APPENDIX E

PRELIMINARY GEOTECHNICAL AND GEOHAZARDS REPORT

Geotechnical Report

Drew Solar Facility
NWC Hwy 98 and Pulliam Road
Calexico, California

Prepared for:

Drew Solar, LLC
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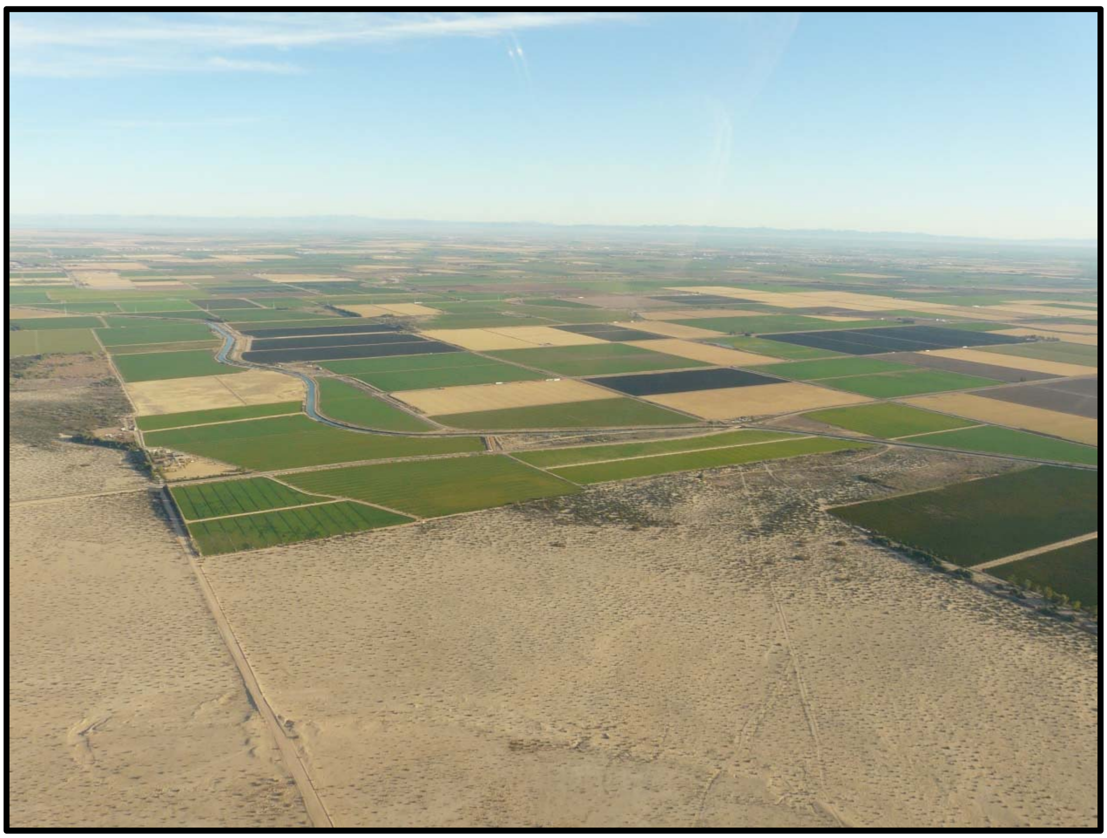
New York, NY 10036



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Geotechnical Report
Drew Solar Facility
NWC Hwy 98 and Pulliam Road
Calexico, California
LCI Report No. LE18150

Dear Mr. Martin:

This geotechnical report is provided for design and construction of a PV solar power generation facility on approximately 855 gross acres (762.8 net acres) located on the north side of Hwy 98 west of Pulliam Road approximately 9 miles west of Calexico, California. The Drew Solar Facility includes an electrical substation, battery storage, and an operations and maintenance building. Our geotechnical exploration was conducted in response to your request for our services. The enclosed report describes our soil engineering site evaluation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

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

- Foundation designs for *thin slabs-on-grade* (O&M building, battery storage) should mitigate expansive soil conditions by one of the following methods:
  1. Remove and replace upper 2.5 feet of clay soils with non-expansive sands.
  2. Design foundations to resist expansive forces in accordance with the 2016 California Building Code (CBC) Chapter 18, Section 1808 or the Post-Tensioning Institute, 3rd Edition. This requires grade-beam stiffened of floor slabs (25 feet maximum on center) or post-tensioned floor slabs. Design soil bearing pressure = 1,500 psf. Differential movement of 1.0 to 1.5 inches can be expected for slab on grade foundations placed on clay soils.
  3. A combination of the methods described above.

- Inverter mat foundations may be designed for a soil bearing pressure of 2,000 psf. The mats should be placed on a 12-inch compacted layer (95% of ASTM D1557 maximum density) of Caltrans Class 2 aggregate base material. Short drilled concrete piers are also acceptable for inverter steel frame supports (see Section 4.3 and Tables 6 and 7).

- The risk of liquefaction induced settlement is low (estimated settlement of less than ¾ inch at 17 to 49 feet below ground surface. There is a very low risk of ground rupture should liquefaction occur.

- Geologic mapping by the USGS after the April 4, 2010 magnitude 7.2M_w El Mayor-Cucapah Earthquake also indicates movement along several known and unknown faults west of the project site. One unnamed fault was traced into the southwest corner of the project site.

- The clay soils are aggressive to concrete and steel. Concrete mixes shall have a maximum water cement ratio of 0.45 and a minimum compressive strength of 4,500 psi (minimum of 6.0 sacks Type V cement per cubic yard. Steel posts will require galvanizing or other corrosion protection to mitigate the corrosive soils.

- All reinforcing bars, anchor bolts and hold down bolts shall have a minimum concrete cover of 3.0 inches unless epoxy coated (ASTM D3963/A934).

- All-weather accessways should consist of a minimum of 6 inches of Caltrans Class 2 aggregate base material placed over 12 inches of compacted (90%) native soil. The native clays become "slick" when wetted and will rut under prolonged wetting.

- Pavement structural sections should be designed for clay subgrade soils (R-Value = 5).

We did not encounter soil conditions that would preclude development of the proposed project provided the professional opinions contained in this report are considered in the design and construction of this project.

Please provide our office with a set of the foundation plans and civil plans for review to insure that the geotechnical site constraints have been included in the design documents.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 370-3000.

Respectfully Submitted,
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Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical exploration and soil testing for the proposed PV solar power generation facility on approximately 855-acre (gross) site located northwest of the intersection of Pulliam Road and Hwy 98 approximately 9 miles west of Calexico, California (See Vicinity Map, Plate A-1). The solar power generation facility will consist of installing PV solar panels mounted on steel racks supported by short piers, shallow driven posts or shallow spread footings. The proposed solar energy facility will have an operations maintenance/storage (O&M) building, battery storage facility, and an electrical substation with step-up transformers and dead-end A-frames for overhead power line connections. The photovoltaic modules are planned to be ground mounted on single-axis tracker frames or fixed-tilt frames.

The electrical substation, O&M building, and battery storage area are planned to be located on both sides of Drew Road north of Hwy 98 (see Appendix A, Plate A-2). Footing loads at exterior bearing walls are estimated at 1 to 5 kips per lineal foot. Column loads are estimated to range from 5 to 30 kips. The O&M building and battery storage facility will consist of slab-on-grade foundation with steel frame and/or wood-frame construction. Site development will include minimal site grading for the PV panel areas, building pad preparation for the O&M building, battery storage facility and electrical substation, underground utility installation, site paving and all weather road surfacing.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 50 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties, liquefaction potential during seismic events, field testing for steel post capacities and soil electrical/thermal resistivity parameters.

Professional opinions were developed from field and laboratory test data and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction.

The scope of our services consisted of the following:

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

This report addresses the following geotechnical parameters:

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

Professional opinions with regard to the above parameters are provided for the following:

- Site grading and earthwork
- Building pad and foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Capacities for drilled piers and/or driven steel posts
- Soil parameters for L-Pile program determined by steel post load tests
- Underlayment for tanks (5,000 and 10,000 gallons)
- Concrete slabs-on-grade
- Concrete walkway sections
- Excavation conditions and buried utility installations
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters
- SWPPP site criteria
- Structural section for unpaved roadways and construction laydown areas
- Pavement structural sections

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions, groundwater mounding, or landscape suitability of the soil.

1.3 Authorization

Authorization to proceed with our work was provided by signed agreement with Mr. David Zwillinger of Drew Solar, LLC on July 26, 2018. We conducted our work according to our written proposal dated June 21, 2018.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on August 18, 2018 using Middle Earth Geo-Testing, Inc. of Orange, California to advance eighteen (18) electric cone penetrometer (CPT) soundings to approximate depths of 20 to 50 feet below existing ground surface. The soundings were made at the locations shown on the Site and Exploration Plan Appendix A, (Plate A-2). The approximate sounding locations were established in the field and plotted on the site map by sighting to discernible site features.

Shallow (3-foot deep) hand auger borings (3-inch diameter auger) were made adjacent to the CPT soundings in order to obtain near surface soil samples for laboratory analysis.

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

The CPT exploration was conducted by hydraulically advancing an instrumented Hogentogler $10cm^2$ conical probe into the ground at a rate of 2cm per second using a 23-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were then applied to the data to give a continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (ϕ) angle (soil friction angle), undrained shear strength (S_u) of clays and over-consolidation ratio (OCR). These correlations may then be used to evaluate vertical and lateral soil bearing capacities and consolidation characteristics of the subsurface soil.

Interpretive logs of the CPT soundings are presented on Plates B-1 through B-18 in Appendix B. A key to the interpretation of CPT soundings is presented on Plate B-19. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

2.2 Laboratory Testing

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

- Plasticity Index (ASTM D4318) – used for soil classification and expansive soil design criteria
- Particle Size Analyses (ASTM D422) – used for soil classification and liquefaction evaluation
- Expansion Index (Swell) Test (ASTM D4829) – used for evaluating relative expansion classification.
- Moisture-Density Relationship (ASTM D1557) – used for soil compaction determinations.
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix proportions and corrosion protection requirements.

The laboratory test results are presented on Plates C-1 through C-7 in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were either extrapolated from correlations with the subsurface CPT data or from data obtained from the field and laboratory testing program.

2.3 Electrical Resistivity Testing

Wenner 4-pin field resistivity testing was conducted by RF Yeager Engineering of Lakeside, California on August 13, 2018 at five (5) locations within the project site in accordance with ASTM G57 standards. The tests were conducted at pin spacings of 2.5, 5, 10, 15, 20, and 40 feet. Additionally, a near surface soil sample (upper 5 feet) was obtained for laboratory soil corrosivity testing at the select locations. The results of the electrical resistivity and soil corrosivity testing are presented in Appendix F.

2.4 Thermal Resistivity Testing

Laboratory soil thermal resistivity testing was conducted at five (5) locations within the project site. The tests were conducted at the locations specified by the client and are shown on Figure 1 in Appendix F. The testing was conducted in accordance with ASTM D5344. A hole was hand excavated to a depth of 4 feet at each location to obtain subsurface soil samples between 3 to 4 feet below ground surface.

The thermal resistivity testing consisted of determining a thermal dry-out curve at each test location. The optimum moisture content and maximum dry density by ASTM D1557 method was determined for each test sample. The test samples were recompacted to 90% of the maximum dry density at various moisture contents ranging from 3% to approximately 15%. Thermal resistivity measurements were taken at the various moisture contents and plotted to develop the thermal dry-out curve. The results of the thermal resistivity testing are presented in Appendix F.

2.5 Infiltration Testing

Infiltration tests were conducted using the California Test 750 (Caltrans 1986) Method for Determining the Percolation Rate of Soils Using a 6-inch-Diameter Test Hole at twelve (12) total locations, two holes per location, within the project site, see Infiltration Test Location Map (Appendix G-1). The percolation rates achieved by field tests were converted to infiltration rates using the approved Riverside County Flood Control Method. The tests were conducted by drilling 6-inch diameter borings to a depth of 18 and 36 inches at each of the twelve locations. After logging the soil, a 2-inch layer of 3/8" pea gravel was placed in the bottom of each hole. Each test hole was presoaked with water at a height of at least 5 times the hole's radius above the gravel for a minimum of 24 hours. Presoaking occurred to achieve soil saturation and to allow for swelling of expansive soils.

After the presoaking was complete, sandy soil classification was verified at six of the test holes by 6-inch water level seeping away in less than 25 minutes. The water level was returned to 5 inches below the top of hole and measurement readings were then taken at 10-minute intervals. A minimum of six (6) 10-minute readings were conducted with the water depth re-established in the hole after each 10-minute reading.

The remaining test holes measurement readings were taken at 30-minuete intervals. A minimum of eight (8) 30-minute readings were conducted with the water depth re-established in the hole after each 30-minute reading.

The standard Riverside County flood control conversion calculations (Plates G-2 thru 25) were then applied to the percolation rates to determine the final infiltration rates for each location. The percolation rate measures the water level changes due to both vertical and lateral seepage. For the purpose of infiltration basins the vertical movement is of interest and therefore a conversion is applied to the percolation rate to reflect an infiltration rate that excludes water movement laterally through the bore hole sidewalls.

Tests No.	Depth	Percolation Rate	Infiltration Rate
I-1	1.5 ft.	120 min/inch	0.05 in/hour
I-1	3.0 ft.	20 min/inch	0.14 in/hour
I-2	1.5 ft.	80 min/inch	0.08 in/hour
I-2	3.0 ft	40 min/inch	0.07 in/hour
I-3	1.5 ft	5.0 min/inch	1.33 in/hour
I-3	3.0 ft	5.0 min/inch	0.57 in/hour
I-4	1.5 ft.	4.0 min/inch	1.70 in/hour
I-4	3.0 ft.	1.67 min/inch	1.83 in/hour
I-5	1.5 ft.	80 min/inch	0.08 in/hour
I-5	3.0 ft	40 min/inch	0.07 in/hour
I-6	1.5 ft	60 min/inch	0.11 in/hour
I-6	3.0 ft	40 min/inch	0.07 in/hour
I-7	1.5 ft.	60 min/inch	0.11 in/hour
I-7	3.0 ft.	34.3 min/inch	0.08 in/hour
I-8	1.5 ft.	60 min/inch	0.11 in/hour
I-8	3.0 ft	60 min/inch	0.05 in/hour
I-9	1.5 ft	40 min/inch	0.16 in/hour
I-9	3.0 ft	15 min/inch	0.19 in/hour
I-10	1.5 ft.	60 min/inch	0.11 in/hour
I-10	3.0 ft.	24 min/inch	0.12 in/hour
I-11	1.5 ft.	20 min/inch	0.33 in/hour
I-11	3.0 ft	2.0 min/inch	1.50 in/hour
I-12	1.5 ft	40 min/inch	0.16 in/hour
I-12	3.0 ft	3.33 min/inch	0.87 in/hour

The infiltration rate for storm water basin design should include appropriate factors of safety.

Section 3
DISCUSSION

3.1 Site Conditions

The project site is located at the northwest corner of Pulliam Road and Hwy 98 approximately 9 miles west of Calexico, California. The project site consists of approximately 855 gross acres after the Project's Parcel Map is recorded (762.8 net acres) comprised of ten (10) agricultural fields (APNs 052-170-039, 052-170-067, 052-170-056, 052-170-037, 052-170-032, and 052-170-031) currently in crop production. The project site is bounded on the south by State Route 98 and the Westside Main Canal (west of Drew Road). Pulliam Road forms the eastern boundary of the site and Kubler Road forms the northern project boundary. Drew Road forms a portion of the west project boundary (northern portion of the project area).

Agricultural fields are located along the northern portion of the project site. Photo-voltaic solar farms (Centinela Solar) are located to the east and south. Agricultural fields and a small sliver of vacant desert land are located to the west. Dirt field roads are located along the margins of the individual fields. The adjacent properties are approximately the same elevation as the project sites. The Westside Main Canal abuts the southwestern corner of the site.

The Drew Solar facility lies at an elevation of approximately 15 to 20 feet below mean sea level (MSL) (El. 985 to 980 local datum) in the southwestern region of the Imperial Valley in the California low desert. The surrounding properties lie on terrain which is flat (planar), part of a large agricultural valley, which was previously an ancient lake bed covered with fresh water (about 300 years ago) to an elevation of 43± feet above MSL.

Annual rainfall in this arid region is less than 3 inches per year with four months of average summertime temperatures above 100 °F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Imperial Valley portion of the Salton Trough physiographic province. The Salton Trough is a topographic and geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments deposited since the Miocene Epoch (Morton, 1977). Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

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

3.3 Subsurface Soil

The U. S. Soil Conservation Service compiled a map of surface soil conditions based on a thirteen-year study from 1962-1975 (Zimmerman, 1981). The Soil Survey maps were published in 1981 and indicate that surficial deposits at the site and surrounding area consist predominantly of silty clay and silty clay loams of the Imperial, Imperial-Glenbar, Meloland, Holtville, and Rositas soil groups (see Appendix B). These loams are formed in sediment and alluvium of mixed origin (Colorado River overflows and fresh-water lake-bed sediments).

Subsurface soils encountered during the field exploration conducted on August 13, 2018 consist of predominantly interbedded stiff to very stiff clays (CL-CH) and medium dense to dense silty sand (SM) soils to a depth of 50 feet below ground surface.

The subsurface soils at the electrical substation and O&M building area are predominately stiff to very stiff leans clays (CL) with interbedded layers of silty sand (SM) soils at a depth of 25 to 30 feet below ground surface. Medium dense to dense silty sand (SM) and sandy silt (ML) soils at were encountered from about 30 to 50 feet below ground surface, the maximum depth of exploration. The subsurface logs (Plates B-1 through B-18) depict the stratigraphic relationships of the various soil types.

The native surface clays encountered in the near surface soil exhibit moderate to high swell potential (Expansion Index, EI = 70 to 130) when correlated to Plasticity Index tests (ASTM D4318) performed on the native clays. The clay is expansive when wetted and can shrink with moisture loss (drying). Large shrinkage cracks and blocky fracturing of the clays occur with long periods of drying or fallowing. The dried clays become very hard. Development of building foundations, concrete flatwork, and asphaltic concrete pavements should include provisions for mitigating potential swelling forces and reduction in soil strength, which can occur from saturation of the soil.

Causes for soil saturation include standing storm water, broken utility lines, or capillary rise in moisture upon sealing the ground surface to evaporation. Moisture losses can occur with lack of landscape watering, close proximity of structures to downslopes and root system moisture extraction from deep rooted shrubs and trees placed near the foundations. Typical measures used for light industrial projects to remediate expansive soil include:

- Replacement of expansive clays with non-expansive sands or silts.
- Moisture conditioning subgrade soils to a minimum of 5% above optimum moisture (ASTM D1557) within the drying zone of surface soils.
- Design of foundations that are resistant to shrink/swell forces of silt/clay soil.
- A combination of the methods described above

3.4 Groundwater

Groundwater was not noted in the CPT soundings, but is typically encountered at about 5 to 8 feet below ground surface within the Drew Solar facility project area. There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, site landscape watering, drainage, and site grading. The referenced groundwater level should not be interpreted to represent an accurate or permanent condition.

3.5 Faulting

The project site is located in the seismically active Imperial Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. The San Andreas Fault System is comprised of the San Andreas, San Jacinto, and Elsinore Fault Zones in southern California. The Imperial fault represents a transition from the more continuous San Andreas fault to a more nearly echelon pattern characteristic of the faults under the Gulf of California (USGS, 1990). We have performed a computer-aided search of known faults or seismic zones that lie within a 44 mile (70 kilometer) radius of the project site (Table 1).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. An active fault is one that has ruptured during Holocene time (roughly within the last 11,000 years). A fault that has ruptured during the last 1.8 million years (Quaternary time), but has not been proven by direct evidence to have not moved within Holocene time is considered to be potentially active. A fault that has not moved during Quaternary time is considered to be inactive.

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2012 and CGS, 2018b) indicates that the nearest mapped Earthquake Fault Zone is an unnamed fault that extends into the southwest corner of the project site (Plate A-5). The nearest mapped ***major*** Earthquake Fault Zones are the Laguna Salada fault located approximately 7.9 miles southwest of the site and the Superstition Hills fault located approximately 10.6 miles northeast of the project site.

Geologic mapping by the USGS (Rymer and others, 2011) of the Imperial Valley after the April 4, 2010 magnitude 7.2M_w El Mayor-Cucapah Earthquake indicates movement along several known and previously unknown faults west of the project site. One unnamed fault was traced into the southwest corner of the project site Surface rupture on these faults is possible from future seismic events in the area.

3.6 General Ground Motion Analysis

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

<u>CBC General Ground Motion Parameters:</u> The 2016 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The U.S. Geological Survey "U.S. Seismic Design Maps Web Application" (USGS, 2018) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. **The site soils have been classified as Site Class D (stiff soil profile).**

Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. Design earthquake ground motion parameters are provided in Table 2. **A Risk Category II was determined using Table 1604A.5 for the O&M building and the Seismic Design Category is D since S_1 is less than 0.75g.**

The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration (PGA_M) value was determined from the "U.S. Seismic Design Maps Web Application" (USGS, 2018) for liquefaction and seismic settlement analysis in accordance with 2016 CBC Section 1803A.5.12 and CGS Note 48 ($PGA_M = F_{PGA}*PGA$). **A PGA_M value of 0.50g has been determined for the project site.**

3.7 Seismic and Other Hazards

- **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Superstition Hills, Imperial and Laguna Salada faults.
- **Surface Rupture.** The California Geological Survey (2016) has established Earthquake Fault Zones in accordance with the 1972 Alquist-Priolo Earthquake Fault Zone Act. The Earthquake Fault Zones consists of boundary zones surrounding well defined, active faults or fault segments. The southwest corner of the project site lies within a State of California, Alquist-Priolo Earthquake Fault Zone (Plate A-5). This is an unnamed fault that was mapped after the 2010 7.2M_w El Mayor-Cucapah Earthquake. If structures for human occupancy are planned within the A-P Fault Zone in the southwest corner of the project site, a fault hazard study including fault trenching will be required. Surface fault rupture at the project site is considered to be low to moderate.
- **Liquefaction.** Liquefaction is a design consideration because of underlying saturated sandy substrata. The potential for liquefaction is discussed in more detail in Section 3.8. Ground failures were noted along the embankments of the Westside Main Canal adjacent to the southwest portion of the project site after the April 4, 2010 earthquake (See Appendix E).

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

- **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.
- **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.
- **Tsunamis and seiches.** The site is not located near any large bodies of water, so the threat of tsunami, seiches, or other seismically-induced flooding is unlikely. The project site lies adjacent to the Westside Main Canal (WSM), a major irrigation supply canal for the Imperial Valley. The embankments of the WSM are elevated approximately 5 feet above the elevation of the project site. There is a potential for sheet flooding of the project site from breaching of the canal embankments from lateral spreading during a strong seismic event. No breaching of WSM canal embankments has occurred during strong earthquakes.
- **Flooding.** The project site is located in FEMA Flood Zone X, an area determined to be outside the 0.2% annual chance floodplain (FIRM Panel 06025C2050C).

- **Expansive soil.** In general, much of the near surface soils in the Imperial Valley consist of silty clays and clays which are moderate to highly expansive. The expansive soil conditions are discussed in more detail in Section 3.3.

3.8 Liquefaction

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

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

All of these conditions exist to some degree at this site. Liquefaction settlement and ground fissures were noted along the Westside Main Canal in the area of the project site after the April 4, 2010 magnitude 7.2M_w El Mayor-Cucapah Earthquake. McCrink and others (2011) reported several liquefaction related failures to the embankment of the Westside Main Canal adjacent to the southwest portion of the project site.

<u>Methods of Analysis:</u> Liquefaction potential at the O & M building, battery storage facility, and electrical substation site (Plate A-2) was evaluated using the 1997 NCEER Liquefaction Workshop methods. The 1997 NCEER methods utilize direct SPT blow counts or CPT cone readings from site exploration and earthquake magnitude/PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio (CSR) versus a corrected blow count $N_{1(60)}$ or Qc_{1N}. A PGA_M value of 0.50g was used in the analysis with an 8-foot groundwater depth and a threshold factor of safety (FS) of 1.3.

The computer program CLiq (Version 2.2.0.32, Geologismiki, 2017) was utilized for liquefaction assessment at the project site. The estimated settlements have been adjusted for transition zones between layers and the post liquefaction volumetric strain has been weighed with depth (Robertson, 2014 and Cetin et al., 2009). Computer printouts of the liquefaction analyses are provided in Appendix D.

The fine content of liquefiable sands and silts increases the liquefaction resistance in that more ground motion cycles are required to fully develop increased pore pressures. The CPT tip pressures (Qc) were adjusted to an equivalent clean sand pressure (Q_{C1Ncs}) in accordance with Robertson and Wride (1997).

The soil encountered at the points of exploration included saturated silts and silty sands that could liquefy during a Maximum Considered Earthquake. Liquefaction can occur within a several isolated silt and sand layers between depths of 13.5 to 50 feet. The likely triggering mechanism for liquefaction appears to be strong groundshaking associated with the rupture of the Laguna Salada fault or other nearby faults. The analysis is summarized in the table below.

Table 3. Summary of Liquefaction Analysis (O&M Building/Substation)

Boring Location	Depth To First Liquefiable Zone (ft)	Potential Induced Settlement (in)
CPT-1	20.5	½
CPT-2	18.0	¾
CPT-3	17.0	¼
CPT-6	19.5	¼

Liquefaction Induced Settlements: ***Based on empirical relationships, total induced settlements are estimated to be up to about ¾-inch should liquefaction occur.*** The magnitude of potential liquefaction induced differential settlement is estimated at be two-thirds of the total potential settlement in accordance with California Special Publication 117; therefore, there is a potential for ½ inch of liquefaction induced differential settlement at the substation, battery storage facility, and O & M building site. The differential settlement based on seismic settlements is estimated at ½ inch over a distance of 100 feet. Foundations should be designed for a maximum deflection of L/720.

Liquefaction Induced Ground Failure: Based on research from Ishihara (1985) and Youd and Garris (1995) small ground fissure or sand boil formation is unlikely because of the thickness of the overlying unliquefiable soil. Sand boils are conical piles of sand derived from the upward flow of groundwater caused by excess porewater pressures created during strong ground shaking. Sand boils are not inherently damaging by themselves, but are an indication that liquefaction occurred at depth (Jones, 2003).

Liquefaction induced lateral spreading is not expected to occur at this site due to the planar topography. According to Youd (2005), if the liquefiable layer lies at a depth greater that about twice the height of a free face, lateral spread is not likely to develop. Slopes or free faces occur only at the open IID drains and canals and large seismic events have typically resulted in small surficial slope failures within the drain and canal maintenance roads.

Liquefaction related failures and ground fissures were noted along the Westside Main Canal in the area of the project site after the April 4, 2010 magnitude 7.2M_w El Mayor-Cucapah Earthquake. McCrink and others (2011) reported several liquefaction related failures to the embankment of the Westside Main Canal along the southern margin of the project site. Ground fissures and sand boils were noted along the embankments of the Westside Main Canal (Appendix E).

Mitigation: Because of the low potential for differential settlement upon liquefaction, no special mitigation measures are required.

Section 4
DESIGN CRITERIA

4.1 Site Preparation (Mass Grading, Inverters, and Tanks)

Clearing and Grubbing: All debris or vegetation including grass, agricultural crops, and weeds on the site at the time of construction should be removed from the construction area. Root balls of trees should be completely excavated. Crops should either be removed by harvesting or burning. Excess crop residue may be disced into the ground or removed by a shallow blade cut (about 0.05 ft. depth). Organic strippings should not be used in structural areas or as engineered fill. All trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be sloped to a bowl shape to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

The site may be underlain by subsurface agricultural tile drain lines at a depth of approximately 5.5 to 6.0 feet below ground surface. Tile lines should be cut and plugged at each Imperial Irrigation District (IID) drain outlet and within 10 feet of any septic system leach fields. The IID requires an encroachment permit for the tile drain outlet cut-offs. The pipelines are likely full of water and may temporarily flood excavations if not plugged promptly. Base (collector) tile lines (8 inch diameter and larger), if under buildings or substations, should be located and crushed in-place with the backfill compacted to a minimum of 90% of ASTM D1557 maximum density.

Mass Grading for PV Posts Area: Prior to placing any fills, the surface 12 inches of native clay/silt soils shall be uniformly moisture conditioned to a minimum of 2% over optimum, and recompacted to at least 90% of ASTM D1557 maximum density. Onsite native clays/silts placed as engineer fill should be uniformly moisture conditioned by discing and wetting or drying to optimum plus 2 to 8% and compacted to a minimum of 90% relative compaction. Clods shall be reduced by discing to a maximum dimension of 1.0 inch prior to being placed as fill.

Building Support Pad Preparation: The soil within the O&M building pad, battery storage slab-on-grade, and substation switchgear areas should be removed to 30 inches below the building pad elevation or existing natural surface grade (whichever is lower) extending five feet beyond all exterior wall/column lines (including concreted areas adjacent to the building). Exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to 5 to 10% above optimum moisture content and recompacted to 85 to 90% of the maximum density determined in accordance with ASTM D1557 methods.

Prior to over-excavation of the surface soil, deep moisture penetration may be achieved by bordering the site and applying multiple floodings or by sprinkler application to allow water to permeate to a minimum depth of 3.0 feet (20% minimum moisture content) below existing natural surface. Extended drying periods may be required when utilizing this method of pre-saturation.

The native soil is suitable for use as general fill provided it is free from concentrations of organic matter or other deleterious material. However, special foundation designs are required when native clays are used. The fill soil should be uniformly moisture conditioned by discing and watering to the limits specified above, placed in maximum 8-inch lifts (loose), and compacted to the limits specified above. Clay soil should not be overcompacted because highly compacted soil will result in increased swelling. Imported fill soil (for foundations designed for expansive soil conditions) should have a Plasticity Index less than 25 and sulfates (SO_4) less than 4,000 ppm.

If foundation designs are to be utilized which do not include provisions for expansive soil conditions, an engineered building support pad consisting of 2.5 feet of non-expansive granular soil. The non-expansive, granular soil shall meet the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to a minimum of 90% of ASTM D1557 maximum dry density at optimum moisture ±2%.

In areas other than the building pad which are to receive sidewalks or area concrete slabs, the ground surface should be presaturated to a minimum depth of 24 inches and then scarified to 8 inches, moisture conditioned to a minimum of 2% over optimum, and recompacted to 85-90% of ASTM D1557 maximum density just prior to concrete placement.

Subgrade Preparation for Mat Foundations at Inverters: The native clay/silt soil within the mat foundation excavations should be removed to 12 inches below the bottom of the mat foundations to 2 feet beyond the edges of the foundation. Exposed subgrade should be scarified to a depth of 12 inches, uniformly moisture conditioned to a minimum of 2% above optimum moisture content, and recompacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

A 12 inch layer of Caltrans Class 2 aggregate base, compacted in maximum 6 inch lifts to at least 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture, shall be placed over the compacted subgrade prior to placing mat foundations. Design soil pressure = 2,000 psf.

Water Tank Foundation Subgrade Preparation: The native clay/silt soil within water tank pad excavations should be removed to 12 inches below the bottom of the mat foundation to 2 feet beyond the edges of the foundation. Exposed subgrade should be scarified to a depth of 12 inches, uniformly moisture conditioned to a minimum of 2% above optimum moisture content, and recompacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods. Water tank mat foundations should be underlain with a minimum of 12 inches of Class 2 aggregate base, compacted in maximum 6 inch lifts to at least 95% of ASTM D1557 maximum density at 2% below to 4% above optimum moisture. Design soil pressure = 2,000 psf.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area.

The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "*geotechnical engineer of record*" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the geotechnical parameters for site development.

4.2 Utility Trench Backfill

Utility Trench Backfill: Trench backfill for utilities should conform to the specifications shown on Plate D-1 (Appendix D), using either Type A, B or C backfill.

Type A backfill for HDPE pipe (above groundwater) consists of a 4 to 6 inch bed of ¾-inch crushed rock below the pipe and pipezone backfill (to 12" above top of pipe) consisting of crusher fines (sand). Sewer pipes (SDR-35), water mains, and stormdrain pipes of other than HDPE pipe may use crusher fines for bedding. The crusher fines shall be compacted to a minimum of 95% of ASTM D1557 maximum density. Pipe deflection should be checked to not exceed 2% of pipe diameter. Native clay/silt soils may be used to backfill the remainder of the trench. Soils used for trench backfill shall be compacted to a minimum of 90% of ASTM D1557 maximum density.

Type B backfill for HDPE pipe (shallow cover) requires 6 inches of ¾-inch crushed rock as bedding and to springline of the pipe. Thereafter, sand/cement slurry (3 sack cement factor) should be used to 12 inches above the top of the pipe. Native clay and silt soils may be used in the remainder of the trench backfill as specified above.

Type C backfill for HDPE pipe (below or partially below groundwater) shall consist of a geotextile filter fabric encapsulating ¾-inch crushed rock. The crushed rock thickness shall be 6 inches below and to the sides of the pipe and shall extend to 12 inches above the top of the pipe. The filter fabric shall cover the trench bottom, sidewalls and over the top of the crushed rock. Native clay and silt soils may be used in the remainder of the trench backfill as specified above.

Type C backfill must be used in wet soils and below groundwater for all buried utility pipelines. When excavations are planned below groundwater, dewatering (by well points) is required to at least 24 inches below the trench bottom prior to excavation. Type A backfill may be used in the case of a dewatered trench condition in clay soils only.

On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill above pipezone, but may be difficult to uniformly maintain at specified moistures and compact to the specified densities. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material.

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

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

4.3 Foundations and Settlements (Mats, Grade-beam Reinforced Slabs, Drilled Piers, Steel Posts)

Shallow spread footings in clay/silt soils are suitable to support the O&M Building provided they are structurally tied with grade-beams to continuous perimeter wall footings to resist differential movement associated with expansive soils. The foundations may be designed using an allowable soil bearing pressure of 1,500 psf for compacted native clay or silt soil and 2,500 psf when foundations are supported on imported sands (extending a minimum of 1.5 feet below footings). The allowable soil pressure may be increased by 20% for each foot of embedment depth of the footings in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 3,000 psf (clays).

As an alternative to shallow spread foundations, flat plate structural mats or grade-beam reinforced foundations may be used to mitigate expansive soil heave related movement.

<u>Flat Plate Structural Mats</u>: Structural concrete mat foundations may be designed using an allowable soil bearing pressure of 2,000 psf when the foundation is supported on 12 inches of compacted Class 2 aggregate base. The allowable soil pressure may be increased by one-third for short term loads induced by winds or seismic events. Design criteria for mat foundations are provided below. The structural mat shall have a double mat of steel and a minimum thickness of 12 inches, except that inverters and water tank slabs may be 8 inches thick.

Structural mats may be designed for a modulus of subgrade reaction (Ks) of 150 pci when placed on 12 inches of compacted Class 2 aggregate base. An allowable friction coefficient of 0.35 may also be used at the base of the mat to resist lateral sliding.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the base of footings. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 250 pcf to resist lateral loadings. An allowable friction coefficient of 0.35 may also be used at the base of the footings to resist lateral sliding.

Grade-beam Reinforced Foundations: Specific soil data for building structures with grade-beam reinforced foundations placed on the native clays (without replacement of the surface clays with 2.5 feet of granular fill) are presented below in accordance with the design method given in CBC Chapter 18 Section 1808A.6.2 (*WRI/CRSI Design of Slab-on-Ground Foundations*):

Weighted Plasticity Index (PI) = 25
Slope Coefficient (C_s) = 1.0
Strength Coefficient (C_o) = 0.8
Climatic Rating (C_w) = 15
Effective PI = 20
Maximum Grade-beam Spacing = 21 feet

All exterior footings in clay soils should be embedded a minimum of 24 inches (18 inches for silt and sand sites) below the building support pad or lowest adjacent final grade, whichever is deeper. Minimum embedment depth of interior should be at least 12 inches into the building support pad to account for variable environmental conditions.

Interior and exterior embedment depths listed herein are minimum depths and greater depths/widths may be required by the structural engineer/designer and should be sufficient to limit differential movement to L/480 for center lift and L/720 for edge lift to comply with the current standards. Continuous wall footings should have a minimum width of 12 inches. Spread footings should have a minimum dimension of 24 inches and should be structurally tied to perimeter footings or grade beams. Concrete reinforcement and sizing for all footings should be provided by the structural engineer.

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 250 pcf (300 pcf for imported sands) to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.25 (0.35 for imported sands) may also be used at the base of the footings to resist lateral loading.

Foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed 1 inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed. Seismically induced liquefaction settlement of the surrounding land mass and structure may be on the order of ¾ inch (total) and ½ inch (differential).

<u>Non-Constrained Drilled Pier Foundations</u>: Individual short piers should be adequate to support the light, security camera poles and other electrical switchyard elements. Embedment depth for short piers to resist lateral loads where no constraint is provided at ground surface may be designed using the following formula per 2016 CBC Section 1807.3.2.1:

$$d = A/2\ [1 + (1+4.36h/A)^{1/2}]$$

where:

- A = 2.34P/S1*b*.
- *b* = Pier diameter in feet.
- d = Embedment depth in feet (not over 12 feet for purpose of computing lateral pressure).
- h = Distance in feet from ground surface to point of application of "P".
- P = Applied lateral force in pounds.
- S1 = Allowable lateral soil bearing pressure (basic value of 100 psf, (Table 1806.2 for Class 5 soil and Section 1806). Isolated piers such solar panel short piers that are not adversely affected by a 0.5 inch motion at the ground surface due to short-term lateral loads are permitted to be designed using lateral soil bearing pressures equal to two times the basic value. (Lateral soil pressure increases may not be desirable for camera poles to increase pole rigidity).

The vertical load capacity of short pier foundations may be designed using an allowable downward soil bearing pressure of 1,500 psf.

***Installation*:** Excavation for piers should be inspected by the geotechnical consultant. A tremie pipe should be used to pour concrete from the bottom up and to ensure less than five feet of free fall. Groundwater is expected to be encountered at approximately 5 to 8 feet below ground surface. The structural steel and concrete should be placed immediately after drilling.

Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

Driven Steel Posts: The use of driven steel posts requires special provisions for corrosion protection due to the corrosive nature of the subsurface soils. Steel posts for PV panel mounting frames have been preliminary sized as W6x7 (frame and axle supports) or W6x15 steel sections (gearbox columns). Due to soil stratigraphy encountered during the soil exploration, the site was divided into two (2) areas for computing the vertical and lateral capacities of W-pile shapes. The west area of the project with predominant surface clay soils between depths of 5 to 9 feet below ground surface encompassing CPT's-1, 3, 4, 5, 9, 10 and 11 and the area located on the east side with surface clay soils between depths of 12 to 26 feet below ground surface elevation is congregated by CPT's-2, 6, 7, 8, 12, 13, 14, 15, 16, 17 and 18. The specified tip elevation (5, 6 and 8 feet) and allowable vertical and lateral capacities for typical driven steel W-pile shapes are provided in Tables 4, 5, 6 and 7.

Vertical Capacity: End bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5. The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads from wind or seismic forces. The allowable vertical shaft capacities are based on the supporting capacity of the soil.

Lateral Capacity: The allowable lateral capacity for the preliminary steel sections (W6x7 and W6x15) at 5, 6 and 8 feet embedment depths are given in Tables 4, 5, 6 and 7. The allowable lateral capacity is based on a deflection of one inch at the top of the steel post section. If greater deflection can be tolerated, lateral load capacity can be increased directly in proportion to a maximum of one inch deflection. Axial and lateral loads were applied at 4.0 feet above ground surface.

Table 4: Allowable Capacities of Driven Steel Posts (Frame Supports)
West Area (CPT's-1, 3, 4, 5, 9, 10 and 11)

Pile Type:		Driven W6x7	
Pile Length (ft):	**9 feet**	**10 feet**	**12 feet**
Specified Tip Depth (ft):	**5 feet**	**6 feet**	**8 feet**
Height Above Ground (ft):	**4 feet**	**4 feet**	**4 feet**
Allowable Axial Capacity (kips) – FS=2.5:	3.30	3.97	5.24
Allowable Uplift Capacity (kips) – FS=2.5:	3.34	4.00	5.12
Lateral Load – Free Head Condition (kips):	1.00	1.20	1.35
Top Deflection (in) – Free Head Condition	1.00	1.00	1.00
Maximum Moment from Lateral Load, Free Head Condition (ft-kips):	4.54	5.84	6.77
Depth of Maximum Moment (from Top of Post), Free Head (ft):	5.0	5.4	5.6

Table 5: Allowable Capacities of Driven Steel Posts (Frame Supports)
East Area (CPT's-2, 6, 7, 8, 12, 13, 14, 15, 16, 17 and 18)

Pile Type:		Driven W6x7	
Pile Length (ft):	**9 feet**	**10 feet**	**12 feet**
Specified Tip Depth (ft):	**5 feet**	**6 feet**	**8 feet**
Height Above Ground (ft):	**4 feet**	**4 feet**	**4 feet**
Allowable Axial Capacity (kips) – FS=2.5:	3.30	3.95	5.25
Allowable Uplift Capacity (kips) – FS=2.5:	3.34	4.00	5.32
Lateral Load – Free Head Condition (kips):	1.00	1.20	1.35
Top Deflection (in) – Free Head Condition	1.00	1.00	1.00
Maximum Moment from Lateral Load, Free Head Condition (ft-kips):	4.54	5.84	6.77
Depth of Maximum Moment (from Top of Post), Free Head (ft):	5.0	5.4	5.5

Table 6: Allowable Capacities of Driven Steel Posts (Motor Supports)
West Area (CPT's-1, 3, 4, 5, 9, 10 and 11)

Pile Type:	Driven W6x15
Pile Length (ft):	**12 feet**
Specified Tip Depth (ft):	**8 feet**
Height Above Ground (ft):	**4 feet**
Allowable Axial Capacity (kips) – FS=2.5:	5.63
Allowable Uplift Capacity (kips) – FS=2.5:	5.39
Lateral Load – Free Head Condition (kips):	2.40
Top Deflection (in) – Free Head Condition	1.00
Maximum Moment from Lateral Load, Free Head Condition (ft-kips):	12.42
Depth of Maximum Moment(from Top of Post), Free Head (ft):	6.0

Table 7: Allowable Capacities of Driven Steel Posts (Motor Supports)
East Area (CPT's-2, 6, 7, 8, 12, 13, 14, 15, 16, 17 and 18)

Pile Type:	Driven W6x15
Pile Length (ft):	**12 feet**
Specified Tip Depth (ft):	**8 feet**
Height Above Ground (ft):	**4 feet**
Allowable Axial Capacity (kips) – FS=2.5:	5.52
Allowable Uplift Capacity (kips) – FS=2.5:	5.59
Lateral Load – Free Head Condition (kips):	2.30
Top Deflection (in) – Free Head Condition	1.00
Maximum Moment from Lateral Load, Free Head Condition (ft-kips):	11.83
Depth of Maximum Moment(from Top of Post), Free Head (ft):	6.0

Design criteria for other steel shapes and sizes can be made available upon request. The top six inches of post embedment should not be considered in computing axial and lateral design.

Soil Parameters: Interpretive soil parameters of the subsoil for L-Pile program are presented in the table below.

Table 8: Soil Strength Parameters for L-Pile Program
West Area (CPT's-1, 3, 4, 5, 9, 10 and 11)

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Strain Factor, E50 or Dr (%)	Lateral Soil Modulus, k (pci) (*)
CL-CH	0 to 7	125	---	1.00	1.00	225
ML-SM	7 to 16	120	30°	0.50	0.85	325
CL-CH	16 to 20	125	---	1.25	0.85	315

Table 9: Soil Strength Parameters for L-Pile Program
East Area (CPT's-2, 6, 7, 8, 12, 13, 14, 15, 16, 17 and 18)

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Strain Factor, E50 or Dr (%)	Lateral Soil Modulus, k (pci) (*)
CL-CH	0 to 17	125	---	1.00	1.00	225
SP-SM	17 to 20	115	35°	---	50.0	75

(*) k value for static loading. For cycling loading, use 50% of listed value.

Settlement: Total settlements of less than ¼ inch, and differential movement of about two-thirds of total movement for single piles designed according to the preceding design values. If pile spacing is at least 2.5 pile diameters center-to-center, no reduction in axial load capacity is considered necessary for a group effect.

<u>Drilled Pier Foundations</u>: The switch stands, bus supports and dead end frames may be supported on cast-in-place, drilled piers.

***Vertical Capacity*:** Vertical capacity for 18 and 24 inch diameter shafts are presented in Figure 4. Capacities for other shaft sizes can be determined in direct proportion to shaft diameters. Point bearing and skin friction parameters have been used to determine the allowable shaft capacity. The allowable capacities include a factor of safety of 2.5. The allowable vertical compression capacities may be increased by 33 percent to accommodate temporary loads that result from wind or seismic forces.

***Lateral Capacity*:** The allowable lateral capacity for 18 and 24 inch diameter shafts are given in the table shown below. The horizontal deflection at the top of the drilled pier for the lateral loads indicated is one-half inch (0.50 inch).

Table 10: Lateral Capacities of Drilled Piers

Shaft Diameter (in.)	**18**		**24**	
Head Condition	Free	Fixed	Free	Fixed
Allowable Head Deflection (in.)	0.5	0.5	0.5	0.5
Minimum Length (ft.)	**5**	**5**	**5**	**5**
Lateral Capacity (kips)	4.7	16.0	5.6	18.5
Maximum Moment (foot-kips)	4.88	-43.6	5.6	-49.8
@Depth from Pier Head (ft.)	2.0	0	2.0	0
Minimum Length (ft.)	**10**	**10**	**10**	**10**
Lateral Capacity (kips)	11.2	32.2	12.9	42.3
Maximum Moment (foot-kips)	24.3	-165.8	27.5	-230.8
@Depth from Pier Head (ft.)	4.2	0	4.3	0
Minimum Length (ft.)	**15**	**15**	**15**	**15**
Lateral Capacity (kips)	17.3	33.8	21.2	50.1
Maximum Moment (foot-kips)	55.5	-158.3	69.4	-321.7
@Depth from Pier Head (ft.)	6.2	0	6.4	0
Minimum Length (ft.)	**20**	**20**	**20**	**20**
Lateral Capacity (kips)	18.7	38.0	27.7	53.6
Maximum Moment (foot-kips)	66.3	-171.7	115.8	-315.0
@Depth from Pier Head (ft.)	7.0	0	8.3	0

Settlement: Total static (non-seismic) settlements of less than ¼ inch are anticipated for single piles designed according to the preceding design values. If pile spacing is a least 2.5 pile diameters center-to-center, no reduction in axial load capacity is considered necessary for a group effect.

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

Soil Parameters for Drilled Piers: Interpretive soil parameters of the subsurface soil for use with L-Pile software are provided in the table below:

TABLE 11: Drilled Pier Soil Parameters

Layer Type	Depth (ft)	Unit Weight (pcf)	Friction Angle (deg)	Cohesion (ksf)	Strain Factor, E50 or Dr (%)	Lateral Soil Modulus, k (pci) (*)
CL-CH	0 to 22	125	---	1.00	1.00	225
ML	22 to 25	120	30°	0.75	0.70	550
CL-CH	25 to 30	125	---	1.25	0.85	315
ML-SM	30 to 35	120	36°	---	55.0	75
SM	35 to 50	115	38°	---	65.0	100

***Installation*:** The drilled piers shall be placed in conformance to ACI 336 guidelines. Excavation for piers should be inspected by the geotechnical consultant. A tremie pipe should be used to pour concrete from the bottom up and to ensure less than five feet of free fall. All drilled piers shall be cased below groundwater depth to prevent caving or lateral deformation. Groundwater is expected to be encountered at about 5 to 8 feet below ground surface within the project site. The structural steel and concrete should be placed immediately after drilling. Prior to placing any structural steel or concrete, loose soil or slough material should be removed from the bottom of the drilled pier excavation.

4.4 Slabs-On-Grade

Structural Concrete: Concrete slabs placed over native clay soil should be designed in accordance with Chapter 18 of the 2016 CBC and shall be a minimum of 5 inches thick due to expansive soil conditions (minimum 6-inch thick where the slab is subjected to wheel loads). Concrete floor slabs shall be monolithically placed with the footings (no cold joints) unless placed on 2.5 feet of granular fill soil.

American Concrete Institute (ACI) guidelines (ACI 302.1R-04 Chapter 3, Section 3.2.3) provide recommendations regarding the use of moisture barriers beneath concrete slabs. The concrete floor slabs should be underlain by a 10-mil polyethylene vapor retarder that works as a capillary break to reduce moisture migration into the slab section. All laps and seams should be overlapped 6-inches or as recommended by the manufacturer. The vapor retarder should be protected from puncture.

The joints and penetrations should be sealed with the manufacturer's recommended adhesive, pressure-sensitive tape, or both. The vapor retarder should extend a minimum of 12 inches into the footing excavations. The vapor retarder should be covered by 4 inches of clean sand (Sand Equivalent SE>30) unless placed on 2.5 feet of granular fill, in which case, the vapor retarder may lie directly on the granular fill with 2 inches of clean sand cover.

For areas with moisture sensitive flooring materials, ACI recommends that concrete slabs be placed without a sand cover directly over the vapor retarder, provided that the concrete mix uses a low-water cement ratio and concrete curing methods are employed to compensate for release of bleed water through the top of the slab. The vapor retarder should have a minimum thickness of 15-mil (Stego-Wrap or equivalent).

Structural concrete slab reinforcement should consist of chaired rebar slab reinforcement (minimum of No. 3 bars at 16-inch centers, both horizontal directions) placed at slab mid-height to resist potential swell forces and cracking. Slab thickness and steel reinforcement are minimums only and should be verified by the structural engineer/designer knowing the actual project loadings. All steel components of the foundation system should be protected from corrosion by maintaining a 3-inch minimum concrete cover of densely consolidated concrete at footings (by use of a vibrator).

The construction joint between the foundation and any mowstrips/sidewalks placed adjacent to foundations should be sealed with a polyurethane based non-hardening sealant to prevent moisture migration between the joint. Epoxy coated embedded steel components (ASTM D3963/A934) or permanent waterproofing membranes placed at the exterior footing sidewall may also be used to mitigate the corrosion potential of concrete placed in contact with native soil.

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

Non-structural Concrete: All non-structural independent flatwork (sidewalks and uncovered area slabs) shall be a minimum of 4 inches thick and should be placed on a minimum of 4 inches of aggregate base compacted to 90%, dowelled to the perimeter foundations where adjacent to the building to prevent separation and sloped 2% (sidewalks) or 1 to 2% (housekeeping slabs) away from the building.

A minimum of 24 inches of moisture conditioned (2% minimum above optimum) and 8 inches of compacted subgrade (87 to 92%) should underlie all independent flatwork. Flatwork which contains steel reinforcing (except wire mesh) should be underlain by a 15-mil (minimum) polyethylene separation sheet and at least 4-inches of Class 2 aggregate base. All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 8 feet or the least width of the sidewalk.

4.5 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-6). The native soils were found to have severe levels of sulfate ion concentration (4,628 to 11,372 ppm). Sulfate ions in high concentrations can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. The following table provides American Concrete Institute (ACI) recommended cement types, water-cement ratio and minimum compressive strengths for concrete in contact with soils:

Table 12. Concrete Mix Design Criteria due to Soluble Sulfate Exposure

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

Note: from ACI 318-11 Table 4.2.1

A minimum of 6.0 sacks per cubic yard of concrete (4,500 psi) of Type V Portland Cement with a maximum water/cement ratio of 0.45 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including sidewalks, housekeeping slabs, and foundations). Admixtures may be required to allow placement of this low water/cement ratio concrete.

The native soil has very severe levels of chloride ion concentration (1,300 to 3,640 ppm). Chloride ions can cause corrosion of reinforcing steel, anchor bolts and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes. Mitigation of the corrosion of steel can be achieved by using steel pipes coated with epoxy corrosion inhibitors, asphaltic and epoxy coatings, cathodic protection or by encapsulating the portion of the pipe lying above groundwater with a minimum of 3 inches of densely consolidated concrete.

Foundation designs shall provide a minimum concrete cover of three (3) inches around steel reinforcing or embedded components (anchor bolts, etc.) exposed to native soil. If the 3-inch concrete edge distance cannot be achieved, all embedded steel components (anchor bolts, etc.) shall be epoxy coated for corrosion protection (in accordance with ASTM D3963/A934) or a corrosion inhibitor and a permanent waterproofing membrane shall be placed along the exterior face of the exterior footings. Additionally, the concrete should be thoroughly vibrated at footings during placement to decrease the permeability of the concrete. Fire protection piping (risers) should be placed outside of the building foundation.

4.6 Excavations

All site excavations should conform to CalOSHA requirements for Type B soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be no steeper than 1:1 (horizontal:vertical). Sandy soil slopes should be kept moist, but not saturated, to reduce the potential of raveling or sloughing. Excavations will require slope inclinations in conformance to CAL/OSHA regulations for Type B soil.

Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

4.7 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the Laguna Salada, Superstition Hills, and Imperial faults. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Site Class D using the seismic coefficients given in Section 3.6 and Table 2 of this report.

4.8 All-Weather Roadways and Construction Laydown Areas

All-weather accessways for Emergency Vehicles and construction laydown areas should consist of 6 inches of Caltrans Class 2 aggregate base (compacted to 90% minimum of ASTM D1557 maximum density) placed over 12 inches of compacted (90% minimum of ASTM D1157 at minimum of 2% above optimum moisture) native clay subgrade soil.

4.9 Soil Erosion Factors for SWPPP Plans

The site soils are classified as heavy clays with greater than 50% clay fraction soil particles (10% sand, 30% silt, and 60% clay). Groundwater can be expected at a depth of 5 to 8 feet below ground surface.

4.10 Pavements

Pavements should be designed according to the 2012 Caltrans Highway Design Manual or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements.

Based on the current Caltrans method, an R-value of 5 for the clay subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) and Portland Cement Concrete (PCC) pavement sections.

Table 13. Pavement Structural Sections (clays)

R-Value of Subgrade Soil - 5 (estimated) Design Method - Caltrans 2012

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

Notes:

1) Asphaltic concrete shall be Caltrans, Type B, ¾ inch maximum (½ inch maximum for parking areas), medium grading with PG70-10 asphalt cement (PG64-16 for parking lot areas), compacted to a minimum of 95% of the Hveem density (CAL 366).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (minimum 4% above optimum if clays) native clay soil compacted to a minimum of 90% of the maximum dry density (ASTM D1557).
4) Portland cement concrete for pavements should have Type V cement, a minimum compressive strength of 4,500 psi at 28 days, and a maximum water-cement ratio of 0.45.
5) Typical Street Classifications (Imperial County).
   - Parking Areas: TI = 4.0
   - Cul-de-Sacs: TI = 5.0
   - Local Streets: TI = 6.0
   - Minor Collectors: TI = 6.5
   - Major Collectors: TI = 8.0
6) Soil-lime subgrade improvement is not recommended at this project site(s) due to very high sulfates in the soil.

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The findings and professional opinions within this report are based on current information regarding the proposed Drew Solar photo-voltaic solar power generation facility situated on the approximately 855-acre site located at the northwest of the intersection of Pulliam Road and Hwy 98 approximately 9 miles west of Calexico, California. The conclusions and professional opinions of this report are invalid if:

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

Findings and professional opinions in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and professional opinions presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. If detected, these conditions may require additional studies, consultation, and possible design revisions.

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

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

This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and professional opinions by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

The client has responsibility to see that all parties to the project including, designer, contractor, and subcontractor are made aware of this entire report. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Additional Services

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

The professional opinions presented in this report are based on the assumption that:

- Consultation during development of design and construction documents to check that the geotechnical professional opinions are appropriate for the proposed project and that the geotechnical professional opinions are properly interpreted and incorporated into the documents.
- Landmark Consultants will have the opportunity to review and comment on the plans and specifications for the project prior to the issuance of such for bidding.
- Observation, inspection, and testing by the geotechnical consultant of record during site clearing, grading, excavation, placement of fills, building pad and subgrade preparation, and backfilling of utility trenches.
- Observation of foundation excavations and reinforcing steel before concrete placement.
- Other consultation as necessary during design and construction.

We emphasize our review of the project plans and specifications to check for compatibility with our professional opinions and conclusions. Additional information concerning the scope and cost of these services can be obtained from our office.

TABLES

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Unnamed 2*	0.3	0.4			
Unnamed 1*	4.6	7.4			
Yuha*	5.7	9.1			
Laguna Salada	7.9	12.7	7	67 ± 7	3.5 ± 1.5
Borrego (Mexico)*	8.7	13.9			
Shell Beds	10.2	16.3			
Superstition Hills	10.6	17.0	6.6	23 ± 2	4 ± 2
Yuha Well *	11.1	17.8			
Vista de Anza*	12.6	20.1			
Superstition Mountain	14.1	22.5	6.6	24 ± 2	5 ± 3
Imperial	14.5	23.2	7	62 ± 6	20 ± 5
Brawley *	15.5	24.8			
Pescadores (Mexico)*	16.2	26.0			
Cerro Prieto *	17.8	28.4			
Rico *	17.9	28.6			
Painted Gorge Wash*	17.9	28.7			
Ocotillo*	18.1	29.0			
Cucapah (Mexico)*	18.5	29.7			
Elsinore - Coyote Mountain	22.0	35.2	6.8	39 ± 4	4 ± 2
Elmore Ranch	26.2	41.9	6.6	29 ± 3	1 ± 0.5
San Jacinto - Borrego	29.6	47.4	6.6	29 ± 3	4 ± 2
Algodones *	43.9	70.2			

* Note: Faults not included in CGS database.

Table 2
2016 California Building Code (CBC) and ASCE 7-10 Seismic Parameters

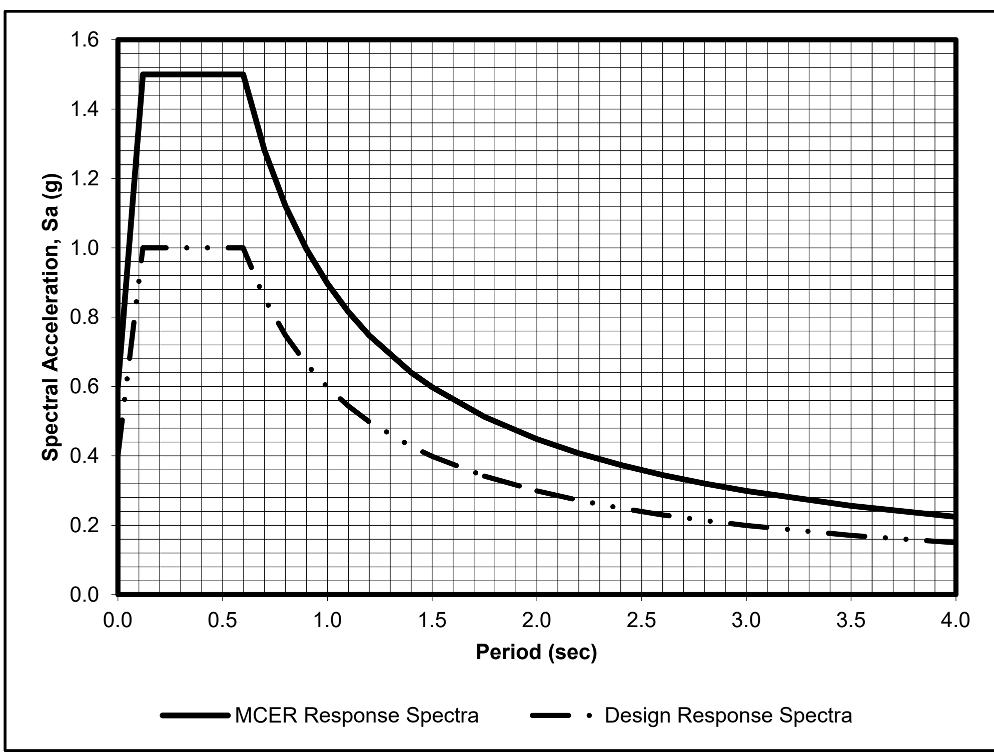
			CBC Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.6812	N	
Longitude:	-115.6743	W	
Risk Category:	II		
Seismic Design Category:	D		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	$\mathbf{S_s}$	1.500 g	Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	$\mathbf{S_1}$	0.598 g	Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	$\mathbf{F_a}$	1.00	Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	$\mathbf{F_v}$	1.50	Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	$\mathbf{S_{MS}}$	1.500 g	$= F_a * S_s$	Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	$\mathbf{S_{M1}}$	0.897 g	$= F_v * S_1$	Equation 16-38

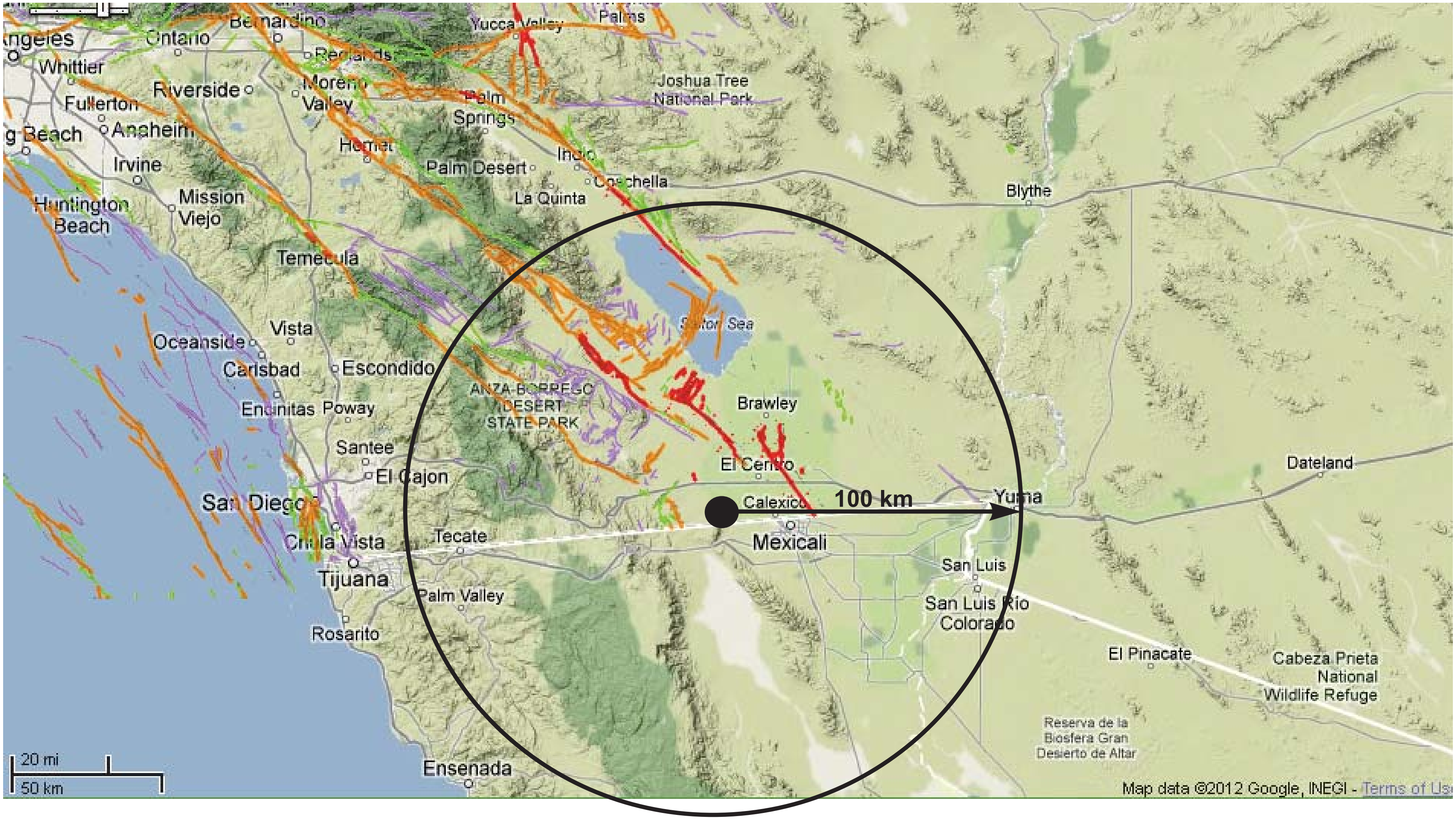
Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	$\mathbf{S_{DS}}$	1.000 g	$= 2/3*S_{MS}$	Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	$\mathbf{S_{D1}}$	0.598 g	$= 2/3*S_{M1}$	Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	$\mathbf{C_{RS}}$	1.118		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	$\mathbf{C_{R1}}$	1.098		ASCE Figure 22-18
	$\mathbf{T_L}$	8.00 sec		ASCE Figure 22-12
	$\mathbf{T_O}$	0.12 sec	$=0.2*S_{D1}/S_{DS}$	
	$\mathbf{T_S}$	0.60 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	$\mathbf{PGA_M}$	0.50 g		ASCE Equation 11.8-1



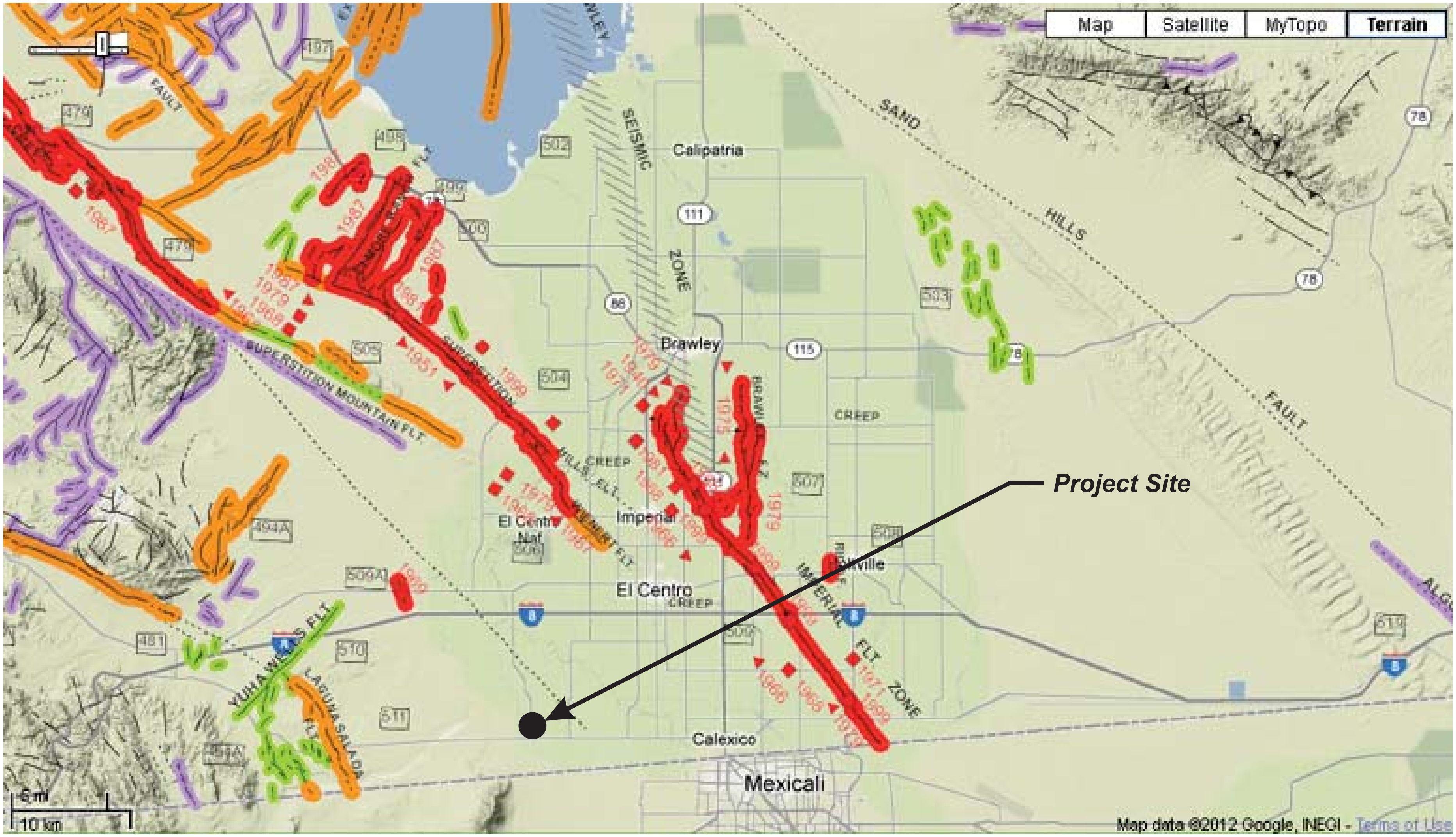
Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.40	0.60
0.12	1.00	1.50
0.60	1.00	1.50
0.70	0.85	1.28
0.80	0.75	1.12
0.90	0.66	1.00
1.00	0.60	0.90
1.10	0.54	0.82
1.20	0.50	0.75
1.20	0.50	0.75
1.40	0.43	0.64
1.50	0.40	0.60
1.75	0.34	0.51
2.00	0.30	0.45
2.20	0.27	0.41
2.40	0.25	0.37
2.60	0.23	0.35
2.80	0.21	0.32
3.00	0.20	0.30
3.50	0.17	0.26
4.00	0.15	0.22

FIGURES



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

LANDMARK Geo-Engineers and Geologists **Project No.: LE18150**	**Regional Fault Map**	**Figure 1**



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

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Map of Local Faults

Figure 2

EXPLANATION

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

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

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

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

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

(c) displaced survey lines.

