FINAL GEOTECHNICAL REPORT
CENTINELA SOLAR ENERGY FACILITY
IMPERIAL COUNTY, CALIFORNIA

Prepared for

FLUOR CONSTRUCTORS INTERNATIONAL, INC. (FCI)
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GDC Project No. IR-558
June 25, 2012
Revised July 11, 2012

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June 25, 2012
Revised July 11, 2012

Fluor Constructors International, Inc. (FCI)
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Attention: Steve Parente
Corporate Procurement & Contracts

Subject: Final Geotechnical Report
Centinela Solar Energy Facility
Imperial County, California
Group Delta Project No. IR-558

Dear Mr. Parente:

Group Delta Consultants (GDC) is pleased to submit our Final Geotechnical Report on supplemental geotechnical investigation for the subject project. This work was performed in general accordance with our proposal dated February 15, 2012 and Fluor Contract No. A4XR-00-K014 dated May 1, 2012. This report was submitted as draft and includes responses to review comments provided via Email by Dilip Sidhpura on June 28, 2012 and results of additional percolation tests performed at your request.

We appreciate the opportunity to provide our services on this important project and look forward to working with you during construction of the project.

Yours Sincerely,
GROUP DELTA CONSULTANTS, INC.

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FIANL GEOTECHNICAL REPORT
CENTINELA SOLAR ENERGY FACILITY
IMPERIAL COUNTY, CALIFORNIA

1.0 INTRODUCTION

This report presents our recommendations for the foundation design of the proposed Centinela Solar Energy Facility to be located in the Vicinity of State Highway 98 and Brockman Road about 7 miles west of Calexico, California. The 175 megawatt Solar Energy Project will utilize Photovoltaic solar technology. The site location is presented in the Vicinity Map, Figure 1A. An aerial view of the site is shown in Figure 1B. The site overall plan and the exploration locations are shown in Figure 2. A Geotechnical Investigation Report was prepared by LandMark Consultants, Inc. in February 2010 for Centinela Solar Energy, LLP for this site. A field load test program consisting of tensile and lateral load tests was performed at the site and the results were submitted in a report by Holdrege & Kull (2011). In response to Fluor's Proposal Invitation Letter dated February 7, 2012 for a supplementary geotechnical investigation, Group Delta Consultants (GDC) submitted a proposal on February 15, 2012. The project was put on hold and a contract was issued on May 1, 2012. GDC performed supplementary field investigation and laboratory testing at the site.

1.1 Objectives of the Geotechnical Evaluation

The objective of this report is to provide site-specific geotechnical recommendations for the design and construction of the proposed solar plant development.

1.2 Scope of Work

We performed the following general scope of work in order to fulfill the objectives of our services:

- Review the existing geotechnical and load test data at the site (LandMark Consultants, Inc., 2010, and Holdredge & Kull, 2011 and 2012);
- Drill and sample 16 hollow stem borings and perform 21 Cone Penetration Tests (CPT) soundings at the site;
- Install piezometers for groundwater monitoring in four borings;
- Perform six percolation tests at three locations;
- Perform seismic shear wave velocity measurements in two CPTs;

- Perform electrical resistivity testing at 11 locations to depths ranging from 2 to 50 ft and at one location from 2 to 800 feet;
- Perform laboratory testing on samples from the borings;
- Perform geotechnical analyses to develop recommendations for the foundation design and construction of the proposed structures;
- Document our analyses and recommendations in this report.

1.3 Project Description

The project site is about 1,700 acre site located in Imperial County, California, see Figures 1A and 1B. The site is bounded by Rockwood Road on the east side and Westside Main Canal on the west side. Fisher Road forms the northern boundary of the site. The proposed Plant area will be located in about 1,000 acres of land within the area shown in Figure 1B. The solar panels are planned to be supported on W6x8.5; W6x15; and W6x20 galvanized steel piers (posts) embedded 5 to 10 ft into the ground and 4 to 5 ft above the ground. The area of Boring B-29 and SCPT-20 is the common area where many of the following facilities will be located.

- A 115,000- gal fire water tank, 31-ft diam. and 24 ft high;
- Five fire water tanks (10,000) gallons each scattered throughout the site;
- A 50 by 100 by 20 ft tall service building with column spacing of about 25 ft and estimated load of 25 to 30 kips each;
- A leach field for sewage disposal;
- Fire water pump skid 8 ft by 12 ft loaded to 2,000 psf;
- Water treatment skid and other miscellaneous skids (5 to 15 kip);
- Inverters up to 40 kip supported on a 35 x 15 ft skid on six drilled caissons located throughout the site;
- Miscellaneous pipe / electrical supports weighing 5 to 10 kip;
- Evaporation Retention Basins 6 to 8 ft deep;
- Gravel and dirt roads capable of handling a fire truck;
- Paved road for plant access; and
- Solar Panel Supports located throughout the site.

2.0 GEOTECHNICAL INVESTIGATION

2.1 Field Investigation

The field investigation consisted of the following investigations performed between May 14 and June 5, 2012.

- Drilling 16 hollow stem auger borings (B-16 through B-31);
- Performing 21 CPT soundings (C-1 through C-21);
- Two SCPTs with shear wave velocity measurements (SCPT-1 and SCPT-20);
- Installing groundwater monitoring wells in four borings;
- Performing four percolation tests at two sites; and
- Performing electrical resistivity testing at 12 locations.

Significant restrictions regarding sequence of drilling and CPTs and days on which certain fields were available for drilling were placed on the field operations due to the fact that the fields were still being actively cultivated by the farmers. Due to these restrictions, the drilling and CPTs were completed in two mobilizations May 14 through May 16, 2012 and May 30 and 31, 2012. The boring, CPT, electrical resistivity, load test, thermal resistivity, and other geotechnical investigation locations are shown in Soil Boring Location Plan, Figure 2.

2.2 Drilling and Sampling

Borings were drilled by GDC's drilling subcontractor Pacific Drilling Company under the continuous technical supervision of a GDC field engineer, who visually inspected the soil samples, measured groundwater levels, maintained detailed records of the borings, and visually / manually classified the soils in accordance with the ASTM D 2488 and the Unified Soil Classification System (USCS). Logging and classification was performed in general accordance with Caltrans "Soil and Rock Logging, Classification, and Presentation Manual (2010 Edition)". A Boring Record Legend and Key for Soil Classification are presented in Figures A-1A through A-1E. The boring records are presented in Figures A-2A through Figure A-17B. Details of sampling procedures, type of samplers, blow counts, etc. are presented in Appendix A.

2.3 CPT Testing

The CPTs were pushed to depths of 30-ft to 60-ft below the ground surface by Kehoe Testing and Engineering (From May 14 through May 16, 2012) and by Middle Earth Geo Testing, Inc. (on May 30 and 31, 2012). Details of CPT procedures and interpretation are discussed in Appendix A. The logs and interpretation of the CPTs are presented in Figures A-18 through A-38 in Appendix A. Boring data by LandMark is included in Appendix A-1.

2.4 SCPT Testing

Shear wave velocity measurements were made in SCPT 1 and SCPT 20. The shear wave velocity data are shown in Table 1.

2.5 Laboratory Testing

Laboratory testing performed on the samples recovered from the borings included:

- Moisture content;
- Dry density;
- Percent passing No. 200 sieve;
- Grain size distribution including hydrometer;
- Atterberg Limits;
- Expansion index;
- CBR;
- Pocket penetrometer; and
- Soil corrosion potential.

The laboratory test results are presented in the boring logs and in Appendix B. Laboratory data by LandMark (2010) is included in Appendix B-.

2.6 Piezometer Installation

A total of four piezometers were installed in Borings B-16, B-18, B-23, and B-31. The piezometers consisted of a 2-in. diameter perforated pipe installed in the 20-ft deep borings. A typical well is shown in Figure A-39. The final readings of the wells were taken on June 5, 2012 and the wells were cutoff 2-ft below the surface and abandoned due to objections by the Farmers. The final water level readings are shown in Table A-1.

2.7 Percolation Testing

Percolation testing was performed at two locations PT-1 and PT-2 in the leach field area shown in Soil Boring Location Plan, Figure 2. Two tests PT-1A and PT-1B were performed at PT-1 location and two tests PT-2A and PT-2B at PT-2 location. Test PT-2A could not be completed since the drilled hole could not hold water. A test was completed at PT-2C in lieu of PT-2A. The tests were performed in accordance with the requirements outlined in Appendix C. At the request of Fluor two additional tests were performed at PT-3A and PT-3B. Test locations are shown in Figure A-47 in Appendix A. The tests were performed using the Standard Method of Conducting Percolation Tests which includes:

1. Drill a hole with 1 square foot x-section to a depth of 4 ft but not more than 3 ft below the depth of the proposed leach field.

2. Remove loose soil from the hole and score the sides to remove smeared soil

3. Fill the hole to a depth of 1 ft with clean pea gravel.

4. Fill the hole to a depth of 6- in. above the top of the gravel and maintain the water in the hole for 24 hours until the hole is saturated.

5. Measure the water drop as follows:

    - Fill the hole to depth of 6 inch above the gravel and let it drop.
    - The rate of drop is measured in minutes and the drop recorded in inches. The rate is recorded in minutes per inch.
    - Make a minimum of three determinations and two determinations must have no more than 10% deviation in drop.
    - Additional saturation may be required if larger deviation is encountered.

6. The results are reported in minutes per inch of drop and calculation of percolation is done using the standard formula:

$$P_t = 5 / (t)^{0.5}$$

Where P_t is the percolation rate in gallons per square foot per day and t is the rate of drop in minutes per inch.

A summary of the percolation tests using this procedure are shown in Table 3. Percolation test sheets are shown in Figures A-40 through A-46 in Appendix A. The test locations are shown in Figure A-47.

2.8 Electrical Resistivity Testing

Electrical resistivity testing was performed at 11 locations to depths ranging from 2 to 50 ft and at one location from 2 to 800 feet by our subcontractor Subsurface Surveys Associates, Inc. of Carlsbad, California. Their report is included in Appendix D. There is no evidence of anisotropy at the site. In general, there is decrease of resistivity from north to south. For example, there is gradual decline form 20-30 ohm-ft (600 to 900 ohm-cm) in the north (ER-1) to less than 10 ohm-ft (300 ohm-cm) in the south (ER-10 and ER-12). The deep test ER-11 shows no significant change in resistivity with depth to 800 feet. The planned deep test to 1,000 ft was terminated at 800 ft depth due to site and equipment limitations.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

The project site is about 1,700 acre area located in Imperial County, California, see Figures 1A and 1B. The site is bounded by Rockwood Road on the east side and Westside Main Canal on the west side. Fisher Road forms the northern boundary of the site. State Highway 98, a paved two-lane highway, crosses the site from east to west in the lower portion of the site (see Figure 1B).

The site is located below sea level with elevations ranging from about El. -10 ft on the south side to El. -25 ft on the north side. These elevations are approximate and are based on the information obtained from the 3D Google Earth Map. The site slopes gently to the north at about 1 in 500. The site is used for agricultural purposes and at the time of the investigation was under active cultivation. The surface ranges from lightly vegetated with grass, to recently plowed/tilled, to unimproved dirt road. Areas or highly cracked and saturated soils are also present. Typical Site Photographs are shown in Appendix E.

3.2 Geology and Seismicity

The project site is located in Imperial Valley portion of the Salton Trough physiographic province. The site geologic map is shown in Figure 3. The regional and local faults are shown in Figures 4A and 4B, respectively. The Salton Trough is a topographic and structural depression caused by large scale faulting and fault related deformation. The Trough is bounded by San Andreas on the northeast and San Jacinto and Elsinore Fault Zone on the southwest (Figure 4A). This area has the highest strain rates in the entire US and some of the highest seismicity rates in all of California. Major faults include Elsinore, San Jacinto, San Andreas and Imperial. Several recent earthquakes on non-major faults have occurred such as Big Bear, Landers, Joshua Tree, and Superstition Hills.

3.3 Subsurface Conditions

The borings and CPTs confirm the soil conditions disclosed by previous borings (LandMark, 2010). The soils in the upper 10 ft (depth critical for design of the supports for solar panels) primarily consist of moderate to high plasticity clays with liquid limits ranging from 30 to 65 and PI ranging from 13 to 45. The natural moisture contents range between 16 and 33 percent. The near-surface clays have high to very high expansion potential (EI 100-154). The undrained shear strength of the clays from pocket penetrometer and interpreted from CPTs is plotted in Figure 5 and shows that the clays are generally stiff to very stiff with undrained shear strength generally above 1 ksf. Zones of loose to medium dense sands and silty sands are present in the upper 10 ft in some borings.

Below 10-ft depth, the clays continue to depths of 20 to 40 ft below which the soils consist of alternate layers of sands and silty sands, silts, and clays. The sands are generally medium dense to very dense and clays are generally stiff to hard.

3.4 Groundwater

Groundwater was encountered during drilling at depths of 6 to 13.8 ft below the existing grade in the hollow stem auger borings. Piezometers were installed in four borings to monitor the stabilized groundwater and showed that the stabilized groundwater was generally higher and ranged between 3.8 and 7.5 feet below the existing grade. The final reading was taken on June 5, 2012 and the piezometers were abandoned due to objections by the farmers. The groundwater may fluctuate based on irrigation and rainfall. Long-term groundwater elevation without irrigation may be deeper than the measurements taken while irrigation is ongoing. Measured groundwater data are shown in Table A-1. Based on the current conditions, the design groundwater may be taken as 4 feet. Actual groundwater may be deeper after irrigation of the fields is stopped.

Based on information in the LandMark (2010) report and discussions with Fluor, subsurface tile drainage pipelines (4-in. diam. plastic or clay perforated pipes wrapped in gravel) are present at depths of 5.5 to 6 ft below the ground surface. These pipelines are used to remove salt accumulating from irrigation and crop production. These pipelines should be removed under buildings, leach field, and other significant structures.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Potential Geologic and Seismic Hazards

Potential geologic and seismic hazards for any site include ground rupture, slope instability, lateral spreading, subsidence, collapsible or highly expansive soils, liquefaction, seismic compaction and settlement, tsunamis / flooding, and seismic shaking.

4.1.1 Ground Surface Rupture

The site is not located within an Alquist-Priolo (AP) earthquake fault zone. The closest major faults are Elsinore Fault Zone, San Jacinto Fault Zone, Brawley Seismic Zone, Imperial fault and San Andreas Fault Zone located at distances of 10 to 46 miles from the site (see Figures 4A and 4B). These faults are capable of generating earthquakes with magnitude ranging from 6.6 to 7.9. Due to distance from the known faults, fault rupture is not a significant hazard at the site.

4.1.2 Seismic Hazard Analysis

Strong shaking should be anticipated during the design life of the project. Nearby active faults are illustrated in Figures 4A and B. The measured shear wave velocity at the site ranges between 400 ft/sec to 900 ft per sec in the upper 60 feet (see Table 1). Based on the soil profile, the site is classified as Site Class D for seismic analyses. For facilities designed in accordance with California Building Code (CBC) 2010 and ASCE 7-05, the seismic design recommendations are presented in Table 2. Design peak horizontal ground acceleration (PGA) is 0.37g. Seismic Deaggregation analysis was performed for 475 years return period to determine probabilistic PGA and Modal Magnitude and the results are shown in Figure 6. The PGA is 0.41 g and the maximum modal magnitude is M 6.8 for a 475 year return period.

4.1.3 Liquefaction Potential

Liquefaction is a seismic phenomenon in which loose to medium dense, saturated, granular soils (primarily sand, silty sand, and sandy silt) lose strength and behave like a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when three conditions simultaneously exist: (1) shallow groundwater, (2) low-density sandy soils, and (3) high-intensity ground motion. Dense granular soils and cohesive soils generally exhibit low to negligible liquefaction potential. Effects of liquefaction on level ground can include sand boils, settlement, and bearing capacity failures below structural foundations. Under sloping ground conditions, slope failure in the form of liquefaction induced lateral spreading is possible.

The current groundwater is quite shallow at a depth of about 4 to 5 feet. Zones of loose to medium dense sands are present below the groundwater within the upper 50 feet of the profile and could be subject to liquefaction during a major earthquake. We performed liquefaction calculations for CPT-01, CPT-02, and CPT-18 using a groundwater depth of 5 feet below existing grade. Liquefaction calculations were based on the simplified method outlined in the NCEER 1996/1998 Workshops (Youd and Idriss, 2001). Settlements were calculated using the method of Tokimatsu and Seed (1987), and residual strengths were based on the method of Seed and Harder (1990). Calculations were carried to a depth of 50 feet below existing grades. We used a Magnitude of 6.8 (based on deaggregation analysis, Figure 6) and a PGA of 0.37g (Table 2) for design level earthquake. The resulting analyses show that limited zones of silty and sandy soils below a depth of 5 ft below site grade may liquefy in the design earthquake. Estimated liquefaction-induced grounds settlements for the CPTs analyzed are generally less than 0.5 inches for the design level earthquake. Settlements for the MCE level earthquake can be as high as 1.3 inches. Differential settlements for design level earthquake may be taken as 50% of the maximum total settlement or about 0.25 inch. These settlements are smaller than the values obtained by LandMark (2010) based on boring data. In general, boring data overpredict liquefaction settlements and therefore, we recommend that the settlements based on CPT data (0.5 inch total and 0.25 in. differential) be used for design.

4.1.4 Other Seismic Hazards

Due to very shallow groundwater, seismic compaction is not an issue. Although settlements of 0.5 to 1.3 inch (depending on the PGA) could occur due to liquefaction, the site is generally level and therefore, no lateral spreading is anticipated. The site has no known history of subsidence. The site is generally level and no post-construction slopes are planned. Therefore, slope stability is not a hazard at the site. All low-lying areas along California's coast are subject to potentially dangerous tsunamis. Due to the distance from the ocean, tsunamis are not a hazard at the site.

Expansion index tests performed on a near-surface clayey soil at Boring B-29 and B-16 indicate and EI of 114 and 131 showing high to very high expansion potential. Other borings indicate EI in the range of 100 to 154 (LandMark, 2010). Building foundations and slab on grade floors must be designed for very high expansion potential.

4.1.5 2010 CBC Seismic Design

For seismic analysis in accordance with the provisions of the California Building Code (CBC, 2010), we recommend the seismic design parameters and the response spectra shown in Table 2.

4.2 Shallow Foundations

4.2.1 Expansive Soils

A 50 by 100 by 20 ft tall service building with column spacing of about 25 ft and estimated load of about 30 kips each is planned in the Common Service Area. The building Plan is shown in Figure 7. The near-surface soils have high plasticity (PI 40-45) and high to very high expansion potential (EI =100 to 154). Due to expansion index greater than 20, the foundations and slabs must be designed for expansive soils in accordance with the provisions of 2010 CBC Section 1808.6. One of the following three methods may be used to mitigate the effects of expansive soils.

1. Buildings should be designed in accordance with WRI/CRSI Design of Slab-on-Ground Foundations, 1808.6.2 OF 2010 CBC; or
2. PTI Standard Requirements for Analysis of Shallow Concrete Foundations on Expansive Soils as per Section 1808.6.2 of 2010 CBC; or
3. The expansive soils should be removed and replaced with non-expansive granular fill (EI<20) compacted to minimum 90% of the maximum dry density to a minimum depth of 5 ft below the bottom of the slab.

A slab and grade beam system using the WRI/CRSI method may be designed for a weighted plasticity index of 45. Recommended parameters for design of post-tensioned slabs are provided in Table 4.

Since the existing drain pipes under the building area will be excavated and removed to a depth of 5 to 6 ft, the excavated area should be backfilled with compacted granular soils. This is the simplest method to mitigate the expansive soils problem. The non-expansive imported granular fill should have an EI<20, minus 200 sieve less than 30, and maximum size of 3 inches. The fill shall be compacted to at least 90% maximum dry density as per ASTM D1557 standard in the building area plus 5 ft around the perimeter of the building.

4.2.2 Bearing Capacity

The building may be supported on shallow spread footings and slab-on grade if expansive soils are mitigated by using non expansive granular backfill to a depth of 5 ft below the building foundations.

Any shallow footings should have a minimum width and minimum embedment in accordance with Section 1809 of 2010 CBC. For minimum footing dimensions and depth of embedment an allowable bearing pressure of 2,500 psf may be assumed in the design of shallow spread foundations supported on compacted engineered fill. This value has a minimum factor of safety of 3 with respect to a bearing failure.

The allowable pressures above may be increased by 33% for short-term loading conditions such as wind or seismic. The allowable bearing pressures assume that the footings are founded in properly compacted fill.

4.2.3 Settlement

The majority of the settlement is anticipated to occur during or shortly after application of structural loads. Assuming that the building footings are supported on about 5 ft of compacted granular soil, we estimate that total column settlement for a 4 ft by 4 ft footing loaded to 2.5 ksf (40 kip load) will be less than 0.5 inch. The differential settlement between columns or wall footings will be on the order of ¼ inch.

In addition to the structural building loads, post-construction differential settlement of up to 0.25 inch may occur due to the liquefaction. Based on this, we recommend that all building foundations and floor slab be designed for a total settlement of 1.0 inch and a differential settlement of 0.5 inch.

4.2.4 Lateral Resistance

For footings placed in compacted granular or native soils on level ground above the water table, we recommend an ultimate passive fluid pressure of 350 pcf. For foundations below water table (4 ft depth), the passive equivalent fluid pressure may be taken as 180 pcf. We recommend an ultimate sliding friction coefficient of 0.35 for design. Passive and sliding resistance may be used in combination without reduction. Required factor of safety is 1.5 for static loads and 1.1 for wind or seismic loads.

4.2.5 Slab-on-Grade

Normal slab on grade floors shall be underlain by a minimum of 5 ft non-expansive onsite soils compacted to 90% relative compaction. The slab-on-grade floor should be a minimum of 5 inches thick and should be reinforced with at least No. 3 bars on 18-inch centers, each way. The actual slab thickness and reinforcement should be determined by the structural engineer.

4.2.6 Moisture Protection of Slabs

Concrete slabs constructed on grade ultimately cause the moisture content to rise in the underlying soil. Excessive moisture coming through the concrete may cause mildewed carpets, lifting or discoloration of floor tiles, or similar problems. To decrease the likelihood of problems related to damp slabs, suitable moisture protection measures should be used where moisture sensitive floor coverings or moisture sensitive equipment are used.

The most commonly used moisture barriers in Southern California consist of two to four inches of clean sand or pea gravel covered by 'Visqueen' plastic sheeting. Two inches of sand are commonly placed over the plastic to decrease concrete curing problems. It has been our experience that such systems could transmit about 6 to 12 lbs of moisture per 1,000 square feet per day. The project architect should review the estimated moisture transmission rates, since these values may be excessive for some applications, such as sheet vinyl, wood flooring, vinyl tiles, or carpeting with impermeable backings that use water soluble adhesives. The architect should specify an appropriate moisture barrier based on the allowable moisture transmission rate for the flooring.

The American Concrete Institute provides detailed recommendations for moisture protection systems (ACI 302.1 R-04). ACI defines a "vapor retarder" as having a minimum thickness of 10-mil, and a water transmission rate of less than 0.3 perms when tested in accordance with ASTM E96. The vapor membrane should be constructed in accordance with ASTM E1643 and E1745 guidelines. All laps or seams should be overlapped a minimum of 6 inches, or as recommended by the manufacturer. Joints and penetrations should be sealed with pressure sensitive tape, or the manufacturers recommended adhesive. The vapor membrane should be protected from puncture, and repaired per the manufacturer's recommendations (if damaged). The project architect should review ACI 302.1R-04 along with the moisture requirements of the proposed flooring system, and incorporate an appropriate level of moisture protection as a part of the flooring design.

The vapor membrane is often placed over 4 inches of a granular base material. The base should be a clean, fine graded sandy material with 10 to 30 percent passing the No. 100 sieve. The base should not be contaminated with clay, silt, or organic material. The base should be proof-rolled prior to placing the vapor membrane.

Based on current ACI recommendations, concrete should be placed directly over the vapor membrane. The common practice of placing sand over the vapor membrane may increase moisture transmission through the slab, because it provides a reservoir for bleed water from the concrete to collect or water may enter the sand from other sources after construction. When placing concrete directly on an impervious membrane finishing delays may occur. Care should be taken to assure that a low water to cement ratio is used, the slab is adequately reinforced, and other necessary measures are taken to reduce shrinkage cracking. The concrete should be moist cured in accordance with ACI guidelines.

4.3 Drilled Pile Foundations

We understand drilled and cast in place piles may be used for support of the inverter skid foundations or pipe or electrical supports. We recommend that short drilled pile (< 10 ft penetration) may be designed for an allowable friction of 500 psf. Due to potential cracking of near-surface soils, the friction in the upper 2 ft should be ignored. Due to presence of shallow groundwater, we recommend that end bearing be ignored. As an example, a 2-ft diameter 8 ft long pile may be designed for allowable axial compressive capacity of 19 kips. Tensile capacity may be taken as 70% of the compressive capacity. Groundwater should be anticipated for drilled pile excavations deeper than 5 feet. Any water in the hole shall be pumped out and concrete placed in dry. If this is not feasible, the concrete shall be placed by tremie and shall displace the water in the hole as the concrete is placed. The bottom of the tremie shall be kept in the concrete as the concrete displaces the water.

4.4 Miscellaneous Foundations

Miscellaneous foundations for water treatment skids, pumps, inverters, small water tanks may be supported on mat foundations using an allowable bearing pressure of 2,500 psf provided the drainage pipes are removed and the area backfilled with compacted fill. Minimum embedment of the mat should be 12 inches below surrounding grade.

4.5 Water Tanks

Fire water tank with a diameter of 31 ft and height of 24 ft is located in the Common Services Area. Smaller Tanks with capacity of 10,000 gallons will be constructed throughout the site. Smaller tanks may be supported on concrete mat foundations and larger tanks may be supported on concrete or crushed stone ring walls. The maximum loading from the 24-ft high tank will be on the order of 1,600 psf. The existing drain pipes should be removed under the tank foundations and soils replaced with compacted fill. The upper 3 ft of fill under the tank and ring walls shall be granular soils meeting the imported fill requirements in Section 4.2.1. Crushed aggregate may be used in lieu of granular fill.

The tank should be hydrotested and settlement during hydrotest be measured at four points along the periphery of the tank. Most of the settlement is expected to be completed during filling of the tank and within a few days after completion of the filling. The water in the tanks should be kept for a minimum of 72 hours. GDC should review the settlement data before removing the water. All permanent connections should be made after completion of the hydrotest. We estimate that the settlement of the tank during hydrotest will be on the order of 1 to 2 inches.

4.6 Solar Panel Supports

4.6.1 Design Loads

The design pier loads provided by Fluor are listed in Table 5. There are two types of Piers, Bearing Pier and Gear Box Pier. The steel section proposed for the Bearing Pier is W6x8.5 and for the Gear Box Pier W6x15 or W6x20. A 4-in diameter standard pipe may be used to support a portion of the gearbox but has no lateral load. The dimensions and properties of the steel sections are shown in the following table.

Section	**A, in^2**	**d, in.**	**bf, in.**	**Ixx, in^4**	**Iyy, in^4**
W6x9 (Test)	2.68	5.9	3.94	16.4	2.19
W6x8.5	2.52	5.88	3.94	14.9	2.0
W6x15	4.43	5.99	5.99	29.1	9.32
W6x20	5.87	6.20	6.02	41.4	13.3

Based on the data in Table 5, design loads for the Bearing Pier for axial compression, tension, and lateral are 0.42 kip, 1.32 kip (1.4), and 1.38 kip (1.4) applied at a height of 4 feet. The connection at the top of the pier is such that no moment is transferred to the top of the pier. For Gear Box Pier, the corresponding design loads for axial compression, tension, and lateral are 0.65 kip, 1.22 kip, and 0.35 kip applied at a height of 4 feet. In addition, a moment of 18 ft-kip is transferred to the top of the pier from the gear box. Therefore, the applied moment at the groundline is 0.4x4+18 = 19.6 ft-kips. The Piers supporting the solar panels and the gear box will be oriented so that the loading is applied in the strong direction. The required lateral deflection under the design loads and moments at a height of 4 ft is1 inch.

4.6.2 Pile Load Test Data

A total of 15 axial tension and 6 lateral load tests were performed at five test pile locations shown as A through E as shown in Figure 2 (H&K 2011). Test piles consisted of W6x9 sections driven to depths of 5 to 8.5 ft below site grade.

Uplift Tests

Uplift loads were applied by using an Enerpac Hydraulic Jack with a load beam supported on a wood cribbing. Maximum tension loads of up to 9,000 lb were applied. A review of the test data indicates that piles at Locations B and E failed in tension at loads ranging between 2,500 and 4,000 lb. This provides a back-calculated average unit friction of 157 to 350 psf.

Assuming an alpha factor of 0.45 and an average friction of 1 ksf in the upper 10 ft, average long-term friction of 450 psf is obtained in the upper 10 feet. This value is much higher than the values measured at two of the locations, B and E. It is not known how much time had elapsed between pile driving and testing. Since the piles were driven in clays, significant set up should be anticipated. The lower measured values could be the result of high pore pressures due to driving which had not dissipated when the test was performed and significant setup was still to occur or could represent localized weaker near-surface soils in the upper 5 to 7 feet.

Lateral Load Tests

For performing lateral load tests, two adjacent piles were jacked apart by an Enerpac jack, which was supported on a wooden cribbing between the piles. Piles were about 5-ft apart. The test load values and resulting cumulative displacement was recorded. The load was applied at a height of 3 to 3.7 ft and the deflection was measured at the point of load application. The lateral loads ranged from 1,200 lb to over 3,000 lb. A plot of these data indicates that in many cases the jack travel had run out without the operator realizing it and the data at higher loads (greater than 1,200 to 1,500 lb) are not correct. The loading was against the weak direction.

Due to the problems with the test program, H&K repeated some lateral load tests at locations B and E (H&K, 2012). These tests indicate that at 1,400 lb load applied at height of 4 ft and pile embedment of 5 ft, the lateral deflection ranges between 0.8 and 1.1 inches. For W6x15 piles, for lateral load of about 2,500 lb applied at a height of 4 ft, 10-ft kip applied moment, the measured deflection at 4-ft height ranges between 0.6 and 1.1 inches.

4.6.3 Pile Analysis

4.6.3.1 Axial Analysis

Based on the back calculated average friction in the range of 157 to 350 psf for two of the test sites, we used an average ultimate friction of 200 psf in the upper 8 feet. For example, for W6x8.5 piles, the ultimate friction for a pile with perimeter of 2.3 ft and penetration of 5 ft may be taken as = 2.3x5x200 = 2,300 lbs. The frictional capacity for W6x8.5 piles for penetrations of 5, 6, 7, and 8 ft are as follows:

Pile Penetration, ft	**Ultimate Frictional Capacity, lbs**
5	2,300
6	2,760
7	3,220
8	5,890

Since the maximum uplift load for the bearing column is 1,320 lb (Table 5), a 6 ft penetration has a factor of safety of greater than 2 with respect to maximum uplift load.

4.6.3.2 Lateral Analysis

For lateral load analyses, we used average undrained shear strength of 1.0 ksf and ε_{50} of 0.01 for determining the p-y curves in the computer program Piled/G (Geosoft, 2000).

We analyzed W6x8.5 piles embedded to depths of 6 to 9 ft, under a lateral load of 1,400 lbs and a groundline moment of 5.6 ft-kip (load applied at 4 ft height) for the Bearing Pier. For the gearbox piles, we analyzed W6x15 piles embedded to depths of 5 to 10 ft under a lateral load of 350 lb and a moment of 19.6 ft-kips at the groundline. Since the lateral deflection was significantly greater than 1 inch at a height of 4 ft, at the request of Fluor, we also analyzed W6x20 piles for the Gearbox Columns. The results of these analyses are presented in Appendix F and summarized in Table 6. The loading was assumed be in the strong direction and the value of Ixx was used for these analyses.

4.6.3.3 Conclusions

Axial test data indicate that a pile penetration of 6 ft is adequate for both compression and tensile loads at this site. Therefore, the minimum design pile penetration is controlled by lateral loads. The following table provides our recommendations for minimum pile penetrations for Bearing and Gear Box piles.

Type of Support	Pile Section	Lateral Load, lb	Groundline Moment, ft-kip	Minimum Pile Penetration, ft	Piletop Deflection, in.
Bearing	W6x8.5	1,400	5.6	8	1.05
Gear Box	W6x15	350	19.6	10	1.66
Gear Box	W6x20	350	19.6	9	1.21
Gear Box	W6x20	350	19.6	10	1.16

The minimum penetration for W6x8.5 piles to limit piletop deflection (4-ft above ground) under a lateral load of 1,400 lb to 1 inch is 8 feet. The minimum piletop deflection for Gear Box piles for a lateral load of 350 lb and groundline moment of 19.6 ft-kip for the W6x15 and W6x20 piles is 1.66 and 1.16 in., respectively, for 10-ft penetration. This indicates that neither pile is capable of reducing the piletop deflection to less than 1 inch. For the Gear Box piles a minimum penetration of 9 ft can be used for W6x20 piles provided a piletop deflection of 1.2 inches is acceptable. The recommended lengths assume that piles are driven in competent native soils or compacted fill. If no leveling or recommended compaction is done and the piles are driven in the existing loose cultivated soils, the recommended minimum penetration shown in this Section should be increased by 1 foot. The actual deflection at the top of the pile may be more than 1 inch for bearing and more than 1.2 in. for gearbox piles, since the moment arm is increased to 5 ft and most of the lateral deflection is contributed by the bending of the freestanding portion of the pile.

4.6.4 Load Test Program

We understand that no additional load test program is proposed. If additional load test program is required, we can provide recommendations for a load test program. It is possible that the pile lengths may be reduced by a well-designed load test program.

4.7 Earthwork and Grading

Existing conditions at the site are shown in Site Photographs in Appendix E. The site conditions consist of ploughed fields, furrows for planting of the crops, and uneven existing soils with variable vegetation. Some areas the vegetation was set on fire. Due to the loose and variable conditions at the site, as a minimum, the site grading will require removal and disposal of vegetation, leveling of the uneven ploughed fields and furrows, and rolling the surface to provide appropriate grade for drainage.

Based on information in the LandMark (2010) report and discussions with Fluor, subsurface tile drainage pipelines (4-in. diam. plastic or clay perforated pipes) wrapped in gravel are present at depths of 5.5 to 6 ft below the ground surface. These pipelines are used to remove salt accumulating from irrigation and crop production. These pipelines should be removed under buildings, tanks, and other significant structures. Any pipes greater than 2 inches in diameter to be abandoned in-place in structure areas should be filled with sand/cement slurry.

There are three types of construction at the site which will require different level of grading and compaction.

1. Gravel, Asphalt, and Dirt Roads

The areas of gravel (aggregate base) and dirt roads should be excavated to the bottom of the subgrade. For a gravel road with 8 inches of aggregate and 12-in. compacted subgrade, the excavation should be made to a minimum of 8 inch and 12 inches of native soils should be brought to optimum moisture content and compacted to 90% relative compaction at a moisture content 0 to 2% wet of optimum per ASTM D 1557.

In the area of the asphalt paved plant entrance road, the excavation should be made to the subgrade level, and bottom recompacted to a depth of 12 in. to 90% relative compaction at a moisture content 0 to 2% wet of optimum. Then the required thickness of base material should be placed and compacted to 90% relative compaction per ASTM D 1557.

For dirt roads where 12 inch of compacted onsite soils serve as the pavement, the excavation should be made to 12-in. depth and bottom scarified and recompacted to 90% relative compaction. Then the 12 inch of soil can be placed in two lifts and compacted to 90% relative compaction.

2. Building, Tank, and other Structures

After removal of the drainage pipes, under the buildings, and other structures such as the Firewater Tank, the bottom should be scarified to a depth of about 8 inches, brought to optimum moisture content and compacted to 90% relative compaction per ASTM D 1557. The water table currently in the area of the building is 6.3 ft below grade. Actual water table may be lower after irrigation is stopped for a period of few months. Wet, saturated, or soft soils are likely to be encountered at or above the excavation level; this may require dewatering and/or removal/stabilization with crushed rock and/or geotextile before placement of compacted fill as directed by GDC in the field. An alternate may be that the excavation is left open to dry out. The area can then be back filled with non-expansive granular fill (EI less than 20 and Minus 200 less than 30) compacted to 90% relative compaction (ASTM D 1557). This will eliminate the need for designing the building slab for highly expansive soils.

3. Tracker Supports

We understand that a typical 13 column tracker consists of with a single gearbox column and 13 bearing columns with a total length of about 205 feet. The bearing columns will consist of W6x8.5 piles and the single gearbox column will consist of a single W6x20 steel pile. A typical tracker layout for Block 1A is shown in Figure 8. The piles will be driven to depths of 8 to 10 ft depending on design. The pile design is based on the assumption that native undisturbed soils with minimum undrained shear strength of at least 1 ksf are present from the ground surface.

With the variable conditions at the site as shown in Appendix E, we recommend that to achieve the design condition, the area of the tracker foundation where the piles are driven, should be cleared of any vegetation, leveled, and compacted by rolling with at least 4 passes of a 8-ton vibratory roller to provide a uniform, level and compacted surface which is resistant to cracking and introduction of water into the soils. As an alternate, the area may be compacted to 90% relative compaction. This recommendation is based on the conditions existing at this time.

The actual conditions at the start of construction are unknown at this time. We recommend that some geotechnical testing by probing, performing insitu density tests, or pocket penetrometer tests be performed before start of the construction to determine the existing conditions at the start of construction and what level of compaction, if any, is required to achieve the design strength. If additional compaction is required, a test section may be used to determine how many passes of the specified roller provide adequate compaction and strength in the field.

If no leveling or recommended compaction is done and the piles are driven in the existing loose and disturbed soils, the recommended minimum penetration shown in Section 4.6.3.3 should be increased by 1 foot. Alternately, the elevation of the tracker assembly could be lowered by 1 ft so that the design "ground level" (See Table 5) is 1 ft below grade to reduce the moment arm.

4. Compacted Fill

All imported granular permanent fill/backfill soils should be brought to near-optimum moisture content and rolled with heavy compaction equipment. Compaction shall be done in maximum 8-inch lifts. All native clays should be compacted at a moisture content of 1 to 3 percent above optimum. General compaction requirement for native or import fill is 90% relative compaction per ASTM D 1557 or 95% relative compaction per ASTM D698. A sufficient number of field density and laboratory compaction tests should be performed during construction to verify minimum compaction requirements. GDC may perform compaction tests or require proof rolling of the subgrade to verify that the foundations will be supported in competent soils. Footing excavations should be clean and free of loose soils, and should be observed by Group Delta Consultants before placement of steel or concrete. Compaction testing depends on the volume of fill to be placed and should be performed as minimum of one test per 5,000 yd^3 provided each lift is tested.

Based on limited insitu data, a shrinkage factor of 10 to 15% may be used for onsite soils recompacted to 90 to 95% recompaction.

4.8 Utility Trenches

4.8.1 Excavation and Shoring

Excavations for utility trenches should be achievable with conventional excavating equipment. All shoring and excavation should comply with current OSHA regulations, and observed by the designated competent person on site.

4.8.2 Bedding

The bedding zone shall be defined as the area containing the material specified that is supporting, surrounding, and extending to 1 foot above the top of the pipe. The bedding shall satisfy the requirements of the Standard Specifications for Public Works Construction (SSPWC) Section 306-1.2.1. There shall be a 4-inch minimum of bedding below the pipe and 1-inch minimum clearance below a projecting bell. There shall be a minimum side clearance of 6 inches on each side of the pipe. Bedding material shall be sand, gravel, crushed aggregate, or native free-draining material having a Sand Equivalent of not less than 30, or other material approved by the engineer. Upon excavation of the utility trench bottom shall be inspected and verified that the future utility is not supported on loose soils. Groundwater may be encountered for utilities deeper than 5 feet and may require dewatering or pumping from sumps. Any loose soils or wet zones, should be overexcavated and re-compacted prior to placing of bedding. We recommend that the materials used for the bedding zone be placed, and compacted to 90% of the maximum dry density as per ASTM D-1557 with mechanical means. Jetting shall not be allowed. Onsite materials will not meet the requirements of bedding material.

4.8.3 Backfill

Backfill shall be considered as starting 12-inches above the pipe. On-site excavated materials in general are suitable as backfill provided they are brought to optimum moisture content. Any boulders or cobbles or debris larger than 3 inches in any dimensions should be removed before backfilling. We recommend that all backfill should be placed in lifts not exceeding six to eight inches in thickness and be compacted to at least 90% maximum dry density as determined by the ASTM D-1557. The upper 12 inches below pavement, and all fills below foundations should be compacted to at least 95% maximum dry density. Mechanical compaction will be required to accomplish compaction above the bedding along the entire pipeline alignments.

In backfill areas, where mechanical compaction of soil backfill is impractical due to space constraints, sand-cement slurry may be substituted for compacted backfill. The slurry should contain one sack of cement per cubic yard and have a maximum slump of 5-inches. When set, such a mix typically has the consistency of hard compacted soil, and allows for future excavation.

4.9 Soil Corrosivity

Caltrans Corrosion Guidelines (2003) define a corrosive area as “an area where the soil contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates or has a pH of less than 5.5.” Representative samples of the site soils obtained from our borings were tested to evaluate the corrosion potential. The tests include pH, electrical resistivity, and soluble chloride and sulfate concentrations. Results of the corrosivity tests performed are summarized as:

BORING NO	SAMPLE NO	DEPTH (FT)	PH CALTRANS 643	SULFATE CONTENT CALTRANS 417 (ppm)	CHLORIDE CONTENT CALTRANS 422 (ppm)	MINIMUM RESISTIVITY CALTRANS 532 (ohm-cm)
B-16	B-1	0-5	-	8,500	300	--
B-22	B-1	0-5	-	4,500	300	287
B-24	B-1	0-5	7.27	800	200	-
B-29	B-1	0-5	-	1,100	400	242

Based on the data from our investigation and from LandMark (2010) report, the soils are defined as corrosive per Caltrans Guidelines and per ACI 318-02 Guidelines.

The sulfate content ranges between 800 ppm and over 8,500 ppm and exposure to sulfate attack is Severe. Therefore, Type V cement, maximum water cement ratio of 0.45 and minimum 4,500 psi concrete should be used for concrete in contact with native soils. The chloride content ranges between 200 and over 1,180 ppm and based on Caltrans Guidelines, for chloride content between 500 and 5,000 ppm, minimum concrete cover over reinforcement should be 3 inches.

The minimum electrical resistivity of the soil is 200 ohm-cm. The generally adopted corrosion severity ratings by the National Association of Corrosion Engineers, in regards to the soil electrical resistivity, are:

Elect. Resistivity, Ohm-cm	Corrosion Potential
Less than 1,000	Severe
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderate
Greater than 10,000	Mild

Based on these data and our test results, onsite soils have a severe corrosive potential for buried metal. All buried metal pipes in contact with onsite soils will need to be protected in place against corrosion. A soil corrosion specialist should be consulted, if additional recommendations are needed. Previous corrosivity and thermal resistivity data and a corrosivity report are presented in Appendix G.

4.10 Pavement Design

There are three types of pavements proposed at the site. Asphalt paved main plant road, N-S running gravel roads, and E-W running dirt roads built from native soils. These roads are about 20-ft wide and typical roads are shown in the Civil Site Plan, Block 1A, Figure 8. These roads are to be designed for use by a fire truck.

4.10.1 Asphalt Paved Road

Due to the presence of highly plastic fat clays near the surface, we used an R-value of 5 and various traffic index (TI) values for calculating pavement sections. The following pavement sections are recommended for TI values of 4, 5, 6, 7, and 8:

R-value 5 (Onsite Fat Clays)

Traffic Index	Section Thickness (Feet) AC Over AB
4	0.2 AC/0.6 AB
5	0.2 AC/0.9 AB
6	0.25 AC/1.15 AB or 0.33 AC/1.0 AB
7	0.35 AC/1.25 AB
8	0.40AC/1.5 AB

Traffic Index values of 4 to 5 are recommended for car parking and non-truck driveways. Traffic Index of 6 or higher may be used for truck areas or for the streets. The County road standard for driveways (4-in. AC over 12-in. AB) is adequate for a traffic index of 6.0. The upper 12-inches of subgrade supporting pavements should be compacted to at least 90 percent relative compaction (ASTM D1557-09). Crushed Miscellaneous Base (CMB) satisfying the requirements of Green Book may be used in lieu of Class 2 Aggregate Base.

4.10.2 Roadway Drainage

Based on discussions with Fluor, we understand that the gravel (aggregate base) and dirt roads will not be raised above the surrounding grade to provide good drainage as is normal for a road. Instead the road surface will be graded level with the surrounding soil to drain by sheet flow. Since the gravel road will be hundreds of times more permeable than the surrounding clay soils, there is significant potential for the normal rainwater draining across the site by sheet flow to be intercepted by the gravel roads and be trapped within the gravel zone. This water could soften the underlying subgrade and cause pumping and rutting of the gravel road, if the road is subjected to traffic after a major rainfall event before the water has a chance to dry out. This is a significant issue that could affect the performance of the gravel roads.

In order to minimize the softening of the subgrade due to water trapped within the gravel road, geotextile or Visqueen may be placed between the boundary of the gravel and subgrade. An alternate was suggested at our meeting with Fluor which calls for the gravel to be placed on top of the appropriately sloped and compacted soil. This option (gravel above the surrounding grade) will allow the rain water to pass through the gravel as it sheet flows across the soil and will prevent water from being trapped within the gravel and softening the subgrade. This option (gravel above the surrounding grade) provides a better solution for gravel roads than the gravel road level with the surrounding soil.

We understand that the roads are expected to be all weather roads capable of transporting a fire truck in all conditions. We anticipate that the fire truck can be handled by the compacted gravel and compacted dirt roads during dry condition. However, during or immediately after an anticipated maximum design rainfall, the gravel and dirt roads are likely to be flooded and underwater and a 75,000 lb fire truck could cause serious rutting or even get stuck. Maintenance of dirt and gravel roads will likely be required after periods of heavy rainfall.

4.10.3 Gravel (Aggregate Base) Roads

Gravel roads may be designed by the recommendations in Appendix A of Gravel Roads Maintenance and Design Manual (FHWA, 2000). Detailed design of the gravel roads is not feasible; however, empirical charts provided in Appendix A can be used for design of the gravel roads. The subgrade soils at the site are fat clays which classify as poor to very poor subgrade condition. Based on Table 5 of Appendix A (see Figure 9A), for very poor and poor soil conditions, climatic region IV (no freezing, low rainfall), and low traffic the recommended thickness of the aggregate base is 8 inches. For medium traffic and poor soil conditions, recommended thickness is 15 inches. Based on FHWA Table 6 (see Figure 9B), for 0 to 5 Heavy Trucks per day and low quality subgrade, the recommended thickness is 6.5 in. and for 5 to 10 Heavy Trucks per day, the recommended thickness of the base is 8.5 inches. Assuming low to very low traffic and poor to very poor subgrade, the minimum thickness of the aggregate base should be 8 inches. The gravel should be placed over 12 inches of native subgrade compacted to 90% relative compaction.

It should be emphasized that the recommended thickness assumes that roadway is built with proper drainage and water is not allowed to pond within the gravel. Due to the type of construction proposed, proper drainage is not feasible and water will pond within the gravel zones. Therefore, we recommend that an impermeable membrane (such as 10 mil Visqueen) and / or a geogrid (Tensar BX 1200 or geotextile with separator or equivalent) be considered at the bottom of the gravel to mitigate softening of the subgrade and pumping and rutting of the road. As an alternate, the gravel road may be constructed above the surrounding grade and be underlain by 12 in. of compacted subgrade to 90% compaction.

4.10.4 Dirt Roads

We recommend that the dirt roads should consist of 12 inches of recompacted native soils compacted to 90% relative compaction as per ASTMD 1557. These roads in dry conditions are expected to handle occasional truck traffic successfully. However, after a major rainfall event and saturation, the road could have significant rutting or vehicles could get stuck (see Figure 10).

4.10.5 Fire Truck Access

Gross vehicle load for 110-ft ladder truck is 64,000 lbs. Different jurisdictions have different weights and axle loads for fire trucks. We understand that the California Fire Code design requirement is a 75,000 lb vehicle. The CPT rig (which was used at the site to perform CPTs) weighs at least 30 ton (60 kip) and its weight is generally similar to a fire truck. The CPT rig and the Mobile B-61 drill rig were able to operate in the dry fields without significant problems (See Figures in Appendix E). Therefore, the fire truck should be able to operate on the dirt or gravel roads without problems in the dry condition. However, if the subgrade of the gravel or dirt roads becomes saturated after a significant rainfall, serious rutting or fire truck could get stuck (See

Figure 10). Maintenance of dirt and gravel roads will likely be required after periods of heavy rainfall.

4.10.6 Test Sections

Due to large number of gravel roads (over 30 miles) at the site, we recommend that test sections be constructed and loaded with and without saturation with heavily loaded truck to simulate the design fire truck. Test section(s) may consist of gravel below the site grade with and without geotextile/geogrid/Visqueen and gravel above the general site grade or the selected option should be tested. The test section(s) will need to be flooded to verify the ability of the road to handle heavy truck during and after a major rainfall.

4.11 Percolation Testing

Percolation testing was performed in accordance with the requirements in Appendix C. The results of percolation testing are summarized in Table 3. Individual test sheets are shown in Appendix A. One of the test locations PT-2A hit an existing underground drainage pipe and could not hold water. The additional test PT-2C performed in lieu of PT-2A, indicated a low percolation rate of 240 min./ inch. We performed two additional tests PT-3A and PT-3B at locations shown in Figure A-47 in Appendix A. The results of the six tests (Table 3) indicate that the percolation rates range between 0.32 and 0.94 gallons /sq.ft./day and discarding one anamlous reading of 240 minutes (0.32 gal. /sf./day) minimum value of 0.56 gallons per sq. ft. per day should be used for design of the leach field.

Groundwater table in the nearby boring B-29 was recorded at 6.3 ft during drilling. Stabilized groundwater in the site area ranges between about 4 and 7.5 feet. The groundwater may be affected by the irrigation of the fields and may be deeper after the irrigation is stopped. The County requires a minimum of 5 ft distance between the bottom of the leach field and water table. Fluor has estimated the bottom of the leach field will be more than 5 ft below the grade of a gravity system. It appears an alternate treatment system will have to be developed.

4.12 Minor Retaining Walls

Minor retaining walls (if used) may be supported near the finish grade on spread footings. Footings may be designed using an allowable bearing pressure of 1.5 ksf. The upper 12 inches of wall footing subgrade should be scarified, moisture conditioned as required, and compacted to a minimum of 90% relative compaction in accordance with ASTM D 1557. Retaining wall footings on level ground should have a minimum embedment of 18-inches below finish grade.

Cantilever walls, which are free to move laterally at least ½ in. for each 10-ft height, may be designed for an equivalent fluid pressure of 36 pcf (with level backfill) or 45 pcf (2:1 sloping backfill). Walls restrained at the top with level backfill should be designed for an equivalent fluid pressure of 55 pcf. Passive resistance may be obtained from Section 4.2.4.

We recommend that all retaining walls be backfilled with non-expansive import granular soils with sand equivalent (SE) of less than 20. On site soils are not suitable for wall backfill. The finish surface should be graded to drain away from the proposed structures. Heavy compaction equipment operating adjacent to retaining walls can cause excessively high lateral soil pressures to be exerted on the wall. Therefore, soils within 5 feet of the wall should either be compacted with hand operated equipment or designed to withstand compaction pressure from heavy equipment.

The above design parameters assume that all walls are constructed with a properly designed drainage system behind the wall to prevent buildup of hydrostatic pressures behind the wall. This may consist of a geocomposite drain board or 12 inches of clean crushed rock encapsulated in filter fabric, discharging to weep holes or drain pipes.

5.0 LIMITATIONS

This investigation was performed in accordance with generally accepted geotechnical engineering principles and practice. The professional engineering work and judgments presented in this report meet the standard of care of our profession at this time. No other warranty, expressed or implied, is made.

The recommendations for this project are, to a high degree, dependent upon proper quality control of grading and foundation construction. Consequently, the recommendations are made contingent on the opportunity of GDC to observe grading operations, spread footing construction, and subgrade/base preparation. If parties other than GDC are engaged to provide such services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the recommendations in this report or provide alternate recommendations as deemed appropriate.

6.0 REFERENCES

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TABLES

Table 1

Shear Wave Velocity Data

Centinela Solar Energy Facility
El Centro, CA

CPT Shear Wave Measurements

DC-1

Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
5.08	7.13	17.32	411.54	
10.13	11.30	24.97	452.41	544.95
15.05	15.86	34.64	457.82	471.78
20.36	20.96	46.21	453.69	441.33
25.31	25.80	57.41	449.38	431.62
30.12	30.53	66.03	462.40	549.08
35.40	35.75	74.15	482.15	642.76
40.07	40.38	80.95	498.84	680.79
45.15	45.43	87.83	517.20	733.32
50.16	50.41	94.37	534.16	761.86
55.17	55.40	103.10	537.30	571.31
60.01	60.22	108.58	554.60	879.90

DC-20

5.13	7.16	18.52	386.80	
10.34	11.49	27.23	421.79	496.20
15.13	15.93	35.58	447.86	532.85
20.33	20.94	44.66	468.78	550.78
25.24	25.73	53.19	483.75	562.09
30.46	30.87	61.08	505.36	651.10
35.12	35.47	69.51	510.35	546.44
40.20	40.51	77.33	523.86	643.94
44.85	45.13	86.18	523.65	521.82
50.02	50.27	92.41	543.98	825.27
55.00	55.23	99.75	553.65	675.41
60.27	60.48	106.80	566.26	744.71

Shear Wave Source Offset = 5 ft

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

TABLE 2
CBC 2010 / ASCE 7-05 ACCELERATION RESPONSE SPECTRA

GDC PROJECT NO. I-558 Fluor - Centinela Solar

Site Latitude: 32.6791 **Site Longitude: -115.6527**

INPUT	S_S=	1.381	g = short period (0.2 sec) mapped spectral response acceleration MCE Site Class B (**CBC 2010 Fig. 1613.5(3) or USGS Ground Motion Calculator**)
	S_1=	0.545	g = 1.0 sec period mapped spectral response acceleration MCE Site Class B (**CBC 2010 Fig. 1613.5(4) or USGS Ground Motion Calculator**)
	Site Class=	D	= Site Class definition based on **CBC 2010 Table 1613.5.2**
	F_a=	1.00	= Site Coefficient applied to S_s to account for soil type (**CBC 2010 Table 1613.5.3(1)**)
	F_v=	1.500	= Site Coefficient applied to S_1 to account for soil type (**CBC 2010 Table 1613.5.3(2)**)
	T_L=	8.00	sec = Long Period Transition Period (**ASCE 7-05 Figure 22-16**)
OUTPUT	S_{MS}=	1.381	= site class modified short period (0.2 sec) MCE spectral response acceleration = F_a x S_s (**CBC 2010 Eqn. 16-37**)
	S_{M1}=	0.818	= site class modified 1.0 sec period MCE spectral response acceleration = F_v x S_1 (**CBC 2010 Eqn. 16-38**)
	S_{DS}=	0.921	= site class modified short period (0.2 sec) Design spectral response acceleration = 2/3 x S_{MS} (**CBC 2010 Eqn. 16-39**)
	S_{D1}=	0.545	= site class modified 1.0 sec period Design spectral response acceleration = 2/3 x S_{M1} (**CBC 2010 Eqn. 16-40**)
	T_0=	0.118	sec = 0.2 S_{D1}/S_{DS} = Control Period (left end of peak) for ARS Curve (Section 11.4.5 ASCE 7-05)
	T_S=	0.592	sec = S_{D1}/S_{DS} = Control Period (right end of peak) for ARS Curve (Section 11.4.5 ASCE 7-05)

SPECTRUM CALCULATION

T (seconds)	Design Sa (g)	MCE Sa (g)
0.000	0.368	0.552
0.118	0.921	1.381
0.592	0.921	1.381
0.600	0.908	1.363
0.700	0.779	1.168
0.800	0.681	1.022
0.900	0.606	0.908
1.000	0.545	0.818
1.100	0.495	0.743
1.200	0.454	0.681
1.300	0.419	0.629
1.400	0.389	0.584
1.500	0.363	0.545
1.600	0.341	0.511
1.700	0.321	0.481
1.800	0.303	0.454
1.900	0.287	0.430
2.000	0.273	0.409
2.100	0.260	0.389
2.200	0.248	0.372
2.300	0.237	0.355
2.400	0.227	0.341
2.500	0.218	0.327
2.600	0.210	0.314
2.700	0.202	0.303
2.800	0.195	0.292
2.900	0.188	0.282
3.000	0.182	0.273
3.100	0.176	0.264
3.200	0.170	0.255
3.300	0.165	0.248
3.400	0.160	0.240
3.500	0.156	0.234
3.600	0.151	0.227
3.700	0.147	0.221
3.800	0.143	0.215
3.900	0.140	0.210
4.000	0.136	0.204
4.000	0.136	0.204

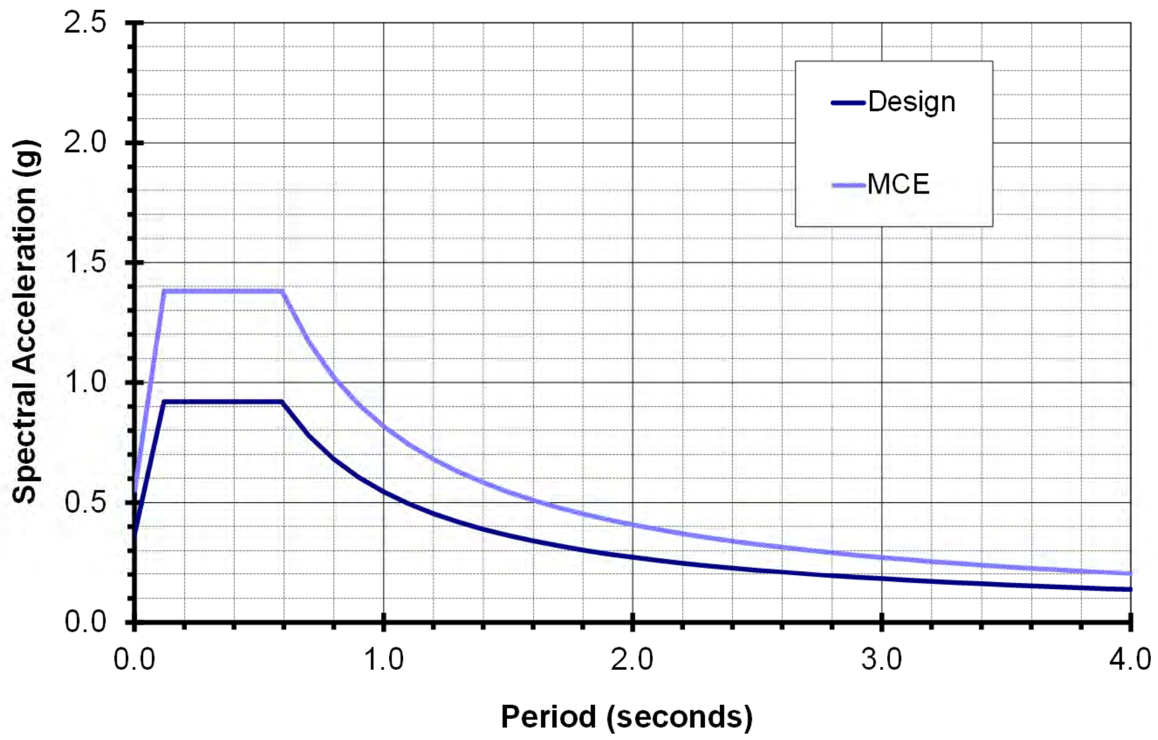

Table 3
Summary of Percolation Tests

Test No.	**Percolation Rate, min/in.**	**Percolation Rate gallons/sq.ft. /day**	**Notes**
PT-1A	36.9	0.82	
PT-2A	No test	--	Hole did not hole water
PT-2B	28.2	0.94	
PT-1B	32.0	0.88	
PT-2C	240	0.32	Moved PT-2A location
PT-3A	80	0.56	
PT-3B	80	0.56	

TABLE 4

PTI Design Parameters for Expansive Soil

Clay Type		Montmorillonite
Clay %		60
Plasticity Index, PI		45
Expansion Index, EI		140
Modulus of Subgrade Reaction Ks (pci)		20
Allowable Bearing Pressure q'_{all} (psf)		2,500
Thornthwaite Moisture Index		-20
Depth of Constant Soil Suction (ft)		7
Soil Suction, pF (ft)		3.6
Moisture Velocity (in./month)		0.7
Center Lift	Edge Moisture Variation Distance, e_m (ft)	3.7
	Center Lift, y_m (in.)	4.0
Edge Lift	Edge Moisture Variation Distance, e_m (ft)	6.0
	Edge Lift, y_m (in.)	2.0

Table 5 Pier Load Data

ARLINGTON VALLEY SOLAR ENERGY II, LLC.
Arlington Valley Solar Energy Project
Arlington, Arizona
Pier Foundation

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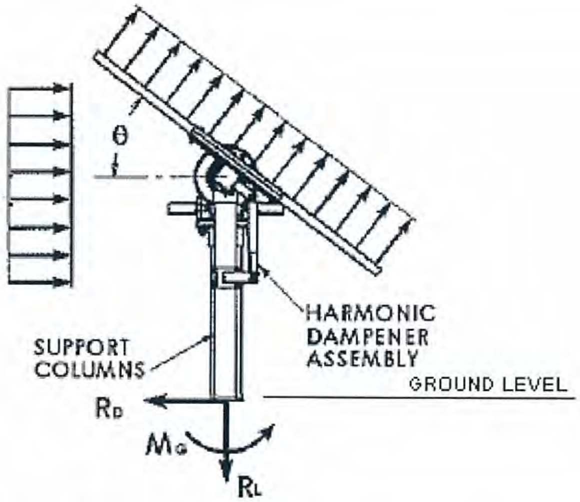
CALCULATIONS and SKETCHES

3/13/2012
Cont. No. A4XB
By: CH Chk'd :______
Sheet No. 1
A4XB-0-CA-2-00.PI.00-10



Column Reactions at Ground Level

From tracking system vendor data by Array (See Atm–A)

	Angle θ (Deg)	No. of Columns	DL (P) ↓ (lbs)	Wind Horizontal (R_D) --> (lbs)	Wind Upward (R_L) ↑ (lbs)	Wind Downward (R_L) ↓ (lbs)	Ground Live Moment (M_G) ↷ 4ft Height (ft*kip)	6ft Height
Bearing Column	45	11	421	1380	–1130	–	5.54	8.28
		13	389	1360	–1110	–	5.46	8.16
		15	357	1220	–1000	–	4.89	7.32
	30	11	421	*	–1320	–	*	*
		13	389	*	–1300	–	*	*
		15	357	*	–1160	–	*	*
	–25	11	421	*	–	1080	*	*
		13	389	*	–	1070	*	*
		15	357	*	–	960	*	*
Gearbox Column	5	11	643	350	–930	–	14.36	15.06
		13	619	340	–890	–	19.43	20.11
		15	579	290	–770	–	16.75	17.33
	30	11	643	**	–1220	–	**	**
		13	619	**	–1170	–	**	**
		15	579	**	–1010	–	**	**
	–25	11	643	**	–	1000	**	**
		13	619	**	–	960	**	**
		15	579	**	–	820	**	**

* Since reactions are not given by the vendor, reactions at 45° are used to design.

** Since reactions are not given by the vendor, reactions at 5° are used to design.

Table 6
Summary of Lateral Load Analyses

W6x8.5
Load Applied at 4 ft above ground
Groundline Moment = 5.6 ft-kip

Lateral Load, lbs	Pile Pene., ft	Piletop Deflection, in.	Max. Moment, ft-kip	Depth to Max. Moment, ft (Below Piletop)
1,400	9	1.02	7.1	6.0
1,400	8	1.05	7.1	6.0
1,400	7	1.25	6.9	5.5
1,400	6	2.10	6.8	5.5

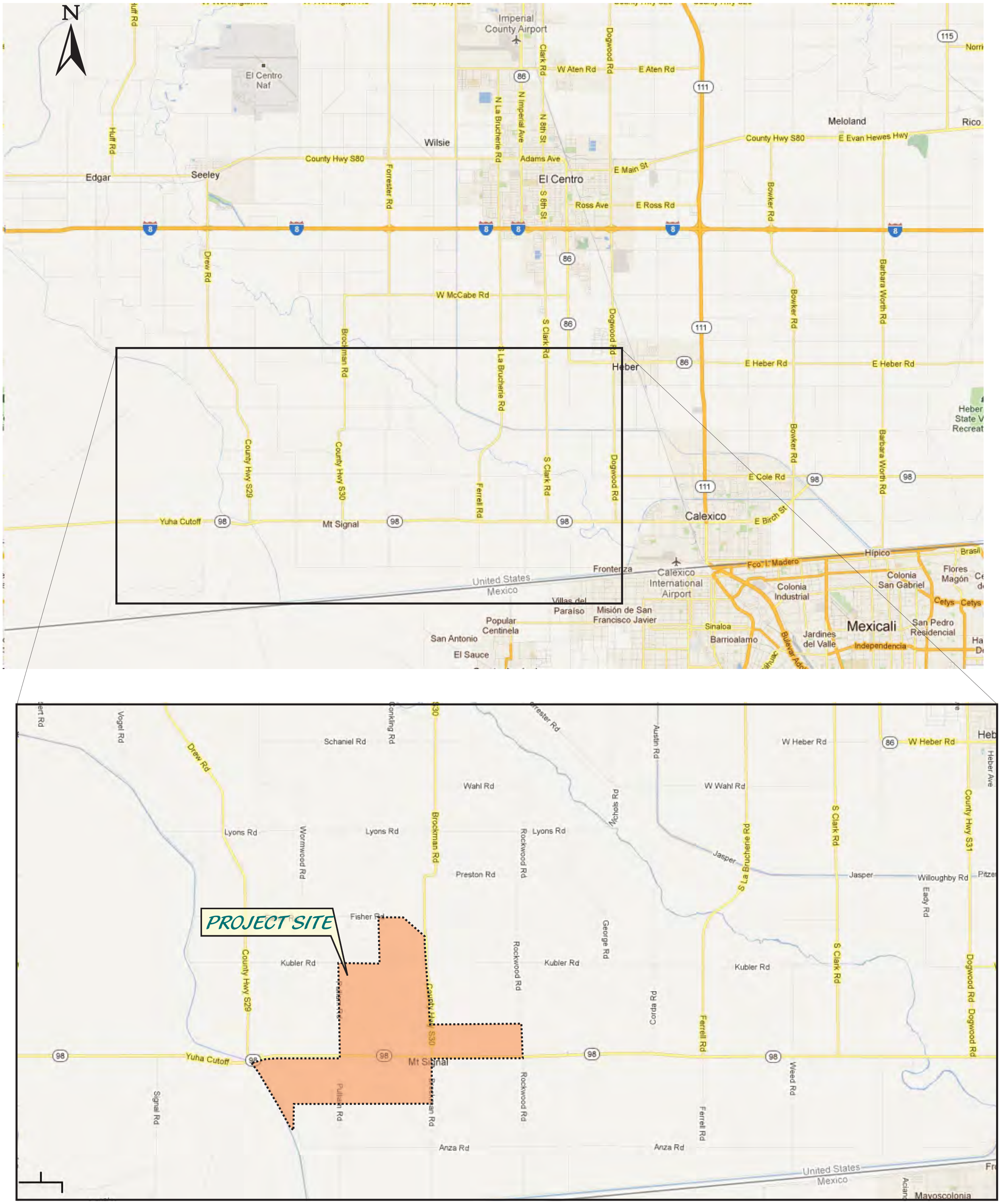
W6x15
Load Applied at 4 ft above ground
Applied Moment = 19.6 ft-kip

Lateral Load, lbs	Pile Pene., ft	Piletop Deflection, in.	Max. Moment, ft-kip	Depth to Max. Moment , ft (below pile top)
350	10	1.66	21.5	4.5
350	9	1.71	21.5	4.5
350	8	1.95	21.5	4.5

W6x20
Load Applied at 4 ft above ground
Applied Moment = 19.6 ft-kip

Lateral Load, lbs	Pile Pene., ft	Piletop Deflection, in.	Max. Moment, ft-kip	Depth to Max. Moment , ft (below pile top)
350	10	1.16	20.3	4.5
350	9	1.21	20.3	4.5
350	8	1.45	20.3	4.5

FIGURES



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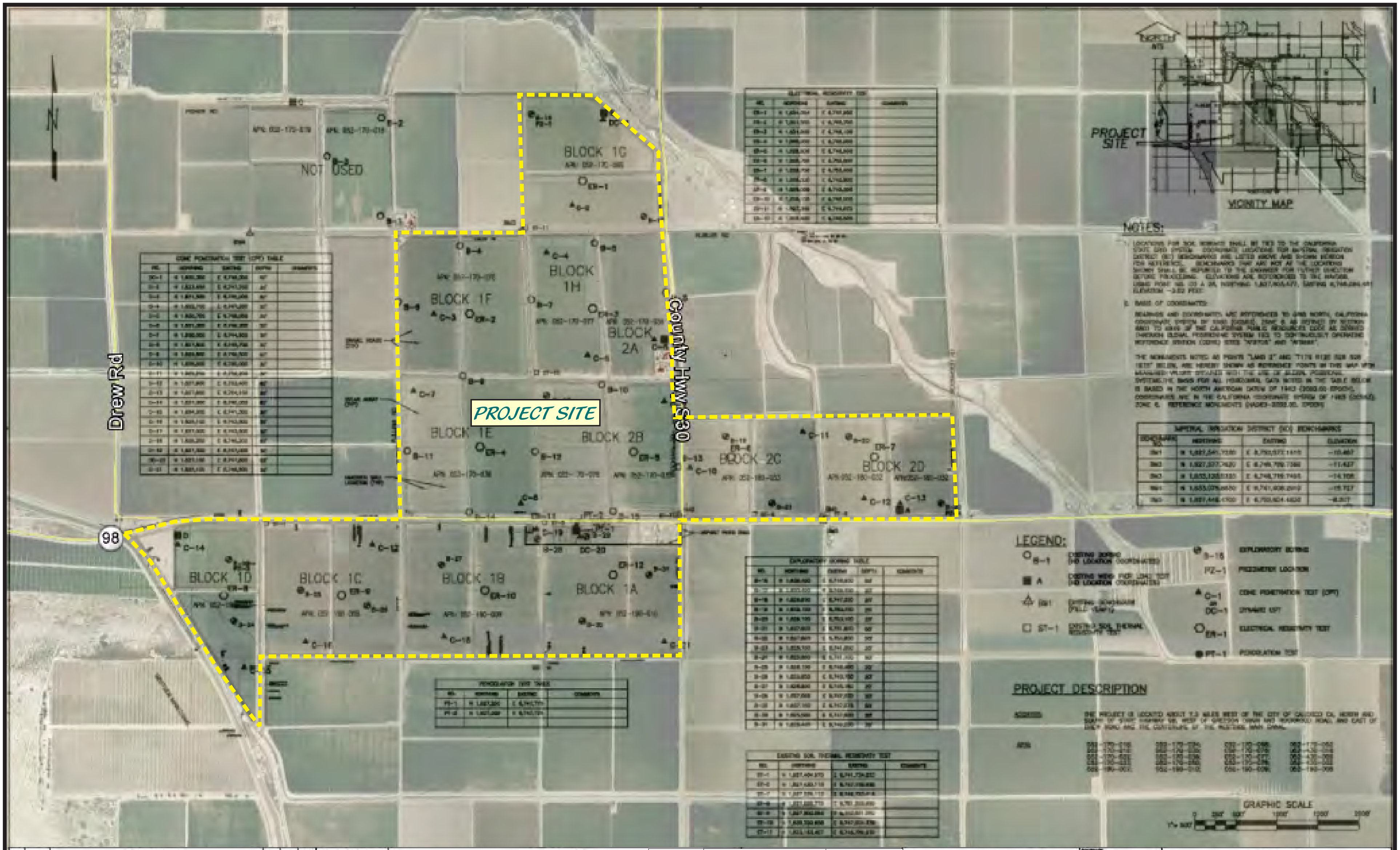
GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
32 MAUCHLY, SUITE B
IRVINE, CA 92618 (949) 450-2100

FIGURE NUMBER	1A
PROJECT NAME	CENTINELA SOLAR PLANT
PROJECT NUMBER	I-558

VICINITY MAP



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A	01/25/12	ISSUED FOR REVIEW	DM	RK	SP		
B	01/31/12	ISSUED FOR INFORMATION	DM	RK	SP		

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FIGURE NUMBER
1B

PROJECT NAME
CENTINELA SOLAR PLANT

PROJECT NUMBER
I-558

AERIAL PHOTOGRAPH

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CHECKED BY J. DAVIS	
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LEAD ENGR/SPEC. S. PAI	APP DATE
ENRG MGR. M. WEBER	APP DATE
PROJECT MGR.	APP DATE
CLIENT CSE	APP DATE

CENTINELA
SOLAR ENERGY PROJECT

CIVIL

SOIL BORING LOCATION PLAN

SCALE	DRAWING NUMBER	REV
1"=500'	A4XR-0-CV-0-BP.PL-01	B

CAD FILE NAME A4XR-0-CV-0-BP.PL-01.dwg

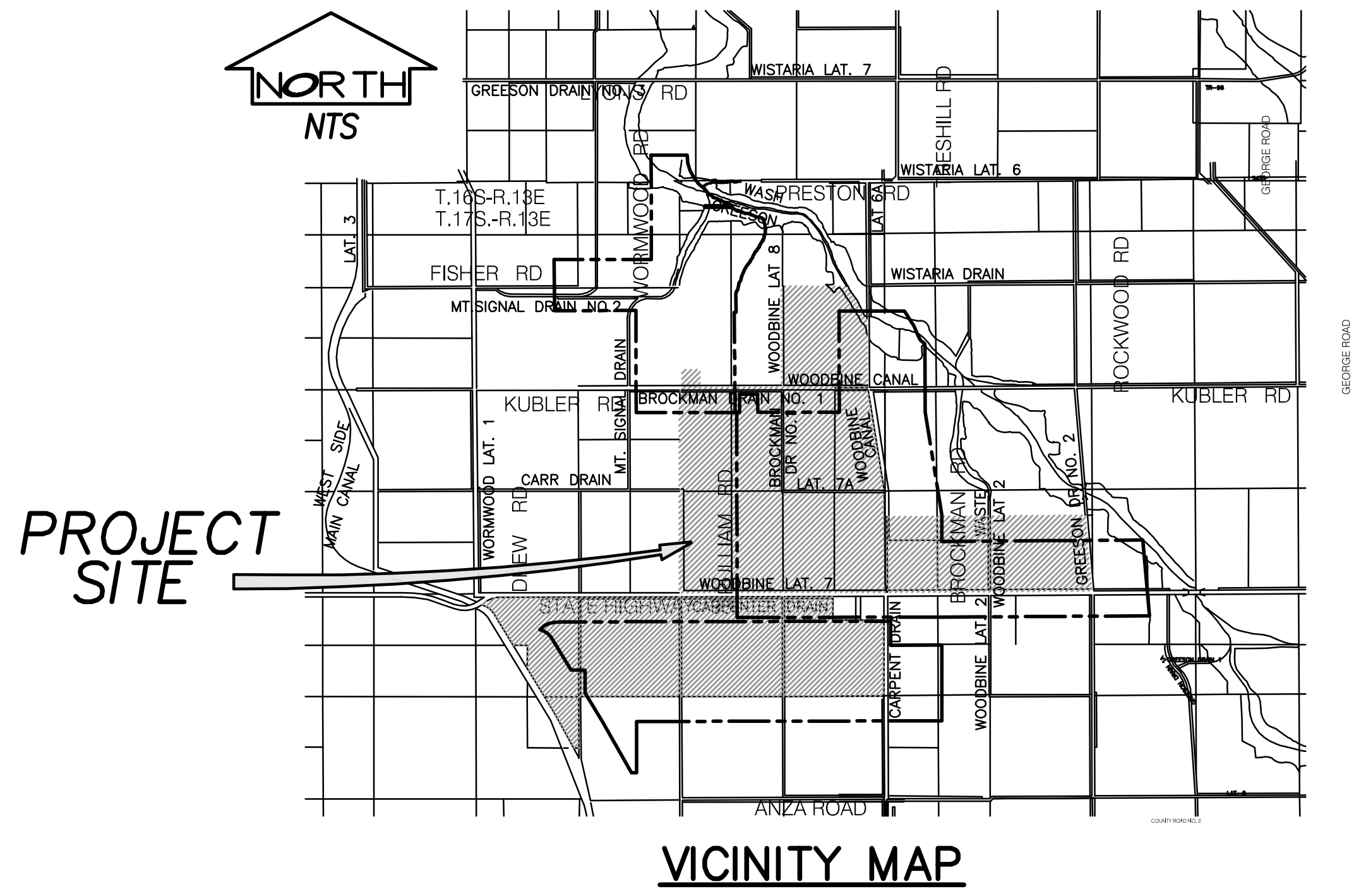
ELECTRICAL RESISTIVITY TEST			
NO.	NORTHING	EASTING	COMMENTS
ER-1	N 1,834,094	E 6,747,902	
ER-2	N 1,831,500	E 6,745,700	
ER-3	N 1,831,600	E 6,748,100	
ER-4	N 1,828,900	E 6,745,900	
ER-5	N 1,828,800	E 6,748,900	
ER-6	N 1,828,700	E 6,750,800	
ER-7	N 1,828,700	E 6,753,600	
ER-8	N 1,826,000	E 6,740,900	
ER-9	N 1,826,000	E 6,743,200	
ER-10	N 1,826,100	E 6,746,000	
ER-11	N 1,827,300	E 6,746,870	
ER-12	N 1,826,400	E 6,748,500	

CONE PENETRATION TEST (CPT) TABLE				
NO.	NORTHING	EASTING	DEPTH	COMMENTS
DC-1	N 1,835,300	E 6,748,300	60'	
C-2	N 1,833,625	E 6,747,700	30'	
C-3	N 1,831,500	E 6,745,000	60'	
C-4	N 1,832,700	E 6,747,200	30'	
C-5	N 1,830,700	E 6,748,000	30'	
C-6	N 1,831,000	E 6,749,300	30'	
C-7	N 1,830,000	E 6,744,600	30'	
C-8	N 1,827,800	E 6,746,700	30'	
C-9	N 1,829,800	E 6,749,500	60'	
C-10	N 1,828,500	E 6,750,000	30'	
C-11	N 1,829,200	E 6,752,200	30'	
C-12	N 1,827,900	E 6,753,400	60'	
C-13	N 1,827,800	E 6,754,100	30'	
C-14	N 1,827,000	E 6,740,000	60'	
C-15	N 1,824,600	E 6,741,300	30'	
C-16	N 1,825,100	E 6,742,500	30'	
C-17	N 1,827,000	E 6,743,800	30'	
C-18	N 1,825,200	E 6,745,200	60'	
C-19	N 1,827,300	E 6,747,000	30'	
DC-20	N 1,827,150	E 6,747,850	60'	
C-21	N 1,825,100	E 6,749,500	30'	

EXPLORATORY BORING TABLE				
NO.	NORTHING	EASTING	DEPTH	COMMENTS
B-16	N 1,835,400	E 6,746,900	50'	
B-17	N 1,833,400	E 6,749,100	20'	
B-18	N 1,829,900	E 6,747,200	20'	
B-19	N 1,829,100	E 6,750,700	20'	
B-20	N 1,829,100	E 6,753,100	20'	
B-21	N 1,827,800	E 6,751,600	50'	
B-22	N 1,827,800	E 6,754,900	50'	
B-23	N 1,826,700	E 6,741,000	20'	
B-24	N 1,825,500	E 6,741,100	50'	
B-25	N 1,826,100	E 6,742,400	20'	
B-26	N 1,825,800	E 6,743,700	20'	
B-27	N 1,826,600	E 6,745,150	20'	
B-28	N 1,827,096	E 6,747,033	20'	
B-29	N 1,827,150	E 6,747,975	50'	
B-30	N 1,825,500	E 6,747,900	20'	
B-31	N 1,826,400	E 6,749,200	20'	

PERCOLATION TEST TABLE			
NO.	NORTHING	EASTING	COMMENTS
PT-1	N 1,827,250	E 6,747,775	
PT-2	N 1,827,300	E 6,747,775	

EXISITNG SOIL THERMAL RESISTIVITY TEST			
NO.	NORTHING	EASTING	COMMENTS
ST-1	N 1,827,404.970	E 6,741,724.263	
ST-5	N 1,827,430.115	E 6,747,159.995	
ST-7	N 1,827,569.112	E 6,749,723.414	
ST-8	N 1,827,585.779	E 6,751,256.989	
ST-9	N 1,827,600.053	E 6,752,681.952	
ST-10	N 1,830,350.958	E 6,747,004.339	
ST-11	N 1,833,183.407	E 6,746,789.839	



VICINITY MAP

NOTES:

1. LOCATIONS FOR SOIL BORINGS SHALL BE TIED TO THE CALIFORNIA STATE GRID SYSTEM. COORDINATE LOCATIONS FOR IMPERIAL IRRIGATION DISTRICT (IID) BENCHMARKS ARE LISTED ABOVE AND SHOWN HEREON FOR REFERENCE. BENCHMARKS THAT ARE NOT AT THE LOCATIONS SHOWN SHALL BE REPORTED TO THE ENGINEER FOR FUTHER DIRECTION BEFORE PROCEEDING. ELEVATIONS ARE REFERENCED TO THE NAVD88, USING POINT NO. CO A 26, NORTHING 1,827,603.477, EASTING 6,766,064.481 ELEVATION −3.02 FEET.
2. BASIS OF COORDINATES:

   BEARINGS AND COORDINATES ARE REFERENCED TO GRID NORTH, CALIFORNIA COORDINATE SYSTEM OF 1983 (CCS83), ZONE 6, AS DEFINED BY SECTION 8801 TO 8819 OF THE CALIFORNIA PUBLIC RESOURCES CODE AS DERIVED THROUGH GLOBAL POSITIONING SYSTEM TIES TO CONTINUOUSLY OPERATING REFERENCE STATION (CORS) SITES "AF9705" AND "AF9696".

