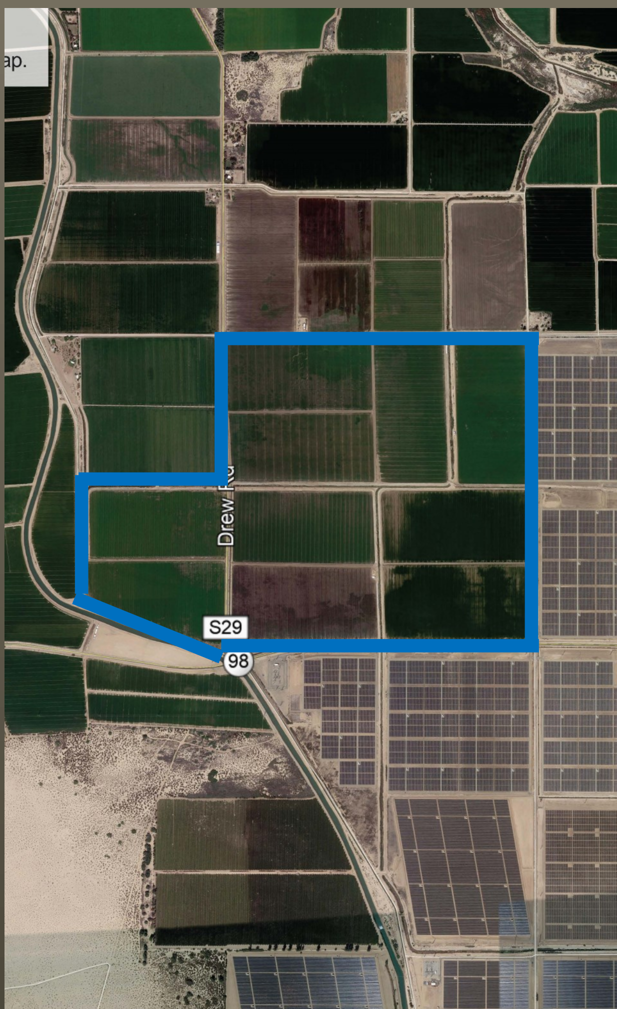
Drew Solar Project

SCH. No. 2018051036



Draft Environmental Impact Report

Volume II — Appendices E-F

Prepared for

Imperial County California 1907

May 2019

Prepared by

egi ericsson-grant inc.

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VOLUME II – APPENDICES E-F

Appendix E – Preliminary Geotechnical Investigation
Appendix F – Cultural Resources Investigation and Built Environment Report

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APPENDIX E

PRELIMINARY GEOTECHNICAL AND GEOHAZARDS REPORT

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Geotechnical Report

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

Prepared for:

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October 1, 2018

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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,
Landmark Consultants, Inc.

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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 ^{o}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.

CBC General Ground Motion Parameters: 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_{ClNcs}) 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.

Flat Plate Structural Mats: 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	30º	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	35º	---	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.

Drilled Pier Foundations: 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

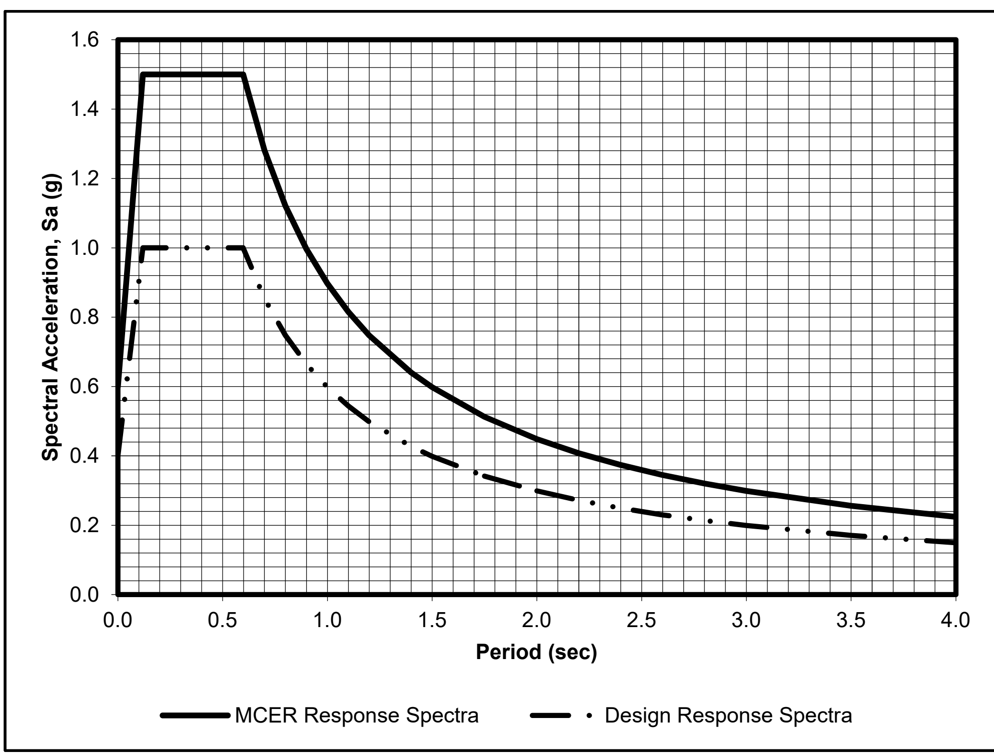
			CBC Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	32.6812	N	
Longitude:	-115.6743	W	
Risk Category:	II		
Seismic Design Category:	D		

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

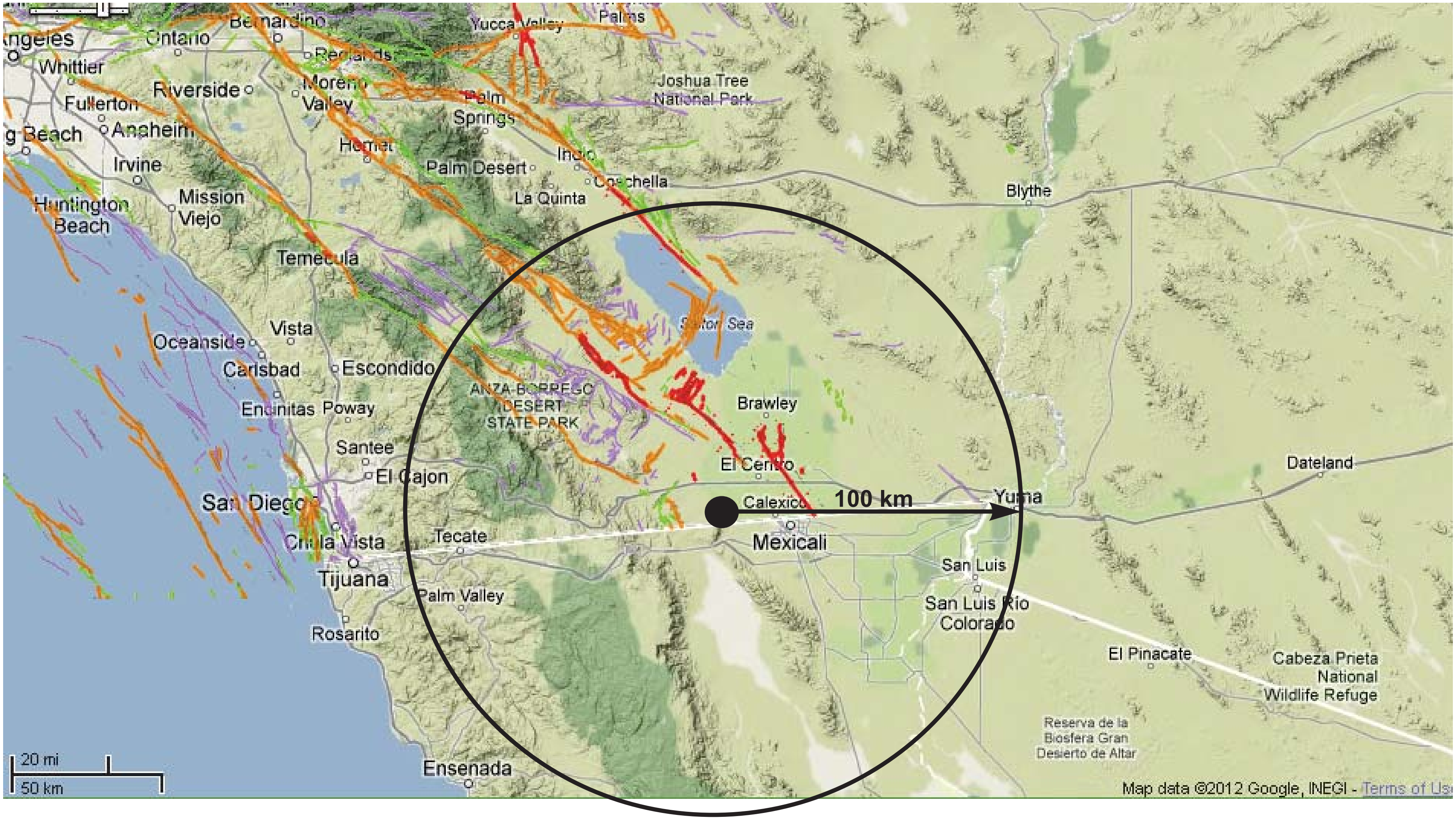
Design Earthquake Ground Motion

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#

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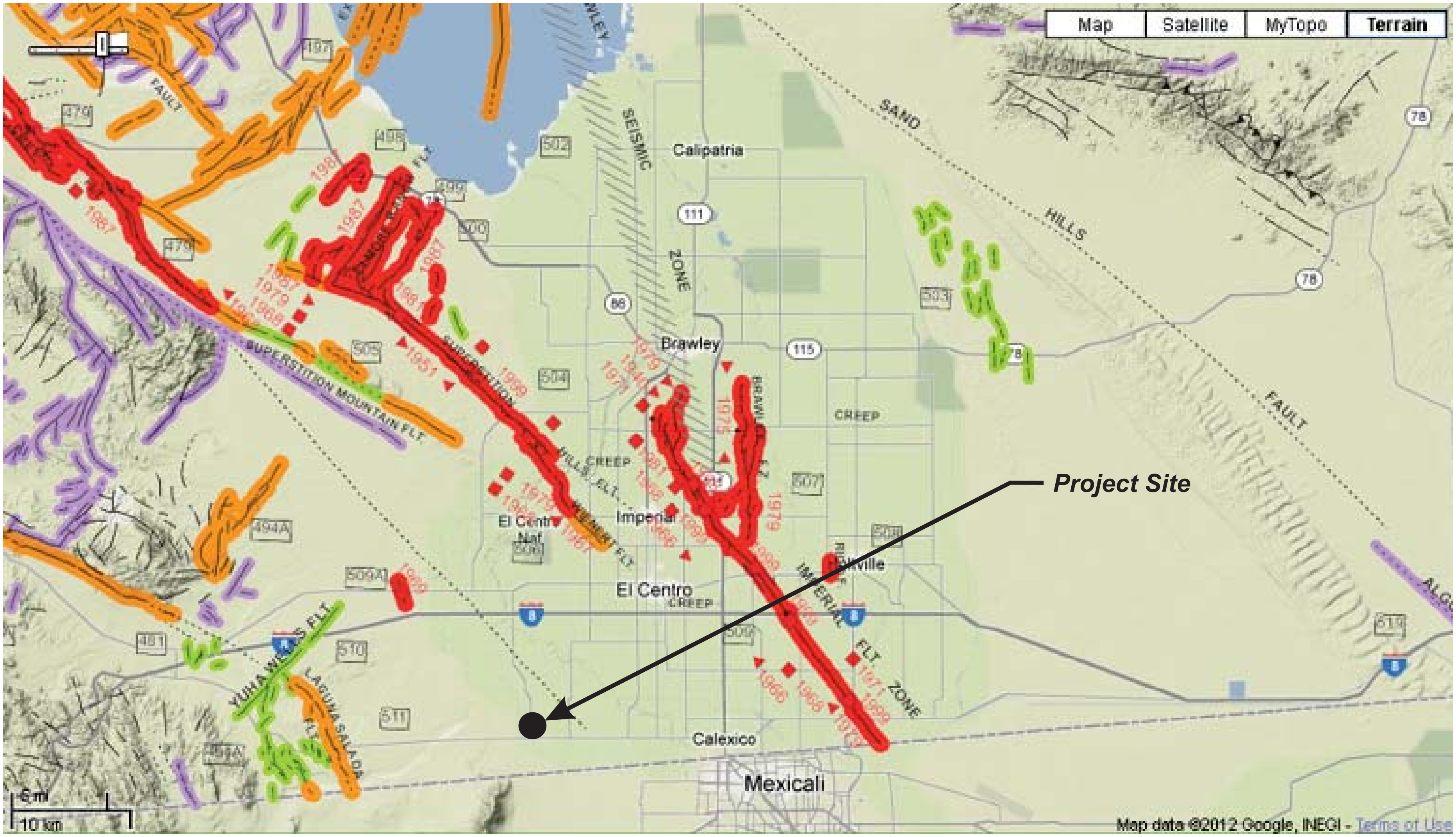
Regional Fault Map