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

Date bracketed by triangles indicates local fault break.

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

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

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

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

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

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

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

ADDITIONAL FAULT SYMBOLS

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

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

Arrow on fault indicates direction of dip.

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

OTHER SYMBOLS

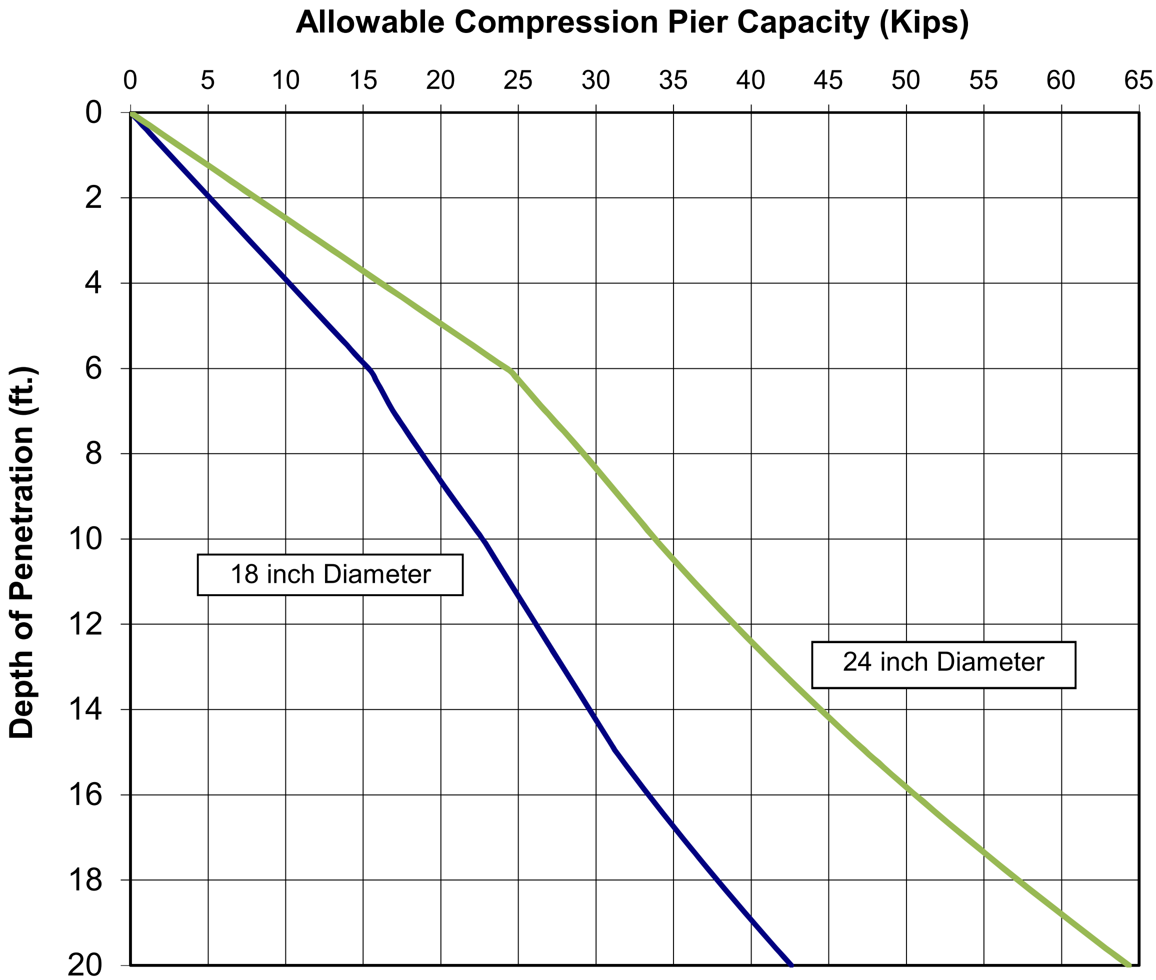
Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires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

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

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

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	0–200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
Quaternary	Late Quaternary	Holocene	200–11,700			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
Quaternary	Late Quaternary	Pleistocene	11,700–700,000			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
Quaternary	Early Quaternary	Pleistocene	700,000–1,600,000*			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*–4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

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



Notes:

1. Compression load capacity are based on skin friction and end-bearing capacity. The structural capacity of the piers should be checked.

2. The indicated capacities are for sustained (dead plus live) vertical compression load, and include a factor of safety of at least 2.5

3. For temporary wind or seismic load, the above values may be increased by one-third.

4. Capacities of other pier sizes are in direct proportion to the pier diameter.

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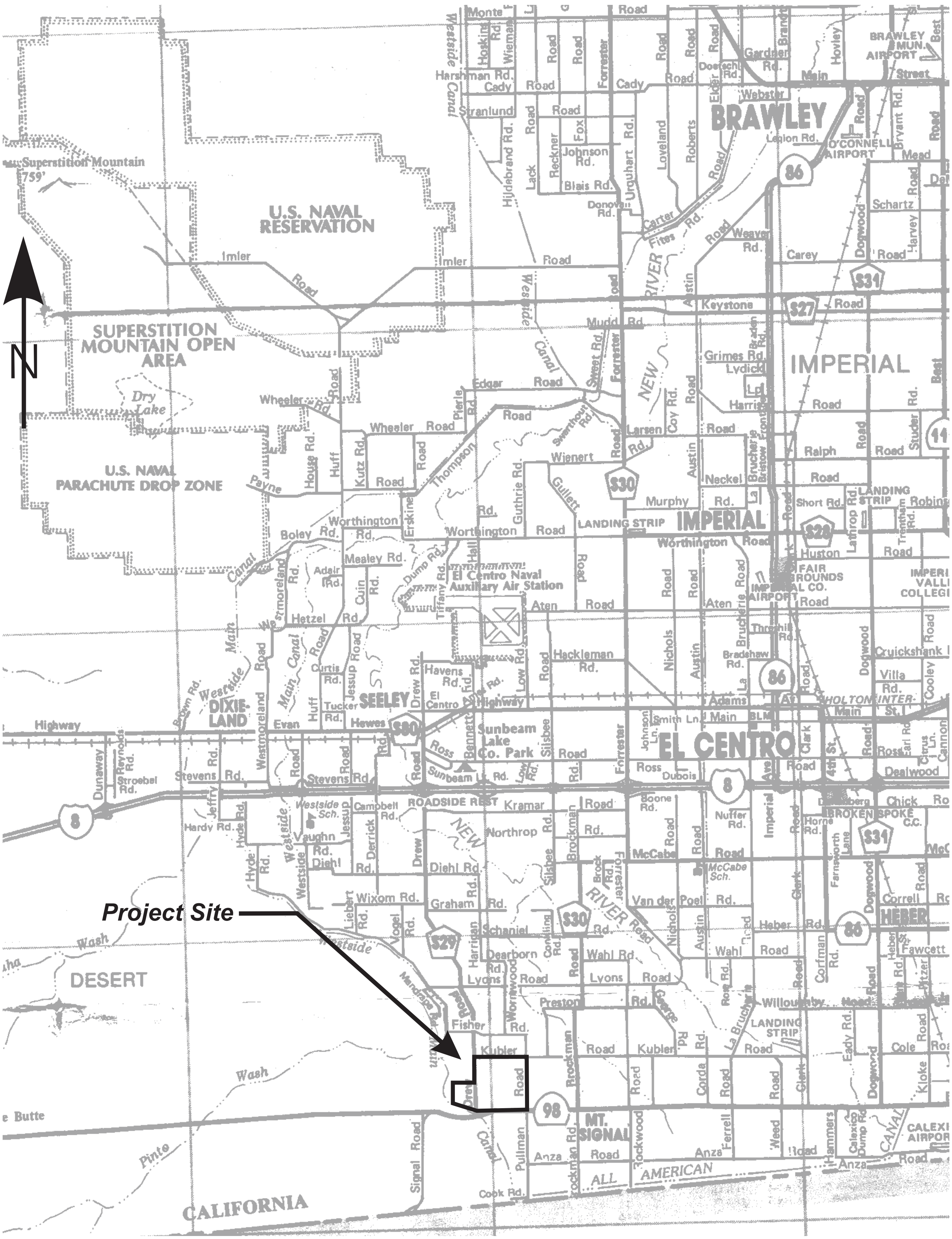
Drilled Pier Compression Capacity Chart
Drew Solar Facility
Calexico, California

Figure 3

APPENDIX A



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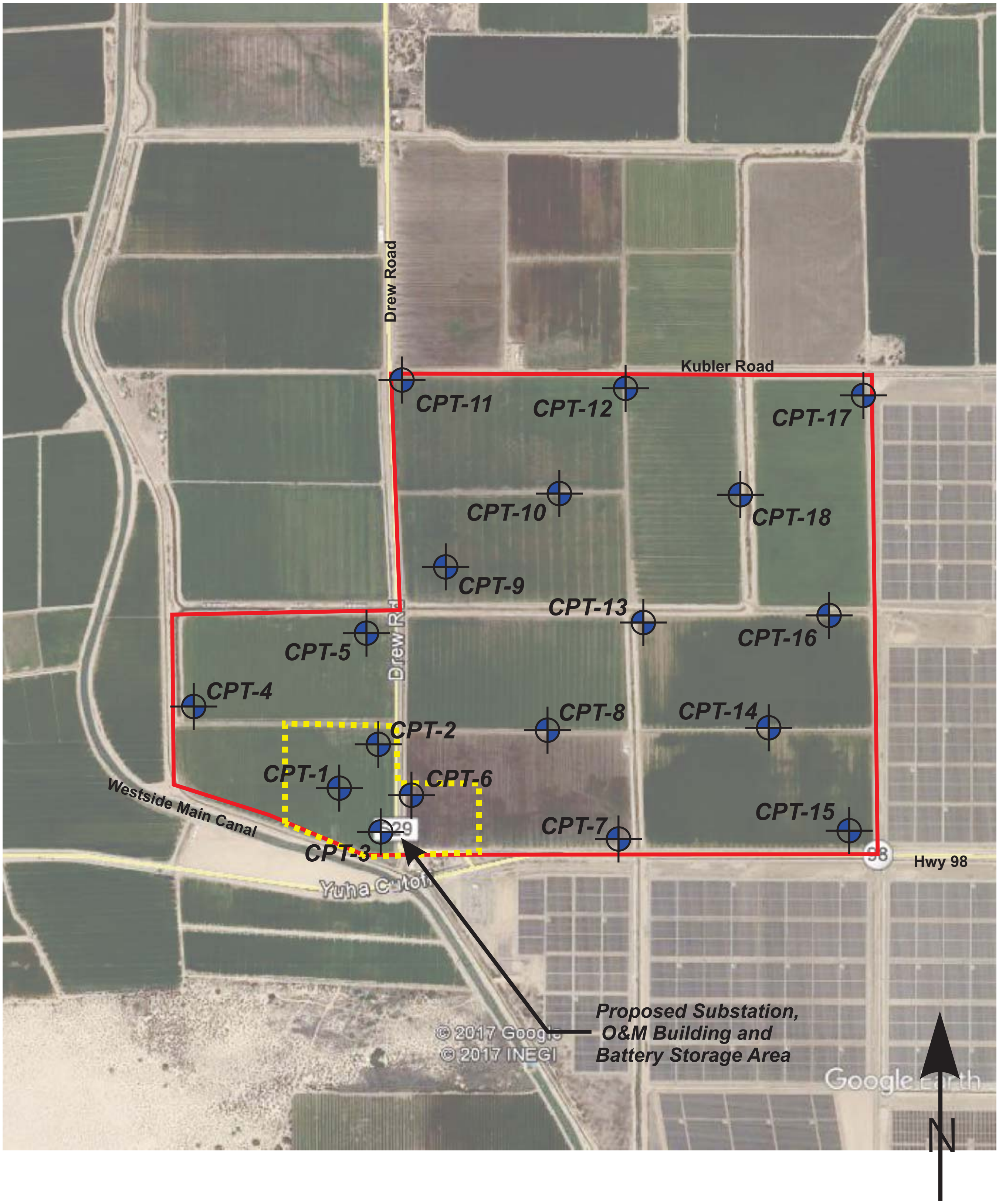
Vicinity Map

Plate A-1



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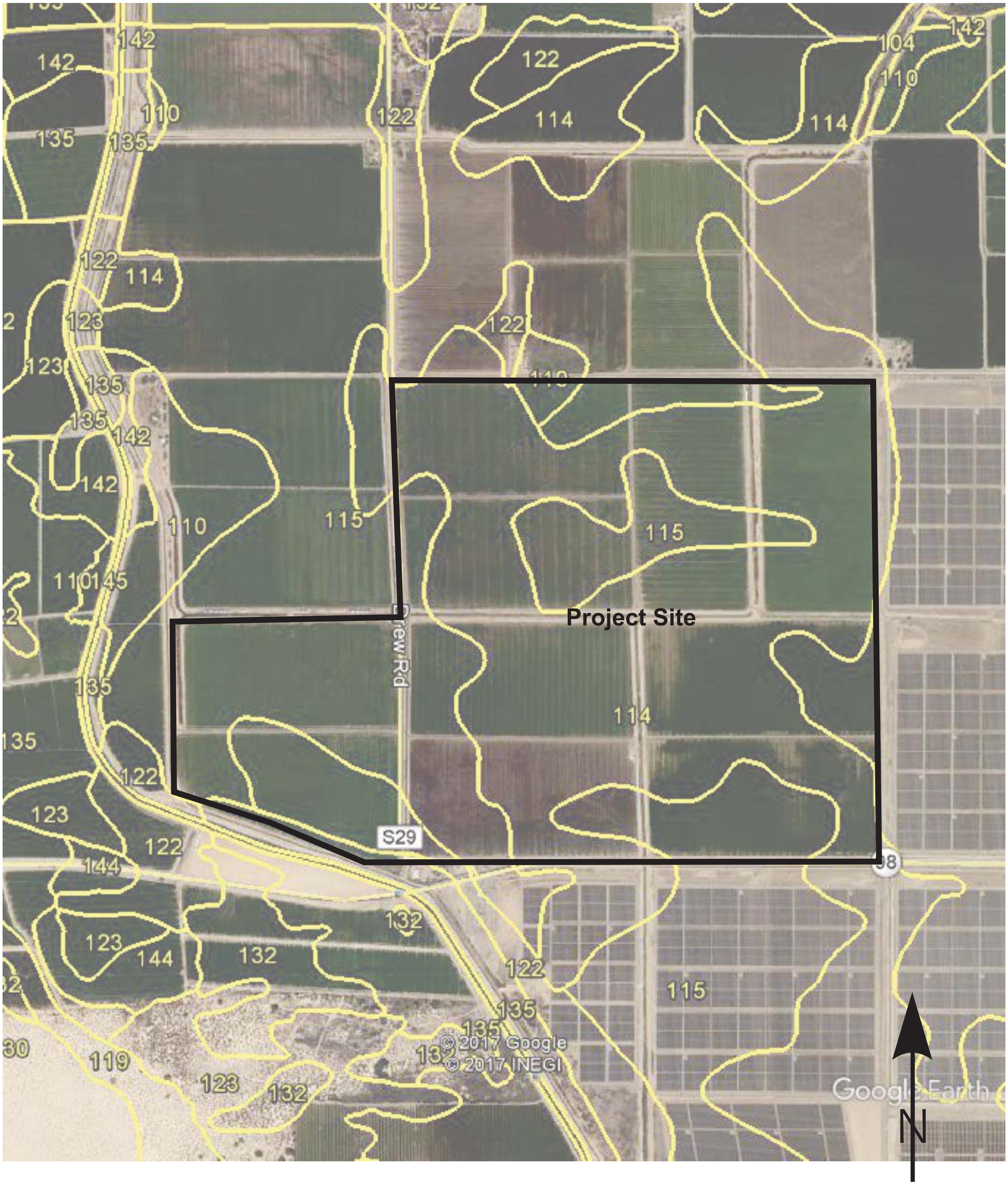
Site and Exploration Map

Plate
A-2



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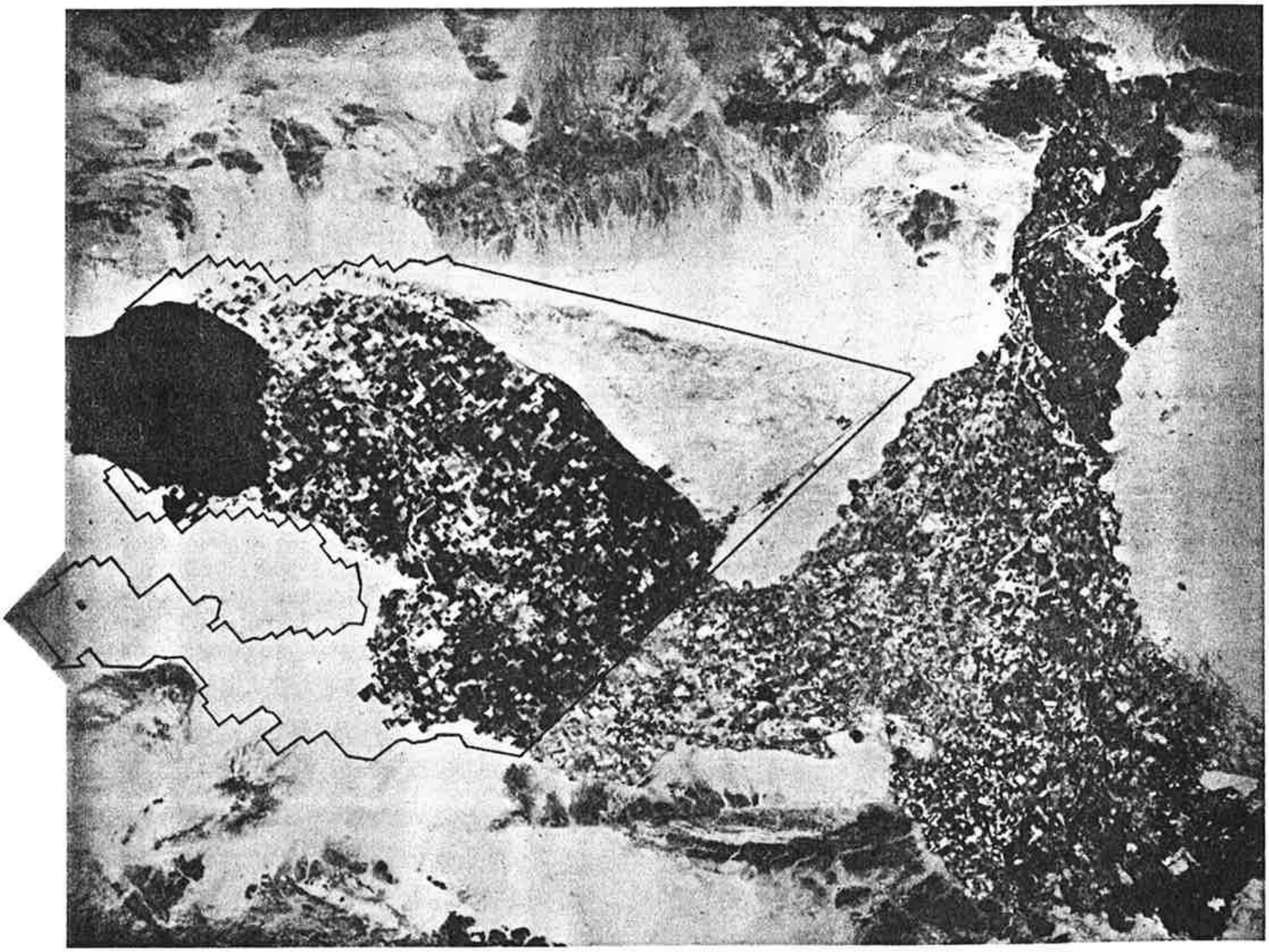
Soil Survey Map

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

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
100---------------- Antho	0-13	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	13-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
101*:											
Antho--------------	0-8	Loamy fine sand	SM	A-2	0	100	100	75-85	10-30	---	NP
	8-60	Sandy loam, fine sandy loam.	SM	A-2, A-4	0	90-100	75-95	50-60	15-40	---	NP
Superstition------	0-6	Fine sand-------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
102*. Badland											
103---------------- Carsitas	0-10	Gravelly sand---	SP, SP-SM	A-1, A-2	0-5	60-90	50-85	30-55	0-10	---	NP
	10-60	Gravelly sand, gravelly coarse sand, sand.	SP, SP-SM	A-1	0-5	60-90	50-85	25-50	0-10	---	NP
104* Fluvaquents											
105---------------- Glenbar	0-13	Clay loam-------	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
	13-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
106---------------- Glenbar	0-13	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
107*--------------- Glenbar	0-13	Loam------------	ML, CL-ML, CL	A-4	0	100	100	100	70-80	20-30	NP-10
	13-60	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	75-95	35-45	15-30
108---------------- Holtville	0-14	Loam------------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	14-22	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
109---------------- Holtville	0-17	Silty clay------	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
110---------------- Holtville	0-17	Silty clay------	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	17-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-35	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	35-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP

See footnote at end of table.

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.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

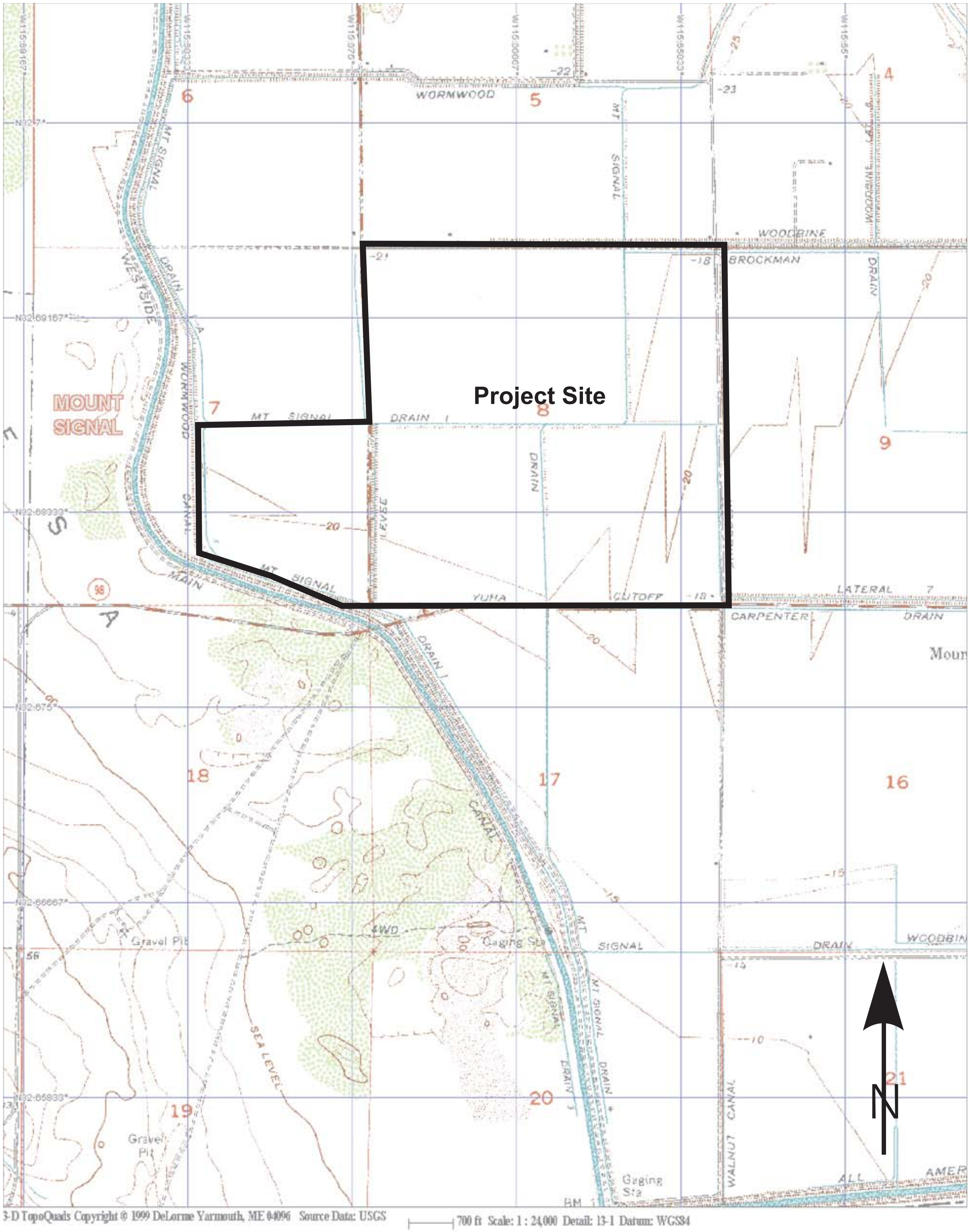
Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
121----------------- Meloland	0-12	Fine sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	75-100	5-30	---	NP
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-65	25-35	NP-10
	26-71	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-40
122----------------- Meloland	0-12	Very fine sandy loam.	ML	A-4	0	95-100	95-100	95-100	55-85	25-35	NP-10
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-70	25-35	NP-10
	26-71	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-40
123*:											
Meloland----------	0-12	Loam-------------	ML	A-4	0	95-100	95-100	95-100	55-85	25-35	NP-10
	12-26	Stratified loamy fine sand to silt loam.	ML	A-4	0	100	100	90-100	50-70	25-35	NP-10
	26-38	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-40
	38-60	Stratified silt loam to loamy fine sand.	SM, ML	A-4	0	100	100	75-100	35-55	25-35	NP-10
Holtville---------	0-12	Loam-------------	ML	A-4	0	100	100	85-100	55-95	25-35	NP-10
	12-24	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-65	20-35
	24-36	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	95-100	55-85	25-35	NP-10
	36-60	Loamy very fine sand, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	75-100	20-55	---	NP
124, 125----------- Niland	0-23	Gravelly sand---	SM, SP-SM	A-2, A-3	0	90-100	70-95	50-65	5-25	---	NP
	23-60	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
126----------------- Niland	0-23	Fine sand-------	SM, SP-SM	A-2, A-3	0	90-100	90-100	50-65	5-25	---	NP
	23-60	Silty clay------	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
127----------------- Niland	0-23	Loamy fine sand	SM	A-2	0	90-100	90-100	50-65	15-30	---	NP
	23-60	Silty clay------	CL, CH	A-7	0	100	100	85-100	80-95	40-65	20-40
128*:											
Niland------------	0-23	Gravelly sand---	SM, SP-SM	A-2, A-3	0	90-100	70-95	50-65	5-25	---	NP
	23-60	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	85-100	80-100	40-65	20-40
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
129*: Pits											
130, 131----------- Rositas	0-27	Sand-------------	SP-SM	A-3, A-1, A-2	0	100	80-100	40-70	5-15	---	NP
	27-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP

See footnote at end of table.

TABLE 11.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
132, 133, 134, 135-Rositas	0-9	Fine sand	SM	A-3, A-2	0	100	80-100	50-80	10-25	---	NP
	9-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
136 Rositas	0-4	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	10-35	---	NP
	4-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
137 Rositas	0-12	Silt loam	ML	A-4	0	100	100	90-100	70-90	20-30	NP-5
	12-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
138*:											
Rositas	0-4	Loamy fine sand	SM	A-1, A-2	0	100	80-100	40-85	10-35	---	NP
	4-60	Sand, fine sand, loamy sand.	SM, SP-SM	A-3, A-2, A-1	0	100	80-100	40-85	5-30	---	NP
Superstition	0-6	Loamy fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
139 Superstition	0-6	Loamy fine sand	SM	A-2	0	100	95-100	70-85	15-25	---	NP
	6-60	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	95-100	70-85	15-25	---	NP
140*: Torriorthents											
Rock outcrop											
141*: Torriorthents											
Orthids											
142 Vint	0-10	Loamy very fine sand.	SM, ML	A-4	0	100	100	85-95	40-65	15-25	NP-5
	10-60	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
143 Vint	0-12	Fine sandy loam	ML, CL-ML, SM, SM-SC	A-4	0	100	100	75-85	45-55	15-25	NP-5
	12-60	Loamy sand, loamy fine sand.	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
144*:											
Vint	0-10	Very fine sandy loam.	SM, ML	A-4	0	100	100	85-95	40-65	15-25	NP-5
	10-40	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
	40-60	Silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35
Indio	0-12	Very fine sandy loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	12-40	Stratified loamy very fine sand to silt loam.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	40-72	Silty clay	CL, CH	A-7	0	100	100	95-100	85-95	40-65	20-35

* See description of the map unit for composition and behavior characteristics of the map unit.



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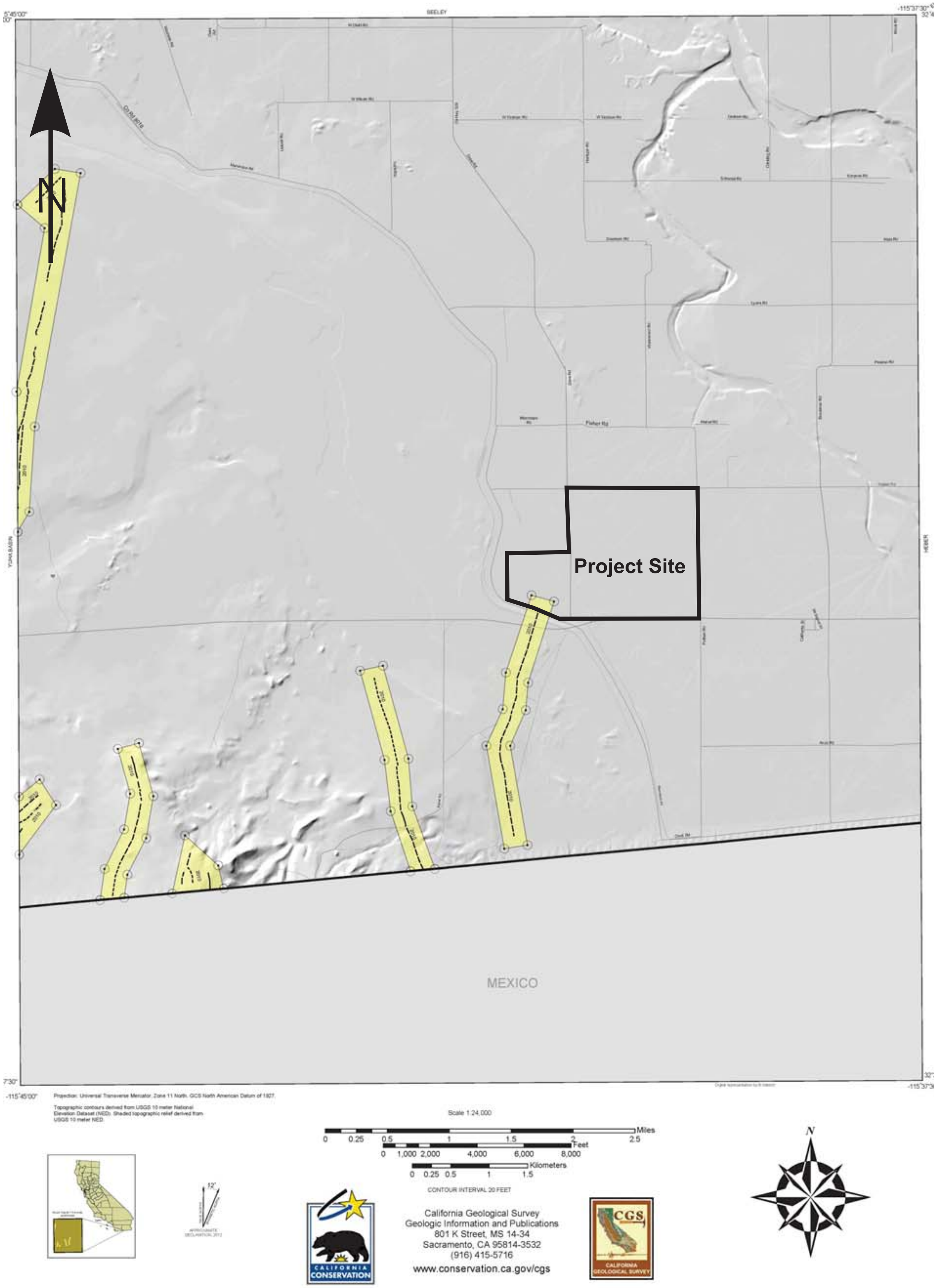
Project No.: LE18150

Topographic Map

Plate A-4



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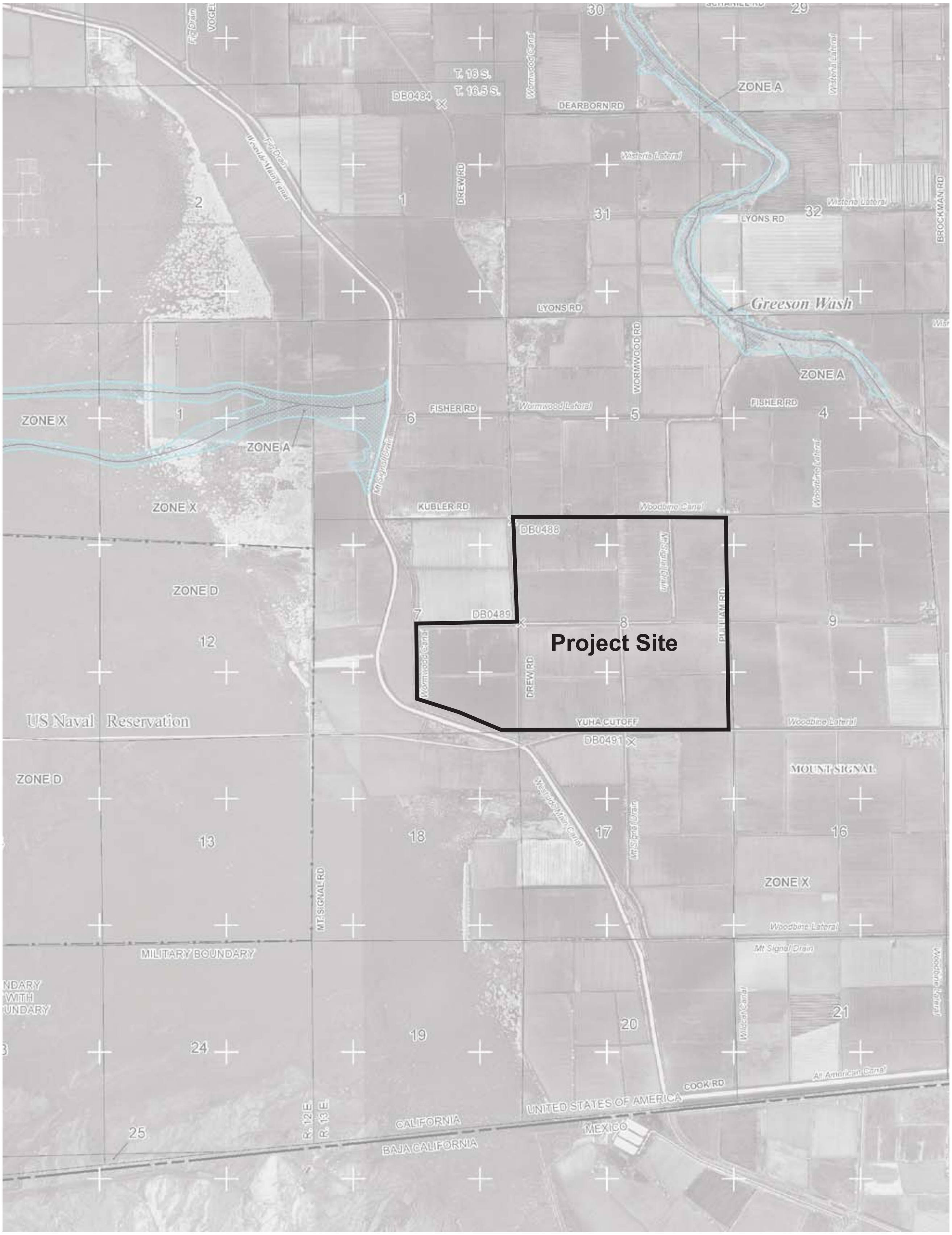
Project No.: LE18150

A-P Earthquake Fault Zone Map

Plate A-5



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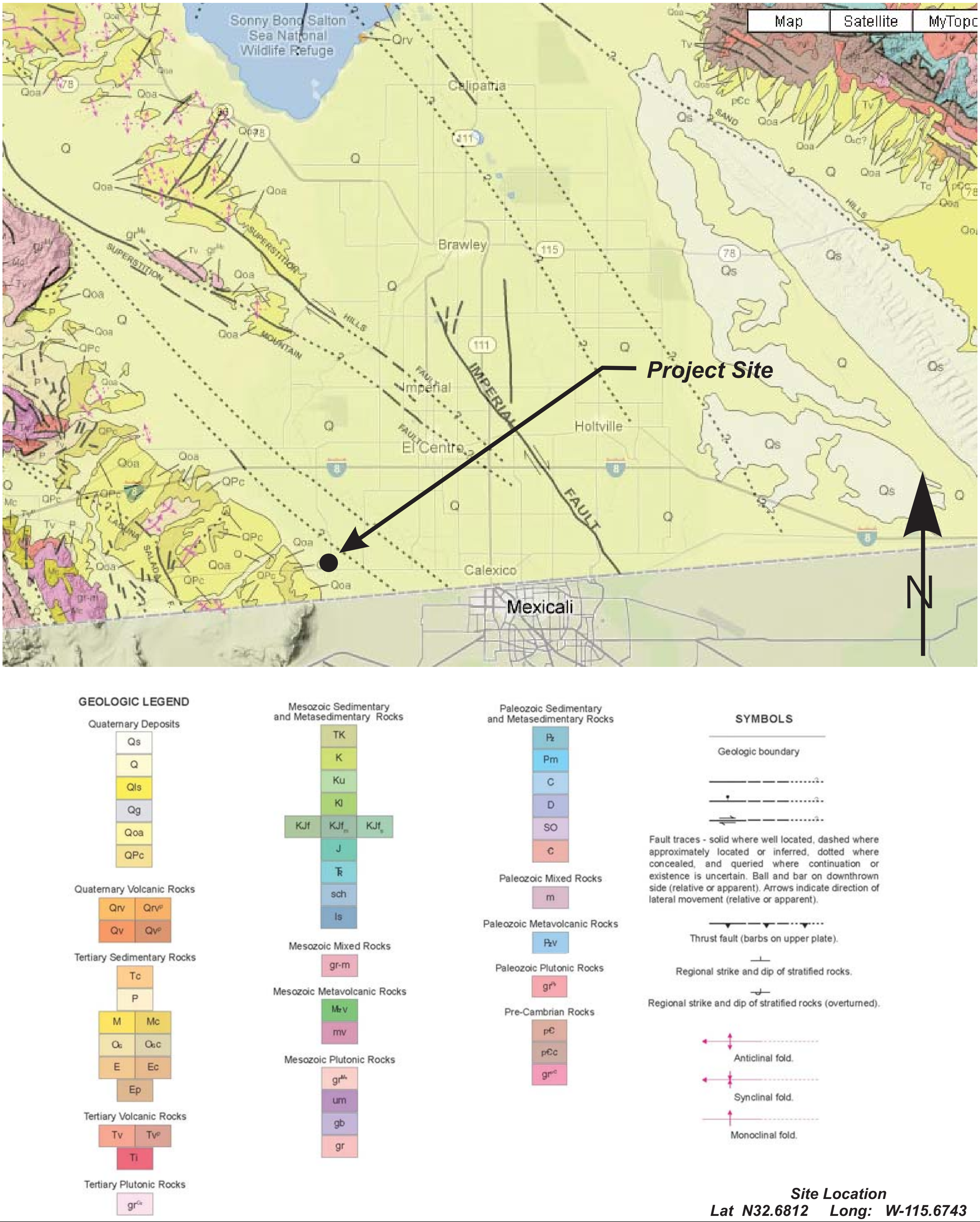
Project No.: LE18150

FEMA Flood Zone Map

Plate A-6



Site Location
Lat N32.6812 Long: W-115.6743

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Regional Geologic Map

Plate A-7

APPENDIX B

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2018

CONE SOUNDING DATA CPT-1

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

5
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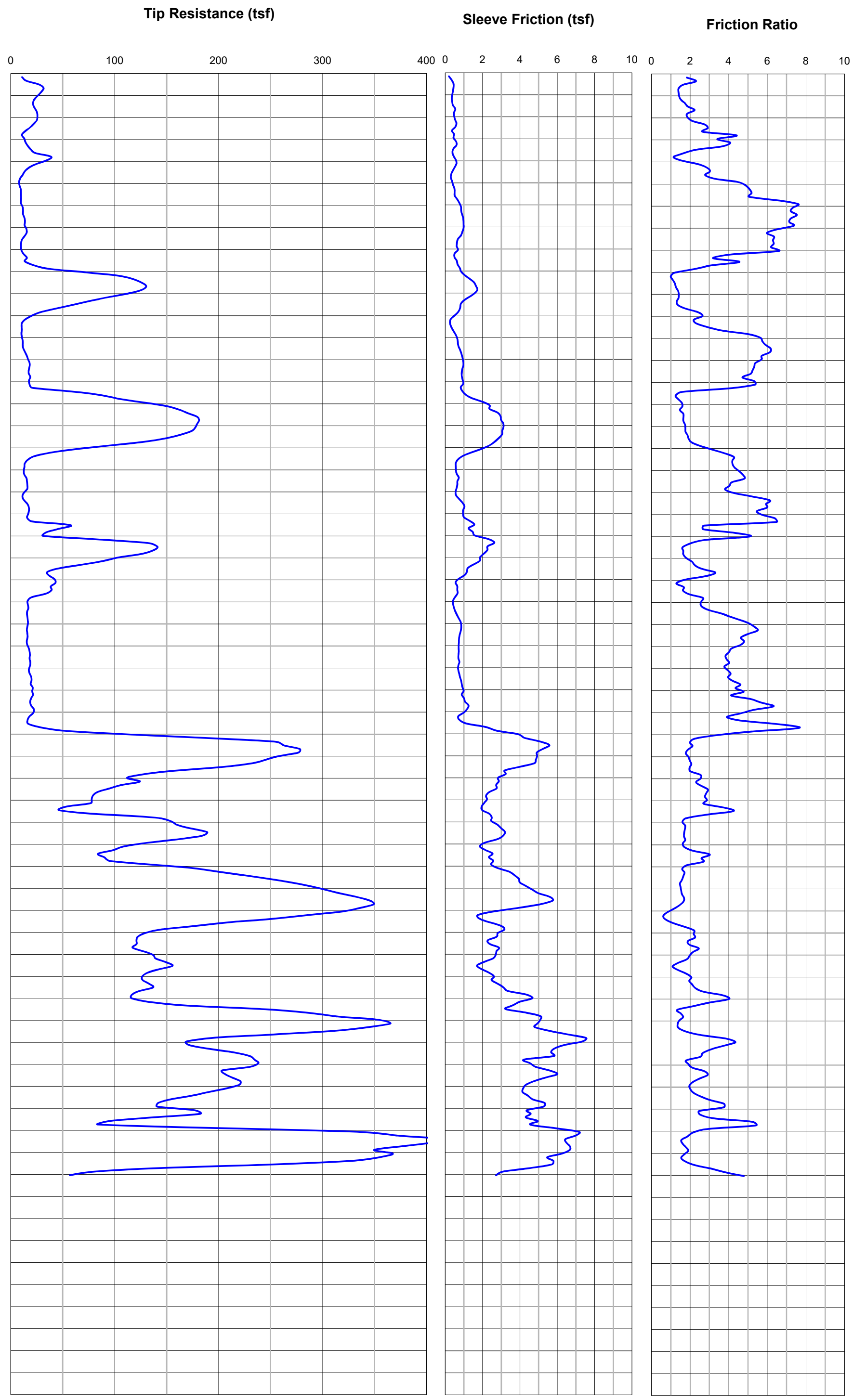


END OF SOUNDING AT 50 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-1

LANDMARK CONSULTANTS, INC.

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-1
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	17.57	1.92	Sandy Silt to Clayey Silt	ML	dense	115	5	33.2	60	83	40		
0.30	1.0	29.22	1.41	Sandy Silt to Clayey Silt	ML	dense	115	8	55.2	40	82	39		
0.45	1.5	22.13	1.70	Sandy Silt to Clayey Silt	ML	medium dense	115	6	41.8	55	66	37		
0.60	2.0	25.03	1.98	Sandy Silt to Clayey Silt	ML	medium dense	115	7	47.3	55	65	37		
0.75	2.5	21.70	2.60	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		65			1.27	>10
0.93	3.0	12.42	3.49	Silty Clay to Clay	CL	stiff	125	7		90			0.72	>10
1.08	3.5	16.55	3.35	Silty Clay to Clay	CL	stiff	125	9		80			0.96	>10
1.23	4.0	32.36	1.46	Sandy Silt to Clayey Silt	ML	medium dense	115	9	61.2	40	61	36		
1.38	4.5	18.82	2.79	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.09	>10
1.53	5.0	9.60	3.54	Clay	CL/CH	stiff	125	8		100			0.55	>10
1.68	5.5	9.45	5.06	Clay	CL/CH	stiff	125	8		100			0.54	>10
1.83	6.0	10.39	7.16	Clay	CL/CH	stiff	125	8		100			0.59	>10
1.98	6.5	12.28	7.32	Clay	CL/CH	stiff	125	10		100			0.70	>10
2.13	7.0	14.01	7.01	Clay	CL/CH	stiff	125	11		100			0.80	>10
2.28	7.5	13.12	6.20	Clay	CL/CH	stiff	125	10		100			0.75	>10
2.45	8.0	10.05	6.37	Clay	CL/CH	stiff	125	8		100			0.56	8.41
2.60	8.5	13.82	3.93	Silty Clay to Clay	CL	stiff	125	8		90			0.78	>10
2.75	9.0	42.37	2.17	Sandy Silt to Clayey Silt	ML	medium dense	115	12	58.3	45	57	36		
2.90	9.5	116.62	1.11	Sand to Silty Sand	SP/SM	dense	115	21	158.4	15	86	40		
3.05	10.0	122.18	1.35	Sand to Silty Sand	SP/SM	dense	115	22	163.8	20	87	40		
3.20	10.5	76.09	1.36	Silty Sand to Sandy Silt	SM/ML	dense	115	17	100.8	25	73	38		
3.35	11.0	31.46	2.29	Sandy Silt to Clayey Silt	ML	medium dense	115	9	41.2	55	46	34		
3.50	11.5	11.84	2.46	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		90			0.66	>10
3.65	12.0	10.51	4.76	Clay	CL/CH	stiff	125	8		100			0.58	6.32
3.80	12.5	11.65	5.94	Clay	CL/CH	stiff	125	9		100			0.65	7.13
3.95	13.0	15.07	5.85	Clay	CL/CH	stiff	125	12		100			0.85	>10
4.13	13.5	17.83	5.31	Clay	CL/CH	very stiff	125	14		100			1.01	>10
4.28	14.0	17.86	5.05	Clay	CL/CH	very stiff	125	14		100			1.01	>10
4.43	14.5	32.12	3.66	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		70			1.85	>10
4.58	15.0	105.11	1.40	Sand to Silty Sand	SP/SM	dense	115	19	124.6	25	79	39		
4.73	15.5	160.11	1.57	Sand to Silty Sand	SP/SM	very dense	115	29	188.0	20	91	41		
4.88	16.0	179.26	1.70	Sand to Silty Sand	SP/SM	very dense	115	33	208.5	20	94	41		
5.03	16.5	161.97	1.85	Silty Sand to Sandy Silt	SM/ML	very dense	115	36	186.7	25	91	41		
5.18	17.0	94.40	2.61	Silty Sand to Sandy Silt	SM/ML	dense	115	21	107.8	40	75	38		
5.33	17.5	25.19	4.09	Silty Clay to Clay	CL	very stiff	125	14		85			1.44	>10
5.48	18.0	13.02	4.36	Clay	CL/CH	stiff	125	10		100			0.72	5.76
5.65	18.5	14.57	4.57	Clay	CL/CH	stiff	125	12		100			0.81	6.65
5.80	19.0	14.87	4.05	Silty Clay to Clay	CL	stiff	125	8		100			0.83	9.00
5.95	19.5	13.08	5.78	Clay	CL/CH	stiff	125	10		100			0.72	5.31
6.10	20.0	17.13	5.73	Clay	CL/CH	stiff	125	14		100			0.96	8.14
6.25	20.5	31.13	5.20	Clay	CL/CH	very stiff	125	25		90			1.78	>10
6.40	21.0	37.38	4.02	Clayey Silt to Silty Clay	ML/CL	hard	120	15		75			2.15	>10
6.55	21.5	119.72	2.10	Silty Sand to Sandy Silt	SM/ML	dense	115	27	125.4	35	79	39		
6.70	22.0	121.95	1.70	Sand to Silty Sand	SP/SM	dense	115	22	126.7	30	79	39		
6.85	22.5	67.34	2.33	Sandy Silt to Clayey Silt	ML	medium dense	115	19	69.5	45	62	37		
7.00	23.0	38.09	2.60	Sandy Silt to Clayey Silt	ML	medium dense	115	11	39.0	65	45	34		
7.18	23.5	40.23	1.53	Silty Sand to Sandy Silt	SM/ML	medium dense	115	9	40.9	50	46	34		
7.33	24.0	23.32	2.40	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		80			1.32	>10
7.48	24.5	16.34	2.91	Clayey Silt to Silty Clay	ML/CL	stiff	120	7		100			0.91	>10
7.63	25.0	16.18	4.51	Clay	CL/CH	stiff	125	13		100			0.90	5.65
7.78	25.5	15.80	5.28	Clay	CL/CH	stiff	125	13		100			0.87	5.21
7.93	26.0	15.77	4.68	Clay	CL/CH	stiff	125	13		100			0.87	5.10
8.08	26.5	17.95	3.97	Silty Clay to Clay	CL	stiff	125	10		100			1.00	8.14
8.23	27.0	18.25	3.92	Silty Clay to Clay	CL	very stiff	125	10		100			1.01	8.14
8.38	27.5	19.20	4.10	Silty Clay to Clay	CL	very stiff	125	11		100			1.07	8.56
8.53	28.0	20.30	4.58	Clay	CL/CH	very stiff	125	16		100			1.13	6.88
8.68	28.5	19.86	4.98	Clay	CL/CH	very stiff	125	16		100			1.11	6.54
8.85	29.0	21.18	5.40	Clay	CL/CH	very stiff	125	17		100			1.18	7.13
9.00	29.5	16.95	5.08	Clay	CL/CH	stiff	125	14		100			0.93	4.78
9.15	30.0	65.98	5.39	Overconsolidated Soil	??	medium dense	120	66	60.8	75	58	36		
9.30	30.5	236.49	2.11	Sand to Silty Sand	SP/SM	very dense	115	43	216.5	25	95	41		
9.45	31.0	270.69	1.86	Sand to Silty Sand	SP/SM	very dense	115	49	246.4	25	99	42		
9.60	31.5	226.37	2.01	Sand to Silty Sand	SP/SM	very dense	115	41	204.9	25	94	41		
9.75	32.0	132.39	2.36	Silty Sand to Sandy Silt	SM/ML	dense	115	29	119.2	40	78	39		
9.90	32.5	108.07	2.60	Silty Sand to Sandy Silt	SM/ML	dense	115	24	96.7	45	71	38		
10.05	33.0	79.85	2.83	Sandy Silt to Clayey Silt	ML	medium dense	115	23	71.1	55	62	37		
10.20	33.5	58.70	3.56	Clayey Silt to Silty Clay	ML/CL	hard	120	23		70			3.38	>10
10.38	34.0	125.69	2.08	Silty Sand to Sandy Silt	SM/ML	dense	115	28	110.6	40	75	39		
10.53	34.5	174.10	1.72	Sand to Silty Sand	SP/SM	dense	115	32	152.4	30	85	40		
10.68	35.0	158.60	1.68	Sand to Silty Sand	SP/SM	dense	115	29	138.1	30	82	39		
10.83	35.5	97.02	2.30	Silty Sand to Sandy Silt	SM/ML	medium dense	115	22	84.0	45	67	37		
10.98	36.0	106.80	2.37	Silty Sand to Sandy Silt	SM/ML	dense	115	24	92.0	45	70	38		
11.13	36.5	212.72	1.63	Sand to Silty Sand	SP/SM	very dense	115	39	182.3	25	90	41		
11.28	37.0	287.56	1.50	Sand to Silty Sand	SP/SM	very dense	115	52	245.2	20	99	42		
11.43	37.5	332.23	1.64	Sand to Silty Sand	SP/SM	very dense	115	60	281.9	20	103	42		
11.58	38.0	334.64	1.15	Sand	SP	very dense	110	51	282.6	15	103	42		
11.73	38.5	248.91	0.82	Sand	SP	very dense	110	38	209.3	15	94	41		

LANDMARK CONSULTANTS, INC.

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-1
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	149.98	2.03	Silty Sand to Sandy Silt	SM/ML	dense	115	33	125.5	35	79	39		
12.05	39.5	121.39	2.03	Silty Sand to Sandy Silt	SM/ML	dense	115	27	101.1	40	73	38		
12.20	40.0	127.25	2.19	Silty Sand to Sandy Silt	SM/ML	dense	115	28	105.5	40	74	38		
12.35	40.5	148.07	1.44	Sand to Silty Sand	SP/SM	dense	115	27	122.1	30	78	39		
12.50	41.0	133.27	1.75	Sand to Silty Sand	SP/SM	dense	115	24	109.4	35	75	39		
12.65	41.5	132.34	2.11	Silty Sand to Sandy Silt	SM/ML	dense	115	29	108.1	40	75	38		
12.80	42.0	118.84	3.48	Sandy Silt to Clayey Silt	ML	dense	115	34	96.7	55	71	38		
12.95	42.5	180.51	2.17	Silty Sand to Sandy Silt	SM/ML	dense	115	40	146.2	35	84	40		
13.10	43.0	317.61	1.53	Sand	SP	very dense	110	49	256.1	20	100	42		
13.25	43.5	340.53	1.51	Sand	SP	very dense	110	52	273.4	20	102	42		
13.40	44.0	205.34	3.60	Sand to Clayey Sand	SP/SC	dense	115	103	164.2	45	87	40		
13.58	44.5	192.46	3.13	Silty Sand to Sandy Silt	SM/ML	dense	115	43	153.2	45	85	40		
13.73	45.0	234.25	2.08	Sand to Silty Sand	SP/SM	very dense	115	43	185.6	30	91	41		
13.88	45.5	213.18	2.59	Silty Sand to Sandy Silt	SM/ML	dense	115	47	168.2	35	88	40		
14.03	46.0	217.99	2.20	Silty Sand to Sandy Silt	SM/ML	dense	115	48	171.3	35	88	40		
14.18	46.5	190.14	2.25	Silty Sand to Sandy Silt	SM/ML	dense	115	42	148.7	35	84	40		
14.33	47.0	153.23	3.25	Sandy Silt to Clayey Silt	ML	dense	115	44	119.4	50	78	39		
14.48	47.5	137.82	3.63	Sandy Silt to Clayey Silt	ML	dense	115	39	106.9	55	74	38		
14.63	48.0	209.00	3.47	Sand to Clayey Sand	SP/SC	dense	115	104	161.4	45	87	40		
14.78	48.5	397.05	1.68	Sand to Silty Sand	SP/SM	very dense	115	72	305.5	20	105	43		
14.93	49.0	364.30	1.79	Sand to Silty Sand	SP/SM	very dense	115	66	279.1	25	103	42		
15.10	49.5	312.67	1.85	Sand to Silty Sand	SP/SM	very dense	115	57	238.6	25	98	42		
15.25	50.0	93.99	3.92	Clayey Silt to Silty Clay	ML/CL	hard	120	38		70			5.43	>10

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2018

CONE SOUNDING DATA CPT-2

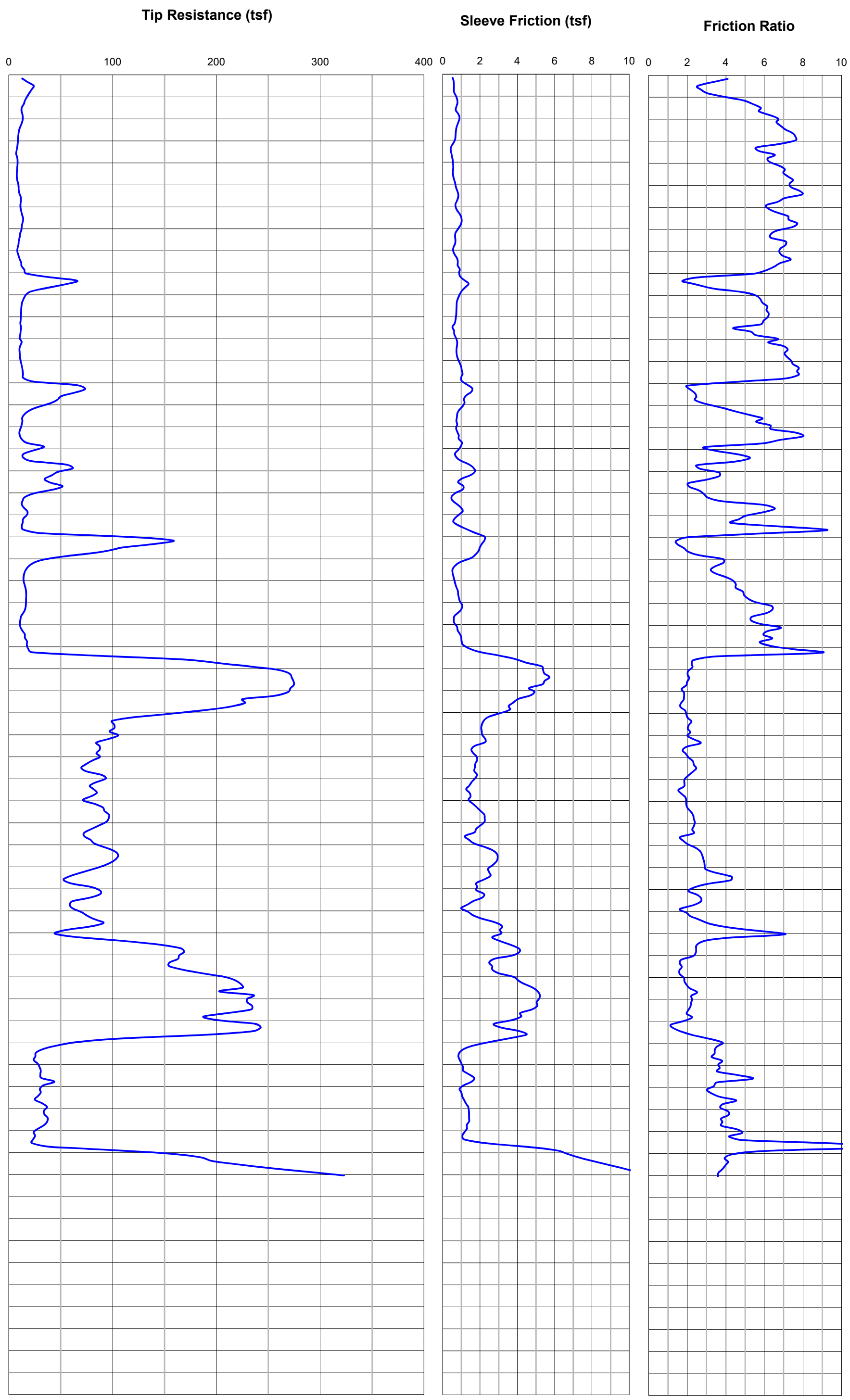
DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	firm
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Clay	CL/CH	stiff
Clay	" "	very stiff
Clayey Silt to Silty Clay	ML/CL	hard
Sandy Silt to Clayey Silt	ML	medium dense
Clay	CL/CH	stiff
Clay	" "	very stiff
Silty Sand to Sandy Silt	SM/ML	dense
Silty Clay to Clay	CL	stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Overconsolidated Soil	??	dense
Sand to Silty Sand	SP/SM	very dense
Sand to Silty Sand	" "	very dense
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Silty Sand to Sandy Silt	" "	medium dense
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Clayey Silt to Silty Clay	ML/CL	hard
Silty Sand to Sandy Silt	SM/ML	dense
Sand to Silty Sand	SP/SM	dense
Sand to Silty Sand	" "	dense
Sand to Silty Sand	" "	dense
Silty Sand to Sandy Silt	SM/ML	dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Clayey Silt to Silty Clay	" "	very stiff
Silty Clay to Clay	CL	very stiff
Overconsolidated Soil	??	medium dense
Sand to Clayey Sand	SP/SC	very dense