   THE MONUMENTS NOTED AS POINTS "LAND 2" AND "T17S R12E S29 S28 1975" BELOW, ARE HEREBY SHOWN AS REFERENCE POINTS IN THIS MAP WITH MEASURED VALUES OBTAINED WITH THE USE OF GLOBAL POSITIONAL SYSTEMS.THE BASIS FOR ALL HORIZONTAL DATA NOTED IN THE TABLE BELOW IS BASED IN THE NORTH AMERICAN DATUM OF 1983 (2002.00 EPOCH), COORDINATES ARE IN THE CALIFORNIA COORDINATE SYSTEM OF 1983 (CCS83), ZONE 6. REFERENCE MONUMENTS (NAD83−2002.00, EPOCH)

IMPERIAL IRRIGATION DISTRICT (IID) BENCHMARKS			
BENCHMARK NO.	NORTHING	EASTING	ELEVATION
BM1	N 1,827,541.7260	E 6,752,577.1410	−10.467
BM2	N 1,827,577.7620	E 6,749,789.7360	−11.437
BM3	N 1,833,130.0320	E 6,746,719.7490	−14.108
BM4	N 1,833,075.8650	E 6,741,408.2910	−15.727
BM5	N 1,827,449.4700	E 6,752,604.4830	−8.207

LEGEND:

○	B-1	EXISTING BORING (NO LOCATION COORDINATES)
■	A	EXISTING W6X9 PIER LOAD TEST (NO LOCATION COORDINATES)
△	BM1	EXISTING BENCHMARK (FIELD VERIFY)
□	ST-1	EXISTING SOIL THERMAL RESISTIVITY TEST
◒	B-16	EXPLORATORY BORING
	PZ-1	PIEZOMETER LOCATION
▲	C-1	CONE PENETRATION TEST (CPT)
	OR DC-1	DYNAMIC CPT
⬡	ER-1	ELECTRICAL RESISTIVITY TEST
●	PT-1	PERCOLATION TEST

PROJECT DESCRIPTION

ADDRESS: THE PROJECT IS LOCATED ABOUT 7.5 MILES WEST OF THE CITY OF CALEXICO CA, NORTH AND SOUTH OF STATE HIGHWAY 98, WEST OF GREESON DRAIN AND ROCKWOOD ROAD, AND EAST OF DREW ROAD AND THE CENTERLINE OF THE WESTSIDE MAIN CANAL.

APN:

052−170−018;	052−170−034;	052−170−068;	052−170−052
052−170−019;	052−170−035;	052−170−076;	052−430−018
052−170−032;	052−170−036;	052−170−077;	052−430−009
052−170−033;	052−170−050;	052−170−078;	052−430−032
052−190−007;	052−190−010;	052−190−009;	052−190−008

Figure 2

GRAPHIC SCALE

0 400' 800' 1600' 2400' 3200'

1"= 800'

REV	DATE	REVISION DESCRIPTION	BY	CHK	APPV	REFERENCE DWG NUMBER	REFERENCE DRAWINGS
A	01/25/12	ISSUED FOR REVIEW	DM	RK	SP		
B	01/31/12	ISSUED FOR INFORMATION	DM	RK	SP		
C	06/25/12	REVISED BACKGROUND	DM	RK	SP		

THE SEAL APPEARING ON THIS DOCUMENT IS VALID FOR REVISION ONLY WHEN SIGNED AND DATED

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DESIGNED BY D. MARTINEZ	
CHECKED BY J. DAVIS	
SUPERVISOR S. PAI	APP DATE
LEAD ENGR/SPEC. S. PAI	APP DATE
ENRG MGR. M. WEBER	APP DATE
PROJECT MGR.	APP DATE
CLIENT CSE	APP DATE

CENTINELA
SOLAR ENERGY PROJECT

CIVIL

SOIL BORING LOCATION PLAN

SCALE	DRAWING NUMBER	REV
1"=800'	A4XR−0−CV−0−BP.PL−01	C

CAD FILE NAME A4XR−0−CV−0−BP.PL−01_RC.dwg

FC.DWG 07DEC10

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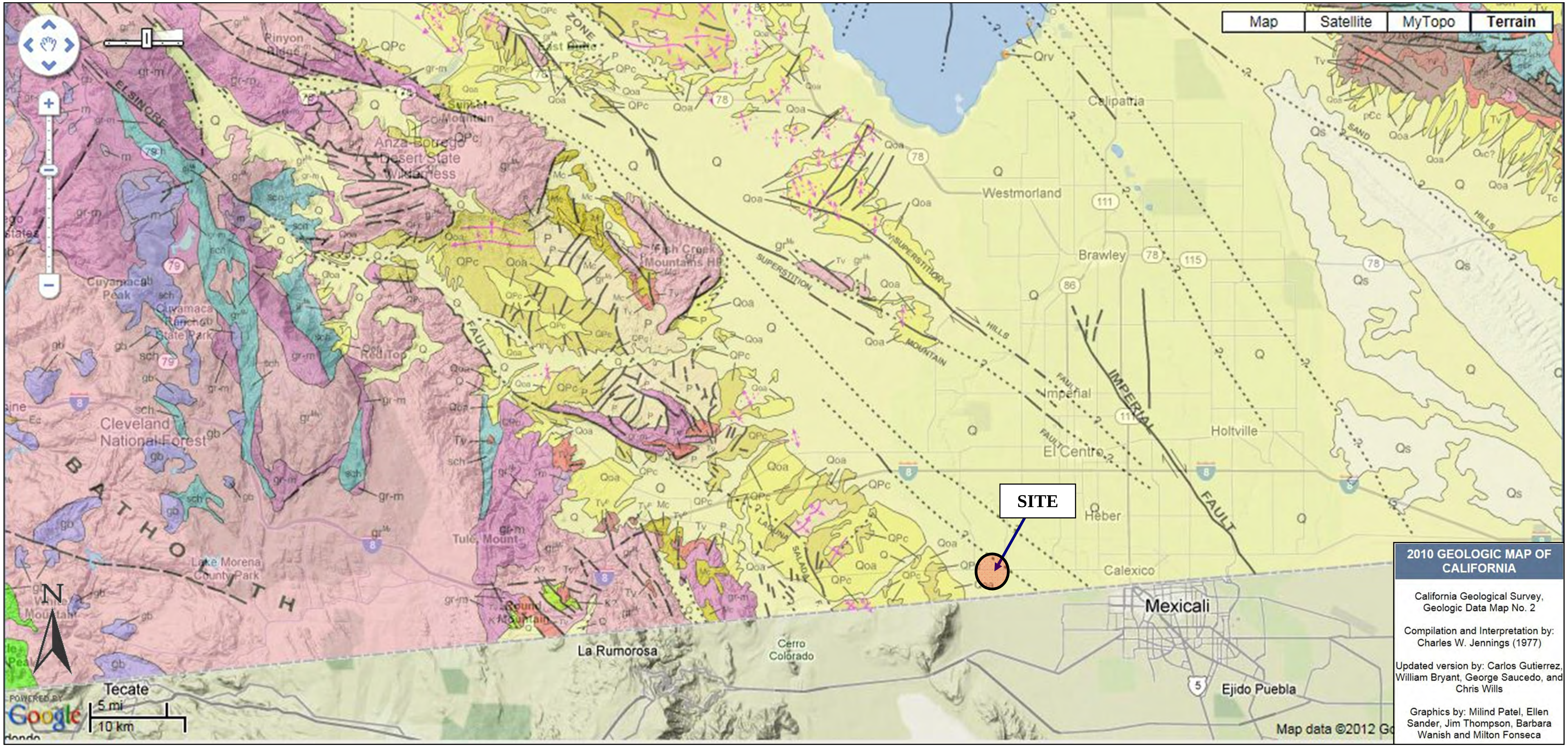


2010 GEOLOGIC MAP OF CALIFORNIA

California Geological Survey, Geologic Data Map No. 2

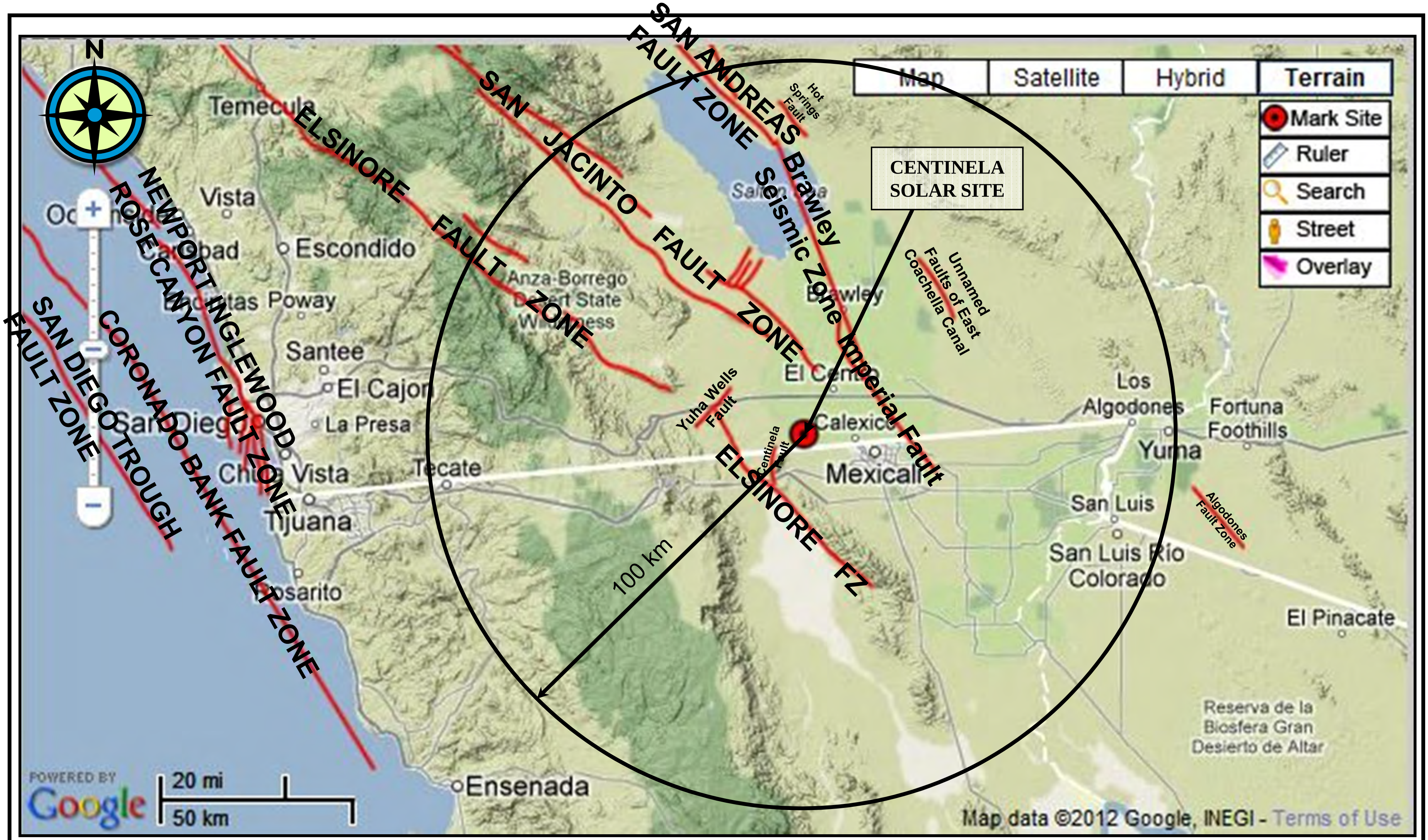
Compilation and Interpretation by: Charles W. Jennings (1977)

Updated version by: Carlos Gutierrez, William Bryant, George Saucedo, and Chris Wills

Graphics by: Milind Patel, Ellen Sander, Jim Thompson, Barbara Wanish and Milton Fonseca

Qs	Extensive marine and nonmarine sand deposits, generally near the coast or desert playas.
Q	Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine, but includes marine deposits near the coast.
Qoa	Older alluvium, lake, playa, and terrace deposits
QPc	Pliocene and/or Pleistocene sandstone, shale, and gravel deposits; mostly loosely consolidated.
Tv	Tertiary volcanic flow rocks; minor pyroclastic deposits
Tv^p	Tertiary pyroclastic and volcanic mudflow deposits.
gr	Undated granitic rocks.
gr-m	Granitic and metamorphic rocks, mostly gneiss and other metamorphic rocks injected by granitic rocks. Mesozoic to Precambrian.
gr^{Mz}	Mesozoic granite, quartz monzonite, granodiorite, and quartz diorite.

SUPPLEMENTAL GEOTECHNICAL INVESTIGATION	CENTINELA SOLAR ENERGY FACILITY GDC PROJECT NO. IR-558	GEOLOGIC MAP	FIGURE 3



Reference: ARS ONLINE http://dap3.dot.ca.gov/shake_stable/

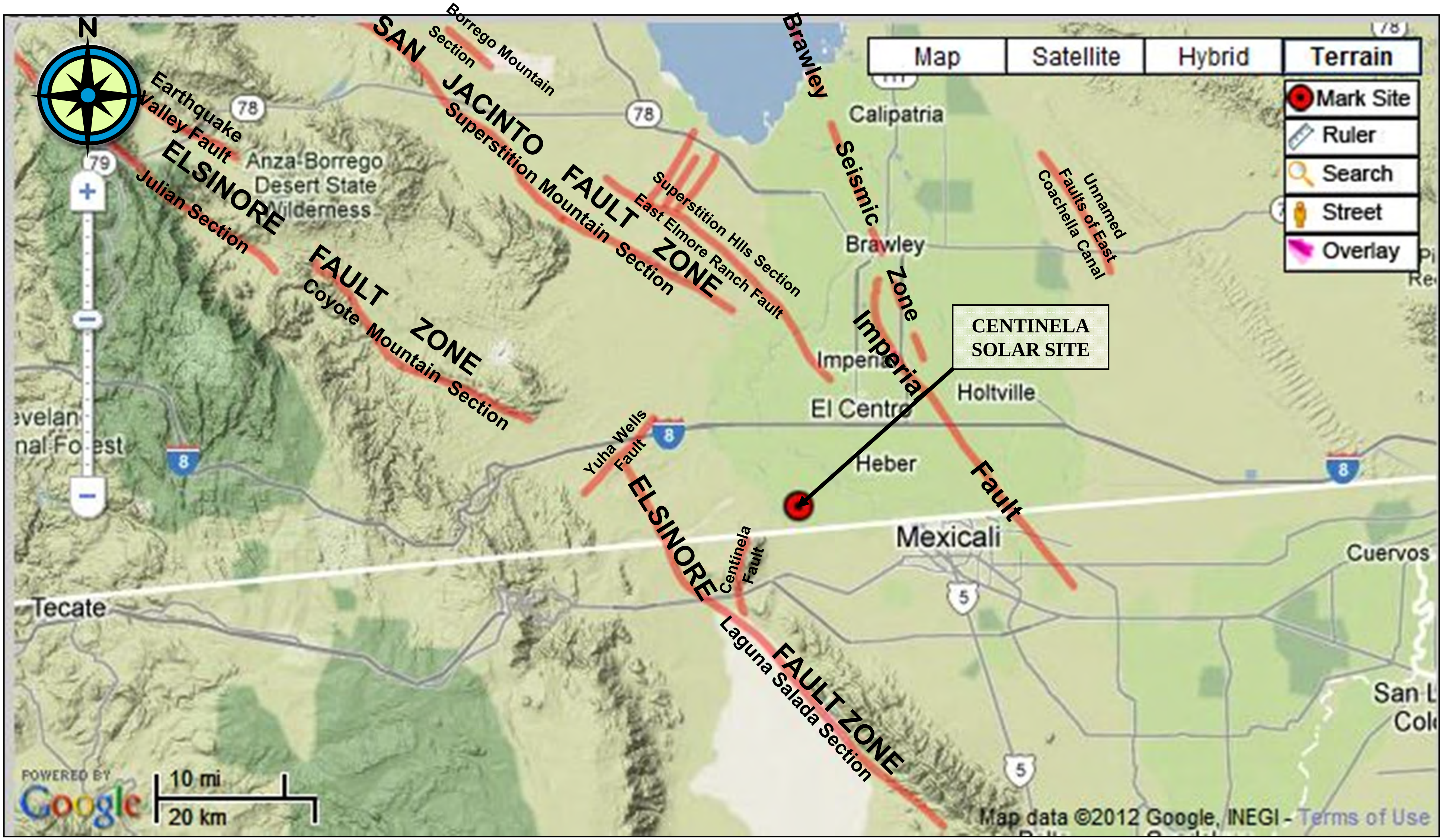
GROUP DELTA CONSULTANTS

GDC Project No. I-558

Centinela Solar Project
Imperial County, California

REGIONAL FAULT MAP

Figure 4A



Reference: ARS ONLINE http://dap3.dot.ca.gov/shake_stable/

GROUP DELTA CONSULTANTS

GDC Project No. IR-558

Centinela Solar Project
Imperial County, California

LOCAL FAULT MAP

Figure 4B

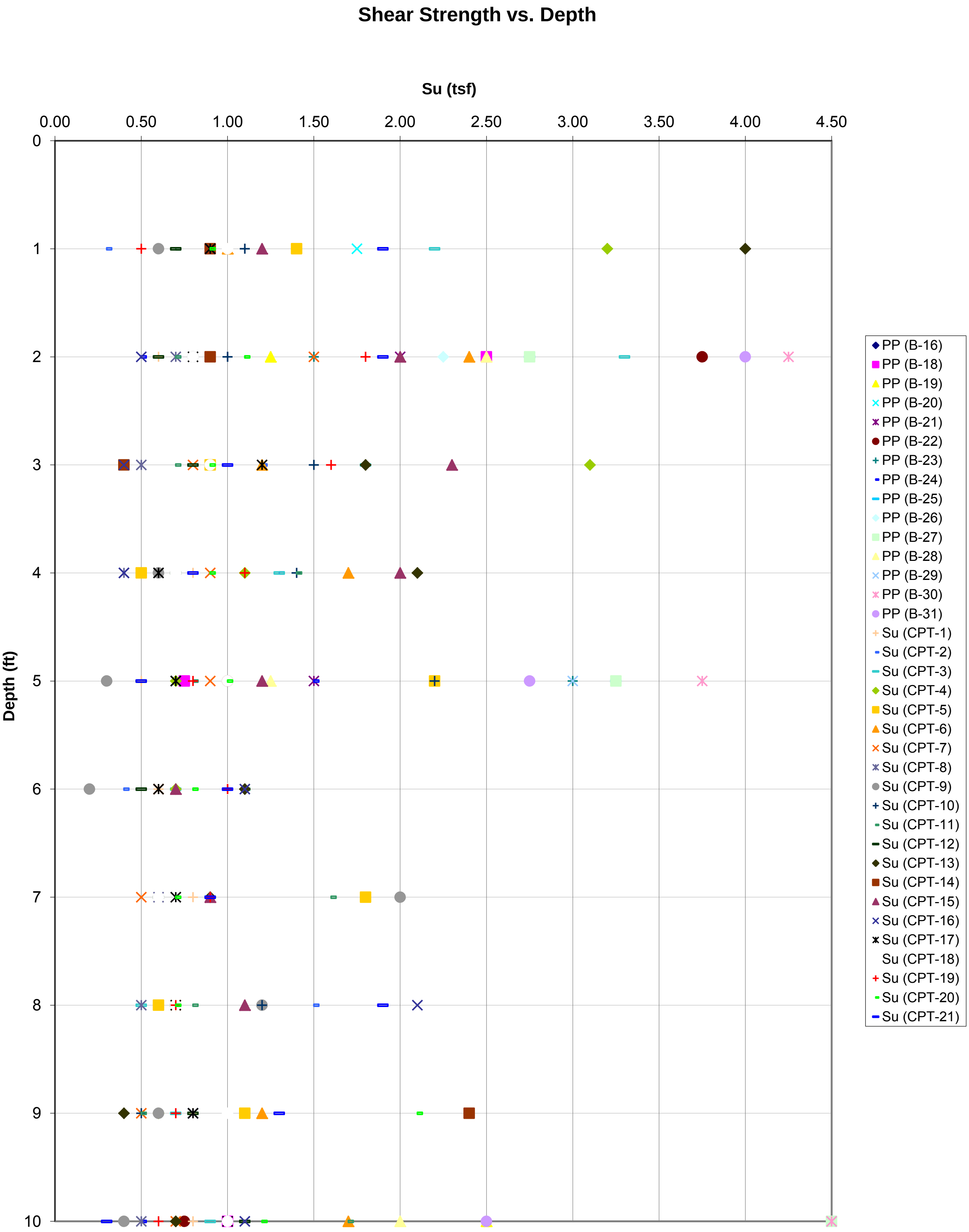


Figure 5

Undrained Shear Strength Profile

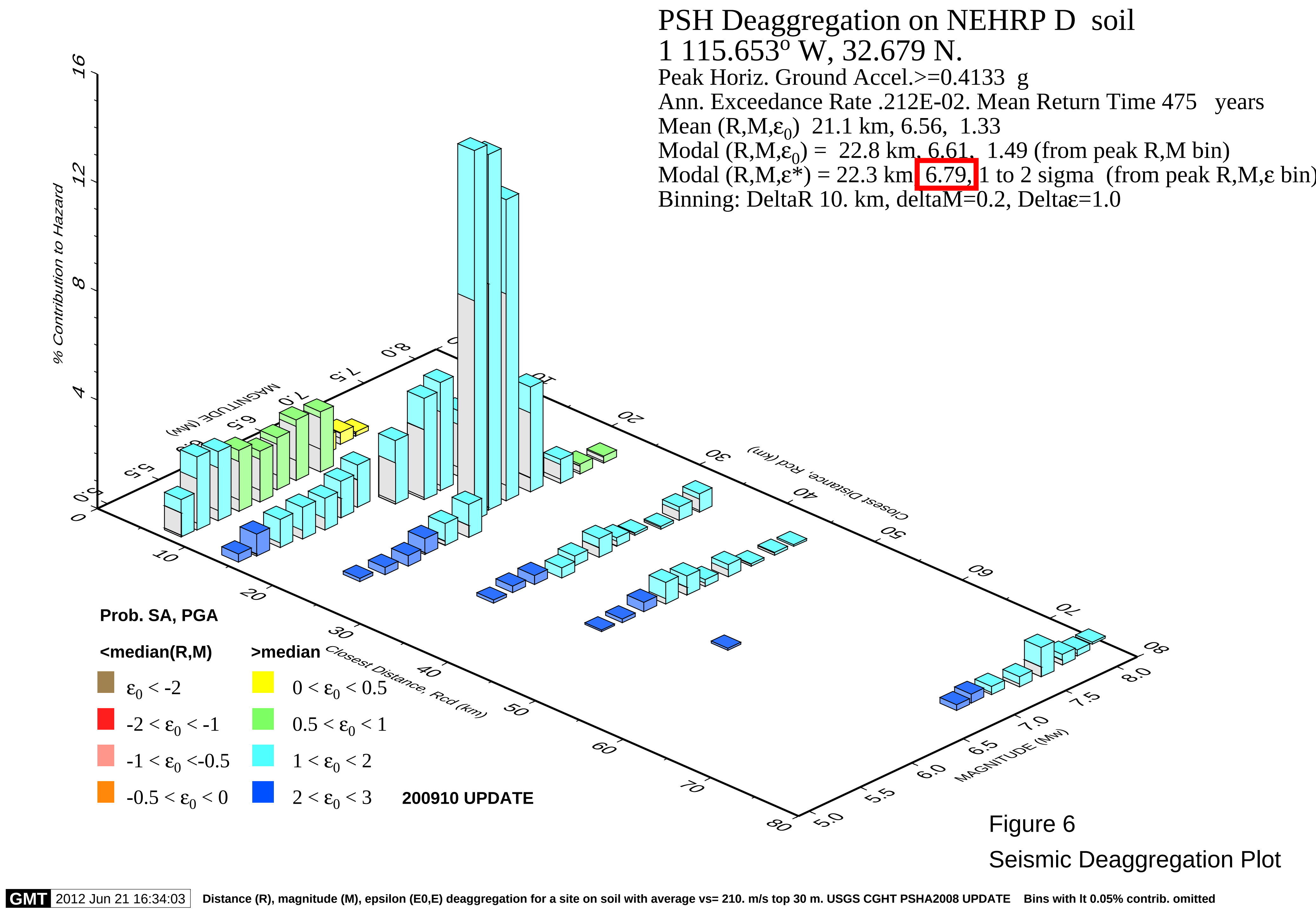
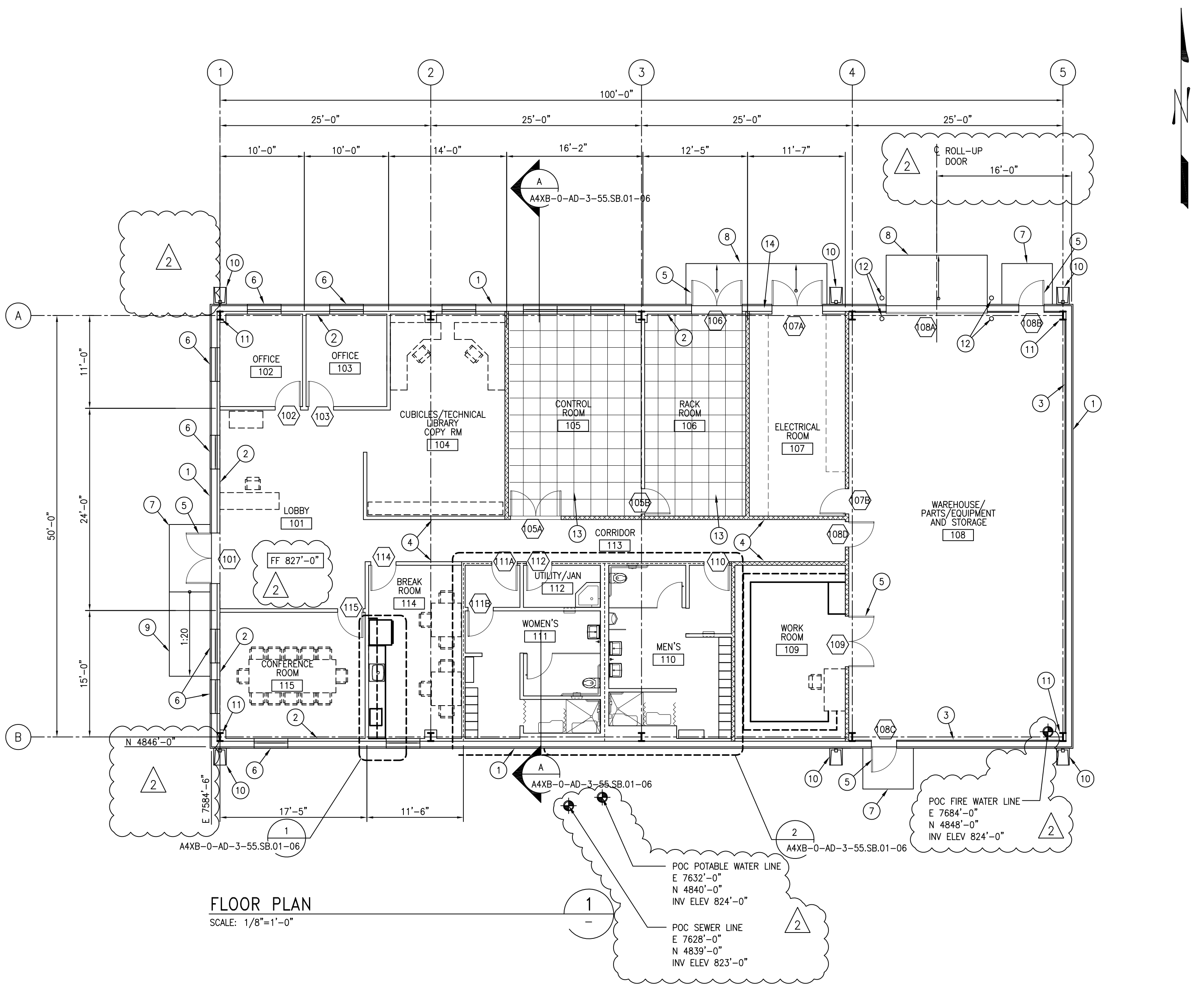


Figure 6

Seismic Deaggregation Plot



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

KEYNOTES:

① METAL WALL PANEL SYSTEM
② LINER PANEL FROM FLOOR TO 12" ABOVE FINISHED CEILING IN FINISHED ROOMS
③ LINER PANEL FROM FLOOR TO 7'-4" IN UNFINISHED ROOMS
④ GYPSUM BOARD FINISH
⑤ DOOR, SEE SCHEDULE ON DWG A4XB-0-AD-3-45.SB.01-07
⑥ 4'-0"x 4'-0" WINDOW, 4'-0" ABOVE FINISH FLOOR
⑦ CONCRETE STOOP
⑧ CONCRETE APRON 10%
⑨ CONCRETE WALKWAY 1:20 SLOPE
⑩ DOWNSPOUT AND CONCRETE SPLASH BLOCK
⑪ STEEL STRUCTURE, TYPICAL
⑫ 6"ø CONCRETE FILLED STEEL BOLLARD
⑬ ACCESS FLOOR SYSTEM
⑭ PROVIDE 24" H x 36" W OPENING UNDER FINISH FLOOR FOR ELECTRICAL CONDUITS ENTRY TO ELECTRICAL ROOM (BY OTHERS)

WALL LEGEND:

═	GYPSUM BOARD PARTITION
▤	FULL HEIGHT METAL STUD AND GYPSUM BOARD PARTITION
▨	TWO HOUR RATED, FULL HEIGHT METAL STUD AND GYPSUM BOARD PARTITION

Figure 7
Service Building Plan

REV	DATE	REVISION DESCRIPTION	BY	CHK	APPV	REFERENCE DWG NUMBER	REFERENCE DRAWINGS
1	04/23/12	ISSUED FOR DESIGN	MCC	MV	MN		
2	05/14/12	REVISED AS NOTED	MCC	MV	MN		

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CONTRACT A4XB	
DESIGNED BY M.C.CHARBEL	
CHECKED BY M.VEAZEY	
SUPERVISOR M.NARAGHI	APP DATE 04/23/12
LEAD ENGR/SPEC. M.NARAGHI	APP DATE 04/23/12
ENRG MGR. A.MARFATIA	APP DATE 04/23/12
PROJECT MGR. B.BERENSON	APP DATE 04/23/12
CLIENT	APP DATE

ARLINGTON VALLEY
SOLAR ENERGY II PROJECT

ARCHITECTURAL
SERVICE BUILDING
FLOOR PLAN

SCALE	DRAWING NUMBER	REV
1/8"=1'-0"	A4XB-0-AD-3-10.SB.01-02	2

CAD FILE NAME A4XB-0-AD-3-10.SB.01-02_R2.dwg

FC.DWG 07DEC10

PLOT DATE: V:\CAD\220\DWG\A4XB-0-AD-3-10.SB.01-02_R2.dwg 05-14-12 9:13 am Printed By: sou50212

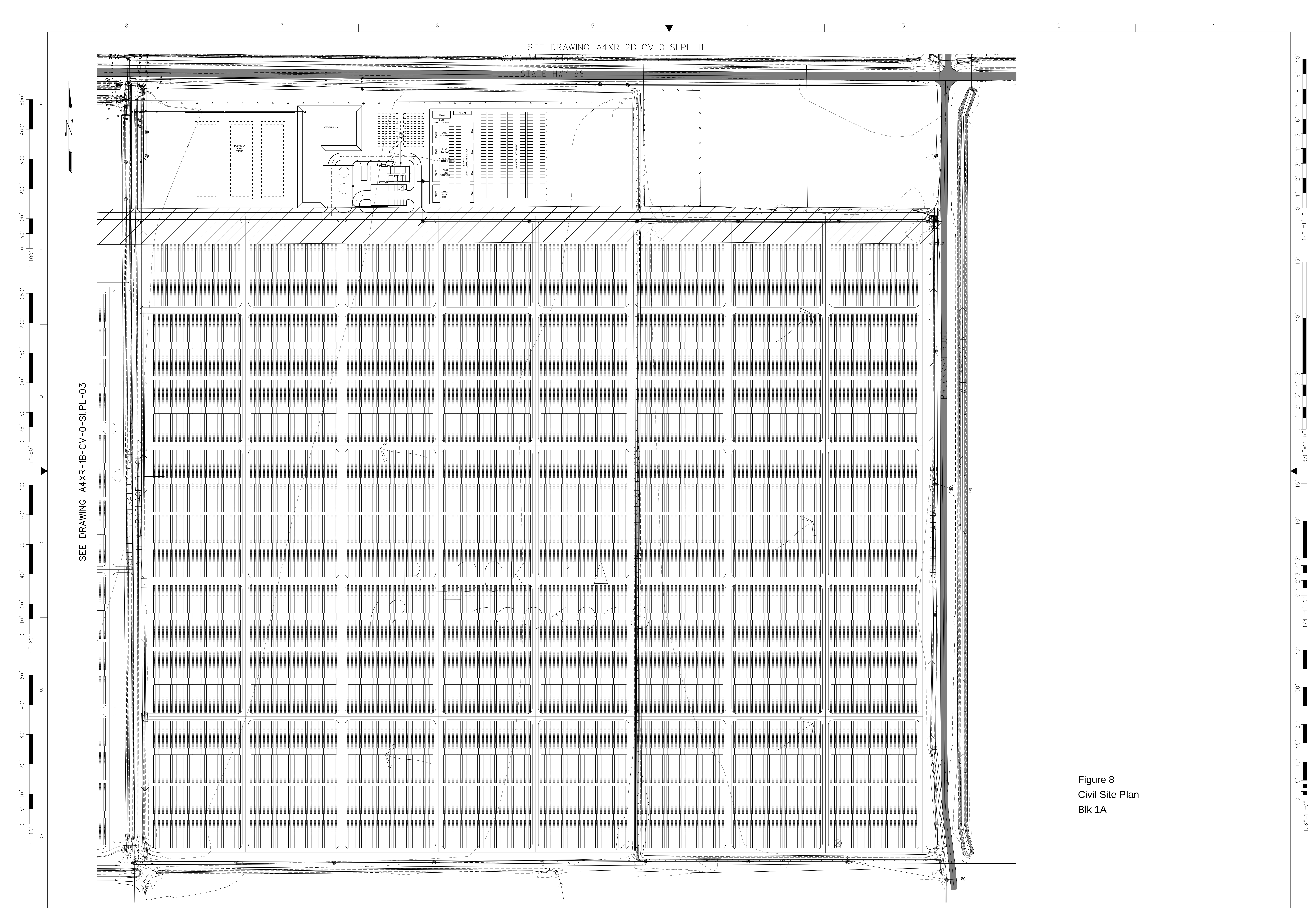

Figure 8
Civil Site Plan
Blk 1A

REV	DATE	REVISION DESCRIPTION	BY	CHK	APPV	REV	DATE	REVISION DESCRIPTION	BY	CHK	APPV	REFERENCE DWG NUMBER	REFERENCE DRAWINGS
0	6/20/12												

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CONTRACT A4XB	
DESIGNED BY A CARRILLO	
CHECKED BY S LEVISEE	
SUPERVISOR J DAVIS	APP DATE
LEAD ENGR/SPEC. S PAI	APP DATE
ENRG MGR. M WEBER	APP DATE
PROJECT MGR. L CHOW	APP DATE
CLIENT	APP DATE

CENTINELA
SOLAR ENERGY PROJECT

CIVIL
SITE PLAN
PLAN VIEW - BLOCK 1A

SCALE	DRAWING NUMBER	REV
1" = 100'	A4XR-1A-CV-0-SI.PL-02	0

CAD FILE NAME: A4XR-1A-CV-0-SI.PL-02

PLOT DATE: 21-JUN-2012 13:22 PLOTTED BY: mar31589 N:\CAD\210\dwgs\Site_Plan\A4XR-1A-CV-0-SI.PL-02.dgn

II. Design Catalogs

When not enough detailed information is available, the design catalog approach is recommended to design aggregate surface roads. Table 5 presents a catalog of aggregate base layer thickness that may be used for the design of low-volume roads. The thicknesses shown are based on specific ranges of 18-kip ESAL applications at traffic levels (39):

Level	18-kip ESAL Traffic Load
High	60,000 - 100,000
Medium	30,000 - 60,000
Low	10,000 - 30,000

Table 5: Aggregate Surfaced Road Design Catalog: Recommended Aggregate Base Thickness (in Inches) For Six U.S. Regions, Five Relative Qualities of Roadbed Soil, and Three Traffic Levels. (39)

Relative Quality of Roadbed Soil	Traffic Level	U.S. Climatic Region					
		I	II	III	IV	V	VI
Very Good	High	8*	10	15	7	9	15
	Medium	6	8	11	5	7	11
	Low	4	4	6	4	4	6
Good	High	11	12	17	10	11	17
	Medium	8	9	12	7	9	12
	Low	4	5	7	4	5	7
Fair	High	13	14	17	12	13	17
	Medium	11	11	12	10	10	12
	Low	6	6	7	5	5	7
Poor	High	**	**	**	**	**	**
	Medium	**	**	**	15	15	**
	Low	9	10	9	8	8	9
Very Poor	High	**	**	**	**	**	**
	Medium	**	**	**	**	**	**
	Low	11	11	10	8	8	9

* Thickness of aggregate base required (in inches) ** Higher type pavement design recommended

Figure 9A
Gravel Road Design Table

The South Dakota Catalog Design Method

A similar approach to the above procedure is suggested for local and other agencies in the state of South Dakota to determine gravel layer thickness. The method is rather crude because it only relies on two parameters, heavy trucks and subgrade support condition. Table 6 represents suggested thicknesses. (3)

Table 6: Suggested Gravel Layer Thickness for New Or Reconstructed Rural Roads.

Estimated Daily Number of Heavy Trucks	Subgrade Support Condition[1]	Suggested Minimum Gravel Layer Thickness,mm (in.)
0 to 5	Low	165 (6.5)
	Medium	140 (5.5)
	High	115 (4.5)
5 to 10	Low	215 (8.5)
	Medium	180 (7.0)
	High	140 (5.5)
10 to 25	Low	290 (11.5)
	Medium	230 (9.0)
	High	180 (7.0)
25 to 50	Low	370 (14.5)
	Medium	290 (11.5)
	High	215 (8.5)

Notes: [1] Low Subgrade support: CBR ≤ 3 percent;
Medium Subgrade support: $3 < \text{CBR} \leq 10$ percent;
High Subgrade support: CBR >10 percent.

Figure 9B
Gravel Road Design Table

Figure 10

CPT Rig Stuck

APPENDIX A
FIELD INVESTIGATION

APPENDIX A
FIELD INVESTIGATION

A.1 Introduction

The subsurface conditions at the Centinela Solar Energy Facility site were investigated by performing sixteen (16) Hollow-Stem Auger borings, twelve (12) soil electro-resistivity tests, and twenty-one (21) Cone Penetration Tests (CPTs) in the period between May 14 and May 31, 2012. The locations of the explorations are presented in Figure 2 of the main report. A summary of field explorations is presented in Table A-1.

Prior to beginning the exploration program, access permission and drilling permits were obtained as necessary by Fluor from local property owners. Subsurface utility maps were reviewed prior to selecting locations for subsurface investigations. Underground Service Alert (USA) was notified and each exploration location was cleared for underground utilities. The exploration methods are described in the following sections.

A.2 Soil Drilling and Sampling

Drilling, Logging, and Soil Classification

Borings were performed by GDC's drilling subcontractors Pacific Drilling Company under the continuous technical supervision of a GDC field engineer, who visually inspected the soil samples, measured groundwater levels, maintained detailed records of the borings, and visually / manually classified the soils in accordance with the ASTM D 2488 and the Unified Soil Classification System (USCS). Logging and classification was performed in general accordance with Caltrans "Soil and Rock Logging, Classification, and Presentation Manual (2010 Edition)". A Boring Record Legend and Key for Soil Classification are presented in Figures A-1A through A-1E. The boring records are presented in Figures A-2A through Figure A-17B.

Sampling

Bulk samples of soil cuttings were collected at selected depths and drive samples were collected at a typical interval of 5 feet from the borings. The sampling was performed using Standard Penetration Test (SPT) samplers in accordance with ASTM D 1586 and Ring-Lined "California" Split Barrel samplers in accordance with ASTM D 3550.

Bulk samples were collected from auger cuttings and placed in plastic bags.

SPT drive samples were obtained using a 2-inch outside diameter and 1.375-inch inside diameter split-spoon sampler without lining. The soil recovered from the SPT sampling was sealed in plastic bags to preserve the natural moisture content.

California drive samples were collected with a 3-inch outside diameter 2.5-inch inside diameter split barrel sampler with a 2.42-inch inside diameter cutting shoe. The sampler barrel is lined with 18-inches of metal rings for sample collection and has an additional length of waste barrel. Stainless steel or brass liner rings for sample collection are 1-inch high, 2.42-inch inside diameter, and 2.5-inch outside diameter. California samples were removed from the sampler, retained in the metal rings and placed in sealed plastic canisters to prevent loss of moisture.

At each sampling interval, the drive samplers were fitted onto sampling rod, lowered to the bottom of the boring, and driven 18 inches or to refusal (50 blows per 6 inches) with a 140-lb hammer free-falling a height of 30-inches using an automatic hammer.

Compared to the SPT, the California sampler provides less disturbed samples.

Penetration Resistance

SPT blow counts adjusted to 60% hammer efficiency (N_{60}) are routinely used as an index of the relative density of coarse grained soils, and are sometimes used (but less reliable) to estimate consistency of cohesive soils. For samples collected using non-SPT samplers, different hammer weight and drop height, and/or efficiency different than 60%, correction factors can be applied to estimate the equivalent SPT N_{60} value following the approach of Burmister (1948) as follows:

$$N^*_{60} = N_R * C_E * C_H * C_S$$

where

N^*_{60} = equivalent SPT N_{60}

N_R = Raw Field Blowcount (blows per foot)

C_E = Hammer Efficiency Correction = Er_i / 60%

C_H = Hammer Energy Correction = $(W * H) / (140 \text{ lb} * 30 \text{ in})$

C_S = Sampler Size Correction = $[(2.0 \text{ in})^2-(1.375 \text{ in})^2]/[D_o^2-D_i^2]$

Er_i = hammer efficiency, %

W= actual drive hammer weight, lbs

H = actual drive hammer drop, inch

D_o, D_i = actual sampler outside and inside diameter, respectively, inches

Burmister's correction assumes that penetration resistance (blowcount) is inversely proportional to the hammer energy. For a hammer other than a 140# hammer with 30" drop the hammer energy correction is equal to the ratio of the theoretical hammer energy (weight times drop) to the theoretical SPT hammer energy, or C_H = (W * H) / (140 lb * 30 in).

Burmister's correction assumes that penetration resistance (blowcount) is proportional to the annular end area of the drive sampler. For California drive samplers with D_o=3 inch and D_i=2.42 inch the sampler size correction factor is the ratio of the annular area of an SPT split spoon to that of the California Sampler, or $C_S = [2.0^2 - 1.375^2]/[3^2 - 2.42^2] = 0.67$.

To normalize the field SPT and California blowcounts to a hammer with 60% efficiency, an energy correction factor equal to Hammer Efficiency (%) / 60% was applied to the field blowcounts. Hammer efficiency was determined by Pile Driving Analyzer (PDA) measurement. The hammer used in this field investigation had a hammer efficiency of 87 percent.

The correction factors applied to obtain N^*_{60} are summarized in the following table:

Borings	**Hammer Type**	**Hammer Weight and Drop**	**C_H**	**Hammer Efficiency (%)**	**C_E**	**Cal Sampler Dimensions**	**C_S**	**Combined Correction Factor SPT Samples**	**Combined Correction Factor CAL Samples**
B-16 through B-28	CME Auto	140# 30" or other	W*H/ (140#*30")	87	1.45	D_o=3.0" D_i=2.42"	0.67	1.45	0.97

Corrected N^*_{60} are generally used, with due engineering judgment, only for qualitative assessment of in place density or consistency, and are not used for other more critical analyses such as liquefaction.

Relative Density and Consistency

Equivalent SPT N_{60} values were used as the basis for classifying relative density of granular/cohesionless soils. Wherever possible consistency classification of cohesive soils was based on undrained shear strength estimated in the field with a pocket penetrometer or by testing in the laboratory. Where pocket penetrometer or other tests could not be performed, consistency of cohesive soils was estimated by correlations to Equivalent SPT N_{60}. The correlations for consistency and relative density are shown in the Boring Record Legend, Figures A-1A through A-1C. Drive sample field blow counts, SPT N^*_{60} values, pocket penetrometer readings, and corresponding density/consistency classifications are presented on the boring records.

Borehole Abandonment

At the completion of the drilling groundwater was measured (where possible) and the borings were abandoned by backfilling the borehole with drill cuttings or Bentonite grout, or as indicated on the records. The surface was patched with cold mix asphalt concrete or quickset concrete, as necessary. Notes describing the borehole abandonment are presented at the bottom of each boring record.

Sample Handling and Transport

Geotechnical samples were sealed to prevent moisture loss, packed in appropriate protective containers, and transported to the geotechnical laboratory for further examination and geotechnical testing.

Laboratory Testing

The soils were further examined and tested in the laboratory and classified in accordance with the Unified Soil Classification System following ASTM D 2487 and D 2488 (see Figures A-1D and A-1E). Field classifications presented on the records were modified where necessary on the basis of the laboratory test results. Descriptions of the laboratory tests performed and a summary of the results are presented in Appendix B.

A.3 Electrical Resistivity Testing

Subsurface Surveys performed electrical resistivity testing as a subcontractor to GDC between the dates of May 21 and May 24, 2012. Testing was performed at 12 locations at depths ranging from 2 to 800 feet below ground surface. The equipment, field procedures, and results are provided in Appendix D.

A.4 Cone Penetration Tests

CPT Soundings

Kehoe Testing & Engineering and Middle Earth Geo Testing, Inc. performed the CPT soundings as a subcontractors to GDC. The CPTs were conducted in accordance with ASTM D 5778 using an electronic piezocone penetrometer. The test consists of hydraulically pushing a conical pointed penetrometer with a cylindrical friction sleeve and a piezo-element located behind the conical point into subsurface soils at a slow, steady rate. Parameters electronically measured and recorded nearly continuously during the CPT are soil bearing resistance at the cone tip (qc), soil frictional resistance along the cylindrical friction sleeve (fs), and pore water pressure directly behind the cone tip (U). These measured values are then used to estimate the type and engineering properties of soils being penetrated using published correlations between qc, fs, and U.

The CPT data in graphical form and accompanying data interpretation by GDC are presented in Figures A-18A to A-38C. At the completion of the sounding the apparent groundwater depth and cave-in depth was measured with weighted tape and the CPT hole was abandoned by backfilling bentonite into the hole. Paved surfaces were patched with cold mix asphalt or quickset concrete.

Seismic CPT Shear Wave Velocity Measurement

Shear wave velocity measurements versus depth were made in two CPTs, DC-1 and DC-20 (SCPT-1 and 20). After each 5 ft of penetration the probe was stopped, a shear wave was generated at the ground surface, and the arrival of the shear wave was detected by the CPT probe. The arrival times of the shear waves were used to calculate the shear wave velocity versus depth. The shear wave velocity data is presented in Table 1 of the main report.

A.5 Piezometer Installation

Upon completion of drilling and sampling activities, borings B-16, B-18, B-23 and B-31 were converted into wells. A detail of the piezometer installed in each borehole is provided as Figure A-39. Ground water was measured immediately after installation and on June 5, 2012. Due to objections by the Farmers, these wells were cut off 2 feet below ground surface and abandoned in place.

A.6 Percolation Testing

Percolation testing was performed at two locations, PT-1 and PT-2, in the proposed leach field area shown in Figure 2 of the main report. The percolation test procedures are discussed in the main report and test results are provided as Figures A-40 through A-44.

A.7 List of Attached Tables and Figures

The following tables and figures are attached and complete this appendix:

List of Tables

Table A-1 Summary of Field Explorations

List of Figures

Figure A-1A through A-1C Boring Record Legend
Figure A-1D and A-1E Key for Soil Classification
Figures A-2A through A-17 Boring Records
Figures A-18 through A-38 CPT Records and Interpretations
Figure A-39 Typical Piezometer Diagram
Figure A-40 to A-44 Percolation Test Results

TABLE A-1
SUMMARY OF FIELD EXPLORATIONS

Exploration No.	Approximate Exploration Location		Date	Exploration			Groundwater		Figure No.
	Latitude	Longitude		Type	Surface Elevation (ft)	Total Depth (ft)	Depth (ft)	Elevation (ft)	
B-16	32.70108	-115.64788	5/31/12	HSA	-18	41.5	NM	--	A-2 (A-C)
B-17	32.69555	-115.6407	5/31/12	HSA	-18	21.5	8.0/7.4 (*)	-26	A-3 (A-C)
B-18	32.68596	-115.64701	5/30/12	HSA	-16	21.5	13.7/3.8	-29.7	A-4 (A-C)
B-19	32.6837	-115.63565	5/14/12	HSA	-16	21.5	10	-26.0	A-5
B-20	32.68366	-115.62785	5/14/12	HSA	-16	26.5	9	-25.0	A-6 (A-B)
B-21	32.68012	-115.63275	5/16/12	HSA	-13	51.5	7	-20.0	A-7 (A-C)
B-22	32.68006	-115.62203	5/31/12	HSA	-14	51.5	6	-20.0	A-8 (A-C)
B-23	32.67726	-115.66722	5/15/12	HSA	-16	21.5	9/4.5	-25.0	A-9 (A-C)
B-24	32.67396	-115.66692	5/15/12	HSA	-13	51.5	8	-21.0	A-10 (A-C)
B-25	32.67559	-115.66268	5/15/12	HSA	-16	21.5	10	-26.0	A-11 (A-C)
B-26	32.67474	-115.65846	5/15/12	HSA	-16	21.5	6	-22.0	A-12 (A-C)
B-27	32.67692	-115.65374	5/30/12	HSA	-16	21.5	13.8	-29.8	A-13 (A-C)
B-28	32.67825	-115.64761	5/16/12	HSA	-16	21.5	NE	--	A-14 (A-C)
B-29	32.67839	-115.64454	5/30/12	HSA	-15	51.5	6.3	-21.3	A-15 (A-C)
B-30	32.67385	-115.64482	5/30/12	HSA	-14	21.5	13.4	-27.4	A-16 (A-C)
B-31	32.67631	-115.64058	5/30/12	HSA	-14	21.5	12.0/7.5	-26.0	A-17 (A-C)
DC-1	32.70078	-115.64333	5/15/12	CPT	-22	60	--	--	A-18 (A-C)
C-2	32.69619	-115.64532	5/15/12	CPT	-19	30	--	--	A-19 (A-B)
C-3**	32.69039	-115.65413	5/30/12	CPT	-18	60	--	--	A-20 (A-C)
C-4**	32.69365	-115.64696	5/31/12	CPT	-17	30	--	--	A-21 (A-B)

TABLE A-1 (Continued)
SUMMARY OF FIELD EXPLORATIONS

Exploration No.	Approximate Exploration Location		Date	Exploration			Groundwater		
	Latitude	Longitude		Type	Surface Elevation (ft)	Total Depth (ft)	Depth (ft)	Elevation (ft)	Figure No.
C-5**	32.68814	-115.6444	5/31/12	CPT	-16	30	--	--	A-22 (A-B)
C-6**	32.68895	-115.64017	5/31/12	CPT	-16	30	--	--	A-23 (A-B)
C-7	32.68627	-115.65546	5/30/12	CPT	-17	30	--	--	A-24 (A-B)
C-8	32.68019	-115.64868	5/30/12	CPT	-16	30	--	--	A-25 (A-B)
C-9	32.68565	-115.63954	5/15/12	CPT	-15	60	--	--	A-26 (A-C)
C-10	32.68206	-115.63794	5/14/12	CPT	-15	30	--	--	A-27 (A-B)
C-11	32.68395	-115.63078	5/14/12	CPT	-16	30	--	--	A-28 (A-C)
C-12	32.68036	-115.6269	5/14/12	CPT	-14	60	--	--	A-29 (A-C)
C-13	32.68007	-115.62463	5/30/12	CPT	-14	30	--	--	A-30 (A-B)
C-14	32.6781	-115.67046	5/31/12	CPT	-13	60	--	--	A-31 (A-C)
C-15	32.67148	-115.66628	5/15/12	CPT	-10	30	--	--	A-32 (A-B)
C-16	32.67284	-115.66237	5/15/12	CPT	-14	30	--	--	A-33 (A-B)
C-17	32.67804	-115.65811	5/15/12	CPT	-17	30	--	--	A-34 (A-B)
C-18	32.67307	-115.6536	5/15/12	CPT	-15	60	--	--	A-35 (A-C)
C-19	32.67881	-115.64771	5/15/12	CPT	-16	30	--	--	A-36 (A-B)
DC-20	32.67839	-115.64495	5/15/12	CPT	-15	60	--	--	A-37 (A-C)
C-21	32.67273	-115.63963	5/14/12	CPT	-13	30	--	--	A-38 (A-B)

Notes: 1) Boring locations are shown in Figure 2 of the main report.

2) Elevations were estimated using Google Earth map.

3) Groundwater levels not measured in CPT soundings.

HSA = Hollow-Stem Auger NE = Not Encountered NM = Not Measured

(*) Piezometers were installed in Borings B-17, B-8, B-23, and B-31. The number after "/" represents the final water level reading in the Piezometer on 6/5/12.

(**) Due to access issues, CPT-3, CPT-4, and CPT-5 were moved east or west to the nearest access road. The location of CPT-6 was moved into the residential property at the discretion of the land owner.

SOIL IDENTIFICATION AND DESCRIPTION SEQUENCE

Sequence	Identification Components	Refer to Section		Required	Optional
		Field	Lab		
1	Group Name	2.5.2	3.2.2	●	
2	Group Symbol	2.5.2	3.2.2	●	
	Description Components				
3	Consistency of Cohesive Soil	2.5.3	3.2.3	●	
4	Apparent Density of Cohesionless Soil	2.5.4		●	
5	Color	2.5.5		●	
6	Moisture	2.5.6		●	
7	Percent or Proportion of Soil	2.5.7	3.2.4	●	⬬
	Particle Size	2.5.8	2.5.8	●	⬬
	Particle Angularity	2.5.9			○
	Particle Shape	2.5.10			○
8	Plasticity (for fine-grained soil)	2.5.11	3.2.5		○
9	Dry Strength (for fine-grained soil)	2.5.12			○
10	Dilatency (for fine-grained soil)	2.5.13			○
11	Toughness (for fine-grained soil)	2.5.14			○
12	Structure	2.5.15			○
13	Cementation	2.5.16		●	
14	Percent of Cobbles and Boulders	2.5.17		●	
	Description of Cobbles and Boulders	2.5.18		●	
15	Consistency Field Test Result	2.5.3		●	
16	Additional Comments	2.5.19			○

Describe the soil using descriptive terms in the order shown

Minimum Required Sequence:

USCS Group Name (Group Symbol); Consistency or Density; Color; Moisture; Percent or Proportion of Soil; Particle Size; Plasticity (optional).

⬬ = optional for non-Caltrans projects

Where applicable:

Cementation; % cobbles & boulders; Description of cobbles & boulders; Consistency field test result

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

HOLE IDENTIFICATION

Holes are identified using the following convention:

H – YY – NNN

Where:

H: Hole Type Code

YY: 2-digit year

NNN: 3-digit number (001-999)

Hole Type Code and Description

Hole Type Code	Description
A	Auger boring (hollow or solid stem, bucket)
R	Rotary drilled boring (conventional)
RC	Rotary core (self-cased wire-line, continuously-sampled)
RW	Rotary core (self-cased wire-line, not continuously sampled)
P	Rotary percussion boring (Air)
HD	Hand driven (1-inch soil tube)
HA	Hand auger
D	Driven (dynamic cone penetrometer)
CPT	Cone Penetration Test
O	Other (note on LOTB)

Description Sequence Examples:

SANDY lean CLAY (CL); very stiff; yellowish brown; moist; mostly fines; some SAND, from fine to medium; few gravels; medium plasticity; PP=2.75.

Well-graded SAND with SILT and GRAVEL and COBBLES (SW-SM); dense; brown; moist; mostly SAND, from fine to coarse; some fine GRAVEL; few fines; weak cementation; 10% GRANITE COBBLES; 3 to 6 inches; hard; subrounded.

Clayey SAND (SC); medium dense, light brown; wet; mostly fine sand,; little fines; low plasticity.

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GDC Project No. IR-558

Centinela Solar Energy Facility
Imperial County, CA

BORING RECORD LEGEND #1

Figure A-1A

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

C	Consolidation (ASTM D 2435)
CL	Collapse Potential (ASTM D 5333)
CP	Compaction Curve (CTM 216)
CR	Corrosion, Sulfates, Chlorides (CTM 643, CTM 417, CTM 422)
CU	Consolidated Undrained Triaxial (ASTM D 4767)
DS	Direct Shear (ASTM D 3080)
EI	Expansion Index (ASTM D 4829)
M	Moisture Content (ASTM D 2216)
OC	Organic Content (ASTM D 2974)
P	Permeability (CTM 220)
PA	Particle Size Analysis (ASTM D 422)
PI	Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89, AASHTO T 90)
PL	Point Load Index (ASTM D 5731)
PM	Pressure Meter
R	R-Value (CTM 301)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T 100)
SL	Shrinkage Limit (ASTM D 427)
SW	Swell Potential (ASTM D 4546)
UC	Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 2938)
UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
UW	Unit Weight (ASTM D 4767)

SAMPLER GRAPHIC SYMBOLS

- ⊠ Standard Penetration Test (SPT)
- ⧗ Standard California Sampler
- ⧗ Modified California Sampler (2.4” ID, 3” OD)
- ▯ Shelby Tube
- ▯ Piston Sampler
- ▯ NX Rock Core
- ▯ HQ Rock Core
- ▩ Bulk Sample
- ◪ Other (see remarks)

DRILLING METHOD SYMBOLS

- ▯ Auger Drilling
- ▯ Rotary Drilling
- ⊠ Dynamic Cone or Hand Driven
- ⊠ Diamond Core

WATER LEVEL SYMBOLS

- ∇ First Water Level Reading (during drilling)
- ▼ Static Water Level Reading (after drilling, date)

Definitions for Change in Material

Term	Definition	Symbol
Material Change	Change in material is observed in the sample or core and the location of change can be accurately located.	———
Estimated Material Change	Change in material cannot be accurately located either because the change is gradational or because of limitations of the drilling and sampling methods.	– – – – –
Soil / Rock Boundary	Material changes from soil characteristics to rock characteristics.	∼∼∼ - ∼ - ∼ -

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

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Centinela Solar Energy Facility
Imperial County, CA

BORING RECORD LEGEND #2

Figure A-1B

CONSISTENCY OF COHESIVE SOILS

Description	Shear Strength (tsf)	Pocket Penetrometer, PP Measurement (tsf)	Torvane, TV, Measurement (tsf)	Vane Shear, VS, Measurement (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 - 0.25	0.25 - 0.5	0.12 - 0.25	0.12 - 0.25
Medium Stiff	0.25 - 0.5	0.5 - 1	0.25 - 0.5	0.25 - 0.5
Stiff	0.5 - 1	1 - 2	0.5 - 1	0.5 - 1
Very Stiff	1 - 2	2 - 4	1 - 2	1 - 2
Hard	Greater than 2	Greater than 4	Greater than 2	Greater than 2

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (blows / 12 inches)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE

Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 - 10%
Little	15 - 25%
Some	30 - 45%
Mostly	50 - 100%

PARTICLE SIZE

Description		Size (in)
Boulder		Greater than 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		Less than 1/300

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Plasticity

Description	Criteria
Nonplastic	A 1⁄8-in. thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), with the exception of consistency of cohesive soils vs. N_{60}.

CONSISTENCY OF COHESIVE SOILS

Description	SPT N_{60} (blows/12 inches)
Very Soft	0 - 2
Soft	2 - 4
Medium Stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	Greater than 30

Ref: Peck, Hansen, and Thornburn, 1974, "Foundation Engineering," Second Edition.

Note: Only to be used (with caution) when pocket penetrometer or other data on undrained shear strength are unavailable. Not allowed by Caltrans Soil and Rock Logging and Classification Manual, 2010.

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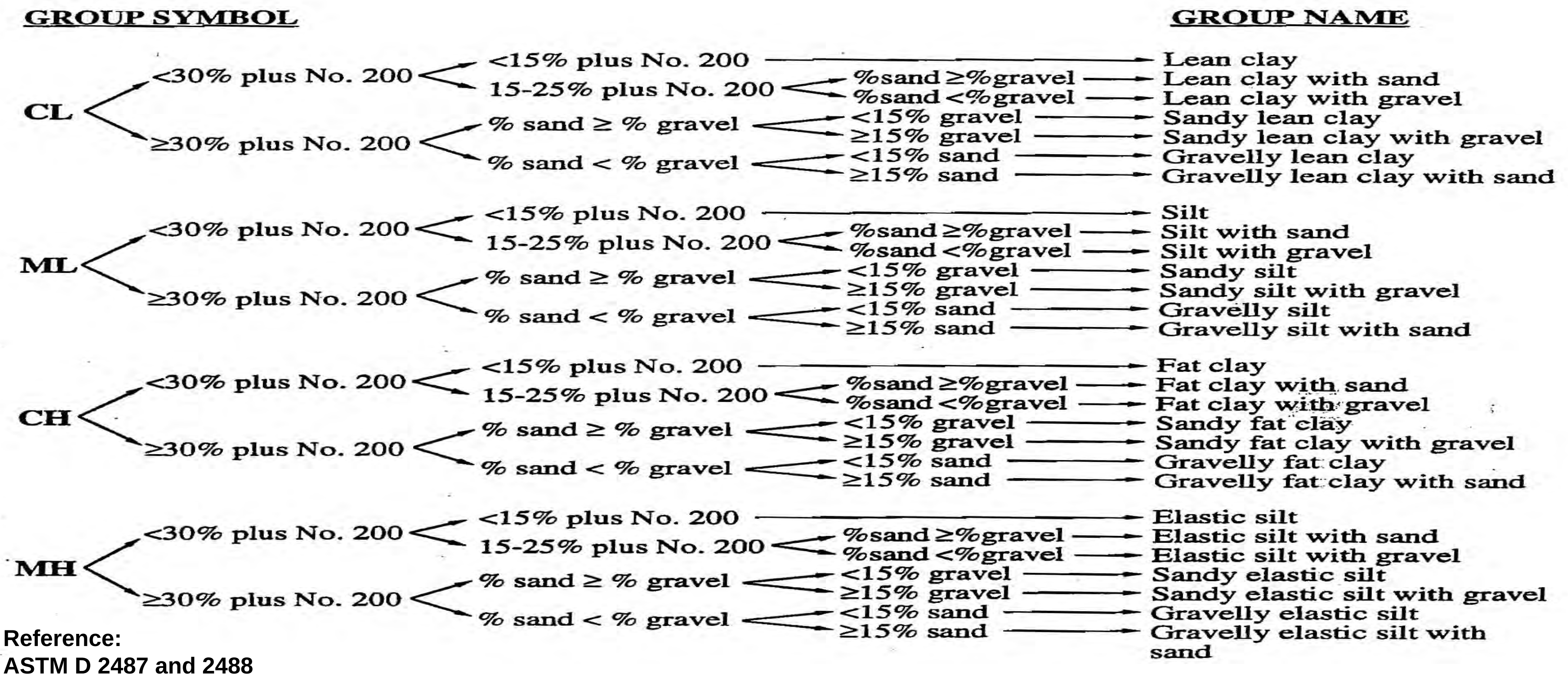
BORING RECORD LEGEND #3

Figure A-1C

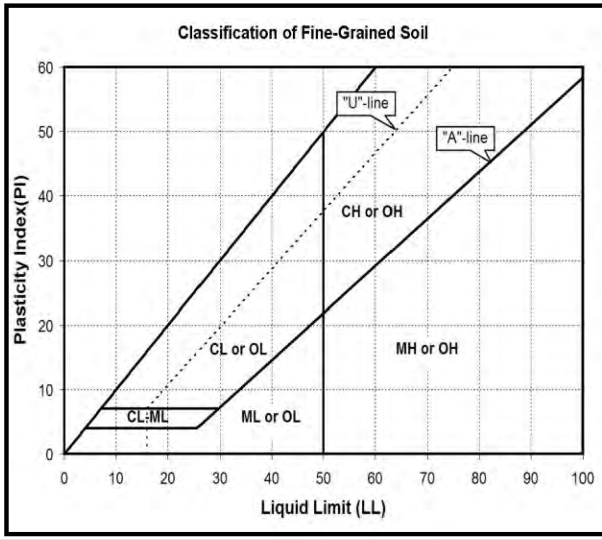
CLASSIFICATION OF INORGANIC FINE GRAINED SOILS (Soils with >50% finer than No. 200 Sieve)



Reference:
ASTM D 2487 and 2488

Laboratory Classification of Clay and Silt

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).



CL: LL<50; above A-Line.

CH: LL>50; above A-Line.

ML: LL<50; below A-Line, or PI<4, or Non-Plastic

MH: LL>50; below A-Line.

CL-ML: above A-Line and PI=4 to 7

CL/CH, ML/MH: at or near LL=50

ML/CL, MH/CH: at or near the A-Line

Field Identification of Clays and Silts

Group Symbol	Dry Strength	Dilatancy	Toughness	Plasticity
ML	None to low	Slow to rapid	Low or thread cannot be formed	Low to nonplastic
CL	Medium to high	None to slow	Medium	Medium
MH	Low to medium	None to slow	Low to medium	Low to medium
CH	High to very high	None	High	High

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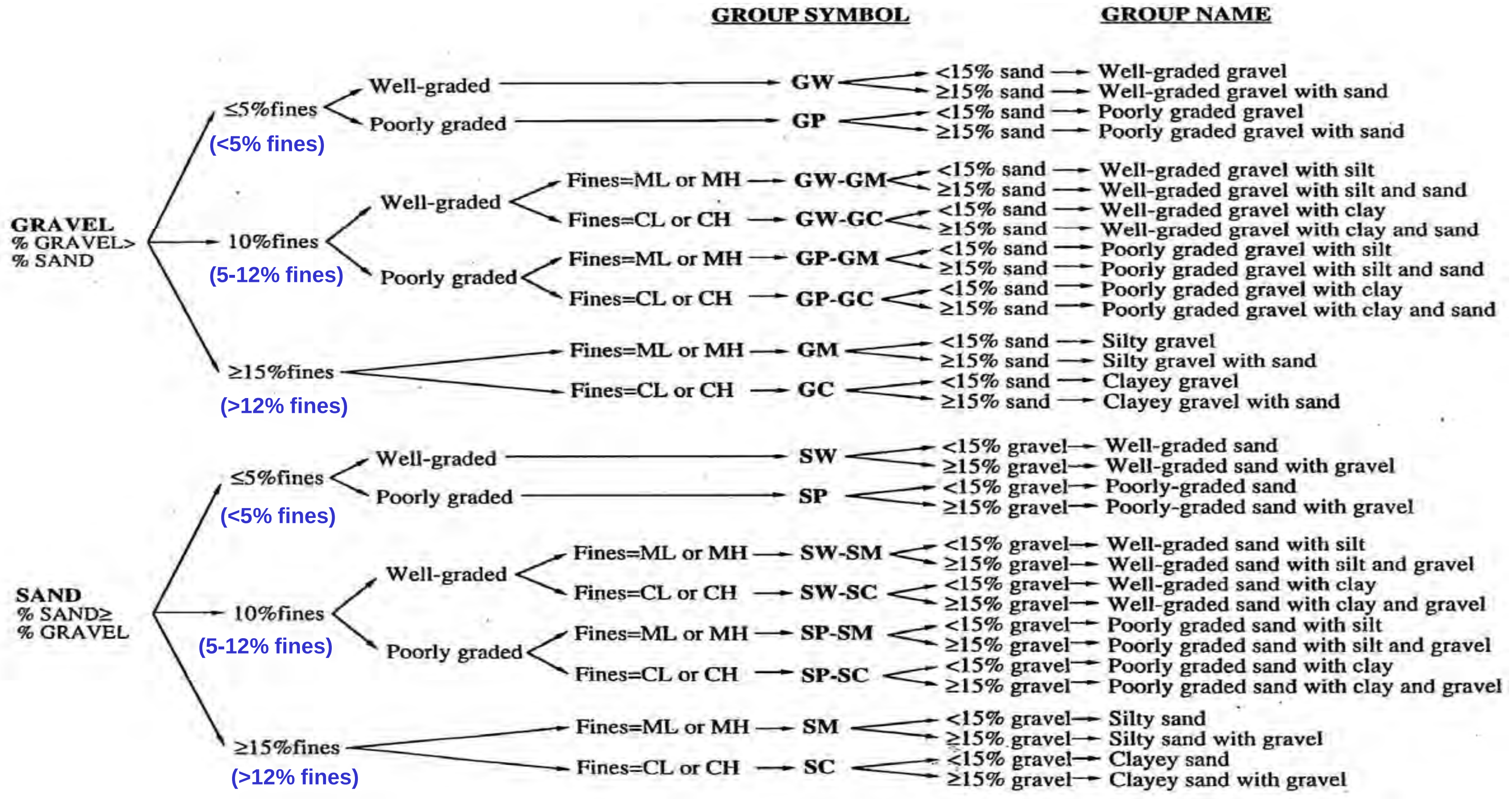
Centinela Solar Energy Facility
Imperial County, CA

KEY FOR SOIL CLASSIFICATION #1

Figure A-1D

CLASSIFICATION OF COARSE-GRAINED SOILS (Soils with <50% "fines" passing No. 200 Sieve)



Reference:

ASTM D 2487 and 2488

Note: Values estimated to nearest 5% to be used for visual identification, values in parentheses to be used for classification when based on laboratory grain size data.

Granular Soil Gradation Parameters

Coefficient of Uniformity: $C_u = D_{60}/D_{10}$

Coefficient of Curvature: $Cc= D_{30}^2 / (D_{60} \times D_{10})$

D_{10} = 10% of soil is finer than this diameter

D_{30} = 10% of soil is finer than this diameter

D_{60} = 10% of soil is finer than this diameter

Group Symbol	Gradation or Plasticity Requirement
SW	$C_u > 6$ and $1 \leq C_c \leq 3$
GW	$C_u > 4$ and $1 \leq C_c \leq 3$
GP or SP	Clean gravel or sand not meeting requirement for SW or GW
SM or GM	Non-plastic fines or below A-Line or PI<4
SC or GC	Plastic fines or above A-Line and PI>7

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Centinela Solar Energy Facility
Imperial County, CA

KEY FOR SOIL CLASSIFICATION #2

Figure A-1E

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility	**PROJECT NUMBER** IR-558	**HOLE ID** **B-16**	
SITE LOCATION Calexico, CA	**START** 5/31/2012	**FINISH** 5/31/2012	**SHEET NO.** 1 of 2
DRILLING COMPANY Pacific Drilling	**DRILL RIG** Unimog	**DRILLING METHOD** HSA	**LOGGED BY** M.Lithgow
CHECKED BY K. Bhushan	**HAMMER TYPE (WEIGHT/DROP)** Automatic (140#, 30")	**HAMMER EFFICIENCY (ERi)** 87	**BORING DIA. (in)** 6
TOTAL DEPTH (ft) 41.5	**GROUND ELEV (ft)** -18	**DEPTH/*ELEV.* GW (ft)** ∇ 12.0 / *-30.0* DURING DRILLING	**AFTER DRILLING** ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")	**NOTES** N*60=1.45Nspt=0.97Ncal		

DEPTH (feet)	ELEVATION (feet)	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
												Fat CLAY (CH); dry; brown; medium SAND; high plasticity. Moist.
	-20											Silty SAND (SM); loose; tan-brown; moist; nonplastic.
		B-1						26.7		73:49	CR EI	
		R-2	3 4 4	8	8			33.4	87			Fat CLAY (CH); stiff; medium brown; moist; fine SAND; high plasticity.
5												Wet; brown; trace fine SAND; PP=1.0.
		R-3	6 8 8	16	15							
	-25											
10												No recovery.
		S-4	2 4 3	7	10							
	-30											∇
15												
		S-5	2 1 1	2	3							
	-35											
20												PP=0
		R-6	4 4 6	10	10			32.1	89			
	-40											

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-16**
SITE LOCATION Calexico, CA
START 5/31/2012
FINISH 5/31/2012
SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 41.5
GROUND ELEV (ft) -18
DEPTH/*ELEV.* GW (ft) ▽ 12.0 / *-30.0* **DURING DRILLING**
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															(Fat CLAY (CL), continued.)
	-45														Silty SAND (SM); medium dense; wet; tan-brown; fine to medium SAND; nonplastic.
30		☒	S-7	6 9 10	19	28									
	-50														
35															
	-55														
40															Heaving SANDS at 40 ft bgs.
		☒	S-8	5 8 6	14	20									
	-60														Borehole terminated at 41.5 ft bgs. Ground water not measured due to mud and addition of water to counteract heaving sand in borehole. Borehole backfilled with soil cuttings.
45															
	-65														

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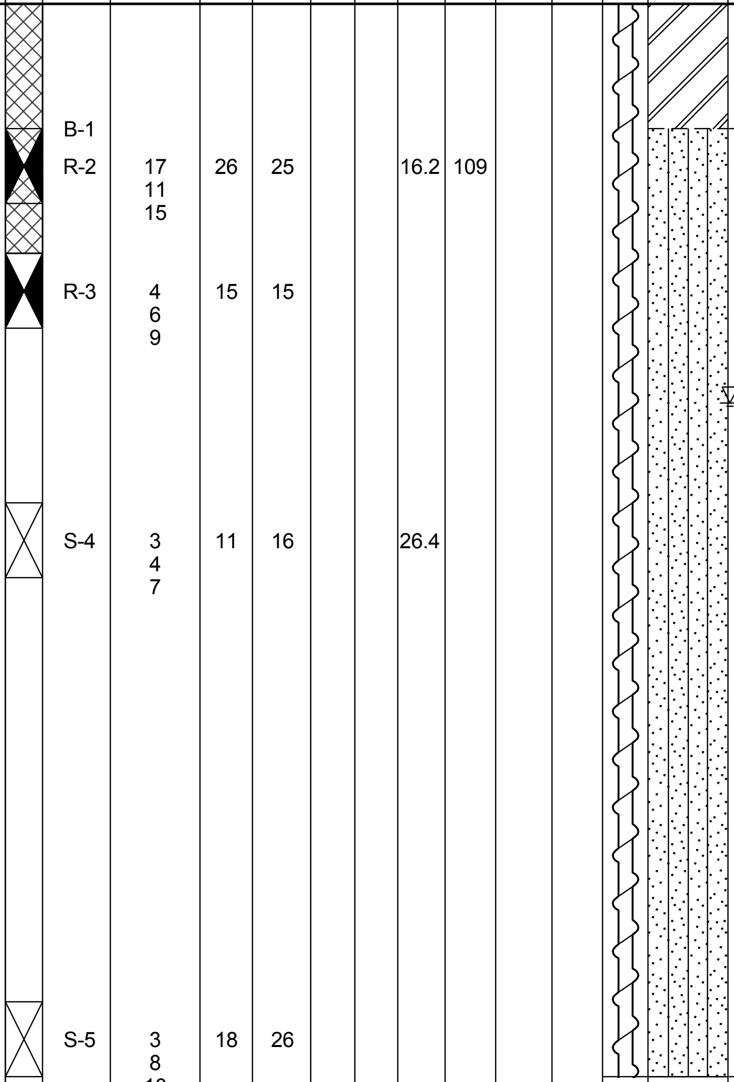
FIGURE

A-2 b

BORING RECORD

PROJECT NAME	Centinela Solar Energy Facility	**PROJECT NUMBER**	IR-558	**HOLE ID**	**B-17**
SITE LOCATION	Calexico, CA	**START**	5/31/2012	**FINISH**	5/31/2012
SHEET NO.	1 of 1				
DRILLING COMPANY	Pacific Drilling	**DRILL RIG**	Unimog	**DRILLING METHOD**	HSA
LOGGED BY	M.Lithgow	**CHECKED BY**	K. Bhushan		
HAMMER TYPE (WEIGHT/DROP)	Automatic (140#, 30")	**HAMMER EFFICIENCY (ERi)**	87	**BORING DIA. (in)**	6
TOTAL DEPTH (ft)	21.5	**GROUND ELEV (ft)**	-18	**DEPTH/*ELEV.* GW (ft)**	∇ 8.0 / *-26.0* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID)	SPT (1.4"), CAL (2.4")	**NOTES**	N*60=1.45Nspt=0.97Ncal		

DEPTH (feet)	ELEVATION (feet)	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
												Fat CLAY (CH); dry; brown; fine SAND; medium plasticity.
	-20											
		B-1										Silty SAND (SM); medium dense; moist; tan-brown; fine to medium SAND; nonplastic.
		R-2	17 11 15	26	25			16.2	109			
5												No recovery.
		R-3	4 6 9	15	15							
	-25											
10												
		S-4	3 4 7	11	16			26.4				
	-30											
15												
	-35											
20												
		S-5	3 8 10	18	26							
	-40											Boring terminated at 21.5 ft bgs. Groundwater encountered at 8 ft bgs. Piezometer constructed in borehole.