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

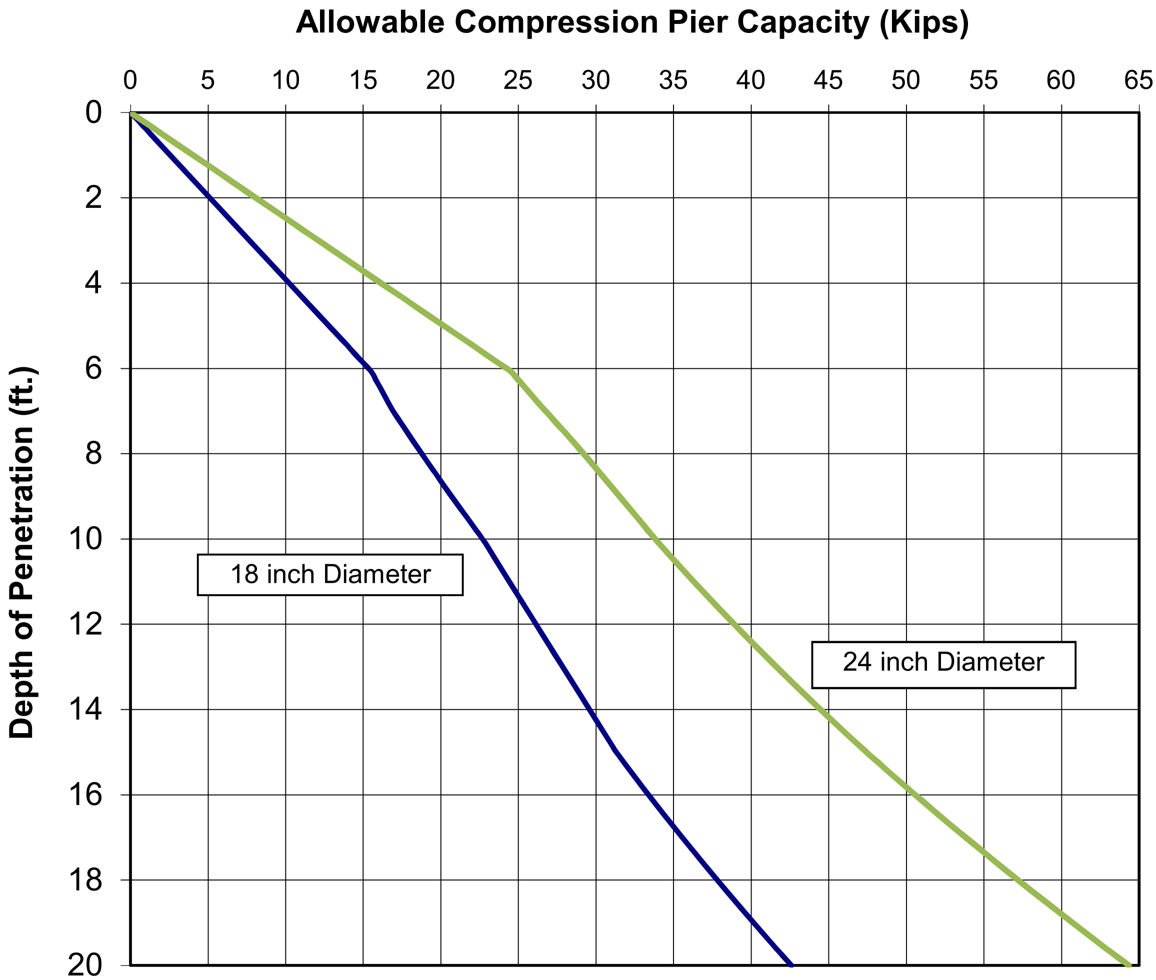
Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires 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				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
			200				
		Holocene				Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
			11,700				
		Pleistocene				Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
			700,000				
	Early Quaternary	Pleistocene				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.
			1,600,000*				
Pre-Quaternary						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.
			4.5 billion (Age of Earth)				

* 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.

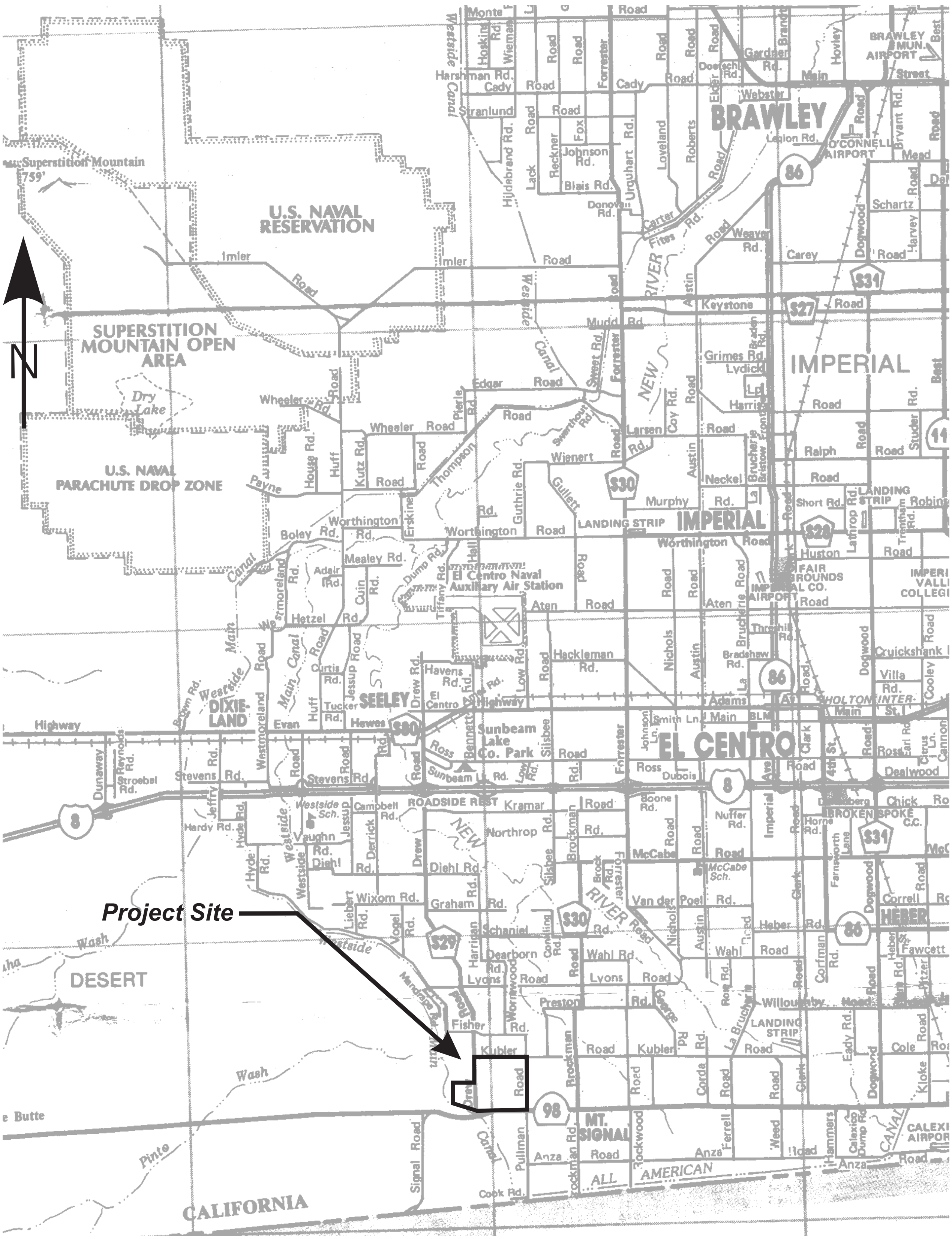


Notes:

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.

LANDMARK Geo-Engineers and Geologists **Project No.: LE18150**	**Drilled Pier Compression Capacity Chart** **Drew Solar Facility** **Calexico, California**	**Figure** **3**

APPENDIX A



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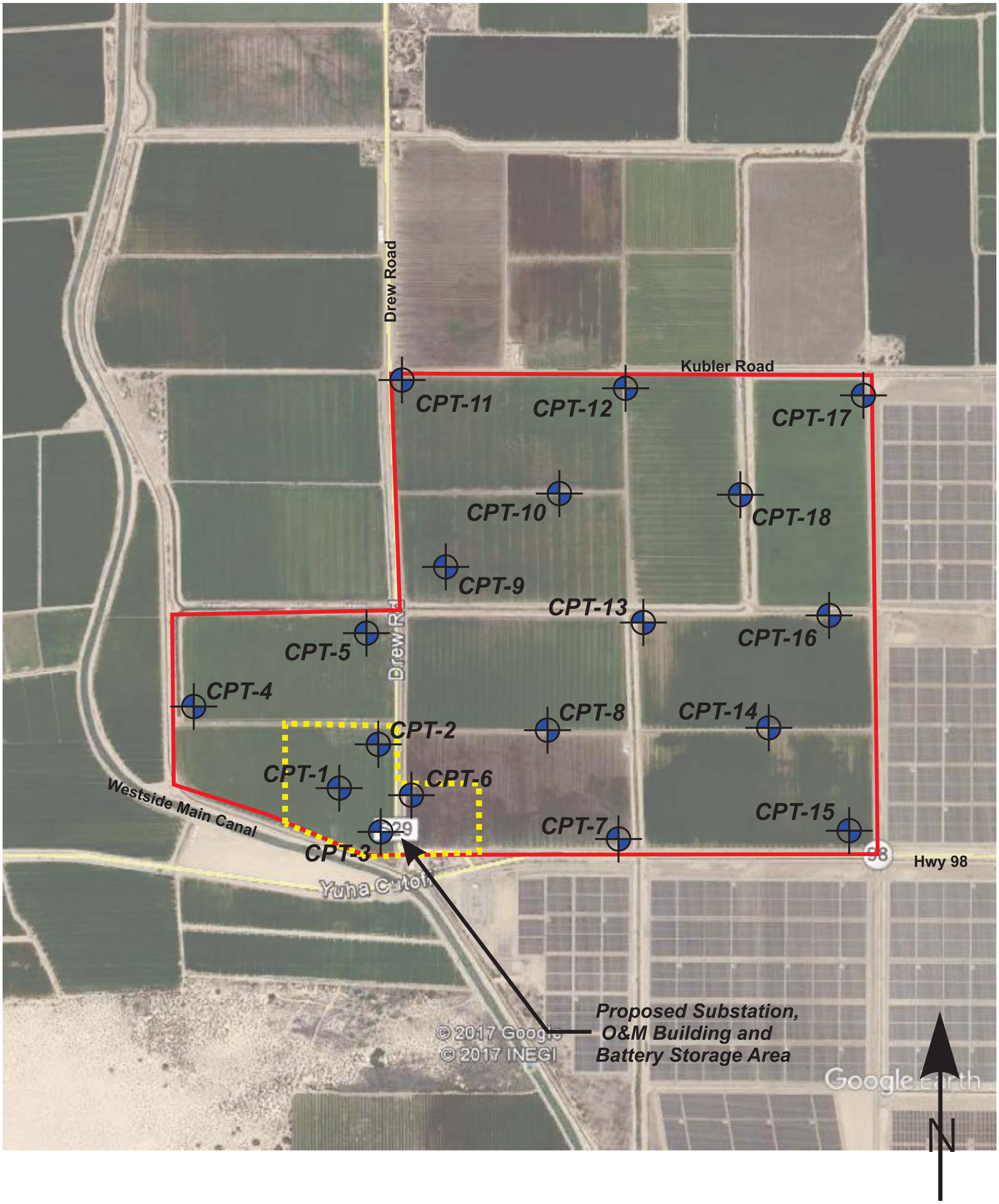
Vicinity Map

Plate A-1



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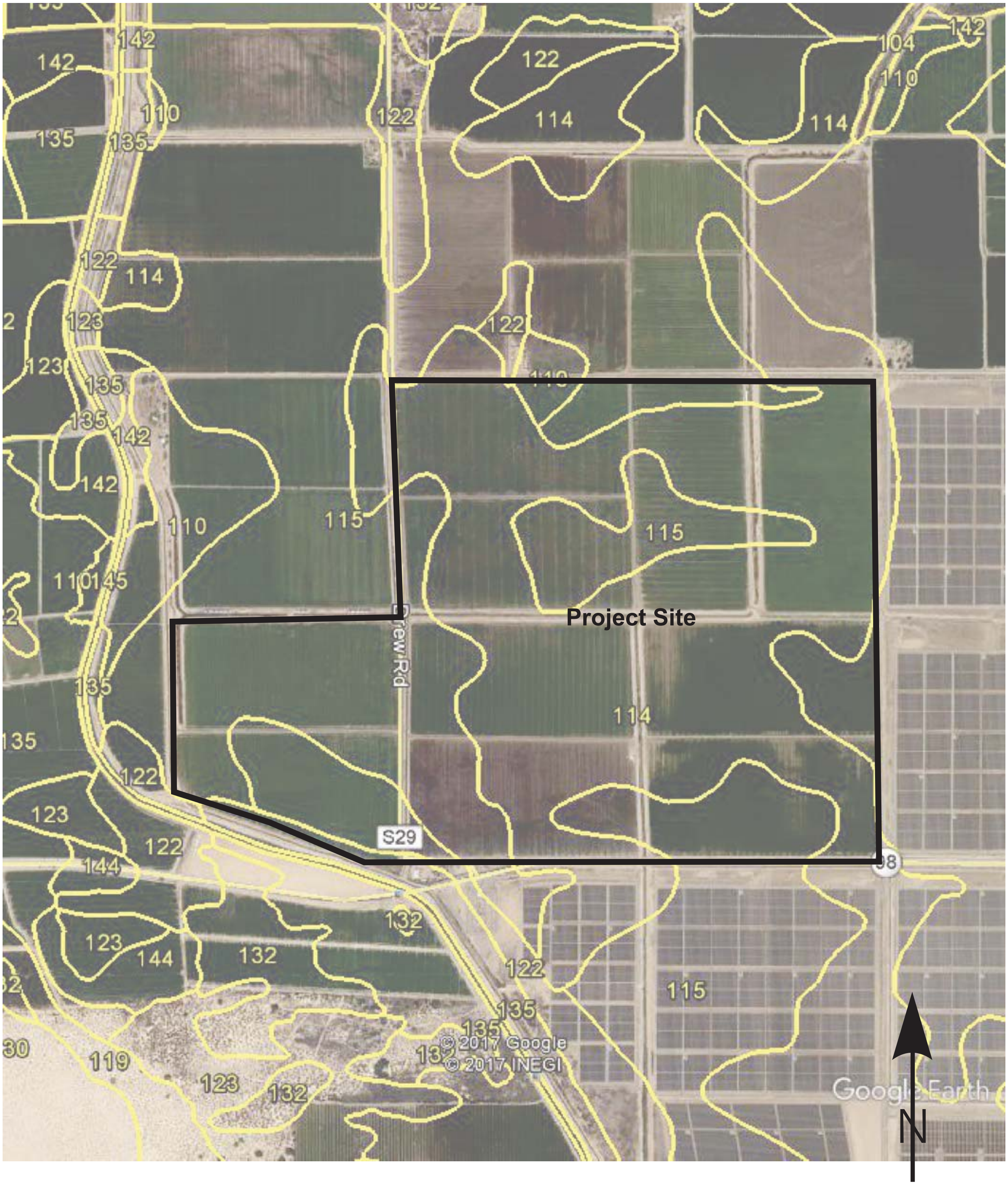
Site and Exploration Map

