.1	0	6.3	0

Allowable Axial and Lateral Capacities
Precast, Prestressed Square Concrete Pile

Pile Size (in)	14x14		14x14		14x14	
Specified Tip Depth (ft)	40		50		60	
Allowable Axial Capacity (kips)	60		79.6		94	
Allowable Deflection (in)	¼		¼		¼	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Lateral Capacity (kips)	9.6	24.5	9.7	24.7	9.6	24.3
Maximum Moments (kips – foot)	41.7	-118.3	41.9	-118.3	41.8	-117.5
Depth of Maximum Moment (ft)	7.0	0	7.0	0	7.0	0

(*) Fixed head is defined when there is no rotation in the pile head (eg. concrete foundation surrounding the pile heads).

Recommendations for other pile types and sizes can be made available upon request.

Vertical Capacity: The allowable pile capacities are based on a factor of safety of 3.0. Resistance to uplift may be considered equivalent to 40 percent of the allowable downward vertical capacity.

Lateral Capacity: The allowable lateral capacity of 12 and 14-inch sections are based on a deflection of one-quarter inch at the top of the pile. If greater deflection can be tolerated, lateral load capacity can be increased directly in proportion to a maximum of one inch deflection.

Settlement: Total settlements of less than ½ inch, and differential settlements of less than ¼ inch, are anticipated for single piles designed according to the preceding recommendations. If pile spacing is a least 2.5 pile diameters center-to-center, no reduction in axial load capacity is considered necessary for a group effect.

Pile Driving: Complete documentation of the proposed hammer should be submitted to the geotechnical engineer for approval prior to mobilization. Driving records should be maintained on each pile. The numbers of blows required to drive a pile each foot should be recorded. Driving energy necessary to insure development of full design capacity shall be established after each selection of the pile driver. The geotechnical engineer should observe pile driving and evaluate each pile on a case-by-case basis. Pre-drilling of pilot holes for piles to a depth of half the pile depth will be allowed without reduction in pile capacity.

4.6 Short Drilled Piers for Pipe Rack Supports

Drilled piers for pipe racks supports have been used successfully on geothermal power plants. Recommendations for 24 and 36 inch diameter shafts are below.

Vertical Capacity: Vertical capacity for 24 and 36 inch diameter shafts are presented in Figure E-1. Capacities for other shaft sizes can be determined in direct proportion to shaft diameters. End bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5.

The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil. The structural capacity of the piers should be verified by the structural engineer. Due to the short length of these piers (15 feet), liquefaction settlements will not be mitigated.

Settlement: Total settlements of less than ¼ inch are anticipated for single pier designed according to the preceding recommendations.

Axial Load Group Effect: If pier spacing is a least 2.5 pier diameters center-to-center, no reduction in axial load capacity is considered necessary for group effect.

Uplift Capacity: Pier capacity in tension should be taken as 50% of the compression capacity.

Lateral Capacity: The allowable lateral capacity for 24 and 36 inch diameter shafts are given in the table below. The allowable horizontal deflection at the shaft head has been assumed to be one-half inch (0.50 inch). Shear loads were applied one (1) foot above ground surface elevation.

Lateral Capacities – Short Drilled Piers

Shaft Diameter (in.)	**24**		**30**		**36**	
Head Condition	Free	Fixed	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5	0.5	0.5
Length (ft.)	**10**	**10**	**10**	**10**	**10**	**10**
Lateral Capacity (kips)	5.2	34	5.8	45.2	6.5	55.6
Maximum Moment (foot-kips)	17.8	-250	19.3	-338.3	21.3	-422.5
@Depth from Pier Head (ft.)	5.2	0	5.2	0	5.2	0
Length (ft.)	**15**	**15**	**15**	**15**	**15**	**15**
Lateral Capacity (kips)	12.1	37.2	13.5	59	14.4	83
Maximum Moment (foot-kips)	61.4	-290	67.5	-542.5	70.4	-814.2
@Depth from Pier Head (ft.)	7.4	0	7.5	0	7.5	0

Installation: The drilled pier shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. The bottom of the excavation for piers should be reasonably free of loose or slough material. A tremie pipe should be used to pour concrete from the bottom up and to ensure less than five feet of free fall. All drilled piers extending below groundwater (about 6.0 feet deep) shall be cased to prevent caving or lateral deformation. Steel reinforcement and concrete shall be placed immediately after drilling. Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

4.7 Slabs-On-Grade

Concrete slabs and flatwork placed over native clay soil should be designed in accordance with Chapter 18, Division III of the 2019 CBC (using an Effective Plasticity Index of 40) and shall be a minimum of 5.5 inches thick due to expansive soil conditions. Concrete floor slabs shall be monolithically placed with the foundations unless placed on 3.0 feet of granular fill. The concrete slabs should be underlain by a minimum of 4 inches of clean sand (Sand Equivalent SE>30) or aggregate base or may be placed directly on the 3.0-foot thick granular fill pad (if used) that has been moistened to approximately optimum moisture just before the concrete placement. A 10-mil polyethylene vapor retarder, properly lapped and sealed with a 2-inch sand cover and extended a minimum of 12 inches into the footing, should be placed as a capillary break to inhibit moisture migration into the slab section. Concrete slabs may be placed directly over a 15-mil vapor retarder if desired (Stego-Wrap or equivalent).

Concrete slab and flatwork reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 4 bars at 18-inch centers, both horizontal directions) placed at slab mid-height to resist potential swell forces and cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings. All steel components of the foundation system should be protected from corrosion by maintaining a 4-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator).

The construction joint between the foundation and any mowstrips/sidewalks placed adjacent to foundations should be sealed with a polyurethane based non-hardening sealant to prevent moisture migration between the joint. Epoxy coated embedded steel components or permanent waterproofing membranes placed at the exterior footing sidewall may also be used to mitigate the corrosion potential of concrete placed in contact with native soil.

Control joints should be provided in all concrete slabs-on-grade at a maximum spacing (in feet) of 2 to 3 times the slab thickness (in inches) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or sawcut (¼ of slab depth) within 6 to 8 hours of concrete placement. Construction (cold) joints in foundations and area flatwork should either be thickened butt-joints with dowels or a thickened keyed-joint designed to resist vertical deflection at the joint. All joints in flatwork should be sealed to prevent moisture, vermin, or foreign material intrusion. Precautions should be taken to prevent curling of slabs in this arid desert region (refer to ACI guidelines).

All independent flatwork (sidewalks, housekeeping slabs) should be placed on a minimum of 2 inches of concrete sand or aggregate base, dowelled to the perimeter foundations where adjacent to the building and sloped 2% or more away from the building. A minimum of 24 inches of moisture conditioned (20% moisture content) and 8 inches of compacted subgrade (83 to 87%) and a 10-mil (minimum) polyethylene separation sheet should underlie the flatwork. All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

4.8 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-15). The native soils were found to have severe levels of sulfate ion concentration (4,266 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling.

Concrete Mix Design Criteria due to Soluble Sulfate Exposure

Sulfate Exposure Class	Water-soluble Sulfate (SO_4) in soil, ppm	Cement Type	Maximum Water-Cement Ratio by weight	Minimum Strength f'c (psi)
S0	0-1,000	–	–	–
S1	1,000-2,000	II	0.50	4,000
S2	2,000-20,000	V	0.45	4,500
S3	Over 20,000	V (plus Pozzolon)	0.45	4,500

Note: From ACI 318-14 Table 19.3.1.1 and Table 19.3.2.1

Due to exposure to geothermal brine spillage and vent stack steam drift, a minimum of 6.5 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used at the site. Admixtures may be required to allow placement of this low water/cement ratio concrete. Thorough concrete consolidation and hard trowel finishes should be used to reduce moisture penetration.

The native soil has a very severe level of chloride ion concentration (1,480 ppm). Chloride ions can cause corrosion of reinforcing steel, anchor bolts and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 4 inches of densely consolidated concrete. ***No metallic pipes or conduits should be placed below foundations.***

Epoxy coatings, cathodic protection and encapsulating steel reinforcing with a minimum of 4 inches of densely consolidated concrete is suggested at this site.

All embedded steel components (anchor bolts, etc.) shall be epoxy coated for corrosion protection (in accordance with ASTM D3963/A934) or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete.

4.9 Embankment Construction and General Site Fill

Site preparation and embankment construction: All areas to receive new fill for the embankments should be stripped of all vegetation. The surface 12 inches of native soil shall be uniformly moisture conditioned to 2 to 8% above optimum moisture by discing and compacted in 6-inch maximum lifts to a minimum of 90% of ASTM D1557 maximum density.

The embankment slopes may be constructed no steeper than 3:1 (unless lined with concrete or HDPE/PVC sheeting) with a minimum crown width of 15 feet. However, flatter slopes may be considered to retard erosion and permit maintenance. Embankments should be overbuilt by 6 inches and subsequently cut to the plan line and grade to remove loose material along the slope faces.

Native cohesive soil from the site or adjacent land areas is anticipated to be used as general and embankment fill. The fill soils should consist of cohesive silty clay (CL) or clay (CH). The clay soils are considered adequate for engineered fill. The general and embankment fill should be pulverized/disced to less than 1.0 inch maximum clod size, uniformly moisture conditioned to 2 to 8% over optimum, placed in 6 inch maximum lifts and compacted to a minimum of 90% of ASTM D1557 maximum density.

Pond Liner and Slope Protection: The raw water pond is anticipated to be lined with a compacted native clay liner to retard seepage from the sideslopes of the ponds. The liner material should be free from deleterious material such as organic matter, construction debris, rocks, or other debris. The clay liner material should be pulverized/disced to less than ¾ inch maximum clod size, uniformly moisture conditioned to 5-10 percent over optimum, and placed in 6 inch maximum lifts to a minimum of 85% of ASTM D1557 maximum density.

Several options are available for protection of slopes from wave erosion. These consist of synthetic liners, stone riprap, soil cement liner, or concrete lining. Slope protection is suggested along west facing slopes (dominant wind direction). Unlined slopes should be constructed substantially flatter (about 5(H) to 1(V)). All slopes should be lined to a water depth of 5 feet to control vegetation growth at the pond edges. Water depths of at least 8 feet will reduce algae growth in the ponds.

4.10 Excavations

All site excavations should conform to CalOSHA requirements for Type C soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type C soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

Groundwater was encountered 3.5 to 5 feet below ground surface at this site as reported in a geotechnical report for the project site conducted by Geotechnics, Inc. of San Diego, California in February 2002 (Geotechnics Project No. 0673-002-00, dated February 5, 2002. The contractor is cautioned to evaluate soil moisture and groundwater conditions at the time of bidding. Groundwater depths may not be apparent in short term open excavations (up to 4 feet deep) due to the equivalency of atmospheric evaporation rates to groundwater migration through the fine grained upper clay soils.

4.12 Utility Trench Backfill

Utility Trench Backfill: Prior to placement of utility bedding, the exposed subgrade at the bottom of trench excavations should be examined for soft, loose, or unstable soil. Loose materials at trench bottoms resulting from excavation disturbance should be removed to firm material. If extensive soft or unstable areas are encountered, these areas should be over-excavated to a depth of at least 2 feet or to a firm base and be replaced with additional bedding material.

Backfill Materials: Pipe zone backfill (i.e., material beneath and in the immediate vicinity of the pipe) should consist of a 4 to 8 inch bed of ⅜-inch crushed rock, sand/cement slurry (3 sack cement factor), and/or crusher fines (sand) extending to a minimum of 12 inches above the top of pipe. If crushed rock is used for pipe zone backfill for utilities, the crushed rock material should be completed surrounded by a 6 oz. non-woven filter fabric such as Mirafi 160N or equivalent. The filter fabric shall cover the trench bottom, sidewalls and over the top of the crushed rock. The filter fabric is recommended to inhibit the migration of fine material into void spaces in the crushed rock which may create the potential for sinkholes or depressions to develop at the ground surface.

Pipe bedding should be in accordance with pipe manufacturer's recommendations. Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local codes and/or bedding requirements for specific types of pipes. On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill above pipezone, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material.

Compaction Criteria: Mechanical compaction is recommended; ponding or jetting should not be allowed, especially in areas supporting structural loads or beneath concrete slabs supported-on-grade, pavements, or other improvements. All trench backfill should be placed and compacted in accordance with recommendations provided above for engineered fill.

The pipe zone material (crusher fines, sand) shall be compacted to a minimum of 95% of ASTM D1557 maximum density. Pipe deflection should be checked to not exceed 2% of pipe diameter. Native clay/silt soils may be used to backfill the remainder of the trench. Soils used for trench backfill shall be placed in maximum 6 inch lifts (loose), compacted to a minimum of 90% of ASTM D1557 maximum density at a minimum of 4% above optimum moisture.

Imported granular material is acceptable for backfill of utility trenches. Granular trench backfill used in building pad areas should be plugged with a solid (no clods or voids) 2-foot width of native clay soils at each end of the building foundation to prevent landscape water migration into the trench below the building.

Backfill soil of utility trenches within paved areas should be uniformly moisture conditioned to a minimum of 4% above optimum moisture, placed in layers not more than 6 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density, except that the top 12 inches shall be compacted to 95% (if granular trench backfill).

4.13 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the Brawley, Superstition Hills, and Imperial Faults. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Seismic Zone 4 using the seismic coefficients given in Section 3.4 of this report. ***This site lies approximately 2.4 km from a Type B fault (Brawley Seismic Zone) and overlies S_D (stiff) soil***.

4.14 All-Weather Roadways and Construction Laydown Areas

All-weather accessways for Emergency Vehicles and construction laydown areas should consist of a minimum of 6 inches of Caltrans Class 2 aggregate base (compacted to 90% minimum of ASTM D1557 maximum density) placed over 12 inches of compacted (90% minimum of ASTM D1557 at minimum of 2% above optimum moisture) native clay subgrade soil.

4.15 Pavements

Pavements should be designed according to the 2020 Caltrans Highway Design Manual or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements. Based on the current Caltrans method, an estimated R-value of 5 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) and Portland Cement Concrete (PCC) pavement sections.

TABLE 10: Pavement Structural Sections

R-Value of Subgrade Soil - 5 (estimated) Design Method - Caltrans 2020

Traffic Index	Flexible Pavements		Rigid (PCC) Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)	Concrete Thickness (in.)	Aggregate Base Thickness (in.)
4.0	3.0	6.5	5.0	6.0
5.0	3.0	10.0	5.5	6.0
6.0	4.0	11.5	6.0	8.0
6.5	4.0	14.0	7.0	8.0
8.0	5.0	17.5	8.0	11.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type A HMA (Hot Mix Asphalt), ¾ inch maximum (½ inch maximum for parking areas), with PG70-10 asphalt concrete, compacted to a minimum of 95% of the Hveem density (CAL 308) or a minimum of 92% of the Maximum Theoretical Density (ASTM D2041).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (minimum 2% above optimum if clays) native clay soil compacted to a minimum of 90% of the maximum dry density determined by ASTM D1557. Prewetting of subgrade soils (to 3.5 feet) may be required depending on moisture of subgrade at time of aggregate base placement.
4) Portland cement concrete for pavements should have Type V cement, a minimum compressive strength of 4,500 psi at 28 days, and a maximum water-cement ratio of 0.45.

5) Typical Street Classifications (Imperial County).
   Parking Areas: TI = 4.0
   Cul-de-Sacs: TI = 5.0

Local Streets:	TI = 6.0
Minor Collectors:	TI = 6.5 (trash truck areas)
Major Collectors:	TI = 8.0

4.16 Onsite Sewage Disposal System

The onsite soils consist of clays of low permeability, generally with an infiltration rate of 240 minutes per inch or greater and high groundwater. These soils are not suited for Imperial County approved leach fields. Advanced treatment engineered systems will be required for wastewater treatment and onsite disposal.

4.17 Observation and Density Testing

All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The recommendations and conclusions within this report are based on current information regarding the proposed 81 MW Black Rock geothermal power plant located at the southwest corner of McKendry Road and Boyle Road northwest of Calipatria, California. The conclusions and recommendations of this report are invalid if:

- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Imperial County at the time the report was prepared. No express or implied warranties are made in connection with our services.

Findings and professional opinions in this report are based on selected points of field exploration, geologic literature, limited laboratory testing, and our understanding of the proposed project. Our analysis of data and professional opinions presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. The nature and extend of such variations may not become evident until, during or after construction. If variations are detected, we should immediately be notified as these conditions may require additional studies, consultation, and possible design revisions.

Environmental or hazardous materials evaluations were not performed by Landmark for this project. Landmark will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

The client has responsibility to see that all parties to the project including designer, contractor, and subcontractor are made aware of this entire report within a reasonable time from its issuance. This report should be considered invalid for periods after two years from the date of report issuance without a review of the validity of the findings and professional opinions by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice. This report is based upon government regulations in effect at the time of preparation of this report. Future changes or modifications to these regulations may require modification of this report. Land or facility use, on and off-site conditions, regulations, design criteria, procedures, or other factors may change over time, which may require additional work. Any party other than the client who wishes to use this report shall notify Landmark of such intended use. Based on the intended use of the report, Landmark may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Landmark from any liability resulting from the use of this report by any unauthorized party and client agrees to defend, indemnify, and hold Landmark harmless from any claim or liability associated with such unauthorized use or non-compliance.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Plan Review

Landmark Consultants, Inc. should be retained during development of design and construction documents to check that the geotechnical professional opinions are appropriate for the proposed project and that the geotechnical professional opinions are properly interpreted and incorporated into the documents. Landmark should have the opportunity to review the final design plans and specifications for the project prior to the issuance of such for bidding.

Governmental agencies may require review of the plans by the geotechnical engineer of record for compliance to the geotechnical report.

5.3 Additional Services

We recommend that Landmark Consultant be retained to provide the tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. professional opinions for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are made contingent upon the opportunity for Landmark Consultants to observe grading operations and foundation excavations for the proposed construction.

If parties other than Landmark Consultants, Inc. are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the professional opinions in this report and/or by providing alternative professional guidance.

Additional information concerning the scope and cost of these services can be obtained from our office.

Section 6
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TABLES

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Elmore Ranch	4.4	7.1	6.6	29 ± 3	1 ± 0.5
San Andreas - Coachella	13.9	22.2	7.2	96 ± 10	25 ± 5
Hot Springs *	14.5	23.1			
Superstition Hills	15.1	24.2	6.6	23 ± 2	4 ± 2
Imperial	16.4	26.3	7	62 ± 6	20 ± 5
Brawley *	17.2	27.6			
Superstition Mountain	19.1	30.6	6.6	24 ± 2	5 ± 3
San Jacinto - Borrego	23.4	37.5	6.6	29 ± 3	4 ± 2
Painted Gorge Wash*	26.0	41.6			
Rico *	27.7	44.3			
San Jacinto - Anza	29.3	46.9	7.2	91 ± 9	12 ± 6
Yuha Well *	30.5	48.8			
Route 247*	30.9	49.4			
Shell Beds	31.0	49.7			
Vista de Anza*	32.1	51.3			
Yuha*	32.7	52.2			
Northern Centinela*	33.7	53.9			
Ocotillo*	34.1	54.6			
Laguna Salada	34.5	55.3	7	67 ± 7	3.5 ± 1.5
San Jacinto - Coyote Creek	34.8	55.7	6.8	41 ± 4	4 ± 2
Elsinore - Coyote Mountain	35.2	56.4	6.8	39 ± 4	4 ± 2
Borrego (Mexico)*	42.3	67.6			

* Note: Faults not included in CGS database.

Table 2
2019 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

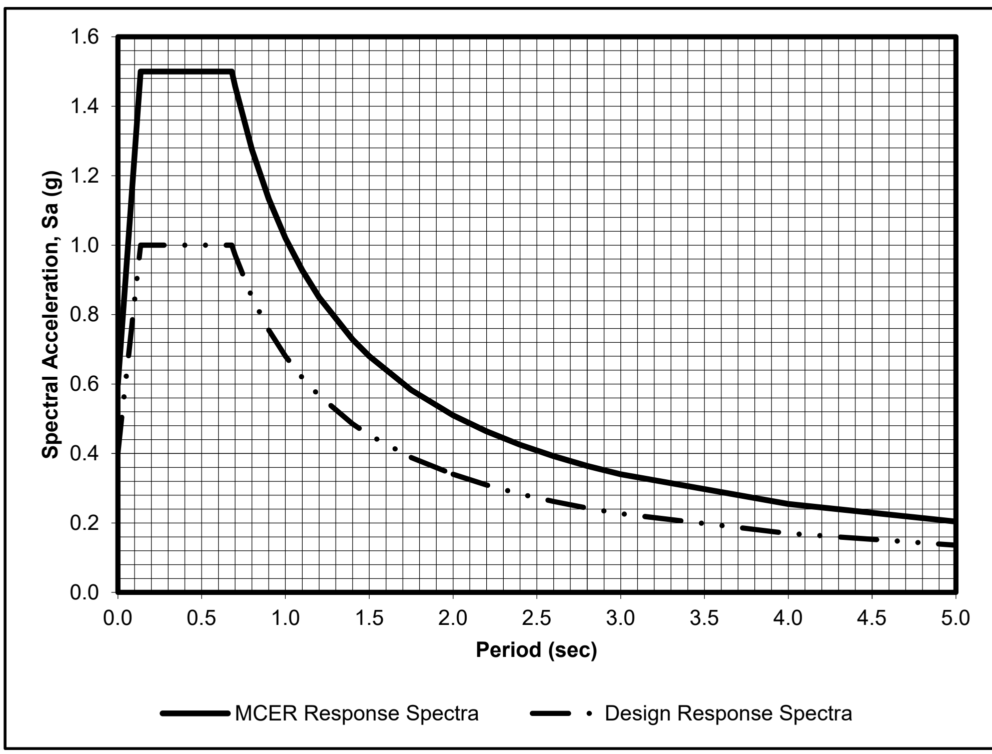
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	33.1679 N	
Longitude:	-115.6250 W	
Risk Category:	III	
Seismic Design Category:	D	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	1.500 g	ASCE Figure 22-1	
Mapped MCE_R 1 second Spectral Response	S_1	0.600 g	ASCE Figure 22-2	
Short Period (0.2 s) Site Coefficient	F_a	1.00	ASCE Table 11.4-1	
Long Period (1.0 s) Site Coefficient	F_v	1.70	ASCE Table 11.4-2	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	1.500 g	$= Fa * S_s$	ASCE Equation 11.4-1
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.020 g	$= Fv * S_1$	ASCE Equation 11.4-2

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.000 g	$= 2/3*S_{MS}$	ASCE Equation 11.4-3
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.680 g	$= 2/3*S_{M1}$	ASCE Equation 11.4-4
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.941		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.909		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.68 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.61 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.14	1.00	1.50
0.68	1.00	1.50
0.70	0.97	1.46
0.80	0.85	1.28
0.90	0.76	1.13
1.00	0.68	1.02
1.10	0.62	0.93
1.20	0.57	0.85
1.20	0.57	0.85
1.40	0.49	0.73
1.50	0.45	0.68
1.75	0.39	0.58
2.00	0.34	0.51
2.20	0.31	0.46
2.40	0.28	0.43
2.60	0.26	0.39
2.80	0.24	0.36
3.00	0.23	0.34
4.00	0.17	0.26
5.00	0.14	0.20

Table 3
Soil Site Class Determination per ASCE 7-10, Section 20.4
Black Rock Geothermal Plant
LCI Project No. LE22199

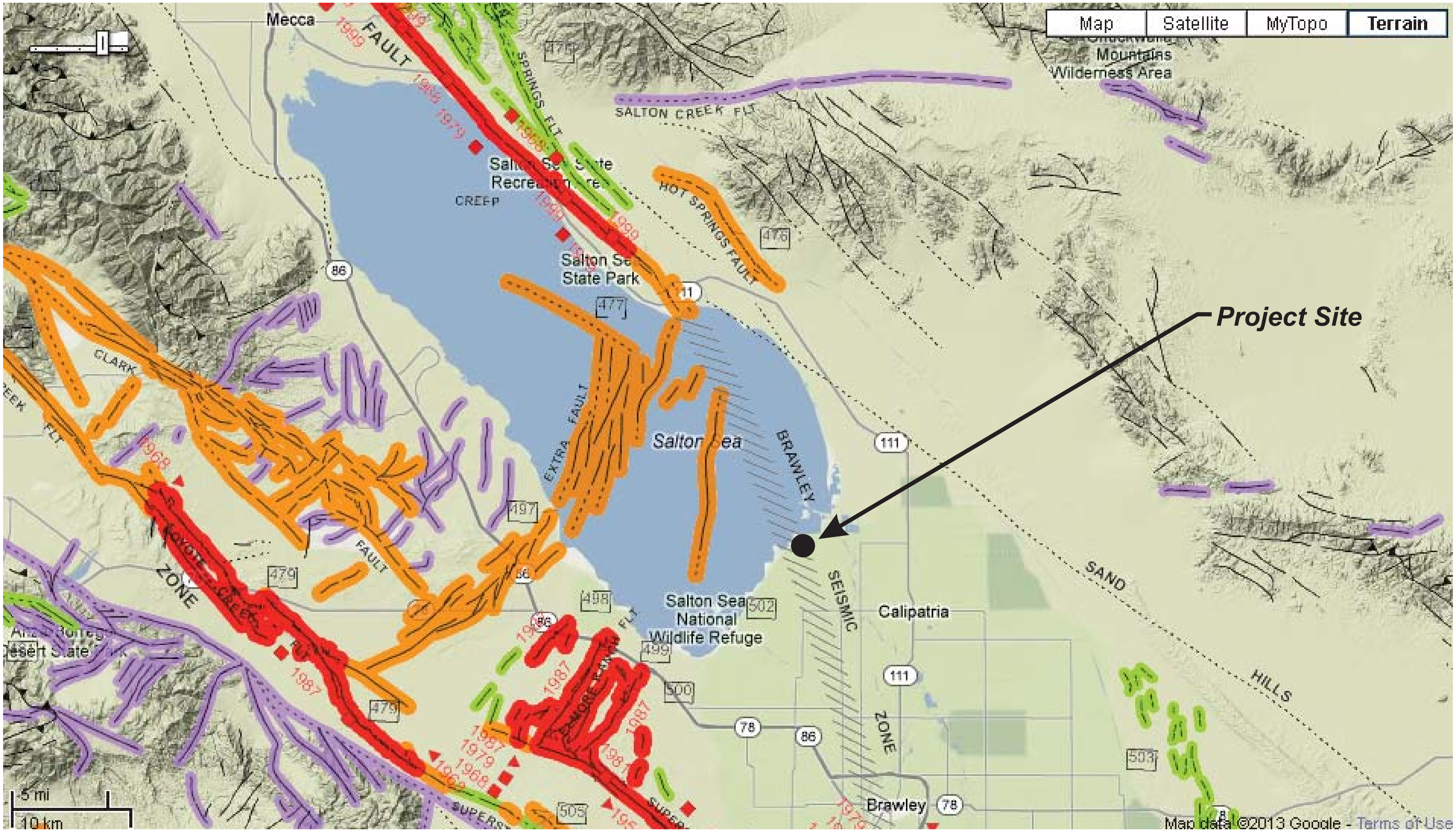
CPT-1

Sample Depth	S-wave Velocity (ft/sec)	di/Ni	Sum di/vsi	Avg. Vs
0				
5.05			0.17	**600**
10.07	454	0.01		
15.06	422	0.01		
20.05	471	0.01		
25	592	0.01		
30.05	602	0.01		
35.07	459	0.01		
39.99	740	0.01		
45.08	730	0.01		
50	565	0.01		
55.02	489	0.01		
60.1	649	0.01		
65.06	570	0.01		
70.08	548	0.01		
75.1	756	0.01		
80.41	640	0.01		
85.07	615	0.01		
90.06	520	0.01		
95.05	546	0.01		
100	845	0.01		

FIGURES

Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LE22199	Regional Fault Map	Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

LANDMARK Geo-Engineers and Geologists Project No.: LE22199	Map of Local Faults	Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
Quaternary	Late Quaternary	Holocene	11,700			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
Quaternary	Late Quaternary	Pleistocene	700,000			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
Quaternary	Early Quaternary	Pleistocene	1,600,000*			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

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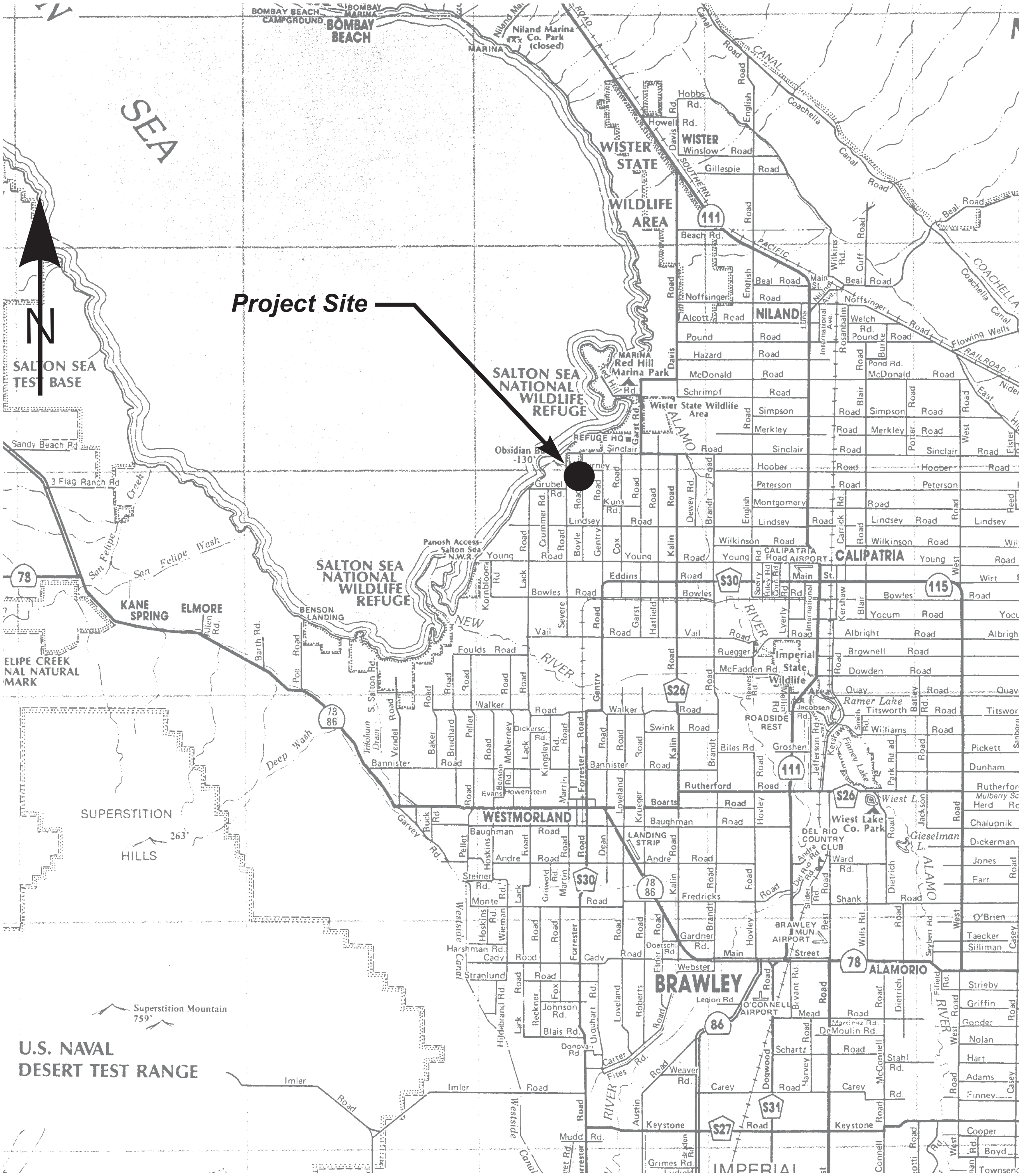
Fault Map Legend

Figure 3

APPENDIX A



LANDMARK

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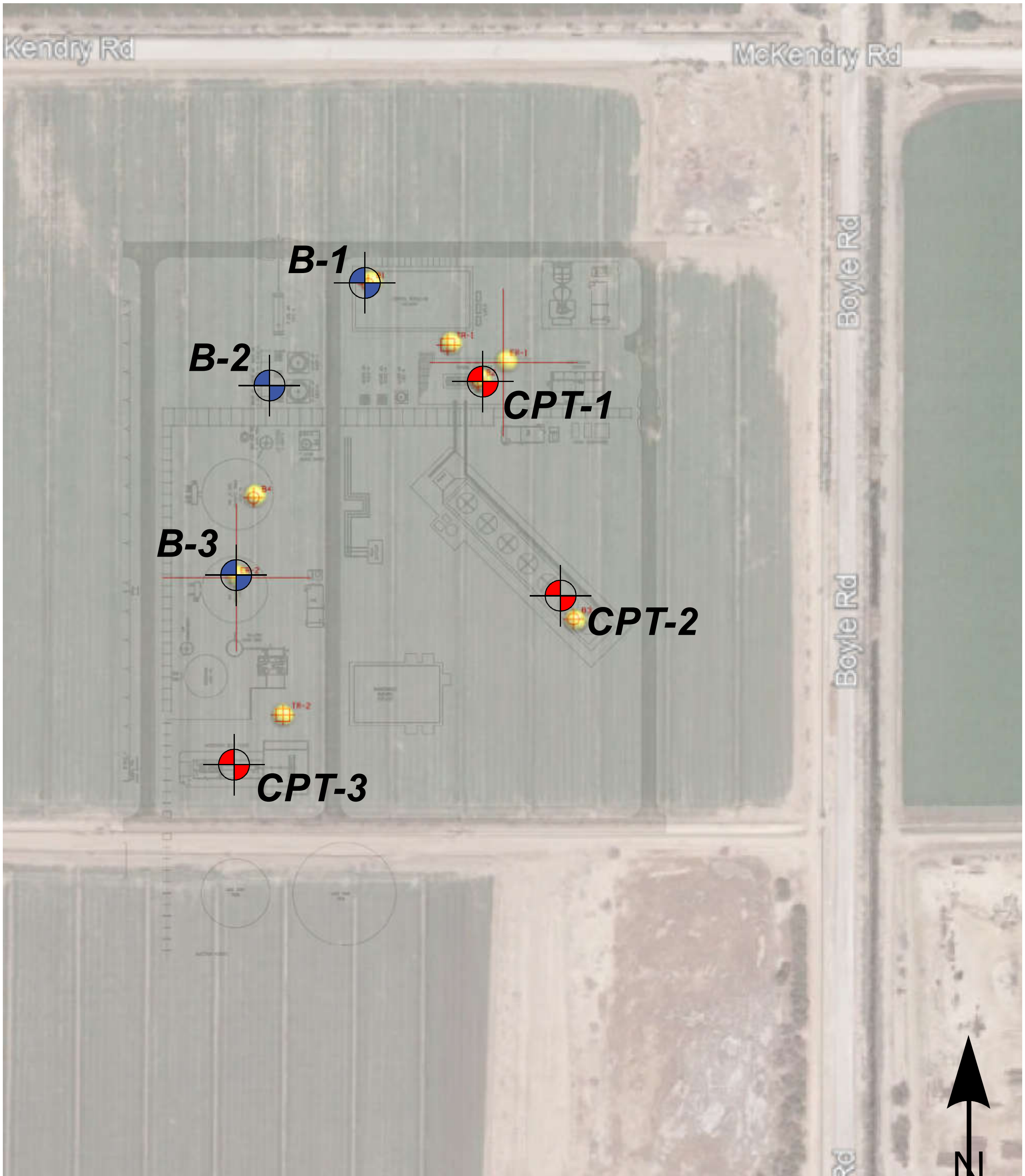
Vicinity Map

Plate A-1



Legend

Approximate CPT Sounding Location

Approximate Boring Location

LandMark Geo-Engineers and Geologists

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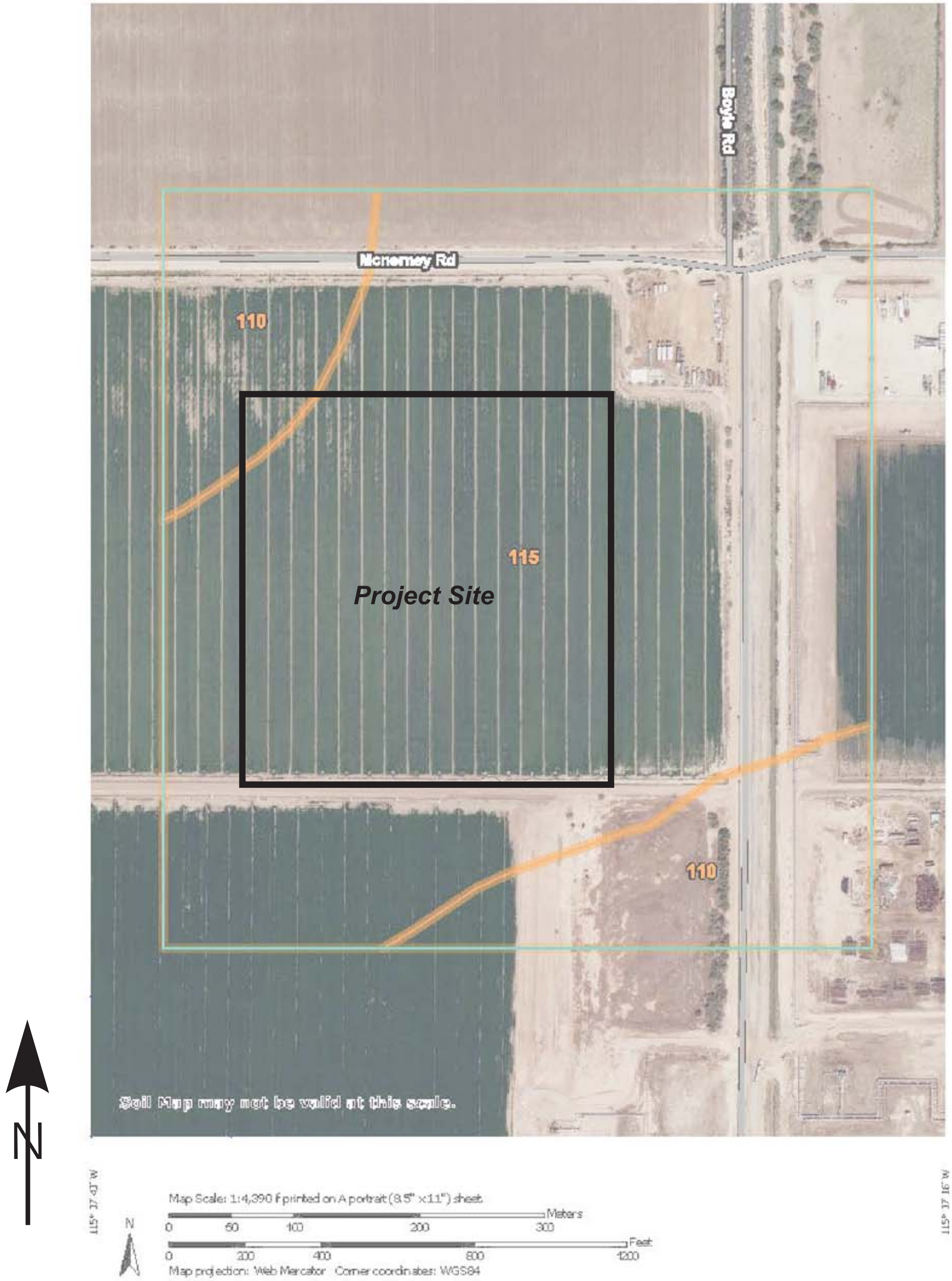
Site and Exploration Plan

Plate A-2



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

10/12/2022
Page 1 of 3

LANDMARK
Geo-Engineers and Geologists

Project No.: LE22199

Soil Survey Map

Plate A-3

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Imperial County, California, Imperial Valley Area
Survey Area Data: Version 14, Sep 1, 2022

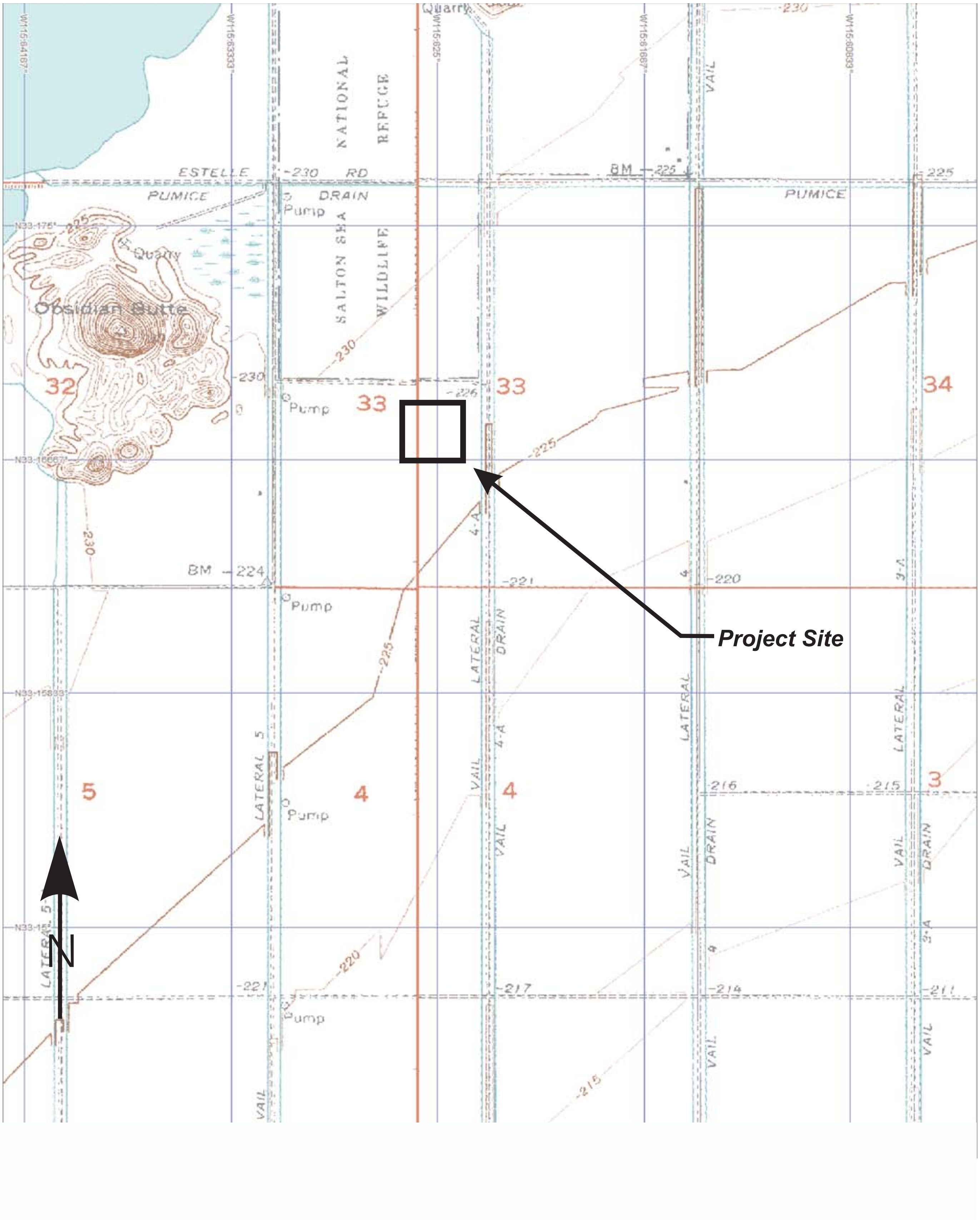
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 6, 2021—May 29, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
110	Holtville silty clay, wet	17.3	20.5%
115	Imperial-Glenbar silty clay loams, wet, 0 to 2 percent slopes	67.4	79.5%
Totals for Area of Interest		**84.8**	**100.0%**



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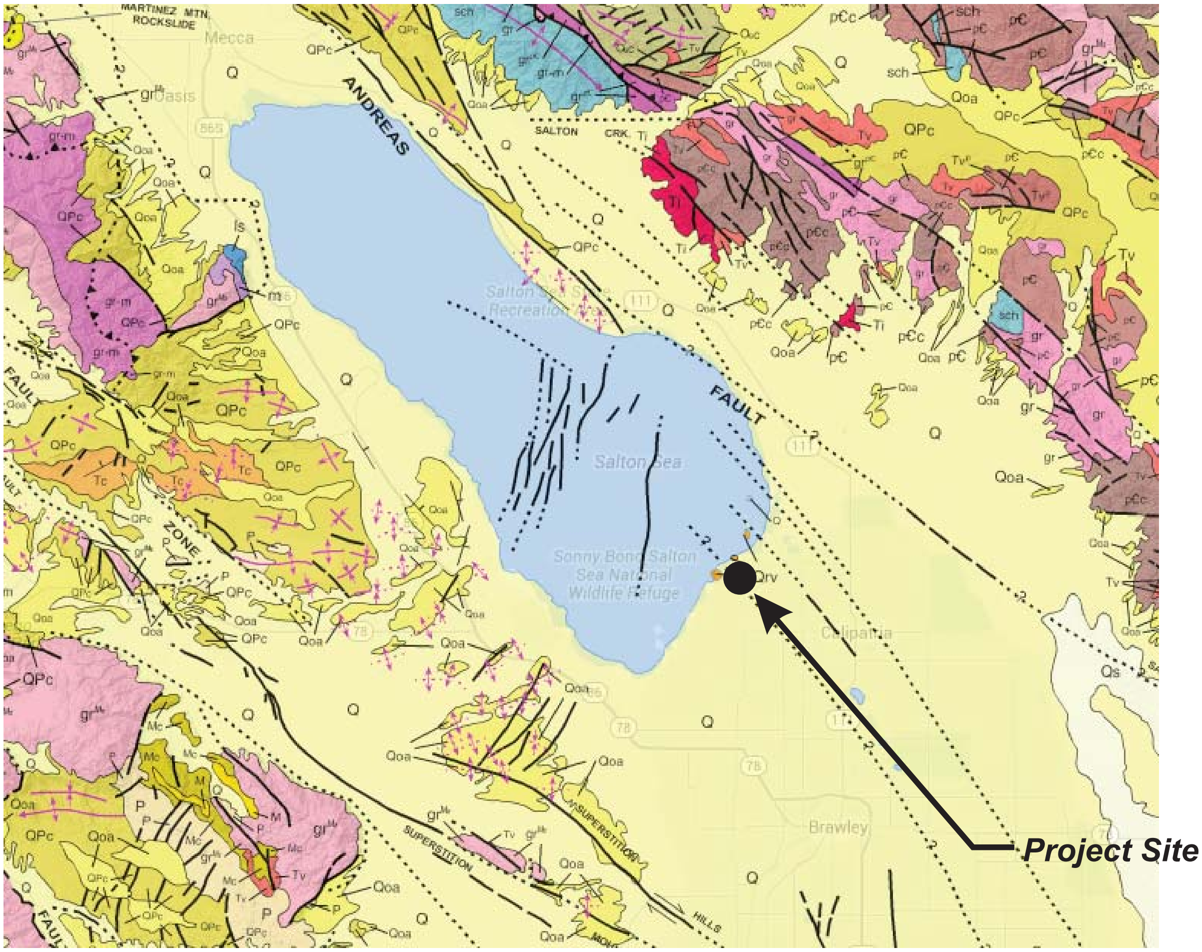
Topographic Map

Plate A-4



GEOLOGIC LEGEND

Quaternary Deposits: Qs, Q, Qls, Qg, Qoa, QPc

Quaternary Volcanic Rocks: Qrv, Qrv[p], Qv, Qv[p]

Tertiary Sedimentary Rocks: Tc, P, M, Mc, Ec, OEc, E, Ec, Ep

Tertiary Volcanic Rocks: Tv, Tv[p], Ti

Tertiary Plutonic Rocks: gr[Cz]

Mesozoic Sedimentary and Metasedimentary Rocks: TK, K, Ku, Kl, KJf, KJf[m], KJf[s], J, TR, sch, ls

Mesozoic Mixed Rocks: gr-m

Mesozoic Metavolcanic Rocks: Mzv, mv

Mesozoic Plutonic Rocks: gr[Mz], um, gb, gr

Paleozoic Sedimentary and Metasedimentary Rocks: Pz, Pm, C, D, SO, €

Paleozoic Mixed Rocks: m

Paleozoic Metavolcanic Rocks: Pzv

Paleozoic Plutonic Rocks: gr[Pz]

Pre-Cambrian Rocks: p€, p€c, gr[p€]

SYMBOLS

Geologic boundary

Fault traces - solid where well located, dashed where approximately located or inferred, dotted where concealed, and queried where continuation or existence is uncertain. Ball and bar on downthrown side (relative or apparent). Arrows indicate direction of lateral movement (relative or apparent).

Thrust fault (barbs on upper plate).

Regional strike and dip of stratified rocks.

Regional strike and dip of stratified rocks (overturned).

Anticlinal fold.

Synclinal fold.

Monoclinal fold.

N

Site Location
Lat: 33.1679 N Long: -115.6250 W

LANDMARK
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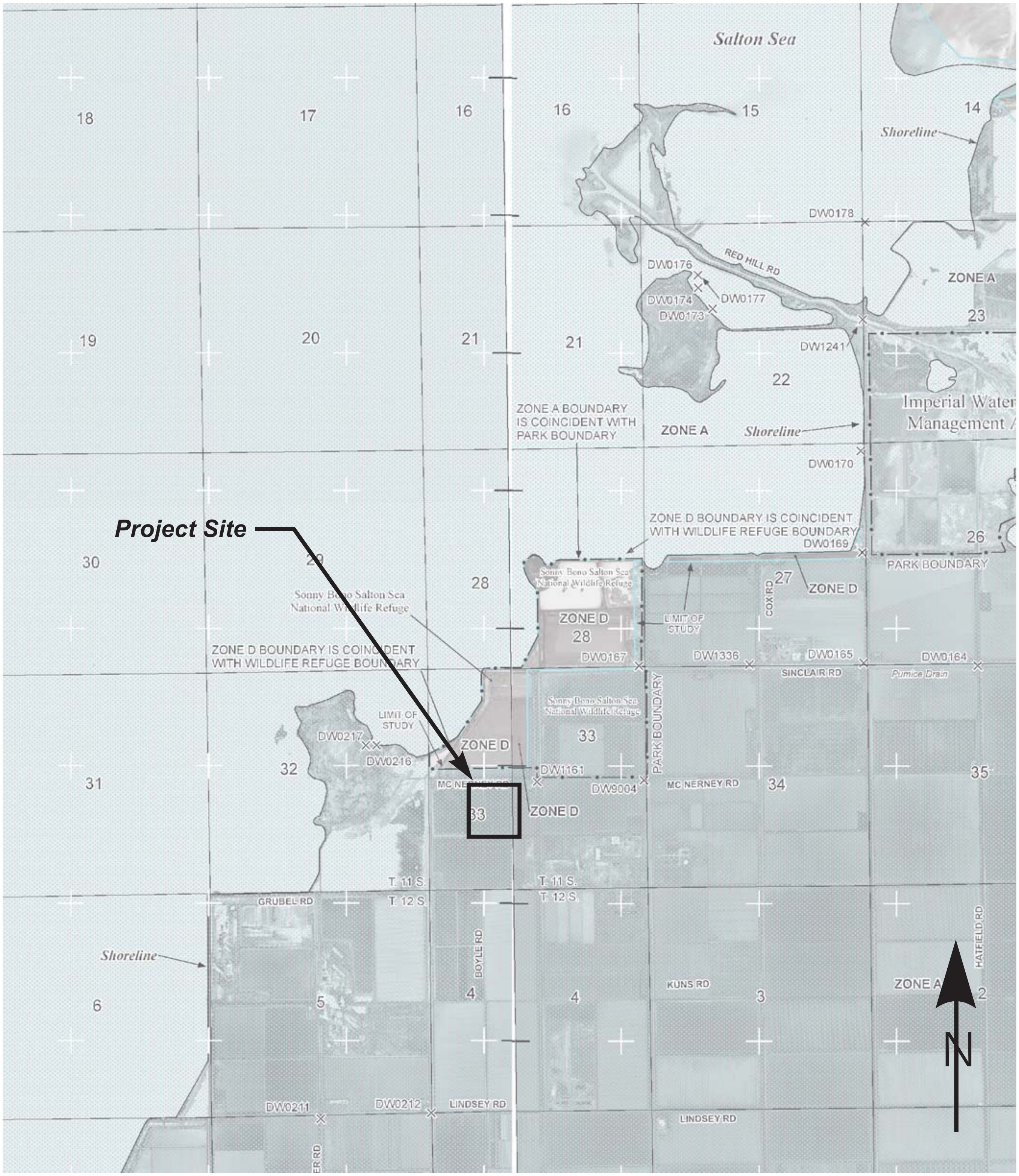
Regional Geologic Map

Plate A-5



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FEMA Flood Map

Plate
A-6

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{24}76^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 11N
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

APPENDIX B

LOG OF BORING NO. B-1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
0–4		CL-ML			SILTY CLAY/CLAYEY SILT (CL-ML): Brown, very moist, soft, low to medium plasticity			LL=26% PI=6%
			2				32.0	
4–24		ML-SM			SANDY SILT/SILTY SAND (ML-SM): Light brown, wet, loose, with very fine grained sand			
5			5			105.5	26.9	
			5		Saturated		30.6	
10			4			101.2	24.9	c=0.25 tsf Φ=26°
15			21		Medium dense			% passing #200 = 58.1%
20			13					
24–26.5		CL-ML			SILTY CLAY/CLAYEY SILT (CL-ML): Gray-brown, very moist/saturated, soft, medium plasticity, some very fine grained sand			
25			4	0.25				
30					Groundwater was measured at 6 feet at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED:	9/27/22	TOTAL DEPTH:	26.5 Feet	DEPTH TO WATER:	6.0 ft.
LOGGED BY:	A. Gomez	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	Approximately -225’	HAMMER WT.:	140 lbs.	DROP:	30 in.