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

FIGURE

A-3

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-18**
SITE LOCATION Calexico, CA
START 5/30/2012
FINISH 5/30/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ⊻ 13.7 / *-29.7* **DURING DRILLING**
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Lean CLAY (CL); brown; moist; trace fine SAND; medium plasticity. 91% fines; 9% SAND
			B-1 R-2	4 5 6	11	11			20.2	108		PA H CP			Stiff; PP=2.5.
	-20														
5			R-3	3 9 7	16	15			25.4		30:12				Very soft; free water; increase in SILT and plasticity; PP=1.0.
	-25														
10			S-4	2 2 2	4	6			29.5						SILT layers interbedded in CLAY; PP=1.0.
														⊻	
	-30														
15															
	-35														
20			S-5	3 6 9	15	22									Hard; less SILT; PP=4.25.
															Boring terminated at 21.5 ft bgs. Groundwater encountered at X ft bgs. Piezometer PZ-2 constructed in borehole.
	-40														

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FIGURE

A-4

LOG OF TEST BORING

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
BORING **B-19**
SITE LOCATION Calexico, CA
START 5/14/2012
FINISH 5/14/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILLING METHOD HSA
LOGGED BY M. Lithgow
CHECKED BY K. Bhushan
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 10.0 / *-26.0*
SAMPLING METHOD Automatic (140#, 30")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	DRY DENSITY (pcf)	MOISTURE (%)	PID (ppm)	% PASSING #200	ATTERBERG LIMITS LL:PI	POCKET PEN (tsf)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▨									▨	Fat CLAY (CH); dark brown; moist; fine SAND; high plasticity. 96% fines; 4% SAND
		▨	B-1			26.7	PA H	96			▨	Stiff; PP=1.25.
		⧗	R-2	5 6 10							▨	
	-20	▨									░	Silty SAND (SM); medium dense; light brown; moist; nonplastic. 99% fines
5		⧗	R-3	4 7 16		26.5	PA	99			░	
											▨	Fat CLAY (CH); stiff; brown; moist; fine SAND; medium plasticity; PP=1.0.
		⧗	R-4	3 7 11	101	16.9					▨	
	-25										▨	
10											▨ ▼	
		⧗	R-5	2 2 4		34.3					▨	
	-30										▨	
15		⧗	R-6	3 6 9	92	30.4	PA	100			▨	PP=2.5; 100% fines
	-35										▨	
20		⧗	R-7	4 7 16							▨	Dark brown; PP=2.0.
												Boring terminated at 21.5 ft bgs. Groundwater encountered at 10 ft bgs. Borehole backfilled with soil cuttings.
	-40											

GDC_LOG_BORING_1A IR-558 CENTINELA SOLAR ENERGY FACILITY.GPJ GDCLOG.GDT 6/29/12

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Irvine, CA 92618

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

FIGURE A-5

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility

PROJECT NUMBER IR-558

HOLE ID **B-20**

SITE LOCATION Calexico, CA

START 5/14/2012

FINISH 5/14/2012

SHEET NO. 1 of 2

DRILLING COMPANY Pacific Drilling

DRILL RIG Unimog

DRILLING METHOD HSA

LOGGED BY M. Lithgow

CHECKED BY K. Bhushan

HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")

HAMMER EFFICIENCY (ERi) 87

BORING DIA. (in) 6

TOTAL DEPTH (ft) 26.5

GROUND ELEV (ft) -16

DEPTH/*ELEV.* GW (ft) ⊻ 9.0 / *-25.0* DURING DRILLING

AFTER DRILLING ▼ */ na*

DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")

NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Fat CLAY (CH); stiff; brown; moist; fine SAND; SILT; high plasticity; PP=1.75.
			B-1								54:38	CP			
			R-2	4 6 8	14	14			26.8	96					
	-20														
5															
			R-3	2 3 4	7	7			29.1	92					
															93% fines; Increase in SILT; PP=0
			S-4	2 3 4	7	10			27.2			PA			Silty SAND (SM); brown; moist; fine to medium SAND; nonplastic.
	-25														
10															
			R-5	2 2 2	4	4									
															Fat CLAY (CH); soft; brown; moist; fine SAND; SILT; high plasticity.
	-30														
15															PP=0
			S-6	2 2 2	4	6			30.4						
	-35														
20															98% fines; PP=0
			S-7	2 3 2	5	7						PA			
	-40														

FIGURE

A-6 a

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-20**
SITE LOCATION Calexico, CA
START 5/14/2012
FINISH 5/14/2012
SHEET NO. 2 of 2
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M. Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 26.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ⊻ 9.0 / *-25.0* **DURING DRILLING**
AFTER DRILLING ▼ */ na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-8	3 2 3	5	7								▨	*(Fat CLAY (CL), continued.)* PP=0
															Boring terminated at 26.5 ft bgs. Groundwater encountered at 9 ft bgs. Borehole backfilled with soil cuttings.
	-45														
30															
	-50														
35															
	-55														
40															
	-60														
45															
	-65														

FIGURE

A-6 b

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-21**
SITE LOCATION Calexico, CA
START 5/16/2012
FINISH 5/16/2012
SHEET NO. 1 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -13
DEPTH/*ELEV.* GW (ft) ∇ 7.0 / *-20.0* DURING DRILLING; ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Lean CLAY (CL); very stiff; brown; moist; fine SAND; medium plasticity; PP=2.0
	-15														
			B-1												
			R-2	5 4 6	10	10			31.1	88					
5															Stiff; PP=1.5; 99% fines.
			R-3	6 7 7	14	14			29.6	93		PA			
	-20													∇	
															Sandy SILT (ML); very soft; wet; nonplastic.
10															No recovery.
			S-4	1 2 2	4	6									
	-25														
15															PP=0.5
			S-4-1	1 1 2	3	4			31						
	-30														
20															PP=1.0
			S-5	2 3 3	6	9									
	-35														

GDC_LOG_BORING_2011 IR-558 CENTINELA SOLAR ENERGY FACILITY.GPJ GDCLOG.GDT 6/26/12

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FIGURE
A-7 a

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-21
SITE LOCATION Calexico, CA
START 5/16/2012
FINISH 5/16/2012
SHEET NO. 2 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -13
DEPTH/*ELEV.* GW (ft) ▽ 7.0 / *-20.0* DURING DRILLING
▼ */ na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															(Sandy SILT (ML), continued.)
	-40														
30															Lean CLAY (CL); very stiff; brown; moist; medium plasticity; PP=2.0.
		⧖	S-6	4 5 6	11	16									
	-45														
35															Silty SAND (SM); medium dense; tan-brown; wet; fine SAND; nonplastic.
	-50														
															Fat CLAY (CH); stiff; moist; brown; high plasticity; PP=1.25.
40															
		⧗	R-7	4 5 6	11	11									
	-55														
45															
	-60														

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FIGURE

A-7 b

BORING RECORD

PROJECT NAME	Centinela Solar Energy Facility	**PROJECT NUMBER**	IR-558	**HOLE ID**	**B-21**
SITE LOCATION	Calexico, CA	**START**	5/16/2012	**FINISH**	5/16/2012
SHEET NO.	3 of 3				
DRILLING COMPANY	Pacific Drilling	**DRILL RIG**	Unimog	**DRILLING METHOD**	HSA
LOGGED BY	F. Cisneros	**CHECKED BY**	K. Bhushan		
HAMMER TYPE (WEIGHT/DROP)	Automatic (140#, 30")	**HAMMER EFFICIENCY (ERi)**	87	**BORING DIA. (in)**	6
TOTAL DEPTH (ft)	51.5	**GROUND ELEV (ft)**	-13	**DEPTH/*ELEV.* GW (ft)**	⊻ 7.0 / *-20.0* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID)	SPT (1.4"), CAL (2.4")	**NOTES**	N*60=1.45Nspt=0.97Ncal		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-8	4 6 9	15	22									Sandy SILT (ML); very soft; wet; tan; low plasticity; PP=0.
	-65														Boring terminated at 51.5 ft bgs. Groundwater encountered at 7 ft bgs. Borehole backfilled with soil cuttings.
55															
	-70														
60															
	-75														
65															
	-80														
70															
	-85														

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-22**
SITE LOCATION Calexico, CA
START 5/31/2012
FINISH 5/31/2012
SHEET NO. 1 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -14
DEPTH/*ELEV.* GW (ft) ▽ 6.0 / *-20.0* **DURING DRILLING**
▼ */ na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-15														Fat CLAY (CH); brown; moist; fine SAND; high plasticity. 86% fines; 14% SAND
			B-1								63:43	PA H CP CR PA			
			R-2	4 6 8	14	14			11.1	96					Very stiff; PP=3.75.
															Silty SAND (SM); medium dense; tan; moist; fine SAND; nonplastic. 25% fines
5															Sandy SILT (ML); medium dense; tan; wet; fine SAND; ▽ trace oxidation; PP=1.0.
	-20		R-3	3 3 7	10	10			30.6	89					
															Fat CLAY (CH); medium stiff; fine SAND; high plasticity; abundant oxidation; PP=0.75.
10															PP=0.75; 88% fines.
	-25		S-4	1 1 3	4	6						PA			
15															
	-30														
20															PP=0.5.
	-35		S-5	2 2 3	5	7			30.1						

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FIGURE

A-8 a

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-22
SITE LOCATION Calexico, CA
START 5/31/2012
FINISH 5/31/2012
SHEET NO. 2 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -14
DEPTH/*ELEV.* GW (ft) ⊻ 6.0 / *-20.0* DURING DRILLING
▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-40														Clayey SILT (ML); very soft; tan; wet; fine SAND; nonplastic; PP=0.0.
30	-45	☒	S-6	0 0 5	5	7					NP	PA			50% fines
35	-50														Silty SAND (SM); medium dense; wet; tan-brown; fine SAND; nonplastic.
40	-55	■	R-7	5 9 12	21	20						PA			25% fines
45	-60														

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-22**
SITE LOCATION Calexico, CA
START 5/31/2012
FINISH 5/31/2012
SHEET NO. 3 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -14
DEPTH/*ELEV.* GW (ft) ∇ 6.0 / *-20.0* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-65	☒	S-8	9 13 17	30	44									*(Silty SAND (SM), continued).* Dense.
															Boring terminated at 51.5 ft bgs. Borehole caved to 6 ft bgs when augers were removed. Borehole backfilled with soil cuttings.
55	-70														
60	-75														
65	-80														
70	-85														

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FIGURE
A-8 c

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-23**
SITE LOCATION Calexico, CA
START 5/15/2012
FINISH 5/15/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ∇ 9.0 / *-25.0* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Fat CLAY (CH); stiff; brown; moist; trace fine SAND; medium plasticity.
			B-1								71:49	CP			PP=1.5
			R-2	4 4 7	11	11			27.1	94					
	-20														
5															Very stiff; PP=3.0 98% fines
			R-3	5 8 12	20	19						PA			
	-25														∇
10															PP=2.5
			R-4	5 7 10	17	25			30.1	92					
	-30														
15															Stiff; medium plasticity; PP=1.5.
			S-5	2 3 5	8	12									
	-35														
20															Very stiff; PP=2.0.
			S-6	2 5 5	10	15									
															Boring terminated at 21.5 ft bgs. Groundwater encountered at 9 ft bgs. Installed PZ-3 in borehole between 0 and 20 ft bgs.
	-40														

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FIGURE
A-9

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-24
SITE LOCATION Calexico, CA
START 5/15/2012
FINISH 5/15/2012
SHEET NO. 1 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -13
DEPTH/*ELEV.* GW (ft) ⊻ 8.0 / *-21.0* DURING DRILLING
▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Silty SAND (SM); medium dense; light brown; moist; low plasticity. 5% fines
	-15														
			B-1									EI CR PA			
			R-2	6 8 8	16	15			11.3	102					
															Fat CLAY (CH); stiff; brown; moist; fine SAND; high plasticity; PP=1.5.
5															
			R-3	3 6 6	12	12			24.1						
	-20														
														⊻	
															Silty SAND (SM); medium dense; light brown brown; moist; fine to medium SAND; nonplastic.
10															
			R-4	10 12 9	21	20			19.6	104					
	-25														
															Fat CLAY (CH); very stiff; brown; moist; fine SAND; high plasticity; PP=2.0
15															
			S-5	3 5 7	12	17									
	-30														
20															Fine to medium SAND; wet; PP=3.0.
			S-6	3 6 7	13	19									
	-35														

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FIGURE
A-10 a

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-24
SITE LOCATION Calexico, CA
START 5/15/2012
FINISH 5/15/2012
SHEET NO. 2 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -13
DEPTH/*ELEV.* GW (ft) ⊻ 8.0 / *-21.0* **DURING DRILLING**
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															(Fat CLAY (CL), continued)
	-40														
30															Lean CLAY (CL); hard; brown; moist; fine SAND; medium plasticity; PP=4.0.
		☒	S-7	4 5 4	9	13			26						
	-45														
35															
	-50														Poorly-Graded SAND with SILT (SP-SM); medium dense; tan; wet; fine to medium SAND; nonplastic.
40															8% fines
		☒	S-8	3 5 6	11	16						PA			
	-55														
45															
	-60														

GDC_LOG_BORING_2011 IR-558 CENTINELA SOLAR ENERGY FACILITY.GPJ GDCLOG.GDT 6/26/12

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FIGURE
A-10 b

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility				**PROJECT NUMBER** IR-558		**HOLE ID** **B-24**	
SITE LOCATION Calexico, CA			**START** 5/15/2012		**FINISH** 5/15/2012	**SHEET NO.** 3 of 3	
DRILLING COMPANY Pacific Drilling	**DRILL RIG** Unimog	**DRILLING METHOD** HSA			**LOGGED BY** F. Cisneros	**CHECKED BY** K. Bhushan	
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")	**HAMMER EFFICIENCY (ERi)** 87	**BORING DIA. (in)** 6	**TOTAL DEPTH (ft)** 51.5	**GROUND ELEV (ft)** -13	**DEPTH/*ELEV.* GW (ft)** ⍗ 8.0 / *-21.0* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**		
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")		**NOTES** N*60=1.45Nspt=0.97Ncal					

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-9	6 10 19	19	28									*(Poorly-Graded SAND with SILT, continued).* Fine SAND.
	-65														Boring terminated at 51.5 ft bgs. Groundwater encountered at 8 ft bgs. Borehole backfilled with soil cuttings.
55															
	-70														
60															
	-75														
65															
	-80														
70															
	-85														

GDC_LOG_BORING_2011 IR-558 CENTINELA SOLAR ENERGY FACILITY.GPJ GDCLOG.GDT 6/26/12

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FIGURE

A-10 c

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-25
SITE LOCATION Calexico, CA
START 5/15/2012
FINISH 5/15/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ⊻ 10.0 / *-26.0* **DURING DRILLING**
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Fat CLAY (CH); brown; moist; fine SAND; high plasticity. 87% fines; 13% SAND
			B-1									PA H			Very stiff; PP=2.75
			R-2	3 5 9	14	14			25.9	96					
	-20														
5															PP=3.25.
			R-3	6 9 22	31	30			15.5	112		PA			
															Poorly-Graded SAND with SILT (SP-SM); medium dense; light brown; moist; low plasticity. 10% fines
	-25														
10														⊻	
			R-4	4 10 13	23	22									
															Lean CLAY (CL); very stiff; brown; wet; fine SAND; medium plasticity.
	-30														
15															PP=2.25
			S-5	3 3 5	8	12									
	-35														
20															PP=3.0
			S-6	2 3 5	8	12									
															Boring terminated at 21.5 ft bgs. Groundwater encountered at 10 ft bgs. Borehole backfilled with soil cuttings.
	-40														

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FIGURE

A-11

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-26
SITE LOCATION Calexico, CA
START 5/15/2012
FINISH 5/15/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ⊻ 6.0 / *-22.0* DURING DRILLING
▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▨													Fat CLAY (CH); hard; brown; moist; high plasticity: PP>4.5. 87% fines; 13% SAND
		▨	B-1								65:45	PA H			Very stiff; PP=2.5
		⧓	R-2	8 11 15	26	25			21.1	104					
	-20	▨													
5		⧓	R-3	6 9 13	22	21			27.4	94		PA			Lean CLAY (CL); very stiff; moist; brown; trace fine SAND; ⊻ medium plasticity; PP=2.25. 98% fines
	-25														Silty SAND (SM); medium dense; wet; brown; fine to medium SAND; nonplastic.
10		⧖	S-4	6 9 11	20	29			21.6						
	-30														Lean CLAY (CL); very stiff; brown; moist; medium plasticity; PP=2.75.
15		⧖	S-5	3 6 6	12	17						PA			86% fines
	-35														Silty SAND (SM); medium dense; wet; brown; medium to fine SAND; nonplastic.
20		⧓	R-6	3 5 9	14	14									
															Boring terminated at 21.5 ft bgs. Groundwater encountered at X ft bgs. Borehole backfilled with soil cuttings.
	-40														

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

FIGURE A-12

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-27**
SITE LOCATION Calexico, CA
START 5/30/2012
FINISH 5/30/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ▽ 13.8 / *-29.8* **DURING DRILLING**
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Lean CLAY (CL); brown; dry; fine to medium SAND; medium plasticity.
		⧗	R-1	5 7 10	17	16			28.7	91					
	-20														Fat CLAY (CH); very stiff; brown; moist; fine SAND; high plasticity; PP=2.75.
5															PP=3.25; trace oxidation.
		⧖	S-2	4 5 7	12	17			26		67:43				
	-25														
10															PP>4.5; oxidation staining throughout sample.
		⧗	R-3	8 15 20	35	34			25.5	99					
														▽	
	-30														
15															
	-35														
20															PP=3.75; no oxidation.
		⧖	S-4	5 6 12	18	26			24.5						
															Boring terminated at 21.5 ft bgs. Groundwater encountered at 13.8 ft bgs. Borehole backfilled with soil cuttings.
	-40														

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FIGURE

A-13

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-28
SITE LOCATION Calexico, CA
START 5/16/2012
FINISH 5/16/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY F. Cisneros
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -16
DEPTH/*ELEV.* GW (ft) ⊻ / *na* DURING DRILLING; ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															Fat CLAY (CH); brown; moist; fine SAND; high plasticity.
			B-1								55:37				Stiff; PP=1.25
			R-2	4 6 7	13	13			29.6	90					
	-20														
5															PP=1.25.
			R-3	4 7 8	15	15			29.6	92					
	-25														
10															Very stiff; PP=2.0 100% fines
			S-4	2 3 3	6	9			27.6			PA			
	-30														
15															PP=3.5
			R-5	5 12 14	26	25									
	-35														
20															PP=2.5.
			S-6	4 6 8	14	20									
															Boring terminated at 21.5 ft bgs. Groundwater not encountered. Borehole backfilled with soil cuttings.
	-40														

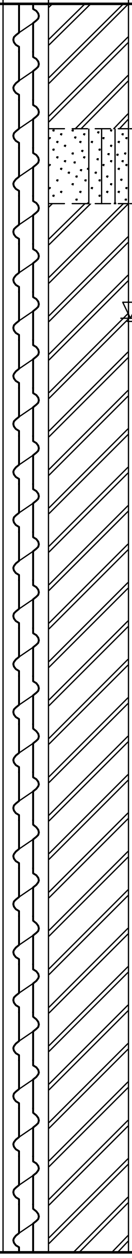
THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE

A-14

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID B-29
SITE LOCATION Calexico, CA
START 5/30/2012
FINISH 5/30/2012
SHEET NO. 1 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -15
DEPTH/*ELEV.* GW (ft) ∇ 6.3 / *-21.3* DURING DRILLING
AFTER DRILLING ▼ */ na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
													Fat CLAY (CH); brown; dry; fine SAND; straw at surface.
			B-1									EI CR PA	Poorly-Graded SAND with SILT (SP-SM); medium dense; tan-brown; moist; fine SAND; nonplastic. 9% fines
			R-2	5 8 12	20	19			9.1	99			
													Fat CLAY (CH); very stiff; brown; moist; fine SAND; high plasticity; PP=3.0.
5	-20												
			R-3	5 9 12	21	20			27.8	95			
10	-25												Hard; trace oxidation; cemented layer; PP>4.5.
			R-4	2 4 8	12	12			31.1	93	58:36		
15	-30												
20	-35												Very stiff; PP=3.25.
			S-5	4 5 7	12	17			26.5				Thin interbeds of Sandy SILT (ML); medium dense; brown; wet; fine to medium SAND.

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
HOLE ID **B-29**
SITE LOCATION Calexico, CA
START 5/30/2012
FINISH 5/30/2012
SHEET NO. 2 of 3
DRILLING COMPANY Pacific Drilling
DRILL RIG Unimog
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
HAMMER TYPE (WEIGHT/DROP) Automatic (140#, 30")
HAMMER EFFICIENCY (ERi) 87
BORING DIA. (in) 6
TOTAL DEPTH (ft) 51.5
GROUND ELEV (ft) -15
DEPTH/*ELEV.* GW (ft) ∇ 6.3 / *-21.3* **DURING DRILLING**
▼ */ na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
															(Fat CLAY, continued). Stiff; wet; PP=1.0.
30	-45														
		☒	S-6	2 4 3	7	10									
35	-50														Very stiff; brown; moist; fine SAND; high plasticity; PP=2.0.
40	-55														86% fines
		☒	S-7	5 6 8	14	20			28.2			PA			
45	-60														

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FIGURE
A-15 b

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility	**PROJECT NUMBER** IR-558	**HOLE ID** **B-29**	
SITE LOCATION Calexico, CA	**START** 5/30/2012	**FINISH** 5/30/2012	**SHEET NO.** 3 of 3
DRILLING COMPANY Pacific Drilling	**DRILL RIG** Unimog	**DRILLING METHOD** HSA	**LOGGED BY** M.Lithgow
CHECKED BY K. Bhushan	**HAMMER TYPE (WEIGHT/DROP)** Automatic (140#, 30")	**HAMMER EFFICIENCY (ERi)** 87	**BORING DIA. (in)** 6
TOTAL DEPTH (ft) 51.5	**GROUND ELEV (ft)** -15	**DEPTH/*ELEV.* GW (ft)** ⊻ 6.3 / *-21.3* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**	
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")	**NOTES** N*60=1.45Nspt=0.97Ncal		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	R-8	5 6 6	12	12								▨	*(Fat CLAY (CH), continued).*
															Boring terminated at 51.5 ft bgs. Groundwater encountered at 6.3 ft bgs. Borehole backfilled with soil cuttings.
55	-70														
60	-75														
65	-80														
70	-85														

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

FIGURE

A-15 c

LOG OF TEST BORING

PROJECT NAME Centinela Solar Energy Facility
PROJECT NUMBER IR-558
BORING **B-30**
SITE LOCATION Calexico, CA
START 5/30/2012
FINISH 5/30/2012
SHEET NO. 1 of 1
DRILLING COMPANY Pacific Drilling
DRILLING METHOD HSA
LOGGED BY M.Lithgow
CHECKED BY K. Bhushan
DRILLING EQUIPMENT Unimog
BORING DIA. (in) 6
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) -14
DEPTH/*ELEV.* GROUND WATER (ft) ▼ 13.4 / *-27.4*
SAMPLING METHOD Automatic (140#, 30")
NOTES N*60=1.45Nspt=0.97Ncal

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	DRY DENSITY (pcf)	MOISTURE (%)	PID (ppm)	% PASSING #200	ATTERBERG LIMITS LL:PI	POCKET PEN (tsf)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-15											Lean CLAY (CL); brown; dry; fine to medium SAND; medium plasticity.
			B-1			23.7						Clayey SAND (SC); medium dense; brown; fine to medium SAND; low plasticity; PP=4.25. 43% fines.
			R-2	6 7 12	108	16.1	PA	43				
5												Fat CLAY (CH); very stiff; brown; moist; trace SAND; medium plasticity; PP=3.75.
	-20		R-3	2 5 5	97	24.9						
10												Thin beds of Sandy SILT (ML) consisting of tan; fine SAND; PP=4.5. 91% fines; 9% SILT
	-25		R-4	4 7 12	95	27.3	PA H	91				
											▼	
15												
	-30											
20												PP=4.0.
	-35		S-5	4 7 12								
												Boring terminated at 21.5 ft bgs. Groundwater encountered at 13.4 ft bgs. Borehole backfilled with soil cuttings.

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

FIGURE A-16

GDC_LOG_BORING_1A IR-558 CENTINELA SOLAR ENERGY FACILITY.GPJ GDCLOG.GDT 6/29/12

BORING RECORD

PROJECT NAME Centinela Solar Energy Facility	**PROJECT NUMBER** IR-558	**HOLE ID** B-31	
SITE LOCATION Calexico, CA	**START** 5/30/2012	**FINISH** 5/30/2012	**SHEET NO.** 1 of 1
DRILLING COMPANY Pacific Drilling	**DRILL RIG** Unimog	**DRILLING METHOD** HSA	**LOGGED BY** M.Lithgow
CHECKED BY K. Bhushan	**HAMMER TYPE (WEIGHT/DROP)** Automatic (140#, 30")	**HAMMER EFFICIENCY (ERi)** 87	**BORING DIA. (in)** 6
TOTAL DEPTH (ft) 21.5	**GROUND ELEV (ft)** -14	**DEPTH/*ELEV.* GW (ft)** ⊻ 12.0 / *-26.0* DURING DRILLING	**AFTER DRILLING** ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")	**NOTES** N*60=1.45Nspt=0.97Ncal		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-15														Lean CLAY (CL); dark brown; moist; fine SAND; medium plasticity. 94% fines; 6% SAND
			B-1									PA H			
			R-2	5 9 10	19	18			30.4	88					Hard; trace white streaks; PP=4.0.
5	-20		R-3	4 8 9	17	16			26.7	96					Fat CLAY (CH); very stiff; brown; moist; trace fine SAND; high plasticity; PP=2.75.
10	-25		S-4	4 5 6	11	16						PA			PP=2.5. 99% fines
														⊻	
15	-30		R-5	6 9 13	22	21			26.3	97					PP=3.75.
															Sandy SILT (ML); loose; tan-brown; wet; fine SAND; nonplastic.
20	-35		S-6	2 2 4	6	9									
															Boring terminated at 21.5 ft bgs. Ground water encountered at 12 ft bgs. Piezometer constructed in borehole.

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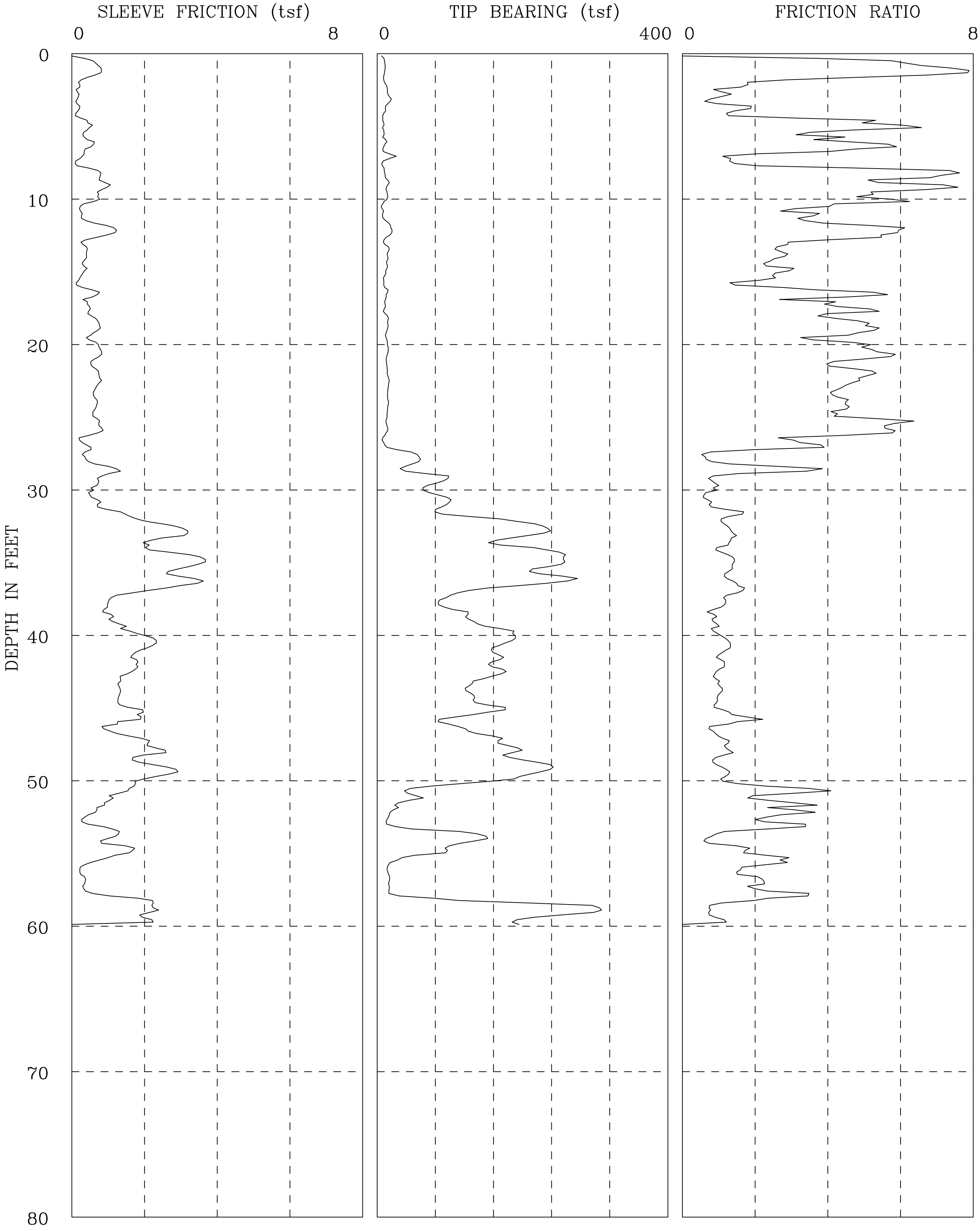

DCPT−1	I−558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-18A

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                                       GROUP DELTA CONSULTANTS

Cone Used  : DCPT-1                                                          Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
------------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE        Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)      deg.    N       tsf
------------------------------------------------------------------------------------------------------------------------------------
     0.30     1         9.73        0.52        5.34        0.03             clay                UNDFND   UNDFD    9          .6
     0.60     2         9.67        0.52        5.36        0.09             clay                UNDFND   UNDFD    9          .6
     0.95     3        15.06        0.18        1.18        0.15    sandy silt to clayey silt    UNDFND   UNDFD    6          .9
     1.25     4        12.77        0.16        1.25        0.22    clayey silt to silty clay    UNDFND   UNDFD    6          .8
     1.55     5         8.20        0.37        4.57        0.28             clay                UNDFND   UNDFD    8          .5
     1.85     6        10.15        0.41        4.01        0.33             clay                UNDFND   UNDFD   10          .6
     2.15     7        13.10        0.41        3.14        0.39       silty clay to clay        UNDFND   UNDFD    8          .8
     2.45     8         9.70        0.29        3.02        0.45       silty clay to clay        UNDFND   UNDFD    6          .6
     2.75     9        13.22        0.85        6.41        0.50             clay                UNDFND   UNDFD   13          .8
     3.05    10        13.48        0.78        5.82        0.52             clay                UNDFND   UNDFD   13          .8
     3.35    11         7.77        0.32        4.08        0.55             clay                UNDFND   UNDFD    7          .4
     3.65    12        13.43        0.61        4.52        0.58             clay                UNDFND   UNDFD   13          .8
     3.95    13        14.85        0.78        5.27        0.61             clay                UNDFND   UNDFD   14          .9
     4.25    14        14.48        0.40        2.73        0.64    clayey silt to silty clay    UNDFND   UNDFD    7          .9
     4.55    15        13.55        0.35        2.57        0.67    clayey silt to silty clay    UNDFND   UNDFD    6          .8
     4.85    16         9.72        0.20        2.11        0.69    clayey silt to silty clay    UNDFND   UNDFD    5          .5
     5.15    17        12.77        0.53        4.15        0.72             clay                UNDFND   UNDFD   12          .7
     5.45    18        10.37        0.46        4.44        0.75             clay                UNDFND   UNDFD   10          .6
     5.75    19        14.85        0.70        4.73        0.78             clay                UNDFND   UNDFD   14          .9
     6.05    20        12.88        0.56        4.37        0.81             clay                UNDFND   UNDFD   12          .7
     6.40    21        14.20        0.75        5.31        0.84             clay                UNDFND   UNDFD   14          .8
     6.70    22        13.53        0.62        4.58        0.87             clay                UNDFND   UNDFD   13          .8
     7.00    23        15.72        0.74        4.72        0.90             clay                UNDFND   UNDFD   15          .9
     7.35    24        14.90        0.64        4.32        0.93             clay                UNDFND   UNDFD   14          .8
     7.65    25        13.92        0.62        4.49        0.96             clay                UNDFND   UNDFD   13          .8
     7.95    26        13.37        0.78        5.81        0.99             clay                UNDFND   UNDFD   13          .7
     8.25    27         9.68        0.35        3.60        1.01             clay                UNDFND   UNDFD    9          .5
     8.55    28        50.57        0.40        0.79        1.04    silty sand to sandy silt     40-50    36-38   16   UNDEFINED
     8.85    29        53.70        1.01        1.88        1.07    silty sand to sandy silt     40-50    36-38   17   UNDEFINED
     9.15    30        77.73        0.66        0.86        1.10       sand to silty sand        50-60    38-40   19   UNDEFINED
     9.45    31        91.55        0.62        0.68        1.13       sand to silty sand        60-70    40-42   22   UNDEFINED
     9.75    32       105.52        1.31        1.24        1.16       sand to silty sand        60-70    40-42   25   UNDEFINED
    10.05    33       222.98        2.79        1.25        1.18             sand                80-90    42-44   43   UNDEFINED
    10.35    34       182.05        2.31        1.27        1.21       sand to silty sand        80-90    42-44   44   UNDEFINED
    10.65    35       252.45        3.16        1.25        1.24             sand                  >90    44-46   48   UNDEFINED
    10.95    36       231.80        2.97        1.28        1.27             sand                80-90    42-44   44   UNDEFINED
    11.25    37       207.32        3.02        1.46        1.30       sand to silty sand        80-90    42-44   50   UNDEFINED
    11.55    38        93.57        1.16        1.25        1.33       sand to silty sand        60-70    38-40   22   UNDEFINED
------------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
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Figure A-18B

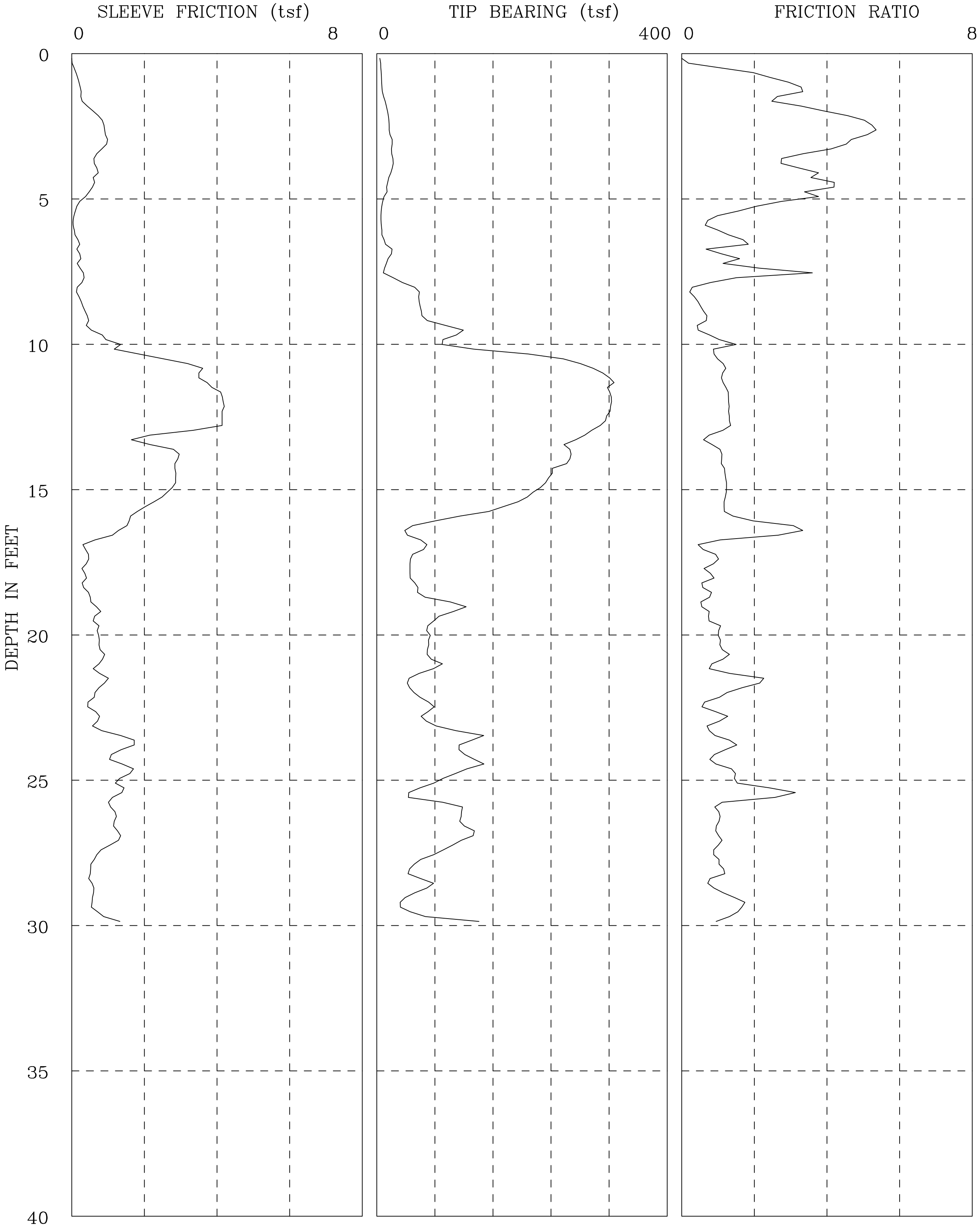
```
                                                    GROUP DELTA CONSULTANTS

Cone Used  : DCPT-1                                                           Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                 Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)   Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE         Eq - Dr    PHI    SPT      Su
 (meters)   (feet)      (tsf)      (tsf)       (%)        (tsf)                                        (%)     deg.    N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85    39       115.80        0.99        0.86        1.35       sand to silty sand          60-70    40-42    28   UNDEFINED
    12.15    40       160.62        1.44        0.90        1.38              sand                 70-80    40-42    31   UNDEFINED
    12.45    41       178.20        2.21        1.24        1.41       sand to silty sand          70-80    42-44    43   UNDEFINED
    12.80    42       162.40        1.76        1.08        1.44       sand to silty sand          70-80    40-42    39   UNDEFINED
    13.10    43       163.81        1.57        0.96        1.47              sand                 70-80    40-42    31   UNDEFINED
    13.40    44       126.88        1.32        1.04        1.50       sand to silty sand          60-70    40-42    30   UNDEFINED
    13.75    45       148.24        1.42        0.96        1.53       sand to silty sand          70-80    40-42    35   UNDEFINED
    14.05    46       110.56        1.68        1.52        1.56       sand to silty sand          60-70    38-40    26   UNDEFINED
    14.35    47       137.91        1.25        0.91        1.59       sand to silty sand          60-70    40-42    33   UNDEFINED
    14.65    48       181.85        2.29        1.26        1.62       sand to silty sand          70-80    40-42    44   UNDEFINED
    14.95    49       209.21        2.00        0.95        1.65              sand                 80-90    42-44    40   UNDEFINED
    15.25    50       202.28        2.42        1.19        1.68              sand                 70-80    40-42    39   UNDEFINED
    15.55    51        61.14        1.49        2.43        1.70    sandy silt to clayey silt      UNDFND   UNDFD    23         3.8
    15.85    52        35.49        0.89        2.52        1.73    sandy silt to clayey silt      UNDFND   UNDFD    14         2.1
    16.15    53        14.88        0.41        2.77        1.76    clayey silt to silty clay      UNDFND   UNDFD     7          .7
    16.45    54       104.35        1.13        1.08        1.79       sand to silty sand          50-60    38-40    25   UNDEFINED
    16.75    55       105.49        1.35        1.28        1.82       sand to silty sand          50-60    38-40    25   UNDEFINED
    17.05    56        26.85        0.67        2.51        1.85    sandy silt to clayey silt      UNDFND   UNDFD    10         1.5
    17.35    57        15.87        0.30        1.87        1.87    clayey silt to silty clay      UNDFND   UNDFD     8          .8
    17.65    58        18.57        0.49        2.66        1.90    clayey silt to silty clay      UNDFND   UNDFD     9         1.0
    17.95    59       218.21        2.19        1.00        1.93              sand                 70-80    40-42    42   UNDEFINED
    18.25    60       223.40        1.73        0.78        1.96              sand                 80-90    40-42    43   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-18C



CPT-2

I-558 Centinela Solar Energy Facility

GROUP DELTA
CONSULTANTS, INC.

Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-19A

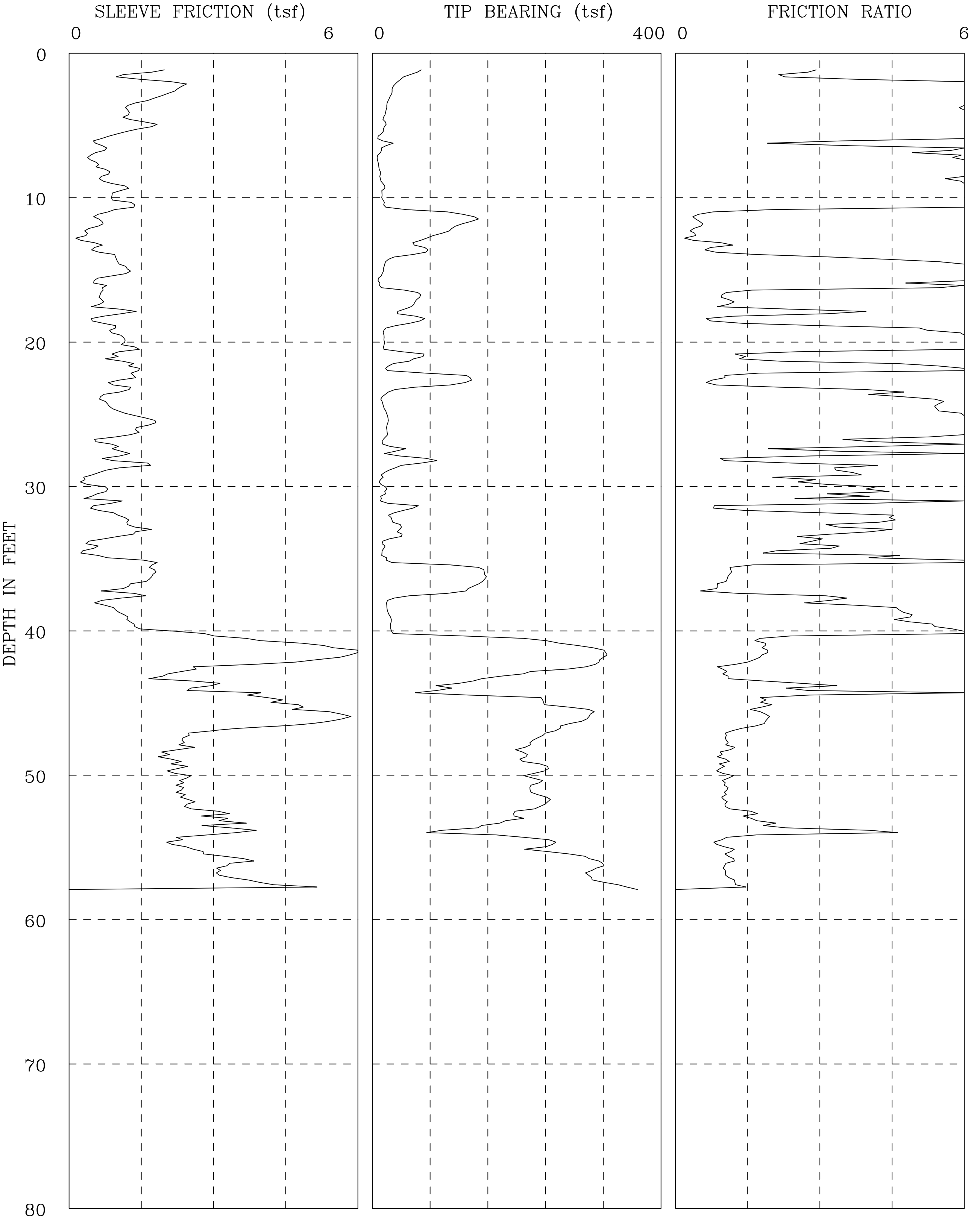
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-2                                                         Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1         5.80        0.09        1.58        0.03     sensitive fine grained       UNDFND   UNDFD     3          .3
     0.60     2        10.67        0.34        3.19        0.09       silty clay to clay         UNDFND   UNDFD     7          .7
     0.95     3        18.19        0.89        4.91        0.15              clay                UNDFND   UNDFD    17         1.2
     1.25     4        21.08        0.70        3.30        0.22    clayey silt to silty clay     UNDFND   UNDFD    10         1.3
     1.55     5        12.92        0.48        3.70        0.28       silty clay to clay         UNDFND   UNDFD     8          .8
     1.85     6         6.37        0.07        1.18        0.33     sensitive fine grained       UNDFND   UNDFD     3          .4
     2.15     7        14.32        0.18        1.27        0.39    sandy silt to clayey silt     UNDFND   UNDFD     5          .9
     2.45     8        23.87        0.24        1.03        0.45    sandy silt to clayey silt     UNDFND   UNDFD     9         1.5
     2.75     9        59.78        0.28        0.47        0.50       sand to silty sand         60-70    40-42    14   UNDEFINED
     3.05    10        95.72        0.76        0.79        0.52       sand to silty sand         70-80    42-44    23   UNDEFINED
     3.35    11       248.13        2.64        1.06        0.55              sand                  >90    46-48    48   UNDEFINED
     3.65    12       322.05        3.92        1.22        0.58              sand                  >90      >48   >50   UNDEFINED
     3.95    13       313.15        4.02        1.28        0.61              sand                  >90    46-48   >50   UNDEFINED
     4.25    14       269.63        2.44        0.90        0.64              sand                  >90    46-48   >50   UNDEFINED
     4.55    15       239.88        2.84        1.18        0.67              sand                  >90    46-48    46   UNDEFINED
     4.85    16       176.85        2.14        1.21        0.69       sand to silty sand         80-90    44-46    42   UNDEFINED
     5.15    17        56.73        1.08        1.90        0.72    silty sand to sandy silt      50-60    38-40    18   UNDEFINED
     5.45    18        49.63        0.39        0.79        0.75    silty sand to sandy silt      50-60    38-40    16   UNDEFINED
     5.75    19        63.23        0.42        0.67        0.78       sand to silty sand         50-60    40-42    15   UNDEFINED
     6.05    20        88.68        0.69        0.78        0.81       sand to silty sand         60-70    40-42    21   UNDEFINED
     6.40    21        74.49        0.79        1.06        0.84       sand to silty sand         60-70    40-42    18   UNDEFINED
     6.70    22        53.25        0.78        1.46        0.87    silty sand to sandy silt      50-60    38-40    17   UNDEFINED
     7.00    23        68.35        0.61        0.89        0.90       sand to silty sand         50-60    38-40    16   UNDEFINED
     7.35    24       116.72        1.23        1.06        0.93       sand to silty sand         70-80    40-42    28   UNDEFINED
     7.65    25       114.06        1.38        1.21        0.96       sand to silty sand         70-80    40-42    27   UNDEFINED
     7.95    26        78.87        1.20        1.52        0.99    silty sand to sandy silt      60-70    40-42    25   UNDEFINED
     8.25    27       122.48        1.24        1.01        1.01       sand to silty sand         70-80    40-42    29   UNDEFINED
     8.55    28        72.06        0.70        0.98        1.04       sand to silty sand         50-60    38-40    17   UNDEFINED
     8.85    29        57.12        0.55        0.97        1.07    silty sand to sandy silt      40-50    36-38    18   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-19B



CPT 3	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-20A

```
                                    GROUP DELTA CONSULTANTS

Cone Used  : CPT-3                                                 Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                      Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
      DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE        Eq - Dr    PHI    SPT       Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        33.88        0.99        2.92        0.03    clayey silt to silty clay    UNDFND   UNDFD   16         2.2
     0.60     2        50.13        1.57        3.13        0.09    sandy silt to clayey silt    UNDFND   UNDFD   19         3.3
     0.95     3        27.36        2.14        7.81        0.15              clay               UNDFND   UNDFD   26         1.8
     1.25     4        20.02        1.31        6.56        0.22              clay               UNDFND   UNDFD   19         1.3
     1.55     5        17.05        1.46        8.53        0.28           undefined             UNDFND   UNDFD   UDF   UNDEFINED
     1.85     6        12.26        0.94        7.67        0.33              clay               UNDFND   UNDFD   12          .7
     2.15     7        15.38        0.63        4.08        0.39              clay               UNDFND   UNDFD   15          .9
     2.45     8         8.20        0.55        6.76        0.45              clay               UNDFND   UNDFD    8          .5
     2.75     9        11.82        0.76        6.45        0.50              clay               UNDFND   UNDFD   11          .7
     3.05    10        14.62        1.03        7.02        0.52              clay               UNDFND   UNDFD   14          .9
     3.35    11        36.25        1.11        3.07        0.55    clayey silt to silty clay    UNDFND   UNDFD   17         2.3
     3.65    12       131.61        0.62        0.47        0.58              sand               80-90    44-46   25    UNDEFINED
     3.95    13        89.95        0.31        0.35        0.61       sand to silty sand        70-80    42-44   22    UNDEFINED
     4.25    14        65.74        0.63        0.96        0.64       sand to silty sand        60-70    40-42   16    UNDEFINED
     4.55    15        19.93        1.07        5.35        0.67              clay               UNDFND   UNDFD   19         1.2
     4.85    16        11.43        0.83        7.24        0.69              clay               UNDFND   UNDFD   11          .7
     5.15    17        43.79        0.69        1.57        0.72    silty sand to sandy silt     40-50    38-40   14    UNDEFINED
     5.45    18        51.88        0.82        1.59        0.75    silty sand to sandy silt     50-60    38-40   17    UNDEFINED
     5.75    19        52.93        0.74        1.40        0.78    silty sand to sandy silt     50-60    38-40   17    UNDEFINED
     6.05    20        16.46        1.01        6.14        0.81              clay               UNDFND   UNDFD   16         1.0
     6.40    21        35.39        1.14        3.23        0.84    clayey silt to silty clay    UNDFND   UNDFD   17         2.2
     6.70    22        33.22        1.23        3.69        0.87    clayey silt to silty clay    UNDFND   UNDFD   16         2.1
     7.00    23       119.10        1.13        0.95        0.90       sand to silty sand        70-80    42-44   29    UNDEFINED
     7.35    24        24.24        0.91        3.74        0.93       silty clay to clay        UNDFND   UNDFD   15         1.5
     7.65    25        17.72        1.02        5.74        0.96              clay               UNDFND   UNDFD   17         1.0
     7.95    26        20.99        1.60        7.63        0.99              clay               UNDFND   UNDFD   20         1.2
     8.25    27        17.28        0.95        5.47        1.01              clay               UNDFND   UNDFD   17         1.0
     8.55    28        38.67        1.00        2.59        1.04    sandy silt to clayey silt    UNDFND   UNDFD   15         2.4
     8.85    29        44.90        1.11        2.48        1.07    sandy silt to clayey silt    UNDFND   UNDFD   17         2.8
     9.15    30        13.02        0.41        3.18        1.10       silty clay to clay        UNDFND   UNDFD    8          .7
     9.45    31        15.26        0.67        4.42        1.13              clay               UNDFND   UNDFD   15          .8
     9.75    32        39.62        0.73        1.85        1.16    sandy silt to clayey silt    UNDFND   UNDFD   15         2.5
    10.05    33        33.16        1.31        3.96        1.18       silty clay to clay        UNDFND   UNDFD   21         2.0
    10.35    34        27.95        0.87        3.12        1.21    clayey silt to silty clay    UNDFND   UNDFD   13         1.7
    10.65    35        15.61        0.51        3.26        1.24       silty clay to clay        UNDFND   UNDFD   10          .9
    10.95    36       101.70        1.72        1.70        1.27    silty sand to sandy silt     60-70    40-42   32    UNDEFINED
    11.25    37       151.58        1.54        1.02        1.30       sand to silty sand        70-80    40-42   36    UNDEFINED
    11.55    38        78.12        1.09        1.39        1.33    silty sand to sandy silt     50-60    38-40   25    UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-20B

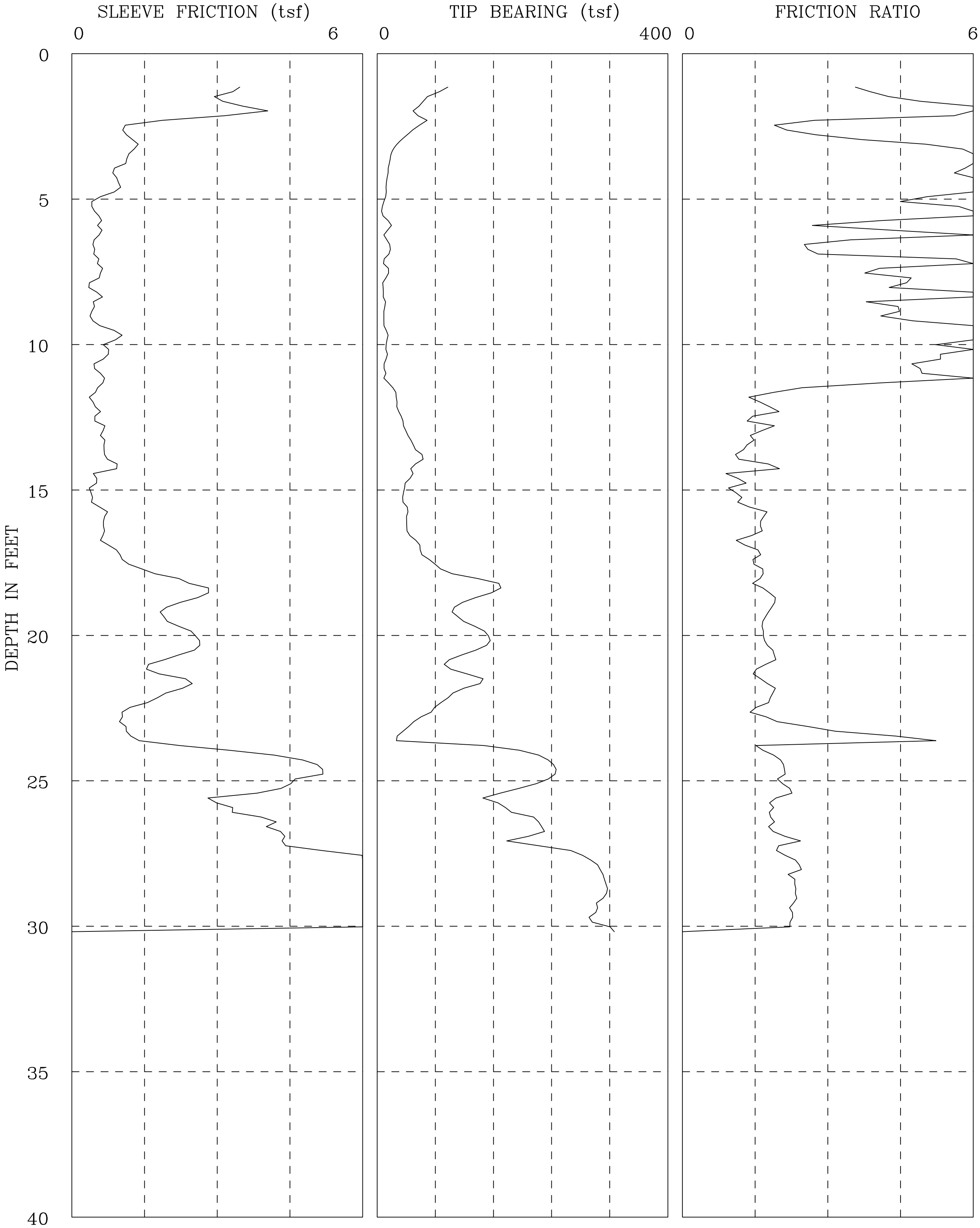
```
                                           GROUP DELTA CONSULTANTS

Cone Used  : CPT-3                                                           Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE         Eq - Dr    PHI    SPT       Su
 (meters)   (feet)     (tsf)       (tsf)        (%)        (tsf)                                      (%)      deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85    39        20.98        0.89        4.24        1.35       silty clay to clay          UNDFND   UNDFD    13          1.2
    12.15    40        25.65        1.31        5.12        1.38              clay                 UNDFND   UNDFD    25          1.5
    12.45    41       148.68        3.42        2.30        1.41    silty sand to sandy silt        70-80   40-42    47   UNDEFINED
    12.80    42       313.58        5.68        1.81        1.44       sand to silty sand            >90    44-46   >50   UNDEFINED
    13.10    43       269.58        3.02        1.12        1.47              sand                  80-90   42-44   >50   UNDEFINED
    13.40    44       131.44        2.46        1.87        1.50    silty sand to sandy silt        60-70   40-42    42   UNDEFINED
    13.75    45       175.22        3.95        2.25        1.53    silty sand to sandy silt        70-80   40-42   >50   UNDEFINED
    14.05    46       296.43        5.35        1.81        1.56       sand to silty sand            >90    42-44   >50   UNDEFINED
    14.35    47       262.88        3.97        1.51        1.59       sand to silty sand           80-90   42-44   >50   UNDEFINED
    14.65    48       222.84        2.42        1.08        1.62              sand                  80-90   42-44    43   UNDEFINED
    14.95    49       207.89        2.10        1.01        1.65              sand                  80-90   42-44    40   UNDEFINED
    15.25    50       232.00        2.27        0.98        1.68              sand                  80-90   42-44    44   UNDEFINED
    15.55    51       224.40        2.34        1.04        1.70              sand                  80-90   42-44    43   UNDEFINED
    15.85    52       236.64        2.42        1.02        1.73              sand                  80-90   42-44    45   UNDEFINED
    16.15    53       209.42        2.90        1.39        1.76       sand to silty sand           70-80   40-42   >50   UNDEFINED
    16.45    54       138.45        3.38        2.44        1.79    silty sand to sandy silt        60-70   38-40    44   UNDEFINED
    16.75    55       228.38        2.34        1.03        1.82              sand                  80-90   40-42    44   UNDEFINED
    17.05    56       272.40        3.14        1.15        1.85              sand                  80-90   42-44   >50   UNDEFINED
    17.35    57       308.23        3.17        1.03        1.87              sand                  80-90   42-44   >50   UNDEFINED
    17.65    58       331.54    -5459.80    -1646.79        1.90            undefined              UNDFND   UNDFD   UDF   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-20C



CPT 4

I–558 Centinela Solar Energy Facility

GROUP DELTA
CONSULTANTS, INC.

Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-21A

```
                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-4                                                           Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'          SOIL BEHAVIOUR TYPE          Eq - Dr    PHI     SPT       Su
 (meters)   (feet)      (tsf)       (tsf)       (%)        (tsf)                                         (%)      deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        48.58        1.73        3.57        0.03    clayey silt to silty clay      UNDFND   UNDFD    23         3.2
     0.60     2        70.42        3.40        4.83        0.09   very stiff fine grained (*)     UNDFND   UNDFD   >50   UNDEFINED
     0.95     3        47.75        1.56        3.27        0.15    clayey silt to silty clay      UNDFND   UNDFD    23         3.1
     1.25     4        17.77        1.07        6.04        0.22              clay                 UNDFND   UNDFD    17         1.1
     1.55     5        12.07        0.80        6.60        0.28              clay                 UNDFND   UNDFD    12          .7
     1.85     6        11.74        0.53        4.55        0.33              clay                 UNDFND   UNDFD    11          .7
     2.15     7        14.04        0.49        3.50        0.39       silty clay to clay          UNDFND   UNDFD     9          .9
     2.45     8        11.38        0.51        4.45        0.45              clay                 UNDFND   UNDFD    11          .7
     2.75     9         9.60        0.48        4.95        0.50              clay                 UNDFND   UNDFD     9          .6
     3.05    10        12.06        0.75        6.18        0.52              clay                 UNDFND   UNDFD    12          .7
     3.35    11        11.60        0.61        5.29        0.55              clay                 UNDFND   UNDFD    11          .7
     3.65    12        21.03        0.52        2.49        0.58    clayey silt to silty clay      UNDFND   UNDFD    10         1.3
     3.95    13        33.52        0.56        1.67        0.61    sandy silt to clayey silt      UNDFND   UNDFD    13         2.1
     4.25    14        52.69        0.67        1.27        0.64    silty sand to sandy silt       50-60    40-42    17   UNDEFINED
     4.55    15        45.07        0.62        1.37        0.67    silty sand to sandy silt       40-50    38-40    14   UNDEFINED
     4.85    16        38.53        0.54        1.39        0.69    silty sand to sandy silt       40-50    38-40    12   UNDEFINED
     5.15    17        46.58        0.66        1.42        0.72    silty sand to sandy silt       40-50    38-40    15   UNDEFINED
     5.45    18        77.15        1.22        1.58        0.75    silty sand to sandy silt       60-70    40-42    25   UNDEFINED
     5.75    19       147.57        2.52        1.71        0.78       sand to silty sand          80-90    42-44    35   UNDEFINED
     6.05    20       120.17        2.05        1.71        0.81    silty sand to sandy silt       70-80    42-44    38   UNDEFINED
     6.40    21       129.01        2.29        1.78        0.84    silty sand to sandy silt       70-80    42-44    41   UNDEFINED
     6.70    22       122.64        2.07        1.69        0.87    silty sand to sandy silt       70-80    42-44    39   UNDEFINED
     7.00    23        74.94        1.27        1.69        0.90    silty sand to sandy silt       50-60    40-42    24   UNDEFINED
     7.35    24        99.73        2.07        2.08        0.93    silty sand to sandy silt       60-70    40-42    32   UNDEFINED
     7.65    25       237.17        4.88        2.06        0.96       sand to silty sand            >90    44-46   >50   UNDEFINED
     7.95    26       172.85        3.43        1.98        0.99    silty sand to sandy silt       80-90    42-44   >50   UNDEFINED
     8.25    27       213.28        4.20        1.97        1.01       sand to silty sand          80-90    44-46   >50   UNDEFINED
     8.55    28       279.26        6.21        2.22        1.04    silty sand to sandy silt         >90    44-46   >50   UNDEFINED
     8.85    29       313.52        7.23        2.31        1.07    silty sand to sandy silt         >90    44-46   >50   UNDEFINED
     9.15    30       302.23        4.91        1.62        1.10       sand to silty sand            >90    44-46   >50   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

                                       (*) overconsolidated or cemented

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
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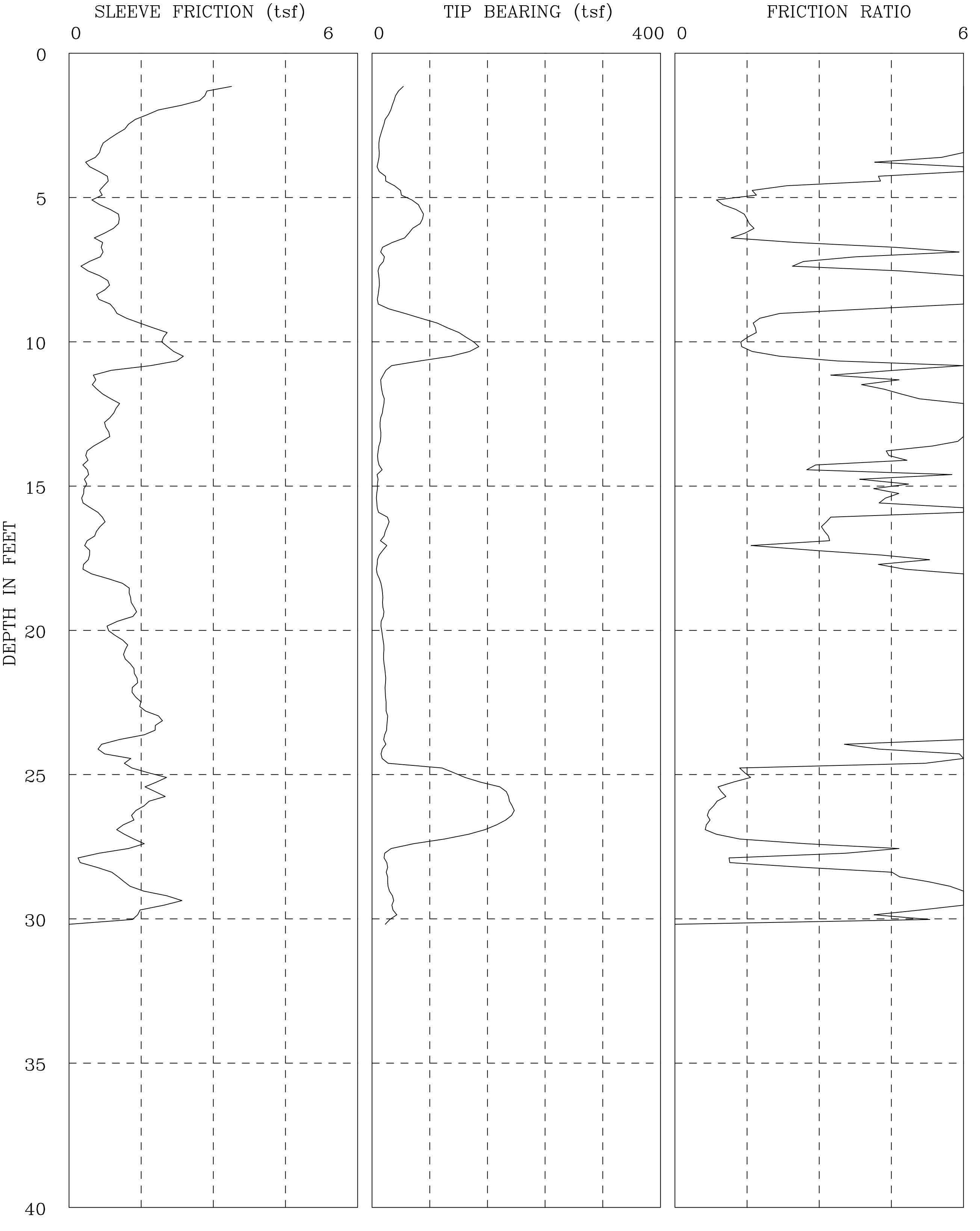
Figure A-21B



CPT 5	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-22A

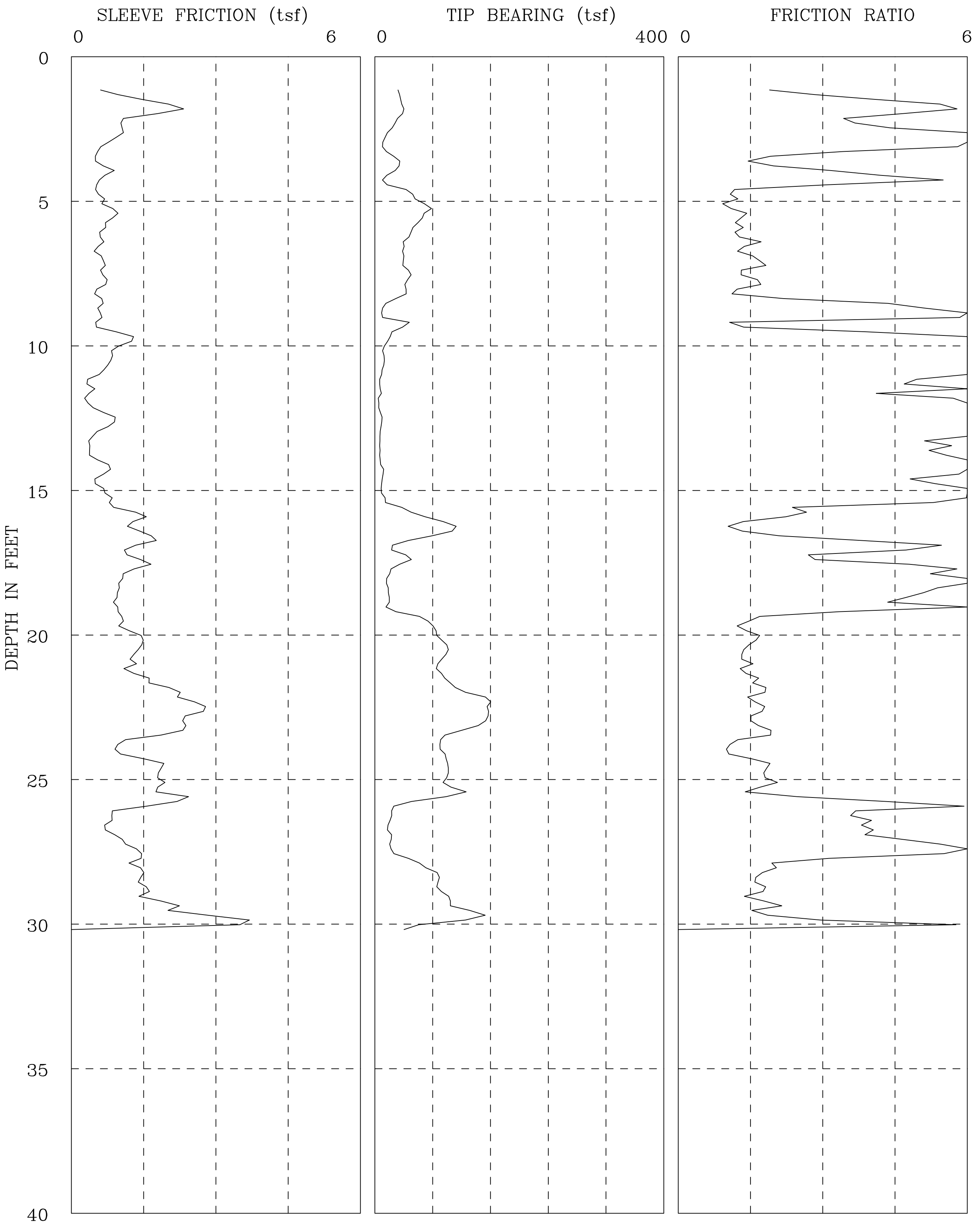
```
                                          GROUP DELTA CONSULTANTS

Cone Used  : CPT-5                                                           Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE          Eq - Dr    PHI     SPT       Su
 (meters)   (feet)      (tsf)       (tsf)       (%)        (tsf)                                       (%)      deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1         21.70        1.69        7.78        0.03             clay                   UNDFND   UNDFD    21         1.4
     0.60     2         32.92        2.66        8.09        0.09           undefined                UNDFND   UNDFD   UDF   UNDEFINED
     0.95     3         14.93        1.14        7.61        0.15             clay                   UNDFND   UNDFD    14          .9
     1.25     4          9.14        0.54        5.93        0.22             clay                   UNDFND   UNDFD     9          .5
     1.55     5         34.12        0.69        2.02        0.28     sandy silt to clayey silt      UNDFND   UNDFD    13         2.2
     1.85     6         66.10        0.92        1.39        0.33     silty sand to sandy silt       70-80    44-46    21   UNDEFINED
     2.15     7         28.00        0.67        2.38        0.39     sandy silt to clayey silt      UNDFND   UNDFD    11         1.8
     2.45     8         10.69        0.56        5.23        0.45             clay                   UNDFND   UNDFD    10          .6
     2.75     9         17.22        0.79        4.58        0.50             clay                   UNDFND   UNDFD    16         1.1
     3.05    10        109.05        1.72        1.58        0.52     silty sand to sandy silt       70-80    44-46    35   UNDEFINED
     3.35    11         84.27        1.90        2.26        0.55     silty sand to sandy silt       70-80    42-44    27   UNDEFINED
     3.65    12         14.26        0.62        4.33        0.58             clay                   UNDFND   UNDFD    14          .9
     3.95    13         13.44        0.89        6.60        0.61             clay                   UNDFND   UNDFD    13          .8
     4.25    14         10.34        0.60        5.80        0.64             clay                   UNDFND   UNDFD    10          .6
     4.55    15          9.19        0.36        3.93        0.67             clay                   UNDFND   UNDFD     9          .5
     4.85    16          7.21        0.37        5.14        0.69             clay                   UNDFND   UNDFD     7          .4
     5.15    17         18.86        0.59        3.15        0.72     clayey silt to silty clay      UNDFND   UNDFD     9         1.1
     5.45    18         11.08        0.36        3.28        0.75        silty clay to clay          UNDFND   UNDFD     7          .6
     5.75    19         12.21        1.03        8.44        0.78           undefined                UNDFND   UNDFD   UDF   UNDEFINED
     6.05    20         14.55        1.20        8.22        0.81           undefined                UNDFND   UNDFD   UDF   UNDEFINED
     6.40    21         15.48        1.09        7.01        0.84             clay                   UNDFND   UNDFD    15          .9
     6.70    22         18.12        1.36        7.49        0.87             clay                   UNDFND   UNDFD    17         1.1
     7.00    23         19.60        1.52        7.75        0.90             clay                   UNDFND   UNDFD    19         1.2
     7.35    24         18.49        1.35        7.28        0.93             clay                   UNDFND   UNDFD    18         1.1
     7.65    25         64.73        1.36        2.10        0.96     silty sand to sandy silt       50-60    38-40    21   UNDEFINED
     7.95    26        181.27        1.74        0.96        0.99             sand                   80-90    42-44    35   UNDEFINED
     8.25    27        173.30        1.22        0.70        1.01             sand                   80-90    42-44    33   UNDEFINED
     8.55    28         39.93        0.87        2.17        1.04     sandy silt to clayey silt      UNDFND   UNDFD    15         2.5
     8.85    29         21.94        1.08        4.92        1.07             clay                   UNDFND   UNDFD    21         1.3
     9.15    30         29.08       -0.11       -0.38        1.10           undefined                UNDFND   UNDFD   UDF   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-22B



CPT 6	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-23A

```
                                             GROUP DELTA CONSULTANTS

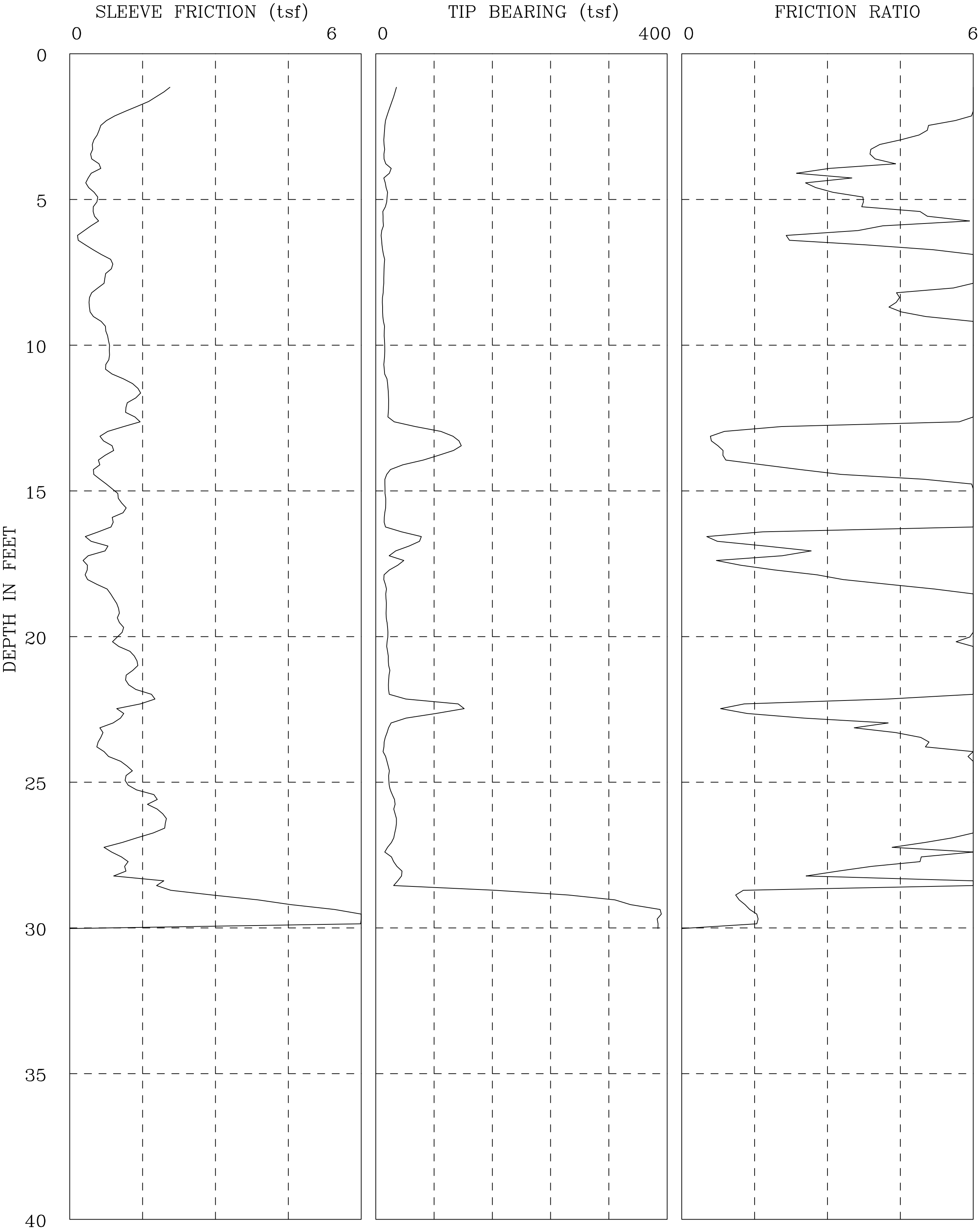
Cone Used  : CPT-6                                                          Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                               Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE         Eq - Dr    PHI    SPT       Su
 (meters)   (feet)      (tsf)       (tsf)       (%)        (tsf)                                      (%)     deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------

     0.30     1         15.99        0.30        1.89        0.03   clayey silt to silty clay    UNDFND   UNDFD    8          1.0
     0.60     2         36.31        1.53        4.21        0.09      silty clay to clay        UNDFND   UNDFD   23          2.4
     0.95     3         19.52        0.94        4.80        0.15             clay               UNDFND   UNDFD   19          1.2
     1.25     4         25.83        0.63        2.45        0.22   sandy silt to clayey silt    UNDFND   UNDFD   10          1.7
     1.55     5         41.24        0.58        1.41        0.28   silty sand to sandy silt     50-60    42-44   13    UNDEFINED
     1.85     6         62.52        0.78        1.25        0.33   silty sand to sandy silt     60-70    42-44   20    UNDEFINED
     2.15     7         40.84        0.60        1.46        0.39   silty sand to sandy silt     50-60    40-42   13    UNDEFINED
     2.45     8         44.28        0.66        1.49        0.45   silty sand to sandy silt     50-60    40-42   14    UNDEFINED
     2.75     9         19.76        0.59        3.00        0.50   clayey silt to silty clay    UNDFND   UNDFD    9          1.2
     3.05    10         27.05        0.91        3.38        0.52   clayey silt to silty clay    UNDFND   UNDFD   13          1.7
     3.35    11         11.47        0.75        6.56        0.55             clay               UNDFND   UNDFD   11           .7
     3.65    12          6.75        0.36        5.28        0.58             clay               UNDFND   UNDFD    6           .4
     3.95    13          8.14        0.71        8.66        0.61           undefined            UNDFND   UNDFD  UDF    UNDEFINED
     4.25    14          7.04        0.41        5.89        0.64             clay               UNDFND   UNDFD    7           .4
     4.55    15          9.97        0.65        6.54        0.67             clay               UNDFND   UNDFD   10           .6
     4.85    16         32.55        1.02        3.13        0.69   clayey silt to silty clay    UNDFND   UNDFD   16          2.1
     5.15    17         77.37        1.44        1.86        0.72   silty sand to sandy silt     60-70    40-42   25    UNDEFINED
     5.45    18         32.37        1.29        3.98        0.75      silty clay to clay        UNDFND   UNDFD   21          2.0
     5.75    19         18.30        0.97        5.30        0.78             clay               UNDFND   UNDFD   18          1.1
     6.05    20         57.56        1.04        1.81        0.81   silty sand to sandy silt     50-60    38-40   18    UNDEFINED
     6.40    21         94.02        1.38        1.47        0.84   silty sand to sandy silt     60-70    40-42   30    UNDEFINED
     6.70    22        102.58        1.65        1.61        0.87   silty sand to sandy silt     60-70    40-42   33    UNDEFINED
     7.00    23        156.05        2.49        1.60        0.90      sand to silty sand        80-90    42-44   37    UNDEFINED
     7.35    24        104.15        1.51        1.45        0.93      sand to silty sand        60-70    40-42   25    UNDEFINED
     7.65    25         99.49        1.81        1.81        0.96   silty sand to sandy silt     60-70    40-42   32    UNDEFINED
     7.95    26         71.82        1.76        2.46        0.99   sandy silt to clayey silt    UNDFND   UNDFD   28          4.6
     8.25    27         21.00        0.84        3.99        1.01      silty clay to clay        UNDFND   UNDFD   13          1.2
     8.55    28         41.37        1.34        3.23        1.04   clayey silt to silty clay    UNDFND   UNDFD   20          2.6
     8.85    29         90.53        1.49        1.64        1.07   silty sand to sandy silt     60-70    40-42   29    UNDEFINED
     9.15    30        113.21        0.81        0.72        1.10      sand to silty sand        60-70    40-42   27    UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-23B



CPT 7	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-24A

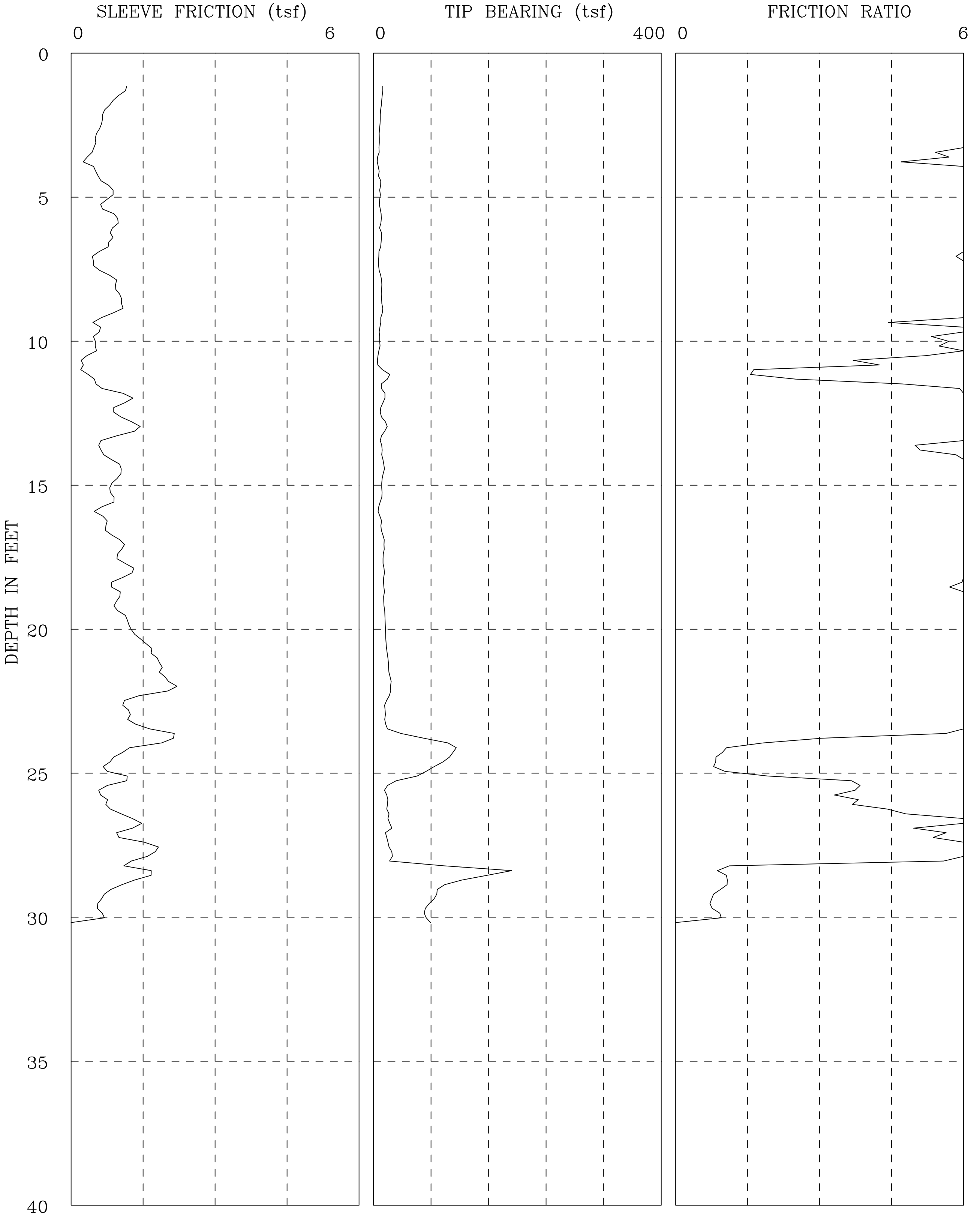
```
                                          GROUP DELTA CONSULTANTS

Cone Used  : CPT-7                                                          Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                               Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
      DEPTH          Qc (avg)   Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE          Eq - Dr    PHI     SPT       Su
 (meters)   (feet)     (tsf)      (tsf)       (%)        (tsf)                                        (%)     deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1       14.16       1.03        7.28        0.03              clay                   UNDFND   UNDFD    14         .9
     0.60     2       23.25       1.66        7.14        0.09              clay                   UNDFND   UNDFD    22        1.5
     0.95     3       12.54       0.64        5.09        0.15              clay                   UNDFND   UNDFD    12         .8
     1.25     4       14.74       0.51        3.45        0.22       silty clay to clay            UNDFND   UNDFD     9         .9
     1.55     5       14.13       0.46        3.24        0.28       silty clay to clay            UNDFND   UNDFD     9         .9
     1.85     6       10.34       0.47        4.54        0.33              clay                   UNDFND   UNDFD    10         .6
     2.15     7        9.38       0.44        4.69        0.39              clay                   UNDFND   UNDFD     9         .5
     2.45     8       11.14       0.75        6.73        0.45              clay                   UNDFND   UNDFD    11         .7
     2.75     9        9.49       0.43        4.52        0.50              clay                   UNDFND   UNDFD     9         .5
     3.05    10       11.71       0.75        6.45        0.52              clay                   UNDFND   UNDFD    11         .7
     3.35    11       11.95       0.80        6.69        0.55              clay                   UNDFND   UNDFD    11         .7
     3.65    12       16.85       1.30        7.73        0.58              clay                   UNDFND   UNDFD    16        1.0
     3.95    13       36.84       1.17        3.17        0.61    clayey silt to silty clay        UNDFND   UNDFD    18        2.4
     4.25    14       99.35       0.74        0.74        0.64       sand to silty sand            70-80    42-44    24  UNDEFINED
     4.55    15       18.38       0.64        3.50        0.67       silty clay to clay            UNDFND   UNDFD    12        1.1
     4.85    16       13.07       1.03        7.91        0.69              clay                   UNDFND   UNDFD    13         .8
     5.15    17       38.12       0.65        1.70        0.72    sandy silt to clayey silt        UNDFND   UNDFD    15        2.4
     5.45    18       24.16       0.41        1.68        0.75    sandy silt to clayey silt        UNDFND   UNDFD     9        1.5
     5.75    19       13.66       0.74        5.40        0.78              clay                   UNDFND   UNDFD    13         .8
     6.05    20       15.24       1.04        6.81        0.81              clay                   UNDFND   UNDFD    15         .9
     6.40    21       16.53       1.18        7.12        0.84              clay                   UNDFND   UNDFD    16        1.0
     6.70    22       18.17       1.31        7.22        0.87              clay                   UNDFND   UNDFD    17        1.1
     7.00    23       70.20       1.21        1.72        0.90    silty sand to sandy silt         50-60    38-40    22  UNDEFINED
     7.35    24       13.19       0.66        4.98        0.93              clay                   UNDFND   UNDFD    13         .7
     7.65    25       17.55       1.17        6.67        0.96              clay                   UNDFND   UNDFD    17        1.0
     7.95    26       24.44       1.71        6.98        0.99              clay                   UNDFND   UNDFD    23        1.5
     8.25    27       26.13       1.68        6.44        1.01              clay                   UNDFND   UNDFD    25        1.6
     8.55    28       23.28       1.02        4.38        1.04              clay                   UNDFND   UNDFD    22        1.4
     8.85    29      141.23       2.26        1.60        1.07       sand to silty sand            70-80    42-44    34  UNDEFINED
     9.15    30      382.09   -5458.42    -1428.59        1.10            undefined                UNDFND   UNDFD   UDF  UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-24B



CPT 08	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-25A

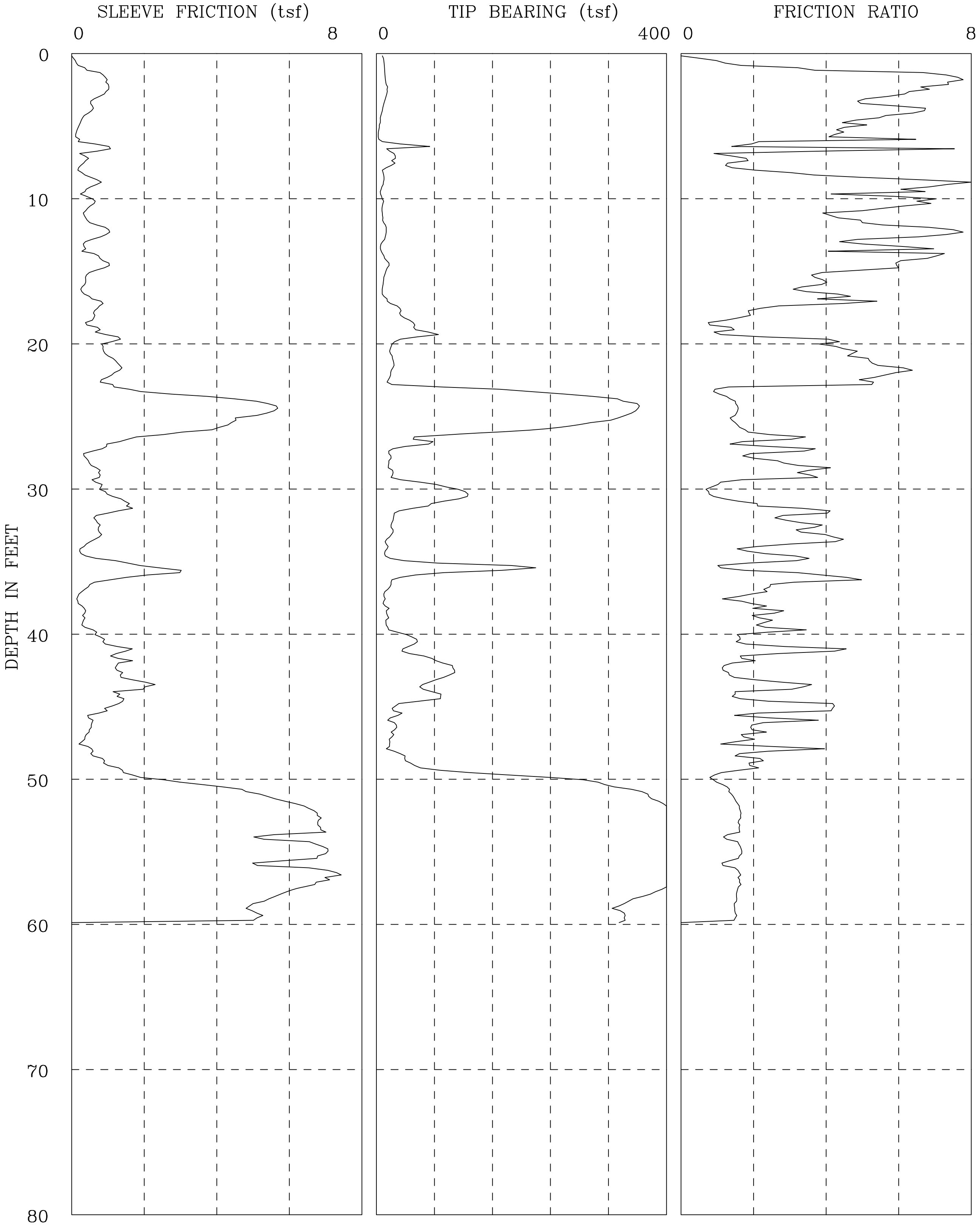
GROUP DELTA CONSULTANTS