Plate A-2



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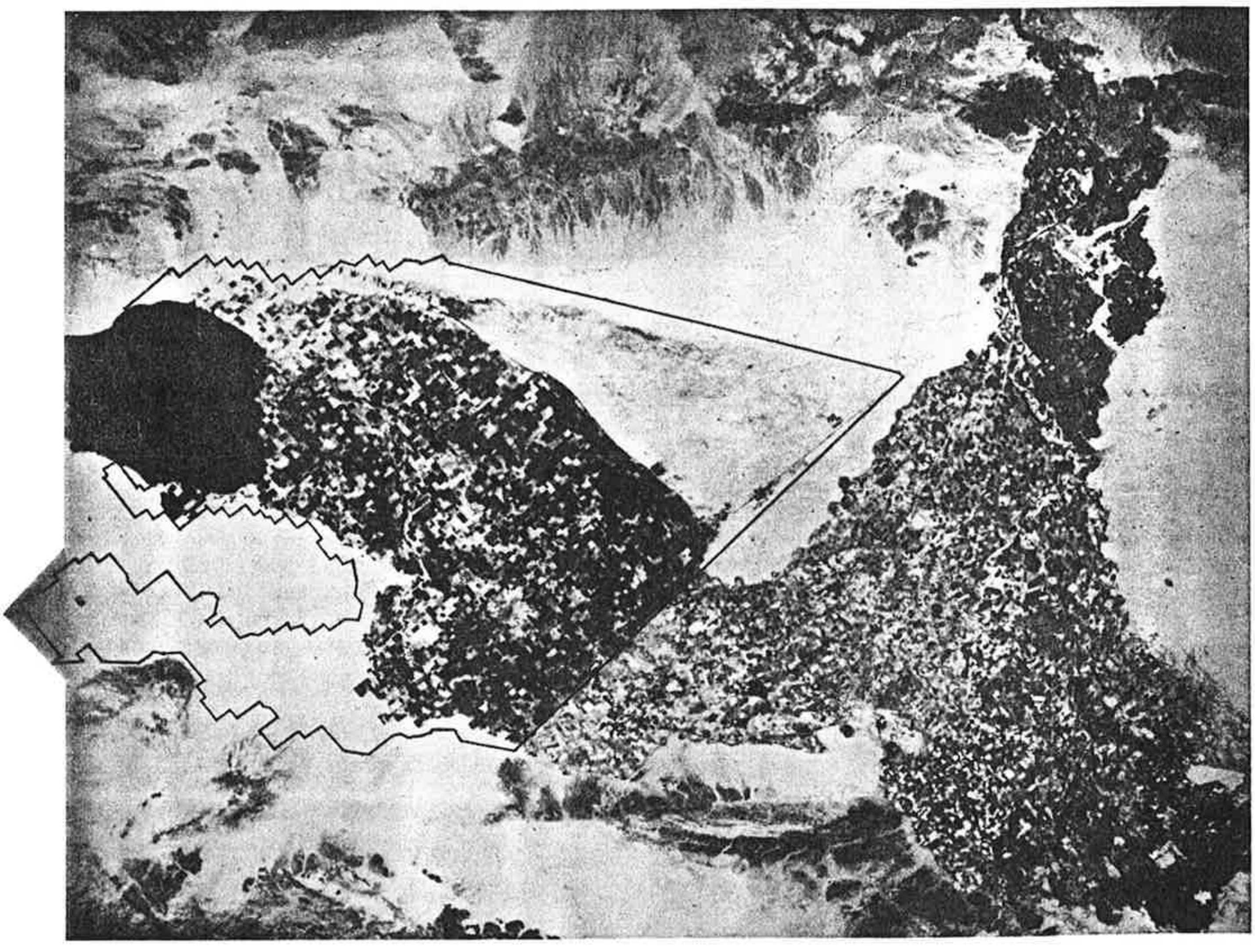
Soil Survey Map

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		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	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

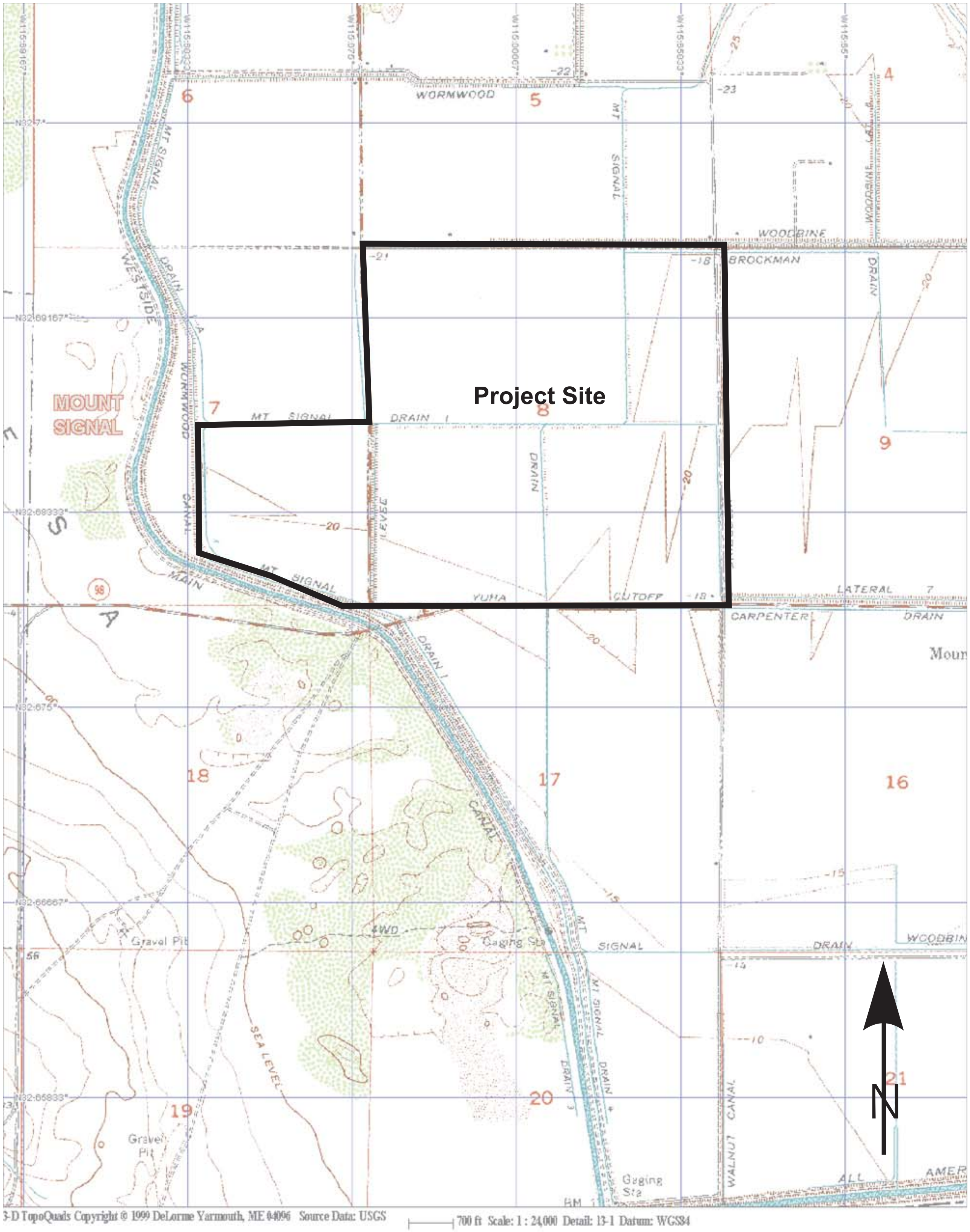
Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
121----------------- Meloland	0-12	Fine sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	75-100	5-30	---	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		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity 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.

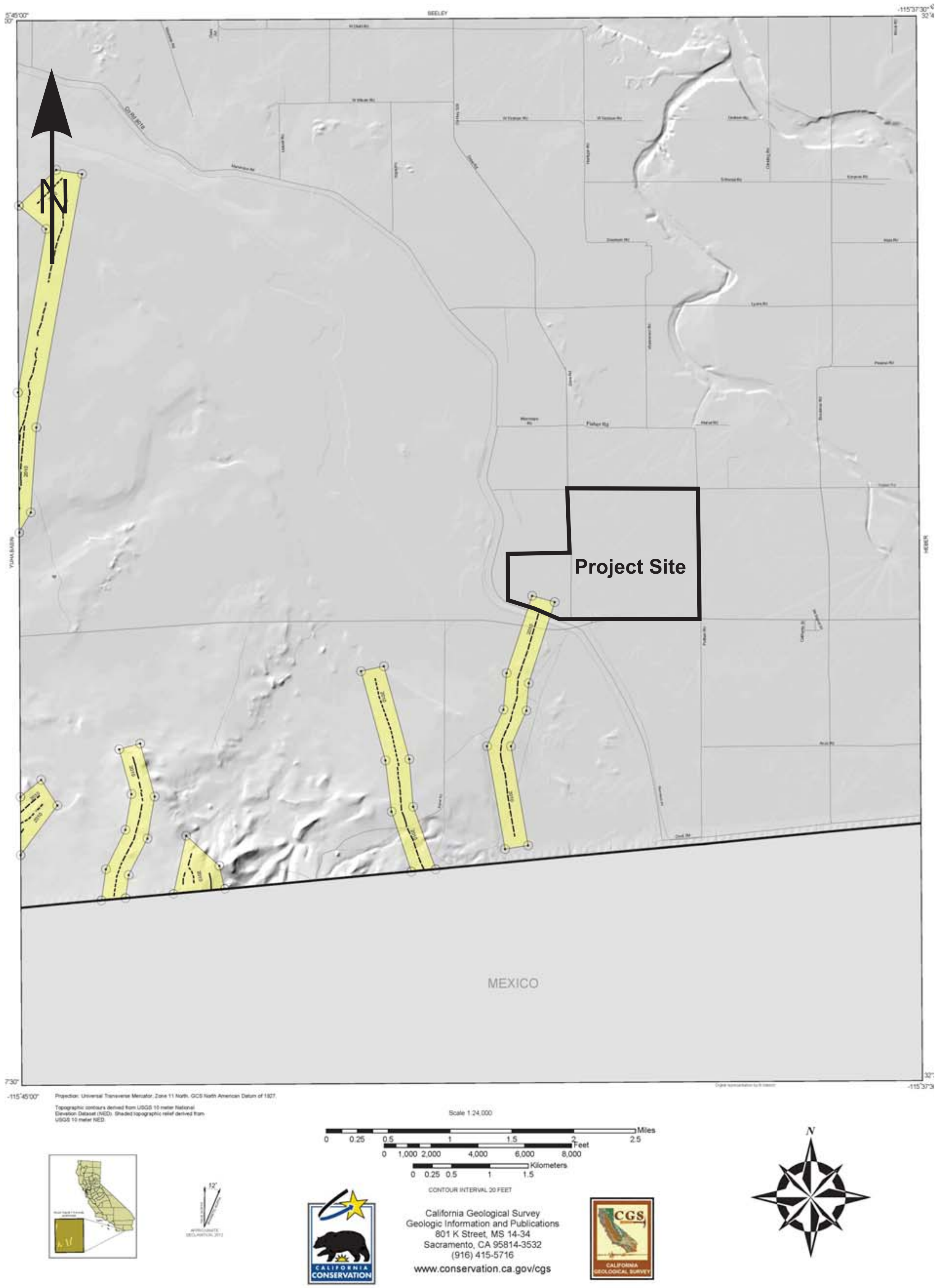


LandMark Geo-Engineers and Geologists

Project No.: LE18150

Topographic Map

Plate A-4



LANDMARK
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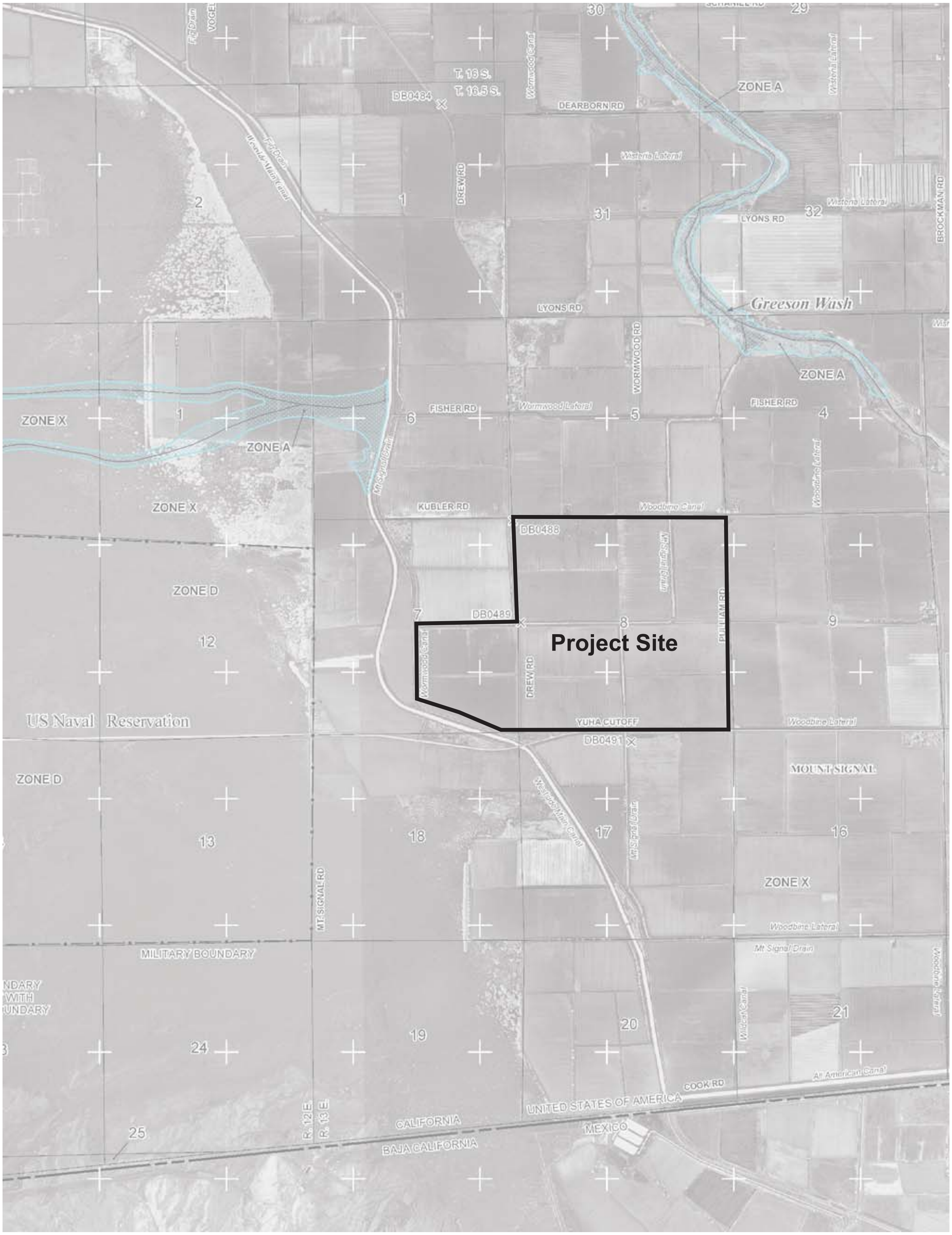
Project No.: LE18150