PROJECT No. LE22199

LANDMARK Geo-Engineers and Geologists

LOG OF BORING NO. B-2

SHEET 1 OF 1

DEPTH	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
			SILTY CLAY/CLAYEY SILT (CL-ML): Brown, very moist, soft, medium plasticity			LL=30% PI=12%
	7			106.6	24.8	c=0.21 tsf
5	1		SILT/SANDY SILT (ML): Light brown, wet, very loose		29.8	% passing #200 = 97.4% <2μ = 11.7%
	7		Saturated, loose, some very fine grained sand	98.7	27.2	% passing #200 = 86.5%
10	7		SILTY SAND (SM): Light brown, saturated, loose, with very fine grained sand		26.4	
15	12		CLAYEY SILT (ML): Light brown, very moist/saturated, firm, low plasticity, some very fine grained sand			LL=27% PI=6% % passing #200 = 92.6% <2μ = 12.4%
20	8		SILTY SAND (SM): Light brown, saturated, loose, with very fine grained sand			% passing #200 = 40.9%
25	4		CLAYEY SILT (ML): Gray-brown, very moist/saturated, very soft, low plasticity			% passing #200 = 95.7% <2μ = 18.0%
			Groundwater was measured at 16 feet at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			
30						

DATE DRILLED: 9/27/22 TOTAL DEPTH: 26.5 Feet DEPTH TO WATER: 6.0 ft.

LOGGED BY: A. Gomez TYPE OF BIT: Hollow Stem Auger DIAMETER: 8 in.

SURFACE ELEVATION: Approximately -225' HAMMER WT.: 140 lbs. DROP: 30 in.

PROJECT No. LE22199

LANDMARK Geo-Engineers and Geologists

PLATE B-2

LOG OF BORING No. B-3

SHEET 1 OF 1

DEPTH	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
			SILTY CLAY/CLAYEY SILT (CL-ML): Brown, very moist, soft, low to medium plasticity			
	2		SANDY SILT (ML): Light brown, wet, very loose, with very fine grained sand		28.3	Passing #200 = 60.6%
5	18		SILTY SAND (SM): Light brown, wet, medium dense, fine grained sand	99.8	24.2	Passing #200 = 24.4%
	1		SANDY SILT/SILTY SAND (ML-SM): Light brown, saturated, very loose, with very fine to fine grained sand		30.7	Passing #200 = 57.4%
10	33		Medium dense	103.9	23.6	Passing #200 = 49.7%
15	5		SILT/CLAYEY SILT (ML): Brown, very moist, firm, low plasticity		30.6	Passing #200 = 94.9%
20	6		SAND/SILTY SAND (SP-SM): Brown, saturated, loose, fine grained sand	96.2	22.0	Passing #200 = 39.7% c=0.04 tsf Φ=35°
25	21		Medium dense		22.8	Passing #200 = 10.9%
30	4		FAT CLAY (CH): Dark brown, very moist, soft, high plasticity			LL=62% PI=43% % passing #200 = 99% <2μ = 54.6%
35	6		SILTY SAND (SM): Light brown, saturated, loose, fine grained sand		28.9	Passing #200 = 82.2%
40	50/6"		SAND/SILTY SAND (SP-SM): Brown, saturated, very dense, fine grained sand	105.6	20.4	c=0.02 tsf Φ=39°
45	21		Medium dense		25.7	Passing #200 = 9.5%
50	88		Very dense			
55	12	2.5	CLAYEY SILT/SILTY CLAY (ML): Brown, very moist, stiff, low to medium plasticity		26.2	LL=23% PI=5%
60			SILTY SAND (SM): Brown, saturated, very dense, fine grained sand			

DATE DRILLED: 9/28/22
TOTAL DEPTH: 76.5 Feet
DEPTH TO WATER: 6.0 ft.
LOGGED BY: A. Gomez
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: Approximately -225'
HAMMER WT.: 140 lbs.
DROP: 30 in.

PROJECT No.: LE22199

LANDMARK Geo-Engineers and Geologists

PLATE B-3a

LOG OF BORING No. B-3

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
		SM	50/6"		SILTY SAND (SM): Brown, saturated, very dense, fine graded sand	107.2	20.1	% passing #200 = 30.4% <2μ = 7.7%
65		CL	12	2.5	SILTY CLAY (CL): Brown, very moist, stiff, medium plasticity	94.6	30.4	c=0.87 tsf
70			15	1.5				LL=30% PI=16%
75			5	1.5		103.5	23.1	c=0.31 tsf
80					Groundwater was measured at 14 feet at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			
85								
90								
95								
100								
105								
110								
115								
120								

DATE DRILLED: 9/28/22	TOTAL DEPTH: 76.5 Feet	DEPTH TO WATER: 6.0 ft.
LOGGED BY: A. Gomez	TYPE OF BIT: Hollow Stem Auger	DIAMETER: 8 in.
SURFACE ELEVATION: Approximately -225'	HAMMER WT.: 140 lbs.	DROP: 30 in.

PROJECT No.: LE22199

LANDMARK Geo-Engineers and Geologists

CLIENT: BHER
PROJECT: Black Rock Geothermal - Calipatria, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight
DATE: 9/28/2022

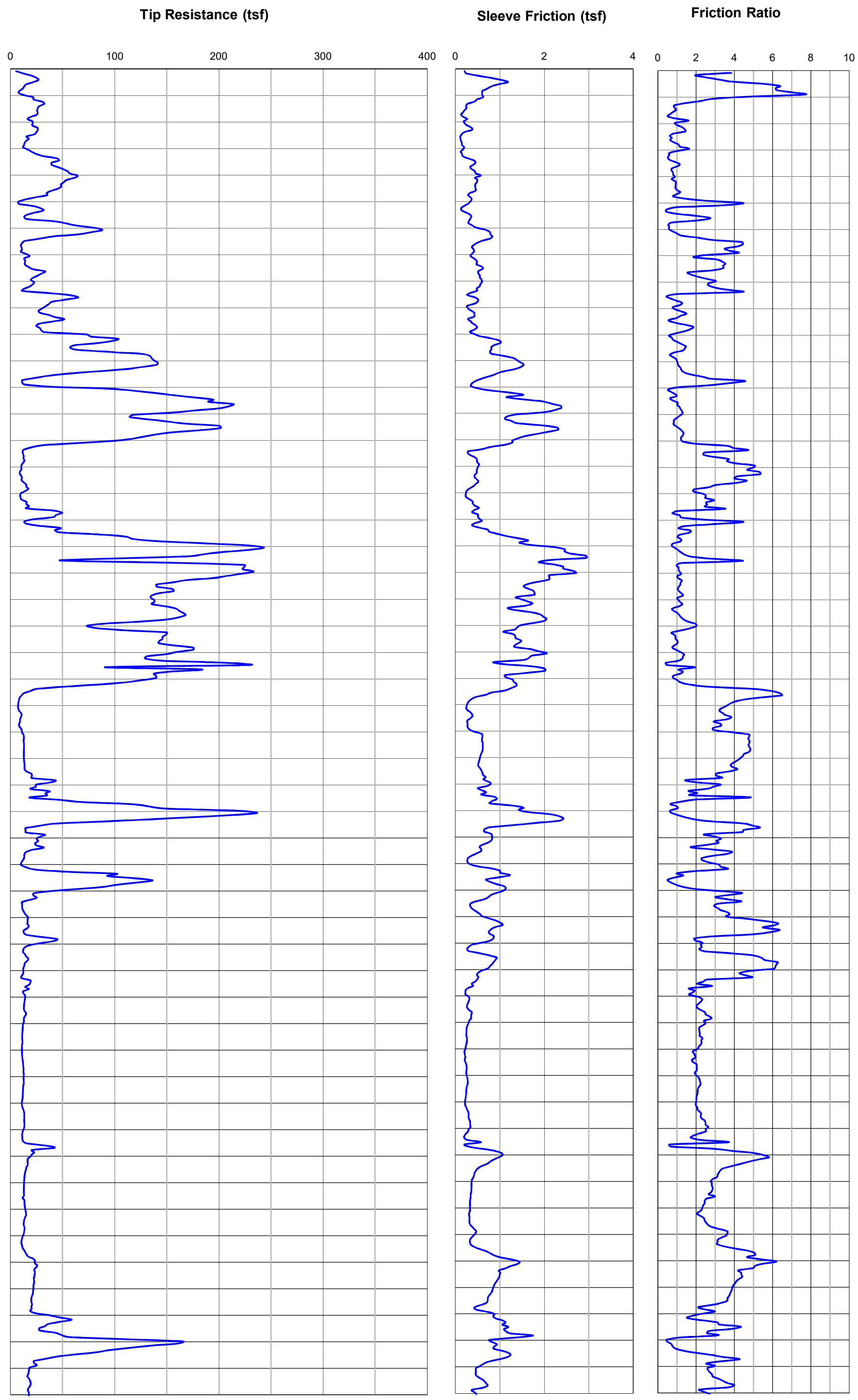
CONE SOUNDING DATA CPT-1

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH			
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clay	CL/CH	stiff
	Sandy Silt to Clayey Sil	ML	medium dense
	Silty Sand to Sandy Sil	SM/ML	medium dense
5	Sandy Silt to Clayey Sil	ML	medium dense
	Sandy Silt to Clayey Sil	" "	loose
	Silty Sand to Sandy Sil	SM/ML	medium dense
	Silty Sand to Sandy Sil	" "	medium dense
	Silty Sand to Sandy Sil	" "	medium dense
10	Sandy Silt to Clayey Sil	ML	medium dense
	Sandy Silt to Clayey Sil	" "	loose
	Silty Sand to Sandy Sil	SM/ML	medium dense
	Silty Sand to Sandy Sil	" "	medium dense
	Clay	CL/CH	stiff
15	Clayey Silt to Silty Clay	ML/CL	stiff
	Sandy Silt to Clayey Sil	ML	loose
	Sandy Silt to Clayey Sil	" "	loose
	Silty Sand to Sandy Sil	SM/ML	medium dense
	Silty Sand to Sandy Sil	" "	medium dense
20	Silty Sand to Sandy Sil	" "	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Sand to Silty Sand	" "	dense
	Sand to Silty Sand	" "	dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
25	Sand	SP	dense
	Sand	" "	very dense
	Sand	" "	dense
	Sand to Silty Sand	SP/SM	dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
30	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Sandy Silt to Clayey Sil	ML	loose
35	Sandy Silt to Clayey Sil	" "	loose
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	dense
	Sand	SP	very dense
	Sand	" "	dense
40	Sand to Silty Sand	SP/SM	dense
	Sand	SP	dense
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
	Sand	SP	dense
45	Sand	" "	dense
	Sand to Silty Sand	SP/SM	dense
	Sandy Silt to Clayey Sil	ML	medium dense
	Clay	CL/CH	firm
	Clay	" "	firm
50	Silty Clay to Clay	CL	firm
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Silty Clay to Clay	CL	stiff
	Sandy Silt to Clayey Sil	ML	loose
55	Sandy Silt to Clayey Sil	" "	loose
	Sand to Silty Sand	SP/SM	medium dense
	Silty Sand to Sandy Sil	SM/ML	dense
	Silty Clay to Clay	CL	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
60	Silty Clay to Clay	CL	stiff
	Silty Sand to Sandy Sil	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
65	Clay	CL/CH	stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clay	CL/CH	stiff
	Silty Clay to Clay	CL	stiff
70	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
75	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
80	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	very stiff
	Clay	CL/CH	stiff
	Silty Clay to Clay	CL	stiff
85	Clayey Silt to Silty Clay	ML/CL	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff
	Silty Clay to Clay	CL	stiff
	Silty Clay to Clay	" "	stiff
90	Clay	CL/CH	stiff
	Clay	" "	very stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	very stiff
	Clayey Silt to Silty Clay	ML/CL	very stiff
95	Sandy Silt to Clayey Sil	ML	loose
	Silty Sand to Sandy Sil	SM/ML	medium dense
	Sand to Silty Sand	SP/SM	medium dense
	Clayey Silt to Silty Clay	ML/CL	very stiff
	Clayey Silt to Silty Clay	" "	stiff
	Clayey Silt to Silty Clay	" "	stiff

END OF SOUNDING AT 100 ft.



Project No. LE22199

LANDMARK
Geo-Engineers and Geologists

PLATE B-4

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-1
Est. GWT (ft): 6
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	12.53	2.77	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		80			0.74	>10
0.30	1.0	24.47	4.14	Silty Clay to Clay	CL	very stiff	125	14		70			1.44	>10
0.45	1.5	13.31	6.25	Clay	CL/CH	stiff	125	11		100			0.78	>10
0.60	2.0	9.88	6.43	Clay	CL/CH	stiff	125	8		100			0.58	>10
0.75	2.5	24.75	2.16	Sandy Silt to Clayey Silt	ML	medium dense	115	7	46.8	55	60	36		
0.93	3.0	28.74	0.89	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	54.3	35	61	37		
1.08	3.5	25.53	0.66	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	48.3	35	55	36		
1.23	4.0	18.89	1.14	Sandy Silt to Clayey Silt	ML	medium dense	115	5	35.7	50	45	34		
1.38	4.5	22.73	1.22	Sandy Silt to Clayey Silt	ML	medium dense	115	6	43.0	45	48	35		
1.53	5.0	24.57	0.96	Silty Sand to Sandy Silt	SM/ML	medium dense	115	5	45.0	40	49	35		
1.68	5.5	15.34	0.82	Sandy Silt to Clayey Silt	ML	loose	115	4	26.8	50	34	33		
1.83	6.0	13.84	1.27	Sandy Silt to Clayey Silt	ML	loose	115	4	23.1	60	29	32		
1.98	6.5	25.34	0.57	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	41.5	30	47	35		
2.13	7.0	43.49	0.87	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	69.9	25	62	37		
2.28	7.5	44.98	0.83	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	71.0	25	62	37		
2.45	8.0	58.73	0.83	Sand to Silty Sand	SP/SM	medium dense	115	11	91.2	20	70	38		
2.60	8.5	55.42	0.86	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	84.7	20	68	37		
2.75	9.0	47.42	0.95	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	71.3	25	62	37		
2.90	9.5	36.22	0.98	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	53.6	30	54	36		
3.05	10.0	14.99	2.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.86	>10
3.20	10.5	19.70	1.63	Sandy Silt to Clayey Silt	ML	loose	115	6	28.3	55	35	33		
3.35	11.0	23.51	1.18	Sandy Silt to Clayey Silt	ML	loose	115	7	33.3	45	40	34		
3.50	11.5	23.72	1.86	Sandy Silt to Clayey Silt	ML	loose	115	7	33.1	55	40	34		
3.65	12.0	66.27	0.57	Sand to Silty Sand	SP/SM	medium dense	115	12	91.3	15	70	38		
3.80	12.5	76.81	0.99	Sand to Silty Sand	SP/SM	dense	115	14	104.4	20	74	38		
3.95	13.0	27.15	3.10	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.57	>10
4.13	13.5	10.57	4.04	Clay	CL/CH	stiff	125	8		100			0.59	7.13
4.28	14.0	11.97	3.48	Silty Clay to Clay	CL	stiff	125	7		100			0.67	>10
4.43	14.5	15.12	2.76	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.86	>10
4.58	15.0	15.09	3.45	Silty Clay to Clay	CL	stiff	125	9		90			0.85	>10
4.73	15.5	28.09	2.06	Sandy Silt to Clayey Silt	ML	medium dense	115	8	35.2	55	42	34		
4.88	16.0	22.40	2.59	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		70			1.28	>10
5.03	16.5	17.58	3.09	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		85			1.00	>10
5.18	17.0	35.41	1.93	Sandy Silt to Clayey Silt	ML	medium dense	115	10	43.0	50	48	35		
5.33	17.5	52.40	0.96	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	62.9	30	59	36		
5.48	18.0	33.82	0.95	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	40.2	40	46	34		
5.65	18.5	30.42	1.30	Silty Sand to Sandy Silt	SM/ML	medium dense	115	7	35.8	50	42	34		
5.80	19.0	45.10	0.78	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	52.6	30	54	35		
5.95	19.5	26.93	1.65	Sandy Silt to Clayey Silt	ML	loose	115	8	31.1	60	38	33		
6.10	20.0	45.04	1.01	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	51.6	35	53	35		
6.25	20.5	92.65	0.84	Sand to Silty Sand	SP/SM	dense	115	17	105.1	20	74	38		
6.40	21.0	67.08	1.36	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	75.4	35	64	37		
6.55	21.5	94.39	0.92	Sand to Silty Sand	SP/SM	dense	115	17	105.2	20	74	38		
6.70	22.0	135.78	0.92	Sand	SP	dense	110	21	150.1	15	84	40		
6.85	22.5	135.54	1.11	Sand to Silty Sand	SP/SM	dense	115	25	148.6	20	84	40		
7.00	23.0	82.98	1.43	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	90.3	30	69	38		
7.18	23.5	23.91	3.21	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		85			1.36	>10
7.33	24.0	19.95	2.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		85			1.12	>10
7.48	24.5	118.95	0.70	Sand	SP	dense	110	18	126.2	15	79	39		
7.63	25.0	176.10	0.80	Sand	SP	very dense	110	27	185.5	10	91	41		
7.78	25.5	204.46	1.06	Sand	SP	very dense	110	31	213.8	15	95	41		
7.93	26.0	176.81	1.25	Sand to Silty Sand	SP/SM	very dense	115	32	183.6	20	90	41		
8.08	26.5	128.22	0.96	Sand to Silty Sand	SP/SM	dense	115	23	132.1	20	81	39		
8.23	27.0	189.68	0.97	Sand	SP	very dense	110	29	194.1	15	92	41		
8.38	27.5	159.57	1.30	Sand to Silty Sand	SP/SM	dense	115	29	162.2	20	87	40		
8.53	28.0	113.87	1.25	Sand to Silty Sand	SP/SM	dense	115	21	114.9	25	77	39		
8.68	28.5	37.66	3.22	Clayey Silt to Silty Clay	ML/CL	hard	120	15		75			2.16	>10
8.85	29.0	12.14	3.17	Silty Clay to Clay	CL	stiff	125	7		100			0.66	4.47
9.00	29.5	12.84	3.39	Silty Clay to Clay	CL	stiff	125	7		100			0.70	4.78
9.15	30.0	10.97	4.70	Clay	CL/CH	stiff	125	9		100			0.59	3.00
9.30	30.5	9.47	5.11	Clay	CL/CH	firm	125	8		100			0.50	2.34
9.45	31.0	10.63	4.27	Clay	CL/CH	stiff	125	9		100			0.57	2.73
9.60	31.5	14.25	3.28	Silty Clay to Clay	CL	stiff	125	8		100			0.78	5.21
9.75	32.0	13.75	2.03	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.75	6.43
9.90	32.5	9.85	2.65	Silty Clay to Clay	CL	stiff	125	6		100			0.52	2.82
10.05	33.0	16.05	2.53	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.88	8.14
10.20	33.5	35.35	1.77	Sandy Silt to Clayey Silt	ML	loose	115	10	32.9	65	40	34		
10.38	34.0	35.57	1.61	Silty Sand to Sandy Silt	SM/ML	loose	115	8	32.9	65	40	34		
10.53	34.5	18.67	2.94	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		100			1.03	>10
10.68	35.0	45.73	1.47	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	41.7	55	47	35		
10.83	35.5	104.77	1.12	Sand to Silty Sand	SP/SM	dense	115	19	95.1	30	71	38		
10.98	36.0	182.86	0.90	Sand	SP	dense	110	28	165.0	15	87	40		
11.13	36.5	216.22	1.14	Sand	SP	very dense	110	33	194.2	20	92	41		
11.28	37.0	107.48	3.00	Sandy Silt to Clayey Silt	ML	dense	115	31	96.0	50	71	38		
11.43	37.5	201.50	1.09	Sand	SP	dense	110	31	179.0	20	90	41		
11.58	38.0	226.35	1.15	Sand	SP	very dense	110	35	200.1	20	93	41		
11.73	38.5	190.62	1.12	Sand	SP	dense	110	29	167.7	20	88	40		

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-1
Est. GWT (ft): 6
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)
Nk: **17**

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
11.88	39.0	145.70	1.15	Sand to Silty Sand	SP/SM	dense	115	26	127.5	25	80	39		
12.05	39.5	151.31	1.13	Sand to Silty Sand	SP/SM	dense	115	28	131.7	25	81	39		
12.20	40.0	135.85	1.13	Sand to Silty Sand	SP/SM	dense	115	25	117.7	25	77	39		
12.35	40.5	140.62	1.17	Sand to Silty Sand	SP/SM	dense	115	26	121.2	25	78	39		
12.50	41.0	161.82	0.87	Sand	SP	dense	110	25	138.8	20	82	40		
12.65	41.5	160.41	1.23	Sand to Silty Sand	SP/SM	dense	115	29	136.9	25	82	39		
12.80	42.0	96.29	1.85	Silty Sand to Sandy Silt	SM/ML	medium dense	115	21	81.8	45	67	37		
12.95	42.5	113.06	1.22	Sand to Silty Sand	SP/SM	dense	115	21	95.5	30	71	38		
13.10	43.0	147.07	0.90	Sand	SP	dense	110	23	123.7	25	79	39		
13.25	43.5	147.26	0.97	Sand	SP	dense	110	23	123.3	25	79	39		
13.40	44.0	170.02	0.96	Sand	SP	dense	110	26	141.7	20	83	40		
13.58	44.5	136.60	1.32	Sand to Silty Sand	SP/SM	dense	115	25	113.3	30	76	39		
13.73	45.0	193.18	0.66	Sand	SP	dense	110	30	159.5	15	86	40		
13.88	45.5	142.36	1.45	Sand to Silty Sand	SP/SM	dense	115	26	117.0	30	77	39		
14.03	46.0	139.03	0.92	Sand	SP	dense	110	21	113.8	25	76	39		
14.18	46.5	105.99	1.29	Sand to Silty Sand	SP/SM	medium dense	115	19	86.4	35	68	38		
14.33	47.0	27.03	4.99	Clay	CL/CH	very stiff	125	22		100			1.51	6.65
14.48	47.5	9.23	5.42	Clay	CL/CH	firm	125	7		100			0.46	1.31
14.63	48.0	7.42	3.75	Clay	CL/CH	firm	125	6		100			0.35	0.99
14.78	48.5	8.51	3.30	Clay	CL/CH	firm	125	7		100			0.41	1.14
14.93	49.0	9.91	3.65	Clay	CL/CH	firm	125	8		100			0.49	1.37
15.10	49.5	8.54	3.16	Silty Clay to Clay	CL	firm	125	5		100			0.41	1.31
15.25	50.0	10.47	3.23	Silty Clay to Clay	CL	stiff	125	6		100			0.53	1.77
15.40	50.5	12.64	4.75	Clay	CL/CH	stiff	125	10		100			0.65	1.92
15.55	51.0	12.75	4.77	Clay	CL/CH	stiff	125	10		100			0.66	1.92
15.70	51.5	12.75	4.80	Clay	CL/CH	stiff	125	10		100			0.66	1.84
15.85	52.0	12.84	4.42	Clay	CL/CH	stiff	125	10		100			0.66	1.84
16.00	52.5	13.28	3.97	Clay	CL/CH	stiff	125	11		100			0.69	1.92
16.15	53.0	14.21	3.93	Silty Clay to Clay	CL	stiff	125	8		100			0.74	2.57
16.30	53.5	20.26	3.15	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.10	5.88
16.45	54.0	35.26	2.22	Sandy Silt to Clayey Silt	ML	loose	115	10	26.6	85	33	33		
16.60	54.5	27.02	2.38	Sandy Silt to Clayey Silt	ML	loose	115	8	20.3	100	25	32		
16.78	55.0	28.83	2.86	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		100			1.60	>10
16.93	55.5	77.51	1.28	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	57.9	50	56	36		
17.08	56.0	165.96	0.88	Sand	SP	dense	110	26	123.5	25	79	39		
17.23	56.5	207.42	1.01	Sand	SP	dense	110	32	153.8	25	85	40		
17.38	57.0	86.81	2.99	Sandy Silt to Clayey Silt	ML	medium dense	115	25	64.1	65	59	36		
17.53	57.5	17.70	4.79	Clay	CL/CH	stiff	125	14		100			0.94	2.57
17.68	58.0	28.58	2.90	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.58	9.79
17.83	58.5	25.00	2.90	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.37	7.27
17.98	59.0	22.44	2.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.21	6.10
18.13	59.5	13.12	2.92	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.67	2.57
18.30	60.0	10.66	2.73	Silty Clay to Clay	CL	stiff	125	6		100			0.52	1.43
18.45	60.5	29.52	2.96	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		100			1.63	9.59
18.60	61.0	104.08	1.05	Sand to Silty Sand	SP/SM	medium dense	115	19	74.4	40	64	37		
18.75	61.5	120.26	0.67	Sand	SP	medium dense	110	19	85.7	30	68	38		
18.90	62.0	63.90	1.96	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	45.4	65	49	35		
19.05	62.5	23.05	3.70	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.24	5.76
19.20	63.0	13.56	3.72	Silty Clay to Clay	CL	stiff	125	8		100			0.69	1.92
19.35	63.5	11.66	3.12	Silty Clay to Clay	CL	stiff	125	7		100			0.57	1.50
19.50	64.0	14.99	3.66	Silty Clay to Clay	CL	stiff	125	9		100			0.77	2.20
19.65	64.5	16.28	5.52	Clay	CL/CH	stiff	125	13		100			0.84	2.00
19.80	65.0	15.46	5.97	Clay	CL/CH	stiff	125	12		100			0.79	1.77
19.98	65.5	18.58	4.73	Clay	CL/CH	stiff	125	15		100			0.98	2.34
20.13	66.0	37.63	2.07	Sandy Silt to Clayey Silt	ML	loose	115	11	25.9	90	33	33		
20.28	66.5	14.15	2.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.71	2.41
20.43	67.0	13.59	3.86	Silty Clay to Clay	CL	stiff	125	8		100			0.68	1.77
20.58	67.5	15.65	5.76	Clay	CL/CH	stiff	125	13		100			0.80	1.70
20.73	68.0	12.60	5.80	Clay	CL/CH	stiff	125	10		100			0.62	1.25
20.88	68.5	11.10	4.58	Clay	CL/CH	stiff	125	9		100			0.53	1.05
21.03	69.0	18.64	2.34	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.97	3.50
21.18	69.5	14.56	2.13	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.73	2.41
21.33	70.0	13.46	1.86	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.67	2.13
21.50	70.5	13.37	2.24	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	2.06
21.65	71.0	13.00	2.11	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.64	2.00
21.80	71.5	14.15	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.71	2.20
21.95	72.0	12.50	2.57	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	1.77
22.10	72.5	11.69	2.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.56	1.56
22.25	73.0	11.32	2.19	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.54	1.50
22.40	73.5	11.35	2.29	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.54	1.50
22.55	74.0	10.94	2.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.51	1.37
22.70	74.5	11.07	1.88	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.52	1.37
22.85	75.0	11.75	1.86	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.56	1.50
23.00	75.5	12.28	2.03	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.59	1.63
23.18	76.0	12.53	1.98	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.60	1.63
23.33	76.5	12.57	2.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.60	1.63
23.48	77.0	12.13	2.18	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.58	1.56

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-1
Est. GWT (ft): 6
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.) [**Nk:**]	Su (tsf) [**17**]	OCR
23.63	77.5	11.78	2.07	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.56	1.43
23.78	78.0	11.26	2.01	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.52	1.37
23.93	78.5	11.69	2.03	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.55	1.43
24.08	79.0	13.22	2.23	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.64	1.70
24.23	79.5	13.22	2.41	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.64	1.70
24.38	80.0	12.72	2.55	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	1.56
24.53	80.5	11.29	2.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.52	1.31
24.68	81.0	13.06	2.58	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.63	1.63
24.83	81.5	32.23	1.41	Silty Sand to Sandy Silt	SM/ML	loose	115	7	20.0	100	25	32		
24.98	82.0	20.79	4.85	Clay	CL/CH	very stiff	125	17		100			1.08	2.00
25.13	82.5	16.52	5.24	Clay	CL/CH	stiff	125	13		100			0.83	1.37
25.28	83.0	15.46	3.86	Silty Clay to Clay	CL	stiff	125	9		100			0.76	1.56
25.43	83.5	13.78	3.19	Silty Clay to Clay	CL	stiff	125	8		100			0.66	1.31
25.58	84.0	13.19	2.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.63	1.56
25.73	84.5	12.82	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.60	1.43
25.88	85.0	12.75	2.76	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.60	1.43
26.03	85.5	12.75	2.66	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.60	1.43
26.17	86.0	13.75	2.39	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.66	1.56
26.32	86.5	14.78	2.17	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.72	1.77
26.47	87.0	13.34	2.37	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.63	1.50
26.62	87.5	13.00	2.65	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.61	1.43
26.77	88.0	12.84	3.49	Silty Clay to Clay	CL	stiff	125	7		100			0.60	1.09
26.92	88.5	10.91	3.33	Silty Clay to Clay	CL	firm	125	6		100			0.49	0.90
27.07	89.0	11.53	3.43	Silty Clay to Clay	CL	stiff	125	7		100			0.52	0.96
27.22	89.5	15.55	4.95	Clay	CL/CH	stiff	125	12		100			0.76	1.14
27.37	90.0	22.82	5.43	Clay	CL/CH	very stiff	125	18		100			1.18	2.00
27.52	90.5	24.25	5.17	Clay	CL/CH	very stiff	125	19		100			1.27	2.13
27.67	91.0	23.10	4.31	Silty Clay to Clay	CL	very stiff	125	13		100			1.20	2.49
27.82	91.5	22.51	4.26	Silty Clay to Clay	CL	very stiff	125	13		100			1.16	2.34
27.97	92.0	21.98	3.95	Silty Clay to Clay	CL	very stiff	125	13		100			1.13	2.27
28.12	92.5	21.26	3.81	Silty Clay to Clay	CL	very stiff	125	12		100			1.09	2.13
28.27	93.0	20.01	3.66	Silty Clay to Clay	CL	very stiff	125	11		100			1.01	1.92
28.42	93.5	20.26	2.76	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.03	2.57
28.57	94.0	26.65	2.58	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		100			1.40	3.83
28.72	94.5	51.06	1.86	Silty Sand to Sandy Silt	SM/ML	loose	115	11	29.5	90	36	33		
28.87	95.0	32.26	3.55	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.73	5.10
29.02	95.5	39.68	3.05	Sandy Silt to Clayey Silt	ML	loose	115	11	22.8	100	29	32		
29.17	96.0	110.42	1.59	Sand to Silty Sand	SP/SM	medium dense	115	20	63.3	60	59	36		
29.32	96.5	135.98	0.66	Sand	SP	medium dense	110	21	77.8	35	65	37		
29.47	97.0	79.93	1.37	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	45.6	65	49	35		
29.62	97.5	33.60	3.49	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		100			1.81	5.21
29.77	98.0	22.14	2.93	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		100			1.13	2.73
29.92	98.5	17.43	2.65	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.85	1.84
30.07	99.0	17.91	3.07	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.88	1.92
30.22	99.5	17.96	3.77	Silty Clay to Clay	CL	stiff	125	10		100			0.88	1.50
30.37	100.0	17.40	2.43	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.85	1.84

CLIENT: BHER
PROJECT: Black Rock Geothermal - Calipatria, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight
DATE: 9/28/2022

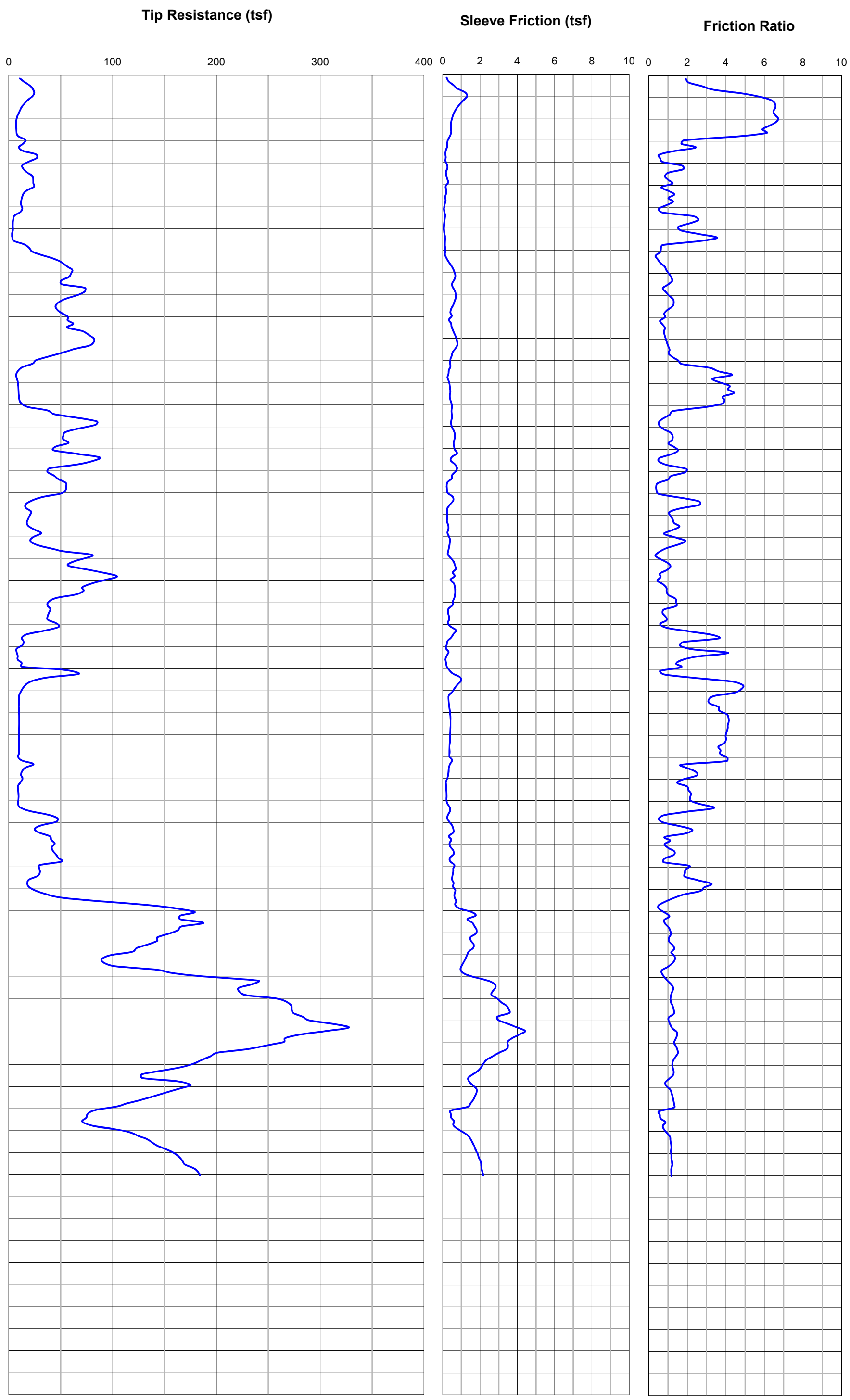
CONE SOUNDING DATA CPT-2

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Sandy Silt to Clayey Silt	" "	loose
Silty Clay to Clay	CL	firm
Clayey Silt to Silty Clay	ML/CL	stiff
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sandy Silt to Clayey Silt	" "	loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	stiff
Clayey Silt to Silty Clay	" "	firm
Sandy Silt to Clayey Silt	ML	loose
Silty Sand to Sandy Silt	SM/ML	loose
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sand to Silty Sand	SP/SM	dense
Sand	SP	dense
Sand to Silty Sand	SP/SM	dense
Sand	SP	dense
Sand	" "	very dense
Sand	" "	very dense
Sand	" "	very dense
Sand to Silty Sand	SP/SM	dense
Sand to Silty Sand	" "	dense
Sand to Silty Sand	" "	dense
Sand to Silty Sand	" "	medium dense
Sand to Silty Sand	" "	dense
Sand	SP	dense



END OF SOUNDING AT 50 ft.

Project No.
LE22199

LANDMARK
Geo-Engineers and Geologists

PLATE
B-5

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-2
Est. GWT (ft): 6
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	15.45	2.25	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		70			0.91	>10
0.30	1.0	23.39	4.67	Clay	CL/CH	very stiff	125	19		75			1.37	>10
0.45	1.5	15.05	6.50	Clay	CL/CH	stiff	125	12		100			0.88	>10
0.60	2.0	9.00	6.58	Clay	CL/CH	stiff	125	7		100			0.52	>10
0.75	2.5	7.13	6.24	Clay	CL/CH	firm	125	6		100			0.41	>10
0.93	3.0	10.81	4.12	Clay	CL/CH	stiff	125	9		100			0.63	>10
1.08	3.5	12.24	1.81	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		70			0.71	>10
1.23	4.0	24.20	0.61	Silty Sand to Sandy Silt	SM/ML	medium dense	115	5	45.8	35	51	35		
1.38	4.5	14.82	1.50	Sandy Silt to Clayey Silt	ML	loose	115	4	28.0	60	35	33		
1.53	5.0	23.22	1.03	Sandy Silt to Clayey Silt	ML	medium dense	115	7	42.1	40	47	35		
1.68	5.5	17.05	1.00	Sandy Silt to Clayey Silt	ML	loose	115	5	29.5	50	36	33		
1.83	6.0	12.23	0.89	Sandy Silt to Clayey Silt	ML	loose	115	3	20.2	60	25	32		
1.98	6.5	6.95	1.86	Silty Clay to Clay	CL	firm	125	4		95			0.39	9.39
2.13	7.0	3.83	1.78	Sensitive fine grained	ML	soft	120	2		100			0.20	5.10
2.28	7.5	3.77	2.90	Clay	CL/CH	soft	125	3		100			0.20	2.41
2.45	8.0	19.19	0.65	Silty Sand to Sandy Silt	SM/ML	loose	115	4	29.3	40	36	33		
2.60	8.5	42.49	0.47	Sand to Silty Sand	SP/SM	medium dense	115	8	63.9	20	59	36		
2.75	9.0	58.94	0.93	Sand to Silty Sand	SP/SM	medium dense	115	11	87.3	20	68	38		
2.90	9.5	52.99	1.12	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	77.3	25	65	37		
3.05	10.0	70.90	0.89	Sand to Silty Sand	SP/SM	dense	115	13	102.0	20	73	38		
3.20	10.5	49.40	1.26	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	70.0	30	62	37		
3.35	11.0	51.37	0.87	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	71.8	25	63	37		
3.50	11.5	58.34	0.71	Sand to Silty Sand	SP/SM	medium dense	115	11	80.5	20	66	37		
3.65	12.0	76.47	0.83	Sand to Silty Sand	SP/SM	dense	115	14	104.1	15	74	38		
3.80	12.5	74.04	1.01	Sand to Silty Sand	SP/SM	dense	115	13	99.6	20	72	38		
3.95	13.0	39.12	1.26	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	51.9	35	53	35		
4.13	13.5	14.98	2.83	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		85			0.85	>10
4.28	14.0	7.79	3.76	Clay	CL/CH	firm	125	6		100			0.42	4.00
4.43	14.5	9.19	4.23	Clay	CL/CH	stiff	125	7		100			0.51	5.00
4.58	15.0	10.59	3.86	Clay	CL/CH	stiff	125	8		100			0.59	6.10
4.73	15.5	32.92	1.72	Sandy Silt to Clayey Silt	ML	medium dense	115	9	41.0	50	46	34		
4.88	16.0	75.13	0.65	Sand to Silty Sand	SP/SM	dense	115	14	92.5	15	70	38		
5.03	16.5	53.06	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	64.6	30	60	36		
5.18	17.0	48.47	1.28	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	58.5	35	57	36		
5.33	17.5	77.78	0.75	Sand to Silty Sand	SP/SM	dense	115	14	92.9	20	70	38		
5.48	18.0	47.25	1.60	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	55.9	40	55	36		
5.65	18.5	48.50	0.87	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	56.8	30	56	36		
5.80	19.0	53.55	0.43	Sand to Silty Sand	SP/SM	medium dense	115	10	62.1	20	58	36		
5.95	19.5	23.44	2.28	Sandy Silt to Clayey Silt	ML	loose	115	7	26.9	70	34	33		
6.10	20.0	19.41	1.27	Sandy Silt to Clayey Silt	ML	loose	115	6	22.1	65	28	32		
6.25	20.5	18.25	1.38	Sandy Silt to Clayey Silt	ML	loose	115	5	20.6	70	26	32		
6.40	21.0	26.57	1.13	Silty Sand to Sandy Silt	SM/ML	loose	115	6	29.7	55	37	33		
6.55	21.5	27.44	1.44	Sandy Silt to Clayey Silt	ML	loose	115	8	30.4	60	37	33		
6.70	22.0	68.28	0.50	Sand to Silty Sand	SP/SM	medium dense	115	12	75.1	20	64	37		
6.85	22.5	64.04	1.02	Sand to Silty Sand	SP/SM	medium dense	115	12	69.8	30	62	37		
7.00	23.0	96.16	0.55	Sand	SP	dense	110	15	104.1	15	74	38		
7.18	23.5	74.01	0.86	Sand to Silty Sand	SP/SM	medium dense	115	13	79.5	25	66	37		
7.33	24.0	49.31	1.27	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	52.5	40	53	35		
7.48	24.5	38.63	0.98	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	40.8	45	46	34		
7.63	25.0	40.28	0.79	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	42.2	40	47	35		
7.78	25.5	33.36	2.07	Sandy Silt to Clayey Silt	ML	medium dense	115	10	34.7	65	41	34		
7.93	26.0	13.27	2.35	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.73	8.27
8.08	26.5	8.06	2.65	Silty Clay to Clay	CL	firm	125	5		100			0.42	2.73
8.23	27.0	27.44	1.23	Silty Sand to Sandy Silt	SM/ML	loose	115	6	27.9	60	35	33		
8.38	27.5	42.18	2.57	Sandy Silt to Clayey Silt	ML	medium dense	115	12	42.6	65	47	35		
8.53	28.0	13.74	4.73	Clay	CL/CH	stiff	125	11		100			0.75	4.37
8.68	28.5	9.87	3.21	Silty Clay to Clay	CL	stiff	125	6		100			0.52	3.35
8.85	29.0	9.81	3.77	Clay	CL/CH	stiff	125	8		100			0.52	2.57
9.00	29.5	9.94	4.13	Clay	CL/CH	stiff	125	8		100			0.53	2.57
9.15	30.0	9.97	4.04	Clay	CL/CH	stiff	125	8		100			0.53	2.49
9.30	30.5	9.72	3.85	Clay	CL/CH	stiff	125	8		100			0.51	2.34
9.45	31.0	9.47	3.84	Clay	CL/CH	firm	125	8		100			0.50	2.20
9.60	31.5	17.35	2.58	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.96	>10
9.75	32.0	12.58	2.25	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.68	5.42
9.90	32.5	9.72	1.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.51	3.50
10.05	33.0	9.28	2.17	Clayey Silt to Silty Clay	ML/CL	firm	120	4		100			0.48	3.28
10.20	33.5	13.24	2.70	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.71	5.53
10.38	34.0	43.27	0.68	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	39.7	40	45	34		
10.53	34.5	28.38	1.93	Sandy Silt to Clayey Silt	ML	loose	115	8	25.9	75	33	33		
10.68	35.0	41.52	0.92	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	37.7	50	44	34		
10.83	35.5	43.02	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	38.8	55	45	34		
10.98	36.0	42.74	1.23	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	38.3	55	44	34		
11.13	36.5	26.66	2.05	Sandy Silt to Clayey Silt	ML	loose	115	8	23.8	85	30	32		
11.28	37.0	20.75	2.93	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		100			1.15	>10
11.43	37.5	57.66	1.29	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	50.8	45	52	35		
11.58	38.0	157.40	0.63	Sand	SP	dense	110	24	138.0	15	82	39		
11.73	38.5	172.58	0.91	Sand	SP	dense	110	27	150.6	20	85	40		

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-2
Est. GWT (ft): 6
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	161.14	1.10	Sand	SP	dense	110	25	140.0	25	82	40		
12.05	39.5	139.83	1.11	Sand to Silty Sand	SP/SM	dense	115	25	120.8	25	78	39		
12.20	40.0	113.15	1.27	Sand to Silty Sand	SP/SM	dense	115	21	97.3	30	72	38		
12.35	40.5	94.13	1.19	Sand to Silty Sand	SP/SM	medium dense	115	17	80.5	35	66	37		
12.50	41.0	165.53	0.74	Sand	SP	dense	110	25	140.9	20	83	40		
12.65	41.5	232.03	1.16	Sand	SP	very dense	110	36	196.6	20	92	41		
12.80	42.0	236.10	1.16	Sand	SP	very dense	110	36	199.2	20	93	41		
12.95	42.5	271.03	1.24	Sand	SP	very dense	110	42	227.6	20	97	42		
13.10	43.0	282.09	1.13	Sand	SP	very dense	110	43	235.9	15	98	42		
13.25	43.5	315.05	1.26	Sand	SP	very dense	110	48	262.3	15	101	42		
13.40	44.0	270.13	1.39	Sand	SP	very dense	110	42	223.9	20	96	41		
13.58	44.5	226.05	1.47	Sand to Silty Sand	SP/SM	very dense	115	41	186.5	25	91	41		
13.73	45.0	186.15	1.29	Sand to Silty Sand	SP/SM	dense	115	34	152.9	25	85	40		
13.88	45.5	146.75	1.27	Sand to Silty Sand	SP/SM	dense	115	27	120.0	30	78	39		
14.03	46.0	156.31	0.95	Sand	SP	dense	110	24	127.2	25	80	39		
14.18	46.5	151.79	1.18	Sand to Silty Sand	SP/SM	dense	115	28	123.0	30	79	39		
14.33	47.0	106.21	1.11	Sand to Silty Sand	SP/SM	medium dense	115	19	85.7	35	68	38		
14.48	47.5	73.67	0.68	Sand to Silty Sand	SP/SM	medium dense	115	13	59.2	35	57	36		
14.63	48.0	97.12	0.82	Sand to Silty Sand	SP/SM	medium dense	115	18	77.6	30	65	37		
14.78	48.5	132.17	1.13	Sand to Silty Sand	SP/SM	dense	115	24	105.2	30	74	38		
14.93	49.0	153.07	1.16	Sand to Silty Sand	SP/SM	dense	115	28	121.3	30	78	39		
15.10	49.5	167.21	1.20	Sand to Silty Sand	SP/SM	dense	115	30	131.9	25	81	39		
15.25	50.0	181.60	1.17	Sand	SP	dense	110	28	142.7	25	83	40		

CLIENT: BHER
PROJECT: Black Rock Geothermal - Calipatria, CA
LOCATION: See Site and Boring Location Plan

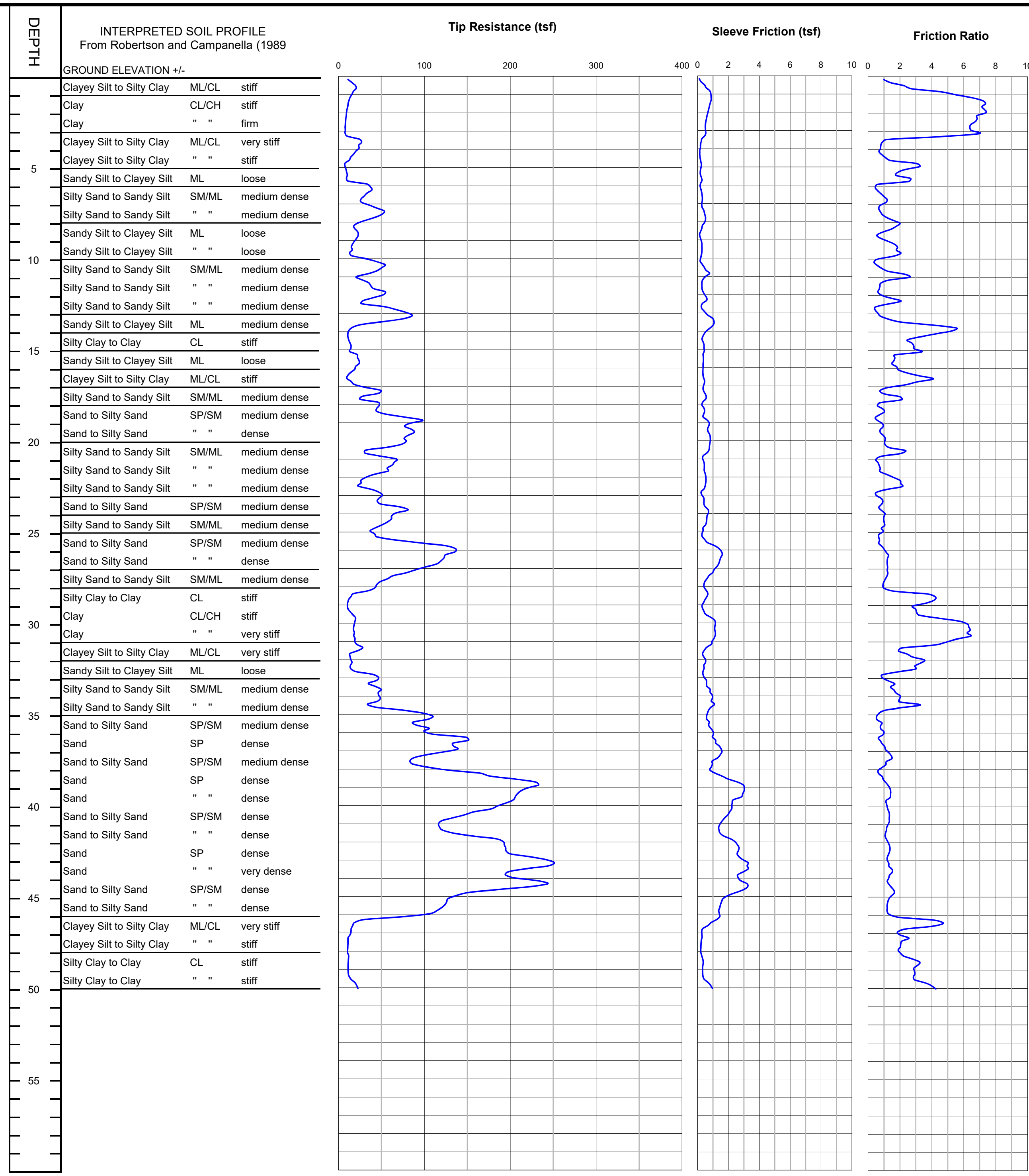
CONE PENETROMETER: Kehoe Testing & Engineering Truck Mounted Electric Cone with 30 ton reaction weight
DATE: 9/28/2022

CONE SOUNDING DATA CPT-3

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clayey Silt to Silty Clay	ML/CL	stiff
Clay	CL/CH	stiff
Clay	" "	firm
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	loose
Sandy Silt to Clayey Silt	" "	loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	stiff
Sandy Silt to Clayey Silt	ML	loose
Clayey Silt to Silty Clay	ML/CL	stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sand to Silty Sand	SP/SM	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand to Silty Sand	" "	dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Sandy Silt to Clayey Silt	ML	loose
Silty Sand to Sandy Silt	SM/ML	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sand to Silty Sand	SP/SM	medium dense
Sand	SP	dense
Sand to Silty Sand	SP/SM	medium dense
Sand	SP	dense
Sand	" "	dense
Sand to Silty Sand	SP/SM	dense
Sand to Silty Sand	" "	dense
Sand	SP	dense
Sand	" "	very dense
Sand to Silty Sand	SP/SM	dense
Sand to Silty Sand	" "	dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	stiff
Silty Clay to Clay	CL	stiff
Silty Clay to Clay	" "	stiff



END OF SOUNDING AT 50 ft.