```
Cone Used  : CPT-8                                                         Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'          SOIL BEHAVIOUR TYPE          Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                         (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1         6.51        0.58        8.90        0.03            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     0.60     2        11.82        0.94        7.98        0.09              clay                UNDFND   UNDFD    11          .7
     0.95     3         8.76        0.58        6.67        0.15              clay                UNDFND   UNDFD     8          .5
     1.25     4         7.00        0.41        5.91        0.22              clay                UNDFND   UNDFD     7          .4
     1.55     5         9.05        0.75        8.24        0.28            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     1.85     6         9.77        0.83        8.51        0.33            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     2.15     7         9.79        0.71        7.29        0.39              clay                UNDFND   UNDFD     9          .6
     2.45     8         9.28        0.70        7.57        0.45              clay                UNDFND   UNDFD     9          .5
     2.75     9        11.91        1.00        8.41        0.50            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     3.05    10         9.18        0.54        5.91        0.52              clay                UNDFND   UNDFD     9          .5
     3.35    11         7.85        0.34        4.30        0.55              clay                UNDFND   UNDFD     8          .4
     3.65    12        16.04        0.73        4.55        0.58              clay                UNDFND   UNDFD    15         1.0
     3.95    13        13.35        1.10        8.27        0.61            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     4.25    14        12.02        0.80        6.62        0.64              clay                UNDFND   UNDFD    12          .7
     4.55    15        13.38        0.96        7.16        0.67              clay                UNDFND   UNDFD    13          .8
     4.85    16         9.79        0.76        7.73        0.69              clay                UNDFND   UNDFD     9          .5
     5.15    17        11.61        0.79        6.79        0.72              clay                UNDFND   UNDFD    11          .7
     5.45    18        14.21        1.09        7.66        0.75              clay                UNDFND   UNDFD    14          .8
     5.75    19        14.68        1.01        6.88        0.78              clay                UNDFND   UNDFD    14          .9
     6.05    20        15.65        1.05        6.73        0.81              clay                UNDFND   UNDFD    15          .9
     6.40    21        18.10        1.53        8.48        0.84            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     6.70    22        22.55        1.96        8.71        0.87            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     7.00    23        18.84        1.34        7.13        0.90              clay                UNDFND   UNDFD    18         1.1
     7.35    24        54.25        1.65        3.04        0.93    sandy silt to clayey silt     UNDFND   UNDFD    21         3.5
     7.65    25        88.62        0.89        1.01        0.96       sand to silty sand         60-70    40-42    21   UNDEFINED
     7.95    26        20.85        0.77        3.67        0.99       silty clay to clay         UNDFND   UNDFD    13         1.2
     8.25    27        21.00        1.14        5.43        1.01              clay                UNDFND   UNDFD    20         1.2
     8.55    28        22.49        1.49        6.63        1.04              clay                UNDFND   UNDFD    22         1.3
     8.85    29       126.60        1.28        1.01        1.07       sand to silty sand         70-80    40-42    30   UNDEFINED
     9.15    30        77.67       -1.25       -1.60        1.10            undefined             UNDFND   UNDFD   UDF   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-25B



CPT-9	I-558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-26A

```
                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-9                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                             Tot. Unit Wt. (avg) : 120 pcf
-------------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE         Eq - Dr     PHI     SPT       Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                      (%)      deg.      N        tsf
-------------------------------------------------------------------------------------------------------------------------------------
     0.30     1        10.18        0.14        1.34        0.03    clayey silt to silty clay     UNDFND   UNDFD     5          .6
     0.60     2        12.10        0.82        6.78        0.09              clay                UNDFND   UNDFD    12          .8
     0.95     3        14.23        0.90        6.33        0.15              clay                UNDFND   UNDFD    14          .9
     1.25     4         9.22        0.54        5.84        0.22              clay                UNDFND   UNDFD     9          .6
     1.55     5         5.13        0.26        5.03        0.28              clay                UNDFND   UNDFD     5          .3
     1.85     6         3.92        0.15        3.83        0.33              clay                UNDFND   UNDFD     4          .2
     2.15     7        31.60        0.67        2.12        0.39    sandy silt to clayey silt     UNDFND   UNDFD    12         2.0
     2.45     8        19.22        0.30        1.56        0.45    sandy silt to clayey silt     UNDFND   UNDFD     7         1.2
     2.75     9        10.00        0.56        5.63        0.50              clay                UNDFND   UNDFD    10          .6
     3.05    10         6.77        0.42        6.18        0.52              clay                UNDFND   UNDFD     6          .4
     3.35    11         8.53        0.49        5.72        0.55              clay                UNDFND   UNDFD     8          .5
     3.65    12        10.35        0.55        5.28        0.58              clay                UNDFND   UNDFD    10          .6
     3.95    13        12.08        0.79        6.57        0.61              clay                UNDFND   UNDFD    12          .7
     4.25    14         7.23        0.45        6.18        0.64              clay                UNDFND   UNDFD     7          .4
     4.55    15        14.87        0.88        5.92        0.67              clay                UNDFND   UNDFD    14          .9
     4.85    16        10.55        0.40        3.82        0.69              clay                UNDFND   UNDFD    10          .6
     5.15    17         9.73        0.37        3.80        0.72              clay                UNDFND   UNDFD     9          .5
     5.45    18        26.92        0.73        2.72        0.75    clayey silt to silty clay     UNDFND   UNDFD    13         1.7
     5.75    19        45.55        0.56        1.22        0.78    silty sand to sandy silt      40-50    38-40    15   UNDEFINED
     6.05    20        54.40        1.02        1.87        0.81    silty sand to sandy silt      50-60    38-40    17   UNDEFINED
     6.40    21        20.41        0.93        4.55        0.84              clay                UNDFND   UNDFD    20         1.2
     6.70    22        22.53        1.28        5.70        0.87              clay                UNDFND   UNDFD    22         1.4
     7.00    23        30.07        1.00        3.32        0.90    clayey silt to silty clay     UNDFND   UNDFD    14         1.9
     7.35    24       281.76        3.56        1.26        0.93              sand                  >90    44-46   >50   UNDEFINED
     7.65    25       351.52        5.32        1.51        0.96       sand to silty sand           >90    46-48   >50   UNDEFINED
     7.95    26       255.22        4.04        1.58        0.99       sand to silty sand           >90    44-46   >50   UNDEFINED
     8.25    27        66.01        1.52        2.30        1.01    sandy silt to clayey silt     UNDFND   UNDFD    25         4.2
     8.55    28        19.08        0.49        2.59        1.04    clayey silt to silty clay     UNDFND   UNDFD     9         1.1
     8.85    29        19.70        0.67        3.41        1.07    clayey silt to silty clay     UNDFND   UNDFD     9         1.1
     9.15    30        67.67        0.73        1.08        1.10    silty sand to sandy silt      50-60    38-40    22   UNDEFINED
     9.45    31       109.45        1.24        1.13        1.13       sand to silty sand         60-70    40-42    26   UNDEFINED
     9.75    32        37.66        1.13        3.00        1.16    clayey silt to silty clay     UNDFND   UNDFD    18         2.3
    10.05    33        21.83        0.73        3.36        1.18    clayey silt to silty clay     UNDFND   UNDFD    10         1.3
    10.35    34        15.83        0.58        3.67        1.21       silty clay to clay         UNDFND   UNDFD    10          .9
    10.65    35        17.94        0.50        2.77        1.24    clayey silt to silty clay     UNDFND   UNDFD     9         1.0
    10.95    36       134.98        2.32        1.72        1.27    silty sand to sandy silt      70-80    40-42    43   UNDEFINED
    11.25    37        21.61        0.75        3.49        1.30    clayey silt to silty clay     UNDFND   UNDFD    10         1.2
    11.55    38        10.77        0.19        1.76        1.33    clayey silt to silty clay     UNDFND   UNDFD     5          .5
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      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15


 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
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Figure A-26B

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                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-9                                                         Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85    39        15.03        0.34        2.28        1.35    clayey silt to silty clay     UNDFND   UNDFD     7           .8
    12.15    40        16.94        0.43        2.52        1.38    clayey silt to silty clay     UNDFND   UNDFD     8           .9
    12.45    41        49.82        0.90        1.80        1.41    silty sand to sandy silt      40-50    34-36    16    UNDEFINED
    12.80    42        61.93        1.39        2.24        1.44    sandy silt to clayey silt     UNDFND   UNDFD    24          3.9
    13.10    43       103.28        1.30        1.26        1.47       sand to silty sand         60-70    38-40    25    UNDEFINED
    13.40    44        70.02        1.85        2.65        1.50    sandy silt to clayey silt     UNDFND   UNDFD    27          4.4
    13.75    45        57.71        1.25        2.17        1.53    sandy silt to clayey silt     UNDFND   UNDFD    22          3.6
    14.05    46        24.75        0.63        2.55        1.56    clayey silt to silty clay     UNDFND   UNDFD    12          1.4
    14.35    47        24.45        0.47        1.92        1.59    sandy silt to clayey silt     UNDFND   UNDFD     9          1.4
    14.65    48        18.52        0.41        2.19        1.62    clayey silt to silty clay     UNDFND   UNDFD     9          1.0
    14.95    49        41.94        0.79        1.89        1.65    sandy silt to clayey silt     UNDFND   UNDFD    16          2.6
    15.25    50       163.85        1.71        1.04        1.68       sand to silty sand         70-80    40-42    39    UNDEFINED
    15.55    51       339.98        4.24        1.25        1.70              sand                  >90    44-46   >50    UNDEFINED
    15.85    52       390.87        6.00        1.53        1.73       sand to silty sand           >90    44-46   >50    UNDEFINED
    16.15    53       418.20        6.78        1.62        1.76       sand to silty sand           >90    44-46   >50    UNDEFINED
    16.45    54       429.30        6.35        1.48        1.79              sand                  >90    44-46   >50    UNDEFINED
    16.75    55       422.48        6.61        1.56        1.82       sand to silty sand           >90    44-46   >50    UNDEFINED
    17.05    56       432.42        6.08        1.41        1.85              sand                  >90    44-46   >50    UNDEFINED
    17.35    57       447.12        7.07        1.58        1.87       sand to silty sand           >90    44-46   >50    UNDEFINED
    17.65    58       397.63        6.27        1.58        1.90       sand to silty sand           >90    44-46   >50    UNDEFINED
    17.95    59       344.88        5.18        1.50        1.93       sand to silty sand           >90    42-44   >50    UNDEFINED
    18.25    60       340.00        4.24        1.25        1.96              sand                  >90    42-44   >50    UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
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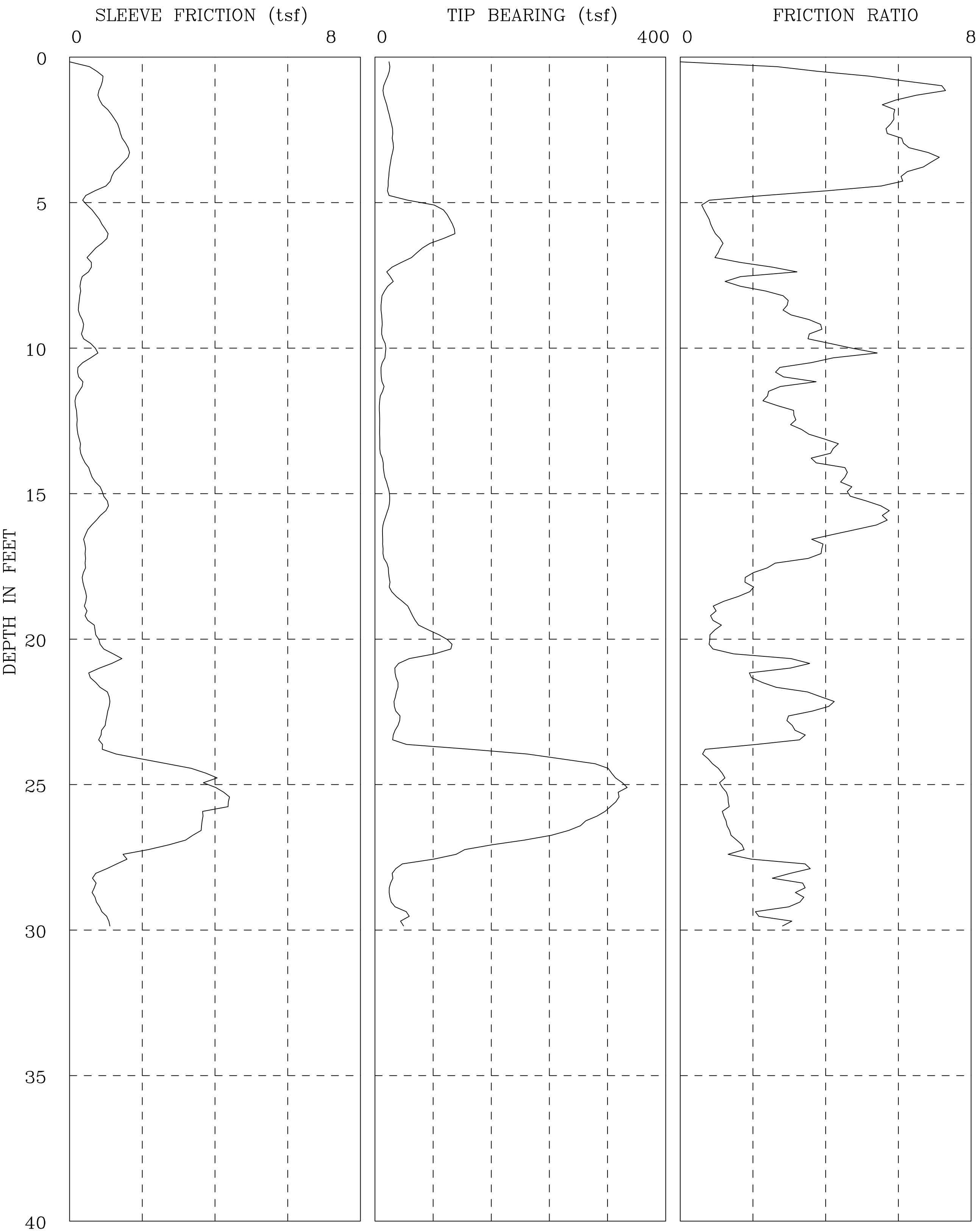
Figure A-26C



CPT-10	I-558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-27A

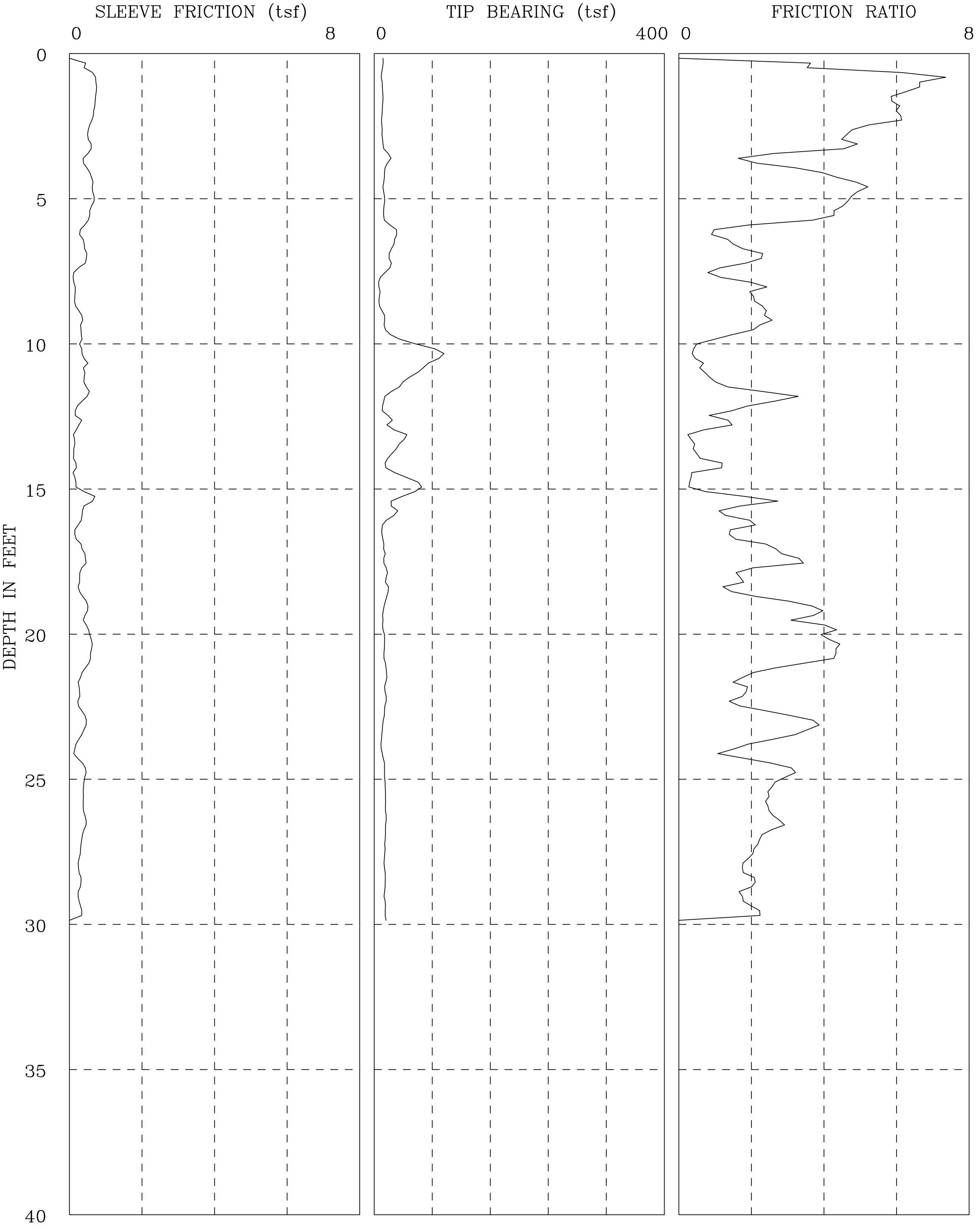
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-10                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        17.42        0.67        3.83        0.03       silty clay to clay         UNDFND   UNDFD    11         1.1
     0.60     2        15.12        0.92        6.09        0.09              clay                UNDFND   UNDFD    14         1.0
     0.95     3        23.89        1.42        5.94        0.15              clay                UNDFND   UNDFD    23         1.5
     1.25     4        21.28        1.42        6.66        0.22              clay                UNDFND   UNDFD    20         1.4
     1.55     5        33.28        0.69        2.06        0.28    sandy silt to clayey silt     UNDFND   UNDFD    13         2.2
     1.85     6       103.82        0.85        0.82        0.33       sand to silty sand         80-90    44-46    25   UNDEFINED
     2.15     7        63.32        0.72        1.14        0.39    silty sand to sandy silt      60-70    42-44    20   UNDEFINED
     2.45     8        19.48        0.40        2.04        0.45    clayey silt to silty clay     UNDFND   UNDFD     9         1.2
     2.75     9         9.18        0.28        3.03        0.50       silty clay to clay         UNDFND   UNDFD     6          .5
     3.05    10        11.52        0.46        4.01        0.52              clay                UNDFND   UNDFD    11          .7
     3.35    11        10.63        0.40        3.79        0.55              clay                UNDFND   UNDFD    10          .6
     3.65    12         8.90        0.25        2.75        0.58       silty clay to clay         UNDFND   UNDFD     6          .5
     3.95    13         6.42        0.21        3.22        0.61              clay                UNDFND   UNDFD     6          .3
     4.25    14         8.27        0.33        3.95        0.64              clay                UNDFND   UNDFD     8          .4
     4.55    15        15.22        0.69        4.57        0.67              clay                UNDFND   UNDFD    15          .9
     4.85    16        17.58        0.94        5.35        0.69              clay                UNDFND   UNDFD    17         1.1
     5.15    17        10.83        0.47        4.31        0.72              clay                UNDFND   UNDFD    10          .6
     5.45    18        16.17        0.41        2.55        0.75    clayey silt to silty clay     UNDFND   UNDFD     8         1.0
     5.75    19        29.37        0.42        1.44        0.78    sandy silt to clayey silt     UNDFND   UNDFD    11         1.8
     6.05    20        63.00        0.59        0.93        0.81    silty sand to sandy silt      50-60    38-40    20   UNDEFINED
     6.40    21        71.34        1.03        1.45        0.84    silty sand to sandy silt      50-60    40-42    23   UNDEFINED
     6.70    22        29.77        0.80        2.68        0.87    sandy silt to clayey silt     UNDFND   UNDFD    11         1.8
     7.00    23        30.38        1.04        3.43        0.90    clayey silt to silty clay     UNDFND   UNDFD    15         1.9
     7.35    24       102.64        1.09        1.06        0.93       sand to silty sand         60-70    40-42    25   UNDEFINED
     7.65    25       327.97        3.59        1.09        0.96              sand                  >90    46-48   >50   UNDEFINED
     7.95    26       324.68        4.12        1.27        0.99              sand                  >90    46-48   >50   UNDEFINED
     8.25    27       241.51        3.37        1.40        1.01       sand to silty sand           >90    44-46   >50   UNDEFINED
     8.55    28        67.78        1.38        2.03        1.04    silty sand to sandy silt      50-60    38-40    22   UNDEFINED
     8.85    29        21.52        0.68        3.18        1.07    clayey silt to silty clay     UNDFND   UNDFD    10         1.3
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15


 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-27B



CPT−11	I−558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-28A

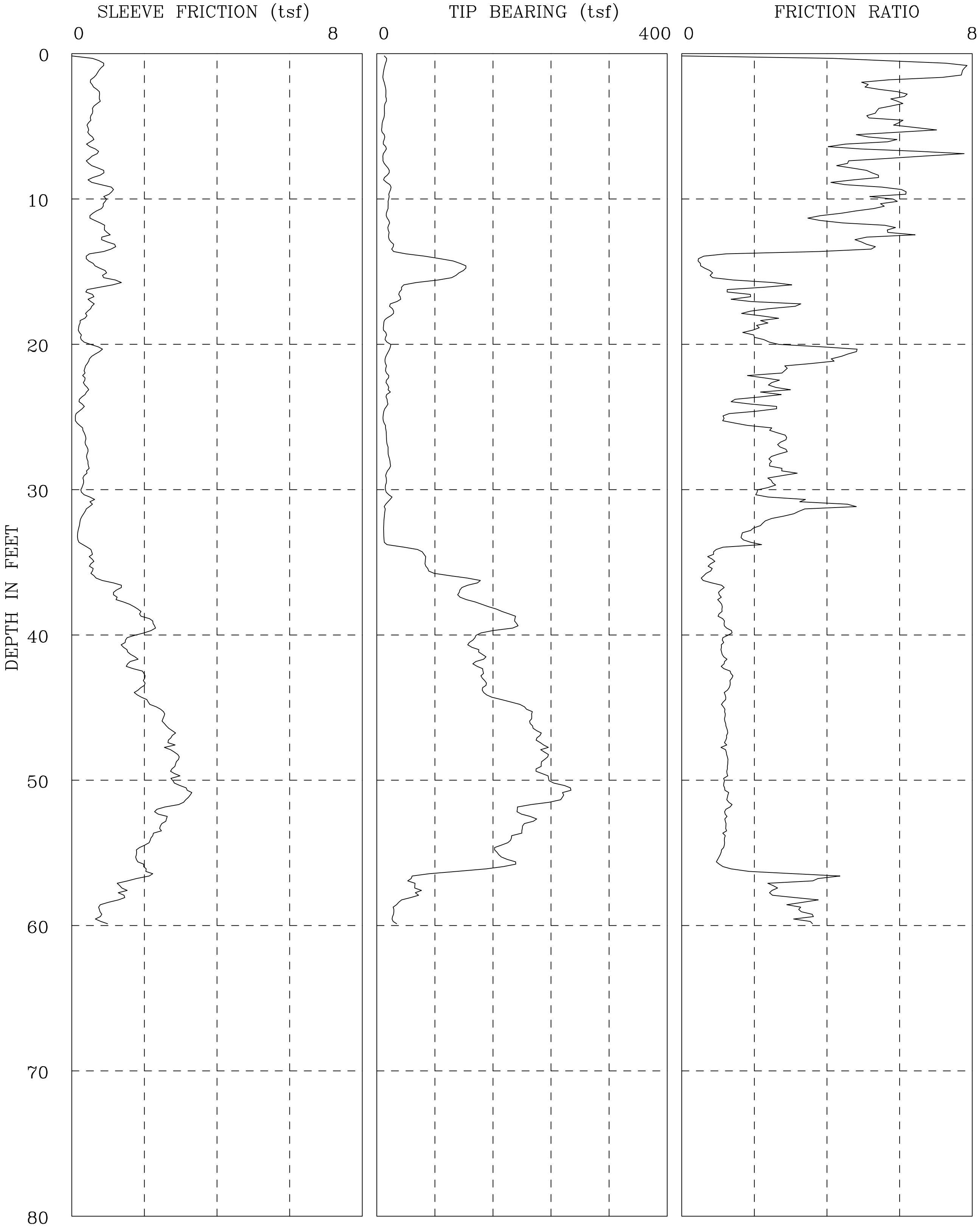
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-11                                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        11.25        0.49        4.37        0.03              clay                UNDFND   UNDFD    11          .7
     0.60     2        11.70        0.72        6.11        0.09              clay                UNDFND   UNDFD    11          .7
     0.95     3        11.01        0.57        5.16        0.15              clay                UNDFND   UNDFD    11          .7
     1.25     4        17.22        0.49        2.83        0.22    clayey silt to silty clay     UNDFND   UNDFD     8         1.1
     1.55     5        13.55        0.65        4.78        0.28              clay                UNDFND   UNDFD    13          .8
     1.85     6        17.75        0.50        2.79        0.33    clayey silt to silty clay     UNDFND   UNDFD     9         1.1
     2.15     7        25.37        0.41        1.60        0.39    sandy silt to clayey silt     UNDFND   UNDFD    10         1.6
     2.45     8        13.70        0.20        1.45        0.45    clayey silt to silty clay     UNDFND   UNDFD     7          .8
     2.75     9         9.13        0.20        2.23        0.50       silty clay to clay         UNDFND   UNDFD     6          .5
     3.05    10        26.53        0.33        1.23        0.52    sandy silt to clayey silt     UNDFND   UNDFD    10         1.7
     3.35    11        78.50        0.40        0.51        0.55       sand to silty sand         60-70    42-44    19   UNDEFINED
     3.65    12        29.05        0.44        1.53        0.58    sandy silt to clayey silt     UNDFND   UNDFD    11         1.8
     3.95    13        18.63        0.22        1.19        0.61    sandy silt to clayey silt     UNDFND   UNDFD     7         1.1
     4.25    14        32.48        0.13        0.38        0.64    silty sand to sandy silt      40-50    36-38    10   UNDEFINED
     4.55    15        38.37        0.16        0.43        0.67    silty sand to sandy silt      40-50    38-40    12   UNDEFINED
     4.85    16        33.62        0.48        1.42        0.69    sandy silt to clayey silt     UNDFND   UNDFD    13         2.1
     5.15    17        12.53        0.23        1.84        0.72    clayey silt to silty clay     UNDFND   UNDFD     6          .7
     5.45    18        15.00        0.38        2.57        0.75    clayey silt to silty clay     UNDFND   UNDFD     7          .9
     5.75    19        17.37        0.32        1.84        0.78    clayey silt to silty clay     UNDFND   UNDFD     8         1.0
     6.05    20        12.38        0.47        3.80        0.81              clay                UNDFND   UNDFD    12          .7
     6.40    21        14.23        0.59        4.12        0.84              clay                UNDFND   UNDFD    14          .8
     6.70    22        16.12        0.31        1.95        0.87    clayey silt to silty clay     UNDFND   UNDFD     8          .9
     7.00    23        14.85        0.34        2.26        0.90    clayey silt to silty clay     UNDFND   UNDFD     7          .9
     7.35    24        10.60        0.27        2.57        0.93       silty clay to clay         UNDFND   UNDFD     7          .6
     7.65    25        14.13        0.38        2.72        0.96    clayey silt to silty clay     UNDFND   UNDFD     7          .8
     7.95    26        15.58        0.38        2.47        0.99    clayey silt to silty clay     UNDFND   UNDFD     7          .9
     8.25    27        15.95        0.41        2.56        1.01    clayey silt to silty clay     UNDFND   UNDFD     8          .9
     8.55    28        14.40        0.28        1.96        1.04    clayey silt to silty clay     UNDFND   UNDFD     7          .8
     8.85    29        14.83        0.28        1.90        1.07    clayey silt to silty clay     UNDFND   UNDFD     7          .8
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-28B



CPT–12	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-29A

GROUP DELTA CONSULTANTS

```
Cone Used  : CPT-12                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI     SPT       Su
 (meters)   (feet)      (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        11.87        0.65        5.46        0.03             clay                UNDFND   UNDFD    11          .7
     0.60     2         9.25        0.63        6.79        0.09             clay                UNDFND   UNDFD     9          .6
     0.95     3        12.33        0.70        5.68        0.15             clay                UNDFND   UNDFD    12          .8
     1.25     4        11.23        0.64        5.67        0.22             clay                UNDFND   UNDFD    11          .7
     1.55     5         8.48        0.48        5.70        0.28             clay                UNDFND   UNDFD     8          .5
     1.85     6         9.12        0.51        5.65        0.33             clay                UNDFND   UNDFD     9          .5
     2.15     7        10.57        0.59        5.62        0.39             clay                UNDFND   UNDFD    10          .6
     2.45     8        12.22        0.59        4.79        0.45             clay                UNDFND   UNDFD    12          .7
     2.75     9        13.83        0.68        4.89        0.50             clay                UNDFND   UNDFD    13          .8
     3.05    10        17.80        1.03        5.81        0.52             clay                UNDFND   UNDFD    17         1.1
     3.35    11        14.98        0.79        5.27        0.55             clay                UNDFND   UNDFD    14          .9
     3.65    12        15.58        0.70        4.52        0.58             clay                UNDFND   UNDFD    15          .9
     3.95    13        17.13        0.93        5.41        0.61             clay                UNDFND   UNDFD    16         1.0
     4.25    14        32.58        0.87        2.68        0.64   sandy silt to clayey silt     UNDFND   UNDFD    12         2.1
     4.55    15       112.07        0.63        0.56        0.67             sand                70-80    42-44    21   UNDEFINED
     4.85    16        83.67        1.07        1.27        0.69      sand to silty sand         60-70    40-42    20   UNDEFINED
     5.15    17        32.52        0.54        1.65        0.72   sandy silt to clayey silt     UNDFND   UNDFD    12         2.1
     5.45    18        22.05        0.51        2.30        0.75   clayey silt to silty clay     UNDFND   UNDFD    11         1.4
     5.75    19        11.97        0.27        2.27        0.78   clayey silt to silty clay     UNDFND   UNDFD     6          .7
     6.05    20        12.15        0.25        2.06        0.81   clayey silt to silty clay     UNDFND   UNDFD     6          .7
     6.40    21        15.79        0.65        4.13        0.84             clay                UNDFND   UNDFD    15          .9
     6.70    22        12.42        0.39        3.15        0.87      silty clay to clay         UNDFND   UNDFD     8          .7
     7.00    23        15.15        0.36        2.35        0.90   clayey silt to silty clay     UNDFND   UNDFD     7          .9
     7.35    24        15.06        0.32        2.12        0.93   clayey silt to silty clay     UNDFND   UNDFD     7          .9
     7.65    25        10.15        0.19        1.90        0.96   clayey silt to silty clay     UNDFND   UNDFD     5          .5
     7.95    26        11.52        0.24        2.05        0.99   clayey silt to silty clay     UNDFND   UNDFD     6          .6
     8.25    27        13.93        0.39        2.78        1.01   clayey silt to silty clay     UNDFND   UNDFD     7          .8
     8.55    28        16.55        0.43        2.62        1.04   clayey silt to silty clay     UNDFND   UNDFD     8          .9
     8.85    29        15.90        0.43        2.68        1.07   clayey silt to silty clay     UNDFND   UNDFD     8          .9
     9.15    30        12.58        0.30        2.40        1.10   clayey silt to silty clay     UNDFND   UNDFD     6          .7
     9.45    31        16.18        0.47        2.89        1.13   clayey silt to silty clay     UNDFND   UNDFD     8          .9
     9.75    32        10.77        0.36        3.30        1.16      silty clay to clay         UNDFND   UNDFD     7          .5
    10.05    33         9.72        0.20        2.04        1.18   clayey silt to silty clay     UNDFND   UNDFD     5          .5
    10.35    34        15.30        0.24        1.56        1.21   sandy silt to clayey silt     UNDFND   UNDFD     6          .8
    10.65    35        64.18        0.55        0.86        1.24      sand to silty sand         50-60    36-38    15   UNDEFINED
    10.95    36        75.82        0.55        0.73        1.27      sand to silty sand         50-60    38-40    18   UNDEFINED
    11.25    37       127.22        1.11        0.87        1.30      sand to silty sand         60-70    40-42    30   UNDEFINED
    11.55    38       123.87        1.30        1.05        1.33      sand to silty sand         60-70    40-42    30   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15


 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-29B

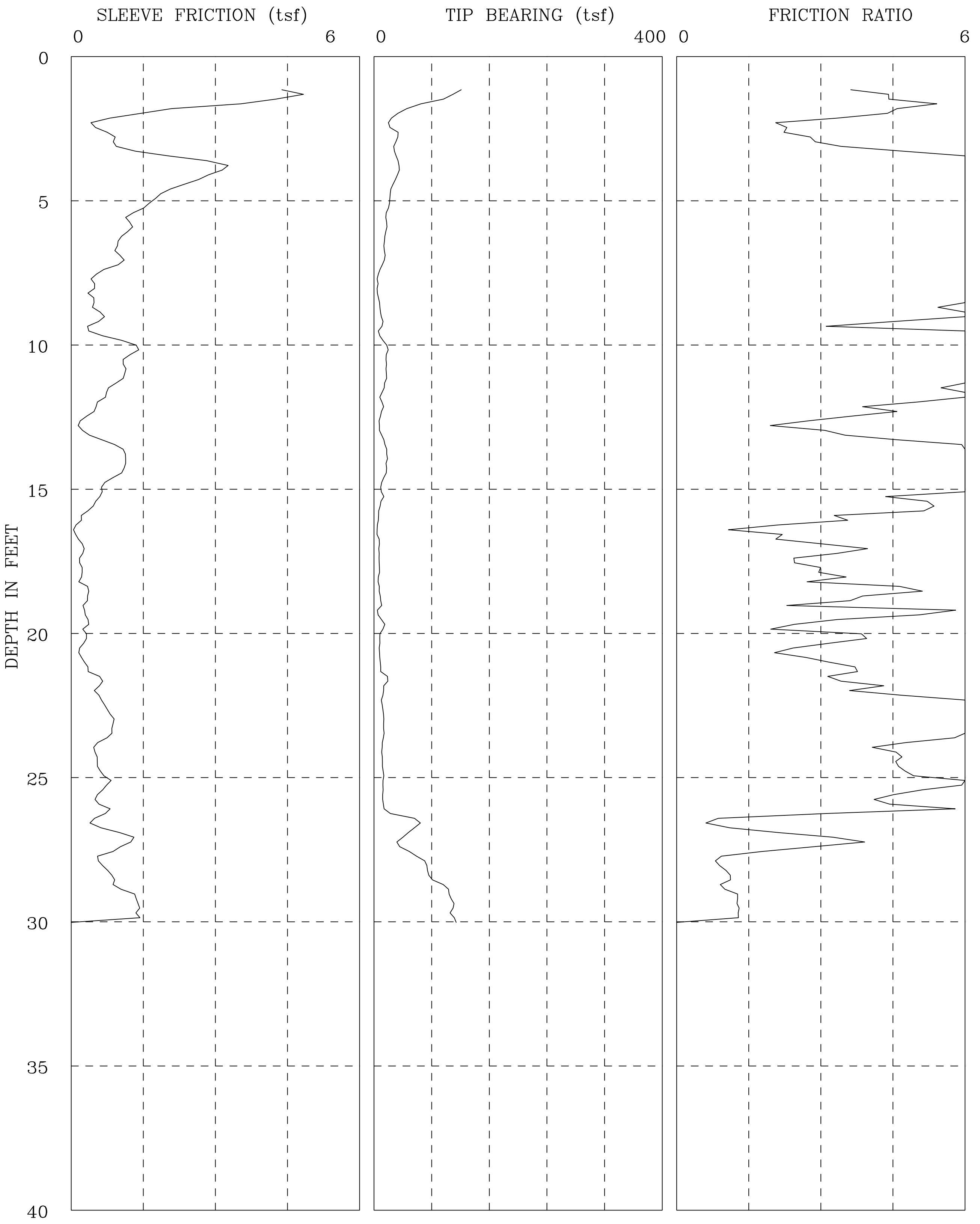
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-12                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr   PHI      SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.      N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85    39       175.85        1.90        1.08        1.35              sand                70-80    42-44    34   UNDEFINED
    12.15    40       177.83        2.20        1.24        1.38       sand to silty sand         70-80    42-44    43   UNDEFINED
    12.45    41       131.33        1.50        1.14        1.41       sand to silty sand         60-70    40-42    31   UNDEFINED
    12.80    42       141.83        1.63        1.15        1.44       sand to silty sand         70-80    40-42    34   UNDEFINED
    13.10    43       144.40        1.86        1.29        1.47       sand to silty sand         70-80    40-42    35   UNDEFINED
    13.40    44       148.03        1.91        1.29        1.50       sand to silty sand         70-80    40-42    35   UNDEFINED
    13.75    45       181.92        2.12        1.17        1.53       sand to silty sand         70-80    40-42    44   UNDEFINED
    14.05    46       212.60        2.53        1.19        1.56              sand                80-90    42-44    41   UNDEFINED
    14.35    47       220.30        2.74        1.24        1.59              sand                80-90    42-44    42   UNDEFINED
    14.65    48       227.92        2.71        1.19        1.62              sand                80-90    42-44    44   UNDEFINED
    14.95    49       230.48        2.90        1.26        1.65              sand                80-90    42-44    44   UNDEFINED
    15.25    50       229.37        2.80        1.22        1.68              sand                80-90    42-44    44   UNDEFINED
    15.55    51       258.37        3.12        1.21        1.70              sand                80-90    42-44    49   UNDEFINED
    15.85    52       224.41        2.88        1.28        1.73              sand                80-90    42-44    43   UNDEFINED
    16.15    53       207.07        2.50        1.20        1.76              sand                70-80    40-42    40   UNDEFINED
    16.45    54       195.33        2.33        1.19        1.79              sand                70-80    40-42    37   UNDEFINED
    16.75    55       171.00        1.96        1.14        1.82       sand to silty sand         70-80    40-42    41   UNDEFINED
    17.05    56       179.48        1.85        1.03        1.85              sand                70-80    40-42    34   UNDEFINED
    17.35    57        78.69        1.96        2.49        1.87    sandy silt to clayey silt     UNDFND   UNDFD    30         5.0
    17.65    58        54.97        1.37        2.49        1.90    sandy silt to clayey silt     UNDFND   UNDFD    21         3.4
    17.95    59        30.82        1.01        3.27        1.93    clayey silt to silty clay     UNDFND   UNDFD    15         1.8
    18.25    60        23.30        0.81        3.46        1.96    clayey silt to silty clay     UNDFND   UNDFD    11         1.3
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-29C



CPT 13	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-30A

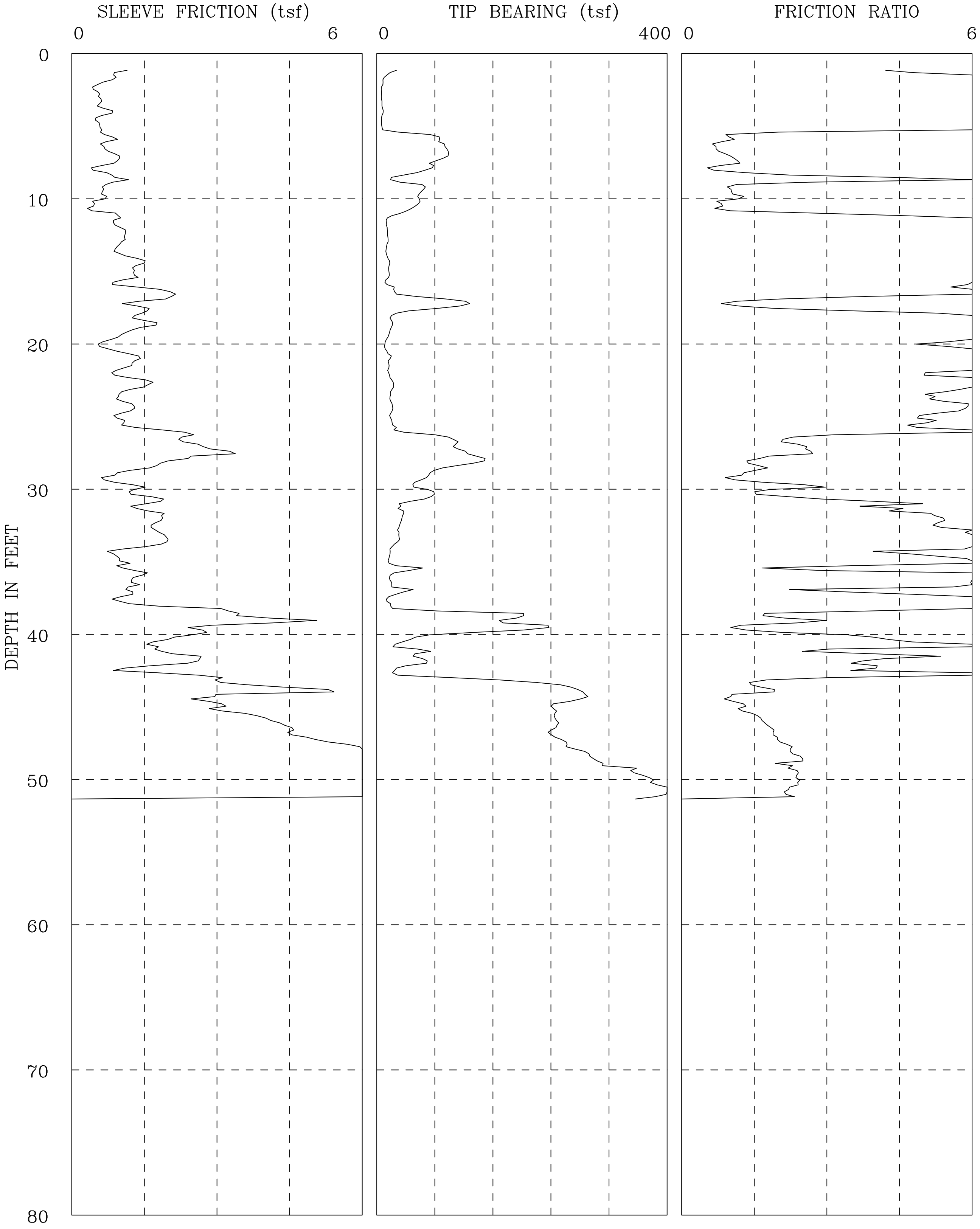
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-13                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr   PHI    SPT       Su
 (meters)   (feet)     (tsf)       (tsf)        (%)        (tsf)                                    (%)     deg.    N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        60.53        2.19        3.62        0.03    clayey silt to silty clay     UNDFND   UNDFD    29          4.0
     0.60     2        78.53        3.42        4.36        0.09    clayey silt to silty clay     UNDFND   UNDFD    38          5.2
     0.95     3        27.22        0.74        2.73        0.15    clayey silt to silty clay     UNDFND   UNDFD    13          1.8
     1.25     4        32.52        2.57        7.91        0.22              clay                UNDFND   UNDFD    31          2.1
     1.55     5        24.29        2.05        8.44        0.28            undefined             UNDFND   UNDFD   UDF    UNDEFINED
     1.85     6        17.58        1.27        7.21        0.33              clay                UNDFND   UNDFD    17          1.1
     2.15     7        14.63        1.00        6.85        0.39              clay                UNDFND   UNDFD    14           .9
     2.45     8         6.75        0.60        8.83        0.45            undefined             UNDFND   UNDFD   UDF    UNDEFINED
     2.75     9         7.70        0.51        6.56        0.50              clay                UNDFND   UNDFD     7           .4
     3.05    10        11.30        0.72        6.39        0.52              clay                UNDFND   UNDFD    11           .7
     3.35    11        17.46        1.17        6.73        0.55              clay                UNDFND   UNDFD    17          1.1
     3.65    12        12.76        0.80        6.26        0.58              clay                UNDFND   UNDFD    12           .8
     3.95    13         9.16        0.32        3.45        0.61              clay                UNDFND   UNDFD     9           .5
     4.25    14        15.71        0.88        5.58        0.64              clay                UNDFND   UNDFD    15           .9
     4.55    15        14.20        0.91        6.44        0.67              clay                UNDFND   UNDFD    14           .8
     4.85    16         9.24        0.46        4.98        0.69              clay                UNDFND   UNDFD     9           .5
     5.15    17         5.72        0.14        2.43        0.72       silty clay to clay         UNDFND   UNDFD     4           .3
     5.45    18         7.27        0.22        3.01        0.75              clay                UNDFND   UNDFD     7           .4
     5.75    19         7.47        0.29        3.94        0.78              clay                UNDFND   UNDFD     7           .4
     6.05    20         9.86        0.30        3.00        0.81       silty clay to clay         UNDFND   UNDFD     6           .5
     6.40    21         8.05        0.25        3.06        0.84              clay                UNDFND   UNDFD     8           .4
     6.70    22        13.97        0.50        3.60        0.87       silty clay to clay         UNDFND   UNDFD     9           .8
     7.00    23        12.20        0.73        5.95        0.90              clay                UNDFND   UNDFD    12           .7
     7.35    24        12.53        0.69        5.51        0.93              clay                UNDFND   UNDFD    12           .7
     7.65    25        12.39        0.62        5.03        0.96              clay                UNDFND   UNDFD    12           .7
     7.95    26        12.75        0.64        5.00        0.99              clay                UNDFND   UNDFD    12           .7
     8.25    27        47.91        0.75        1.57        1.01    silty sand to sandy silt      40-50    36-38    15    UNDEFINED
     8.55    28        53.24        0.82        1.54        1.04    silty sand to sandy silt      40-50    36-38    17    UNDEFINED
     8.85    29        89.15        0.96        1.07        1.07       sand to silty sand         60-70    40-42    21    UNDEFINED
     9.15    30       109.78    -5461.95    -4975.38        1.10            undefined             UNDFND   UNDFD   UDF    UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-30B



CPT 14	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-31A

```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-14                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr   PHI     SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)    deg.      N       tsf
----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        13.60        0.57        4.21        0.03              clay                UNDFND   UNDFD    13          .9
     0.60     2        14.62        0.88        6.04        0.09              clay                UNDFND   UNDFD    14          .9
     0.95     3         6.86        0.53        7.68        0.15              clay                UNDFND   UNDFD     7          .4
     1.25     4         7.90        0.68        8.57        0.22            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     1.55     5         6.90        0.56        8.08        0.28            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     1.85     6        61.66        0.73        1.19        0.33    silty sand to sandy silt      60-70    42-44    20   UNDEFINED
     2.15     7        96.56        0.76        0.79        0.39       sand to silty sand         70-80    44-46    23   UNDEFINED
     2.45     8        77.83        0.71        0.92        0.45       sand to silty sand         70-80    42-44    19   UNDEFINED
     2.75     9        37.70        0.86        2.28        0.50    sandy silt to clayey silt     UNDFND   UNDFD    14         2.4
     3.05    10        61.08        0.66        1.08        0.52    silty sand to sandy silt      60-70    40-42    20   UNDEFINED
     3.35    11        48.91        0.50        1.02        0.55    silty sand to sandy silt      50-60    40-42    16   UNDEFINED
     3.65    12        15.02        0.93        6.21        0.58              clay                UNDFND   UNDFD    14          .9
     3.95    13        15.21        1.09        7.18        0.61              clay                UNDFND   UNDFD    15          .9
     4.25    14        13.45        0.97        7.20        0.64              clay                UNDFND   UNDFD    13          .8
     4.55    15        16.87        1.38        8.15        0.67            undefined             UNDFND   UNDFD   UDF   UNDEFINED
     4.85    16        14.88        1.12        7.52        0.69              clay                UNDFND   UNDFD    14          .9
     5.15    17        41.47        1.89        4.56        0.72       silty clay to clay         UNDFND   UNDFD    26         2.6
     5.45    18        86.66        1.40        1.62        0.75    silty sand to sandy silt      60-70    40-42    28   UNDEFINED
     5.75    19        20.43        1.49        7.31        0.78              clay                UNDFND   UNDFD    20         1.2
     6.05    20        15.63        0.97        6.22        0.81              clay                UNDFND   UNDFD    15          .9
     6.40    21        14.58        0.97        6.66        0.84              clay                UNDFND   UNDFD    14          .8
     6.70    22        16.26        1.10        6.78        0.87              clay                UNDFND   UNDFD    16          .9
     7.00    23        20.98        1.39        6.61        0.90              clay                UNDFND   UNDFD    20         1.3
     7.35    24        19.47        1.06        5.43        0.93              clay                UNDFND   UNDFD    19         1.2
     7.65    25        20.24        1.10        5.46        0.96              clay                UNDFND   UNDFD    19         1.2
     7.95    26        25.35        1.45        5.73        0.99              clay                UNDFND   UNDFD    24         1.5
     8.25    27       101.72        2.44        2.40        1.01    silty sand to sandy silt      60-70    40-42    32   UNDEFINED
     8.55    28       132.22        2.73        2.06        1.04    silty sand to sandy silt      70-80    42-44    42   UNDEFINED
     8.85    29        93.06        1.37        1.47        1.07    silty sand to sandy silt      60-70    40-42    30   UNDEFINED
     9.15    30        58.80        1.04        1.77        1.10    silty sand to sandy silt      50-60    36-38    19   UNDEFINED
     9.45    31        62.73        1.55        2.48        1.13    sandy silt to clayey silt     UNDFND   UNDFD    24         4.0
     9.75    32        34.50        1.63        4.73        1.16              clay                UNDFND   UNDFD    33         2.1
    10.05    33        31.37        1.73        5.52        1.18              clay                UNDFND   UNDFD    30         1.9
    10.35    34        27.88        1.86        6.69        1.21              clay                UNDFND   UNDFD    27         1.7
    10.65    35        17.56        0.93        5.28        1.24              clay                UNDFND   UNDFD    17         1.0
    10.95    36        32.44        1.25        3.86        1.27    clayey silt to silty clay     UNDFND   UNDFD    16         2.0
    11.25    37        24.69        1.24        5.01        1.30              clay                UNDFND   UNDFD    24         1.5
    11.55    38        21.23        1.09        5.16        1.33              clay                UNDFND   UNDFD    20         1.2
----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15


 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-31B

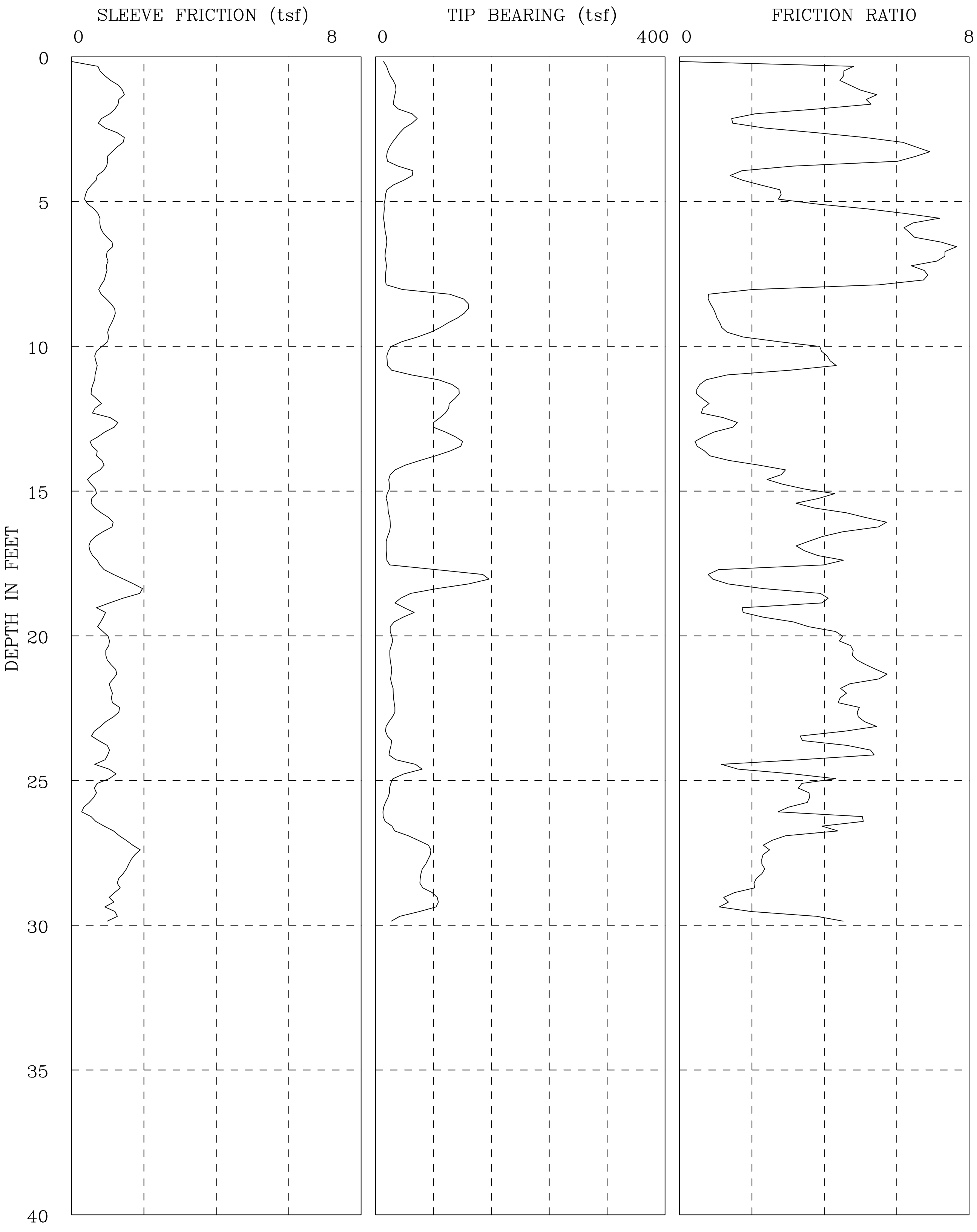
```
                                                    GROUP DELTA CONSULTANTS

Cone Used  : CPT-14                                                         Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                               Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)      SIGV'        SOIL BEHAVIOUR TYPE        Eq - Dr    PHI    SPT       Su
 (meters)   (feet)     (tsf)       (tsf)        (%)         (tsf)                                     (%)      deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85    39       120.28        3.18        2.64        1.35    silty sand to sandy silt      60-70    40-42   38   UNDEFINED
    12.15    40       192.09        3.33        1.74        1.38       sand to silty sand         80-90    42-44   46   UNDEFINED
    12.45    41        42.85        1.94        4.52        1.41       silty clay to clay         UNDFND   UNDFD   27         2.6
    12.80    42        62.16        2.28        3.67        1.44    clayey silt to silty clay     UNDFND   UNDFD   30         3.9
    13.10    43        40.88        1.85        4.53        1.47       silty clay to clay         UNDFND   UNDFD   26         2.5
    13.40    44       244.92        4.12        1.68        1.50       sand to silty sand         80-90    42-44  >50   UNDEFINED
    13.75    45       264.48        2.91        1.10        1.53              sand                80-90    42-44  >50   UNDEFINED
    14.05    46       246.94        3.82        1.55        1.56       sand to silty sand         80-90    42-44  >50   UNDEFINED
    14.35    47       243.00        4.57        1.88        1.59       sand to silty sand         80-90    42-44  >50   UNDEFINED
    14.65    48       266.25        5.76        2.16        1.62       sand to silty sand         80-90    42-44  >50   UNDEFINED
    14.95    49       301.84        7.02        2.33        1.65    silty sand to sandy silt        >90    42-44  >50   UNDEFINED
    15.25    50       364.27        8.61        2.36        1.68       sand to silty sand           >90    44-46  >50   UNDEFINED
    15.55    51       396.87        8.93        2.25        1.70       sand to silty sand           >90    44-46  >50   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-31C



CPT−15	I−558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-32A

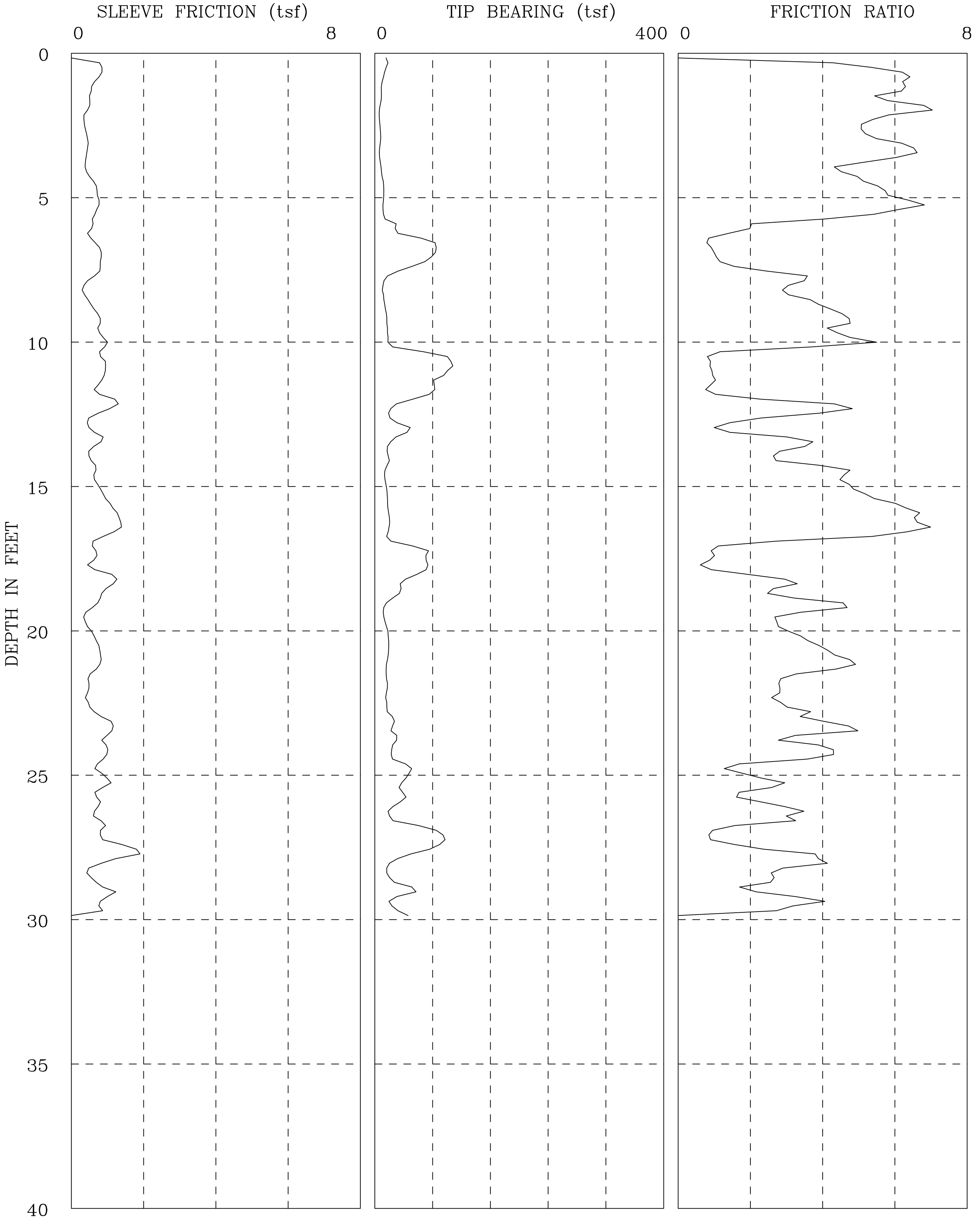
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : CPT-15                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        19.33        0.80        4.16        0.03       silty clay to clay         UNDFND   UNDFD    12          1.2
     0.60     2        31.15        1.29        4.14        0.09       silty clay to clay         UNDFND   UNDFD    20          2.0
     0.95     3        36.09        1.13        3.14        0.15    clayey silt to silty clay     UNDFND   UNDFD    17          2.3
     1.25     4        30.25        0.95        3.13        0.22    clayey silt to silty clay     UNDFND   UNDFD    14          2.0
     1.55     5        19.75        0.48        2.42        0.28    clayey silt to silty clay     UNDFND   UNDFD     9          1.2
     1.85     6        12.23        0.77        6.25        0.33              clay                UNDFND   UNDFD    12           .7
     2.15     7        14.38        1.03        7.18        0.39              clay                UNDFND   UNDFD    14           .9
     2.45     8        18.15        0.89        4.92        0.45              clay                UNDFND   UNDFD    17          1.1
     2.75     9       119.37        1.07        0.90        0.50       sand to silty sand         80-90    44-46    29    UNDEFINED
     3.05    10        63.70        1.00        1.57        0.52    silty sand to sandy silt      60-70    40-42    20    UNDEFINED
     3.35    11        22.95        0.67        2.93        0.55    clayey silt to silty clay     UNDFND   UNDFD    11          1.4
     3.65    12       105.82        0.64        0.60        0.58       sand to silty sand         70-80    42-44    25    UNDEFINED
     3.95    13        90.52        0.95        1.05        0.61       sand to silty sand         70-80    42-44    22    UNDEFINED
     4.25    14        99.38        0.68        0.68        0.64       sand to silty sand         70-80    42-44    24    UNDEFINED
     4.55    15        24.10        0.65        2.70        0.67    clayey silt to silty clay     UNDFND   UNDFD    12          1.5
     4.85    16        17.07        0.71        4.17        0.69              clay                UNDFND   UNDFD    16          1.0
     5.15    17        17.70        0.80        4.53        0.72              clay                UNDFND   UNDFD    17          1.1
     5.45    18        49.48        0.77        1.56        0.75    silty sand to sandy silt      50-60    38-40    16    UNDEFINED
     5.75    19        79.95        1.58        1.98        0.78    silty sand to sandy silt      60-70    40-42    26    UNDEFINED
     6.05    20        32.95        0.82        2.48        0.81    sandy silt to clayey silt     UNDFND   UNDFD    13          2.1
     6.40    21        21.30        1.01        4.74        0.84              clay                UNDFND   UNDFD    20          1.3
     6.70    22        22.68        1.14        5.05        0.87              clay                UNDFND   UNDFD    22          1.4
     7.00    23        24.37        1.16        4.77        0.90              clay                UNDFND   UNDFD    23          1.5
     7.35    24        18.14        0.82        4.54        0.93              clay                UNDFND   UNDFD    17          1.1
     7.65    25        38.68        0.93        2.41        0.96    sandy silt to clayey silt     UNDFND   UNDFD    15          2.4
     7.95    26        15.17        0.51        3.34        0.99       silty clay to clay         UNDFND   UNDFD    10           .9
     8.25    27        29.59        1.02        3.44        1.01    clayey silt to silty clay     UNDFND   UNDFD    14          1.8
     8.55    28        72.05        1.68        2.33        1.04    sandy silt to clayey silt     UNDFND   UNDFD    28          4.6
     8.85    29        69.10        1.26        1.83        1.07    silty sand to sandy silt      50-60    38-40    22    UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-32B



CPT−16	I−558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-33A

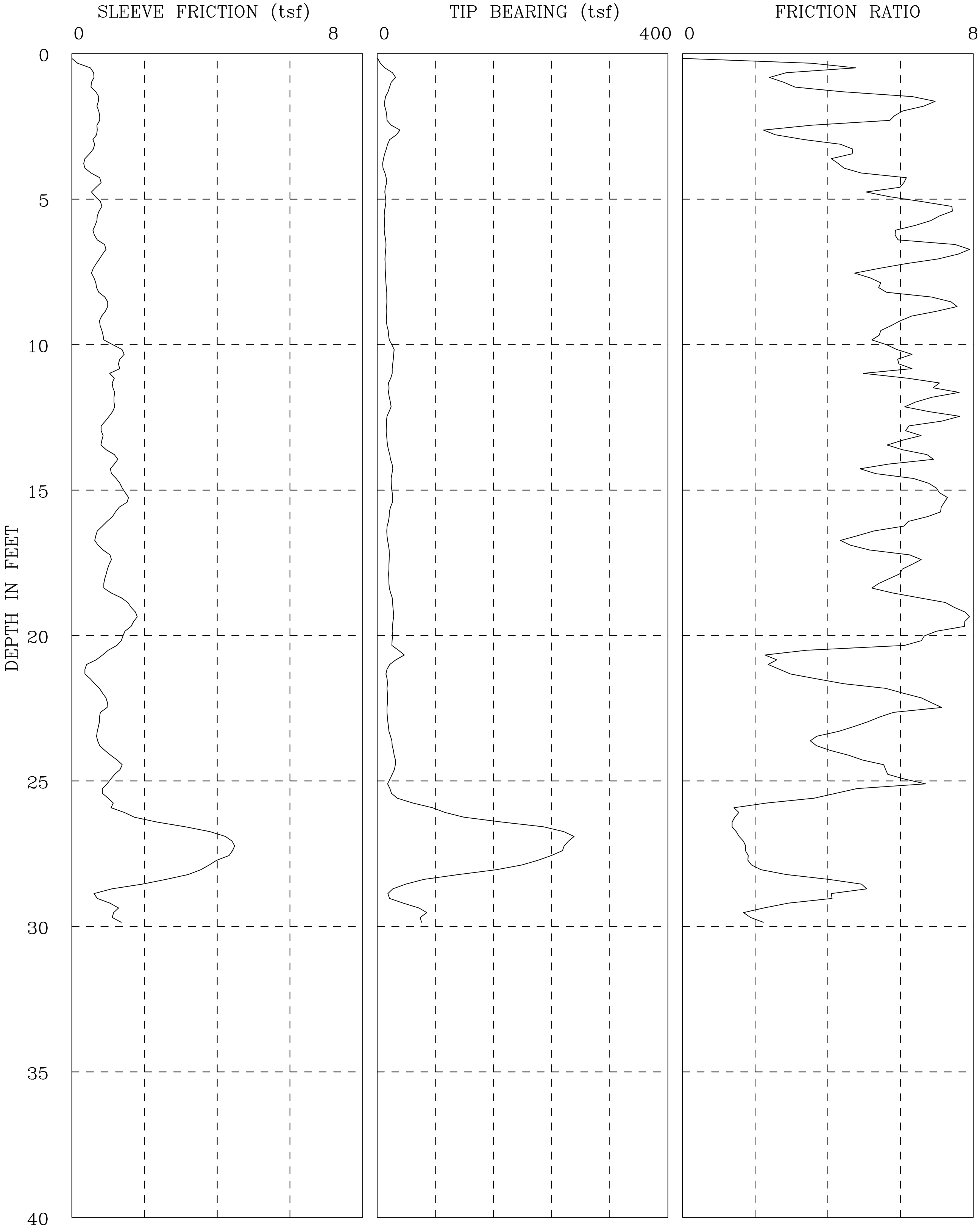
```
                                    GROUP DELTA CONSULTANTS

Cone Used  : CPT-16                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
------------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE         Eq - Dr    PHI     SPT       Su
 (meters)   (feet)     (tsf)       (tsf)        (%)        (tsf)                                       (%)      deg.     N        tsf
------------------------------------------------------------------------------------------------------------------------------------
     0.30     1        14.30        0.65        4.53        0.03              clay                UNDFND   UNDFD    14           .9
     0.60     2         8.28        0.51        6.20        0.09              clay                UNDFND   UNDFD     8           .5
     0.95     3         7.31        0.40        5.45        0.15              clay                UNDFND   UNDFD     7           .4
     1.25     4         7.65        0.41        5.40        0.22              clay                UNDFND   UNDFD     7           .4
     1.55     5        11.90        0.67        5.60        0.28              clay                UNDFND   UNDFD    11           .7
     1.85     6        17.82        0.64        3.61        0.33      silty clay to clay          UNDFND   UNDFD    11          1.1
     2.15     7        71.15        0.68        0.96        0.39      sand to silty sand          70-80    42-44    17    UNDEFINED
     2.45     8        32.50        0.64        1.96        0.45   sandy silt to clayey silt      UNDFND   UNDFD    12          2.1
     2.75     9        13.33        0.51        3.79        0.50      silty clay to clay          UNDFND   UNDFD     9           .8
     3.05    10        17.63        0.83        4.72        0.52              clay                UNDFND   UNDFD    17          1.1
     3.35    11        84.45        0.89        1.05        0.55      sand to silty sand          70-80    42-44    20    UNDEFINED
     3.65    12        78.40        0.85        1.08        0.58      sand to silty sand          60-70    42-44    19    UNDEFINED
     3.95    13        28.67        0.75        2.62        0.61   sandy silt to clayey silt      UNDFND   UNDFD    11          1.8
     4.25    14        24.90        0.66        2.63        0.64   clayey silt to silty clay      UNDFND   UNDFD    12          1.6
     4.55    15        15.82        0.65        4.10        0.67              clay                UNDFND   UNDFD    15           .9
     4.85    16        17.70        1.02        5.77        0.69              clay                UNDFND   UNDFD    17          1.1
     5.15    17        19.65        1.12        5.72        0.72              clay                UNDFND   UNDFD    19          1.2
     5.45    18        68.88        0.62        0.89        0.75      sand to silty sand          60-70    40-42    16    UNDEFINED
     5.75    19        38.58        1.02        2.65        0.78   sandy silt to clayey silt      UNDFND   UNDFD    15          2.4
     6.05    20        13.90        0.48        3.47        0.81      silty clay to clay          UNDFND   UNDFD     9           .8
     6.40    21        18.70        0.72        3.87        0.84      silty clay to clay          UNDFND   UNDFD    12          1.1
     6.70    22        16.50        0.57        3.47        0.87      silty clay to clay          UNDFND   UNDFD    11          1.0
     7.00    23        17.68        0.54        3.08        0.90   clayey silt to silty clay      UNDFND   UNDFD     8          1.0
     7.35    24        26.21        1.03        3.91        0.93      silty clay to clay          UNDFND   UNDFD    17          1.6
     7.65    25        38.58        0.84        2.19        0.96   sandy silt to clayey silt      UNDFND   UNDFD    15          2.4
     7.95    26        35.58        0.81        2.28        0.99   sandy silt to clayey silt      UNDFND   UNDFD    14          2.2
     8.25    27        50.67        0.77        1.52        1.01   silty sand to sandy silt       40-50    36-38    16    UNDEFINED
     8.55    28        60.83        1.34        2.20        1.04   sandy silt to clayey silt      UNDFND   UNDFD    23          3.9
     8.85    29        31.53        0.71        2.25        1.07   sandy silt to clayey silt      UNDFND   UNDFD    12          1.9
------------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-33B



CPT–17

I–558 Centinela Solar Energy Facility

GROUP DELTA
CONSULTANTS, INC.

Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-34A

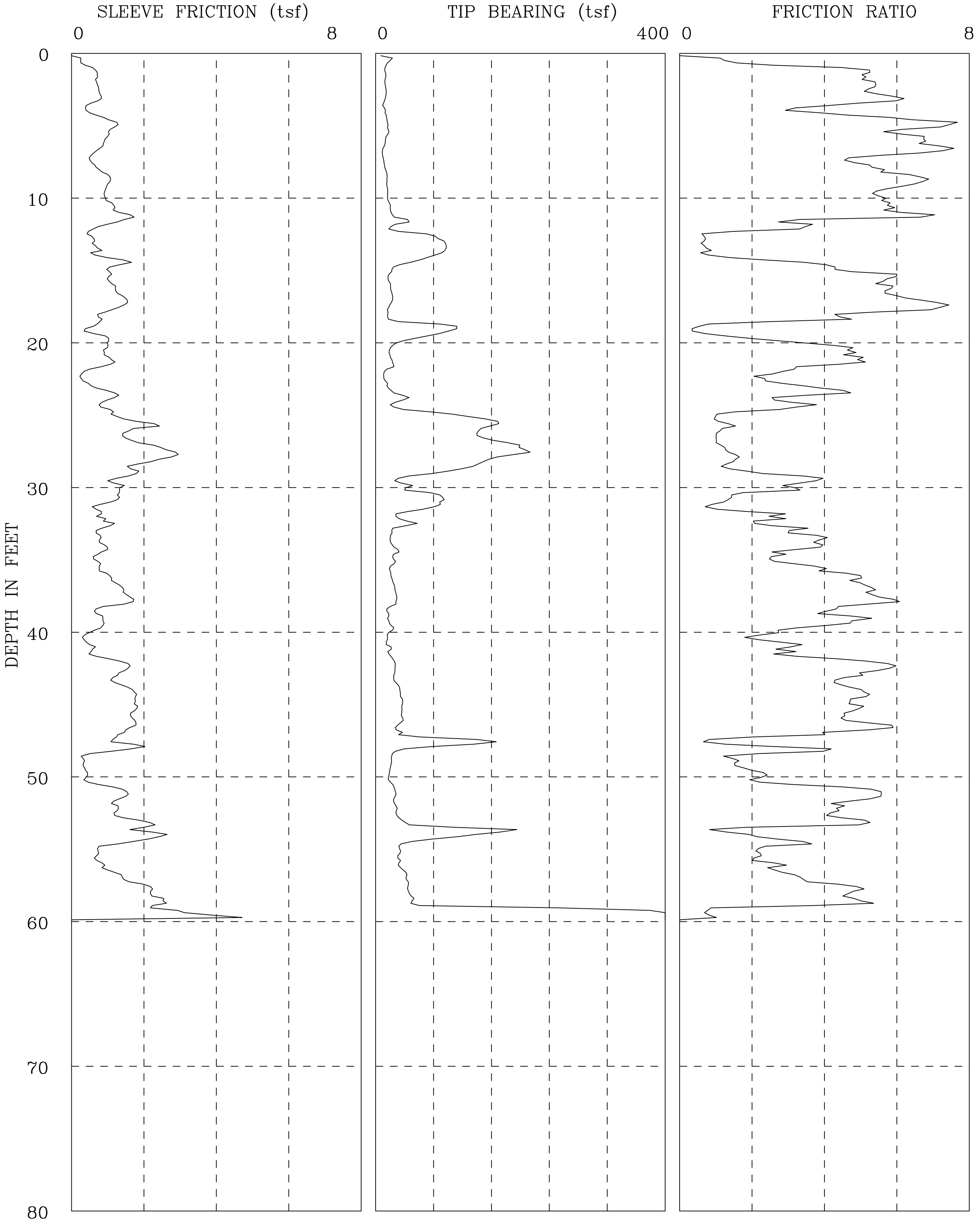
```
                                              GROUP DELTA CONSULTANTS

Cone Used  : CPT-17                                                       Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                             Tot. Unit Wt. (avg) : 120 pcf
-------------------------------------------------------------------------------------------------------------------------------------
      DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'          SOIL BEHAVIOUR TYPE          Eq - Dr    PHI    SPT       Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                         (%)      deg.     N       tsf
-------------------------------------------------------------------------------------------------------------------------------------
     0.30     1        13.67        0.40        2.95        0.03        silty clay to clay          UNDFND   UNDFD    9         .9
     0.60     2        12.82        0.68        5.32        0.09               clay                 UNDFND   UNDFD   12         .8
     0.95     3        19.41        0.69        3.55        0.15        silty clay to clay          UNDFND   UNDFD   12        1.2
     1.25     4         9.75        0.44        4.55        0.22               clay                 UNDFND   UNDFD    9         .6
     1.55     5        11.85        0.70        5.95        0.28               clay                 UNDFND   UNDFD   11         .7
     1.85     6        10.20        0.70        6.85        0.33               clay                 UNDFND   UNDFD   10         .6
     2.15     7        11.38        0.79        6.98        0.39               clay                 UNDFND   UNDFD   11         .7
     2.45     8        11.62        0.63        5.38        0.45               clay                 UNDFND   UNDFD   11         .7
     2.75     9        13.20        0.90        6.78        0.50               clay                 UNDFND   UNDFD   13         .8
     3.05    10        15.73        0.87        5.55        0.52               clay                 UNDFND   UNDFD   15        1.0
     3.35    11        21.97        1.30        5.90        0.55               clay                 UNDFND   UNDFD   21        1.4
     3.65    12        16.92        1.15        6.81        0.58               clay                 UNDFND   UNDFD   16        1.0
     3.95    13        14.73        0.98        6.64        0.61               clay                 UNDFND   UNDFD   14         .9
     4.25    14        15.42        0.98        6.36        0.64               clay                 UNDFND   UNDFD   15         .9
     4.55    15        20.23        1.21        5.97        0.67               clay                 UNDFND   UNDFD   19        1.2
     4.85    16        19.20        1.36        7.10        0.69               clay                 UNDFND   UNDFD   18        1.2
     5.15    17        14.42        0.75        5.23        0.72               clay                 UNDFND   UNDFD   14         .8
     5.45    18        16.42        0.99        6.05        0.75               clay                 UNDFND   UNDFD   16        1.0
     5.75    19        18.35        1.11        6.04        0.78               clay                 UNDFND   UNDFD   18        1.1
     6.05    20        21.82        1.66        7.62        0.81               clay                 UNDFND   UNDFD   21        1.3
     6.40    21        24.60        0.99        4.03        0.84        silty clay to clay          UNDFND   UNDFD   16        1.5
     6.70    22        13.53        0.58        4.27        0.87               clay                 UNDFND   UNDFD   13         .8
     7.00    23        14.12        0.87        6.14        0.90               clay                 UNDFND   UNDFD   14         .8
     7.35    24        19.59        0.80        4.06        0.93        silty clay to clay          UNDFND   UNDFD   13        1.2
     7.65    25        21.17        1.20        5.66        0.96               clay                 UNDFND   UNDFD   20        1.3
     7.95    26        47.32        1.06        2.24        0.99     sandy silt to clayey silt      UNDFND   UNDFD   18        3.0
     8.25    27       218.47        3.27        1.50        1.01        sand to silty sand          80-90    44-46  >50  UNDEFINED
     8.55    28       222.78        4.09        1.84        1.04        sand to silty sand          80-90    44-46  >50  UNDEFINED
     8.85    29        44.90        1.69        3.76        1.07     clayey silt to silty clay      UNDFND   UNDFD   22        2.8
-------------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15