A-P Earthquake Fault Zone Map

Plate A-5



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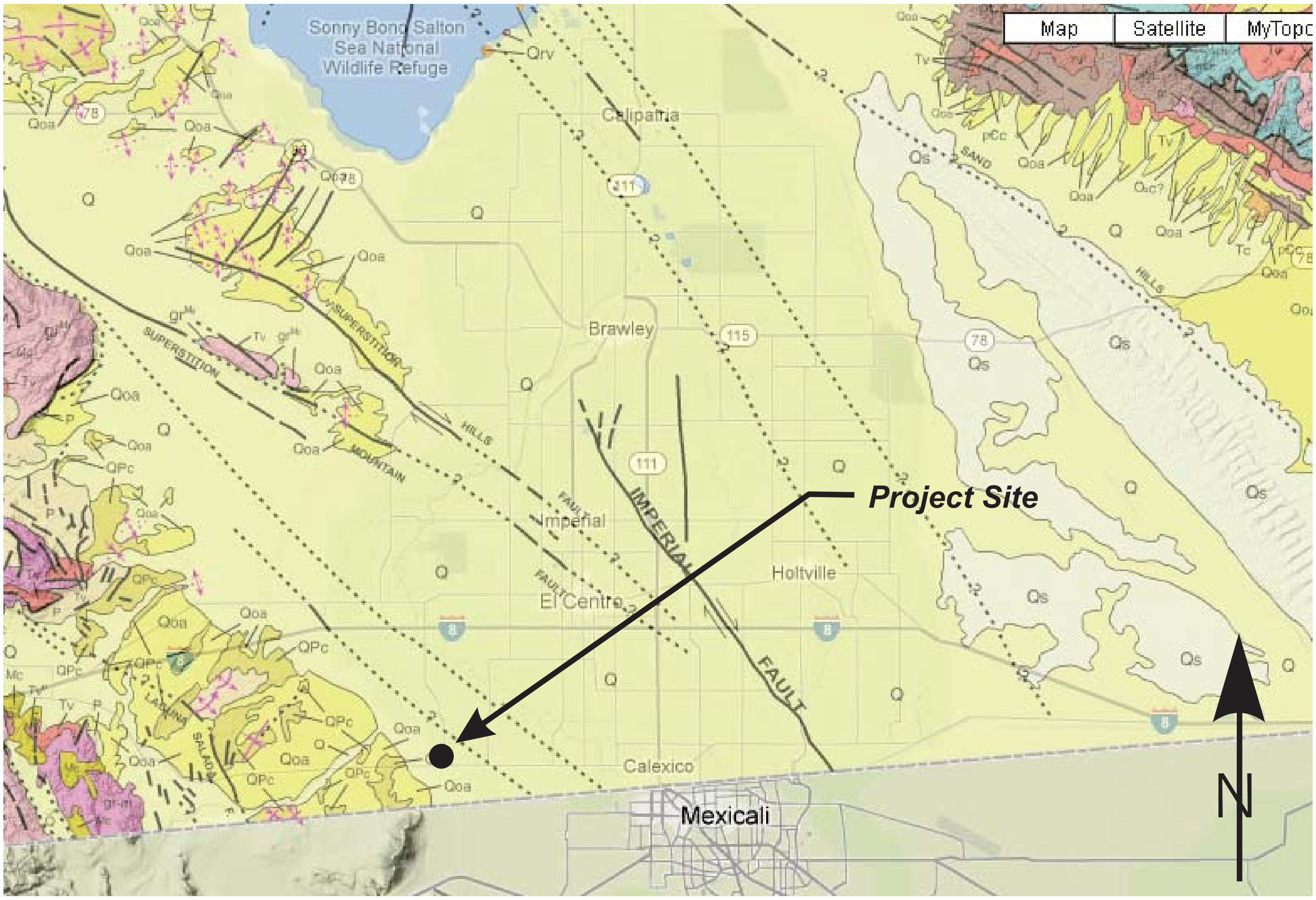
FEMA Flood Zone Map

Plate A-6



GEOLOGIC LEGEND

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

Quaternary Volcanic Rocks: Qrv, Qrv, Qv, Qv

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

Tertiary Volcanic Rocks: Tv, Tv, Ti

Tertiary Plutonic Rocks: gr

Mesozoic Sedimentary and Metasedimentary Rocks: TK, K, Ku, Kl, KJf, KJf, KJf, J, Ŧ, sch, ls

Mesozoic Mixed Rocks: gr-m

Mesozoic Metavolcanic Rocks: Mzv, mv

Mesozoic Plutonic Rocks: gr, um, gb, gr

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

Paleozoic Mixed Rocks: m

Paleozoic Metavolcanic Rocks: Pzv

Paleozoic Plutonic Rocks: gr

Pre-Cambrian Rocks: pC, pCc, gr

SYMBOLS

Geologic boundary

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

Thrust fault (barbs on upper plate).

Regional strike and dip of stratified rocks.

Regional strike and dip of stratified rocks (overturned).

Anticlinal fold.

Synclinal fold.

Monoclinal fold.

Site Location
Lat N32.6812 Long: W-115.6743

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Regional Geologic Map

Plate A-7

APPENDIX B

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-1

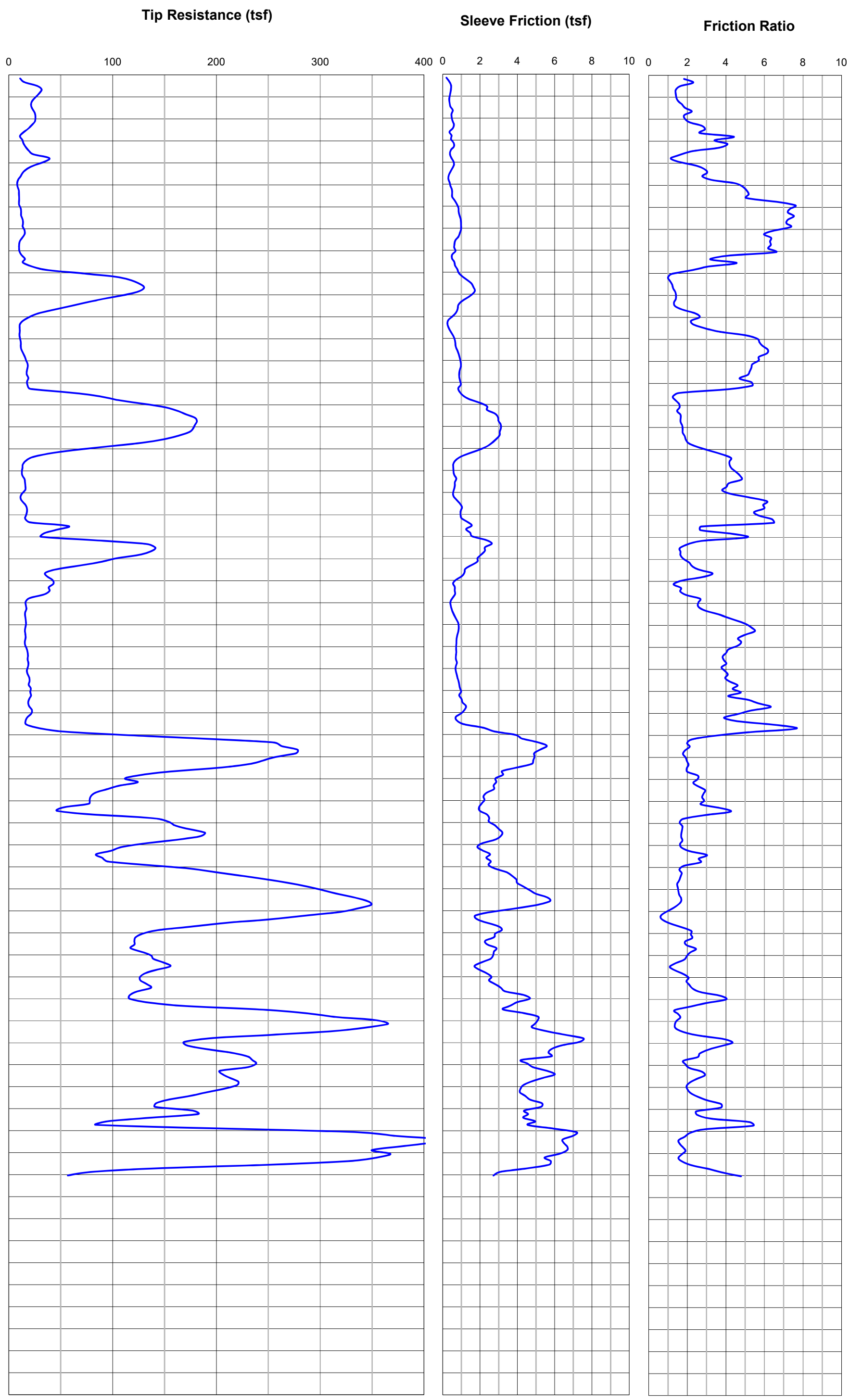
DEPTH

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 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-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