Project No.
LE22199

LANDMARK
Geo-Engineers and Geologists

PLATE
B-6

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-3
Est. GWT (ft): 6
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	15.33	1.57	Sandy Silt to Clayey Silt	ML	dense	115	4	29.0	60	79	39		
0.30	1.0	17.85	4.24	Silty Clay to Clay	CL	very stiff	125	10		85			1.05	>10
0.45	1.5	12.30	7.02	Clay	CL/CH	stiff	125	10		100			0.72	>10
0.60	2.0	10.03	7.28	Clay	CL/CH	stiff	125	8		100			0.58	>10
0.75	2.5	8.63	6.80	Clay	CL/CH	firm	125	7		100			0.50	>10
0.93	3.0	7.88	6.44	Clay	CL/CH	firm	125	6		100			0.45	>10
1.08	3.5	14.14	4.25	Clay	CL/CH	stiff	125	11		90			0.82	>10
1.23	4.0	24.79	0.82	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	46.9	35	52	35		
1.38	4.5	17.32	0.87	Sandy Silt to Clayey Silt	ML	loose	115	5	32.7	45	40	34		
1.53	5.0	9.25	2.57	Silty Clay to Clay	CL	stiff	125	5		90			0.53	>10
1.68	5.5	9.44	2.15	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		85			0.54	>10
1.83	6.0	27.16	1.19	Silty Sand to Sandy Silt	SM/ML	medium dense	115	6	44.7	40	49	35		
1.98	6.5	34.01	0.78	Silty Sand to Sandy Silt	SM/ML	medium dense	115	8	54.9	30	55	36		
2.13	7.0	29.25	1.03	Silty Sand to Sandy Silt	SM/ML	medium dense	115	7	46.4	35	50	35		
2.28	7.5	49.62	0.77	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	77.4	20	65	37		
2.45	8.0	33.21	1.57	Sandy Silt to Clayey Silt	ML	medium dense	115	9	50.9	40	53	35		
2.60	8.5	19.81	1.36	Sandy Silt to Clayey Silt	ML	loose	115	6	29.9	50	37	33		
2.75	9.0	21.06	0.86	Sandy Silt to Clayey Silt	ML	loose	115	6	31.3	40	38	33		
2.90	9.5	15.85	1.76	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		65			0.91	>10
3.05	10.0	20.44	1.41	Sandy Silt to Clayey Silt	ML	loose	115	6	29.4	50	36	33		
3.20	10.5	49.81	0.60	Sand to Silty Sand	SP/SM	medium dense	115	9	70.7	20	62	37		
3.35	11.0	33.17	2.04	Sandy Silt to Clayey Silt	ML	medium dense	115	9	46.4	45	50	35		
3.50	11.5	33.27	0.95	Silty Sand to Sandy Silt	SM/ML	medium dense	115	7	46.0	35	50	35		
3.65	12.0	49.28	0.72	Sand to Silty Sand	SP/SM	medium dense	115	9	67.2	20	61	37		
3.80	12.5	32.02	1.57	Sandy Silt to Clayey Silt	ML	medium dense	115	9	43.1	45	48	35		
3.95	13.0	66.60	0.50	Sand to Silty Sand	SP/SM	medium dense	115	12	88.5	15	69	38		
4.13	13.5	71.52	1.35	Silty Sand to Sandy Silt	SM/ML	dense	115	16	93.9	25	71	38		
4.28	14.0	18.04	4.93	Clay	CL/CH	very stiff	125	14		95			1.03	>10
4.43	14.5	11.18	3.30	Silty Clay to Clay	CL	stiff	125	6		100			0.62	9.39
4.58	15.0	14.02	2.84	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		90			0.79	>10
4.73	15.5	18.88	2.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.07	>10
4.88	16.0	21.66	1.70	Sandy Silt to Clayey Silt	ML	loose	115	6	26.7	60	33	33		
5.03	16.5	11.59	3.25	Silty Clay to Clay	CL	stiff	125	7		100			0.64	8.41
5.18	17.0	21.40	2.20	Sandy Silt to Clayey Silt	ML	loose	115	6	25.8	70	32	33		
5.33	17.5	41.15	1.25	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	49.1	40	51	35		
5.48	18.0	39.74	1.14	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	47.0	40	50	35		
5.65	18.5	48.32	0.89	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	56.6	30	56	36		
5.80	19.0	86.56	0.66	Sand to Silty Sand	SP/SM	dense	115	16	100.4	15	73	38		
5.95	19.5	83.36	0.83	Sand to Silty Sand	SP/SM	dense	115	15	95.8	20	71	38		
6.10	20.0	78.90	1.03	Sand to Silty Sand	SP/SM	medium dense	115	14	89.9	25	69	38		
6.25	20.5	54.23	1.58	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	61.2	40	58	36		
6.40	21.0	49.25	1.08	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	55.1	35	55	36		
6.55	21.5	61.36	0.70	Sand to Silty Sand	SP/SM	medium dense	115	11	68.1	25	61	37		
6.70	22.0	44.42	1.18	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	48.8	40	51	35		
6.85	22.5	25.09	2.07	Sandy Silt to Clayey Silt	ML	loose	115	7	27.4	70	34	33		
7.00	23.0	44.98	0.73	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	48.7	35	51	35		
7.18	23.5	47.16	0.87	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	50.6	35	52	35		
7.33	24.0	73.27	0.86	Sand to Silty Sand	SP/SM	medium dense	115	13	78.0	25	65	37		
7.48	24.5	60.20	1.00	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	63.6	35	59	36		
7.63	25.0	43.36	0.95	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	45.5	40	49	35		
7.78	25.5	50.65	0.69	Sand to Silty Sand	SP/SM	medium dense	115	9	52.7	30	54	35		
7.93	26.0	119.21	0.85	Sand	SP	dense	110	18	123.1	20	79	39		
8.08	26.5	125.62	1.21	Sand to Silty Sand	SP/SM	dense	115	23	128.8	25	80	39		
8.23	27.0	102.24	1.21	Sand to Silty Sand	SP/SM	dense	115	19	104.1	25	74	38		
8.38	27.5	66.57	1.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	67.3	35	61	37		
8.53	28.0	45.11	0.97	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	45.3	40	49	35		
8.68	28.5	22.21	3.23	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		95			1.25	>10
8.85	29.0	11.02	3.52	Silty Clay to Clay	CL	stiff	125	6		100			0.59	3.83
9.00	29.5	13.64	3.08	Silty Clay to Clay	CL	stiff	125	8		100			0.74	5.21
9.15	30.0	19.19	5.44	Clay	CL/CH	very stiff	125	15		100			1.07	6.88
9.30	30.5	17.85	6.31	Clay	CL/CH	stiff	125	14		100			0.99	6.00
9.45	31.0	18.69	5.64	Clay	CL/CH	very stiff	125	15		100			1.04	6.32
9.60	31.5	24.20	2.72	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		90			1.36	>10
9.75	32.0	13.75	2.93	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.75	6.43
9.90	32.5	14.55	3.08	Silty Clay to Clay	CL	stiff	125	8		100			0.79	5.00
10.05	33.0	35.32	1.21	Silty Sand to Sandy Silt	SM/ML	loose	115	8	32.9	55	40	34		
10.20	33.5	40.62	1.46	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	37.6	55	44	34		
10.38	34.0	47.66	1.80	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	43.9	55	48	35		
10.53	34.5	42.52	2.41	Sandy Silt to Clayey Silt	ML	medium dense	115	12	38.9	70	45	34		
10.68	35.0	72.98	1.19	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	66.4	40	60	36		
10.83	35.5	100.24	0.66	Sand to Silty Sand	SP/SM	medium dense	115	18	90.7	25	70	38		
10.98	36.0	98.68	0.86	Sand to Silty Sand	SP/SM	medium dense	115	18	88.8	25	69	38		
11.13	36.5	135.66	0.81	Sand	SP	dense	110	21	121.4	20	78	39		
11.28	37.0	131.17	1.15	Sand to Silty Sand	SP/SM	dense	115	24	116.8	25	77	39		
11.43	37.5	90.02	1.36	Sand to Silty Sand	SP/SM	medium dense	115	16	79.7	35	66	37		
11.58	38.0	105.63	0.87	Sand to Silty Sand	SP/SM	dense	115	19	93.0	25	70	38		
11.73	38.5	181.95	0.84	Sand	SP	dense	110	28	159.4	15	86	40		

LANDMARK CONSULTANTS, INC.
CONE PENETROMETER INTERPRETATION (based on Robertson & Campanella, 1989, refer to Key to CPT logs)

Project: Black Rock Geothermal - Calipatria, CA **Project No:** LE22199 **Date:** 9/28/2022

CONE SOUNDING: CPT-3
Est. GWT (ft): 6
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	227.33	1.26	Sand	SP	very dense	110	35	198.2	20	93	41		
12.05	39.5	208.67	1.40	Sand to Silty Sand	SP/SM	very dense	115	38	181.1	25	90	41		
12.20	40.0	194.50	1.16	Sand	SP	dense	110	30	167.9	20	88	40		
12.35	40.5	160.39	1.30	Sand to Silty Sand	SP/SM	dense	115	29	137.8	25	82	39		
12.50	41.0	122.89	1.31	Sand to Silty Sand	SP/SM	dense	115	22	105.0	30	74	38		
12.65	41.5	123.51	1.14	Sand to Silty Sand	SP/SM	dense	115	22	105.0	30	74	38		
12.80	42.0	176.99	1.17	Sand to Silty Sand	SP/SM	dense	115	32	149.8	25	84	40		
12.95	42.5	194.25	1.36	Sand to Silty Sand	SP/SM	dense	115	35	163.6	25	87	40		
13.10	43.0	221.78	1.23	Sand	SP	very dense	110	34	185.9	20	91	41		
13.25	43.5	238.14	1.37	Sand to Silty Sand	SP/SM	very dense	115	43	198.7	20	93	41		
13.40	44.0	198.55	1.38	Sand to Silty Sand	SP/SM	dense	115	36	164.8	25	87	40		
13.58	44.5	232.69	1.33	Sand	SP	very dense	110	36	192.3	20	92	41		
13.73	45.0	156.99	1.56	Sand to Silty Sand	SP/SM	dense	115	29	129.2	30	80	39		
13.88	45.5	125.84	1.24	Sand to Silty Sand	SP/SM	dense	115	23	103.1	30	73	38		
14.03	46.0	113.91	1.24	Sand to Silty Sand	SP/SM	dense	115	21	92.9	35	70	38		
14.18	46.5	41.62	3.59	Clayey Silt to Silty Clay	ML/CL	hard	120	17		90			2.36	>10
14.33	47.0	14.88	2.56	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		100			0.79	4.28
14.48	47.5	11.07	2.24	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.57	2.73
14.63	48.0	10.71	1.98	Clayey Silt to Silty Clay	ML/CL	stiff	120	4		100			0.54	2.57
14.78	48.5	11.55	2.76	Silty Clay to Clay	CL	stiff	125	7		100			0.59	2.20
14.93	49.0	11.24	2.97	Silty Clay to Clay	CL	stiff	125	6		100			0.57	2.06
15.10	49.5	12.77	2.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.66	3.21
15.25	50.0	20.87	3.96	Silty Clay to Clay	CL	very stiff	125	12		100			1.14	5.00

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS		SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	Gravels	Clean gravels (less than 5% fines)		GW	Well graded gravels, gravel-sand mixtures, little or no fines
	More than half of coarse fraction is larger than No. 4 sieve			GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines		GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands	Clean sands (less than 5% fines)		SW	Well graded sands, gravelly sands, little or no fines
	More than half of coarse fraction is smaller than No. 4 sieve			SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines		SM	Silty sands, sand-silt mixtures, non-plastic fines
				SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	Silts and clays			ML	Inorganic silts, clayey silts with slight plasticity
	Liquid limit is less than 50%			CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
				OL	Organic silts and organic clays of low plasticity
	Silts and clays			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	Liquid limit is more than 50%			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

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 40 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

Ring Sample — Standard Penetration Test — Shelby Tube — Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

LANDMARK Geo-Engineers and Geologists

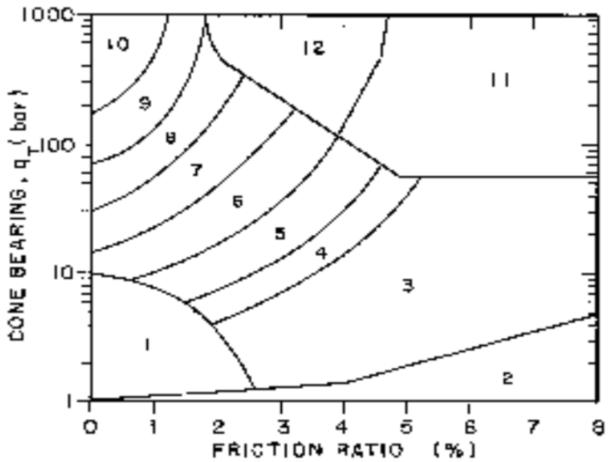
Project No. **LE22199**

Key to Logs

Plate B-7

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



Geotechnical Parameters from CPT Data:

Equivalent SPT N(60) blow count = Qc/(Qc/N Ratio)

N1(60) = Cn*N(60) Normalized SPT blow count

Cn = 1/(p'o)^0.5 < 1.6 max. from Liao & Whitman (1986)

p'o = effective overburden pressure (tsf) using unit densities given below and estimated groundwater table.

Dr = Relative density (%) from Jamiolkowski et. al. (1986) relationship = -98 +68*log(Qc/p'o^0.5) where Qc, p'o in tonne/sqm

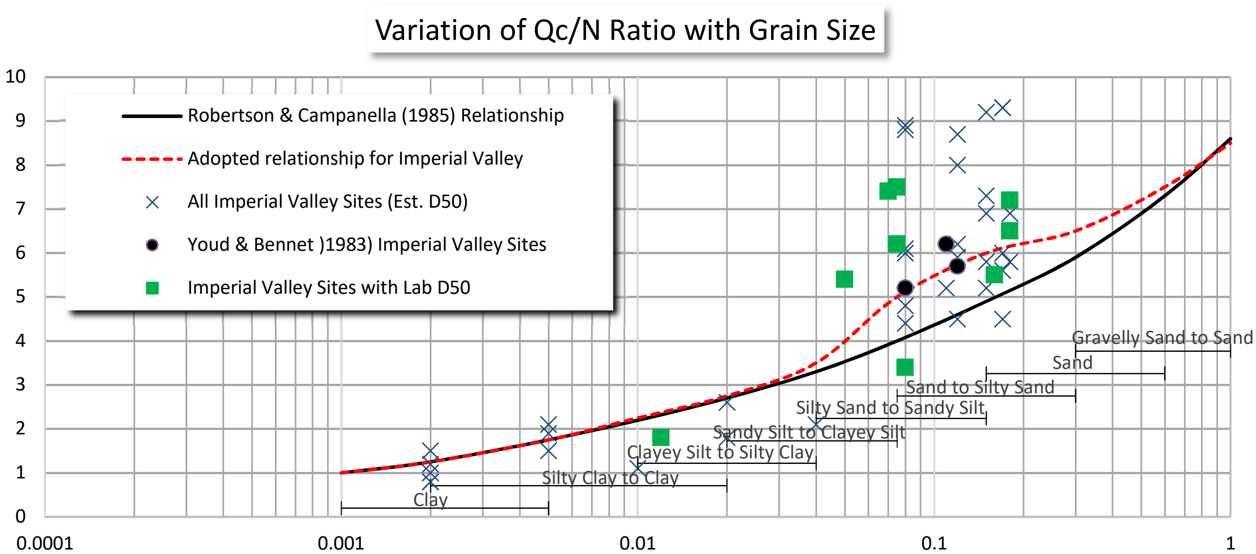
Note: 1 tonne/sqm = 0.1024 tsf, 1 bar =1.0443 tsf

Phi = Friction Angle estimated from either:

1. Roberton & Campanella (1983) chart:
   Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

Su = undrained shear strength (tsf) = (Qc-p'o)/Nk where Nk varies from 10 to 22, 17 for OC clays

OCR = Overconsolidation Ratio estimated from Schmertman (1978) chart using Su/p'o ratio and estimated normal consolidated Su/p'o



Note: Assumed Properties and Adopted Qc/N Ratio based on correlations from Imperial Valley, California soils

Table of Soil Types and Assumed Properties

Zone	Soil Classification	UCS	Density (pcf)	R&C Qc/N	Adopted Qc/N	Est. PI	Fines (%)	D50 (mm)
1	Sensitive fine grained	ML	120	2	2	NP-15	65-100	0.02
2	Organic Material	OL/OH	120	1	1	--	--	--
3	Clay	CL/CH	125	1	1.25	25-40+	90-100	0.002
4	Silty Clay to Clay	CL	125	1.5	2	15-40	90-100	0.01
5	Clayey Silt to Silty Clay	ML/CL	120	2	2.75	25-May	90-100	0.02
6	Sandy Silt to Clayey Silt	ML	115	2.5	3.5	NP-10	65-100	0.04
7	Silty Sand to Sandy Silt	SM/ML	115	3	5	NP	35-75	0.075
8	Sand to Silty Sand	SP/SM	115	4	6	NP	May-35	0.15
9	Sand	SP	110	5	6.5	NP	0-5	0.3
10	Gravelly Sand to Sand	SW	115	6	7.5	NP	0-5	0.6
11	Overconsolidated Soil	--	120	1	1	NP	90-100	0.01
12	Sand to Clayey Sand	SP/SC	115	2	2	NP-5	--	---

Su (tsf)	Consistency
0-0.13	very soft
0.13-.25	soft
0.25-0.5	firm
0.5-1.0	stiff
1.0-2.0	very stiff
>2.0	hard
Dr (%)	**Relative Density**
0-15	very loose
15-35	loose
35-65	medium dense
65-85	dense
>85	very dense

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Geo-Engineers and Geologists

Project No: LE22199

Key to CPT Interpretation of Logs

Plate B-8

APPENDIX C

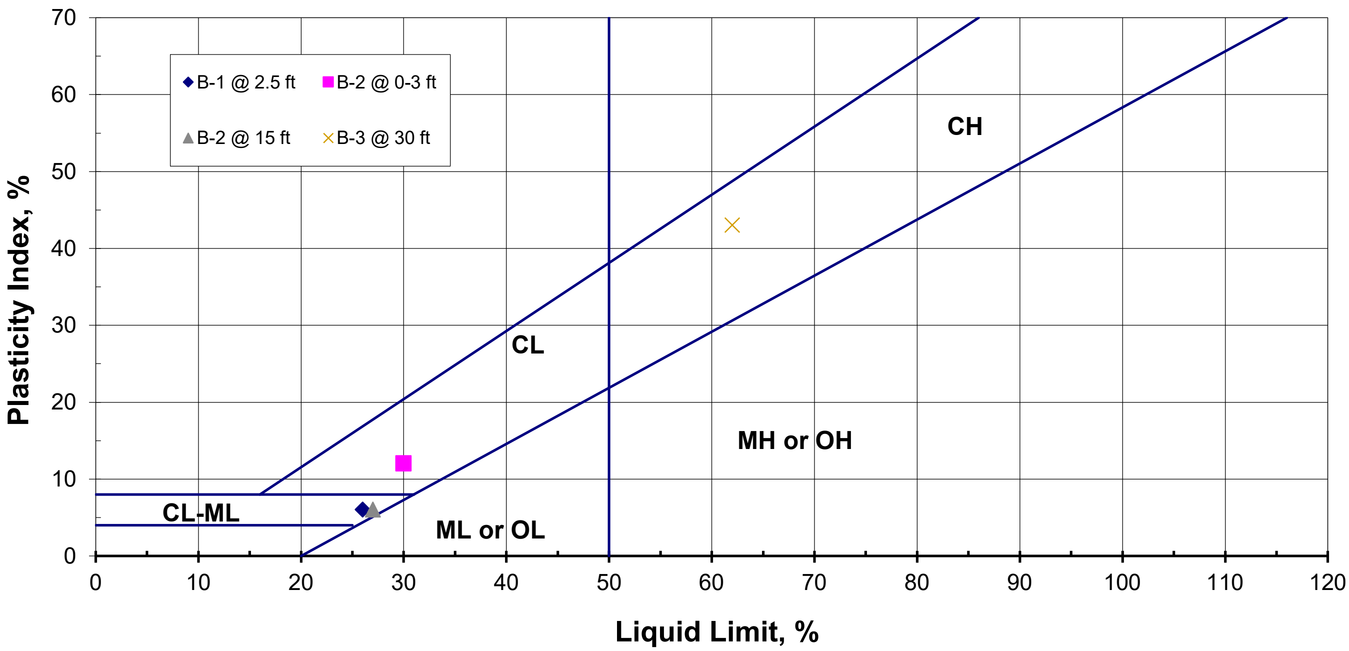
LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
JOB No.: LE22199
DATE: 10/03/22

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
B-1	2.5	26	20	6	CL-ML
B-2	0-3	30	18	12	CL
B-2	15	27	21	6	CL-ML
B-3	30	62	19	43	CH

PLASTICITY CHART



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Project No.: LE22199

Atterberg Limits Test Results

Plate C-1

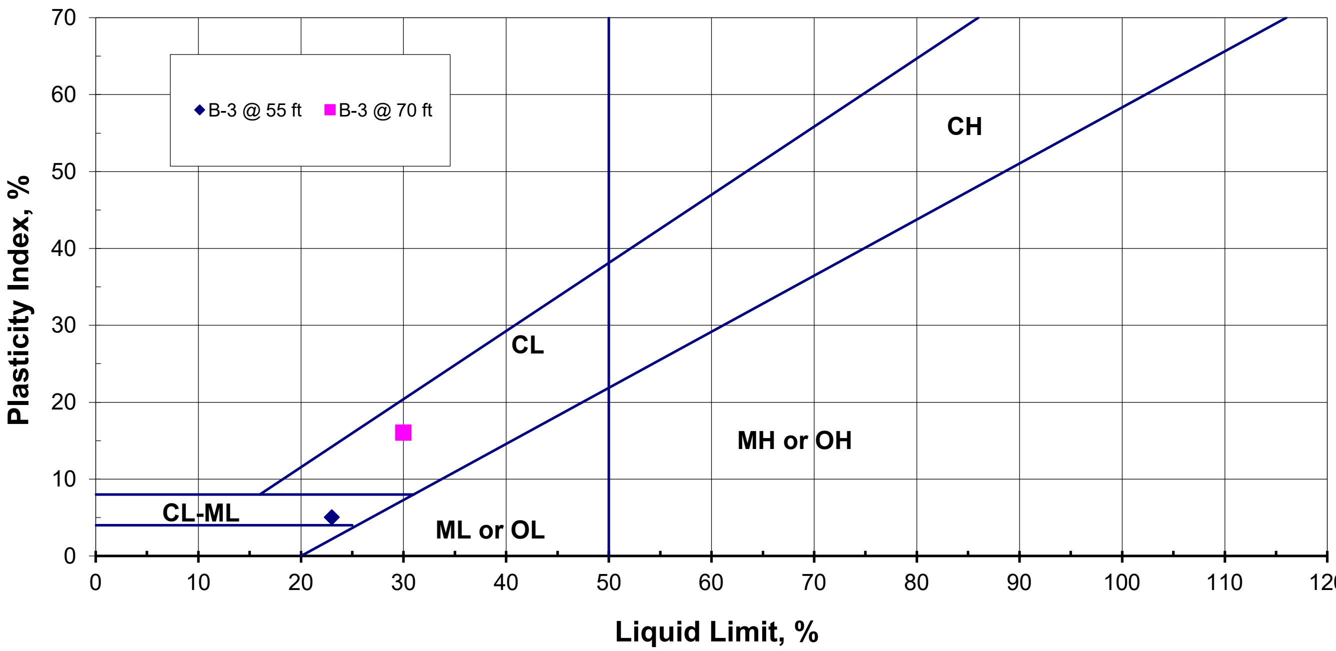
LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
JOB No.: LE22199
DATE: 10/03/22

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
B-3	55	23	18	5	CL-ML
B-3	70	30	14	16	CL

PLASTICITY CHART



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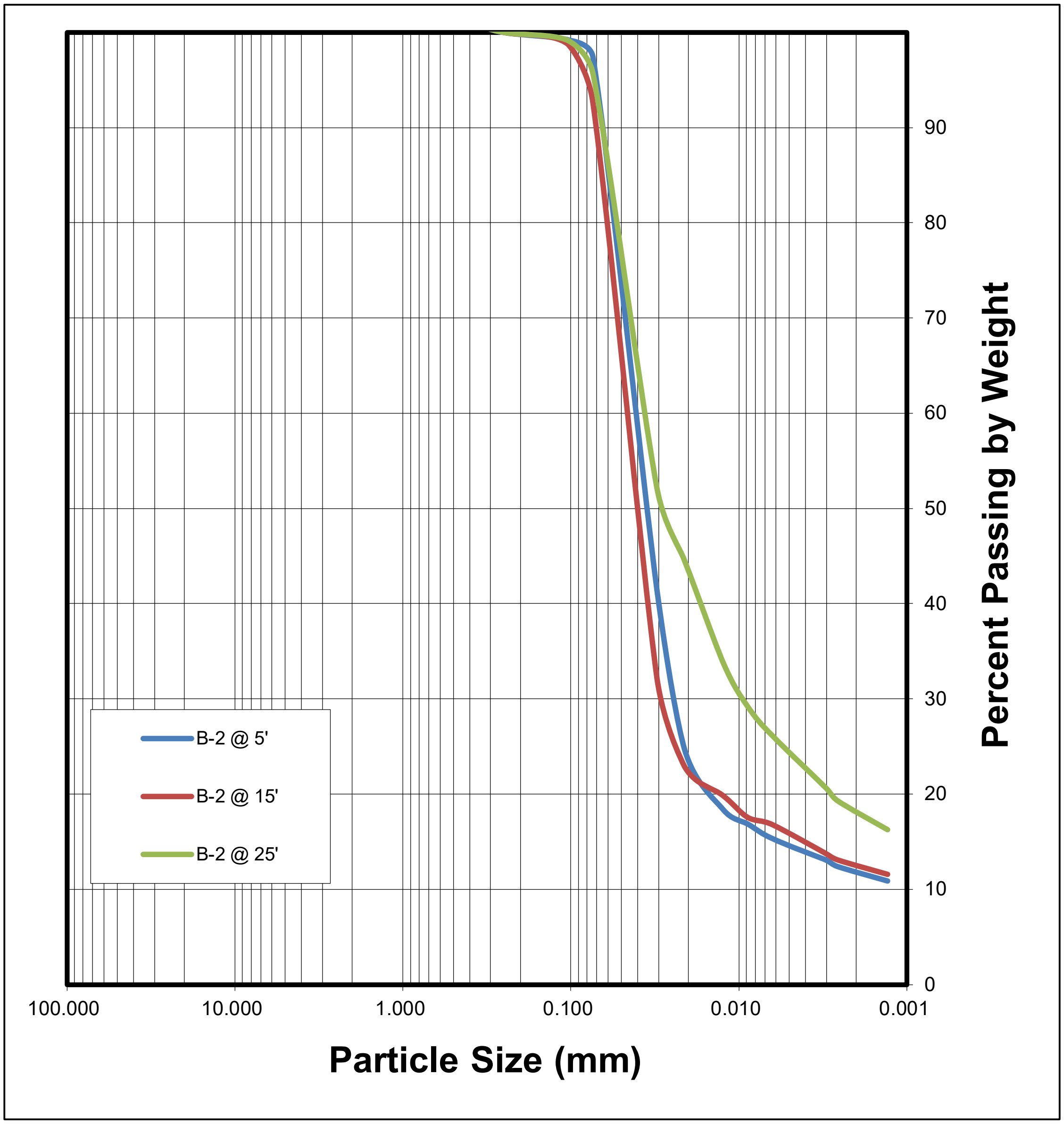
Project No.: LE22199

Atterberg Limits Test Results

Plate C-2

SIEVE ANALYSIS					HYDROMETER ANALYSIS
Gravel		Sand			Silt and Clay Fraction
Coarse	Fine	Coarse	Medium	Fine	

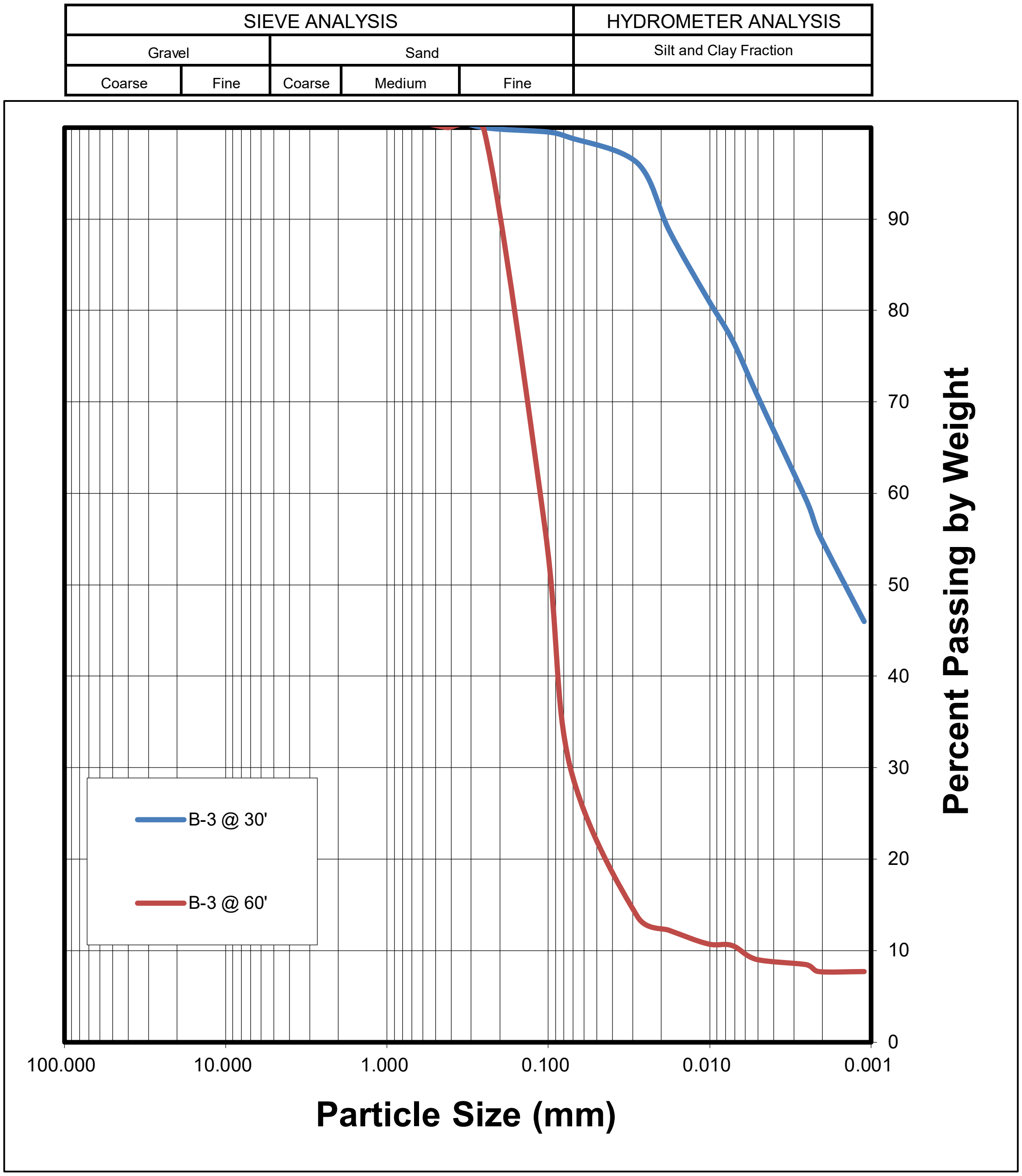


LANDMARK Geo-Engineers and Geologists

Project No.: LE22199

Grain Size Analysis

Plate C-3



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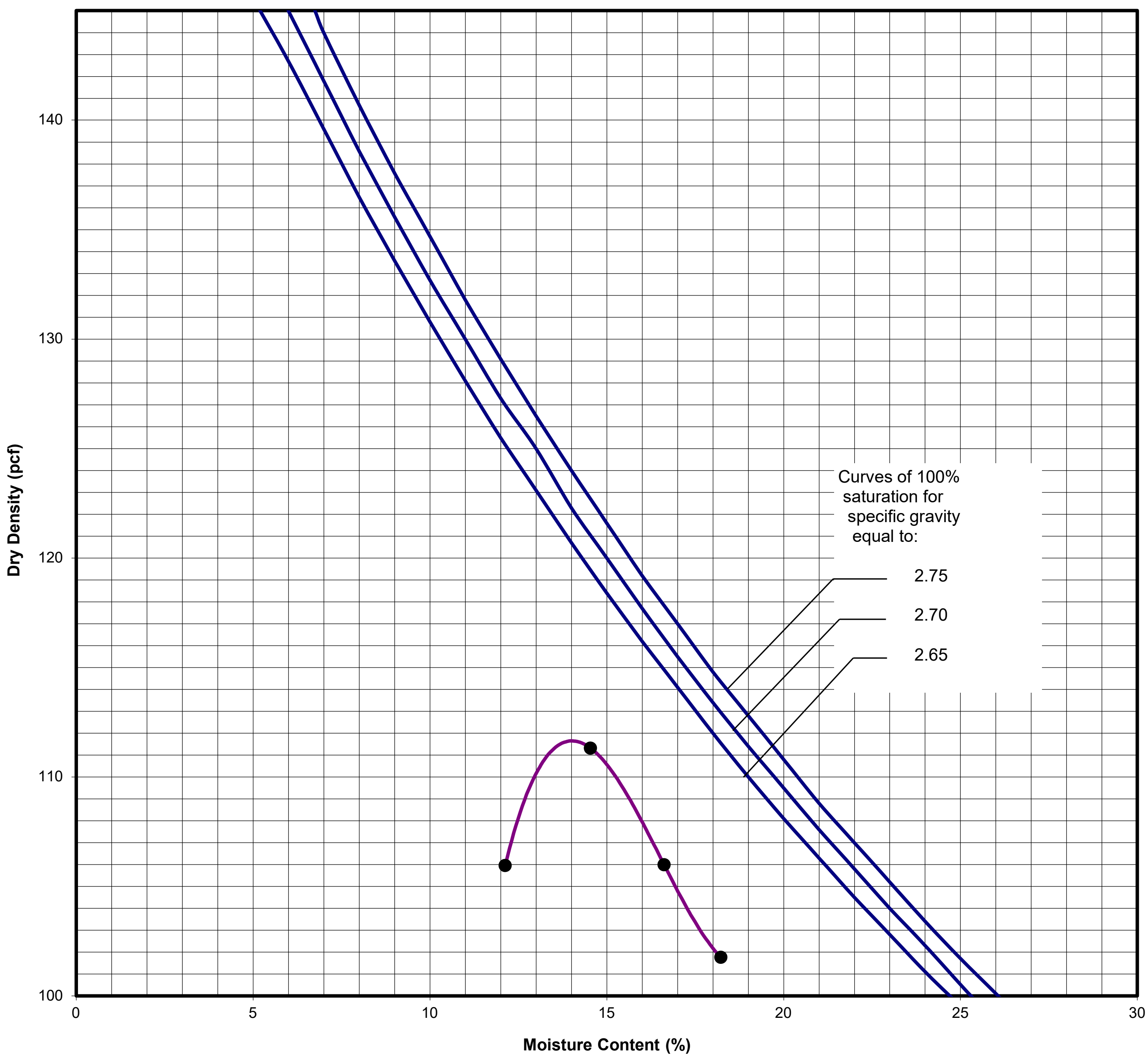
Project No.: LE22199

Grain Size Analysis

Plate C-4

Client: BHER
Project: Black Rock Geothermal
Project No.: LE22199
Date: 10/11/2022
Lab. No.: 619

Soil Description: Silty Sand/Sandy Silt (SM-ML)
Sample Location: TR-1 @ 0-2'
Test Method: D1557
Maximum Dry Density (pcf): **111.6**
Optimum Moisture Content (%): **14.0**



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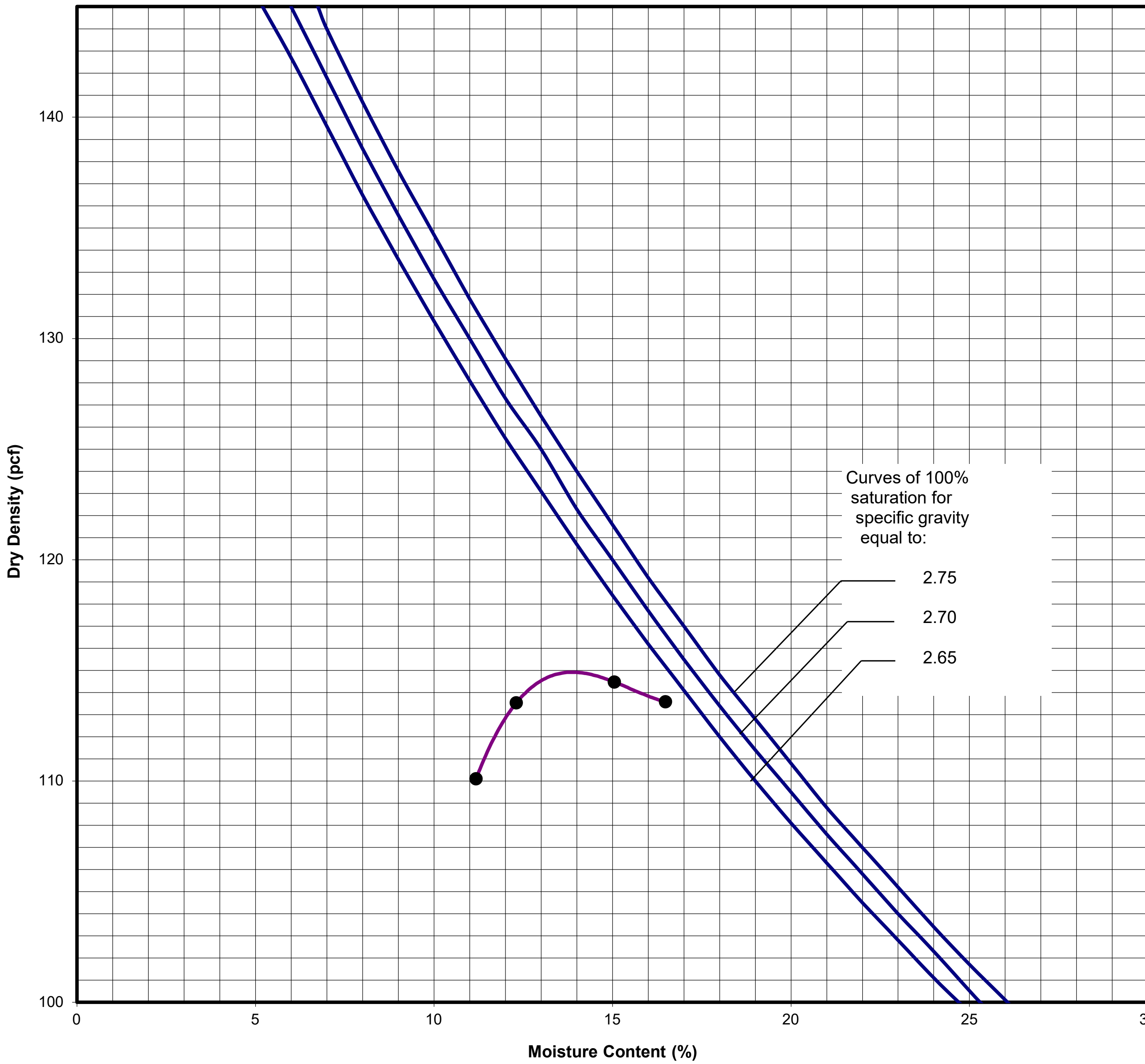
Project No.: LE22199

Moisture Density Relationship

Plate C-5

Client:	BHER	**Soil Description:**	Silty Clay (CL)
Project:	Black Rock Geothermal	**Sample Location:**	TR-2 @0-3
Project No.:	LE22199	**Test Method:**	D1557
Date:	10/12/2022	**Maximum Dry Density (pcf):**	**114.9**
Lab. No.:	620	**Optimum Moisture Content (%):**	**13.8**



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Project No.: LE22199

Moisture Density Relationship

Plate C-6

LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
JOB NO: LE22199
DATE: 10/2/2022

EXPANSION INDEX TEST (UBC 29-2 & ASTM D4829)

Sample Location & Depth (ft)	Initial Moisture (%)	Compacted Dry Density (pcf)	Final Moisture (%)	Volumetric Swell (%)	Expansion Index (EI)	Expansive Potential
B-1 0-3 ft.	10.4	103.4	25.6	7.0	66	Medium
TR-1 0-2 ft.	9.8	104.4	21.8	1.5	12	Very Low

UBC CLASSIFICATION

0-20	Very Low
20-50	Low
50-90	Medium
90-130	High
130+	Very High

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Expansion Index Test Results

Plate

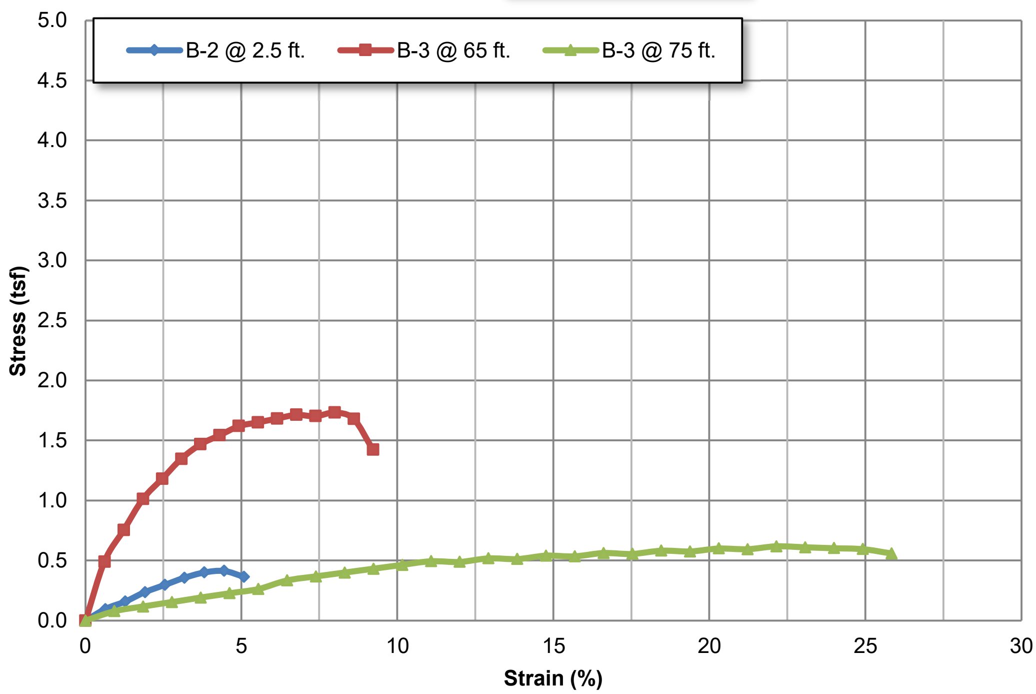
LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
JOB NO: LE22199
DATE: 10/1/2022

UNCONFINED COMPRESSION TEST (ASTM D2166)

Boring No.	Sample Depth (ft)	Natural Moisture Content (%)	Unit Dry Weight (pcf)	Maximum Compressive Strength (tsf)	Cohesion (tsf)	Failure Strain (%)
B-2	2.5	24.8	106.6	0.41	0.21	4.4
B-3	65	30.4	94.6	1.73	0.87	8.0
B-3	75	23.1	103.5	0.62	0.31	22.1

Stress - Strain Plot



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Project No.: LE22199

Unconfined Compression Test Results

Plate C-8

LANDMARK CONSULTANTS, INC.

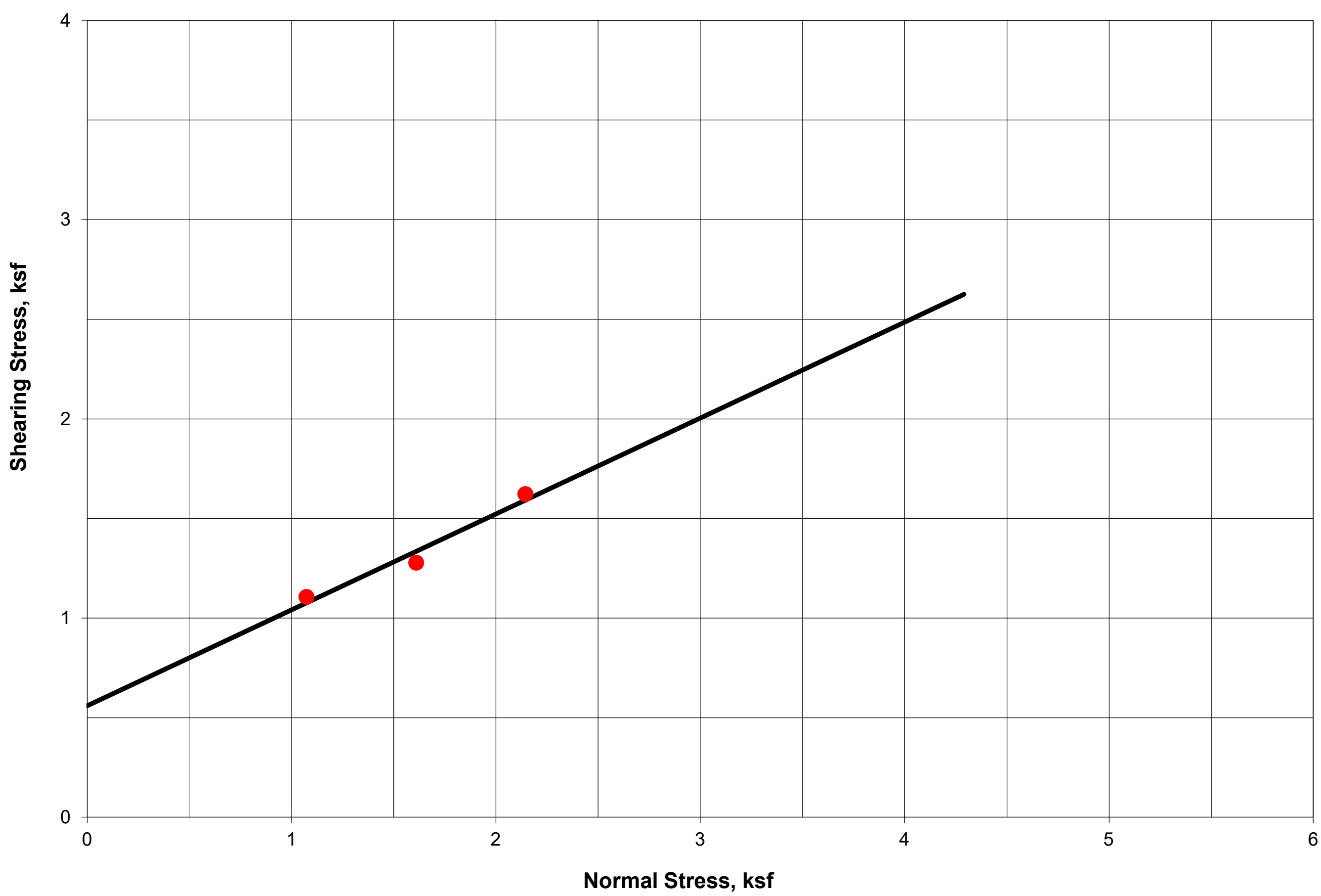
CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
PROJECT No: LE22199 **DATE:** 10/1/2022

DIRECT SHEAR TEST - INSITU (ASTM D3080)

SAMPLE LOCATION: B-1 @ 10 ft
SAMPLE DESCRIPTION: Silty Sand/Sandy Silt (SM-ML)

Angle of Internal Friction:	**26º**	**Initial Dry Density:**	**101.2 pcf**
Cohesion:	**0.56 ksf**	**Initial Moisture Content:**	**24.9%**

DIRECT SHEAR TEST RESULTS



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PROJECT No: LE22199

Direct Shear Test Results

Plate C-9

LANDMARK CONSULTANTS, INC.

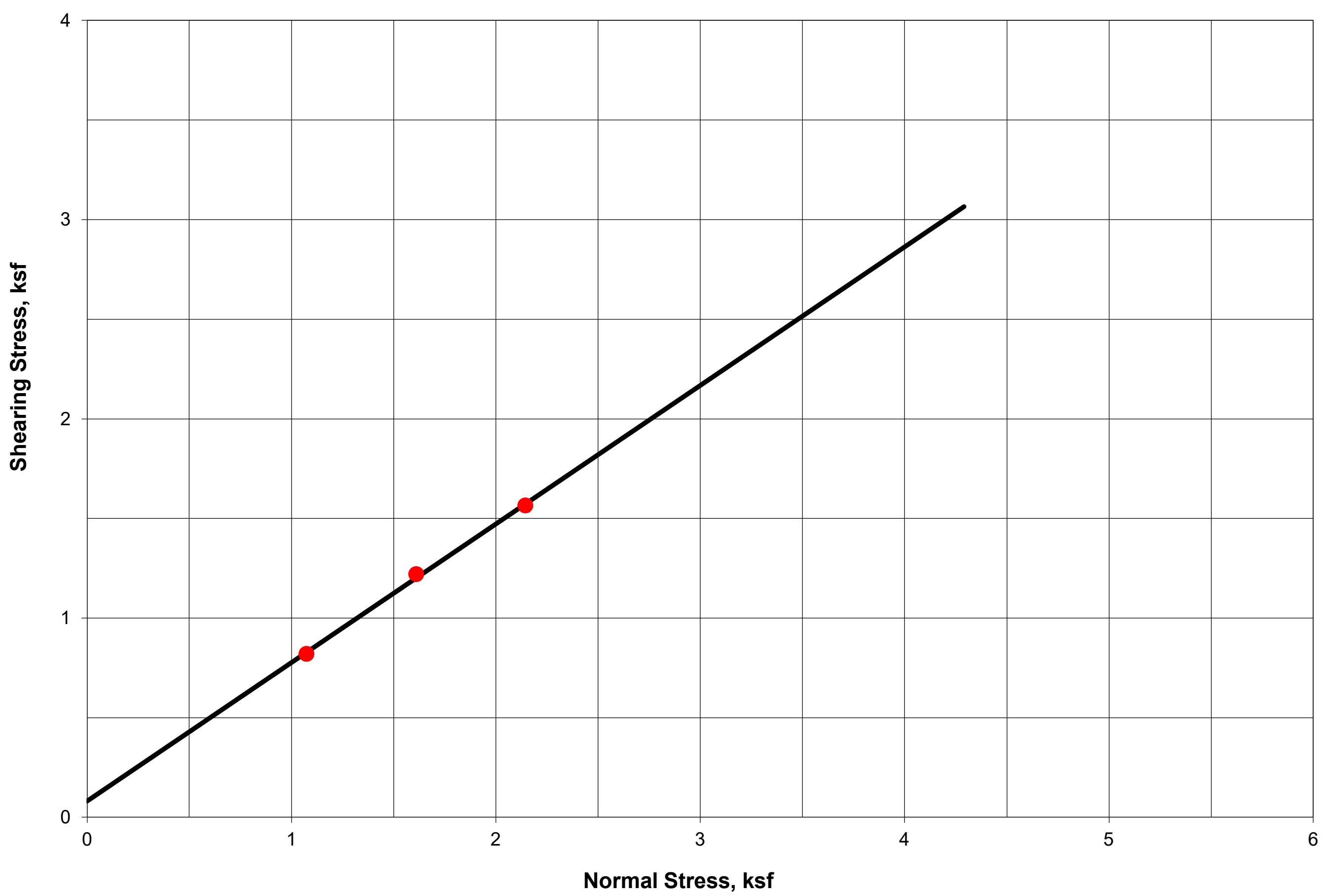
CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
PROJECT No: LE22199 **DATE:** 10/1/2022

DIRECT SHEAR TEST - INSITU (ASTM D3080)

SAMPLE LOCATION: B-3 @ 20 ft
SAMPLE DESCRIPTION: Silty Sand (SM)

Angle of Internal Friction: 35º
Cohesion: 0.08 ksf
Initial Dry Density: 96.2 pcf
Initial Moisture Content: 22%

DIRECT SHEAR TEST RESULTS



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PROJECT No: LE22199

Direct Shear Test Results

Plate C-10

LANDMARK CONSULTANTS, INC.