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55



END OF SOUNDING AT 50 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-2

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-2
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	18.37	3.27	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		75			1.08	>10
0.30	1.0	19.87	3.25	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		70			1.17	>10
0.45	1.5	14.25	5.39	Clay	CL/CH	stiff	125	11		100			0.83	>10
0.60	2.0	12.94	6.23	Clay	CL/CH	stiff	125	10		100			0.75	>10
0.75	2.5	11.55	6.85	Clay	CL/CH	stiff	125	9		100			0.67	>10
0.93	3.0	9.05	7.56	Clay	CL/CH	stiff	125	7		100			0.52	>10
1.08	3.5	8.04	6.04	Clay	CL/CH	firm	125	6		100			0.46	>10
1.23	4.0	7.97	6.33	Clay	CL/CH	firm	125	6		100			0.46	>10
1.38	4.5	7.99	6.92	Clay	CL/CH	firm	125	6		100			0.45	>10
1.53	5.0	8.20	7.33	Clay	CL/CH	firm	125	7		100			0.47	>10
1.68	5.5	10.24	7.56	Clay	CL/CH	stiff	125	8		100			0.58	>10
1.83	6.0	11.35	6.34	Clay	CL/CH	stiff	125	9		100			0.65	>10
1.98	6.5	12.98	7.04	Clay	CL/CH	stiff	125	10		100			0.74	>10
2.13	7.0	12.52	7.28	Clay	CL/CH	stiff	125	10		100			0.71	>10
2.28	7.5	10.27	6.59	Clay	CL/CH	stiff	125	8		100			0.58	9.59
2.45	8.0	8.64	6.90	Clay	CL/CH	firm	125	7		100			0.48	6.21
2.60	8.5	10.51	7.05	Clay	CL/CH	stiff	125	8		100			0.59	8.14
2.75	9.0	14.52	5.99	Clay	CL/CH	stiff	125	12		100			0.82	>10
2.90	9.5	52.47	2.25	Sandy Silt to Clayey Silt	ML	medium dense	115	15	70.2	40	62	37		
3.05	10.0	25.01	4.54	Silty Clay to Clay	CL	very stiff	125	14		80			1.44	>10
3.20	10.5	13.12	5.95	Clay	CL/CH	stiff	125	10		100			0.74	>10
3.35	11.0	11.81	6.16	Clay	CL/CH	stiff	125	9		100			0.66	7.85
3.50	11.5	11.41	5.38	Clay	CL/CH	stiff	125	9		100			0.64	7.00
3.65	12.0	10.96	5.85	Clay	CL/CH	stiff	125	9		100			0.61	6.32
3.80	12.5	11.20	6.80	Clay	CL/CH	stiff	125	9		100			0.62	6.21
3.95	13.0	10.76	7.20	Clay	CL/CH	stiff	125	9		100			0.60	5.65
4.13	13.5	12.67	7.65	Clay	CL/CH	stiff	125	10		100			0.71	7.00
4.28	14.0	17.15	6.38	Clay	CL/CH	stiff	125	14		100			0.97	>10
4.43	14.5	68.03	2.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	80.1	40	66	37		
4.58	15.0	45.88	2.60	Sandy Silt to Clayey Silt	ML	medium dense	115	13	53.5	55	54	36		
4.73	15.5	21.14	4.44	Silty Clay to Clay	CL	very stiff	125	12		95			1.20	>10
4.88	16.0	12.38	6.03	Clay	CL/CH	stiff	125	10		100			0.69	5.65
5.03	16.5	11.12	7.49	Clay	CL/CH	stiff	125	9		100			0.61	4.57
5.18	17.0	25.22	4.06	Silty Clay to Clay	CL	very stiff	125	14		85			1.44	>10
5.33	17.5	16.32	4.79	Clay	CL/CH	stiff	125	13		100			0.91	8.14
5.48	18.0	54.86	2.93	Sandy Silt to Clayey Silt	ML	medium dense	115	16	60.2	55	57	36		
5.65	18.5	38.57	2.91	Sandy Silt to Clayey Silt	ML	medium dense	115	11	41.9	65	47	35		
5.80	19.0	38.88	2.52	Sandy Silt to Clayey Silt	ML	medium dense	115	11	41.9	60	47	35		
5.95	19.5	13.72	4.28	Clay	CL/CH	stiff	125	11		100			0.76	5.42
6.10	20.0	16.61	5.85	Clay	CL/CH	stiff	125	13		100			0.93	7.13
6.25	20.5	13.24	5.26	Clay	CL/CH	stiff	125	11		100			0.73	4.78
6.40	21.0	52.56	5.59	Clay	CL/CH	hard	125	42		75			3.04	>10
6.55	21.5	135.59	1.59	Sand to Silty Sand	SP/SM	dense	115	25	139.9	25	82	40		
6.70	22.0	66.45	2.85	Sandy Silt to Clayey Silt	ML	medium dense	115	19	68.0	55	61	37		
6.85	22.5	20.66	3.52	Clayey Silt to Silty Clay	ML/CL	very stiff	120	8		95			1.16	>10
7.00	23.0	14.50	3.94	Silty Clay to Clay	CL	stiff	125	8		100			0.80	6.32
7.18	23.5	15.75	4.64	Clay	CL/CH	stiff	125	13		100			0.87	5.42
7.33	24.0	16.62	5.22	Clay	CL/CH	stiff	125	13		100			0.92	5.76
7.48	24.5	15.42	6.29	Clay	CL/CH	stiff	125	12		100			0.85	5.00
7.63	25.0	11.23	5.48	Clay	CL/CH	stiff	125	9		100			0.60	3.07
7.78	25.5	13.15	6.32	Clay	CL/CH	stiff	125	11		100			0.71	3.74
7.93	26.0	16.80	6.13	Clay	CL/CH	stiff	125	13		100			0.93	5.31
8.08	26.5	74.07	5.55	Overconsolidated Soil	??	medium dense	120	74	70.6	70	62	37		
8.23	27.0	232.72	2.18	Silty Sand to Sandy Silt	SM/ML	very dense	115	52	220.5	25	96	41		
8.38	27.5	272.47	2.04	Sand to Silty Sand	SP/SM	very dense	115	50	256.6	25	100	42		
8.53	28.0	271.69	1.82	Sand to Silty Sand	SP/SM	very dense	115	49	254.3	20	100	42		
8.68	28.5	236.83	1.77	Sand to Silty Sand	SP/SM	very dense	115	43	220.3	25	96	41		
8.85	29.0	187.59	1.83	Sand to Silty Sand	SP/SM	dense	115	34	173.5	25	89	40		
9.00	29.5	107.36	2.11	Silty Sand to Sandy Silt	SM/ML	dense	115	24	98.7	40	72	38		
9.15	30.0	101.41	2.06	Silty Sand to Sandy Silt	SM/ML	dense	115	23	92.7	40	70	38		
9.30	30.5	89.47	2.34	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	81.3	45	66	37		
9.45	31.0	86.56	1.92	Silty Sand to Sandy Silt	SM/ML	medium dense	115	19	78.2	45	65	37		
9.60	31.5	74.91	2.36	Sandy Silt to Clayey Silt	ML	medium dense	115	21	67.3	50	61	37		
9.75	32.0	85.81	2.06	Silty Sand to Sandy Silt	SM/ML	medium dense	115	19	76.7	45	65	37		
9.90	32.5	81.39	1.74	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	72.3	45	63	37		
10.05	33.0	78.19	1.84	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	69.1	45	62	37		
10.20	33.5	88.32	2.05	Silty Sand to Sandy Silt	SM/ML	medium dense	115	20	77.6	45	65	37		
10.38	34.0	95.52	2.34	Silty Sand to Sandy Silt	SM/ML	medium dense	115	21	83.5	45	67	37		
10.53	34.5	79.70	2.31	Silty Sand to Sandy Silt	SM/ML	medium dense	115	18	69.3	50	62	37		
10.68	35.0	77.96	1.81	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	67.4	45	61	37		
10.83	35.5	99.29	2.62	Silty Sand to Sandy Silt	SM/ML	medium dense	115	22	85.4	50	68	37		
10.98	36.0	99.00	2.87	Sandy Silt to Clayey Silt	ML	medium dense	115	28	84.8	50	68	37		
11.13	36.5	66.18	3.76	Clayey Silt to Silty Clay	ML/CL	hard	120	26		70			3.82	>10
11.28	37.0	74.98	2.49	Sandy Silt to Clayey Silt	ML	medium dense	115	21	63.5	55	59	36		
11.43	37.5	75.91	2.63	Sandy Silt to Clayey Silt	ML	medium dense	115	22	64.0	60	59	36		
11.58	38.0	63.37	1.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	53.2	55	54	36		
11.73	38.5	83.07	2.66	Sandy Silt to Clayey Silt	ML	medium dense	115	24	69.3	55	62	37		

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-2
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	59.06	5.58	Clay	CL/CH	hard	125	47		90			3.39	>10
12.05	39.5	107.33	3.05	Sandy Silt to Clayey Silt	ML	medium dense	115	31	88.7	55	69	38		
12.20	40.0	166.09	2.40	Silty Sand to Sandy Silt	SM/ML	dense	115	37	136.5	40	82	39		
12.35	40.5	157.39	1.67	Sand to Silty Sand	SP/SM	dense	115	29	128.8	35	80	39		
12.50	41.0	187.74	1.67	Sand to Silty Sand	SP/SM	dense	115	34	152.9	30	85	40		
12.65	41.5	222.47	1.99	Sand to Silty Sand	SP/SM	dense	115	40	180.4	30	90	41		
12.80	42.0	222.71	2.32	Silty Sand to Sandy Silt	SM/ML	dense	115	49	179.7	35	90	41		
12.95	42.5	232.52	2.13	Sand to Silty Sand	SP/SM	very dense	115	42	186.8	30	91	41		
13.10	43.0	200.22	2.01	Sand to Silty Sand	SP/SM	dense	115	36	160.1	30	86	40		
13.25	43.5	238.71	1.39	Sand to Silty Sand	SP/SM	very dense	115	43	190.1	25	91	41		
13.40	44.0	122.58	3.14	Sandy Silt to Clayey Silt	ML	dense	115	35	97.2	55	72	38		
13.58	44.5	34.99	3.46	Clayey Silt to Silty Clay	ML/CL	very stiff	120	14		95			1.97	>10
13.73	45.0	25.76	3.56	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		100			1.43	>10
13.88	45.5	30.27	3.96	Silty Clay to Clay	CL	very stiff	125	17		100			1.69	9.59
14.03	46.0	36.21	4.10	Clayey Silt to Silty Clay	ML/CL	hard	120	14		100			2.04	>10
14.18	46.5	29.58	3.32	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		100			1.65	>10
14.33	47.0	31.96	4.05	Silty Clay to Clay	CL	very stiff	125	18		100			1.79	>10
14.48	47.5	36.18	3.91	Clayey Silt to Silty Clay	ML/CL	hard	120	14		100			2.03	>10
14.63	48.0	28.83	4.40	Silty Clay to Clay	CL	very stiff	125	16		100			1.60	8.00
14.78	48.5	23.62	6.37	Clay	CL/CH	very stiff	125	19		100			1.29	4.28
14.93	49.0	98.75	7.31	Overconsolidated Soil	??	medium dense	120	99	74.7	85	64	37		
15.10	49.5	201.22	4.00	Sand to Clayey Sand	SP/SC	dense	115	101	151.6	50	85	40		
15.25	50.0	287.97	3.68	Sand to Clayey Sand	SP/SC	very dense	115	144	216.1	40	95	41		

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

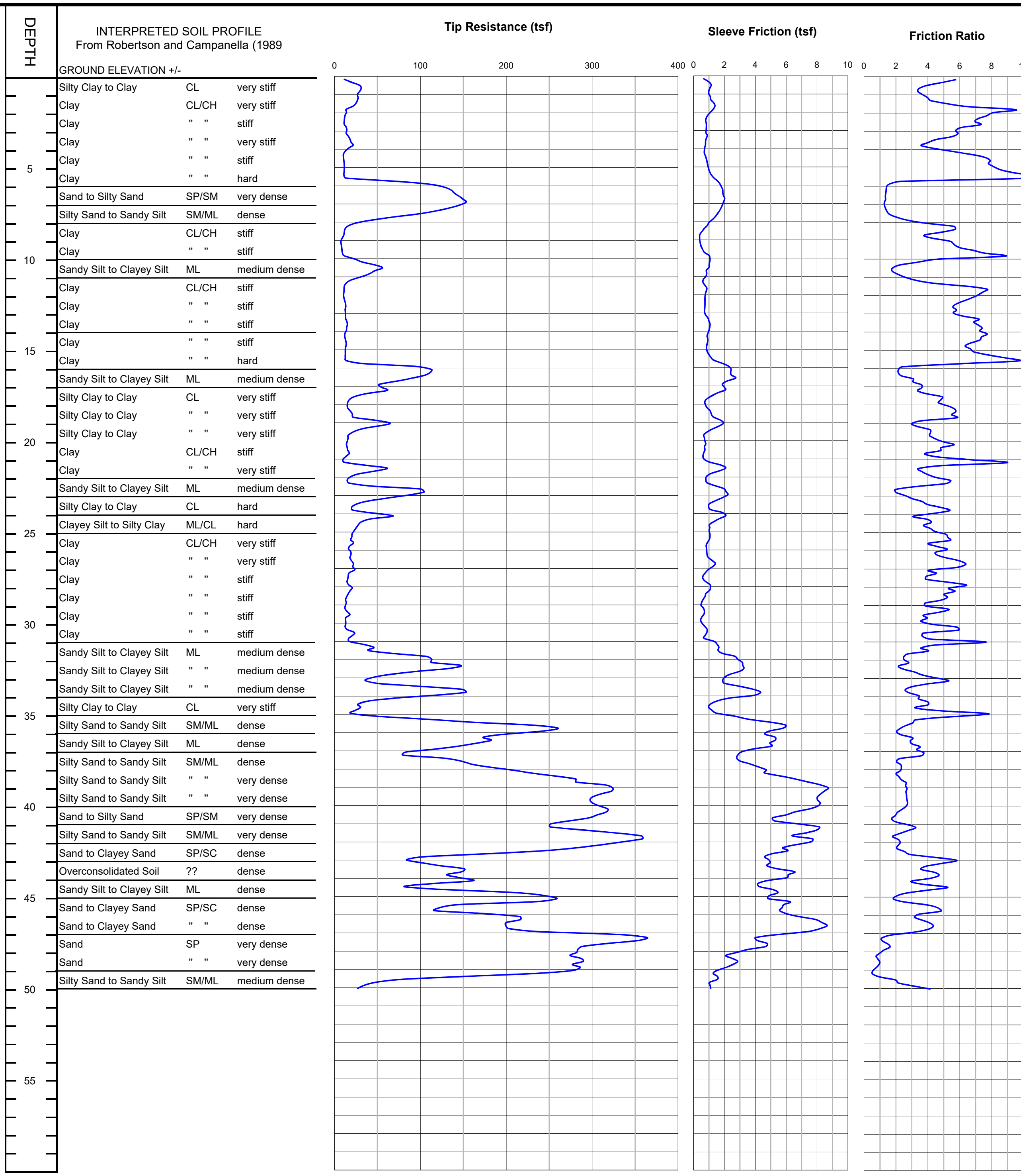
DATE: 8/13/2018

CONE SOUNDING DATA CPT-3

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Silty Clay to Clay	CL	very stiff
Clay	CL/CH	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	hard
Sand to Silty Sand	SP/SM	very dense
Silty Sand to Sandy Silt	SM/ML	dense
Clay	CL/CH	stiff
Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	hard
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	very stiff
Silty Clay to Clay	" "	very stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	hard
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Silty Clay to Clay	CL	very stiff
Silty Sand to Sandy Silt	SM/ML	dense
Sandy Silt to Clayey Silt	ML	dense
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	very dense
Silty Sand to Sandy Silt	" "	very dense
Sand to Silty Sand	SP/SM	very dense
Silty Sand to Sandy Silt	SM/ML	very dense
Sand to Clayey Sand	SP/SC	dense
Overconsolidated Soil	??	dense
Sandy Silt to Clayey Silt	ML	dense
Sand to Clayey Sand	SP/SC	dense
Sand to Clayey Sand	" "	dense
Sand	SP	very dense
Sand	" "	very dense
Silty Sand to Sandy Silt	SM/ML	medium dense



END OF SOUNDING AT 50 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-3

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-3
Est. GWT (ft): 8
Phi Correlation: 0 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Nk: Phi (deg.)	17 Su (tsf)	OCR
0.15	0.5	20.42	4.80	Clay	CL/CH	very stiff	125	16		80			1.20	>10
0.30	1.0	29.00	3.50	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		65			1.70	>10
0.45	1.5	26.32	4.47	Silty Clay to Clay	CL	very stiff	125	15		75			1.54	>10
0.60	2.0	16.30	8.05	Clay	CL/CH	stiff	125	13		100			0.95	>10
0.75	2.5	11.73	7.27	Clay	CL/CH	stiff	125	9		100			0.68	>10
0.93	3.0	13.11	6.38	Clay	CL/CH	stiff	125	10		100			0.76	>10
1.08	3.5	15.90	5.31	Clay	CL/CH	stiff	125	13		95			0.92	>10
1.23	4.0	19.06	4.01	Silty Clay to Clay	CL	very stiff	125	11		80			1.11	>10
1.38	4.5	11.11	6.65	Clay	CL/CH	stiff	125	9		100			0.64	>10
1.53	5.0	11.12	7.94	Clay	CL/CH	stiff	125	9		100			0.64	>10
1.68	5.5	11.66	9.50	Clay	CL/CH	stiff	125	9		100			0.67	>10
1.83	6.0	101.34	1.74	Silty Sand to Sandy Silt	SM/ML	dense	115	23	164.9	25	87	40		
1.98	6.5	139.98	1.36	Sand to Silty Sand	SP/SM	very dense	115	25	219.1	15	96	41		
2.13	7.0	149.58	1.30	Sand to Silty Sand	SP/SM	very dense	115	27	225.9	15	97	42		
2.28	7.5	116.42	1.46	Sand to Silty Sand	SP/SM	dense	115	21	170.0	20	88	40		
2.45	8.0	46.37	2.91	Sandy Silt to Clayey Silt	ML	medium dense	115	13	65.6	45	60	36		
2.60	8.5	13.23	5.39	Clay	CL/CH	stiff	125	11		100			0.75	>10
2.75	9.0	9.18	4.49	Clay	CL/CH	stiff	125	7		100			0.51	6.32
2.90	9.5	8.21	6.11	Clay	CL/CH	firm	125	7		100			0.45	5.10
3.05	10.0	14.44	7.01	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.20	10.5	44.52	2.44	Sandy Silt to Clayey Silt	ML	medium dense	115	13	58.5	45	57	36		
3.35	11.0	39.67	2.14	Sandy Silt to Clayey Silt	ML	medium dense	115	11	51.5	45	53	35		
3.50	11.5	15.19	4.62	Clay	CL/CH	stiff	125	12		100			0.86	>10
3.65	12.0	10.93	7.43	Clay	CL/CH	stiff	125	9		100			0.61	6.43
3.80	12.5	11.90	6.24	Clay	CL/CH	stiff	125	10		100			0.66	7.13
3.95	13.0	12.73	5.66	Clay	CL/CH	stiff	125	10		100			0.71	7.70
4.13	13.5	13.40	6.75	Clay	CL/CH	stiff	125	11		100			0.75	8.14
4.28	14.0	14.30	7.27	Clay	CL/CH	stiff	125	11		100			0.80	8.70
4.43	14.5	12.25	7.45	Clay	CL/CH	stiff	125	10		100			0.68	6.43
4.58	15.0	13.21	6.57	Clay	CL/CH	stiff	125	11		100			0.74	6.88
4.73	15.5	12.59	7.84	Clay	CL/CH	stiff	125	10		100			0.70	6.21
4.88	16.0	63.14	5.00	Overconsolidated Soil	??	medium dense	120	63	72.6	65	63	37		
5.03	16.5	101.49	2.53	Silty Sand to Sandy Silt	SM/ML	dense	115	23	115.5	35	77	39		
5.18	17.0	59.21	3.43	Sandy Silt to Clayey Silt	ML	medium dense	115	17	66.8	55	61	36		
5.33	17.5	41.54	4.06	Clayey Silt to Silty Clay	ML/CL	hard	120	17		70			2.40	>10
5.48	18.0	16.00	4.91	Clay	CL/CH	stiff	125	13		100			0.90	8.00
5.65	18.5	18.37	5.63	Clay	CL/CH	very stiff	125	15		100			1.03	>10
5.80	19.0	44.72	4.14	Clayey Silt to Silty Clay	ML/CL	hard	120	18		70			2.58	>10
5.95	19.5	33.54	3.90	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		80			1.92	>10
6.10	20.0	15.51	4.50	Clay	CL/CH	stiff	125	12		100			0.86	6.54
6.25	20.5	14.63	5.09	Clay	CL/CH	stiff	125	12		100			0.81	5.76
6.40	21.0	13.69	4.94	Clay	CL/CH	stiff	125	11		100			0.75	5.10
6.55	21.5	35.60	5.76	Clay	CL/CH	hard	125	28		90			2.04	>10
6.70	22.0	30.77	4.05	Silty Clay to Clay	CL	very stiff	125	18		85			1.76	>10
6.85	22.5	24.71	4.62	Clay	CL/CH	very stiff	125	20		100			1.40	>10
7.00	23.0	97.01	2.18	Silty Sand to Sandy Silt	SM/ML	dense	115	22	98.1	40	72	38		
7.18	23.5	42.54	3.54	Clayey Silt to Silty Clay	ML/CL	hard	120	17		70			2.45	>10
7.33	24.0	28.09	4.85	Clay	CL/CH	very stiff	125	22		95			1.60	>10
7.48	24.5	47.12	3.76	Clayey Silt to Silty Clay	ML/CL	hard	120	19		70			2.71	>10
7.63	25.0	25.20	4.10	Silty Clay to Clay	CL	very stiff	125	14		95			1.42	>10
7.78	25.5	19.85	5.27	Clay	CL/CH	very stiff	125	16		100			1.11	7.27
7.93	26.0	18.81	4.60	Clay	CL/CH	very stiff	125	15		100			1.05	6.54
8.08	26.5	18.97	5.12	Clay	CL/CH	very stiff	125	15		100			1.06	6.43
8.23	27.0	22.32	5.44	Clay	CL/CH	very stiff	125	18		100			1.25	8.27
8.38	27.5	16.24	4.11	Silty Clay to Clay	CL	stiff	125	9		100			0.89	6.21
8.53	28.0	17.23	5.67	Clay	CL/CH	stiff	125	14		100			0.95	5.10
8.68	28.5	16.12	5.31	Clay	CL/CH	stiff	125	13		100			0.88	4.47
8.85	29.0	13.06	4.17	Clay	CL/CH	stiff	125	10		100			0.70	3.21
9.00	29.5	14.99	4.59	Clay	CL/CH	stiff	125	12		100			0.82	3.83
9.15	30.0	13.07	3.91	Clay	CL/CH	stiff	125	10		100			0.70	3.14
9.30	30.5	16.78	5.15	Clay	CL/CH	stiff	125	13		100			0.92	4.37
9.45	31.0	18.12	5.14	Clay	CL/CH	stiff	125	14		100			1.00	4.89
9.60	31.5	39.93	4.01	Clayey Silt to Silty Clay	ML/CL	hard	120	16		85			2.28	>10
9.75	32.0	96.23	2.58	Silty Sand to Sandy Silt	SM/ML	medium dense	115	21	85.4	50	68	37		
9.90	32.5	131.32	2.46	Silty Sand to Sandy Silt	SM/ML	dense	115	29	115.9	40	77	39		
10.05	33.0	68.34	3.77	Clayey Silt to Silty Clay	ML/CL	hard	120	27		70			3.95	>10
10.20	33.5	61.90	4.07	Clayey Silt to Silty Clay	ML/CL	hard	120	25		75			3.57	>10
10.38	34.0	138.95	2.96	Sandy Silt to Clayey Silt	ML	dense	115	40	120.6	45	78	39		
10.53	34.5	44.08	3.81	Clayey Silt to Silty Clay	ML/CL	hard	120	18		85			2.52	>10
10.68	35.0	24.51	5.29	Clay	CL/CH	very stiff	125	20		100			1.37	6.76
10.83	35.5	106.10	3.89	Clayey Silt to Silty Clay	ML/CL	hard	120	42		60			6.16	>10
10.98	36.0	244.38	2.28	Silty Sand to Sandy Silt	SM/ML	very dense	115	54	207.4	30	94	41		
11.13	36.5	179.86	2.82	Silty Sand to Sandy Silt	SM/ML	dense	115	40	151.9	40	85	40		
11.28	37.0	114.59	3.52	Sandy Silt to Clayey Silt	ML	dense	115	33	96.3	55	71	38		
11.43	37.5	118.01	2.62	Silty Sand to Sandy Silt	SM/ML	dense	115	26	98.7	45	72	38		
11.58	38.0	182.13	2.31	Silty Sand to Sandy Silt	SM/ML	dense	115	40	151.6	35	85	40		
11.73	38.5	255.85	2.18	Silty Sand to Sandy Silt	SM/ML	very dense	115	57	211.9	30	95	41		

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-3
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	307.07	2.65	Silty Sand to Sandy Silt	SM/ML	very dense	115	68	253.1	30	100	42		
12.05	39.5	310.97	2.65	Sand to Clayey Sand	SP/SC	very dense	115	155	255.1	30	100	42		
12.20	40.0	302.17	2.68	Sand to Clayey Sand	SP/SC	very dense	115	151	246.8	30	99	42		
12.35	40.5	313.51	2.14	Sand to Silty Sand	SP/SM	very dense	115	57	254.8	25	100	42		
12.50	41.0	273.56	2.11	Sand to Silty Sand	SP/SM	very dense	115	50	221.4	30	96	41		
12.65	41.5	288.56	2.76	Sand to Clayey Sand	SP/SC	very dense	115	144	232.4	35	97	42		
12.80	42.0	350.50	2.07	Sand to Silty Sand	SP/SM	very dense	115	64	281.1	25	103	42		
12.95	42.5	277.90	2.24	Sand to Silty Sand	SP/SM	very dense	115	51	221.9	30	96	41		
13.10	43.0	121.37	4.38	Overconsolidated Soil	??	dense	120	121	96.5	60	71	38		
13.25	43.5	125.41	4.10	Overconsolidated Soil	??	dense	120	125	99.2	60	72	38		
13.40	44.0	141.65	4.42	Overconsolidated Soil	??	dense	120	142	111.5	60	76	39		
13.58	44.5	118.33	3.97	Overconsolidated Soil	??	dense	120	118	92.7	60	70	38		
13.73	45.0	196.23	2.83	Silty Sand to Sandy Silt	SM/ML	dense	115	44	153.0	40	85	40		
13.88	45.5	212.64	2.86	Silty Sand to Sandy Silt	SM/ML	dense	115	47	165.1	40	87	40		
14.03	46.0	137.80	4.31	Overconsolidated Soil	??	dense	120	138	106.6	60	74	38		
14.18	46.5	210.79	3.66	Sand to Clayey Sand	SP/SC	dense	115	105	162.3	45	87	40		
14.33	47.0	242.38	3.30	Sand to Clayey Sand	SP/SC	very dense	115	121	185.9	40	91	41		
14.48	47.5	345.01	1.26	Sand	SP	very dense	110	53	263.5	20	101	42		
14.63	48.0	284.45	1.29	Sand	SP	very dense	110	44	216.5	20	95	41		
14.78	48.5	283.65	0.87	Sand	SP	very dense	110	44	215.1	15	95	41		
14.93	49.0	280.32	0.73	Sand	SP	very dense	110	43	211.8	15	95	41		
15.10	49.5	155.14	1.18	Sand to Silty Sand	SP/SM	dense	115	28	116.8	30	77	39		
15.25	50.0	36.35	3.13	Clayey Silt to Silty Clay	ML/CL	hard	120	15		95			2.04	>10

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

DATE: 8/13/2018

CONE SOUNDING DATA CPT-4

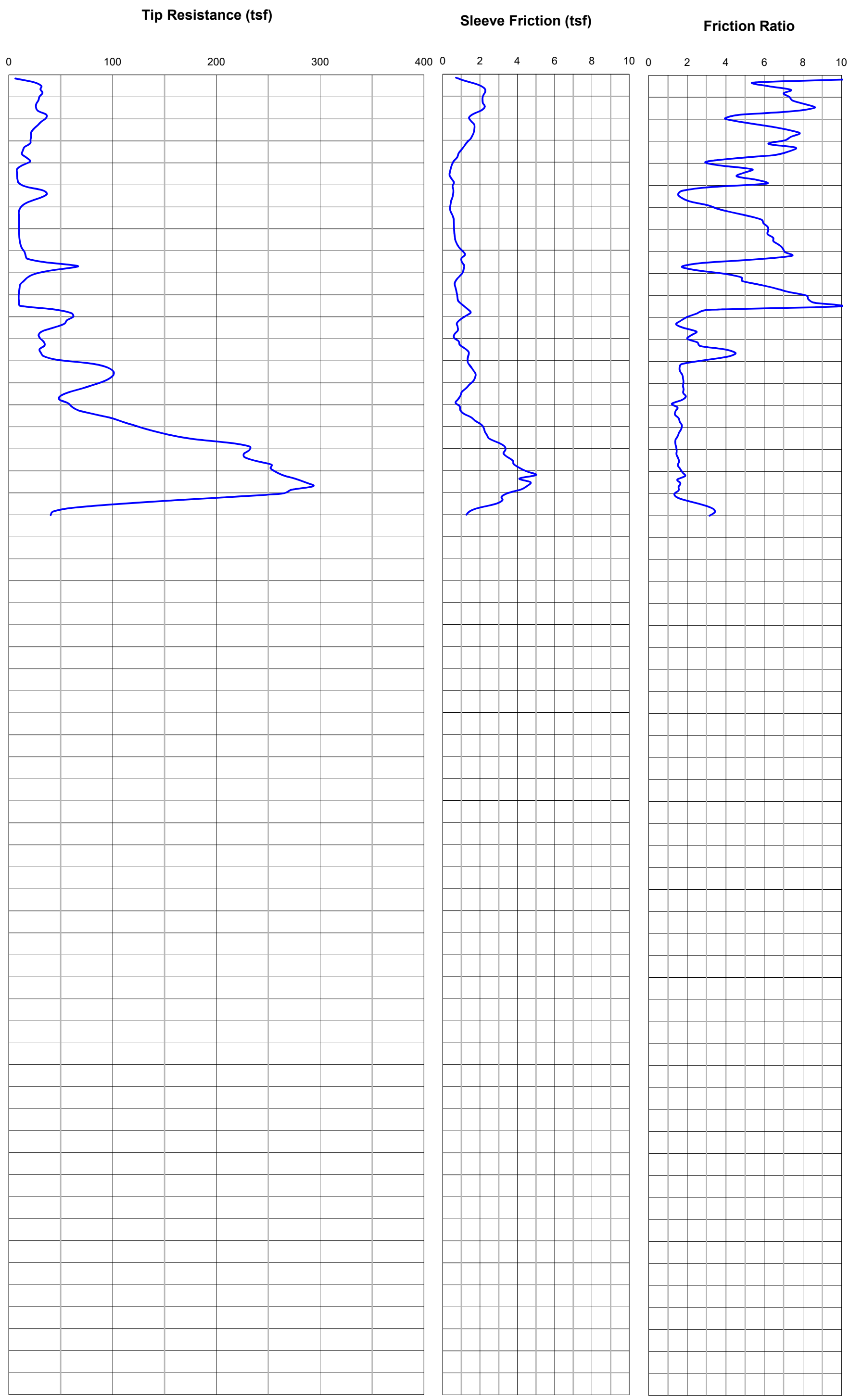
DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

5 10 15 20 25 30 35 40 45 50 55



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-4

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-4
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)
Nk: **17**

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	Phi (deg.)	Su (tsf)	OCR
0.15	0.5	20.41	7.65	Clay	CL/CH	very stiff	125	16		100			1.20	>10
0.30	1.0	30.82	7.22	Clay	CL/CH	very stiff	125	25		85			1.81	>10
0.45	1.5	27.09	8.06	Clay	CL/CH	very stiff	125	22		90			1.59	>10
0.60	2.0	33.31	5.30	Clay	CL/CH	very stiff	125	27		70			1.95	>10
0.75	2.5	27.50	6.04	Clay	CL/CH	very stiff	125	22		80			1.61	>10
0.93	3.0	21.26	7.43	Clay	CL/CH	very stiff	125	17		95			1.24	>10
1.08	3.5	16.37	7.03	Clay	CL/CH	stiff	125	13		100			0.95	>10
1.23	4.0	16.86	4.69	Clay	CL/CH	stiff	125	13		90			0.98	>10
1.38	4.5	9.74	4.67	Clay	CL/CH	stiff	125	8		100			0.56	>10
1.53	5.0	8.72	5.44	Clay	CL/CH	firm	125	7		100			0.50	>10
1.68	5.5	29.27	2.02	Sandy Silt to Clayey Silt	ML	medium dense	115	8	49.8	50	52	35		
1.83	6.0	15.16	2.94	Clayey Silt to Silty Clay	ML/CL	stiff	120	6		80			0.87	>10
1.98	6.5	9.79	5.14	Clay	CL/CH	stiff	125	8		100			0.55	>10
2.13	7.0	9.84	6.11	Clay	CL/CH	stiff	125	8		100			0.55	>10
2.28	7.5	10.19	6.36	Clay	CL/CH	stiff	125	8		100			0.57	9.39
2.45	8.0	12.94	6.93	Clay	CL/CH	stiff	125	10		100			0.73	>10
2.60	8.5	23.92	5.23	Clay	CL/CH	very stiff	125	19		80			1.38	>10
2.75	9.0	46.16	2.72	Sandy Silt to Clayey Silt	ML	medium dense	115	13	62.8	45	59	36		
2.90	9.5	14.87	5.14	Clay	CL/CH	stiff	125	12		100			0.84	>10
3.05	10.0	9.92	7.33	Clay	CL/CH	stiff	125	8		100			0.55	6.43
3.20	10.5	10.14	8.92	Clay	CL/CH	stiff	125	8		100			0.56	6.32
3.35	11.0	55.28	2.49	Sandy Silt to Clayey Silt	ML	medium dense	115	16	71.1	45	62	37		
3.50	11.5	50.96	1.64	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	64.8	35	60	36		
3.65	12.0	30.48	2.23	Sandy Silt to Clayey Silt	ML	medium dense	115	9	38.3	55	44	34		
3.80	12.5	32.57	3.07	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		65			1.88	>10
3.95	13.0	37.52	3.78	Clayey Silt to Silty Clay	ML/CL	hard	120	15		65			2.17	>10
4.13	13.5	91.35	1.64	Silty Sand to Sandy Silt	SM/ML	dense	115	20	111.1	30	76	39		
4.28	14.0	96.41	1.77	Silty Sand to Sandy Silt	SM/ML	dense	115	21	116.1	30	77	39		
4.43	14.5	68.84	1.79	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	82.1	35	67	37		
4.58	15.0	51.88	1.60	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	61.2	40	58	36		
4.73	15.5	69.98	1.42	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	81.8	30	67	37		
4.88	16.0	113.96	1.64	Sand to Silty Sand	SP/SM	dense	115	21	132.0	25	81	39		
5.03	16.5	160.88	1.49	Sand to Silty Sand	SP/SM	very dense	115	29	184.6	20	91	41		
5.18	17.0	225.87	1.42	Sand to Silty Sand	SP/SM	very dense	115	41	256.8	15	100	42		
5.33	17.5	230.74	1.51	Sand to Silty Sand	SP/SM	very dense	115	42	260.0	15	101	42		
5.48	18.0	254.09	1.63	Sand to Silty Sand	SP/SM	very dense	115	46	283.9	15	103	42		
5.65	18.5	276.04	1.67	Sand to Silty Sand	SP/SM	very dense	115	50	305.7	15	105	43		
5.80	19.0	276.31	1.47	Sand to Silty Sand	SP/SM	very dense	115	50	303.5	15	105	43		
5.95	19.5	155.40	2.13	Silty Sand to Sandy Silt	SM/ML	dense	115	35	169.2	30	88	40		
6.10	20.0	47.84	3.30	Clayey Silt to Silty Clay	ML/CL	hard	120	19		60			2.77	>10

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2018

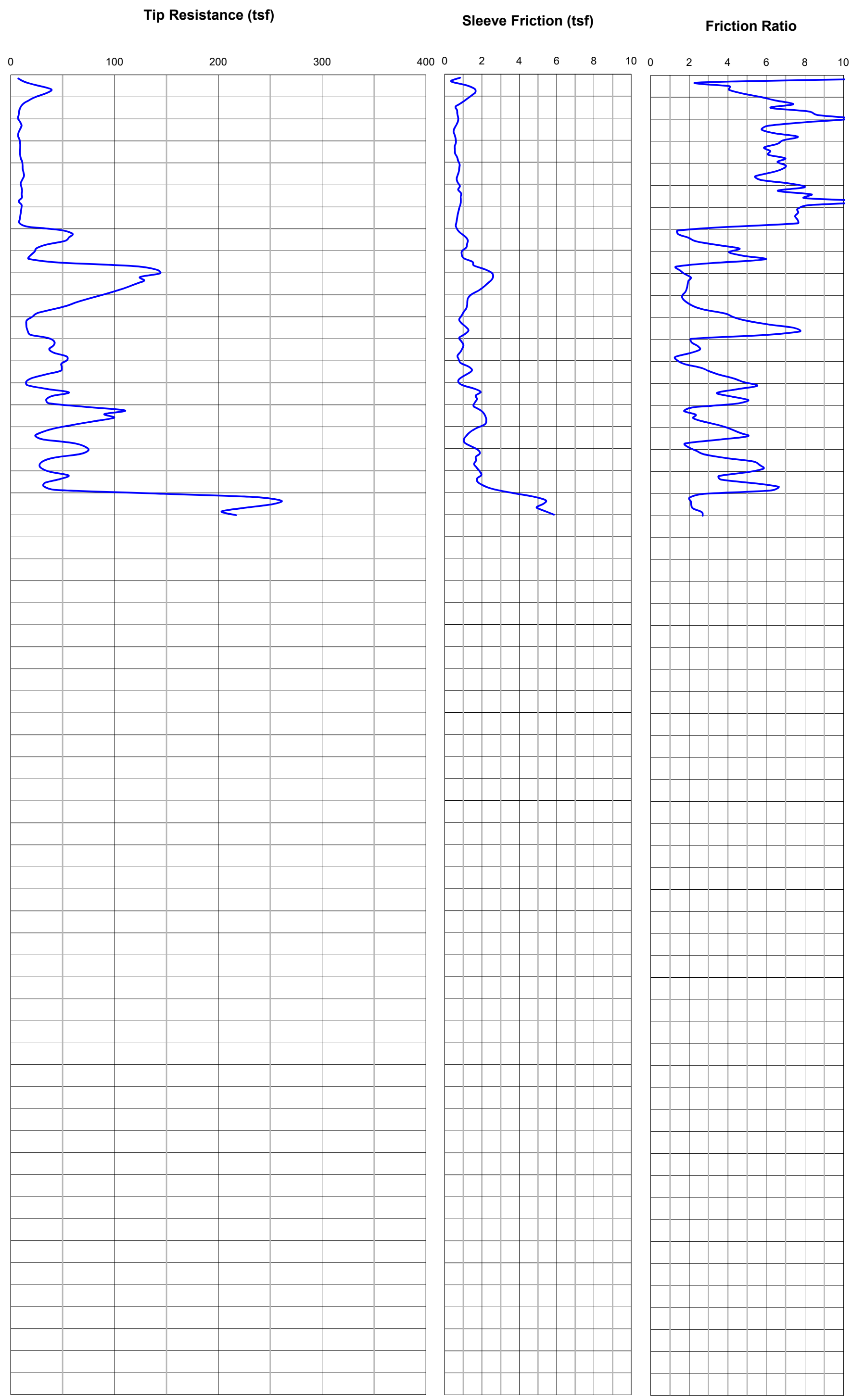
CONE SOUNDING DATA CPT-5

DEPTH: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK Geo-Engineers and Geologists

PLATE
B-5

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-5
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	16.01	5.95	Clay	CL/CH	stiff	125	13		95			0.94	>10
0.30	1.0	32.89	4.83	Silty Clay to Clay	CL	very stiff	125	19		70			1.93	>10
0.45	1.5	13.05	6.70	Clay	CL/CH	stiff	125	10		100			0.76	>10
0.60	2.0	7.61	9.06	Clay	CL/CH	firm	125	6		100			0.44	>10
0.75	2.5	9.43	6.60	Clay	CL/CH	stiff	125	8		100			0.55	>10
0.93	3.0	7.72	6.95	Clay	CL/CH	firm	125	6		100			0.44	>10
1.08	3.5	9.03	6.22	Clay	CL/CH	stiff	125	7		100			0.52	>10
1.23	4.0	9.87	6.55	Clay	CL/CH	stiff	125	8		100			0.57	>10
1.38	4.5	11.70	6.67	Clay	CL/CH	stiff	125	9		100			0.67	>10
1.53	5.0	11.19	6.13	Clay	CL/CH	stiff	125	9		100			0.64	>10
1.68	5.5	10.59	7.72	Clay	CL/CH	stiff	125	8		100			0.60	>10
1.83	6.0	9.43	9.02	Clay	CL/CH	stiff	125	8		100			0.53	>10
1.98	6.5	9.19	7.58	Clay	CL/CH	stiff	125	7		100			0.52	>10
2.13	7.0	23.81	4.34	Silty Clay to Clay	CL	very stiff	125	14		75			1.38	>10
2.28	7.5	56.01	1.91	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	81.0	35	66	37		
2.45	8.0	27.59	4.04	Silty Clay to Clay	CL	very stiff	125	16		70			1.59	>10
2.60	8.5	27.66	4.65	Clay	CL/CH	very stiff	125	22		75			1.60	>10
2.75	9.0	134.74	1.52	Sand to Silty Sand	SP/SM	very dense	115	24	183.1	20	90	41		
2.90	9.5	124.25	1.98	Silty Sand to Sandy Silt	SM/ML	dense	115	28	166.7	25	88	40		
3.05	10.0	99.39	1.77	Silty Sand to Sandy Silt	SM/ML	dense	115	22	131.7	25	81	39		
3.20	10.5	64.04	1.94	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	83.8	35	67	37		
3.35	11.0	28.84	3.67	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		70			1.66	>10
3.50	11.5	15.22	6.19	Clay	CL/CH	stiff	125	12		100			0.86	>10
3.65	12.0	24.18	5.17	Clay	CL/CH	very stiff	125	19		85			1.39	>10
3.80	12.5	40.08	2.37	Sandy Silt to Clayey Silt	ML	medium dense	115	11	49.9	50	52	35		
3.95	13.0	49.84	1.56	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	61.4	40	58	36		
4.13	13.5	48.71	2.46	Sandy Silt to Clayey Silt	ML	medium dense	115	14	59.4	50	57	36		
4.28	14.0	23.13	4.25	Silty Clay to Clay	CL	very stiff	125	13		85			1.32	>10
4.43	14.5	35.42	4.46	Silty Clay to Clay	CL	hard	125	20		75			2.04	>10
4.58	15.0	36.76	4.56	Silty Clay to Clay	CL	hard	125	21		75			2.12	>10
4.73	15.5	90.83	2.07	Silty Sand to Sandy Silt	SM/ML	dense	115	20	105.8	35	74	38		
4.88	16.0	70.15	3.18	Sandy Silt to Clayey Silt	ML	medium dense	115	20	80.9	50	66	37		
5.03	16.5	28.11	4.34	Silty Clay to Clay	CL	very stiff	125	16		85			1.61	>10
5.18	17.0	68.65	2.02	Silty Sand to Sandy Silt	SM/ML	medium dense	115	15	77.7	40	65	37		
5.33	17.5	47.59	3.99	Clayey Silt to Silty Clay	ML/CL	hard	120	19		65			2.76	>10
5.48	18.0	31.70	5.48	Clay	CL/CH	very stiff	125	25		90			1.82	>10
5.65	18.5	45.46	4.18	Clayey Silt to Silty Clay	ML/CL	hard	120	18		70			2.63	>10
5.80	19.0	70.69	5.18	Overconsolidated Soil	??	medium dense	120	71	77.0	65	65	37		
5.95	19.5	249.53	2.06	Sand to Silty Sand	SP/SM	very dense	115	45	269.5	20	102	42		
6.10	20.0	214.96	2.51	Silty Sand to Sandy Silt	SM/ML	very dense	115	48	230.3	25	97	42		

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2018

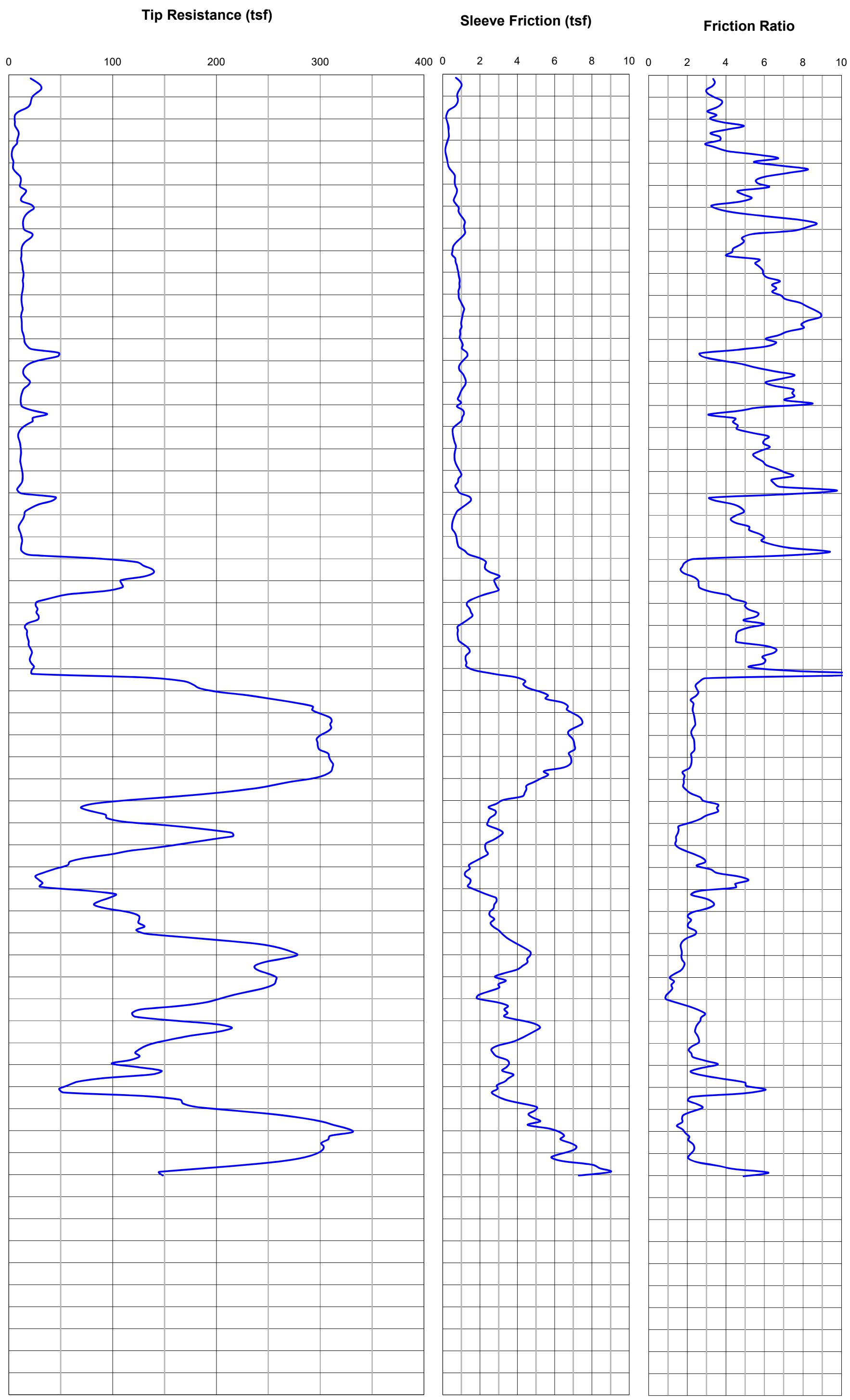
CONE SOUNDING DATA CPT-6

DEPTH: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Clay to Clay	CL	stiff
Clay	CL/CH	firm
Clay	" "	soft
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	very stiff
Silty Sand to Sandy Silt	SM/ML	dense
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	very stiff
Clay	" "	stiff
Clay	" "	very stiff
Overconsolidated Soil	??	dense
Silty Sand to Sandy Silt	SM/ML	very dense
Silty Sand to Sandy Silt	" "	very dense
Silty Sand to Sandy Silt	" "	very dense
Sand to Silty Sand	SP/SM	very dense
Silty Sand to Sandy Silt	SM/ML	dense
Sandy Silt to Clayey Silt	ML	medium dense
Sand to Silty Sand	SP/SM	dense
Silty Sand to Sandy Silt	SM/ML	medium dense
Clayey Silt to Silty Clay	ML/CL	hard
Sandy Silt to Clayey Silt	ML	medium dense
Silty Sand to Sandy Silt	SM/ML	dense
Sand to Silty Sand	SP/SM	very dense
Sand to Silty Sand	" "	very dense
Sand	SP	very dense
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	dense
Silty Sand to Sandy Silt	" "	dense
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	dense
Sand to Silty Sand	SP/SM	very dense
Sand to Silty Sand	" "	very dense
Sand to Clayey Sand	SP/SC	dense



END OF SOUNDING AT 50 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-6

LANDMARK CONSULTANTS, INC.

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-6
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	26.22	3.36	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		65			1.54	>10
0.30	1.0	26.92	3.14	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		60			1.58	>10
0.45	1.5	20.10	3.67	Silty Clay to Clay	CL	very stiff	125	11		75			1.18	>10
0.60	2.0	7.48	3.25	Clay	CL/CH	firm	125	6		100			0.43	>10
0.75	2.5	6.49	4.28	Clay	CL/CH	firm	125	5		100			0.37	>10
0.93	3.0	8.87	3.52	Clay	CL/CH	stiff	125	7		100			0.51	>10
1.08	3.5	5.28	3.50	Clay	CL/CH	firm	125	4		100			0.30	>10
1.23	4.0	3.45	5.95	Clay	CL/CH	soft	125	3		100			0.19	4.57
1.38	4.5	5.07	7.44	Clay	CL/CH	firm	125	4		100			0.28	6.88
1.53	5.0	11.12	5.79	Clay	CL/CH	stiff	125	9		100			0.64	>10
1.68	5.5	13.68	5.27	Clay	CL/CH	stiff	125	11		100			0.79	>10
1.83	6.0	19.40	3.86	Silty Clay to Clay	CL	very stiff	125	11		80			1.12	>10
1.98	6.5	16.33	6.07	Clay	CL/CH	stiff	125	13		100			0.94	>10
2.13	7.0	14.30	8.18	Clay	CL/CH	stiff	125	11		100			0.82	>10
2.28	7.5	20.35	5.03	Clay	CL/CH	very stiff	125	16		85			1.17	>10
2.45	8.0	12.73	4.47	Clay	CL/CH	stiff	125	10		95			0.72	>10
2.60	8.5	12.13	5.09	Clay	CL/CH	stiff	125	10		100			0.68	>10
2.75	9.0	13.59	5.86	Clay	CL/CH	stiff	125	11		100			0.77	>10
2.90	9.5	13.75	6.45	Clay	CL/CH	stiff	125	11		100			0.78	>10
3.05	10.0	13.06	6.63	Clay	CL/CH	stiff	125	10		100			0.74	>10
3.20	10.5	12.45	7.71	Clay	CL/CH	stiff	125	10		100			0.70	9.00
3.35	11.0	12.49	8.81	Clay	CL/CH	stiff	125	10		100			0.70	8.56
3.50	11.5	12.46	8.06	Clay	CL/CH	stiff	125	10		100			0.70	8.14
3.65	12.0	13.92	6.66	Clay	CL/CH	stiff	125	11		100			0.78	9.59
3.80	12.5	18.17	5.83	Clay	CL/CH	very stiff	125	15		100			1.03	>10
3.95	13.0	41.85	3.08	Sandy Silt to Clayey Silt	ML	medium dense	115	12	51.0	55	53	35		
4.13	13.5	16.52	5.64	Clay	CL/CH	stiff	125	13		100			0.93	>10
4.28	14.0	17.19	6.85	Clay	CL/CH	stiff	125	14		100			0.97	>10
4.43	14.5	15.27	7.14	Clay	CL/CH	stiff	125	12		100			0.86	9.00
4.58	15.0	11.63	7.69	Clay	CL/CH	stiff	125	9		100			0.64	5.42
4.73	15.5	24.39	4.48	Silty Clay to Clay	CL	very stiff	125	14		90			1.39	>10
4.88	16.0	18.80	4.51	Clay	CL/CH	very stiff	125	15		100			1.06	>10
5.03	16.5	9.52	5.84	Clay	CL/CH	stiff	125	8		100			0.52	3.58
5.18	17.0	11.21	6.01	Clay	CL/CH	stiff	125	9		100			0.61	4.47
5.33	17.5	11.31	5.64	Clay	CL/CH	stiff	125	9		100			0.62	4.37
5.48	18.0	12.32	6.60	Clay	CL/CH	stiff	125	10		100			0.68	4.89
5.65	18.5	13.02	6.79	Clay	CL/CH	stiff	125	10		100			0.72	5.21
5.80	19.0	10.09	8.00	Clay	CL/CH	stiff	125	8		100			0.55	3.43
5.95	19.5	38.62	3.75	Clayey Silt to Silty Clay	ML/CL	hard	120	15		75			2.22	>10
6.10	20.0	17.43	4.75	Clay	CL/CH	stiff	125	14		100			0.97	7.70
6.25	20.5	11.63	4.66	Clay	CL/CH	stiff	125	9		100			0.63	3.83
6.40	21.0	11.08	5.64	Clay	CL/CH	stiff	125	9		100			0.60	3.50
6.55	21.5	12.34	6.56	Clay	CL/CH	stiff	125	10		100			0.67	4.00
6.70	22.0	38.84	6.31	Clay	CL/CH	hard	125	31		90			2.23	>10
6.85	22.5	130.21	1.76	Silty Sand to Sandy Silt	SM/ML	dense	115	29	131.2	30	81	39		
7.00	23.0	125.94	2.25	Silty Sand to Sandy Silt	SM/ML	dense	115	28	126.0	35	79	39		
7.18	23.5	103.87	2.81	Sandy Silt to Clayey Silt	ML	dense	115	30	103.2	45	73	38		
7.33	24.0	41.37	4.49	Silty Clay to Clay	CL	hard	125	24		80			2.38	>10
7.48	24.5	26.71	5.29	Clay	CL/CH	very stiff	125	21		100			1.51	>10
7.63	25.0	24.80	5.48	Clay	CL/CH	very stiff	125	20		100			1.40	>10
7.78	25.5	16.74	4.79	Clay	CL/CH	stiff	125	13		100			0.92	5.31
7.93	26.0	18.76	5.03	Clay	CL/CH	very stiff	125	15		100			1.04	6.32
8.08	26.5	21.13	6.26	Clay	CL/CH	very stiff	125	17		100			1.18	7.41
8.23	27.0	22.57	6.22	Clay	CL/CH	very stiff	125	18		100			1.27	8.27
8.38	27.5	107.45	5.77	Overconsolidated Soil	??	dense	120	107	100.5	65	73	38		
8.53	28.0	187.92	2.50	Silty Sand to Sandy Silt	SM/ML	dense	115	42	174.7	35	89	40		
8.68	28.5	254.27	2.31	Silty Sand to Sandy Silt	SM/ML	very dense	115	57	234.9	25	98	42		
8.85	29.0	294.93	2.30	Silty Sand to Sandy Silt	SM/ML	very dense	115	66	270.9	25	102	42		
9.00	29.5	309.88	2.39	Silty Sand to Sandy Silt	SM/ML	very dense	115	69	283.0	25	103	42		
9.15	30.0	305.85	2.24	Sand to Silty Sand	SP/SM	very dense	115	56	277.7	25	103	42		
9.30	30.5	297.26	2.36	Silty Sand to Sandy Silt	SM/ML	very dense	115	66	268.3	25	102	42		
9.45	31.0	305.11	2.26	Silty Sand to Sandy Silt	SM/ML	very dense	115	68	273.9	25	102	42		
9.60	31.5	311.36	2.17	Sand to Silty Sand	SP/SM	very dense	115	57	277.9	25	103	42		
9.75	32.0	302.45	1.81	Sand to Silty Sand	SP/SM	very dense	115	55	268.5	20	102	42		
9.90	32.5	250.37	1.85	Sand to Silty Sand	SP/SM	very dense	115	46	221.1	25	96	41		
10.05	33.0	157.89	2.57	Silty Sand to Sandy Silt	SM/ML	dense	115	35	138.7	40	82	39		
10.20	33.5	76.36	3.57	Sandy Silt to Clayey Silt	ML	medium dense	115	22	66.7	65	61	36		
10.38	34.0	99.79	2.62	Silty Sand to Sandy Silt	SM/ML	medium dense	115	22	86.7	50	68	38		
10.53	34.5	185.20	1.54	Sand to Silty Sand	SP/SM	dense	115	34	160.1	25	86	40		
10.68	35.0	192.27	1.40	Sand to Silty Sand	SP/SM	dense	115	35	165.3	25	87	40		
10.83	35.5	120.59	2.00	Silty Sand to Sandy Silt	SM/ML	dense	115	27	103.2	40	73	38		
10.98	36.0	63.17	2.75	Sandy Silt to Clayey Silt	ML	medium dense	115	18	53.8	65	54	36		
11.13	36.5	33.37	4.16	Silty Clay to Clay	CL	very stiff	125	19		100			1.89	>10
11.28	37.0	44.68	3.85	Clayey Silt to Silty Clay	ML/CL	hard	120	18		85			2.55	>10
11.43	37.5	95.68	2.80	Sandy Silt to Clayey Silt	ML	medium dense	115	27	80.1	55	66	37		
11.58	38.0	97.03	2.82	Sandy Silt to Clayey Silt	ML	medium dense	115	28	80.9	55	66	37		
11.73	38.5	125.17	2.09	Silty Sand to Sandy Silt	SM/ML	dense	115	28	103.8	40	74	38		

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-6
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
11.88	39.0	128.43	2.29	Silty Sand to Sandy Silt	SM/ML	dense	115	29	106.0	45	74	38		
12.05	39.5	208.83	1.80	Sand to Silty Sand	SP/SM	dense	115	38	171.6	30	88	40		
12.20	40.0	270.40	1.70	Sand to Silty Sand	SP/SM	very dense	115	49	221.1	25	96	41		
12.35	40.5	247.82	1.80	Sand to Silty Sand	SP/SM	very dense	115	45	201.7	25	93	41		
12.50	41.0	248.51	1.35	Sand to Silty Sand	SP/SM	very dense	115	45	201.4	20	93	41		
12.65	41.5	253.23	1.24	Sand	SP	very dense	110	39	204.3	20	94	41		
12.80	42.0	217.18	0.96	Sand	SP	dense	110	33	174.5	20	89	40		
12.95	42.5	160.55	2.08	Silty Sand to Sandy Silt	SM/ML	dense	115	36	128.4	35	80	39		
13.10	43.0	131.96	2.77	Silty Sand to Sandy Silt	SM/ML	dense	115	29	105.1	50	74	38		
13.25	43.5	205.82	2.45	Silty Sand to Sandy Silt	SM/ML	dense	115	46	163.2	35	87	40		
13.40	44.0	162.57	2.57	Silty Sand to Sandy Silt	SM/ML	dense	115	36	128.4	40	80	39		
13.58	44.5	126.84	2.18	Silty Sand to Sandy Silt	SM/ML	dense	115	28	99.7	45	72	38		
13.73	45.0	114.09	2.94	Sandy Silt to Clayey Silt	ML	medium dense	115	33	89.3	55	69	38		
13.88	45.5	136.72	2.55	Silty Sand to Sandy Silt	SM/ML	dense	115	30	106.6	45	74	38		
14.03	46.0	72.12	4.62	Silty Clay to Clay	CL	hard	125	41		80			4.15	>10
14.18	46.5	77.39	4.42	Clayey Silt to Silty Clay	ML/CL	hard	120	31		75			4.46	>10
14.33	47.0	182.15	2.40	Silty Sand to Sandy Silt	SM/ML	dense	115	40	140.1	40	82	40		
14.48	47.5	278.37	1.76	Sand to Silty Sand	SP/SM	very dense	115	51	213.2	25	95	41		
14.63	48.0	323.18	1.70	Sand to Silty Sand	SP/SM	very dense	115	59	246.5	25	99	42		
14.78	48.5	306.21	2.14	Sand to Silty Sand	SP/SM	very dense	115	56	232.6	30	97	42		
14.93	49.0	300.45	2.27	Silty Sand to Sandy Silt	SM/ML	very dense	115	67	227.3	30	97	42		
15.10	49.5	259.29	2.65	Silty Sand to Sandy Silt	SM/ML	very dense	115	58	195.4	35	92	41		
15.25	50.0	161.26	5.18	Overconsolidated Soil	??	dense	120	161	121.0	65	78	39		

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

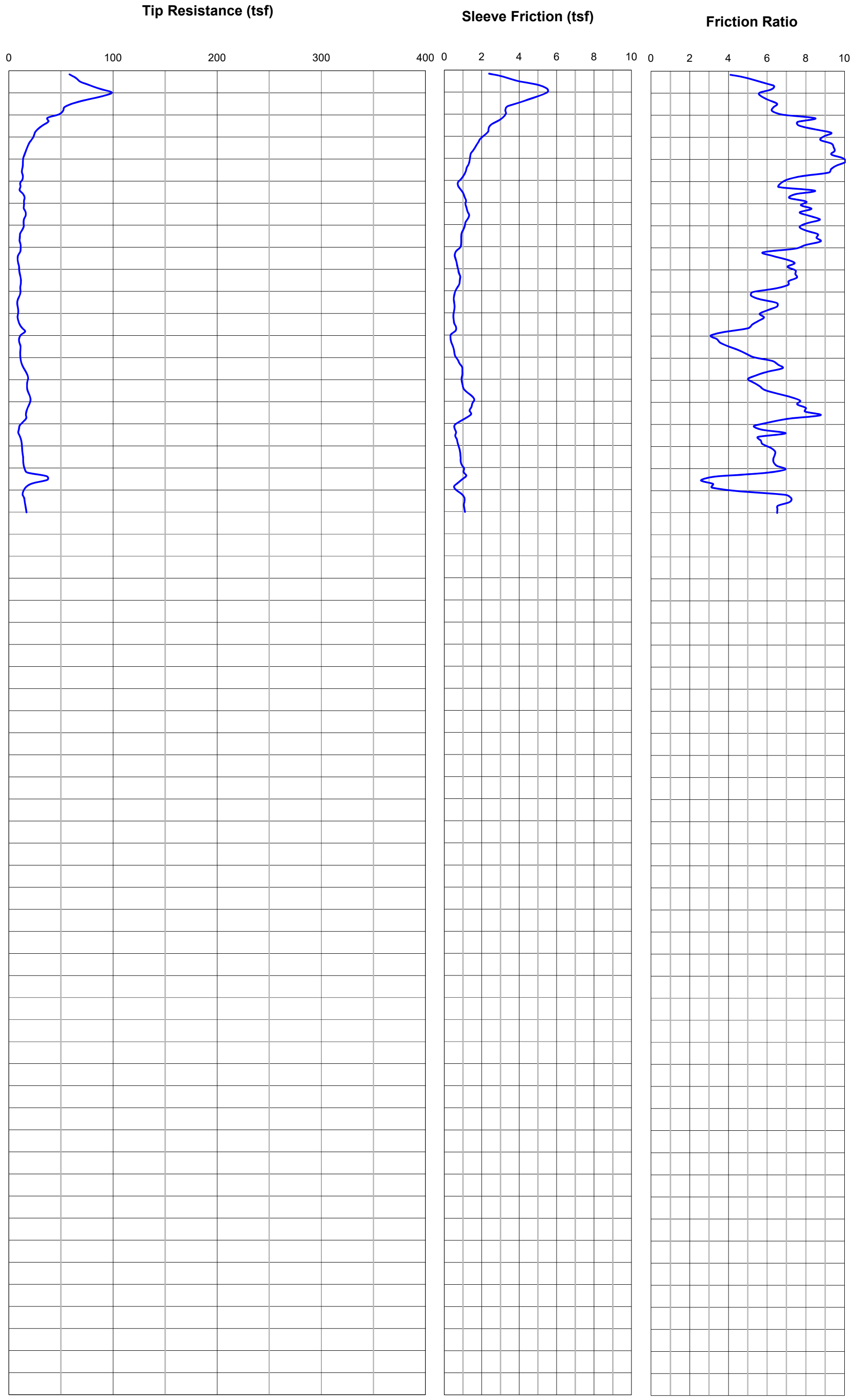
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-7

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-		
Overconsolidated Soil	??	very dense
Overconsolidated Soil	" "	very dense
Clay	CL/CH	very stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clayey Silt to Silty Clay	ML/CL	very stiff
Clay	CL/CH	stiff



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-7

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-7
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	63.75	4.95	Overconsolidated Soil	??	very dense	120	64	120.5	55	120	45		
0.30	1.0	88.04	6.06	Overconsolidated Soil	??	very dense	120	88	166.4	55	114	44		
0.45	1.5	75.47	6.11	Overconsolidated Soil	??	very dense	120	75	142.7	55	102	42		
0.60	2.0	51.35	6.46	Clay	CL/CH	hard	125	41		65			3.01	>10
0.75	2.5	36.02	7.90	Clay	CL/CH	hard	125	29		85			2.11	>10
0.93	3.0	25.78	8.89	Clay	CL/CH	very stiff	125	21		95			1.51	>10
1.08	3.5	19.73	9.18	Clay	CL/CH	very stiff	125	16		100			1.15	>10
1.23	4.0	15.23	9.57	Clay	CL/CH	stiff	125	12		100			0.88	>10
1.38	4.5	13.25	9.67	Clay	CL/CH	stiff	125	11		100			0.76	>10
1.53	5.0	12.99	7.99	Clay	CL/CH	stiff	125	10		100			0.75	>10
1.68	5.5	11.50	7.30	Clay	CL/CH	stiff	125	9		100			0.66	>10
1.83	6.0	14.71	7.64	Clay	CL/CH	stiff	125	12		100			0.84	>10
1.98	6.5	15.48	8.07	Clay	CL/CH	stiff	125	12		100			0.89	>10
2.13	7.0	14.28	8.15	Clay	CL/CH	stiff	125	11		100			0.82	>10
2.28	7.5	11.37	8.39	Clay	CL/CH	stiff	125	9		100			0.64	>10
2.45	8.0	10.96	8.07	Clay	CL/CH	stiff	125	9		100			0.62	9.59
2.60	8.5	9.38	6.35	Clay	CL/CH	stiff	125	8		100			0.52	6.65
2.75	9.0	9.48	7.31	Clay	CL/CH	stiff	125	8		100			0.53	6.54
2.90	9.5	11.10	7.37	Clay	CL/CH	stiff	125	9		100			0.62	8.14
3.05	10.0	11.16	6.26	Clay	CL/CH	stiff	125	9		100			0.62	7.70
3.20	10.5	9.13	5.77	Clay	CL/CH	stiff	125	7		100			0.50	5.31
3.35	11.0	8.71	6.05	Clay	CL/CH	firm	125	7		100			0.48	4.68
3.50	11.5	9.20	5.53	Clay	CL/CH	stiff	125	7		100			0.51	4.89
3.65	12.0	13.19	3.97	Clay	CL/CH	stiff	125	11		100			0.74	8.70
3.80	12.5	10.33	3.66	Clay	CL/CH	stiff	125	8		100			0.57	5.42
3.95	13.0	11.00	4.91	Clay	CL/CH	stiff	125	9		100			0.61	5.76
4.13	13.5	12.61	6.54	Clay	CL/CH	stiff	125	10		100			0.70	7.00
4.28	14.0	17.43	5.49	Clay	CL/CH	stiff	125	14		100			0.99	>10
4.43	14.5	17.58	5.59	Clay	CL/CH	stiff	125	14		100			0.99	>10
4.58	15.0	19.99	7.14	Clay	CL/CH	very stiff	125	16		100			1.13	>10
4.73	15.5	18.29	7.84	Clay	CL/CH	very stiff	125	15		100			1.03	>10
4.88	16.0	14.27	6.81	Clay	CL/CH	stiff	125	11		100			0.80	7.00
5.03	16.5	9.75	6.07	Clay	CL/CH	stiff	125	8		100			0.53	3.74
5.18	17.0	12.26	5.87	Clay	CL/CH	stiff	125	10		100			0.68	5.21
5.33	17.5	13.33	6.38	Clay	CL/CH	stiff	125	11		100			0.74	5.76
5.48	18.0	14.41	6.60	Clay	CL/CH	stiff	125	12		100			0.80	6.32
5.65	18.5	30.36	3.87	Clayey Silt to Silty Clay	ML/CL	very stiff	120	12		80			1.74	>10
5.80	19.0	17.70	3.64	Silty Clay to Clay	CL	stiff	125	10		100			0.99	>10
5.95	19.5	14.31	7.12	Clay	CL/CH	stiff	125	11		100			0.79	5.65
6.10	20.0	16.39	6.54	Clay	CL/CH	stiff	125	13		100			0.91	6.88