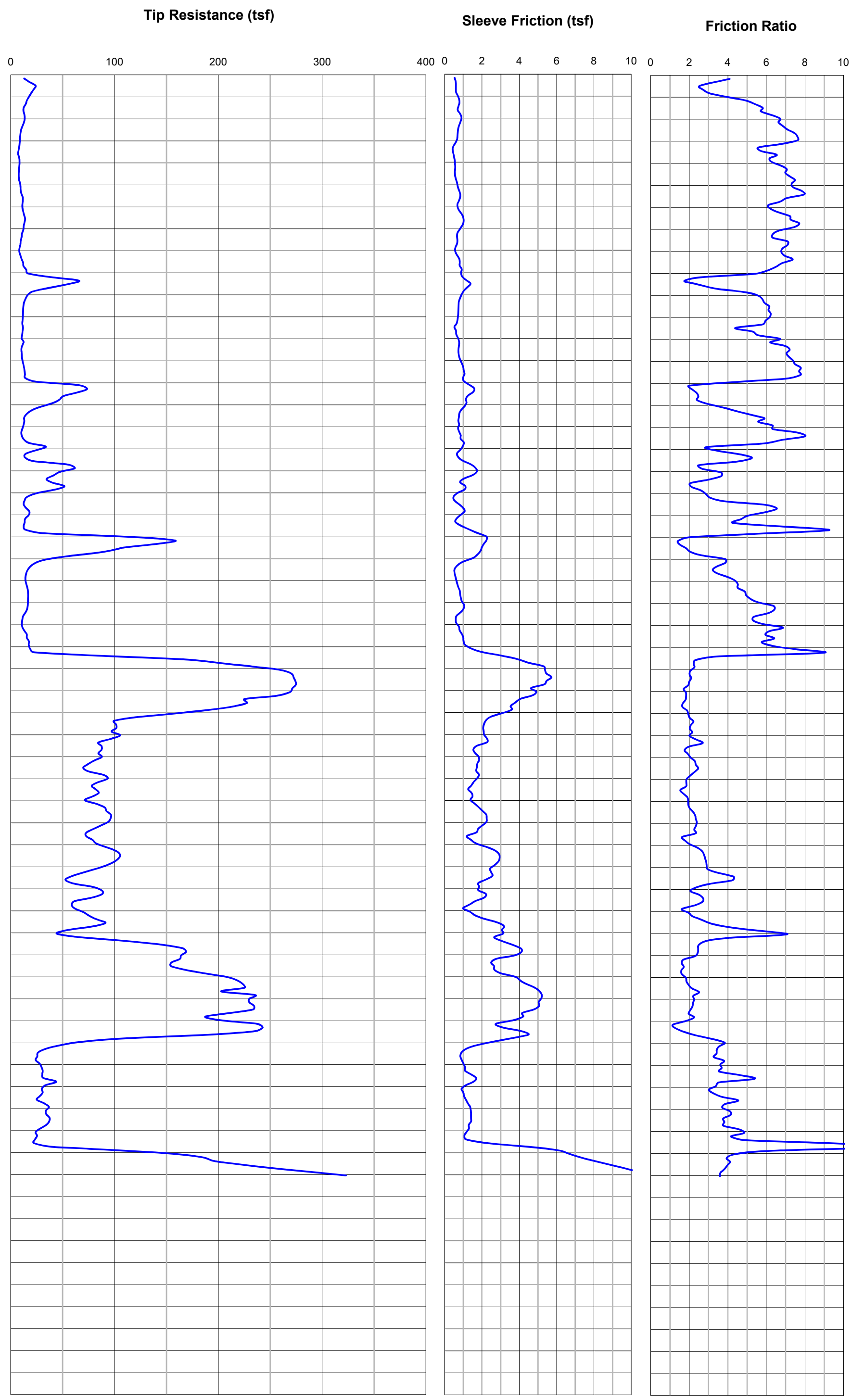
DATE: 8/13/2018

CONE SOUNDING DATA CPT-2

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

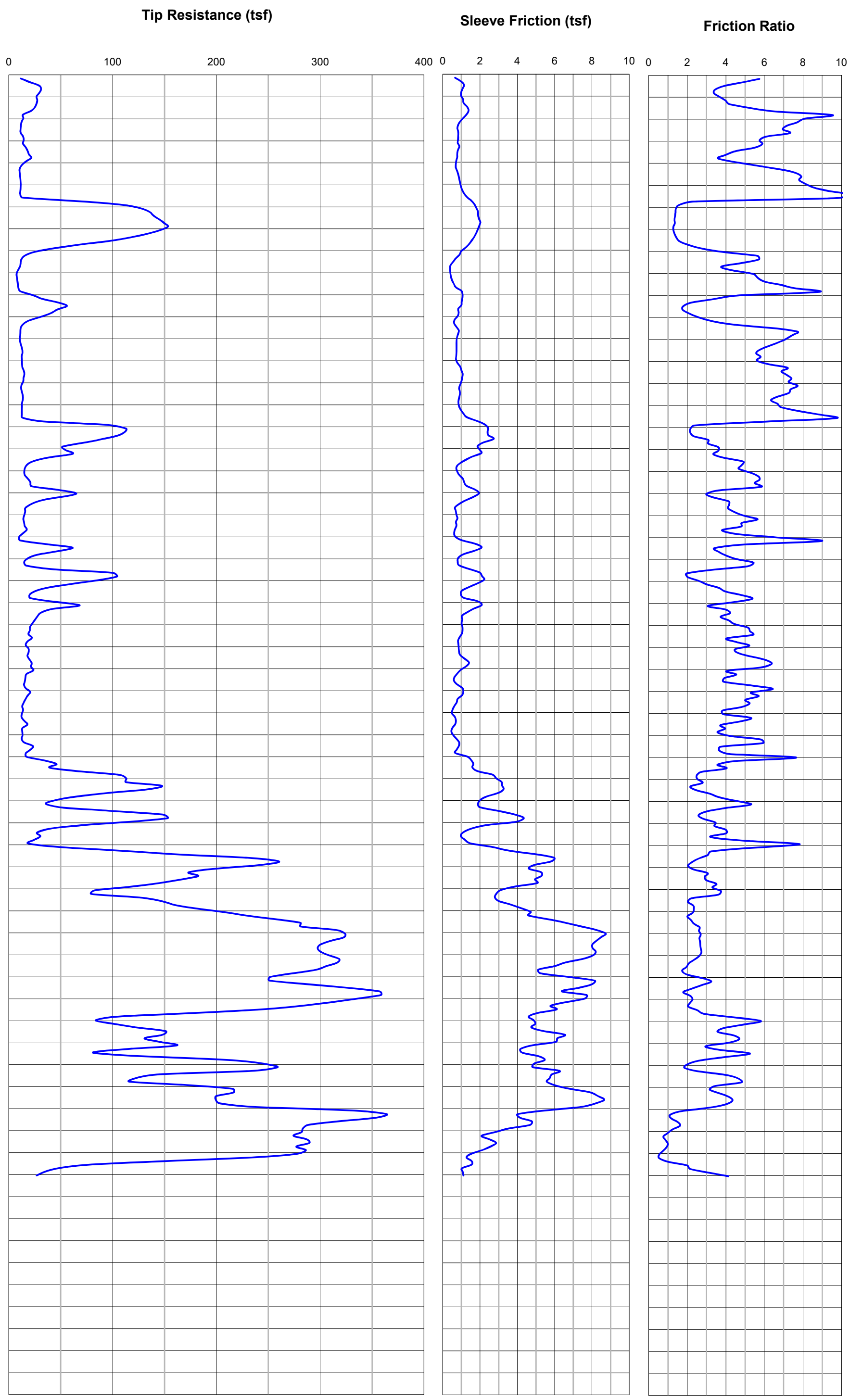
CONE SOUNDING DATA CPT-3

DEPTH

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



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-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

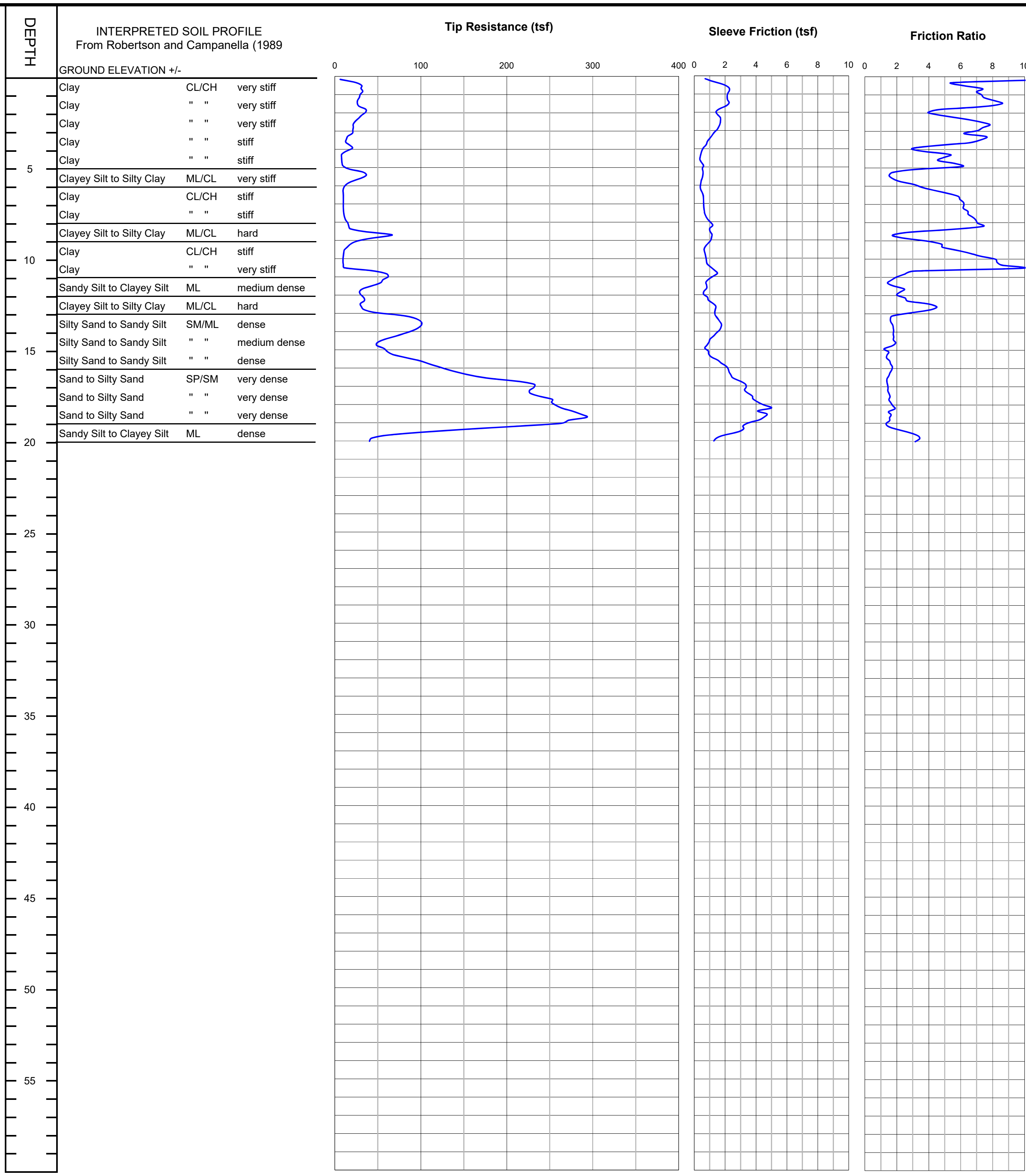
CONE SOUNDING DATA CPT-4

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



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

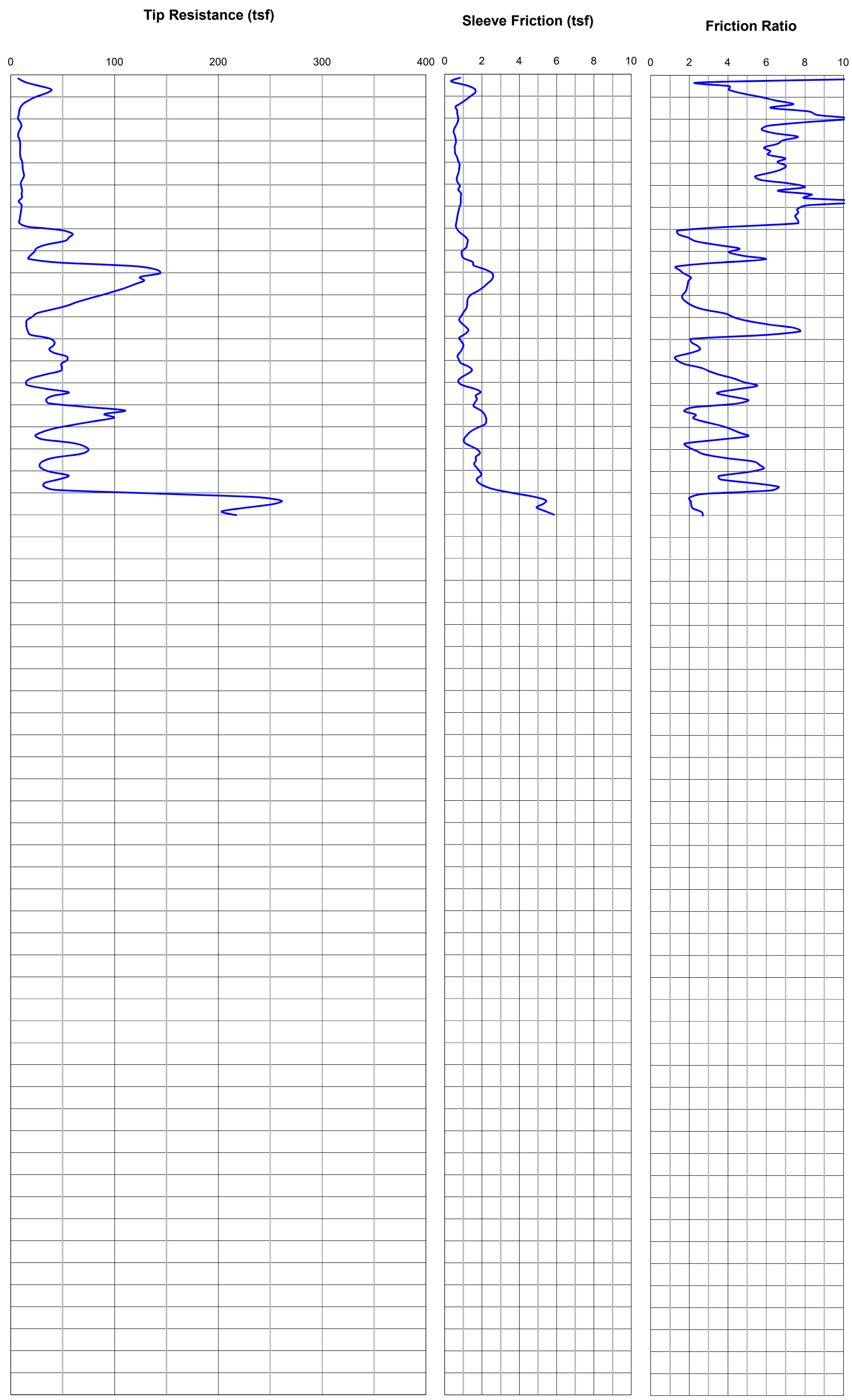
CONE SOUNDING DATA CPT-5

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

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-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