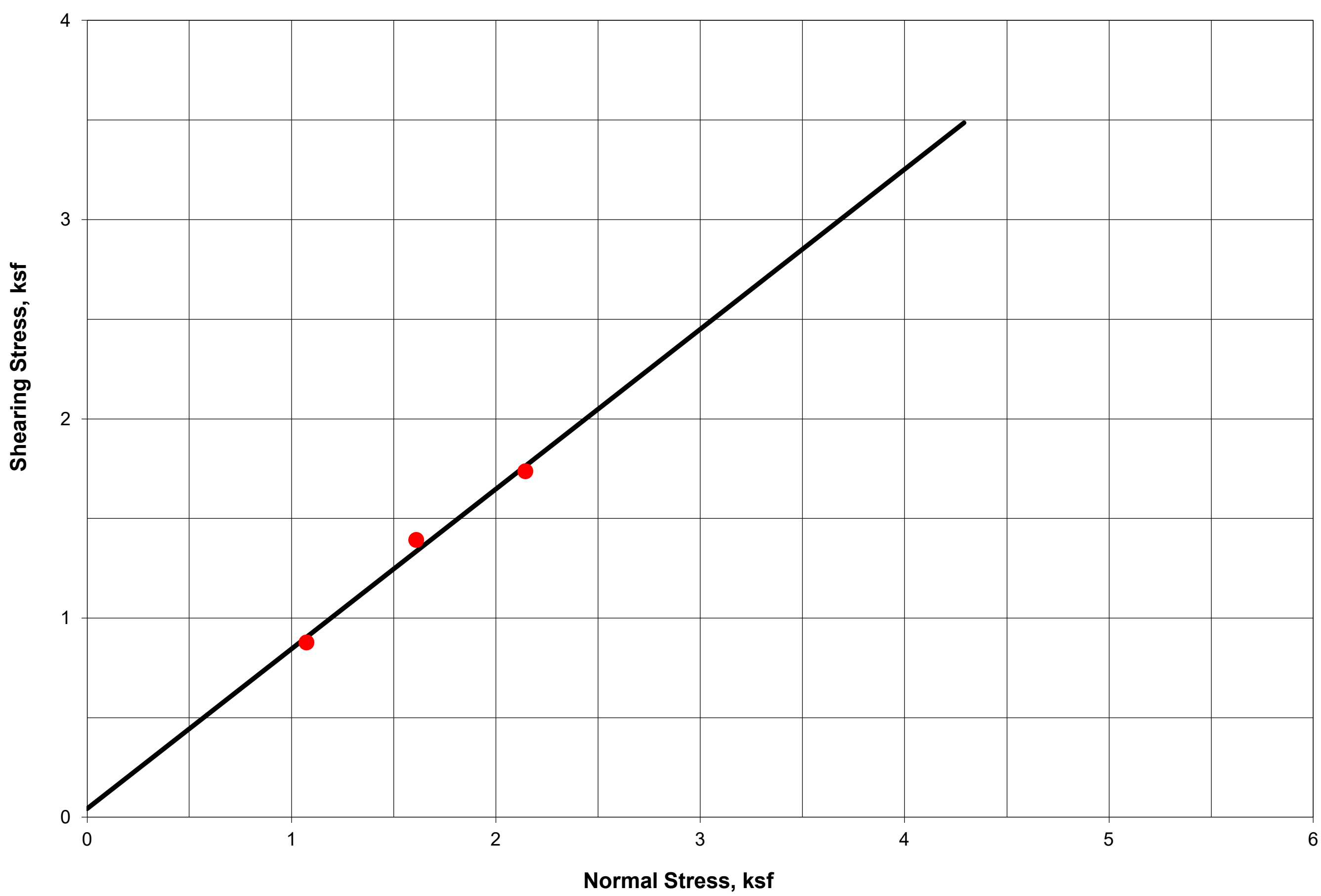
CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
PROJECT No: LE22199 **DATE:** 10/6/2022

DIRECT SHEAR TEST - INSITU (ASTM D3080)

SAMPLE LOCATION: B-3 @ 40 ft
SAMPLE DESCRIPTION: Sand/Silty Sand (SP-SM)

Angle of Internal Friction:	**39º**	**Initial Dry Density:**	**105.6 pcf**
Cohesion:	**0.04 ksf**	**Initial Moisture Content:**	**20.4%**

DIRECT SHEAR TEST RESULTS



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PROJECT No: LE22199

Direct Shear Test Results

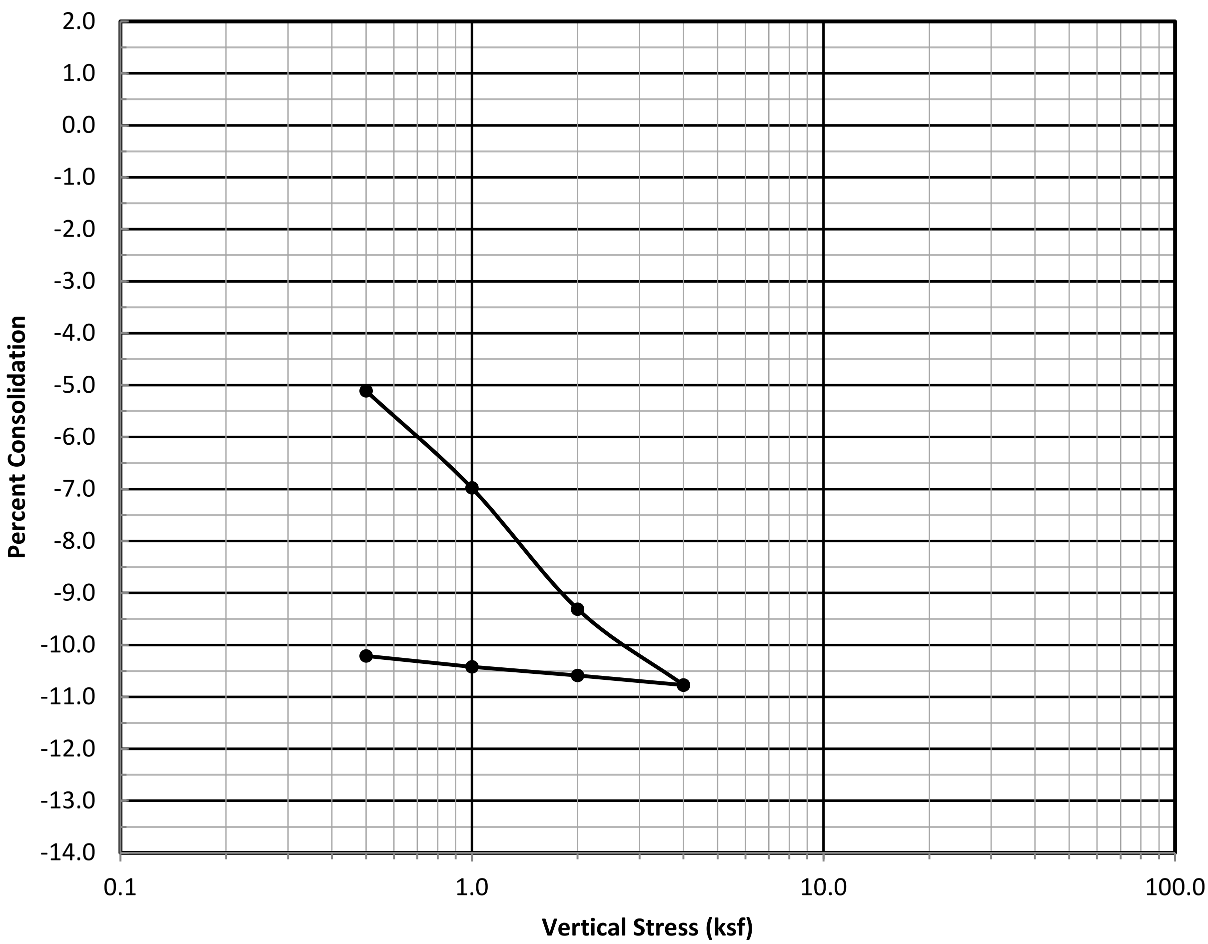
Plate C-11

LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal - Calipatria, CA
JOB NO: LE22199
DATE: 10/7/2022

Sample Location: B-2 @ 25 ft.
Soil Type: Clayey Silt/Silty Clay (ML-CL)

ONE DIMENSIONAL CONSOLIDATION TEST (ASTM D2435)



Results of Test

			Initial	Final
Overburden Pressure, Po:	2.0 ksf	**Dry Density (pcf):**	88.3	98.5
Preconsol Pressure, Pc:	2.4 ksf	**Water Content (%):**	35.2	28.0
Compression Index, Cc:	0.305	**Void Ratio (e):**	0.945	0.742
Recompression Index, Cr:	0.011	**Saturation (%):**	102.4	103.8

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Project No.: LE22199

One Dimensional Consolidation Test Results

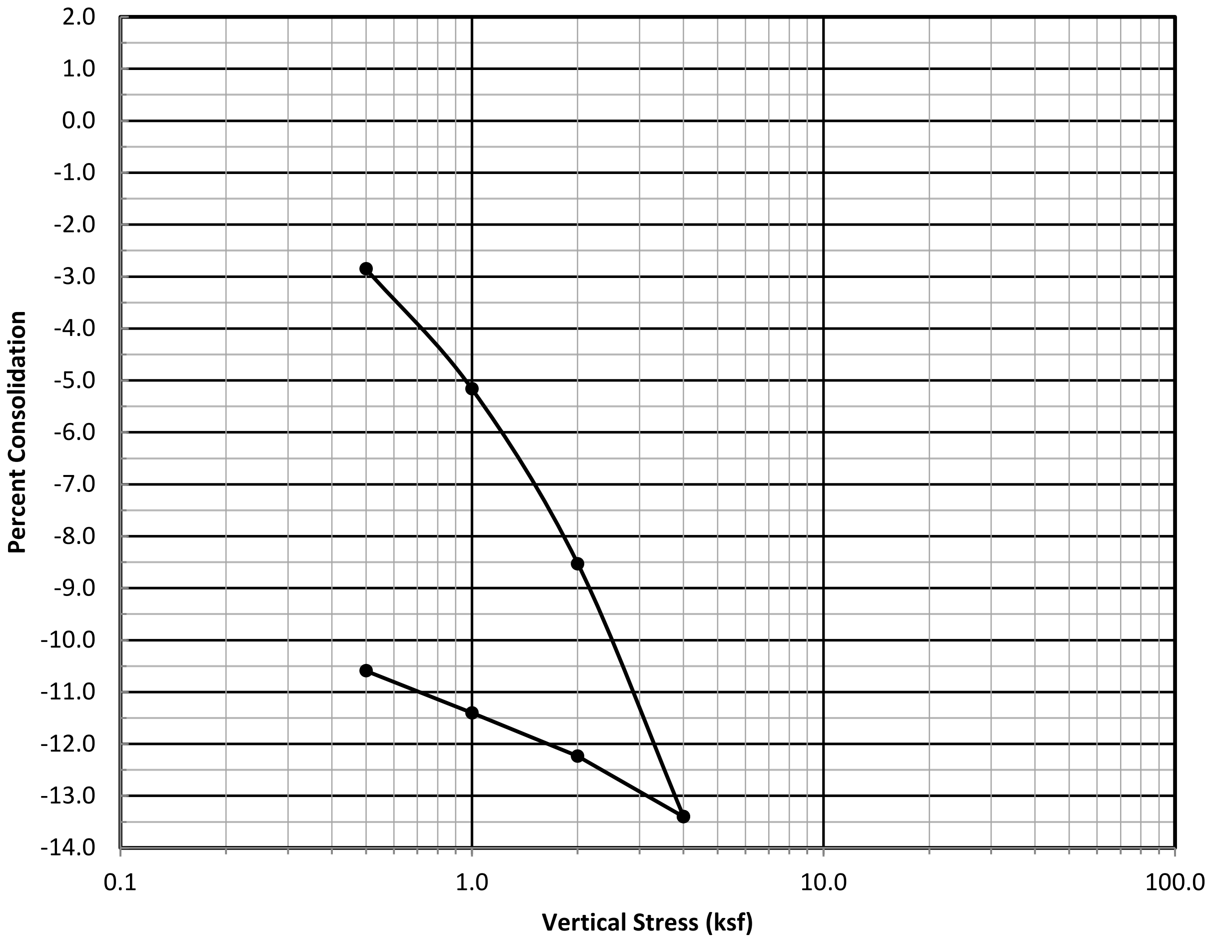
Plate C-12

LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal - Calipatria, CA
JOB NO: LE22199
DATE: 10/7/2022

Sample Location: B-3 @ 30 ft.
Soil Type: Silty Clay/Clay (CL-CH)

ONE DIMENSIONAL CONSOLIDATION TEST (ASTM D2435)



Results of Test

				Initial	Final
Overburden Pressure, Po:	1.9 ksf		**Dry Density (pcf):**	72.9	81.7
Preconsol Pressure, Pc:	1.6 ksf		**Water Content (%):**	46.2	38.9
Compression Index, Cc:	0.605		**Void Ratio (e):**	1.354	1.101
Recompression Index, Cr:	0.065		**Saturation (%):**	93.8	97.2

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Geo-Engineers and Geologists

Project No.: LE22199

One Dimensional Consolidation Test Results

Plate C-13

LANDMARK CONSULTANTS, INC.

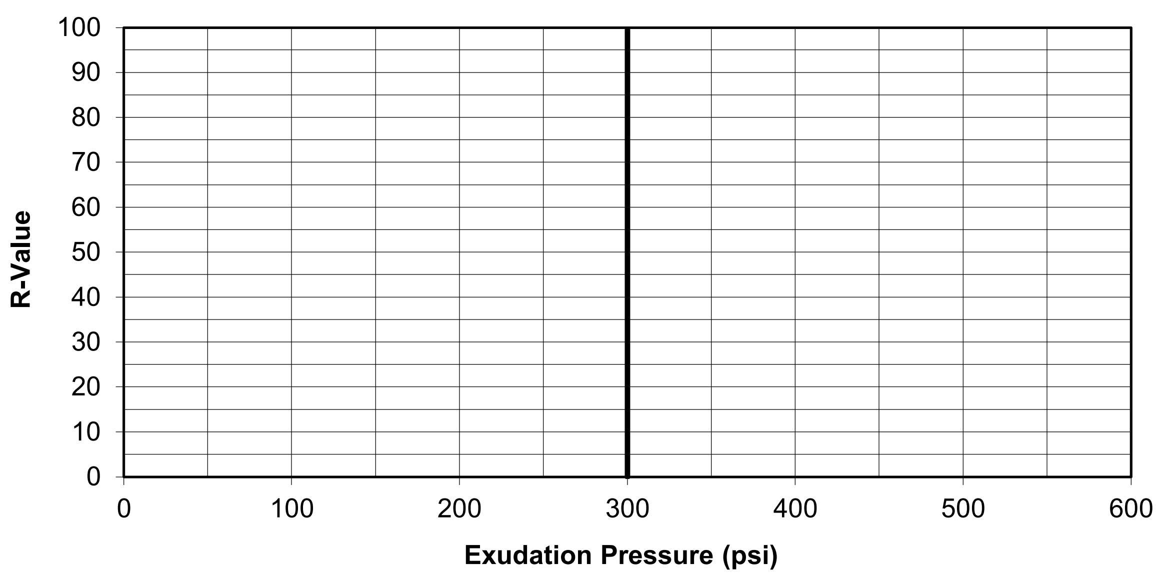
Client: BHER
Project: Black Rock Geothermal Plant - Calipatria, CA
Project No.: LE22199
Date: 10/4/2022 **Lab No.:** EC22-616

R-Value By Exudation Pressure (ASTM D2844/CAL 301)

Description: Clayey Silty/Silty Clay (ML-CL)
Sample Location: B-1
Sample Depth: 0-3 ft.

Sample	A	B	C
Moisture Content, %:	20.0%	18.0%	16.0%
Dry Density, pcf:	107.1	112.9	113.6
Compaction foot pressure, psi:	150	200	350
Specimen Height, in.:	2.50	2.55	2.42
Stabilometer, Ph @ 1000 lb:	---	---	---
Stabilometer, Ph @ 2000 lb:	---	---	---
Displacement:	---	---	---
Expantion pressure, psf:	100	205	371
Exudation pressure, psi:	220	338	480
Equilibrum R Value:	---	---	---

R-Value **Less than 5**



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Project No.: LE22199

R-Value Test

Plate C-14

LANDMARK CONSULTANTS, INC.

CLIENT: BHER
PROJECT: Black Rock Geothermal Plant - Calipatria, CA
JOB No.: LE22199
DATE: 10/4/2022

CHEMICAL ANALYSIS

Boring:	B-2	**Caltrans**
Sample Depth, ft:	0-3	**Method**
pH:	6.50	**643**
Electrical Conductivity (mmhos):	---	**424**
Resistivity (ohm-cm):	200	**643**
Chloride (Cl), ppm:	1,480	**422**
Sulfate (SO4), ppm:	4,266	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

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Project No.: LE22199

Selected Chemical Test Results

Plate C-15

APPENDIX D

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

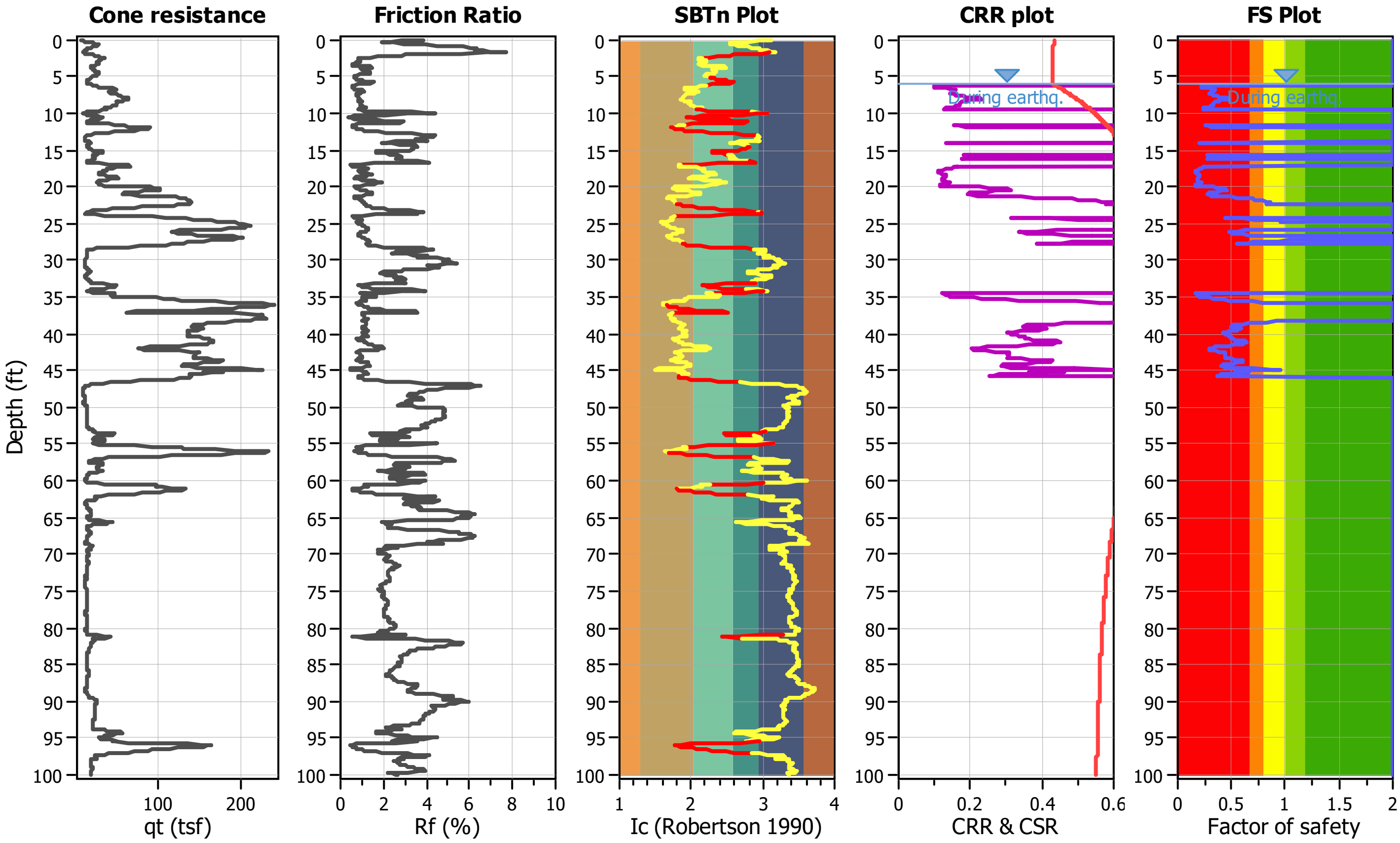
LIQUEFACTION ANALYSIS REPORT

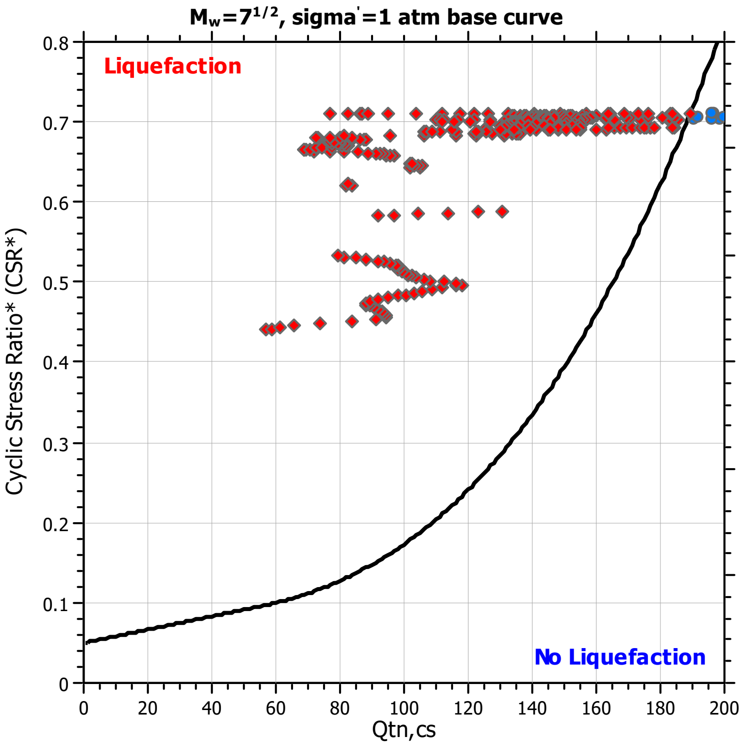
Project title : Elmore North Geothermal Plant **Location : Calipatria, CA**

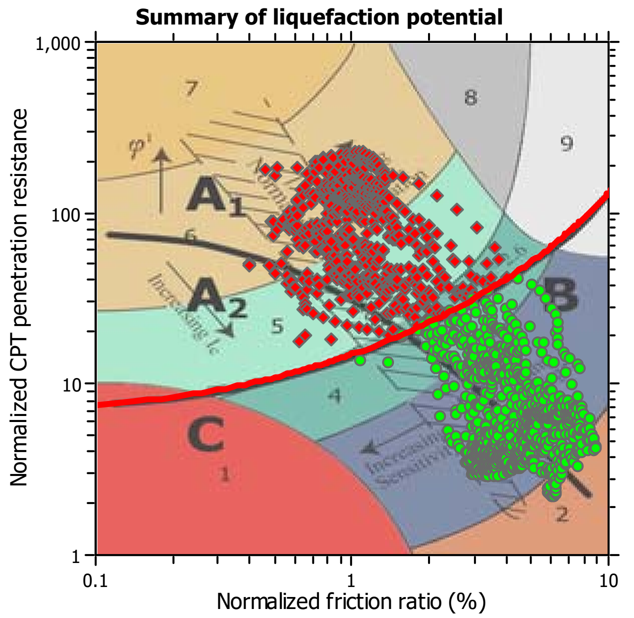
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	50.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.61	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

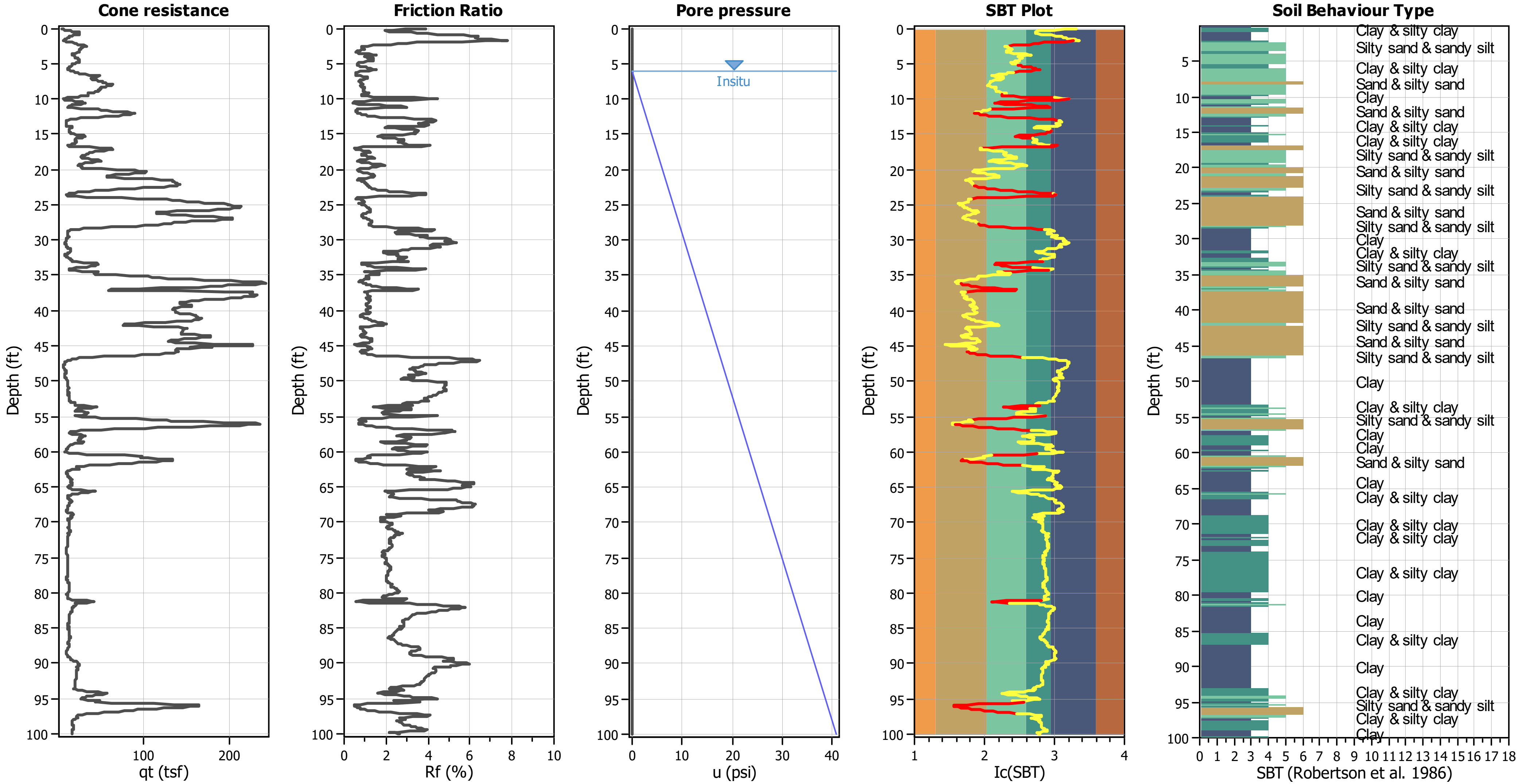






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



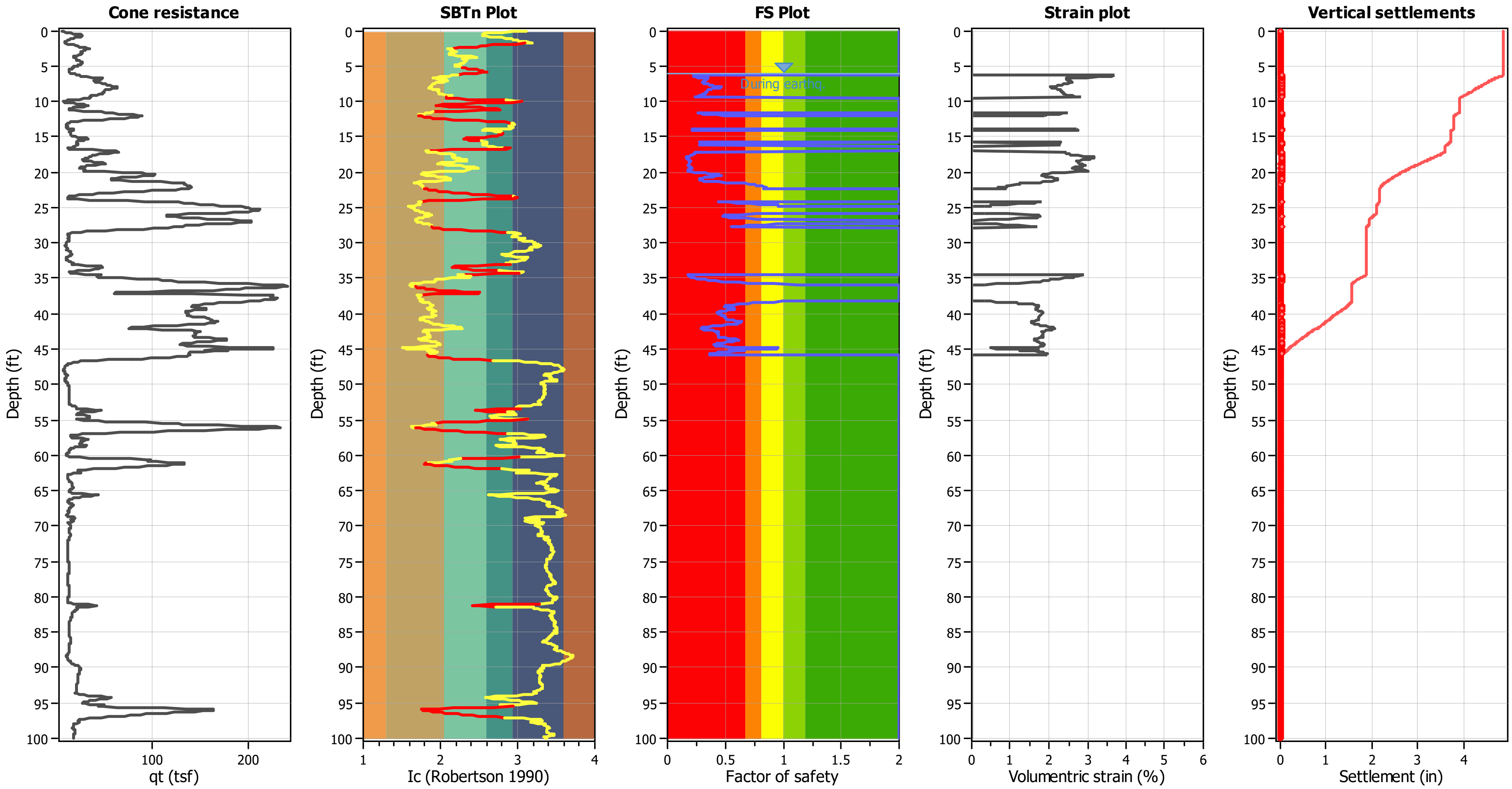
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

SBT legend

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

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

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.05	59.69	2.00	0.00	1.00	0.00	6.11	56.71	2.00	0.00	1.00	0.00
6.18	54.80	2.00	0.00	1.00	0.00	6.24	55.09	2.00	0.00	1.00	0.00
6.33	56.93	0.22	3.71	1.00	0.04	6.38	58.65	0.22	3.62	1.00	0.02
6.44	61.10	0.23	3.50	1.00	0.02	6.52	65.62	0.24	3.30	1.00	0.03
6.57	73.87	0.26	3.00	1.00	0.02	6.63	83.64	0.30	2.71	1.00	0.02
6.73	90.99	0.33	2.52	1.00	0.03	6.77	94.45	0.35	2.45	1.00	0.01
6.83	94.41	0.35	2.45	1.00	0.02	6.92	93.90	0.34	2.46	1.00	0.03
6.98	93.27	0.34	2.47	1.00	0.02	7.03	92.07	0.33	2.50	1.00	0.01
7.12	90.84	0.32	2.53	1.00	0.03	7.18	89.39	0.31	2.56	1.00	0.02
7.22	88.21	0.30	2.59	1.00	0.01	7.31	87.98	0.30	2.60	1.00	0.03
7.37	89.10	0.31	2.57	1.00	0.02	7.42	91.95	0.32	2.50	1.00	0.02
7.52	95.00	0.33	2.44	1.00	0.03	7.57	97.84	0.35	2.38	1.00	0.01
7.62	100.48	0.36	2.33	1.00	0.01	7.68	102.96	0.37	2.28	1.00	0.02
7.75	105.31	0.39	2.24	1.00	0.02	7.81	108.55	0.41	2.18	1.00	0.02
7.92	111.92	0.43	2.13	1.00	0.03	7.96	116.05	0.46	2.07	1.00	0.01
8.01	118.11	0.47	2.04	1.00	0.01	8.07	116.51	0.46	2.06	1.00	0.02
8.16	112.74	0.43	2.12	1.00	0.02	8.21	108.18	0.39	2.19	1.00	0.01
8.30	106.52	0.38	2.22	1.00	0.02	8.36	103.66	0.36	2.27	1.00	0.01
8.40	102.53	0.36	2.29	1.00	0.01	8.49	101.13	0.35	2.32	1.00	0.02
8.53	100.80	0.34	2.32	1.00	0.01	8.63	99.37	0.33	2.35	1.00	0.03
8.68	98.32	0.33	2.37	1.00	0.01	8.73	98.22	0.33	2.37	1.00	0.01
8.81	98.47	0.33	2.37	1.00	0.02	8.87	98.13	0.32	2.37	1.00	0.02
8.93	97.34	0.32	2.39	1.00	0.02	8.99	95.44	0.31	2.43	1.00	0.02
9.08	93.72	0.30	2.46	1.00	0.03	9.13	91.61	0.29	2.51	1.00	0.01
9.19	88.41	0.27	2.59	1.00	0.02	9.28	84.77	0.26	2.68	1.00	0.03
9.32	81.01	0.24	2.78	1.00	0.02	9.42	79.10	0.24	2.83	1.00	0.03
9.47	77.75	2.00	0.00	1.00	0.00	9.52	76.27	2.00	0.00	1.00	0.00
9.62	76.49	2.00	0.00	1.00	0.00	9.67	78.01	2.00	0.00	1.00	0.00
9.72	81.70	2.00	0.00	1.00	0.00	9.80	86.19	2.00	0.00	1.00	0.00
9.86	89.90	2.00	0.00	1.00	0.00	9.91	89.64	2.00	0.00	1.00	0.00
9.99	86.84	2.00	0.00	1.00	0.00	10.04	83.13	2.00	0.00	1.00	0.00
10.11	79.54	2.00	0.00	1.00	0.00	10.21	73.82	2.00	0.00	1.00	0.00
10.26	67.52	2.00	0.00	1.00	0.00	10.32	63.56	2.00	0.00	1.00	0.00
10.38	61.27	2.00	0.00	1.00	0.00	10.46	60.56	2.00	0.00	1.00	0.00
10.51	49.26	2.00	0.00	1.00	0.00	10.59	50.66	2.00	0.00	1.00	0.00
10.65	48.95	2.00	0.00	1.00	0.00	10.70	64.31	2.00	0.00	1.00	0.00
10.78	67.22	2.00	0.00	1.00	0.00	10.84	71.77	2.00	0.00	1.00	0.00
10.90	76.39	2.00	0.00	1.00	0.00	10.97	79.83	2.00	0.00	1.00	0.00
11.04	83.24	2.00	0.00	1.00	0.00	11.10	86.44	2.00	0.00	1.00	0.00
11.16	88.57	2.00	0.00	1.00	0.00	11.24	86.90	2.00	0.00	1.00	0.00
11.30	80.84	2.00	0.00	1.00	0.00	11.36	76.55	2.00	0.00	1.00	0.00
11.45	81.35	2.00	0.00	1.00	0.00	11.50	87.52	2.00	0.00	1.00	0.00
11.55	90.20	2.00	0.00	1.00	0.00	11.64	91.92	0.26	2.50	1.00	0.03
11.69	97.04	0.28	2.40	1.00	0.01	11.78	104.24	0.32	2.26	1.00	0.02
11.84	113.66	0.37	2.10	1.00	0.02	11.89	123.16	0.43	1.97	1.00	0.01
11.98	130.65	0.49	1.88	1.00	0.02	12.03	135.87	2.00	0.00	1.00	0.00
12.08	137.40	2.00	0.00	1.00	0.00	12.14	137.26	2.00	0.00	1.00	0.00
12.21	135.81	2.00	0.00	1.00	0.00	12.28	132.99	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
12.38	129.17	2.00	0.00	1.00	0.00	12.43	124.89	2.00	0.00	1.00	0.00
12.48	121.28	2.00	0.00	1.00	0.00	12.56	118.70	2.00	0.00	1.00	0.00
12.62	117.67	2.00	0.00	1.00	0.00	12.68	117.57	2.00	0.00	1.00	0.00
12.73	117.55	2.00	0.00	1.00	0.00	12.80	117.07	2.00	0.00	1.00	0.00
12.87	115.17	2.00	0.00	1.00	0.00	12.95	111.09	2.00	0.00	1.00	0.00
13.02	106.45	2.00	0.00	1.00	0.00	13.07	102.68	2.00	0.00	1.00	0.00
13.13	99.60	2.00	0.00	1.00	0.00	13.22	96.82	2.00	0.00	1.00	0.00
13.28	94.14	2.00	0.00	1.00	0.00	13.32	91.92	2.00	0.00	1.00	0.00
13.41	90.61	2.00	0.00	1.00	0.00	13.47	90.50	2.00	0.00	1.00	0.00
13.52	91.86	2.00	0.00	1.00	0.00	13.61	93.13	2.00	0.00	1.00	0.00
13.66	94.13	2.00	0.00	1.00	0.00	13.71	94.48	2.00	0.00	1.00	0.00
13.80	94.03	2.00	0.00	1.00	0.00	13.85	91.53	2.00	0.00	1.00	0.00
13.91	87.40	2.00	0.00	1.00	0.00	13.99	83.45	0.22	2.71	1.00	0.02
14.06	81.72	0.21	2.76	1.00	0.02	14.12	82.53	0.21	2.74	1.00	0.02
14.18	86.18	2.00	0.00	1.00	0.00	14.26	90.00	2.00	0.00	1.00	0.00
14.31	94.28	2.00	0.00	1.00	0.00	14.39	97.10	2.00	0.00	1.00	0.00
14.45	99.53	2.00	0.00	1.00	0.00	14.51	100.24	2.00	0.00	1.00	0.00
14.60	100.05	2.00	0.00	1.00	0.00	14.65	99.49	2.00	0.00	1.00	0.00
14.70	98.80	2.00	0.00	1.00	0.00	14.77	100.78	2.00	0.00	1.00	0.00
14.85	103.85	2.00	0.00	1.00	0.00	14.90	107.19	2.00	0.00	1.00	0.00
15.00	107.75	2.00	0.00	1.00	0.00	15.05	106.07	2.00	0.00	1.00	0.00
15.09	102.12	2.00	0.00	1.00	0.00	15.16	97.28	2.00	0.00	1.00	0.00
15.25	93.68	2.00	0.00	1.00	0.00	15.30	92.58	2.00	0.00	1.00	0.00
15.39	93.12	2.00	0.00	1.00	0.00	15.44	95.19	2.00	0.00	1.00	0.00
15.49	97.40	2.00	0.00	1.00	0.00	15.59	99.31	2.00	0.00	1.00	0.00
15.63	100.38	2.00	0.00	1.00	0.00	15.69	101.25	2.00	0.00	1.00	0.00
15.77	102.10	0.28	2.30	1.00	0.02	15.83	103.82	2.00	0.00	1.00	0.00
15.89	105.17	0.29	2.24	1.00	0.01	15.97	105.77	0.29	2.23	1.00	0.02
16.04	104.46	0.29	2.25	1.00	0.02	16.08	102.84	0.28	2.28	1.00	0.01
16.15	102.01	0.28	2.30	1.00	0.02	16.21	102.21	0.28	2.30	1.00	0.02
16.28	102.51	2.00	0.00	1.00	0.00	16.34	100.64	2.00	0.00	1.00	0.00
16.43	98.34	2.00	0.00	1.00	0.00	16.48	97.29	2.00	0.00	1.00	0.00
16.54	99.30	2.00	0.00	1.00	0.00	16.63	100.95	2.00	0.00	1.00	0.00
16.67	99.57	2.00	0.00	1.00	0.00	16.77	93.46	2.00	0.00	1.00	0.00
16.82	83.03	2.00	0.00	1.00	0.00	16.87	78.16	2.00	0.00	1.00	0.00
16.93	79.78	2.00	0.00	1.00	0.00	17.01	74.31	2.00	0.00	1.00	0.00
17.06	90.11	2.00	0.00	1.00	0.00	17.17	94.40	0.24	2.45	1.00	0.03
17.22	96.73	0.25	2.40	1.00	0.01	17.27	95.51	0.24	2.43	1.00	0.01
17.36	93.94	0.24	2.46	1.00	0.03	17.39	92.61	0.23	2.49	1.00	0.01
17.46	90.98	0.23	2.53	1.00	0.02	17.54	88.69	0.22	2.58	1.00	0.02
17.60	85.62	0.21	2.65	1.00	0.02	17.66	81.36	0.20	2.77	1.00	0.02
17.75	76.78	0.18	2.90	1.00	0.03	17.80	72.09	0.17	3.06	1.00	0.02
17.86	69.40	0.17	3.15	1.00	0.02	17.92	68.56	0.17	3.18	1.00	0.02
18.01	69.03	0.17	3.17	1.00	0.04	18.05	70.58	0.17	3.11	1.00	0.02
18.15	72.24	0.17	3.05	1.00	0.04	18.21	74.24	0.18	2.98	1.00	0.02
18.26	77.36	0.18	2.88	1.00	0.02	18.35	80.35	0.19	2.80	1.00	0.03
18.40	82.72	0.20	2.73	1.00	0.02	18.45	82.69	0.20	2.73	1.00	0.02
18.51	82.03	0.20	2.75	1.00	0.02	18.59	81.59	0.19	2.76	1.00	0.03