 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-34B



CPT−18	I−558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-35A

```
                                                GROUP DELTA CONSULTANTS

Cone Used  : CPT-18                                                        Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
      DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE        Eq - Dr    PHI     SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)      deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        15.85        0.29        1.82        0.03    clayey silt to silty clay     UNDFND   UNDFD     8         1.0
     0.60     2        13.35        0.69        5.18        0.09              clay                UNDFND   UNDFD    13          .8
     0.95     3        13.99        0.77        5.51        0.15              clay                UNDFND   UNDFD    13          .9
     1.25     4        11.97        0.49        4.12        0.22              clay                UNDFND   UNDFD    11          .7
     1.55     5        15.98        1.05        6.59        0.28              clay                UNDFND   UNDFD    15         1.0
     1.85     6        15.75        0.99        6.32        0.33              clay                UNDFND   UNDFD    15         1.0
     2.15     7        10.70        0.73        6.81        0.39              clay                UNDFND   UNDFD    10          .6
     2.45     8        11.98        0.61        5.08        0.45              clay                UNDFND   UNDFD    11          .7
     2.75     9        15.67        1.01        6.44        0.50              clay                UNDFND   UNDFD    15         1.0
     3.05    10        16.55        0.93        5.63        0.52              clay                UNDFND   UNDFD    16         1.0
     3.35    11        19.80        1.15        5.81        0.55              clay                UNDFND   UNDFD    19         1.2
     3.65    12        31.27        1.30        4.16        0.58       silty clay to clay         UNDFND   UNDFD    20         2.0
     3.95    13        63.73        0.55        0.87        0.61       sand to silty sand         60-70    40-42    15   UNDEFINED
     4.25    14        93.60        0.66        0.71        0.64       sand to silty sand         70-80    42-44    22   UNDEFINED
     4.55    15        43.53        1.24        2.84        0.67    sandy silt to clayey silt     UNDFND   UNDFD    17         2.8
     4.85    16        19.02        1.05        5.55        0.69              clay                UNDFND   UNDFD    18         1.2
     5.15    17        22.08        1.30        5.89        0.72              clay                UNDFND   UNDFD    21         1.4
     5.45    18        19.28        1.31        6.81        0.75              clay                UNDFND   UNDFD    18         1.2
     5.75    19        47.27        0.73        1.55        0.78    silty sand to sandy silt      40-50    38-40    15   UNDEFINED
     6.05    20        77.98        0.72        0.93        0.81       sand to silty sand         60-70    40-42    19   UNDEFINED
     6.40    21        21.57        0.96        4.45        0.84              clay                UNDFND   UNDFD    21         1.3
     6.70    22        20.62        0.84        4.07        0.87       silty clay to clay         UNDFND   UNDFD    13         1.2
     7.00    23        13.25        0.35        2.65        0.90    clayey silt to silty clay     UNDFND   UNDFD     6          .7
     7.35    24        30.36        1.02        3.37        0.93    clayey silt to silty clay     UNDFND   UNDFD    15         1.9
     7.65    25        65.77        1.03        1.56        0.96    silty sand to sandy silt      50-60    38-40    21   UNDEFINED
     7.95    26       156.02        1.88        1.20        0.99       sand to silty sand         70-80    42-44    37   UNDEFINED
     8.25    27       162.07        1.68        1.04        1.01       sand to silty sand         80-90    42-44    39   UNDEFINED
     8.55    28       188.90        2.68        1.42        1.04       sand to silty sand         80-90    42-44    45   UNDEFINED
     8.85    29       120.16        1.81        1.51        1.07       sand to silty sand         70-80    40-42    29   UNDEFINED
     9.15    30        38.60        1.29        3.35        1.10    clayey silt to silty clay     UNDFND   UNDFD    18         2.4
     9.45    31        79.94        1.27        1.58        1.13    silty sand to sandy silt      50-60    38-40    26   UNDEFINED
     9.75    32        56.03        0.73        1.30        1.16    silty sand to sandy silt      40-50    36-38    18   UNDEFINED
    10.05    33        36.92        0.93        2.53        1.18    sandy silt to clayey silt     UNDFND   UNDFD    14         2.3
    10.35    34        21.25        0.79        3.72        1.21       silty clay to clay         UNDFND   UNDFD    14         1.2
    10.65    35        27.02        0.79        2.94        1.24    clayey silt to silty clay     UNDFND   UNDFD    13         1.6
    10.95    36        22.37        0.80        3.59        1.27       silty clay to clay         UNDFND   UNDFD    14         1.3
    11.25    37        23.87        1.20        5.03        1.30              clay                UNDFND   UNDFD    23         1.4
    11.55    38        28.28        1.57        5.56        1.33              clay                UNDFND   UNDFD    27         1.7
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
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Figure A-35B

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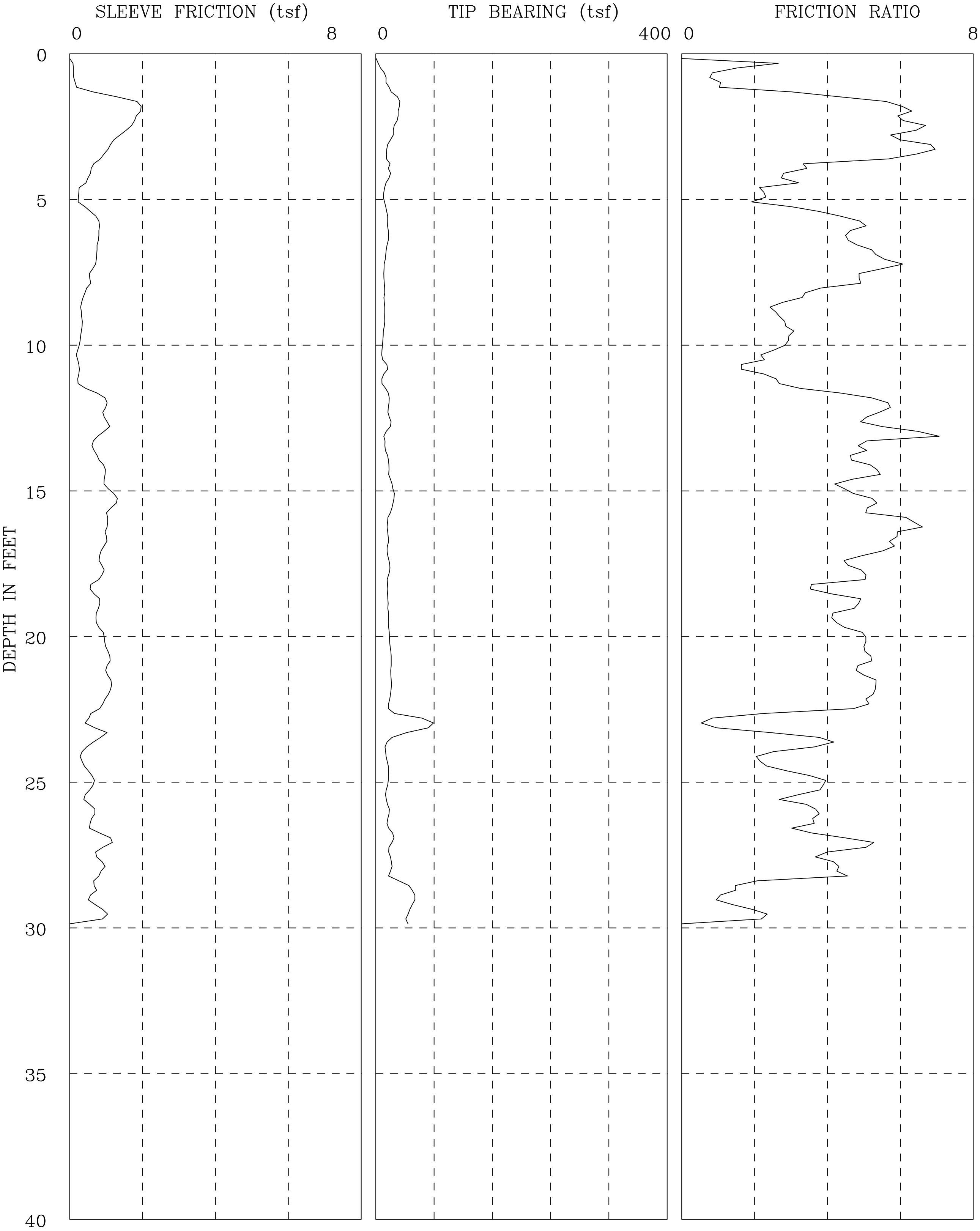
                                                      GROUP DELTA CONSULTANTS

Cone Used  : CPT-18                                                         Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                               Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
      DEPTH           Qc (avg)     Fs (avg)     Rf (avg)      SIGV'         SOIL BEHAVIOUR TYPE          Eq - Dr    PHI     SPT       Su
 (meters)   (feet)     (tsf)        (tsf)         (%)         (tsf)                                         (%)     deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85     39        19.28         0.86         4.49         1.35               clay                  UNDFND   UNDFD    18          1.1
    12.15     40        20.60         0.82         4.00         1.38         silty clay to clay          UNDFND   UNDFD    13          1.2
    12.45     41        16.05         0.40         2.50         1.41      clayey silt to silty clay      UNDFND   UNDFD     8           .9
    12.80     42        21.33         0.76         3.54         1.44         silty clay to clay          UNDFND   UNDFD    14          1.2
    13.10     43        26.60         1.46         5.51         1.47               clay                  UNDFND   UNDFD    25          1.6
    13.40     44        29.25         1.34         4.56         1.50         silty clay to clay          UNDFND   UNDFD    19          1.7
    13.75     45        35.77         1.77         4.94         1.53               clay                  UNDFND   UNDFD    34          2.2
    14.05     46        36.67         1.70         4.65         1.56         silty clay to clay          UNDFND   UNDFD    23          2.2
    14.35     47        31.59         1.57         4.97         1.59               clay                  UNDFND   UNDFD    30          1.9
    14.65     48       103.66         1.47         1.42         1.62         sand to silty sand          60-70    38-40    25    UNDEFINED
    14.95     49        23.13         0.48         2.07         1.65      sandy silt to clayey silt      UNDFND   UNDFD     9          1.3
    15.25     50        19.42         0.39         2.03         1.68      clayey silt to silty clay      UNDFND   UNDFD     9          1.0
    15.55     51        23.58         0.94         3.97         1.70         silty clay to clay          UNDFND   UNDFD    15          1.3
    15.85     52        26.60         1.32         4.97         1.73               clay                  UNDFND   UNDFD    25          1.5
    16.15     53        30.68         1.37         4.45         1.76         silty clay to clay          UNDFND   UNDFD    20          1.8
    16.45     54       116.91         2.16         1.85         1.79      silty sand to sandy silt       60-70    38-40    37    UNDEFINED
    16.75     55        56.92         1.50         2.63         1.82      sandy silt to clayey silt      UNDFND   UNDFD    22          3.5
    17.05     56        32.80         0.72         2.21         1.85      sandy silt to clayey silt      UNDFND   UNDFD    13          1.9
    17.35     57        38.53         1.12         2.91         1.87      sandy silt to clayey silt      UNDFND   UNDFD    15          2.3
    17.65     58        44.52         1.94         4.35         1.90         silty clay to clay          UNDFND   UNDFD    28          2.7
    17.95     59        51.49         2.39         4.64         1.93         silty clay to clay          UNDFND   UNDFD    33          3.1
    18.25     60       413.22         2.80         0.68         1.96        gravelly sand to sand          >90     44-46   >50    UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-35C



CPT−19	I−558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-36A

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                                          GROUP DELTA CONSULTANTS

Cone Used  : CPT-19                                                          Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH          Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE        Eq - Dr    PHI     SPT       Su
 (meters)   (feet)     (tsf)       (tsf)       (%)         (tsf)                                     (%)      deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1          8.50        0.09        1.08        0.03    clayey silt to silty clay     UNDFND   UNDFD     4          .5
     0.60     2         27.63        1.31        4.75        0.09              clay                UNDFND   UNDFD    26         1.8
     0.95     3         24.34        1.51        6.20        0.15              clay                UNDFND   UNDFD    23         1.6
     1.25     4         16.98        0.78        4.56        0.22              clay                UNDFND   UNDFD    16         1.1
     1.55     5         13.00        0.32        2.47        0.28    clayey silt to silty clay     UNDFND   UNDFD     6          .8
     1.85     6         15.90        0.69        4.33        0.33              clay                UNDFND   UNDFD    15         1.0
     2.15     7         15.35        0.76        4.95        0.39              clay                UNDFND   UNDFD    15          .9
     2.45     8         11.62        0.58        4.99        0.45              clay                UNDFND   UNDFD    11          .7
     2.75     9         12.10        0.35        2.85        0.50       silty clay to clay         UNDFND   UNDFD     8          .7
     3.05    10         10.67        0.31        2.91        0.52       silty clay to clay         UNDFND   UNDFD     7          .6
     3.35    11         11.60        0.23        2.00        0.55    clayey silt to silty clay     UNDFND   UNDFD     6          .7
     3.65    12         14.10        0.61        4.30        0.58              clay                UNDFND   UNDFD    14          .8
     3.95    13         18.05        0.99        5.47        0.61              clay                UNDFND   UNDFD    17         1.1
     4.25    14         13.85        0.71        5.13        0.64              clay                UNDFND   UNDFD    13          .8
     4.55    15         20.08        0.97        4.84        0.67              clay                UNDFND   UNDFD    19         1.2
     4.85    16         22.30        1.16        5.22        0.69              clay                UNDFND   UNDFD    21         1.4
     5.15    17         16.57        1.00        6.05        0.72              clay                UNDFND   UNDFD    16         1.0
     5.45    18         17.77        0.87        4.89        0.75              clay                UNDFND   UNDFD    17         1.1
     5.75    19         16.37        0.71        4.34        0.78              clay                UNDFND   UNDFD    16         1.0
     6.05    20         17.58        0.78        4.45        0.81              clay                UNDFND   UNDFD    17         1.0
     6.40    21         20.33        1.03        5.05        0.84              clay                UNDFND   UNDFD    19         1.2
     6.70    22         20.93        1.08        5.17        0.87              clay                UNDFND   UNDFD    20         1.3
     7.00    23         37.13        0.70        1.90        0.90    sandy silt to clayey silt     UNDFND   UNDFD    14         2.3
     7.35    24         27.64        0.62        2.23        0.93    sandy silt to clayey silt     UNDFND   UNDFD    11         1.7
     7.65    25         16.97        0.53        3.12        0.96    clayey silt to silty clay     UNDFND   UNDFD     8         1.0
     7.95    26         15.95        0.55        3.45        0.99       silty clay to clay         UNDFND   UNDFD    10          .9
     8.25    27         20.03        0.80        4.00        1.01       silty clay to clay         UNDFND   UNDFD    13         1.2
     8.55    28         20.02        0.85        4.23        1.04       silty clay to clay         UNDFND   UNDFD    13         1.2
     8.85    29         42.17        0.66        1.56        1.07    silty sand to sandy silt      40-50    36-38    13   UNDEFINED
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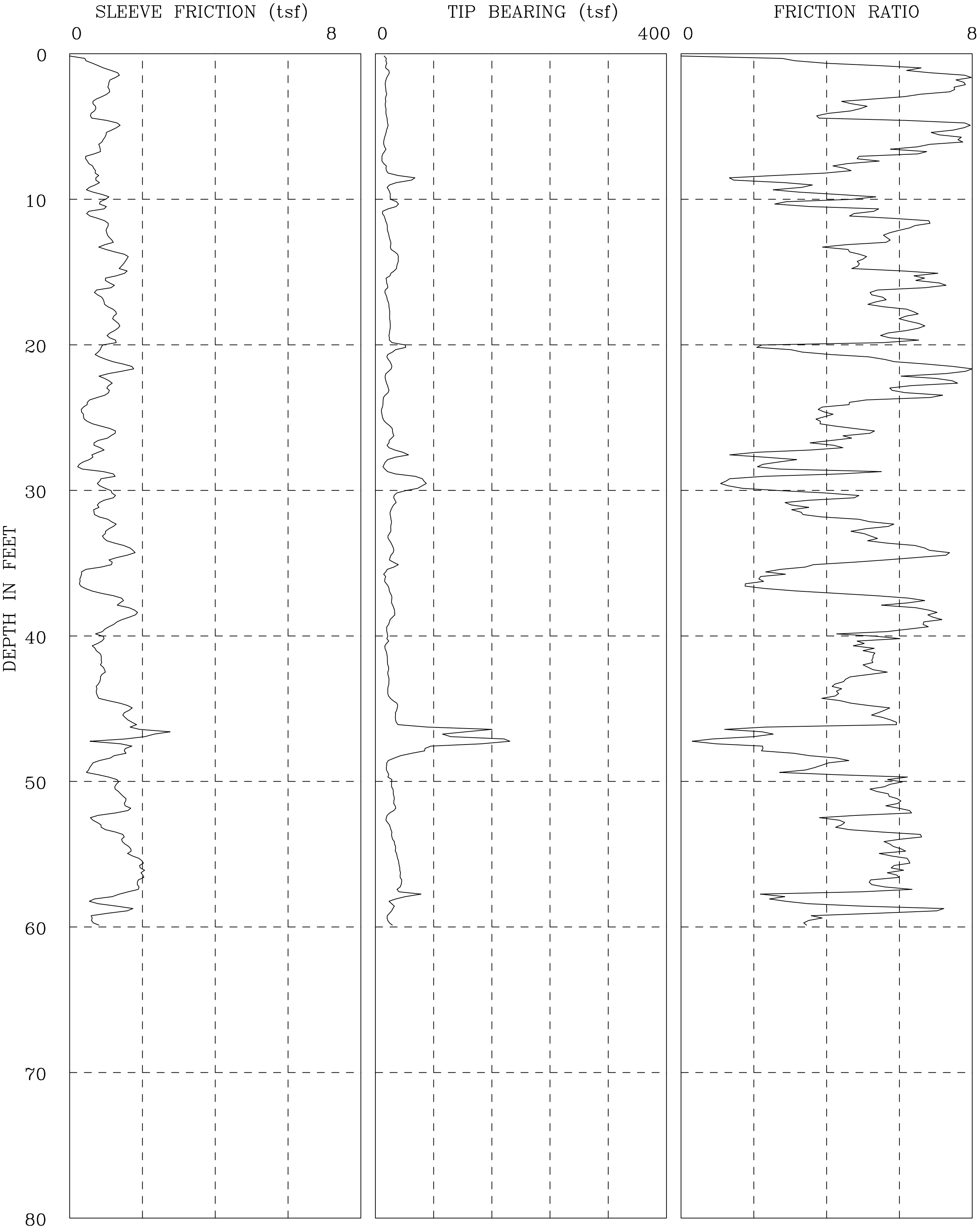
      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-36B



DCPT-20	I-558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-37A

```
                                        GROUP DELTA CONSULTANTS

Cone Used  : DCPT-20                                                         Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'        SOIL BEHAVIOUR TYPE        Eq - Dr    PHI     SPT       Su
 (meters)   (feet)     (tsf)       (tsf)        (%)       (tsf)                                     (%)      deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        14.30        0.54        3.74        0.03       silty clay to clay         UNDFND   UNDFD     9          .9
     0.60     2        16.62        1.21        7.30        0.09              clay                UNDFND   UNDFD    16         1.1
     0.95     3        14.43        0.99        6.88        0.15              clay                UNDFND   UNDFD    14          .9
     1.25     4        14.32        0.66        4.63        0.22              clay                UNDFND   UNDFD    14          .9
     1.55     5        16.47        1.03        6.27        0.28              clay                UNDFND   UNDFD    16         1.0
     1.85     6        13.40        0.99        7.39        0.33              clay                UNDFND   UNDFD    13          .8
     2.15     7        11.83        0.74        6.24        0.39              clay                UNDFND   UNDFD    11          .7
     2.45     8        12.45        0.58        4.63        0.45              clay                UNDFND   UNDFD    12          .7
     2.75     9        33.50        0.74        2.22        0.50    sandy silt to clayey silt     UNDFND   UNDFD    13         2.1
     3.05    10        19.37        0.77        3.96        0.52       silty clay to clay         UNDFND   UNDFD    12         1.2
     3.35    11        21.17        0.77        3.64        0.55       silty clay to clay         UNDFND   UNDFD    14         1.3
     3.65    12        14.65        0.91        6.20        0.58              clay                UNDFND   UNDFD    14          .9
     3.95    13        19.00        1.09        5.71        0.61              clay                UNDFND   UNDFD    18         1.2
     4.25    14        25.45        1.19        4.66        0.64              clay                UNDFND   UNDFD    24         1.6
     4.55    15        29.57        1.49        5.04        0.67              clay                UNDFND   UNDFD    28         1.9
     4.85    16        17.30        1.18        6.83        0.69              clay                UNDFND   UNDFD    17         1.0
     5.15    17        15.15        0.86        5.65        0.72              clay                UNDFND   UNDFD    15          .9
     5.45    18        19.05        1.12        5.87        0.75              clay                UNDFND   UNDFD    18         1.2
     5.75    19        20.17        1.28        6.36        0.78              clay                UNDFND   UNDFD    19         1.2
     6.05    20        19.97        1.17        5.85        0.81              clay                UNDFND   UNDFD    19         1.2
     6.40    21        26.40        0.85        3.20        0.84    clayey silt to silty clay     UNDFND   UNDFD    13         1.6
     6.70    22        19.98        1.44        7.21        0.87              clay                UNDFND   UNDFD    19         1.2
     7.00    23        15.28        1.02        6.66        0.90              clay                UNDFND   UNDFD    15          .9
     7.35    24        13.23        0.77        5.84        0.93              clay                UNDFND   UNDFD    13          .7
     7.65    25         9.37        0.37        3.90        0.96              clay                UNDFND   UNDFD     9          .5
     7.95    26        20.12        0.93        4.64        0.99              clay                UNDFND   UNDFD    19         1.2
     8.25    27        20.08        0.86        4.27        1.01              clay                UNDFND   UNDFD    19         1.2
     8.55    28        28.15        0.65        2.30        1.04    sandy silt to clayey silt     UNDFND   UNDFD    11         1.7
     8.85    29        22.45        0.70        3.13        1.07    clayey silt to silty clay     UNDFND   UNDFD    11         1.3
     9.15    30        60.91        0.90        1.48        1.10    silty sand to sandy silt      50-60    38-40    19   UNDEFINED
     9.45    31        26.85        1.02        3.82        1.13       silty clay to clay         UNDFND   UNDFD    17         1.6
     9.75    32        21.33        0.78        3.66        1.16       silty clay to clay         UNDFND   UNDFD    14         1.2
    10.05    33        21.20        1.11        5.25        1.18              clay                UNDFND   UNDFD    20         1.2
    10.35    34        20.78        1.21        5.82        1.21              clay                UNDFND   UNDFD    20         1.2
    10.65    35        22.62        1.45        6.40        1.24              clay                UNDFND   UNDFD    22         1.3
    10.95    36        18.92        0.57        3.03        1.27    clayey silt to silty clay     UNDFND   UNDFD     9         1.1
    11.25    37        16.17        0.37        2.26        1.30    clayey silt to silty clay     UNDFND   UNDFD     8          .9
    11.55    38        22.35        1.28        5.73        1.33              clay                UNDFND   UNDFD    21         1.3
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-37B

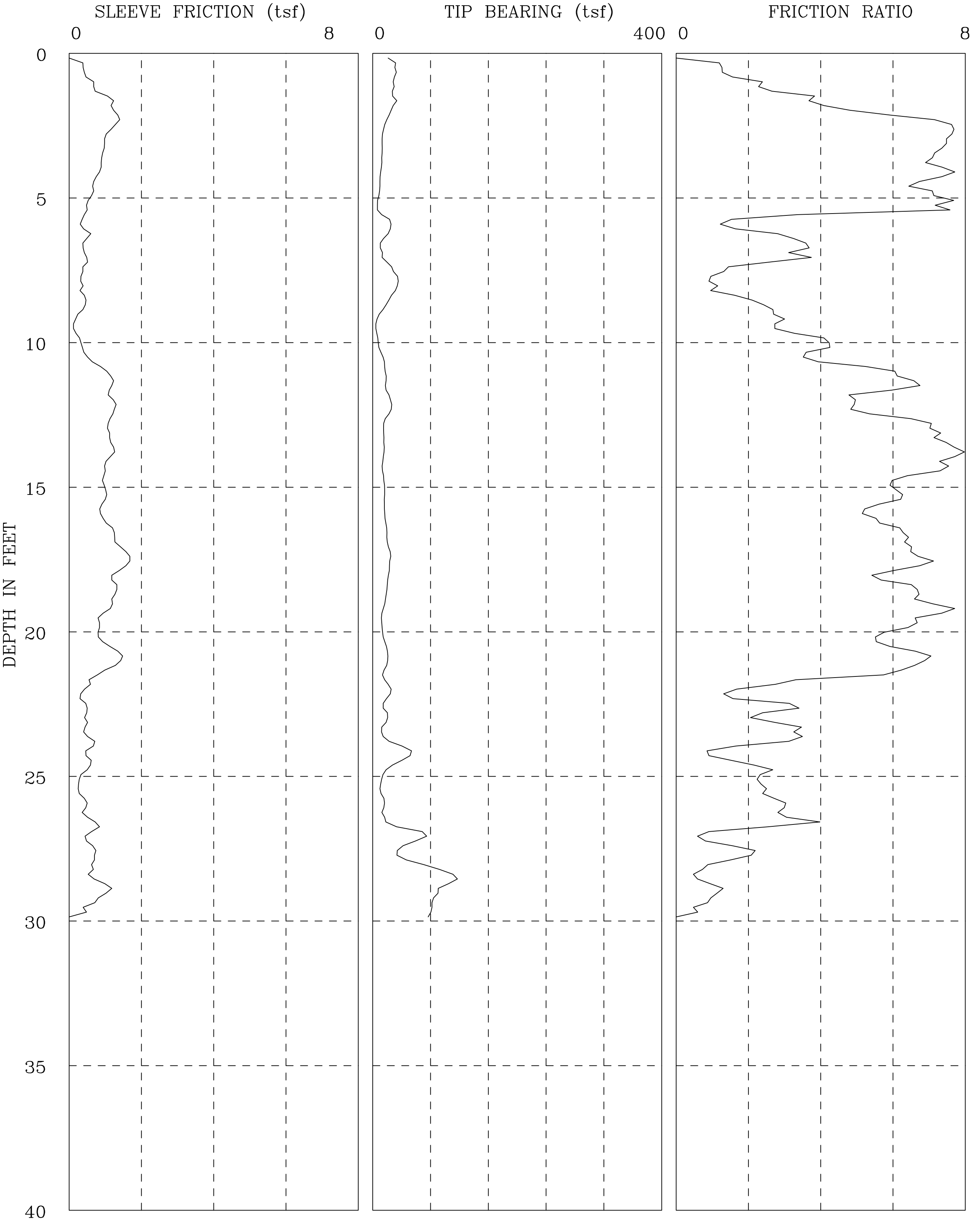
```
                                                        GROUP DELTA CONSULTANTS

Cone Used  : DCPT-20                                                       Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                              Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH         Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE       Eq - Dr    PHI    SPT      Su
 (meters)   (feet)     (tsf)       (tsf)       (%)        (tsf)                                     (%)     deg.     N       tsf
-----------------------------------------------------------------------------------------------------------------------------------
    11.85    39        24.77        1.69        6.84        1.35              clay                UNDFND   UNDFD    24         1.4
    12.15    40        16.93        1.03        6.07        1.38              clay                UNDFND   UNDFD    16          .9
    12.45    41        15.48        0.81        5.22        1.41              clay                UNDFND   UNDFD    15          .8
    12.80    42        16.16        0.84        5.20        1.44              clay                UNDFND   UNDFD    15          .9
    13.10    43        17.98        0.91        5.06        1.47              clay                UNDFND   UNDFD    17         1.0
    13.40    44        17.68        0.76        4.31        1.50              clay                UNDFND   UNDFD    17         1.0
    13.75    45        26.13        1.28        4.89        1.53              clay                UNDFND   UNDFD    25         1.5
    14.05    46        28.49        1.61        5.63        1.56              clay                UNDFND   UNDFD    27         1.7
    14.35    47       121.46        2.04        1.68        1.59    silty sand to sandy silt      60-70    38-40    39   UNDEFINED
    14.65    48        98.81        1.38        1.39        1.62       sand to silty sand         50-60    38-40    24   UNDEFINED
    14.95    49        20.83        0.82        3.96        1.65       silty clay to clay         UNDFND   UNDFD    13         1.1
    15.25    50        18.82        0.92        4.86        1.68              clay                UNDFND   UNDFD    18         1.0
    15.55    51        23.97        1.33        5.55        1.70              clay                UNDFND   UNDFD    23         1.3
    15.85    52        26.27        1.57        5.96        1.73              clay                UNDFND   UNDFD    25         1.5
    16.15    53        17.03        0.81        4.76        1.76              clay                UNDFND   UNDFD    16          .9
    16.45    54        22.25        1.25        5.63        1.79              clay                UNDFND   UNDFD    21         1.2
    16.75    55        27.45        1.59        5.80        1.82              clay                UNDFND   UNDFD    26         1.6
    17.05    56        31.83        1.92        6.03        1.85              clay                UNDFND   UNDFD    30         1.9
    17.35    57        34.77        1.97        5.67        1.87              clay                UNDFND   UNDFD    33         2.0
    17.65    58        39.30        1.63        4.16        1.90       silty clay to clay         UNDFND   UNDFD    25         2.3
    17.95    59        23.65        1.10        4.66        1.93              clay                UNDFND   UNDFD    23         1.3
    18.25    60        18.67        0.72        3.87        1.96       silty clay to clay         UNDFND   UNDFD    12         1.0
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983         Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-37C



CPT–21	I–558 Centinela Solar Energy Facility
GROUP DELTA CONSULTANTS, INC.	Fs, Qc, AND FRICTION RATIO vs DEPTH

Figure A-38A

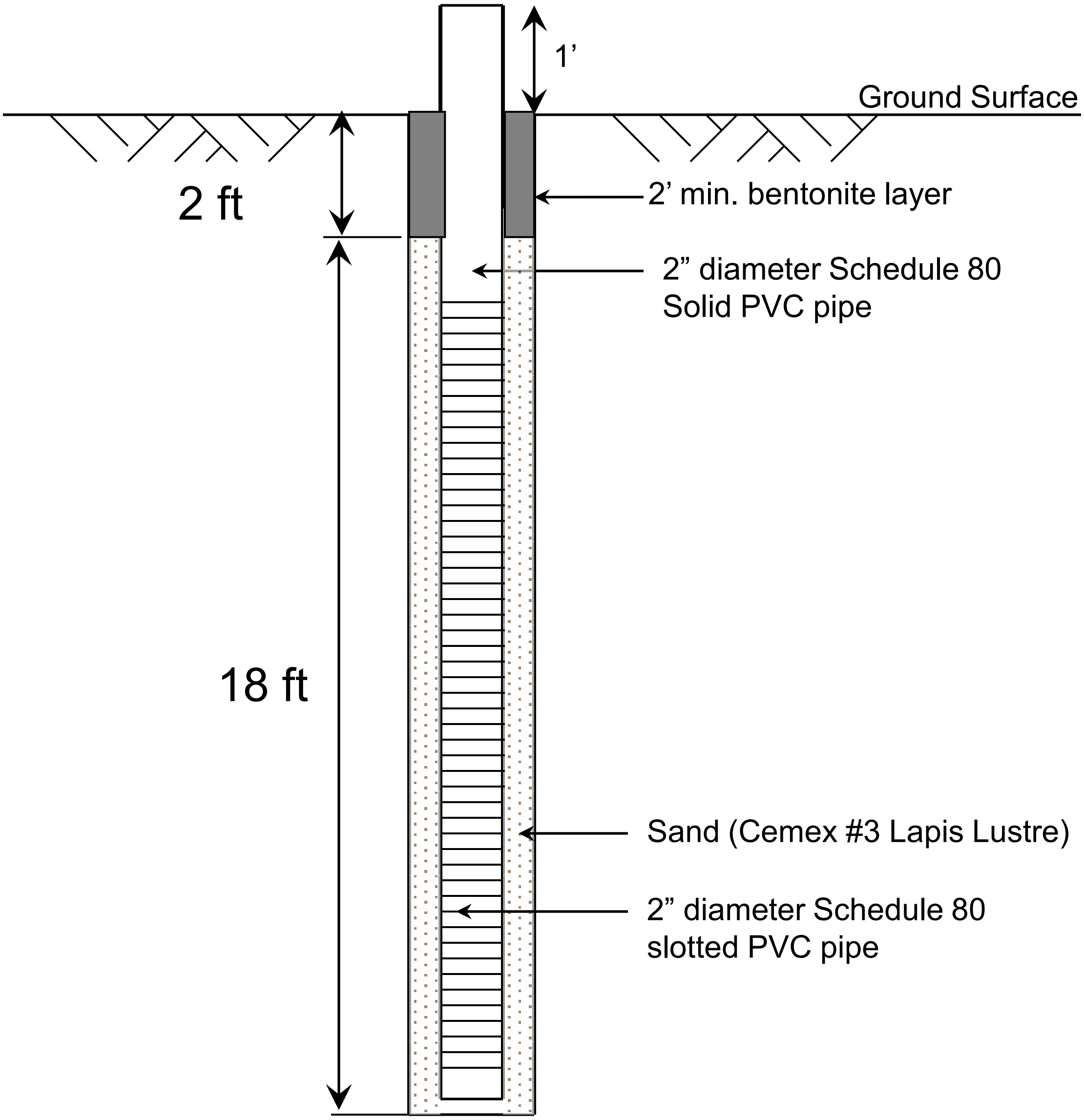
```
                                              GROUP DELTA CONSULTANTS

Cone Used  : CPT-21                                                          Job No. : I-558 Centinela Solar Energy Facility
Depth to water table (ft) : 8                                                Tot. Unit Wt. (avg) : 120 pcf
-----------------------------------------------------------------------------------------------------------------------------------
       DEPTH           Qc (avg)    Fs (avg)    Rf (avg)     SIGV'         SOIL BEHAVIOUR TYPE         Eq - Dr    PHI     SPT       Su
 (meters)   (feet)       (tsf)       (tsf)       (%)        (tsf)                                       (%)     deg.     N        tsf
-----------------------------------------------------------------------------------------------------------------------------------
     0.30     1        29.30        0.39        1.33        0.03    sandy silt to clayey silt     UNDFND   UNDFD    11         1.9
     0.60     2        28.70        1.01        3.53        0.09    clayey silt to silty clay     UNDFND   UNDFD    14         1.9
     0.95     3        16.29        1.17        7.18        0.15              clay                UNDFND   UNDFD    16         1.0
     1.25     4        12.47        0.90        7.25        0.22              clay                UNDFND   UNDFD    12          .8
     1.55     5         9.27        0.65        7.03        0.28              clay                UNDFND   UNDFD     9          .5
     1.85     6        16.52        0.41        2.49        0.33    clayey silt to silty clay     UNDFND   UNDFD     8         1.0
     2.15     7        14.05        0.46        3.29        0.39       silty clay to clay         UNDFND   UNDFD     9          .9
     2.45     8        29.80        0.38        1.29        0.45    sandy silt to clayey silt     UNDFND   UNDFD    11         1.9
     2.75     9        20.27        0.38        1.86        0.50    sandy silt to clayey silt     UNDFND   UNDFD     8         1.3
     3.05    10         5.92        0.20        3.46        0.52              clay                UNDFND   UNDFD     6          .3
     3.35    11        14.12        0.64        4.53        0.55              clay                UNDFND   UNDFD    14          .8
     3.65    12        20.13        1.16        5.77        0.58              clay                UNDFND   UNDFD    19         1.2
     3.95    13        20.45        1.17        5.73        0.61              clay                UNDFND   UNDFD    20         1.3
     4.25    14        15.50        1.17        7.55        0.64              clay                UNDFND   UNDFD    15          .9
     4.55    15        14.58        0.98        6.69        0.67              clay                UNDFND   UNDFD    14          .9
     4.85    16        16.45        0.95        5.75        0.69              clay                UNDFND   UNDFD    16         1.0
     5.15    17        19.05        1.16        6.08        0.72              clay                UNDFND   UNDFD    18         1.2
     5.45    18        23.52        1.55        6.60        0.75              clay                UNDFND   UNDFD    23         1.4
     5.75    19        19.92        1.24        6.23        0.78              clay                UNDFND   UNDFD    19         1.2
     6.05    20        13.72        0.96        7.00        0.81              clay                UNDFND   UNDFD    13          .8
     6.40    21        18.10        1.13        6.26        0.84              clay                UNDFND   UNDFD    17         1.1
     6.70    22        18.78        0.77        4.10        0.87       silty clay to clay         UNDFND   UNDFD    12         1.1
     7.00    23        19.05        0.42        2.19        0.90    clayey silt to silty clay     UNDFND   UNDFD     9         1.1
     7.35    24        25.09        0.53        2.11        0.93    sandy silt to clayey silt     UNDFND   UNDFD    10         1.5
     7.65    25        27.53        0.46        1.68        0.96    sandy silt to clayey silt     UNDFND   UNDFD    11         1.7
     7.95    26        13.37        0.36        2.71        0.99    clayey silt to silty clay     UNDFND   UNDFD     6          .7
     8.25    27        37.37        0.58        1.56        1.01    sandy silt to clayey silt     UNDFND   UNDFD    14         2.3
     8.55    28        47.72        0.65        1.36        1.04    silty sand to sandy silt      40-50    36-38    15   UNDEFINED
     8.85    29       101.20        0.85        0.84        1.07       sand to silty sand         60-70    40-42    24   UNDEFINED
-----------------------------------------------------------------------------------------------------------------------------------

      Dr -  All sands (Jamiolkowski et al. 1985)      PHI -     Robertson and Campanella 1983        Su: Nk= 15