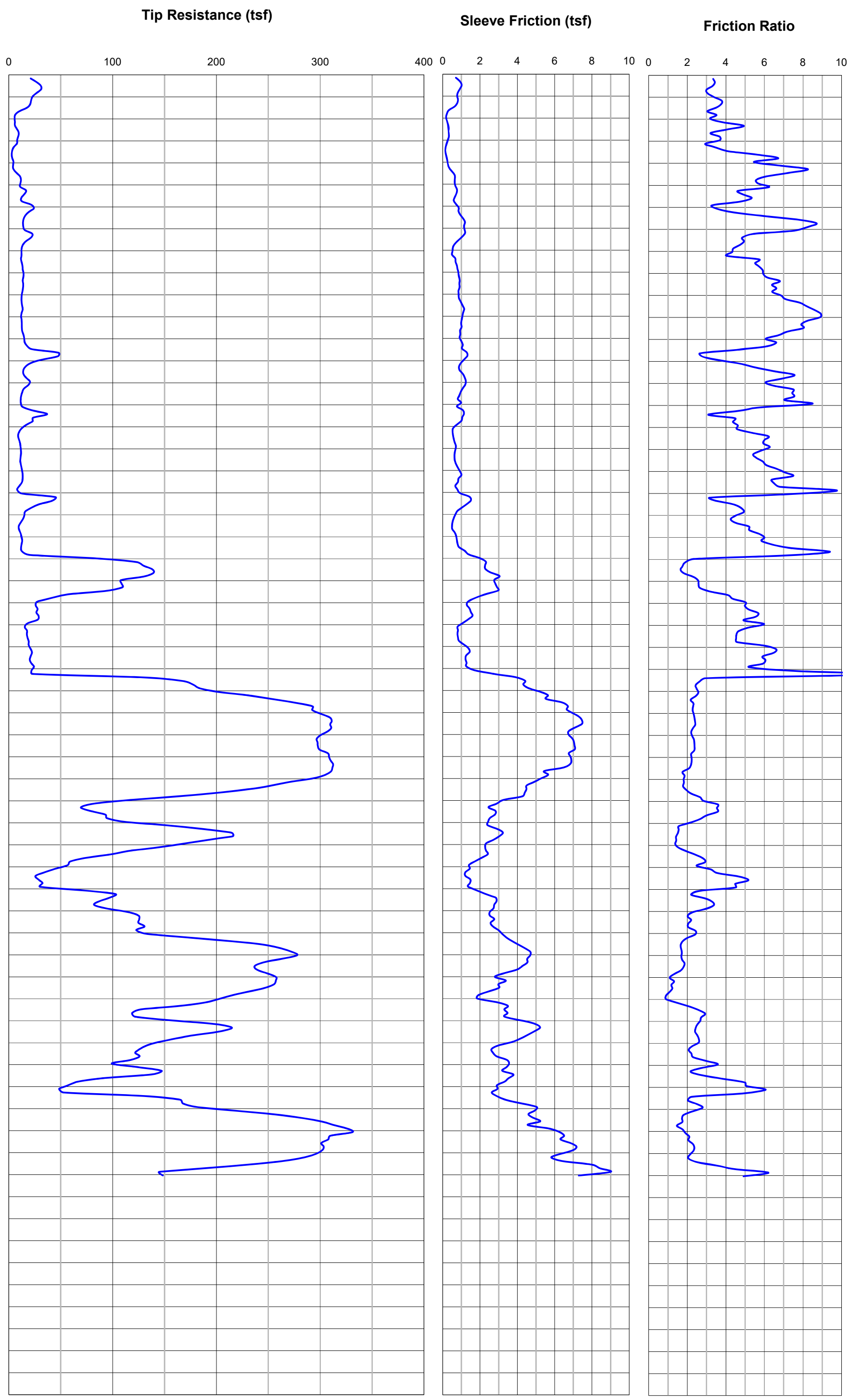
DEPTH

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

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-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

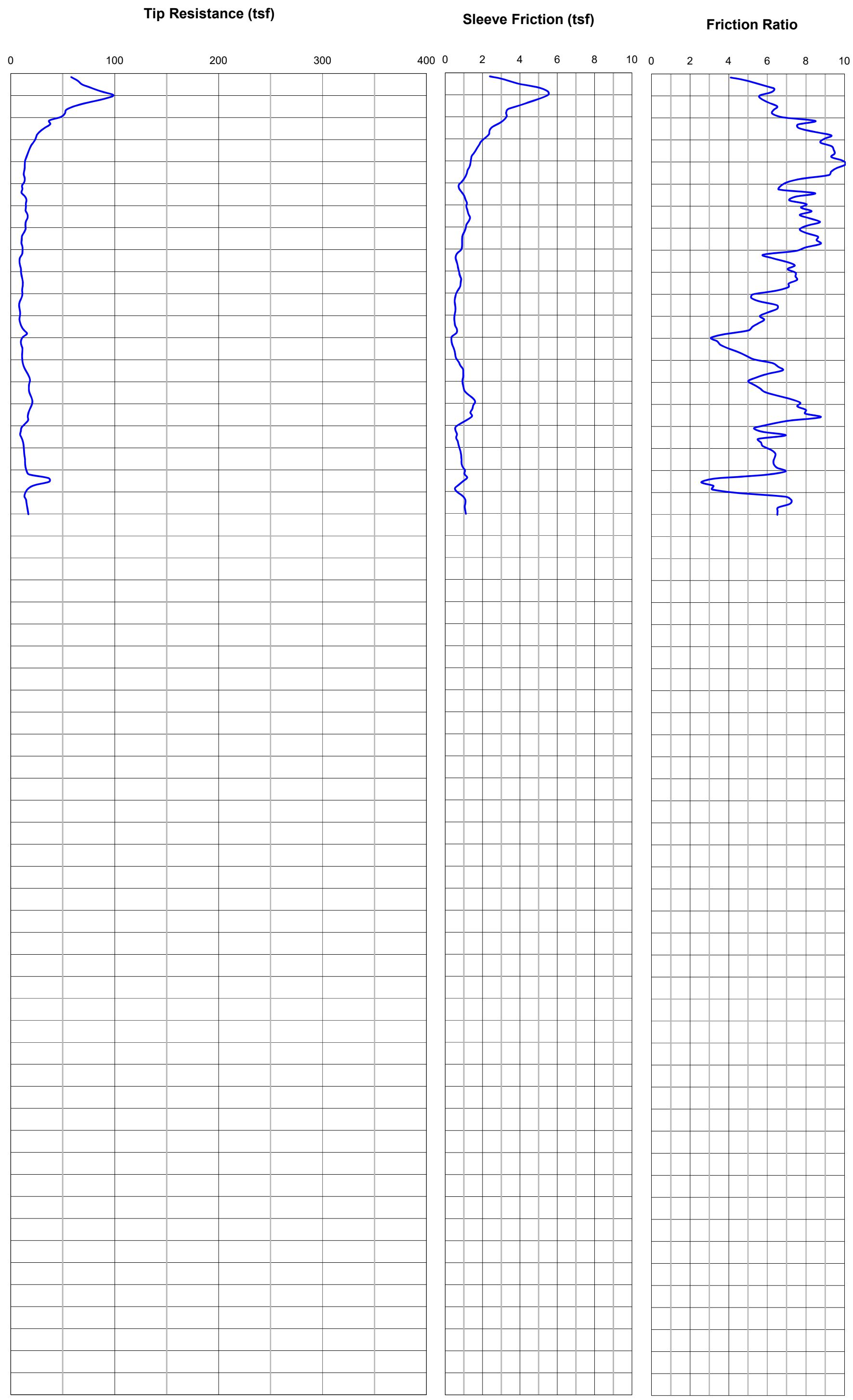
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-7

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
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

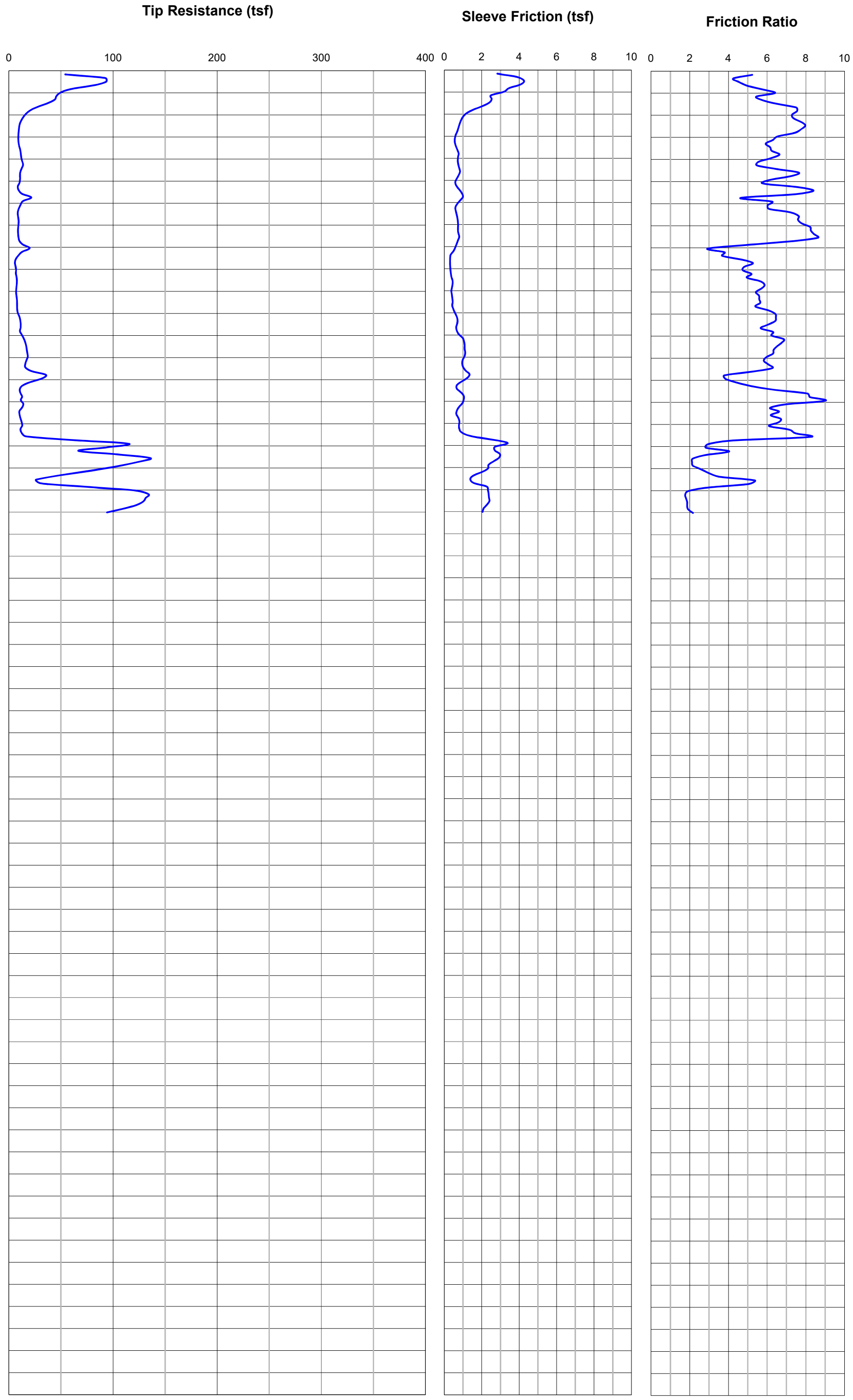
CONE SOUNDING DATA CPT-8

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

DEPTH	Soil	Classification	Consistency
	Overconsolidated Soil	??	very dense
	Clay	CL/CH	very stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
5	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	firm
	Clay	" "	firm
10	Clay	" "	firm
	Clay	" "	stiff
	Clay	" "	stiff
	Clay	" "	very stiff
	Clay	" "	stiff
15	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
20			

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-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
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-9

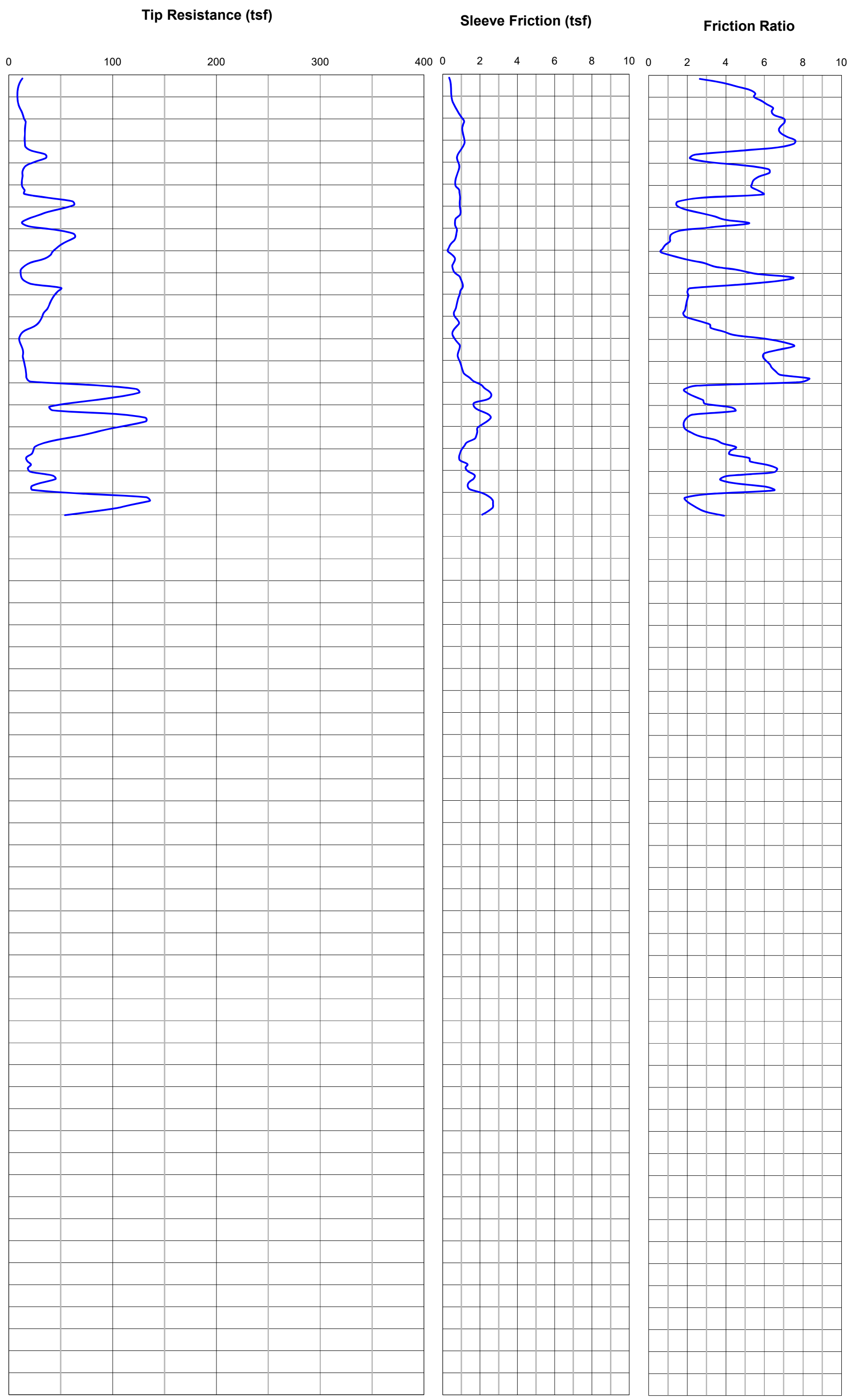
DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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 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-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
LOCATION: See Site and Boring Location Plan