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
18.65	81.50	0.19	2.76	1.00	0.02	18.72	81.18	0.19	2.77	1.00	0.02
18.80	80.27	0.19	2.80	1.00	0.03	18.84	79.27	0.19	2.83	1.00	0.01
18.91	77.52	0.18	2.88	1.00	0.02	18.98	76.67	0.18	2.91	1.00	0.03
19.04	76.00	0.18	2.93	1.00	0.02	19.10	76.84	0.18	2.90	1.00	0.02
19.19	77.82	0.18	2.87	1.00	0.03	19.24	80.67	0.19	2.79	1.00	0.02
19.33	83.96	0.20	2.70	1.00	0.03	19.39	87.71	0.21	2.60	1.00	0.02
19.42	88.07	0.21	2.59	1.00	0.01	19.49	86.23	0.21	2.64	1.00	0.02
19.59	83.45	0.20	2.71	1.00	0.03	19.64	80.30	0.19	2.80	1.00	0.02
19.69	76.56	0.18	2.91	1.00	0.02	19.77	73.34	0.17	3.01	1.00	0.03
19.83	72.69	0.17	3.04	1.00	0.02	19.89	81.00	0.19	2.78	1.00	0.02
19.98	95.33	0.24	2.43	1.00	0.03	20.02	106.07	0.28	2.23	1.00	0.01
20.09	116.29	0.33	2.06	1.00	0.02	20.18	122.46	0.37	1.98	1.00	0.02
20.21	131.48	0.43	1.87	1.00	0.01	20.29	133.87	0.44	1.84	1.00	0.02
20.38	135.85	0.46	1.82	1.00	0.02	20.43	136.48	0.46	1.81	1.00	0.01
20.48	134.89	0.45	1.83	1.00	0.01	20.57	131.65	0.43	1.87	1.00	0.02
20.63	127.19	0.40	1.92	1.00	0.01	20.68	121.59	0.36	1.99	1.00	0.01
20.77	116.22	0.33	2.07	1.00	0.02	20.81	111.50	0.30	2.14	1.00	0.01
20.87	108.61	0.29	2.18	1.00	0.02	20.96	106.74	0.28	2.22	1.00	0.02
21.00	106.11	0.28	2.23	1.00	0.01	21.07	106.59	0.28	2.22	1.00	0.02
21.13	109.06	0.29	2.18	1.00	0.02	21.22	114.90	0.32	2.09	1.00	0.02
21.27	125.12	0.38	1.94	1.00	0.01	21.35	133.99	0.44	1.84	1.00	0.02
21.41	141.51	0.50	1.76	1.00	0.01	21.47	148.05	0.55	1.72	1.00	0.01
21.54	154.74	0.61	1.61	1.00	0.01	21.60	159.80	0.67	1.26	1.00	0.01
21.66	163.15	0.70	1.23	1.00	0.01	21.76	165.43	0.72	1.20	1.00	0.01
21.82	167.72	0.75	1.18	1.00	0.01	21.86	169.59	0.77	0.94	1.00	0.01
21.92	171.48	0.79	0.92	1.00	0.01	22.01	173.48	0.82	0.91	1.00	0.01
22.06	175.44	0.84	0.89	1.00	0.01	22.15	176.60	0.85	0.68	1.00	0.01
22.21	176.77	0.86	0.67	1.00	0.00	22.26	175.05	0.83	0.90	1.00	0.01
22.34	172.02	2.00	0.00	1.00	0.00	22.40	168.02	2.00	0.00	1.00	0.00
22.45	163.08	2.00	0.00	1.00	0.00	22.52	157.24	2.00	0.00	1.00	0.00
22.58	150.59	2.00	0.00	1.00	0.00	22.64	141.36	2.00	0.00	1.00	0.00
22.75	133.05	2.00	0.00	1.00	0.00	22.77	125.01	2.00	0.00	1.00	0.00
22.84	118.13	2.00	0.00	1.00	0.00	22.94	111.66	2.00	0.00	1.00	0.00
23.00	107.71	2.00	0.00	1.00	0.00	23.03	106.04	2.00	0.00	1.00	0.00
23.10	103.30	2.00	0.00	1.00	0.00	23.19	101.44	2.00	0.00	1.00	0.00
23.25	99.90	2.00	0.00	1.00	0.00	23.30	99.55	2.00	0.00	1.00	0.00
23.38	98.36	2.00	0.00	1.00	0.00	23.43	94.15	2.00	0.00	1.00	0.00
23.50	90.22	2.00	0.00	1.00	0.00	23.58	86.79	2.00	0.00	1.00	0.00
23.64	84.09	2.00	0.00	1.00	0.00	23.73	81.92	2.00	0.00	1.00	0.00
23.78	79.35	2.00	0.00	1.00	0.00	23.83	74.01	2.00	0.00	1.00	0.00
23.92	71.65	2.00	0.00	1.00	0.00	23.97	78.68	2.00	0.00	1.00	0.00
24.02	93.45	2.00	0.00	1.00	0.00	24.09	109.22	2.00	0.00	1.00	0.00
24.15	124.34	2.00	0.00	1.00	0.00	24.23	135.72	0.45	1.82	1.00	0.02
24.28	146.22	0.53	1.71	1.00	0.01	24.36	154.79	0.61	1.61	1.00	0.02
24.42	165.32	0.71	1.20	1.00	0.01	24.52	173.62	0.81	0.91	1.00	0.01
24.54	182.58	0.92	0.64	1.00	0.00	24.62	185.20	0.96	0.50	1.00	0.00
24.71	185.35	0.96	0.50	1.00	0.01	24.77	190.50	1.03	0.49	1.00	0.00
24.81	198.54	1.15	0.35	1.00	0.00	24.89	206.91	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.96	212.97	2.00	0.00	1.00	0.00	25.01	211.84	2.00	0.00	1.00	0.00
25.09	216.66	2.00	0.00	1.00	0.00	25.15	221.79	2.00	0.00	1.00	0.00
25.21	228.75	2.00	0.00	1.00	0.00	25.28	231.41	2.00	0.00	1.00	0.00
25.33	232.15	2.00	0.00	1.00	0.00	25.41	230.92	2.00	0.00	1.00	0.00
25.50	228.49	2.00	0.00	1.00	0.00	25.55	225.22	2.00	0.00	1.00	0.00
25.60	221.15	2.00	0.00	1.00	0.00	25.66	214.53	2.00	0.00	1.00	0.00
25.73	206.16	2.00	0.00	1.00	0.00	25.80	195.97	1.11	0.36	1.00	0.00
25.86	183.40	0.93	0.64	1.00	0.00	25.93	170.25	0.77	0.93	1.00	0.01
26.00	157.15	0.63	1.58	1.00	0.01	26.07	148.32	0.55	1.69	1.00	0.01
26.13	142.19	0.49	1.75	1.00	0.01	26.20	140.00	0.48	1.77	1.00	0.01
26.25	140.88	0.48	1.76	1.00	0.01	26.34	143.93	0.51	1.73	1.00	0.02
26.40	148.56	0.55	1.69	1.00	0.01	26.45	155.31	0.61	1.60	1.00	0.01
26.55	162.56	0.68	1.23	1.00	0.01	26.58	170.56	0.77	0.93	1.00	0.00
26.64	180.82	0.89	0.65	1.00	0.00	26.74	191.64	1.04	0.48	1.00	0.01
26.79	202.60	2.00	0.00	1.00	0.00	26.85	210.64	2.00	0.00	1.00	0.00
26.94	216.18	2.00	0.00	1.00	0.00	26.98	219.19	2.00	0.00	1.00	0.00
27.04	217.39	2.00	0.00	1.00	0.00	27.13	213.10	2.00	0.00	1.00	0.00
27.18	207.00	2.00	0.00	1.00	0.00	27.24	199.85	1.17	0.25	1.00	0.00
27.31	192.11	1.05	0.48	1.00	0.00	27.38	184.23	0.94	0.63	1.00	0.01
27.43	176.54	0.84	0.89	1.00	0.01	27.50	169.49	0.76	0.94	1.00	0.01
27.56	163.30	0.69	1.23	1.00	0.01	27.63	158.52	0.64	1.56	1.00	0.01
27.71	153.99	0.60	1.62	1.00	0.02	27.77	148.87	0.55	1.69	1.00	0.01
27.83	142.86	2.00	0.00	1.00	0.00	27.92	136.61	2.00	0.00	1.00	0.00
27.97	131.75	2.00	0.00	1.00	0.00	28.03	125.79	2.00	0.00	1.00	0.00
28.12	120.92	2.00	0.00	1.00	0.00	28.18	118.29	2.00	0.00	1.00	0.00
28.22	117.77	2.00	0.00	1.00	0.00	28.31	118.10	2.00	0.00	1.00	0.00
28.37	116.80	2.00	0.00	1.00	0.00	28.42	112.06	2.00	0.00	1.00	0.00
28.52	106.24	2.00	0.00	1.00	0.00	28.55	99.64	2.00	0.00	1.00	0.00
28.62	90.39	2.00	0.00	1.00	0.00	28.72	80.38	2.00	0.00	1.00	0.00
28.76	71.55	2.00	0.00	1.00	0.00	28.82	69.19	2.00	0.00	1.00	0.00
28.90	68.50	2.00	0.00	1.00	0.00	28.96	68.48	2.00	0.00	1.00	0.00
29.01	68.18	2.00	0.00	1.00	0.00	29.08	70.02	2.00	0.00	1.00	0.00
29.16	73.03	2.00	0.00	1.00	0.00	29.21	77.19	2.00	0.00	1.00	0.00
29.31	79.59	2.00	0.00	1.00	0.00	29.35	81.72	2.00	0.00	1.00	0.00
29.40	82.97	2.00	0.00	1.00	0.00	29.49	83.55	2.00	0.00	1.00	0.00
29.54	83.49	2.00	0.00	1.00	0.00	29.59	83.52	2.00	0.00	1.00	0.00
29.69	84.12	2.00	0.00	1.00	0.00	29.74	85.29	2.00	0.00	1.00	0.00
29.83	85.85	2.00	0.00	1.00	0.00	29.86	85.69	2.00	0.00	1.00	0.00
29.94	85.03	2.00	0.00	1.00	0.00	29.99	84.26	2.00	0.00	1.00	0.00
30.06	83.50	2.00	0.00	1.00	0.00	30.13	82.82	2.00	0.00	1.00	0.00
30.19	82.21	2.00	0.00	1.00	0.00	30.25	81.53	2.00	0.00	1.00	0.00
30.34	80.77	2.00	0.00	1.00	0.00	30.39	80.18	2.00	0.00	1.00	0.00
30.46	79.76	2.00	0.00	1.00	0.00	30.53	79.26	2.00	0.00	1.00	0.00
30.58	78.73	2.00	0.00	1.00	0.00	30.66	78.36	2.00	0.00	1.00	0.00
30.72	78.42	2.00	0.00	1.00	0.00	30.78	79.25	2.00	0.00	1.00	0.00
30.88	80.05	2.00	0.00	1.00	0.00	30.91	81.17	2.00	0.00	1.00	0.00
30.98	82.19	2.00	0.00	1.00	0.00	31.05	83.46	2.00	0.00	1.00	0.00
31.13	83.99	2.00	0.00	1.00	0.00	31.17	83.00	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
31.27	81.36	2.00	0.00	1.00	0.00	31.32	79.83	2.00	0.00	1.00	0.00
31.37	78.36	2.00	0.00	1.00	0.00	31.46	76.34	2.00	0.00	1.00	0.00
31.51	73.90	2.00	0.00	1.00	0.00	31.57	71.21	2.00	0.00	1.00	0.00
31.64	68.19	2.00	0.00	1.00	0.00	31.70	65.26	2.00	0.00	1.00	0.00
31.77	63.33	2.00	0.00	1.00	0.00	31.86	62.01	2.00	0.00	1.00	0.00
31.91	61.32	2.00	0.00	1.00	0.00	31.96	60.77	2.00	0.00	1.00	0.00
32.06	60.28	2.00	0.00	1.00	0.00	32.11	59.97	2.00	0.00	1.00	0.00
32.16	59.93	2.00	0.00	1.00	0.00	32.24	60.13	2.00	0.00	1.00	0.00
32.31	60.78	2.00	0.00	1.00	0.00	32.35	63.42	2.00	0.00	1.00	0.00
32.43	67.01	2.00	0.00	1.00	0.00	32.49	70.93	2.00	0.00	1.00	0.00
32.55	72.92	2.00	0.00	1.00	0.00	32.63	73.54	2.00	0.00	1.00	0.00
32.71	73.49	2.00	0.00	1.00	0.00	32.75	74.24	2.00	0.00	1.00	0.00
32.82	75.18	2.00	0.00	1.00	0.00	32.90	76.16	2.00	0.00	1.00	0.00
32.95	77.77	2.00	0.00	1.00	0.00	33.01	80.45	2.00	0.00	1.00	0.00
33.10	82.28	2.00	0.00	1.00	0.00	33.15	80.03	2.00	0.00	1.00	0.00
33.23	74.37	2.00	0.00	1.00	0.00	33.28	70.12	2.00	0.00	1.00	0.00
33.34	68.95	2.00	0.00	1.00	0.00	33.41	69.54	2.00	0.00	1.00	0.00
33.47	71.59	2.00	0.00	1.00	0.00	33.55	73.61	2.00	0.00	1.00	0.00
33.60	74.72	2.00	0.00	1.00	0.00	33.67	74.67	2.00	0.00	1.00	0.00
33.73	74.74	2.00	0.00	1.00	0.00	33.80	75.79	2.00	0.00	1.00	0.00
33.89	78.38	2.00	0.00	1.00	0.00	33.94	82.12	2.00	0.00	1.00	0.00
33.99	85.32	2.00	0.00	1.00	0.00	34.08	85.02	2.00	0.00	1.00	0.00
34.13	82.99	2.00	0.00	1.00	0.00	34.22	79.64	2.00	0.00	1.00	0.00
34.27	76.73	2.00	0.00	1.00	0.00	34.33	72.61	2.00	0.00	1.00	0.00
34.42	67.63	2.00	0.00	1.00	0.00	34.47	66.52	2.00	0.00	1.00	0.00
34.53	70.10	2.00	0.00	1.00	0.00	34.58	76.69	0.17	2.90	1.00	0.02
34.67	82.74	0.19	2.73	1.00	0.03	34.73	86.58	0.20	2.63	1.00	0.02
34.78	86.47	0.20	2.63	1.00	0.02	34.87	86.85	0.20	2.62	1.00	0.03
34.92	88.89	0.20	2.57	1.00	0.02	35.00	95.17	0.23	2.43	1.00	0.02
35.06	103.77	0.26	2.27	1.00	0.02	35.12	111.85	0.30	2.13	1.00	0.01
35.21	117.74	0.33	2.04	1.00	0.02	35.26	122.15	0.35	1.98	1.00	0.01
35.31	126.17	0.38	1.93	1.00	0.01	35.40	132.30	0.42	1.86	1.00	0.02
35.45	140.33	0.47	1.77	1.00	0.01	35.51	148.71	0.54	1.69	1.00	0.01
35.61	156.92	0.62	1.58	1.00	0.02	35.66	164.56	0.70	1.21	1.00	0.01
35.71	172.96	0.79	0.91	1.00	0.01	35.81	183.31	0.92	0.64	1.00	0.01
35.86	197.03	1.11	0.35	1.00	0.00	35.91	207.98	2.00	0.00	1.00	0.00
35.99	216.03	2.00	0.00	1.00	0.00	36.05	220.64	2.00	0.00	1.00	0.00
36.10	220.56	2.00	0.00	1.00	0.00	36.18	219.81	2.00	0.00	1.00	0.00
36.24	216.35	2.00	0.00	1.00	0.00	36.30	209.97	2.00	0.00	1.00	0.00
36.36	203.04	2.00	0.00	1.00	0.00	36.42	196.94	2.00	0.00	1.00	0.00
36.49	193.52	2.00	0.00	1.00	0.00	36.56	191.18	2.00	0.00	1.00	0.00
36.64	189.76	2.00	0.00	1.00	0.00	36.69	185.71	2.00	0.00	1.00	0.00
36.76	178.03	2.00	0.00	1.00	0.00	36.84	171.27	2.00	0.00	1.00	0.00
36.88	163.89	2.00	0.00	1.00	0.00	36.95	155.88	2.00	0.00	1.00	0.00
37.04	146.24	2.00	0.00	1.00	0.00	37.09	136.71	2.00	0.00	1.00	0.00
37.14	133.09	2.00	0.00	1.00	0.00	37.22	151.94	2.00	0.00	1.00	0.00
37.28	185.70	2.00	0.00	1.00	0.00	37.34	203.22	2.00	0.00	1.00	0.00
37.42	209.86	2.00	0.00	1.00	0.00	37.47	210.87	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
37.53	209.32	2.00	0.00	1.00	0.00	37.60	208.38	2.00	0.00	1.00	0.00
37.67	209.49	2.00	0.00	1.00	0.00	37.73	212.64	2.00	0.00	1.00	0.00
37.83	215.58	2.00	0.00	1.00	0.00	37.88	216.44	2.00	0.00	1.00	0.00
37.97	214.58	2.00	0.00	1.00	0.00	38.01	211.67	2.00	0.00	1.00	0.00
38.08	208.62	2.00	0.00	1.00	0.00	38.13	202.45	2.00	0.00	1.00	0.00
38.22	196.03	1.10	0.36	1.00	0.00	38.27	189.11	1.00	0.49	1.00	0.00
38.33	183.55	0.92	0.64	1.00	0.00	38.43	176.33	0.83	0.89	1.00	0.01
38.46	169.05	0.75	1.17	1.00	0.01	38.55	164.02	0.69	1.22	1.00	0.01
38.60	160.17	0.65	1.26	1.00	0.01	38.65	155.92	0.61	1.59	1.00	0.01
38.74	151.15	0.57	1.67	1.00	0.02	38.79	146.66	0.53	1.71	1.00	0.01
38.85	144.27	0.51	1.73	1.00	0.01	38.93	142.35	0.49	1.75	1.00	0.02
39.00	142.53	0.49	1.75	1.00	0.01	39.05	143.88	0.50	1.73	1.00	0.01
39.14	146.93	0.53	1.70	1.00	0.02	39.20	149.99	0.56	1.69	1.00	0.01
39.25	152.05	0.57	1.65	1.00	0.01	39.33	152.68	0.58	1.64	1.00	0.02
39.39	151.86	0.57	1.66	1.00	0.01	39.44	149.34	0.55	1.70	1.00	0.01
39.52	146.37	0.53	1.71	1.00	0.02	39.58	143.68	0.50	1.74	1.00	0.01
39.64	140.90	0.48	1.76	1.00	0.01	39.72	137.50	0.45	1.80	1.00	0.02
39.77	134.49	0.43	1.83	1.00	0.01	39.84	133.53	0.43	1.84	1.00	0.01
39.90	134.52	0.43	1.83	1.00	0.01	39.98	135.95	0.44	1.82	1.00	0.02
40.03	137.20	0.45	1.80	1.00	0.01	40.13	138.03	0.46	1.79	1.00	0.02
40.18	138.88	0.47	1.78	1.00	0.01	40.24	139.54	0.47	1.78	1.00	0.01
40.29	140.24	0.48	1.77	1.00	0.01	40.36	141.42	0.49	1.76	1.00	0.01
40.43	142.62	0.50	1.75	1.00	0.01	40.49	143.39	0.50	1.74	1.00	0.01
40.55	143.19	0.50	1.74	1.00	0.01	40.62	143.20	0.50	1.74	1.00	0.01
40.70	143.44	0.50	1.74	1.00	0.02	40.77	144.89	0.51	1.72	1.00	0.02
40.83	146.72	0.53	1.71	1.00	0.01	40.88	150.26	0.56	1.68	1.00	0.01
40.98	153.50	0.59	1.63	1.00	0.02	41.02	157.02	0.62	1.58	1.00	0.01
41.12	158.49	0.64	1.56	1.00	0.02	41.16	159.03	0.64	1.55	1.00	0.01
41.22	158.06	0.64	1.56	1.00	0.01	41.27	156.92	0.62	1.58	1.00	0.01
41.36	155.71	0.61	1.60	1.00	0.02	41.42	154.11	0.60	1.62	1.00	0.01
41.47	150.49	0.56	1.68	1.00	0.01	41.57	145.19	0.52	1.72	1.00	0.02
41.62	139.01	0.47	1.78	1.00	0.01	41.67	132.80	0.42	1.85	1.00	0.01
41.76	127.17	0.39	1.92	1.00	0.02	41.81	121.69	0.35	1.99	1.00	0.01
41.87	116.83	0.33	2.06	1.00	0.02	41.93	112.49	0.30	2.12	1.00	0.02
42.01	110.56	0.29	2.15	1.00	0.02	42.06	109.82	0.29	2.16	1.00	0.01
42.15	111.02	0.30	2.14	1.00	0.02	42.21	112.08	0.30	2.13	1.00	0.01
42.27	115.76	0.32	2.07	1.00	0.01	42.36	120.48	0.35	2.01	1.00	0.02
42.41	126.96	0.39	1.92	1.00	0.01	42.46	131.31	0.41	1.87	1.00	0.01
42.56	134.62	0.44	1.83	1.00	0.02	42.60	135.31	0.44	1.82	1.00	0.01
42.66	134.53	0.44	1.83	1.00	0.01	42.75	134.12	0.43	1.84	1.00	0.02
42.81	133.84	0.43	1.84	1.00	0.01	42.85	134.19	0.44	1.84	1.00	0.01
42.92	134.21	0.44	1.84	1.00	0.02	43.00	134.69	0.44	1.83	1.00	0.02
43.05	134.76	0.44	1.83	1.00	0.01	43.13	135.04	0.44	1.83	1.00	0.02
43.18	134.52	0.44	1.83	1.00	0.01	43.25	134.16	0.44	1.84	1.00	0.01
43.34	134.14	0.44	1.84	1.00	0.02	43.40	136.28	0.45	1.81	1.00	0.01
43.44	140.98	0.49	1.76	1.00	0.01	43.55	145.78	0.53	1.72	1.00	0.02
43.57	150.69	0.57	1.67	1.00	0.01	43.64	153.24	0.59	1.63	1.00	0.01
43.70	155.06	0.61	1.61	1.00	0.01	43.78	154.55	0.61	1.61	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
43.84	152.58	0.59	1.64	1.00	0.01	43.92	150.30	0.57	1.68	1.00	0.02
43.99	148.34	0.55	1.71	1.00	0.01	44.04	143.80	0.51	1.73	1.00	0.01
44.14	138.66	0.47	1.79	1.00	0.02	44.19	133.44	0.43	1.84	1.00	0.01
44.23	131.82	0.42	1.86	1.00	0.01	44.30	130.71	0.41	1.88	1.00	0.02
44.37	129.86	0.41	1.89	1.00	0.02	44.44	130.32	0.41	1.88	1.00	0.02
44.52	131.46	0.42	1.87	1.00	0.02	44.56	135.54	0.45	1.82	1.00	0.01
44.62	140.09	0.48	1.77	1.00	0.01	44.70	148.00	0.55	1.72	1.00	0.02
44.77	163.84	0.71	1.22	1.00	0.01	44.83	178.40	0.88	0.67	1.00	0.01
44.88	184.21	0.96	0.50	1.00	0.00	44.95	183.47	0.95	0.64	1.00	0.01
45.04	154.71	0.61	1.61	1.00	0.02	45.08	150.36	0.57	1.68	1.00	0.01
45.15	145.22	0.53	1.72	1.00	0.01	45.21	160.14	0.67	1.26	1.00	0.01
45.30	153.51	0.60	1.63	1.00	0.02	45.36	145.44	0.53	1.72	1.00	0.01
45.45	139.35	0.48	1.78	1.00	0.02	45.48	134.11	0.44	1.84	1.00	0.01
45.56	129.69	0.41	1.89	1.00	0.02	45.65	125.80	0.38	1.94	1.00	0.02
45.71	123.26	0.37	1.97	1.00	0.01	45.76	122.66	0.37	1.98	1.00	0.01
45.80	122.77	0.37	1.97	1.00	0.01	45.91	122.35	2.00	0.00	1.00	0.00
45.94	121.75	2.00	0.00	1.00	0.00	46.00	119.93	2.00	0.00	1.00	0.00
46.09	117.55	2.00	0.00	1.00	0.00	46.15	114.36	2.00	0.00	1.00	0.00
46.20	110.82	2.00	0.00	1.00	0.00	46.29	107.63	2.00	0.00	1.00	0.00
46.35	105.73	2.00	0.00	1.00	0.00	46.40	104.45	2.00	0.00	1.00	0.00
46.48	104.35	2.00	0.00	1.00	0.00	46.53	105.43	2.00	0.00	1.00	0.00
46.59	106.56	2.00	0.00	1.00	0.00	46.69	106.75	2.00	0.00	1.00	0.00
46.73	105.65	2.00	0.00	1.00	0.00	46.79	103.59	2.00	0.00	1.00	0.00
46.86	100.71	2.00	0.00	1.00	0.00	46.93	95.66	2.00	0.00	1.00	0.00
46.99	90.07	2.00	0.00	1.00	0.00	47.08	84.60	2.00	0.00	1.00	0.00
47.12	79.79	2.00	0.00	1.00	0.00	47.19	74.84	2.00	0.00	1.00	0.00
47.28	69.10	2.00	0.00	1.00	0.00	47.33	64.68	2.00	0.00	1.00	0.00
47.38	61.24	2.00	0.00	1.00	0.00	47.48	58.32	2.00	0.00	1.00	0.00
47.53	55.79	2.00	0.00	1.00	0.00	47.58	54.03	2.00	0.00	1.00	0.00
47.65	52.51	2.00	0.00	1.00	0.00	47.71	51.14	2.00	0.00	1.00	0.00
47.78	49.91	2.00	0.00	1.00	0.00	47.87	48.84	2.00	0.00	1.00	0.00
47.92	48.06	2.00	0.00	1.00	0.00	47.98	47.52	2.00	0.00	1.00	0.00
48.04	47.14	2.00	0.00	1.00	0.00	48.10	46.89	2.00	0.00	1.00	0.00
48.17	47.43	2.00	0.00	1.00	0.00	48.26	48.29	2.00	0.00	1.00	0.00
48.32	49.21	2.00	0.00	1.00	0.00	48.36	50.67	2.00	0.00	1.00	0.00
48.44	53.08	2.00	0.00	1.00	0.00	48.53	55.58	2.00	0.00	1.00	0.00
48.57	57.59	2.00	0.00	1.00	0.00	48.64	58.61	2.00	0.00	1.00	0.00
48.71	59.24	2.00	0.00	1.00	0.00	48.77	59.19	2.00	0.00	1.00	0.00
48.83	58.64	2.00	0.00	1.00	0.00	48.90	57.86	2.00	0.00	1.00	0.00
48.95	56.53	2.00	0.00	1.00	0.00	49.03	54.84	2.00	0.00	1.00	0.00
49.10	52.77	2.00	0.00	1.00	0.00	49.16	51.40	2.00	0.00	1.00	0.00
49.22	50.67	2.00	0.00	1.00	0.00	49.28	50.33	2.00	0.00	1.00	0.00
49.35	49.62	2.00	0.00	1.00	0.00	49.43	49.32	2.00	0.00	1.00	0.00
49.51	49.75	2.00	0.00	1.00	0.00	49.56	50.97	2.00	0.00	1.00	0.00
49.62	52.08	2.00	0.00	1.00	0.00	49.71	52.90	2.00	0.00	1.00	0.00
49.76	54.12	2.00	0.00	1.00	0.00	49.80	57.07	2.00	0.00	1.00	0.00
49.90	59.73	2.00	0.00	1.00	0.00	49.96	61.72	2.00	0.00	1.00	0.00
50.01	64.43	2.00	0.00	1.00	0.00	50.10	67.57	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
50.15	71.09	2.00	0.00	1.00	0.00	50.21	72.35	2.00	0.00	1.00	0.00
50.26	72.68	2.00	0.00	1.00	0.00	50.35	72.35	2.00	0.00	1.00	0.00
50.40	71.96	2.00	0.00	1.00	0.00	50.46	71.58	2.00	0.00	1.00	0.00
50.54	71.49	2.00	0.00	1.00	0.00	50.61	71.26	2.00	0.00	1.00	0.00
50.66	71.47	2.00	0.00	1.00	0.00	50.72	71.69	2.00	0.00	1.00	0.00
50.79	72.17	2.00	0.00	1.00	0.00	50.87	72.48	2.00	0.00	1.00	0.00
50.95	72.56	2.00	0.00	1.00	0.00	51.00	72.42	2.00	0.00	1.00	0.00
51.06	72.21	2.00	0.00	1.00	0.00	51.14	71.99	2.00	0.00	1.00	0.00
51.20	71.85	2.00	0.00	1.00	0.00	51.26	71.80	2.00	0.00	1.00	0.00
51.32	71.77	2.00	0.00	1.00	0.00	51.39	71.63	2.00	0.00	1.00	0.00
51.45	71.31	2.00	0.00	1.00	0.00	51.54	70.94	2.00	0.00	1.00	0.00
51.60	70.63	2.00	0.00	1.00	0.00	51.65	70.35	2.00	0.00	1.00	0.00
51.71	70.02	2.00	0.00	1.00	0.00	51.79	69.70	2.00	0.00	1.00	0.00
51.84	69.43	2.00	0.00	1.00	0.00	51.94	69.11	2.00	0.00	1.00	0.00
51.99	68.80	2.00	0.00	1.00	0.00	52.04	68.51	2.00	0.00	1.00	0.00
52.11	68.33	2.00	0.00	1.00	0.00	52.17	68.16	2.00	0.00	1.00	0.00
52.26	68.05	2.00	0.00	1.00	0.00	52.32	67.90	2.00	0.00	1.00	0.00
52.38	67.62	2.00	0.00	1.00	0.00	52.44	67.37	2.00	0.00	1.00	0.00
52.50	67.19	2.00	0.00	1.00	0.00	52.57	67.27	2.00	0.00	1.00	0.00
52.65	67.74	2.00	0.00	1.00	0.00	52.73	68.50	2.00	0.00	1.00	0.00
52.78	69.04	2.00	0.00	1.00	0.00	52.84	69.50	2.00	0.00	1.00	0.00
52.89	70.27	2.00	0.00	1.00	0.00	52.96	71.50	2.00	0.00	1.00	0.00
53.03	72.90	2.00	0.00	1.00	0.00	53.13	72.80	2.00	0.00	1.00	0.00
53.17	71.79	2.00	0.00	1.00	0.00	53.23	72.03	2.00	0.00	1.00	0.00
53.29	73.99	2.00	0.00	1.00	0.00	53.35	76.37	2.00	0.00	1.00	0.00
53.42	76.77	2.00	0.00	1.00	0.00	53.50	75.19	2.00	0.00	1.00	0.00
53.55	72.42	2.00	0.00	1.00	0.00	53.65	72.10	2.00	0.00	1.00	0.00
53.70	73.99	2.00	0.00	1.00	0.00	53.77	77.09	2.00	0.00	1.00	0.00
53.81	79.88	2.00	0.00	1.00	0.00	53.89	81.22	2.00	0.00	1.00	0.00
53.94	81.54	2.00	0.00	1.00	0.00	54.04	80.59	2.00	0.00	1.00	0.00
54.09	78.07	2.00	0.00	1.00	0.00	54.14	73.78	2.00	0.00	1.00	0.00
54.21	70.28	2.00	0.00	1.00	0.00	54.29	68.78	2.00	0.00	1.00	0.00
54.34	69.98	2.00	0.00	1.00	0.00	54.40	71.63	2.00	0.00	1.00	0.00
54.48	73.02	2.00	0.00	1.00	0.00	54.53	74.73	2.00	0.00	1.00	0.00
54.62	74.40	2.00	0.00	1.00	0.00	54.67	73.15	2.00	0.00	1.00	0.00
54.73	76.81	2.00	0.00	1.00	0.00	54.79	81.57	2.00	0.00	1.00	0.00
54.88	85.96	2.00	0.00	1.00	0.00	54.93	85.60	2.00	0.00	1.00	0.00
55.02	86.34	2.00	0.00	1.00	0.00	55.05	87.47	2.00	0.00	1.00	0.00
55.12	85.40	2.00	0.00	1.00	0.00	55.22	82.86	2.00	0.00	1.00	0.00
55.26	80.12	2.00	0.00	1.00	0.00	55.32	84.63	2.00	0.00	1.00	0.00
55.42	92.84	2.00	0.00	1.00	0.00	55.47	100.54	2.00	0.00	1.00	0.00
55.52	106.09	2.00	0.00	1.00	0.00	55.61	111.40	2.00	0.00	1.00	0.00
55.65	117.62	2.00	0.00	1.00	0.00	55.72	124.65	2.00	0.00	1.00	0.00
55.79	135.37	2.00	0.00	1.00	0.00	55.86	147.80	2.00	0.00	1.00	0.00
55.91	159.60	2.00	0.00	1.00	0.00	56.01	169.46	2.00	0.00	1.00	0.00
56.05	172.81	2.00	0.00	1.00	0.00	56.12	172.28	2.00	0.00	1.00	0.00
56.20	170.17	2.00	0.00	1.00	0.00	56.26	165.70	2.00	0.00	1.00	0.00
56.30	157.60	2.00	0.00	1.00	0.00	56.39	149.69	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
56.45	140.76	2.00	0.00	1.00	0.00	56.50	134.70	2.00	0.00	1.00	0.00
56.60	130.19	2.00	0.00	1.00	0.00	56.64	127.85	2.00	0.00	1.00	0.00
56.70	125.62	2.00	0.00	1.00	0.00	56.79	123.85	2.00	0.00	1.00	0.00
56.85	121.04	2.00	0.00	1.00	0.00	56.89	116.44	2.00	0.00	1.00	0.00
56.96	109.36	2.00	0.00	1.00	0.00	57.03	101.74	2.00	0.00	1.00	0.00
57.09	92.98	2.00	0.00	1.00	0.00	57.19	84.44	2.00	0.00	1.00	0.00
57.24	76.43	2.00	0.00	1.00	0.00	57.28	72.40	2.00	0.00	1.00	0.00
57.38	70.56	2.00	0.00	1.00	0.00	57.43	70.94	2.00	0.00	1.00	0.00
57.49	73.79	2.00	0.00	1.00	0.00	57.58	76.01	2.00	0.00	1.00	0.00
57.61	78.41	2.00	0.00	1.00	0.00	57.68	79.59	2.00	0.00	1.00	0.00
57.75	80.58	2.00	0.00	1.00	0.00	57.84	80.97	2.00	0.00	1.00	0.00
57.89	81.02	2.00	0.00	1.00	0.00	57.97	80.88	2.00	0.00	1.00	0.00
58.01	80.61	2.00	0.00	1.00	0.00	58.08	80.66	2.00	0.00	1.00	0.00
58.15	80.42	2.00	0.00	1.00	0.00	58.22	79.39	2.00	0.00	1.00	0.00
58.28	78.11	2.00	0.00	1.00	0.00	58.37	76.22	2.00	0.00	1.00	0.00
58.43	74.48	2.00	0.00	1.00	0.00	58.49	71.84	2.00	0.00	1.00	0.00
58.58	69.59	2.00	0.00	1.00	0.00	58.62	68.14	2.00	0.00	1.00	0.00
58.67	67.57	2.00	0.00	1.00	0.00	58.73	68.27	2.00	0.00	1.00	0.00
58.82	68.99	2.00	0.00	1.00	0.00	58.86	69.14	2.00	0.00	1.00	0.00
58.97	68.42	2.00	0.00	1.00	0.00	59.00	67.66	2.00	0.00	1.00	0.00
59.07	67.46	2.00	0.00	1.00	0.00	59.12	65.66	2.00	0.00	1.00	0.00
59.21	62.37	2.00	0.00	1.00	0.00	59.26	58.96	2.00	0.00	1.00	0.00
59.33	55.57	2.00	0.00	1.00	0.00	59.41	53.62	2.00	0.00	1.00	0.00
59.45	51.95	2.00	0.00	1.00	0.00	59.52	51.39	2.00	0.00	1.00	0.00
59.61	50.33	2.00	0.00	1.00	0.00	59.65	49.10	2.00	0.00	1.00	0.00
59.72	48.29	2.00	0.00	1.00	0.00	59.78	47.74	2.00	0.00	1.00	0.00
59.87	47.85	2.00	0.00	1.00	0.00	59.91	48.79	2.00	0.00	1.00	0.00
60.02	50.14	2.00	0.00	1.00	0.00	60.06	49.67	2.00	0.00	1.00	0.00
60.11	55.24	2.00	0.00	1.00	0.00	60.19	61.74	2.00	0.00	1.00	0.00
60.24	71.06	2.00	0.00	1.00	0.00	60.33	78.13	2.00	0.00	1.00	0.00
60.39	83.61	2.00	0.00	1.00	0.00	60.44	84.34	2.00	0.00	1.00	0.00
60.53	85.87	2.00	0.00	1.00	0.00	60.58	89.23	2.00	0.00	1.00	0.00
60.63	90.68	2.00	0.00	1.00	0.00	60.71	92.72	2.00	0.00	1.00	0.00
60.78	93.81	2.00	0.00	1.00	0.00	60.84	94.59	2.00	0.00	1.00	0.00
60.90	94.17	2.00	0.00	1.00	0.00	60.98	96.25	2.00	0.00	1.00	0.00
61.03	98.66	2.00	0.00	1.00	0.00	61.13	100.30	2.00	0.00	1.00	0.00
61.17	99.50	2.00	0.00	1.00	0.00	61.24	97.26	2.00	0.00	1.00	0.00
61.30	94.25	2.00	0.00	1.00	0.00	61.38	91.72	2.00	0.00	1.00	0.00
61.43	89.60	2.00	0.00	1.00	0.00	61.49	87.68	2.00	0.00	1.00	0.00
61.55	87.22	2.00	0.00	1.00	0.00	61.62	87.30	2.00	0.00	1.00	0.00
61.71	88.15	2.00	0.00	1.00	0.00	61.75	88.29	2.00	0.00	1.00	0.00
61.81	88.24	2.00	0.00	1.00	0.00	61.89	88.69	2.00	0.00	1.00	0.00
61.97	89.64	2.00	0.00	1.00	0.00	62.02	88.31	2.00	0.00	1.00	0.00
62.12	86.74	2.00	0.00	1.00	0.00	62.16	83.88	2.00	0.00	1.00	0.00
62.22	81.51	2.00	0.00	1.00	0.00	62.31	79.02	2.00	0.00	1.00	0.00
62.37	76.95	2.00	0.00	1.00	0.00	62.42	75.98	2.00	0.00	1.00	0.00
62.49	75.30	2.00	0.00	1.00	0.00	62.55	73.94	2.00	0.00	1.00	0.00
62.60	70.76	2.00	0.00	1.00	0.00	62.71	66.40	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
62.76	61.11	2.00	0.00	1.00	0.00	62.81	57.30	2.00	0.00	1.00	0.00
62.86	54.32	2.00	0.00	1.00	0.00	62.96	51.97	2.00	0.00	1.00	0.00
63.01	50.77	2.00	0.00	1.00	0.00	63.08	50.46	2.00	0.00	1.00	0.00
63.14	50.60	2.00	0.00	1.00	0.00	63.20	51.08	2.00	0.00	1.00	0.00
63.26	51.96	2.00	0.00	1.00	0.00	63.33	53.12	2.00	0.00	1.00	0.00
63.39	54.41	2.00	0.00	1.00	0.00	63.45	56.29	2.00	0.00	1.00	0.00
63.55	58.08	2.00	0.00	1.00	0.00	63.60	59.59	2.00	0.00	1.00	0.00
63.66	60.67	2.00	0.00	1.00	0.00	63.74	62.14	2.00	0.00	1.00	0.00
63.80	64.09	2.00	0.00	1.00	0.00	63.86	65.75	2.00	0.00	1.00	0.00
63.94	67.03	2.00	0.00	1.00	0.00	63.98	68.35	2.00	0.00	1.00	0.00
64.04	70.35	2.00	0.00	1.00	0.00	64.11	73.20	2.00	0.00	1.00	0.00
64.19	75.93	2.00	0.00	1.00	0.00	64.28	77.62	2.00	0.00	1.00	0.00
64.33	78.48	2.00	0.00	1.00	0.00	64.39	79.33	2.00	0.00	1.00	0.00
64.44	81.18	2.00	0.00	1.00	0.00	64.54	82.58	2.00	0.00	1.00	0.00
64.58	82.82	2.00	0.00	1.00	0.00	64.65	80.41	2.00	0.00	1.00	0.00
64.73	77.47	2.00	0.00	1.00	0.00	64.80	74.70	2.00	0.00	1.00	0.00
64.84	72.41	2.00	0.00	1.00	0.00	64.90	70.21	2.00	0.00	1.00	0.00
64.97	68.09	2.00	0.00	1.00	0.00	65.04	67.51	2.00	0.00	1.00	0.00
65.11	67.88	2.00	0.00	1.00	0.00	65.18	69.34	2.00	0.00	1.00	0.00
65.24	71.29	2.00	0.00	1.00	0.00	65.31	74.35	2.00	0.00	1.00	0.00
65.39	77.79	2.00	0.00	1.00	0.00	65.45	78.84	2.00	0.00	1.00	0.00
65.50	78.88	2.00	0.00	1.00	0.00	65.59	77.93	2.00	0.00	1.00	0.00
65.64	76.82	2.00	0.00	1.00	0.00	65.70	75.55	2.00	0.00	1.00	0.00
65.80	73.91	2.00	0.00	1.00	0.00	65.85	71.65	2.00	0.00	1.00	0.00
65.90	69.10	2.00	0.00	1.00	0.00	65.95	65.55	2.00	0.00	1.00	0.00
66.02	61.26	2.00	0.00	1.00	0.00	66.08	57.02	2.00	0.00	1.00	0.00
66.14	53.42	2.00	0.00	1.00	0.00	66.22	50.68	2.00	0.00	1.00	0.00
66.29	48.28	2.00	0.00	1.00	0.00	66.35	47.03	2.00	0.00	1.00	0.00
66.44	46.72	2.00	0.00	1.00	0.00	66.48	47.26	2.00	0.00	1.00	0.00
66.54	49.82	2.00	0.00	1.00	0.00	66.63	52.89	2.00	0.00	1.00	0.00
66.68	57.20	2.00	0.00	1.00	0.00	66.74	61.63	2.00	0.00	1.00	0.00
66.82	66.31	2.00	0.00	1.00	0.00	66.89	70.23	2.00	0.00	1.00	0.00
66.94	73.21	2.00	0.00	1.00	0.00	67.01	75.54	2.00	0.00	1.00	0.00
67.08	76.80	2.00	0.00	1.00	0.00	67.13	76.74	2.00	0.00	1.00	0.00
67.23	75.52	2.00	0.00	1.00	0.00	67.28	73.95	2.00	0.00	1.00	0.00
67.32	72.52	2.00	0.00	1.00	0.00	67.41	71.36	2.00	0.00	1.00	0.00
67.48	70.37	2.00	0.00	1.00	0.00	67.53	69.47	2.00	0.00	1.00	0.00
67.61	68.55	2.00	0.00	1.00	0.00	67.66	67.60	2.00	0.00	1.00	0.00
67.72	66.33	2.00	0.00	1.00	0.00	67.81	65.24	2.00	0.00	1.00	0.00
67.85	63.99	2.00	0.00	1.00	0.00	67.92	62.98	2.00	0.00	1.00	0.00
68.01	61.69	2.00	0.00	1.00	0.00	68.07	60.48	2.00	0.00	1.00	0.00
68.12	59.04	2.00	0.00	1.00	0.00	68.22	57.31	2.00	0.00	1.00	0.00
68.25	54.94	2.00	0.00	1.00	0.00	68.31	53.80	2.00	0.00	1.00	0.00
68.37	53.16	2.00	0.00	1.00	0.00	68.46	53.80	2.00	0.00	1.00	0.00
68.51	55.10	2.00	0.00	1.00	0.00	68.60	56.56	2.00	0.00	1.00	0.00
68.65	59.77	2.00	0.00	1.00	0.00	68.73	60.56	2.00	0.00	1.00	0.00
68.79	60.20	2.00	0.00	1.00	0.00	68.84	58.39	2.00	0.00	1.00	0.00
68.92	56.16	2.00	0.00	1.00	0.00	68.98	54.67	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
69.03	54.56	2.00	0.00	1.00	0.00	69.14	54.76	2.00	0.00	1.00	0.00
69.18	54.69	2.00	0.00	1.00	0.00	69.24	54.48	2.00	0.00	1.00	0.00
69.33	52.95	2.00	0.00	1.00	0.00	69.39	50.27	2.00	0.00	1.00	0.00
69.43	47.41	2.00	0.00	1.00	0.00	69.49	45.18	2.00	0.00	1.00	0.00
69.58	43.85	2.00	0.00	1.00	0.00	69.63	43.87	2.00	0.00	1.00	0.00
69.69	44.08	2.00	0.00	1.00	0.00	69.76	44.39	2.00	0.00	1.00	0.00
69.82	45.30	2.00	0.00	1.00	0.00	69.90	46.66	2.00	0.00	1.00	0.00
69.98	47.98	2.00	0.00	1.00	0.00	70.03	48.96	2.00	0.00	1.00	0.00
70.09	49.47	2.00	0.00	1.00	0.00	70.16	49.66	2.00	0.00	1.00	0.00
70.25	49.42	2.00	0.00	1.00	0.00	70.30	48.98	2.00	0.00	1.00	0.00
70.35	48.45	2.00	0.00	1.00	0.00	70.44	47.89	2.00	0.00	1.00	0.00
70.49	47.28	2.00	0.00	1.00	0.00	70.56	46.71	2.00	0.00	1.00	0.00
70.65	46.27	2.00	0.00	1.00	0.00	70.67	46.13	2.00	0.00	1.00	0.00
70.75	46.04	2.00	0.00	1.00	0.00	70.80	46.13	2.00	0.00	1.00	0.00
70.90	46.29	2.00	0.00	1.00	0.00	70.95	47.11	2.00	0.00	1.00	0.00
71.01	48.60	2.00	0.00	1.00	0.00	71.09	50.59	2.00	0.00	1.00	0.00
71.15	52.09	2.00	0.00	1.00	0.00	71.20	52.70	2.00	0.00	1.00	0.00
71.30	52.55	2.00	0.00	1.00	0.00	71.34	52.25	2.00	0.00	1.00	0.00
71.39	51.63	2.00	0.00	1.00	0.00	71.49	50.95	2.00	0.00	1.00	0.00
71.54	50.31	2.00	0.00	1.00	0.00	71.59	50.11	2.00	0.00	1.00	0.00
71.69	49.82	2.00	0.00	1.00	0.00	71.74	49.30	2.00	0.00	1.00	0.00
71.79	48.57	2.00	0.00	1.00	0.00	71.88	47.86	2.00	0.00	1.00	0.00
71.93	47.20	2.00	0.00	1.00	0.00	71.99	46.56	2.00	0.00	1.00	0.00
72.08	45.95	2.00	0.00	1.00	0.00	72.14	45.33	2.00	0.00	1.00	0.00
72.18	44.77	2.00	0.00	1.00	0.00	72.25	44.30	2.00	0.00	1.00	0.00
72.33	44.10	2.00	0.00	1.00	0.00	72.38	43.93	2.00	0.00	1.00	0.00
72.48	43.73	2.00	0.00	1.00	0.00	72.54	43.51	2.00	0.00	1.00	0.00
72.58	43.39	2.00	0.00	1.00	0.00	72.68	43.31	2.00	0.00	1.00	0.00
72.73	43.25	2.00	0.00	1.00	0.00	72.77	43.14	2.00	0.00	1.00	0.00
72.87	43.03	2.00	0.00	1.00	0.00	72.92	42.92	2.00	0.00	1.00	0.00
72.97	42.99	2.00	0.00	1.00	0.00	73.05	43.21	2.00	0.00	1.00	0.00
73.12	43.59	2.00	0.00	1.00	0.00	73.17	43.87	2.00	0.00	1.00	0.00
73.25	43.94	2.00	0.00	1.00	0.00	73.31	43.90	2.00	0.00	1.00	0.00
73.37	43.75	2.00	0.00	1.00	0.00	73.43	43.45	2.00	0.00	1.00	0.00
73.49	43.04	2.00	0.00	1.00	0.00	73.57	42.62	2.00	0.00	1.00	0.00
73.62	42.21	2.00	0.00	1.00	0.00	73.71	41.87	2.00	0.00	1.00	0.00
73.76	41.58	2.00	0.00	1.00	0.00	73.85	41.42	2.00	0.00	1.00	0.00
73.91	41.30	2.00	0.00	1.00	0.00	73.97	41.23	2.00	0.00	1.00	0.00
74.02	40.87	2.00	0.00	1.00	0.00	74.11	40.33	2.00	0.00	1.00	0.00
74.16	39.96	2.00	0.00	1.00	0.00	74.24	40.00	2.00	0.00	1.00	0.00
74.30	40.21	2.00	0.00	1.00	0.00	74.36	40.37	2.00	0.00	1.00	0.00
74.41	40.46	2.00	0.00	1.00	0.00	74.49	40.70	2.00	0.00	1.00	0.00
74.56	41.01	2.00	0.00	1.00	0.00	74.63	41.27	2.00	0.00	1.00	0.00
74.71	41.27	2.00	0.00	1.00	0.00	74.76	40.99	2.00	0.00	1.00	0.00
74.81	41.09	2.00	0.00	1.00	0.00	74.89	41.41	2.00	0.00	1.00	0.00
74.95	41.93	2.00	0.00	1.00	0.00	75.01	42.44	2.00	0.00	1.00	0.00
75.11	42.90	2.00	0.00	1.00	0.00	75.18	43.39	2.00	0.00	1.00	0.00
75.23	43.60	2.00	0.00	1.00	0.00	75.27	43.72	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
75.33	43.81	2.00	0.00	1.00	0.00	75.43	43.87	2.00	0.00	1.00	0.00
75.47	43.83	2.00	0.00	1.00	0.00	75.53	43.71	2.00	0.00	1.00	0.00
75.63	43.61	2.00	0.00	1.00	0.00	75.67	43.63	2.00	0.00	1.00	0.00
75.73	43.65	2.00	0.00	1.00	0.00	75.81	43.71	2.00	0.00	1.00	0.00
75.87	43.74	2.00	0.00	1.00	0.00	75.93	43.91	2.00	0.00	1.00	0.00
76.00	44.07	2.00	0.00	1.00	0.00	76.07	44.38	2.00	0.00	1.00	0.00
76.12	44.62	2.00	0.00	1.00	0.00	76.21	44.85	2.00	0.00	1.00	0.00
76.27	45.00	2.00	0.00	1.00	0.00	76.32	45.09	2.00	0.00	1.00	0.00
76.38	45.10	2.00	0.00	1.00	0.00	76.45	45.01	2.00	0.00	1.00	0.00
76.51	44.69	2.00	0.00	1.00	0.00	76.61	44.32	2.00	0.00	1.00	0.00
76.67	43.94	2.00	0.00	1.00	0.00	76.71	43.67	2.00	0.00	1.00	0.00
76.80	43.38	2.00	0.00	1.00	0.00	76.85	43.06	2.00	0.00	1.00	0.00
76.91	42.82	2.00	0.00	1.00	0.00	76.98	42.65	2.00	0.00	1.00	0.00
77.06	42.57	2.00	0.00	1.00	0.00	77.12	42.51	2.00	0.00	1.00	0.00
77.19	42.42	2.00	0.00	1.00	0.00	77.26	42.23	2.00	0.00	1.00	0.00
77.30	42.08	2.00	0.00	1.00	0.00	77.40	41.96	2.00	0.00	1.00	0.00
77.44	41.94	2.00	0.00	1.00	0.00	77.50	41.77	2.00	0.00	1.00	0.00
77.59	41.46	2.00	0.00	1.00	0.00	77.65	41.08	2.00	0.00	1.00	0.00
77.70	40.64	2.00	0.00	1.00	0.00	77.80	40.23	2.00	0.00	1.00	0.00
77.85	39.84	2.00	0.00	1.00	0.00	77.90	39.61	2.00	0.00	1.00	0.00
77.99	39.46	2.00	0.00	1.00	0.00	78.03	39.41	2.00	0.00	1.00	0.00
78.09	39.57	2.00	0.00	1.00	0.00	78.19	39.85	2.00	0.00	1.00	0.00
78.22	40.51	2.00	0.00	1.00	0.00	78.30	41.33	2.00	0.00	1.00	0.00
78.39	42.25	2.00	0.00	1.00	0.00	78.44	43.11	2.00	0.00	1.00	0.00
78.49	43.94	2.00	0.00	1.00	0.00	78.59	44.61	2.00	0.00	1.00	0.00
78.62	45.19	2.00	0.00	1.00	0.00	78.69	45.53	2.00	0.00	1.00	0.00
78.74	45.85	2.00	0.00	1.00	0.00	78.81	45.98	2.00	0.00	1.00	0.00
78.89	45.95	2.00	0.00	1.00	0.00	78.97	45.91	2.00	0.00	1.00	0.00
79.02	45.98	2.00	0.00	1.00	0.00	79.08	45.90	2.00	0.00	1.00	0.00
79.17	45.94	2.00	0.00	1.00	0.00	79.23	46.07	2.00	0.00	1.00	0.00
79.27	46.56	2.00	0.00	1.00	0.00	79.33	46.97	2.00	0.00	1.00	0.00
79.43	47.23	2.00	0.00	1.00	0.00	79.47	47.36	2.00	0.00	1.00	0.00
79.54	47.32	2.00	0.00	1.00	0.00	79.60	47.33	2.00	0.00	1.00	0.00
79.66	47.65	2.00	0.00	1.00	0.00	79.74	47.94	2.00	0.00	1.00	0.00
79.83	47.90	2.00	0.00	1.00	0.00	79.88	47.21	2.00	0.00	1.00	0.00
79.93	46.00	2.00	0.00	1.00	0.00	80.02	44.74	2.00	0.00	1.00	0.00
80.07	43.64	2.00	0.00	1.00	0.00	80.12	42.53	2.00	0.00	1.00	0.00
80.23	41.53	2.00	0.00	1.00	0.00	80.28	40.64	2.00	0.00	1.00	0.00
80.32	40.30	2.00	0.00	1.00	0.00	80.40	39.88	2.00	0.00	1.00	0.00
80.48	39.43	2.00	0.00	1.00	0.00	80.53	39.01	2.00	0.00	1.00	0.00
80.58	38.74	2.00	0.00	1.00	0.00	80.67	38.72	2.00	0.00	1.00	0.00
80.72	39.52	2.00	0.00	1.00	0.00	80.79	41.16	2.00	0.00	1.00	0.00
80.85	44.48	2.00	0.00	1.00	0.00	80.92	50.71	2.00	0.00	1.00	0.00
80.97	56.61	2.00	0.00	1.00	0.00	81.05	55.72	2.00	0.00	1.00	0.00
81.12	49.79	2.00	0.00	1.00	0.00	81.22	44.30	2.00	0.00	1.00	0.00
81.26	46.04	2.00	0.00	1.00	0.00	81.32	49.24	2.00	0.00	1.00	0.00
81.37	54.64	2.00	0.00	1.00	0.00	81.46	59.07	2.00	0.00	1.00	0.00
81.51	63.82	2.00	0.00	1.00	0.00	81.59	68.57	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
81.66	72.57	2.00	0.00	1.00	0.00	81.71	74.63	2.00	0.00	1.00	0.00
81.79	75.66	2.00	0.00	1.00	0.00	81.85	76.45	2.00	0.00	1.00	0.00
81.91	76.43	2.00	0.00	1.00	0.00	81.97	75.64	2.00	0.00	1.00	0.00
82.06	74.26	2.00	0.00	1.00	0.00	82.11	72.62	2.00	0.00	1.00	0.00
82.16	70.70	2.00	0.00	1.00	0.00	82.26	68.93	2.00	0.00	1.00	0.00
82.30	67.72	2.00	0.00	1.00	0.00	82.35	66.98	2.00	0.00	1.00	0.00
82.44	66.18	2.00	0.00	1.00	0.00	82.50	65.35	2.00	0.00	1.00	0.00
82.55	64.36	2.00	0.00	1.00	0.00	82.64	63.35	2.00	0.00	1.00	0.00
82.69	62.10	2.00	0.00	1.00	0.00	82.75	60.37	2.00	0.00	1.00	0.00
82.83	58.27	2.00	0.00	1.00	0.00	82.89	56.25	2.00	0.00	1.00	0.00
82.95	54.82	2.00	0.00	1.00	0.00	83.02	53.75	2.00	0.00	1.00	0.00
83.09	52.90	2.00	0.00	1.00	0.00	83.14	52.13	2.00	0.00	1.00	0.00
83.24	51.54	2.00	0.00	1.00	0.00	83.29	51.04	2.00	0.00	1.00	0.00
83.35	50.76	2.00	0.00	1.00	0.00	83.43	50.41	2.00	0.00	1.00	0.00
83.49	50.00	2.00	0.00	1.00	0.00	83.54	49.60	2.00	0.00	1.00	0.00
83.61	49.18	2.00	0.00	1.00	0.00	83.67	48.83	2.00	0.00	1.00	0.00
83.73	48.43	2.00	0.00	1.00	0.00	83.82	48.04	2.00	0.00	1.00	0.00
83.87	47.66	2.00	0.00	1.00	0.00	83.93	47.40	2.00	0.00	1.00	0.00
84.00	47.21	2.00	0.00	1.00	0.00	84.06	47.07	2.00	0.00	1.00	0.00
84.13	46.99	2.00	0.00	1.00	0.00	84.22	46.93	2.00	0.00	1.00	0.00
84.27	46.87	2.00	0.00	1.00	0.00	84.32	46.76	2.00	0.00	1.00	0.00
84.42	46.58	2.00	0.00	1.00	0.00	84.47	46.46	2.00	0.00	1.00	0.00
84.52	46.36	2.00	0.00	1.00	0.00	84.61	46.28	2.00	0.00	1.00	0.00
84.66	46.20	2.00	0.00	1.00	0.00	84.72	46.04	2.00	0.00	1.00	0.00
84.81	45.92	2.00	0.00	1.00	0.00	84.86	45.83	2.00	0.00	1.00	0.00
84.91	45.88	2.00	0.00	1.00	0.00	85.01	45.89	2.00	0.00	1.00	0.00
85.05	45.37	2.00	0.00	1.00	0.00	85.11	45.43	2.00	0.00	1.00	0.00
85.20	45.45	2.00	0.00	1.00	0.00	85.26	45.98	2.00	0.00	1.00	0.00
85.31	45.86	2.00	0.00	1.00	0.00	85.40	45.75	2.00	0.00	1.00	0.00
85.45	45.60	2.00	0.00	1.00	0.00	85.50	45.64	2.00	0.00	1.00	0.00
85.59	45.72	2.00	0.00	1.00	0.00	85.65	45.84	2.00	0.00	1.00	0.00
85.70	45.88	2.00	0.00	1.00	0.00	85.80	45.91	2.00	0.00	1.00	0.00
85.83	46.00	2.00	0.00	1.00	0.00	85.90	46.08	2.00	0.00	1.00	0.00
85.99	46.16	2.00	0.00	1.00	0.00	86.04	46.36	2.00	0.00	1.00	0.00
86.10	46.51	2.00	0.00	1.00	0.00	86.19	46.59	2.00	0.00	1.00	0.00
86.25	46.55	2.00	0.00	1.00	0.00	86.30	46.39	2.00	0.00	1.00	0.00
86.39	46.13	2.00	0.00	1.00	0.00	86.43	45.72	2.00	0.00	1.00	0.00
86.49	45.44	2.00	0.00	1.00	0.00	86.59	45.20	2.00	0.00	1.00	0.00
86.64	45.00	2.00	0.00	1.00	0.00	86.69	44.81	2.00	0.00	1.00	0.00
86.78	44.56	2.00	0.00	1.00	0.00	86.84	44.37	2.00	0.00	1.00	0.00
86.89	44.14	2.00	0.00	1.00	0.00	86.97	43.95	2.00	0.00	1.00	0.00
87.04	43.79	2.00	0.00	1.00	0.00	87.08	43.76	2.00	0.00	1.00	0.00
87.14	44.15	2.00	0.00	1.00	0.00	87.23	44.82	2.00	0.00	1.00	0.00
87.28	45.96	2.00	0.00	1.00	0.00	87.38	46.75	2.00	0.00	1.00	0.00
87.41	47.48	2.00	0.00	1.00	0.00	87.48	48.01	2.00	0.00	1.00	0.00
87.57	48.66	2.00	0.00	1.00	0.00	87.62	49.20	2.00	0.00	1.00	0.00
87.68	49.23	2.00	0.00	1.00	0.00	87.77	48.93	2.00	0.00	1.00	0.00
87.82	48.39	2.00	0.00	1.00	0.00	87.88	47.78	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
87.97	46.92	2.00	0.00	1.00	0.00	88.02	45.89	2.00	0.00	1.00	0.00
88.07	44.61	2.00	0.00	1.00	0.00	88.16	43.30	2.00	0.00	1.00	0.00
88.22	41.94	2.00	0.00	1.00	0.00	88.27	40.98	2.00	0.00	1.00	0.00
88.33	40.34	2.00	0.00	1.00	0.00	88.41	40.09	2.00	0.00	1.00	0.00
88.47	40.06	2.00	0.00	1.00	0.00	88.55	40.20	2.00	0.00	1.00	0.00
88.61	40.51	2.00	0.00	1.00	0.00	88.66	41.06	2.00	0.00	1.00	0.00
88.72	41.92	2.00	0.00	1.00	0.00	88.78	43.28	2.00	0.00	1.00	0.00
88.86	44.75	2.00	0.00	1.00	0.00	88.91	46.68	2.00	0.00	1.00	0.00
89.00	48.63	2.00	0.00	1.00	0.00	89.06	51.12	2.00	0.00	1.00	0.00
89.12	53.82	2.00	0.00	1.00	0.00	89.17	56.52	2.00	0.00	1.00	0.00
89.26	58.89	2.00	0.00	1.00	0.00	89.35	60.25	2.00	0.00	1.00	0.00
89.37	60.85	2.00	0.00	1.00	0.00	89.44	62.55	2.00	0.00	1.00	0.00
89.51	65.62	2.00	0.00	1.00	0.00	89.60	68.98	2.00	0.00	1.00	0.00
89.66	71.41	2.00	0.00	1.00	0.00	89.72	73.91	2.00	0.00	1.00	0.00
89.79	77.15	2.00	0.00	1.00	0.00	89.85	80.21	2.00	0.00	1.00	0.00
89.91	82.28	2.00	0.00	1.00	0.00	89.98	83.51	2.00	0.00	1.00	0.00
90.04	84.37	2.00	0.00	1.00	0.00	90.14	84.79	2.00	0.00	1.00	0.00
90.19	84.42	2.00	0.00	1.00	0.00	90.24	82.89	2.00	0.00	1.00	0.00
90.34	80.96	2.00	0.00	1.00	0.00	90.39	78.98	2.00	0.00	1.00	0.00
90.44	77.67	2.00	0.00	1.00	0.00	90.49	75.86	2.00	0.00	1.00	0.00
90.58	74.35	2.00	0.00	1.00	0.00	90.62	73.06	2.00	0.00	1.00	0.00
90.68	73.00	2.00	0.00	1.00	0.00	90.78	73.09	2.00	0.00	1.00	0.00
90.83	73.26	2.00	0.00	1.00	0.00	90.88	73.16	2.00	0.00	1.00	0.00
90.94	72.95	2.00	0.00	1.00	0.00	91.03	72.74	2.00	0.00	1.00	0.00
91.08	72.50	2.00	0.00	1.00	0.00	91.17	72.28	2.00	0.00	1.00	0.00
91.21	72.06	2.00	0.00	1.00	0.00	91.28	71.81	2.00	0.00	1.00	0.00
91.34	71.44	2.00	0.00	1.00	0.00	91.41	71.02	2.00	0.00	1.00	0.00
91.47	70.49	2.00	0.00	1.00	0.00	91.58	69.96	2.00	0.00	1.00	0.00
91.62	69.49	2.00	0.00	1.00	0.00	91.67	69.06	2.00	0.00	1.00	0.00
91.77	68.70	2.00	0.00	1.00	0.00	91.80	68.42	2.00	0.00	1.00	0.00
91.87	68.15	2.00	0.00	1.00	0.00	91.97	67.86	2.00	0.00	1.00	0.00
92.00	67.61	2.00	0.00	1.00	0.00	92.07	67.41	2.00	0.00	1.00	0.00
92.13	67.14	2.00	0.00	1.00	0.00	92.20	66.78	2.00	0.00	1.00	0.00
92.26	66.33	2.00	0.00	1.00	0.00	92.36	65.88	2.00	0.00	1.00	0.00
92.39	65.40	2.00	0.00	1.00	0.00	92.46	64.97	2.00	0.00	1.00	0.00
92.52	64.45	2.00	0.00	1.00	0.00	92.60	63.89	2.00	0.00	1.00	0.00
92.66	63.36	2.00	0.00	1.00	0.00	92.74	62.96	2.00	0.00	1.00	0.00
92.80	62.77	2.00	0.00	1.00	0.00	92.86	62.71	2.00	0.00	1.00	0.00
92.93	62.68	2.00	0.00	1.00	0.00	93.00	62.58	2.00	0.00	1.00	0.00
93.05	62.31	2.00	0.00	1.00	0.00	93.12	61.60	2.00	0.00	1.00	0.00
93.20	60.45	2.00	0.00	1.00	0.00	93.25	58.85	2.00	0.00	1.00	0.00
93.31	56.85	2.00	0.00	1.00	0.00	93.38	54.57	2.00	0.00	1.00	0.00
93.45	52.75	2.00	0.00	1.00	0.00	93.55	52.05	2.00	0.00	1.00	0.00
93.58	52.27	2.00	0.00	1.00	0.00	93.65	53.81	2.00	0.00	1.00	0.00
93.70	57.56	2.00	0.00	1.00	0.00	93.79	62.18	2.00	0.00	1.00	0.00
93.84	66.55	2.00	0.00	1.00	0.00	93.95	68.64	2.00	0.00	1.00	0.00
93.99	70.41	2.00	0.00	1.00	0.00	94.04	70.70	2.00	0.00	1.00	0.00
94.12	70.37	2.00	0.00	1.00	0.00	94.18	70.04	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
94.24	71.75	2.00	0.00	1.00	0.00	94.34	73.92	2.00	0.00	1.00	0.00
94.39	75.77	2.00	0.00	1.00	0.00	94.42	77.07	2.00	0.00	1.00	0.00
94.51	78.36	2.00	0.00	1.00	0.00	94.57	78.70	2.00	0.00	1.00	0.00
94.63	77.44	2.00	0.00	1.00	0.00	94.72	76.07	2.00	0.00	1.00	0.00
94.78	76.10	2.00	0.00	1.00	0.00	94.83	77.47	2.00	0.00	1.00	0.00
94.93	78.29	2.00	0.00	1.00	0.00	94.97	77.83	2.00	0.00	1.00	0.00
95.03	76.87	2.00	0.00	1.00	0.00	95.11	76.25	2.00	0.00	1.00	0.00
95.17	76.59	2.00	0.00	1.00	0.00	95.22	77.22	2.00	0.00	1.00	0.00
95.31	78.63	2.00	0.00	1.00	0.00	95.36	79.62	2.00	0.00	1.00	0.00
95.41	83.34	2.00	0.00	1.00	0.00	95.51	86.99	2.00	0.00	1.00	0.00
95.56	91.28	2.00	0.00	1.00	0.00	95.61	91.31	2.00	0.00	1.00	0.00
95.71	87.33	2.00	0.00	1.00	0.00	95.75	84.63	2.00	0.00	1.00	0.00
95.81	87.25	2.00	0.00	1.00	0.00	95.91	93.15	2.00	0.00	1.00	0.00
95.95	90.12	2.00	0.00	1.00	0.00	96.00	90.00	2.00	0.00	1.00	0.00
96.09	96.07	2.00	0.00	1.00	0.00	96.14	93.21	2.00	0.00	1.00	0.00
96.20	89.36	2.00	0.00	1.00	0.00	96.27	85.02	2.00	0.00	1.00	0.00
96.35	80.61	2.00	0.00	1.00	0.00	96.40	77.09	2.00	0.00	1.00	0.00
96.50	74.40	2.00	0.00	1.00	0.00	96.55	72.65	2.00	0.00	1.00	0.00
96.59	72.26	2.00	0.00	1.00	0.00	96.69	73.08	2.00	0.00	1.00	0.00
96.73	75.06	2.00	0.00	1.00	0.00	96.79	76.77	2.00	0.00	1.00	0.00
96.89	78.22	2.00	0.00	1.00	0.00	96.95	79.34	2.00	0.00	1.00	0.00
96.99	80.14	2.00	0.00	1.00	0.00	97.08	80.42	2.00	0.00	1.00	0.00
97.14	79.11	2.00	0.00	1.00	0.00	97.19	77.47	2.00	0.00	1.00	0.00
97.28	74.77	2.00	0.00	1.00	0.00	97.32	71.83	2.00	0.00	1.00	0.00
97.39	69.21	2.00	0.00	1.00	0.00	97.49	66.61	2.00	0.00	1.00	0.00
97.53	64.55	2.00	0.00	1.00	0.00	97.59	62.99	2.00	0.00	1.00	0.00
97.66	61.47	2.00	0.00	1.00	0.00	97.72	59.82	2.00	0.00	1.00	0.00
97.79	58.43	2.00	0.00	1.00	0.00	97.85	56.63	2.00	0.00	1.00	0.00
97.93	54.92	2.00	0.00	1.00	0.00	97.98	52.91	2.00	0.00	1.00	0.00
98.08	51.52	2.00	0.00	1.00	0.00	98.13	50.28	2.00	0.00	1.00	0.00
98.17	50.16	2.00	0.00	1.00	0.00	98.24	50.16	2.00	0.00	1.00	0.00
98.33	50.33	2.00	0.00	1.00	0.00	98.38	50.09	2.00	0.00	1.00	0.00
98.43	49.99	2.00	0.00	1.00	0.00	98.52	49.66	2.00	0.00	1.00	0.00
98.57	49.82	2.00	0.00	1.00	0.00	98.63	50.50	2.00	0.00	1.00	0.00
98.70	51.89	2.00	0.00	1.00	0.00	98.76	53.37	2.00	0.00	1.00	0.00
98.83	54.58	2.00	0.00	1.00	0.00	98.89	55.78	2.00	0.00	1.00	0.00
98.97	56.84	2.00	0.00	1.00	0.00	99.03	57.73	2.00	0.00	1.00	0.00
99.09	58.31	2.00	0.00	1.00	0.00	99.17	58.62	2.00	0.00	1.00	0.00
99.22	58.89	2.00	0.00	1.00	0.00	99.32	58.95	2.00	0.00	1.00	0.00
99.35	58.56	2.00	0.00	1.00	0.00	99.42	57.40	2.00	0.00	1.00	0.00
99.50	55.84	2.00	0.00	1.00	0.00	99.56	54.39	2.00	0.00	1.00	0.00
99.62	51.63	2.00	0.00	1.00	0.00	99.72	48.73	2.00	0.00	1.00	0.00
99.74	46.78	2.00	0.00	1.00	0.00	99.82	47.61	2.00	0.00	1.00	0.00
99.87	48.93	2.00	0.00	1.00	0.00	99.96	49.68	2.00	0.00	1.00	0.00
100.00	50.22	2.00	0.00	1.00	0.00						