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric
Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2018

CONE SOUNDING DATA CPT-8

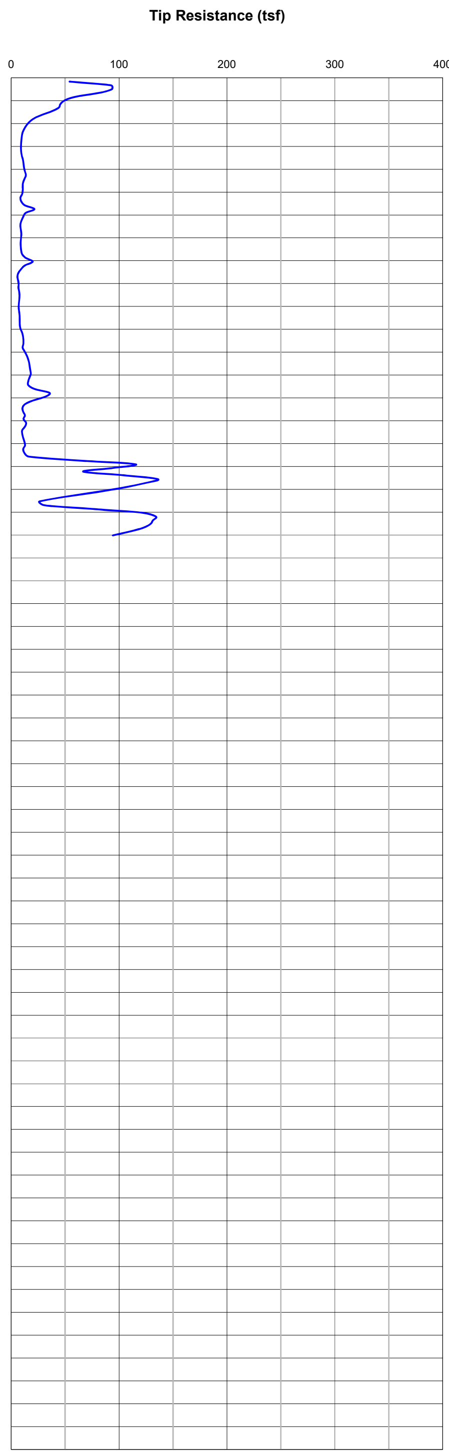
DEPTH

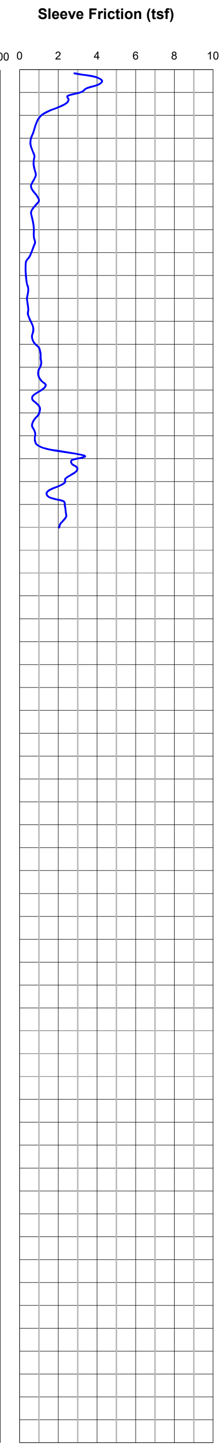
5 10 15 20 25 30 35 40 45 50 55

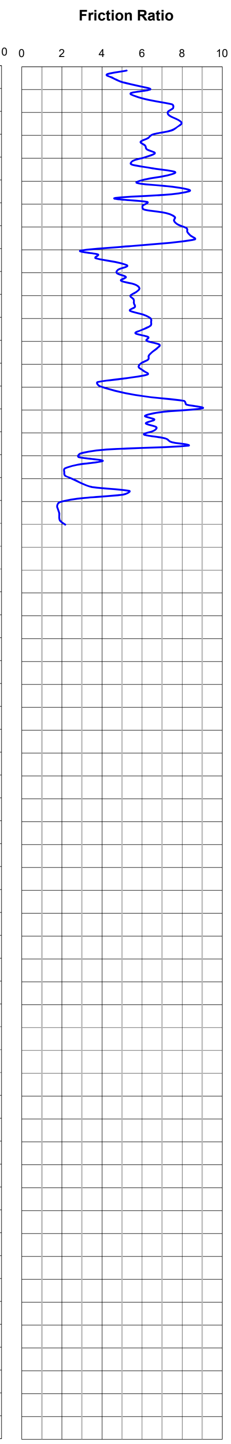
INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Overconsolidated Soil	??	very dense
Clay	CL/CH	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	firm
Clay	" "	firm
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	hard
Silty Sand to Sandy Silt	SM/ML	dense
Clayey Silt to Silty Clay	ML/CL	hard
Silty Sand to Sandy Silt	SM/ML	dense







END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-8

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-8
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	80.09	4.68	Overconsolidated Soil	??	very dense	120	80	151.4	50	127	46		
0.30	1.0	63.94	5.71	Overconsolidated Soil	??	very dense	120	64	120.9	60	104	43		
0.45	1.5	42.22	5.90	Clay	CL/CH	hard	125	34		70			2.48	>10
0.60	2.0	21.10	7.45	Clay	CL/CH	very stiff	125	17		95			1.23	>10
0.75	2.5	11.64	7.70	Clay	CL/CH	stiff	125	9		100			0.68	>10
0.93	3.0	9.38	7.25	Clay	CL/CH	stiff	125	8		100			0.54	>10
1.08	3.5	9.50	6.13	Clay	CL/CH	stiff	125	8		100			0.55	>10
1.23	4.0	11.47	6.36	Clay	CL/CH	stiff	125	9		100			0.66	>10
1.38	4.5	12.93	5.83	Clay	CL/CH	stiff	125	10		100			0.74	>10
1.53	5.0	10.80	7.01	Clay	CL/CH	stiff	125	9		100			0.62	>10
1.68	5.5	10.21	7.28	Clay	CL/CH	stiff	125	8		100			0.58	>10
1.83	6.0	15.45	5.63	Clay	CL/CH	stiff	125	12		95			0.89	>10
1.98	6.5	8.97	6.98	Clay	CL/CH	stiff	125	7		100			0.51	9.79
2.13	7.0	9.20	7.87	Clay	CL/CH	stiff	125	7		100			0.52	8.70
2.28	7.5	8.97	8.44	Clay	CL/CH	stiff	125	7		100			0.50	7.27
2.45	8.0	14.49	5.01	Clay	CL/CH	stiff	125	12		95			0.82	>10
2.60	8.5	9.58	4.04	Clay	CL/CH	stiff	125	8		100			0.53	6.88
2.75	9.0	6.37	4.95	Clay	CL/CH	firm	125	5		100			0.34	3.50
2.90	9.5	7.28	5.26	Clay	CL/CH	firm	125	6		100			0.40	4.00
3.05	10.0	7.23	5.67	Clay	CL/CH	firm	125	6		100			0.39	3.83
3.20	10.5	7.60	5.61	Clay	CL/CH	firm	125	6		100			0.41	3.91
3.35	11.0	8.19	5.95	Clay	CL/CH	firm	125	7		100			0.45	4.18
3.50	11.5	10.88	6.30	Clay	CL/CH	stiff	125	9		100			0.61	6.43
3.65	12.0	11.45	6.07	Clay	CL/CH	stiff	125	9		100			0.64	6.65
3.80	12.5	15.56	6.71	Clay	CL/CH	stiff	125	12		100			0.88	>10
3.95	13.0	17.66	6.20	Clay	CL/CH	very stiff	125	14		100			1.00	>10
4.13	13.5	16.20	6.06	Clay	CL/CH	stiff	125	13		100			0.91	>10
4.28	14.0	29.79	4.28	Silty Clay to Clay	CL	very stiff	125	17		80			1.71	>10
4.43	14.5	14.70	5.35	Clay	CL/CH	stiff	125	12		100			0.82	8.41
4.58	15.0	11.74	8.43	Clay	CL/CH	stiff	125	9		100			0.65	5.53
4.73	15.5	12.27	6.58	Clay	CL/CH	stiff	125	10		100			0.68	5.76
4.88	16.0	11.65	6.39	Clay	CL/CH	stiff	125	9		100			0.64	5.10
5.03	16.5	13.26	7.62	Clay	CL/CH	stiff	125	11		100			0.74	6.10
5.18	17.0	90.03	3.32	Sandy Silt to Clayey Silt	ML	dense	115	26	100.2	45	73	38		
5.33	17.5	102.52	3.01	Sandy Silt to Clayey Silt	ML	dense	115	29	113.2	40	76	39		
5.48	18.0	107.65	2.30	Silty Sand to Sandy Silt	SM/ML	dense	115	24	117.9	35	77	39		
5.65	18.5	45.46	3.96	Clayey Silt to Silty Clay	ML/CL	hard	120	18		70			2.63	>10
5.80	19.0	77.17	3.29	Sandy Silt to Clayey Silt	ML	medium dense	115	22	83.0	50	67	37		
5.95	19.5	131.54	1.81	Silty Sand to Sandy Silt	SM/ML	dense	115	29	140.4	30	83	40		
6.10	20.0	108.67	1.98	Silty Sand to Sandy Silt	SM/ML	dense	115	24	115.1	35	77	39		

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan
DATE: 8/13/2018

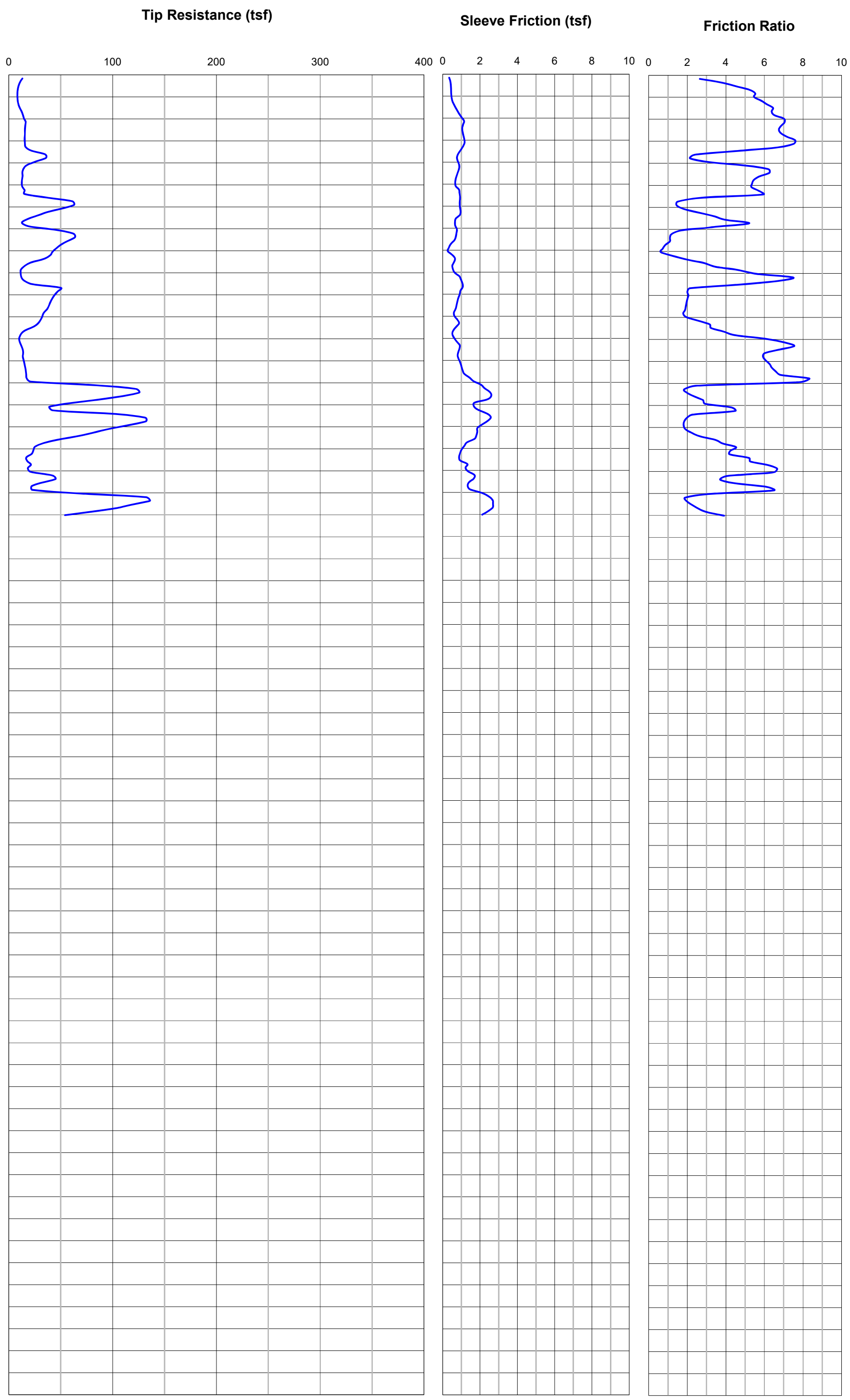
CONE SOUNDING DATA CPT-9

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Soil	Class	Consistency
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clayey Silt to Silty Clay	ML/CL	hard
Clayey Silt to Silty Clay	" "	very stiff
Silty Sand to Sandy Silt	SM/ML	medium dense
Clayey Silt to Silty Clay	ML/CL	very stiff
Silty Clay to Clay	CL	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	dense
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	very stiff
Silty Clay to Clay	CL	hard
Silty Sand to Sandy Silt	SM/ML	dense

DEPTH: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-9

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-9
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	11.11	3.64	Silty Clay to Clay	CL	stiff	125	6		95			0.65	>10
0.30	1.0	8.35	5.40	Clay	CL/CH	firm	125	7		100			0.49	>10
0.45	1.5	9.29	6.13	Clay	CL/CH	stiff	125	7		100			0.54	>10
0.60	2.0	13.36	6.63	Clay	CL/CH	stiff	125	11		100			0.78	>10
0.75	2.5	15.84	6.89	Clay	CL/CH	stiff	125	13		100			0.92	>10
0.93	3.0	15.40	7.20	Clay	CL/CH	stiff	125	12		100			0.90	>10
1.08	3.5	17.84	6.21	Clay	CL/CH	very stiff	125	14		95			1.04	>10
1.23	4.0	32.20	2.53	Sandy Silt to Clayey Silt	ML	medium dense	115	9	60.9	50	60	36		
1.38	4.5	14.88	5.83	Clay	CL/CH	stiff	125	12		100			0.86	>10
1.53	5.0	12.81	5.52	Clay	CL/CH	stiff	125	10		100			0.74	>10
1.68	5.5	19.97	4.88	Clay	CL/CH	very stiff	125	16		85			1.16	>10
1.83	6.0	58.47	1.58	Silty Sand to Sandy Silt	SM/ML	dense	115	13	95.3	30	71	38		
1.98	6.5	27.42	3.29	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.59	>10
2.13	7.0	26.33	3.41	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.52	>10
2.28	7.5	60.96	1.13	Silty Sand to Sandy Silt	SM/ML	medium dense	115	14	88.9	25	69	38		
2.45	8.0	46.18	0.74	Silty Sand to Sandy Silt	SM/ML	medium dense	115	10	65.3	25	60	36		
2.60	8.5	31.56	2.02	Sandy Silt to Clayey Silt	ML	medium dense	115	9	44.0	50	48	35		
2.75	9.0	12.68	4.57	Clay	CL/CH	stiff	125	10		100			0.72	>10
2.90	9.5	16.47	6.27	Clay	CL/CH	stiff	125	13		100			0.94	>10
3.05	10.0	47.12	2.06	Sandy Silt to Clayey Silt	ML	medium dense	115	13	62.9	40	59	36		
3.20	10.5	40.09	1.96	Sandy Silt to Clayey Silt	ML	medium dense	115	11	52.8	45	54	36		
3.35	11.0	34.08	1.87	Sandy Silt to Clayey Silt	ML	medium dense	115	10	44.4	50	48	35		
3.50	11.5	26.74	2.99	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.54	>10
3.65	12.0	11.96	4.82	Clay	CL/CH	stiff	125	10		100			0.67	7.70
3.80	12.5	11.91	7.11	Clay	CL/CH	stiff	125	10		100			0.67	7.27
3.95	13.0	13.82	6.00	Clay	CL/CH	stiff	125	11		100			0.78	9.19
4.13	13.5	15.68	6.41	Clay	CL/CH	stiff	125	13		100			0.88	>10
4.28	14.0	18.30	7.67	Clay	CL/CH	very stiff	125	15		100			1.04	>10
4.43	14.5	110.51	2.10	Silty Sand to Sandy Silt	SM/ML	dense	115	25	132.0	30	81	39		
4.58	15.0	84.72	2.70	Sandy Silt to Clayey Silt	ML	dense	115	24	100.2	40	73	38		
4.73	15.5	62.04	3.68	Clayey Silt to Silty Clay	ML/CL	hard	120	25		55			3.61	>10
4.88	16.0	119.55	1.87	Silty Sand to Sandy Silt	SM/ML	dense	115	27	138.6	25	82	39		
5.03	16.5	67.13	2.77	Sandy Silt to Clayey Silt	ML	medium dense	115	19	77.1	45	65	37		
5.18	17.0	27.59	4.20	Silty Clay to Clay	CL	very stiff	125	16		85			1.58	>10
5.33	17.5	18.91	4.89	Clay	CL/CH	very stiff	125	15		100			1.07	>10
5.48	18.0	20.19	6.45	Clay	CL/CH	very stiff	125	16		100			1.14	>10
5.65	18.5	39.54	4.06	Clayey Silt to Silty Clay	ML/CL	hard	120	16		70			2.28	>10
5.80	19.0	37.63	5.23	Clay	CL/CH	hard	125	30		80			2.17	>10
5.95	19.5	129.20	2.03	Silty Sand to Sandy Silt	SM/ML	dense	115	29	139.8	30	82	40		
6.10	20.0	80.01	3.16	Sandy Silt to Clayey Silt	ML	medium dense	115	23	85.9	50	68	38		

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan
DATE: 8/13/2018

CONE SOUNDING DATA CPT-10

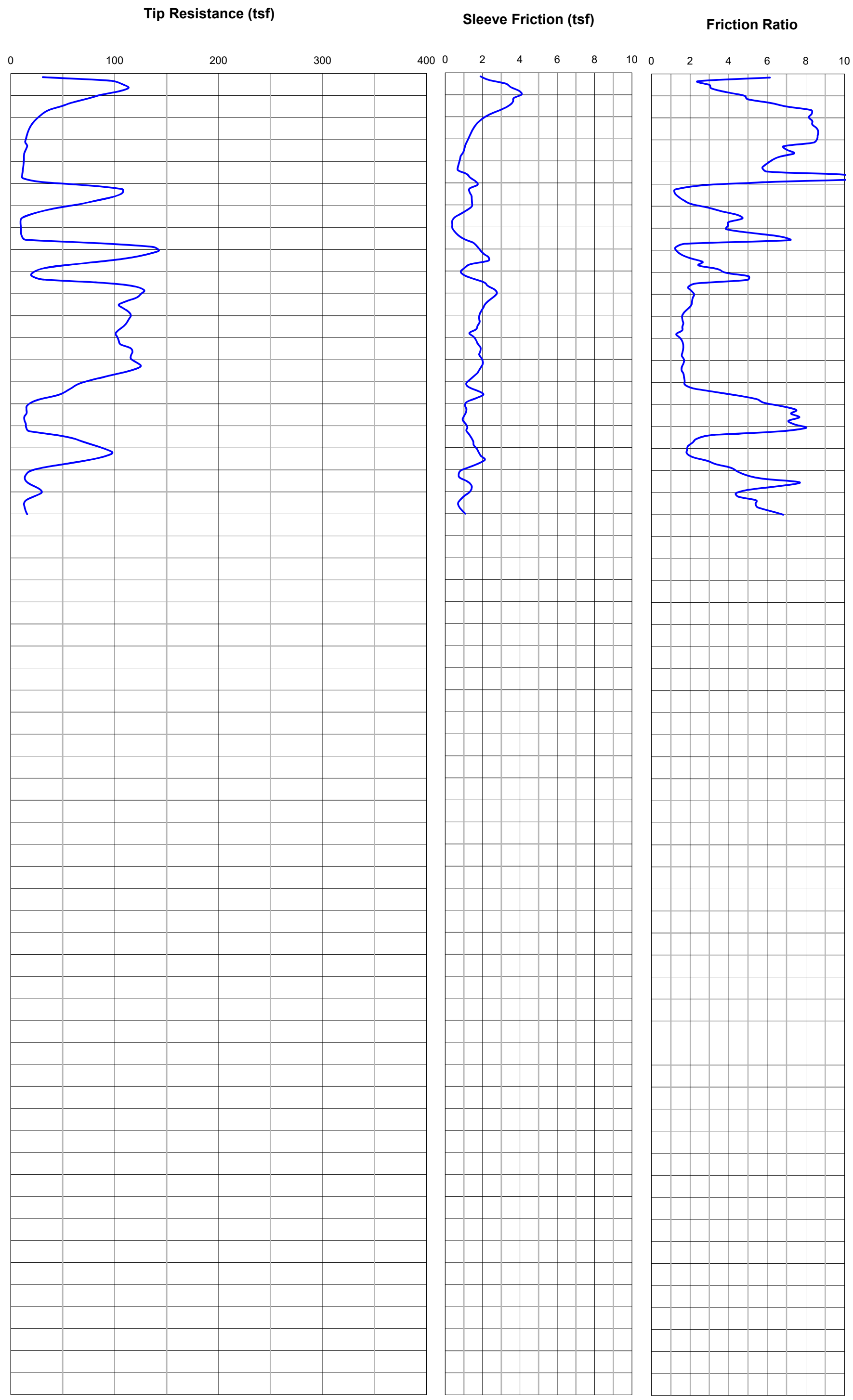
DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-10

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-10
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	78.35	3.85	Clayey Silt to Silty Clay	ML/CL	hard	120	31		45			4.61	>10
0.30	1.0	100.38	3.92	Clayey Silt to Silty Clay	ML/CL	hard	120	40		40			5.90	>10
0.45	1.5	60.69	6.04	Overconsolidated Soil	??	very dense	120	61	114.7	60	95	41		
0.60	2.0	31.92	8.24	Clay	CL/CH	very stiff	125	26		85			1.87	>10
0.75	2.5	20.59	8.41	Clay	CL/CH	very stiff	125	16		100			1.20	>10
0.93	3.0	15.66	8.61	Clay	CL/CH	stiff	125	13		100			0.91	>10
1.08	3.5	14.75	7.42	Clay	CL/CH	stiff	125	12		100			0.86	>10
1.23	4.0	12.81	6.72	Clay	CL/CH	stiff	125	10		100			0.74	>10
1.38	4.5	11.93	5.88	Clay	CL/CH	stiff	125	10		100			0.69	>10
1.53	5.0	17.21	9.11	Clay	CL/CH	stiff	125	14		100			1.00	>10
1.68	5.5	97.77	1.53	Sand to Silty Sand	SP/SM	dense	115	18	167.2	20	88	40		
1.83	6.0	67.49	2.23	Silty Sand to Sandy Silt	SM/ML	dense	115	15	110.6	35	75	39		
1.98	6.5	20.50	4.26	Silty Clay to Clay	CL	very stiff	125	12		80			1.18	>10
2.13	7.0	9.58	3.95	Clay	CL/CH	stiff	125	8		100			0.54	>10
2.28	7.5	11.53	6.34	Clay	CL/CH	stiff	125	9		100			0.65	>10
2.45	8.0	121.87	1.43	Sand to Silty Sand	SP/SM	dense	115	22	172.0	20	89	40		
2.60	8.5	111.28	2.07	Silty Sand to Sandy Silt	SM/ML	dense	115	25	154.9	25	85	40		
2.75	9.0	35.33	3.24	Clayey Silt to Silty Clay	ML/CL	hard	120	14		55			2.05	>10
2.90	9.5	47.49	4.09	Clayey Silt to Silty Clay	ML/CL	hard	120	19		55			2.76	>10
3.05	10.0	124.80	2.06	Silty Sand to Sandy Silt	SM/ML	dense	115	28	166.7	25	88	40		
3.20	10.5	112.28	2.10	Silty Sand to Sandy Silt	SM/ML	dense	115	25	148.2	25	84	40		
3.35	11.0	112.46	1.72	Silty Sand to Sandy Silt	SM/ML	dense	115	25	146.7	25	84	40		
3.50	11.5	111.18	1.62	Sand to Silty Sand	SP/SM	dense	115	20	143.3	25	83	40		
3.65	12.0	102.45	1.45	Sand to Silty Sand	SP/SM	dense	115	19	130.6	20	80	39		
3.80	12.5	108.24	1.63	Sand to Silty Sand	SP/SM	dense	115	20	136.4	25	82	39		
3.95	13.0	116.17	1.62	Sand to Silty Sand	SP/SM	dense	115	21	144.8	25	83	40		
4.13	13.5	121.44	1.60	Sand to Silty Sand	SP/SM	dense	115	22	149.8	25	84	40		
4.28	14.0	90.01	1.69	Silty Sand to Sandy Silt	SM/ML	dense	115	20	109.8	30	75	39		
4.43	14.5	58.80	2.39	Sandy Silt to Clayey Silt	ML	medium dense	115	17	71.0	45	62	37		
4.58	15.0	32.09	5.25	Clay	CL/CH	very stiff	125	26		80			1.85	>10
4.73	15.5	15.31	7.18	Clay	CL/CH	stiff	125	12		100			0.86	9.39
4.88	16.0	13.88	7.54	Clay	CL/CH	stiff	125	11		100			0.78	7.41
5.03	16.5	39.96	3.92	Clayey Silt to Silty Clay	ML/CL	hard	120	16		70			2.31	>10
5.18	17.0	80.98	1.95	Silty Sand to Sandy Silt	SM/ML	dense	115	18	92.6	35	70	38		
5.33	17.5	87.68	2.26	Silty Sand to Sandy Silt	SM/ML	dense	115	19	99.4	35	72	38		
5.48	18.0	35.31	3.97	Clayey Silt to Silty Clay	ML/CL	hard	120	14		75			2.03	>10
5.65	18.5	14.49	6.10	Clay	CL/CH	stiff	125	12		100			0.81	6.76
5.80	19.0	25.98	5.41	Clay	CL/CH	very stiff	125	21		95			1.48	>10
5.95	19.5	17.06	5.11	Clay	CL/CH	stiff	125	14		100			0.96	8.41
6.10	20.0	14.44	6.18	Clay	CL/CH	stiff	125	12		100			0.80	6.10

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan

DATE: 8/13/2018

CONE SOUNDING DATA CPT-11

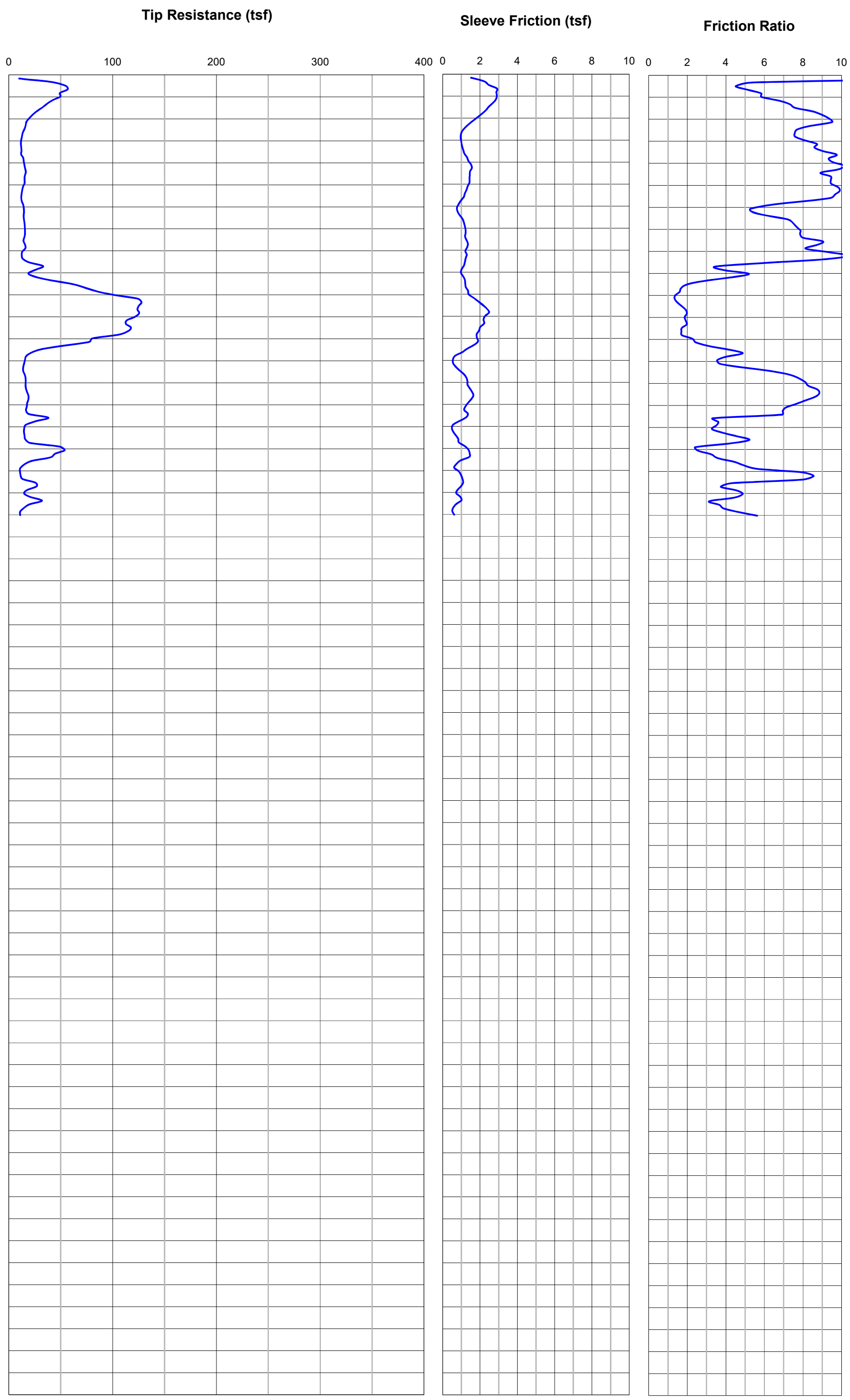
DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55



END OF SOUNDING AT 20 ft.

Project No.		PLATE
LE18150	LANDMARK Geo-Engineers and Geologists	B-11

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-11
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	35.51	8.34	Clay	CL/CH	hard	125	28		85			2.09	>10
0.30	1.0	51.85	5.60	Clay	CL/CH	hard	125	41		60			3.05	>10
0.45	1.5	37.14	7.22	Clay	CL/CH	hard	125	30		80			2.18	>10
0.60	2.0	23.39	8.96	Clay	CL/CH	very stiff	125	19		100			1.37	>10
0.75	2.5	16.06	8.53	Clay	CL/CH	stiff	125	13		100			0.94	>10
0.93	3.0	12.71	7.75	Clay	CL/CH	stiff	125	10		100			0.74	>10
1.08	3.5	11.90	8.78	Clay	CL/CH	stiff	125	10		100			0.69	>10
1.23	4.0	13.38	9.54	Clay	CL/CH	stiff	125	11		100			0.77	>10
1.38	4.5	15.70	9.64	Clay	CL/CH	stiff	125	13		100			0.91	>10
1.53	5.0	15.23	9.45	Clay	CL/CH	stiff	125	12		100			0.88	>10
1.68	5.5	12.69	9.71	Clay	CL/CH	stiff	125	10		100			0.73	>10
1.83	6.0	13.57	6.43	Clay	CL/CH	stiff	125	11		100			0.78	>10
1.98	6.5	14.45	6.33	Clay	CL/CH	stiff	125	12		100			0.83	>10
2.13	7.0	15.31	7.68	Clay	CL/CH	stiff	125	12		100			0.88	>10
2.28	7.5	14.89	8.29	Clay	CL/CH	stiff	125	12		100			0.85	>10
2.45	8.0	14.82	8.73	Clay	CL/CH	stiff	125	12		100			0.84	>10
2.60	8.5	15.34	8.44	Clay	CL/CH	stiff	125	12		100			0.87	>10
2.75	9.0	25.90	4.19	Silty Clay to Clay	CL	very stiff	125	15		75			1.49	>10
2.90	9.5	43.24	3.00	Sandy Silt to Clayey Silt	ML	medium dense	115	12	57.7	50	56	36		
3.05	10.0	86.83	1.55	Silty Sand to Sandy Silt	SM/ML	dense	115	19	114.5	25	76	39		
3.20	10.5	125.68	1.52	Sand to Silty Sand	SP/SM	dense	115	23	163.8	20	87	40		
3.35	11.0	123.74	1.92	Silty Sand to Sandy Silt	SM/ML	dense	115	27	159.4	25	86	40		
3.50	11.5	114.73	1.87	Silty Sand to Sandy Silt	SM/ML	dense	115	25	146.1	25	84	40		
3.65	12.0	100.39	1.90	Silty Sand to Sandy Silt	SM/ML	dense	115	22	126.4	30	79	39		
3.80	12.5	54.30	3.24	Sandy Silt to Clayey Silt	ML	medium dense	115	16	67.7	50	61	37		
3.95	13.0	17.87	4.13	Silty Clay to Clay	CL	very stiff	125	10		90			1.01	>10
4.13	13.5	14.13	5.04	Clay	CL/CH	stiff	125	11		100			0.79	8.85
4.28	14.0	15.88	7.76	Clay	CL/CH	stiff	125	13		100			0.90	>10
4.43	14.5	16.79	8.62	Clay	CL/CH	stiff	125	13		100			0.95	>10
4.58	15.0	18.47	8.16	Clay	CL/CH	very stiff	125	15		100			1.05	>10
4.73	15.5	17.73	7.00	Clay	CL/CH	very stiff	125	14		100			1.00	>10
4.88	16.0	23.69	3.43	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		80			1.35	>10
5.03	16.5	15.22	4.54	Clay	CL/CH	stiff	125	12		100			0.85	8.00
5.18	17.0	41.03	3.06	Clayey Silt to Silty Clay	ML/CL	hard	120	16		60			2.37	>10
5.33	17.5	35.42	3.72	Clayey Silt to Silty Clay	ML/CL	hard	120	14		70			2.04	>10
5.48	18.0	12.19	6.16	Clay	CL/CH	stiff	125	10		100			0.67	5.00
5.65	18.5	16.73	6.94	Clay	CL/CH	stiff	125	13		100			0.94	8.14
5.80	19.0	19.84	4.39	Clay	CL/CH	very stiff	125	16		100			1.12	>10
5.95	19.5	24.32	3.74	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		90			1.38	>10
6.10	20.0	12.16	4.73	Clay	CL/CH	stiff	125	10		100			0.67	4.37

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

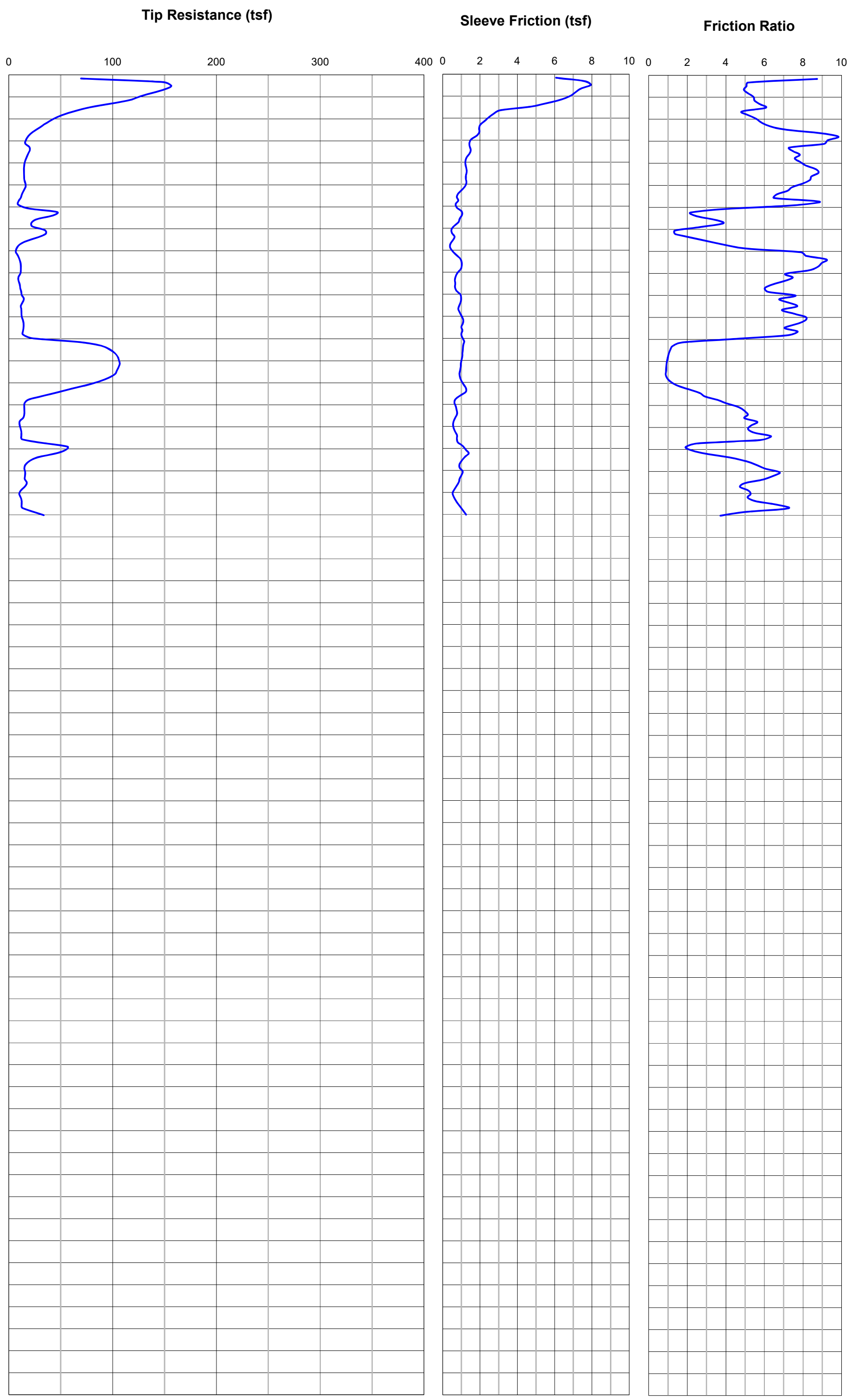
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-12

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH	Soil		
	Overconsolidated Soil	??	very dense
	Overconsolidated Soil	" "	very dense
	Clay	CL/CH	very stiff
	Clay	" "	very stiff
	Clay	" "	stiff
5	Clay	" "	stiff
	Sandy Silt to Clayey Silt	ML	medium dense
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
10	Clay	" "	stiff
	Clay	" "	stiff
	Sand to Silty Sand	SP/SM	dense
	Sand to Silty Sand	" "	dense
	Sandy Silt to Clayey Silt	ML	medium dense
15	Clay	CL/CH	stiff
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
20			



DEPTH: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-12

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-12
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	124.99	6.32	Overconsolidated Soil	??	very dense	120	125	236.3	50	140	48		
0.30	1.0	138.12	5.18	Overconsolidated Soil	??	very dense	120	138	261.1	40	127	46		
0.45	1.5	97.17	5.77	Overconsolidated Soil	??	very dense	120	97	183.7	50	109	43		
0.60	2.0	53.61	5.18	Clay	CL/CH	hard	125	43		60			3.15	>10
0.75	2.5	32.85	6.35	Clay	CL/CH	very stiff	125	26		80			1.92	>10
0.93	3.0	19.12	9.33	Clay	CL/CH	very stiff	125	15		100			1.11	>10
1.08	3.5	18.54	7.95	Clay	CL/CH	very stiff	125	15		100			1.08	>10
1.23	4.0	16.94	7.76	Clay	CL/CH	stiff	125	14		100			0.98	>10
1.38	4.5	14.67	8.54	Clay	CL/CH	stiff	125	12		100			0.85	>10
1.53	5.0	15.17	8.26	Clay	CL/CH	stiff	125	12		100			0.87	>10
1.68	5.5	13.72	6.94	Clay	CL/CH	stiff	125	11		100			0.79	>10
1.83	6.0	12.40	6.84	Clay	CL/CH	stiff	125	10		100			0.71	>10
1.98	6.5	38.39	2.68	Sandy Silt to Clayey Silt	ML	medium dense	115	11	60.1	50	57	36		
2.13	7.0	26.32	2.65	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		60			1.52	>10
2.28	7.5	27.02	2.25	Sandy Silt to Clayey Silt	ML	medium dense	115	8	39.4	55	45	34		
2.45	8.0	8.26	5.63	Clay	CL/CH	firm	125	7		100			0.46	5.88
2.60	8.5	9.95	8.78	Clay	CL/CH	stiff	125	8		100			0.56	7.56
2.75	9.0	11.45	8.07	Clay	CL/CH	stiff	125	9		100			0.64	9.39
2.90	9.5	9.69	6.96	Clay	CL/CH	stiff	125	8		100			0.54	6.54
3.05	10.0	11.74	6.61	Clay	CL/CH	stiff	125	9		100			0.66	8.70
3.20	10.5	13.12	7.25	Clay	CL/CH	stiff	125	10		100			0.74	>10
3.35	11.0	12.21	7.53	Clay	CL/CH	stiff	125	10		100			0.68	8.41
3.50	11.5	13.99	7.58	Clay	CL/CH	stiff	125	11		100			0.79	>10
3.65	12.0	16.85	6.50	Clay	CL/CH	stiff	125	13		100			0.96	>10
3.80	12.5	83.87	1.36	Silty Sand to Sandy Silt	SM/ML	dense	115	19	104.1	25	74	38		
3.95	13.0	104.13	1.00	Sand to Silty Sand	SP/SM	dense	115	19	127.8	20	80	39		
4.13	13.5	105.53	0.91	Sand to Silty Sand	SP/SM	dense	115	19	128.2	15	80	39		
4.28	14.0	94.74	1.00	Sand to Silty Sand	SP/SM	dense	115	17	113.9	20	76	39		
4.43	14.5	60.36	2.08	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	71.9	40	63	37		
4.58	15.0	22.08	3.55	Clayey Silt to Silty Clay	ML/CL	very stiff	120	9		85			1.26	>10
4.73	15.5	14.94	4.94	Clay	CL/CH	stiff	125	12		100			0.84	8.41
4.88	16.0	11.53	5.27	Clay	CL/CH	stiff	125	9		100			0.64	5.21
5.03	16.5	12.36	5.89	Clay	CL/CH	stiff	125	10		100			0.68	5.65
5.18	17.0	47.90	2.22	Sandy Silt to Clayey Silt	ML	medium dense	115	14	54.1	50	54	36		
5.33	17.5	30.44	4.20	Silty Clay to Clay	CL	very stiff	125	17		80			1.75	>10
5.48	18.0	15.57	6.16	Clay	CL/CH	stiff	125	12		100			0.87	7.56
5.65	18.5	16.10	5.78	Clay	CL/CH	stiff	125	13		100			0.90	7.70
5.80	19.0	12.61	5.06	Clay	CL/CH	stiff	125	10		100			0.69	5.00
5.95	19.5	11.99	5.80	Clay	CL/CH	stiff	125	10		100			0.66	4.47
6.10	20.0	23.16	5.29	Clay	CL/CH	very stiff	125	19		100			1.31	>10

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight

LOCATION: See Site and Boring Location Plan
DATE: 8/13/2018

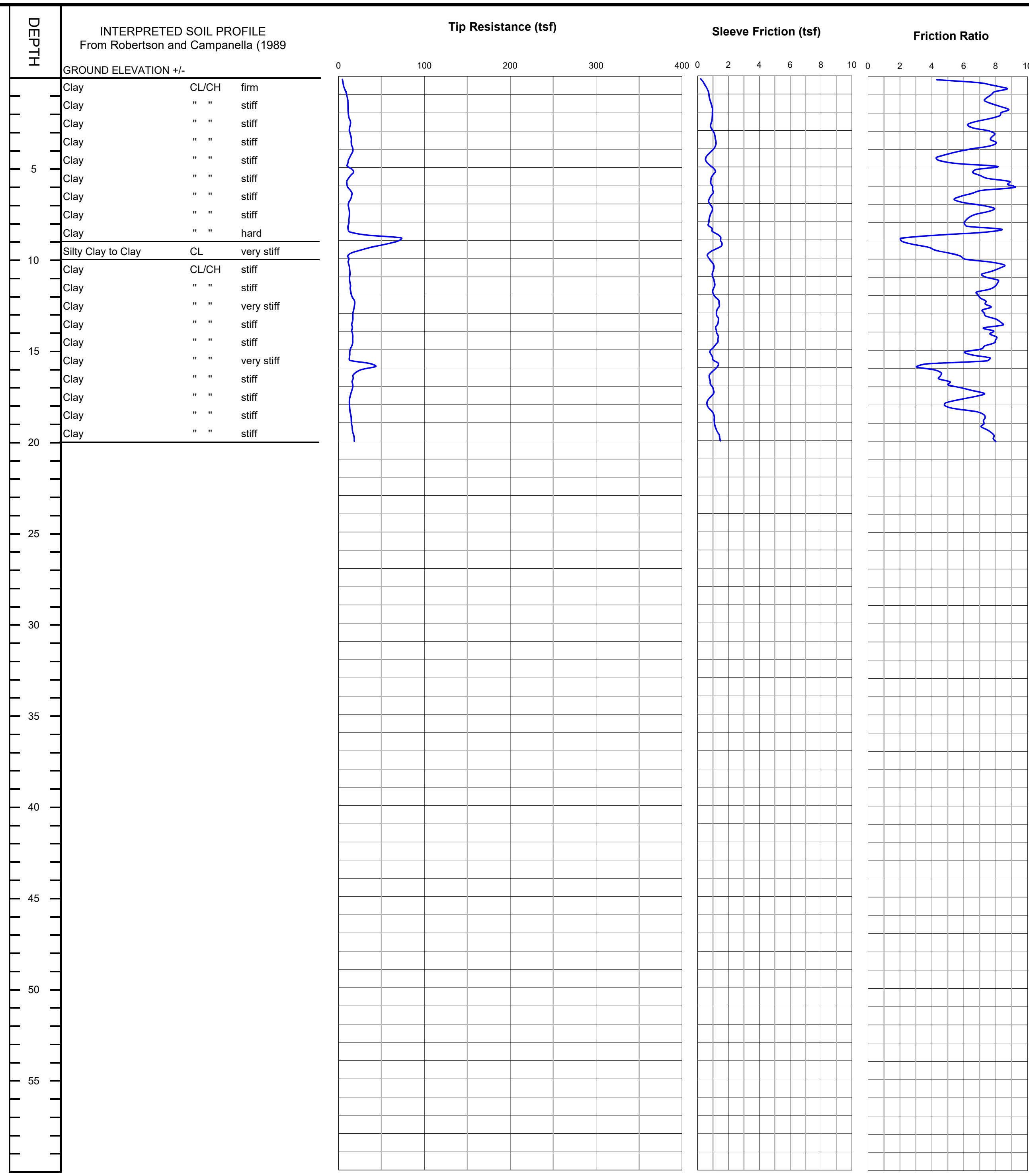
CONE SOUNDING DATA CPT-13

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clay	CL/CH	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	hard
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-13

LANDMARK CONSULTANTS, INC.

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-13

Est. GWT (ft): 8 Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	5.19	6.41	Clay	CL/CH	firm	125	4		100			0.30	>10
0.30	1.0	8.26	8.13	Clay	CL/CH	firm	125	7		100			0.48	>10
0.45	1.5	10.70	7.50	Clay	CL/CH	stiff	125	9		100			0.63	>10
0.60	2.0	11.10	8.50	Clay	CL/CH	stiff	125	9		100			0.65	>10
0.75	2.5	12.62	7.54	Clay	CL/CH	stiff	125	10		100			0.73	>10
0.93	3.0	13.17	6.74	Clay	CL/CH	stiff	125	11		100			0.76	>10
1.08	3.5	14.26	7.80	Clay	CL/CH	stiff	125	11		100			0.83	>10
1.23	4.0	15.59	7.47	Clay	CL/CH	stiff	125	12		100			0.90	>10
1.38	4.5	15.02	4.94	Clay	CL/CH	stiff	125	12		95			0.87	>10
1.53	5.0	10.88	6.05	Clay	CL/CH	stiff	125	9		100			0.62	>10
1.68	5.5	14.86	6.97	Clay	CL/CH	stiff	125	12		100			0.85	>10
1.83	6.0	10.05	8.94	Clay	CL/CH	stiff	125	8		100			0.57	>10
1.98	6.5	14.80	6.47	Clay	CL/CH	stiff	125	12		100			0.85	>10
2.13	7.0	12.58	6.15	Clay	CL/CH	stiff	125	10		100			0.72	>10
2.28	7.5	12.44	7.41	Clay	CL/CH	stiff	125	10		100			0.71	>10
2.45	8.0	12.23	6.17	Clay	CL/CH	stiff	125	10		100			0.69	>10
2.60	8.5	11.80	7.29	Clay	CL/CH	stiff	125	9		100			0.66	>10
2.75	9.0	57.87	2.79	Sandy Silt to Clayey Silt	ML	medium dense	115	17	78.4	45	65	37		
2.90	9.5	41.33	3.60	Clayey Silt to Silty Clay	ML/CL	hard	120	17		55			2.40	>10
3.05	10.0	12.74	5.68	Clay	CL/CH	stiff	125	10		100			0.72	>10
3.20	10.5	12.04	8.18	Clay	CL/CH	stiff	125	10		100			0.68	8.41
3.35	11.0	13.22	7.43	Clay	CL/CH	stiff	125	11		100			0.74	9.79
3.50	11.5	13.42	8.08	Clay	CL/CH	stiff	125	11		100			0.75	9.39
3.65	12.0	14.28	7.12	Clay	CL/CH	stiff	125	11		100			0.80	>10
3.80	12.5	17.95	7.26	Clay	CL/CH	very stiff	125	14		100			1.02	>10
3.95	13.0	17.66	7.39	Clay	CL/CH	very stiff	125	14		100			1.00	>10
4.13	13.5	16.54	7.89	Clay	CL/CH	stiff	125	13		100			0.93	>10
4.28	14.0	15.67	7.86	Clay	CL/CH	stiff	125	13		100			0.88	>10
4.43	14.5	16.49	7.90	Clay	CL/CH	stiff	125	13		100			0.93	>10
4.58	15.0	15.42	7.44	Clay	CL/CH	stiff	125	12		100			0.87	8.85
4.73	15.5	13.03	6.74	Clay	CL/CH	stiff	125	10		100			0.72	6.32
4.88	16.0	30.05	4.58	Silty Clay to Clay	CL	very stiff	125	17		85			1.72	>10
5.03	16.5	18.11	4.52	Clay	CL/CH	very stiff	125	14		100			1.02	>10
5.18	17.0	16.29	5.33	Clay	CL/CH	stiff	125	13		100			0.91	8.41
5.33	17.5	14.51	6.85	Clay	CL/CH	stiff	125	12		100			0.81	6.54
5.48	18.0	12.75	5.12	Clay	CL/CH	stiff	125	10		100			0.70	5.10
5.65	18.5	13.53	6.52	Clay	CL/CH	stiff	125	11		100			0.75	5.53
5.80	19.0	14.93	7.28	Clay	CL/CH	stiff	125	12		100			0.83	6.21
5.95	19.5	16.18	7.43	Clay	CL/CH	stiff	125	13		100			0.90	6.88
6.10	20.0	18.15	7.92	Clay	CL/CH	very stiff	125	15		100			1.02	8.27

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

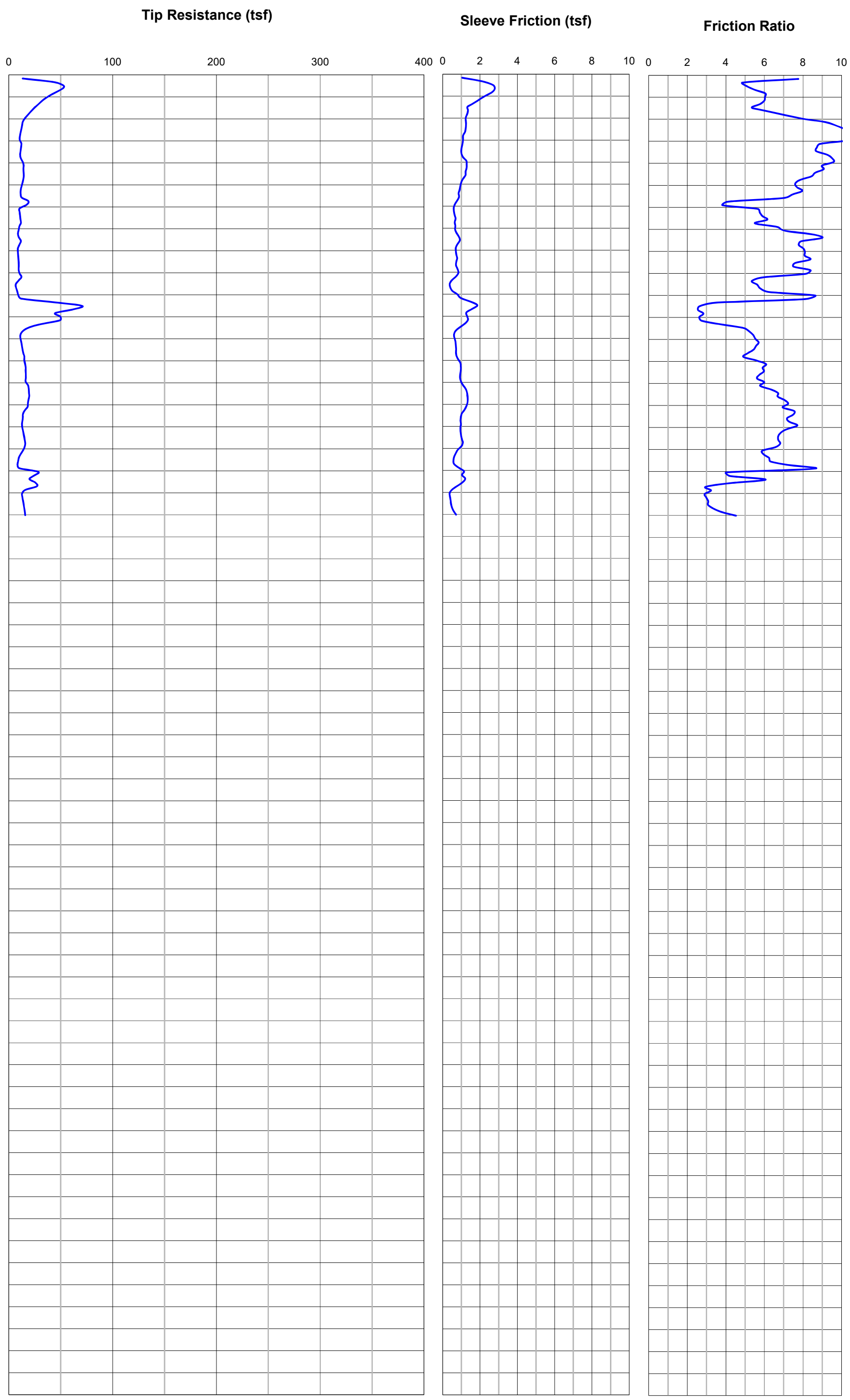
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-14

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH			
	Clay	CL/CH	hard
	Clay	" "	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
5	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	firm
10	Clayey Silt to Silty Clay	ML/CL	hard
	Clay	CL/CH	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
15	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Silty Clay to Clay	CL	very stiff
	Silty Clay to Clay	" "	stiff
20			



END OF SOUNDING AT 20 ft.

Project No. LE18150

LANDMARK Geo-Engineers and Geologists

PLATE B-14

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-14
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	36.59	5.90	Clay	CL/CH	hard	125	29		70			2.15	>10
0.30	1.0	44.20	5.86	Clay	CL/CH	hard	125	35		65			2.60	>10
0.45	1.5	28.94	5.70	Clay	CL/CH	very stiff	125	23		80			1.70	>10
0.60	2.0	18.63	7.08	Clay	CL/CH	very stiff	125	15		100			1.09	>10
0.75	2.5	12.76	9.73	Clay	CL/CH	stiff	125	10		100			0.74	>10
0.93	3.0	10.82	10.37	Clay	CL/CH	stiff	125	9		100			0.63	>10
1.08	3.5	11.75	8.76	Clay	CL/CH	stiff	125	9		100			0.68	>10
1.23	4.0	11.82	9.45	Clay	CL/CH	stiff	125	9		100			0.68	>10
1.38	4.5	14.17	8.90	Clay	CL/CH	stiff	125	11		100			0.82	>10
1.53	5.0	13.79	7.96	Clay	CL/CH	stiff	125	11		100			0.79	>10
1.68	5.5	11.85	7.53	Clay	CL/CH	stiff	125	9		100			0.68	>10
1.83	6.0	15.45	4.53	Clay	CL/CH	stiff	125	12		90			0.89	>10
1.98	6.5	10.78	5.93	Clay	CL/CH	stiff	125	9		100			0.61	>10
2.13	7.0	10.40	6.39	Clay	CL/CH	stiff	125	8		100			0.59	>10
2.28	7.5	10.01	8.44	Clay	CL/CH	stiff	125	8		100			0.56	8.85
2.45	8.0	9.25	7.97	Clay	CL/CH	stiff	125	7		100			0.52	6.76
2.60	8.5	9.23	8.02	Clay	CL/CH	stiff	125	7		100			0.51	6.43
2.75	9.0	9.75	8.01	Clay	CL/CH	stiff	125	8		100			0.54	6.65
2.90	9.5	9.41	5.62	Clay	CL/CH	stiff	125	8		100			0.52	6.10
3.05	10.0	8.07	6.87	Clay	CL/CH	firm	125	6		100			0.44	4.47
3.20	10.5	41.90	4.72	Silty Clay to Clay	CL	hard	125	24		65			2.43	>10
3.35	11.0	52.03	2.67	Sandy Silt to Clayey Silt	ML	medium dense	115	15	66.6	45	60	36		
3.50	11.5	33.56	3.80	Clayey Silt to Silty Clay	ML/CL	very stiff	120	13		65			1.94	>10
3.65	12.0	11.98	5.39	Clay	CL/CH	stiff	125	10		100			0.67	7.27
3.80	12.5	12.56	5.57	Clay	CL/CH	stiff	125	10		100			0.70	7.56
3.95	13.0	14.54	5.21	Clay	CL/CH	stiff	125	12		100			0.82	9.59
4.13	13.5	16.02	5.99	Clay	CL/CH	stiff	125	13		100			0.90	>10
4.28	14.0	16.33	5.78	Clay	CL/CH	stiff	125	13		100			0.92	>10
4.43	14.5	19.00	6.27	Clay	CL/CH	very stiff	125	15		100			1.08	>10
4.58	15.0	19.01	6.99	Clay	CL/CH	very stiff	125	15		100			1.08	>10
4.73	15.5	15.66	7.33	Clay	CL/CH	stiff	125	13		100			0.88	8.70
4.88	16.0	13.07	7.34	Clay	CL/CH	stiff	125	10		100			0.73	6.10
5.03	16.5	14.55	6.76	Clay	CL/CH	stiff	125	12		100			0.81	7.00
5.18	17.0	14.96	6.43	Clay	CL/CH	stiff	125	12		100			0.83	7.13
5.33	17.5	10.15	6.17	Clay	CL/CH	stiff	125	8		100			0.55	3.74
5.48	18.0	15.57	6.63	Clay	CL/CH	stiff	125	12		100			0.87	7.13
5.65	18.5	23.31	4.82	Clay	CL/CH	very stiff	125	19		95			1.32	>10
5.80	19.0	18.55	3.03	Clayey Silt to Silty Clay	ML/CL	very stiff	120	7		90			1.04	>10
5.95	19.5	13.66	3.05	Clayey Silt to Silty Clay	ML/CL	stiff	120	5		100			0.75	9.79
6.10	20.0	15.32	3.89	Silty Clay to Clay	CL	stiff	125	9		100			0.85	8.14

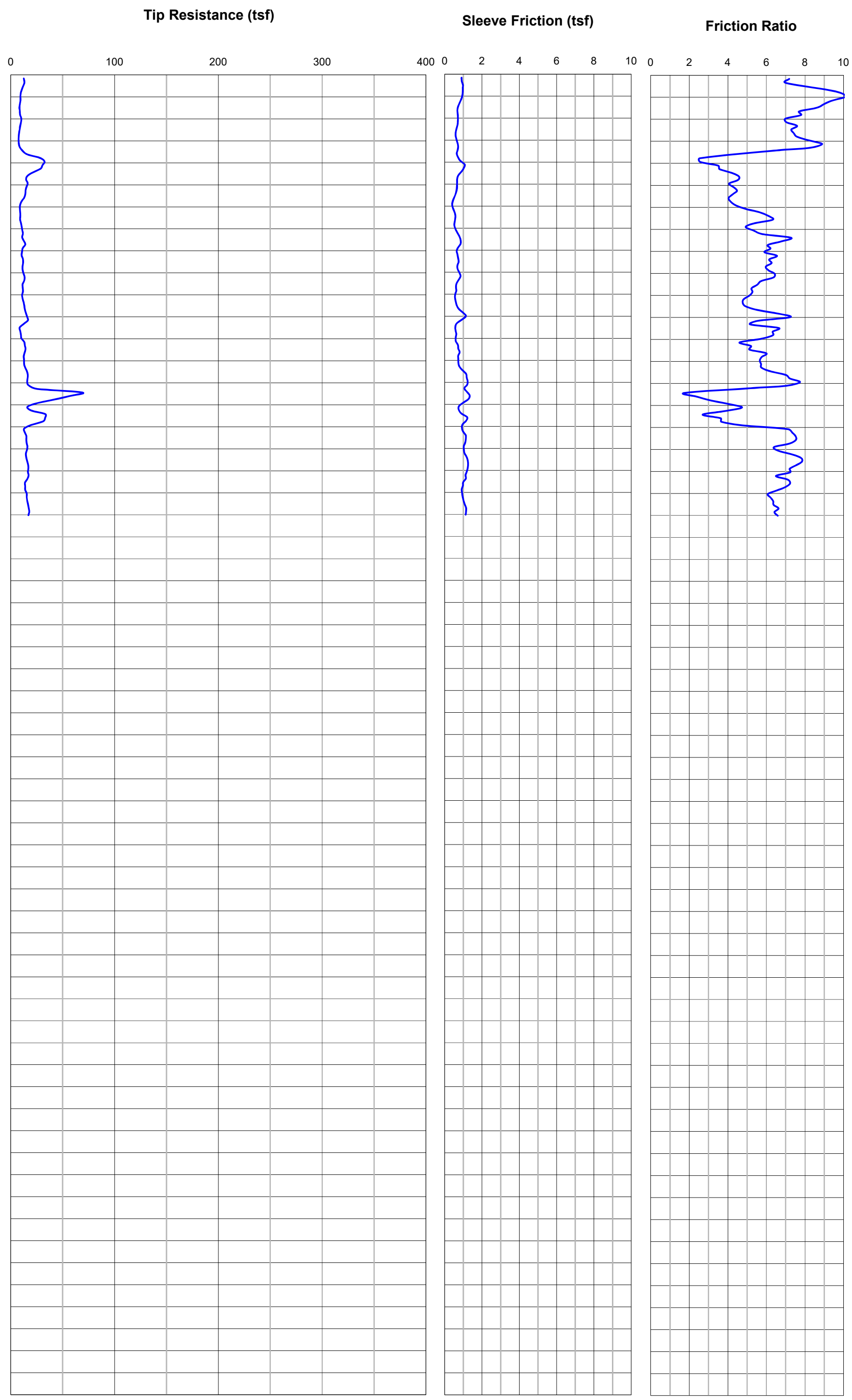
CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-15

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

DEPTH	GROUND ELEVATION +/-		
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	firm
	Clay	" "	very stiff
5	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
10	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
15	Clayey Silt to Silty Clay	ML/CL	hard
	Silty Clay to Clay	CL	very stiff
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
20			
25			
30			
35			
40			
45			
50			
55			



END OF SOUNDING AT 20 ft.