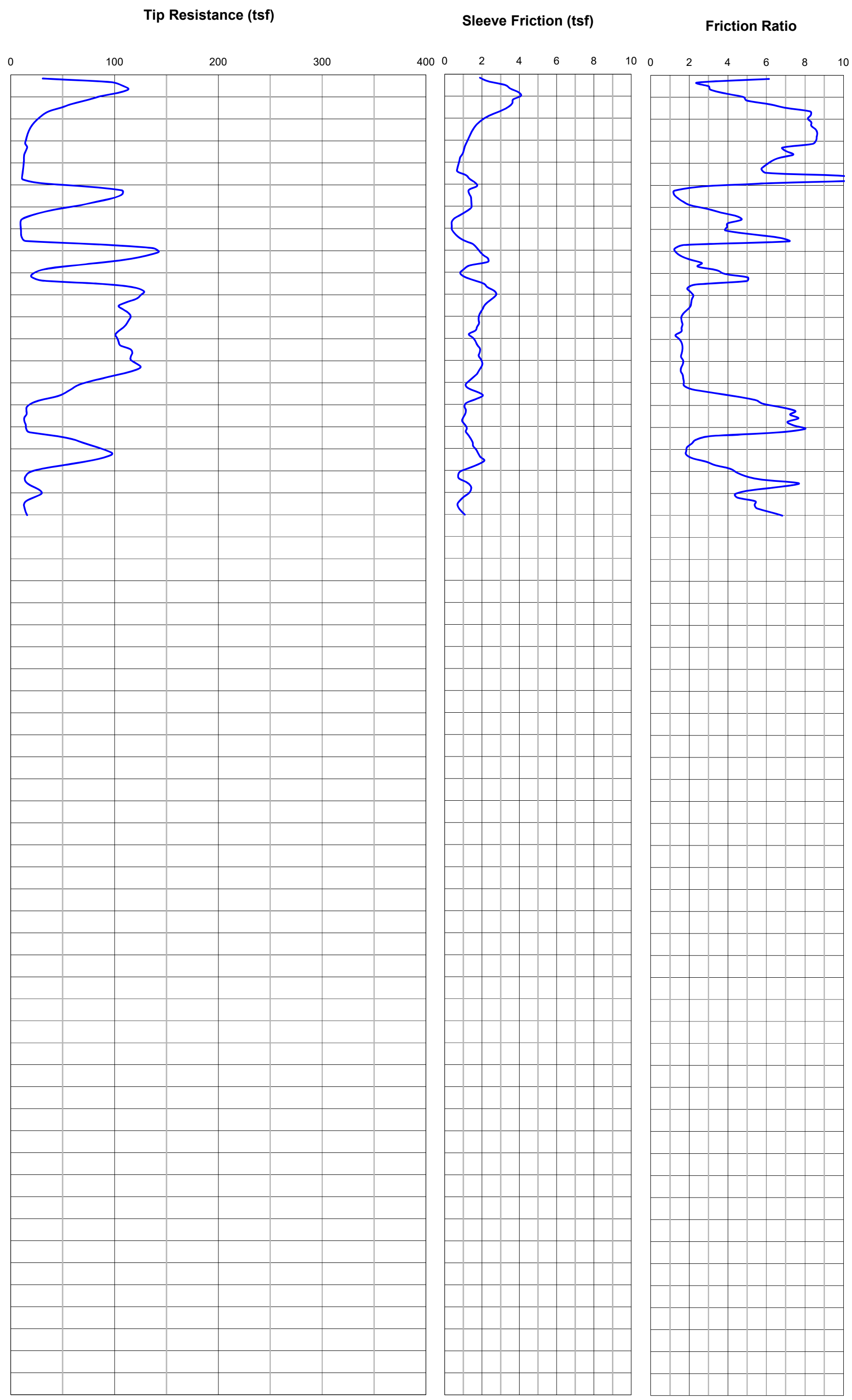
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-10

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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



END OF SOUNDING AT 20 ft.

Project No.		PLATE
LE18150	LANDMARK Geo-Engineers and Geologists	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
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

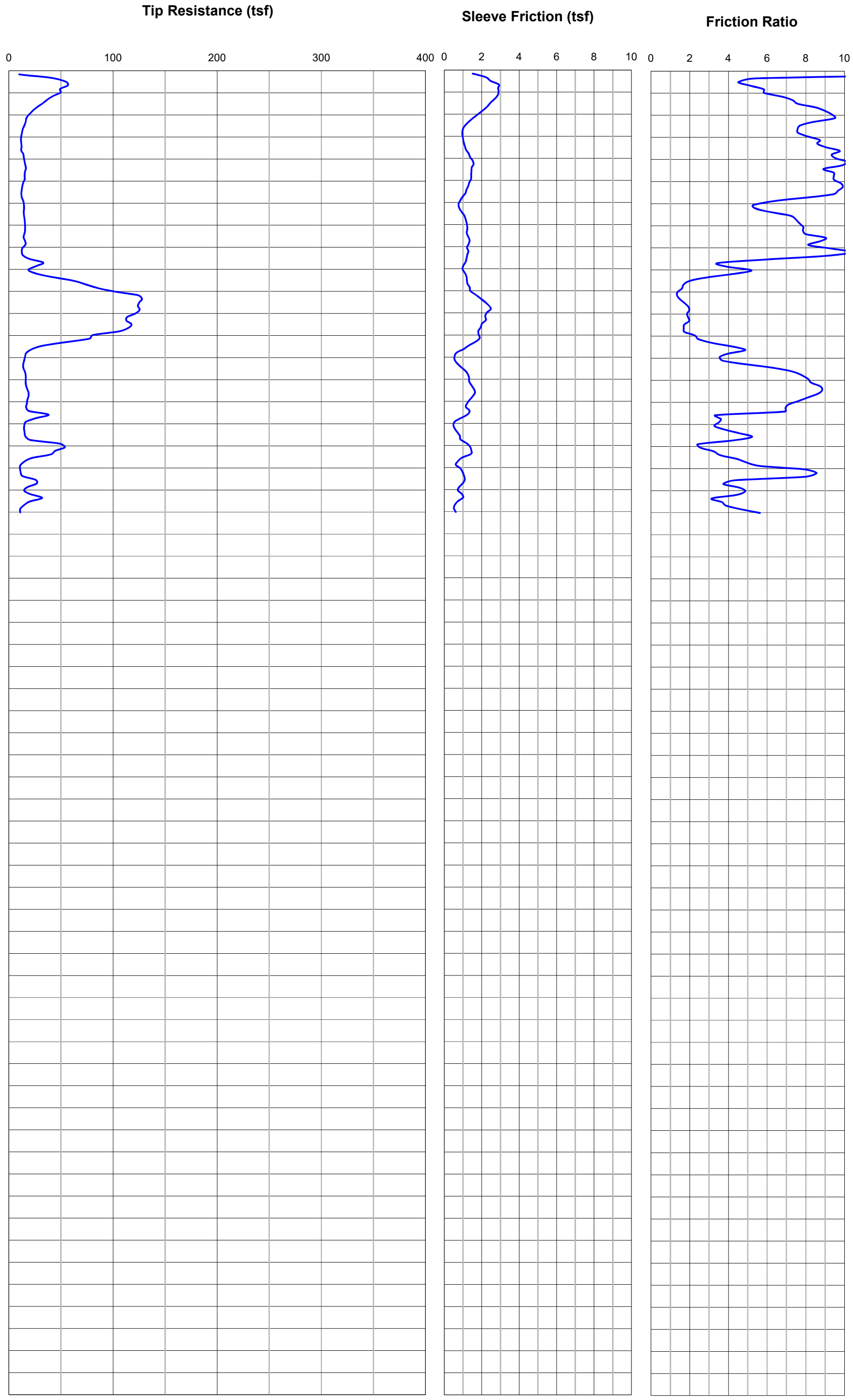
CONE SOUNDING DATA CPT-11

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: 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-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

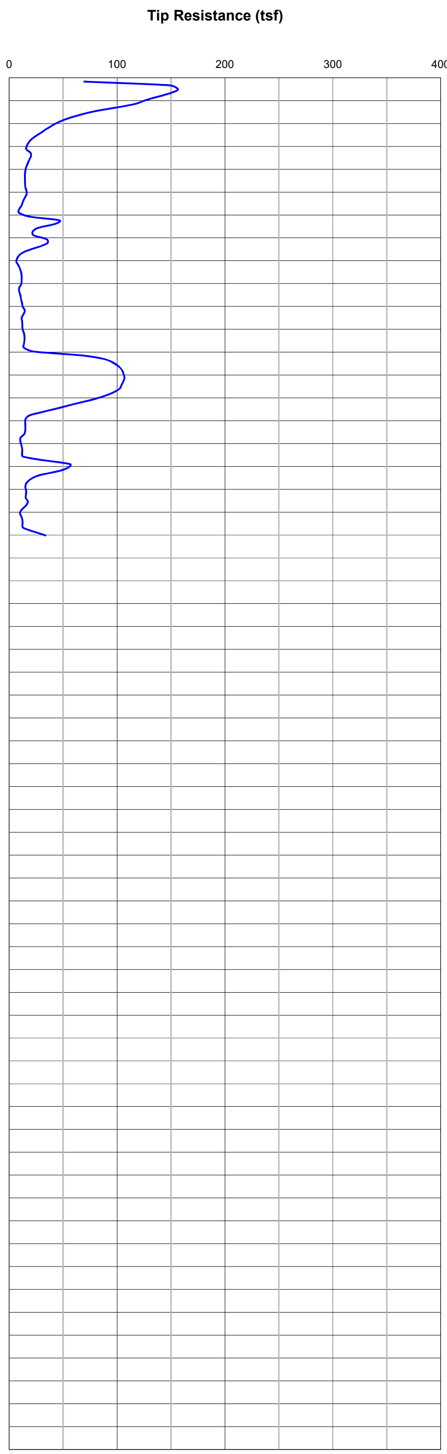
DEPTH

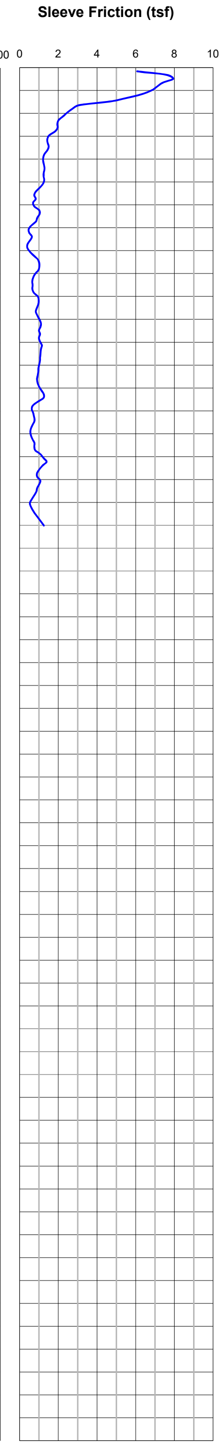
INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

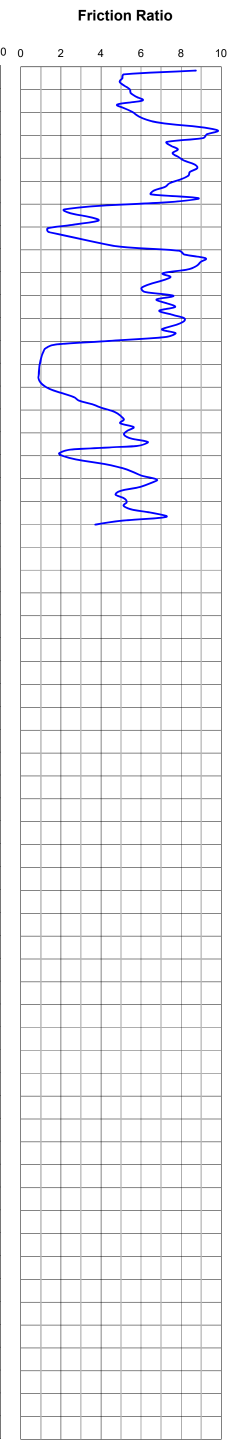
GROUND ELEVATION +/-

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

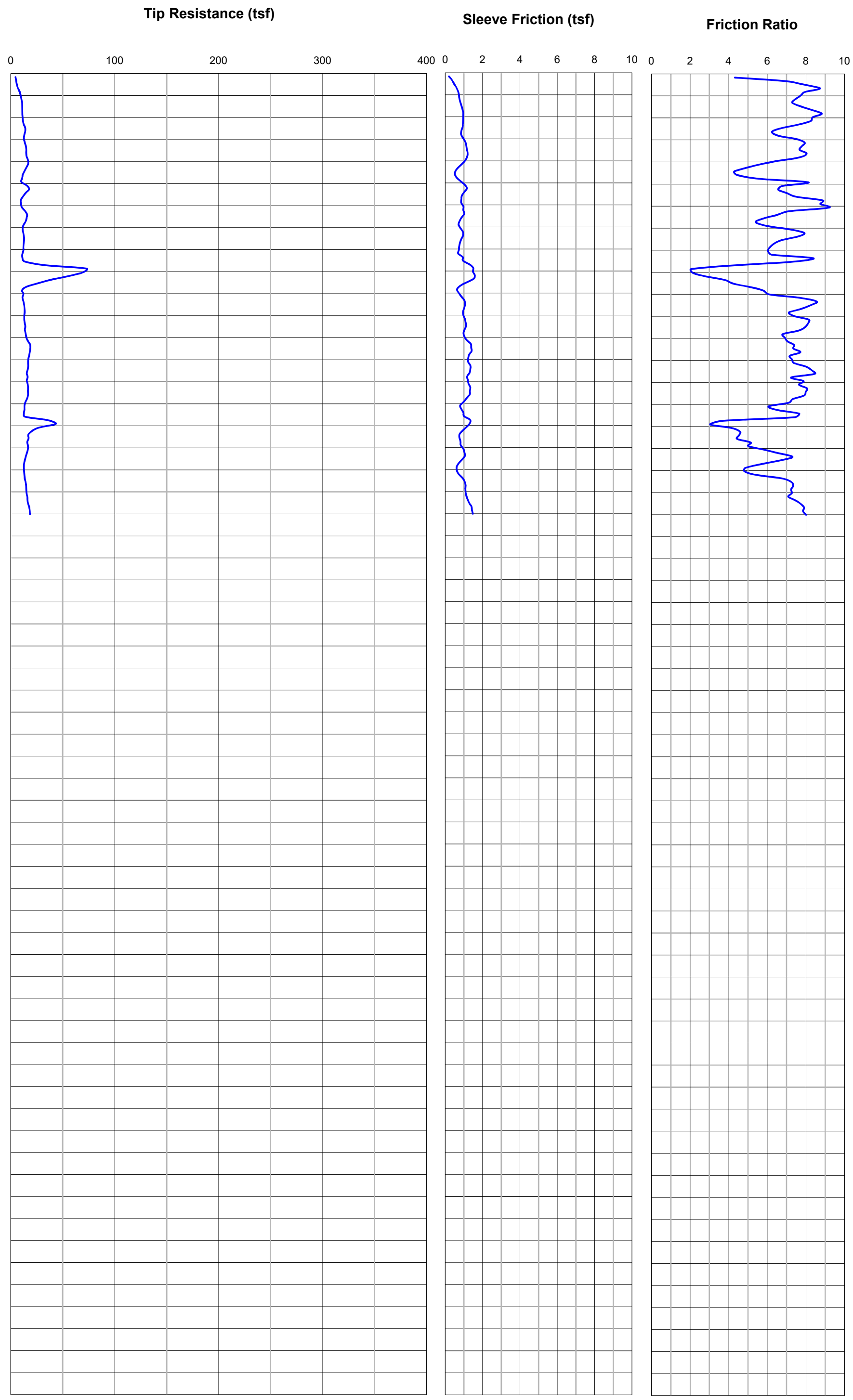
CONE SOUNDING DATA CPT-13

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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