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)

Total estimated settlement: 4.86

Abbreviations

$Q_{tn,cs}$:	Equivalent clean sand normalized cone resistance
FS:	Factor of safety against liquefaction
e_v (%):	Post-liquefaction volumentric strain
DF:	e_v depth weighting factor
Settlement:	Calculated settlement

LANDMARK
Geo-Engineers and Geologists

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

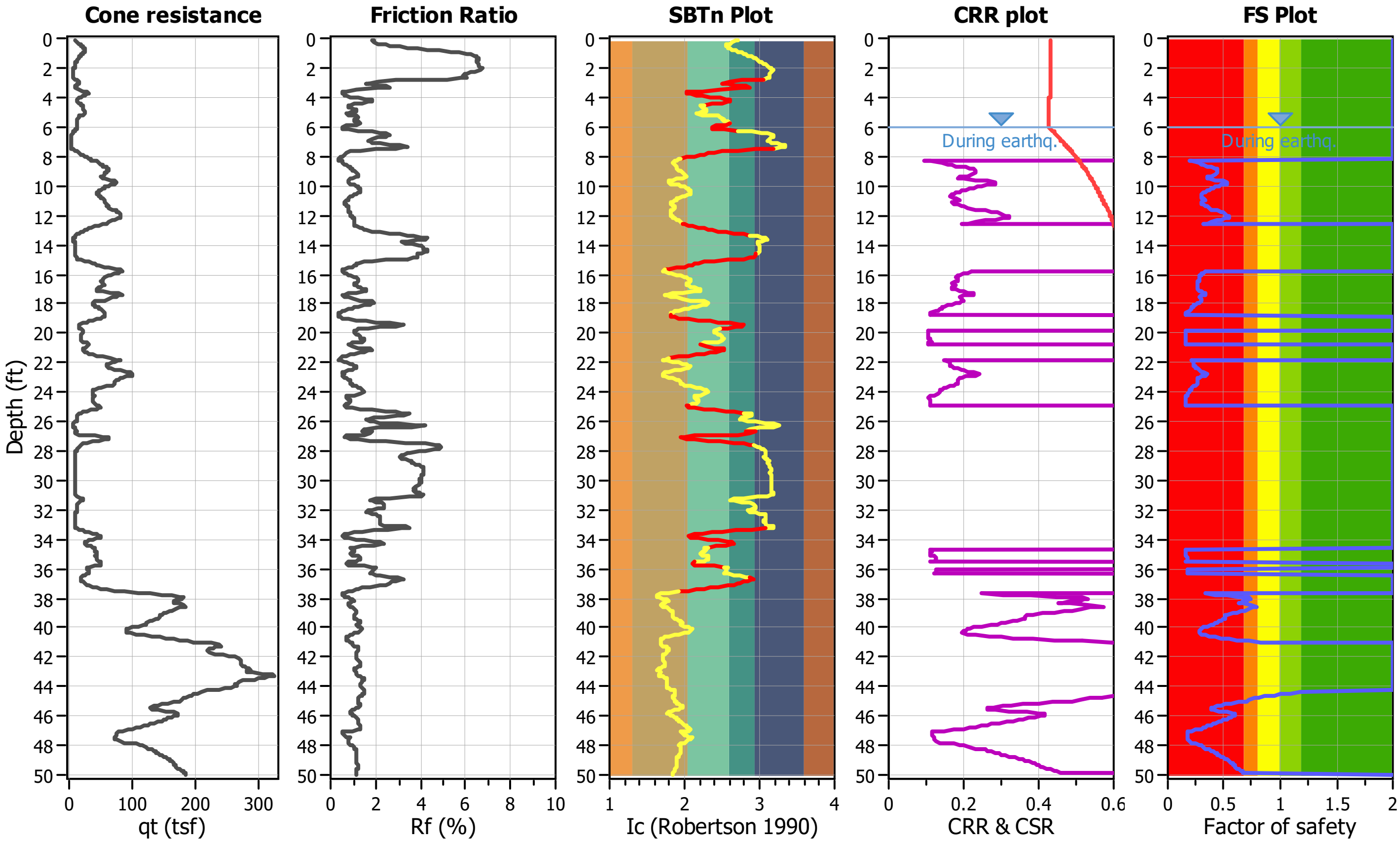
LIQUEFACTION ANALYSIS REPORT

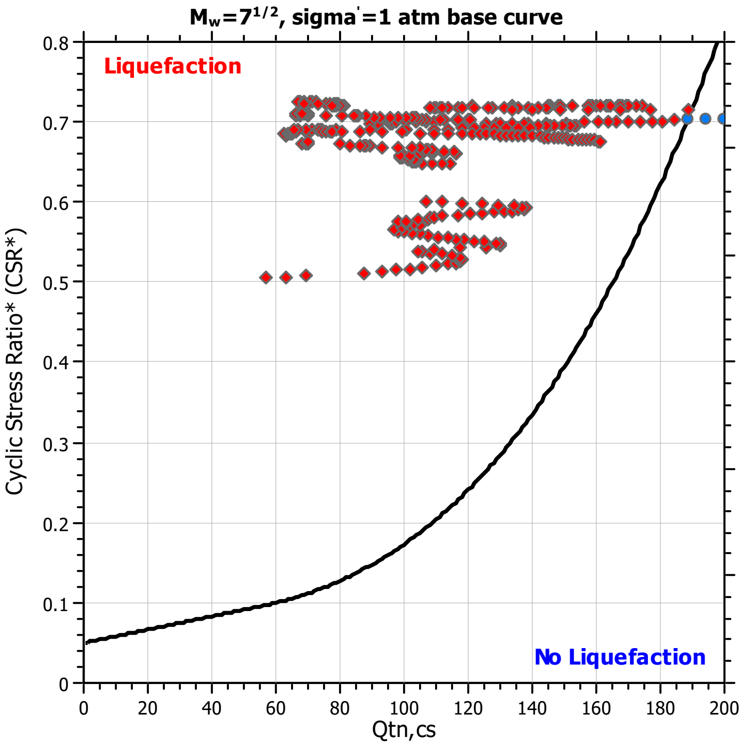
Project title : Elmore North Geothermal Plant **Location : Calipatria, CA**

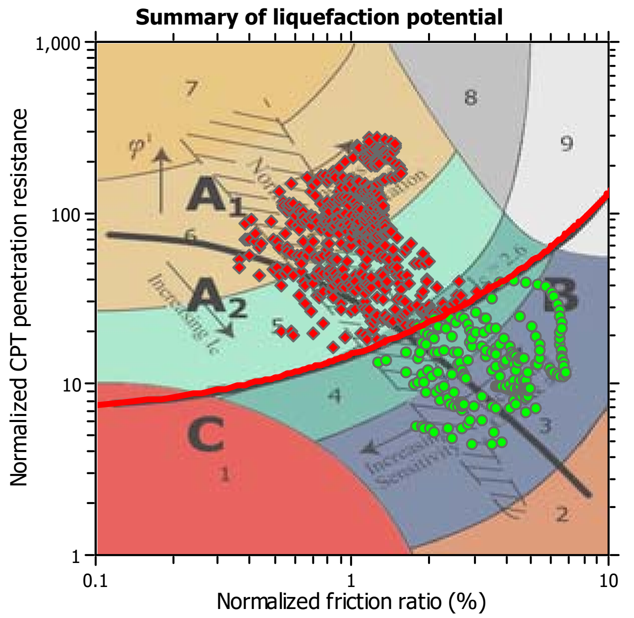
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	50.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.61	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

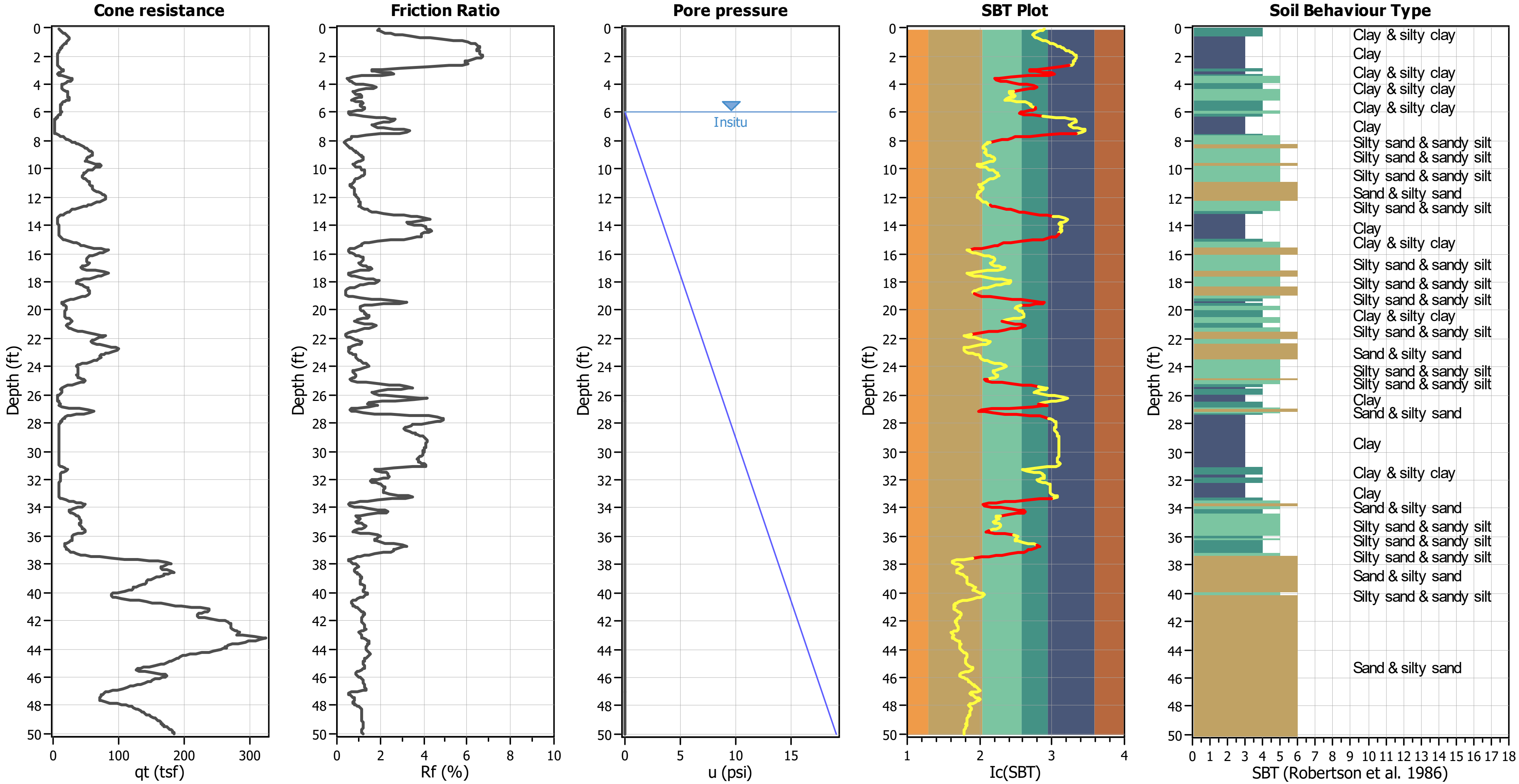






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



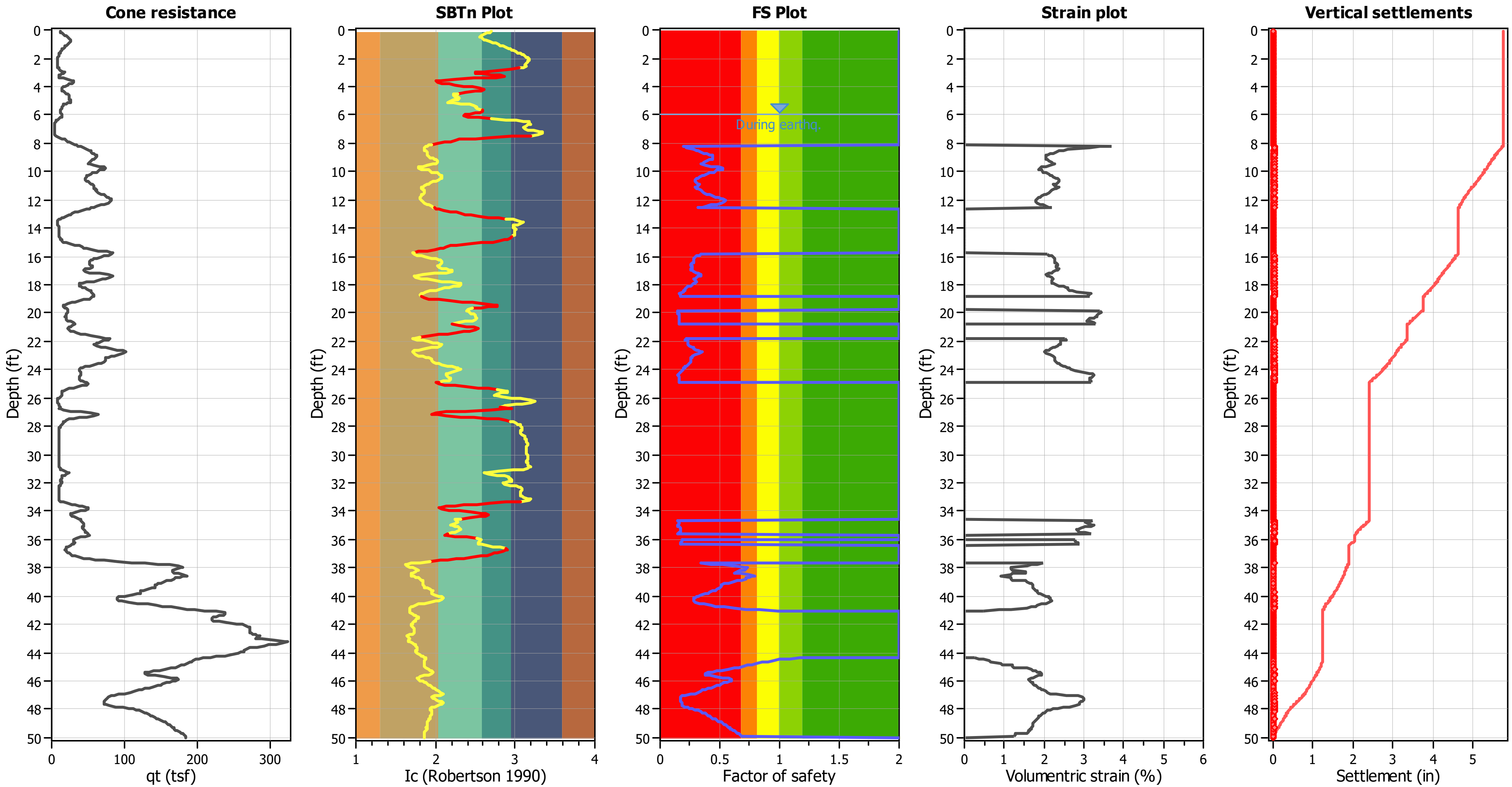
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

SBT legend

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

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

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.07	43.82	2.00	0.00	1.00	0.00	6.12	44.42	2.00	0.00	1.00	0.00
6.17	47.87	2.00	0.00	1.00	0.00	6.27	52.27	2.00	0.00	1.00	0.00
6.32	56.11	2.00	0.00	1.00	0.00	6.37	56.30	2.00	0.00	1.00	0.00
6.46	55.37	2.00	0.00	1.00	0.00	6.52	53.63	2.00	0.00	1.00	0.00
6.57	51.98	2.00	0.00	1.00	0.00	6.66	49.83	2.00	0.00	1.00	0.00
6.72	47.72	2.00	0.00	1.00	0.00	6.77	45.59	2.00	0.00	1.00	0.00
6.87	44.47	2.00	0.00	1.00	0.00	6.92	44.13	2.00	0.00	1.00	0.00
6.96	44.57	2.00	0.00	1.00	0.00	7.06	44.72	2.00	0.00	1.00	0.00
7.10	45.36	2.00	0.00	1.00	0.00	7.17	46.78	2.00	0.00	1.00	0.00
7.23	49.04	2.00	0.00	1.00	0.00	7.30	51.35	2.00	0.00	1.00	0.00
7.35	53.97	2.00	0.00	1.00	0.00	7.46	55.61	2.00	0.00	1.00	0.00
7.49	56.32	2.00	0.00	1.00	0.00	7.57	54.47	2.00	0.00	1.00	0.00
7.66	52.15	2.00	0.00	1.00	0.00	7.71	51.22	2.00	0.00	1.00	0.00
7.75	52.03	2.00	0.00	1.00	0.00	7.85	53.34	2.00	0.00	1.00	0.00
7.90	55.18	2.00	0.00	1.00	0.00	7.96	55.88	2.00	0.00	1.00	0.00
8.05	42.95	2.00	0.00	1.00	0.00	8.11	48.15	2.00	0.00	1.00	0.00
8.16	52.91	2.00	0.00	1.00	0.00	8.21	56.91	0.19	3.71	1.00	0.02
8.27	62.96	0.20	3.41	1.00	0.02	8.34	69.56	0.22	3.15	1.00	0.03
8.41	87.66	0.28	2.60	1.00	0.02	8.48	93.32	0.30	2.47	1.00	0.02
8.54	97.52	0.32	2.39	1.00	0.02	8.61	101.61	0.34	2.31	1.00	0.02
8.68	105.63	0.37	2.23	1.00	0.02	8.74	110.26	0.39	2.16	1.00	0.01
8.83	113.93	0.42	2.10	1.00	0.02	8.87	116.46	0.43	2.06	1.00	0.01
8.93	117.23	0.44	2.05	1.00	0.02	9.00	117.71	0.44	2.04	1.00	0.02
9.08	117.95	0.44	2.04	1.00	0.02	9.13	117.22	0.43	2.05	1.00	0.01
9.20	115.12	0.42	2.08	1.00	0.02	9.29	112.08	0.39	2.13	1.00	0.02
9.32	108.38	0.37	2.19	1.00	0.01	9.41	105.41	0.35	2.24	1.00	0.02
9.47	104.37	0.34	2.26	1.00	0.02	9.52	109.29	0.37	2.17	1.00	0.01
9.62	117.33	0.42	2.05	1.00	0.02	9.65	125.92	0.49	1.93	1.00	0.01
9.72	129.86	0.52	1.89	1.00	0.02	9.83	130.25	0.52	1.88	1.00	0.02
9.88	128.65	0.51	1.90	1.00	0.01	9.92	124.91	0.48	1.95	1.00	0.01
10.02	121.80	0.45	1.99	1.00	0.03	10.05	118.55	0.43	2.03	1.00	0.01
10.12	116.35	0.41	2.06	1.00	0.02	10.17	113.53	0.39	2.11	1.00	0.01
10.24	110.71	0.37	2.15	1.00	0.02	10.31	107.78	0.35	2.20	1.00	0.02
10.38	104.98	0.34	2.25	1.00	0.02	10.46	102.19	0.32	2.30	1.00	0.02
10.52	99.81	0.31	2.34	1.00	0.02	10.57	98.01	0.30	2.38	1.00	0.01
10.64	97.08	0.29	2.39	1.00	0.02	10.70	97.16	0.29	2.39	1.00	0.02
10.76	99.31	0.30	2.35	1.00	0.02	10.85	102.04	0.31	2.30	1.00	0.02
10.90	105.20	0.33	2.24	1.00	0.01	10.97	102.83	0.32	2.28	1.00	0.02
11.06	100.48	0.30	2.33	1.00	0.03	11.12	98.07	0.29	2.37	1.00	0.02
11.17	100.87	0.30	2.32	1.00	0.01	11.24	104.42	0.32	2.26	1.00	0.02
11.31	107.39	0.34	2.20	1.00	0.02	11.35	107.94	0.34	2.19	1.00	0.01
11.42	109.59	0.35	2.17	1.00	0.02	11.51	112.08	0.36	2.13	1.00	0.02
11.57	117.16	0.39	2.05	1.00	0.02	11.62	120.58	0.42	2.00	1.00	0.01
11.68	124.52	0.44	1.95	1.00	0.01	11.77	127.88	0.47	1.91	1.00	0.02
11.83	131.14	0.49	1.87	1.00	0.01	11.88	133.70	0.51	1.84	1.00	0.01
11.97	135.73	0.53	1.82	1.00	0.02	12.02	137.38	0.54	1.80	1.00	0.01
12.07	137.83	0.55	1.80	1.00	0.01	12.16	137.05	0.54	1.80	1.00	0.02
12.22	134.25	0.51	1.84	1.00	0.01	12.32	129.60	0.47	1.89	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
12.37	124.07	0.43	1.96	1.00	0.01	12.41	117.84	0.39	2.04	1.00	0.01
12.51	111.98	0.35	2.13	1.00	0.02	12.56	106.86	0.32	2.21	1.00	0.01
12.61	103.59	2.00	0.00	1.00	0.00	12.66	99.07	2.00	0.00	1.00	0.00
12.76	94.91	2.00	0.00	1.00	0.00	12.81	90.34	2.00	0.00	1.00	0.00
12.87	87.61	2.00	0.00	1.00	0.00	12.96	85.80	2.00	0.00	1.00	0.00
13.01	85.06	2.00	0.00	1.00	0.00	13.06	86.10	2.00	0.00	1.00	0.00
13.15	88.48	2.00	0.00	1.00	0.00	13.21	91.15	2.00	0.00	1.00	0.00
13.26	91.15	2.00	0.00	1.00	0.00	13.35	88.61	2.00	0.00	1.00	0.00
13.41	85.88	2.00	0.00	1.00	0.00	13.46	84.68	2.00	0.00	1.00	0.00
13.55	83.87	2.00	0.00	1.00	0.00	13.61	82.07	2.00	0.00	1.00	0.00
13.65	79.16	2.00	0.00	1.00	0.00	13.74	77.01	2.00	0.00	1.00	0.00
13.80	76.68	2.00	0.00	1.00	0.00	13.85	79.38	2.00	0.00	1.00	0.00
13.94	83.18	2.00	0.00	1.00	0.00	14.00	87.09	2.00	0.00	1.00	0.00
14.05	89.04	2.00	0.00	1.00	0.00	14.13	89.94	2.00	0.00	1.00	0.00
14.20	90.47	2.00	0.00	1.00	0.00	14.24	91.70	2.00	0.00	1.00	0.00
14.34	92.95	2.00	0.00	1.00	0.00	14.40	93.75	2.00	0.00	1.00	0.00
14.45	93.07	2.00	0.00	1.00	0.00	14.54	91.83	2.00	0.00	1.00	0.00
14.59	90.60	2.00	0.00	1.00	0.00	14.64	90.95	2.00	0.00	1.00	0.00
14.70	92.96	2.00	0.00	1.00	0.00	14.79	95.42	2.00	0.00	1.00	0.00
14.84	97.41	2.00	0.00	1.00	0.00	14.93	98.43	2.00	0.00	1.00	0.00
14.99	98.63	2.00	0.00	1.00	0.00	15.04	95.92	2.00	0.00	1.00	0.00
15.12	92.52	2.00	0.00	1.00	0.00	15.18	89.52	2.00	0.00	1.00	0.00
15.24	89.34	2.00	0.00	1.00	0.00	15.31	90.12	2.00	0.00	1.00	0.00
15.37	92.18	2.00	0.00	1.00	0.00	15.44	94.85	2.00	0.00	1.00	0.00
15.49	98.90	2.00	0.00	1.00	0.00	15.58	103.73	2.00	0.00	1.00	0.00
15.63	110.38	2.00	0.00	1.00	0.00	15.72	114.48	2.00	0.00	1.00	0.00
15.78	116.28	2.00	0.00	1.00	0.00	15.83	114.56	0.34	2.09	1.00	0.01
15.93	111.73	0.32	2.13	1.00	0.02	15.97	108.58	0.31	2.18	1.00	0.01
16.01	105.88	0.29	2.23	1.00	0.01	16.11	103.63	0.28	2.27	1.00	0.03
16.15	102.76	0.28	2.29	1.00	0.01	16.22	103.11	0.28	2.28	1.00	0.02
16.27	103.68	0.28	2.27	1.00	0.01	16.37	103.72	0.28	2.27	1.00	0.03
16.42	103.29	0.28	2.28	1.00	0.01	16.48	101.22	0.27	2.31	1.00	0.02
16.57	99.17	0.26	2.35	1.00	0.03	16.61	98.83	0.26	2.36	1.00	0.01
16.68	100.83	0.27	2.32	1.00	0.02	16.76	101.44	0.27	2.31	1.00	0.02
16.82	99.92	0.26	2.34	1.00	0.02	16.87	98.74	0.26	2.36	1.00	0.01
16.95	98.88	0.26	2.36	1.00	0.02	17.00	101.72	0.27	2.30	1.00	0.01
17.07	105.29	0.29	2.24	1.00	0.02	17.17	108.81	0.30	2.18	1.00	0.03
17.21	112.66	0.32	2.12	1.00	0.01	17.27	116.26	0.34	2.07	1.00	0.01
17.36	115.90	0.34	2.07	1.00	0.02	17.41	112.38	0.32	2.12	1.00	0.01
17.46	108.56	0.30	2.18	1.00	0.01	17.56	106.11	0.29	2.23	1.00	0.03
17.60	105.74	0.29	2.23	1.00	0.01	17.66	107.25	0.29	2.21	1.00	0.02
17.75	108.66	0.30	2.18	1.00	0.02	17.79	108.85	0.30	2.18	1.00	0.01
17.87	107.14	0.29	2.21	1.00	0.02	17.91	105.13	0.28	2.24	1.00	0.01
17.99	102.35	0.27	2.29	1.00	0.02	18.05	98.26	0.25	2.37	1.00	0.02
18.11	93.42	0.23	2.47	1.00	0.02	18.19	89.64	0.22	2.56	1.00	0.02
18.25	88.24	0.21	2.59	1.00	0.02	18.31	87.32	0.21	2.61	1.00	0.02
18.39	85.99	0.21	2.64	1.00	0.03	18.45	83.13	0.20	2.72	1.00	0.02
18.51	79.98	0.19	2.81	1.00	0.02	18.59	68.37	0.16	3.19	1.00	0.03

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
18.65	69.11	0.16	3.16	1.00	0.02	18.70	70.15	0.17	3.13	1.00	0.02
18.80	69.84	0.17	3.14	1.00	0.04	18.84	69.33	2.00	0.00	1.00	0.00
18.93	66.79	2.00	0.00	1.00	0.00	18.99	76.12	2.00	0.00	1.00	0.00
19.04	77.01	2.00	0.00	1.00	0.00	19.13	80.98	2.00	0.00	1.00	0.00
19.19	88.19	2.00	0.00	1.00	0.00	19.24	93.53	2.00	0.00	1.00	0.00
19.30	98.05	2.00	0.00	1.00	0.00	19.39	99.62	2.00	0.00	1.00	0.00
19.44	96.63	2.00	0.00	1.00	0.00	19.49	88.98	2.00	0.00	1.00	0.00
19.58	79.34	2.00	0.00	1.00	0.00	19.64	70.91	2.00	0.00	1.00	0.00
19.69	66.05	2.00	0.00	1.00	0.00	19.77	63.94	2.00	0.00	1.00	0.00
19.84	62.90	0.15	3.42	1.00	0.03	19.89	62.85	0.15	3.42	1.00	0.02
19.98	62.79	0.15	3.42	1.00	0.04	20.03	63.79	0.15	3.38	1.00	0.02
20.09	64.44	0.15	3.35	1.00	0.02	20.19	64.95	0.15	3.33	1.00	0.04
20.23	64.91	0.15	3.33	1.00	0.01	20.28	65.47	0.15	3.31	1.00	0.02
20.38	66.52	0.16	3.26	1.00	0.04	20.41	69.12	0.16	3.16	1.00	0.01
20.48	70.74	0.16	3.10	1.00	0.02	20.58	71.10	0.16	3.09	1.00	0.04
20.62	69.37	0.16	3.15	1.00	0.02	20.67	66.93	0.16	3.25	1.00	0.02
20.78	65.39	0.15	3.31	1.00	0.04	20.82	64.44	2.00	0.00	1.00	0.00
20.88	66.73	2.00	0.00	1.00	0.00	20.97	70.77	2.00	0.00	1.00	0.00
21.03	76.01	2.00	0.00	1.00	0.00	21.07	78.82	2.00	0.00	1.00	0.00
21.13	79.22	2.00	0.00	1.00	0.00	21.22	78.11	2.00	0.00	1.00	0.00
21.27	76.04	2.00	0.00	1.00	0.00	21.33	74.46	2.00	0.00	1.00	0.00
21.40	73.17	2.00	0.00	1.00	0.00	21.47	73.11	2.00	0.00	1.00	0.00
21.53	74.14	2.00	0.00	1.00	0.00	21.61	77.07	2.00	0.00	1.00	0.00
21.66	75.87	2.00	0.00	1.00	0.00	21.77	85.86	2.00	0.00	1.00	0.00
21.82	91.80	0.22	2.51	1.00	0.01	21.86	89.52	0.21	2.56	1.00	0.01
21.92	96.42	0.23	2.41	1.00	0.02	22.02	95.72	0.23	2.42	1.00	0.03
22.07	95.74	0.23	2.42	1.00	0.01	22.12	95.78	0.23	2.42	1.00	0.01
22.22	96.01	0.23	2.42	1.00	0.03	22.25	97.47	0.24	2.39	1.00	0.01
22.32	100.69	0.25	2.32	1.00	0.02	22.41	104.05	0.26	2.26	1.00	0.03
22.46	106.59	0.27	2.22	1.00	0.01	22.52	109.14	0.29	2.17	1.00	0.01
22.61	112.45	0.30	2.12	1.00	0.02	22.66	116.27	0.32	2.06	1.00	0.01
22.71	120.23	0.34	2.01	1.00	0.01	22.77	120.85	0.35	2.00	1.00	0.01
22.86	117.16	0.33	2.05	1.00	0.02	22.91	111.18	0.30	2.14	1.00	0.01
23.01	106.64	0.27	2.22	1.00	0.03	23.06	105.76	0.27	2.23	1.00	0.01
23.11	104.32	0.26	2.26	1.00	0.01	23.20	103.14	0.26	2.28	1.00	0.02
23.24	103.09	0.26	2.28	1.00	0.01	23.32	103.52	0.26	2.27	1.00	0.02
23.38	103.92	0.26	2.26	1.00	0.01	23.44	102.33	0.25	2.29	1.00	0.02
23.54	100.58	0.25	2.33	1.00	0.03	23.57	98.22	0.24	2.37	1.00	0.01
23.64	95.48	0.23	2.43	1.00	0.02	23.73	92.76	0.22	2.49	1.00	0.03
23.76	90.40	0.21	2.54	1.00	0.01	23.83	88.02	0.20	2.59	1.00	0.02
23.89	85.93	0.20	2.65	1.00	0.02	23.97	84.87	0.19	2.67	1.00	0.03
24.02	84.67	0.19	2.68	1.00	0.01	24.08	80.78	0.18	2.78	1.00	0.02
24.18	75.40	0.17	2.95	1.00	0.03	24.23	69.76	0.16	3.14	1.00	0.02
24.30	67.37	0.15	3.23	1.00	0.03	24.38	66.32	0.15	3.27	1.00	0.03
24.43	66.27	0.15	3.27	1.00	0.02	24.48	67.29	0.15	3.23	1.00	0.02
24.58	68.50	0.15	3.19	1.00	0.04	24.63	69.77	0.16	3.14	1.00	0.02
24.68	69.98	0.16	3.13	1.00	0.02	24.78	69.35	0.16	3.15	1.00	0.04
24.82	68.44	0.15	3.19	1.00	0.02	24.87	68.42	0.15	3.19	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.93	70.42	2.00	0.00	1.00	0.00	25.02	73.59	2.00	0.00	1.00	0.00
25.07	78.84	2.00	0.00	1.00	0.00	25.14	85.68	2.00	0.00	1.00	0.00
25.22	93.17	2.00	0.00	1.00	0.00	25.27	98.17	2.00	0.00	1.00	0.00
25.34	98.35	2.00	0.00	1.00	0.00	25.42	95.76	2.00	0.00	1.00	0.00
25.47	91.92	2.00	0.00	1.00	0.00	25.54	86.76	2.00	0.00	1.00	0.00
25.60	81.08	2.00	0.00	1.00	0.00	25.66	74.14	2.00	0.00	1.00	0.00
25.73	68.31	2.00	0.00	1.00	0.00	25.82	63.84	2.00	0.00	1.00	0.00
25.87	61.96	2.00	0.00	1.00	0.00	25.93	60.66	2.00	0.00	1.00	0.00
26.02	59.45	2.00	0.00	1.00	0.00	26.07	57.67	2.00	0.00	1.00	0.00
26.16	62.77	2.00	0.00	1.00	0.00	26.21	67.65	2.00	0.00	1.00	0.00
26.26	71.51	2.00	0.00	1.00	0.00	26.35	68.91	2.00	0.00	1.00	0.00
26.41	64.27	2.00	0.00	1.00	0.00	26.46	59.09	2.00	0.00	1.00	0.00
26.51	55.14	2.00	0.00	1.00	0.00	26.58	54.27	2.00	0.00	1.00	0.00
26.66	55.29	2.00	0.00	1.00	0.00	26.72	57.89	2.00	0.00	1.00	0.00
26.78	59.64	2.00	0.00	1.00	0.00	26.86	60.58	2.00	0.00	1.00	0.00
26.92	59.27	2.00	0.00	1.00	0.00	26.98	64.54	2.00	0.00	1.00	0.00
27.06	73.95	2.00	0.00	1.00	0.00	27.11	83.93	2.00	0.00	1.00	0.00
27.17	89.17	2.00	0.00	1.00	0.00	27.26	93.59	2.00	0.00	1.00	0.00
27.32	99.42	2.00	0.00	1.00	0.00	27.37	107.21	2.00	0.00	1.00	0.00
27.47	114.19	2.00	0.00	1.00	0.00	27.51	117.84	2.00	0.00	1.00	0.00
27.57	116.50	2.00	0.00	1.00	0.00	27.66	113.35	2.00	0.00	1.00	0.00
27.71	109.39	2.00	0.00	1.00	0.00	27.77	105.04	2.00	0.00	1.00	0.00
27.86	99.98	2.00	0.00	1.00	0.00	27.91	94.88	2.00	0.00	1.00	0.00
27.96	87.76	2.00	0.00	1.00	0.00	28.07	81.42	2.00	0.00	1.00	0.00
28.09	75.75	2.00	0.00	1.00	0.00	28.16	74.14	2.00	0.00	1.00	0.00
28.26	72.73	2.00	0.00	1.00	0.00	28.31	71.95	2.00	0.00	1.00	0.00
28.36	71.47	2.00	0.00	1.00	0.00	28.42	71.55	2.00	0.00	1.00	0.00
28.51	72.05	2.00	0.00	1.00	0.00	28.55	73.15	2.00	0.00	1.00	0.00
28.66	73.88	2.00	0.00	1.00	0.00	28.69	74.72	2.00	0.00	1.00	0.00
28.76	75.46	2.00	0.00	1.00	0.00	28.82	76.54	2.00	0.00	1.00	0.00
28.90	77.55	2.00	0.00	1.00	0.00	28.95	78.47	2.00	0.00	1.00	0.00
29.01	79.05	2.00	0.00	1.00	0.00	29.09	79.49	2.00	0.00	1.00	0.00
29.16	79.73	2.00	0.00	1.00	0.00	29.21	79.78	2.00	0.00	1.00	0.00
29.29	79.74	2.00	0.00	1.00	0.00	29.35	79.65	2.00	0.00	1.00	0.00
29.41	79.58	2.00	0.00	1.00	0.00	29.50	79.46	2.00	0.00	1.00	0.00
29.55	79.36	2.00	0.00	1.00	0.00	29.60	79.22	2.00	0.00	1.00	0.00
29.70	79.01	2.00	0.00	1.00	0.00	29.73	78.82	2.00	0.00	1.00	0.00
29.80	78.57	2.00	0.00	1.00	0.00	29.89	78.29	2.00	0.00	1.00	0.00
29.94	78.02	2.00	0.00	1.00	0.00	30.00	77.73	2.00	0.00	1.00	0.00
30.08	77.38	2.00	0.00	1.00	0.00	30.14	77.03	2.00	0.00	1.00	0.00
30.20	76.73	2.00	0.00	1.00	0.00	30.27	76.44	2.00	0.00	1.00	0.00
30.34	76.19	2.00	0.00	1.00	0.00	30.40	75.26	2.00	0.00	1.00	0.00
30.48	74.64	2.00	0.00	1.00	0.00	30.54	74.23	2.00	0.00	1.00	0.00
30.59	74.49	2.00	0.00	1.00	0.00	30.67	74.49	2.00	0.00	1.00	0.00
30.74	74.38	2.00	0.00	1.00	0.00	30.78	74.26	2.00	0.00	1.00	0.00
30.86	73.95	2.00	0.00	1.00	0.00	30.91	75.72	2.00	0.00	1.00	0.00
31.02	78.84	2.00	0.00	1.00	0.00	31.07	82.80	2.00	0.00	1.00	0.00
31.11	84.68	2.00	0.00	1.00	0.00	31.17	82.03	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
31.26	77.31	2.00	0.00	1.00	0.00	31.31	73.65	2.00	0.00	1.00	0.00
31.37	71.77	2.00	0.00	1.00	0.00	31.46	70.84	2.00	0.00	1.00	0.00
31.52	69.89	2.00	0.00	1.00	0.00	31.57	68.93	2.00	0.00	1.00	0.00
31.66	68.06	2.00	0.00	1.00	0.00	31.71	67.41	2.00	0.00	1.00	0.00
31.77	67.21	2.00	0.00	1.00	0.00	31.86	66.65	2.00	0.00	1.00	0.00
31.90	64.75	2.00	0.00	1.00	0.00	31.96	62.04	2.00	0.00	1.00	0.00
32.02	58.18	2.00	0.00	1.00	0.00	32.11	55.49	2.00	0.00	1.00	0.00
32.16	54.36	2.00	0.00	1.00	0.00	32.25	54.62	2.00	0.00	1.00	0.00
32.30	54.95	2.00	0.00	1.00	0.00	32.36	55.29	2.00	0.00	1.00	0.00
32.43	55.85	2.00	0.00	1.00	0.00	32.49	56.68	2.00	0.00	1.00	0.00
32.55	57.42	2.00	0.00	1.00	0.00	32.64	57.83	2.00	0.00	1.00	0.00
32.69	57.98	2.00	0.00	1.00	0.00	32.75	57.87	2.00	0.00	1.00	0.00
32.83	57.74	2.00	0.00	1.00	0.00	32.88	57.56	2.00	0.00	1.00	0.00
32.95	57.69	2.00	0.00	1.00	0.00	33.04	59.06	2.00	0.00	1.00	0.00
33.09	62.16	2.00	0.00	1.00	0.00	33.15	65.98	2.00	0.00	1.00	0.00
33.22	69.81	2.00	0.00	1.00	0.00	33.29	72.68	2.00	0.00	1.00	0.00
33.34	73.97	2.00	0.00	1.00	0.00	33.41	72.35	2.00	0.00	1.00	0.00
33.50	69.28	2.00	0.00	1.00	0.00	33.55	65.24	2.00	0.00	1.00	0.00
33.60	61.95	2.00	0.00	1.00	0.00	33.66	60.61	2.00	0.00	1.00	0.00
33.74	61.24	2.00	0.00	1.00	0.00	33.80	63.16	2.00	0.00	1.00	0.00
33.89	64.80	2.00	0.00	1.00	0.00	33.94	67.63	2.00	0.00	1.00	0.00
34.00	71.02	2.00	0.00	1.00	0.00	34.09	75.89	2.00	0.00	1.00	0.00
34.14	80.06	2.00	0.00	1.00	0.00	34.20	83.80	2.00	0.00	1.00	0.00
34.29	85.84	2.00	0.00	1.00	0.00	34.34	85.28	2.00	0.00	1.00	0.00
34.39	81.31	2.00	0.00	1.00	0.00	34.45	74.41	2.00	0.00	1.00	0.00
34.53	68.44	2.00	0.00	1.00	0.00	34.59	65.27	2.00	0.00	1.00	0.00
34.65	67.56	0.15	3.22	1.00	0.02	34.74	70.99	0.16	3.09	1.00	0.03
34.78	72.25	0.16	3.05	1.00	0.02	34.88	70.39	0.16	3.12	1.00	0.04
34.94	67.33	0.15	3.23	1.00	0.02	34.99	67.10	0.15	3.24	1.00	0.02
35.08	68.58	0.15	3.18	1.00	0.04	35.11	72.51	0.16	3.04	1.00	0.01
35.17	75.58	0.17	2.94	1.00	0.02	35.24	78.32	0.17	2.86	1.00	0.02
35.33	79.39	0.17	2.82	1.00	0.03	35.37	78.91	0.17	2.84	1.00	0.01
35.47	76.60	0.17	2.91	1.00	0.04	35.52	72.90	0.16	3.03	1.00	0.02
35.57	68.67	0.15	3.18	1.00	0.02	35.67	67.81	2.00	0.00	1.00	0.00
35.72	69.91	2.00	0.00	1.00	0.00	35.77	74.55	2.00	0.00	1.00	0.00
35.83	79.11	2.00	0.00	1.00	0.00	35.92	82.62	2.00	0.00	1.00	0.00
35.97	82.88	2.00	0.00	1.00	0.00	36.02	81.46	0.18	2.76	1.00	0.02
36.12	80.68	0.18	2.79	1.00	0.03	36.17	79.84	0.18	2.81	1.00	0.02
36.26	78.84	0.17	2.84	1.00	0.03	36.29	78.07	0.17	2.86	1.00	0.01
36.37	77.73	0.17	2.87	1.00	0.03	36.42	77.77	2.00	0.00	1.00	0.00
36.51	78.26	2.00	0.00	1.00	0.00	36.56	80.93	2.00	0.00	1.00	0.00
36.65	83.66	2.00	0.00	1.00	0.00	36.71	85.65	2.00	0.00	1.00	0.00
36.77	85.07	2.00	0.00	1.00	0.00	36.81	84.72	2.00	0.00	1.00	0.00
36.91	84.99	2.00	0.00	1.00	0.00	36.96	86.99	2.00	0.00	1.00	0.00
37.01	89.10	2.00	0.00	1.00	0.00	37.11	89.40	2.00	0.00	1.00	0.00
37.16	87.12	2.00	0.00	1.00	0.00	37.21	83.51	2.00	0.00	1.00	0.00
37.30	81.36	2.00	0.00	1.00	0.00	37.36	81.36	2.00	0.00	1.00	0.00
37.41	83.76	2.00	0.00	1.00	0.00	37.49	88.94	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
37.55	97.74	2.00	0.00	1.00	0.00	37.61	109.41	2.00	0.00	1.00	0.00
37.70	121.43	0.34	1.99	1.00	0.02	37.75	133.99	0.42	1.84	1.00	0.01
37.80	148.01	0.53	1.69	1.00	0.01	37.90	158.42	0.62	1.56	1.00	0.02
37.95	167.10	0.71	1.19	1.00	0.01	38.01	169.16	0.74	1.17	1.00	0.01
38.09	168.07	0.72	1.18	1.00	0.01	38.15	166.56	0.71	1.19	1.00	0.01
38.20	163.17	0.67	1.23	1.00	0.01	38.30	160.28	0.64	1.53	1.00	0.02
38.35	158.66	0.63	1.55	1.00	0.01	38.40	163.49	0.68	1.22	1.00	0.01
38.50	169.54	0.74	1.16	1.00	0.01	38.55	174.46	0.80	0.90	1.00	0.01
38.60	172.23	0.77	0.92	1.00	0.01	38.65	170.28	0.75	1.15	1.00	0.01
38.73	167.34	0.72	1.18	1.00	0.01	38.78	167.26	0.72	1.18	1.00	0.01
38.85	164.23	0.68	1.22	1.00	0.01	38.94	160.94	0.65	1.52	1.00	0.02
38.99	157.20	0.61	1.58	1.00	0.01	39.05	152.66	0.57	1.64	1.00	0.01
39.14	148.46	0.53	1.69	1.00	0.02	39.19	145.73	0.51	1.72	1.00	0.01
39.24	145.22	0.51	1.72	1.00	0.01	39.32	145.15	0.51	1.72	1.00	0.02
39.38	145.04	0.51	1.72	1.00	0.01	39.44	144.12	0.50	1.73	1.00	0.01
39.51	141.57	0.48	1.76	1.00	0.01	39.58	138.94	0.46	1.78	1.00	0.01
39.64	135.71	0.43	1.82	1.00	0.01	39.73	133.56	0.42	1.84	1.00	0.02
39.79	131.01	0.40	1.87	1.00	0.01	39.83	127.49	0.38	1.91	1.00	0.01
39.91	122.14	0.35	1.98	1.00	0.02	39.98	116.89	0.32	2.06	1.00	0.02
40.03	113.44	0.30	2.11	1.00	0.01	40.13	111.55	0.29	2.14	1.00	0.02
40.17	110.29	0.29	2.16	1.00	0.01	40.23	109.17	0.28	2.17	1.00	0.02
40.29	107.90	0.27	2.20	1.00	0.02	40.37	107.94	0.27	2.19	1.00	0.02
40.42	111.57	0.29	2.14	1.00	0.01	40.53	118.11	0.33	2.04	1.00	0.03
40.57	125.95	0.37	1.93	1.00	0.01	40.63	133.73	0.42	1.84	1.00	0.01
40.72	139.82	0.47	1.78	1.00	0.02	40.75	148.48	0.54	1.69	1.00	0.01
40.87	157.29	0.62	1.57	1.00	0.02	40.92	167.41	0.72	1.18	1.00	0.01
40.96	177.08	0.83	0.88	1.00	0.00	41.02	188.87	0.99	0.49	1.00	0.00
41.08	202.19	2.00	0.00	1.00	0.00	41.15	213.31	2.00	0.00	1.00	0.00
41.22	217.77	2.00	0.00	1.00	0.00	41.32	217.95	2.00	0.00	1.00	0.00
41.34	215.82	2.00	0.00	1.00	0.00	41.42	213.26	2.00	0.00	1.00	0.00
41.47	209.83	2.00	0.00	1.00	0.00	41.56	207.70	2.00	0.00	1.00	0.00
41.62	206.03	2.00	0.00	1.00	0.00	41.71	205.94	2.00	0.00	1.00	0.00
41.73	206.74	2.00	0.00	1.00	0.00	41.80	211.91	2.00	0.00	1.00	0.00
41.87	220.68	2.00	0.00	1.00	0.00	41.96	229.09	2.00	0.00	1.00	0.00
42.00	235.82	2.00	0.00	1.00	0.00	42.08	239.84	2.00	0.00	1.00	0.00
42.16	243.32	2.00	0.00	1.00	0.00	42.21	245.41	2.00	0.00	1.00	0.00
42.26	246.52	2.00	0.00	1.00	0.00	42.35	246.97	2.00	0.00	1.00	0.00
42.40	247.38	2.00	0.00	1.00	0.00	42.45	247.59	2.00	0.00	1.00	0.00
42.55	247.85	2.00	0.00	1.00	0.00	42.59	249.18	2.00	0.00	1.00	0.00
42.66	247.87	2.00	0.00	1.00	0.00	42.75	246.11	2.00	0.00	1.00	0.00
42.80	243.46	2.00	0.00	1.00	0.00	42.86	244.80	2.00	0.00	1.00	0.00
42.94	243.40	2.00	0.00	1.00	0.00	43.00	245.64	2.00	0.00	1.00	0.00
43.06	252.37	2.00	0.00	1.00	0.00	43.14	264.82	2.00	0.00	1.00	0.00
43.19	275.25	2.00	0.00	1.00	0.00	43.26	281.43	2.00	0.00	1.00	0.00
43.36	279.45	2.00	0.00	1.00	0.00	43.39	276.81	2.00	0.00	1.00	0.00
43.46	270.88	2.00	0.00	1.00	0.00	43.51	265.83	2.00	0.00	1.00	0.00
43.60	257.78	2.00	0.00	1.00	0.00	43.64	249.29	2.00	0.00	1.00	0.00
43.71	243.49	2.00	0.00	1.00	0.00	43.80	238.91	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
43.85	237.57	2.00	0.00	1.00	0.00	43.91	237.24	2.00	0.00	1.00	0.00
43.97	235.45	2.00	0.00	1.00	0.00	44.05	231.87	2.00	0.00	1.00	0.00
44.10	226.04	2.00	0.00	1.00	0.00	44.20	220.40	2.00	0.00	1.00	0.00
44.25	213.53	2.00	0.00	1.00	0.00	44.30	207.43	2.00	0.00	1.00	0.00
44.36	199.83	1.17	0.25	1.00	0.00	44.45	194.11	1.08	0.36	1.00	0.00
44.49	188.56	1.00	0.49	1.00	0.00	44.59	184.61	0.95	0.63	1.00	0.01
44.65	180.91	0.90	0.65	1.00	0.00	44.69	177.53	0.86	0.67	1.00	0.00
44.77	173.74	0.81	0.91	1.00	0.01	44.84	169.91	0.77	0.94	1.00	0.01
44.90	166.39	0.73	1.19	1.00	0.01	44.99	163.56	0.70	1.22	1.00	0.01
45.03	160.51	0.66	1.26	1.00	0.01	45.08	156.46	0.62	1.59	1.00	0.01
45.19	150.61	0.57	1.68	1.00	0.02	45.24	144.47	0.52	1.73	1.00	0.01
45.29	138.81	0.47	1.79	1.00	0.01	45.35	133.81	0.43	1.84	1.00	0.01
45.41	128.86	0.40	1.90	1.00	0.01	45.49	125.70	0.38	1.94	1.00	0.02
45.54	125.72	0.38	1.94	1.00	0.01	45.64	130.11	0.41	1.88	1.00	0.02
45.68	137.40	0.46	1.80	1.00	0.01	45.75	145.49	0.53	1.72	1.00	0.01
45.83	151.07	0.58	1.67	1.00	0.02	45.87	153.80	0.60	1.63	1.00	0.01
45.98	153.38	0.60	1.63	1.00	0.02	46.03	151.90	0.58	1.66	1.00	0.01
46.06	149.47	0.56	1.69	1.00	0.01	46.14	146.71	0.54	1.71	1.00	0.02
46.21	144.31	0.52	1.73	1.00	0.01	46.27	142.07	0.50	1.75	1.00	0.01
46.33	139.34	0.48	1.78	1.00	0.01	46.41	135.85	0.45	1.82	1.00	0.02
46.48	131.92	0.42	1.86	1.00	0.02	46.53	128.23	0.40	1.91	1.00	0.01
46.60	124.96	0.38	1.95	1.00	0.01	46.66	121.90	0.36	1.99	1.00	0.02
46.73	117.83	0.34	2.04	1.00	0.02	46.82	113.80	0.31	2.10	1.00	0.02
46.87	109.16	0.29	2.17	1.00	0.01	46.93	100.89	0.25	2.32	1.00	0.02
47.02	89.52	0.21	2.56	1.00	0.03	47.07	78.94	0.18	2.84	1.00	0.02
47.12	74.43	0.17	2.98	1.00	0.02	47.22	73.36	0.17	3.01	1.00	0.03
47.27	73.24	0.17	3.02	1.00	0.02	47.31	73.54	0.17	3.01	1.00	0.02
47.41	74.55	0.17	2.97	1.00	0.03	47.46	75.86	0.18	2.93	1.00	0.02
47.52	76.94	0.18	2.90	1.00	0.02	47.61	77.25	0.18	2.89	1.00	0.03
47.65	77.48	0.18	2.88	1.00	0.01	47.71	80.65	0.19	2.79	1.00	0.02
47.81	86.00	0.20	2.64	1.00	0.03	47.86	93.20	0.23	2.48	1.00	0.01
47.91	99.32	0.25	2.35	1.00	0.01	47.98	104.79	0.27	2.25	1.00	0.02
48.03	109.55	0.29	2.17	1.00	0.01	48.10	114.03	0.32	2.10	1.00	0.02
48.20	118.01	0.34	2.04	1.00	0.02	48.26	121.10	0.36	2.00	1.00	0.01
48.30	123.54	0.37	1.96	1.00	0.01	48.36	125.73	0.39	1.94	1.00	0.02
48.42	128.07	0.40	1.91	1.00	0.01	48.50	130.03	0.42	1.88	1.00	0.02
48.56	132.05	0.43	1.86	1.00	0.01	48.65	133.67	0.44	1.84	1.00	0.02
48.70	135.77	0.46	1.82	1.00	0.01	48.76	137.81	0.47	1.80	1.00	0.01
48.84	140.29	0.49	1.77	1.00	0.02	48.90	142.19	0.51	1.75	1.00	0.01
48.96	143.87	0.52	1.73	1.00	0.01	49.04	145.20	0.54	1.72	1.00	0.02
49.10	146.59	0.55	1.71	1.00	0.01	49.15	148.19	0.56	1.72	1.00	0.01
49.24	149.44	0.57	1.70	1.00	0.02	49.30	150.34	0.58	1.68	1.00	0.01
49.34	150.92	0.59	1.67	1.00	0.01	49.44	151.54	0.59	1.66	1.00	0.02
49.50	152.60	0.60	1.64	1.00	0.01	49.55	154.09	0.62	1.62	1.00	0.01
49.64	155.57	0.63	1.60	1.00	0.02	49.69	156.95	0.65	1.58	1.00	0.01
49.74	158.17	0.66	1.28	1.00	0.01	49.81	159.41	0.67	1.27	1.00	0.01
49.88	160.46	0.69	1.26	1.00	0.01	49.94	160.96	0.69	1.25	1.00	0.01
50.01	161.02	2.00	0.00	1.00	0.00						