 **** Note: For interpretation purposes the PLOTTED CPT PROFILE should be used with the TABULATED OUTPUT from CPTINTR1 (v 3.04) ****
```

Figure A-38B



Note: Drawing not to scale

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GDC Project No. I-558

Centinela Solar Energy Facility, Imperial County, California

Typical Well Diagram

Figure A-39

PERCOLATION TEST FIELD DATA SHEET
LEACH LINE SEPTIC SYSTEM

Project Name: Centinela **Job No.:** IR558 **ested By:** MAS

Test Hole No: PT-1A **Date Drilled:** 5/16/2012 **Tested:** 5/17/2012

Drilling Method:

Depth of Hole as Drilled: 4 ft **Depth Before Test:** 4.00 ft **fter Test:** 4.00 ft

Reading Number	Time	T1 (min.)	H1 (in.)	H2 (in.)	D (in.)	t (min./in.)
1	7:13 7:43	30	21.00	21.69	0.69	43.64
2	8:13 8:43	30	21.69	22.25	0.56	53.33
3	9:13 9:43	30	21.50	22.31	0.81	36.90
4	10:13 10:43	30	21.69	22.50	0.81	36.90
5	11:13 11:43	30	21.25	22.25	1.00	30.00
6	12:13 12:43	30	21.88	22.69	0.81	36.95

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

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Figure A-40

FALLING HEAD PERCOLATION TEST FIELD DATA SHEET
LEACH LINE SEPTIC SYSTEM

Project Name: Centinela **Job No.:** IR558 **Tested By:** MAS

Test Hole No: PT-2A **Date Drilled:** 5/16/2012 **Date Tested:** 5/17/2012

Drilling Method:

Depth of Hole as Drilled: 4 ft **Depth Before Test:** 4.00 ft **Depth After Test:** 4.00 ft

Reading Number	Time	T1 (min.)	H1 (ft.)	H2 (in.)	D (in.)	t (min./in.)
1						
2						
3						
4						
5						
6						

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

Note: Test could not be performed since the hole did not hold water. Probably hit existing drains.

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Figure A-41

FALLING HEAD PERCOLATION TEST FIELD DATA SHEET

LEACH LINE SEPTIC SYSTEM

Project Name: Centinela
Job No.: IR558
Tested By: MAS

Test Hole No: PT-2B
Date Drilled: 5/16/2012
Date Tested: 5/17/2012

Drilling Method:

Depth of Hole as Drilled: 4 ft
Depth Before Test: 4.00 ft
After Test: 4.00 ft

Reading Number	Time	T1 (min.)	H1 (in.)	H2 (in.)	D (in.)	t (min./in.)	Pt (gallons/sq ft /day)
1	7:26 7:56	30	23.50	24.19	0.69	43.60	0.76
2	8:26 8:56	30	23.63	24.31	0.69	43.60	0.76
3	9:26 9:56	30	23.63	24.50	0.88	34.29	0.85
4	10:26 10:56	30	23.81	24.88	1.06	28.25	0.94
5	11:26 11:56	30	23.75	24.81	1.06	28.22	0.94
6	12:26 12:56	30	23.50	24.50	1.00	30.00	0.91

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

GROUP
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Figure A-42

FALLING HEAD PERCOLATION TEST FIELD DATA SHEET

LEACH LINE SEPTIC SYSTEM

Project Name: Centinela **Job No.:** IR558 **Tested By:** MAS

Test Hole No: PT-1B **Date Drilled:** 5/16/2012 **Date Tested:** 5/17/2012

Drilling Method:

Depth of Hole as Drilled: 4 ft **Depth Before Test:** 4.00 ft **After Test:** 4.00 ft

Reading Number	Time	T1 (min.)	H1 (in.)	H2 (in.)	D (in.)	t (min./in.)	Pt (gallons/sq ft /day)
1	7:29 7:59	30	24.88	25.63	0.75	40.00	0.79
2	8:29 8:59	30	25.06	26.00	0.94	32.02	0.88
3	9:29 9:59	30	25.63	26.31	0.69	43.60	0.76
4	10:29 10:59	30	25.00	26.00	1.00	30.00	0.91
5	11:29 11:59	30	25.19	26.13	0.94	32.02	0.88
6	12:29 12:59	30	25.19	26.06	0.88	34.29	0.85

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

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Figure A-43

PERCOLATION TEST FIELD DATA SHEET

LEACH LINE SEPTIC SYSTEM

Project Name: Centinela **Job No.:** IR558 **Tested By:** MAS

Test Hole No: PT-2C **Date Drilled:** 5/31/2012 **Date Tested:** 6/5/2012

Drilling Method:

Depth of Hole as Drilled: **Depth Before Test:** **Depth After Test:**

Reading Number	Time	T1 (min.)	H1 (in.)	H2 (in.)	D (in.)	t (min./in.)	Pt (gallons/sq ft /day)
1	3:57 4:27	30	6.00	5.38	0.63	48.00	0.72
2	4:32 5:02	30	6.00	5.81	0.19	159.57	0.40
3	5:07 5:37	30	6.00	5.63	0.38	80.00	0.56
4	5:42 6:12	30	6.00	5.75	0.25	120.00	0.46
5	6:17 6:47	30	6.00	5.88	0.13	240.00	0.32
6	6:52 7:22	30	6.00	5.88	0.13	240.00	0.32

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

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Figure A-44

PERCOLATION TEST FIELD DATA SHEET

LEACH LINE SEPTIC SYSTEM

Project Name: Centinela **Job No.:** IR558 **Tested By:** PG

Test Hole No: PT-3A **Date Drilled:** 7/5/2012 **Date Tested:** 7/6/2012

Drilling Method: One man post hole digger

Depth of Hole as Drilled: 4' **Depth Before Test:** **Depth After Test:**

Reading Number	Time	T1 (min.)	H1 (in.)	H2 (in.)	D (in.)	t (min./in.)	Pt (gallons/sq ft /day)
1	8:00 8:30	30	6.00	5.50	0.50	60.00	0.65
2	8:32 9:02	30	6.00	5.50	0.50	60.00	0.65
3	9:07 9:37	30	6.00	5.63	0.38	80.00	0.56
4	9:42 10:12	30	6.00	5.63	0.38	80.00	0.56
5	10:17 10:47	30	6.00	5.63	0.38	80.00	0.56
6	11:52 12:22	30	6.00	5.63	0.38	80.00	0.56

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

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Figure A-45

PERCOLATION TEST FIELD DATA SHEET

LEACH LINE SEPTIC SYSTEM

Project Name: Centinela **Job No.:** IR558 **Tested By:** PG

Test Hole No: PT-3B **Date Drilled:** 7/5/2012 **Date Tested:** 7/6/2012

Drilling Method: One man post hole digger

Depth of Hole as Drilled: 4' **Depth Before Test:** **Depth After Test:**

Reading Number	Time	T1 (min.)	H1 (in.)	H2 (in.)	D (in.)	t (min./in.)	Pt (gallons/sq ft /day)
1	8:10 8:40	30	6.00	5.50	0.50	60.00	0.65
2	8:42 9:12	30	6.00	5.50	0.50	60.00	0.65
3	9:17 9:47	30	6.00	5.63	0.38	80.00	0.56
4	9:52 10:22	30	6.00	5.63	0.38	80.00	0.56
5	10:27 10:57	30	6.00	5.63	0.38	80.00	0.56
6	11:02 11:32	30	6.00	5.63	0.38	80.00	0.56

T1	Time Interval
H1	Initial Water Level
H2	Final Water Level
D	Change in Water Level
t	Rate of Drop (min/in)

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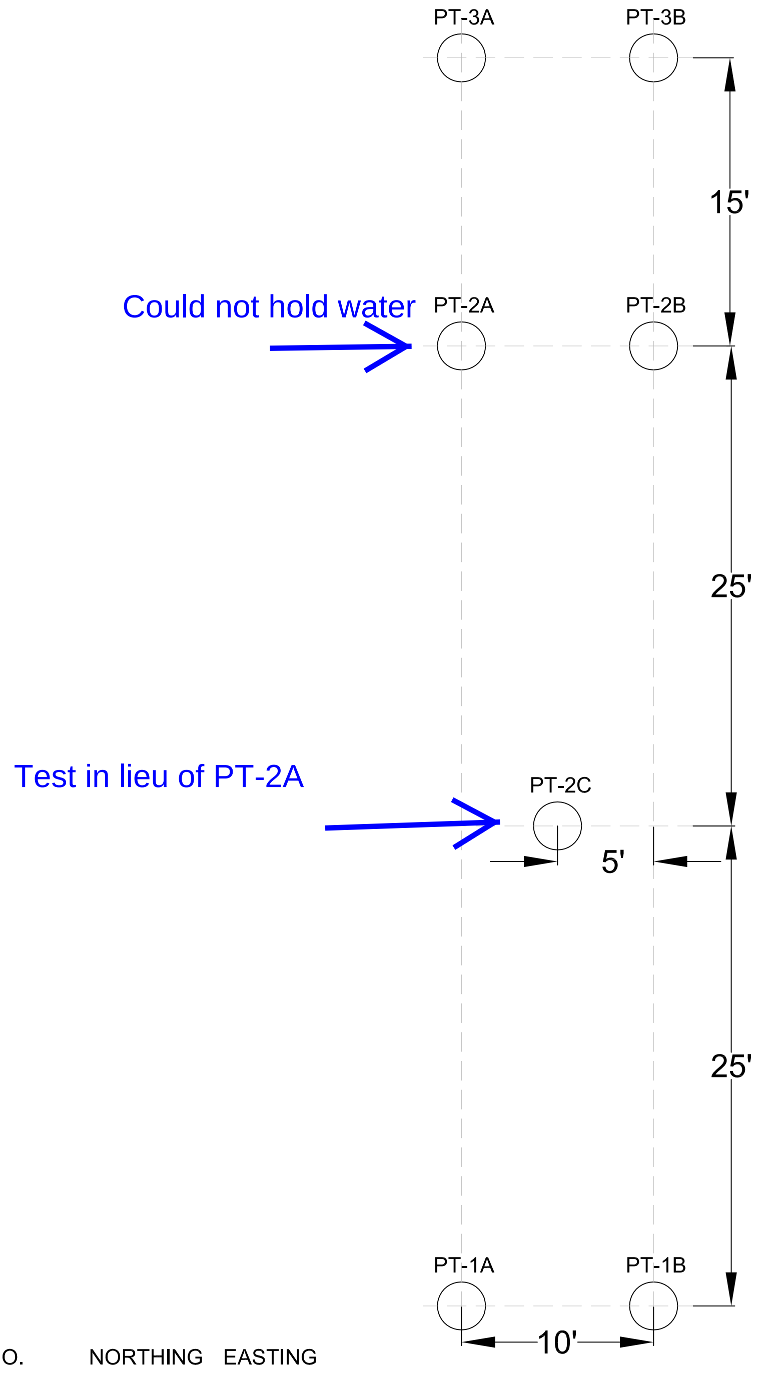
Figure A-46



Could not hold water

Test in lieu of PT-2A

NO.	NORTHING	EASTING
PT-1A	1,827,250	6,747,775
PT-2A	1,827,300	6,747,775

GROUP
DELTA
CONSULTANTS

GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
32 MAUCHLY, SUITE B
IRVINE, CA 92618 (949) 450-2100

FIGURE NUMBER
A-47

PROJECT NAME
CENTINELA SOLAR PLANT
CALEXICO, CALIFORNIA

PROJECT NUMBER
I-558

PERCOLATION TEST LOCATIONS

APPENDIX B
LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

B.1 General

The laboratory testing was performed using appropriate American Society for Testing and Materials (ASTM) and Caltrans Test Methods (CTM).

Modified California drive samples, Standard Penetration Test (SPT) drive samples, and bulk samples collected during the field investigation were carefully sealed in the field to prevent moisture loss. The samples of earth materials were then transported to the laboratory for further examination and testing. Tests were performed on selected samples as an aid in classifying the earth materials and to evaluate their physical properties and engineering characteristics. Laboratory testing for this investigation included:

- Soil Classification: USCS (ASTM D 2487) and Visual Manual (ASTM D 2488);
- Moisture content (ASTM D 2216) and Dry Unit Weight (ASTM D 2937);
- Atterberg Limits (ASTM D 4318);
- Grain Size Distribution (ASTM D 422) & % Passing #200 Sieve (ASTM D 1140);
- Expansion Index (ASTM D 4829);
- Soil Corrosivity:
    - pH (CTM 643);
    - Water-Soluble Sulfate (ASTM D 516, CTM 417);
    - Water-Soluble Chloride(Ion-Specific Probe, CTM 422);
    - Minimum Electrical Resistivity (CTM 643);
- Compaction Test (ASTM D 1557); and
- California Bearing Ratio (ASTM D1883).

Brief descriptions of the laboratory testing program and test results are presented below.

B.2 Soil Classification

Earth materials recovered from subsurface explorations were classified in general accordance with Caltrans' "Soil and Rock Logging Classification Manual, 2010". The subsurface soils were classified visually / manually in the field in accordance with the Unified Soil Classification System (USCS) following ASTM D 2488; soil classifications were modified as necessary based on testing in the laboratory in accordance with ASTM D 2487. The details of the soil classification system and boring records presenting the classifications are presented in Appendix A.

B.3 Moisture Content and Dry Unit Weight

The in-situ moisture content of selected bulk, SPT, and Ring samples was determined by oven drying in general accordance with ASTM D 2216. Selected California Ring samples were trimmed flush in the metal rings and wet weight was measured. After drying, the dry weight of each sample was measured, volume and weight of the metal containers was measured, and moisture content and dry density were calculated in general accordance with ASTM D 2216 and D 2937. Results of these tests are presented on the boring records in Appendix A.

B.4 Atterberg Limits

Characterization of the fine-grained fractions of soils was evaluated using the Atterberg Limits. This test includes Liquid Limit and Plastic Limit tests to determine the Plasticity Index in accordance with ASTM D 4318. Results of these tests are presented on the boring records in Appendix A and are plotted on a Plasticity Chart in Figure B-1 of this Appendix.

B.5 Grain Size Distribution and Percent Passing No. 200 Sieve:

Representative samples were dried, weighed, soaked in water until individual soil particles were separated, and then washed on the No. 200 sieve. The percentage of fines (soil passing No. 200 sieve) was determined for selected samples in accordance with ASTM D 1140. For selected samples the washed fraction retained on the No. 200 sieve was then screened on a No. 4 sieve, and the percentage retained on No. 4 was weighed to determine the percentage of gravel. For selected samples, the washed material retained on No. 200 sieve was shaken through a standard stack of sieves in accordance with ASTM D 422 to determine the grain size distribution. For selected samples, the grain size distribution of the fraction finer than No. 200 sieve was determined by Hydrometer Analysis in accordance with ASTM D 422. The results of grain size distribution tests are plotted in Figure B-2 of this appendix. The relative proportion (or percentage) by dry weight of gravel (retained on No. 4 sieve), sand (passing No. 4 and retained on No. 200 sieve), and fines (passing No. 200 sieve) are listed on the boring records in Appendix A.

B.6 Expansion Index

This test method provides an index to the expansion potential of compacted soils when submerged under water. The test was conducted in general accordance with ASTM D-4829. Results of these tests are presented in Table B-1 of this Appendix.

B.7 Soil Corrosivity

Tests were performed in order to determine corrosion potential of site soils on concrete and ferrous metals. Corrosivity testing included minimum electrical resistivity and soil pH (Caltrans method 643), water-soluble chlorides (Orion 170A+ Ion Probe), and water-soluble sulfates (ASTM D 516). The test results are presented in Table B-2 of this appendix.

B.8 Compaction Test

A compaction test was performed on a bulk sample to evaluate the maximum density and optimum moisture content. The test was performed in general accordance with ASTM D 1557 using a 4" diameter mold and modified effort hammer. Results of the test are presented in Table B-3.

B.9 California Bearing Ratio

A California Bearing Ratio test was performed on a combined bulk sample to evaluate that potential strength of subgrade material for use in road pavement. The test was performed in general accordance with ASTM D 1883. Results of the California Bearing Ratio tests are presented in Table B-4.

B.10 List of Attached Figures

The following tables and figures are attached and complete this appendix:

List of Tables

Table B-1 Expansion Index Test Results
Table B-2 Corrosion Test Results
Table B-3 Compaction Test Results
Table B-4 California Bearing Ratio

List of Figures

Figures B-1 A,B Atterberg Limits Test Results
Figure B-2 A,B Grain Size Analysis Test Results

Table B-1

Expansion Index Test Results

BORING NO	SAMPLE NO	DEPTH (feet)	SOIL TYPE	EXPANSION INDEX	EXPANSION POTENTIAL
B-16	B-1	0-5	CH	131	"Very High"
B-24	B-1	0-5	SM	24	"Low"
B-29	B-1	0-5	CH	114	"High"

Table B-2

Corrosion Test Results

BORING NO	SAMPLE NO	DEPTH (FT)	SOIL TYPE	PH CALTRANS 643	SULFATE CONTENT CALTRANS 417 (ppm)	CHLORIDE CONTENT CALTRANS 422 (ppm)	MINIMUM RESISTIVITY CALTRANS 532 (ohm-cm)
B-16	B-1	0-5	CH	-	8,500	300	-
B-22	B-1	0-5	CH	-	4,500	300	287
B-24	B-1	0-5	SM	7.27	800	200	-
B-29	B-1	0-5	CH	-	1,100	400	242

Table B-3

Compaction Test Results

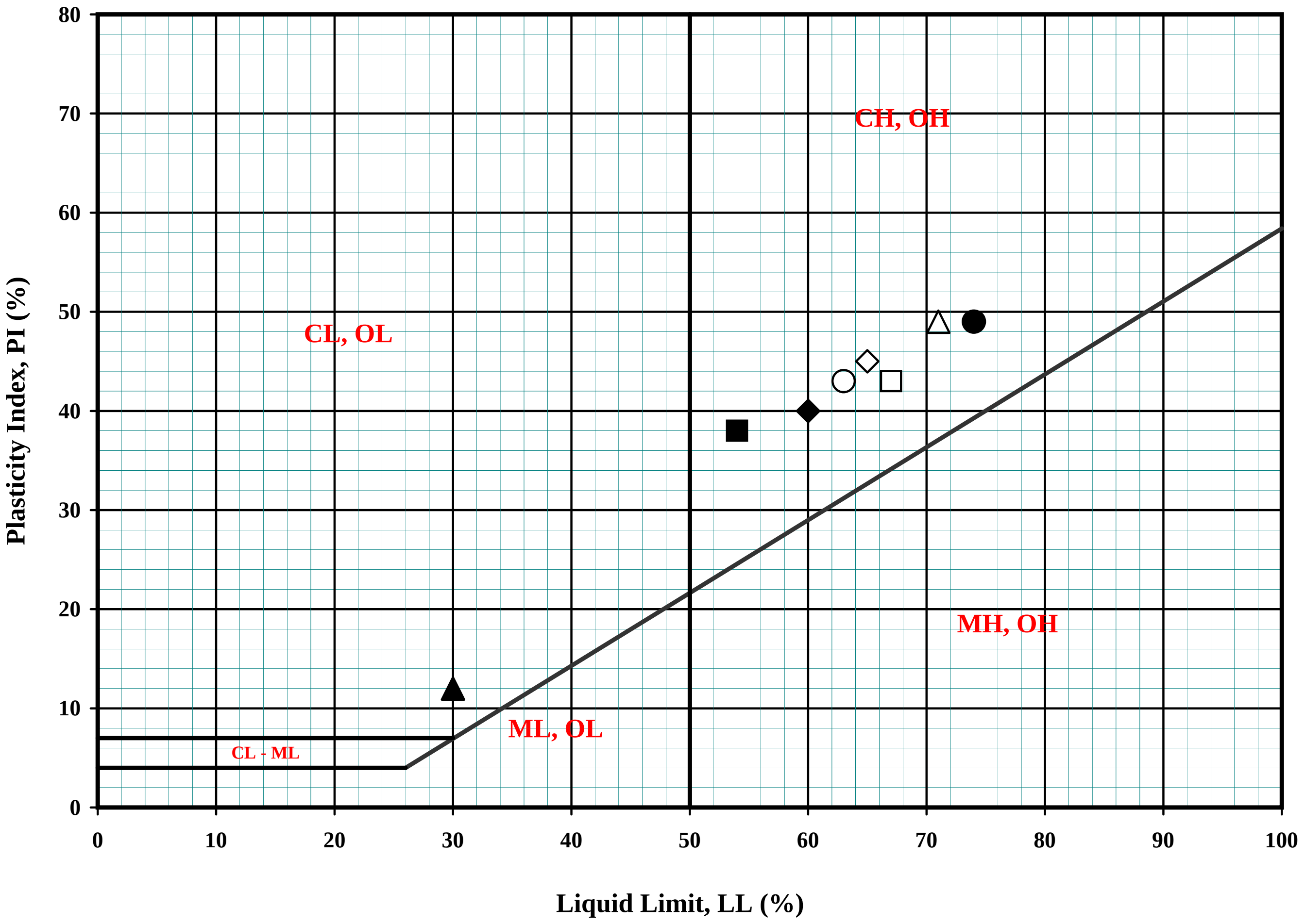
BORING NO	SAMPLE NO	DEPTH (FT)	SOIL TYPE	OPTIMUM MOISTURE CONTENT (%)	MAXIMUM DRY DENSITY (PCF)	MAXIMUM WET DENSITY (PCF)
B-18	B-1	0-5	CL	13.5	119	135
B-20, B-22, B-23	B-1	0-5	CH	12.5	116.5	117

Table B-4

California Bearing Ratio Results

BORING NO	SAMPLE NO	DEPTH (FT)	SOIL TYPE	CALIFORNIA BEARING RATIO
B-20, B-22, B-23	B-1	0-5	CH	6.4

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth				MC	LL	PL	PI	LI	Description
			(ft)		(m)		(%)					
●	B-16	B-1	0.0	5.0	0.0	1.5	26.7	74	25	49	0.03	Fat CLAY (CH)
▲	B-18	R-3	5.0	6.5	1.5	2.0	25.4	30	18	12	0.62	Lean CLAY (CL)
◆	B-19	B-1	0.0	5.0	0.0	1.5	26.7	60	20	40	0.17	Fat CLAY (CH)
■	B-20	B-1	0.0	5.0	0.0	1.5	26.8	54	16	38	0.28	Fat CLAY (CH)
○	B-22	B-1	0.0	5.0	0.0	1.5	-	63	20	43	-	Fat CLAY (CH)
△	B-23	B-1	0.0	5.0	0.0	1.5	27.1	71	22	49	0.10	Fat CLAY (CH)
◇	B-26	B-1	0.0	5.0	0.0	1.5	21.1	65	20	45	0.02	Fat CLAY (CH)
□	B-27	S-2	5.0	6.5	1.5	2.0	26.0	67	24	43	0.05	Fat CLAY (CH)

Remarks :

GROUP
DELTA
CONSULTANTS

Centinela Solar Energy Facility

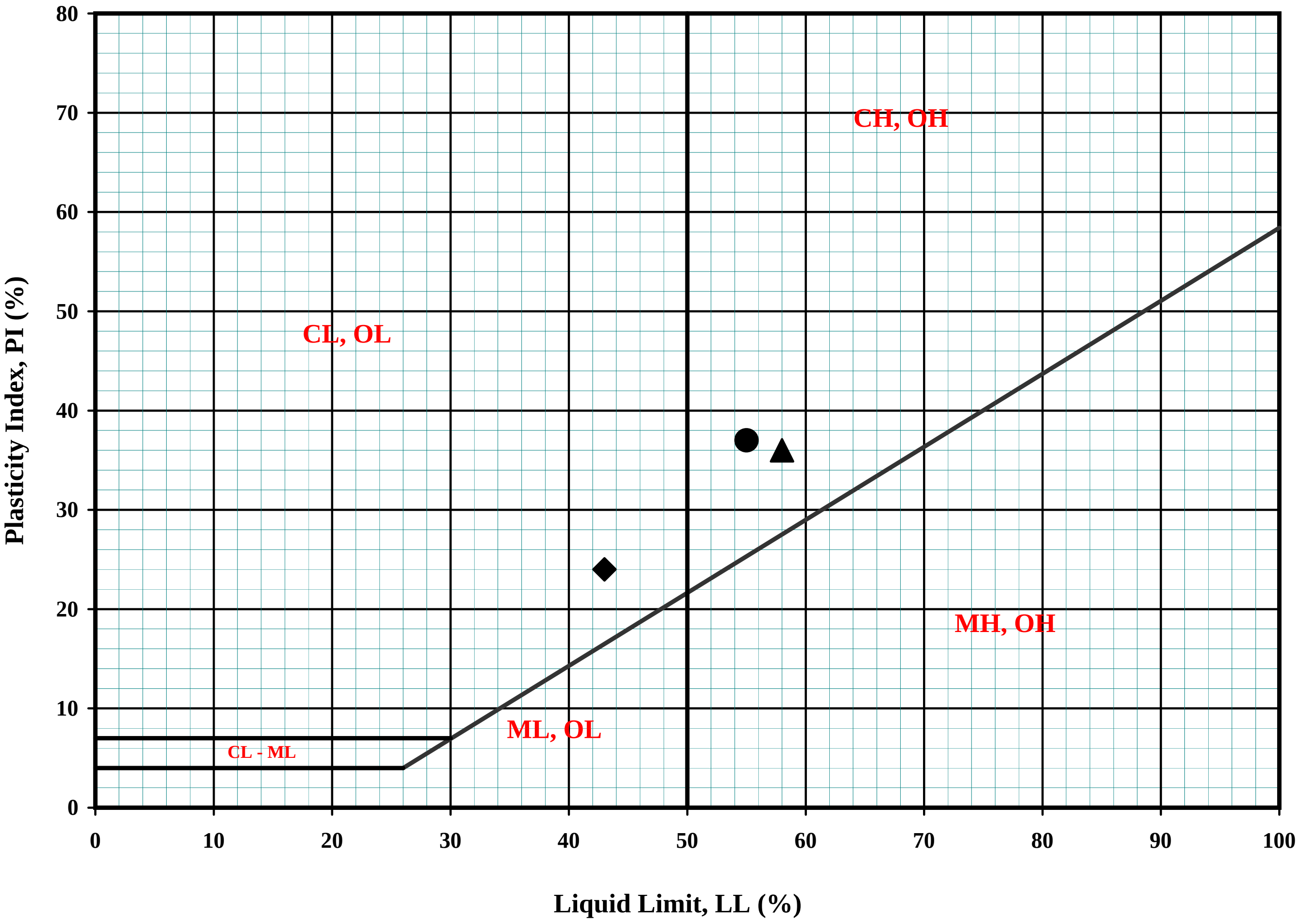
Project No. : *IR-558*

Date : *06/25/12*

ATTERBERG LIMITS
(ASTM D-4318 / CT-204 / T-89)

Figure No. : B-1 a

PLASTICITY CHART



Symbol	Boring No.	Sample No.	Depth				MC	LL	PL	PI	LI	Description
			(ft)		(m)		(%)					
●	*B-28*	*B-1*	*0.0*	*5.0*	*0.0*	*1.5*	*29.6*	*55*	*18*	*37*	*0.31*	*Fat CLAY (CH)*
▲	*B-29*	*R-4*	*10.0*	*11.5*	*3.1*	*3.5*	*31.1*	*58*	*22*	*36*	*0.25*	*Fat CLAY (CH)*
◆	*B-30*	*B-1*	*0.0*	*5.0*	*0.0*	*1.5*	*23.7*	*43*	*19*	*24*	*0.20*	*Lean CLAY (CL)*
■												
○												
△												
◇												
□												

Remarks :

GROUP DELTA CONSULTANTS

Centinela Solar Energy Facility

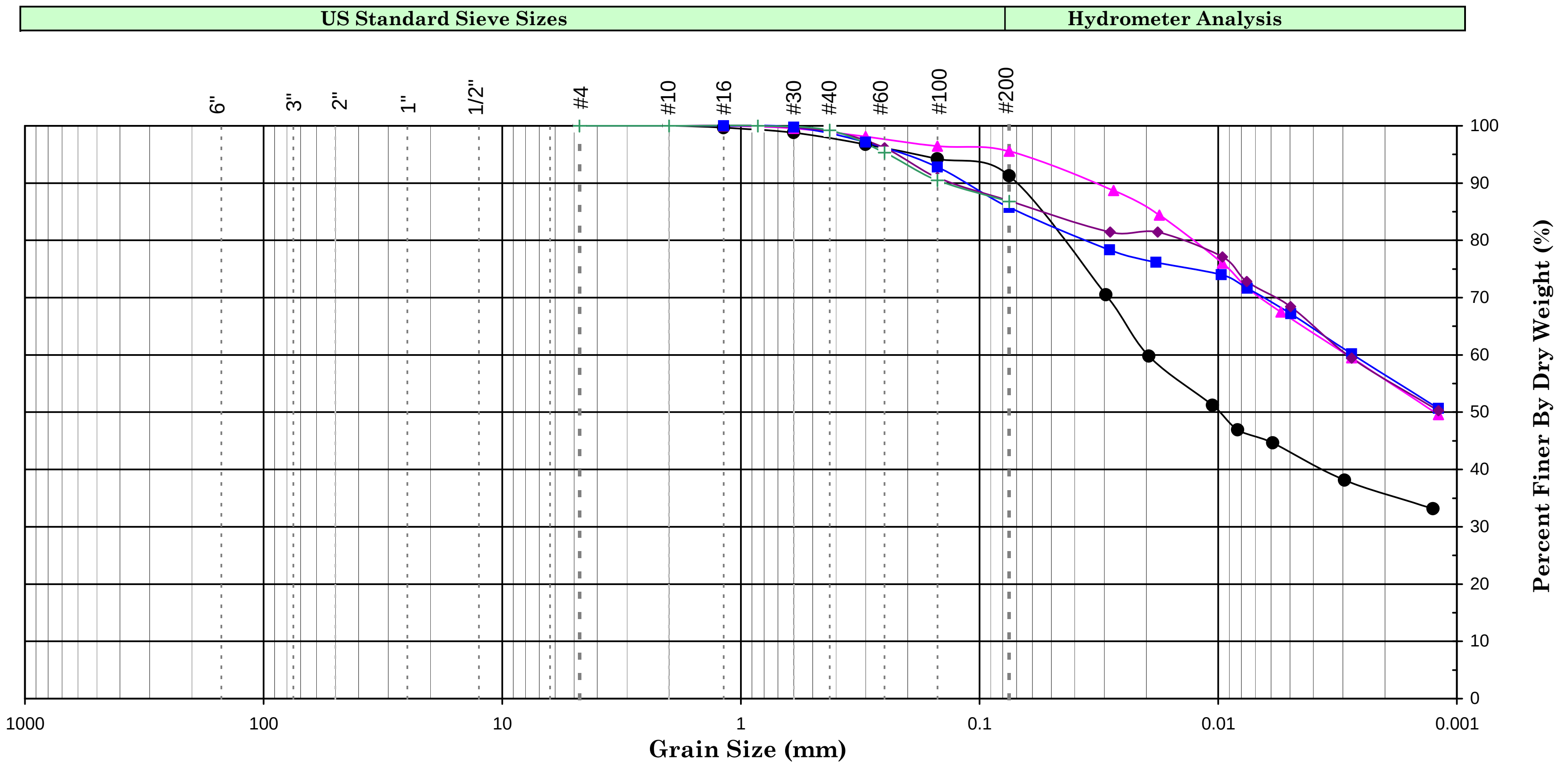
Project No. : *IR-558*

Date : *06/25/12*

ATTERBERG LIMITS

(ASTM D-4318 / CT-204 / T-89)

Figure No. : B-1 b



Boulders	Cobbles	Gravel		Sand			Fines (Silt / Clay)
		Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Sample Depth [from/to] (ft)		(m)		Grain Size Percentage			Atterberg Limits		Soil Description	U.S.C.S.
							Gravel	Sand	Fines	LL	PI		
●	*B-18*	*B-1*	*0.0*	*5.0*	*0.00*	*1.52*	*0*	*9*	*91*	*-*	*-*	*Lean CLAY*	*CL*
▲	*B-19*	*B-1*	*0.0*	*5.0*	*0.00*	*1.52*	*0*	*4*	*96*	*60*	*40*	*Fat CLAY*	*CH*
■	*B-22*	*B-1*	*0.0*	*5.0*	*0.00*	*1.52*	*0*	*14*	*86*	*63*	*43*	*Fat CLAY*	*CH*
◆	*B-25*	*B-1*	*0.0*	*5.0*	*0.00*	*1.52*	*0*	*13*	*87*	*-*	*-*	*Fat CLAY*	*CH*
+	*B-26*	*B-1*	*0.0*	*5.0*	*0.00*	*1.52*	*0*	*13*	*87*	*65*	*45*	*Fat CLAY*	*CH*

GROUP DELTA

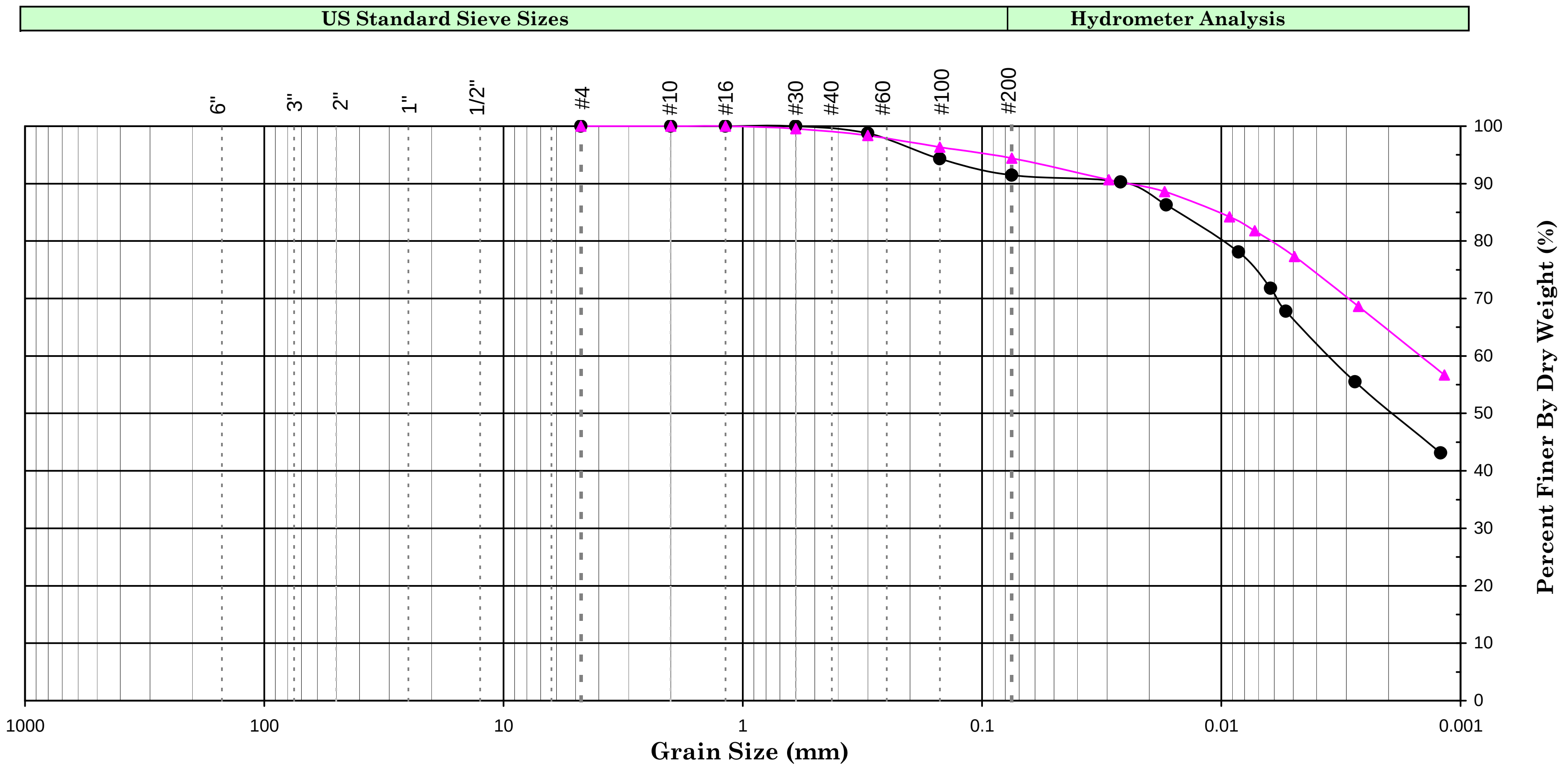
Centinela Solar Energy Faclity

Project No. : *IR-558* **Date :** *06/14/12*

GRAIN SIZE ANALYSIS

(ASTM D-422)

FigureNo. **B-2 a**



Boulders	Cobbles	Gravel		Sand			Fines (Silt / Clay)
		Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Sample Depth [from/to]				Grain Size Percentage			Atterberg Limits		Soil Description	U.S.C.S.
			(ft)		(m)		Gravel	Sand	Fines	LL	PI		
●	B-30	R-4	10.0	11.5	3.05	3.51	0	9	91	-	-	Fat CLAY	CH
▲	B-31	B-1	0.0	5.0	0.00	1.52	0	6	94	-	-	Lean CLAY	CL
■													
◆													
+													

GROUP DELTA

Centinela Solar Energy Faclity

Project No. : IR-558

Date : 06/14/12

GRAIN SIZE ANALYSIS

(ASTM D-422)

FigureNo. B-2 b

APPENDIX C
PERCOLATION TESTING REQUIREMENTS

IMPERIAL COUNTY PUBLIC HEALTH DEPARTMENT
DIVISION OF ENVIRONMENTAL HEALTH
MAIN STREET PROFESSIONAL BUILDING, 797 MAIN ST., STE B
EL CENTRO, CA 92243
PHONE: (760 336-8530•FAX: (760) 352-1309

IMPERIAL COUNTY UNIFORM POLICY AND METHOD FOR SOILS EVALUATION, TESTING, AND REPORTING

(RELATIVE TO APPLICATIONS FOR PRIVATE SEWAGE SYSTEM PERMITS)

AUTHORITY:

Imperial County Ordinances adopting the Uniform Plumbing Code authorizes the Division of Environmental Health to be the local Administering Authority for applicable code sections governing the installation of private sewage disposal systems.

The current edition of the Uniform Plumbing Code provides the following relative to private sewage disposal systems.

a) Percolation tests may be required by the administering agency, and

b) Soils types may be used as a basis to compute disposal field size, and

c) There is provision for requiring a log of soil formations and for determining ground water level and water absorption characteristics of the soil at the proposed site as determined by appropriate percolation tests, at the discretion of the department having jurisdiction for issuance of installation permits.

PURPOSE:

Per authority as the local Administering Authority to implement specific sections of the Uniform Plumbing Code, establish a uniform requirement and method for on-site soils and percolation testing in the County of Imperial for evaluating the issuance of permits for private domestic sewage disposal systems with a capacity of 5,000 gallons per day or less. Information on soils is a critical element in the evaluation of sites for feasibility of installation, and for evaluation of designs of systems for intended application.

REQUIREMENTS:

1. Soils Report: As a part of most applications for a private sewage disposal system, the applicant shall provide a site-specific Soils Report. The report shall be done by a qualified person, as determined by the Division of Environmental Health Services (EHS). "Qualified persons" shall include: California-licensed civil engineers or other persons professionally qualified per the California Business and Professions Code to evaluate soil types and characteristics related to percolation.

   a) Soils Reports shall identify soil by type(s), using standard soils classification, to a depth of at least eight (8) feet in the area of the leaching system, as well as the planned expansion replacement area. The investigation for the report shall be sufficient in scope to determine the suitability of the soil throughout the area of leach line installation.

   b) Soils Reports shall be comprehensive, and identify any impervious soil layers, within three (3) horizontal feet of the leaching system and replacement area, as well as depth to any groundwater and any saturated soil layers. Should impervious layers be identified, the extent in depth to 3 feet below leach/field maximum depth, and within 3 feet of the boundary of the area of the leach/field shall be included in the Soils Report.

2. Design of Systems-Responsibility for Systems: The design of private sewage disposal systems is the responsibility of the permit applicant, and shall consider the minimum requirements and standards as adopted by the County of Imperial, or incorporated cities, depending on jurisdiction. Plans shall be submitted for review at the time of installation permit application, and must be approved by the Division of EHS as meeting the minimum requirements of the current edition of Imperial County adopted Uniform Plumbing Code. Plans must be designed by and bear the wet-ink signature and stamp of a California licensed civil engineer. All plans must be legible, to reasonable scale, and provide all information necessary to evaluate the design relative to code compliance.

   In lieu of an engineer-designed plan, the applicant may consider a standard design that meets minimum code requirements. In order to consider a standard design, the applicant shall supply a written recommendation for a minimum system from and signed by, the civil engineer responsible for the site-specific Soils Report. The recommendation shall be based upon site-specific soil type and percolation test results (if percolation testing is required - see section on "Percolation Testing").

3. Percolation Testing: Percolation testing shall be required in soils that are predominantly clay or silt, or where the evaluating civil engineer requires such testing to provide a soils evaluation. Soils containing 50% or more clay or silt, or other fine-grained, poorly drained soils, shall have percolation testing done. Those soils that are found to be coarse-grained, containing less than 50% clay or silt and are well-drained, as determined by the civil engineer, may rely upon the table of percolation values for soils types contained in the current Uniform Plumbing Code, without percolation testing, provided that the civil engineer agrees and so states in writing that the testing is

unnecessary due to the engineer's evaluation and identification of standard soils types contained in the site-specific soils report (see requirements for Soils Report) .

Percolation testing shall only be performed by a California Registered Environmental Health Specialist, or a California licensed civil engineer. The test results shall be accompanied by written certification that the testing conformed to the Imperial County Standard Method (see "Standard Method" in this policy), and shall be wet-ink stamped and signed by the responsible REHS or engineer. Percolation testing shall only be done by persons listed as qualified on the most current Imperial County Health Department list of participating qualified soils testers.

a) Percolation Tests, when required, shall be performed on each lot where any private sewage system is to be installed. The testing shall be done in the actual area of leach field installation, as well as one test hole in the area proposed for replacement. It shall be the responsibility of the project engineer to locate the most suitable on-site area for sewage system installation and replacement area, based upon most favorable percolation characteristics.

b) The number of test holes shall be sufficient for the project engineer to certify the results as representative of percolation rate throughout the area of leach field. In no case shall less than two (2) test holes be considered per installation.

c) Percolation values shall be reported in gallons per square foot per day, and shall be calculated from actual test results, using a Standard Formula (See "Standard Method" for Imperial County, "d)" of this article).

Copies of all field notes, name of persons performing the tests, and all actual test results for each test hole, shall be supplied with the reported percolation value. Any deviation from the Standard Method shall be reported, and justified in writing as equivalent results. All deviations from Standard Method shall be approved by the Division of Environmental Health Services prior to implementing the change.

d) Standard Method of Conducting Percolation Tests: Imperial County established the following method as the Standard Method:

1. A round or square hole of one (1) square foot cross-section shall be excavated, with vertical sides. The depth shall be a minimum of four (4) feet, but no more than three (3) feet below the depth of the proposed leach field. The depth of the hole shall be included in the field report, and submitted to the Division of EHS. Where a test hole of lesser cross-sectional area is used for testing, the results are to be adjusted for a one square foot area. The cross sectional area of the test hole shall be reported in the field notes.

2. The walls and bottom of the test hole shall be mechanically scored to remove all smeared soil. Loose soil shall be removed from the test hole.

3. The hole shall be filled to a depth of one (1) foot, measured from the bottom, with clean pea gravel aggregate.

   4. The test hole shall be filled with clean water to a depth of six (6) inches above the top of the gravel. The liquid depth shall be maintained until the soil is saturated, but not less than a 24 hours period. Care is to be taken not to wash excessive soil into the gravel pack. Measurement of drop shall not be made until the soil is saturated, nor prior to 24 hours soak, as above.

   5. Water drop shall be measured as follows:

      An accurate measuring device shall be employed. Water is brought to six inches above the gravel pack, and allowed to drop. The rate of drop is measured in minutes, with the drop in inches recorded for the amount of time. The rate is expressed in minutes per inch. Three determinations per hole are minimum, with ten minutes allowed between determinations. The water level shall be re-established at the six-inch level prior to each determination. The last two determinations must be compared, and have no more than a 10% deviation in rate of drop. Greater deviation requires additional ground saturation prior to repeating the testing series of measurements of drop. At least two measurements, agreeing within 10%, are to be done after allowing additional ground saturation.

   6. Reporting of results: all results shall be reported in minutes per inch of drop. Calculation of percolation rate is by the following standard formula:

$$P_{\psi} = \frac{5}{\sqrt{t}}$$

Where t = the rate of drop, in minutes per inch; and P_{ψ} = percolation rate.

4. Plot maps (site plans): In addition to the Soils Report, Percolation Test (if required) and supporting reports and engineered design, a drawn-to-scale plot map of the lot is required, to include (but not limited to) all of the following:

   1 Existing and proposed structures and surface features, and

   2 Water supply canals, drains, streams, ponds, and other surface water conveyances, and

   3 Location of all wells within two hundred (200) feet of the proposed system, and

   4 Location of all domestic surface water systems within fifty (50) feet of the proposed system, and

   5 Water lines, both pressurized and unpressureized, and any tile damage lines, and

   6 Paved and unpaved driveways and vehicle traffic areas, such as parking areas, and

7 Cement and/or paved pads and slabs, and

8 On-site storm water retention basins, man-made and natural, including any water impoundment structures, and

9 Constructed subsurface installations, such as swimming pools, and

10 Location of all percolation test holes, and

11 Actual location and layout of proposed sewage system, all existing sewage systems (functional or abandoned), and the equivalent replacement area for 100% replacement of the leaching structures.

Plot maps will need to show the presence of any 100 year Flood Plain, agricultural tile lines, drain systems, streams, desert washes, and indicate the direction of surface slope, with an indication of slope in inches per 100 feet. Any large trees should be located on the plot map, as well as the location of property lines.

Three (3) copies of the plot map shall be submitted with the application for a permit to install a private sewage disposal system. One copy shall be retained as an official record by ICEHS, the inspector during the inspection of the system will use one copy, and the other copy shall be returned to the permit applicant following review and issuance of the permit. The returned copy shall be stamped "approved", or rejected with a written explanation of reasons for rejection. No permit shall be issued, unless review of the proposed application finds it complete and in compliance with currently adopted codes and standards. The ICEHS Division may, at its discretion, request additional information before approving an application.

The applicant's copy of the approved plan and permit shall be kept at the site of installation, and shall be reviewed by the system installer prior to installation. There shall be no deviation from the approved design or layout of the system on the lot, unless first approved by ICEHS Division.

APPENDIX D
ELECTRICAL RESISTIVITY SURVEY

Subsurface Surveys & Associates, Inc.
2075 Corte Del Nogal, Suite W   Carlsbad, CA 92011
Phone: (760) 476-0492   Fax: (760) 476-0493

Group Delta Consultants, Inc.
32 Mauchly, Suite B
Irvine, CA 92618

June 6, 2012

Attn: Meghan Lithgow
Kul Bhushan

Re: Summary Report - Electrical Resistivity Survey
Centinela Project, El Centro, CA

This report covers the results of an electrical resistivity survey performed at the Centinela Solar Energy Project Site in El Centro, California. The purpose of the survey was to measure soil resistivity to depths of 50 feet along twenty-two sounding traverses and to a depth of 1000 feet on one traverse. This information is to be used for engineering design and construction.

The field work was conducted during May 21-24, 2010. Data was recorded at twelve survey sites selected by Group Delta. A survey location map is provided on Figure 1 that shows the twelve sites labeled ER-1 through ER-12.

GEOLOGIC SETTING

A review of the “Geologic Map of California, San Diego-El Centro Sheet”, (California Division of Mines and Geology, 1966) indicates the local area is by underlain by Quaternary lake deposits. During the fieldwork, mostly silty and clayey soils were observed at the ground surface and in shallow electrode holes.

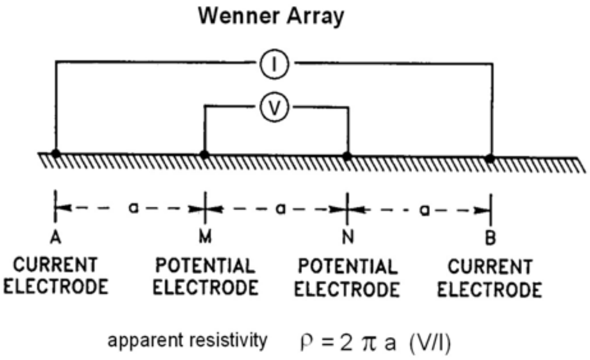
EQUIPMENT AND FIELD PROCEDURES

Direct current resistivity measurements were made with a Sting R1/IP earth resistivity meter made by Advanced Geosciences. The Wenner four electrode in-line array was used with electrode spacings of 2, 4, 6, 8, 10, 20, 30 and 50 feet. The spacing between the stainless steel electrodes were systematically expanded outward from the central midpoint to produce a depth sounding.

Two companion soundings were recorded at eleven of the sites, one orientated N-S and the other E-W. Both shared a common midpoint. This orthogonal configuration provides a check for possible anisotropy.

RESISTIVITY METHOD

The direct current resistivity method uses a man-made source of electrical current that is injected into the earth through grounded electrodes. The resulting potential field is measured along the ground using a second pair of electrodes. The transmitting and receiving electrode pairs are referred to as dipoles. A schematic diagram of the Wenner array is shown below.



Resistivity is best understood if thought of as a volume or "bulk resistance" measurement. It is based on Ohm's Law which is usually written as V = IR where V is the potential difference is volts, I is the electrical current in amperes, and R is resistance in ohms. Now if current is passed through the opposite faces of a unit cube of earth with side length = L, then its three dimensional resistivity is R = V/I*((L*L)/L) which has the dimensions of ohms times length. The most common units for expressing resistivity are ohm-meters (ohm-m) and ohm-feet (ohm-ft).

SUMMARY OF RESULTS

Resistivity data from this survey are plotted on x-y graphs (see Figures 2-13). The y-axis is labeled “Wenner spacing (feet)”. This array is fairly unique in that the electrode spacing is roughly equal to the depth of penetration.

The resistivity values displayed on the graphs are considered very low (i.e. highly conductive soil) and are the low end of the range for topsoil. However, this is typical of lake bed deposits that are primarily silt and clay and may contain salts and other evaporites.

The presence of clay has a significant impact on lowering resistivity. The ion adsorption phenomenon that takes place along the surface of clay particles allows the particle to act as a separate conducting path in addition to the electrolytic path that migrates through pore spaces, along grain boundaries and through fractures.

At several locations, the near surface measurements made at 2 and 4 foot spacing, were affected by void space created by deep mud cracks. Consequently, the values are somewhat higher (more resistive) than if the cracks were filled in with soil. See E-9 and E-12 for examples.

Comparison of the E-W verses N-S data sets from each site showed little evidence of anisotropic conditions across the project site. The shape of the companion sounding curves and the range of values are very similar. There does appear to be a general decrease is resistivity from north to south. For example, there is a gradual decline from 20-30 ohm-ft at ER-1 to less than 10 ohm-ft at ER-10 and ER-12 located on the south side of the survey area.

Three sites were relocated because of access problems. The new Lat-Long coordinates are listed below.

Site	Latitude	Longitude
ER-6	32 40.961	-115 38.016
ER-8	32 40.565	-115 39.617
ER-11	32 40.779	-115 38.997

Site ER-11 is the location of the deep sounding. It was recorded in an E-W direction along the north side of the Yuma Cutoff Road. The original proposal requested a 1000-foot depth of investigation, however, due to limitations of the site and equipment, the maximum depth achieved was 800 feet. The plot for ER-11-EW (Figure 12) shows no major resistivity changes in the soil section down to 800 feet.

All data acquired during this survey is considered confidential and is available for review by your staff at any time. We appreciate the opportunity to participate in this project.

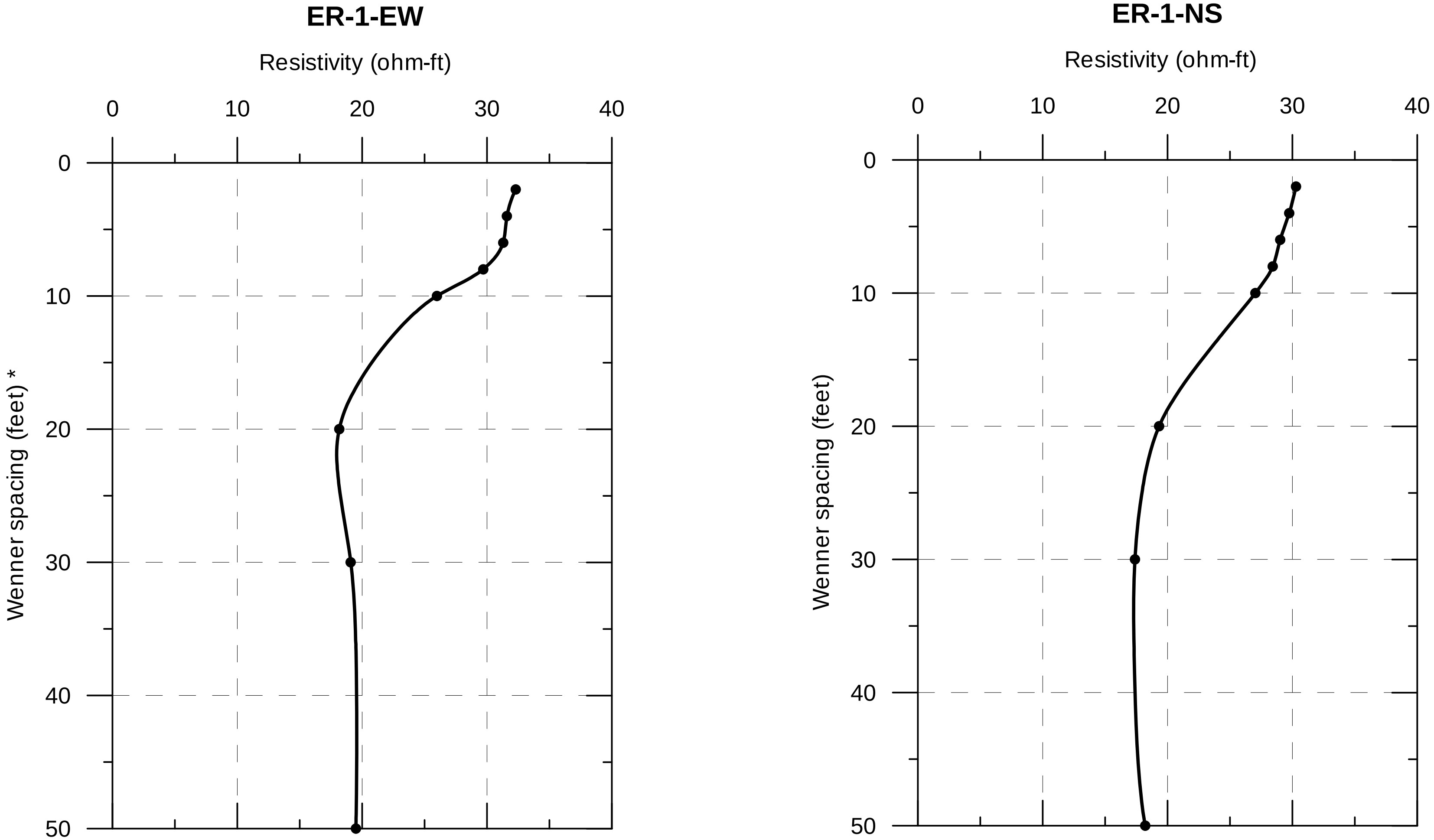
Please call if there are any questions.

PAWalen

Phillip A. Walen
Senior Geophysicist
CA Registration No. GP917

Figure 1. Resistivity Survey Location Maps

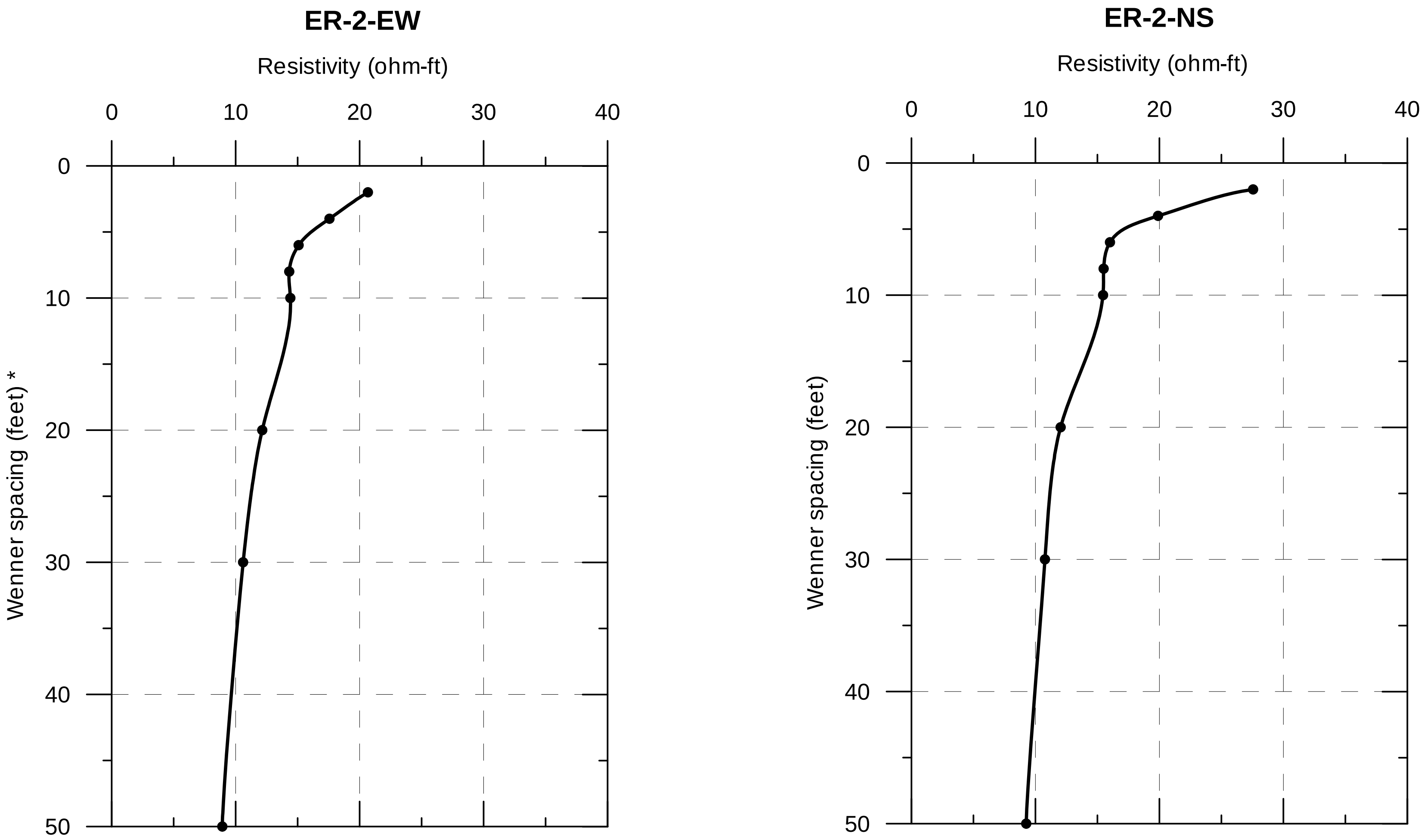
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 2

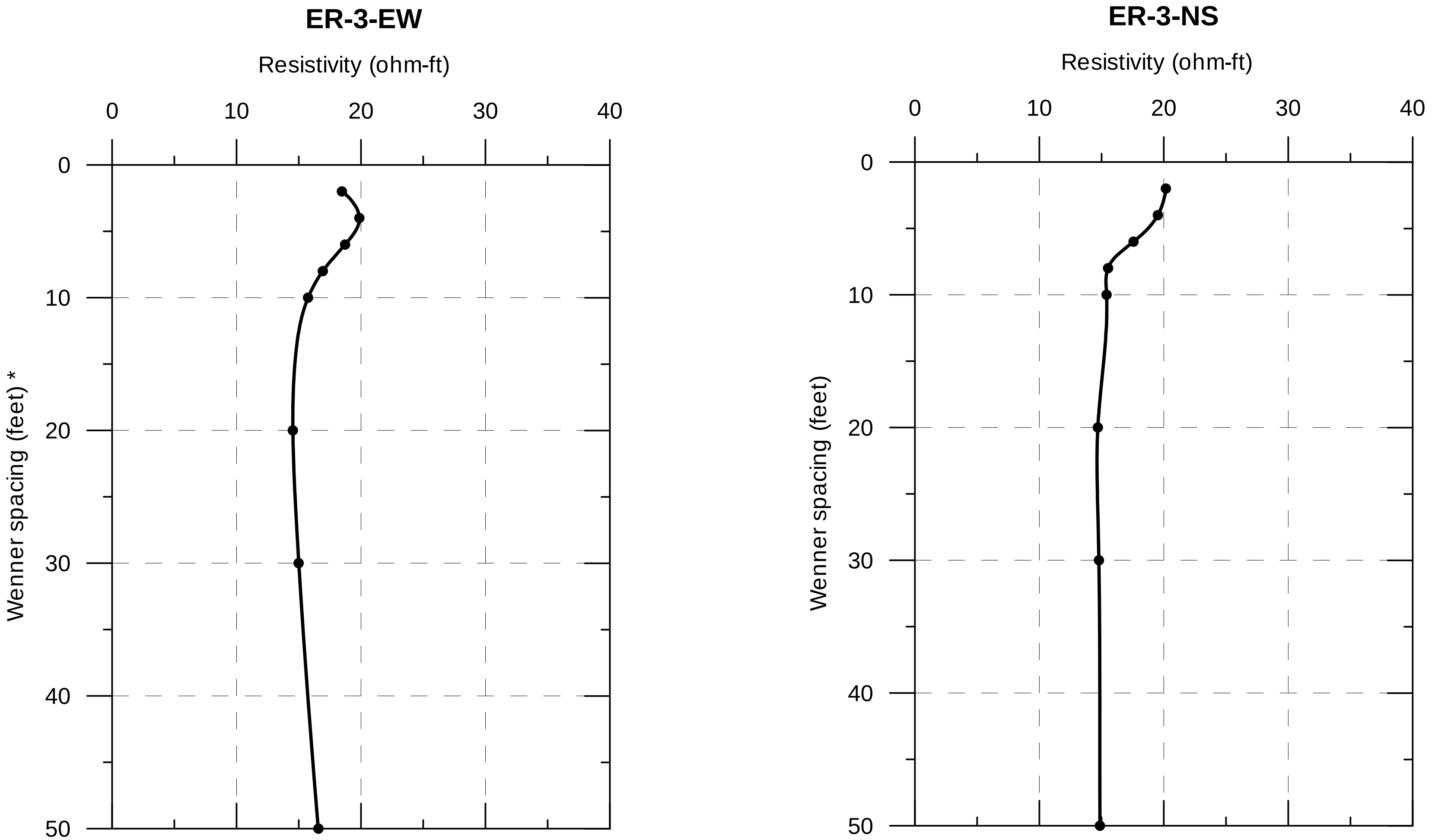
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 3

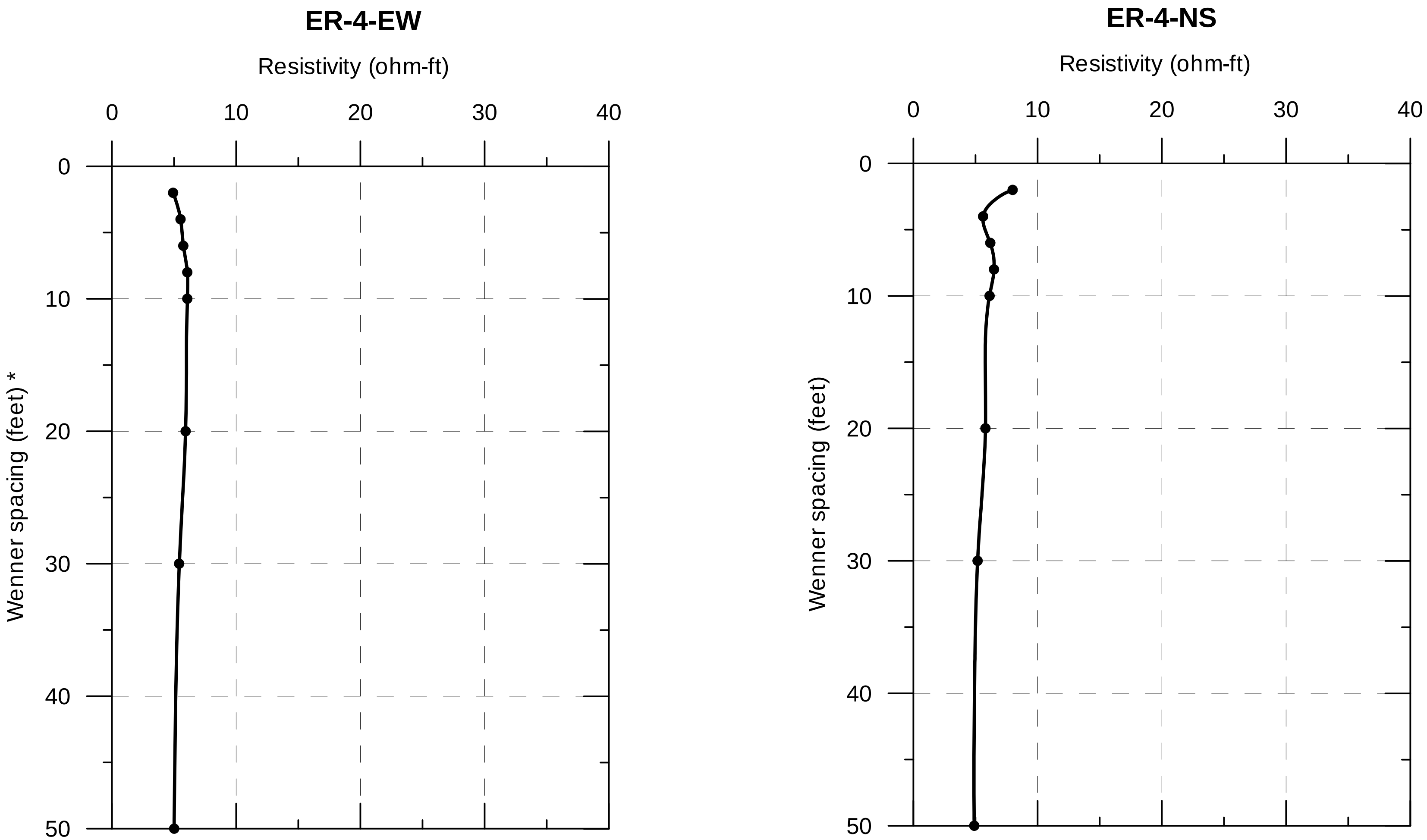
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 4

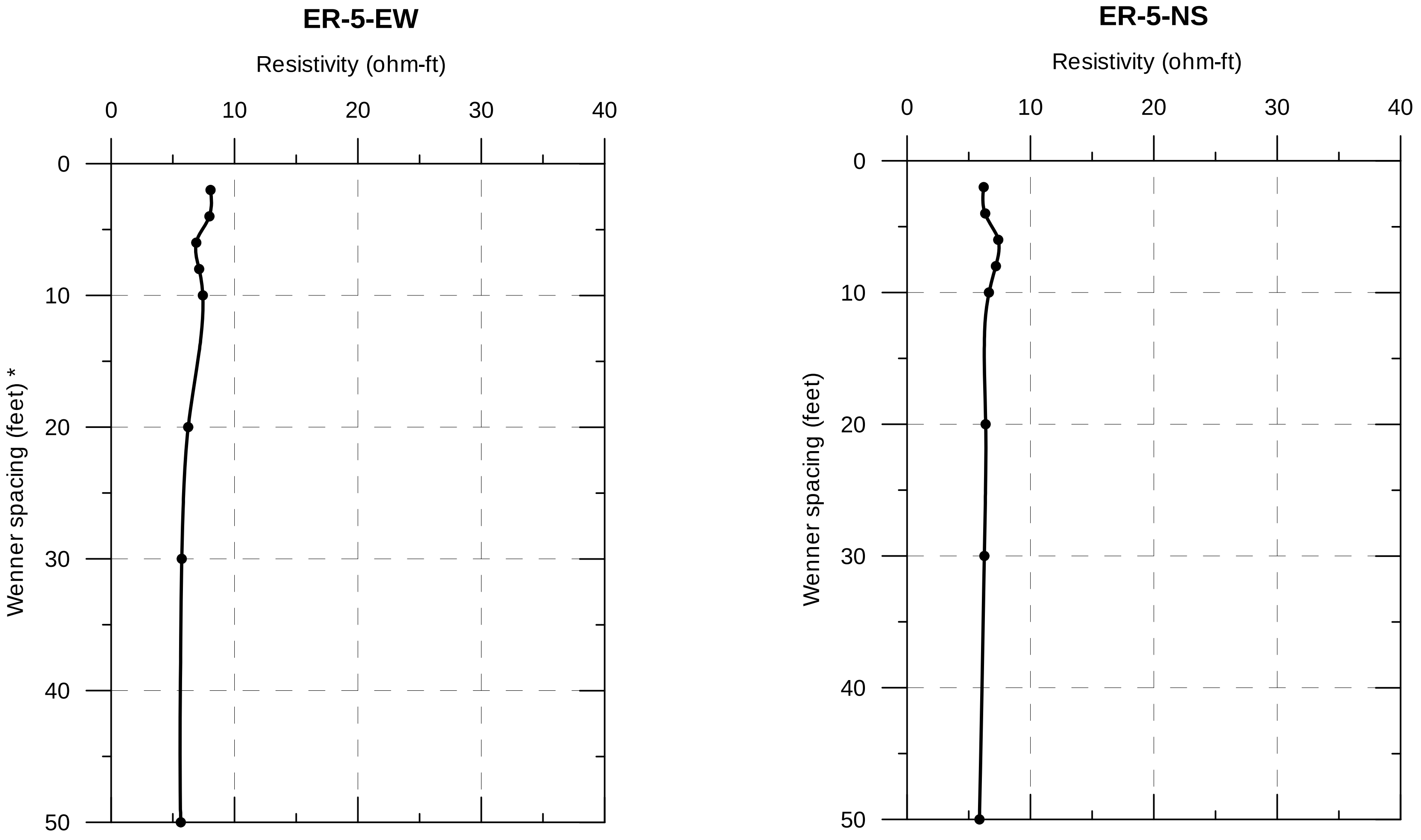
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 5

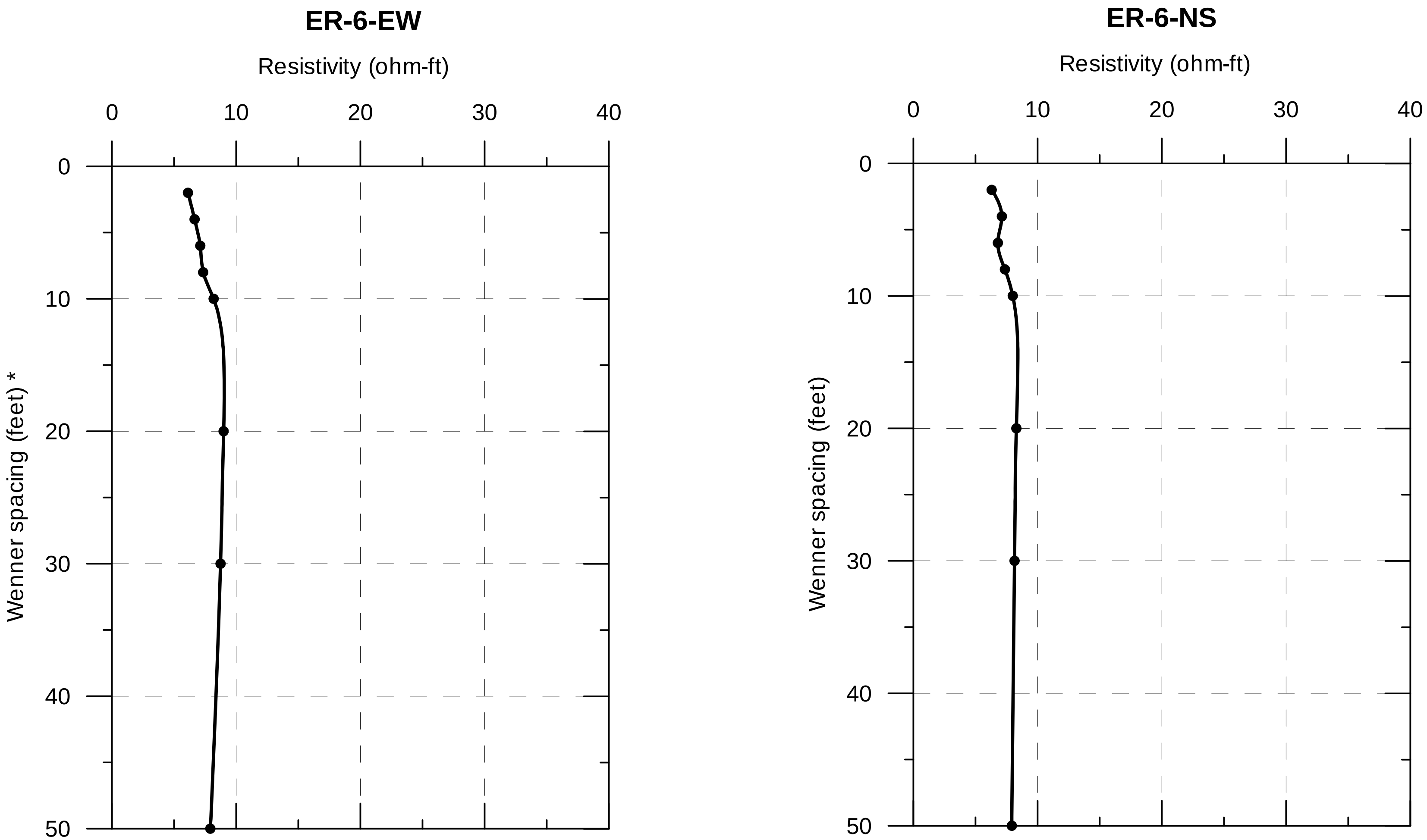
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 6

Centinela Project -- Resistivity Data



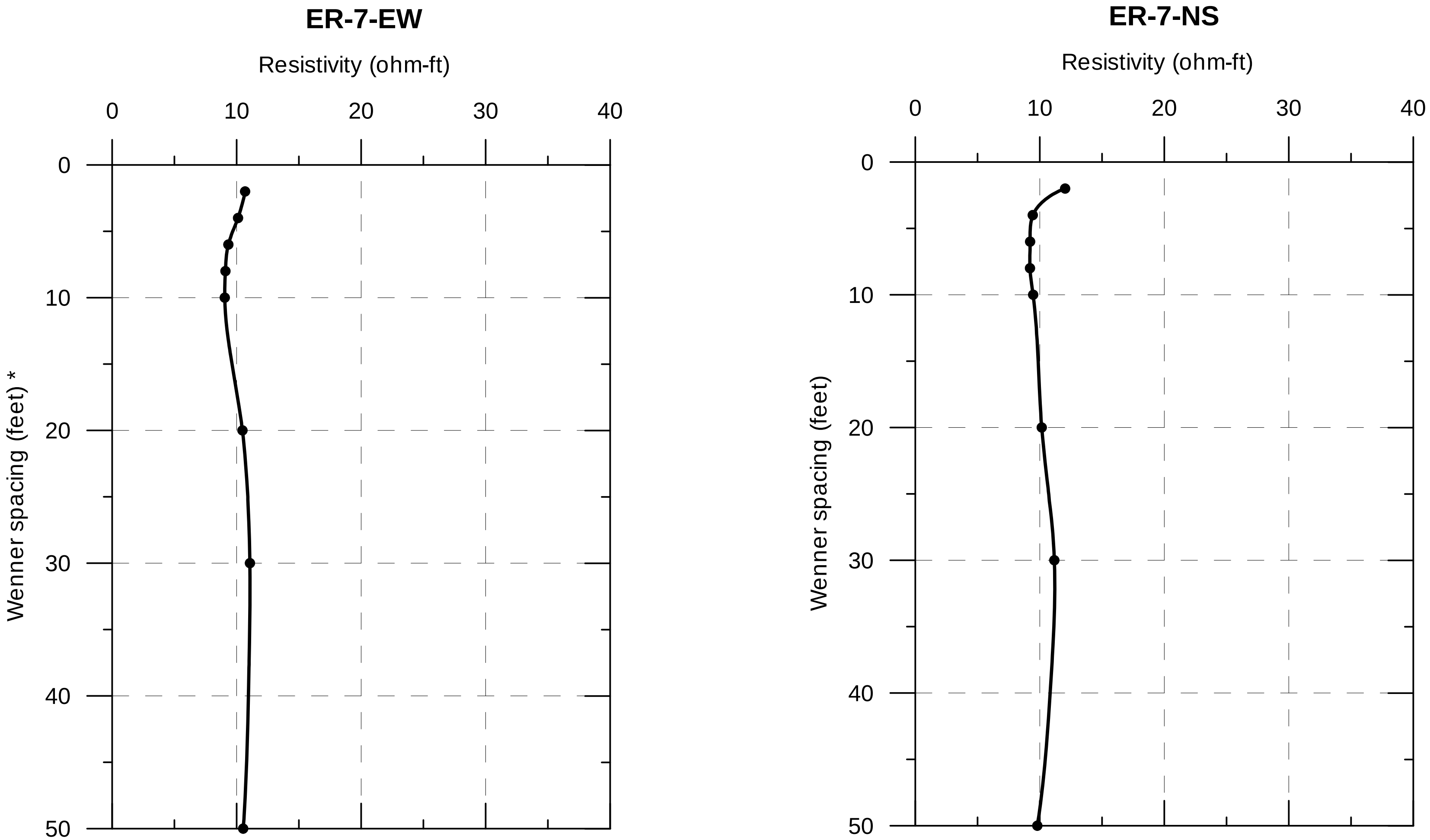
ER-6-EW

ER-6-NS

* Approximately equal to
penetration depth

Figure 7

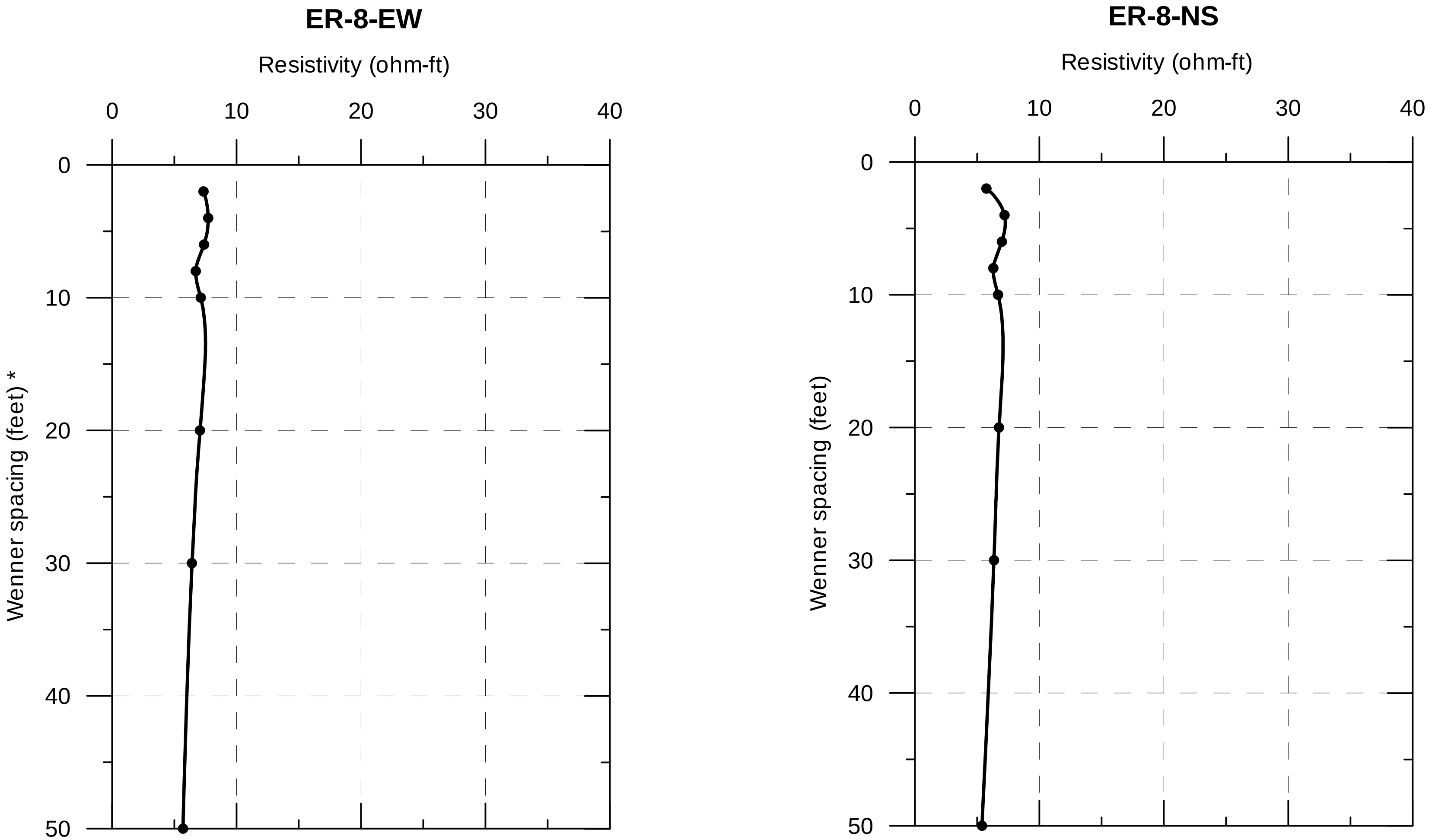
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 8

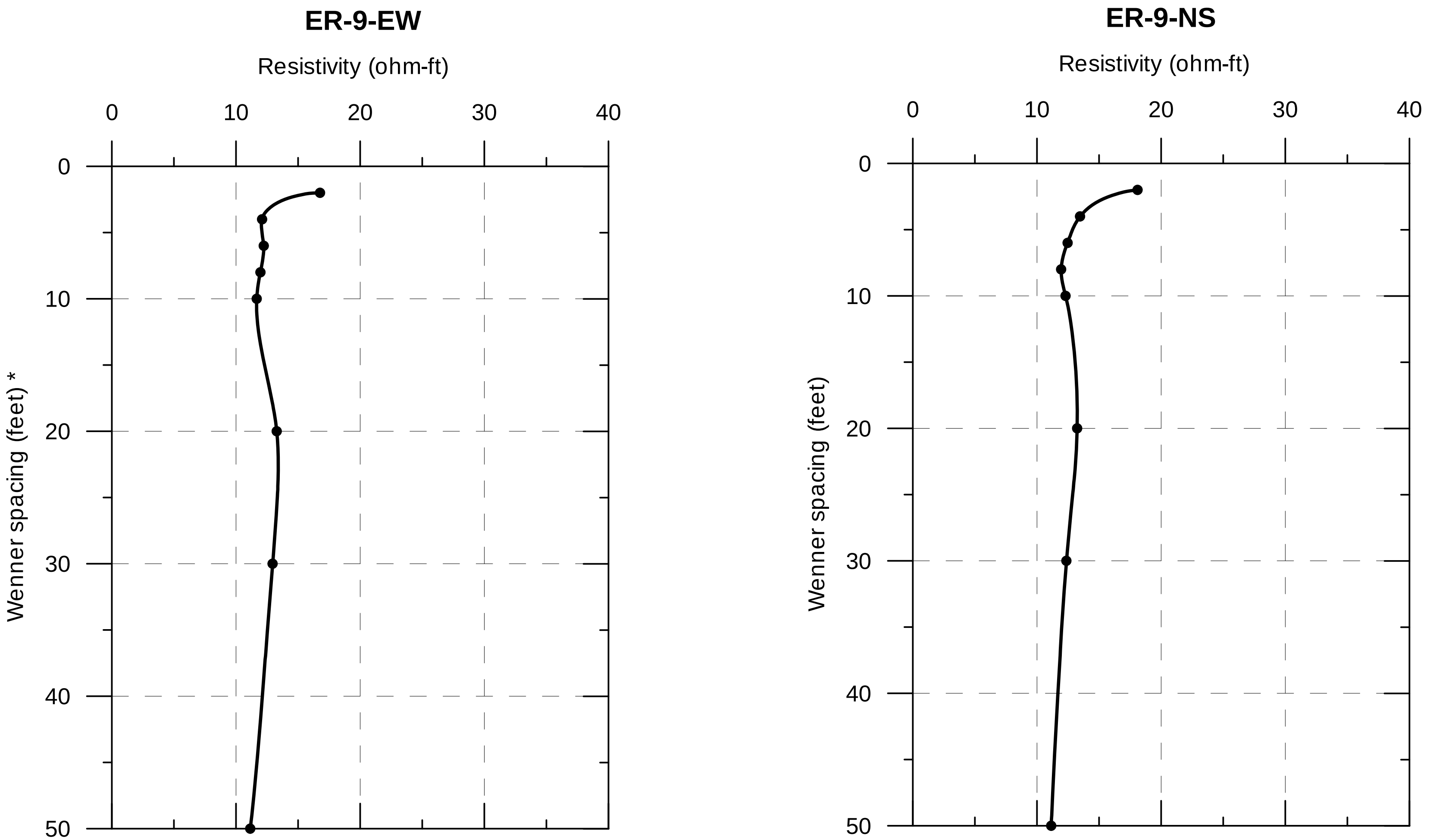
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 9

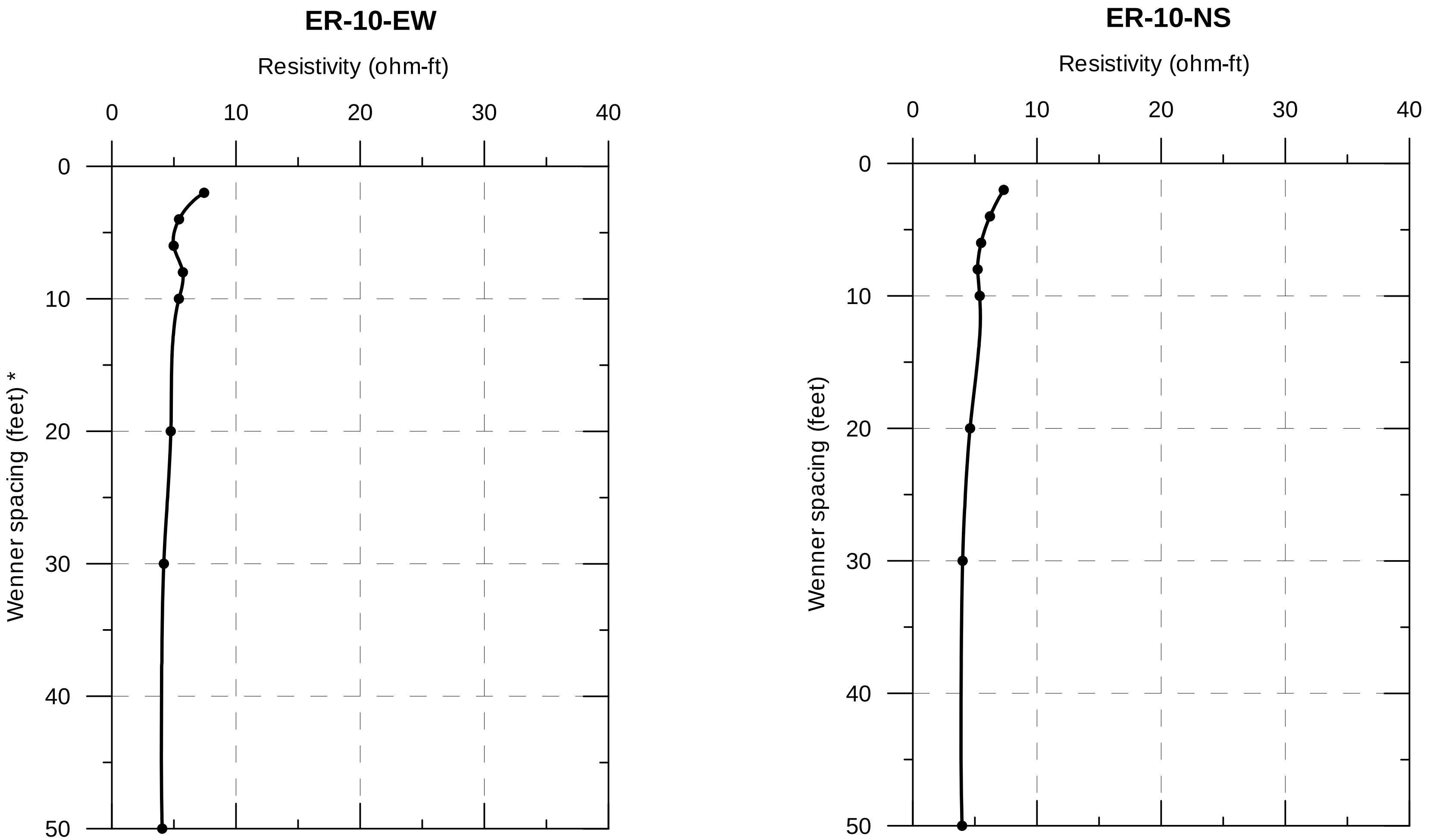
Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 10

Centinela Project -- Resistivity Data



ER-10-EW

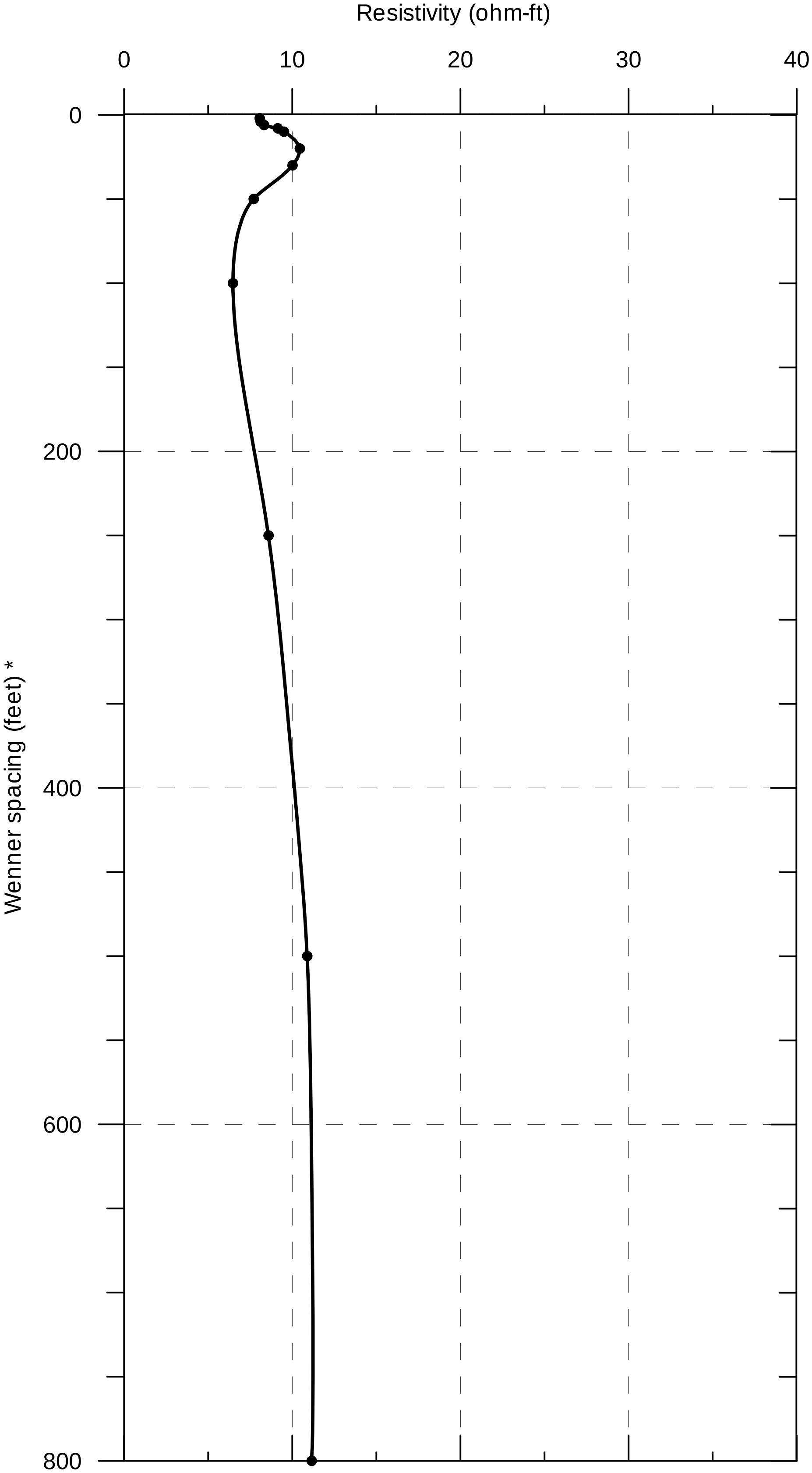
ER-10-NS

* Approximately equal to
penetration depth

Figure 11

Centinela Project -- Resistivity Data

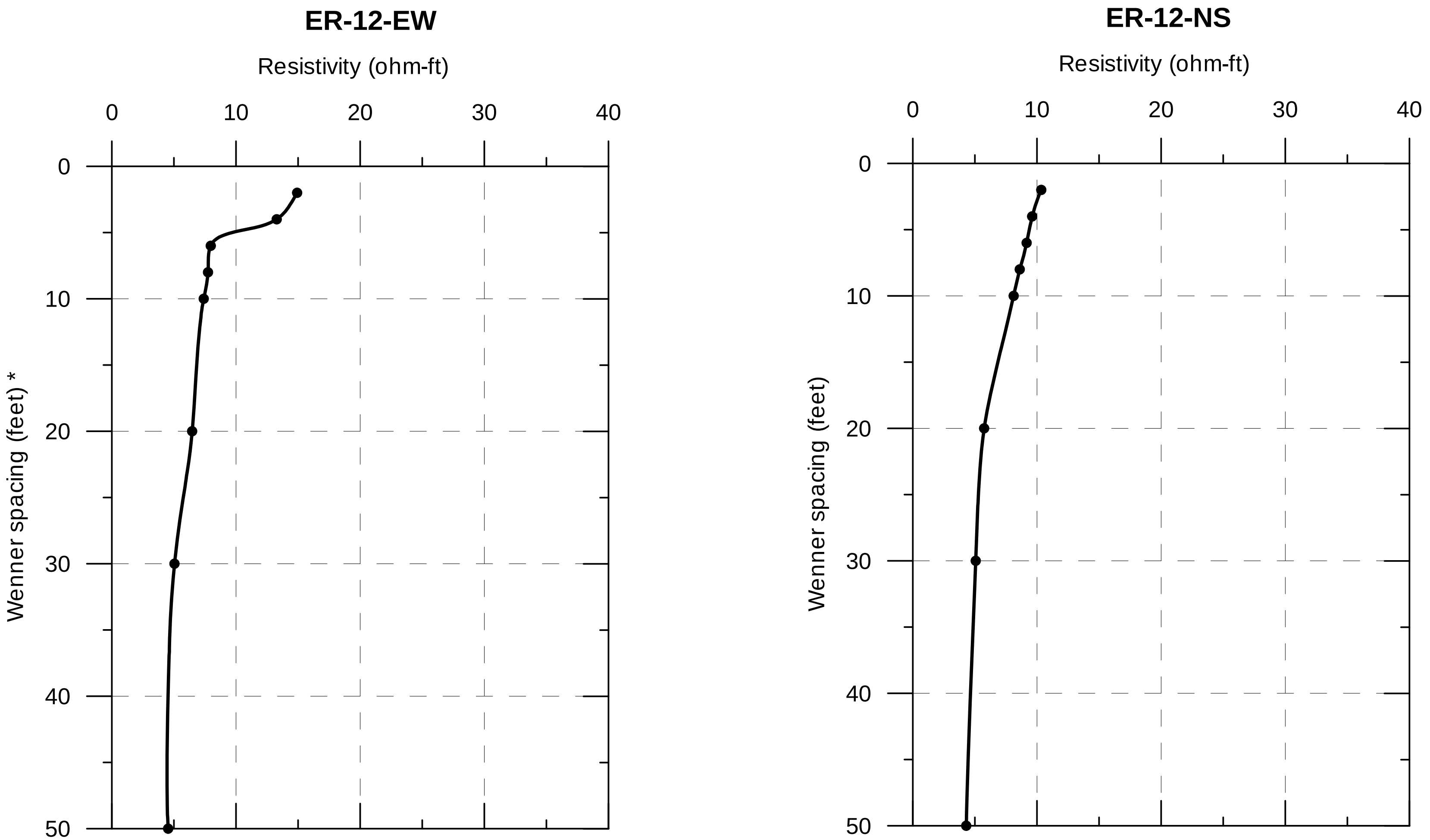
ER-11-EW



* Approximately equal to
penetration depth

Figure 12

Centinela Project -- Resistivity Data



* Approximately equal to
penetration depth

Figure 13

APPENDIX E
SITE PHOTOGRAPHS




APPENDIX F
RESULTS OF LATERAL LOAD ANALYSES

W6x8Cl1.out

```
                    LATERALLY LOADED PILE PROGRAM

                               PILEDG

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W6x8.5 free head , load = 1400 lb, ht = 48 in. Ixx, L= 9 ft


 INPUT DATA FOR COMPUTING P-Y CURVES
 ***** **** *** ********* *** ******

 NO. OF LAYERS =   2


 INPUT DATA FOR LAYER NO.=  1 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


   0.000    4.000    7.000    0.001    0.010    0.000    0.001    1.000



 INPUT DATA FOR LAYER NO.=  1 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


  48.000    4.000    7.000    0.001    0.010    0.000    0.001    1.000



 INPUT DATA FOR LAYER NO.=  2 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


  48.000    4.000    7.000    0.060    0.010    0.000    0.330    1.000



 INPUT DATA FOR LAYER NO.=  2 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


 156.000    4.000    7.000    0.060    0.010    0.000    1.000    1.000
```

```
ITERATION INFORMATION


 1             1.364214780338523
 2             1.267631042713078
 3             1.130795547975094
 4             1.069760023064469
 5             1.041349278354352
 6             1.027382139792021
 7             1.020965368498227
 8             1.018231994437913
 9             1.01702705399237
 10            1.016491691303028

W6x8.5 free head , load = 1400 lb, ht = 48 in. Ixx, L= 9 ft


INPUT INFORMATION
*****************
SHEAR           = 1400 LBS.
MOMENT          = 0 LBS-IN
KODE            = 1
DIAMETER        = 4  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 26
PILE LENGTH     = 13 FT.
TOLERANCE       = 1.01702705399237D-03 IN.

   P - Y DATA
   **********
DEPTH TO P-Y   Y,IN.      P,LB/IN.
CURVE,IN.
************   *****      ********

     0.000      0.000      0.000
     0.000      0.013      0.018
     0.000      0.025      0.024
     0.000      0.050      0.032
     0.000      0.100      0.042
     0.000      0.200      0.055
     0.000      0.400      0.073
     0.000      0.800      0.084
     0.000      4.000      0.084
    48.000      0.000      0.000
    48.000      0.013      0.055
    48.000      0.025      0.072
    48.000      0.050      0.095
    48.000      0.100      0.126
    48.000      0.200      0.166
    48.000      0.400      0.219
    48.000      0.800      0.252
    48.000      4.000      0.252
    48.000      0.000      0.000
    48.000      0.013     18.099
    48.000      0.025     23.881
    48.000      0.050     31.512
    48.000      0.100     41.580
    48.000      0.200     54.865
    48.000      0.400     72.395
    48.000      0.800     83.160
    48.000      4.000     83.160
   156.000      0.000      0.000
   156.000      0.013     54.845
   156.000      0.025     72.368
   156.000      0.050     95.490
   156.000      0.100    126.000
   156.000      0.200    166.258
   156.000      0.400    219.379
   156.000      0.800    252.000
   156.000      4.000    252.000
```

```
W6x8.5 free head , load = 1400 lb, ht = 48 in. Ixx, L= 9 ft



OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.02         0.00         0.08        -0.08   0.4470D+09
      0.50         0.93         0.70         0.11        -0.10   0.4470D+09
      1.00         0.84         1.40         0.15        -0.13   0.4470D+09
      1.50         0.75         2.10         0.19        -0.14   0.4470D+09
      2.00         0.67         2.80         0.24        -0.16   0.4470D+09
      2.50         0.58         3.50         0.30        -0.18   0.4470D+09
      3.00         0.51         4.19         0.38        -0.19   0.4470D+09
      3.50         0.43         4.89         0.47        -0.20   0.4470D+09
      4.00         0.36         5.59         0.58        -0.21   0.4470D+09
      4.50         0.29         6.28       238.31       -70.27   0.4470D+09
      5.00         0.24         6.77       301.06       -71.07   0.4470D+09
      5.50         0.18         7.04       383.61       -70.50   0.4470D+09
      6.00         0.14         7.10       489.20       -67.67   0.4470D+09
      6.50         0.10         6.96       650.63       -64.89   0.4470D+09
      7.00         0.07         6.62       866.36       -58.80   0.4470D+09
      7.50         0.04         6.11      1230.37       -52.17   0.4470D+09
      8.00         0.02         5.44      1902.60       -43.44   0.4470D+09
      8.50         0.01         4.64      2917.74       -24.84   0.4470D+09
      9.00        -0.00         3.76      3081.05         4.07   0.4470D+09
      9.50        -0.01         2.90      3244.37        24.40   0.4470D+09
     10.00        -0.01         2.11      3407.68        37.21   0.4470D+09
     10.50        -0.01         1.43      3571.00        43.85   0.4470D+09
     11.00        -0.01         0.88      3734.31        45.78   0.4470D+09
     11.50        -0.01         0.48      3897.63        44.36   0.4470D+09
     12.00        -0.01         0.20      4060.94        40.79   0.4470D+09
     12.50        -0.01         0.05      4224.26        35.98   0.4470D+09
     13.00        -0.01         0.00      4387.57        30.46   0.4470D+09


                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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L = 8 ft

ITERATION INFORMATION

1             1.48242169011017
 2             1.376375394338547
 3             1.218279231585583
 4             1.139962702557557
 5             1.10134943715193
 6             1.080614610750014
 7             1.068975388196952
 8             1.062307696751132
 9             1.05843626228087
 10            1.056167358987638
 11            1.054828335878704
 12            1.054059052815711
```

```
L = 8 ft



INPUT INFORMATION
*****************
SHEAR           = 1400 LBS.
MOMENT          = 0 LBS-IN
KODE            = 1
DIAMETER        = 4  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 24
PILE LENGTH     = 12 FT.
TOLERANCE       = 1.054828335878704D-03 IN.




L = 8 ft



OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.05         0.00         0.08        -0.08   0.4470D+09
      0.50         0.96         0.70         0.11        -0.10   0.4470D+09
      1.00         0.87         1.40         0.14        -0.13   0.4470D+09
      1.50         0.78         2.10         0.19        -0.15   0.4470D+09
      2.00         0.70         2.80         0.23        -0.16   0.4470D+09
      2.50         0.61         3.50         0.29        -0.18   0.4470D+09
      3.00         0.53         4.19         0.36        -0.19   0.4470D+09
      3.50         0.45         4.89         0.45        -0.20   0.4470D+09
      4.00         0.38         5.59         0.56        -0.21   0.4470D+09
      4.50         0.31         6.28       229.52       -72.16   0.4470D+09
      5.00         0.25         6.76       287.62       -72.94   0.4470D+09
      5.50         0.20         7.02       367.52       -73.25   0.4470D+09
      6.00         0.15         7.06       462.77       -70.26   0.4470D+09
      6.50         0.11         6.89       605.04       -67.27   0.4470D+09
      7.00         0.08         6.52       802.44       -61.94   0.4470D+09
      7.50         0.05         5.96      1132.24       -56.04   0.4470D+09
      8.00         0.03         5.24      1698.45       -46.82   0.4470D+09
      8.50         0.01         4.37      2917.74       -31.23   0.4470D+09
      9.00        -0.00         3.41      3081.05         5.95   0.4470D+09
      9.50        -0.01         2.47      3244.37        36.57   0.4470D+09
     10.00        -0.02         1.64      2672.90        48.70   0.4470D+09
     10.50        -0.02         0.95      2422.27        57.14   0.4470D+09
     11.00        -0.03         0.44      2273.75        63.74   0.4470D+09
     11.50        -0.03         0.11      2177.66        69.81   0.4470D+09
     12.00        -0.04         0.00      2114.61        76.07   0.4470D+09




                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG
```

```
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L = 7 ft

ITERATION INFORMATION

 1             1.657368979093098
 2             1.604524973046956
 3             1.457792566491797
 4             1.375419415049293
 5             1.328209169068813
 6             1.300504824164797
 7             1.283517565909403
 8             1.272839225068858
 9             1.26602310811537
 10            1.261629714293187
 11            1.258855342599741
 12            1.257110366880274
 13            1.25601073494206



L = 7 ft

INPUT INFORMATION
*****************
SHEAR           = 1400 LBS.
MOMENT          = 0 LBS-IN
KODE            = 1
DIAMETER        = 4  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 22
PILE LENGTH     = 11 FT.
TOLERANCE       = 1.257110366880274D-03 IN.

L = 7 ft

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.26        -0.00         0.07        -0.08   0.4470D+09
      0.50         1.15         0.70         0.09        -0.10   0.4470D+09
      1.00         1.05         1.40         0.12        -0.13   0.4470D+09
      1.50         0.95         2.10         0.15        -0.15   0.4470D+09
      2.00         0.85         2.80         0.20        -0.17   0.4470D+09
      2.50         0.75         3.50         0.25        -0.19   0.4470D+09
      3.00         0.66         4.19         0.30        -0.20   0.4470D+09
      3.50         0.57         4.89         0.37        -0.21   0.4470D+09
      4.00         0.49         5.59         0.46        -0.23   0.4470D+09
      4.50         0.41         6.28       197.70       -80.72   0.4470D+09
      5.00         0.34         6.74       243.63       -81.74   0.4470D+09
      5.50         0.27         6.94       302.66       -81.48   0.4470D+09
      6.00         0.21         6.91       385.28       -80.76   0.4470D+09
      6.50         0.16         6.63       489.72       -76.74   0.4470D+09
      7.00         0.11         6.12       652.57       -71.90   0.4470D+09
      7.50         0.07         5.40       910.66       -63.38   0.4470D+09
      8.00         0.03         4.48      1482.01       -50.72   0.4470D+09
      8.50         0.00         3.42      2917.74        -9.30   0.4470D+09
      9.00        -0.02         2.32      2049.59        50.32   0.4470D+09
      9.50        -0.05         1.38      1409.13        70.52   0.4470D+09
     10.00        -0.07         0.65      1152.41        85.52   0.4470D+09
     10.50        -0.10         0.17      1036.40       101.30   0.4470D+09
     11.00        -0.12         0.00       943.70       114.29   0.4470D+09
```

```
                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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L = 6.0 ft



ITERATION INFORMATION



 1             1.911771225845311
 2             2.087185155885402
 3             2.073149270020707
 4             2.073212850742645
 5             2.07900376439162
 6             2.085181465663469
 7             2.09018191386015
 8             2.093642517359088
 9             2.095970120199336
 10            2.097519924968151


L = 6.0 ft

INPUT INFORMATION
*****************
SHEAR           = 1400 LBS.
MOMENT          = 0 LBS-IN
KODE            = 1
DIAMETER        = 4  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 20
PILE LENGTH     = 10 FT.
TOLERANCE       = 2.095970120199336D-03 IN.

L = 6.0 ft

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         2.10         0.00         0.04        -0.08   0.4470D+09
      0.50         1.94         0.70         0.05        -0.11   0.4470D+09
      1.00         1.78         1.40         0.07        -0.13   0.4470D+09
      1.50         1.63         2.10         0.09        -0.15   0.4470D+09
      2.00         1.47         2.80         0.11        -0.17   0.4470D+09
      2.50         1.32         3.50         0.14        -0.19   0.4470D+09
      3.00         1.17         4.19         0.18        -0.21   0.4470D+09
      3.50         1.03         4.89         0.22        -0.23   0.4470D+09
      4.00         0.89         5.59         0.28        -0.25   0.4470D+09
      4.50         0.76         6.28       120.48       -91.35   0.4470D+09
      5.00         0.63         6.70       152.84       -96.42   0.4470D+09
      5.50         0.51         6.84       197.97      -100.94   0.4470D+09
      6.00         0.40         6.67       264.33      -104.55   0.4470D+09
      6.50         0.29         6.18       340.34       -97.89   0.4470D+09
      7.00         0.19         5.40       478.62       -88.88   0.4470D+09
      7.50         0.09         4.36       792.42       -70.52   0.4470D+09
      8.00        -0.00         3.10      2754.42         9.66   0.4470D+09
      8.50        -0.09         1.88       870.45        80.95   0.4470D+09
      9.00        -0.18         0.89       616.11       111.32   0.4470D+09
      9.50        -0.27         0.24       509.35       136.25   0.4470D+09
     10.00        -0.35         0.00       454.63       160.98   0.4470D+09
```

W6x15cl.out

```
                       LATERALLY LOADED PILE PROGRAM

                                  PILEDG

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W6x15 free head , load = 350 lb, ht = 48 in. Ixx, L= 9 ft

 INPUT DATA FOR COMPUTING P-Y CURVES
 ***** **** *** ********* *** ******

 NO. OF LAYERS =   2



 INPUT DATA FOR LAYER NO.=  1 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


   0.000    6.000    7.000    0.001    0.010    0.000    0.001    1.000




 INPUT DATA FOR LAYER NO.=  1 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


  48.000    6.000    7.000    0.001    0.010    0.000    0.001    1.000




 INPUT DATA FOR LAYER NO.=  2 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


  48.000    6.000    7.000    0.060    0.010    0.000    0.330    1.000




 INPUT DATA FOR LAYER NO.=  2 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


 156.000    6.000    7.000    0.060    0.010    0.000    1.000    1.000
```

```
ITERATION INFORMATION



 1             2.50248013307659
 2             2.132843740300918
 3             1.909125375048252
 4             1.809564188995994
 5             1.761168275916296
 6             1.735411223648254
 7             1.721734094974019
 8             1.714202216599806
 9             1.709913005226414
 10            1.707404098466106
 11            1.705916348412337
```

```
W6x15 free head , load = 350 lb, ht = 48 in. Ixx, L= 9 ft
```

```
INPUT INFORMATION
*****************
SHEAR           = 350 LBS.
MOMENT          = 240000 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 26
PILE LENGTH     = 13 FT.
TOLERANCE       = 1.707404098466106D-03 IN.

   P - Y DATA
   **********
DEPTH TO P-Y   Y,IN.      P,LB/IN.
CURVE,IN.
************   *****      ********

     0.000      0.000      0.000
     0.000      0.019      0.027
     0.000      0.038      0.036
     0.000      0.075      0.048
     0.000      0.150      0.063
     0.000      0.300      0.083
     0.000      0.600      0.110
     0.000      1.200      0.126
     0.000      6.000      0.126
    48.000      0.000      0.000
    48.000      0.019      0.082
    48.000      0.038      0.109
    48.000      0.075      0.143
    48.000      0.150      0.189
    48.000      0.300      0.249
    48.000      0.600      0.329
    48.000      1.200      0.378
    48.000      6.000      0.378
    48.000      0.000      0.000
    48.000      0.019     27.148
    48.000      0.038     35.822
    48.000      0.075     47.268
    48.000      0.150     62.370
```

```
    48.000      0.300     82.298
    48.000      0.600    108.592
    48.000      1.200    124.740
    48.000      6.000    124.740
   156.000      0.000      0.000
   156.000      0.019     82.267
   156.000      0.038    108.552
   156.000      0.075    143.235
   156.000      0.150    189.000
   156.000      0.300    249.387
   156.000      0.600    329.068
   156.000      1.200    378.000
   156.000      6.000    378.000
```

```
W6x15 free head , load = 350 lb, ht = 48 in. Ixx, L= 9 ft
```

```
OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00          1.71        20.00          0.07        -0.13   0.8730D+09
      0.50          1.52        20.17          0.10        -0.16   0.8730D+09
      1.00          1.35        20.35          0.14        -0.19   0.8730D+09
      1.50          1.19        20.52          0.18        -0.22   0.8730D+09
      2.00          1.04        20.70          0.23        -0.24   0.8730D+09
      2.50          0.90        20.87          0.29        -0.26   0.8730D+09
      3.00          0.77        21.04          0.37        -0.29   0.8730D+09
      3.50          0.65        21.21          0.47        -0.31   0.8730D+09
      4.00          0.54        21.38          0.58        -0.31   0.8730D+09
      4.50          0.44        21.55        238.02      -105.41   0.8730D+09
      5.00          0.35        21.40        300.57      -106.62   0.8730D+09
      5.50          0.28        20.93        382.34      -105.97   0.8730D+09
      6.00          0.21        20.15        485.46      -101.94   0.8730D+09
      6.50          0.15        19.06        641.24       -97.95   0.8730D+09
      7.00          0.10        17.67        850.04       -89.22   0.8730D+09
      7.50          0.07        16.02       1205.90       -79.49   0.8730D+09
      8.00          0.03        14.13       1886.39       -65.64   0.8730D+09
      8.50          0.01        12.04       2917.74       -31.13   0.8730D+09
      9.00         -0.01         9.86       3081.05        23.10   0.8730D+09
      9.50         -0.02         7.75       3016.28        62.69   0.8730D+09
     10.00         -0.03         5.83       2516.82        76.10   0.8730D+09
     10.50         -0.04         4.13       2369.05        87.19   0.8730D+09
     11.00         -0.04         2.70       2294.47        94.83   0.8730D+09
     11.50         -0.04         1.55       2280.25       101.52   0.8730D+09
     12.00         -0.05         0.70       2295.46       107.77   0.8730D+09
     12.50         -0.05         0.18       2322.55       113.87   0.8730D+09
     13.00         -0.05         0.00       2352.70       120.03   0.8730D+09
```

```
                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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L = 8 ft
ITERATION INFORMATION

1             2.857507796829235
 2             2.524675144647636
 3             2.263342285450055
 4             2.128817223671689
 5             2.055879878286583
 6             2.01320813817056
 7             1.988047889047274
 8             1.97347673931759
 9             1.964916845518038
 10            1.959819985568195
 11            1.956759164479625
 12            1.954911278922421
L = 8 ft

INPUT INFORMATION
*****************
SHEAR           = 350 LBS.
MOMENT          = 240000 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 24
PILE LENGTH     = 12 FT.
TOLERANCE       = 1.956759164479625D-03 IN.

L = 8 ft

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.95        20.00         0.06        -0.13   0.8730D+09
      0.50         1.76        20.17         0.09        -0.16   0.8730D+09
      1.00         1.57        20.35         0.12        -0.19   0.8730D+09
      1.50         1.40        20.52         0.16        -0.22   0.8730D+09
      2.00         1.23        20.70         0.20        -0.25   0.8730D+09
      2.50         1.08        20.87         0.26        -0.28   0.8730D+09
      3.00         0.93        21.04         0.32        -0.30   0.8730D+09
      3.50         0.80        21.21         0.40        -0.32   0.8730D+09
      4.00         0.67        21.38         0.50        -0.33   0.8730D+09
      4.50         0.56        21.55       208.39      -116.97   0.8730D+09
      5.00         0.46        21.37       256.81      -117.80   0.8730D+09
      5.50         0.37        20.83       321.40      -117.83   0.8730D+09
      6.00         0.28        19.94       408.61      -116.39   0.8730D+09
      6.50         0.21        18.70       518.87      -110.49   0.8730D+09
      7.00         0.15        17.13       695.25      -104.50   0.8730D+09
      7.50         0.10        15.25       957.82       -92.08   0.8730D+09
      8.00         0.05        13.09      1515.29       -75.03   0.8730D+09
      8.50         0.01        10.71      2917.74       -27.36   0.8730D+09
      9.00        -0.03         8.24      2520.72        64.19   0.8730D+09
      9.50        -0.06         5.97      1651.28        92.85   0.8730D+09
     10.00        -0.08         3.97      1371.00       115.22   0.8730D+09
     10.50        -0.11         2.32      1215.55       133.58   0.8730D+09
     11.00        -0.13         1.07      1133.14       152.51   0.8730D+09
     11.50        -0.16         0.28      1074.21       170.54   0.8730D+09
     12.00        -0.18         0.00      1021.04       186.63   0.8730D+09
```

```
                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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L = 10 ft


ITERATION INFORMATION


 1             2.268725215544814
 2             1.956876702835385
 3             1.782741091123557
 4             1.713627055139587
 5             1.683240915045692
 6             1.669393445544064
 7             1.663271911375255
 8             1.660781413205316
 9             1.65980076712635





L = 10 ft



INPUT INFORMATION
*****************
SHEAR           = 350 LBS.
MOMENT          = 240000 LBS-IN
KODE            = 1
DIAMETER        = 4  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 28
PILE LENGTH     = 14 FT.
TOLERANCE       = 1.660781413205316D-03 IN.


L = 10 ft

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.66        20.00         0.08         -0.13   0.8730D+09
      0.50         1.48        20.17         0.11         -0.16   0.8730D+09
      1.00         1.31        20.35         0.14         -0.19   0.8730D+09
      1.50         1.15        20.52         0.19         -0.22   0.8730D+09
      2.00         1.01        20.70         0.24         -0.24   0.8730D+09
      2.50         0.87        20.87         0.30         -0.26   0.8730D+09
      3.00         0.74        21.04         0.38         -0.28   0.8730D+09
      3.50         0.62        21.21         0.49         -0.30   0.8730D+09
      4.00         0.52        21.38         0.59         -0.31   0.8730D+09
      4.50         0.42        21.55       246.05       -103.13   0.8730D+09
      5.00         0.33        21.41       312.97       -104.37   0.8730D+09
      5.50         0.26        20.96       397.29       -102.67   0.8730D+09
      6.00         0.19        20.19       510.18        -98.84   0.8730D+09
      6.50         0.14        19.14       676.05        -94.00   0.8730D+09
      7.00         0.09        17.80       911.28        -85.48   0.8730D+09
```

```
      7.50         0.06        16.20      1304.28       -74.84   0.8730D+09
      8.00         0.03        14.38      2088.30       -60.50   0.8730D+09
      8.50         0.01        12.38      2917.74       -22.41   0.8730D+09
      9.00        -0.01        10.31      3081.05        23.08   0.8730D+09
      9.50        -0.02         8.31      3244.37        56.97   0.8730D+09
     10.00        -0.02         6.48      2934.03        69.01   0.8730D+09
     10.50        -0.03         4.85      2870.43        75.42   0.8730D+09
     11.00        -0.03         3.46      2976.32        79.26   0.8730D+09
     11.50        -0.03         2.30      3204.84        81.00   0.8730D+09
     12.00        -0.02         1.38      3560.63        81.11   0.8730D+09
     12.50        -0.02         0.71      4082.56        80.03   0.8730D+09
     13.00        -0.02         0.28      4387.57        70.52   0.8730D+09
     13.50        -0.01         0.06      4387.57        54.43   0.8730D+09
     14.00        -0.01         0.00      4387.57        38.22   0.8730D+09



                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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L= 9 ft"



ITERATION INFORMATION



 1             4.32769792362377
 2             4.939266428723782
 3             4.981493478613257



L= 9 ft"



INPUT INFORMATION
*****************
SHEAR           = 5000 LBS.
MOMENT          = 0 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 26
PILE LENGTH     = 13 FT.
TOLERANCE       = 4.939266428723782D-02 IN.





L= 9 ft"




OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         4.98         0.00         0.03        -0.13   0.8730D+09
      0.50         4.66         2.50         0.03        -0.16   0.8730D+09
      1.00         4.34         5.00         0.04        -0.19   0.8730D+09
```

```
    1.50         4.02         7.50         0.06        -0.22   0.8730D+09
    2.00         3.70        10.00         0.07        -0.25   0.8730D+09
    2.50         3.39        12.49         0.08        -0.29   0.8730D+09
    3.00         3.09        14.99         0.10        -0.32   0.8730D+09
    3.50         2.79        17.49         0.13        -0.35   0.8730D+09
    4.00         2.50        19.98         0.15        -0.38   0.8730D+09
    4.50         2.23        22.47        63.63      -141.68   0.8730D+09
    5.00         1.96        24.54        79.87      -156.51   0.8730D+09
    5.50         1.70        26.14       100.64      -171.56   0.8730D+09
    6.00         1.46        27.22       127.78      -186.92   0.8730D+09
    6.50         1.23        27.75       163.82      -202.22   0.8730D+09
    7.00         1.02        27.66       204.53      -208.57   0.8730D+09
    7.50         0.82        26.95       262.85      -215.20   0.8730D+09
    8.00         0.63        25.60       349.85      -220.78   0.8730D+09
    8.50         0.46        23.58       454.97      -207.50   0.8730D+09
    9.00         0.29        20.94       658.38      -192.74   0.8730D+09
    9.50         0.14        17.73      1295.48      -181.11   0.8730D+09
   10.00        -0.00        13.96      1655.13         7.26   0.8730D+09
   10.50        -0.14        10.23       847.62       120.08   0.8730D+09
   11.00        -0.27         6.85       655.10       179.42   0.8730D+09
   11.50        -0.40         4.01       557.49       224.50   0.8730D+09
   12.00        -0.53         1.84       507.96       268.99   0.8730D+09
   12.50        -0.66         0.48       448.62       294.06   0.8730D+09
   13.00        -0.78         0.00       408.03       318.75   0.8730D+09
```

W6x20c1.out

```
                           LATERALLY LOADED PILE PROGRAM

                                      PILEDG

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W6x20 free head , load = 350 lb, ht = 48 in. Ixx, L= 9 ft

 INPUT DATA FOR COMPUTING P-Y CURVES
 ***** **** *** ********* *** ******

 NO. OF LAYERS =   2


 INPUT DATA FOR LAYER NO.=  1 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


   0.000    6.000    7.000    0.001    0.010    0.000    0.001    1.000



 INPUT DATA FOR LAYER NO.=  1 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


  48.000    6.000    7.000    0.001    0.010    0.000    0.001    1.000



 INPUT DATA FOR LAYER NO.=  2 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


  48.000    6.000    7.000    0.060    0.010    0.000    0.330    1.000



 INPUT DATA FOR LAYER NO.=  2 SOIL TYPE= CLAY


 DEPTH,    DIAM.,   C  ,      GAMMA,   E50,   BETA,    CONST,   SLOPE
 INCH.     INCH.   PSI        PCI     IN/IN.  DEG.      -       FACTOR


 156.000    6.000    7.000    0.060    0.010    0.000    1.000    1.000
```

```
ITERATION INFORMATION

1             2.168219371905818
 2             1.658597299456999
 3             1.421957259774316
 4             1.320558614811077
 5             1.270462490716699
 6             1.244008512542012
 7             1.229937282918256
 8             1.222188367951519
 9             1.217782355138779
 10            1.215216564542716
 11            1.213700986831969
 12            1.212803501707513

W6x20 free head , load = 350 lb, ht = 48 in. Ixx, L= 9 ft


INPUT INFORMATION
*****************
SHEAR           = 350 LBS.
MOMENT          = 224520 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 26
PILE LENGTH     = 13 FT.
TOLERANCE       = 1.213700986831969D-03 IN.

   P - Y DATA
   **********
DEPTH TO P-Y   Y,IN.      P,LB/IN.
CURVE,IN.
************   *****      ********

     0.000      0.000      0.000
     0.000      0.019      0.027
     0.000      0.038      0.036
     0.000      0.075      0.048
     0.000      0.150      0.063
     0.000      0.300      0.083
     0.000      0.600      0.110
     0.000      1.200      0.126
     0.000      6.000      0.126
    48.000      0.000      0.000
    48.000      0.019      0.082
    48.000      0.038      0.109
    48.000      0.075      0.143
    48.000      0.150      0.189
    48.000      0.300      0.249
    48.000      0.600      0.329
    48.000      1.200      0.378
    48.000      6.000      0.378
    48.000      0.000      0.000
    48.000      0.019     27.148
    48.000      0.038     35.822
    48.000      0.075     47.268
    48.000      0.150     62.370
    48.000      0.300     82.298
    48.000      0.600    108.592
    48.000      1.200    124.740
    48.000      6.000    124.740
   156.000      0.000      0.000
   156.000      0.019     82.267
   156.000      0.038    108.552
```

```
   156.000      0.075    143.235
   156.000      0.150    189.000
   156.000      0.300    249.387
   156.000      0.600    329.068
   156.000      1.200    378.000
   156.000      6.000    378.000


W6x20 free head , load = 350 lb, ht = 48 in. Ixx, L= 9 ft


OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.21        18.71         0.10        -0.13   0.1230D+10
      0.50         1.09        18.88         0.14        -0.15   0.1230D+10
      1.00         0.97        19.06         0.19        -0.18   0.1230D+10
      1.50         0.86        19.23         0.24        -0.20   0.1230D+10
      2.00         0.75        19.41         0.30        -0.23   0.1230D+10
      2.50         0.66        19.58         0.38        -0.25   0.1230D+10
      3.00         0.56        19.75         0.47        -0.27   0.1230D+10
      3.50         0.48        19.92         0.57        -0.27   0.1230D+10
      4.00         0.40        20.09         0.69        -0.28   0.1230D+10
      4.50         0.33        20.26       284.03       -94.78   0.1230D+10
      5.00         0.27        20.15       354.62       -96.03   0.1230D+10
      5.50         0.21        19.74       441.59       -94.94   0.1230D+10
      6.00         0.17        19.05       562.92       -93.50   0.1230D+10
      6.50         0.12        18.09       720.10       -89.23   0.1230D+10
      7.00         0.09        16.85       948.67       -83.55   0.1230D+10
      7.50         0.06        15.36      1294.55       -75.27   0.1230D+10
      8.00         0.03        13.65      1922.46       -64.63   0.1230D+10
      8.50         0.01        11.74      2917.74       -40.51   0.1230D+10
      9.00        -0.00         9.72      3081.05         5.32   0.1230D+10
      9.50        -0.01         7.70      3244.37        45.17   0.1230D+10
     10.00        -0.02         5.83      2937.91        68.79   0.1230D+10
     10.50        -0.03         4.16      2610.40        80.55   0.1230D+10
     11.00        -0.04         2.73      2479.47        91.35   0.1230D+10
     11.50        -0.04         1.57      2379.66        99.63   0.1230D+10
     12.00        -0.05         0.72      2321.96       107.60   0.1230D+10
     12.50        -0.05         0.19      2287.44       115.65   0.1230D+10
     13.00        -0.05         0.00      2265.17       123.93   0.1230D+10

                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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L = 10 ft

ITERATION INFORMATION



 1             1.9230812086585
 2             1.477427332909761
 3             1.291881425114666
 4             1.218037576813306
 5             1.18526569710681
 6             1.169684752918775
 7             1.161797650006037
 8             1.158202478898234
 9             1.156761741632401
 10            1.156211007559776
```

```
L = 10 ft



INPUT INFORMATION
*****************
SHEAR           = 350 LBS.
MOMENT          = 224520 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 28
PILE LENGTH     = 14 FT.
TOLERANCE       = 1.156761741632401D-03 IN.