Project No.	LANDMARK Geo-Engineers and Geologists	PLATE
LE18150		B-15

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-15
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	12.67	7.36	Clay	CL/CH	stiff	125	10		100			0.74	>10
0.30	1.0	9.88	9.72	Clay	CL/CH	stiff	125	8		100			0.58	>10
0.45	1.5	8.84	9.00	Clay	CL/CH	stiff	125	7		100			0.52	>10
0.60	2.0	9.27	7.49	Clay	CL/CH	stiff	125	7		100			0.54	>10
0.75	2.5	9.26	7.31	Clay	CL/CH	stiff	125	7		100			0.54	>10
0.93	3.0	7.76	7.73	Clay	CL/CH	firm	125	6		100			0.45	>10
1.08	3.5	9.21	7.78	Clay	CL/CH	stiff	125	7		100			0.53	>10
1.23	4.0	25.47	3.08	Clayey Silt to Silty Clay	ML/CL	very stiff	120	10		65			1.48	>10
1.38	4.5	26.89	3.75	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		65			1.57	>10
1.53	5.0	15.69	4.39	Clay	CL/CH	stiff	125	13		90			0.91	>10
1.68	5.5	14.13	4.26	Clay	CL/CH	stiff	125	11		90			0.81	>10
1.83	6.0	9.44	4.49	Clay	CL/CH	stiff	125	8		100			0.53	>10
1.98	6.5	9.08	6.04	Clay	CL/CH	stiff	125	7		100			0.51	>10
2.13	7.0	10.47	5.21	Clay	CL/CH	stiff	125	8		100			0.59	>10
2.28	7.5	11.75	6.62	Clay	CL/CH	stiff	125	9		100			0.66	>10
2.45	8.0	12.13	6.06	Clay	CL/CH	stiff	125	10		100			0.69	>10
2.60	8.5	11.35	6.32	Clay	CL/CH	stiff	125	9		100			0.64	9.59
2.75	9.0	11.67	6.17	Clay	CL/CH	stiff	125	9		100			0.66	9.39
2.90	9.5	12.56	5.87	Clay	CL/CH	stiff	125	10		100			0.71	>10
3.05	10.0	11.41	5.21	Clay	CL/CH	stiff	125	9		100			0.64	8.14
3.20	10.5	12.29	4.84	Clay	CL/CH	stiff	125	10		100			0.69	8.70
3.35	11.0	14.64	6.45	Clay	CL/CH	stiff	125	12		100			0.83	>10
3.50	11.5	12.53	5.78	Clay	CL/CH	stiff	125	10		100			0.70	8.27
3.65	12.0	9.73	6.13	Clay	CL/CH	stiff	125	8		100			0.54	5.10
3.80	12.5	13.57	4.98	Clay	CL/CH	stiff	125	11		100			0.76	8.70
3.95	13.0	12.89	5.80	Clay	CL/CH	stiff	125	10		100			0.72	7.56
4.13	13.5	13.97	5.89	Clay	CL/CH	stiff	125	11		100			0.78	8.27
4.28	14.0	16.16	7.32	Clay	CL/CH	stiff	125	13		100			0.91	>10
4.43	14.5	36.86	4.35	Silty Clay to Clay	CL	hard	125	21		75			2.13	>10
4.58	15.0	40.91	3.14	Clayey Silt to Silty Clay	ML/CL	hard	120	16		60			2.37	>10
4.73	15.5	22.95	3.76	Silty Clay to Clay	CL	very stiff	125	13		85			1.31	>10
4.88	16.0	24.30	4.80	Clay	CL/CH	very stiff	125	19		90			1.39	>10
5.03	16.5	14.45	7.46	Clay	CL/CH	stiff	125	12		100			0.81	7.00
5.18	17.0	15.61	6.74	Clay	CL/CH	stiff	125	12		100			0.87	7.70
5.33	17.5	15.09	7.65	Clay	CL/CH	stiff	125	12		100			0.84	7.00
5.48	18.0	16.74	7.33	Clay	CL/CH	stiff	125	13		100			0.94	8.14
5.65	18.5	15.61	6.94	Clay	CL/CH	stiff	125	12		100			0.87	6.88
5.80	19.0	14.39	6.54	Clay	CL/CH	stiff	125	12		100			0.80	5.88
5.95	19.5	15.96	6.32	Clay	CL/CH	stiff	125	13		100			0.89	6.76
6.10	20.0	17.37	6.54	Clay	CL/CH	stiff	125	14		100			0.97	7.56

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

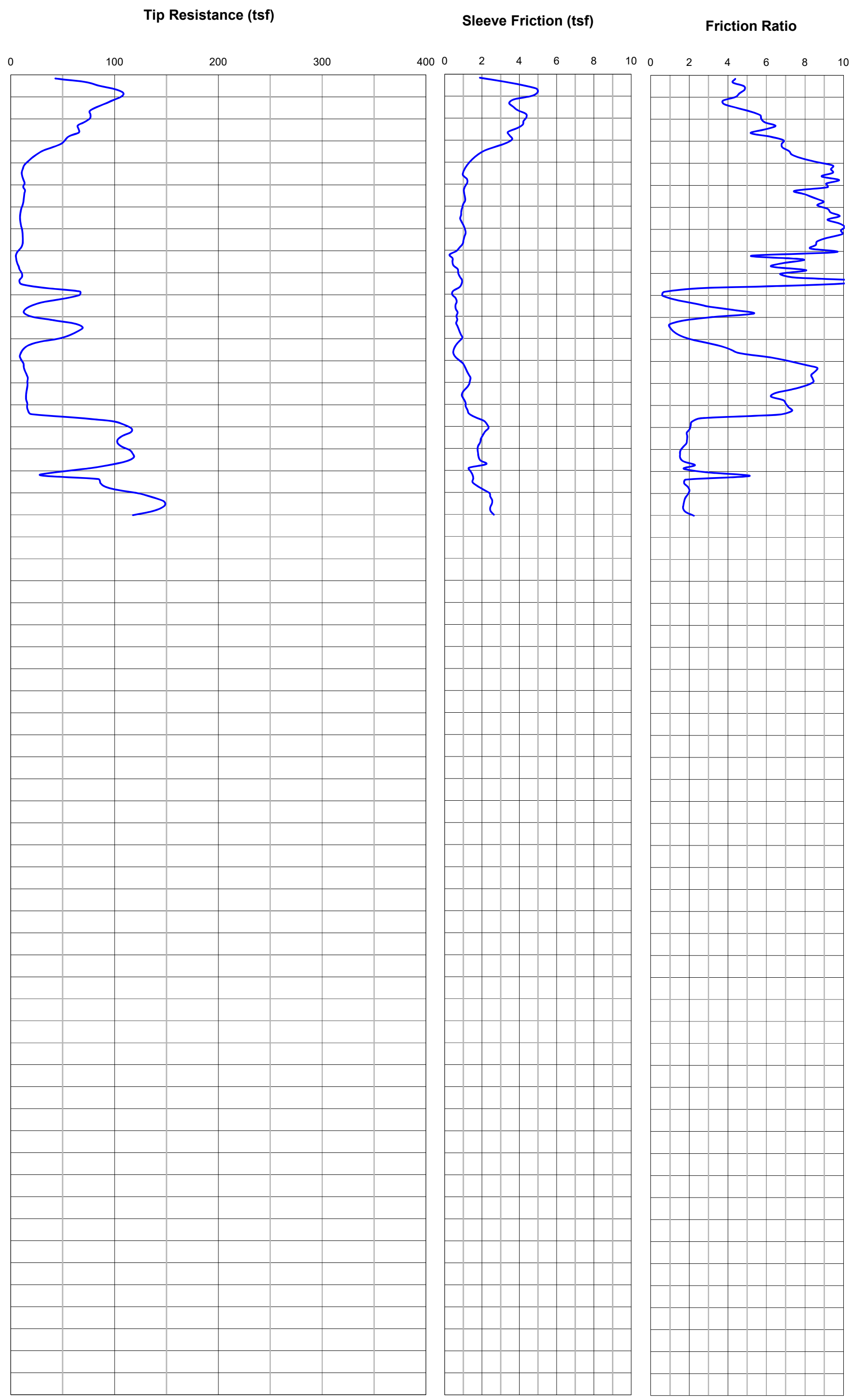
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-16

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH	Soil	Symbol	Consistency
	Overconsolidated Soil	??	very dense
	Overconsolidated Soil	" "	very dense
	Overconsolidated Soil	" "	dense
	Clay	CL/CH	very stiff
5	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	firm
	Clay	" "	very stiff
10	Clayey Silt to Silty Clay	ML/CL	very stiff
	Silty Sand to Sandy Silt	SM/ML	medium dense
	Clay	CL/CH	stiff
	Clay	" "	stiff
	Clay	" "	stiff
15	Clayey Silt to Silty Clay	ML/CL	hard
	Silty Sand to Sandy Silt	SM/ML	dense
	Silty Sand to Sandy Silt	" "	dense
	Silty Sand to Sandy Silt	" "	dense
	Sand to Silty Sand	SP/SM	dense
20			
25			
30			
35			
40			
45			
50			
55			



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-16

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-16
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	66.88	4.49	Clayey Silt to Silty Clay	ML/CL	hard	120	27		50			3.93	>10
0.30	1.0	105.31	4.62	Overconsolidated Soil	??	very dense	120	105	199.1	45	119	45		
0.45	1.5	90.56	4.01	Clayey Silt to Silty Clay	ML/CL	hard	120	36		40			5.32	>10
0.60	2.0	76.40	5.51	Overconsolidated Soil	??	very dense	120	76	144.4	55	97	42		
0.75	2.5	67.16	6.10	Overconsolidated Soil	??	dense	120	67	127.0	60	89	41		
0.93	3.0	58.01	6.09	Clay	CL/CH	hard	125	46		65			3.40	>10
1.08	3.5	40.24	6.93	Clay	CL/CH	hard	125	32		75			2.36	>10
1.23	4.0	20.68	7.92	Clay	CL/CH	very stiff	125	17		100			1.20	>10
1.38	4.5	11.76	9.41	Clay	CL/CH	stiff	125	9		100			0.68	>10
1.53	5.0	12.15	9.24	Clay	CL/CH	stiff	125	10		100			0.70	>10
1.68	5.5	12.87	8.29	Clay	CL/CH	stiff	125	10		100			0.74	>10
1.83	6.0	11.31	8.93	Clay	CL/CH	stiff	125	9		100			0.64	>10
1.98	6.5	9.16	9.44	Clay	CL/CH	stiff	125	7		100			0.52	>10
2.13	7.0	10.17	9.90	Clay	CL/CH	stiff	125	8		100			0.57	>10
2.28	7.5	11.48	9.25	Clay	CL/CH	stiff	125	9		100			0.65	>10
2.45	8.0	9.10	8.81	Clay	CL/CH	stiff	125	7		100			0.51	6.76
2.60	8.5	5.42	6.67	Clay	CL/CH	firm	125	4		100			0.29	3.00
2.75	9.0	8.95	7.02	Clay	CL/CH	firm	125	7		100			0.50	6.00
2.90	9.5	9.79	9.13	Clay	CL/CH	stiff	125	8		100			0.54	6.54
3.05	10.0	54.77	1.26	Silty Sand to Sandy Silt	SM/ML	medium dense	115	12	72.5	30	63	37		
3.20	10.5	33.81	2.05	Sandy Silt to Clayey Silt	ML	medium dense	115	10	44.2	50	48	35		
3.35	11.0	15.62	4.25	Clay	CL/CH	stiff	125	12		95			0.89	>10
3.50	11.5	57.88	1.20	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	73.8	30	64	37		
3.65	12.0	56.74	1.55	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	71.5	35	63	37		
3.80	12.5	18.71	3.53	Silty Clay to Clay	CL	very stiff	125	11		85			1.06	>10
3.95	13.0	9.60	5.89	Clay	CL/CH	stiff	125	8		100			0.53	4.78
4.13	13.5	12.80	8.33	Clay	CL/CH	stiff	125	10		100			0.72	7.41
4.28	14.0	15.86	8.38	Clay	CL/CH	stiff	125	13		100			0.89	>10
4.43	14.5	15.58	7.27	Clay	CL/CH	stiff	125	12		100			0.88	>10
4.58	15.0	15.17	6.71	Clay	CL/CH	stiff	125	12		100			0.85	8.85
4.73	15.5	17.29	7.04	Clay	CL/CH	stiff	125	14		100			0.98	>10
4.88	16.0	96.80	2.20	Silty Sand to Sandy Silt	SM/ML	dense	115	22	111.1	35	76	39		
5.03	16.5	108.95	1.88	Silty Sand to Sandy Silt	SM/ML	dense	115	24	123.9	30	79	39		
5.18	17.0	108.14	1.68	Silty Sand to Sandy Silt	SM/ML	dense	115	24	121.9	30	78	39		
5.33	17.5	116.02	1.59	Sand to Silty Sand	SP/SM	dense	115	21	129.7	25	80	39		
5.48	18.0	73.41	2.32	Silty Sand to Sandy Silt	SM/ML	medium dense	115	16	81.3	40	66	37		
5.65	18.5	66.54	2.89	Sandy Silt to Clayey Silt	ML	medium dense	115	19	73.1	50	63	37		
5.80	19.0	105.45	1.96	Silty Sand to Sandy Silt	SM/ML	dense	115	23	114.9	30	77	39		
5.95	19.5	143.73	1.74	Sand to Silty Sand	SP/SM	dense	115	26	155.3	25	85	40		
6.10	20.0	132.74	1.91	Silty Sand to Sandy Silt	SM/ML	dense	115	29	142.3	30	83	40		

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

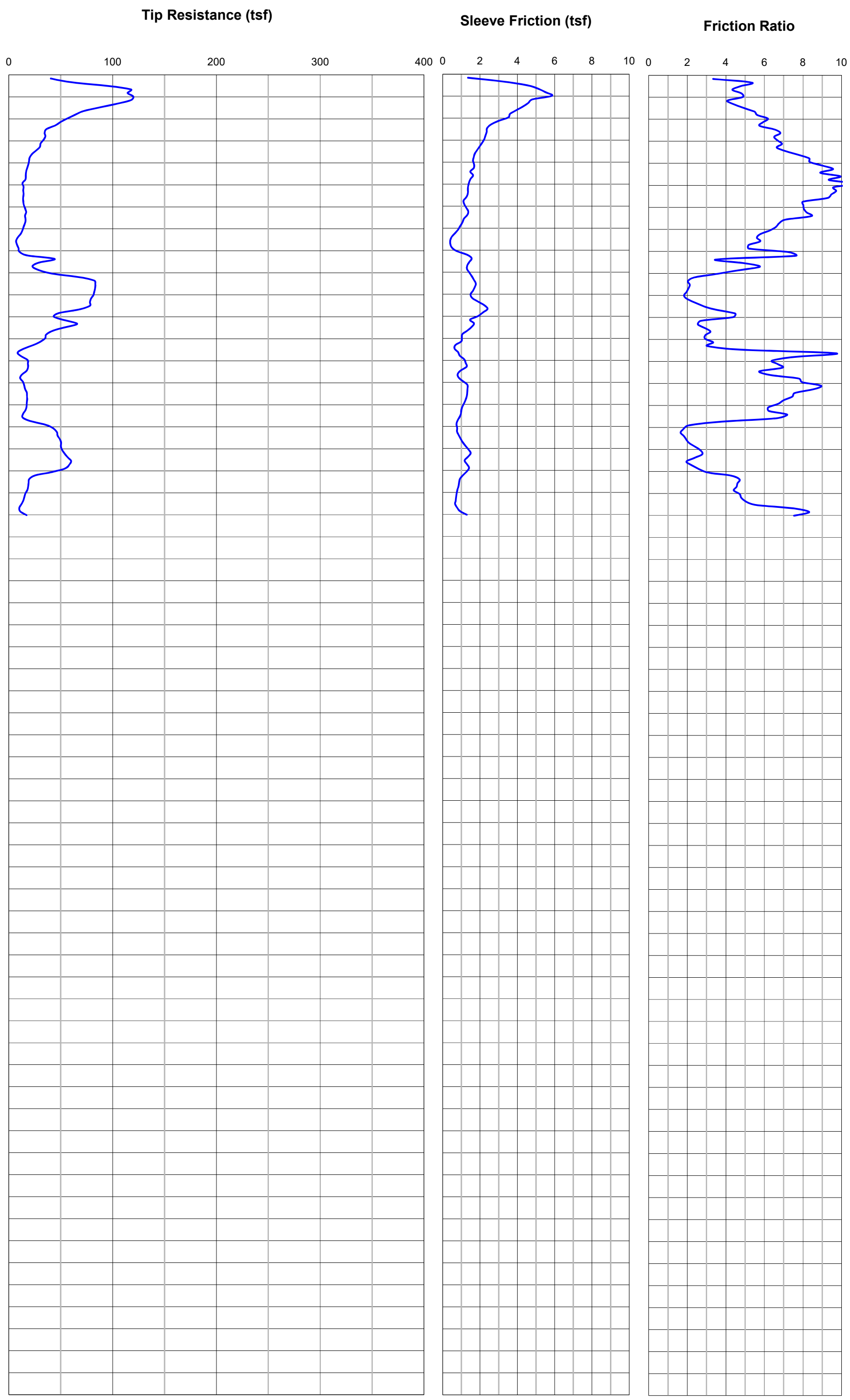
CONE SOUNDING DATA CPT-17

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Overconsolidated Soil	??	very dense
Overconsolidated Soil	" "	very dense
Clay	CL/CH	hard
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Silty Sand to Sandy Silt	SM/ML	dense
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Sandy Silt to Clayey Silt	" "	medium dense
Clay	CL/CH	very stiff
Clay	" "	stiff



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-17

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

Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-17
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	64.29	4.48	Clayey Silt to Silty Clay	ML/CL	hard	120	26		50			3.78	>10
0.30	1.0	117.32	4.67	Overconsolidated Soil	??	very dense	120	117	221.8	40	122	45		
0.45	1.5	103.12	4.46	Overconsolidated Soil	??	very dense	120	103	194.9	45	111	44		
0.60	2.0	64.36	5.76	Overconsolidated Soil	??	very dense	120	64	121.7	60	92	41		
0.75	2.5	43.76	6.07	Clay	CL/CH	hard	125	35		70			2.57	>10
0.93	3.0	34.36	6.67	Clay	CL/CH	hard	125	27		80			2.01	>10
1.08	3.5	28.82	6.88	Clay	CL/CH	very stiff	125	23		85			1.68	>10
1.23	4.0	20.52	8.14	Clay	CL/CH	very stiff	125	16		100			1.19	>10
1.38	4.5	17.55	9.15	Clay	CL/CH	very stiff	125	14		100			1.02	>10
1.53	5.0	15.16	10.01	Clay	CL/CH	stiff	125	12		100			0.87	>10
1.68	5.5	14.00	9.51	Clay	CL/CH	stiff	125	11		100			0.80	>10
1.83	6.0	14.66	8.02	Clay	CL/CH	stiff	125	12		100			0.84	>10
1.98	6.5	16.14	7.90	Clay	CL/CH	stiff	125	13		100			0.93	>10
2.13	7.0	14.41	6.54	Clay	CL/CH	stiff	125	12		100			0.82	>10
2.28	7.5	9.09	5.72	Clay	CL/CH	stiff	125	7		100			0.51	7.56
2.45	8.0	9.09	5.89	Clay	CL/CH	stiff	125	7		100			0.51	6.76
2.60	8.5	30.10	5.34	Clay	CL/CH	very stiff	125	24		75			1.74	>10
2.75	9.0	30.35	4.66	Silty Clay to Clay	CL	very stiff	125	17		70			1.76	>10
2.90	9.5	77.38	2.17	Silty Sand to Sandy Silt	SM/ML	dense	115	17	103.8	30	74	38		
3.05	10.0	82.35	1.95	Silty Sand to Sandy Silt	SM/ML	dense	115	18	109.1	30	75	39		
3.20	10.5	78.45	2.42	Silty Sand to Sandy Silt	SM/ML	dense	115	17	102.7	35	73	38		
3.35	11.0	53.06	4.13	Clayey Silt to Silty Clay	ML/CL	hard	120	21		55			3.09	>10
3.50	11.5	57.81	2.72	Sandy Silt to Clayey Silt	ML	medium dense	115	17	73.9	45	64	37		
3.65	12.0	37.44	3.02	Clayey Silt to Silty Clay	ML/CL	hard	120	15		60			2.17	>10
3.80	12.5	21.89	3.70	Silty Clay to Clay	CL	very stiff	125	13		80			1.25	>10
3.95	13.0	12.85	7.90	Clay	CL/CH	stiff	125	10		100			0.72	7.85
4.13	13.5	18.00	6.45	Clay	CL/CH	very stiff	125	14		100			1.02	>10
4.28	14.0	12.39	7.33	Clay	CL/CH	stiff	125	10		100			0.69	6.76
4.43	14.5	15.88	8.35	Clay	CL/CH	stiff	125	13		100			0.89	>10
4.58	15.0	17.45	7.06	Clay	CL/CH	stiff	125	14		100			0.99	>10
4.73	15.5	15.53	6.54	Clay	CL/CH	stiff	125	12		100			0.87	8.85
4.88	16.0	28.50	3.53	Clayey Silt to Silty Clay	ML/CL	very stiff	120	11		75			1.63	>10
5.03	16.5	47.53	1.81	Silty Sand to Sandy Silt	SM/ML	medium dense	115	11	54.1	45	54	36		
5.18	17.0	50.65	2.43	Sandy Silt to Clayey Silt	ML	medium dense	115	14	57.1	50	56	36		
5.33	17.5	56.92	2.37	Sandy Silt to Clayey Silt	ML	medium dense	115	16	63.6	50	59	36		
5.48	18.0	51.86	2.61	Sandy Silt to Clayey Silt	ML	medium dense	115	15	57.5	55	56	36		
5.65	18.5	21.29	4.56	Clay	CL/CH	very stiff	125	17		100			1.21	>10
5.80	19.0	17.51	4.56	Clay	CL/CH	stiff	125	14		100			0.98	8.70
5.95	19.5	13.60	5.11	Clay	CL/CH	stiff	125	11		100			0.75	5.42
6.10	20.0	12.74	7.80	Clay	CL/CH	stiff	125	10		100			0.70	4.78

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Project -- Calexico, CA
LOCATION: See Site and Boring Location Plan

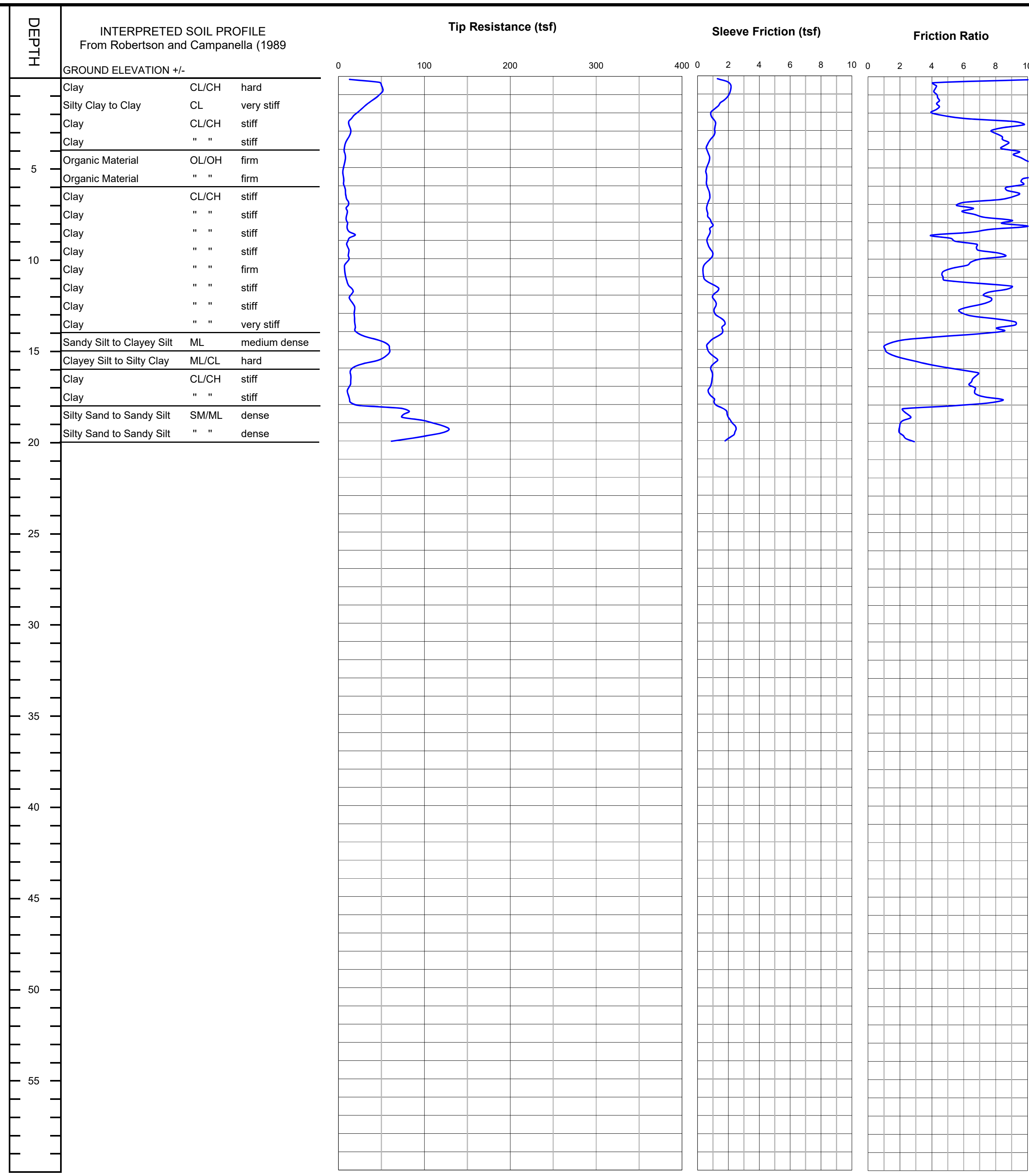
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-18

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clay	CL/CH	hard
Silty Clay to Clay	CL	very stiff
Clay	CL/CH	stiff
Clay	" "	stiff
Organic Material	OL/OH	firm
Organic Material	" "	firm
Clay	CL/CH	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	firm
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Sandy Silt to Clayey Silt	ML	medium dense
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	stiff
Clay	" "	stiff
Silty Sand to Sandy Silt	SM/ML	dense
Silty Sand to Sandy Silt	" "	dense



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
B-18

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

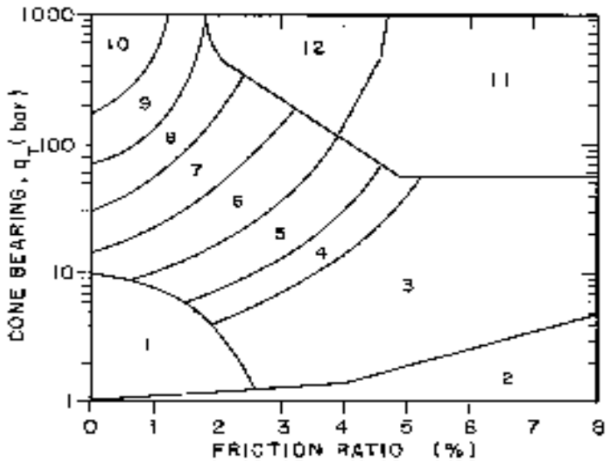
Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

CONE SOUNDING: CPT-18
Est. GWT (ft): 8
Phi Correlation: **0** 0-Schm(78),1-R&C(83),2-PHT(74)

Base Depth (m)	Base Depth (ft)	Avg Tip Qc, tsf	Avg Friction Ratio, %	Soil Classification	USCS	Density or Consistency	Est. Density (pcf)	SPT N(60)	Norm. Qc1n	Est. % Fines	Rel. Dens. Dr (%)	**Nk:** Phi (deg.)	**17** Su (tsf)	OCR
0.15	0.5	36.89	6.12	Clay	CL/CH	hard	125	30		75			2.17	>10
0.30	1.0	50.29	4.22	Clayey Silt to Silty Clay	ML/CL	hard	120	20		55			2.96	>10
0.45	1.5	39.37	4.38	Silty Clay to Clay	CL	hard	125	22		60			2.31	>10
0.60	2.0	26.33	4.23	Silty Clay to Clay	CL	very stiff	125	15		70			1.54	>10
0.75	2.5	15.15	6.72	Clay	CL/CH	stiff	125	12		100			0.88	>10
0.93	3.0	13.19	8.67	Clay	CL/CH	stiff	125	11		100			0.77	>10
1.08	3.5	12.32	8.29	Clay	CL/CH	stiff	125	10		100			0.71	>10
1.23	4.0	7.53	8.58	Clay	CL/CH	firm	125	6		100			0.43	>10
1.38	4.5	7.47	9.38	Organic Material	OL/OH	firm	120	7		100			0.42	>10
1.53	5.0	7.02	10.13	Organic Material	OL/OH	firm	120	7		100			0.40	>10
1.68	5.5	5.47	10.47	Organic Material	OL/OH	firm	120	5		100			0.30	7.27
1.83	6.0	6.39	9.33	Organic Material	OL/OH	firm	120	6		100			0.36	8.27
1.98	6.5	8.27	9.12	Clay	CL/CH	firm	125	7		100			0.46	8.41
2.13	7.0	10.88	6.64	Clay	CL/CH	stiff	125	9		100			0.62	>10
2.28	7.5	9.67	6.38	Clay	CL/CH	stiff	125	8		100			0.54	8.56
2.45	8.0	9.54	8.24	Clay	CL/CH	stiff	125	8		100			0.53	7.41
2.60	8.5	11.03	8.04	Clay	CL/CH	stiff	125	9		100			0.62	9.00
2.75	9.0	14.45	4.86	Clay	CL/CH	stiff	125	12		95			0.82	>10
2.90	9.5	10.76	6.84	Clay	CL/CH	stiff	125	9		100			0.60	7.70
3.05	10.0	11.88	7.94	Clay	CL/CH	stiff	125	10		100			0.67	8.70
3.20	10.5	8.13	5.98	Clay	CL/CH	firm	125	7		100			0.45	4.37
3.35	11.0	7.73	4.69	Clay	CL/CH	firm	125	6		100			0.42	3.91
3.50	11.5	10.59	6.84	Clay	CL/CH	stiff	125	8		100			0.59	6.21
3.65	12.0	15.74	7.84	Clay	CL/CH	stiff	125	13		100			0.89	>10
3.80	12.5	14.57	7.52	Clay	CL/CH	stiff	125	12		100			0.82	>10
3.95	13.0	18.63	5.96	Clay	CL/CH	very stiff	125	15		100			1.06	>10
4.13	13.5	18.64	7.96	Clay	CL/CH	very stiff	125	15		100			1.06	>10
4.28	14.0	19.32	8.61	Clay	CL/CH	very stiff	125	15		100			1.10	>10
4.43	14.5	32.87	4.40	Silty Clay to Clay	CL	very stiff	125	19		75			1.89	>10
4.58	15.0	57.30	1.17	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	66.8	30	61	36		
4.73	15.5	56.62	1.58	Silty Sand to Sandy Silt	SM/ML	medium dense	115	13	65.4	40	60	36		
4.88	16.0	27.30	4.25	Silty Clay to Clay	CL	very stiff	125	16		85			1.56	>10
5.03	16.5	14.11	6.74	Clay	CL/CH	stiff	125	11		100			0.79	6.76
5.18	17.0	13.43	6.51	Clay	CL/CH	stiff	125	11		100			0.75	6.10
5.33	17.5	11.01	6.89	Clay	CL/CH	stiff	125	9		100			0.60	4.28
5.48	18.0	16.29	7.16	Clay	CL/CH	stiff	125	13		100			0.91	7.85
5.65	18.5	77.08	2.32	Silty Sand to Sandy Silt	SM/ML	medium dense	115	17	83.8	40	67	37		
5.80	19.0	94.19	2.29	Silty Sand to Sandy Silt	SM/ML	dense	115	21	101.5	40	73	38		
5.95	19.5	124.97	1.96	Silty Sand to Sandy Silt	SM/ML	dense	115	28	133.6	30	81	39		
6.10	20.0	84.63	2.49	Silty Sand to Sandy Silt	SM/ML	medium dense	115	19	89.8	45	69	38		

Simplified Soil Classification Chart

After Robertson & Campanella (1989)



Geotechnical Parameters from CPT Data:

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

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

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

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

Dr = Relative density (%) from Jamiolkowski et. al. (1986) relationship

= -98 +68*log(Qc/p'o^0.5) where Qc, p'o in tonne/sqm

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

Phi = Friction Angle estimated from either:

1. Roberton & Campanella (1983) chart:

Phi = 5.3 + 24*(log(Qc/p'o))+3(log(Qc/p'o))^2

2. Peck, Hansen & Thornburn (1974) N-Phi Correlation

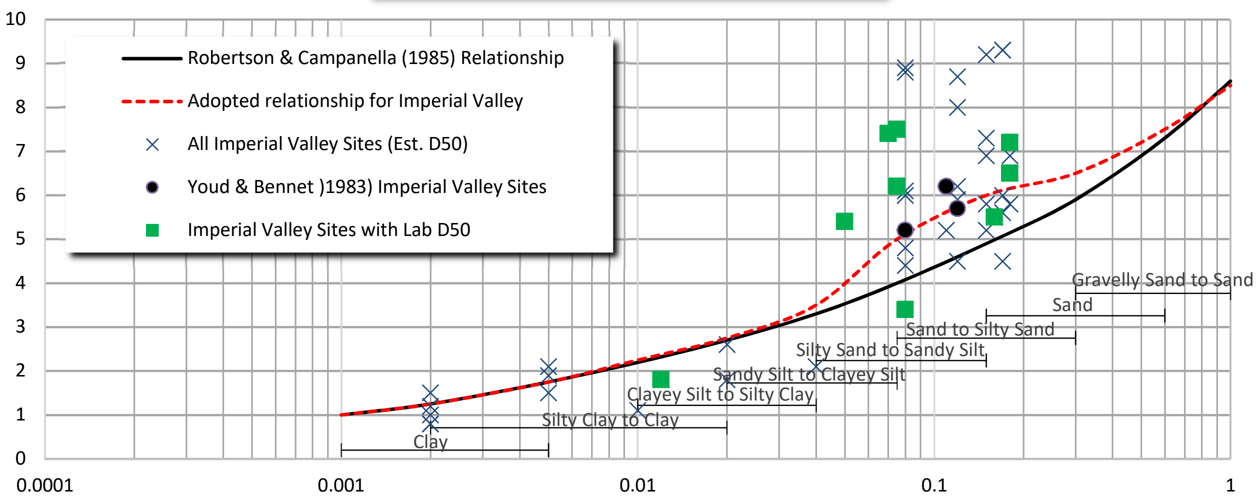
3. Schmertman (1978) chart [Phi = 28+0.14*Dr for fine uniform sands]

Su = undrained shear strength (tsf)

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

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

Variation of Qc/N Ratio with Grain Size



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

Table of Soil Types and Assumed Properties

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

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

LANDMARK Geo-Engineers and Geologists

Project No: LE18150

Key to CPT Interpretation of Logs

Plate B-19

APPENDIX C

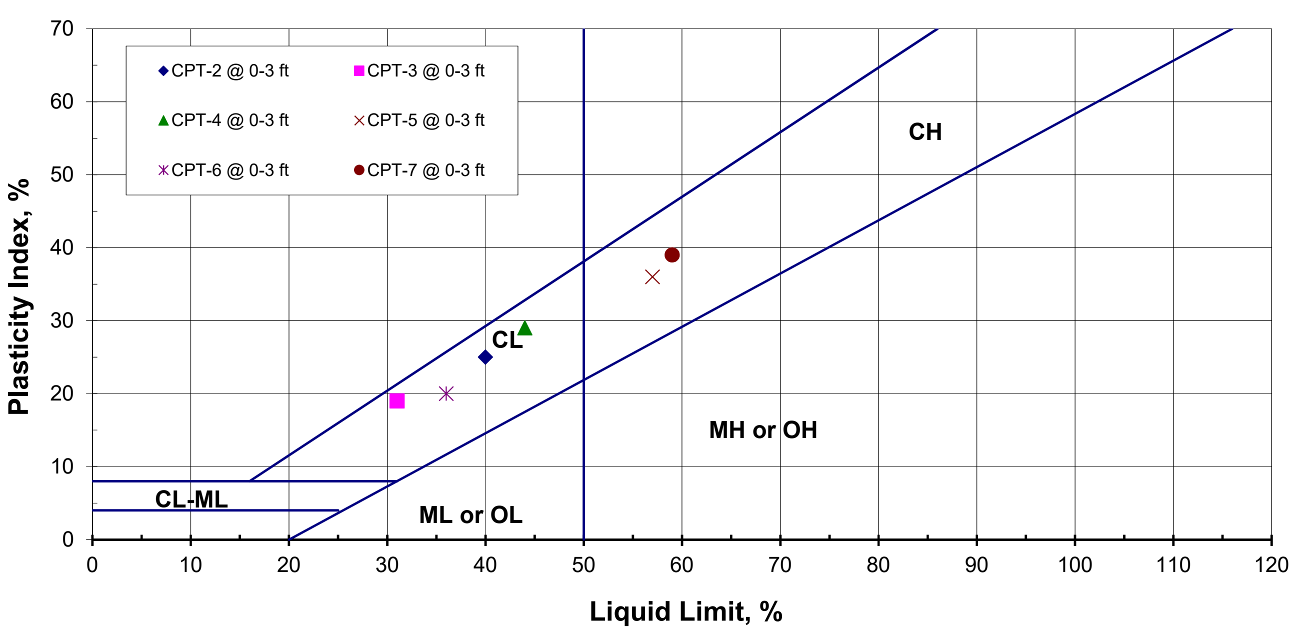
LANDMARK CONSULTANTS, INC.

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Facility - Calexico, CA
JOB No.: LE18150
DATE: 09/14/18

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
CPT-2	0-3	40	15	25	CL
CPT-3	0-3	31	12	19	CL
CPT-4	0-3	44	15	29	CL
CPT-5	0-3	57	21	36	CH
CPT-6	0-3	36	16	20	CL
CPT-7	0-3	59	20	39	CH

PLASTICITY CHART



LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Atterberg Limits Test Results

Plate C-1

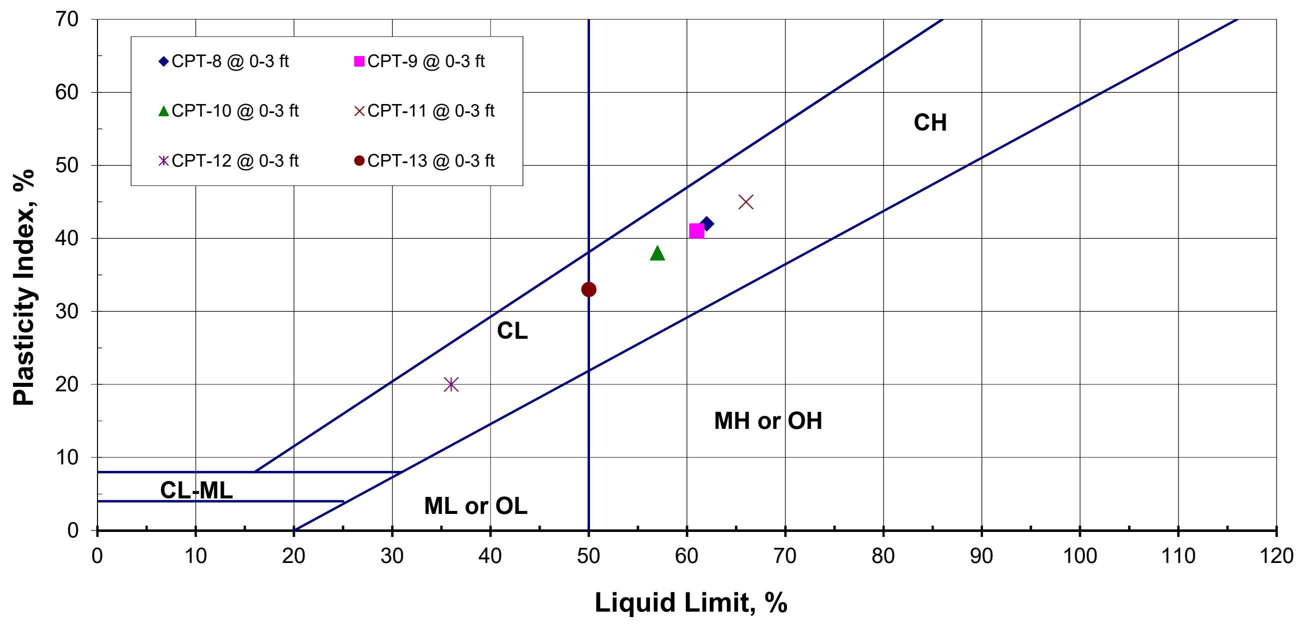
LANDMARK CONSULTANTS, INC.

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Facility - Calexico, CA
JOB No.: LE18150
DATE: 09/14/18

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
CPT-8	0-3	62	20	42	CH
CPT-9	0-3	61	20	41	CH
CPT-10	0-3	57	19	38	CH
CPT-11	0-3	66	21	45	CH
CPT-12	0-3	36	16	20	CL
CPT-13	0-3	50	17	33	CL-CH

PLASTICITY CHART



Project No.: LE18150

Atterberg Limits Test Results

Plate C-2

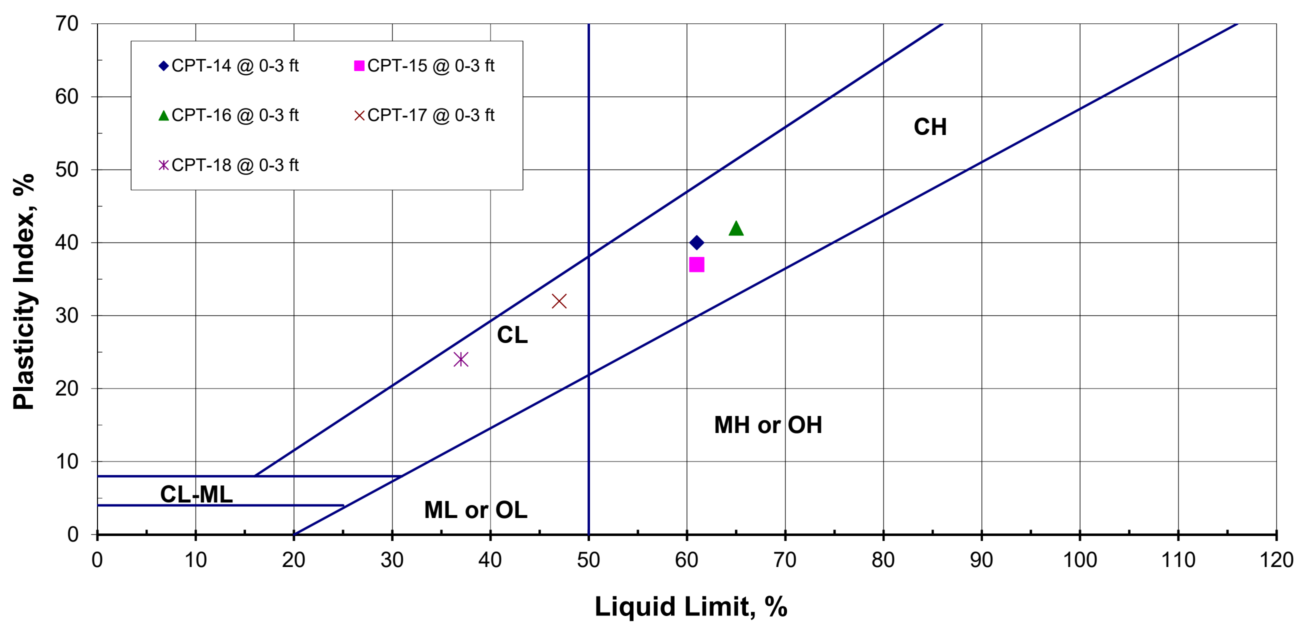
LANDMARK CONSULTANTS, INC.

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Facility - Calexico, CA
JOB No.: LE18150
DATE: 09/14/18

ATTERBERG LIMITS (ASTM D4318)

Sample Location	Sample Depth (ft)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	USCS Classification
CPT-14	0-3	61	21	40	CH
CPT-15	0-3	61	24	37	CH
CPT-16	0-3	65	23	42	CH
CPT-17	0-3	47	15	32	CL
CPT-18	0-3	37	13	24	CL

PLASTICITY CHART

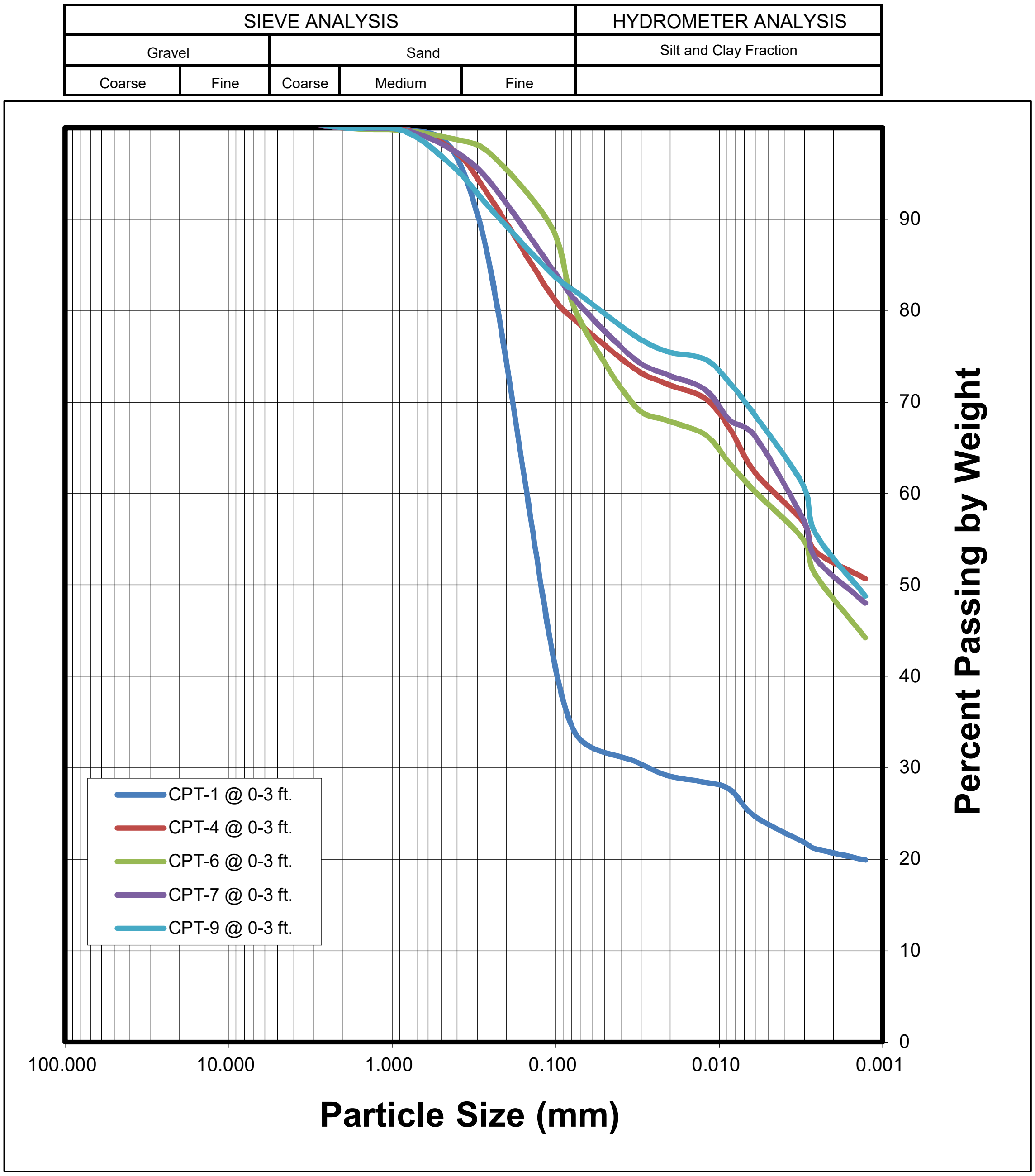


LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Atterberg Limits Test Results

Plate C-3

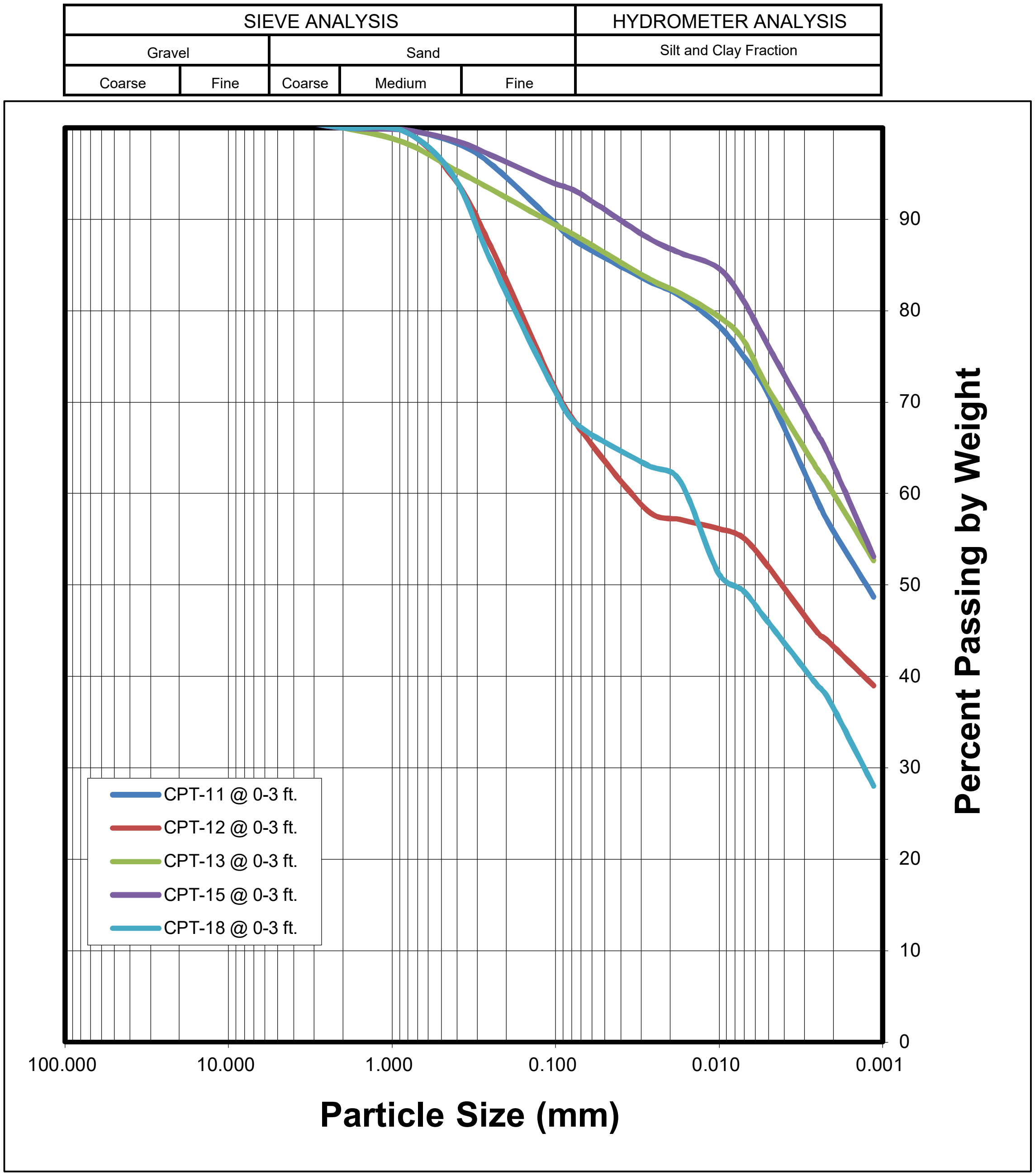


LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Grain Size Analysis

Plate C-4



LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Grain Size Analysis

Plate C-5

LANDMARK CONSULTANTS, INC.

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Facility -- Calexico, CA
JOB No.: LE18150
DATE: 09/11/18

CHEMICAL ANALYSIS

Boring:	CPT-5	CPT-8	CPT-10	CPT-14	CPT-17	**Caltrans**
Sample Depth, ft:	0-3	0-3	0-3	0-3	0-3	**Method**
pH:	7.5	7.8	7.6	7.6	7.5	**643**
Electrical Conductivity (mmhos):	5.6	5.1	3.2	6.3	3.4	**424**
Resistivity (ohm-cm):	160	150	240	140	160	**643**
Chloride (Cl), ppm:	1,660	2,560	1,300	3,640	1,300	**422**
Sulfate (SO4), ppm:	11,372	9,305	4,628	11,280	5,486	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	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.: LE18150

Selected Chemical Test Results

Plate C-6

LANDMARK CONSULTANTS, INC.

CLIENT: Drew Solar, LLC
PROJECT: Drew Solar Facility -- Calexico, CA
JOB NO: LE18150
DATE: 9/13/2018

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
CPT-1 0-3 ft.	13.8	103.7	28.6	10.9	119	High

UBC CLASSIFICATION

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

LANDMARK
Geo-Engineers and Geologists
Project No.: LE18150

Expansion Index Test Results

Plate C-7

APPENDIX D

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

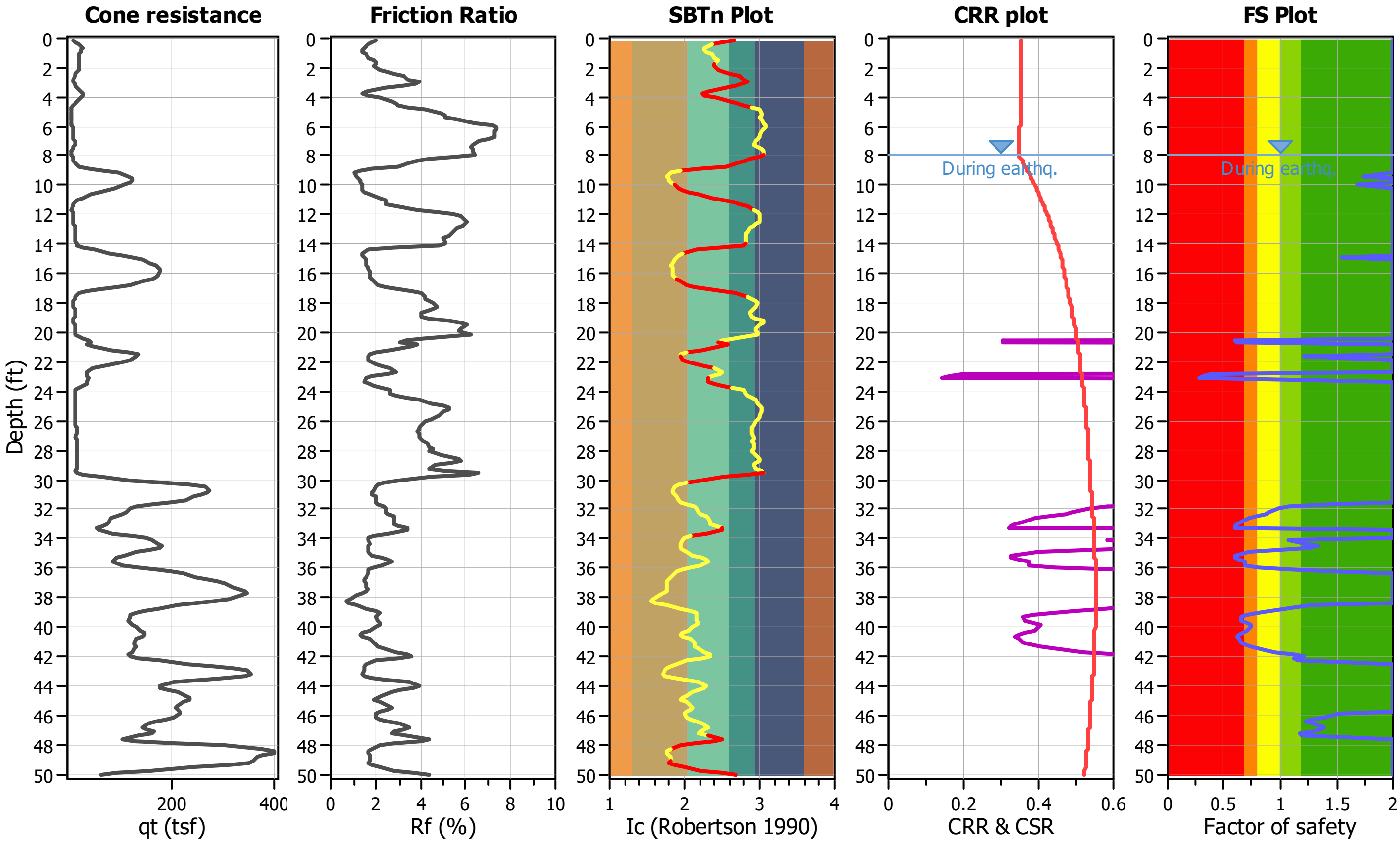
LIQUEFACTION ANALYSIS REPORT

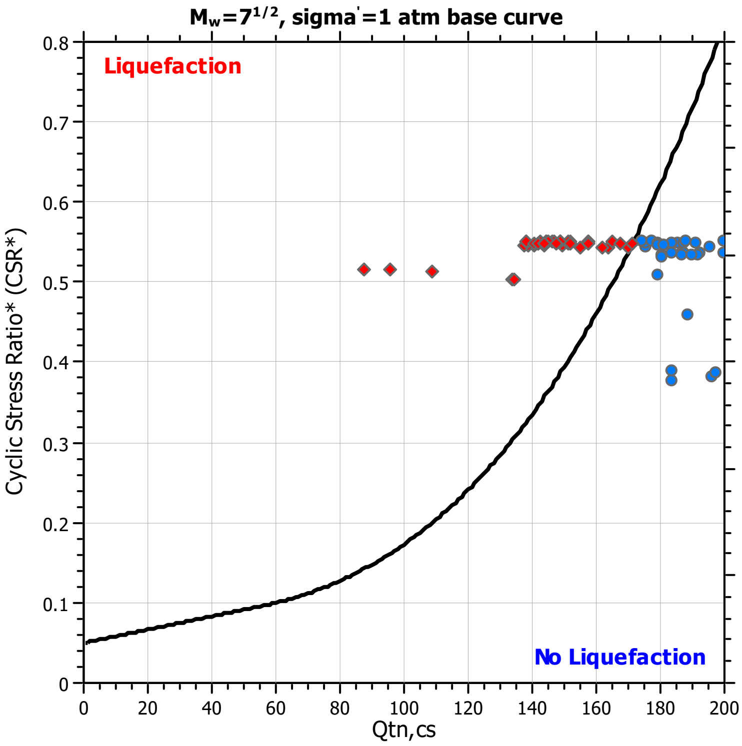
Project title : Drew Solar Project **Location : Calexico, CA**