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)

Total estimated settlement: 5.76

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

Landmark Consultants, Inc.
780 N. 4th Street
El Centro, CA 92243

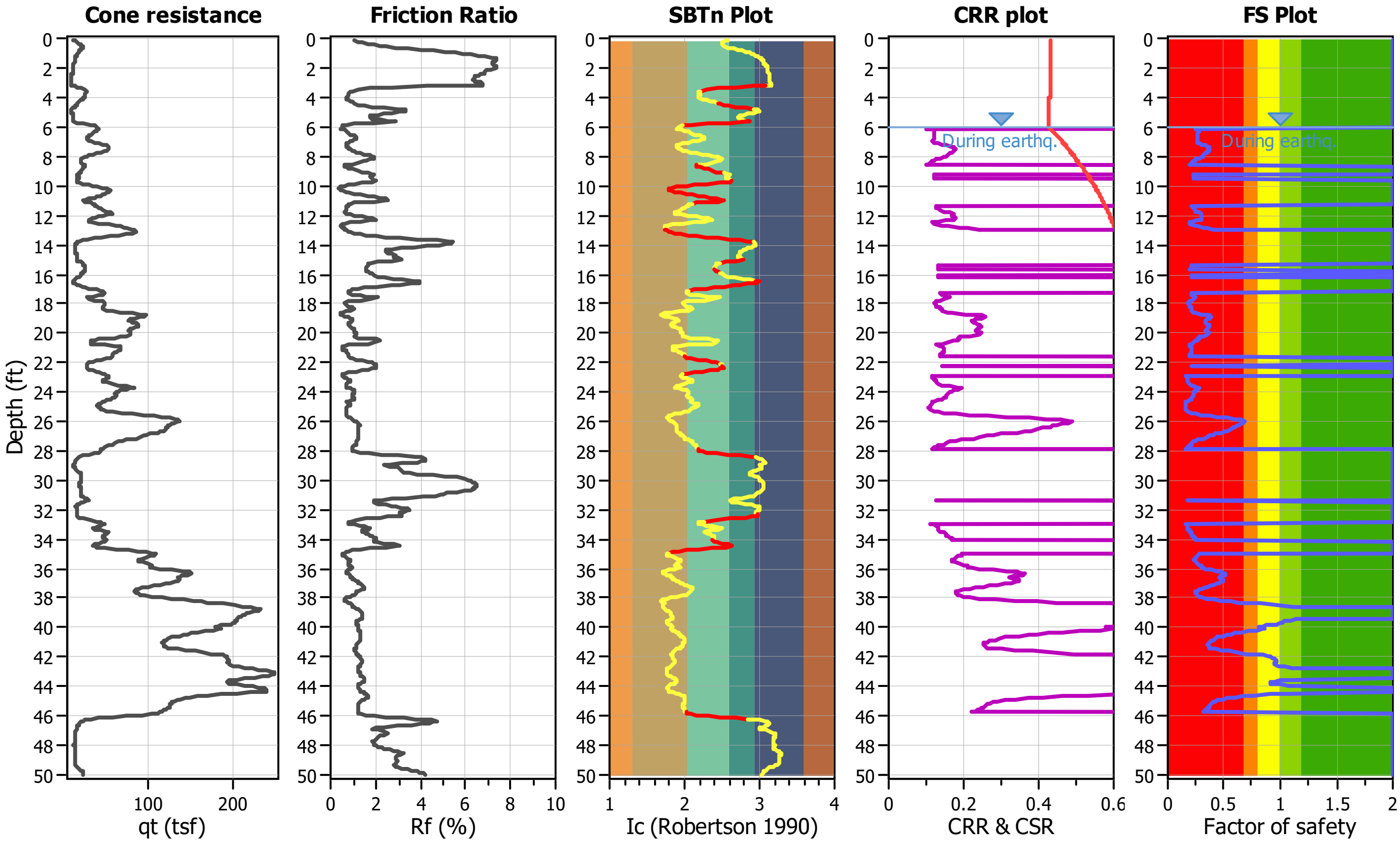
LIQUEFACTION ANALYSIS REPORT

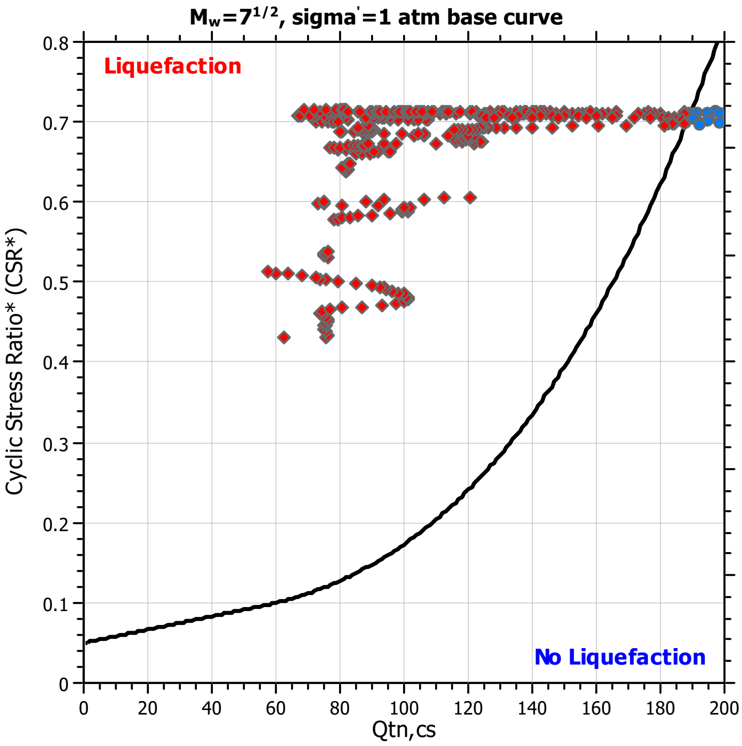
Project title : Elmore North Geothermal Plant **Location : Calipatria, CA**

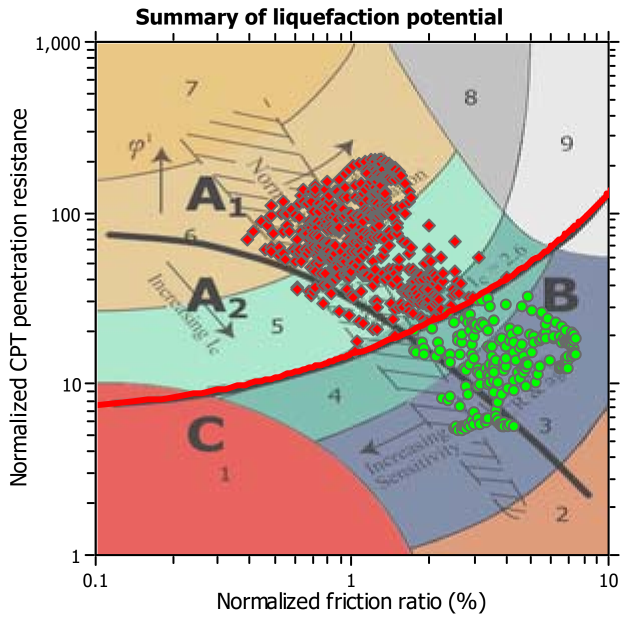
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.00 ft	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	50.00 ft
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.61	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

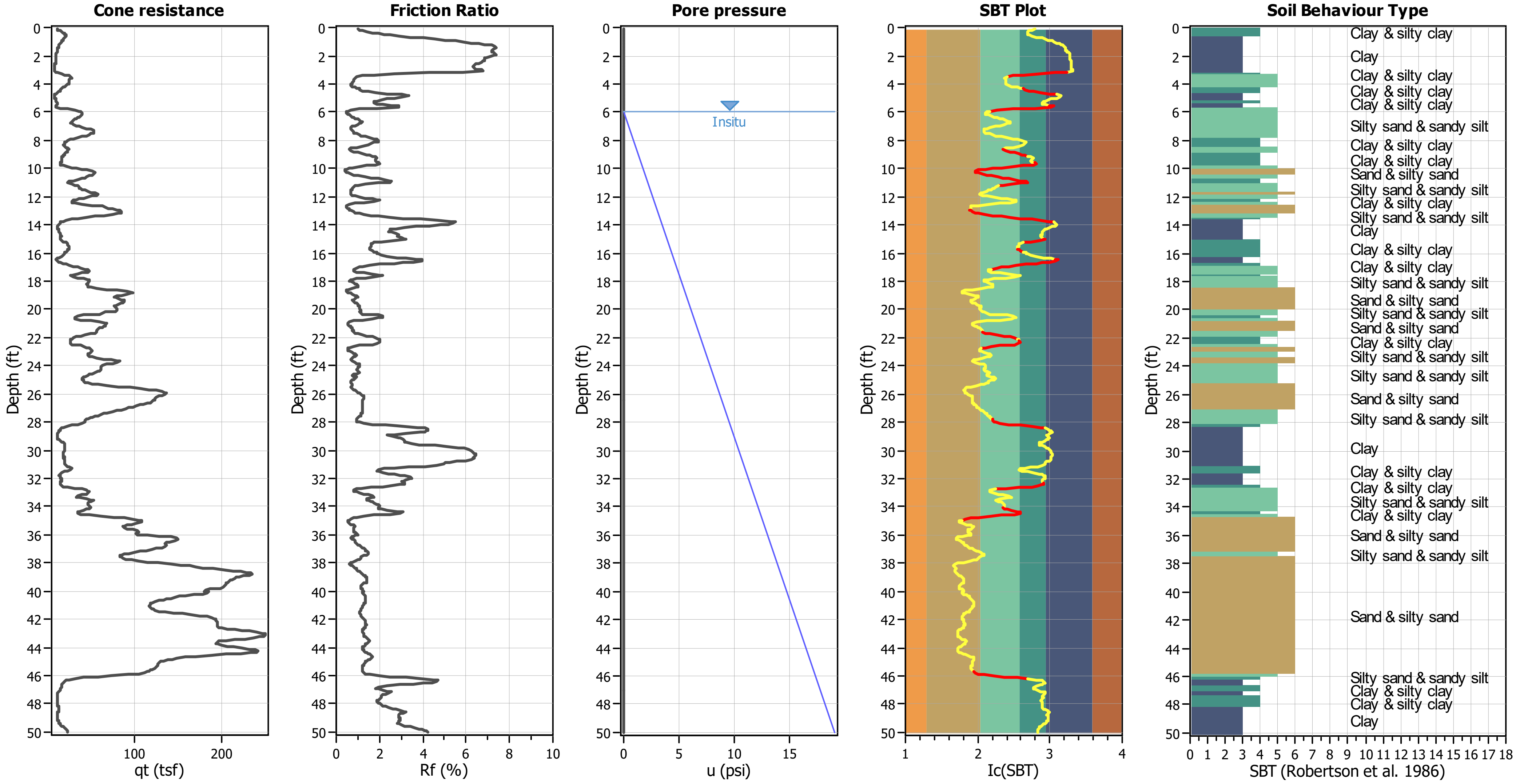






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



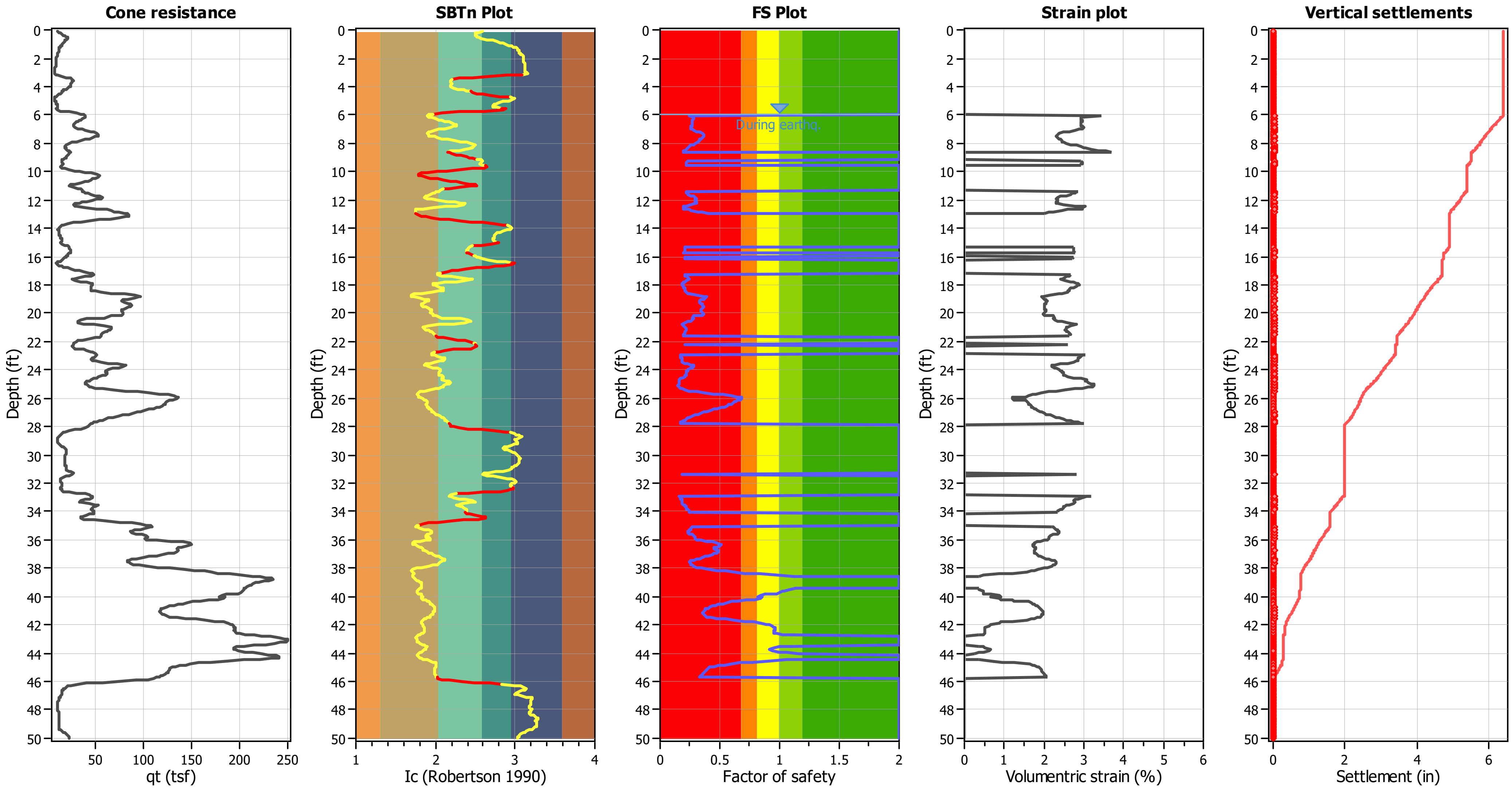
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	6.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_{σ} applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	6.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

SBT legend

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

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

:: Post-earthquake settlement due to soil liquefaction ::

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
6.08	62.23	0.24	3.45	1.00	0.05	6.13	75.79	0.28	2.93	1.00	0.02
6.18	75.97	0.28	2.93	1.00	0.02	6.27	75.88	0.28	2.93	1.00	0.03
6.32	75.57	0.27	2.94	1.00	0.02	6.37	75.27	0.27	2.95	1.00	0.02
6.47	75.21	0.27	2.95	1.00	0.03	6.52	75.45	0.27	2.94	1.00	0.02
6.57	75.83	0.27	2.93	1.00	0.02	6.66	76.16	0.27	2.92	1.00	0.03
6.72	76.24	0.27	2.92	1.00	0.02	6.77	75.62	0.26	2.94	1.00	0.02
6.83	74.50	0.26	2.97	1.00	0.02	6.91	73.86	0.25	3.00	1.00	0.03
6.97	74.48	0.26	2.98	1.00	0.02	7.04	76.75	0.26	2.90	1.00	0.02
7.11	80.88	0.28	2.78	1.00	0.02	7.16	86.85	0.30	2.62	1.00	0.02
7.24	92.85	0.33	2.48	1.00	0.02	7.31	97.66	0.35	2.38	1.00	0.02
7.36	100.10	0.36	2.33	1.00	0.01	7.45	101.01	0.37	2.32	1.00	0.03
7.49	101.41	0.37	2.31	1.00	0.01	7.55	100.87	0.36	2.32	1.00	0.02
7.64	99.91	0.36	2.34	1.00	0.02	7.70	98.00	0.34	2.38	1.00	0.02
7.75	95.96	0.33	2.42	1.00	0.02	7.86	94.66	0.32	2.44	1.00	0.03
7.89	93.87	0.32	2.46	1.00	0.01	7.95	92.65	0.31	2.49	1.00	0.02
8.01	89.95	0.30	2.55	1.00	0.02	8.08	85.17	0.28	2.67	1.00	0.02
8.15	79.56	0.25	2.82	1.00	0.02	8.22	75.71	0.24	2.94	1.00	0.02
8.29	73.98	0.23	2.99	1.00	0.03	8.34	72.38	0.23	3.05	1.00	0.02
8.40	68.43	0.22	3.19	1.00	0.03	8.49	63.89	0.20	3.37	1.00	0.03
8.54	59.82	0.20	3.56	1.00	0.02	8.60	57.19	0.19	3.69	1.00	0.02
8.67	56.76	2.00	0.00	1.00	0.00	8.75	58.34	2.00	0.00	1.00	0.00
8.80	60.76	2.00	0.00	1.00	0.00	8.87	63.64	2.00	0.00	1.00	0.00
8.94	67.82	2.00	0.00	1.00	0.00	9.03	71.34	2.00	0.00	1.00	0.00
9.08	73.37	2.00	0.00	1.00	0.00	9.14	74.71	2.00	0.00	1.00	0.00
9.19	75.68	2.00	0.00	1.00	0.00	9.27	75.98	0.23	2.93	1.00	0.03
9.33	75.24	0.22	2.95	1.00	0.02	9.41	75.07	0.22	2.96	1.00	0.03
9.47	75.59	0.22	2.94	1.00	0.02	9.53	75.97	0.22	2.93	1.00	0.02
9.58	75.83	2.00	0.00	1.00	0.00	9.67	74.95	2.00	0.00	1.00	0.00
9.73	73.38	2.00	0.00	1.00	0.00	9.78	70.13	2.00	0.00	1.00	0.00
9.87	67.69	2.00	0.00	1.00	0.00	9.93	67.12	2.00	0.00	1.00	0.00
9.99	68.69	2.00	0.00	1.00	0.00	10.06	61.08	2.00	0.00	1.00	0.00
10.13	70.40	2.00	0.00	1.00	0.00	10.17	78.48	2.00	0.00	1.00	0.00
10.26	83.37	2.00	0.00	1.00	0.00	10.32	95.21	2.00	0.00	1.00	0.00
10.37	97.17	2.00	0.00	1.00	0.00	10.46	97.86	2.00	0.00	1.00	0.00
10.52	99.41	2.00	0.00	1.00	0.00	10.57	103.56	2.00	0.00	1.00	0.00
10.67	108.72	2.00	0.00	1.00	0.00	10.71	113.29	2.00	0.00	1.00	0.00
10.78	113.04	2.00	0.00	1.00	0.00	10.85	111.29	2.00	0.00	1.00	0.00
10.90	106.61	2.00	0.00	1.00	0.00	10.96	99.27	2.00	0.00	1.00	0.00
11.03	89.20	2.00	0.00	1.00	0.00	11.10	81.44	2.00	0.00	1.00	0.00
11.16	78.45	2.00	0.00	1.00	0.00	11.25	77.80	2.00	0.00	1.00	0.00
11.29	77.74	2.00	0.00	1.00	0.00	11.37	78.07	0.22	2.86	1.00	0.03
11.42	79.36	0.22	2.82	1.00	0.02	11.51	80.74	0.22	2.78	1.00	0.03
11.56	82.96	0.23	2.72	1.00	0.02	11.65	85.67	0.24	2.65	1.00	0.03
11.70	89.90	0.25	2.55	1.00	0.02	11.75	95.59	0.28	2.42	1.00	0.01
11.86	99.45	0.29	2.35	1.00	0.03	11.88	100.96	0.30	2.32	1.00	0.01
11.94	99.26	0.29	2.35	1.00	0.02	12.01	99.29	0.29	2.35	1.00	0.02
12.10	99.85	0.29	2.34	1.00	0.02	12.14	101.41	0.30	2.31	1.00	0.01
12.22	101.83	0.30	2.30	1.00	0.02	12.29	99.92	0.29	2.34	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
12.34	91.94	0.26	2.50	1.00	0.02	12.42	80.87	0.22	2.78	1.00	0.03
12.47	73.02	0.19	3.02	1.00	0.02	12.53	75.23	0.20	2.95	1.00	0.02
12.62	75.14	0.20	2.95	1.00	0.03	12.70	88.43	0.24	2.58	1.00	0.02
12.73	93.91	0.26	2.46	1.00	0.01	12.80	106.11	0.32	2.23	1.00	0.02
12.90	112.43	0.35	2.12	1.00	0.03	12.95	120.48	0.40	2.01	1.00	0.01
13.00	126.37	2.00	0.00	1.00	0.00	13.06	132.24	2.00	0.00	1.00	0.00
13.15	136.13	2.00	0.00	1.00	0.00	13.21	138.01	2.00	0.00	1.00	0.00
13.27	137.03	2.00	0.00	1.00	0.00	13.35	134.88	2.00	0.00	1.00	0.00
13.39	133.96	2.00	0.00	1.00	0.00	13.46	133.67	2.00	0.00	1.00	0.00
13.54	135.16	2.00	0.00	1.00	0.00	13.60	138.09	2.00	0.00	1.00	0.00
13.65	137.72	2.00	0.00	1.00	0.00	13.74	134.01	2.00	0.00	1.00	0.00
13.79	126.76	2.00	0.00	1.00	0.00	13.88	120.48	2.00	0.00	1.00	0.00
13.94	114.52	2.00	0.00	1.00	0.00	13.99	107.85	2.00	0.00	1.00	0.00
14.09	100.62	2.00	0.00	1.00	0.00	14.14	93.05	2.00	0.00	1.00	0.00
14.19	86.53	2.00	0.00	1.00	0.00	14.28	81.79	2.00	0.00	1.00	0.00
14.33	78.85	2.00	0.00	1.00	0.00	14.38	79.29	2.00	0.00	1.00	0.00
14.47	80.30	2.00	0.00	1.00	0.00	14.53	82.98	2.00	0.00	1.00	0.00
14.59	87.12	2.00	0.00	1.00	0.00	14.67	90.52	2.00	0.00	1.00	0.00
14.73	92.09	2.00	0.00	1.00	0.00	14.78	91.63	2.00	0.00	1.00	0.00
14.83	91.61	2.00	0.00	1.00	0.00	14.90	93.11	2.00	0.00	1.00	0.00
14.98	94.46	2.00	0.00	1.00	0.00	15.03	94.07	2.00	0.00	1.00	0.00
15.11	90.29	2.00	0.00	1.00	0.00	15.17	85.48	2.00	0.00	1.00	0.00
15.24	82.71	2.00	0.00	1.00	0.00	15.32	81.80	2.00	0.00	1.00	0.00
15.38	81.87	0.21	2.75	1.00	0.02	15.42	82.18	0.21	2.74	1.00	0.02
15.52	82.30	0.21	2.74	1.00	0.03	15.55	82.51	0.21	2.74	1.00	0.01
15.63	81.60	0.20	2.76	1.00	0.03	15.72	80.81	0.20	2.78	1.00	0.03
15.78	80.39	2.00	0.00	1.00	0.00	15.81	81.05	2.00	0.00	1.00	0.00
15.89	81.63	2.00	0.00	1.00	0.00	15.97	82.14	2.00	0.00	1.00	0.00
16.02	82.31	0.20	2.74	1.00	0.02	16.09	82.46	0.20	2.74	1.00	0.02
16.15	83.28	0.21	2.72	1.00	0.02	16.22	84.39	2.00	0.00	1.00	0.00
16.31	85.73	2.00	0.00	1.00	0.00	16.36	86.03	2.00	0.00	1.00	0.00
16.41	87.75	2.00	0.00	1.00	0.00	16.51	89.64	2.00	0.00	1.00	0.00
16.54	93.75	2.00	0.00	1.00	0.00	16.61	95.54	2.00	0.00	1.00	0.00
16.70	95.90	2.00	0.00	1.00	0.00	16.75	93.39	2.00	0.00	1.00	0.00
16.81	85.96	2.00	0.00	1.00	0.00	16.91	79.92	2.00	0.00	1.00	0.00
16.95	76.73	2.00	0.00	1.00	0.00	17.00	77.55	2.00	0.00	1.00	0.00
17.06	78.11	2.00	0.00	1.00	0.00	17.15	80.30	2.00	0.00	1.00	0.00
17.20	81.61	2.00	0.00	1.00	0.00	17.26	85.06	0.21	2.67	1.00	0.02
17.36	86.69	0.21	2.63	1.00	0.03	17.39	89.34	0.22	2.56	1.00	0.01
17.51	91.77	0.23	2.51	1.00	0.03	17.54	95.20	0.24	2.43	1.00	0.01
17.59	95.34	0.24	2.43	1.00	0.01	17.65	90.79	0.23	2.53	1.00	0.02
17.75	85.35	0.21	2.66	1.00	0.03	17.80	81.65	0.20	2.76	1.00	0.02
17.85	79.35	0.19	2.82	1.00	0.02	17.95	77.89	0.19	2.87	1.00	0.03
18.00	76.98	0.18	2.90	1.00	0.02	18.05	78.06	0.19	2.86	1.00	0.02
18.15	80.10	0.19	2.80	1.00	0.03	18.20	82.75	0.20	2.73	1.00	0.02
18.25	84.59	0.20	2.68	1.00	0.02	18.34	85.92	0.21	2.65	1.00	0.03
18.39	86.84	0.21	2.62	1.00	0.02	18.44	87.23	0.21	2.61	1.00	0.01
18.53	88.56	0.22	2.58	1.00	0.03	18.59	93.82	0.23	2.46	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
18.64	97.49	0.25	2.39	1.00	0.02	18.72	109.89	0.30	2.16	1.00	0.02
18.79	121.71	0.37	1.99	1.00	0.02	18.84	124.59	0.39	1.95	1.00	0.01
18.93	123.87	0.38	1.96	1.00	0.02	18.99	121.27	0.36	1.99	1.00	0.01
19.03	118.36	0.35	2.04	1.00	0.01	19.14	116.37	0.33	2.06	1.00	0.03
19.18	115.41	0.33	2.08	1.00	0.01	19.23	116.15	0.33	2.07	1.00	0.01
19.31	117.52	0.34	2.05	1.00	0.02	19.38	119.35	0.35	2.02	1.00	0.02
19.43	120.84	0.36	2.00	1.00	0.01	19.52	121.25	0.36	2.00	1.00	0.02
19.57	120.93	0.36	2.00	1.00	0.01	19.63	119.78	0.35	2.02	1.00	0.01
19.73	118.70	0.35	2.03	1.00	0.02	19.77	118.01	0.34	2.04	1.00	0.01
19.83	118.05	0.34	2.04	1.00	0.02	19.89	118.45	0.34	2.03	1.00	0.02
19.96	119.36	0.35	2.02	1.00	0.02	20.01	121.75	0.36	1.99	1.00	0.01
20.12	120.07	0.35	2.01	1.00	0.03	20.17	113.87	0.32	2.10	1.00	0.01
20.21	106.41	0.28	2.22	1.00	0.01	20.32	103.04	0.27	2.28	1.00	0.03
20.36	106.22	0.28	2.22	1.00	0.01	20.41	106.17	0.28	2.22	1.00	0.01
20.50	104.19	0.27	2.26	1.00	0.02	20.55	99.58	0.25	2.34	1.00	0.01
20.61	93.97	0.23	2.46	1.00	0.02	20.70	87.80	0.21	2.60	1.00	0.03
20.75	80.50	0.19	2.79	1.00	0.02	20.80	80.05	0.19	2.80	1.00	0.02
20.90	84.68	0.20	2.68	1.00	0.03	20.94	88.38	0.21	2.59	1.00	0.01
21.00	89.55	0.21	2.56	1.00	0.02	21.10	90.13	0.21	2.54	1.00	0.03
21.15	90.50	0.22	2.54	1.00	0.01	21.20	90.16	0.21	2.54	1.00	0.02
21.27	89.43	0.21	2.56	1.00	0.02	21.34	88.11	0.21	2.59	1.00	0.02
21.40	86.61	0.20	2.63	1.00	0.02	21.49	85.61	0.20	2.65	1.00	0.03
21.53	85.75	0.20	2.65	1.00	0.01	21.59	85.88	0.20	2.65	1.00	0.02
21.69	85.98	2.00	0.00	1.00	0.00	21.74	85.00	2.00	0.00	1.00	0.00
21.79	84.68	2.00	0.00	1.00	0.00	21.89	85.34	2.00	0.00	1.00	0.00
21.93	86.95	2.00	0.00	1.00	0.00	21.99	88.00	2.00	0.00	1.00	0.00
22.09	88.87	2.00	0.00	1.00	0.00	22.12	89.15	2.00	0.00	1.00	0.00
22.18	89.09	0.21	2.57	1.00	0.02	22.25	88.45	0.21	2.58	1.00	0.02
22.32	87.71	2.00	0.00	1.00	0.00	22.38	85.21	2.00	0.00	1.00	0.00
22.48	83.20	2.00	0.00	1.00	0.00	22.51	80.23	2.00	0.00	1.00	0.00
22.58	76.22	2.00	0.00	1.00	0.00	22.68	72.35	2.00	0.00	1.00	0.00
22.72	69.35	2.00	0.00	1.00	0.00	22.78	68.97	2.00	0.00	1.00	0.00
22.86	70.17	2.00	0.00	1.00	0.00	22.92	72.33	0.16	3.05	1.00	0.02
22.98	74.48	0.17	2.98	1.00	0.02	23.07	76.19	0.17	2.92	1.00	0.03
23.13	77.57	0.18	2.88	1.00	0.02	23.18	78.09	0.18	2.86	1.00	0.02
23.26	78.14	0.18	2.86	1.00	0.03	23.32	78.32	0.18	2.86	1.00	0.02
23.37	79.57	0.18	2.82	1.00	0.02	23.46	82.41	0.19	2.74	1.00	0.03
23.51	88.02	0.20	2.59	1.00	0.02	23.57	95.91	0.23	2.42	1.00	0.02
23.65	103.17	0.26	2.28	1.00	0.02	23.70	107.42	0.28	2.20	1.00	0.02
23.77	107.04	0.28	2.21	1.00	0.02	23.86	104.43	0.26	2.26	1.00	0.02
23.90	101.15	0.25	2.31	1.00	0.01	23.96	97.87	0.24	2.38	1.00	0.02
24.04	95.68	0.23	2.42	1.00	0.02	24.11	94.00	0.22	2.46	1.00	0.02
24.16	93.61	0.22	2.47	1.00	0.02	24.21	93.18	0.22	2.48	1.00	0.02
24.30	92.92	0.22	2.48	1.00	0.03	24.36	91.82	0.22	2.51	1.00	0.02
24.41	90.40	0.21	2.54	1.00	0.02	24.50	88.02	0.20	2.59	1.00	0.03
24.56	81.81	0.19	2.75	1.00	0.02	24.61	75.69	0.17	2.94	1.00	0.02
24.71	71.15	0.16	3.09	1.00	0.04	24.76	72.14	0.16	3.05	1.00	0.02
24.81	72.11	0.16	3.06	1.00	0.02	24.89	70.60	0.16	3.11	1.00	0.03

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
24.96	68.13	0.15	3.20	1.00	0.03	25.02	66.98	0.15	3.25	1.00	0.02
25.10	66.91	0.15	3.25	1.00	0.03	25.16	67.74	0.15	3.22	1.00	0.02
25.21	70.33	0.16	3.12	1.00	0.02	25.29	75.00	0.17	2.96	1.00	0.03
25.36	81.20	0.18	2.77	1.00	0.02	25.41	90.48	0.21	2.54	1.00	0.01
25.50	101.30	0.25	2.31	1.00	0.03	25.54	113.41	0.30	2.11	1.00	0.01
25.61	125.52	0.37	1.94	1.00	0.01	25.70	136.60	0.45	1.81	1.00	0.02
25.75	146.56	0.53	1.71	1.00	0.01	25.80	154.14	0.59	1.62	1.00	0.01
25.88	159.94	0.65	1.54	1.00	0.01	25.95	163.49	0.68	1.22	1.00	0.01
26.00	163.77	0.69	1.22	1.00	0.01	26.10	162.15	0.67	1.24	1.00	0.02
26.15	160.09	0.65	1.53	1.00	0.01	26.20	158.29	0.63	1.56	1.00	0.01
26.25	156.80	0.62	1.58	1.00	0.01	26.34	155.43	0.60	1.60	1.00	0.02
26.40	154.11	0.59	1.62	1.00	0.01	26.45	152.32	0.58	1.65	1.00	0.01
26.54	150.11	0.56	1.68	1.00	0.02	26.60	147.66	0.53	1.70	1.00	0.01
26.65	144.60	0.51	1.73	1.00	0.01	26.74	141.07	0.48	1.76	1.00	0.02
26.79	137.39	0.45	1.80	1.00	0.01	26.84	133.44	0.42	1.84	1.00	0.01
26.94	129.26	0.40	1.89	1.00	0.02	26.99	125.02	0.37	1.95	1.00	0.01
27.04	120.72	0.34	2.00	1.00	0.01	27.13	116.51	0.32	2.06	1.00	0.02
27.18	111.29	0.29	2.14	1.00	0.01	27.26	106.57	0.27	2.22	1.00	0.02
27.32	101.24	0.25	2.31	1.00	0.02	27.38	97.03	0.23	2.40	1.00	0.02
27.45	92.71	0.22	2.49	1.00	0.02	27.54	89.35	0.21	2.56	1.00	0.03
27.56	85.35	0.19	2.66	1.00	0.01	27.66	81.94	0.18	2.75	1.00	0.03
27.71	78.29	0.18	2.86	1.00	0.02	27.77	76.02	0.17	2.93	1.00	0.02
27.83	73.94	0.17	2.99	1.00	0.02	27.93	72.61	2.00	0.00	1.00	0.00
27.96	72.67	2.00	0.00	1.00	0.00	28.02	74.98	2.00	0.00	1.00	0.00
28.09	78.55	2.00	0.00	1.00	0.00	28.16	84.31	2.00	0.00	1.00	0.00
28.22	90.47	2.00	0.00	1.00	0.00	28.30	95.76	2.00	0.00	1.00	0.00
28.36	97.91	2.00	0.00	1.00	0.00	28.43	97.21	2.00	0.00	1.00	0.00
28.51	95.31	2.00	0.00	1.00	0.00	28.58	92.60	2.00	0.00	1.00	0.00
28.62	89.46	2.00	0.00	1.00	0.00	28.70	86.02	2.00	0.00	1.00	0.00
28.75	82.20	2.00	0.00	1.00	0.00	28.81	74.15	2.00	0.00	1.00	0.00
28.92	67.68	2.00	0.00	1.00	0.00	28.95	64.02	2.00	0.00	1.00	0.00
29.01	67.30	2.00	0.00	1.00	0.00	29.08	69.96	2.00	0.00	1.00	0.00
29.14	71.82	2.00	0.00	1.00	0.00	29.22	73.63	2.00	0.00	1.00	0.00
29.27	76.30	2.00	0.00	1.00	0.00	29.35	79.79	2.00	0.00	1.00	0.00
29.41	83.80	2.00	0.00	1.00	0.00	29.47	88.14	2.00	0.00	1.00	0.00
29.53	94.68	2.00	0.00	1.00	0.00	29.60	101.94	2.00	0.00	1.00	0.00
29.67	110.72	2.00	0.00	1.00	0.00	29.76	117.26	2.00	0.00	1.00	0.00
29.80	122.39	2.00	0.00	1.00	0.00	29.86	124.71	2.00	0.00	1.00	0.00
29.96	125.44	2.00	0.00	1.00	0.00	29.99	125.18	2.00	0.00	1.00	0.00
30.06	124.49	2.00	0.00	1.00	0.00	30.16	123.85	2.00	0.00	1.00	0.00
30.21	123.40	2.00	0.00	1.00	0.00	30.26	123.66	2.00	0.00	1.00	0.00
30.36	123.88	2.00	0.00	1.00	0.00	30.41	124.57	2.00	0.00	1.00	0.00
30.46	124.58	2.00	0.00	1.00	0.00	30.55	124.34	2.00	0.00	1.00	0.00
30.61	124.14	2.00	0.00	1.00	0.00	30.65	123.52	2.00	0.00	1.00	0.00
30.75	122.02	2.00	0.00	1.00	0.00	30.80	119.27	2.00	0.00	1.00	0.00
30.85	115.92	2.00	0.00	1.00	0.00	30.91	113.40	2.00	0.00	1.00	0.00
31.00	112.27	2.00	0.00	1.00	0.00	31.05	111.08	2.00	0.00	1.00	0.00
31.14	107.90	2.00	0.00	1.00	0.00	31.20	102.45	2.00	0.00	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
31.24	94.74	2.00	0.00	1.00	0.00	31.33	86.97	2.00	0.00	1.00	0.00
31.39	80.05	0.18	2.80	1.00	0.02	31.44	75.14	2.00	0.00	1.00	0.00
31.53	71.84	2.00	0.00	1.00	0.00	31.59	69.91	2.00	0.00	1.00	0.00
31.64	70.39	2.00	0.00	1.00	0.00	31.70	72.03	2.00	0.00	1.00	0.00
31.78	73.98	2.00	0.00	1.00	0.00	31.84	77.20	2.00	0.00	1.00	0.00
31.92	80.45	2.00	0.00	1.00	0.00	31.98	83.58	2.00	0.00	1.00	0.00
32.04	84.70	2.00	0.00	1.00	0.00	32.11	82.78	2.00	0.00	1.00	0.00
32.19	79.64	2.00	0.00	1.00	0.00	32.24	77.94	2.00	0.00	1.00	0.00
32.33	78.19	2.00	0.00	1.00	0.00	32.38	78.59	2.00	0.00	1.00	0.00
32.42	76.22	2.00	0.00	1.00	0.00	32.48	73.57	2.00	0.00	1.00	0.00
32.57	71.02	2.00	0.00	1.00	0.00	32.62	68.67	2.00	0.00	1.00	0.00
32.70	66.21	2.00	0.00	1.00	0.00	32.77	65.60	2.00	0.00	1.00	0.00
32.82	66.66	2.00	0.00	1.00	0.00	32.90	68.70	0.15	3.18	1.00	0.03
32.96	71.75	0.16	3.07	1.00	0.02	33.02	75.37	0.17	2.95	1.00	0.02
33.10	78.77	0.18	2.84	1.00	0.03	33.15	80.78	0.18	2.78	1.00	0.02
33.22	81.72	0.18	2.76	1.00	0.02	33.30	81.48	0.18	2.76	1.00	0.03
33.36	81.13	0.18	2.77	1.00	0.02	33.41	82.69	0.19	2.73	1.00	0.02
33.50	86.15	0.20	2.64	1.00	0.03	33.55	89.73	0.21	2.55	1.00	0.02
33.61	91.30	0.21	2.52	1.00	0.02	33.66	92.04	0.21	2.50	1.00	0.02
33.76	92.53	0.22	2.49	1.00	0.03	33.80	94.60	0.22	2.45	1.00	0.01
33.90	96.88	0.23	2.40	1.00	0.03	33.95	98.97	0.24	2.36	1.00	0.01
34.00	99.59	0.24	2.34	1.00	0.01	34.05	98.90	0.24	2.36	1.00	0.01
34.15	97.69	2.00	0.00	1.00	0.00	34.20	97.63	2.00	0.00	1.00	0.00
34.29	100.47	2.00	0.00	1.00	0.00	34.35	105.76	2.00	0.00	1.00	0.00
34.40	108.37	2.00	0.00	1.00	0.00	34.48	106.64	2.00	0.00	1.00	0.00
34.55	101.01	2.00	0.00	1.00	0.00	34.60	93.60	2.00	0.00	1.00	0.00
34.70	90.76	2.00	0.00	1.00	0.00	34.74	92.92	2.00	0.00	1.00	0.00
34.80	97.67	2.00	0.00	1.00	0.00	34.87	101.89	2.00	0.00	1.00	0.00
34.94	105.28	2.00	0.00	1.00	0.00	34.99	107.05	2.00	0.00	1.00	0.00
35.04	107.39	0.27	2.20	1.00	0.01	35.14	106.51	0.27	2.22	1.00	0.03
35.17	104.32	0.26	2.26	1.00	0.01	35.29	102.11	0.25	2.30	1.00	0.03
35.33	100.06	0.24	2.34	1.00	0.01	35.38	99.03	0.24	2.36	1.00	0.01
35.44	98.29	0.24	2.37	1.00	0.02	35.52	98.63	0.24	2.36	1.00	0.02
35.59	100.59	0.25	2.33	1.00	0.02	35.64	105.27	0.26	2.24	1.00	0.01
35.72	109.40	0.28	2.17	1.00	0.02	35.78	111.60	0.29	2.14	1.00	0.01
35.84	111.61	0.29	2.14	1.00	0.02	35.91	112.29	0.30	2.12	1.00	0.02
35.98	114.60	0.31	2.09	1.00	0.02	36.03	120.74	0.34	2.00	1.00	0.01
36.12	129.12	0.39	1.89	1.00	0.02	36.17	136.40	0.44	1.81	1.00	0.01
36.23	140.81	0.48	1.76	1.00	0.01	36.30	143.22	0.50	1.74	1.00	0.02
36.37	145.33	0.51	1.72	1.00	0.01	36.42	143.85	0.50	1.73	1.00	0.01
36.52	139.99	0.47	1.77	1.00	0.02	36.56	137.77	0.45	1.80	1.00	0.01
36.62	137.83	0.45	1.80	1.00	0.01	36.73	140.58	0.47	1.77	1.00	0.02
36.77	142.55	0.49	1.75	1.00	0.01	36.82	142.63	0.49	1.75	1.00	0.01
36.91	141.14	0.48	1.76	1.00	0.02	36.97	138.11	0.46	1.79	1.00	0.01
37.02	135.04	0.43	1.83	1.00	0.01	37.11	131.14	0.41	1.87	1.00	0.02
37.15	127.05	0.38	1.92	1.00	0.01	37.22	122.37	0.35	1.98	1.00	0.01
37.30	117.68	0.32	2.04	1.00	0.02	37.35	113.05	0.30	2.11	1.00	0.01
37.41	108.65	0.28	2.18	1.00	0.02	37.50	104.45	0.26	2.25	1.00	0.02