L = 10 ft

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.16        18.71         0.11        -0.12   0.1230D+10
      0.50         1.03        18.88         0.15        -0.15   0.1230D+10
      1.00         0.92        19.06         0.19        -0.18   0.1230D+10
      1.50         0.81        19.23         0.25        -0.20   0.1230D+10
      2.00         0.71        19.41         0.32        -0.23   0.1230D+10
      2.50         0.61        19.58         0.40        -0.25   0.1230D+10
      3.00         0.53        19.75         0.49        -0.26   0.1230D+10
      3.50         0.45        19.92         0.59        -0.26   0.1230D+10
      4.00         0.37        20.09         0.72        -0.27   0.1230D+10
      4.50         0.30        20.26       301.96       -91.97   0.1230D+10
      5.00         0.24        20.15       375.15       -91.81   0.1230D+10
      5.50         0.19        19.77       473.37       -90.87   0.1230D+10
      6.00         0.15        19.12       611.19       -89.32   0.1230D+10
      6.50         0.11        18.20       784.19       -83.93   0.1230D+10
      7.00         0.07        17.02      1060.73       -78.83   0.1230D+10
      7.50         0.05        15.61      1460.88       -69.50   0.1230D+10
      8.00         0.03        13.99      2210.73       -58.19   0.1230D+10
      8.50         0.01        12.20      2917.74       -29.12   0.1230D+10
      9.00        -0.00        10.32      3081.05         6.40   0.1230D+10
      9.50        -0.01         8.45      3244.37        34.10   0.1230D+10
     10.00        -0.02         6.70      3407.68        54.44   0.1230D+10
     10.50        -0.02         5.10      3526.94        67.33   0.1230D+10
     11.00        -0.02         3.70      3525.34        71.95   0.1230D+10
     11.50        -0.02         2.53      3675.92        75.10   0.1230D+10
     12.00        -0.02         1.57      3940.96        77.11   0.1230D+10
     12.50        -0.02         0.85      4224.26        76.65   0.1230D+10
     13.00        -0.02         0.36      4387.57        72.08   0.1230D+10
     13.50        -0.01         0.08      4387.57        63.99   0.1230D+10
     14.00        -0.01         0.00      4387.57        55.77   0.1230D+10







                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

                ***** (C) COPYRIGHT 1984, 1987  GEOSOFT *****

                              ALL RIGHTS RESERVED
```

```
L = 8 ft


ITERATION INFORMATION

 1             2.527862400760818
 2             2.038539878626039
 3             1.757083203848712
 4             1.620438125160477
 5             1.549837333958347
 6             1.510329604865244
 7             1.487476160919339
 8             1.473861845652794
 9             1.465571507607242
 10            1.460452576208682
 11            1.45737519940993
 12            1.455536835191229
 13            1.454441351049986
```

```
L = 8 ft


INPUT INFORMATION
*****************
SHEAR           = 350 LBS.
MOMENT          = 224520 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 24
PILE LENGTH     = 12 FT.
TOLERANCE       = 1.455536835191229D-03 IN.
```

```
L = 8 ft

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         1.45        18.71         0.09        -0.13   0.1230D+10
      0.50         1.32        18.88         0.12        -0.16   0.1230D+10
      1.00         1.18        19.06         0.16        -0.19   0.1230D+10
      1.50         1.06        19.23         0.20        -0.21   0.1230D+10
      2.00         0.94        19.41         0.25        -0.24   0.1230D+10
      2.50         0.83        19.58         0.31        -0.26   0.1230D+10
      3.00         0.72        19.75         0.39        -0.28   0.1230D+10
      3.50         0.62        19.92         0.49        -0.30   0.1230D+10
      4.00         0.53        20.09         0.58        -0.31   0.1230D+10
      4.50         0.45        20.26       236.25      -106.02   0.1230D+10
      5.00         0.37        20.11       291.80      -108.49   0.1230D+10
      5.50         0.30        19.64       365.26      -110.27   0.1230D+10
      6.00         0.24        18.83       450.25      -107.56   0.1230D+10
      6.50         0.18        17.70       570.95      -104.19   0.1230D+10
      7.00         0.13        16.26       744.57       -98.52   0.1230D+10
      7.50         0.09        14.53      1014.36       -89.12   0.1230D+10
      8.00         0.05        12.52      1534.96       -74.44   0.1230D+10
      8.50         0.01        10.30      2917.74       -39.50   0.1230D+10
      9.00        -0.02         7.95      3081.05        54.86   0.1230D+10
      9.50        -0.05         5.77      1859.71        86.22   0.1230D+10
     10.00        -0.07         3.85      1503.77       109.60   0.1230D+10
     10.50        -0.10         2.25      1303.80       127.85   0.1230D+10
     11.00        -0.12         1.04      1195.30       146.36   0.1230D+10
     11.50        -0.15         0.27      1131.85       165.78   0.1230D+10
     12.00        -0.17         0.00      1069.59       182.24   0.1230D+10
```

```
                        LATERALLY LOADED PILE PROGRAM

                                   PILEDG

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                              ALL RIGHTS RESERVED



L= 9 ft"


ITERATION INFORMATION



 1             4.151624445128525
 2             4.541740649760775
 3             4.544215436301349


L= 9 ft"



INPUT INFORMATION
*****************
SHEAR           = 5000 LBS.
MOMENT          = 0 LBS-IN
KODE            = 1
DIAMETER        = 6  IN.
INCR.LENGTH     = 6  IN.
NO.OF INCREMENTS= 26
PILE LENGTH     = 13 FT.
TOLERANCE       = 4.541740649760775D-02 IN.


L= 9 ft"

OUTPUT INFORMATION
******************
    X,FT.         Y,IN.       M,FT-KIPS    ES,LBS/IN2 P,LB/IN.  EI,LB-IN.2
      0.00         4.54        -0.00         0.03        -0.13   0.1230D+10
      0.50         4.27         2.50         0.04        -0.16   0.1230D+10
      1.00         3.99         5.00         0.05        -0.19   0.1230D+10
      1.50         3.71         7.50         0.06        -0.22   0.1230D+10
      2.00         3.44        10.00         0.07        -0.25   0.1230D+10
      2.50         3.17        12.49         0.09        -0.28   0.1230D+10
      3.00         2.90        14.99         0.11        -0.32   0.1230D+10
      3.50         2.64        17.49         0.13        -0.35   0.1230D+10
      4.00         2.39        19.98         0.16        -0.38   0.1230D+10
      4.50         2.14        22.47        65.57      -140.35   0.1230D+10
      5.00         1.90        24.55        81.52      -154.98   0.1230D+10
      5.50         1.67        26.15       101.66      -169.81   0.1230D+10
      6.00         1.45        27.25       127.62      -184.91   0.1230D+10
      6.50         1.24        27.79       162.02      -200.41   0.1230D+10
      7.00         1.03        27.74       200.22      -207.19   0.1230D+10
      7.50         0.84        27.06       253.82      -213.80   0.1230D+10
      8.00         0.66        25.74       335.40      -221.17   0.1230D+10
      8.50         0.49        23.75       431.93      -209.72   0.1230D+10
      9.00         0.32        21.14       612.98      -196.15   0.1230D+10
      9.50         0.16        17.94      1094.25      -177.13   0.1230D+10
     10.00         0.01        14.20      2046.83       -20.57   0.1230D+10
     10.50        -0.14        10.41       868.05       118.74   0.1230D+10
```