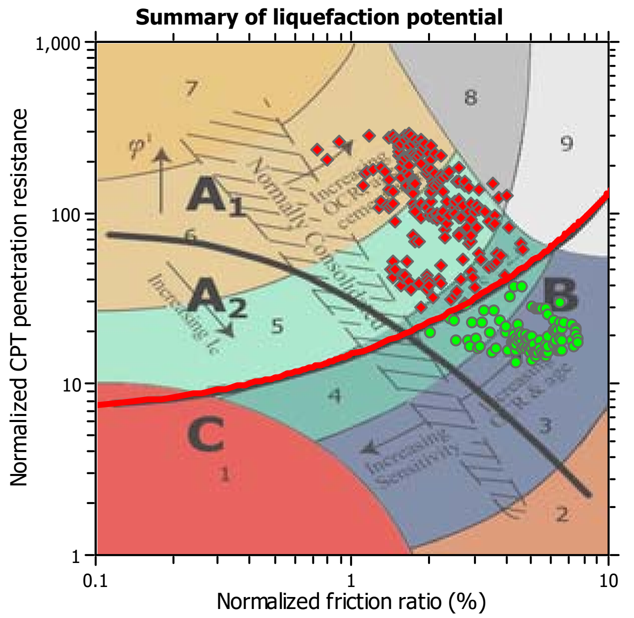
CPT file : CPT-01

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

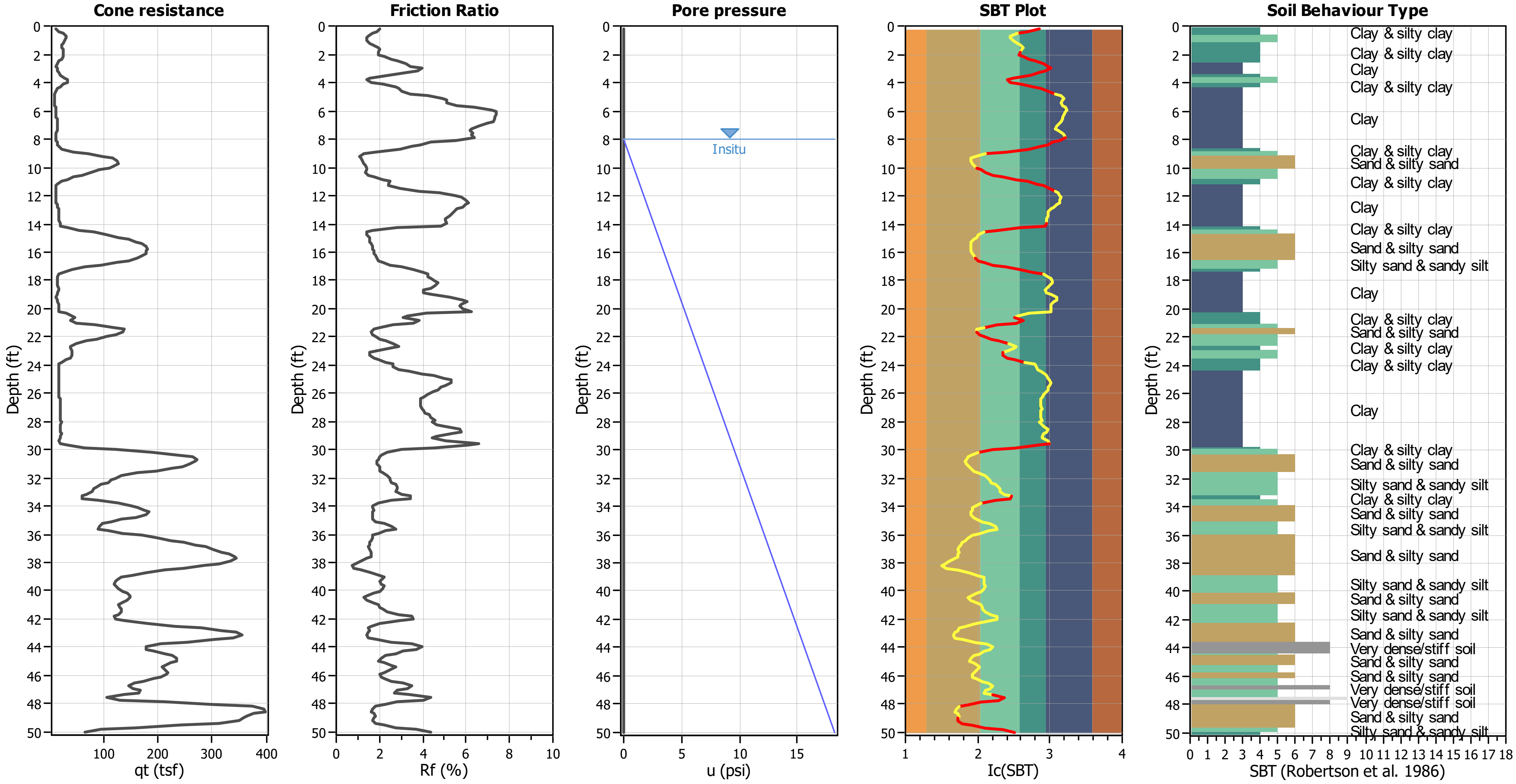






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



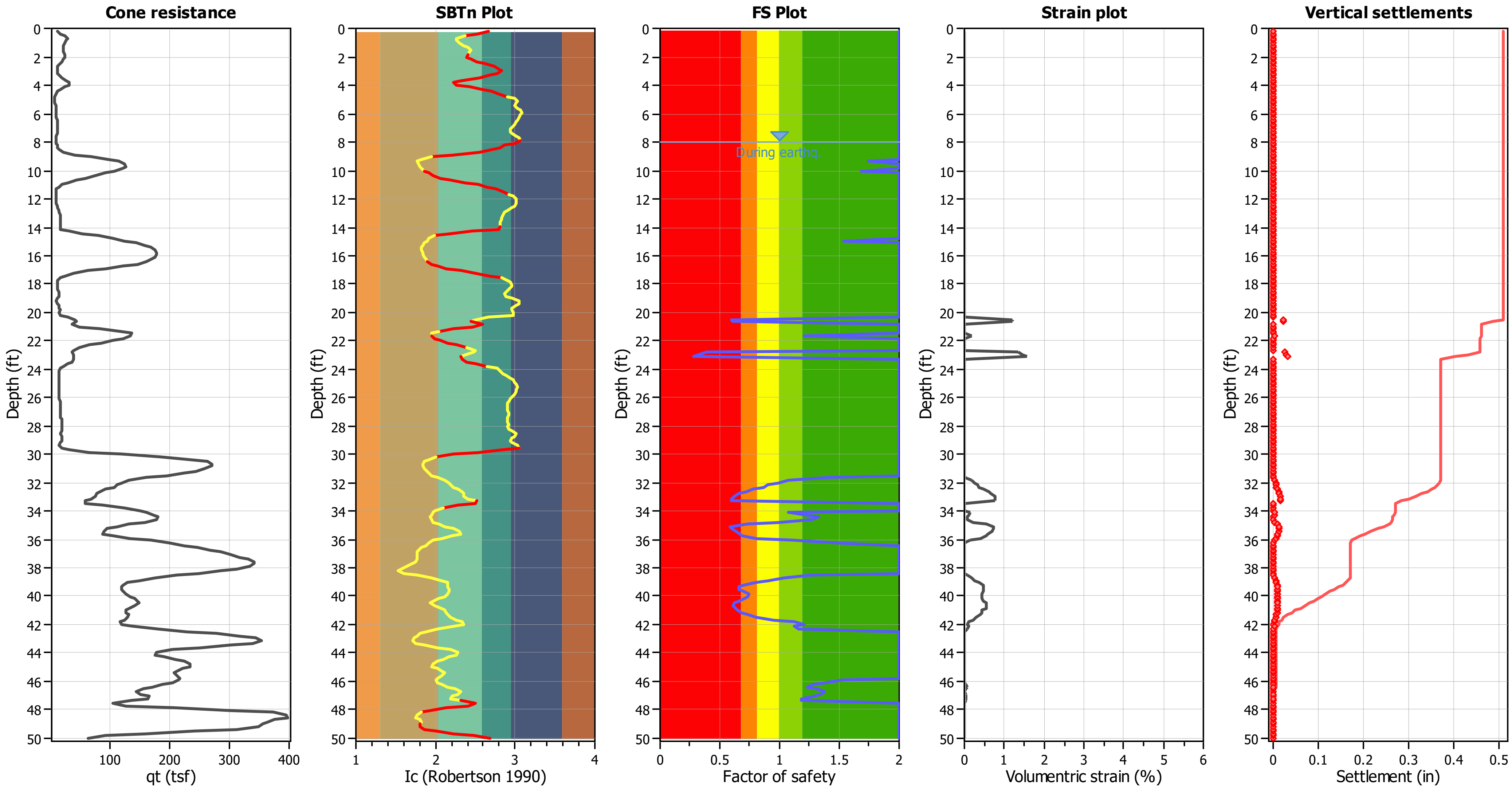
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.50	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	111.76	2.00	0.00	0.86	0.00	8.20	107.42	2.00	0.00	0.86	0.00
8.37	104.73	2.00	0.00	0.86	0.00	8.53	107.56	2.00	0.00	0.86	0.00
8.69	111.65	2.00	0.00	0.85	0.00	8.86	113.98	2.00	0.00	0.85	0.00
9.02	134.62	2.00	0.00	0.85	0.00	9.19	161.35	2.00	0.00	0.84	0.00
9.35	183.64	1.74	0.00	0.84	0.00	9.51	196.55	2.00	0.00	0.84	0.00
9.68	202.25	2.00	0.00	0.84	0.00	9.84	197.76	2.00	0.00	0.83	0.00
10.01	183.62	1.68	0.00	0.83	0.00	10.17	162.30	2.00	0.00	0.83	0.00
10.33	140.50	2.00	0.00	0.82	0.00	10.50	123.73	2.00	0.00	0.82	0.00
10.66	113.77	2.00	0.00	0.82	0.00	10.83	108.28	2.00	0.00	0.82	0.00
10.99	98.24	2.00	0.00	0.81	0.00	11.15	86.10	2.00	0.00	0.81	0.00
11.32	78.66	2.00	0.00	0.81	0.00	11.48	82.37	2.00	0.00	0.81	0.00
11.65	92.49	2.00	0.00	0.80	0.00	11.81	102.83	2.00	0.00	0.80	0.00
11.98	111.32	2.00	0.00	0.80	0.00	12.14	116.09	2.00	0.00	0.79	0.00
12.30	119.76	2.00	0.00	0.79	0.00	12.47	124.15	2.00	0.00	0.79	0.00
12.63	129.07	2.00	0.00	0.79	0.00	12.80	133.72	2.00	0.00	0.78	0.00
12.96	136.54	2.00	0.00	0.78	0.00	13.12	138.37	2.00	0.00	0.78	0.00
13.29	137.43	2.00	0.00	0.77	0.00	13.45	135.48	2.00	0.00	0.77	0.00
13.62	133.15	2.00	0.00	0.77	0.00	13.78	133.66	2.00	0.00	0.77	0.00
13.94	135.21	2.00	0.00	0.76	0.00	14.11	132.72	2.00	0.00	0.76	0.00
14.27	119.70	2.00	0.00	0.76	0.00	14.44	117.56	2.00	0.00	0.76	0.00
14.60	136.88	2.00	0.00	0.75	0.00	14.76	162.74	2.00	0.00	0.75	0.00
14.93	188.83	1.54	0.00	0.75	0.00	15.09	210.14	2.00	0.00	0.74	0.00
15.26	226.46	2.00	0.00	0.74	0.00	15.42	237.47	2.00	0.00	0.74	0.00
15.58	245.99	2.00	0.00	0.74	0.00	15.75	249.59	2.00	0.00	0.73	0.00
15.91	249.52	2.00	0.00	0.73	0.00	16.08	247.43	2.00	0.00	0.73	0.00
16.24	242.44	2.00	0.00	0.72	0.00	16.40	233.41	2.00	0.00	0.72	0.00
16.57	219.57	2.00	0.00	0.72	0.00	16.73	200.64	2.00	0.00	0.72	0.00
16.90	179.56	2.00	0.00	0.71	0.00	17.06	160.73	2.00	0.00	0.71	0.00
17.22	143.71	2.00	0.00	0.71	0.00	17.39	126.84	2.00	0.00	0.71	0.00
17.55	111.78	2.00	0.00	0.70	0.00	17.72	103.39	2.00	0.00	0.70	0.00
17.88	100.85	2.00	0.00	0.70	0.00	18.04	102.14	2.00	0.00	0.69	0.00
18.21	106.04	2.00	0.00	0.69	0.00	18.37	107.35	2.00	0.00	0.69	0.00
18.54	107.20	2.00	0.00	0.69	0.00	18.70	103.49	2.00	0.00	0.68	0.00
18.86	101.15	2.00	0.00	0.68	0.00	19.03	100.34	2.00	0.00	0.68	0.00
19.19	104.15	2.00	0.00	0.67	0.00	19.36	113.13	2.00	0.00	0.67	0.00
19.52	122.69	2.00	0.00	0.67	0.00	19.69	126.36	2.00	0.00	0.67	0.00
19.85	126.40	2.00	0.00	0.66	0.00	20.01	125.72	2.00	0.00	0.66	0.00
20.18	132.72	2.00	0.00	0.66	0.00	20.34	135.78	2.00	0.00	0.66	0.00
20.51	133.94	0.60	1.20	0.65	0.02	20.67	134.26	0.61	1.19	0.65	0.02
20.83	138.89	2.00	0.00	0.65	0.00	21.00	150.34	2.00	0.00	0.64	0.00
21.16	161.15	2.00	0.00	0.64	0.00	21.33	178.03	2.00	0.00	0.64	0.00
21.49	185.63	2.00	0.00	0.64	0.00	21.65	179.21	1.21	0.17	0.63	0.00
21.82	168.41	2.00	0.00	0.63	0.00	21.98	156.57	2.00	0.00	0.63	0.00
22.15	143.83	2.00	0.00	0.62	0.00	22.31	132.42	2.00	0.00	0.62	0.00
22.47	123.55	2.00	0.00	0.62	0.00	22.64	118.00	2.00	0.00	0.62	0.00
22.80	108.81	0.39	1.34	0.61	0.03	22.97	95.56	0.31	1.48	0.61	0.03
23.13	87.41	0.28	1.59	0.61	0.03	23.29	85.77	2.00	0.00	0.61	0.00
23.46	88.44	2.00	0.00	0.60	0.00	23.62	87.58	2.00	0.00	0.60	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	85.38	2.00	0.00	0.60	0.00	23.95	81.70	2.00	0.00	0.59	0.00
24.11	80.38	2.00	0.00	0.59	0.00	24.28	83.59	2.00	0.00	0.59	0.00
24.44	89.03	2.00	0.00	0.59	0.00	24.61	95.45	2.00	0.00	0.58	0.00
24.77	101.94	2.00	0.00	0.58	0.00	24.93	106.57	2.00	0.00	0.58	0.00
25.10	108.73	2.00	0.00	0.57	0.00	25.26	107.76	2.00	0.00	0.57	0.00
25.43	105.39	2.00	0.00	0.57	0.00	25.59	102.90	2.00	0.00	0.57	0.00
25.75	101.22	2.00	0.00	0.56	0.00	25.92	100.27	2.00	0.00	0.56	0.00
26.08	99.57	2.00	0.00	0.56	0.00	26.25	98.72	2.00	0.00	0.56	0.00
26.41	98.24	2.00	0.00	0.55	0.00	26.57	98.72	2.00	0.00	0.55	0.00
26.74	98.34	2.00	0.00	0.55	0.00	26.90	97.85	2.00	0.00	0.54	0.00
27.07	97.30	2.00	0.00	0.54	0.00	27.23	98.76	2.00	0.00	0.54	0.00
27.40	101.58	2.00	0.00	0.54	0.00	27.56	104.22	2.00	0.00	0.53	0.00
27.72	106.67	2.00	0.00	0.53	0.00	27.89	109.18	2.00	0.00	0.53	0.00
28.05	108.72	2.00	0.00	0.52	0.00	28.22	110.27	2.00	0.00	0.52	0.00
28.38	111.64	2.00	0.00	0.52	0.00	28.54	117.90	2.00	0.00	0.52	0.00
28.71	120.45	2.00	0.00	0.51	0.00	28.87	118.90	2.00	0.00	0.51	0.00
29.04	109.12	2.00	0.00	0.51	0.00	29.20	101.47	2.00	0.00	0.51	0.00
29.36	103.72	2.00	0.00	0.50	0.00	29.53	128.20	2.00	0.00	0.50	0.00
29.69	154.22	2.00	0.00	0.50	0.00	29.86	176.34	2.00	0.00	0.49	0.00
30.02	191.88	2.00	0.00	0.49	0.00	30.18	229.46	2.00	0.00	0.49	0.00
30.35	263.45	2.00	0.00	0.49	0.00	30.51	284.49	2.00	0.00	0.48	0.00
30.68	287.30	2.00	0.00	0.48	0.00	30.84	282.47	2.00	0.00	0.48	0.00
31.00	273.21	2.00	0.00	0.47	0.00	31.17	262.92	2.00	0.00	0.47	0.00
31.33	247.27	2.00	0.00	0.47	0.00	31.50	222.10	2.00	0.00	0.47	0.00
31.66	195.64	1.43	0.00	0.46	0.00	31.82	175.76	1.08	0.18	0.46	0.00
31.99	169.93	0.99	0.25	0.46	0.00	32.15	163.70	0.90	0.34	0.46	0.01
32.32	161.63	0.87	0.35	0.45	0.01	32.48	155.25	0.79	0.48	0.45	0.01
32.64	149.41	0.72	0.62	0.45	0.01	32.81	143.88	0.65	0.65	0.44	0.01
32.97	140.72	0.62	0.78	0.44	0.02	33.14	138.83	0.60	0.78	0.44	0.02
33.30	137.80	0.59	0.78	0.44	0.02	33.46	140.51	2.00	0.00	0.43	0.00
33.63	143.17	2.00	0.00	0.43	0.00	33.79	154.41	2.00	0.00	0.43	0.00
33.96	167.65	2.00	0.00	0.42	0.00	34.12	175.83	1.07	0.16	0.42	0.00
34.28	185.58	1.23	0.11	0.42	0.00	34.45	191.17	1.33	0.08	0.42	0.00
34.61	187.51	1.26	0.08	0.41	0.00	34.78	171.04	0.99	0.22	0.41	0.00
34.94	150.97	0.73	0.56	0.41	0.01	35.10	138.00	0.59	0.73	0.41	0.01
35.27	138.19	0.59	0.72	0.40	0.01	35.43	142.27	0.63	0.70	0.40	0.01
35.60	146.44	0.68	0.57	0.40	0.01	35.76	146.69	0.68	0.56	0.39	0.01
35.93	157.64	0.81	0.41	0.39	0.01	36.09	177.76	1.09	0.15	0.39	0.00
36.25	199.80	1.49	0.00	0.39	0.00	36.42	218.42	2.00	0.00	0.38	0.00
36.58	234.17	2.00	0.00	0.38	0.00	36.75	248.63	2.00	0.00	0.38	0.00
36.91	261.69	2.00	0.00	0.37	0.00	37.07	274.25	2.00	0.00	0.37	0.00
37.24	287.46	2.00	0.00	0.37	0.00	37.40	299.32	2.00	0.00	0.37	0.00
37.57	305.33	2.00	0.00	0.36	0.00	37.73	298.92	2.00	0.00	0.36	0.00
37.89	279.23	2.00	0.00	0.36	0.00	38.06	260.66	2.00	0.00	0.35	0.00
38.22	236.86	2.00	0.00	0.35	0.00	38.39	205.86	2.00	0.00	0.35	0.00
38.55	188.41	1.27	0.06	0.35	0.00	38.71	174.26	1.04	0.18	0.34	0.00
38.88	165.00	0.90	0.25	0.34	0.01	39.04	157.41	0.80	0.35	0.34	0.01
39.21	148.53	0.70	0.47	0.34	0.01	39.37	144.27	0.65	0.49	0.33	0.01

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	144.59	0.66	0.48	0.33	0.01	39.70	148.52	0.70	0.46	0.33	0.01
39.86	151.93	0.74	0.44	0.32	0.01	40.03	151.37	0.73	0.44	0.32	0.01
40.19	148.95	0.70	0.45	0.32	0.01	40.35	145.04	0.66	0.46	0.32	0.01
40.52	141.76	0.63	0.55	0.31	0.01	40.68	140.36	0.61	0.55	0.31	0.01
40.85	142.15	0.63	0.54	0.31	0.01	41.01	144.00	0.65	0.45	0.30	0.01
41.17	147.25	0.69	0.43	0.30	0.01	41.34	151.60	0.74	0.41	0.30	0.01
41.50	157.37	0.81	0.31	0.30	0.01	41.67	167.69	0.95	0.21	0.29	0.00
41.83	179.12	1.12	0.11	0.29	0.00	41.99	183.84	1.20	0.08	0.29	0.00
42.16	179.21	1.12	0.11	0.29	0.00	42.32	181.12	1.16	0.08	0.28	0.00
42.49	206.82	2.00	0.00	0.28	0.00	42.65	239.04	2.00	0.00	0.28	0.00
42.81	266.62	2.00	0.00	0.27	0.00	42.98	283.35	2.00	0.00	0.27	0.00
43.14	287.60	2.00	0.00	0.27	0.00	43.31	280.67	2.00	0.00	0.27	0.00
43.47	264.08	2.00	0.00	0.26	0.00	43.64	249.20	2.00	0.00	0.26	0.00
43.80	242.56	2.00	0.00	0.26	0.00	43.96	237.14	2.00	0.00	0.25	0.00
44.13	226.42	2.00	0.00	0.25	0.00	44.29	219.06	2.00	0.00	0.25	0.00
44.46	221.19	2.00	0.00	0.25	0.00	44.62	218.38	2.00	0.00	0.24	0.00
44.78	216.49	2.00	0.00	0.24	0.00	44.95	212.05	2.00	0.00	0.24	0.00
45.11	212.85	2.00	0.00	0.24	0.00	45.28	215.25	2.00	0.00	0.23	0.00
45.44	215.55	2.00	0.00	0.23	0.00	45.60	212.92	2.00	0.00	0.23	0.00
45.77	206.29	2.00	0.00	0.22	0.00	45.93	199.71	1.53	0.00	0.22	0.00
46.10	192.31	1.38	0.00	0.22	0.00	46.26	186.82	1.28	0.04	0.22	0.00
46.42	184.03	1.23	0.06	0.21	0.00	46.59	187.81	1.30	0.04	0.21	0.00
46.75	191.84	1.38	0.00	0.21	0.00	46.92	190.10	1.35	0.04	0.20	0.00
47.08	187.13	1.29	0.04	0.20	0.00	47.24	180.90	1.18	0.05	0.20	0.00
47.41	180.89	1.18	0.05	0.20	0.00	47.57	181.77	2.00	0.00	0.19	0.00
47.74	191.23	2.00	0.00	0.19	0.00	47.90	214.28	2.00	0.00	0.19	0.00
48.06	261.66	2.00	0.00	0.19	0.00	48.23	299.42	2.00	0.00	0.18	0.00
48.39	309.93	2.00	0.00	0.18	0.00	48.56	309.42	2.00	0.00	0.18	0.00
48.72	297.25	2.00	0.00	0.17	0.00	48.88	289.19	2.00	0.00	0.17	0.00
49.05	281.66	2.00	0.00	0.17	0.00	49.21	274.98	2.00	0.00	0.17	0.00
49.38	252.39	2.00	0.00	0.16	0.00	49.54	215.05	2.00	0.00	0.16	0.00
49.70	176.08	2.00	0.00	0.16	0.00	49.87	152.66	2.00	0.00	0.15	0.00
50.03	141.15	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.51

Abbreviations

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

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

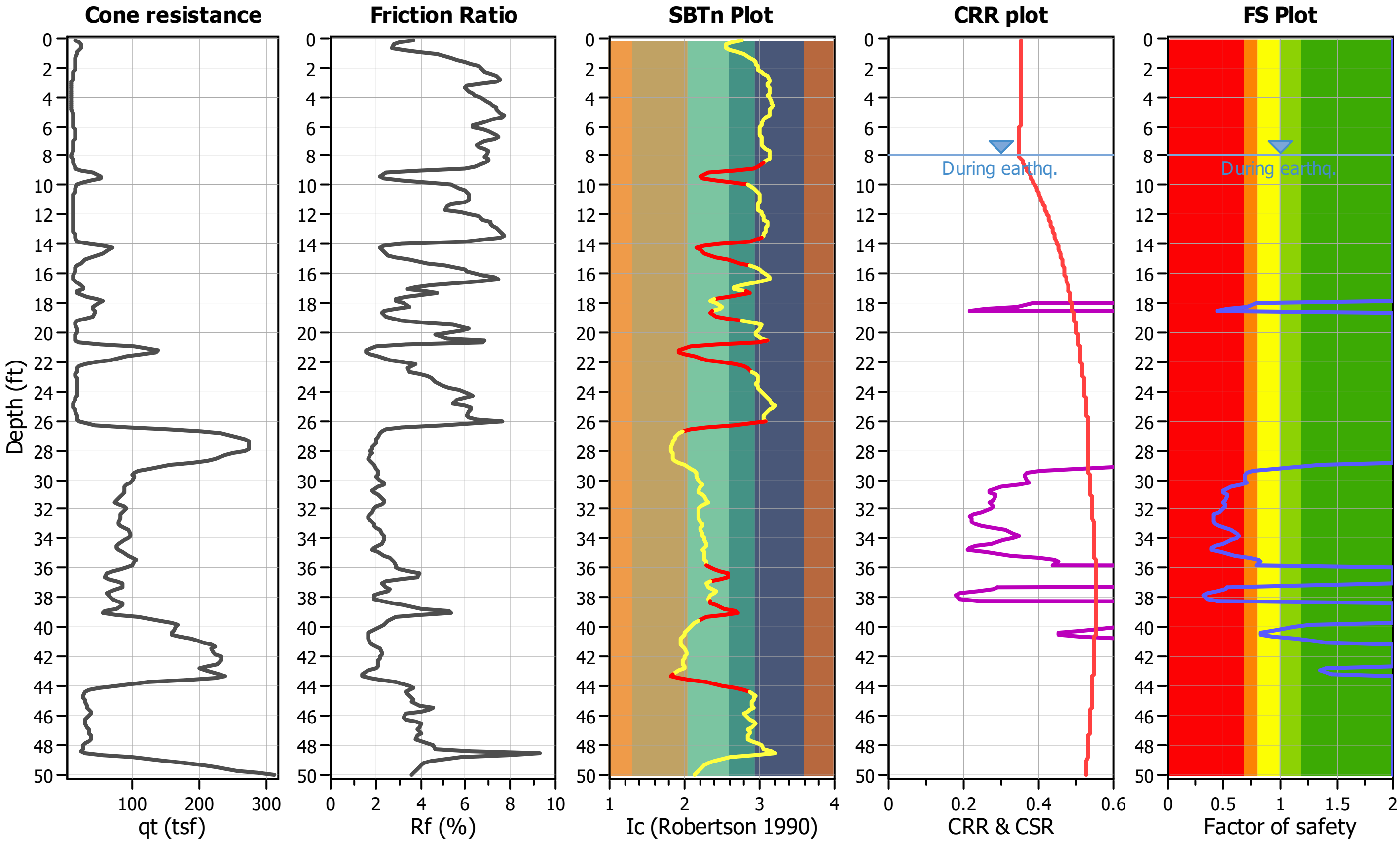
LIQUEFACTION ANALYSIS REPORT

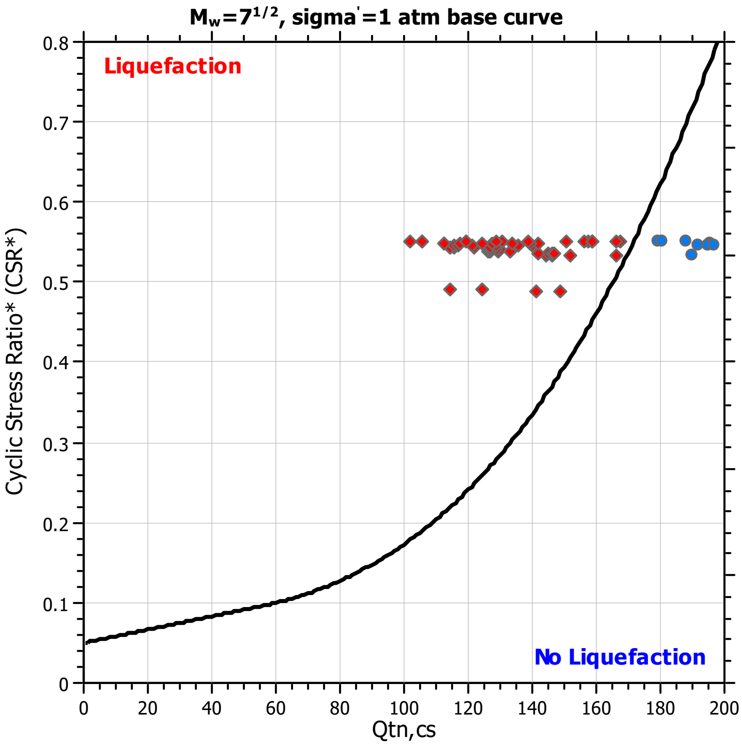
Project title : Drew Solar Project **Location : Calexico, CA**

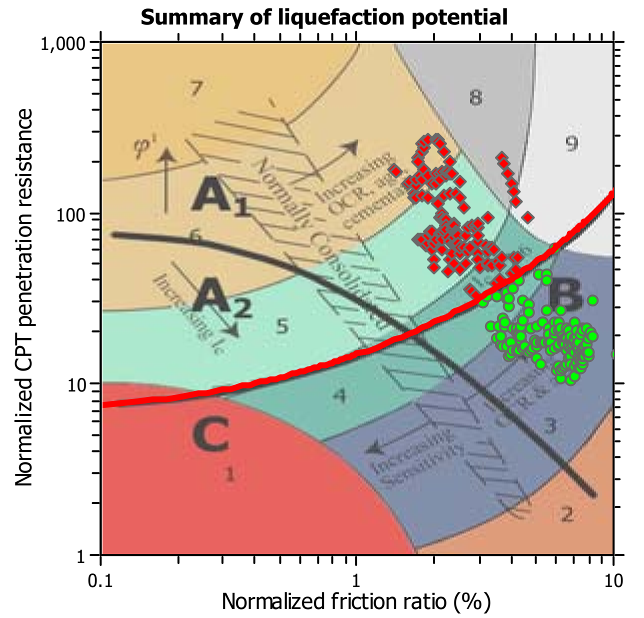
CPT file : CPT-02

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

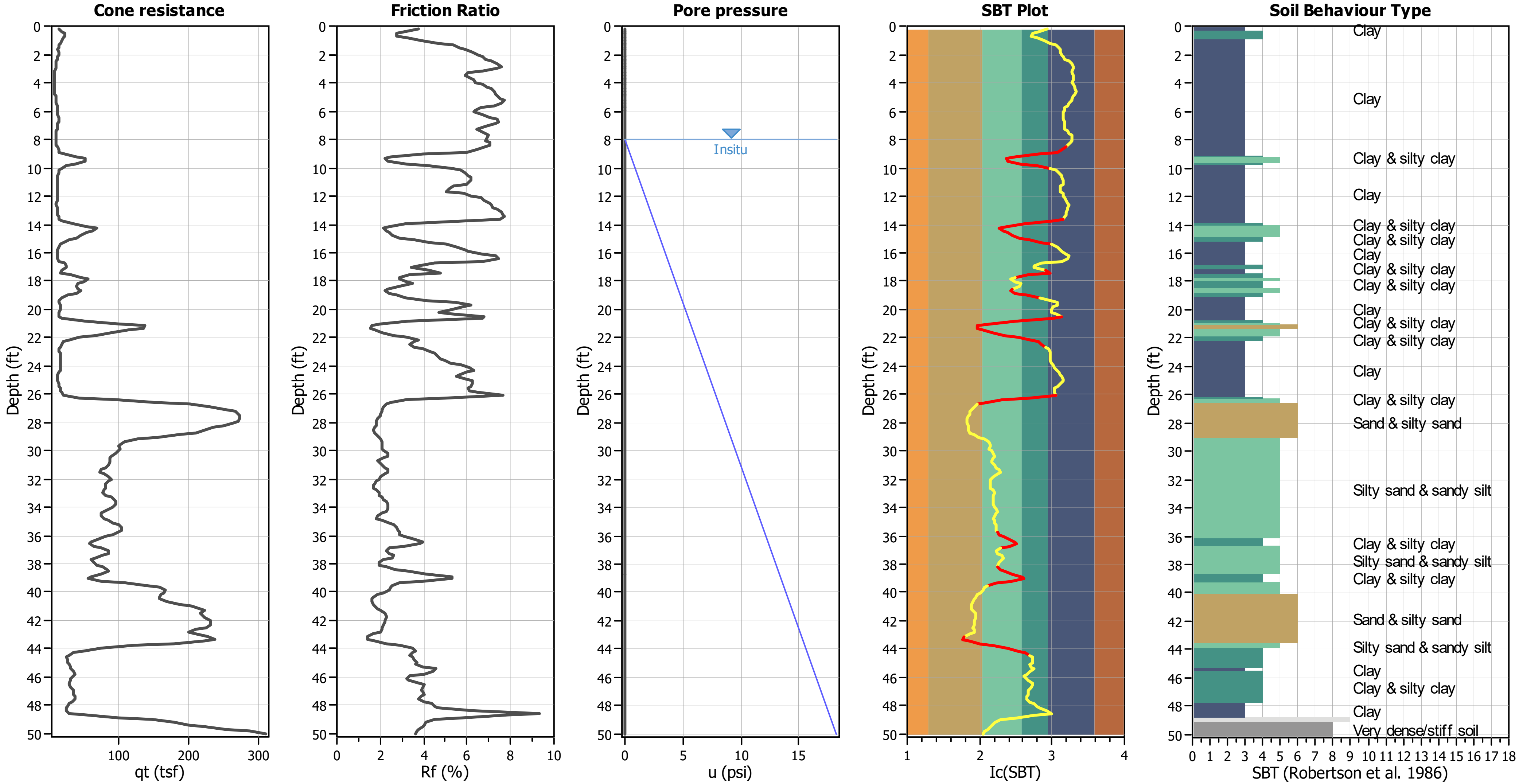






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



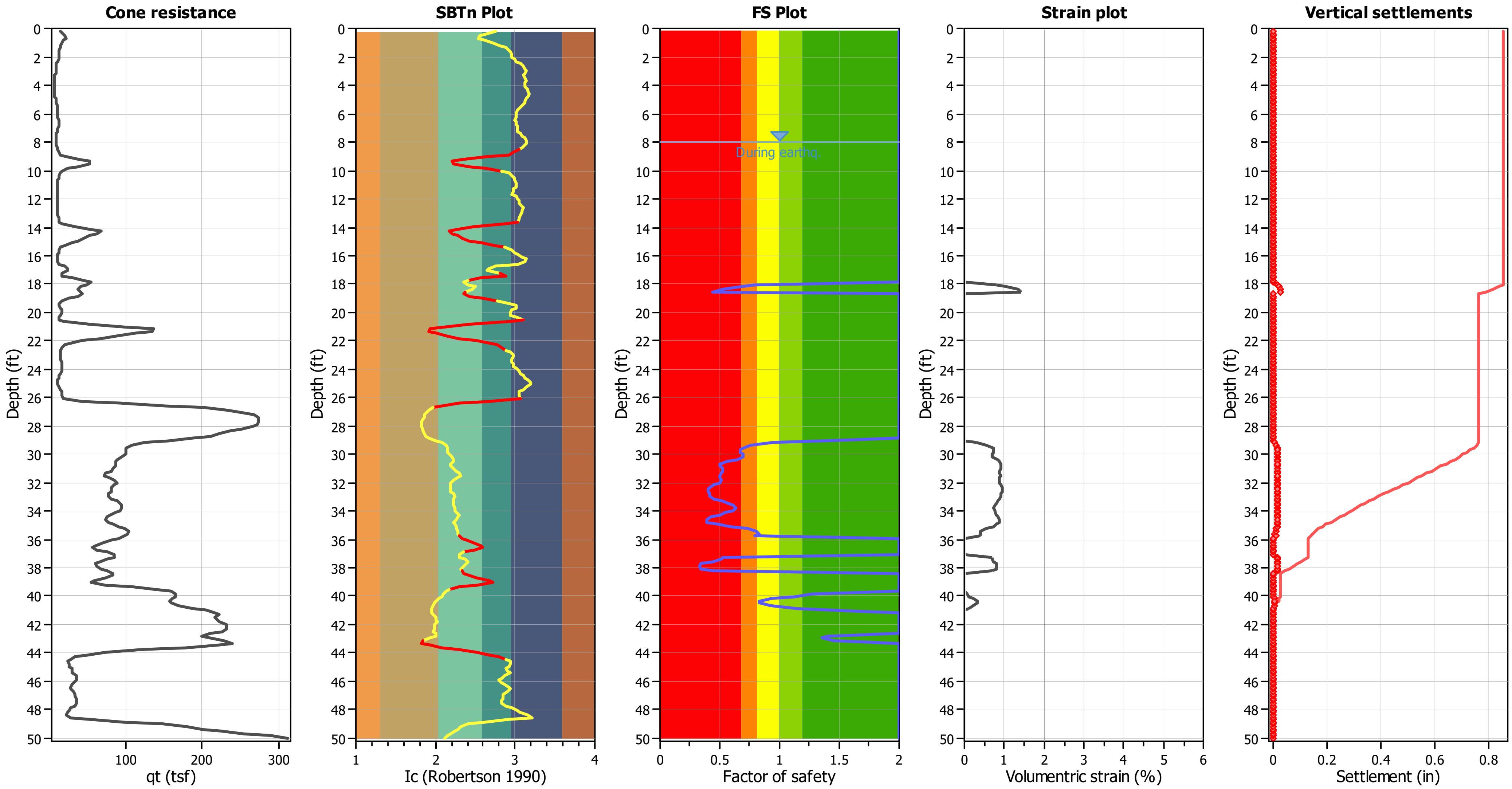
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.50	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	110.73	2.00	0.00	0.86	0.00	8.20	116.46	2.00	0.00	0.86	0.00
8.37	123.50	2.00	0.00	0.86	0.00	8.53	127.73	2.00	0.00	0.86	0.00
8.69	131.28	2.00	0.00	0.85	0.00	8.86	132.58	2.00	0.00	0.85	0.00
9.02	130.28	2.00	0.00	0.85	0.00	9.19	128.25	2.00	0.00	0.84	0.00
9.35	139.46	2.00	0.00	0.84	0.00	9.51	144.87	2.00	0.00	0.84	0.00
9.68	143.65	2.00	0.00	0.84	0.00	9.84	139.72	2.00	0.00	0.83	0.00
10.01	135.41	2.00	0.00	0.83	0.00	10.17	130.13	2.00	0.00	0.83	0.00
10.33	126.46	2.00	0.00	0.82	0.00	10.50	123.91	2.00	0.00	0.82	0.00
10.66	123.35	2.00	0.00	0.82	0.00	10.83	122.64	2.00	0.00	0.82	0.00
10.99	121.21	2.00	0.00	0.81	0.00	11.15	118.75	2.00	0.00	0.81	0.00
11.32	112.88	2.00	0.00	0.81	0.00	11.48	110.65	2.00	0.00	0.81	0.00
11.65	109.78	2.00	0.00	0.80	0.00	11.81	115.29	2.00	0.00	0.80	0.00
11.98	119.89	2.00	0.00	0.80	0.00	12.14	124.12	2.00	0.00	0.79	0.00
12.30	125.00	2.00	0.00	0.79	0.00	12.47	124.12	2.00	0.00	0.79	0.00
12.63	124.03	2.00	0.00	0.79	0.00	12.80	126.23	2.00	0.00	0.78	0.00
12.96	130.63	2.00	0.00	0.78	0.00	13.12	136.18	2.00	0.00	0.78	0.00
13.29	140.98	2.00	0.00	0.77	0.00	13.45	144.68	2.00	0.00	0.77	0.00
13.62	144.66	2.00	0.00	0.77	0.00	13.78	143.64	2.00	0.00	0.77	0.00
13.94	133.32	2.00	0.00	0.76	0.00	14.11	138.11	2.00	0.00	0.76	0.00
14.27	146.87	2.00	0.00	0.76	0.00	14.44	145.02	2.00	0.00	0.76	0.00
14.60	137.13	2.00	0.00	0.75	0.00	14.76	131.46	2.00	0.00	0.75	0.00
14.93	130.05	2.00	0.00	0.75	0.00	15.09	129.95	2.00	0.00	0.74	0.00
15.26	127.32	2.00	0.00	0.74	0.00	15.42	124.01	2.00	0.00	0.74	0.00
15.58	121.44	2.00	0.00	0.74	0.00	15.75	121.11	2.00	0.00	0.73	0.00
15.91	119.59	2.00	0.00	0.73	0.00	16.08	120.19	2.00	0.00	0.73	0.00
16.24	121.60	2.00	0.00	0.72	0.00	16.40	124.69	2.00	0.00	0.72	0.00
16.57	130.69	2.00	0.00	0.72	0.00	16.73	127.81	2.00	0.00	0.72	0.00
16.90	123.77	2.00	0.00	0.71	0.00	17.06	115.36	2.00	0.00	0.71	0.00
17.22	113.97	2.00	0.00	0.71	0.00	17.39	117.35	2.00	0.00	0.71	0.00
17.55	123.70	2.00	0.00	0.70	0.00	17.72	134.09	2.00	0.00	0.70	0.00
17.88	145.01	2.00	0.00	0.70	0.00	18.04	148.49	0.79	0.79	0.69	0.02
18.21	141.38	0.70	1.04	0.69	0.02	18.37	124.37	0.53	1.35	0.69	0.03
18.54	114.14	0.44	1.44	0.69	0.03	18.70	113.98	2.00	0.00	0.68	0.00
18.86	112.56	2.00	0.00	0.68	0.00	19.03	104.29	2.00	0.00	0.68	0.00
19.19	95.42	2.00	0.00	0.67	0.00	19.36	99.53	2.00	0.00	0.67	0.00
19.52	111.78	2.00	0.00	0.67	0.00	19.69	124.19	2.00	0.00	0.67	0.00
19.85	126.32	2.00	0.00	0.66	0.00	20.01	119.11	2.00	0.00	0.66	0.00
20.18	107.50	2.00	0.00	0.66	0.00	20.34	107.08	2.00	0.00	0.66	0.00
20.51	120.83	2.00	0.00	0.65	0.00	20.67	143.01	2.00	0.00	0.65	0.00
20.83	148.00	2.00	0.00	0.65	0.00	21.00	162.13	2.00	0.00	0.64	0.00
21.16	183.01	2.00	0.00	0.64	0.00	21.33	179.73	2.00	0.00	0.64	0.00
21.49	164.70	2.00	0.00	0.64	0.00	21.65	151.49	2.00	0.00	0.63	0.00
21.82	142.86	2.00	0.00	0.63	0.00	21.98	133.46	2.00	0.00	0.63	0.00
22.15	121.30	2.00	0.00	0.62	0.00	22.31	103.90	2.00	0.00	0.62	0.00
22.47	94.01	2.00	0.00	0.62	0.00	22.64	91.61	2.00	0.00	0.62	0.00
22.80	94.07	2.00	0.00	0.61	0.00	22.97	97.64	2.00	0.00	0.61	0.00
23.13	100.89	2.00	0.00	0.61	0.00	23.29	104.74	2.00	0.00	0.61	0.00
23.46	107.83	2.00	0.00	0.60	0.00	23.62	110.60	2.00	0.00	0.60	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	112.72	2.00	0.00	0.60	0.00	23.95	116.84	2.00	0.00	0.59	0.00
24.11	119.55	2.00	0.00	0.59	0.00	24.28	118.09	2.00	0.00	0.59	0.00
24.44	109.65	2.00	0.00	0.59	0.00	24.61	100.21	2.00	0.00	0.58	0.00
24.77	94.33	2.00	0.00	0.58	0.00	24.93	96.62	2.00	0.00	0.58	0.00
25.10	101.01	2.00	0.00	0.57	0.00	25.26	107.42	2.00	0.00	0.57	0.00
25.43	112.12	2.00	0.00	0.57	0.00	25.59	116.09	2.00	0.00	0.57	0.00
25.75	118.94	2.00	0.00	0.56	0.00	25.92	125.89	2.00	0.00	0.56	0.00
26.08	141.14	2.00	0.00	0.56	0.00	26.25	161.03	2.00	0.00	0.56	0.00
26.41	178.55	2.00	0.00	0.55	0.00	26.57	213.25	2.00	0.00	0.55	0.00
26.74	250.82	2.00	0.00	0.55	0.00	26.90	276.07	2.00	0.00	0.54	0.00
27.07	294.04	2.00	0.00	0.54	0.00	27.23	302.99	2.00	0.00	0.54	0.00
27.40	305.11	2.00	0.00	0.54	0.00	27.56	304.43	2.00	0.00	0.53	0.00
27.72	298.05	2.00	0.00	0.53	0.00	27.89	293.48	2.00	0.00	0.53	0.00
28.05	286.16	2.00	0.00	0.52	0.00	28.22	272.92	2.00	0.00	0.52	0.00
28.38	258.00	2.00	0.00	0.52	0.00	28.54	242.41	2.00	0.00	0.52	0.00
28.71	232.24	2.00	0.00	0.51	0.00	28.87	213.88	2.00	0.00	0.51	0.00
29.04	190.13	1.35	0.00	0.51	0.00	29.20	166.48	0.96	0.28	0.51	0.01
29.36	151.90	0.76	0.55	0.50	0.01	29.53	146.25	0.69	0.72	0.50	0.01
29.69	144.68	0.68	0.72	0.50	0.01	29.86	144.75	0.68	0.72	0.49	0.01
30.02	146.11	0.69	0.70	0.49	0.01	30.18	146.94	0.70	0.70	0.49	0.01
30.35	141.82	0.64	0.85	0.49	0.02	30.51	133.29	0.56	0.89	0.48	0.02
30.68	125.97	0.49	0.93	0.48	0.02	30.84	126.75	0.50	0.92	0.48	0.02
31.00	129.52	0.52	0.90	0.47	0.02	31.17	130.29	0.53	0.89	0.47	0.02
31.33	128.78	0.52	0.89	0.47	0.02	31.50	126.82	0.50	0.90	0.47	0.02
31.66	127.74	0.51	0.89	0.46	0.02	31.82	128.38	0.51	0.88	0.46	0.02
31.99	127.17	0.50	0.88	0.46	0.02	32.15	121.87	0.46	0.90	0.46	0.02
32.32	115.65	0.41	0.94	0.45	0.02	32.48	114.10	0.40	0.94	0.45	0.02
32.64	114.66	0.40	0.93	0.45	0.02	32.81	115.38	0.41	0.92	0.44	0.02
32.97	117.07	0.42	0.91	0.44	0.02	33.14	121.11	0.45	0.88	0.44	0.02
33.30	128.64	0.51	0.83	0.44	0.02	33.46	135.47	0.57	0.79	0.43	0.02
33.63	139.75	0.61	0.76	0.43	0.02	33.79	141.85	0.63	0.75	0.43	0.01
33.96	139.40	0.61	0.76	0.42	0.01	34.12	134.04	0.55	0.77	0.42	0.02
34.28	127.58	0.50	0.80	0.42	0.02	34.45	117.59	0.42	0.85	0.42	0.02
34.61	112.73	0.39	0.88	0.41	0.02	34.78	112.50	0.39	0.87	0.41	0.02
34.94	124.57	0.47	0.80	0.41	0.02	35.10	138.49	0.60	0.72	0.41	0.01
35.27	150.92	0.73	0.55	0.40	0.01	35.43	157.57	0.81	0.42	0.40	0.01
35.60	158.97	0.82	0.41	0.40	0.01	35.76	156.49	0.79	0.42	0.39	0.01
35.93	151.37	2.00	0.00	0.39	0.00	36.09	147.80	2.00	0.00	0.39	0.00
36.25	147.95	2.00	0.00	0.39	0.00	36.42	147.82	2.00	0.00	0.38	0.00
36.58	140.70	2.00	0.00	0.38	0.00	36.75	130.47	2.00	0.00	0.38	0.00
36.91	123.81	2.00	0.00	0.37	0.00	37.07	127.96	2.00	0.00	0.37	0.00
37.24	130.71	0.52	0.69	0.37	0.01	37.40	129.03	0.51	0.69	0.37	0.01
37.57	119.64	0.43	0.73	0.36	0.01	37.73	105.78	0.34	0.80	0.36	0.02
37.89	101.92	0.32	0.82	0.36	0.02	38.06	105.72	0.34	0.79	0.35	0.02
38.22	119.66	0.43	0.71	0.35	0.01	38.39	135.31	2.00	0.00	0.35	0.00
38.55	150.66	2.00	0.00	0.35	0.00	38.71	160.72	2.00	0.00	0.34	0.00
38.88	167.15	2.00	0.00	0.34	0.00	39.04	162.47	2.00	0.00	0.34	0.00
39.21	157.20	2.00	0.00	0.34	0.00	39.37	158.03	2.00	0.00	0.33	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	173.00	2.00	0.00	0.33	0.00	39.70	184.92	2.00	0.00	0.33	0.00
39.86	187.90	1.27	0.06	0.32	0.00	40.03	179.31	1.12	0.12	0.32	0.00
40.19	167.33	0.94	0.23	0.32	0.00	40.35	158.94	0.82	0.33	0.32	0.01
40.52	158.86	0.82	0.32	0.31	0.01	40.68	166.37	0.92	0.23	0.31	0.00
40.85	180.68	1.14	0.12	0.31	0.00	41.01	195.34	1.41	0.00	0.30	0.00
41.17	207.44	2.00	0.00	0.30	0.00	41.34	214.39	2.00	0.00	0.30	0.00
41.50	216.33	2.00	0.00	0.30	0.00	41.67	221.42	2.00	0.00	0.29	0.00
41.83	223.24	2.00	0.00	0.29	0.00	41.99	226.49	2.00	0.00	0.29	0.00
42.16	225.23	2.00	0.00	0.29	0.00	42.32	223.63	2.00	0.00	0.28	0.00
42.49	216.39	2.00	0.00	0.28	0.00	42.65	204.92	2.00	0.00	0.28	0.00
42.81	194.69	1.40	0.00	0.27	0.00	42.98	191.99	1.35	0.00	0.27	0.00
43.14	196.94	1.45	0.00	0.27	0.00	43.31	204.39	2.00	0.00	0.27	0.00
43.47	202.41	2.00	0.00	0.26	0.00	43.64	185.28	2.00	0.00	0.26	0.00
43.80	162.80	2.00	0.00	0.26	0.00	43.96	140.06	2.00	0.00	0.25	0.00
44.13	119.10	2.00	0.00	0.25	0.00	44.29	101.00	2.00	0.00	0.25	0.00
44.46	90.56	2.00	0.00	0.25	0.00	44.62	87.57	2.00	0.00	0.24	0.00
44.78	89.05	2.00	0.00	0.24	0.00	44.95	92.51	2.00	0.00	0.24	0.00
45.11	94.84	2.00	0.00	0.24	0.00	45.28	100.05	2.00	0.00	0.23	0.00
45.44	107.22	2.00	0.00	0.23	0.00	45.60	112.26	2.00	0.00	0.23	0.00
45.77	108.73	2.00	0.00	0.22	0.00	45.93	98.83	2.00	0.00	0.22	0.00
46.10	91.83	2.00	0.00	0.22	0.00	46.26	90.54	2.00	0.00	0.22	0.00
46.42	93.62	2.00	0.00	0.21	0.00	46.59	96.60	2.00	0.00	0.21	0.00
46.75	100.61	2.00	0.00	0.21	0.00	46.92	103.45	2.00	0.00	0.20	0.00
47.08	105.42	2.00	0.00	0.20	0.00	47.24	105.74	2.00	0.00	0.20	0.00
47.41	105.78	2.00	0.00	0.20	0.00	47.57	104.13	2.00	0.00	0.19	0.00
47.74	102.94	2.00	0.00	0.19	0.00	47.90	99.80	2.00	0.00	0.19	0.00
48.06	96.89	2.00	0.00	0.19	0.00	48.23	94.75	2.00	0.00	0.18	0.00
48.39	106.80	2.00	0.00	0.18	0.00	48.56	138.64	2.00	0.00	0.18	0.00
48.72	179.46	2.00	0.00	0.17	0.00	48.88	206.07	2.00	0.00	0.17	0.00
49.05	220.18	2.00	0.00	0.17	0.00	49.21	232.18	2.00	0.00	0.17	0.00
49.38	245.64	2.00	0.00	0.16	0.00	49.54	260.52	2.00	0.00	0.16	0.00
49.70	277.17	2.00	0.00	0.16	0.00	49.87	296.93	2.00	0.00	0.15	0.00
50.03	310.92	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.85

Abbreviations

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

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

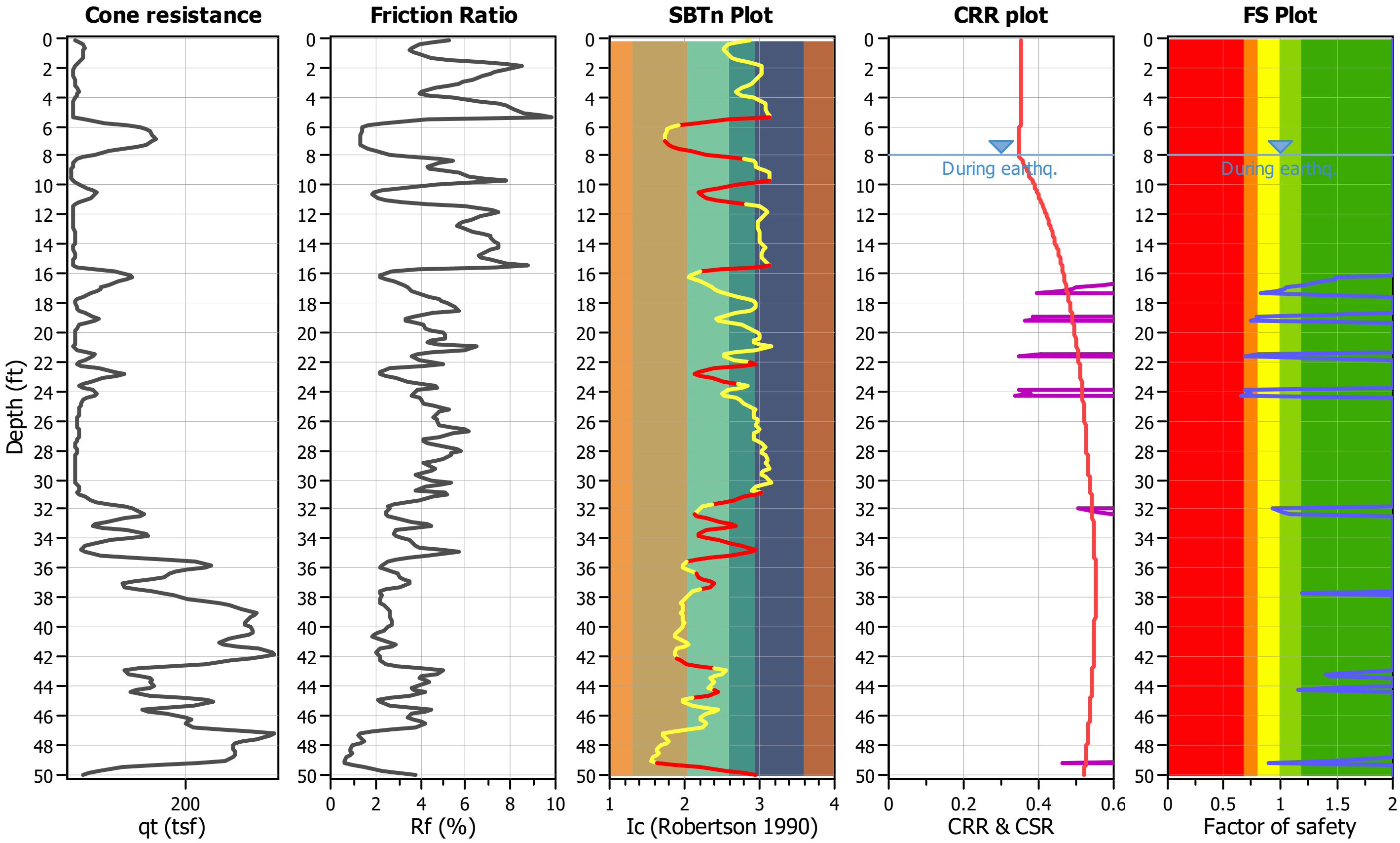
LIQUEFACTION ANALYSIS REPORT

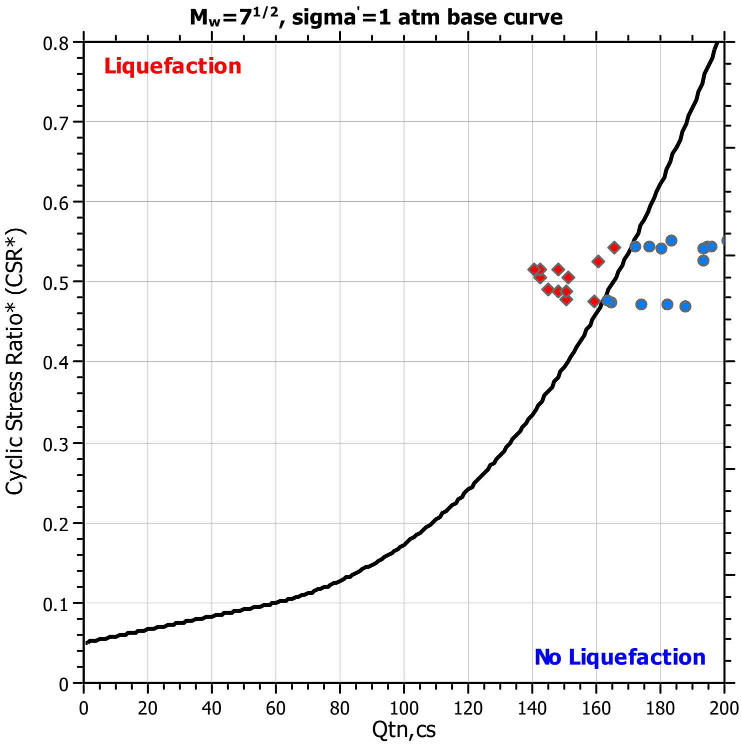
Project title : Drew Solar Project **Location : Calexico, CA**

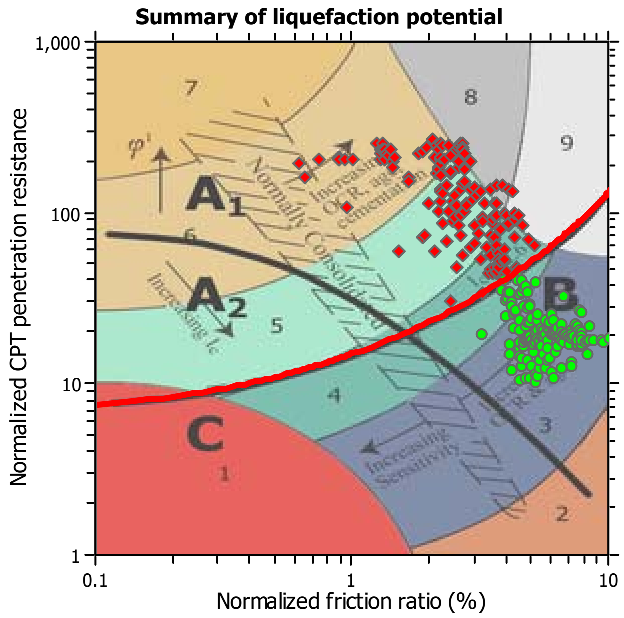
CPT file : CPT-03

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A		
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

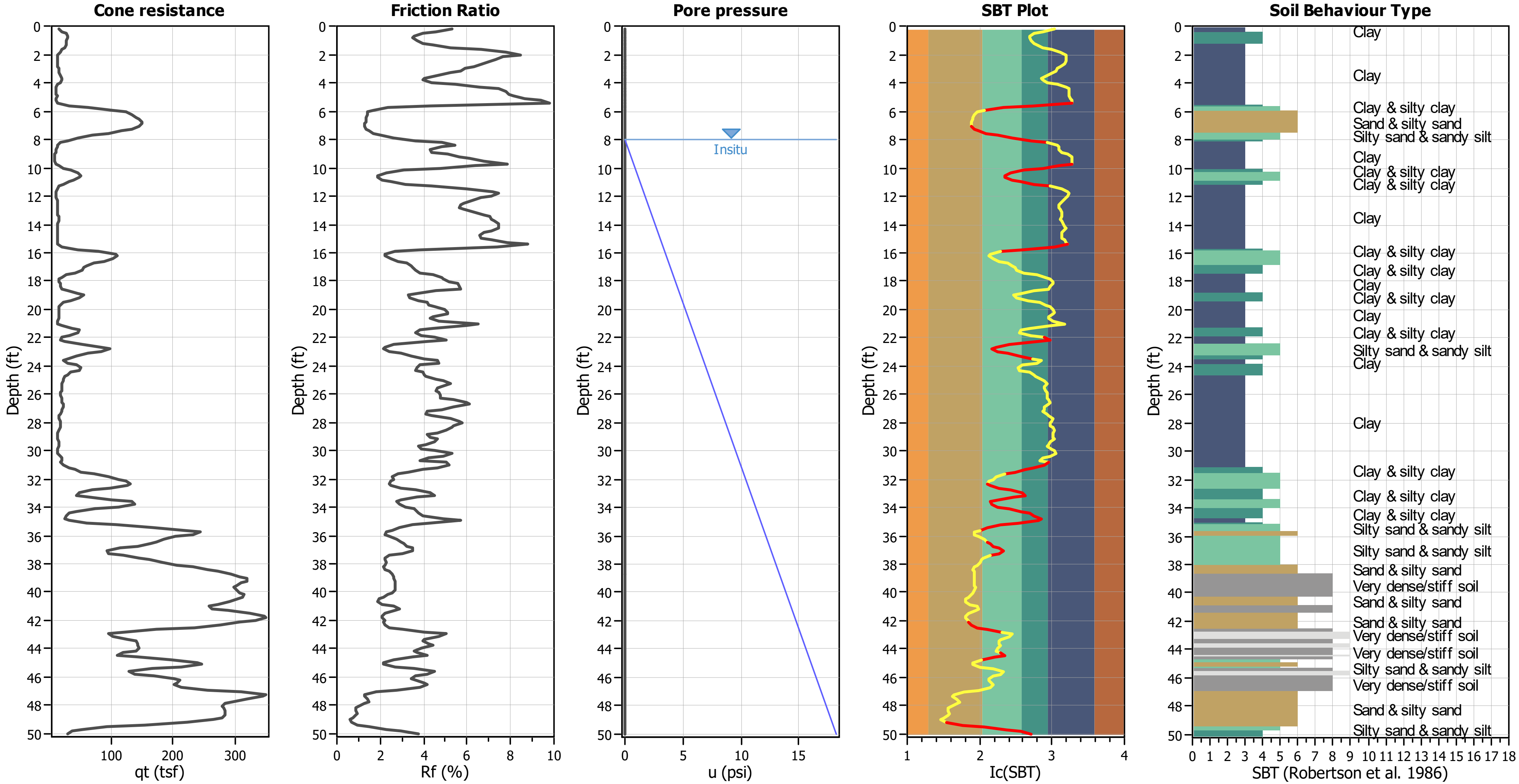






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



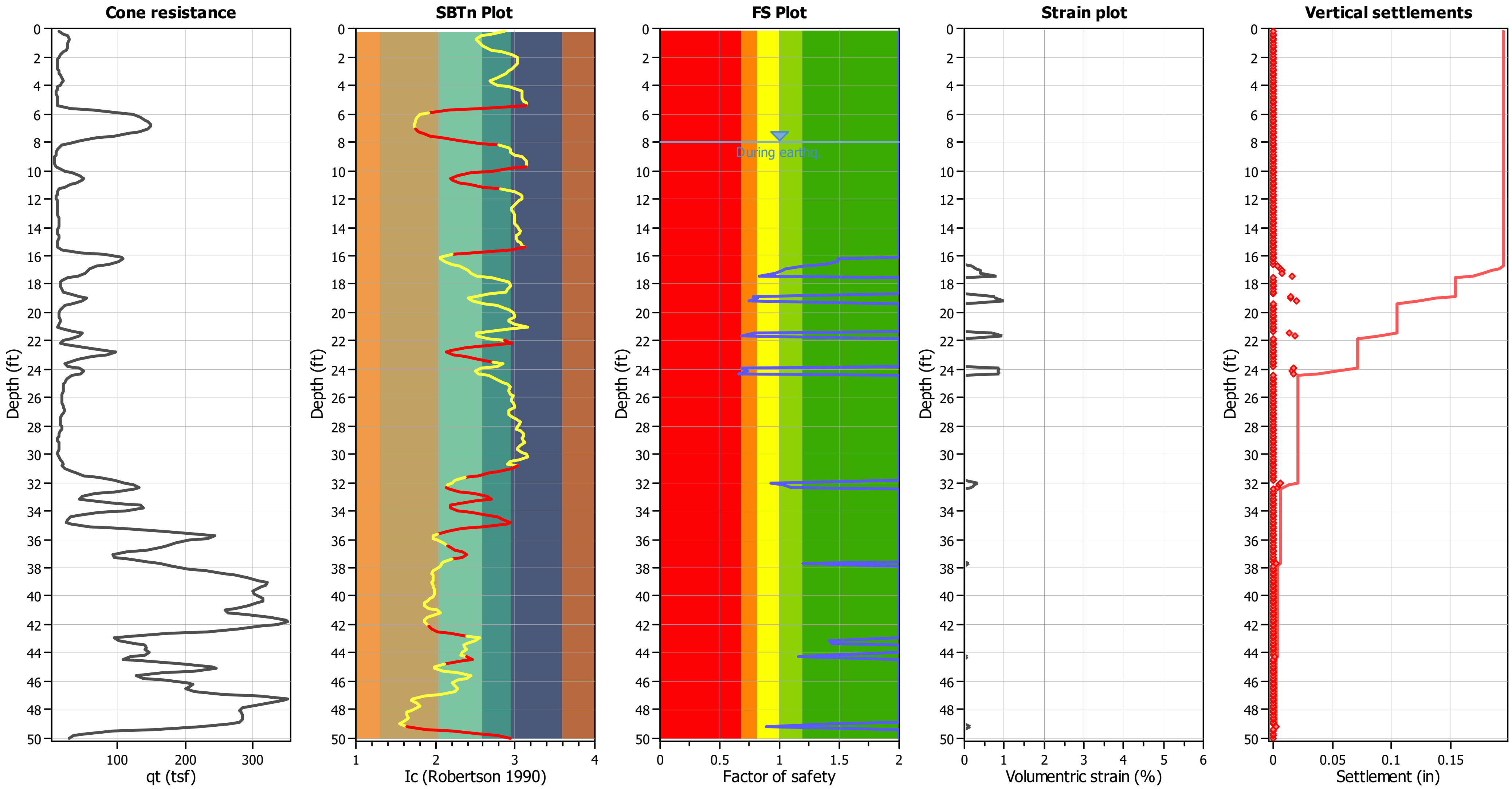
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.50	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	136.69	2.00	0.00	0.86	0.00	8.20	130.68	2.00	0.00	0.86	0.00
8.37	121.35	2.00	0.00	0.86	0.00	8.53	107.60	2.00	0.00	0.86	0.00
8.69	97.98	2.00	0.00	0.85	0.00	8.86	93.27	2.00	0.00	0.85	0.00
9.02	94.01	2.00	0.00	0.85	0.00	9.19	96.82	2.00	0.00	0.84	0.00
9.35	102.79	2.00	0.00	0.84	0.00	9.51	110.62	2.00	0.00	0.84	0.00
9.68	124.84	2.00	0.00	0.84	0.00	9.84	136.81	2.00	0.00	0.83	0.00
10.01	141.22	2.00	0.00	0.83	0.00	10.17	134.05	2.00	0.00	0.83	0.00
10.33	128.93	2.00	0.00	0.82	0.00	10.50	123.45	2.00	0.00	0.82	0.00
10.66	119.71	2.00	0.00	0.82	0.00	10.83	115.62	2.00	0.00	0.82	0.00
10.99	113.88	2.00	0.00	0.81	0.00	11.15	112.58	2.00	0.00	0.81	0.00
11.32	115.28	2.00	0.00	0.81	0.00	11.48	123.12	2.00	0.00	0.81	0.00
11.65	128.64	2.00	0.00	0.80	0.00	11.81	129.13	2.00	0.00	0.80	0.00
11.98	125.94	2.00	0.00	0.80	0.00	12.14	123.84	2.00	0.00	0.79	0.00
12.30	123.53	2.00	0.00	0.79	0.00	12.47	123.27	2.00	0.00	0.79	0.00
12.63	122.71	2.00	0.00	0.79	0.00	12.80	121.82	2.00	0.00	0.78	0.00
12.96	123.42	2.00	0.00	0.78	0.00	13.12	129.17	2.00	0.00	0.78	0.00
13.29	136.34	2.00	0.00	0.77	0.00	13.45	143.13	2.00	0.00	0.77	0.00
13.62	145.52	2.00	0.00	0.77	0.00	13.78	145.26	2.00	0.00	0.77	0.00
13.94	141.64	2.00	0.00	0.76	0.00	14.11	137.20	2.00	0.00	0.76	0.00
14.27	134.76	2.00	0.00	0.76	0.00	14.44	133.68	2.00	0.00	0.76	0.00
14.60	132.67	2.00	0.00	0.75	0.00	14.76	130.32	2.00	0.00	0.75	0.00
14.93	129.07	2.00	0.00	0.75	0.00	15.09	131.55	2.00	0.00	0.74	0.00
15.26	137.22	2.00	0.00	0.74	0.00	15.42	145.67	2.00	0.00	0.74	0.00
15.58	162.12	2.00	0.00	0.74	0.00	15.75	162.16	2.00	0.00	0.73	0.00
15.91	172.39	2.00	0.00	0.73	0.00	16.08	185.31	2.00	0.00	0.73	0.00
16.24	188.02	1.49	0.00	0.72	0.00	16.40	188.07	1.49	0.00	0.72	0.00
16.57	182.19	1.36	0.00	0.72	0.00	16.73	174.20	1.21	0.20	0.72	0.00
16.90	164.96	1.05	0.28	0.71	0.01	17.06	163.72	1.03	0.40	0.71	0.01
17.22	159.55	0.96	0.41	0.71	0.01	17.39	150.39	0.83	0.79	0.71	0.02
17.55	136.16	2.00	0.00	0.70	0.00	17.72	123.69	2.00	0.00	0.70	0.00
17.88	115.61	2.00	0.00	0.70	0.00	18.04	116.52	2.00	0.00	0.69	0.00
18.21	123.95	2.00	0.00	0.69	0.00	18.37	130.85	2.00	0.00	0.69	0.00
18.54	137.60	2.00	0.00	0.69	0.00	18.70	143.19	2.00	0.00	0.68	0.00
18.86	148.26	0.78	0.78	0.68	0.02	19.03	150.75	0.81	0.76	0.68	0.01
19.19	144.78	0.74	0.98	0.67	0.02	19.36	132.95	2.00	0.00	0.67	0.00
19.52	118.71	2.00	0.00	0.67	0.00	19.69	109.01	2.00	0.00	0.67	0.00
19.85	106.04	2.00	0.00	0.66	0.00	20.01	109.19	2.00	0.00	0.66	0.00
20.18	109.08	2.00	0.00	0.66	0.00	20.34	108.89	2.00	0.00	0.66	0.00
20.51	105.20	2.00	0.00	0.65	0.00	20.67	102.79	2.00	0.00	0.65	0.00
20.83	101.19	2.00	0.00	0.65	0.00	21.00	107.68	2.00	0.00	0.64	0.00
21.16	130.10	2.00	0.00	0.64	0.00	21.33	146.36	2.00	0.00	0.64	0.00
21.49	151.51	0.80	0.70	0.64	0.01	21.65	142.31	0.69	0.94	0.63	0.02
21.82	127.22	2.00	0.00	0.63	0.00	21.98	115.04	2.00	0.00	0.63	0.00
22.15	111.60	2.00	0.00	0.62	0.00	22.31	119.25	2.00	0.00	0.62	0.00
22.47	127.63	2.00	0.00	0.62	0.00	22.64	143.98	2.00	0.00	0.62	0.00
22.80	156.13	2.00	0.00	0.61	0.00	22.97	152.35	2.00	0.00	0.61	0.00
23.13	144.08	2.00	0.00	0.61	0.00	23.29	131.72	2.00	0.00	0.61	0.00
23.46	122.63	2.00	0.00	0.60	0.00	23.62	119.60	2.00	0.00	0.60	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	132.39	2.00	0.00	0.60	0.00	23.95	142.55	0.68	0.88	0.59	0.02
24.11	147.82	0.74	0.83	0.59	0.02	24.28	140.43	0.65	0.89	0.59	0.02
24.44	129.08	2.00	0.00	0.59	0.00	24.61	120.46	2.00	0.00	0.58	0.00
24.77	115.78	2.00	0.00	0.58	0.00	24.93	117.18	2.00	0.00	0.58	0.00
25.10	117.88	2.00	0.00	0.57	0.00	25.26	118.35	2.00	0.00	0.57	0.00
25.43	114.95	2.00	0.00	0.57	0.00	25.59	110.21	2.00	0.00	0.57	0.00
25.75	106.81	2.00	0.00	0.56	0.00	25.92	105.97	2.00	0.00	0.56	0.00
26.08	106.89	2.00	0.00	0.56	0.00	26.25	108.58	2.00	0.00	0.56	0.00
26.41	115.02	2.00	0.00	0.55	0.00	26.57	123.95	2.00	0.00	0.55	0.00
26.74	128.54	2.00	0.00	0.55	0.00	26.90	123.79	2.00	0.00	0.54	0.00
27.07	112.82	2.00	0.00	0.54	0.00	27.23	100.95	2.00	0.00	0.54	0.00
27.40	93.95	2.00	0.00	0.54	0.00	27.56	93.57	2.00	0.00	0.53	0.00
27.72	101.92	2.00	0.00	0.53	0.00	27.89	110.94	2.00	0.00	0.53	0.00
28.05	115.34	2.00	0.00	0.52	0.00	28.22	110.71	2.00	0.00	0.52	0.00
28.38	104.02	2.00	0.00	0.52	0.00	28.54	95.72	2.00	0.00	0.52	0.00
28.71	89.86	2.00	0.00	0.51	0.00	28.87	84.12	2.00	0.00	0.51	0.00
29.04	84.53	2.00	0.00	0.51	0.00	29.20	88.19	2.00	0.00	0.51	0.00
29.36	92.07	2.00	0.00	0.50	0.00	29.53	89.30	2.00	0.00	0.50	0.00
29.69	83.96	2.00	0.00	0.50	0.00	29.86	81.06	2.00	0.00	0.49	0.00
30.02	85.12	2.00	0.00	0.49	0.00	30.18	93.26	2.00	0.00	0.49	0.00
30.35	99.61	2.00	0.00	0.49	0.00	30.51	99.91	2.00	0.00	0.48	0.00
30.68	95.75	2.00	0.00	0.48	0.00	30.84	104.32	2.00	0.00	0.48	0.00
31.00	116.62	2.00	0.00	0.47	0.00	31.17	128.59	2.00	0.00	0.47	0.00
31.33	129.46	2.00	0.00	0.47	0.00	31.50	129.78	2.00	0.00	0.47	0.00
31.66	138.48	2.00	0.00	0.46	0.00	31.82	151.88	2.00	0.00	0.46	0.00
31.99	165.72	0.93	0.34	0.46	0.01	32.15	172.38	1.02	0.24	0.46	0.00
32.32	176.90	1.09	0.17	0.45	0.00	32.48	173.95	2.00	0.00	0.45	0.00
32.64	162.99	2.00	0.00	0.45	0.00	32.81	152.59	2.00	0.00	0.44	0.00
32.97	144.77	2.00	0.00	0.44	0.00	33.14	141.25	2.00	0.00	0.44	0.00
33.30	146.79	2.00	0.00	0.44	0.00	33.46	162.77	2.00	0.00	0.43	0.00
33.63	186.74	2.00	0.00	0.43	0.00	33.79	195.33	2.00	0.00	0.43	0.00
33.96	179.38	2.00	0.00	0.42	0.00	34.12	153.94	2.00	0.00	0.42	0.00
34.28	126.00	2.00	0.00	0.42	0.00	34.45	110.31	2.00	0.00	0.42	0.00
34.61	106.32	2.00	0.00	0.41	0.00	34.78	112.50	2.00	0.00	0.41	0.00
34.94	134.48	2.00	0.00	0.41	0.00	35.10	154.27	2.00	0.00	0.41	0.00
35.27	180.88	2.00	0.00	0.40	0.00	35.43	213.66	2.00	0.00	0.40	0.00
35.60	244.61	2.00	0.00	0.40	0.00	35.76	256.37	2.00	0.00	0.39	0.00
35.93	243.87	2.00	0.00	0.39	0.00	36.09	227.04	2.00	0.00	0.39	0.00
36.25	221.50	2.00	0.00	0.39	0.00	36.42	219.87	2.00	0.00	0.38	0.00
36.58	215.92	2.00	0.00	0.38	0.00	36.75	201.81	2.00	0.00	0.38	0.00
36.91	185.41	2.00	0.00	0.37	0.00	37.07	166.79	2.00	0.00	0.37	0.00
37.24	156.34	2.00	0.00	0.37	0.00	37.40	156.79	2.00	0.00	0.37	0.00
37.57	168.97	2.00	0.00	0.36	0.00	37.73	183.80	1.19	0.10	0.36	0.00
37.89	201.01	2.00	0.00	0.36	0.00	38.06	215.25	2.00	0.00	0.35	0.00
38.22	233.71	2.00	0.00	0.35	0.00	38.39	253.64	2.00	0.00	0.35	0.00
38.55	273.59	2.00	0.00	0.35	0.00	38.71	293.31	2.00	0.00	0.34	0.00
38.88	308.34	2.00	0.00	0.34	0.00	39.04	318.69	2.00	0.00	0.34	0.00
39.21	317.01	2.00	0.00	0.34	0.00	39.37	309.67	2.00	0.00	0.33	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	303.15	2.00	0.00	0.33	0.00	39.70	300.82	2.00	0.00	0.33	0.00
39.86	301.65	2.00	0.00	0.32	0.00	40.03	302.37	2.00	0.00	0.32	0.00
40.19	298.44	2.00	0.00	0.32	0.00	40.35	289.96	2.00	0.00	0.32	0.00
40.52	276.85	2.00	0.00	0.31	0.00	40.68	263.49	2.00	0.00	0.31	0.00
40.85	255.77	2.00	0.00	0.31	0.00	41.01	260.42	2.00	0.00	0.30	0.00
41.17	274.08	2.00	0.00	0.30	0.00	41.34	286.47	2.00	0.00	0.30	0.00
41.50	296.84	2.00	0.00	0.30	0.00	41.67	308.09	2.00	0.00	0.29	0.00
41.83	310.14	2.00	0.00	0.29	0.00	41.99	301.43	2.00	0.00	0.29	0.00
42.16	280.65	2.00	0.00	0.29	0.00	42.32	258.56	2.00	0.00	0.28	0.00
42.49	231.44	2.00	0.00	0.28	0.00	42.65	206.00	2.00	0.00	0.28	0.00
42.81	193.21	2.00	0.00	0.27	0.00	42.98	195.00	2.00	0.00	0.27	0.00
43.14	194.78	1.41	0.00	0.27	0.00	43.31	196.24	1.44	0.00	0.27	0.00
43.47	206.79	2.00	0.00	0.26	0.00	43.64	215.78	2.00	0.00	0.26	0.00
43.80	219.91	2.00	0.00	0.26	0.00	43.96	207.45	2.00	0.00	0.25	0.00
44.13	193.56	1.39	0.00	0.25	0.00	44.29	180.41	1.16	0.07	0.25	0.00
44.46	184.02	2.00	0.00	0.25	0.00	44.62	192.30	2.00	0.00	0.24	0.00
44.78	205.51	2.00	0.00	0.24	0.00	44.95	219.63	2.00	0.00	0.24	0.00
45.11	225.96	2.00	0.00	0.24	0.00	45.28	216.58	2.00	0.00	0.23	0.00
45.44	211.45	2.00	0.00	0.23	0.00	45.60	206.15	2.00	0.00	0.23	0.00
45.77	206.40	2.00	0.00	0.22	0.00	45.93	214.00	2.00	0.00	0.22	0.00
46.10	231.72	2.00	0.00	0.22	0.00	46.26	244.98	2.00	0.00	0.22	0.00
46.42	253.41	2.00	0.00	0.21	0.00	46.59	254.02	2.00	0.00	0.21	0.00
46.75	250.43	2.00	0.00	0.21	0.00	46.92	246.68	2.00	0.00	0.20	0.00
47.08	256.13	2.00	0.00	0.20	0.00	47.24	267.58	2.00	0.00	0.20	0.00
47.41	262.26	2.00	0.00	0.20	0.00	47.57	250.07	2.00	0.00	0.19	0.00
47.74	234.69	2.00	0.00	0.19	0.00	47.90	221.61	2.00	0.00	0.19	0.00
48.06	209.71	2.00	0.00	0.19	0.00	48.23	205.72	2.00	0.00	0.18	0.00
48.39	206.94	2.00	0.00	0.18	0.00	48.56	209.23	2.00	0.00	0.18	0.00
48.72	206.89	2.00	0.00	0.17	0.00	48.88	204.21	2.00	0.00	0.17	0.00
49.05	193.60	1.44	0.00	0.17	0.00	49.21	160.61	0.89	0.13	0.17	0.00
49.38	124.38	2.00	0.00	0.16	0.00	49.54	98.87	2.00	0.00	0.16	0.00
49.70	93.17	2.00	0.00	0.16	0.00	49.87	90.06	2.00	0.00	0.15	0.00
50.03	91.15	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.19