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
37.56	101.64	0.25	2.31	1.00	0.02	37.61	101.26	0.25	2.31	1.00	0.01
37.69	102.18	0.25	2.30	1.00	0.02	37.75	103.85	0.26	2.27	1.00	0.02
37.81	105.80	0.27	2.23	1.00	0.01	37.88	109.02	0.28	2.18	1.00	0.02
37.94	114.05	0.31	2.10	1.00	0.01	38.00	120.94	0.34	2.00	1.00	0.02
38.06	130.32	0.40	1.88	1.00	0.01	38.15	139.91	0.47	1.77	1.00	0.02
38.20	150.15	0.55	1.68	1.00	0.01	38.29	158.07	0.63	1.56	1.00	0.02
38.35	166.13	0.71	1.20	1.00	0.01	38.40	176.30	0.83	0.89	1.00	0.01
38.50	187.26	0.97	0.49	1.00	0.01	38.55	197.36	1.12	0.35	1.00	0.00
38.60	205.38	2.00	0.00	1.00	0.00	38.68	212.15	2.00	0.00	1.00	0.00
38.74	218.11	2.00	0.00	1.00	0.00	38.79	220.59	2.00	0.00	1.00	0.00
38.85	219.91	2.00	0.00	1.00	0.00	38.94	217.09	2.00	0.00	1.00	0.00
38.99	214.28	2.00	0.00	1.00	0.00	39.04	211.92	2.00	0.00	1.00	0.00
39.15	210.13	2.00	0.00	1.00	0.00	39.18	208.36	2.00	0.00	1.00	0.00
39.24	206.55	2.00	0.00	1.00	0.00	39.34	204.32	2.00	0.00	1.00	0.00
39.40	202.44	2.00	0.00	1.00	0.00	39.44	198.74	1.14	0.35	1.00	0.00
39.54	195.28	1.09	0.36	1.00	0.00	39.58	192.00	1.04	0.48	1.00	0.00
39.64	190.95	1.02	0.48	1.00	0.00	39.73	189.41	1.00	0.49	1.00	0.01
39.77	187.32	0.97	0.49	1.00	0.00	39.83	180.07	0.88	0.66	1.00	0.00
39.90	176.95	0.84	0.88	1.00	0.01	39.99	174.81	0.81	0.90	1.00	0.01
40.04	178.37	0.86	0.67	1.00	0.00	40.10	176.68	0.84	0.89	1.00	0.01
40.19	172.90	0.79	0.91	1.00	0.01	40.24	166.39	0.72	1.19	1.00	0.01
40.33	160.05	0.65	1.26	1.00	0.01	40.38	154.65	0.60	1.61	1.00	0.01
40.43	150.31	0.56	1.68	1.00	0.01	40.52	146.36	0.52	1.71	1.00	0.02
40.58	142.46	0.49	1.75	1.00	0.01	40.63	139.25	0.47	1.78	1.00	0.01
40.69	135.70	0.44	1.82	1.00	0.01	40.78	132.42	0.42	1.86	1.00	0.02
40.83	129.49	0.40	1.89	1.00	0.01	40.88	127.09	0.38	1.92	1.00	0.01
40.97	125.37	0.37	1.94	1.00	0.02	41.02	123.98	0.36	1.96	1.00	0.01
41.08	123.43	0.36	1.97	1.00	0.01	41.17	123.02	0.36	1.97	1.00	0.02
41.23	123.54	0.36	1.96	1.00	0.01	41.28	124.48	0.37	1.95	1.00	0.01
41.37	125.92	0.38	1.93	1.00	0.02	41.42	128.34	0.39	1.90	1.00	0.01
41.48	133.59	0.43	1.84	1.00	0.01	41.57	140.26	0.48	1.77	1.00	0.02
41.62	148.33	0.54	1.69	1.00	0.01	41.67	156.83	0.62	1.58	1.00	0.01
41.77	164.92	0.70	1.21	1.00	0.01	41.82	172.13	0.79	0.92	1.00	0.01
41.87	177.02	0.85	0.88	1.00	0.01	41.96	180.34	0.89	0.66	1.00	0.01
42.01	182.57	0.92	0.64	1.00	0.00	42.06	184.17	0.94	0.64	1.00	0.00
42.16	185.23	0.95	0.50	1.00	0.01	42.21	185.93	0.96	0.50	1.00	0.00
42.26	185.91	0.96	0.50	1.00	0.00	42.36	185.52	0.96	0.50	1.00	0.01
42.41	185.27	0.95	0.50	1.00	0.00	42.46	184.99	0.95	0.50	1.00	0.00
42.55	185.27	0.96	0.50	1.00	0.01	42.61	186.68	0.98	0.49	1.00	0.00
42.66	190.42	1.03	0.49	1.00	0.00	42.75	195.41	1.10	0.36	1.00	0.00
42.80	201.35	2.00	0.00	1.00	0.00	42.86	207.90	2.00	0.00	1.00	0.00
42.92	214.68	2.00	0.00	1.00	0.00	43.00	220.70	2.00	0.00	1.00	0.00
43.05	223.82	2.00	0.00	1.00	0.00	43.13	223.63	2.00	0.00	1.00	0.00
43.20	221.93	2.00	0.00	1.00	0.00	43.25	218.81	2.00	0.00	1.00	0.00
43.32	215.43	2.00	0.00	1.00	0.00	43.39	210.37	2.00	0.00	1.00	0.00
43.45	202.62	2.00	0.00	1.00	0.00	43.53	195.18	1.10	0.36	1.00	0.00
43.58	188.30	1.00	0.49	1.00	0.00	43.65	184.63	0.95	0.50	1.00	0.00
43.72	182.03	0.92	0.65	1.00	0.01	43.78	182.22	0.92	0.65	1.00	0.00

:: Post-earthquake settlement due to soil liquefaction :: (continued)

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
43.87	183.87	0.94	0.64	1.00	0.01	43.90	187.59	0.99	0.49	1.00	0.00
43.97	192.37	1.06	0.36	1.00	0.00	44.04	198.45	1.16	0.25	1.00	0.00
44.10	204.42	2.00	0.00	1.00	0.00	44.17	210.37	2.00	0.00	1.00	0.00
44.26	214.28	2.00	0.00	1.00	0.00	44.31	214.93	2.00	0.00	1.00	0.00
44.37	210.77	2.00	0.00	1.00	0.00	44.43	203.21	2.00	0.00	1.00	0.00
44.50	192.28	1.07	0.36	1.00	0.00	44.57	181.03	0.91	0.65	1.00	0.01
44.62	169.13	0.76	0.94	1.00	0.01	44.71	160.65	0.67	1.25	1.00	0.01
44.76	152.68	0.59	1.64	1.00	0.01	44.82	146.30	0.54	1.71	1.00	0.01
44.91	139.90	0.48	1.77	1.00	0.02	44.96	134.96	0.45	1.83	1.00	0.01
45.02	131.36	0.42	1.87	1.00	0.01	45.10	128.48	0.40	1.90	1.00	0.02
45.15	126.37	0.39	1.93	1.00	0.01	45.23	125.24	0.38	1.94	1.00	0.02
45.29	124.46	0.37	1.95	1.00	0.01	45.35	123.56	0.37	1.96	1.00	0.01
45.42	122.68	0.36	1.98	1.00	0.02	45.50	121.17	0.36	2.00	1.00	0.02
45.56	120.00	0.35	2.01	1.00	0.01	45.62	118.41	0.34	2.03	1.00	0.02
45.70	117.01	0.33	2.05	1.00	0.02	45.74	115.51	0.32	2.08	1.00	0.01
45.81	114.10	2.00	0.00	1.00	0.00	45.88	111.86	2.00	0.00	1.00	0.00
45.94	109.02	2.00	0.00	1.00	0.00	46.00	106.46	2.00	0.00	1.00	0.00
46.10	106.63	2.00	0.00	1.00	0.00	46.14	107.37	2.00	0.00	1.00	0.00
46.20	104.74	2.00	0.00	1.00	0.00	46.29	100.06	2.00	0.00	1.00	0.00
46.34	94.82	2.00	0.00	1.00	0.00	46.39	89.91	2.00	0.00	1.00	0.00
46.49	85.09	2.00	0.00	1.00	0.00	46.54	79.93	2.00	0.00	1.00	0.00
46.59	74.76	2.00	0.00	1.00	0.00	46.66	68.28	2.00	0.00	1.00	0.00
46.74	61.73	2.00	0.00	1.00	0.00	46.83	57.30	2.00	0.00	1.00	0.00
46.89	55.55	2.00	0.00	1.00	0.00	46.92	55.72	2.00	0.00	1.00	0.00
46.99	56.64	2.00	0.00	1.00	0.00	47.08	57.30	2.00	0.00	1.00	0.00
47.13	57.10	2.00	0.00	1.00	0.00	47.18	55.69	2.00	0.00	1.00	0.00
47.27	54.16	2.00	0.00	1.00	0.00	47.33	52.81	2.00	0.00	1.00	0.00
47.38	51.81	2.00	0.00	1.00	0.00	47.47	51.09	2.00	0.00	1.00	0.00
47.53	50.75	2.00	0.00	1.00	0.00	47.59	50.64	2.00	0.00	1.00	0.00
47.65	50.16	2.00	0.00	1.00	0.00	47.74	49.61	2.00	0.00	1.00	0.00
47.79	49.02	2.00	0.00	1.00	0.00	47.84	48.84	2.00	0.00	1.00	0.00
47.94	48.90	2.00	0.00	1.00	0.00	47.99	49.21	2.00	0.00	1.00	0.00
48.04	50.33	2.00	0.00	1.00	0.00	48.13	51.90	2.00	0.00	1.00	0.00
48.18	53.91	2.00	0.00	1.00	0.00	48.23	55.73	2.00	0.00	1.00	0.00
48.32	57.12	2.00	0.00	1.00	0.00	48.38	58.08	2.00	0.00	1.00	0.00
48.43	58.87	2.00	0.00	1.00	0.00	48.52	59.43	2.00	0.00	1.00	0.00
48.58	59.57	2.00	0.00	1.00	0.00	48.63	58.72	2.00	0.00	1.00	0.00
48.72	57.84	2.00	0.00	1.00	0.00	48.77	57.32	2.00	0.00	1.00	0.00
48.83	57.39	2.00	0.00	1.00	0.00	48.92	57.38	2.00	0.00	1.00	0.00
48.97	57.34	2.00	0.00	1.00	0.00	49.03	57.35	2.00	0.00	1.00	0.00
49.11	57.42	2.00	0.00	1.00	0.00	49.17	57.44	2.00	0.00	1.00	0.00
49.22	57.69	2.00	0.00	1.00	0.00	49.32	58.45	2.00	0.00	1.00	0.00
49.37	59.76	2.00	0.00	1.00	0.00	49.41	62.25	2.00	0.00	1.00	0.00
49.49	65.46	2.00	0.00	1.00	0.00	49.56	69.42	2.00	0.00	1.00	0.00
49.61	74.21	2.00	0.00	1.00	0.00	49.68	79.33	2.00	0.00	1.00	0.00
49.77	83.89	2.00	0.00	1.00	0.00	49.82	86.98	2.00	0.00	1.00	0.00
49.87	89.08	2.00	0.00	1.00	0.00	49.95	90.72	2.00	0.00	1.00	0.00
50.01	91.77	2.00	0.00	1.00	0.00						

:: Post-earthquake settlement due to soil liquefaction :: (continued)

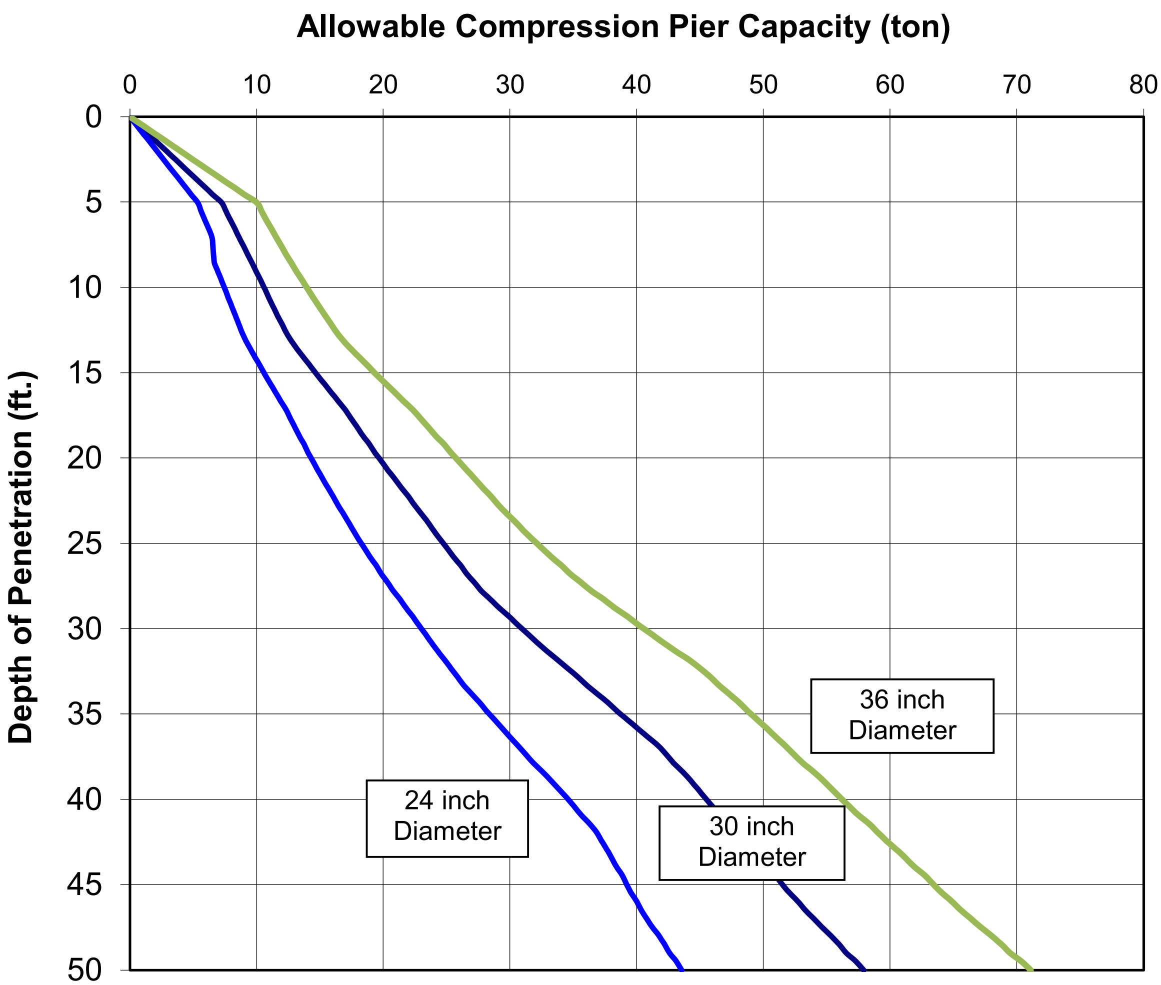
Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)

Total estimated settlement: 6.40

Abbreviations

$Q_{tn,cs}$: Equivalent clean sand normalized cone resistance
FS: Factor of safety against liquefaction
e_v (%): Post-liquefaction volumentric strain
DF: e_v depth weighting factor
Settlement: Calculated settlement

APPENDIX E

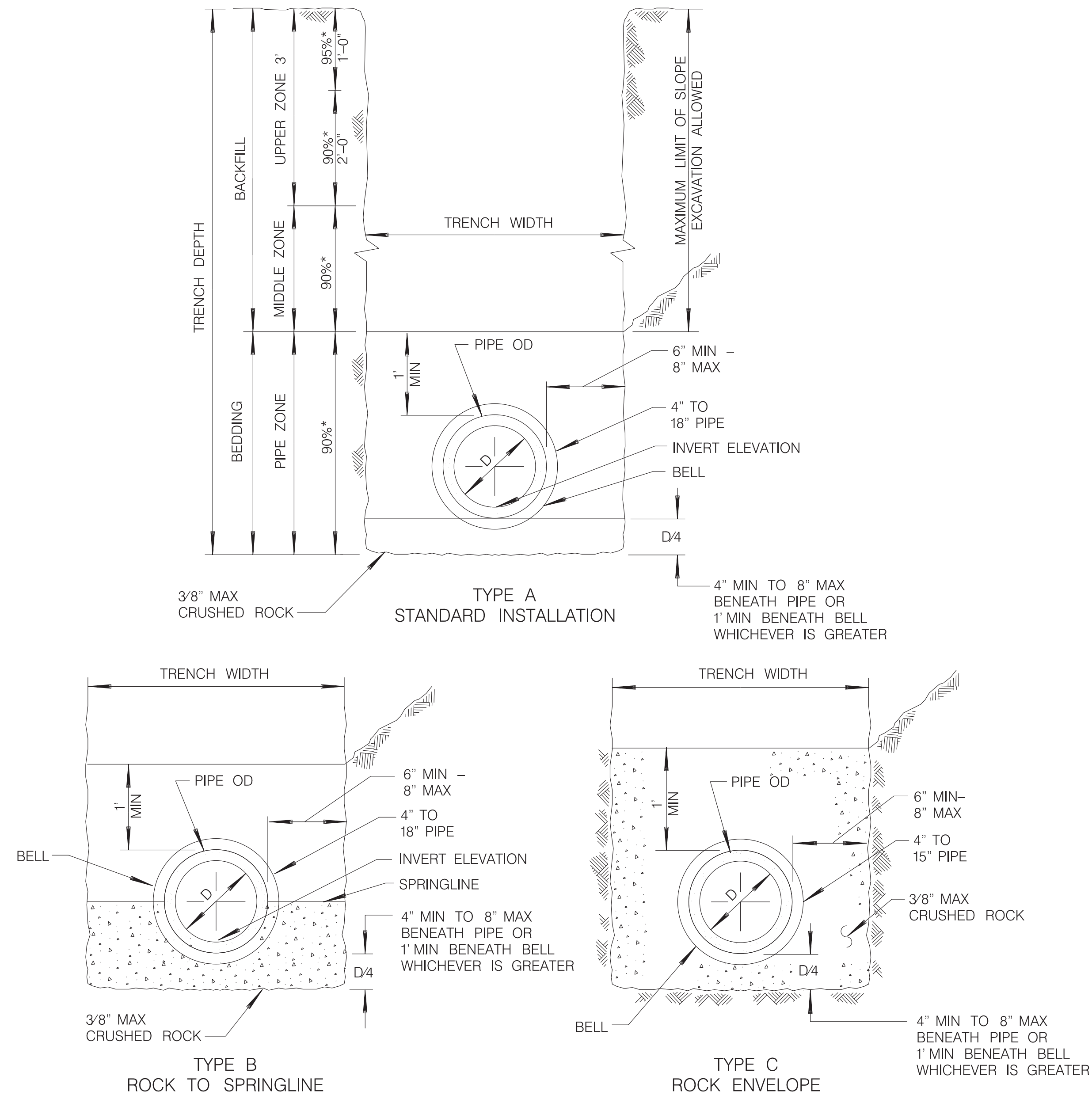


Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.
2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5
3. For temporary wind or seismic load, the above values may be increased by one-third.
4. Capacities of other pier sizes are in direct proportion to the pile diameter.
5. Pier capacity in tension should be taken as 50% of the compression capacity.

LANDMARK Geo-Engineers and Geologists **Project No.: LE22199**	**Drlled Piers Compression Capacity Chart Black Rock Geothermal Plant Calipatria, California**	**Figure E-1**

APPENDIX F



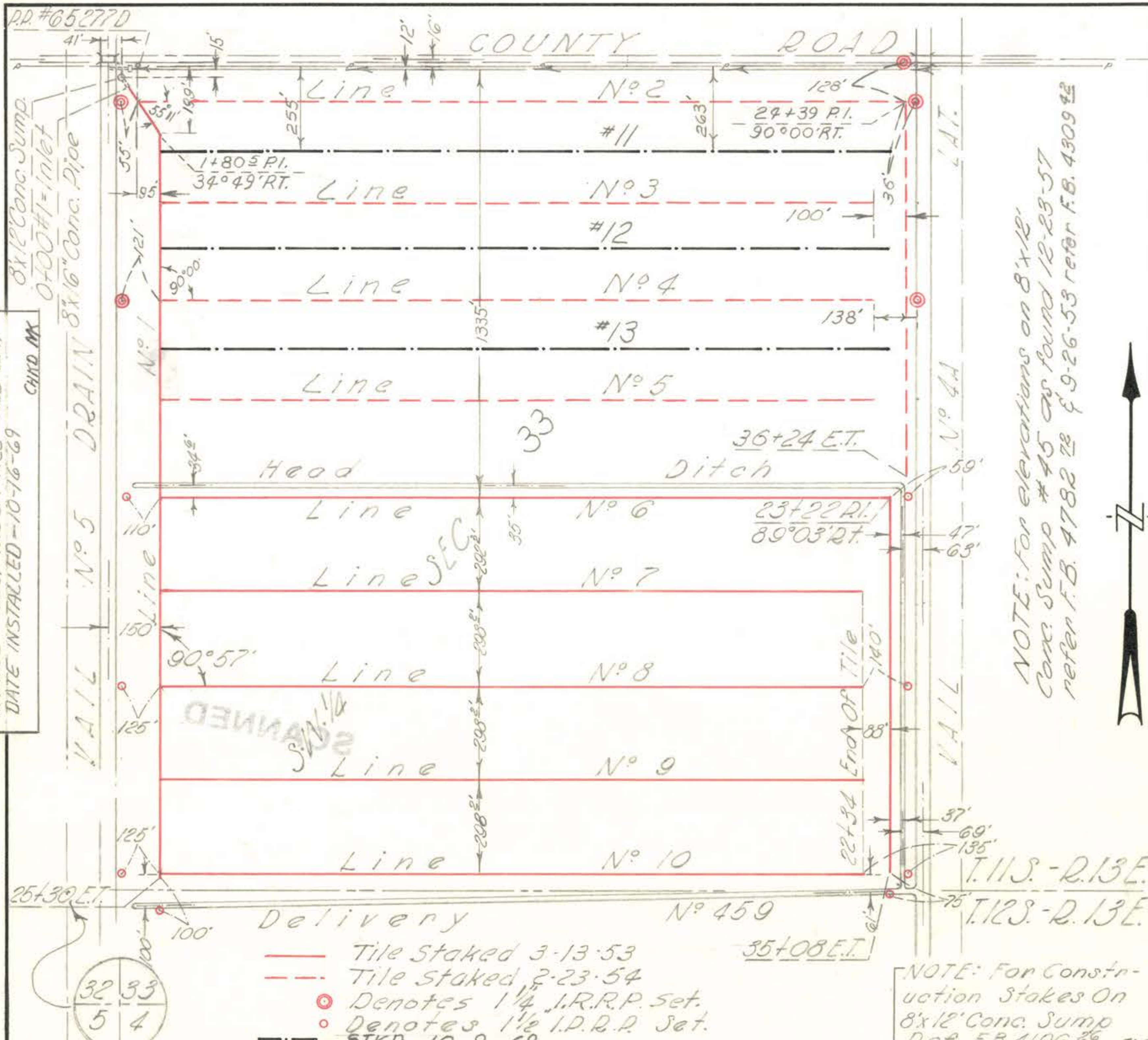
NOTES

1. FOR TRENCH RESURFACING IN IMPROVED STREETS, SEE STANDARD DRAWINGS SDG–107 AND SDG–108.
2. (*) INDICATES MINIMUM RELATIVE COMPACTION.
3. MINIMUM DEPTH OF COVER FROM THE TOP OF PIPE TO FINISH GRADE FOR PVC SDR 35 SEWER MAIN SHALL BE 5'. FOR SHALLOWER DEPTH, SPECIAL DESIGN IS REQUIRED. SEE SDS–101.
4. SEE TYPE A INSTALLATION FOR DETAILS NOT SHOWN FOR TYPES B AND C.
5. FOR PIPE SIZE ENCASEMENT LARGER THAN 15", MAXIMUM SIDE WALL CLEARANCE SHALL BE 12" OR AS SHOWN ON THE PLANS.
6. 6" METAL TAPE SHALL BE INSTALLED ABOVE PIPE 4" BELOW TRENCH CAP AND 12" BELOW FINISH GRADE IN UNIMPROVED STREETS.
7. 1' SAND CUSHION OR A 6" MINIMUM SAND CUSHION WITH 1" NEOPRENE PAD SHALL BE PLACED FOR CROSSINGS UTILITIES WHEN VERTICAL CLEARANCE IS 1' OR LESS. THE NEOPRENE PAD SHALL BE PLACED ON THE MOST FRAGILE UTILITY.

From: City of San Diego Standard Drawing SDS-110 (2016)

LANDMARK Geo-Engineers and Geologists **Project No.: LE22199**	**Pipe Bedding and Trench Backfill Recommendations**	**Plate F-1**

APPENDIX G



Line No.	Outlet Elev.	Footage Staked	TILE INSTALLED				
			OUTLET STA. 0+00	8"	6"	5"	4"
1	765.19	2530	T.O.	1300	1230		
6	766.77	3508	13+28 #1				3508
7	767.07	2234	$16+26^{2}$ #1				2234
8	767.36	2234	$19+24^{4}$ #1				2234
9	767.66	2234	$22+22^{6}$ #1				2234
10	767.96	2234	$25+20^{8}$ #1				2234
2	765.50	3624	$0+59^{78}$ #1				3624
3	765.85	2271	$3+93^{12}$ #1				2271
4	766.16	2271	$7+04^{74}$ #1				2271
5	766.47	2271	$10+16^{36}$ #1				2271
11		2321	$2+37^{3}$ #1				2290
12		2321	$5+48^{9}$ #1				2290
13		2321	$8+60^{5}$ #1				2290

Const. F.B. 4196 Pg. 28 **By** Hays **Date** 3-13-53
Installed By Clendenin & Son **Date** 3-26-53
Gravel Used Inland
Tile Used Pinner
Const. F.B. 4330 55-64 **By** Donaldson **Date** 2-23-54
Installed By Clendenin & Son **Date** 3-5-54
Gravel Used Inland
Tile Used Pinner
References:

IMPERIAL IRRIGATION DISTRICT
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN CONSTRUCTION

S.W.1/4 Sec. 33

DELL RANCH — PROP.

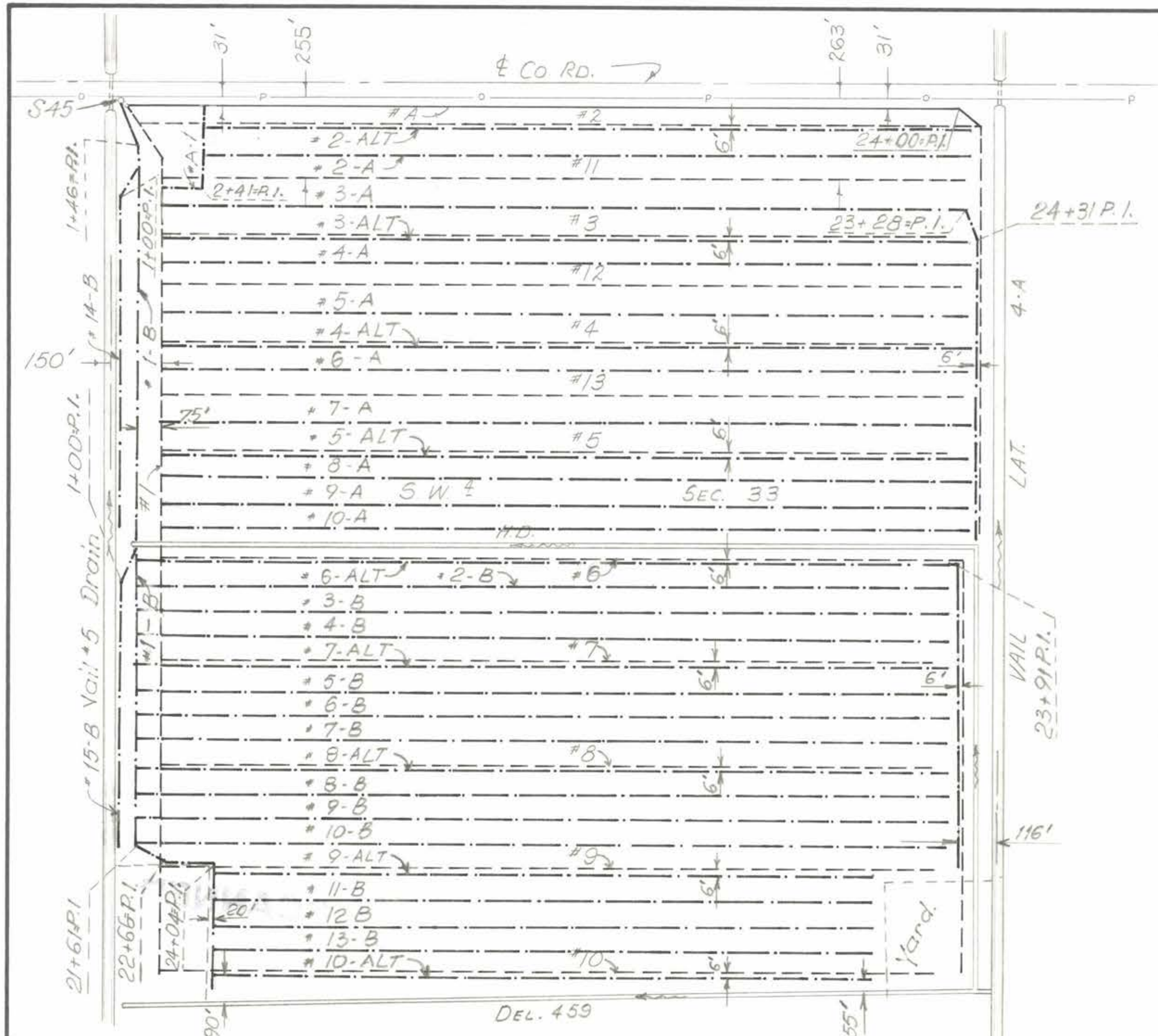
Property T. 11 S.-R. 13 E.

Scale: 1" = 400' | Plotted By F.V. | Checked By APD, KC

Well Book 4068 23 | Sh. 1 of 3 Shs. | TD 1373

IID-447

TD-1373[2]



RECOMMENDED					AS STAKED		TILE INSTALLED			
LINE NO.	Slope	STA 1+00	End Tile	OUT. ELEV. @ 0+00	OUTLET STA. 0+00 =	FOOTAGE	3"	8"	6"	4"
A				764.50	T.O.	2492		2492		
A-1	001	6.6	6.6	764.10	2+03 # A			339		
1-B	001	8.4	6.3	764.40	T. O.			2760		
2-ALT	001	5.6	4.9	765.00	0+76[20] # A-1		2195			
2-A	001	5.7	4.9	765.10	1+54[10] # A-1		2195			
3-A	PLOW				3+15[20] # 1		3290			
3-ALT					3+99 # 1		2330			
4-A					4+71 # 1		2330			
5-A					6+26[80] # 1		2330			
4-ALT	001	6.1	4.8	765.80	7+10[74] # 1		2330			
6-A	001	6.0	4.9	765.80	7+82[60] # 1		2330			
7-A	001	6.0	4.8	766.20	9+38[40] # 1		2330			
5-ALT	001	6.5	4.8	766.30	10+22[36] # 1		2330			
8-A	001	5.7	4.8	766.50	10+94[20] # 1		2330			
9-A	001	5.9	4.8	766.50	11+72[10] # 1		2330			
10-A	001	5.7	4.8	766.90	12+50 # 1		2330			
6-ALT	001	5.5	4.9	766.90	13+14 # 1-B		3267			
2-B	001	5.0	5.0	766.70	13+88 # 1-B		2354			
3-B	001	4.8	5.1	766.70	14+62 # 1-B		2354			
4-B	001	5.0	5.0	766.90	15+36 # 1-B		2354			
7-ALT	001	5.1	5.0	766.90	16+10 # 1-B		2354			
5-B	001	5.1	5.1	767.00	16+84[50] # 1-B		2354			
6-B	001	5.3	5.0	767.00	17+59 # 1-B		2354			
				Continued on Sh. 3						

Continued on Sh. 3

STAKED BY BRYANT, JEHLE & ASSOC. DATE 6-3-71 F.B.
PLOTTED D.D. CH'K'D. [initials] INSTALLED BY LA BOLSA
GRAVEL WEST MESA TILE RED CLAY DATE 6-9-71
STAKED BY TESCO DATE 12-7-83 F.B.
PLOTTED [initials] CH'K'D D.D. [initials] INSTALLED BY Lidco
GRAVEL West Mesa TILE Plastic DATE 1-10-84

LEGEND

— —	EXIST. TILE
———	STKD 6-3-71
—·—	Stk'd 12-7-83
O.P.	OVERPOUR
	HEAD DITCH
	FIELD ROAD
	FIELD WASTE

REFERENCES:

IMPERIAL IRRIGATION DISTRICT
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN CONSTRUCTION
S.W.¼ SEC. 33

PROP. DELL RANCH T. 11 S.-R. 13 E.
SCALE: 1" = 400' SH. 2 OF SHS. TD 1373

B.M. 60 d SPK. E.S. POW. POLE # R-7037-D BETWEEN VAIL #5 DR. & VAIL LAT. 5 NEAR CTR. W. LINE SEC. 33
Elevation 774.54 F.B. 4330 56

ISSUE 4	
ISSUE 3	
ISSUE 2	Constr. Stks 11-9-84 [initials]
ISSUE 1	CONSTR. STKS. 8-24-71 D.D.

TD-1373 3

LINE NO.	OUTLET ELEV.	SLOPE	TILE DEPTH STA 1+00	TILE DEPTH END TILE	OUTLET STA. 0+00 =	STAKED FOOTAGE	TILE INSTALLED 3"	TILE INSTALLED 8"	TILE INSTALLED 6"	TILE INSTALLED 4"
					Continued	from	Sh.2			
7-B	767.10	001	5.2	5.1	$18+33^{50}$ = 1-B		2354			
8-ALT	767.20	001	5.0	5.1	19+08 = 1-B		2354			
8-B	767.20	001	5.1	5.1	$19+82^{50}$ = 1-B		2354			
9-B	767.30	001	5.2	5.0	20+57 = 1-B		2354			
10-B	767.50	001	5.1	5.1	$21+31^{50}$ = 1-B		2354			
9-ALT	768.00	001	5.0	5.0	$24+28^{50}$ = 1-B		2354			
11-B	768.00	001	4.9	5.3	25+03 = 1-B		1910			
12-B	768.20	001	4.9	5.3	$25+77^{50}$ 1-B		1910			
13-B	768.20	001	4.9	5.0	26+52 = 1-B		1911			
10 ALT	768.20	001	5.1	5.2	$27+26^{50}$ = 1-B		1911			
14-B	765.00	001	5.9	6.4	2+00 = 1-B					1050
15-B	766.00	001	5.7	5.6	13+00 = 1-B					857

For Tile location
See Sh. 2

N

B.M.

Elevation F.B.

LEGEND

IMPERIAL IRRIGATION DISTRICT
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN CONSTRUCTION

S 1/4 Sec. 33

PROP. Dell Ranch T. 11 S.– R. 13 E.

SCALE: 1" = 400' SH. 3 OF TD-1373

STAKED 12-7-83 BY Tesco	STAKED BY	ISSUE 4	
INSTALLED 1-10-84 BY Lidco	INSTALLED BY	ISSUE 3	
GRAVEL West Mesa TILE Plastic	GRAVEL TILE	ISSUE 2	
PLOTTED S CHECKED D.D. F.B.	PLOTTED CHECKED F.B.	ISSUE 1	Constr. Stks 11-9-84 S

REFER:

APPENDIX H

CALENERGY – BLACK ROCK SITE
SOIL ASSESSMENT SUMMARY REPORT

Presented To:

Landmark Consultants

Prepared by:

Project No. 22136

OCTOBER 20, 2022

INTRODUCTION

RFYeager Engineering Inc. (RFYeager Engineering) has completed an electrical and thermal resistivity assessment at the proposed CalEnergy Black Rock site near Calipatria, California. A chemical analysis of two (2) soil samples provided by Landmark was also conducted. The objective of this study is to determine the thermal and electrical resistivity, as well as to determine the corrosivity of the soil at the project site.

The location and numbering of the assessment sites is shown in Figure 1 at the end of this report. Figure 1 is based upon the site map provided by Landmark.

SCOPE

The electrical resistivity of the soil was determined by using the Wenner 4 pin method in accordance with ASTM G57 standards. Six readings were obtained and recorded for each assessment site based upon pin spacings of 40, 20, 15, 10, 5, and 2.5 feet. Readings were recorded at two locations within the Black Rock site boundaries. All resistivity readings were recorded utilizing a Soil Resistance Meter (Megger Model DET4T2).

The soil corrosivity was evaluated based on the results of the field soil electrical resistivity assessment and the chemical analyses of the two soil samples. The soil samples were obtained by Landmark from a depth of approximately 3 feet. The samples were analyzed for pH, soluble salts (chlorides and sulfates) as well as resistivity in the saturated condition.

The thermal resistivity was determined using a Decagon KD2 Pro Portable Thermal Properties Analyzer (KD2 Pro) outfitted with the 100 mm long, 2.4 mm diameter TR-1 sensor. The KD2 Pro works in accordance with ASTM D5334-08 using a transient heat method.

CONCLUSIONS

The following are significant conclusions resulting from this assessment:

1. The results of the field electrical resistivity assessment are provided in Table 1. Resistivity readings ranging from less than 77 ohm-cm to 393 ohm-cm. All readings fell within the "Very Corrosive" soil classification (see Discussion).

Table 1 – CalEnergy Black Rock Site Soil Electrical Resistivity Data Prepared by: RFYeager Engineering Test Date: 9.29.2022							
		Soil Resistivity (Ohm-cm)					
	Assessment Site	Ave. Soil Depth (feet)					
Test No.	**ID**	**40**	**20**	**15**	**10**	**5**	**2.5**
1	ER-1 (E/W Orientation)	<77[2]	77	86	153	192	239
	ER-1 (N/S Orientation)	<77	77	115	172	239	287
2	ER-2 (E/W Orientation)	<77	77	115	134	287	393
	ER-2 (N/S Orientation)	<77	77	115	172	278	345

1 - See Figure 1 for soil assessment location relative to project site
2 - Electrical resistivity below detectable level of field equipment

2. The chemical analysis results are provided in Table 2. Both samples contained very high concentrations of sulfates (i.e. greater than 1000 ppm). One of the two samples contain high chloride concentrations (i.e. greater than 300 ppm). The saturated soil resistivities of the two samples were very low at 270 ohm-cm and 180 ohm-cm, respectively. The pH readings were indicative of slightly alkaline soil conditions.

Table 2 – CalEnergy Black Rock Site Chemical Analysis Data Prepared by: RFYeager Engineering				
Sample ID[1]	**Min. Soil Box Resistivity[2] (ohm-cm)**	**Chloride Concentration[3] (ppm)**	**Sulfate Concentration[4] (ppm)**	**pH[5]**
1	270	260	2520	7.9
2	180	730	2040	7.8

1 - See Figure 1 for soil sample location. Soil sample taken from a depth of 3 feet
2 - Min. Electrical Resistivity - Miller Soil Box Method, Cal. Test 643
3 - Soluble Soil Chlorides - Cal. Test 422
4 - Soluble Sulfate Content - Cal. Test 417
5 - pH - Cal. Test 643

3. The data collected from the project site indicates that the soil should be considered as very aggressive to buried metallic utilities. This conclusion is based upon the low soil resistivities and high concentrations of soluble salts.

4. Overall, the data from project site indicates that the surrounding soil will support and promote metallic corrosion. Accordingly, supplemental corrosion control measures, such as cathodic protection, are recommended for any buried metallic utilities in order to prevent premature failure.

5. The soil thermal resistivity is provided in Table 3. The corresponding Time vs. Temperature graphs for each assessment site is provided in Appendix A.

Table 3 – CalEnergy Black Rock Site **Thermal Resistivity Data** Prepared by: RFYeager Engineering	
Sample ID[1]	**In-Situ Thermal Resistivity[2] (m $^{0}CW^{-1}$)**
TR1	0.67
TR2	0.87

1 - See Figure 1 for test location relative to project site
2 – ASTM D5334-08.

DISCUSSION

Electrical Resistivity Assessment

Soil electrical resistivity (inverse of conductivity) measures the ability of an electrolyte (soil) to support electrical current flow. The most common method of measuring soil electrical resistivity is the Wenner 4-Pin Method which uses four pins (electrodes) that are driven into the earth and equally spaced apart in a straight line. The Wenner 4-pin Method provides an average resistivity of a hemisphere (essentially) of soil whose radius is approximately equal to the pin spacing. For example, the electrical resistivity value obtained with the pins spaced at 5 feet apart is the average resistivity of a hemisphere of soil from the surface to a depth of 5 feet. By taking readings at different pin spacings (or depths), average soil electrical resistivity conditions can be obtained within areas at, above, and below trench zones.

Corrosion versus Resistivity

Corrosion is an electrochemical process, whereby the reaction rate is largely dependent upon the electrical conductivity of the surrounding electrolyte. Accordingly, the lower the electrical resistivity, then the greater the current flow and the greater the corrosion rate assuming all other factors are equal.

One common relationship between corrosivity and soil electrical resistivity used by corrosion engineers is provided below.

Corrosivity	Electrical Resistivity
Very Corrosive	0-1000 ohm-cm
Corrosive	1001-2000 ohm-cm
Fairly Corrosive	2001-5000 ohm-cm
Moderately Corrosive	5001-12000 ohm-cm
Slightly Corrosive	12001-30000 ohm-cm
Relatively Non-Corrosive	Greater than 30001 ohm-cm

Thermal Resistivity Assessment

Thermal resistivity of the soil was measured at two locations selected by Landmark within the Black Rock site. Assessments were conducted within test pits at a depth of approximately 2 feet. At each site, the thermal resistivity was measured three times with the average provided in Table 3. The assessment was conducted in general accordance with the standard method ASTM D5334-08 which calculates thermal resistivity by monitoring the dissipation of heat from a line heat source. The field assessment consists of inserting a thermal sensor into the soil with a known current and voltage applied. The corresponding temperature rise in the soil over a period of time is recorded. The thermal resistivity is obtained from an analysis of the time series temperature data during the heating and cooling cycle of the sensor.

For purposes of this report, the thermal resistivity values are provided as "data only" in order to assist others in the project design.

Thank you for this opportunity to provide these corrosion engineering services. Please contact me if you have any questions.

Randy J. Geving, PE
Registered Professional Engineer – Corrosion No.1060
RGeving@RFYeager.com, 760.715.2358

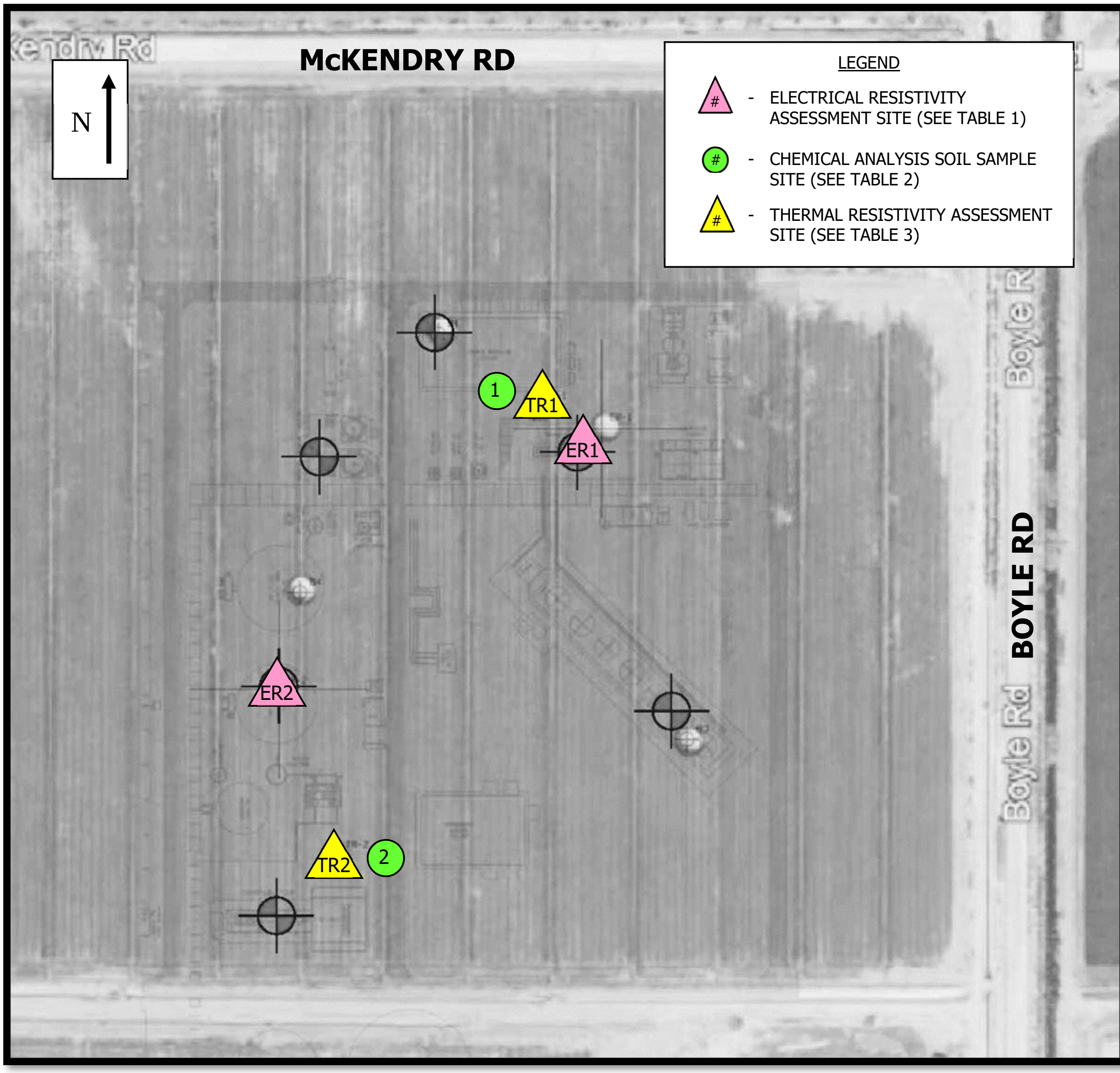
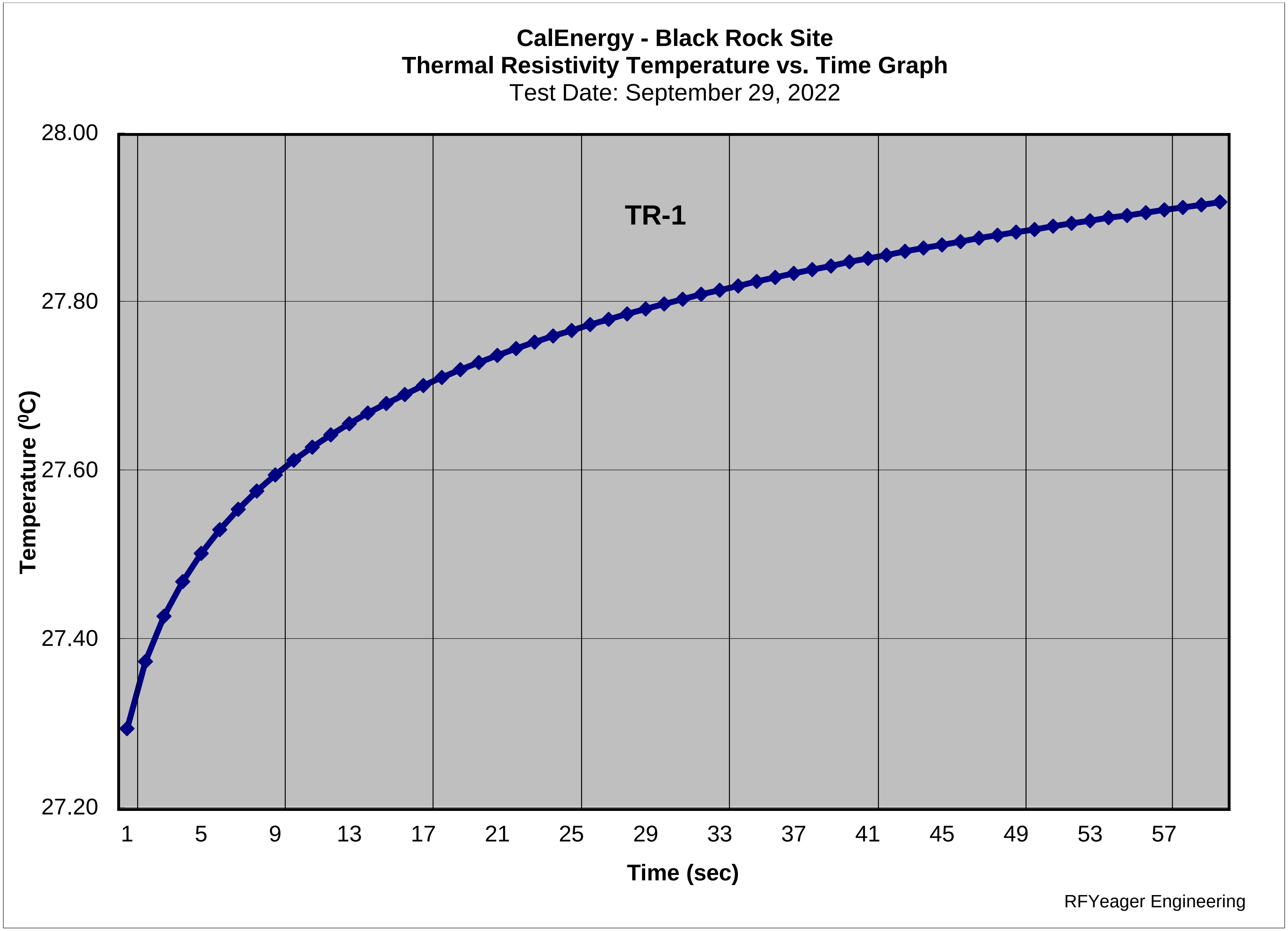


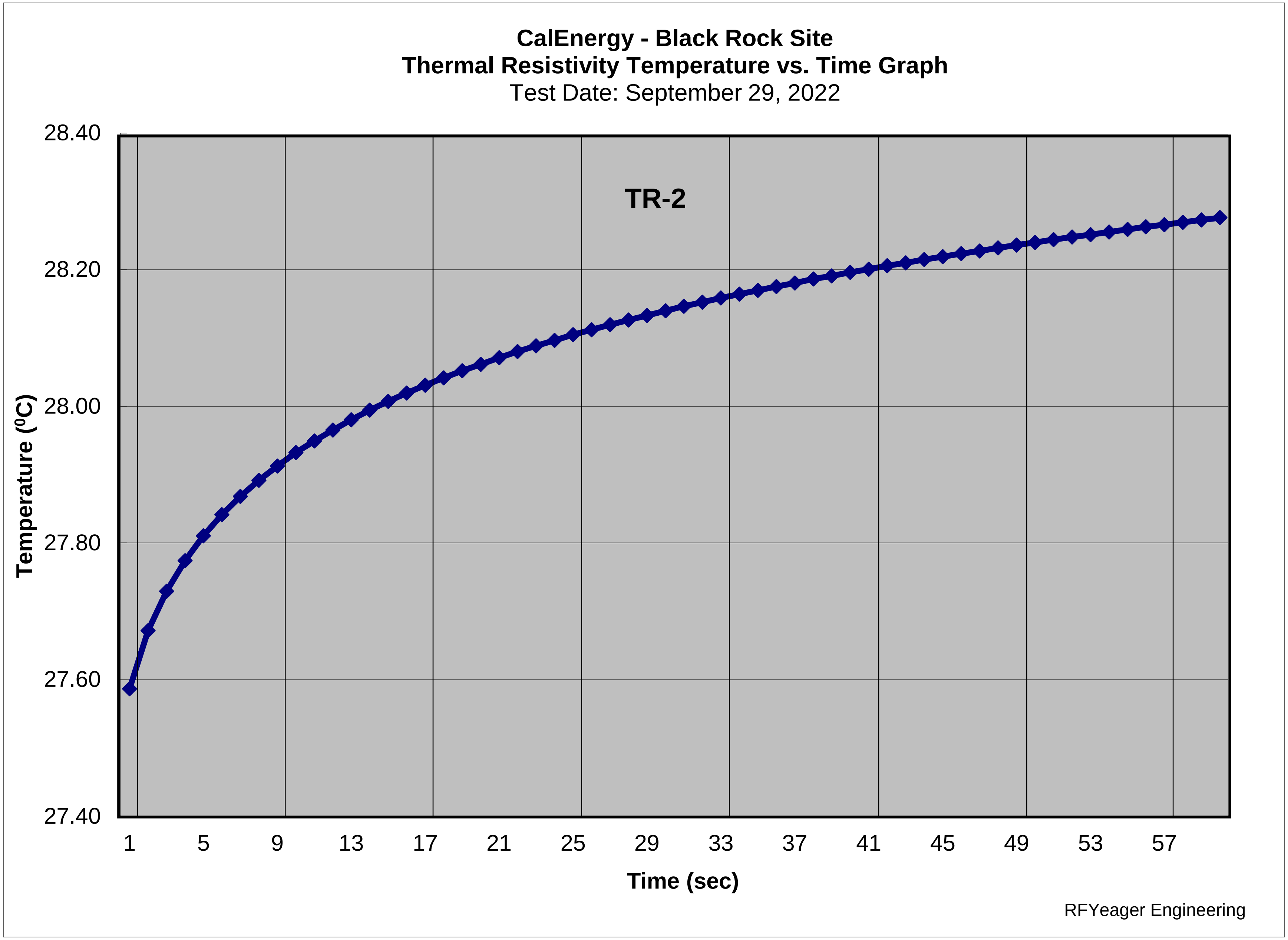
Figure 1 – CalEnergy Black Rock Assessment Locations

APPENDIX A

THERMAL RESISTIVITY

TEMPERATURE VS. TIME GRAPHS


CalEnergy - Black Rock Site
Thermal Resistivity Temperature vs. Time Graph
Test Date: September 29, 2022
TR-1
28.00
27.80
27.60
27.40
27.20
Temperature (⁰C)
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
Time (sec)
RFYeager Engineering


CalEnergy - Black Rock Site
Thermal Resistivity Temperature vs. Time Graph
Test Date: September 29, 2022
TR-2
28.40
28.20
28.00
27.80
27.60
27.40
Temperature (°C)
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
Time (sec)
RFYeager Engineering