```
   11.00         -0.28          6.97        649.92        181.96   0.1230D+10
   11.50         -0.42          4.07        546.44        229.89   0.1230D+10
   12.00         -0.56          1.87        487.72        273.12   0.1230D+10
   12.50         -0.70          0.49        427.98        299.01   0.1230D+10
   13.00         -0.84          0.00        387.90        324.72   0.1230D+10
```

APPENDIX G
EXISTING BORING LOGS AND LABORATORY DATA

APPENDIX A

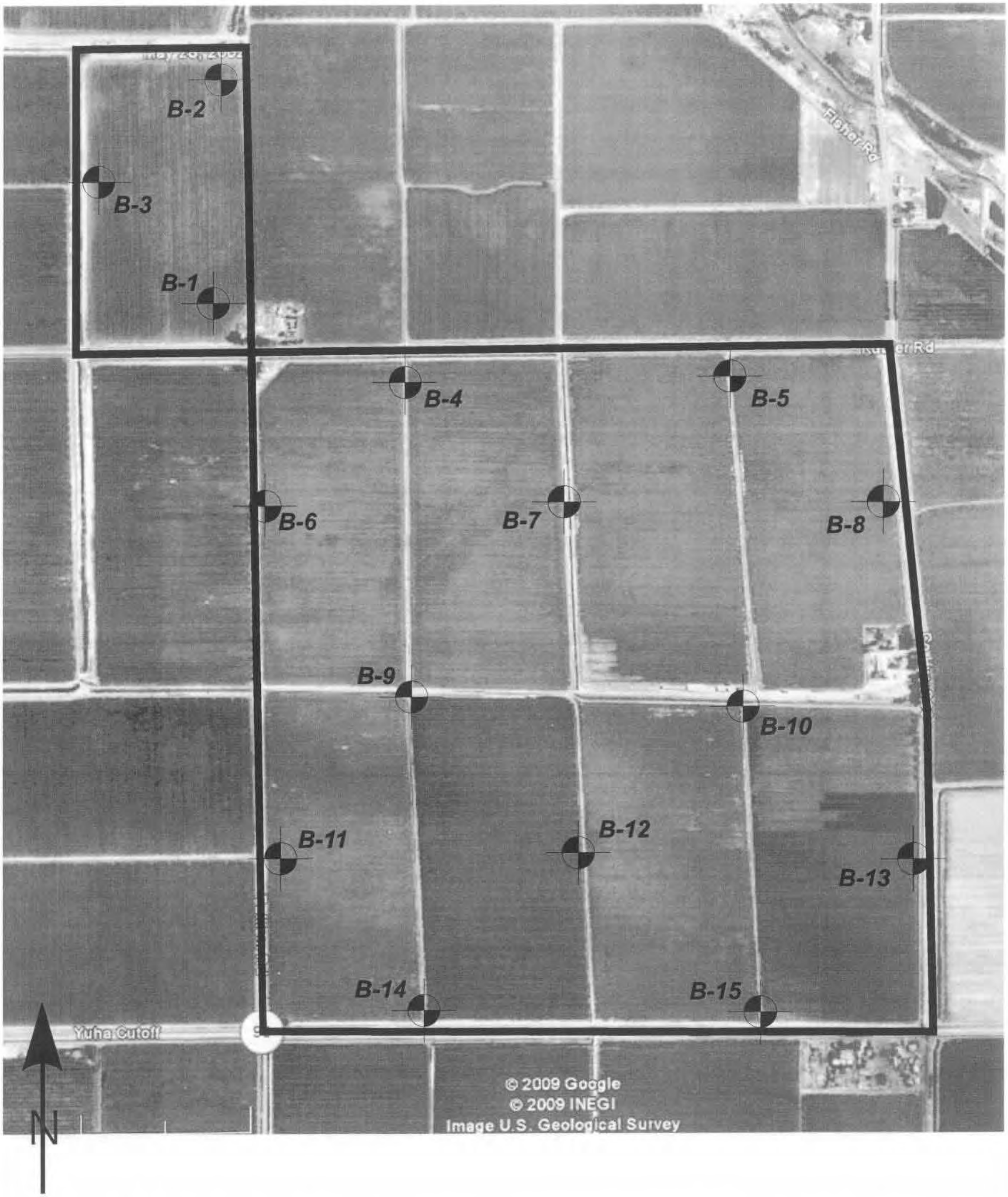
LANDMARK

Geo-Engineers and Geologists

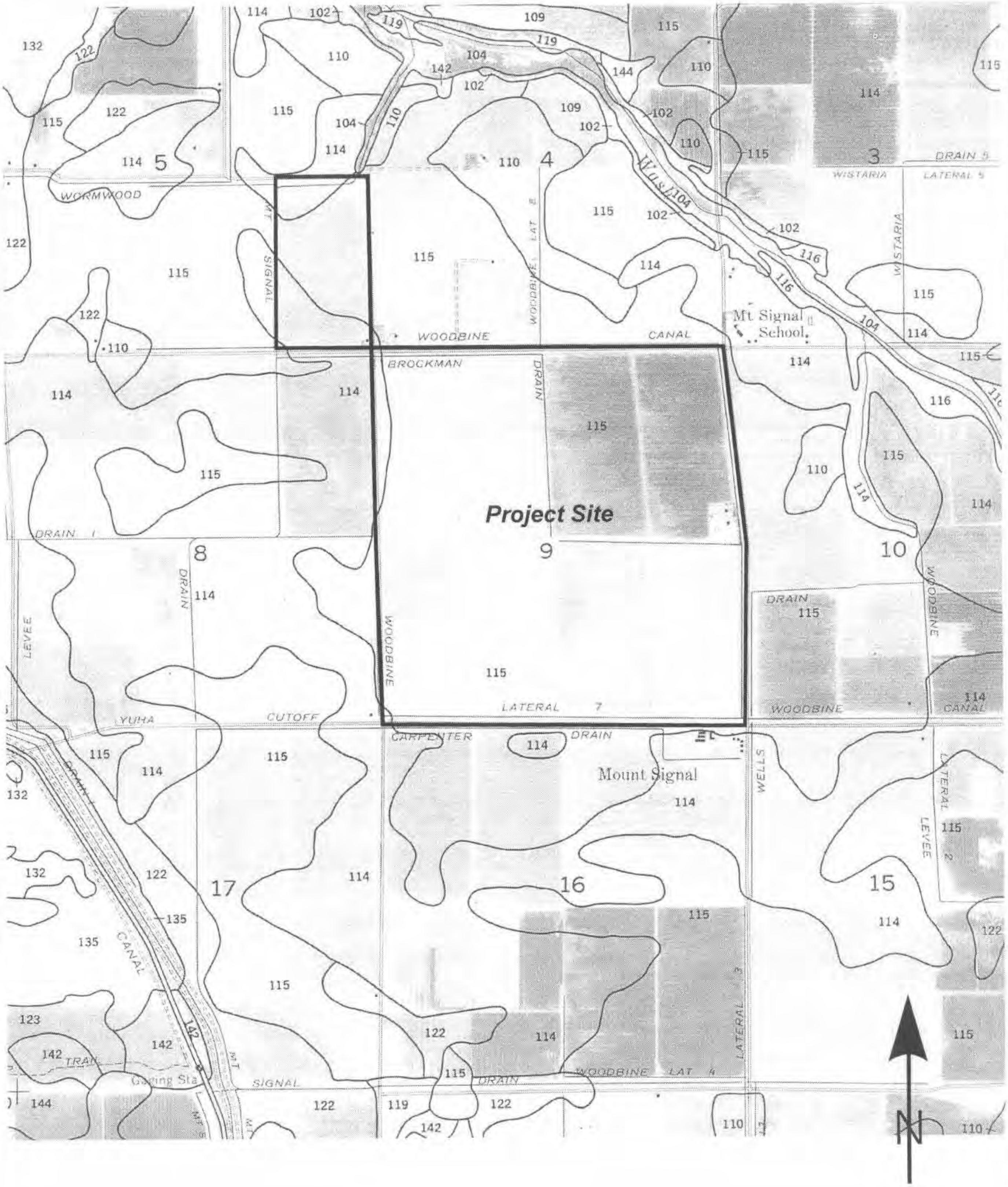
Project No.: LE09253

Vicinity Map

Plate A-1



LANDMARK Geo-Engineers and Geologists **Project No.: LE09233**	**Site and Exploration Map**	**Plate** **A-2**



LANDMARK

Geo-Engineers and Geologists

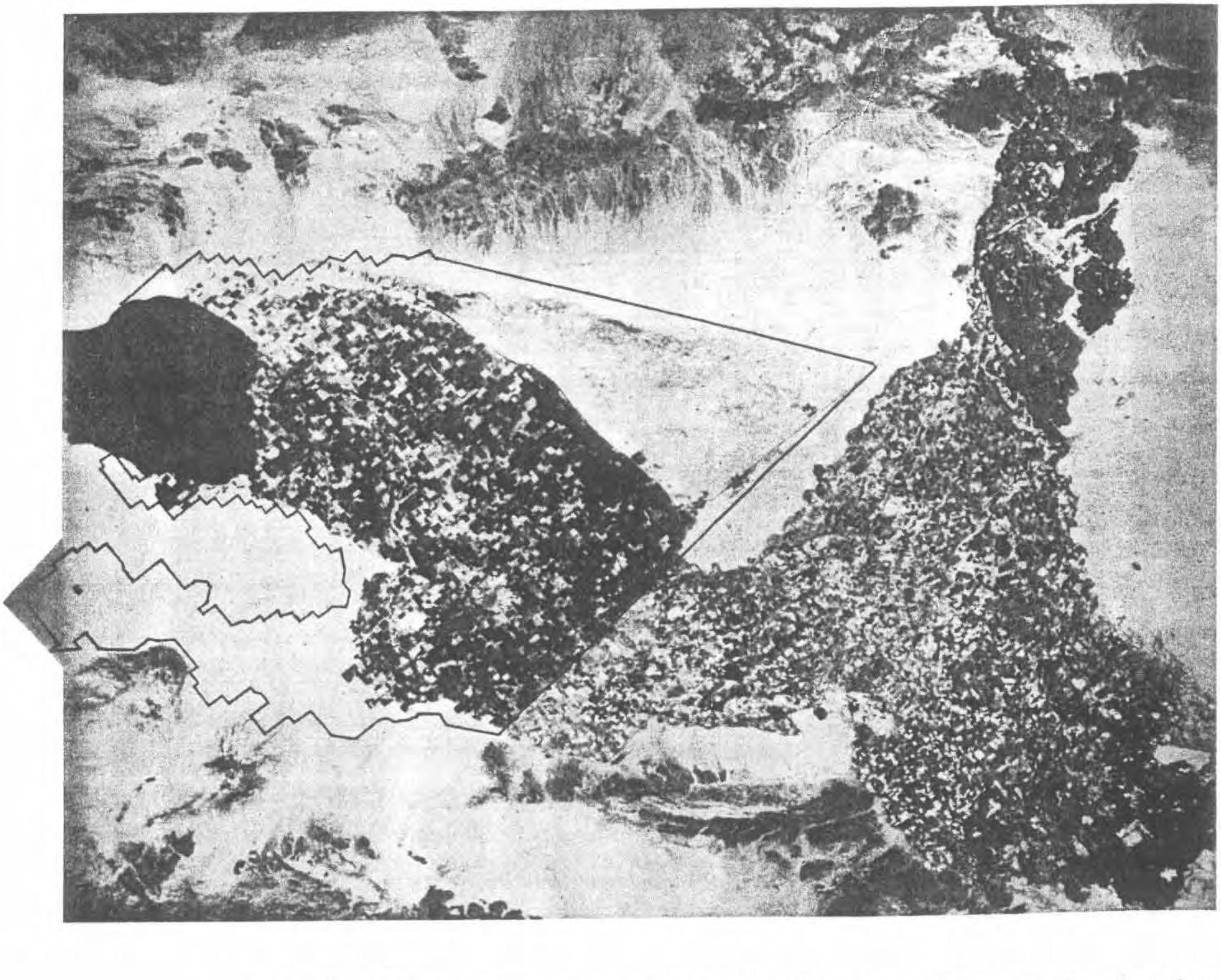
Project No.: LE09253

Soil Survey Map

Plate
A-3

Soil Survey of

IMPERIAL COUNTY
CALIFORNIA
IMPERIAL VALLEY AREA

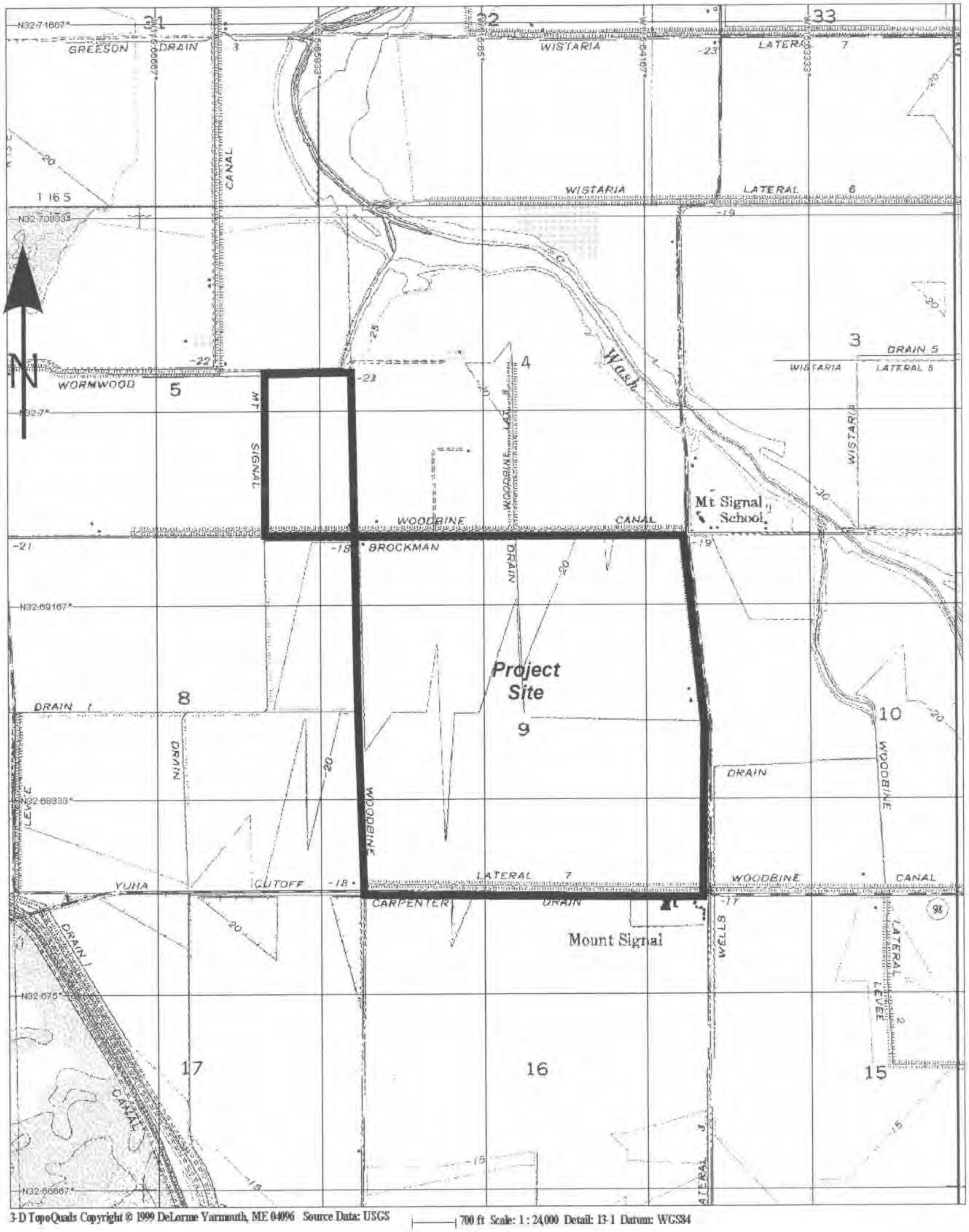


United States Department of Agriculture Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station
and
Imperial Irrigation District

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
111*:											
Holtville----------	0-10	Silty clay loam	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	10-22	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	22-60	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
Imperial----------	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
112---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
113---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	100	85-95	50-70	25-45
114---------------- Imperial	0-12	Silty clay------	CH	A-7	0	100	100	100	85-95	50-70	25-45
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
115*:											
Imperial----------	0-12	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	12-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar-----------	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
116*:											
Imperial----------	0-13	Silty clay loam	CL	A-7	0	100	100	100	85-95	40-50	10-20
	13-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	100	85-95	50-70	25-45
Glenbar-----------	0-13	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	35-45	15-25
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
117, 118----------- Indio	0-12	Loam------------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
119*:											
Indio-------------	0-12	Loam------------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-72	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Vint--------------	0-10	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	10-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
120*--------------- Laveen	0-12	Loam------------	ML, CL-ML	A-4	0	100	95-100	75-85	55-65	20-30	NP-10
	12-60	Loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-95	70-80	55-65	15-25	NP-10

See footnote at end of table.



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS

700 ft Scale: 1 : 24,000 Detail: 13-1 Datum: WGS84

LANDMARK

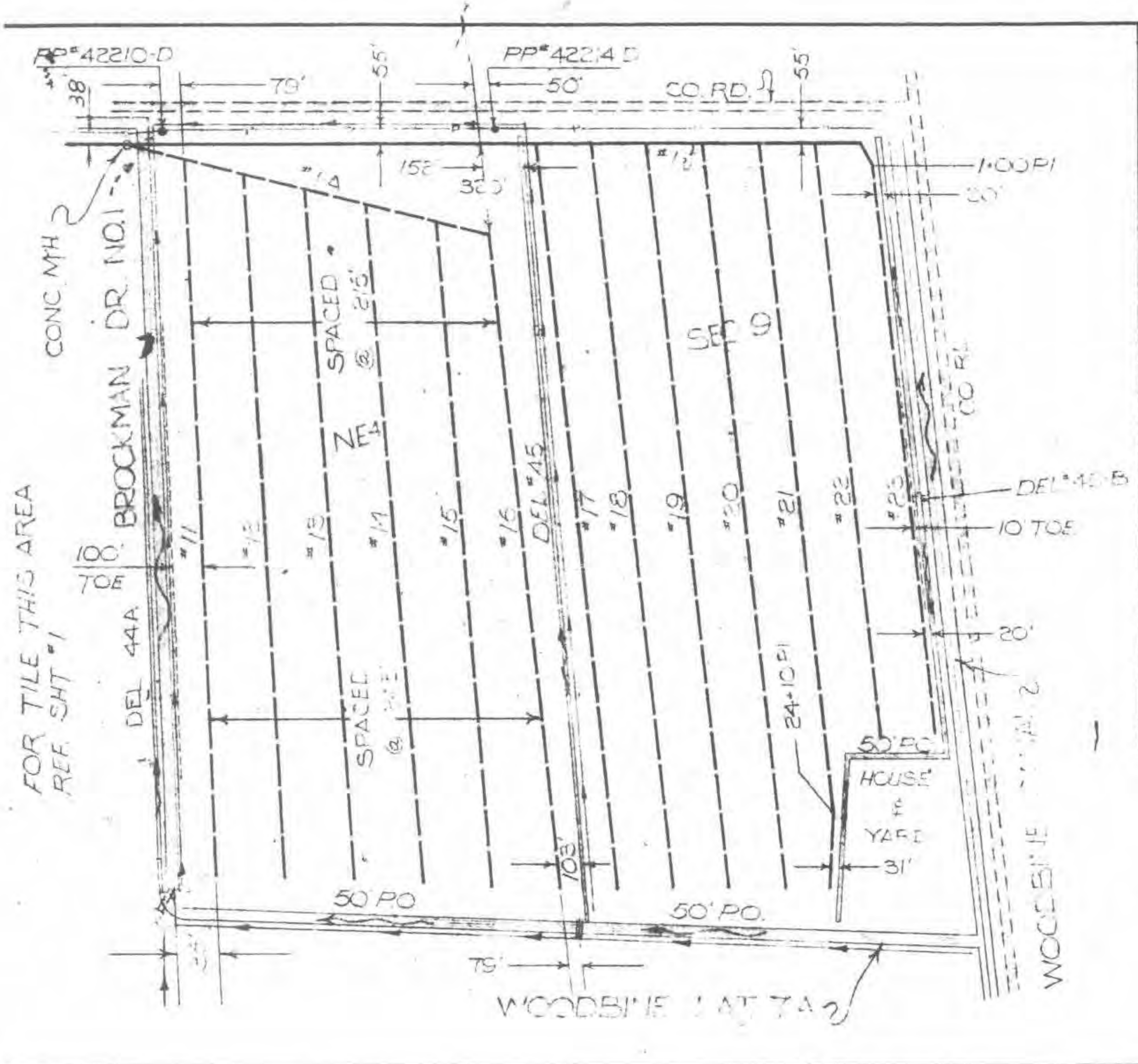
Geo-Engineers and Geologists

Project No.: LE09253

Topographic Map

Plate A-4

2725-2 [illegible]



RECOMMENDED					AS STAKED		TILE INSTALLED			
LINE NO.	TILE SIZE	LENGTH	O P	OUTLET ELEV.	OUTLET STA 0+00 =	FOOTAGE		8"	6"	4"
1		REFER		TO	SH. 1	INSTALLED	TILE			
1A				970.90		1307		1307		
11				970.70		2573				2574
12				970.90		2530				2532
13				971.10		2490				2490
14				971.30		2447				2447
15				971.60		2413				2404
16				971.80		2362				2373
17				972.00	37+30 #1	2636				2636
18				972.20	39+30 #1	2636				2636
19				972.40	41+30 #1	2686				2686
20				972.60	43+30 #1	2687				2687
21				972.80	45+30 #1	2687				2687
22				973.00	47+30 #1	2136				2136
23				973.10	48+90 #1	2154			2154	

STAKED BY BRYANT JEHLE & ASSOC DATE 6-2-65 F.B.
PLOTTED LE CH'K'D BS Mc INSTALLED BY McELVANY & SONS
GRAVEL WEST MORLAND PIT TILE QUALITY TILE DATE 7-21-65

STAKED BY DATE F.B.
PLOTTED CH'K'D INSTALLED BY
GRAVEL TILE DATE

LEGEND

———	Stkd. 7-14-64
— —	STKD 6-2-65
O P	OVERPOUR
═══	HEAD DITCH
═ ═ ═	FIELD ROAD

REFERENCES
12F-2460

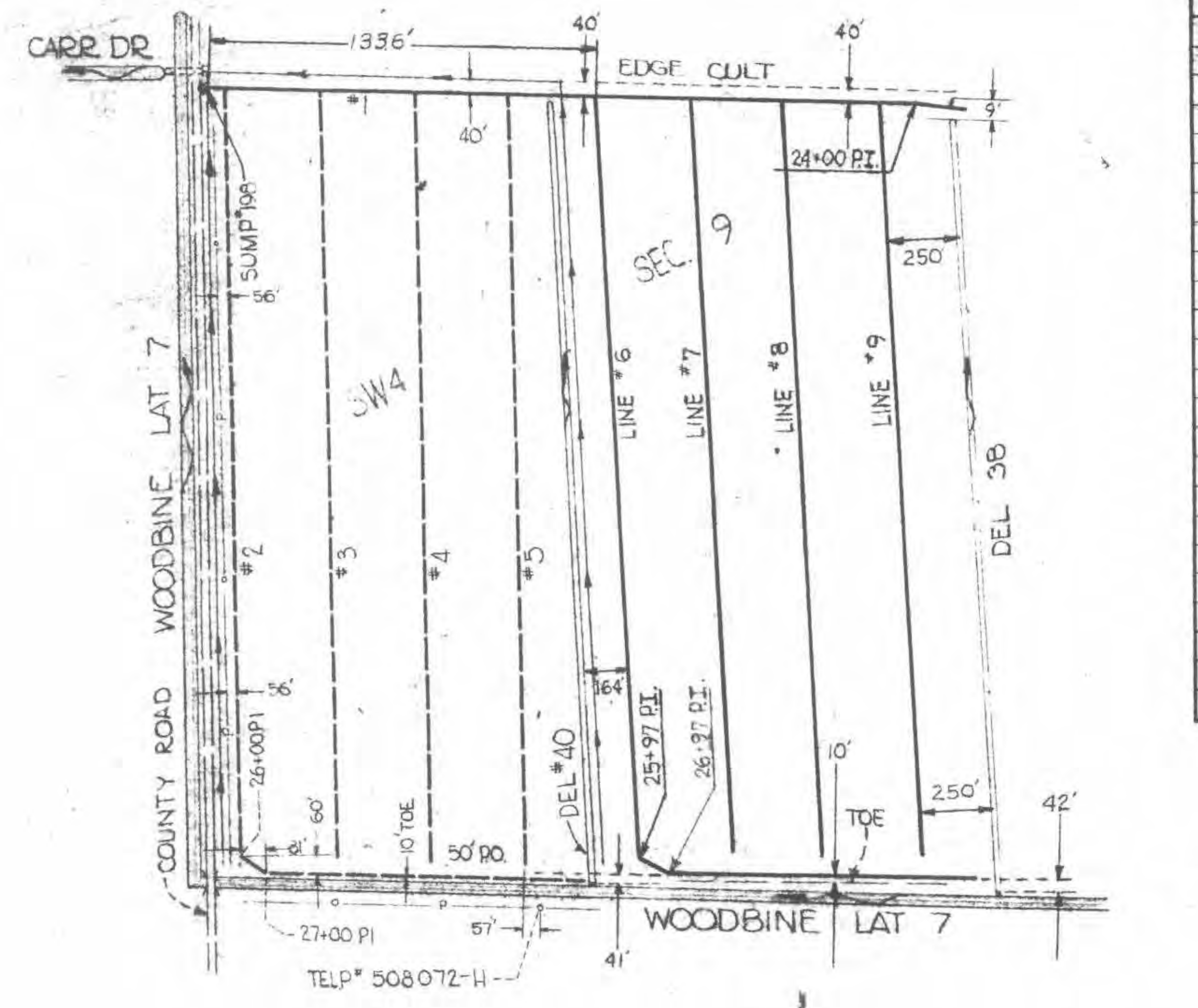
IMPERIAL IRRIGATION DISTRICT
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN CONSTRUCTION
NE4 SEC 9
PROP. BROCKMAN T 17 S - R 13 E

M

ISSUE 4
ISSUE 3

2725-3



Δ "D" CHIPPED NO. UPSTR. W.W. DEL. No 43-A
WOODBINE LAT. 7

RECOMMENDED					AS STAKED		TILE INSTALLED			
LINE NO.	TILE SIZE	LENGTH	O.P.	OUTLET ELEV.	OUTLET STA. 0+00 =	FOOTAGE	12"	8"	6"	4"
1				968.80	TO	2596	2596			
6				970.40	13+36^{1} #1	3759			3759	
9				971.30	23+00 #1	2575			2565	
7				970.70	16+57^{5} #1	2583			2550	
8				971.00	19+78^{2} #1	2579			2547	
2				969.10	0+54^{3} #1	3777			2640	1137
3				969.45	3+73^{4} #1	2600			2600	
4				969.75	6+94^{5} #1	2600			2600	
5				970.10	10+15^{6} #1	2600			2600	

STAKED BY BRYANT · JEHLE & ASSOC DATE 3-10-64 F.B.
PLOTTED GK CH'K'D JE INSTALLED BY J.L. McELVANY
GRAVEL MT. SIGNAL PIT TILE QUALITY DATE 3-25-64
STAKED BY BRYANT · JEHLE & ASSOC. DATE 2-22-65 F.B.
PLOTTED GKIBBLE CH'K'D ~~DB~~ DBMc INSTALLED BY Mc ELVANY
GRAVEL MT. SIGNAL PIT TILE QUALITY DATE 3-30-65

LEGEND

———	STKD. 3-10-64
– – –	STK'D. 2-22-65
O.P.	OVERPOUR
═══	HEAD DITCH
═ ═ ═	FIELD ROAD

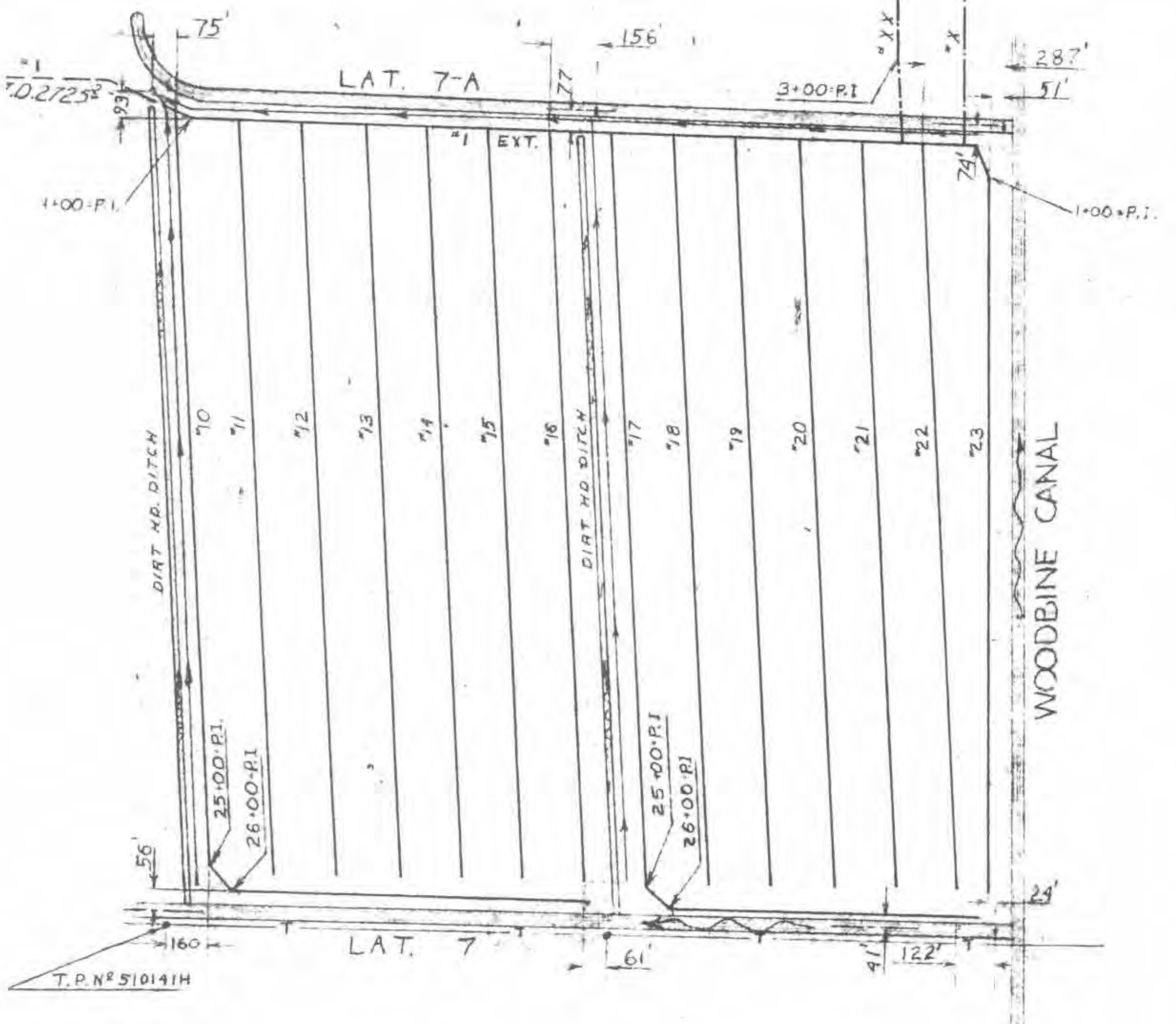
REFERENCES: 12F 2460

IMPERIAL IRRIGATION DISTRICT
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN
SW4 SEC 9
PROP BROCKMAN T. 17 S. - R. 13 E.

ISSUE 4
ISSUE 3 CONSTD STK'S 8-10-65 GK

2725-4 1D C1C2 7



RECOMMENDED					AS STAKED		TILE INSTALLED			
LINE NO	TILE SIZE	LENGTH	O P	OUTLET ELEV.	OUTLET STA. 0+00 =	FOOTAGE		8"	6"	4"
1 Ext.				971.80	25+96 "1	2728		2728		
10				972.00	0+53 -"1 EXT.	3763			1250	2513
11				972.20	2+53$^{25'}$-"1 EXT	2500				2500
12				972.40	4+60$^{50'}$-1 EXT	2499				2499
13				972.60	6+73$^{25'}$-1 EXT	2498				2498
14				972.80	8+80 -"1 EXT	2497				2497
15				973.00	10+86$^{25'}$-1 EXT	2496				2496
16				973.20	12+93$^{50'}$-1 EXT	2493				2493
17				973.30	15+00$^{25'}$-"1 EXT	3600			1250	2350
18				973.55	17+07 -"1 EXT	2488				2488
19				973.75	19+13$^{25'}$-"1 EXT	2485				2485
20				973.95	21+20$^{50'}$"1 EXT	2482				2482
21				974.20	23+27$^{25'}$-"1 EXT	2479				2479
22				974.40	25+34 -"1 EXT	2473				2473
23				974.60	27+28 -"1 EXT	2479				2479
X				974.60	26+70 -"1 EXT	570				530
XX				974.40	24+58 -"1 EXT	500				490

STAKED BY Bryant, Jehle & Associates DATE 6-22-64 F.B.
PLOTTED J.C. CH'K'D. JR Mc INSTALLED BY McElvany
GRAVEL Mt. Signal Pit TILE Quality DATE 7-22-64
STAKED BY G. B. & J. Engr. DATE 7-14-64 F.B.
PLOTTED J.C. CH'K'D JR INSTALLED BY McElvany
GRAVEL Mt. Signal Pit TILE Quality DATE 7-22-64

LEGEND

— — —	Existing
———	Stkd. 6-22-64
—·—·—	Stkd 7-14-64

REFERENCES 12F-2460

IMPERIAL IRRIGATION DISTRICT
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN CONSTRUCTION

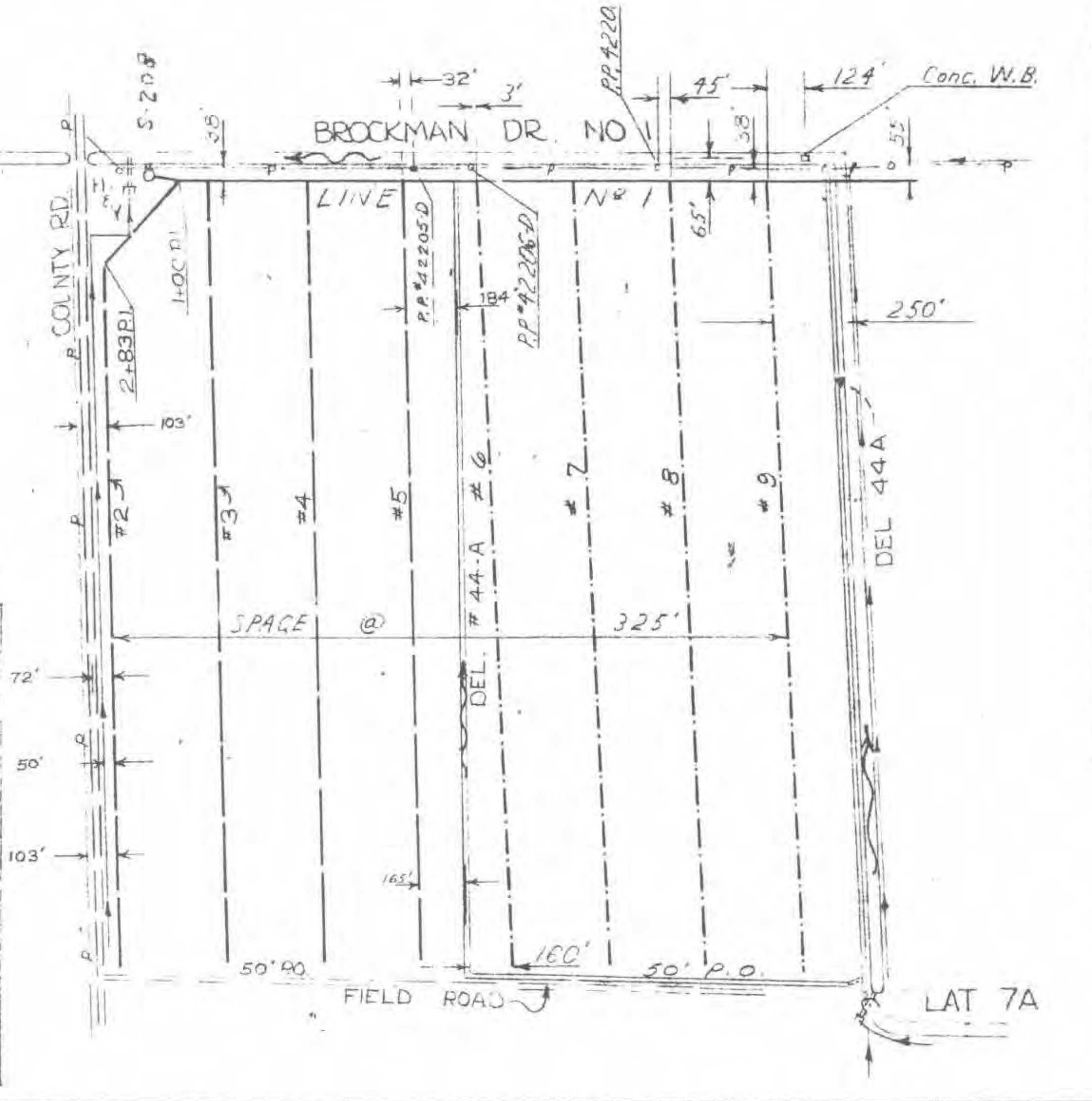
SE4 SEC 9

PROP. BROCKMAN T 17 S - R 13 E

O P	OVERPOUR
	HEAD DITCH
	FIELD ROAD

ISSUE 4
ISSUE 3
ISSUE 2

For lines 6 Thru 9 Only
Staked By - B, J, & Assoc. 5-12-67
Installed By - McElvany 5-26-67
Gravel - Eastside
Tile - Quality Plotted HP



28 25-1

LINE NO	TILE SIZE	LENGTH	O.P.	OUTLET ELEV.	OUTLET STA. 0+00 ±	FOOTAGE	12"	8"	6"
1				968.00		4890	2515	2375	
2	\			968.40	0+72 #1	2673			267
3				968.50	1+89 #1	2600			260
4				968.80	5+14 #1	2600			260
5				969.10	8+39 #1	2600			260
6				969.40	11+64 #1	2615			261
7				969.70	14+89 #1	2625			262
8				970.10	18+14 #1	2630			263
9				970.40	21+39 #1	2630			263

STAKED BY G. B. & J. Associates DATE 7-14-64 F.B.
PLOTTED J. C. CH'K'D JR Mc INSTALLED BY McElvany
GRAVEL Mt. Signal Pit TILE Quality DATE
STAKED BY BRYANT & ASSOC DATE 7-13-66 F.B.
PLOTTED TAL CH'K'D JS Mc INSTALLED BY McELVANY
GRAVEL WESTMORLAND PIT TILE QUALITY DATE

LEGEND

———	Stk'd 7-14-64
— —	Stk'd 7-13-66
—·—·—	Stk'd. 5-12-67
O.P.	OVERPOUR
═══	HEAD DITCH
═ ═ ═	FIELD ROAD
←——→	FIELD WASTE

REFERENCES
12F-2660

IMPERIAL IRRIGATION DIST
ENGINEERING DEPARTMENT
IMPERIAL, CALIFORNIA

TILE DRAIN CONSTRUCT

NW 4 SEC 9
PROP BROCKMAN T. 17 S.

SCALE 1" 500' SH. 1 OF 4 SRS. TD 2

B.M. "D" CHIPPED E. UFSTR. IV. W. DEL. No 52 WOODBINE CANAL
Elevation 982.78
F.B. 5534 10

ISSUE 4	
ISSUE 3	Const. Stks. 7-18-67 HP
ISSUE 2	Const. Stk's 9-7-66 TAL
ISSUE 1	Const. Stks. 11-19-64 J.C.

APPENDIX B

LOG OF BORING NO. 1

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●				FAT CLAY (CH): Dark brown, very moist, high plasticity			LL=62% PI=44% EI = 108 (High)
5	◩		9	2.5	Stiff to very stiff	96.3	25.5	
					Anticipated GW=8.0 ft ▼			
10	◩		18	2.0		98.3	26.6	C = 0.97 tsf
15	⧄		14	2.0	Thin interbedded layers of silty sand			
20	◩		18	3.0				
25	⧄		10	2.0				
					SANDY SILT (ML): Brown, saturated, loose, with very fine grained sand			
30	◩		9					
					SILTY SAND (SM): Brown, saturated, dense to very dense, fine grained sand			
35	⧄		48					
40	◩		50/4"			105.1	21.2	SAND=77% FINES=23%
45	⧄		50				21.5	SAND=69% FINES=31%
50	⧄		51					
					Total Depth = 51.5' Groundwater was encountered at 17.6 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
55								
60								

DATE DRILLED: 1/11/10

TOTAL DEPTH: 51.5 Feet

DEPTH TO WATER: 8.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

PROJECT No. LE09253

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PLATE B-1

LOG OF BORING NO. 2
SHEET 1 OF 1

FIELD						LABORATORY		
DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●				CLAY (CL): Dark brown, very moist, medium plasticity			LL=44% PI=30%
5	◩		18		SANDY SILT (ML): Brown, damp, medium dense, with fine grained sand Anticipated GW=8.0 ft ▼			
				1.5	CLAY (CL-CH): Brown, very moist, very stiff, high plasticity			
10	◺		10		SILTY SAND (SM): Gray brown, saturated, medium dense, fine grained sand			
				2.0	CLAY (CL-CH): Dark brown, very moist, very stiff, high plasticity			
15	◩		14		SILTY SAND (SM): Gray brown, saturated, loose to medium dense, fine grained sand	101.6	22.8	ϕ=37°
				3.0	CLAY (CL-CH): Dark brown, very moist, very stiff, medium to high plasticity			
20	◺		10		SILTY SAND (SM): Gray brown, saturated, med dense, fine grained			
				2.0	CLAY (CL-CH): Dark brown, very moist, very stiff, medium to high plasticity			
25	◩		29		SILT (ML): Brown, saturated, medium dense			
30					Total Depth = 26.5' Groundwater was encountered at 17.6 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/11/10
TOTAL DEPTH: 26.5 Feet
DEPTH TO WATER: 8.0 ft.
LOGGED BY: J. Avalos
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: -20 ft
HAMMER WT.: 140 lbs.
DROP: 30 in.

PROJECT No. LE09253

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PLATE B-2

LOG OF BORING NO. 3

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●				CLAY (CL): Dark brown, very moist, medium to high plasticity			
5			8		CLAYEY SILT/SILTY CLAY (ML/CL): Brown, very moist, medium stiff, low plasticity			
					SILTY SAND (SM): Gray brown, damp, loose to medium dense, fine grained sand Anticipated GW=8.0 ft			
10			19	3.0	CLAY (CL-CH): Brown, very moist, very stiff, medium to high plasticity	96.6	28.1	C = 0.87 tsf
					SILTY SAND (SM): Gray brown, saturated, loose to medium dense, fine grained sand			
15			9	4.0	CLAY (CH): Dark brown, very moist, hard, high plasticity			
20			28	4.0		104.7	19.7	
					SILTY SAND (SM): Gray brown, saturated, medium dense, fine grained			
25					Total Depth = 21.5' Groundwater was encountered at 17.0 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/11/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 8.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-3

LOG OF BORING NO. 4

SHEET 1 OF 1

DEPTH	FIELD SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
		▨			CLAY (CL): Dark brown, very moist, medium to high plasticity			
	●	▥			CLAYEY SILT/SILTY CLAY (ML/CL): Brown, very moist, low plasticity			
5	◪	▨	9	4.0	CLAY (CL-CH): Brown, very moist, hard, medium to high plasticity Anticipated GW=8.0 ft			
10	⧄	▨	9	1.0	Stiff			
		▒			SILTY SAND (SM): Gray brown, saturated, loose to medium dense, fine grained sand			
15	◪	▨	27	4.0	CLAY (CH): Dark brown, very moist, very stiff to hard, high plasticity	98.9	25.6	C = 1.84 tsf
20	⧄	▨	16	3.0				
		▒			SILTY SAND (SM): Gray brown, saturated, medium dense, fine grained			

Total Depth = 21.5'
Groundwater was not encountered at the time of exploration
but may raise with time to about 8.0 ft bgs.
Backfilled with excavated soil

DATE DRILLED: 1/11/10
TOTAL DEPTH: 21.5 Feet
DEPTH TO WATER: 8.0 ft.
LOGGED BY: J. Avalos
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: -20 ft
HAMMER WT.: 140 lbs.
DROP: 30 in.

PROJECT No. LE09253

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PLATE B-4

LOG OF BORING NO. 5

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			CLAY (CL): Dark brown, very moist, medium to high plasticity			
5	⧄	▨	4	0.5	SILTY CLAY (CL): Brown, very moist, soft, medium plasticity Anticipated GW=8.0 ft		30.1	LL=32% PI=13%
10	◪	▨	7		CLAYEY SANDY SILT (ML): Brown, saturated, loose, low plasticity, some very fine grained sand	95.6	27.4	ϕ =33° C = 0.05 tsf
15	⧄	░	29		SILTY SAND (SM): Yellow brown, saturated, medium dense to dense, fine grained sand		25.0	SAND=61% FINES=39%
20	◪	░	90/11"		Very dense	105.5	22.0	
25					Total Depth = 21.5' Groundwater was encountered at 14 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/11/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 8.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-5

LOG OF BORING NO. 5

SHEET 1 OF 1

DEPTH	FIELD SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			CLAY (CL): Dark brown, very moist, medium to high plasticity			
5	☐	▨	4	0.5	SILTY CLAY (CL): Brown, very moist, soft, medium plasticity Anticipated GW=8.0 ft ▼		30.1	LL=32% PI=13%
10	◩	▨	7		CLAYEY SANDY SILT (ML): Brown, saturated, loose, low plasticity, some very fine grained sand	95.6	27.4	ϕ =33° C = 0.05 tsf
15	☐	░	29		SILTY SAND (SM): Yellow brown, saturated, medium dense to dense, fine grained sand		25.0	SAND=61% FINES=39%
20	◩	░	90/11"		Very dense	105.5	22.0	
					Total Depth = 21.5' Groundwater was encountered at 14 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
25								
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/11/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 8.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-5

LOG OF BORING NO. 6

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			CLAY (CL-CH): Dark brown, very moist, medium to high plasticity			
5	⧄	▨	10	1.5				
		▨			CLAYEY SAND (SC): Brown, damp, medium dense, low plasticity Anticipated GW=8.0 ft			
10	◩	▨	20	3.0	CLAY (CL-CH): Reddish brown, very moist, very stiff, medium to high plasticity	98.4	26.6	C = 0.96 tsf
15	⧄	▨	7	2.0				
20	◩	▨	33		SILTY SAND (SM): Yellow brown, saturated, medium dense, fine grained sand	113.1	16.4	ϕ =37° C = 0.16 tsf
25	⧄	▨	15	4.0	CLAY (CH): Reddish brown, very moist, hard, high plasticity			
30					Total Depth = 26.5' Groundwater was encountered at 18.4 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/12/10
TOTAL DEPTH: 26.5 Feet
DEPTH TO WATER: 8.0 ft.
LOGGED BY: J. Avalos
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: -20 ft
HAMMER WT.: 140 lbs.
DROP: 30 in.

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PLATE B-6

LOG OF BORING NO. 7

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
		▨			FAT CLAY (CH): Light brown, dry, high plasticity			
	●	▨						LL=50% PI=35%
5	⧄	▨	8	2.0	Moist, stiff to very stiff			
10	◩	▨	7	0.25	SILTY CLAY (CL): Light brown, very moist, soft, medium plasticity Anticipated GW=10.0 ft ▼	94.5	25.2	LL=41% PI=23%
15	⧄	▨	6	0.5	CLAY (CL-CH): Reddish brown, very moist, soft to medium stiff, medium to high plasticity			
20	◩	▨	9	0.5		99.4	22.8	
					Total Depth = 21.5' Groundwater was encountered at 14 ft at the time of exploration but may raise with time to about 10.0 ft bgs. Backfilled with excavated soil			
25								
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/11/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 10.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-7

LOG OF BORING NO. 8

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			FAT CLAY (CH): Reddish brown, moist, high plasticity			LL=62% PI=44% EI = 147 (V. High)
5	◩	▨	12		Very moist, stiff to very stiff Anticipated GW=8.0 ft ▼			
10	⧄	▨	4	1.5				
15	◩	▨	12	3.0		100.8	23.1	
20	⧄	▨	5	1.5				
25	◩	▨	15	4.0	Hard			
30					Total Depth = 26.5' Groundwater was encountered at 19.9 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
35								
40								
45								
50								
55								
60								

DATE DRILLED:	1/12/10	TOTAL DEPTH:	26.5 Feet	DEPTH TO WATER:	8.0 ft.
LOGGED BY:	J. Avalos	TYPE OF BIT:	Hollow Stem Auger	DIAMETER:	8 in.
SURFACE ELEVATION:	-20 ft	HAMMER WT.:	140 lbs.	DROP:	30 in.

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PLATE B-8

LOG OF BORING NO. 9

SHEET 1 OF 1

DEPTH	FIELD					LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●				FAT CLAY (CH): Reddish brown, very moist, high plasticity			LL=50% PI=35% EI = 100 (High)
5	⧄		6		CLAYEY SILT (ML): Brown, very moist, medium to low plasticity, some very fine grained sand			
				2.0	CLAY (CL-CH): Reddish brown, very moist, very stiff, medium to high plasticity			
10	◪		27	3.0	Anticipated GW=12.0 ft	108.6	15.4	
15	⧄		9	4.0	Hard			
20	◪		24	3.0	Very stiff			
					SILTY SAND (SM): Brown, saturated, medium dense, fine grainedn sand			
25					Total Depth = 21.5' Groundwater was encountered at 14.4 ft at the time of exploration but may raise with time to about 12.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/12/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 12.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-9

LOG OF BORING NO. 10

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			CLAY (CL-CH): Brown, moist, medium to high plasticity			
5	◩	▨	10		SILTY CLAY/CLAYEY SILT (CL/ML): Brown, very moist, soft, low plasticity Anticipated GW=8.0 ft	99.2	21.9	LL=30% PI=8%
10	⧄	▨	4	1.0	CLAY (CL-CH): Brown, very moist, stiff, medium to high plasticity			
15	◩	▨	20		CLAYEY SILT (ML): Brown, saturated, medium stiff, low plasticity, some very fine grained sand	100.1	22.5	LL=30% PI=6%
20	⧄	▨	6	0.5	SILTY CLAY (CL): Brown, very moist, medium stiff, low to medium plasticity			
25					Total Depth = 21.5' Groundwater was encountered at 18.3 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/12/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 8.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

PROJECT No. LE09253

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PLATE B-10

LOG OF BORING NO. 11

SHEET 1 OF 1

DEPTH	FIELD SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			FAT CLAY (CH): Reddish brown, moist, high plasticity			LL=57% PI=41%
5	◩	▨	9	1.0	Very moist, stiff Anticipated GW=8.0 ft	95.1	28.9	C = 0.33 tsf
10	⧄	▨	9	3.0	Very stiff			
15	◩	▨	13	3.0		100.7	23.1	
20	⧄	▨	13	2.5	Thin interbedded silty sand layers			
25	◩	▨	19	2.5				
30					Total Depth = 26.5' Groundwater was encountered at 19.0 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/12/10
TOTAL DEPTH: 26.5 Feet
DEPTH TO WATER: 8.0 ft.
LOGGED BY: J. Avalos
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: -20 ft
HAMMER WT.: 140 lbs.
DROP: 30 in.

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PLATE B-11

LOG OF BORING NO. 12

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
		▨			FAT CLAY (CH): Dark brown, moist, high plasticity			LL=63% PI=44%
	●	▨						
5	◩	▨	12	0.75	Very moist, stiff Anticipated GW=8.0 ft ▼	92.8	27.3	C = 0.62 tsf
10	◩	▨	14	1.0				
15	⧄	▨	8	1.5	Stiff to very stiff			
20	◩	▨	27	3.0		98.5	26.8	C = 1.58 tsf
		░			SILTY SAND (SM): Brown, saturated, loose, fine grained sand			
25	⧄	░	8					
		▨		2.0	CLAY (CH): Dark brown, very moist, very stiff, high plasticity			
		▥			CLAYEY SILT (ML): Brown, saturated, loose, low plasticity			
30	◩	▥	9			91.4	31.4	LL=28% PI=3%
35	⧄	▥	7					
		▨		2.0	CLAY (CH): Dark brown, very moist, very stiff, high plasticity			
40	◩	▨	33	2.0				
45	⧄	▨	16	2.0				
50	⧄	▨	20	2.0	Thin interbedded silty sand layers			
					Total Depth = 51.5' Groundwater was encountered at 24 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
55								
60								

DATE DRILLED: 1/11/10
TOTAL DEPTH: 51.5 Feet
DEPTH TO WATER: 8.0 ft.
LOGGED BY: J. Avalos
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: -20 ft
HAMMER WT.: 140 lbs.
DROP: 30 in.

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PLATE B-12

LOG OF BORING NO. 13

SHEET 1 OF 1

DEPTH	FIELD				DESCRIPTION OF MATERIAL	LABORATORY		
	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)		DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
		▨			FAT CLAY (CH): Light brown, dry, high plasticity			
	●	▨			Moist			
5		▨						
	⧄	▨	13	1.0	Stiff			
10	◪	▨	8	0.75	Anticipated GW=12.0 ft	94.1	26.9	
15	⧄	▨	13	2.0	Very stiff, very moist			
20	◪	▨	13	3.5				
25					Total Depth = 21.5' Groundwater was encountered at 18.3 ft at the time of exploration but may raise with time to about 12.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/12/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 12.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-13

LOG OF BORING NO. 14

SHEET 1 OF 1

	FIELD					LABORATORY		
DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
		▨			FAT CLAY (CH): Dark brown, moist, high plasticity			LL=61% PI=42%
	●	▨			Very moist			
5	◪	▨	17	2.0	Very stiff Anticipated GW=8.0 ft	99.8	21.0	
10	⧄	▨	9	0.50	Medium stiff			
15	◪	▨	26	3.0	Very stiff	103.1	18.6	
20	⧄	▨	12	2.0				
25					Total Depth = 21.5' Groundwater was encountered at 18.2 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/12/10

TOTAL DEPTH: 21.5 Feet

DEPTH TO WATER: 12.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

PROJECT No. LE09253

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PLATE B-14

LOG OF BORING NO. 15

SHEET 1 OF 1

FIELD						LABORATORY		
DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
	●	▨			FAT CLAY (CH): Dark brown, moist, high plasticity			LL=63% PI=43% EI = 154 (V. High)
5	⧄	▨	7	2.5	Very moist, very stiff Anticipated GW=8.0 ft ▼			
10	◪	▨	13	1.5		93.2	30.6	C = 0.80 tsf
15	⧄	▨	10	2.0				
20	◪	▨	31	3.0				
25	⧄	░	12		SAND/SILTY SAND (SP/SM): Brown, saturated, medium dense, fine grained sand		19.4	SAND=88% FINES=12%
					Total Depth = 26.5' Groundwater was encountered at 18.0 ft at the time of exploration but may raise with time to about 8.0 ft bgs. Backfilled with excavated soil			
30								
35								
40								
45								
50								
55								
60								

DATE DRILLED: 1/11/10

TOTAL DEPTH: 26.5 Feet

DEPTH TO WATER: 8.0 ft.

LOGGED BY: J. Avalos

TYPE OF BIT: Hollow Stem Auger

DIAMETER: 8 in.

SURFACE ELEVATION: -20 ft

HAMMER WT.: 140 lbs.

DROP: 30 in.

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PLATE B-15

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 I 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. LE09253

Key to Logs

Plate
B-16

APPENDIX C

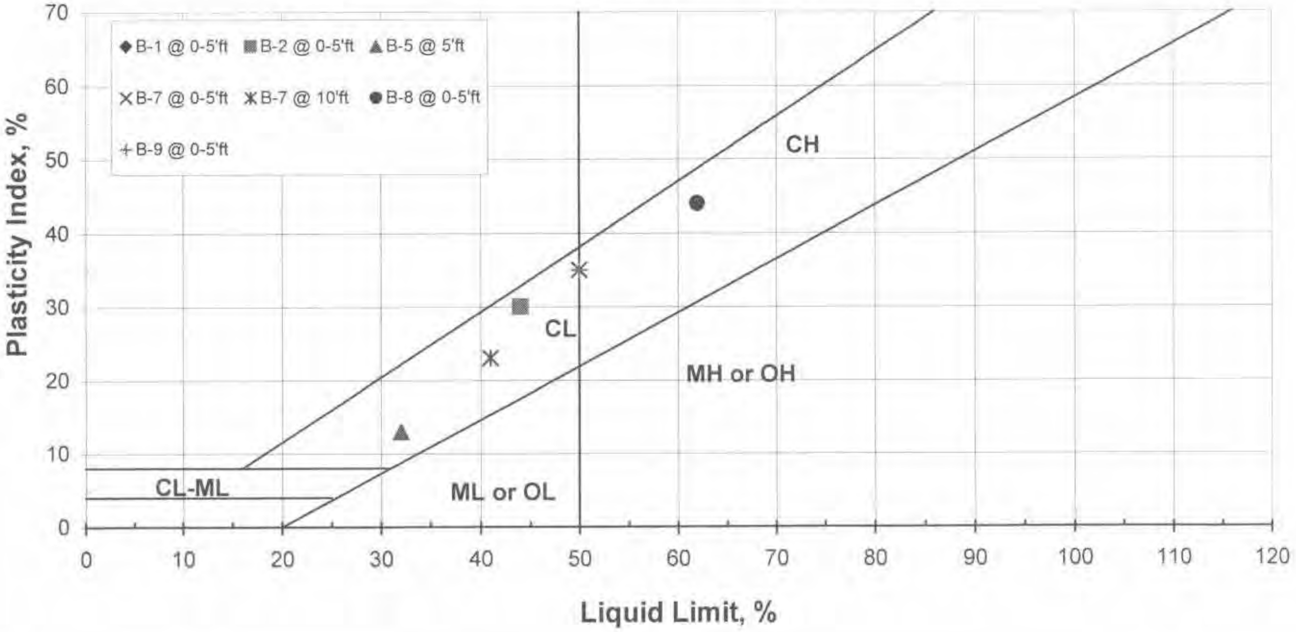
LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
JOB No.: LE09253
DATE: 02/01/10

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
B-1	0-5'	62	18	44	CL-ML
B-2	0-5'	44	14	30	ML
B-5	5'	32	19	13	CL
B-7	0-5'	50	15	35	CL-CH
B-7	10'	41	18	23	ML
B-8	0-5'	62	18	44	CH
B-9	0-5'	50	15	35	CL-CH

PLASTICITY CHART



LANDMARK
Geo-Engineers and Geologists

Project No.: LE09253

Atterberg Limits Test Results

Plate C-1

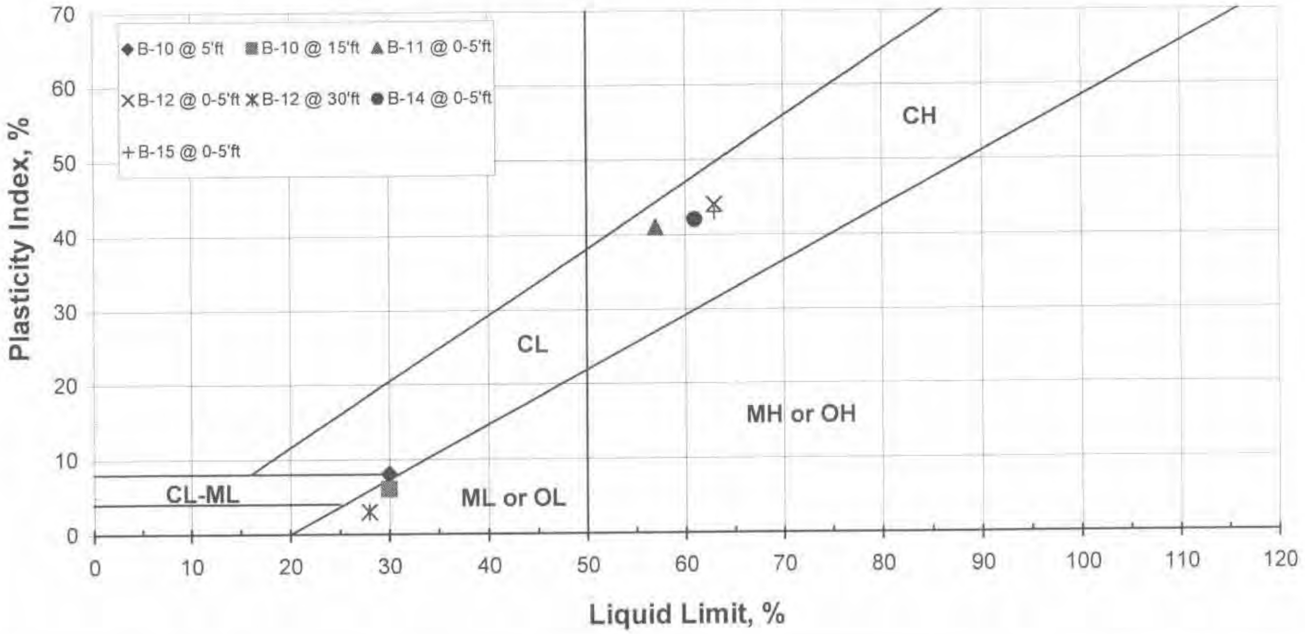
LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
JOB No.: LE09253
DATE: 02/01/10

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
B-10	5'	30	22	8	CL-ML
B-10	15'	30	24	6	ML
B-11	0-5'	57	16	41	CH
B-12	0-5'	63	19	44	CH
B-12	30'	28	25	3	ML
B-14	0-5'	61	19	42	CH
B-15	0-5'	63	20	43	CH

PLASTICITY CHART



LANDMARK
Geo-Engineers and Geologists

Project No.: LE09253

Atterberg Limits
Test Results

Plate
C-2

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
JOB NO: LE09253
DATE: 02/01/10

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 0-5 ft.	14.4	95.7	34.8	10.7	108	High
B-8 0-5 ft.	12.7	98.5	34.7	14.9	147	Very High
B-9 0-5 ft.	11.7	102.8	29.9	10.1	100	High
B-15 0-5 ft.	12.1	100.3	37.1	15.6	154	Very High

UBC CLASSIFICATION

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

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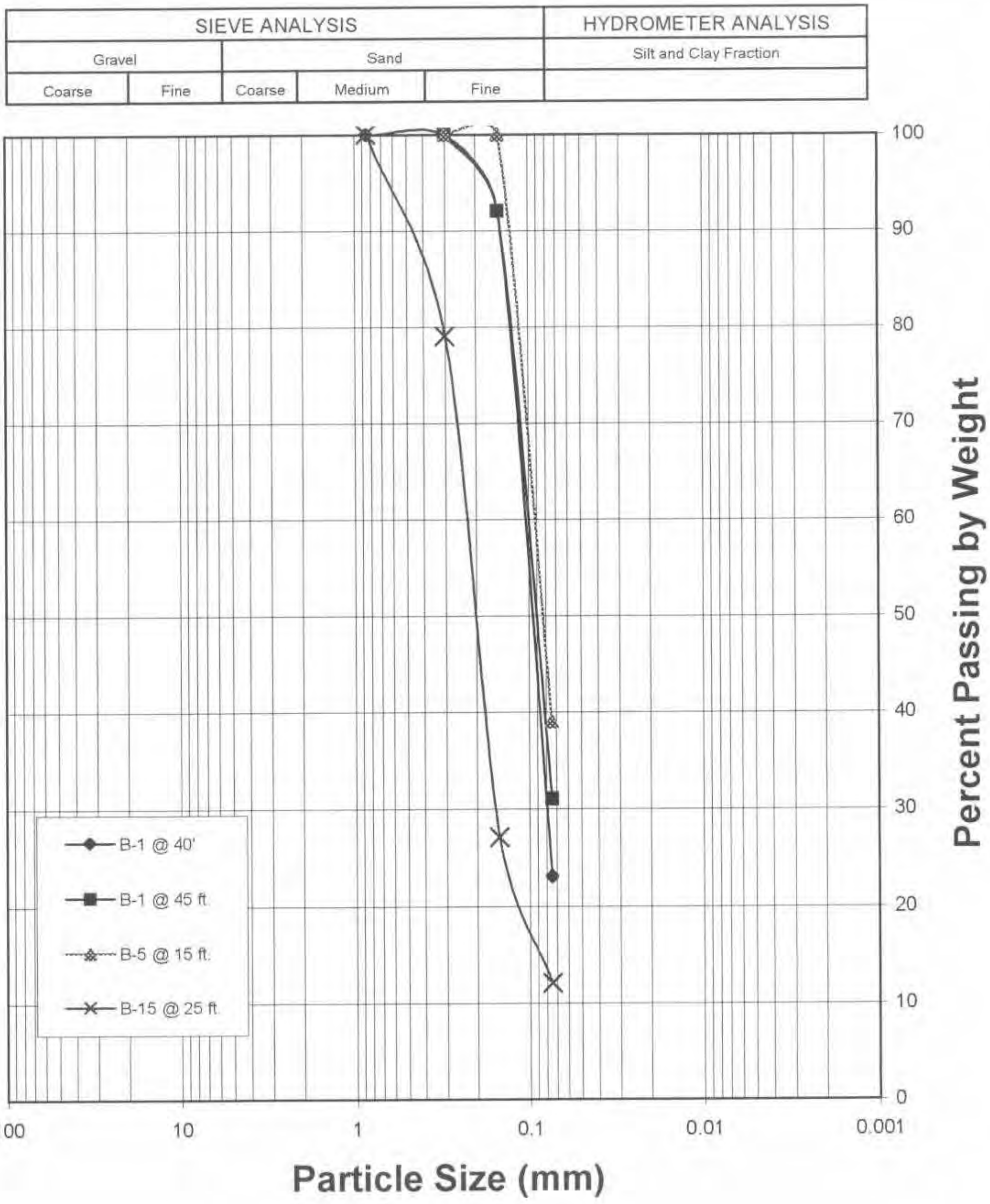
Project No.: LE09253

Expansion Index Test Results

Plate C-3



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Project No.: LE09253

Grain Size Analysis

Plate
C-4

LANDMARK CONSULTANTS, INC.

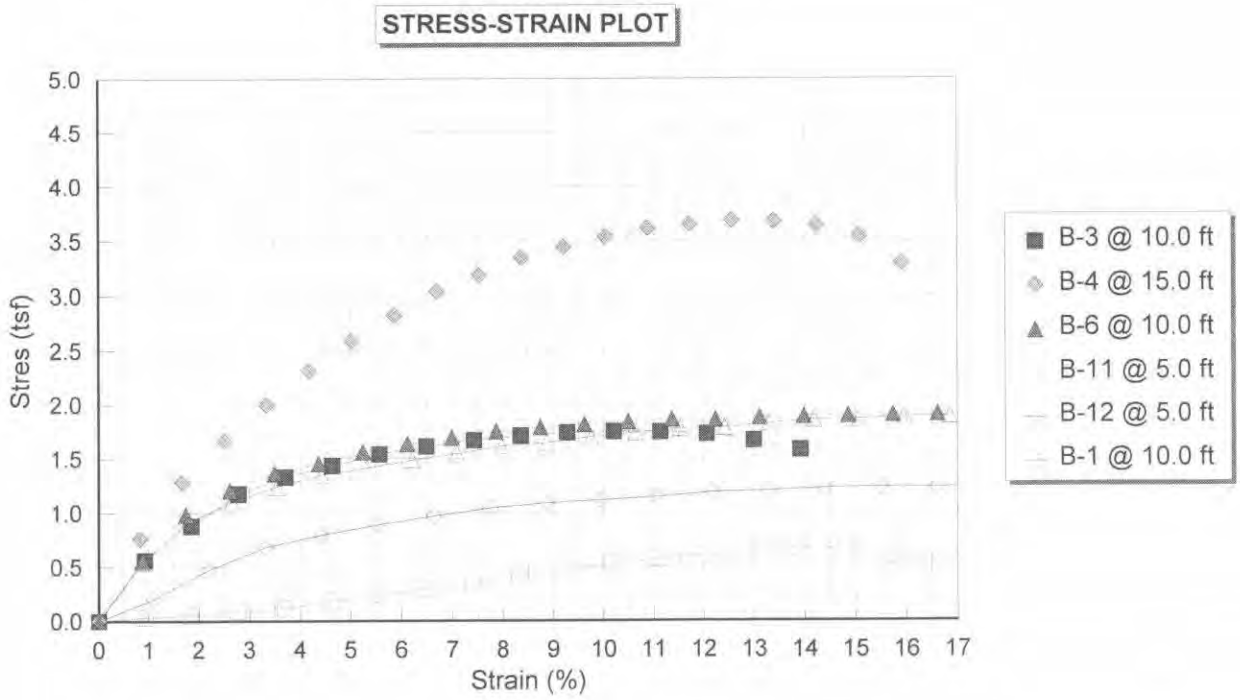
CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Energy Generating Facility
JOB NO: LE09253
DATE: 02/01/10

==

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-3	10.0	28.1	96.6	1.74	0.87	10.2
B-4	15.0	25.6	98.9	3.68	1.84	12.6
B-6	10.0	26.6	98.4	1.92	0.96	19.2
B-11	5.0	28.9	95.1	0.66	0.33	13.9
B-12	5.0	27.3	92.8	1.24	0.62	19.9
B-1	10.0	26.6	98.3	1.94	0.97	23.0


STRESS-STRAIN PLOT

LANDMARK
Geo-Engineers and Geologists

Project No: LE09253

Unconfined Compression Test Results

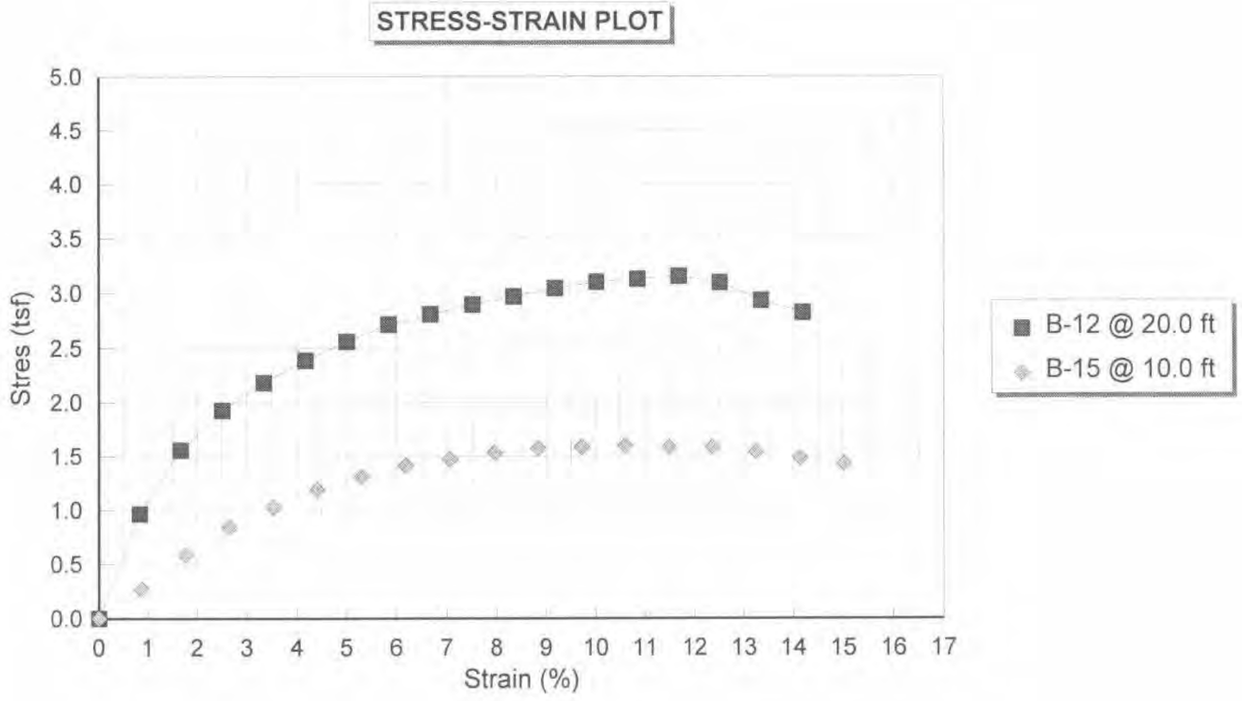
Plate C-5

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Energy Generating Facility
JOB NO: LE09253
DATE: 02/01/10

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-12	20.0	26.8	98.5	3.15	1.58	11.7
B-15	10.0	30.6	93.2	1.60	0.80	10.6



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Project No: LE09253

Unconfined Compression Test Results

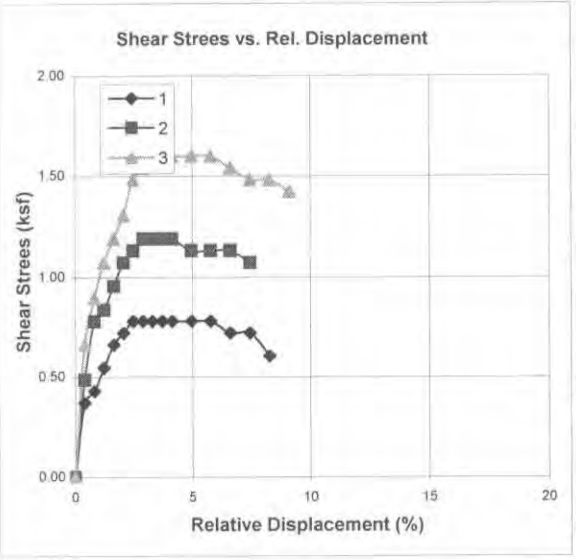
Plate C-6

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
PROJECT No: LE09253 **DATE:** 2/22/2010

DIRECT SHEAR TEST - INSITU (ASTM D3080)

SAMPLE LOCATION: B-2 @ 15 ft
SAMPLE DESCRIPTION: Silty Sand (SM)



	Specimen:	1	2	3	Avg.
Initial	Moisture Content, %:	22.8	22.8	22.8	22.8
	Dry Density, pcf:	101.9	101.3	101.5	101.6
	Saturation, %:	97	96	96	
Final	Moisture Content, %:	28.3	26.2	26.9	
	Dry Density, pcf:	98.8	100.4	100.2	
	Saturation, %:	111	107	110	
	Normal Stress, ksf:	1.07	1.61	2.15	
	Peak Shear Stress, ksf:	0.78	1.19	1.60	
	Residual Shear Stress, ksf:	0.72	1.13	1.54	
	Deformation Rate, in./min.	0.01	0.01	0.01	

	Peak	Residual	
Angle of Internal Friction, deg.:	37	37	
Cohesion, ksf:	0.00	0.00	

DIRECT SHEAR TEST RESULTS

LANDMARK
Geo-Engineers and Geologists
PROJECT No: LE09253

Direct Shear
Test Results

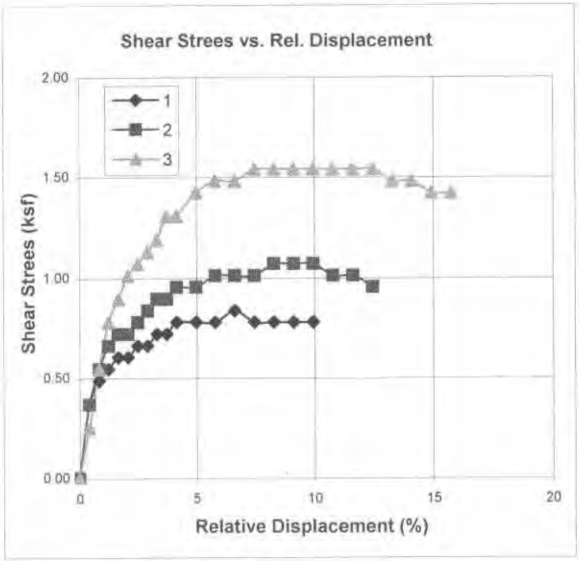
C-7

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
PROJECT No: LE09253 **DATE:** 2/22/2010

DIRECT SHEAR TEST - INSITU (ASTM D3080)

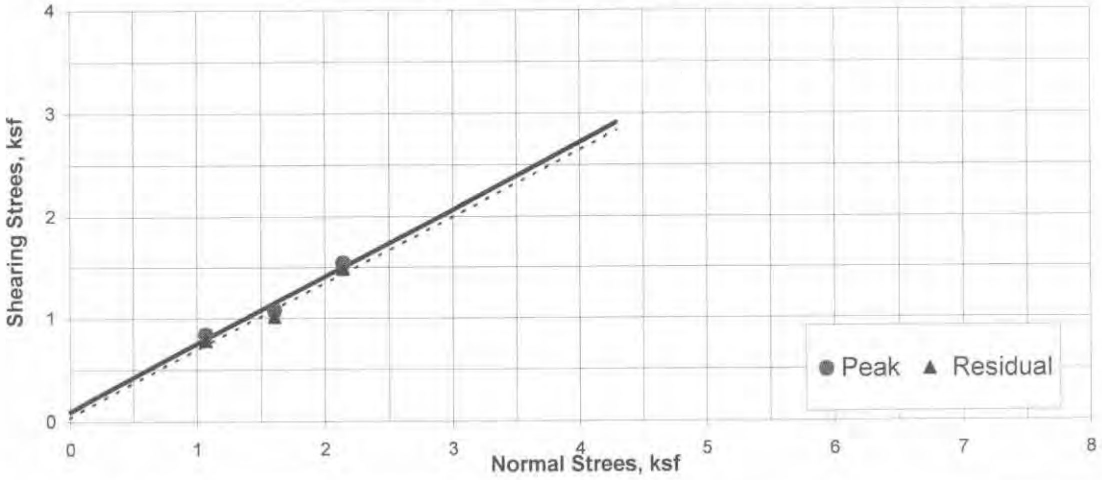
SAMPLE LOCATION: B-5 @ 10 ft
SAMPLE DESCRIPTION: Sandy Silt (ML)



	Specimen:	1	2	3	Avg.
Initial	Moisture Content, %:	27.4	27.3	27.5	27.4
	Dry Density, pcf:	96.6	94.8	95.3	95.6
	Saturation, %:	102	97	99	
Final	Moisture Content, %:	29.5	31.5	30.2	
	Dry Density, pcf:	100.0	99.3	97.9	
	Saturation, %:	119	125	116	
	Normal Stress, ksf:	1.07	1.61	2.15	
	Peak Shear Stress, ksf:	0.84	1.07	1.54	
	Residual Shear Stress, ksf:	0.78	1.01	1.48	
	Deformation Rate, in./min.	0.01	0.01	0.01	

	Peak	Residual	
Angle of Internal Friction, deg.:	33	33	
Cohesion, ksf:	0.09	0.04	

DIRECT SHEAR TEST RESULTS



LANDMARK
Geo-Engineers and Geologists

PROJECT No: LE09253

Direct Shear
Test Results

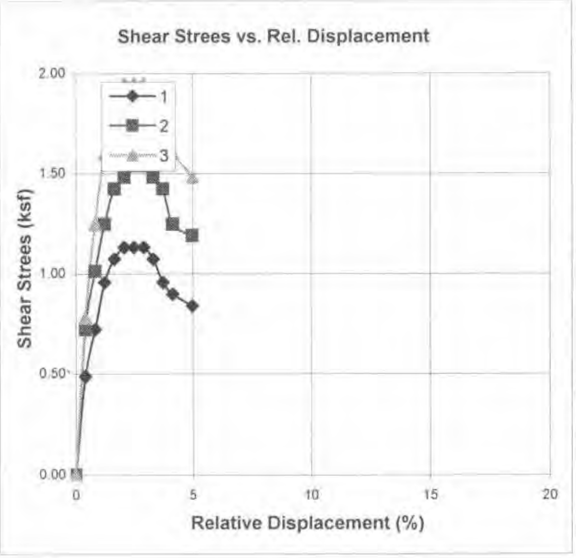
C-8

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
PROJECT No: LE09253 **DATE:** 2/22/2010

DIRECT SHEAR TEST - INSITU (ASTM D3080)

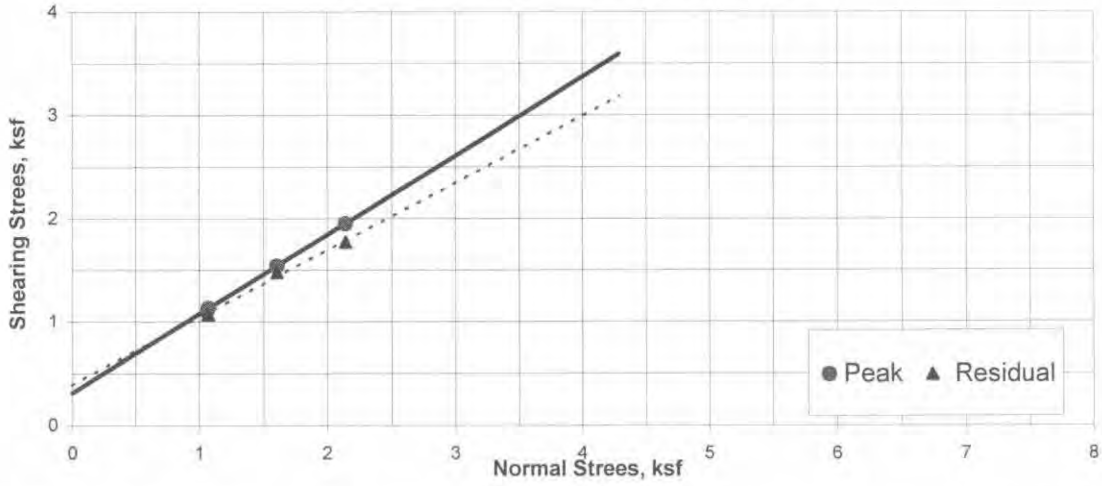
SAMPLE LOCATION: B-6 @ 20 ft
SAMPLE DESCRIPTION: Silty Sand (SM)



	Specimen:	1	2	3	Avg.
Initial	**Moisture Content, %:**	**16.4**	**16.5**	**16.3**	**16.4**
	Dry Density, pcf:	**115.0**	**111.3**	**112.9**	**113.1**
	Saturation, %:	99	90	93	
Final	**Moisture Content, %:**	17.7	17.9	18.3	
	Dry Density, pcf:	112.6	108.5	109.6	
	Saturation, %:	100	91	95	
	Normal Stress, ksf:	**1.07**	**1.61**	**2.15**	
	Peak Shear Stress, ksf:	**1.13**	**1.54**	**1.95**	
	Residual Shear Stress, ksf:	1.07	1.48	1.77	
	Deformation Rate, in./min.	0.01	0.01	0.01	

	Peak	Residual	
Angle of Internal Friction, deg.:	**37**	**33**	
Cohesion, ksf:	**0.31**	**0.39**	

DIRECT SHEAR TEST RESULTS



LANDMARK
Geo-Engineers and Geologists
PROJECT No: LE09253

Direct Shear
Test Results

C-9

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
JOB No.: LE09253
DATE: 02/01/10

CHEMICAL ANALYSIS

Boring:	B-1	B-2	B-5	B-6	B-7	B-8	**Caltrans Method**
Sample Depth, ft:	0-5	0-5	0-5	0-5	0-5	0-5	
pH:	7.3	7.4	7.7	7.4	7.4	7.4	**643**
Electrical Conductivity (mmhos):	2.23	1.88	0.89	3.61	2.53	3.51	**424**
Resistivity (ohm-cm):	440	450	560	220	250	240	**643**
Chloride (Cl), ppm:	520	400	220	1,120	1,000	1,180	**422**
Sulfate (SO4), ppm:	3,660	3,438	931	6,438	3,300	5,952	**417**

General Guidelines for Soil Corrosivity

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

LANDMARK
Geo-Engineers and Geologists

Project No.: LE09253

Selected Chemical Test Results

Plate
C-10

LANDMARK CONSULTANTS, INC.

CLIENT: LS Power Development, LLC
PROJECT: Solar Photovoltaic Electric Generating Facility
JOB No.: LE09253
DATE: 02/01/10

CHEMICAL ANALYSIS

Boring:	B-9	B-11	B-12	B-14	B-15	**Caltrans**
Sample Depth, ft:	0-5	0-5	0-5	0-5	0-5	**Method**
pH:	7.6	7.3	7.2	7.4	7.4	643
Electrical Conductivity (mmhos):	2.17	4.09	3.53	3.85	4.19	424
Resistivity (ohm-cm):	360	200	280	210	220	643
Chloride (Cl), ppm:	520	1,540	1,600	1,300	2,860	422
Sulfate (SO4), ppm:	3,360	6,516	4,860	6,198	5,598	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

LANDMARK
Geo-Engineers and Geologists

Project No.: LE09253

Selected Chemical Test Results

Plate C-11

APPENDIX D

Liquefaction Evaluation and Settlement Calculation

Project Name: Centinela Solar Facility
Project No.: LE09253
Location: B-1

Maximum Credible Earthquake	7
Design Ground Motion	0.42 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	8 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
5	1.52		9	0	575	0.67	6	1.5	1.0	0.75	1	1.70	12	95	19	0.203	0.270	Non-Liq.	0.00	0.00
10	3.05		18	0	1025	0.67	12	1.5	1.0	0.80	1	1.36	20	95	29	0.359	0.300	1.43	0.00	0.00
15	4.57	14		0	1288	1	14	1.5	1.0	0.85	1.1	1.11	22	70	31		0.354	Non-Liq.	0.00	0.00
20	6.10		18	0	1551	0.67	12	1.5	1.0	0.95	1	0.96	16	95	25	0.279	0.387	0.86	0.00	0.00
25	7.62	10		0	1814	1	10	1.5	1.0	0.95	1.1	0.86	13	95	21	0.229	0.407	0.67	0.00	0.00
30	9.14		9	1	2077	0.67	6	1.5	1.0	0.95	1	0.78	7	70	13	0.142	0.417	0.40	2.15	1.29
35	10.67	48		1	2340	1	48	1.5	1.0	1.00	1.1	0.73	57	23	67		0.418	Non-Liq.	0.00	0.00
40	12.19		50	1	2603	0.67	34	1.5	1.0	1.00	1	0.68	34	23	42		0.411	Non-Liq.	0.00	0.00
45	13.72	50		1	2866	1	50	1.5	1.0	1.00	1.1	0.64	53	31	66		0.396	Non-Liq.	0.00	0.00
50	15.24	51		1	3129	1	51	1.5	1.0	1.00	1.1	0.61	51	31	64		0.378	Non-Liq.	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **1.29**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ $C_N<=2$
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

Liquefaction Evaluation and Settlement Calculation

Project Name: **Centinela Solar Facility**
Project No.: **LE09253**
Location: **B-12**

Maximum Credible Earthquake	7
Design Ground Motion	0.42 g
Total Unit Weight,	115 pcf
Water Unit Weight,	62.4 pcf
Depth to Groundwater	8 ft
Hammer Effenciency	90
Required Factor of Safety	1.0

Boring Data						Sampling Corrections							Corrected	Fines	SPT Clean	Cyclical	Cyclical	Factor	Volumetric	Induced
Depth		Blow Counts		Liquefiable	Overburden	Sampler	SPT	Energy	Borehole	Rod	Liner	Overburden	SPT	Content	Sands	Resistance	Stress	of	Strain (%)	Subsidence
(ft)	(m)	SPT	Mod. Cal.	Soil (0 / 1)	Pressure	Diameter	N_m	C_E	C_B	C_R	C_L	C_N	$(N_1)_{60}$	%	$(N_1)_{60CS}$	$CRR_{M7.5}$	CSR	Safety		(inch)
5	1.52		12	0	575	0.67	8	1.5	1.0	0.75	1	1.70	15	95	23	0.259	0.270	Non-Liq.	0.00	0.00
10	3.05		14	0	1025	0.67	9	1.5	1.0	0.80	1	1.36	15	95	23	0.258	0.300	1.02	0.00	0.00
15	4.57	8		0	1288	1	8	1.5	1.0	0.85	1.1	1.11	12	95	20	0.215	0.354	0.73	0.00	0.00
20	6.10		27	0	1551	0.67	18	1.5	1.0	0.95	1	0.96	25	95	35		0.387	Non-Liq.	0.00	0.00
25	7.62	8		1	1814	1	8	1.5	1.0	0.95	1.1	0.86	11	30	17	0.185	0.407	0.54	1.78	1.07
30	9.14		9	1	2077	0.67	6	1.5	1.0	0.95	1	0.78	7	70	13	0.142	0.417	0.40	2.15	1.29
35	10.67	7		0	2340	1	7	1.5	1.0	1.00	1.1	0.73	8	95	15	0.163	0.418	0.46	0.00	0.00
40	12.19		33	0	2603	0.67	22	1.5	1.0	1.00	1	0.68	22	95	32		0.411	Non-Liq.	0.00	0.00
45	13.72	16		0	2866	1	16	1.5	1.0	1.00	1.1	0.64	17	95	25	0.287	0.396	0.86	0.00	0.00
50	15.24	20		0	3129	1	20	1.5	1.0	1.00	1.1	0.61	20	95	29	0.376	0.378	1.19	0.00	0.00

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997.

Total Settlement **2.36**

Corrections to SPT (Modified from Skempton, 1986) as listed by Robertson and Wride.

Factor	Equipment Variable	Term	Correction
Overburden Pressure		C_N	$(P_a/\sigma_{VO})^{0.5}$ $C_N<=2$
Energy Ratio	Donut Hammer	C_E	0.5 to 1.0
	Safety Hammer		0.7 to 1.2
	Automatic-trip Donut type Hammer		0.8 to 1.3
Borehole Diameter	2.6 inch to 6 inch	C_B	1
	6 inch		1.05
	8 inch		1.15
Rod Length	10 feet to 13 feet	C_R	0.75
	13 feet to 19.8 ft.		0.85
	19.8 ft. to 33 ft.		0.95
	33 ft. to 98 ft.		1
	> 98 ft.		<1.0
Sampling Method	Standard Sampler	C_L	1
	Sampler without liners		1.1 to 1.3

APPENDIX E

REFERENCES

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ATTACHMENT A-4-b

CORROSION STUDY

(8 Pages)

NORTON CORROSION LIMITED

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May 25, 2010

Joe Otahal
LS Power Development, LLC
Via e-mail: JOtahal@LSPower.com

Subject: **CENTINELA SOLAR ENERGY PROJECT**
STEEL PILING EVALUATION
CORROSION LOSS PREDICTION

Dear Joe:

Norton Corrosion Limited (NCL) has been retained by Centinela Solar Energy to review design details of the proposed Centinela Solar Energy Project to predict steel piling corrosion loss. That work was authorized by Professional Services Agreement dated March 15, 2010 and Work Authorization Task 1- Steel Piling Evaluation.

Project Details

The subject project proposes to install approximately 250,000 6-inch steel ¼" I-Beams by direct imbed to a depth of 8 feet spaced 10 feet on center to support photovoltaic (PV) panels. The project is to be located in the Imperial Valley region of the California low desert near Calexico, California. The approximately 1000 acre site is currently used in agricultural production and lies at an elevation of 15 feet below mean sea level with average precipitation of less than 3 inches per year. The anticipated design life is 30 years and corrosion control is planned to be provided by hot dip galvanizing to a thickness of 6 mils.

Geotechnical Report

Geotechnical investigations were performed by others at the site with the following findings relative to corrosion:

1. Sulfate concentrations ranged from 931 to 6516 parts per million (ppm)
2. Chlorides ranged from 220 to 2860 ppm
3. Resistivity ranged from 200 to 560 ohm-cm
4. Conductivity ranged from 0.89 to 4.19 mmhos
5. pH ranged from 7.2 to 7.7

Average values for those characteristic were as follows:

1. Sulfate 4568 ppm
2. Chlorides 1191 ppm
3. Resistivity 312 ohm-cm
4. Conductivity 2.95 mmhos
5. pH 7.4

Corrosion Environment

These five electrochemical characteristics are instrumental in describing corrosion tendencies. Sulfates often promote rapid bacteriological activity which can accelerate corrosion activity. Naturally occurring sulfates are reduced to sulfides by specific bacteria under anaerobic conditions. Those bacteria are associated with heavy soils. Soils high in sulfates can be very damaging to concrete materials. Sulfate concentration above 2000 ppm represents a severely corrosive environment toward steel and above 5000 ppm toward concrete.

Chlorides act to accelerate corrosion by breaking down the naturally occurring passive film that tends to retard corrosion after it has initiated. Chloride concentration above 1000 ppm represents a severely corrosive environment toward carbon steel.

Electrical resistivity is a measure of the resistance toward current flow in the soil medium. Corrosion is an electrical and chemical process dependent upon flow of electric current and soils with low resistivity provide very little limitation toward corrosion activity. Resistivity below 1000 ohm-cm represents soil that will actively support corrosion toward carbon steel exposure. Once corrosion has been initiated, chlorides allow the process to continue by compromising the naturally limiting passive film. Conductivity is the inverse of resistivity so high conductivity provides the same damaging environment.

pH is the measure of hydrogen ion concentration and soils with excessive hydrogen ions promote corrosion activity. pH is measured as the negative exponent of hydrogen concentration so values less than 7 represent an acidic environment with greater potential for corrosion activity. Values greater than 7 represent an alkaline environment that tends to limit corrosion activity.

Corrosion rates for carbon steel exposed directly to soil are also dependent upon several physical variables and are quite complex. Most soils provide a heterogeneous environment consisting of gaseous, liquid and solid phases. The gaseous phase includes air found in soil pores with free oxygen necessary to support the corrosion process. It is the lack of free oxygen at depth that stifles corrosion activity. The liquid phase represents soil moisture content which provides the agent that allows the corrosion activity to proceed. The solid phase represents soil particles which vary in size and chemical content. The smallest particles are described as clays which tend to readily absorb water and therefore provide an active corrosion environment. All three constituents are instrumental in describing corrosion activity and ultimately service life of a structure.

The geotechnical report classified the soils encountered at this site as predominantly clays with silts and sandy silts. The clays will readily retain moisture and groundwater is reported at 8 to 10 feet. That groundwater will have less effect on corrosion due to lack of free oxygen compared to other sources of water. The water sources most responsible for support of corrosion activity are surface sources such as rainfall or irrigation and capillary water trapped in pores and attached to soil particles. These soils are reported to have relatively high moisture content ranging from 11 to 30%.

<u>Galvanizing</u>

Galvanizing provides corrosion control by galvanic cathodic protection. The active zinc layer applied by hot dip galvanizing represents an inherently active material in relation to the more passive carbon steel substrate. The application process not only adds a thin outer layer of pure zinc but also results in a much thicker inner layer of beneficial zinc-iron alloy. Long term testing has shown that inner layer consumes at a much slower rate than the pure zinc outer layer. Standard zinc application using the hot dip galvanizing process provides a layer approximately 3 mils thick and this project is designed with twice that application for extended service life. Studies have shown galvanizing consumption rates exposed to low resistivity soils at approximately ¼ to ½ mil per year.

State of California has studied service life (time to through wall penetration) of 18 gauge (52 mils section) galvanized steel culverts exposed to aggressive soil environments and has concluded soil resistivity and pH alone to be good indicators of service life per the following document: State of California Department of Transportation *Method of Estimating the Service Life of Steel Culverts* California Test 643. The pH indicates the relative acidity of the local environment and the resistivity indicates the relative quantity of soluble salts present. Two formulas have been developed considering those two indicators alone to show estimated time to perforation of the galvanized steel culverts. Those formulas are as follows:

$$\text{Service Life} = 13.79(\log R - \log (2160 - 2490 (\log pH)) \quad :\text{for } pH \leq 7.3$$
$$\text{Service Life} = 1.47\ R^{0.41} \quad :\text{for } pH > 7.3$$

The R represents a value for <u>minimum resistivity</u> derived by adding de-ionized or distilled water to the soil sample which allows salts to enter into solution until a minimum value is recorded. The geotechnical report for this project provided no minimum resistivity data so a value is assumed as 75% of reported resistivity value since moisture content is already naturally quite high. The pH value is simply the value recorded in the geotechnical report using normal techniques. The pH values were all elevated which is beneficial for projected service life. The following service life values are derived for standard 18 gauge galvanized (3 mils) steel at the soil sampling sites reported using assumed minimum resistivity values and actual pH.

SERVICE LIFE FOR GALVANIZED 18 GAUGE STEEL

Boring	Resistivity	Min. Resistivity	pH	Service Life
B1	440 ohm cm	330 ohm cm	7.3	20.7 years
B2	450	338	7.4	16.0
B5	560	420	7.7	17.5
B6	220	165	7.4	11.9
B7	250	188	7.4	12.6
B8	240	180	7.4	12.4
B9	360	270	7.6	14.6
B11	200	150	7.3	16.0
B12	280	210	7.2	12.7
B14	210	158	7.4	11.7
B15	220	165	7.4	11.9

Since the formulas predict service life for 18 gauge culverts, meaning loss of 3 mils galvanizing and complete loss of steel section at first penetration, a multiplier is provided to estimate service life for larger gauge steel as follows:

Gauge	16	14	12	10	8
Section (mils)	64	80	110	138	168
Factor	1.3	1.6	2.2	2.8	3.4

That multiplier can be utilized to establish metal loss over a 30 year period assuming a linear rate of section loss by determining fraction of life calculated relative to 30 year service and applying the resulting factor as follows: 30 years desired/ Service Life calculated = Life Factor. That factor can then be applied to indicate metal loss after 30 years exposure and resulting thinning of the ¼" I-Beams proposed for this project as follows:

30 YEAR BEAM THINNING FROM SINGLE SIDE SOIL EXPOSURE

Boring	Life Factor	Metal Loss (mils)	Beam Thinning (%)
B1	1.45	75	30
B2	1.87	98	39
B5	1.71	89	36
B6	2.52	131	52
B7	2.38	126	50
B8	2.42	126	50
B9	2.05	107	43
B11	1.88	98	39
B12	2.36	123	49
B14	2.56	133	53
B15	2.52	131	52

That section loss described as ¼" I-Beam thinning applies to one side soil exposure similar to the culvert model comparison. Culverts can sometimes experience corrosion on internal surfaces where standing water and debris can support damage similar to soil side corrosion. The culvert model does not account for internal loss since internal exposure is site specific and typically limited to bottom surface only. Therefore the application of the culvert model for this analysis should include section loss from both sides of the ¼" I-Beam since both sides have constant soil contact.

Corrosion Loss of Proposed ¼" I-Beam

That significant thinning of the proposed ¼" I-Beam pile occurs over a 30 year period. The service life of the pile depends upon the minimum allowable thickness for design loads. Section loss will be limited by the galvanizing and it will be most prominent at the soil-air interface where free oxygen readily supports the corrosion activity. These proposed I-Beam piles will have 6 mils of galvanizing applied which is twice the thickness considered for the culvert model so additional service life can be expected. Galvanizing exposed to corrosive soils typically consumes at ¼ to ½ mil per year extending service life approximately 6 to 12 additional years as a result.

An added consideration affecting service life is the ¼" I-Beam pile connection to a copper grounding grid which establishes a galvanic corrosion cell that will adversely impact service life by a factor of 2-4 times dependent upon several factors.

Galvanic Corrosion Cell

Corrosion refers to the destruction of a metal by electrochemical reaction with its environment. Fundamental to every corrosion reaction is a cell in which a DC current flows. The following basic requirements must exist before corrosion will occur: 1) Anodic and cathodic areas must exist on the metallic surface; 2) there must be a metallic path or connection between the anode and cathode; and 3) the anode and cathode must be exposed to a common electrolyte. The anode is the point where current discharges from the metal and enters the electrolyte (soil) and where corrosion damage occurs. The cathode is the point where the current re-enters the metal and where corrosion does not occur.

Carbon steel exposed to corrosive soil provides a corrosion cell where the electrochemical process can be quite rapid. This is a result of low electrical resistance of the wet soil and the ease of current flow. Even though the normally occurring anodic and cathodic areas of the steel have a limited potential difference, enough exterior current flows to eventually destroy the steel. The amount of metal lost is directly proportional to the current flow. For carbon steel, this consumption rate is 20 pounds per ampere-year.

One form of electrochemical corrosion is called a galvanic corrosion cell. This occurs when two dissimilar metals or alloys are electrically joined and are exposed to a single electrolyte (soil). Certain dissimilar metals produce an inherently high potential difference that results in current discharging from the more active metal where corrosion occurs. Such galvanic cells can quickly produce serious corrosion problems. An example of this type corrosion is the connection of a copper grounding system to a carbon steel pile.

The table below illustrates the galvanic series of various metals. If two metals were electrically connected and exposed to corrosive soils, the upper one with the most negative potential (anodic) will act as an anode and the lower as a cathode. The anode will discharge current and corrode, while the cathode will receive current and be protected. The greater potential difference between the metals or the greater separation on the chart results in a faster corrosion rate.

GALVANIC SERIES OF METALS & ALLOYS

CORRODING END (ANODIC OR LEAST NOBLE)
Magnesium
Zinc
Aluminum
Carbon steel or iron
Cast iron
Stainless steel (active)
Lead
Tin
Muntz metal
Brasses
Copper
70-30 Copper-nickel alloy
Monel nickel-copper alloy
Stainless steel (passive)
Titanium
Graphite
Platinum
PROTECTED END (CATHODIC OR MOST NOBLE)

When different metals are interconnected forming the cell, corrosion currents flow between them. The result of that current flow will gradually polarize the potential of both metals which diminishes the potential difference over time. The period of time required to materially change the potential difference depends upon surface areas of both metals so a significant copper area causes more damaging current to flow resulting in more corrosion damage. Therefore, efforts should be made to mitigate the impact of the copper grounding.

Corrosion Mitigation Options

Several options are available to mitigate corrosion of the steel piles so the 30 year service life can be realized.

1. Utilize coated grounding wire for the below grade routing utilizing the piles as ground rods or route the ground wiring above grade.
2. Provide cathodic protection to depress the potential of the grounding system to more closely match the potential of the galvanized piles. It has been reported that ground current will be constantly monitored and operations will be interrupted for safety when currents are detected. To minimize ground current, zinc ribbon anode can be placed on both sides of the grounding grid in proximity so potential gradient can reduce the potential difference without significant ground current flowing.
3. Electrically isolate the grounding from the steel piles using capacitive coupling so fault currents can safely pass to ground while preserving the isolation of the galvanized piles.
4. Consider use of alternate materials in this very corrosive environment so strength is maintained without damage from corrosion. A carbon steel pipe could be used in lieu of the I-beam and filled with concrete using a reinforcing rod so the structural support would continue to be satisfactory after loss of the steel shell to corrosion.
5. The PV panels could be supported on concrete ballasts anchored to the soil so the corrosive soil did not impact sled construction.
6. Coatings can also be considered to isolate the steel from contact with the soil, especially at the air-soil interface where corrosion will be most pronounced.

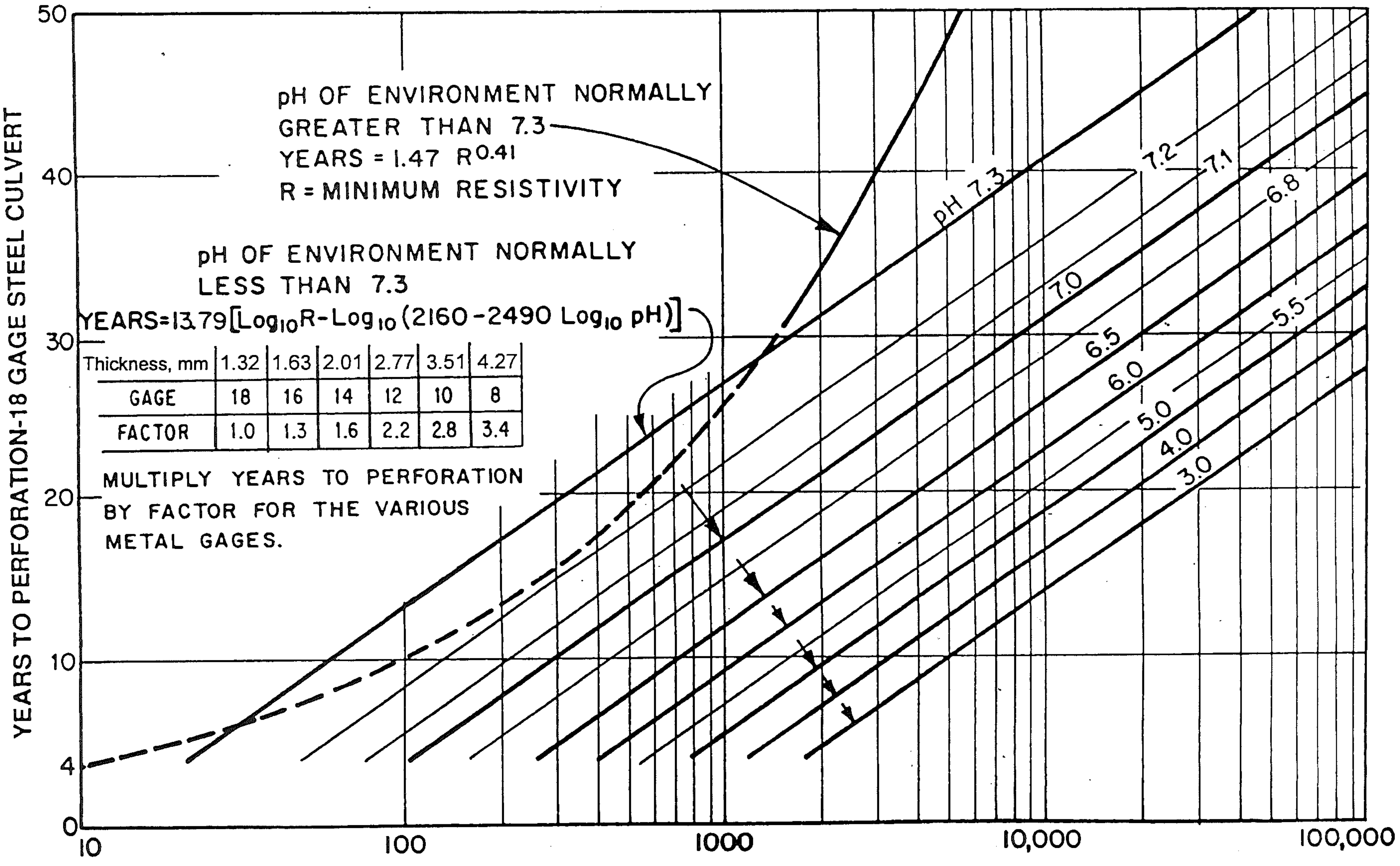
NCL appreciates this opportunity of serving Centinela on this solar energy project. Do not hesitate to contact this office with any questions regarding this report.

Sincerely,

Dale Doughty

Dale Doughty P.E.
Manager of Engineering
E-20026

CHART FOR ESTIMATING YEARS TO PERFORATION OF STEEL CULVERTS



Thickness, mm	1.32	1.63	2.01	2.77	3.51	4.27
GAGE	18	16	14	12	10	8
FACTOR	1.0	1.3	1.6	2.2	2.8	3.4

FIGURE 1
]

ATTACHMENT A-4-c

PILE TEST REPORT

(11 Pages)

HOLDREGE & KULL
CONSULTING ENGINEERS • GEOLOGISTS

Project No. 3913-01
March 31, 2011

Hans Shillinger
Manuel Brothers, Inc.
908 Taylorville Road
Grass Valley, California 95949

Reference: ***Proposed Centinela Solar Farm Project Site***
Imperial County, California

Subject: ***Summary of Pile Load Testing***

Dear Mr. Shillinger,

This letter summarizes the results of our recent field testing of vibratory driven test piles at the proposed Centinela Solar Farm site in Imperial County, California. We understand that the proposed photovoltaic rack structures will be supported on relatively shallow, vibratory-driven piles. The purpose of our recent testing was to provide supplemental information regarding the likely performance of shallow, small dimension piles at the site in an effort to facilitate foundation design for the project. Although foundation design loads for the project have not been established, we anticipate that the critical design loading condition will be tensile or uplift resistance to wind loading. The lateral deflection resulting from wind loading is also a design consideration.

In general, required pile embedment is established by the foundation designer based on measured SPT blow counts and the results of soil shear strength testing. However, our experience with vibratory driven piles indicates that these approaches are often conservative and may result in unnecessarily deep pile embedment. We anticipate that the information obtained during tensile and lateral deflection testing of piles at the site, in conjunction with engineering analysis based on soil shear strength, will result in a more accurate foundation design and a potential cost savings to the project.

Field Testing Summary

On March 15, 2011, representatives of Manuel Brothers, Inc. and Holdrege & Kull visited the project site to install test piles.

Following the selection of target embedment depths for the test piles by a representative of Holdrege & Kull, test piles were installed at five separate test areas within the proposed Centinela site. Test location A was generally located in the southeastern portion of the site, near the intersection of State Highway 98 and Rockwood Road. Test location B was generally located in the northeastern portion of the site, near a broad drainage swale or wash accessed off of Fisher Road near the intersection with County Highway S30/Brockman Road. Test location C was located in the northern portion of the site, near the intersections of Fisher and Wormwood Roads. Test Location D was located in the western portion of the site, near the intersection of Mandarapa Road and State Highway 98. Test location E was located in the central portion of the project, and accessed from Brockman Road. The approximate test locations are presented in Figure 1, attached.

The test piles, consisting of W6 x 9 sections, were driven to embedments varying between approximately 5 feet and 8 feet below the ground surface using an Orteco HD crawler mounted pile driver.

Representatives of Holdrege & Kull and Manuel Brothers returned to the site on March 16 and 17, 2011 to perform uplift load testing and lateral load testing on selected test piles.

Uplift Load Testing

For the purposes of uplift load testing, an Enerpac hydraulic load jack was used in conjunction with a load beam supported on a temporary wood crib structure to apply uplift loads to individual test piles. In general, the test loads were applied in 400 pound to 800 pound increments, for durations ranging from 2 to 4 minutes in length. The test loading was increased until a failure load was reached. Failure was generally defined as vertical displacement of the pile without an increase in resistance during the application of subsequent loads (i.e. “pulling” or gradual removal of the pile by use of the jack), or reaching an arbitrarily determined failure displacement of 0.25 inches. It should be noted that, given the short term, transient nature of the design loads resulting from wind, the loads were applied in relatively rapid duration. Tables 1 through 5, below, summarize the results of the short duration uplift load testing.

Table 1 – Short Duration Uplift Load Testing – Location A

Test Pile	Embedment Depth (feet)	Maximum Applied Tensile Load (pounds)
TP-A3	6	8,000
TP-A4	7.5	8,500
TP-A5	8	9,500

Table 2 – Short Duration Uplift Load Testing – Location B

Test Pile	Embedment Depth (feet)	Maximum Applied Tensile Load (pounds)
TP-B3	6	5,300
TP-B4	7	3,200
TP-B5	8.25	4,600

Table 3 – Short Duration Uplift Load Testing – Location C

Test Pile	Embedment Depth (feet)	Maximum Applied Tensile Load (pounds)
TP-C2	5	6,300
TP-C4	7	8,000
TP-C5	8	9,500

Table 4 – Short Duration Uplift Load Testing – Location D

Test Pile	Embedment Depth (feet)	Maximum Applied Tensile Load (pounds)
TP-D3	5	5,100
TP-D4	7	6,600
TP-D5	8	7,100

Table 5 – Short Duration Uplift Load Testing – Location E

Test Pile	Embedment Depth (feet)	Maximum Applied Tensile Load (pounds)
TP-E3	6	3,800
TP-E4	7	4,900
TP-E5	8	4,000

Lateral Load Testing

In an effort to evaluate lateral load, we also performed a cursory lateral load test on selected piles at each of the test locations. The lateral load testing was performed by building a temporary wood crib support structure between two adjacent test piles with a nominal horizontal separation of 4 feet. The Enerpac load jack was then supported on the crib structure, and the test loading was applied horizontally, in effect jacking the test piles apart. The location of the test load above the ground surface, the test load value, and the resulting cumulative displacement were recorded. The results of the lateral load testing are summarized in the following Table:

Table 6 – Short Duration Lateral Load Testing

Test Location	Embedment Depth (feet)	Applied Load Height Above Ground Surface (feet)	Applied Lateral Load	Lateral Deflection [1] (inches)
A	5	3.5	3,200	1.2
B	5	3.7	2,700	0.7
C	6	3.5	2,700	1.3
D	5	3.0	1,900	1.5
E	5	3.7	3,200	1.1

[1] Lateral deflection reported is per pile at the load application height, or total measured deflection between the loaded piles divided by 2. Load applied against weak axis of pile (bending about Y-Y axis).

Additional Load Testing During Pile Removal

Following the pile load testing described above, we observed the removal of the test piles at each of the five test sites on March 17, 2011. During the removal of the piles, we attempted to obtain additional information regarding the uplift capacity of the piles by measuring the maximum load used during pile removal.

The piles were removed through the use of the loader bucket on a John Deere 710D backhoe. Maximum tensile load measurements were obtained through the use of a Dynafor H99092 Dynamometer with a rated capacity of 50 tons. Two of the piles could not be removed by applying tensile loads with the backhoe bucket, which had an estimated limiting capacity ranging from approximately 12,000 to 13,000 pounds, depending on the bucket orientation and height above the ground surface. Piles which could not be removed by the loader bucket were subsequently removed by excavation. Table 7 summarizes the results of maximum load measurements made during pile removal.

Table 7 – Maximum Loading Recorded During Pile Removal

Test Pile	Embedment Depth (feet)	Maximum Applied Tensile Load (pounds)
TP-A1	5	10,300
TP-A2	5	9,350
TP-A3	6	12,200
TP-A4	7	12,400[1]
TP-A5	8	12,400[1]
TP-B1	5	5,350
TP-B2	5	5,400
TP-B3	6	6,800
TP-B4	7	6,200
TP-B5	8	6,850
TP-C1	5	9,900
TP-C2	6	11,350
TP-C3	6	10,600
TP-C4	7	10,700
TP-C5	8	11,250
TP-D1	5	6,450
TP-D2	6	7,250
TP-D3	6	7,650
TP-D4	7	8,400
TP-D5	8	10,150
TP-E1	5	5,000
TP-E2	5	4,800
TP-E3	6	5,350
TP-E4	7	5,900
TP-E5	8	6,300

[1] Apparent capacity of the loader bucket, pile removed by excavation

Conclusions

The following conclusions are professional opinions based on our observation of pile load testing, as well as our experience with similar projects.

The tension or uplift loads presented in the tables are representative of short duration or dynamic loads. We anticipate that under long term or continuous loading, much lower values of uplift resistance will be observed, particularly in the predominantly fine-grained, plastic soil encountered in much of the project site. The discrepancy between the lower uplift resistance values typically encountered during the application of short duration loads using the hydraulic jack versus the maximum loads recorded during pile removal illustrates the dramatic difference in pile resistance depending on the duration or pulse of the loading.

The approach to the pile testing was rudimentary in nature, and although it was based in large part on the methodology described in ASTM guidelines D 3689 *Deep Foundations Under Static Axial Tensile Load* and D 3966 *Deep Foundations Under Lateral Load*, several discrepancies exist. The test approach we used was specifically established to economically provide design information for this photovoltaic project, considering short duration loading to the rack structures. Notably, for the purposes of our testing, the load application duration was much shorter than that described in the ASTM methods. Our opinion is that the use of shorter test durations is appropriate for this project due to the short term, dynamic nature of the wind loading expected to generate the design uplift and lateral loads. Although not anticipated as a part of this project, if continuous uplift or lateral load resistance piles are proposed, it will be appropriate to consider additional, longer duration pile testing in general accordance with the established ASTM methods.

Relatively high uplift resistance values were recorded during the removal of the test piles. These measurements were obtained in an effort to provide additional information to supplement our load test measurements. However, it must be recognized that the values obtained during the removal or attempted removal of the test piles represent relatively low-quality data. Limitations to the quality of the applied load testing include the application of relatively short term, dynamic loading through the use of the backhoe. Because the use of the backhoe to reliably apply test loads relies heavily on the ability of the operator, some variability of the test results may be attributable to variations in the load application rate. In addition, although slings were used during pile removal and the operator attempted to apply a vertical uplift load, the swing of the bucket results in variation in direction of load application, potentially increasing the frictional resistance of the pile.

A significant amount of variability in the tested pile capacity was observed across the site. We suspect that the majority of the variability is associated with variations in the soil fabric due to past soil disturbance associated with cultivation and compaction of surface materials due to equipment or vehicle traffic. For example, the relatively high capacities encountered at test location C may be attributable to compaction of soil adjacent to Fisher Road due to vehicle traffic. In addition, the relatively low capacities observed at test location B may be associated with the placement of fill during grading of the road adjacent to the wash, or the accumulation of sandier soil in this area, which are probably not representative of the soil conditions across the majority of the project site. Additional pile load testing may reveal that portions of the project site contain more favorable soil conditions which allow the use of reduced pile embedment or more favorable design criteria.

Recommendations

We anticipate that the critical design loading for the foundation systems will be short duration uplift loading due to wind. The recommendations assume that W6 x 9 sections will be placed as shallow, vibratory driven piles. If other pile sections are considered, including circular pipe piles, we should review the proposed pile to confirm the recommended design criteria. If requested, we can provide design for driven piles or other alternate foundation systems once design loading or reactions for the foundation systems have been established. The following section presents general recommendations to be incorporated into the pile design for photovoltaic rack structures.

1. When reviewing short term or transient uplift loads resulting from wind, we recommend that a minimum factor of safety of 2.0 be considered. The allowable adhesion and uplift resistance values presented in the following paragraphs assume this minimum factor of safety for short duration loads.
2. We recommend that a minimum pile embedment of 5 feet be considered. Although shallower depths may provide sufficient uplift resistance, we anticipate that the potential lateral deflections for piles embedded less than 5 feet may be excessive. Furthermore, dessication cracking and seasonal shrinkage of plastic soil near the ground surface can result in the uplift and lateral resistance of shallower piers being unreliable. We can provide an estimation or review of anticipated lateral deflection once design loads for the piles have been established.

3. Based on the load testing, we recommend that an allowable uplift resistance of 2,000 pounds be used for an embedment of 5 feet when designing W6 x 9 piles for short term, wind loading. For piles with embedments deeper than 5 feet, we recommend that an additional allowable uplift resistance of 500 pounds per foot of embedment be added for short term, transient loads. For example, a proposed pile embedment of 7 feet would result in an allowable uplift resistance of 3,000 pounds.

4. If other pile sections are being considered for the project, we recommend that the piles be sized considering an allowable adhesion of 300 pounds per square foot of embedded pile surface. As a minimum, the upper 12 inches of pile embedment should be considered unreliable, and neglected from the uplift capacity determination. For steel piles using W or HP cross sections, the soil will likely fail across the flange tips, resulting in a soil plug within the web area of the pile. Thus, the pile surface area should be calculated as an equivalent rectangular section.

5. We anticipate that the piles will likely be designed using LPILE or similar software. The following table presents recommended design criteria to be used in pile design for lateral loading:

Table 8 – Recommended Design Criteria

Soil Depth (feet)	LPILE Soil Class	K[1] (pounds per cubic inch)	Strain at 50% stress, E50
1 to 10	Clay without free water (3)	200	0.010

[1] For cohesive soil, K value considers cyclic loading.

6. Because of the potentially expansive nature of the soil, we recommend that the upper 1 foot of soil be neglected when estimating lateral deflection of the test piles.

7. As a part of our review, we estimated the lateral deflection which would occur under a short duration, cyclical loading of approximately 1,000 pounds on the proposed W6 X 9 piles. For the purposes of our calculation, we assumed that the load would be applied at the top of the pile, which would extend 4 feet above the ground surface. We also assumed that the resistance provided by the upper 12 inches of soil was negligible. Using the design criteria presented above, we estimated the resulting lateral deflection to be less than one inch if

the loading was oriented about the strong, X-X axis of the pile. This analysis assumes a single, free-head cantilevered pile and does not consider group effects, bracing due to the overlying rack structure, or restriction to the angular rotation of the top of the pile due to the pile/rack connection. These factors would likely reduce pile deflection.

Limitations

The following limitations apply to the findings, conclusions and recommendations presented in this report:

1. Our professional services were performed consistent with the generally accepted geotechnical engineering principles and practices employed in northern California. No warranty is expressed or implied.
2. These services were performed consistent with our agreement with our client. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of our services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report. This report is solely for the use of our client unless noted otherwise. Any reliance on this report by a third party is at the party's sole risk.
3. If changes are made to the nature or design of the project as described in this report, then the conclusions and recommendations presented in this report should be considered invalid. Only our firm can determine the validity of the conclusions and recommendations presented in this report. Therefore, we should be retained to review all project changes and prepare written responses with regards to their impacts on our conclusions and recommendations. However, we may require additional fieldwork and laboratory testing to develop any modifications to our recommendations. Costs to review project changes and perform additional fieldwork and laboratory testing necessary to modify our recommendations are beyond the scope of services presented in this report. Any additional work will be performed only after receipt of an approved scope of services, budget, and written authorization to proceed.
4. The analyses, conclusions and recommendations presented in this report are based on site conditions as they existed at the time we performed our surface and subsurface field investigations. We have assumed that the subsurface soil and groundwater conditions encountered at the locations of our testing are generally representative of the subsurface conditions throughout the entire project site. However, the actual subsurface conditions at locations between

and beyond our exploratory test locations may differ. Therefore, if the subsurface conditions encountered during construction are different than those described in this report, then we should be notified immediately so that we can review these differences and, if necessary, modify our recommendations.

5. The project test location map shows approximate test locations; therefore, the test locations should not be relied upon as being exact nor located with surveying methods.
6. The findings of this report are valid as of the present date. However, changes in the conditions of the property can occur with the passage of time. The changes may be due to natural processes or to the works of man, on the project site or adjacent properties. In addition, changes in applicable or appropriate standards can occur, whether they result from legislation or the broadening of knowledge. Therefore, the recommendations presented in this report should not be relied upon after a period of two years from the issue date without our review.

Please contact us if you have any questions regarding our observations or the recommendations presented in this report.

Sincerely,

HOLDREGE & KULL

Rob Fingerson, G.E. 2699
Senior Geotechnical Engineer

ROBERT E. FINGERSON
No. 2699
Exp. 12/2011

Attached: Figure 1 – Site Testing Location Map

Copies: 2 to Manuel Brothers, Inc.

F:\1 Projects\3913 Centinela Photovoltaic\3913-01 Pile Testing.doc

Imagery Date: February 1, 2008

SCALE
1 inch = Approximately 1500 feet

▲ A = Pile Load Testing Location

HOLDREGE & KULL
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792 Searls Avenue • Nevada City, CA 95959
(530) 478-1305 • FAX (530) 478-1019

SITE TESTING LOCATION MAP

CENTINELA PHOTOVOLTAIC PROJECT
IMPERIAL COUNTY, CALIFORNIA

PROJECT NO. 3913-01
APRIL 2011
FIGURE 1

ATTACHMENT A-4-d

SOIL THERMAL RESISTIVITY STUDY

(13 pages)

Geotherm USA LLC.

email: info@geothermusa.com

6354 Clark Ave.
Dublin, CA 94568

Tel: 925-999-9232
Fax: 925-999-8837

Field Soil Thermal Resistivity Survey
For Underground Power Cables
Centinela Solar Energy Project
Near El Centro, CA

April, 2011

Prepared for:

Centinela Solar Energy, LLC
c/o LS Power Development/ LLC
400 Chesterfield Center, Suite 110
Saint Louis, Missouri 63017

Submitted by:

GEOTHERM USA, LLC.

Field Soil Thermal Resistivity Survey
For Underground Power Cables
Centinela Solar Energy Project
Near El Centro, CA

April, 2011

INTRODUCTION

A field thermal resistivity survey of the native soils was performed for the proposed underground power cables for the *Centinela Solar Energy Project* near El Centro, CA. It was intended to conduct in-situ thermal resistivity testing to a depth of about 4-ft or 5-ft at seven (7) locations identified by the client (*Centinela Solar Energy, LLC)*. The fieldwork was carried out on the 14th of April, 2011. *Landmark GeoEngineers* provided the backhoe and crew for excavating the test pits.

MEASUREMENT OF THERMAL RESISTIVITY

The soil thermal resistivity is a significant component of the total thermal resistance that is used to calculate the rating (ampacity) of an underground cable.

In order to maintain the cable design ampacity and safe operating temperatures, the heat generated by the cable must be dissipated through the soil. The thermal resistivity or rho [°C-cm/W] is a measure of the resistance to heat flow through a unit area of soil, and is measured by the 'transient thermal probe' technique. Basically, a thin cylindrical probe containing a heater and temperature sensor is inserted into the soil to be tested. Constant power is applied to the heater and the probe temperature-time data is monitored. The thermal resistivity can be calculated from this curve. As long as certain theoretical assumptions and test procedures are met, the technique is equally applicable to small probes in laboratory soil samples and large probe installed in-situ.

The **TPA-2000** (**EPRI EL-2128**), manufactured by *Geotherm Inc*., is a system that fully automates the thermal probe test. It is computer controlled and provides programmable power to the thermal probes, reads temperature sensors and heater current and voltage, and immediately computes the thermal resistivity. A statistical analysis of data indicates whether an acceptable test has been accomplished. Test data (time, temperature, power) can be printed, plotted and stored on disk for future analysis and reference to the results.

FACTORS AFFECTING THERMAL RESISTIVITY

Heat flows through a soil mainly by conduction along mineral particles, and secondarily by conduction and convection through the moisture or air that occupies the pore space between solid particles. Thermal resistivity depends on soil composition and texture, water content, density, and various other factors to a lesser degree. This complex interrelationship does not lend itself to a simple formula; rather a thermal probe test must be carried out on a given soil in an undisturbed condition. Laboratory tests on disturbed soil samples should only be performed when correlated to field test results. Note that for the installed backfill or the native soil, moisture is the only parameter that changes significantly with time; as a result of the cable load and other factors.

FIELD TESTING

It was requested to conduct in-situ thermal testing at seven (7) locations as specified by the client. At each test location, a backhoe was used to dig a 4-ft or 5-foot deep test pit and in-situ thermal resistivity measurements were taken at three depths (**Table 1**) by installing thermal probes and using the *Geotherm* **TPA-2000;** run off a portable power source. In addition, some soil samples for moisture content measurement and thermal dryout characterization were also taken at these test depths.

All field (in-situ) and laboratory thermal testing were conducted in accordance with the IEEE Standard (**IEEE-442**). Laboratory geotechnical testing was conducted in accordance with **ASTM**.

The field thermal resistivity values were measured at the given soil moisture on that particular day. Please note that the soil may be drier at other times of the year and therefore, the design thermal resistivities for the native soils should be chosen at the driest expected conditions.

The attached results present factual information on the subsurface conditions at the specific test pit locations; no warrantee is expressed or implied that materials or conditions other than those described herein may not be encountered along the cable route.

LABORATORY TESTING

Test Procedure and Equipment: The tests included the measurement of moisture content, density and thermal dryout characterization (thermal resistivity as a function of moisture content). At each location, undisturbed tube samples at the cable burial depth (bottom of the trench at 4-ft or 5-ft) along with a bulk sample taken ***from 2-ft to 4-ft/5-ft depth*** were collected (see Table 1 for depth details for each test pit). The bulk samples were re-compacted to the “in-situ” moisture content and 85% of standard Proctor density (Single Point). For all the samples, a laboratory type thermal probe was installed central and vertical in the sample and a series of thermal resistivity measurements were made in stages with moisture content ranging from “in-situ” to totally dry condition. **The laboratory test results are given in Table 1.** The tests were conducted in accordance with IEEE standard-442 and the thermal dryout curves are presented in **Figures 1 to 7.**

COMMENTS

Ambient Temperature: At the end of a warm summer, the ambient temperatures may be significantly higher; especially at shallow depths. This should be taken into consideration for the cable rating.

Thermal resistivity for the cable rating

In order to compute the 'effective thermal resistivity' for the cable rating, the following thermal resistivity values will apply.

1. ***Thermal resistivity of native soil in-situ***. For all practical purpose, thermal resistivity value of **90 °C-cm/W** can be used. This does not take into consideration any soil drying.
2. If the native soil is used as the backfill for directly buried cables, it is normally installed at a **density of say ~85%.** In this case its thermal performance will be slightly poorer and also its moisture content will decrease because this layer of native soil is directly around the heat source. Therefore a thermal resistivity of **135 °C-cm/W** is suggested.
3. For the sections where the cables are installed in **HDD (horizontal direction drilled bores)** at depth of about 10-ft below grade, some de-rating will apply as a result of the depth and also because of the air space around the cables in the annulus of the HDD casing. In order to mitigate the de-rating, you may consider filling-in the annular space with a thermal grout with a thermal resistivity similar to that of the native soil (**~85 °C-cm/W**). If this is implemented, a thermal resistivity of **140 °C-cm/W** is suggested for HDD sections. If the conduits are left un-filled, a thermal resistivity of **170 °C-cm/W** is suggested. We will be pleased to discuss these options with you.
4. Below the water table, the chances of soil drying is negligible. In-situ measurements and soil sampling was not conducted at depths below the water table. However, based on the soil description and in-situ measurements of soils above the water table, we assume a value of **90 °C-cm/W** can be used.

Should you have any questions or require further details, please contact us.

Yours truly
Geotherm USA, LLC

Nimesh Patel

TABLE 1

Test Pit (See Below)	Depth from Surface (feet)	Ambient Temp. (°C)	Field TR (°C-cm/W)	Lab TR Undisturbed Tube Samples		Dry Density (pcf)	Moisture Content (%)	Lab TR 85% Compaction		Dry Density (pcf)	Moisture Content (%)	Visual Description
				Wet	Dry			Wet	Dry			
1	2	23.5	87	77	176	24	95	83	204	85	24	CLAY with silt and sand
	3	22.2	84									
	5	22.3	84									
5	2	20.8	89	72	188	28	90	78	218	82	28	CLAY with silt and sand
	3	20.8	68									
	4	21.0	71									
7	2	21.7	61	87	188	27	85	94	229	79	26	CLAY with silt and sand
	3	21.3	82									
	5	21.4	82									
8	2	21.8	97	72	168	12	100	78	195	86	18	CLAY with silt and sand
	3	21.7	86									
	4	21.8	75									
9	2	22.6	84	74	179	24	94	80	212	82	22	CLAY with silt and sand
	3	21.8	64									
	5	22.3	75									
10	2	21.5	88	79	187	29	89	85	237	78	27	CLAY with silt and sand
	3	21.4	81									
	5	21.8	71									
11	2	22.6	94	83	191	22	92	89	225	80	26	CLAY with silt and sand
	3	22.5	93									
	5	22.7	77									

Test Pit	Lat	Long
1	32.679186°	115.664853°
5	32.679170°	115.647188°
7	32.679511°	115.638855°
8	32.679532°	115.633871°
9	32.679548°	115.629240°
10	32.687200°	115.647639°
11	32.694988°	115.648283°


N
#11
#10
County Hwy S30
Drew Rd
#1
98
#5
#7
#8
#9
Yuha Cutoff
Image U.S. Geological Survey
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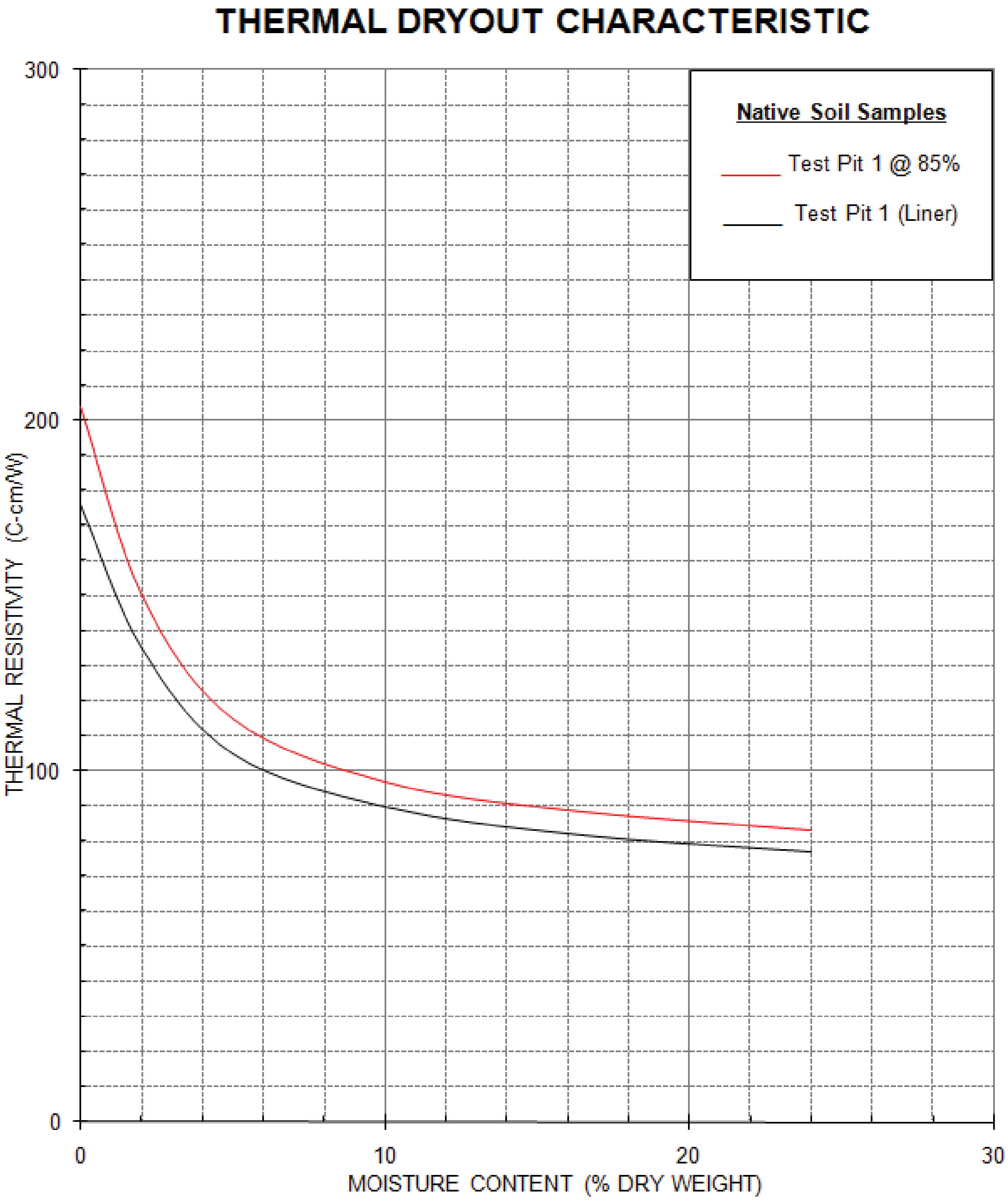
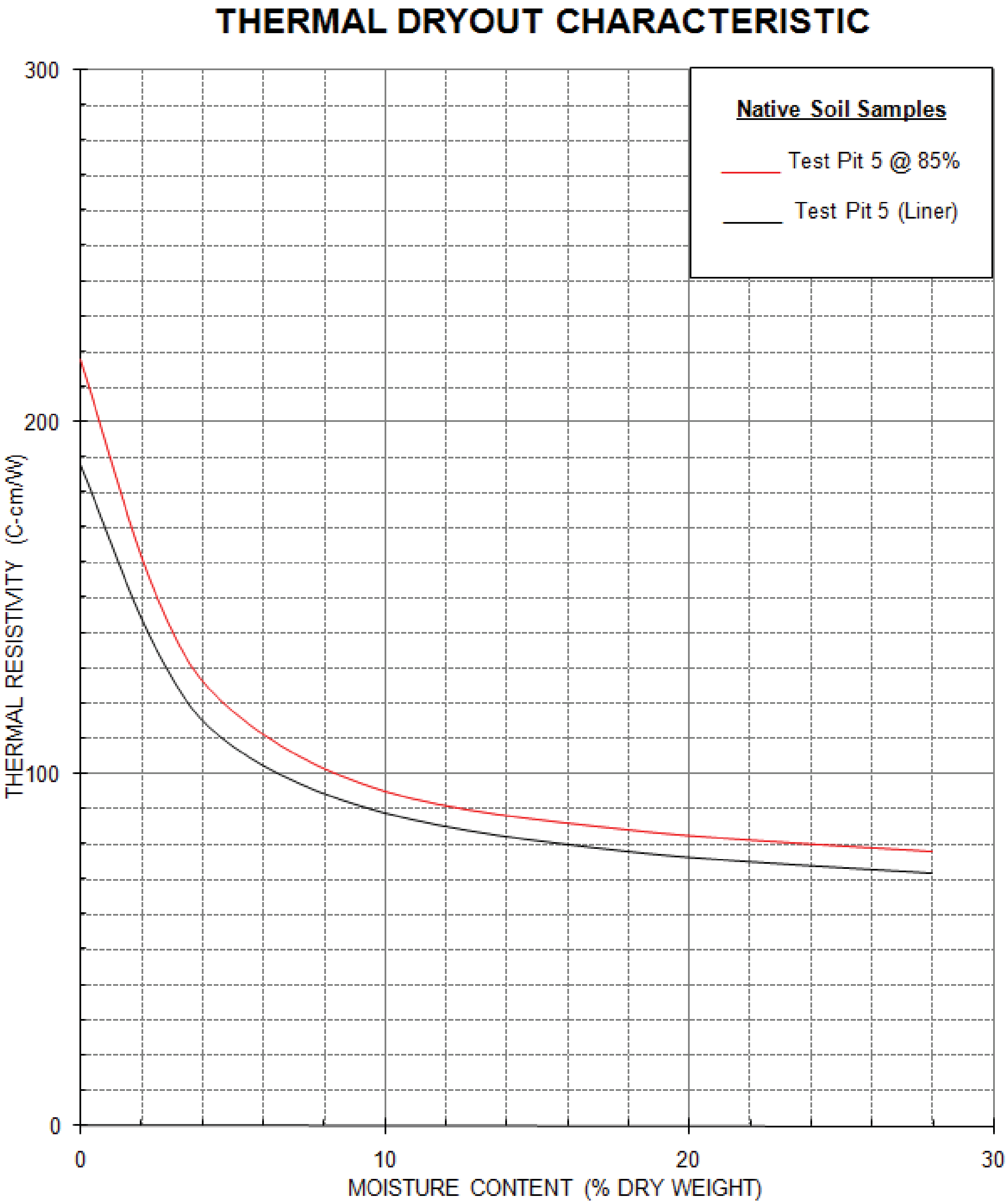


Native Soil Samples

Centinela Solar Energy Project - El Centro, CA

April 2011

Figure 1



Native Soil Samples

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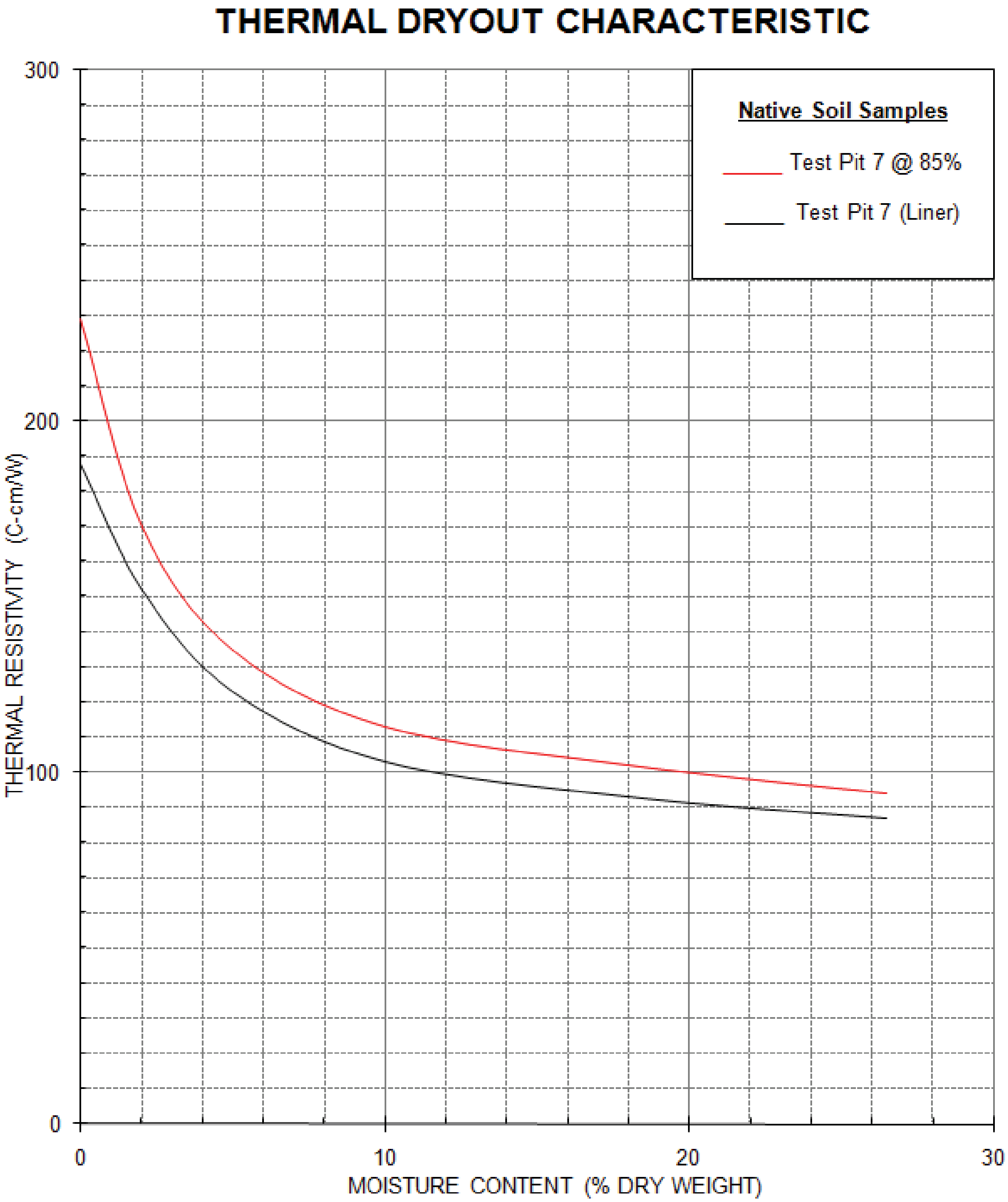
Figure 2



Native Soil Samples

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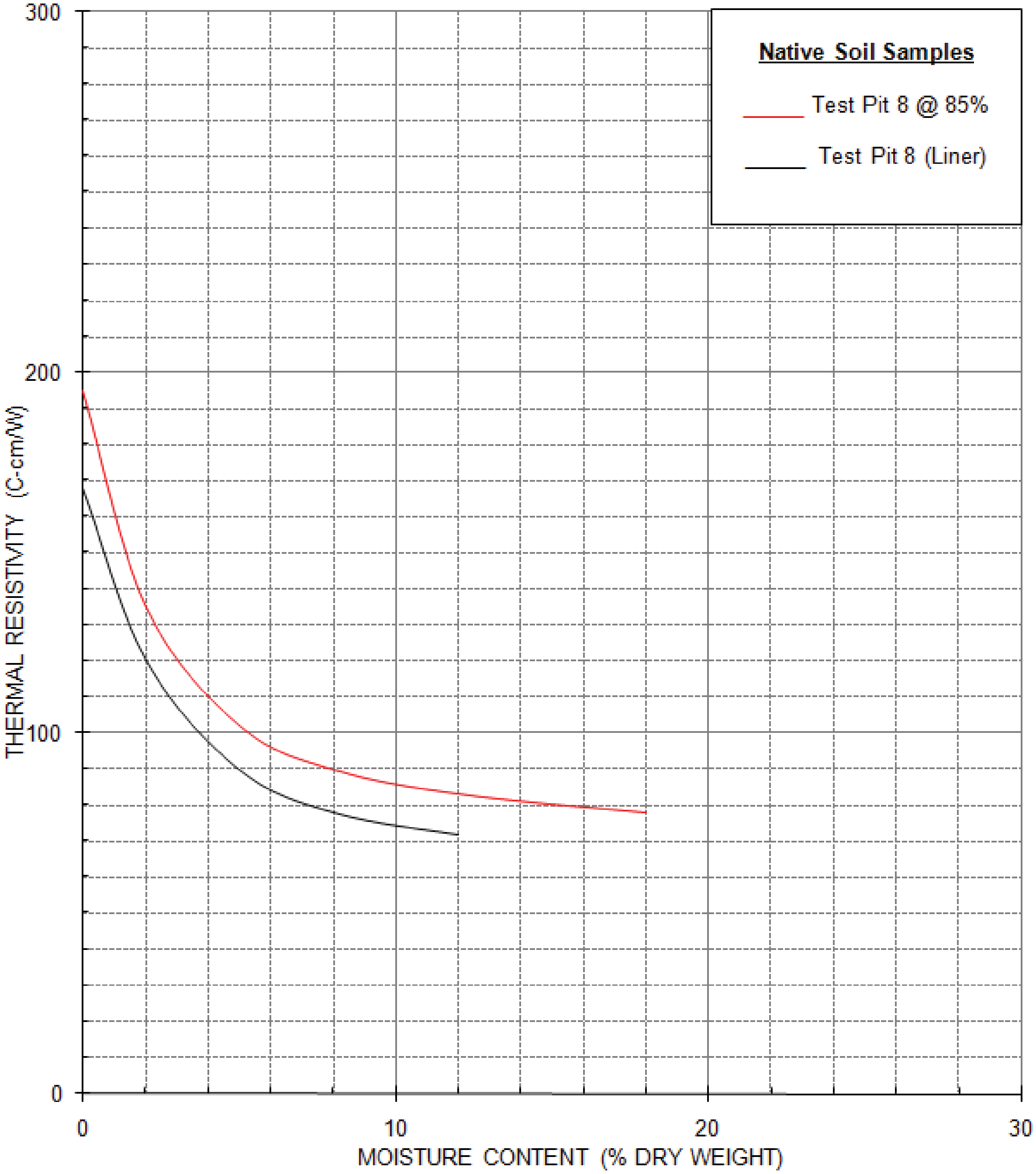
Figure 3

THERMAL DRYOUT CHARACTERISTIC



Native Soil Samples

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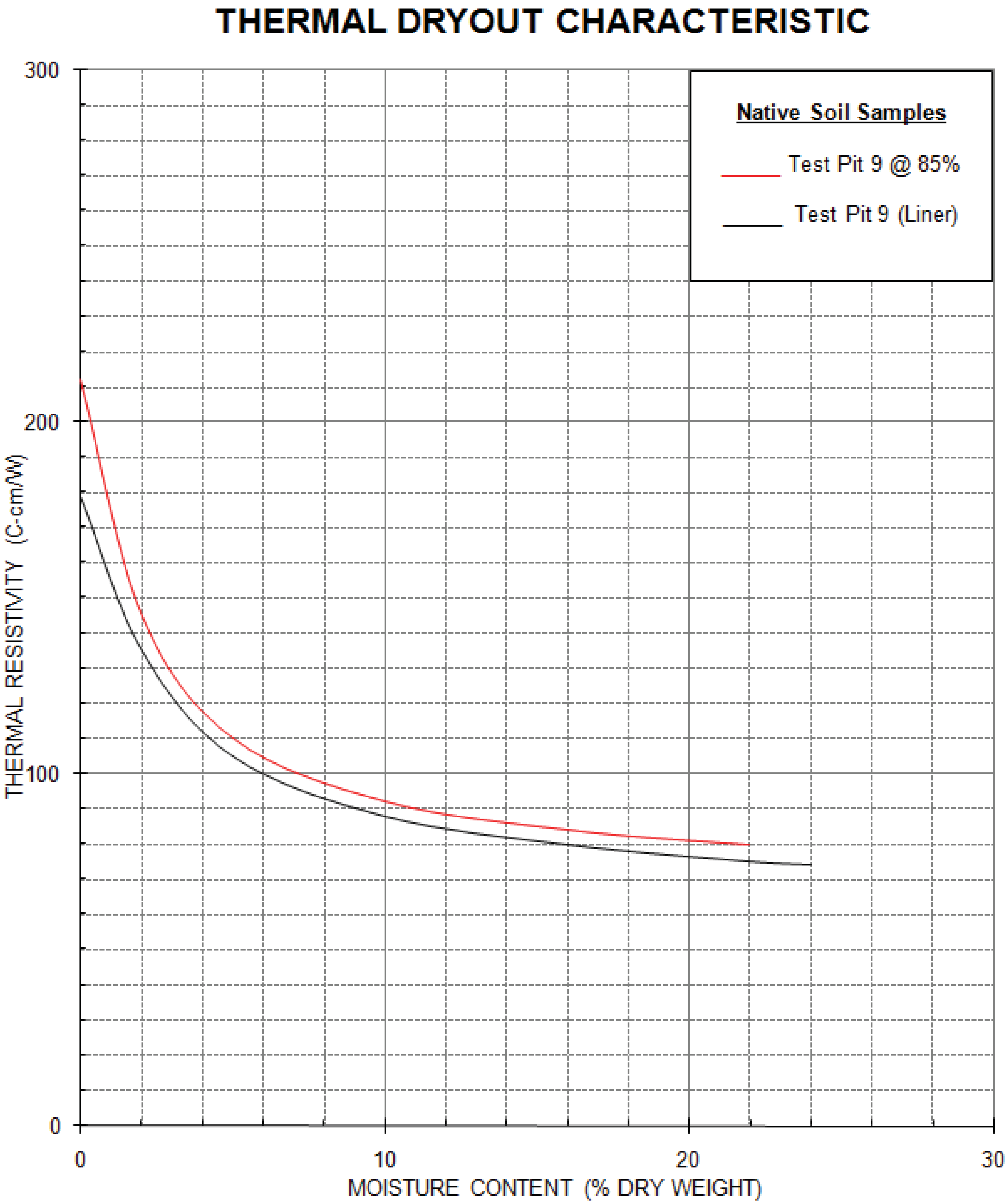
Figure 4



Native Soil Samples

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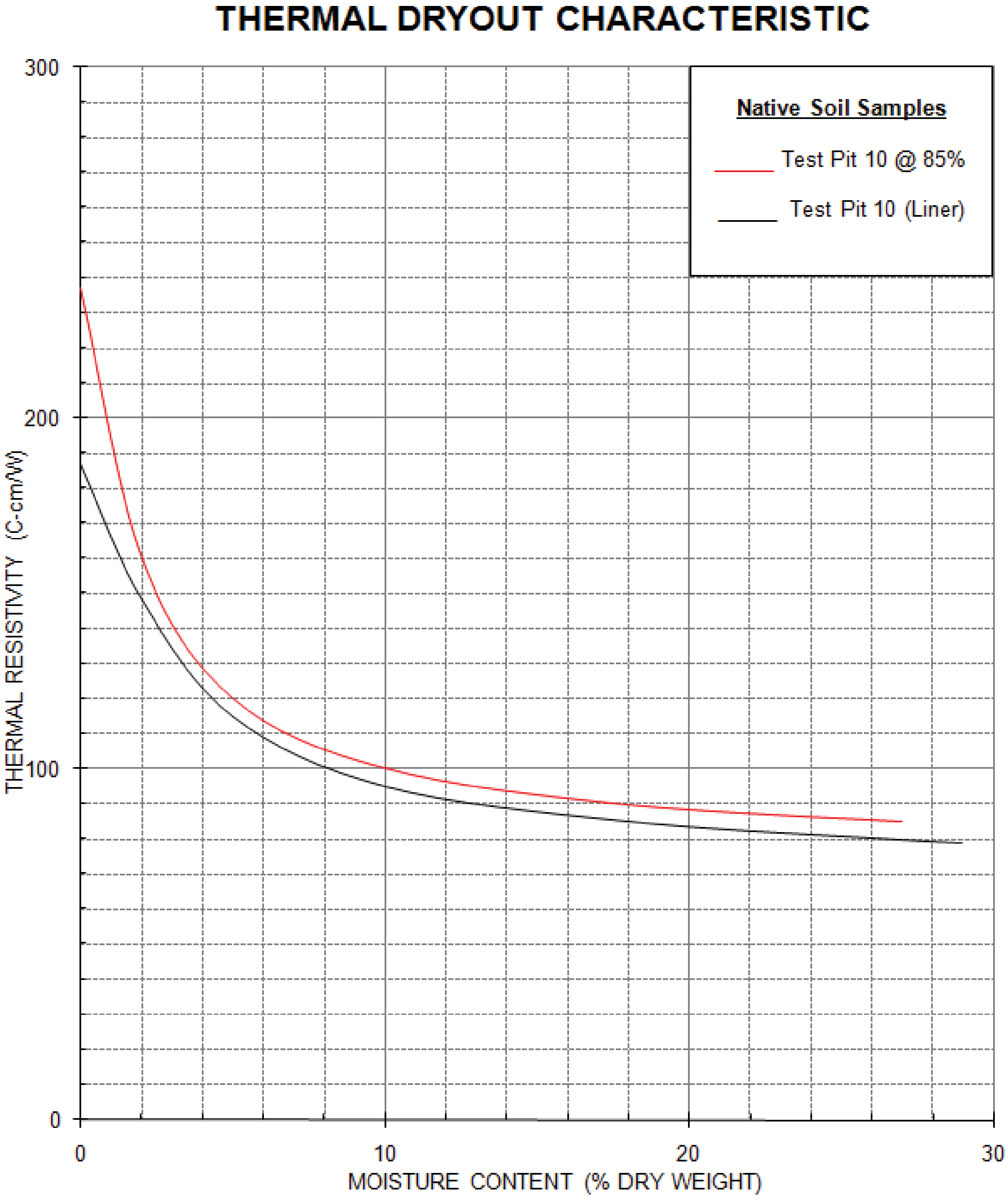
Figure 5



Native Soil Samples

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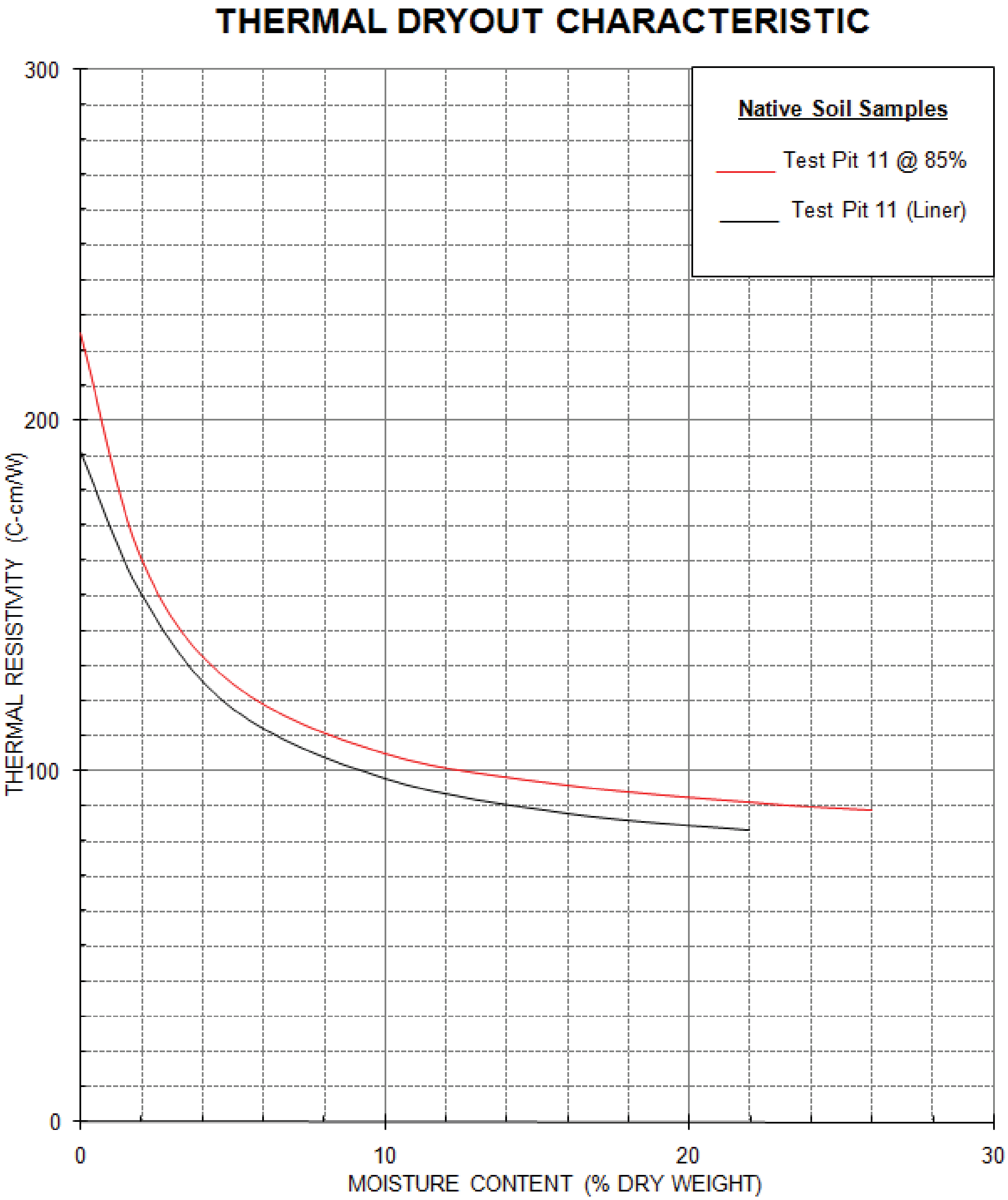
Figure 6



Native Soil Samples

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Figure 7