Abbreviations

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

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

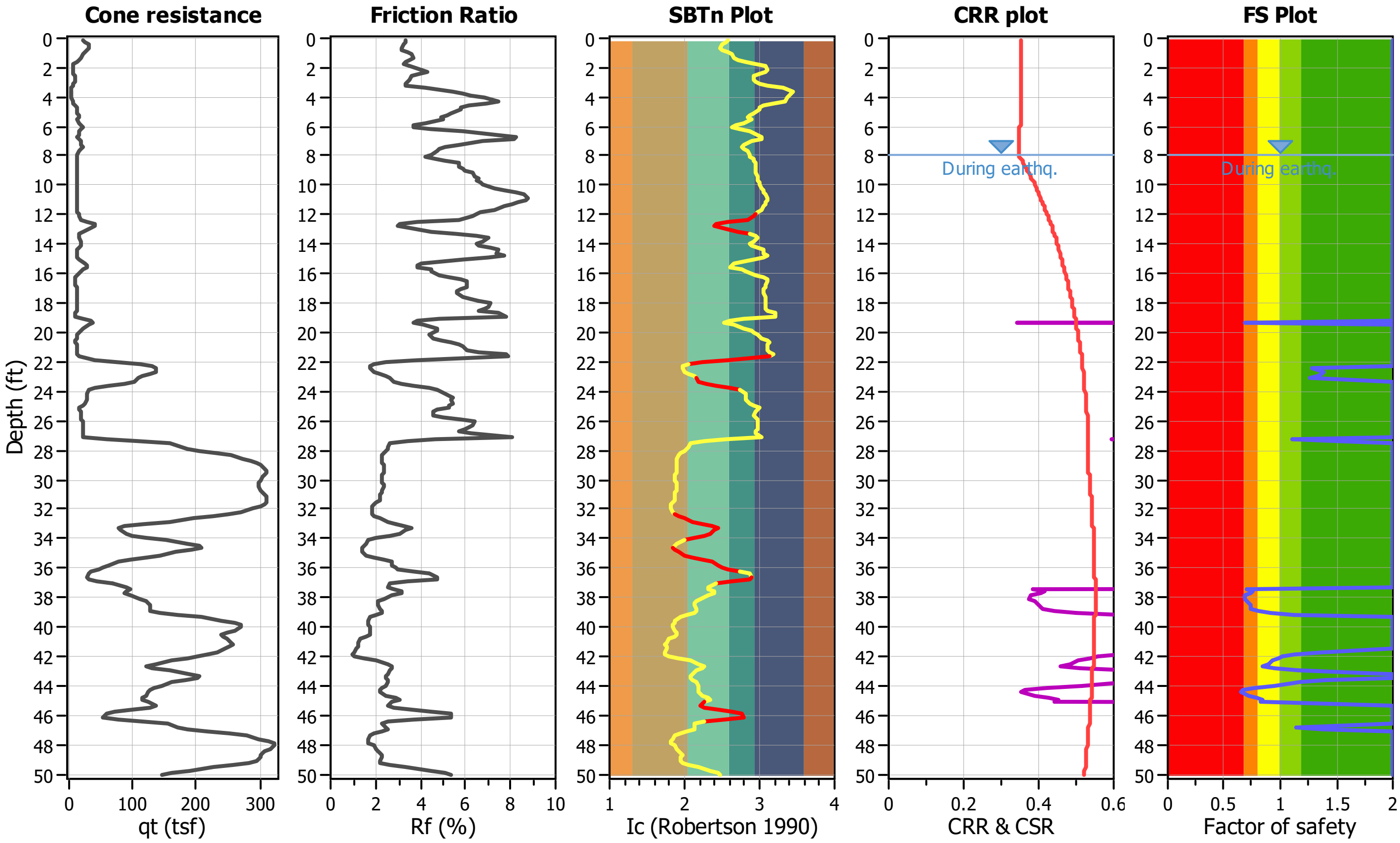
LIQUEFACTION ANALYSIS REPORT

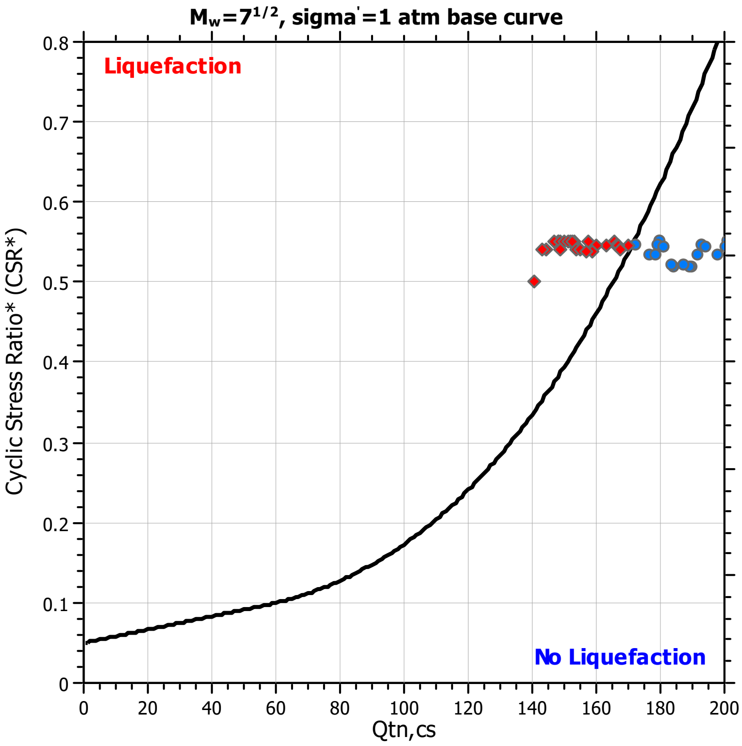
Project title : Drew Solar Project **Location : Calexico, CA**

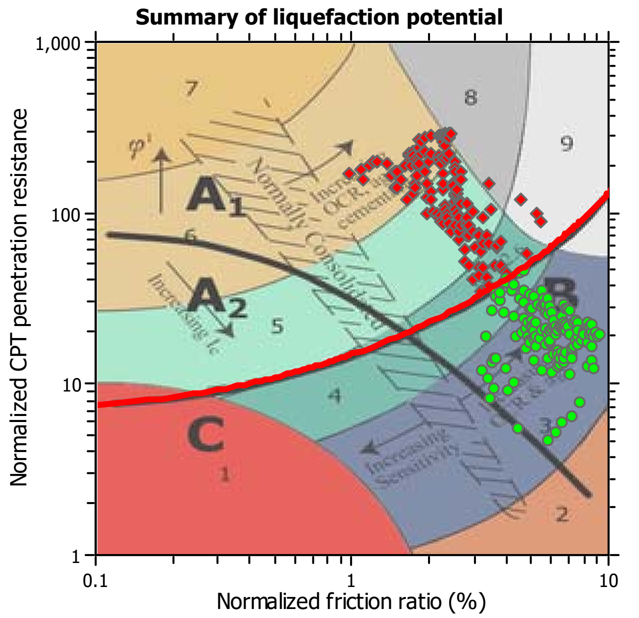
CPT file : CPT-06

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	8.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	8.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	MSF method:	Method based
Peak ground acceleration:	0.50	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

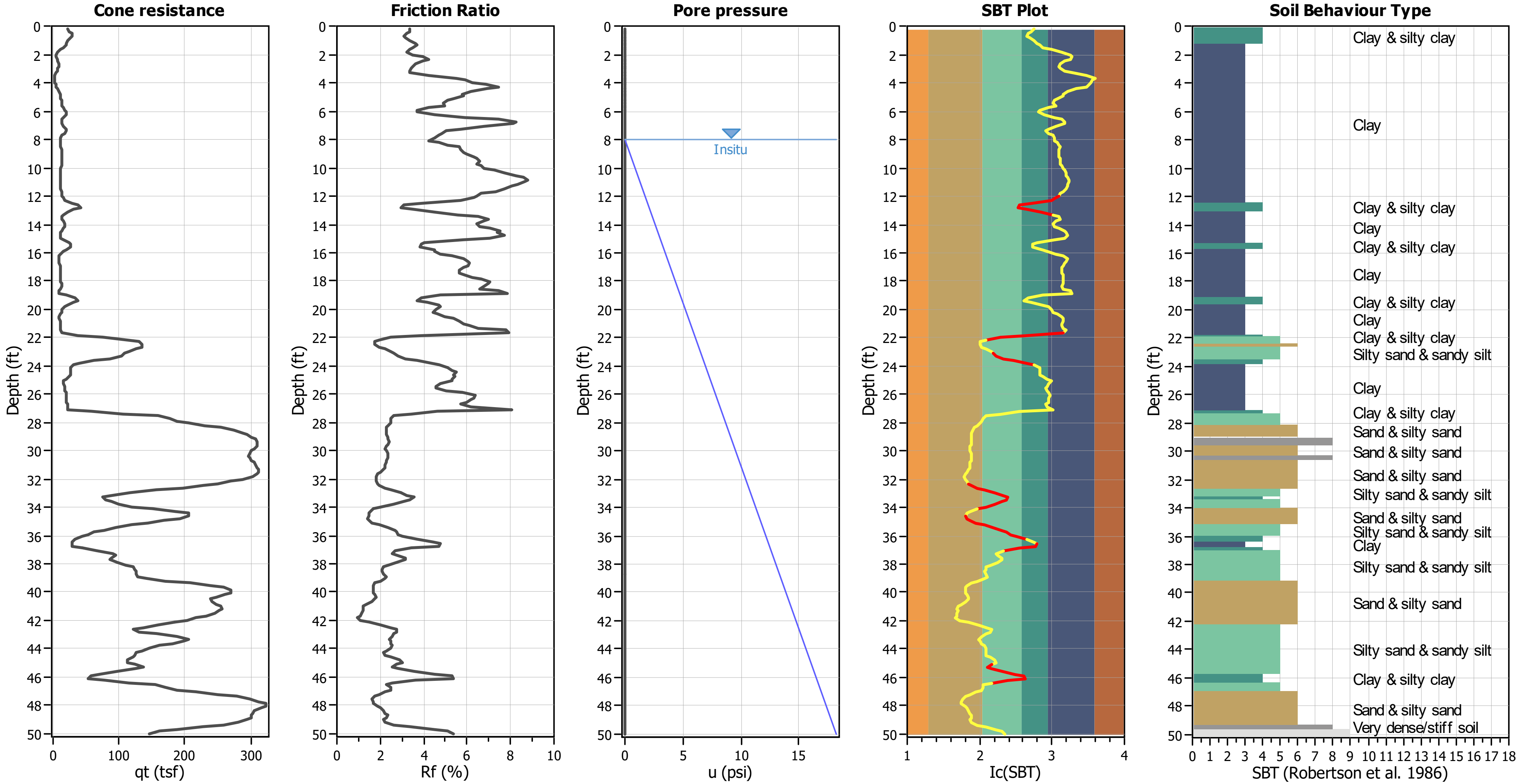






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



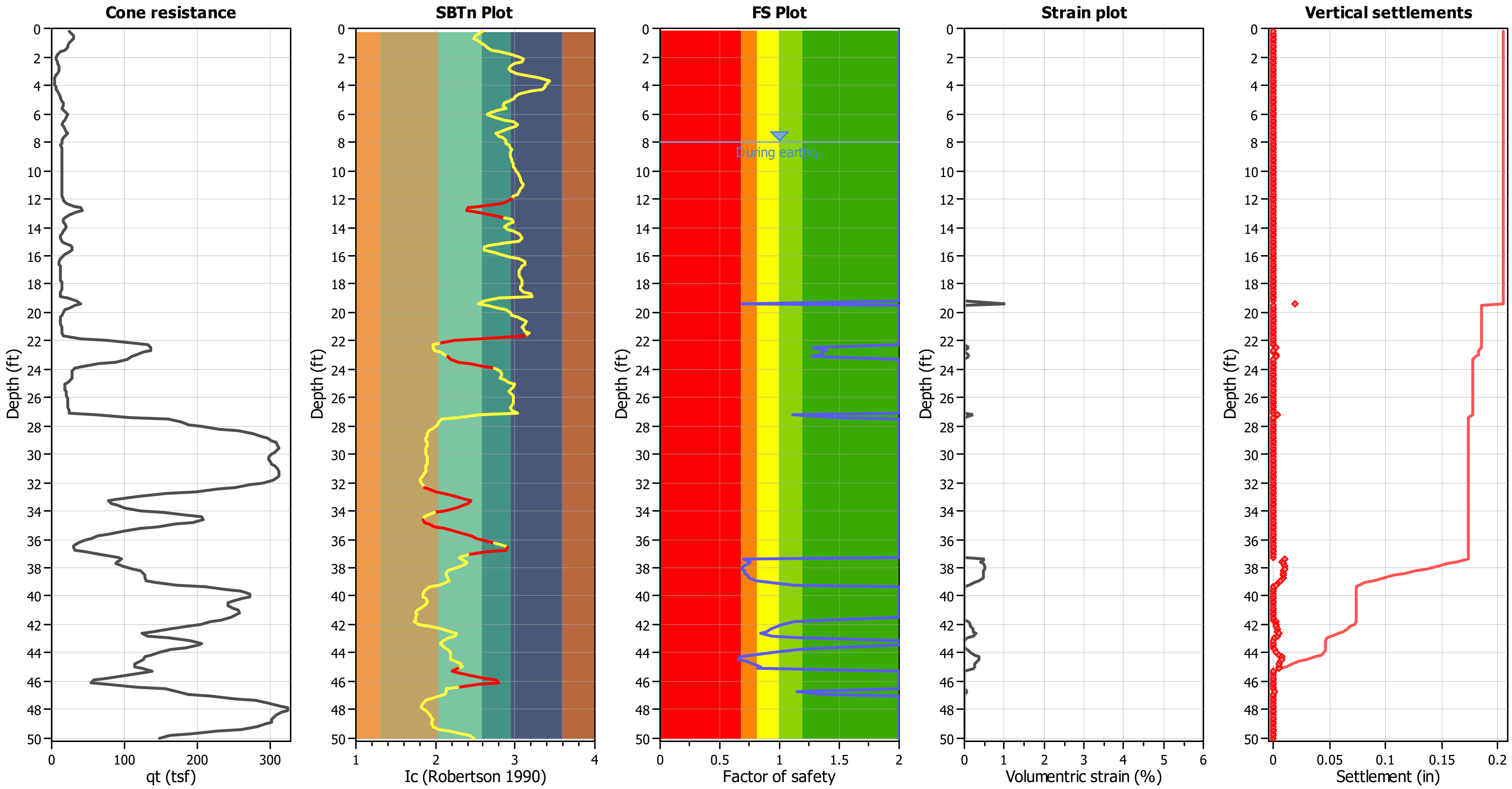
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	8.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.50	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	8.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
8.04	103.97	2.00	0.00	0.86	0.00	8.20	108.10	2.00	0.00	0.86	0.00
8.37	113.05	2.00	0.00	0.86	0.00	8.53	120.46	2.00	0.00	0.86	0.00
8.69	123.74	2.00	0.00	0.85	0.00	8.86	127.71	2.00	0.00	0.85	0.00
9.02	130.40	2.00	0.00	0.85	0.00	9.19	133.43	2.00	0.00	0.84	0.00
9.35	134.66	2.00	0.00	0.84	0.00	9.51	135.74	2.00	0.00	0.84	0.00
9.68	134.06	2.00	0.00	0.84	0.00	9.84	133.26	2.00	0.00	0.83	0.00
10.01	132.42	2.00	0.00	0.83	0.00	10.17	135.43	2.00	0.00	0.83	0.00
10.33	140.33	2.00	0.00	0.82	0.00	10.50	146.97	2.00	0.00	0.82	0.00
10.66	149.96	2.00	0.00	0.82	0.00	10.83	149.82	2.00	0.00	0.82	0.00
10.99	146.80	2.00	0.00	0.81	0.00	11.15	144.28	2.00	0.00	0.81	0.00
11.32	143.35	2.00	0.00	0.81	0.00	11.48	141.24	2.00	0.00	0.81	0.00
11.65	140.25	2.00	0.00	0.80	0.00	11.81	137.53	2.00	0.00	0.80	0.00
11.98	139.17	2.00	0.00	0.80	0.00	12.14	142.04	2.00	0.00	0.79	0.00
12.30	143.86	2.00	0.00	0.79	0.00	12.47	142.67	2.00	0.00	0.79	0.00
12.63	140.84	2.00	0.00	0.79	0.00	12.80	141.63	2.00	0.00	0.78	0.00
12.96	140.17	2.00	0.00	0.78	0.00	13.12	138.15	2.00	0.00	0.78	0.00
13.29	135.73	2.00	0.00	0.77	0.00	13.45	139.36	2.00	0.00	0.77	0.00
13.62	146.60	2.00	0.00	0.77	0.00	13.78	153.60	2.00	0.00	0.77	0.00
13.94	155.78	2.00	0.00	0.76	0.00	14.11	154.00	2.00	0.00	0.76	0.00
14.27	148.48	2.00	0.00	0.76	0.00	14.44	141.43	2.00	0.00	0.76	0.00
14.60	134.52	2.00	0.00	0.75	0.00	14.76	134.64	2.00	0.00	0.75	0.00
14.93	131.04	2.00	0.00	0.75	0.00	15.09	135.67	2.00	0.00	0.74	0.00
15.26	130.89	2.00	0.00	0.74	0.00	15.42	134.56	2.00	0.00	0.74	0.00
15.58	132.69	2.00	0.00	0.74	0.00	15.75	129.48	2.00	0.00	0.73	0.00
15.91	119.73	2.00	0.00	0.73	0.00	16.08	109.58	2.00	0.00	0.73	0.00
16.24	103.48	2.00	0.00	0.72	0.00	16.40	103.78	2.00	0.00	0.72	0.00
16.57	106.74	2.00	0.00	0.72	0.00	16.73	110.77	2.00	0.00	0.72	0.00
16.90	112.88	2.00	0.00	0.71	0.00	17.06	112.48	2.00	0.00	0.71	0.00
17.22	110.23	2.00	0.00	0.71	0.00	17.39	109.13	2.00	0.00	0.71	0.00
17.55	110.73	2.00	0.00	0.70	0.00	17.72	115.14	2.00	0.00	0.70	0.00
17.88	121.43	2.00	0.00	0.70	0.00	18.04	127.80	2.00	0.00	0.69	0.00
18.21	128.07	2.00	0.00	0.69	0.00	18.37	125.27	2.00	0.00	0.69	0.00
18.54	117.14	2.00	0.00	0.69	0.00	18.70	114.41	2.00	0.00	0.68	0.00
18.86	116.34	2.00	0.00	0.68	0.00	19.03	130.32	2.00	0.00	0.68	0.00
19.19	137.02	2.00	0.00	0.67	0.00	19.36	140.79	0.68	1.02	0.67	0.02
19.52	138.06	2.00	0.00	0.67	0.00	19.69	128.70	2.00	0.00	0.67	0.00
19.85	117.04	2.00	0.00	0.66	0.00	20.01	107.00	2.00	0.00	0.66	0.00
20.18	100.63	2.00	0.00	0.66	0.00	20.34	95.88	2.00	0.00	0.66	0.00
20.51	93.42	2.00	0.00	0.65	0.00	20.67	96.46	2.00	0.00	0.65	0.00
20.83	102.10	2.00	0.00	0.65	0.00	21.00	107.93	2.00	0.00	0.64	0.00
21.16	110.91	2.00	0.00	0.64	0.00	21.33	113.87	2.00	0.00	0.64	0.00
21.49	122.07	2.00	0.00	0.64	0.00	21.65	134.16	2.00	0.00	0.63	0.00
21.82	142.12	2.00	0.00	0.63	0.00	21.98	149.85	2.00	0.00	0.63	0.00
22.15	168.73	2.00	0.00	0.62	0.00	22.31	179.62	2.00	0.00	0.62	0.00
22.47	184.23	1.28	0.12	0.62	0.00	22.64	190.25	1.39	0.00	0.62	0.00
22.80	189.45	1.37	0.00	0.61	0.00	22.97	187.71	1.34	0.11	0.61	0.00
23.13	183.99	1.27	0.11	0.61	0.00	23.29	184.72	2.00	0.00	0.61	0.00
23.46	177.61	2.00	0.00	0.60	0.00	23.62	166.78	2.00	0.00	0.60	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
23.79	152.16	2.00	0.00	0.60	0.00	23.95	140.65	2.00	0.00	0.59	0.00
24.11	136.92	2.00	0.00	0.59	0.00	24.28	139.27	2.00	0.00	0.59	0.00
24.44	143.77	2.00	0.00	0.59	0.00	24.61	142.10	2.00	0.00	0.58	0.00
24.77	135.67	2.00	0.00	0.58	0.00	24.93	122.59	2.00	0.00	0.58	0.00
25.10	112.52	2.00	0.00	0.57	0.00	25.26	106.42	2.00	0.00	0.57	0.00
25.43	106.41	2.00	0.00	0.57	0.00	25.59	107.31	2.00	0.00	0.57	0.00
25.75	114.17	2.00	0.00	0.56	0.00	25.92	124.28	2.00	0.00	0.56	0.00
26.08	133.67	2.00	0.00	0.56	0.00	26.25	135.03	2.00	0.00	0.56	0.00
26.41	132.12	2.00	0.00	0.55	0.00	26.57	129.01	2.00	0.00	0.55	0.00
26.74	128.66	2.00	0.00	0.55	0.00	26.90	135.47	2.00	0.00	0.54	0.00
27.07	155.69	2.00	0.00	0.54	0.00	27.23	176.61	1.11	0.21	0.54	0.00
27.40	197.95	1.50	0.00	0.54	0.00	27.56	222.28	2.00	0.00	0.53	0.00
27.72	233.36	2.00	0.00	0.53	0.00	27.89	242.79	2.00	0.00	0.53	0.00
28.05	258.82	2.00	0.00	0.52	0.00	28.22	275.49	2.00	0.00	0.52	0.00
28.38	294.88	2.00	0.00	0.52	0.00	28.54	311.04	2.00	0.00	0.52	0.00
28.71	323.02	2.00	0.00	0.51	0.00	28.87	329.47	2.00	0.00	0.51	0.00
29.04	334.56	2.00	0.00	0.51	0.00	29.20	341.02	2.00	0.00	0.51	0.00
29.36	344.01	2.00	0.00	0.50	0.00	29.53	342.26	2.00	0.00	0.50	0.00
29.69	337.25	2.00	0.00	0.50	0.00	29.86	331.41	2.00	0.00	0.49	0.00
30.02	327.18	2.00	0.00	0.49	0.00	30.18	325.71	2.00	0.00	0.49	0.00
30.35	325.68	2.00	0.00	0.49	0.00	30.51	325.88	2.00	0.00	0.48	0.00
30.68	325.74	2.00	0.00	0.48	0.00	30.84	326.04	2.00	0.00	0.48	0.00
31.00	326.49	2.00	0.00	0.47	0.00	31.17	326.94	2.00	0.00	0.47	0.00
31.33	325.26	2.00	0.00	0.47	0.00	31.50	318.48	2.00	0.00	0.47	0.00
31.66	311.18	2.00	0.00	0.46	0.00	31.82	301.41	2.00	0.00	0.46	0.00
31.99	289.93	2.00	0.00	0.46	0.00	32.15	273.71	2.00	0.00	0.46	0.00
32.32	256.98	2.00	0.00	0.45	0.00	32.48	240.66	2.00	0.00	0.45	0.00
32.64	223.07	2.00	0.00	0.45	0.00	32.81	199.50	2.00	0.00	0.44	0.00
32.97	178.94	2.00	0.00	0.44	0.00	33.14	161.24	2.00	0.00	0.44	0.00
33.30	158.15	2.00	0.00	0.44	0.00	33.46	156.16	2.00	0.00	0.43	0.00
33.63	155.87	2.00	0.00	0.43	0.00	33.79	151.84	2.00	0.00	0.43	0.00
33.96	151.75	2.00	0.00	0.42	0.00	34.12	165.84	2.00	0.00	0.42	0.00
34.28	187.64	2.00	0.00	0.42	0.00	34.45	202.12	2.00	0.00	0.42	0.00
34.61	201.73	2.00	0.00	0.41	0.00	34.78	188.25	2.00	0.00	0.41	0.00
34.94	170.77	2.00	0.00	0.41	0.00	35.10	155.39	2.00	0.00	0.41	0.00
35.27	146.60	2.00	0.00	0.40	0.00	35.43	139.92	2.00	0.00	0.40	0.00
35.60	133.37	2.00	0.00	0.40	0.00	35.76	123.06	2.00	0.00	0.39	0.00
35.93	116.57	2.00	0.00	0.39	0.00	36.09	111.52	2.00	0.00	0.39	0.00
36.25	111.57	2.00	0.00	0.39	0.00	36.42	113.16	2.00	0.00	0.38	0.00
36.58	116.46	2.00	0.00	0.38	0.00	36.75	118.03	2.00	0.00	0.38	0.00
36.91	118.69	2.00	0.00	0.37	0.00	37.07	123.49	2.00	0.00	0.37	0.00
37.24	138.02	2.00	0.00	0.37	0.00	37.40	148.20	0.70	0.51	0.37	0.01
37.57	153.08	0.75	0.40	0.36	0.01	37.73	151.95	0.74	0.49	0.36	0.01
37.89	147.90	0.69	0.50	0.36	0.01	38.06	146.73	0.68	0.51	0.35	0.01
38.22	148.88	0.70	0.49	0.35	0.01	38.39	149.76	0.71	0.48	0.35	0.01
38.55	151.21	0.73	0.47	0.35	0.01	38.71	152.32	0.74	0.47	0.34	0.01
38.88	157.25	0.80	0.36	0.34	0.01	39.04	165.46	0.91	0.25	0.34	0.00
39.21	179.73	1.13	0.13	0.34	0.00	39.37	201.32	2.00	0.00	0.33	0.00

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
39.53	221.15	2.00	0.00	0.33	0.00	39.70	236.31	2.00	0.00	0.33	0.00
39.86	244.43	2.00	0.00	0.32	0.00	40.03	244.81	2.00	0.00	0.32	0.00
40.19	238.38	2.00	0.00	0.32	0.00	40.35	228.78	2.00	0.00	0.32	0.00
40.52	221.93	2.00	0.00	0.31	0.00	40.68	217.24	2.00	0.00	0.31	0.00
40.85	215.02	2.00	0.00	0.31	0.00	41.01	215.80	2.00	0.00	0.30	0.00
41.17	215.52	2.00	0.00	0.30	0.00	41.34	214.03	2.00	0.00	0.30	0.00
41.50	205.20	2.00	0.00	0.30	0.00	41.67	192.90	1.37	0.00	0.29	0.00
41.83	179.22	1.13	0.11	0.29	0.00	41.99	172.75	1.02	0.15	0.29	0.00
42.16	170.12	0.99	0.15	0.29	0.00	42.32	166.29	0.93	0.21	0.28	0.00
42.49	163.43	0.89	0.21	0.28	0.00	42.65	159.80	0.84	0.28	0.28	0.01
42.81	166.96	0.94	0.20	0.27	0.00	42.98	181.39	1.17	0.07	0.27	0.00
43.14	200.74	2.00	0.00	0.27	0.00	43.31	210.06	2.00	0.00	0.27	0.00
43.47	205.85	2.00	0.00	0.26	0.00	43.64	194.31	1.40	0.00	0.26	0.00
43.80	181.52	1.17	0.07	0.26	0.00	43.96	167.32	0.95	0.14	0.25	0.00
44.13	153.82	0.77	0.27	0.25	0.01	44.29	144.55	0.67	0.36	0.25	0.01
44.46	143.35	0.65	0.36	0.25	0.01	44.62	148.89	0.72	0.34	0.24	0.01
44.78	154.75	0.79	0.26	0.24	0.01	44.95	158.64	0.84	0.25	0.24	0.00
45.11	157.01	0.82	0.25	0.24	0.00	45.28	160.05	2.00	0.00	0.23	0.00
45.44	159.34	2.00	0.00	0.23	0.00	45.60	160.09	2.00	0.00	0.23	0.00
45.77	156.25	2.00	0.00	0.22	0.00	45.93	153.30	2.00	0.00	0.22	0.00
46.10	147.59	2.00	0.00	0.22	0.00	46.26	143.14	2.00	0.00	0.22	0.00
46.42	144.92	2.00	0.00	0.21	0.00	46.59	162.22	2.00	0.00	0.21	0.00
46.75	178.82	1.15	0.08	0.21	0.00	46.92	191.98	1.38	0.00	0.20	0.00
47.08	203.45	2.00	0.00	0.20	0.00	47.24	217.03	2.00	0.00	0.20	0.00
47.41	231.95	2.00	0.00	0.20	0.00	47.57	241.99	2.00	0.00	0.19	0.00
47.74	252.41	2.00	0.00	0.19	0.00	47.90	260.58	2.00	0.00	0.19	0.00
48.06	265.27	2.00	0.00	0.19	0.00	48.23	263.47	2.00	0.00	0.18	0.00
48.39	259.75	2.00	0.00	0.18	0.00	48.56	260.41	2.00	0.00	0.18	0.00
48.72	261.26	2.00	0.00	0.17	0.00	48.88	258.23	2.00	0.00	0.17	0.00
49.05	250.28	2.00	0.00	0.17	0.00	49.21	241.96	2.00	0.00	0.17	0.00
49.38	238.48	2.00	0.00	0.16	0.00	49.54	240.06	2.00	0.00	0.16	0.00
49.70	247.50	2.00	0.00	0.16	0.00	49.87	243.08	2.00	0.00	0.15	0.00
50.03	236.88	2.00	0.00	0.15	0.00						

Total estimated settlement: 0.20

Abbreviations

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

APPENDIX E

Irrigation Canals

Westside Main Canal

The Westside Main Canal extends towards the Salton Sea northward from the western terminus of the All American Canal. A number of lateral canals diverge from the Westside Main Canal and distribute water for irrigation of crops across parts of the Imperial Valley west of the New River. Damage to the Westside Main Canal was evaluated by continuous driving of the canal's levee roads from the All American Canal to Huff Road on the north. It was also observed at Forrester Road, Fites Road (see Cook Drain at Fites Road site in the Drains and Rivers section of this report), and at several locations along West Carter Road south of State Highway 86.

The Westside Main Canal did not fail, but slumps and fissures of variable sizes and extents were common from the All American Canal north to the Fillaree Canal diversion, at the bridge where Westmorland and Boley roads meet. The frequency and intensity of damage generally decreased northward, away from the earthquake epicenter. The Westside Main Canal sustained its most severe liquefaction-related damage south of Interstate 8, between Interstate 8 and the confluence with the All American Canal. North of Interstate 8, and especially north of Evan Hewes Highway (County Highway S80), observed ground failures were mainly limited to bank caving and, in a few locations, to incipient lateral spreads. The latter contained a few millimeters of horizontal displacement, enough to open a few arcuate fractures that defined the failure zone, but not enough displacement to imperil the function of the Westside Main Canal.

The sites described below are presented in order of increasing distance from the seismic source, and smaller canals as well as drains adjacent to the Westside Main Canal are included in this section of the report. Geographic reference points that could be used for locating individual sites along the Westside Main Canal are generally lacking. Therefore, a pair of site reference maps has been prepared to assist the reader (figs. 29 and 50). Secondary canals and drains adjacent to the All American Canal are included here for convenience.

Westside Main Canal and Wormwood Canal at the All American Canal (C01)

Extensive liquefaction and related deformation occurred at the Westside Main Canal and the much smaller Wormwood Canal where they receive water from the western terminus of the All American Canal (fig. 30). Liquefaction-induced lateral spreading is present on both sides of the Westside Main Canal and on both sides of the adjacent Wormwood Canal, with a visibly displaced concrete liner in the Wormwood Canal. Liquefaction was confirmed by sand erupted from extensional fracture sets and at the bases of tilted utility poles, a deformed stream gauging station, and related settlements of embankments (figs. 31 to 35). South of the All American Canal, sand was vented subaqueously in a large puddle (fig. 36). Settlement cracks on the embankment supporting the international border fence bracket a 20-m-wide zone of settlement that coincides with the old trace of the Westside Main Canal, which used to enter the United States from Mexico prior to the construction of the All American Canal.

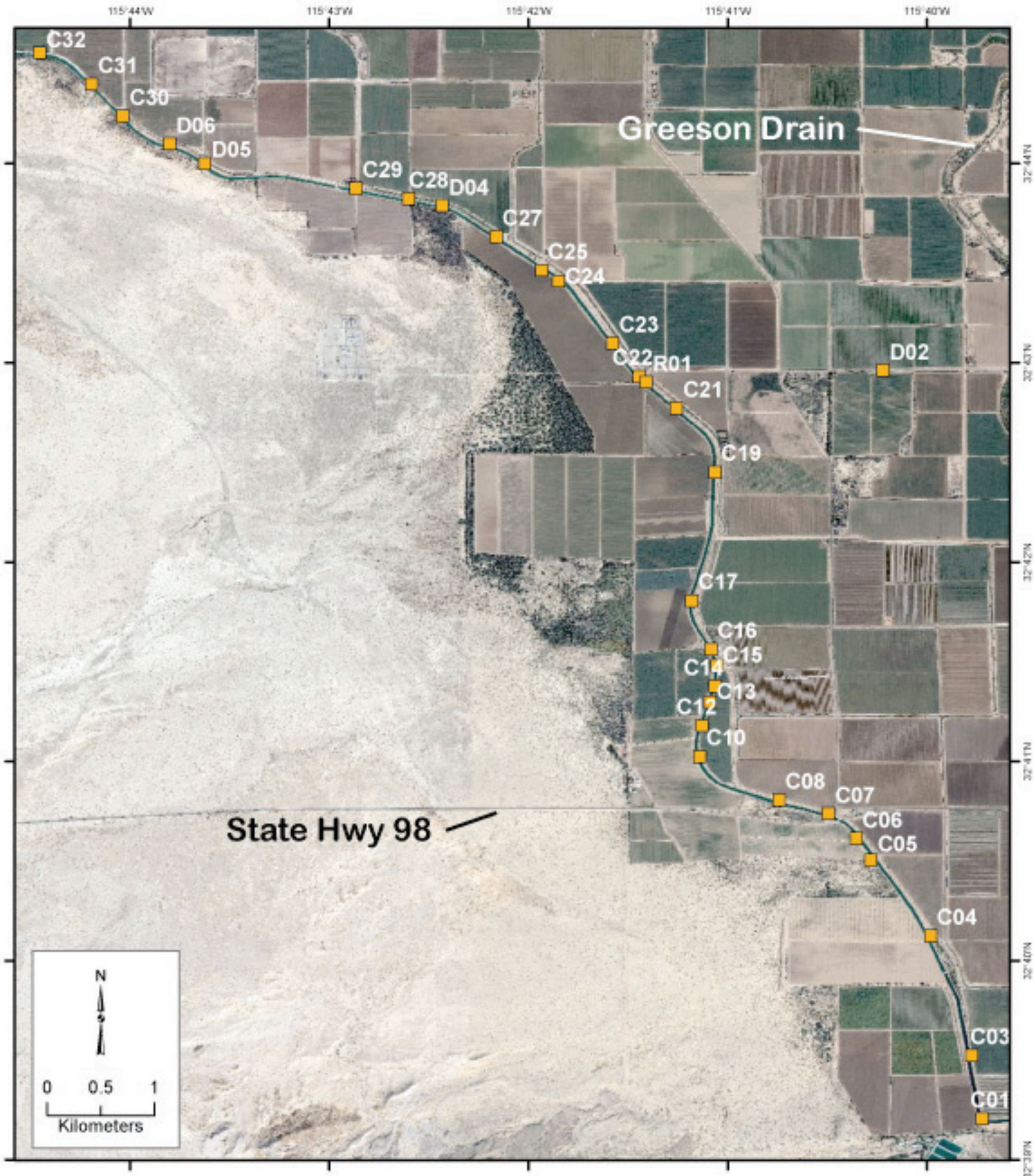


Figure 29. Location of ground failure sites along the southern extent of the Westside Main Canal, from Site C1 in the southeast corner to Site C32 in the northwest. In this reach, the Westside Main Canal skirts the western margin of irrigated land in the southwestern aspect of the Imperial Valley. The principal east-west trending highway in the lower third of this image is State Highway 98 (Yuha Cutoff), and the Greeson Drain is visible in the northeast corner of this image. The letter designation preceding site numbers indicates the structure or facility type at the site: C – irrigation canals; D – drains and rivers; R – roads and bridges; and F – major facilities and earthen dams. National Agricultural Imagery Program (NAIP), 2005, orthophoto base.

Westside Main and Wormwood Canals 550 m North of Anza Road (C04)

On the strip of land between the Westside Main Canal and Wormwood Canal, a lateral spread with a graben at the headscarp extended for 60 m along a trend of N. 27° W. subparallel to the trend of the Westside Main Canal. Displacement was toward the Westside Main Canal and amounted to 3 to 6 cm along the graben. Damage to the canal was not observed and no vented sand was found.

Westside Main Canal West Bank 450 m Southeast of State Highway 98 (C05)

Approximately 450 m south of Highway 98, a part of the Westside Main Canal's western levee collapsed into a void of uncertain origin (fig. 38). An absence of vented sand suggests that the observed ground failure may be ascribed to pre-earthquake piping that caused voids to form beneath the road surface within the levee materials. A nearby well and pump installation also showed evidence of ground settlement.

Westside Main Canal West Bank 250 m Southeast of Highway 98 (C06)

A substantial lateral spread spanned the 19 m width of the west bank levee of the Westside Main Canal and extended into an area of higher ground farther west (fig. 39). These arcuate fractures continue for about 100 m along the channel, and cumulative extensional displacements amounted to about 10 cm at the head of the failure. No vented sand was observed, but liquefaction is a likely cause of the deformation.

Westside Main Canal East Bank 120 m Northwest of State Highway 98 (C07)

A set of extensional fractures subparallel to the east bank of the Westside Main Canal extended about 22 m. Fractures stood open to a depth of 50 cm and horizontal extension amounted to about 9 cm (fig. 40). No vented materials were observed and liquefaction is uncertain. This type of ground failure, which was commonly observed near the Westside Main Canal banks on both sides of the channel, posed no immediate threat to the integrity of the levee.

Figure 38. Collapse of the Westside Main Canal's western access road (C05). Undermining of the road surface probably reflects pre-earthquake piping along transverse subgrade structures or other zone of seepage from the canal. No vented liquefied materials were noted in the area. Photo by J. Tinsley, 4/6/10.

Figure 39. View of extensional fractures at head scarp of lateral spread crossing the embankment in the foreground and including Westside Main Canal's service road to the left (C06). Riparian vegetation is tilted towards the canal owing to lateral spreading. Photo by J. Tinsley, 4/6/10.

Figure 40. Minor extensional fractures parallel to the channel of the Westside Main Canal (C07). No vented materials were observed in association with this ground failure; the failure is likely a result of strong shaking and not liquefaction. Photo by J. Tinsley, 4/7/10.

Westside Main Canal from 250 m to 800 m Northwest of Highway 98 (C08)

A series of shallow slumps in the east and west banks of the Westside Main Canal extended almost continuously for nearly a kilometer north of State Highway 98. Vented soil materials were not observed in association with these bank failures, and the failures likely are due to strong shaking rather than liquefaction. Figure 41 shows a typical example of this type of ground failure.

Westside Main Canal East Bank 2,000 m Northwest of Highway 98 (C14)

A small ground failure, possibly a lateral spread, was observed (fig. 42). Extensional fractures were open to a depth of 94 cm and one single block shows a maximum differential vertical separation of 16.5 cm near the canal's bank. Neither vented materials nor leakage associated with this ground failure in levee materials was observed. However, the geometry of the failure is consistent with liquefaction.

Westside Main Canal West Bank 380 m South of Kubler Road (C15)

A substantial ground failure, probably a lateral spread, was being repaired by a tracked excavator on the morning of April 7, 2010 (fig. 43). The slumping of the surface of the levee amounted to several tens of centimeters, because vegetation was submerged in the affected reach along the west levee of the Westside Main Canal.

Figure 41. Bank failure probably unrelated to liquefaction in the west bank of Westside Main Canal (C08). This style of failure was observed on both sides of the Westside Main Canal for nearly a kilometer north of State Highway 98. Failures seldom extended more than a meter or two into the levee materials and the bulk of the levees remained undamaged. Photo by J. Tinsley, 4/7/10.

Figure 42. View to north across inferred liquefaction lateral spread in the east bank of the Westside Main Canal (C14). Extensional fractures are open to 95 cm depth and extend across entire width of Westside Main Canal east service road for tens of m. Photo by J. Tinsley, 4/6/10.

APPENDIX F

September 7, 2018

Steve Williams
Landmark Consultants
780 N. 4th Street
El Centro, California 92243

SUBJECT: DREW SOLAR - SOIL TESTING SUMMARY REPORT

RFYeager Engineering Project No.: 18118

Dear Steve,

RFYeager Engineering has completed electrical and thermal soil resistivity testing at five (5) sites comprising the Drew Solar project near Calexico, California. The electrical resistivity testing was conducted in the field. The thermal resistivity testing was conducted at RFYeager Engineering office facilities on samples prepared and delivered by Landmark Consultants (Landmark). A chemical analysis of five (5) soil samples provided by Landmark was also conducted. The objective of this study is to determine the thermal and electrical resistivity, as well as to determine the corrosivity of the soil at the project site.

The location and numbering of the test sites is shown in Figure 1 which was based upon the site map provided by Landmark. The electrical resistivity of the soil was determined by using the Wenner 4-pin method in accordance with ASTM G57 standards. Readings were obtained and recorded based upon pin spacings of 40, 20, 15, 10, 5, and 2.5 feet in both the east-west and north-south orientation. All resistivity readings were recorded utilizing a Soil Resistance Meter (Megger Model DET4T2).

The soil corrosivity was evaluated based on the results of the soil resistivity survey and the chemical analyses of the soil samples obtained from augured holes dug by Landmark. The soil sample depths were approximately 3 to 5 feet. The samples were analyzed for pH, soluble salts (chlorides and sulfates) as well as minimum resistivity (in the saturated condition).

The thermal resistivity testing was determined using a Decagon KD2 Pro Portable Thermal Properties Analyzer (KD2 Pro) outfitted with the 100 mm long, 2.4 mm diameter TR-1 sensor. The KD2 Pro works in accordance with ASTM D5334-08 using a transient heat method. Soil samples from each of the five sites were tested at selected moisture contents and densities. The samples, as prepared by Landmark per ASTM D1557, were tested in a 2.50 inch diameter by 6.75 inch deep holder. Based upon the results of this testing, a thermal dry out curve was developed for each site in order to show the corresponding effect of moisture content on thermal resistivity.

.

From the test data, the following conclusions are offered:

1. The results of the field soil electrical resistivity testing are provided in Table 1 below. Three of the five sites (#3, #4, and #5) had resistivity readings below 260 ohm-cm for all pin spacings. Resistivity reads for Sites #1 and #2 were slightly higher, but all readings were below 1,630 ohm-cm.

Table 1 – Drew Solar
Soil Resistivity Test Data
Prepared by: RFYeager Engineering
Test Date: August 13, 2018

Test Site[1]		Soil Resistivity (Ohm-cm) Ave. Soil Depth (feet)					
Test No.	**Site ID & Test Orientation**	**40**	**20**	**15**	**10**	**5**	**2.5**
1	Site #1 (N/S orientation)	613	728	575	517	469	838
2	Site #1 (E/W orientation)	766	766	689	728	843	1216
3	Site #2 (N/S orientation)	153	306	373	479	833	1455
4	Site #2 (E/W orientation)	<77[2]	460	488	517	661	1628
5	Site #3 (N/S orientation)	153	153	201	230	259	254
6	Site #3 (E/W orientation)	<77	115	144	211	220	196
7	Site #4 (N/S orientation)	<77	77	115	134	134	105
8	Site #4 (E/W orientation)	<77	77	86	134	144	134
9	Site #5 (N/S orientation)	<77	192	230	211	192	139
10	Site #5 (E/W orientation)	<77	153	172	211	192	187

1 - See Figure 1 for test site location
2 - Electrical resistivity below detectable level of field equipment

2. The soil chemical analysis results indicated extreme variations in chloride concentrations ranging from 90 ppm to 1,140 ppm (see Table 2 below). Sulfate concentrations were also highly varied (200 ppm to 11,160 ppm). Samples 1 and

2 had the lowest combined chloride and sulfate concentrations. Samples 4 and 5 had the highest combined chloride and sulfate concentrations. The soil sample pH readings were all indicative of neutral to alkaline soil conditions. With the exception of Sample 2, the saturated resistivities of the soil samples were 440 ohm-cm or less.

Table 2 – Drew Solar
Soil Chemical Analysis Data
Prepared by: RFYeager Engineering

Soil Sample Site No.[1]	Min. Soil Box Resistivity[2] (ohm-cm)	Chloride Concentration[3] (ppm)	Sulfate Concentration[4] (ppm)	pH[5]
1	440	90	930	7.9
2	1400	40	200	8.3
3	170	600	5820	8.4
4	150	960	11160	8.2
5	180	1140	4260	8.1

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

3. The results of the field soil resistivity testing and soil sample analysis indicate a wide variance in the level of soil corrosivity between the sites comprising the Drew Solar project. Overall, however, the results of the soil testing indicate that the soil at all five sites should be considered as corrosive to buried metallic structures. Any metallic utilities buried in this type of soil would require supplemental corrosion control measures in order to prevent premature failures (i.e. dielectric coating and cathodic protection).

4. The thermal dry out curves for each sample site are provided in Appendix A. For purposes of this report, the thermal resistivity values and thermal dry out curves are provided as “data only” in order to assist others in the project design.

DISCUSSION

Soil Electrical Resistivity Survey - Soil electrical resistivity (inverse of conductivity) measures the ability of an electrolyte (soil) to support electrical current flow. The most common method of measuring soil electrical resistivity is the Wenner 4-Pin Method which uses four pins (electrodes) that are driven into the earth and equally spaced apart in a straight line. The Wenner 4-pin Method provides an average resistivity of a hemisphere (essentially) of soil whose diameter is approximately equal to the pin spacing. For example, the electrical resistivity value obtained with the pins spaced at 5 feet apart is the average resistivity of a hemisphere of soil from the surface to a depth of 5 feet.

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

One common relationship between corrosivity and soil resistivity used by corrosion engineers is as follows:

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

Soil Thermal Resistivity Testing

Thermal resistivity was tested on a total of 25 soil samples (5 from each site) measured at 5 separate locations. Testing was conducted in general accordance with the standard method ASTM D5334-08 which calculates thermal resistivity by monitoring the dissipation of heat from a line heat source. The test consists of inserting a thermal sensor into the soil with a known current and voltage applied. The corresponding temperature rise in the soil over a period of time is recorded. The thermal resistivity is obtained from an analysis of the time series temperature data during the heating and cooling cycle of the sensor.

Thank you for this opportunity to provide our professional services. Please call if you have any questions.

With best regards,

Randy J. Geving, PE
Registered Professional Engineer – Corrosion No.1060

REGISTERED PROFESSIONAL ENGINEER
RANDY J. GEVING
Exp.6/30/20
No.1060
CORROSION
STATE OF CALIFORNIA

1016 Broadway, Suite A, El Cajon, CA 92027 Ph: 760.715.2358 Fax:619.561.0031 RGeving@RFYeager.com

FIGURE 1 – DREW SOLAR SOIL TEST SITES

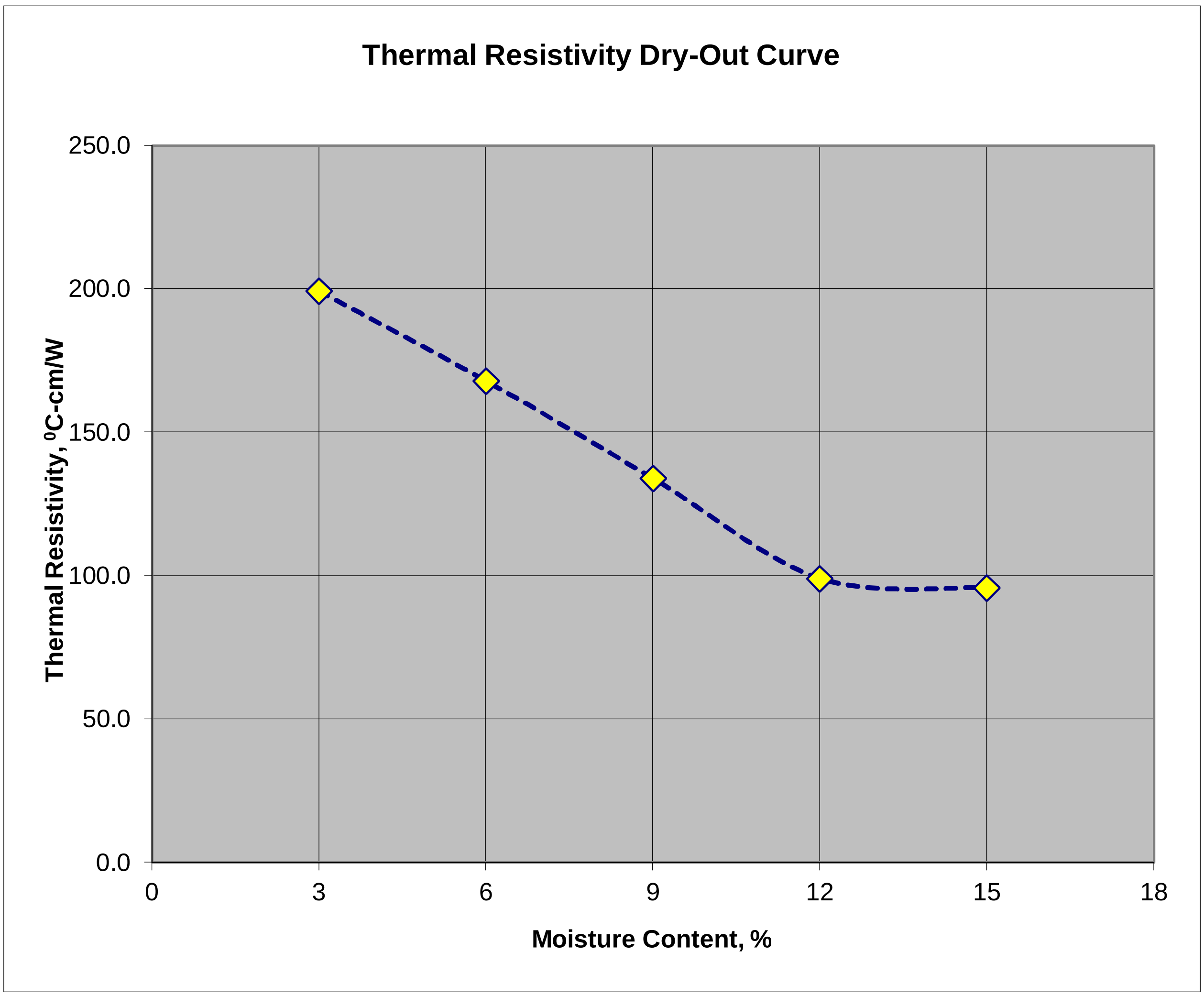
1016 Broadway, Suite A, El Cajon, CA 92027 Phone: 760.715.2358 Fax: 619.561.0031 RGeving@RFYeager.com

APPENDIX A
DREW SOLAR PROJECT
THERMAL RESISTIVITY
DRY-OUT CURVES

Drew Solar

Sample ID: TR-1
Therm. Resitivity Test Standard: ASTM D5334
Max Dry Density, pcf: 110.6
Opt. Moisture Content, % 14.8
Target % Compaction: 90%
Compaction Standard: ASTM D-1557-A

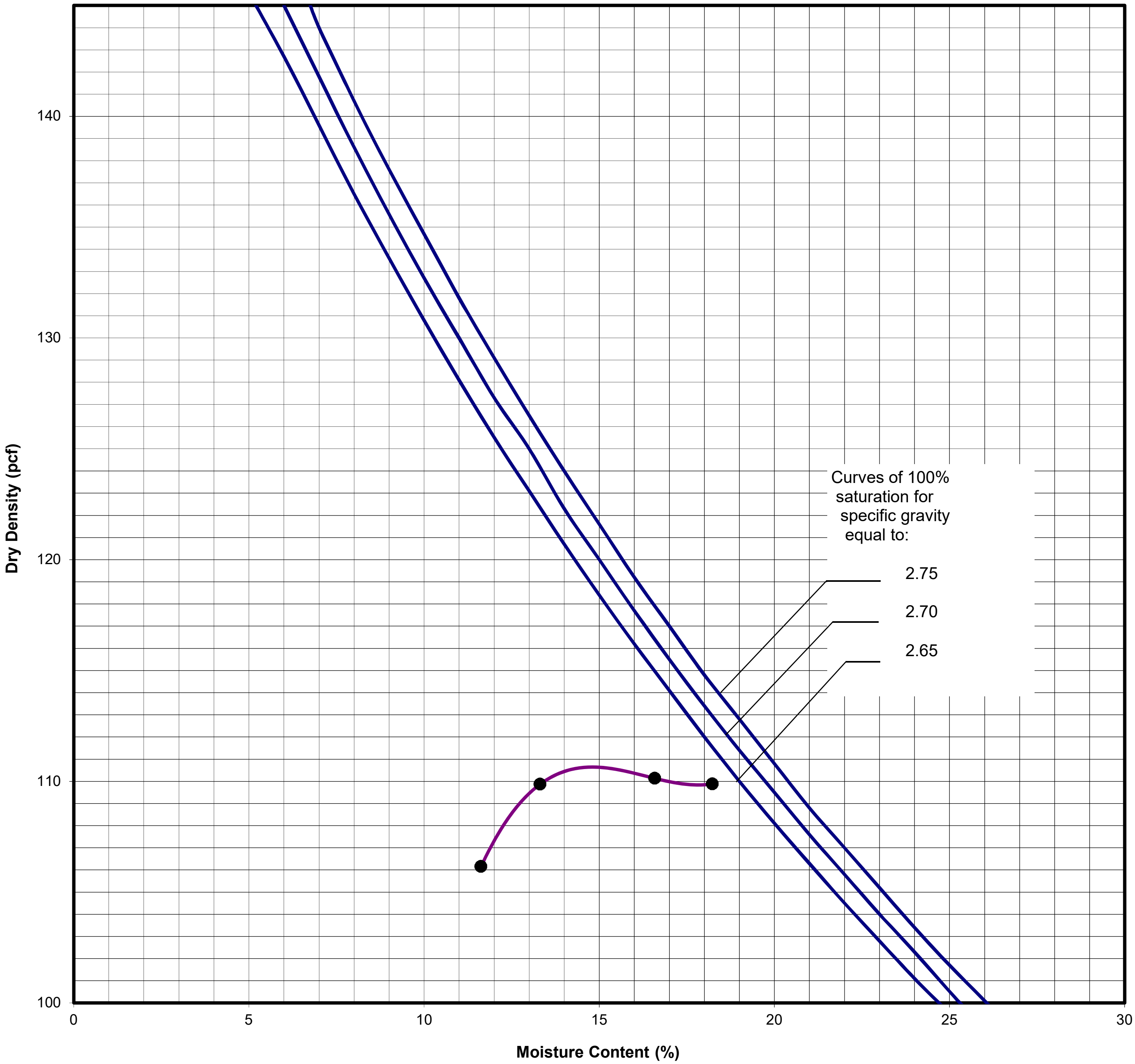
Moisture Content (%)	Thermal Resistivity (oC-cm/W)
3.0	199.3
6.0	168.0
9.0	134.0
12.0	99.1
15.0	95.9



Date: 9.4.2018

RFYeager Engineering

Client:	Drew Solar LLC	**Soil Description:**	Clay (CL)
Project:	Drew Solar	**Sample Location:**	TR-1 @ 0-4'
Project No.:	LE18150	**Test Method:**	ASTM D-1557-A
Date:	8/20/2018	**Maximum Dry Density (pcf):**	**110.6**
Lab. No.:	EC18-625	**Optimum Moisture Content (%):**	**14.8**



LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

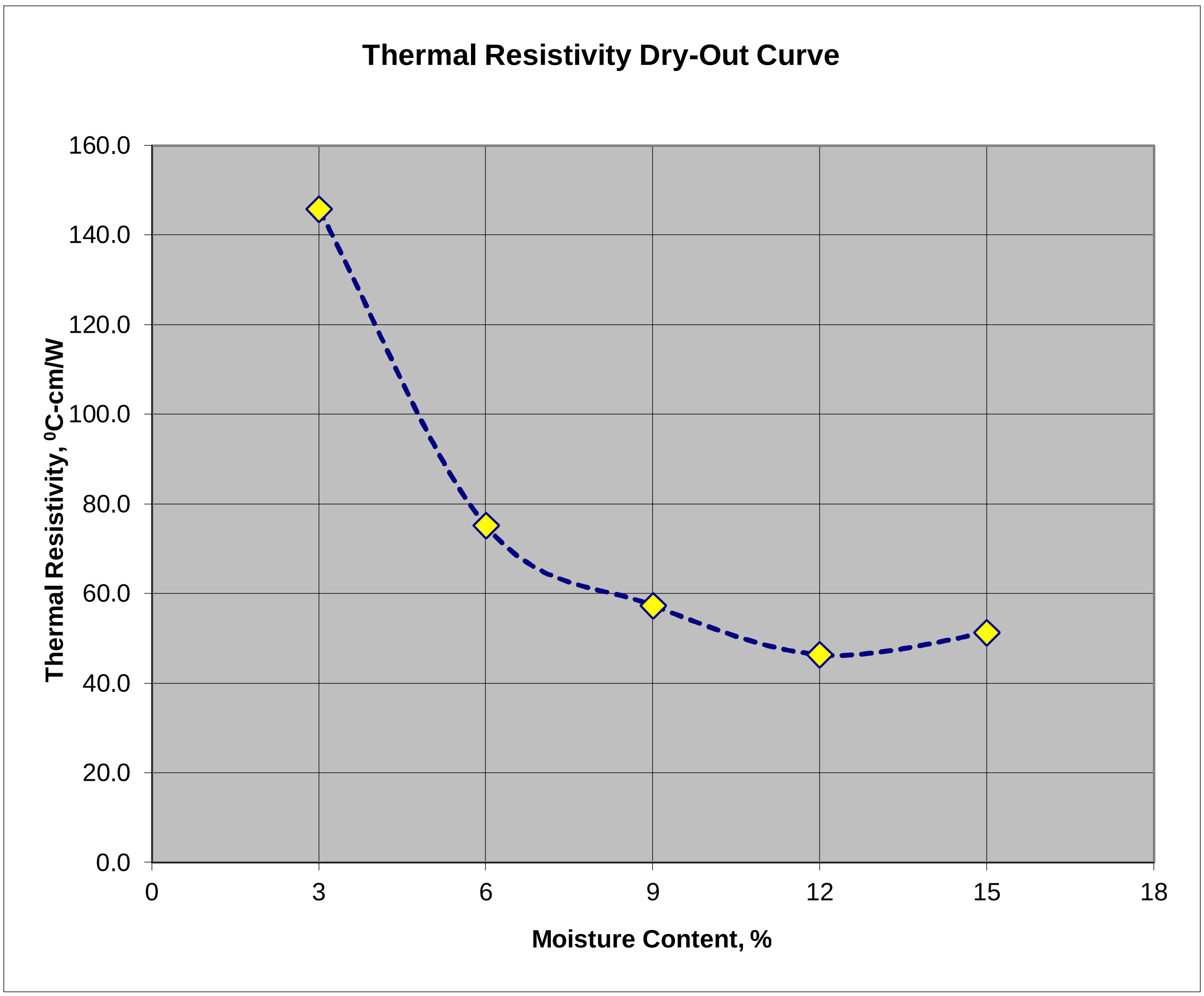
Moisture Density Relationship

Plate F-1

Drew Solar

Sample ID: TR-2
Therm. Resitivity Test Standard: ASTM D5334
Max Dry Density, pcf: 128
Opt. Moisture Content, % 9.2
Target % Compaction: 90%
Compaction Standard: ASTM D-1557-A

Moisture Content (%)	Thermal Resistivity (oC-cm/W)
3.0	145.8
6.0	75.2
9.0	57.4
12.0	46.4
15.0	51.3

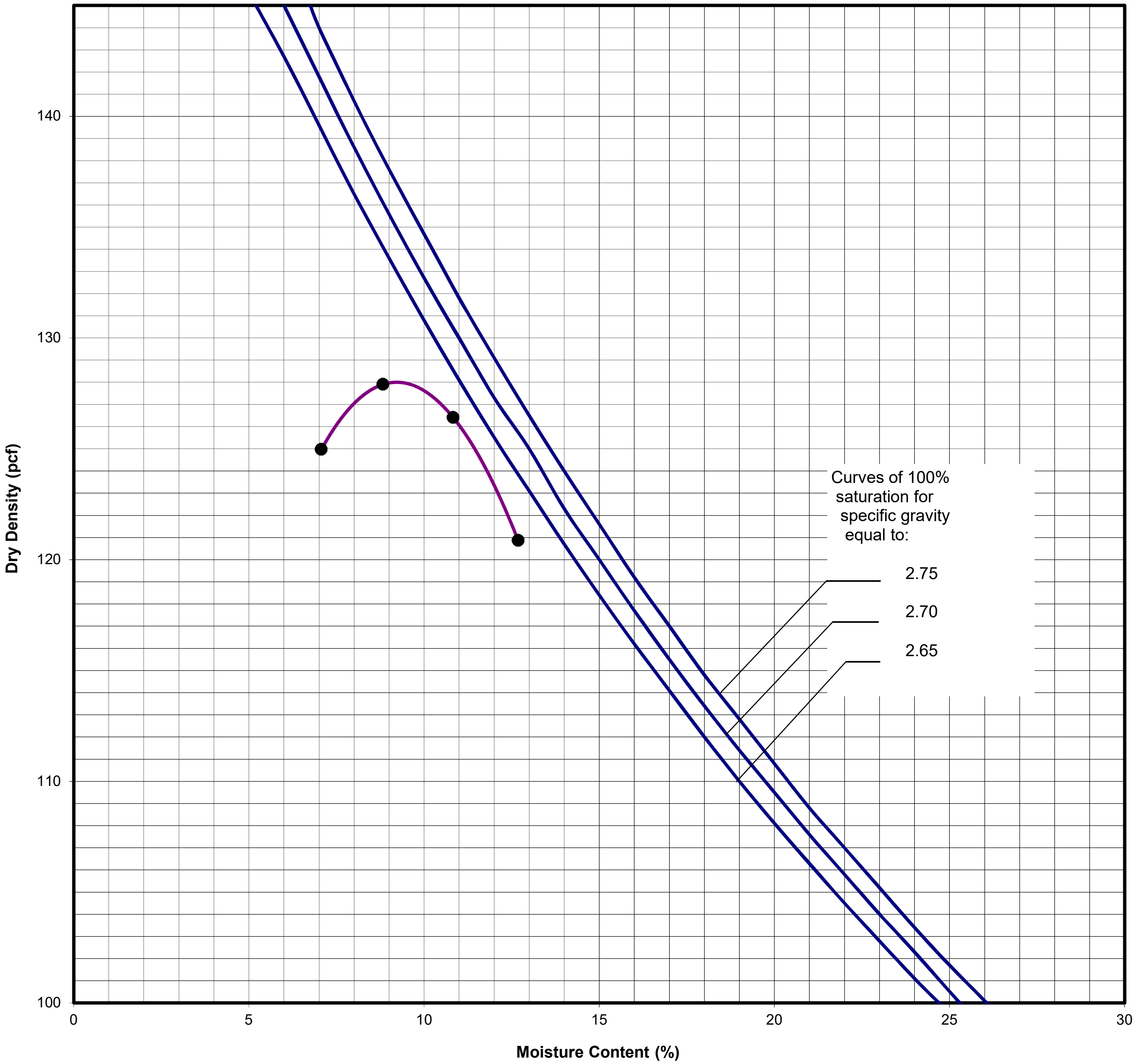


Date: 9.4.2018

RFYeager Engineering

Client: Drew Solar LLC
Project: Drew Solar
Project No.: LE18150
Date: 8/20/2018
Lab. No.: EC18-626

Soil Description: Silt (ML)
Sample Location: TR-2 @ 0-4'
Test Method: ASTM D-1557-A
Maximum Dry Density (pcf): 128.0
Optimum Moisture Content (%): 9.2



LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

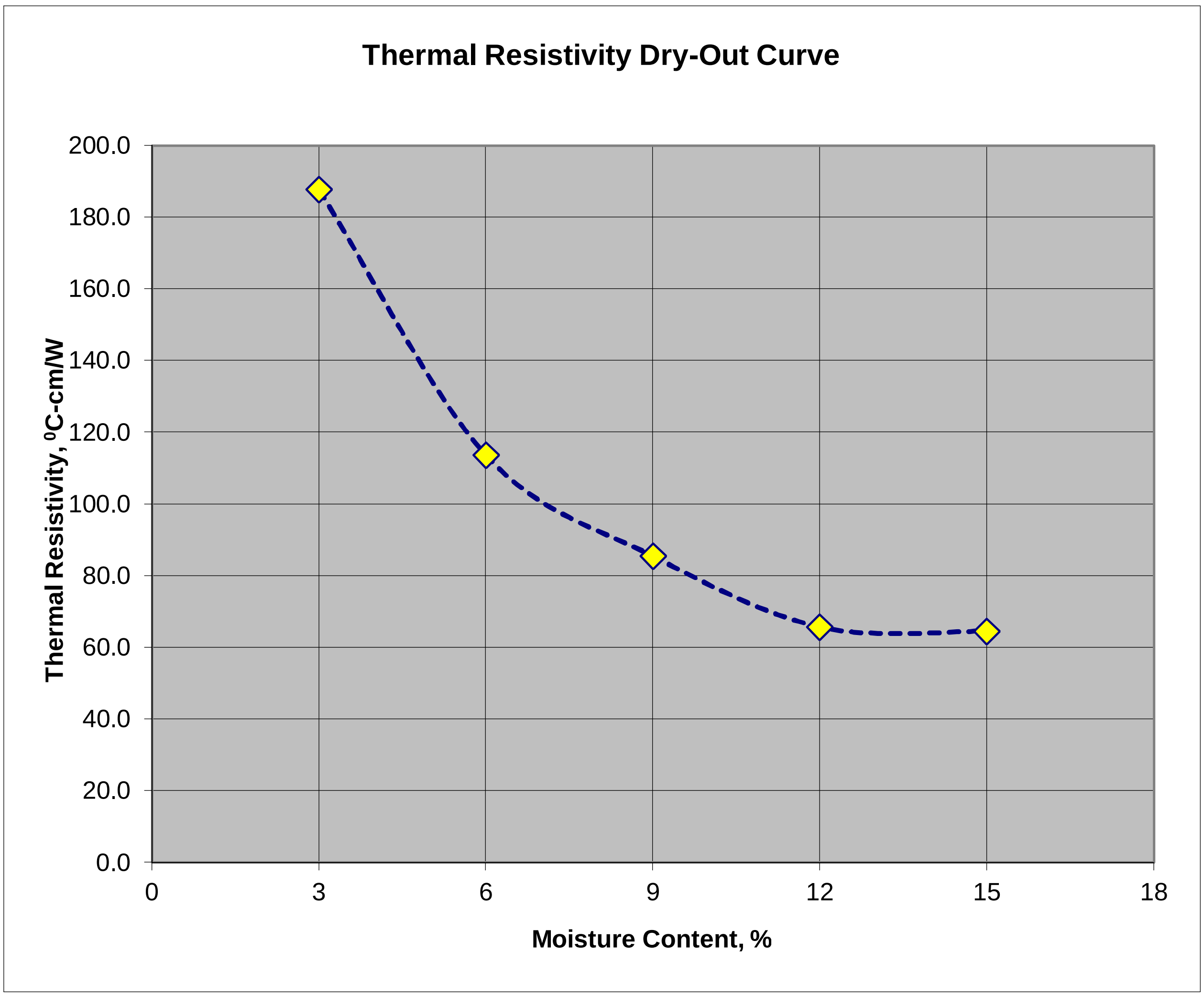
Moisture Density Relationship

Plate F-2

Drew Solar

Sample ID:	TR-3
Therm. Resitivity Test Standard:	ASTM D5334
Max Dry Density, pcf:	115.2
Opt. Moisture Content, %	14.4
Target % Compaction:	90%
Compaction Standard:	ASTM D-1557-A

Moisture Content (%)	Thermal Resistivity (oC-cm/W)
3.0	187.7
6.0	113.7
9.0	85.5
12.0	65.7
15.0	64.6

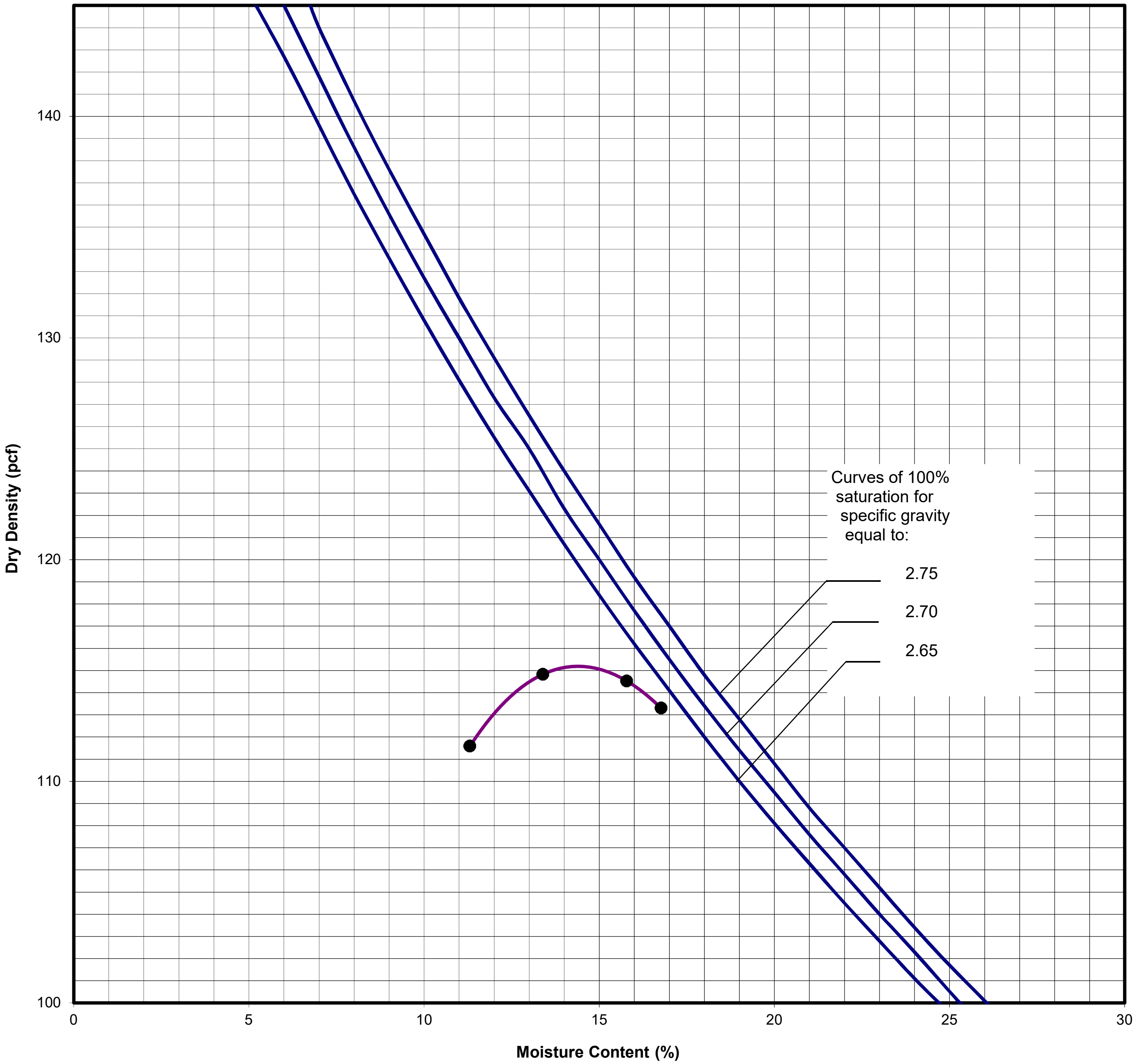


Date: 9.4.2018

RFYeager Engineering

Client: Drew Solar LLC
Project: Drew Solar
Project No.: LE18150
Date: 8/20/2018
Lab. No.: EC18-627

Soil Description: Silty Clay (CL)
Sample Location: TR-3 @ 0-4'
Test Method: ASTM D-1557-A
Maximum Dry Density (pcf): 115.2
Optimum Moisture Content (%): 14.4



LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

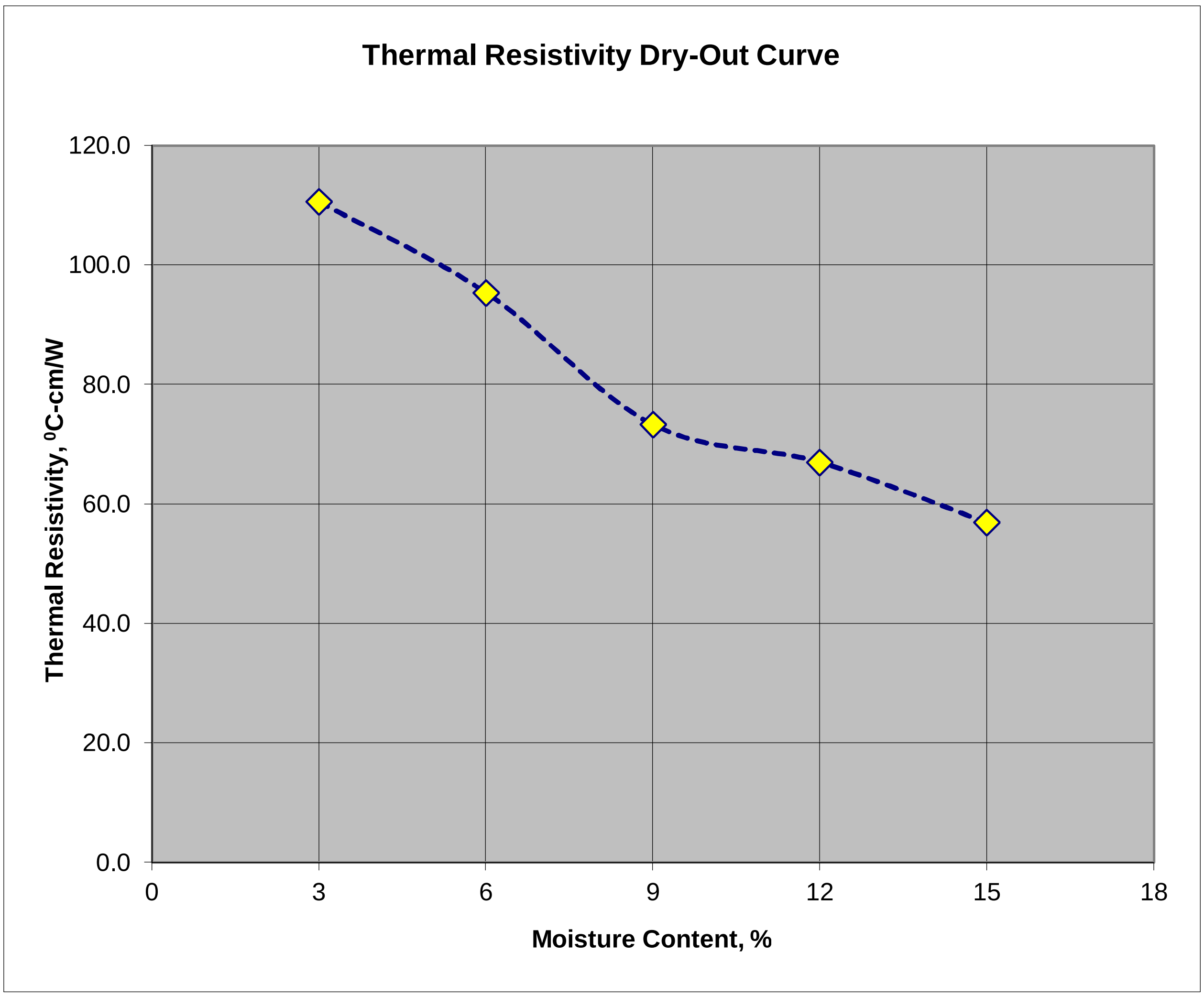
Moisture Density Relationship

Plate F-3

Drew Solar

Sample ID: TR-4
Therm. Resitivity Test Standard: ASTM D5334
Max Dry Density, pcf: 122.1
Opt. Moisture Content, % 10.7
Target % Compaction: 90%
Compaction Standard: ASTM D-1557-A

Moisture Content (%)	Thermal Resistivity (oC-cm/W)
3.0	110.6
6.0	95.4
9.0	73.3
12.0	67.0
15.0	56.9

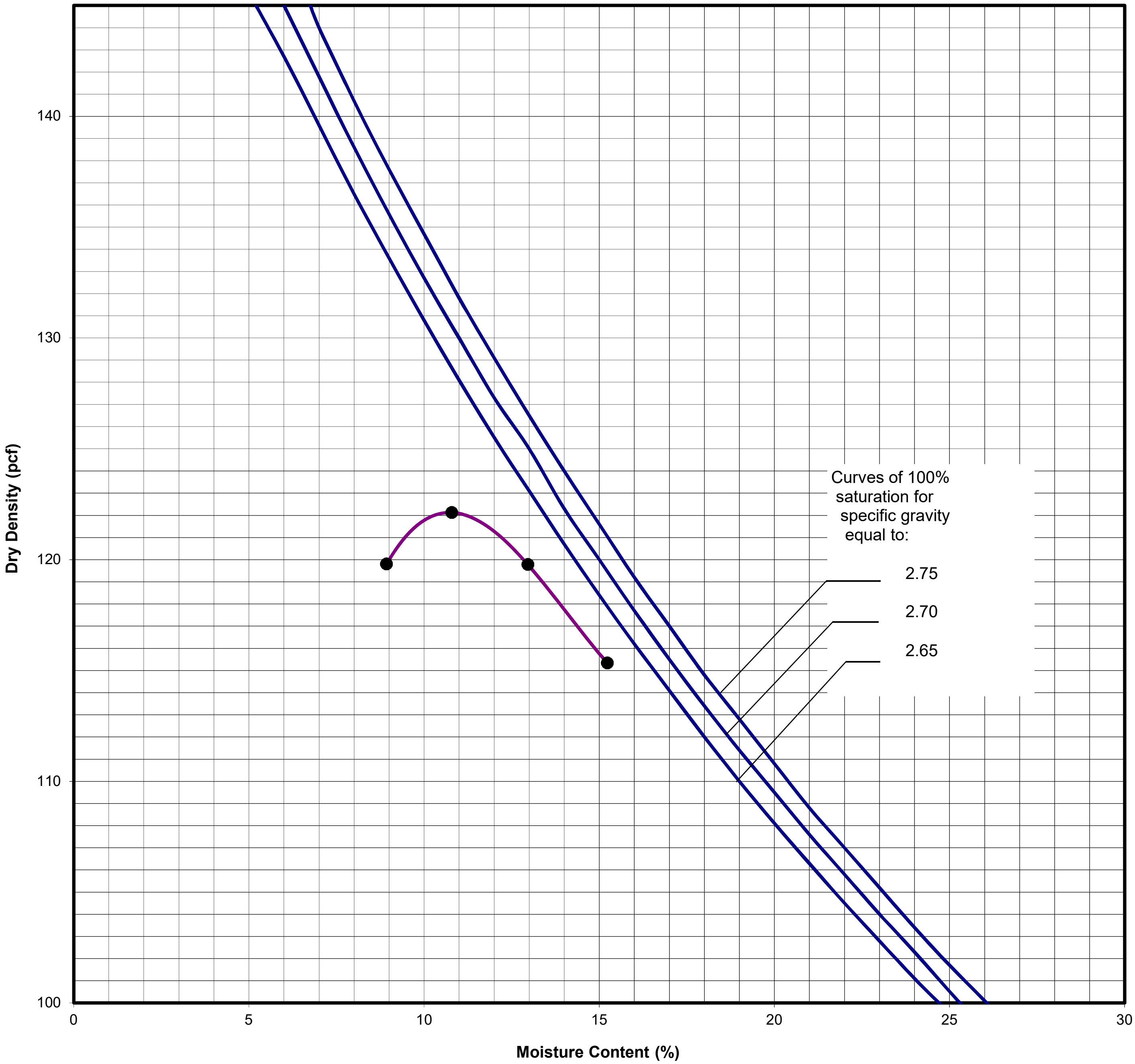


Date: 9.4.2018

RFYeager Engineering

Client: Drew Solar LLC
Project: Drew Solar
Project No.: LE18150
Date: 8/20/2018
Lab. No.: EC18-628

Soil Description: Silty Clay (CL)
Sample Location: TR-4 @ 0-4'
Test Method: ASTM D-1557-A
Maximum Dry Density (pcf): **122.1**
Optimum Moisture Content (%): **10.7**



LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

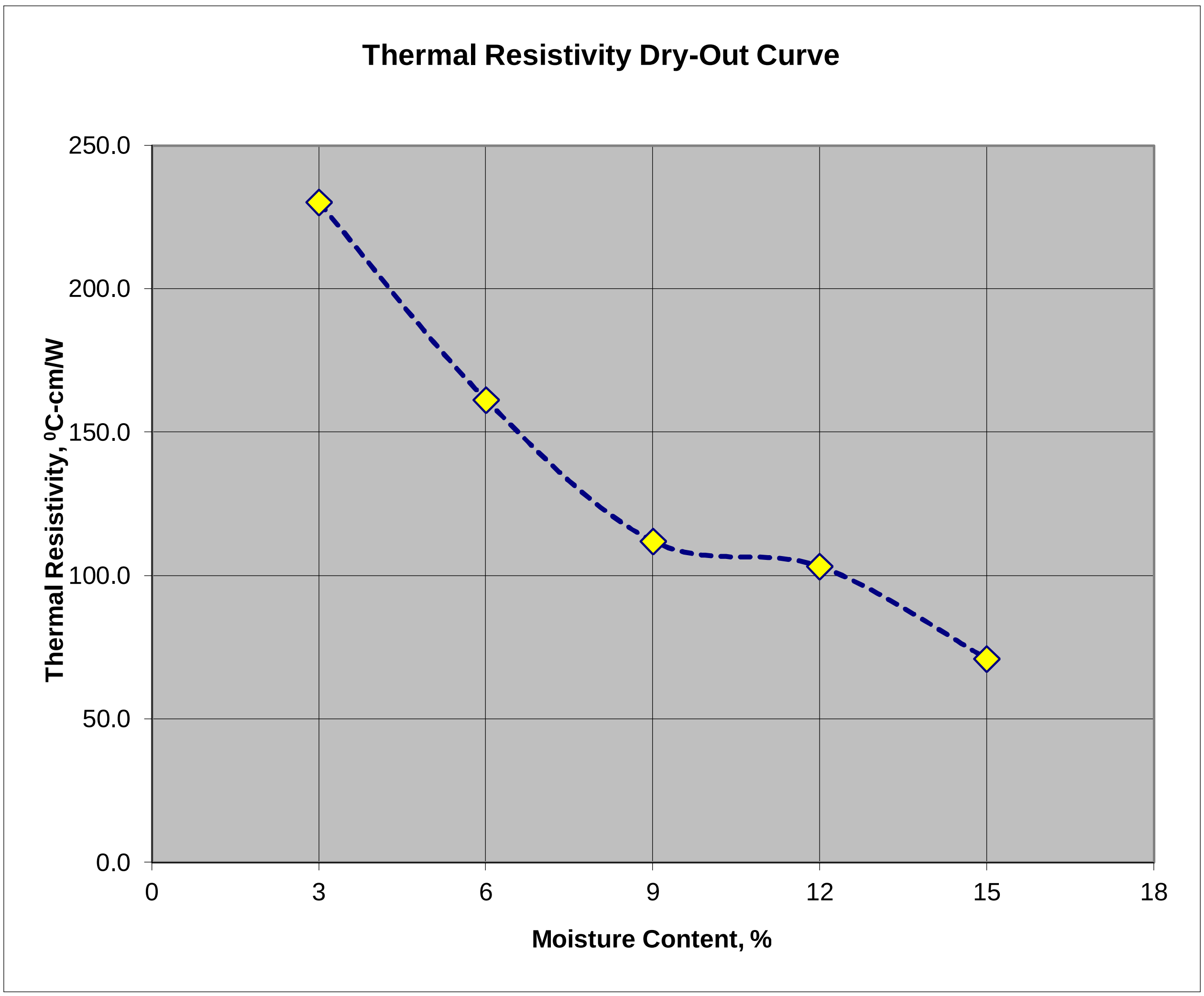
Moisture Density Relationship

Plate F-4

Drew Solar

Sample ID: TR-5
Therm. Resitivity Test Standard: ASTM D5334
Max Dry Density, pcf: 108.1
Opt. Moisture Content, % 18.2
Target % Compaction: 90%
Compaction Standard: ASTM D-1557-A

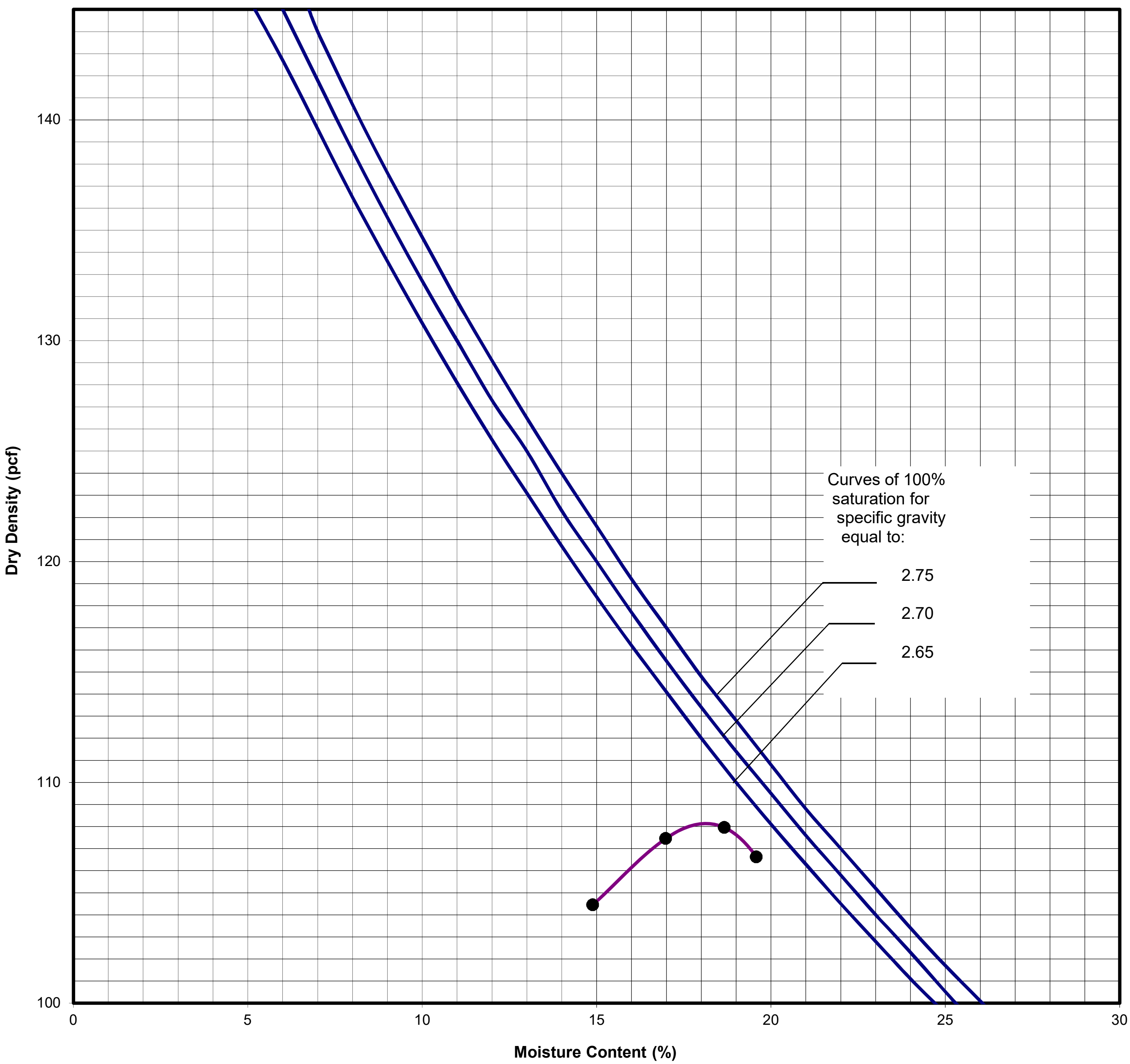
Moisture Content (%)	Thermal Resistivity (oC-cm/W)
3.0	230.2
6.0	161.4
9.0	112.1
12.0	103.3
15.0	71.1



Date: 9.4.2018

RFYeager Engineering

Client:	Drew Solar LLC	**Soil Description:**	Fat Clay (CH)
Project:	Drew Solar	**Sample Location:**	TR-5 @ 0-4'
Project No.:	LE18150	**Test Method:**	ASTM D-1557-A
Date:	8/20/2018	**Maximum Dry Density (pcf):**	**108.1**
Lab. No.:	EC18-629	**Optimum Moisture Content (%):**	**18.2**



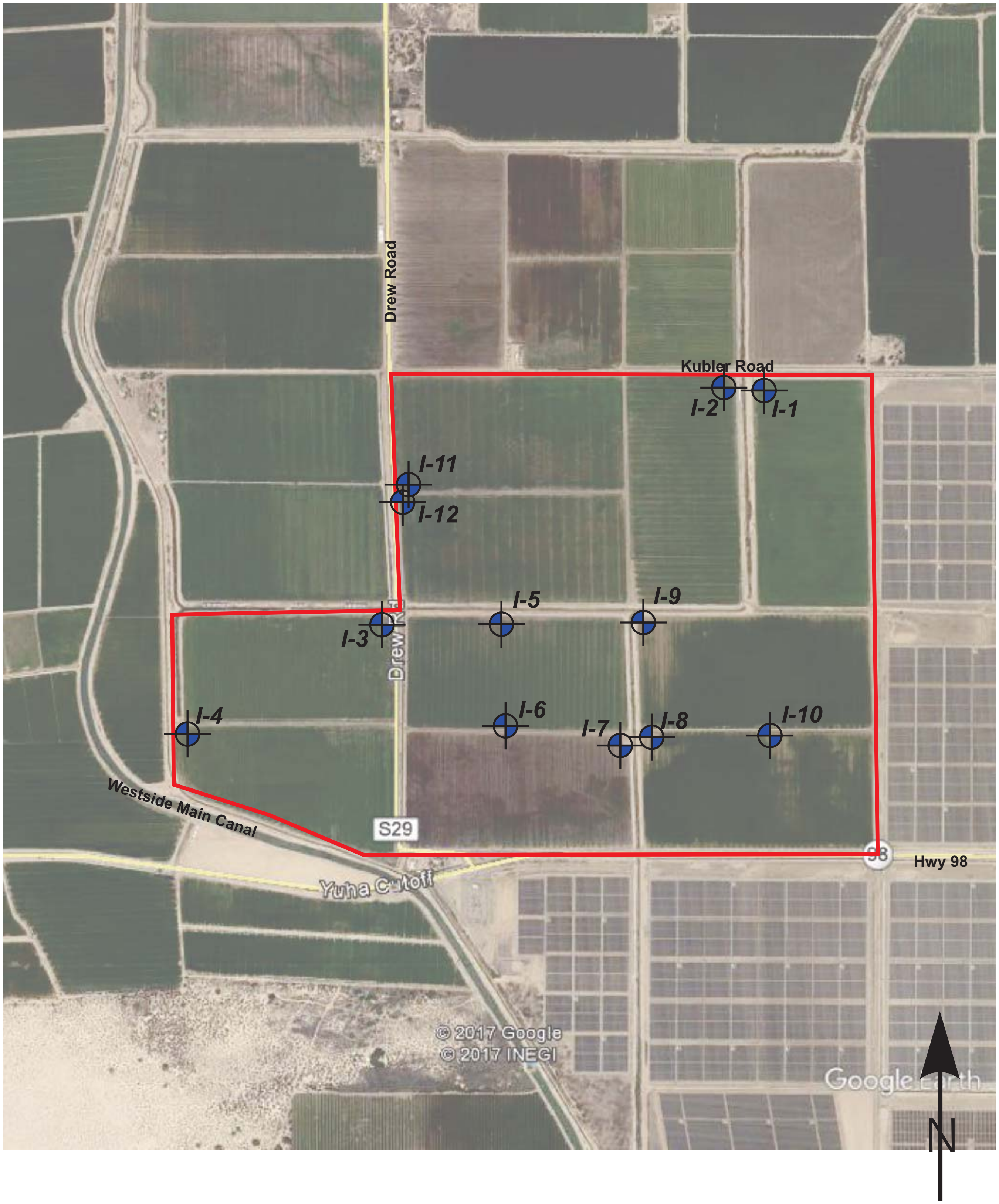
LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Moisture Density Relationship

Plate F-5

APPENDIX G



LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Infiltration Test Location Map

Plate
G-1

LandMark
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Test Hole No: I-1
Depth of Test Hole: 1.5 ft.
Check for Sandy Soil Criteria Tested By: NA
Actual Percolation Tested By: P. LaBrucherie

Job No: LE18150
Date Excavated: 09/10/18
Soil Classification: Silty Clay
Date: 09/10/18 Presoak: Yes
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:00 AM 7:30 AM	30	30	13	12.5	0.5	60.00
7:30 AM 8:00 AM	30	60	13	12.66	0.34	88.24
8:00 AM 8:30 AM	30	90	13	12.66	0.34	88.24
8:30 AM 9:00 AM	30	120	13	12.75	0.25	120.00
9:00 AM 9:30 AM	30	150	13	12.75	0.25	120.00
9:30 AM 10:00 AM	30	180	13	12.75	0.25	120.00
10:00 AM 10:30 AM	30	210	13	12.75	0.25	120.00
10:30 AM 11:00 AM	30	240	13	12.75	0.25	120.00

Stabilized Drop (min/in)	120.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-1

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.25	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.25 = 12.75 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.75 = 0.25 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.75)/2 = 12.875 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{0.25 \times 60 \times 3}{30 \times (3 + 2 \times 12.875\ )}$ **=** **0.05 in/hr**

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Project No.: LE18150

Percolation Rate Conversion

Plate
G-2

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-1
Date Excavated: 09/10/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay w/ sand laye
Check for Sandy Soil Criteria Tested By: NA
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:01 AM 7:31 AM	30	30	31	29	2	15.00
7:31 AM 8:01 AM	30	60	31	29.25	1.75	17.14
8:01 AM 8:31 AM	30	90	31	29.5	1.5	20.00
8:31 AM 9:01 AM	30	120	31	29.5	1.5	20.00
9:01 AM 9:31 AM	30	150	31	29.5	1.5	20.00
9:31 AM 10:01 AM	30	180	31	29.5	1.5	20.00
10:01 AM 10:31 AM	30	210	31	29.5	1.5	20.00
10:31 AM 11:01 AM	30	240	31	29.5	1.5	20.00
					Stabilized Drop (min/in)	20.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-1

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	6.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 6.5 = 29.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 29.5 = 1.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 29.5)/2 = 30.25 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r+2H_{avg}\right)}$$

It = $\frac{1.5 \times 60 \times 3}{30 \times (3 + 2 \times 30.25)}$ = 0.14 in/hr

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-3

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-2
Date Excavated: 09/10/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL	TIME	TIME	INITIAL	FINAL	CHANGE

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:05 AM 7:35 AM	30	30	13	12.625	0.375	80.00
7:35 AM 8:05 AM	30	60	13	12.625	0.375	80.00
8:05 AM 8:35 AM	30	90	13	12.625	0.375	80.00
8:35 AM 9:05 AM	30	120	13	12.625	0.375	80.00
9:05 AM 9:35 AM	30	150	13	12.625	0.375	80.00
9:35 AM 10:05 AM	30	180	13	12.625	0.375	80.00
10:05 AM 10:35 AM	30	210	13	12.625	0.375	80.00
10:35 AM 11:05 AM	30	240	13	12.625	0.375	80.00
					Stabilized Drop (min/in)	**80.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-2

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.38	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.375 = 12.625 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.625 = 0.375 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.625)/2 = 12.8125 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\textbf{0.375 x 60 x 3}}{\textbf{30 x (3 + 2 x 12.8125)}}$ **=** **0.08 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate
G-4

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-2
Date Excavated: 09/10/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:06 AM 7:36 AM	30	30	31	30	1	30.00
7:36 AM 8:06 AM	30	60	31	30.25	0.75	40.00
8:06 AM 8:36 AM	30	90	31	30.25	0.75	40.00
8:36 AM 9:06 AM	30	120	31	30.25	0.75	40.00
9:06 AM 9:36 AM	30	150	31	30.25	0.75	40.00
9:36 AM 10:06 AM	30	180	31	30.25	0.75	40.00
10:06 AM 10:36 AM	30	210	31	30.25	0.75	40.00
10:36 AM 11:06 AM	30	240	31	30.25	0.75	40.00
					Stabilized Drop (min/in)	**40.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-2

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.75	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 5.75 = 30.25 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 30.25 = 0.75 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 30.25)/2 = 30.625 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\textbf{0.75 x 60 x 3}}{\textbf{30 x (3 + 2 x 30.625)}}$ **=** **0.07 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-5

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Test Hole No: I-3
Depth of Test Hole: 1.5 ft.
Check for Sandy Soil Criteria Tested By: PL
Actual Percolation Tested By: P. LaBrucherie

Job No: LE18150
Date Excavated: 09/10/18
Soil Classification: Silty Sand w/ clays
Date: 09/10/18 Presoak: Yes
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
11:30 AM 11:40 AM	10	10	13	10.75	2.25	4.44
11:40 AM 11:50 AM	10	20	13	11	2	5.00
11:50 AM 12:00 PM	10	30	13	11	2	5.00
12:00 PM 12:10 PM	10	40	13	11	2	5.00
12:10 PM 12:20 PM	10	50	13	11	2	5.00
12:20 PM 12:30 PM	10	60	13	11	2	5.00

Stabilized Drop (min/in)	**5.00**

PERCOLATION RATE CONVERSION

CLIENT:	**Drew Solar LLC**
PROJECT:	**Drew Solar**
PROJECT NO.:	**LE18150**
DATE:	**9/18/2018**

TEST HOLE NO: I-3

Time interval	**Δt :**	10	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	7	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 7 = 11 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 11 = 2 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 11)/2 = 12 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{2 \times 60 \times 3}{10 \times (3 + 2 \times 12)}$ **=** **1.33 in/hr**

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Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate
G-6

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-3
Date Excavated: 09/10/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Sand w/ Clays
Check for Sandy Soil Criteria Tested By: PL
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
11:31 AM 11:41 AM	10	10	31	28	3	3.33
11:41 AM 11:51 AM	10	20	31	28.5	2.5	4.00
11:51 AM 12:01 PM	10	30	31	29	2	5.00
12:01 PM 12:11 PM	10	40	31	29	2	5.00
12:11 PM 12:21 PM	10	50	31	29	2	5.00
12:21 PM 12:31 PM	10	60	31	29	2	5.00
					Stabilized Drop (min/in)	5.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-3

Time interval	**Δt :**	10	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	7	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 7 = 29 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 29 = 2 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 29)/2 = 30 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\mathbf{2 \times 60 \times 3}}{\mathbf{10 \times (3 + 2 \times 30)}}$ **= 0.57 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-7

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-4
Date Excavated: 09/10/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Sand w/ clays
Check for Sandy Soil Criteria Tested By: PL
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL	TIME	TIME	INITIAL	FINAL	CHANGE

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
12:40 PM 12:50 PM	10	10	13	10.5	2.5	4.00
12:50 PM 1:00 PM	10	20	13	10.5	2.5	4.00
1:00 PM 1:10 PM	10	30	13	10.5	2.5	4.00
1:10 PM 1:20 PM	10	40	13	10.5	2.5	4.00
1:20 PM 1:30 PM	10	50	13	10.5	2.5	4.00
1:30 PM 1:40 PM	10	60	13	10.5	2.5	4.00
					Stabilized Drop (min/in)	**4.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-4

Time interval	**Δt :**	10	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	7.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 7.5 = 10.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 10.5 = 2.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 10.5)/2 = 11.75 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r+2H_{avg}\right)}$$

It = $\frac{\mathbf{2.5 \times 60 \times 3}}{\mathbf{10 \times (3 + 2 \times 11.75\ )}}$ **=** **1.70 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-8

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-4
Date Excavated: 09/10/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Sand w/ clays
Check for Sandy Soil Criteria Tested By: PL
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
12:41 AM 12:51 AM	10	10	31	24.5	6.5	1.54
12:51 AM 1:01 AM	10	20	31	24.5	6.5	1.54
1:01 AM 1:11 AM	10	30	31	25	6	1.67
1:11 AM 1:21 AM	10	40	31	25	6	1.67
1:21 AM 1:31 AM	10	50	31	25	6	1.67
1:31 AM 1:41 AM	10	60	31	25	6	1.67

Stabilized Drop (min/in)	1.67

PERCOLATION RATE CONVERSION

CLIENT: **Drew Solar LLC**
PROJECT: **Drew Solar**
PROJECT NO.: **LE18150**
DATE: **9/18/2018**

TEST HOLE NO: I-4

Time interval	**Δt :**	10	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	11	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 11 = 25 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 25 = 6 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 25)/2 = 28 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\mathbf{6 \times 60 \times 3}}{\mathbf{10 \times (3 + 2 \times 28)}}$ **=** **1.83 in/hr**

LANDMARK
Geo-Engineers and Geologists
Project No.: LE18150

Percolation Rate Conversion

Plate
G-9

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Test Hole No: I-5
Depth of Test Hole: 1.5 ft.
Check for Sandy Soil Criteria Tested By: NA
Actual Percolation Tested By: P. LaBrucherie

Job No: LE18150
Date Excavated: 09/10/18
Soil Classification: Silty Clay
Date: 09/10/18 Presoak: Yes
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:10 AM 7:40 AM	30	30	13	12.5	0.5	60.00
7:40 AM 8:10 AM	30	60	13	12.5	0.5	60.00
8:10 AM 8:40 AM	30	90	13	12.625	0.375	80.00
8:40 AM 9:10 AM	30	120	13	12.625	0.375	80.00
9:10 AM 9:40 AM	30	150	13	12.625	0.375	80.00
9:40 AM 10:10 AM	30	180	13	12.625	0.375	80.00
10:10 AM 10:40 AM	30	210	13	12.625	0.375	80.00
10:40 AM 11:10 AM	30	240	13	12.625	0.375	80.00
					Stabilized Drop (min/in)	80.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-5

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.38	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.375 = 12.625 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.625 = 0.375 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.625)/2 = 12.8125 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r + 2H_{avg}\right)}$$

It = $\frac{\mathbf{0.375 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 12.8125\ )}}$ **=** **0.08 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate
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LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-5
Date Excavated: 09/10/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/10/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/11/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:11 AM 7:41 AM	30	30	31	30	1	30.00
7:41 AM 8:11 AM	30	60	31	30	1	30.00
8:11 AM 8:41 AM	30	90	31	30.15	0.85	35.29
8:41 AM 9:11 AM	30	120	31	30.15	0.85	35.29
9:11 AM 9:41 AM	30	150	31	30.25	0.75	40.00
9:41 AM 10:11 AM	30	180	31	30.25	0.75	40.00
10:11 AM 10:41 AM	30	210	31	30.25	0.75	40.00
10:41 AM 11:11 AM	30	240	31	30.25	0.75	40.00
					Stabilized Drop (min/in)	40.00

PERCOLATION RATE CONVERSION

CLIENT:	**Drew Solar LLC**
PROJECT:	**Drew Solar**
PROJECT NO.:	**LE18150**
DATE:	**9/18/2018**

TEST HOLE NO: I-5

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.75	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t (r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 5.75 = 30.25 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 30.25 = 0.75 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 30.25)/2 = 30.625 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\textbf{0.75 x 60 x 3}}{\textbf{30 x (3 + 2 x 30.625)}}$ **=** **0.07 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-11

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-6
Date Excavated: 09/11/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL	TIME	TIME	INITIAL	FINAL	CHANGE

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:00 AM 7:30 AM	30	30	13	12.25	0.75	40.00
7:30 AM 8:00 AM	30	60	13	12.25	0.75	40.00
8:00 AM 8:30 AM	30	90	13	12.25	0.75	40.00
8:30 AM 9:00 AM	30	120	13	12.5	0.5	60.00
9:00 AM 9:30 AM	30	150	13	12.5	0.5	60.00
9:30 AM 10:00 AM	30	180	13	12.5	0.5	60.00
10:00 AM 10:30 AM	30	210	13	12.5	0.5	60.00
10:30 AM 11:00 AM	30	240	13	12.5	0.5	60.00
					Stabilized Drop (min/in)	60.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-6

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.5 = 12.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.5 = 0.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f) / 2$ **Havg = (13 - 12.5)/2 = 12.75 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{0.5 \times 60 \times 3}{30 \times (3 + 2 \times 12.75)}$ = 0.11 in/hr

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate
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LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-6
Date Excavated: 09/11/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:01 AM 7:31 AM	30	30	31	29.75	1.25	24.00
7:31 AM 8:01 AM	30	60	31	30.25	0.75	40.00
8:01 AM 8:31 AM	30	90	31	30.25	0.75	40.00
8:31 AM 9:01 AM	30	120	31	30.25	0.75	40.00
9:01 AM 9:31 AM	30	150	31	30.25	0.75	40.00
9:31 AM 10:01 AM	30	180	31	30.25	0.75	40.00
10:01 AM 10:31 AM	30	210	31	30.25	0.75	40.00
10:31 AM 11:01 AM	30	240	31	30.25	0.75	40.00
						Stabilized Drop (min/in) **40.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-6

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.75	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 5.75 = 30.25 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 30.25 = 0.75 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 30.25)/2 = 30.625 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{\textbf{0.75 x 60 x 3}}{\textbf{30 x (3 + 2 x 30.625)}}$ **=** **0.07 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-13

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-7
Date Excavated: 09/11/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:05 AM 7:35 AM	30	30	13	12.5	0.5	60.00
7:35 AM 8:05 AM	30	60	13	12.5	0.5	60.00
8:05 AM 8:35 AM	30	90	13	12.5	0.5	60.00
8:35 AM 9:05 AM	30	120	13	12.5	0.5	60.00
9:05 AM 9:35 AM	30	150	13	12.5	0.5	60.00
9:35 AM 10:05 AM	30	180	13	12.5	0.5	60.00
10:05 AM 10:35 AM	30	210	13	12.5	0.5	60.00
10:35 AM 11:05 AM	30	240	13	12.5	0.5	60.00
					Stabilized Drop (min/in)	60.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-7

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.5 = 12.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.5 = 0.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.5)/2 = 12.75 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{0.5 \times 60 \times 3}{30 \times (3 + 2 \times 12.75)}$ = 0.11 in/hr

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

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LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-7
Date Excavated: 09/11/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:11 AM 7:41 AM	30	30	31	29.75	1.25	24.00
7:41 AM 8:11 AM	30	60	31	30	1	30.00
8:11 AM 8:41 AM	30	90	31	30	1	30.00
8:41 AM 9:11 AM	30	120	31	30.125	0.875	34.29
9:11 AM 9:41 AM	30	150	31	30.125	0.875	34.29
9:41 AM 10:11 AM	30	180	31	30.125	0.875	34.29
10:11 AM 10:41 AM	30	210	31	30.125	0.875	34.29
10:41 AM 11:11 AM	30	240	31	30.125	0.875	34.29
					Stabilized Drop (min/in)	**34.29**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-7

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.88	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t (r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 5.875 = 30.125 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 30.125 = 0.875 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 30.125)/2 = 30.5625 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\mathbf{0.875 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 30.5625)}}$ **=** **0.08 in/hr**

LANDMARK Geo-Engineers and Geologists **Project No.: LE18150**	**Percolation Rate Conversion**	**Plate G-15**

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-8
Date Excavated: 09/11/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL	TIME	TIME	INITIAL	FINAL	CHANGE

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:00 AM 7:30 AM	30	30	13	12	1	30.00
7:30 AM 8:00 AM	30	60	13	12.25	0.75	40.00
8:00 AM 8:30 AM	30	90	13	12.25	0.75	40.00
8:30 AM 9:00 AM	30	120	13	12.5	0.5	60.00
9:00 AM 9:30 AM	30	150	13	12.5	0.5	60.00
9:30 AM 10:00 AM	30	180	13	12.5	0.5	60.00
10:00 AM 10:30 AM	30	210	13	12.5	0.5	60.00
10:30 AM 11:00 AM	30	240	13	12.5	0.5	60.00
					Stabilized Drop (min/in)	**60.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-8

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t (r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.5 = 12.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.5 = 0.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.5)/2 = 12.75 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \; 60 \; r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{0.5 \times 60 \times 3}{30 \times (3 + 2 \times 12.75)}$ = 0.11 in/hr

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-16

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-8
Date Excavated: 09/11/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:01 AM 7:31 AM	30	30	31	29.75	1.25	24.00
7:31 AM 8:01 AM	30	60	31	29.75	1.25	24.00
8:01 AM 8:31 AM	30	90	31	30	1	30.00
8:31 AM 9:01 AM	30	120	31	30	1	30.00
9:01 AM 9:31 AM	30	150	31	30.5	0.5	60.00
9:31 AM 10:01 AM	30	180	31	30.5	0.5	60.00
10:01 AM 10:31 AM	30	210	31	30.5	0.5	60.00
10:31 AM 11:01 AM	30	240	31	30.5	0.5	60.00
					Stabilized Drop (min/in)	60.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-8

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 5.5 = 30.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 30.5 = 0.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 30.5)/2 = 30.75 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{0.5 \times 60 \times 3}{30 \times (3 + 2 \times 30.75)}$ = 0.05 in/hr

Project No.: LE18150

Percolation Rate Conversion

Plate G-17

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-9
Date Excavated: 09/11/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:15 AM 7:45 AM	30	30	13	12.25	0.75	40.00
7:45 AM 8:15 AM	30	60	13	12.25	0.75	40.00
8:15 AM 8:45 AM	30	90	13	12.25	0.75	40.00
8:45 AM 9:15 AM	30	120	13	12.25	0.75	40.00
9:15 AM 9:45 AM	30	150	13	12.25	0.75	40.00
9:45 AM 10:15 AM	30	180	13	12.25	0.75	40.00
10:15 AM 10:45 AM	30	210	13	12.25	0.75	40.00
10:45 AM 11:15 AM	30	240	13	12.25	0.75	40.00

Stabilized Drop (min/in)	**40.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-9

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.75	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.75 = 12.25 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.25 = 0.75 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.25)/2 = 12.625 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r+2H_{avg}\right)}$$

It = $\frac{0.75 \times 60 \times 3}{30 \times (3 + 2 \times 12.625)}$ **= 0.16 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-18

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-9
Date Excavated: 09/11/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:16 AM 7:46 AM	30	30	31	27.5	3.5	8.57
7:46 AM 8:16 AM	30	60	31	28.5	2.5	12.00
8:16 AM 8:46 AM	30	90	31	29	2	15.00
8:46 AM 9:16 AM	30	120	31	29	2	15.00
9:16 AM 9:46 AM	30	150	31	29	2	15.00
9:46 AM 10:16 AM	30	180	31	29	2	15.00
10:16 AM 10:46 AM	30	210	31	29	2	15.00
10:46 AM 11:16 AM	30	240	31	29	2	15.00
					Stabilized Drop (min/in)	15.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-9

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	7	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 7 = 29 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 29 = 2 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 29)/2 = 30 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r+2H_{avg}\right)}$$

It = $\frac{2 \times 60 \times 3}{30 \times (3 + 2 \times 30)}$ = 0.19 in/hr

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Project No.: LE18150

Percolation Rate Conversion

Plate
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LANDMARK
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Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-10
Date Excavated: 09/11/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL	TIME	TIME	INITIAL	FINAL	CHANGE

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:20 AM 7:50 AM	30	30	13	12.25	0.75	40.00
7:50 AM 8:20 AM	30	60	13	12.25	0.75	40.00
8:20 AM 8:50 AM	30	90	13	12.5	0.5	60.00
8:50 AM 9:20 AM	30	120	13	12.5	0.5	60.00
9:20 AM 9:50 AM	30	150	13	12.5	0.5	60.00
9:50 AM 10:20 AM	30	180	13	12.5	0.5	60.00
10:20 AM 10:50 AM	30	210	13	12.5	0.5	60.00
10:50 AM 11:20 AM	30	240	13	12.5	0.5	60.00
					Stabilized Drop (min/in)	**60.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-10

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t (r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.5 = 12.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.5 = 0.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.5)/2 = 12.75 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H \, 60 \, r}{\Delta t \left(r + 2H_{avg}\right)}$$

It = $\frac{\textbf{0.5 x 60 x 3}}{\textbf{30 x (3 + 2 x 12.75)}}$ **=** **0.11 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-20

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-10
Date Excavated: 09/11/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/11/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/12/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
7:21 AM 7:51 AM	30	30	31	28	3	10.00
7:51 AM 8:21 AM	30	60	31	29	2	15.00
8:21 AM 8:51 AM	30	90	31	29.5	1.5	20.00
8:51 AM 9:21 AM	30	120	31	29.5	1.5	20.00
9:21 AM 9:51 AM	30	150	31	29.75	1.25	24.00
9:51 AM 10:21 AM	30	180	31	29.75	1.25	24.00
10:21 AM 10:51 AM	30	210	31	29.75	1.25	24.00
10:51 AM 11:21 AM	30	240	31	29.75	1.25	24.00
					Stabilized Drop (min/in)	24.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-10

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	6.25	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 6.25 = 29.75 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 29.75 = 1.25 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 29.75)/2 = 30.375 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{\mathbf{1.25 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 30.375\ )}}$ **=** **0.12 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate
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LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-11
Date Excavated: 09/12/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/12/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/13/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
9:00 AM 9:30 AM	30	30	13	10.25	2.75	10.91
9:30 AM 10:00 AM	30	60	13	10.75	2.25	13.33
10:00 AM 10:30 AM	30	90	13	11	2	15.00
10:30 AM 11:00 AM	30	120	13	11	2	15.00
11:00 AM 11:30 AM	30	150	13	11.5	1.5	20.00
11:30 AM 12:00 PM	30	180	13	11.5	1.5	20.00
12:00 PM 12:30 PM	30	210	13	11.5	1.5	20.00
12:30 PM 1:00 PM	30	240	13	11.5	1.5	20.00
					Stabilized Drop (min/in)	20.00

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-11

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	6.5	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 6.5 = 11.5 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 11.5 = 1.5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 11.5)/2 = 12.25 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{1.5 \times 60 \times 3}{30 \times (3 + 2 \times 12.25)}$ = 0.33 in/hr

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-22

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-11
Date Excavated: 09/12/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Sand w/ clay top
Check for Sandy Soil Criteria Tested By: NA
Date: 09/12/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/13/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
9:01 AM 9:11 AM	10	10	31	23	8	1.25
9:11 AM 9:21 AM	10	20	31	24.25	6.75	1.48
9:21 AM 9:31 AM	10	30	31	25	6	1.67
9:31 AM 9:41 AM	10	40	31	26	5	2.00
9:41 AM 9:51 AM	10	50	31	26	5	2.00
9:51 AM 10:01 AM	10	60	31	26	5	2.00
					Stabilized Drop (min/in)	**2.00**

PERCOLATION RATE CONVERSION

CLIENT: **Drew Solar LLC**
PROJECT: **Drew Solar**
PROJECT NO.: **LE18150**
DATE: **9/18/2018**

TEST HOLE NO: I-11

Time interval	**Δt :**	10	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	10	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r + 2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 10 = 26 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 26 = 5 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 26)/2 = 28.5 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r + 2H_{avg}\right)}$$

It = $\frac{5 \times 60 \times 3}{10 \times (3 + 2 \times 28.5)}$ **=** **1.50 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-23

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-12
Date Excavated: 09/12/18
Depth of Test Hole: 1.5 ft.
Soil Classification: Silty Clay
Check for Sandy Soil Criteria Tested By: NA
Date: 09/12/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/13/18

Sandy Soil Criteria Test

TRIAL	TIME	TIME	INITIAL	FINAL	CHANGE

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
9:05 AM 9:35 AM	30	30	13	11.5	1.5	20.00
9:35 AM 10:05 AM	30	60	13	12	1	30.00
10:05 AM 10:35 AM	30	90	13	12	1	30.00
10:35 AM 11:05 AM	30	120	13	12.25	0.75	40.00
11:05 AM 11:35 AM	30	150	13	12.25	0.75	40.00
11:35 AM 12:05 PM	30	180	13	12.25	0.75	40.00
12:05 PM 12:35 PM	30	210	13	12.25	0.75	40.00
12:35 PM 1:05 PM	30	240	13	12.25	0.75	40.00
					Stabilized Drop (min/in)	**40.00**

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-12

Time interval	**Δt :**	30	minutes	**Total Depth of Test Hole**	**Dt :**	18	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	5.75	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 18 - 5 = 13 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 18 - 5.75 = 12.25 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 13 - 12.25 = 0.75 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (13 - 12.25)/2 = 12.625 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{0.75 \times 60 \times 3}{30 \times (3 + 2 \times 12.625)}$ **= 0.16 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-24

LANDMARK
Geo-Engineers and Geologists

Leach Line Percolation Data Sheet

Project: Drew Solar
Job No: LE18150
Test Hole No: I-12
Date Excavated: 09/12/18
Depth of Test Hole: 3.0 ft.
Soil Classification: Silty Sand w/ clay top
Check for Sandy Soil Criteria Tested By: NA
Date: 09/12/18 Presoak: Yes
Actual Percolation Tested By: P. LaBrucherie
Date: 09/13/18

Sandy Soil Criteria Test

TRIAL No.	TIME	TIME INTERVAL (MIN.)	INITIAL WATER LEVEL (IN.)	FINAL WATER LEVEL(IN.)	CHANGE WATER LEVEL (IN.)

Use Normal/Sandy (CIRCLE ONE) Soil Criteria

TIME	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL	PERCOLATION RATE (MIN/INCH)
9:06 AM 9:16 AM	10	10	31	25	6	1.67
9:16 AM 9:26 AM	10	20	31	26.5	4.5	2.22
9:26 AM 9:36 AM	10	30	31	27	4	2.50
9:36 AM 9:46 AM	10	40	31	28	3	3.33
9:46 AM 9:56 AM	10	50	31	28	3	3.33
9:56 AM 10:06 AM	10	60	31	28	3	3.33
					Stabilized Drop (min/in)	3.33

PERCOLATION RATE CONVERSION

CLIENT: Drew Solar LLC
PROJECT: Drew Solar
PROJECT NO.: LE18150
DATE: 9/18/2018

TEST HOLE NO: I-12

Time interval	**Δt :**	10	minutes	**Total Depth of Test Hole**	**Dt :**	36	inches
Initial Depth to Water	**Do :**	5	inches	**²Test Hole Radius**	**r :**	3	inches
Final Depth to Water	**Df :**	8	inches				

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ **Ho = 36 - 5 = 31 inches**

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_f$ **Hf = 36 - 8 = 28 inches**

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ **ΔH = 31 - 28 = 3 inches**

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o + H_f)/2$ **Havg = (31 - 28)/2 = 29.5 inches**

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\left(r+2H_{avg}\right)}$$

It = $\frac{3 \times 60 \times 3}{10 \times (3 + 2 \times 29.5)}$ = 0.87 in/hr

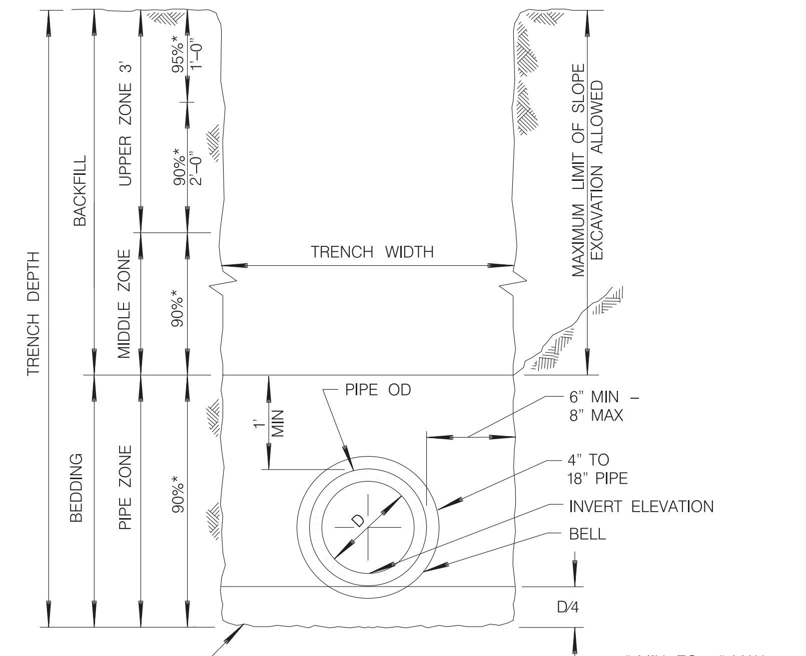
LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

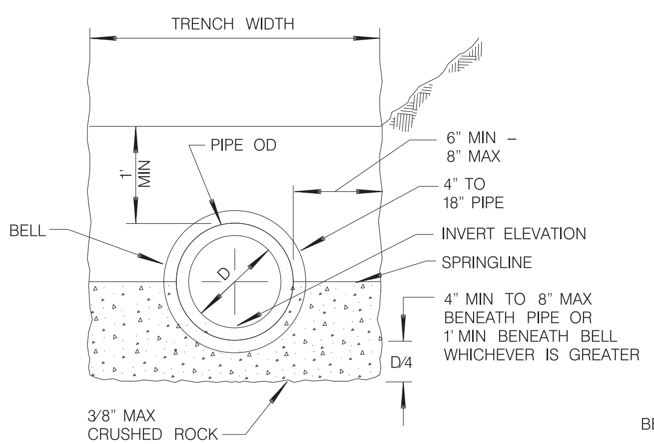
Percolation Rate Conversion

Plate G-25

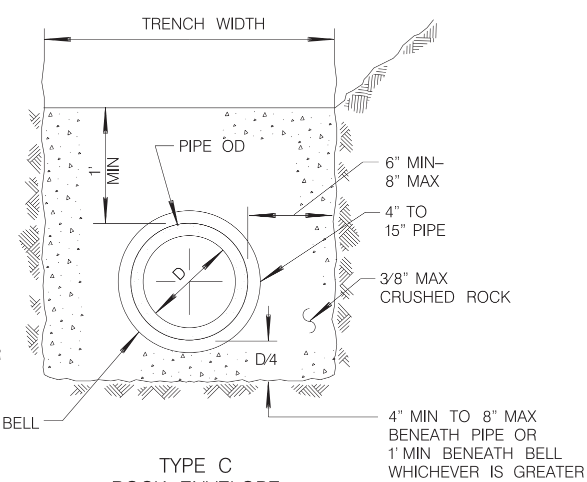
APPENDIX H



TYPE A
STANDARD INSTALLATION



TYPE B
ROCK TO SPRINGLINE



TYPE C
ROCK ENVELOPE

NOTES

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

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

LANDMARK Geo-Engineers and Geologists **Project No.: LE18150**	**Pipe Bedding and Trench Backfill Recommendations**	**Plate H-1**

APPENDIX I

REFERENCES

American Concrete Institute (ACI), 2013, ACI Manual of Concrete Practice 302.1R-04

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