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-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

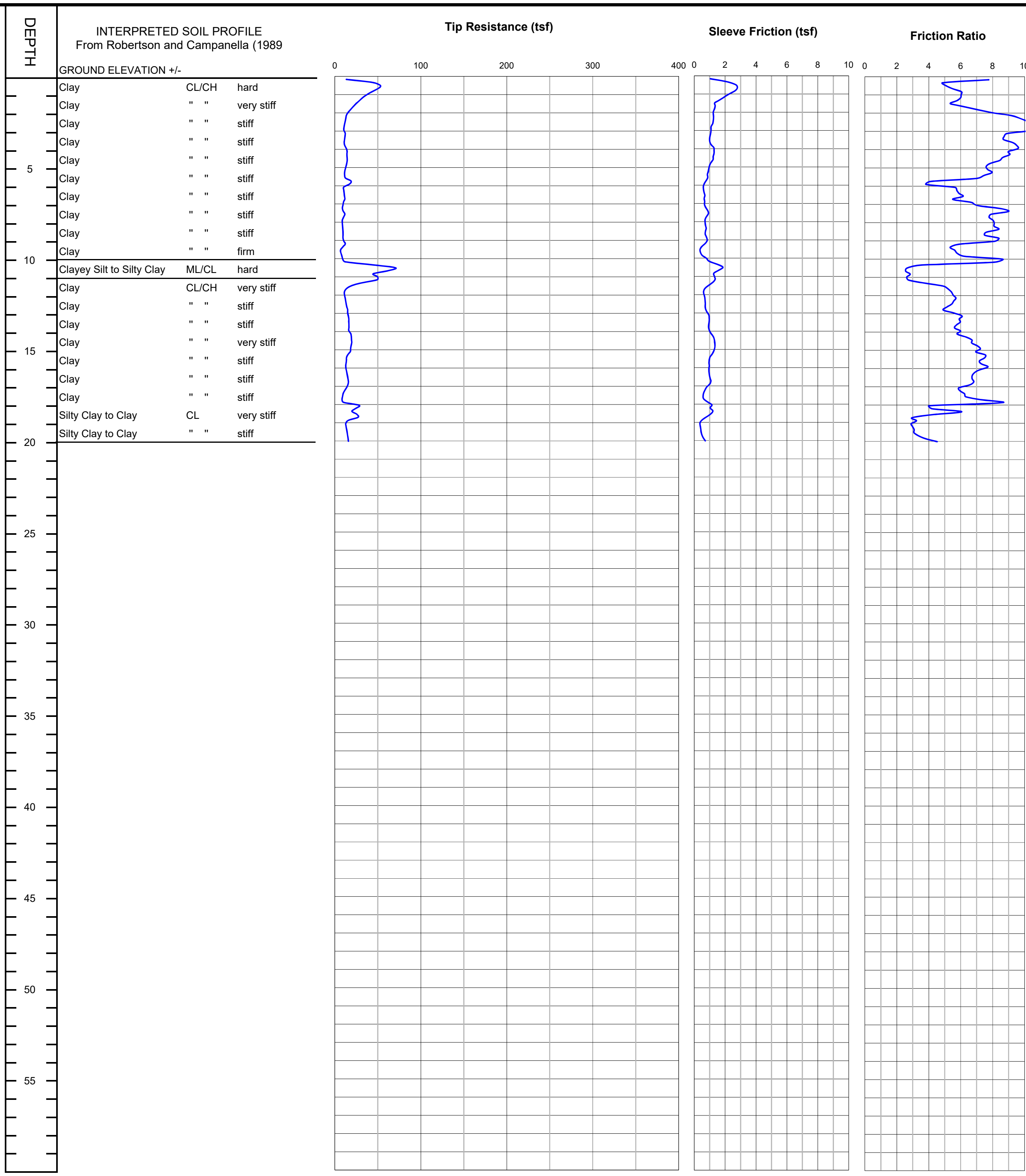
CONE PENETROMETER: Middle Earth Geotesting Truck Mounted Electric Cone with 25 ton reaction weight
DATE: 8/13/2018

CONE SOUNDING DATA CPT-14

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

Clay	CL/CH	hard
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	firm
Clayey Silt to Silty Clay	ML/CL	hard
Clay	CL/CH	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	very stiff
Clay	" "	stiff
Clay	" "	stiff
Clay	" "	stiff
Silty Clay to Clay	CL	very stiff
Silty Clay to Clay	" "	stiff



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

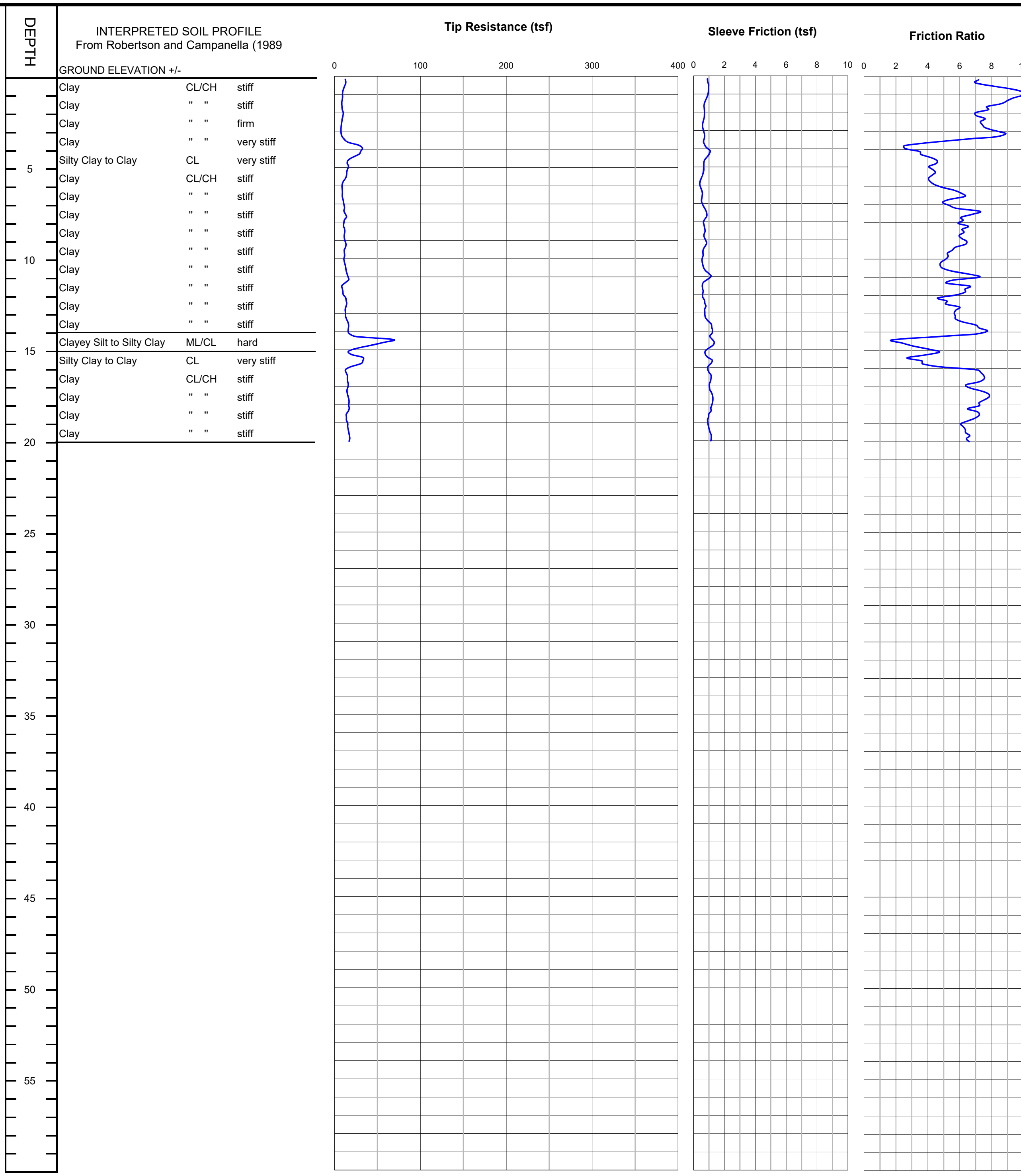
CONE SOUNDING DATA CPT-15

DEPTH

INTERPRETED SOIL PROFILE
From Robertson and Campanella (1989

GROUND ELEVATION +/-

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



END OF SOUNDING AT 20 ft.

Project No.
LE18150

LANDMARK
Geo-Engineers and Geologists

PLATE
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

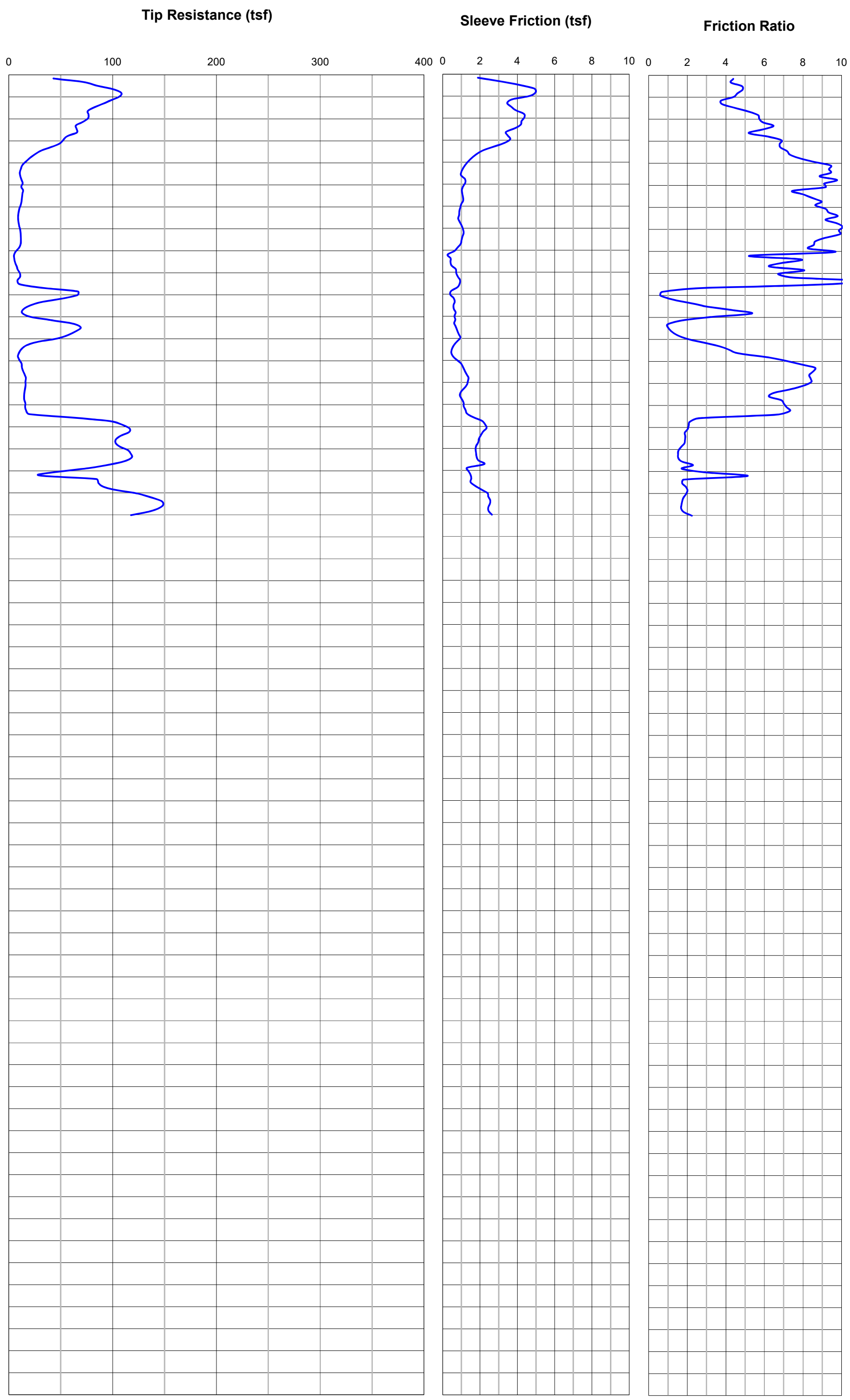
CONE SOUNDING DATA CPT-16

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

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-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

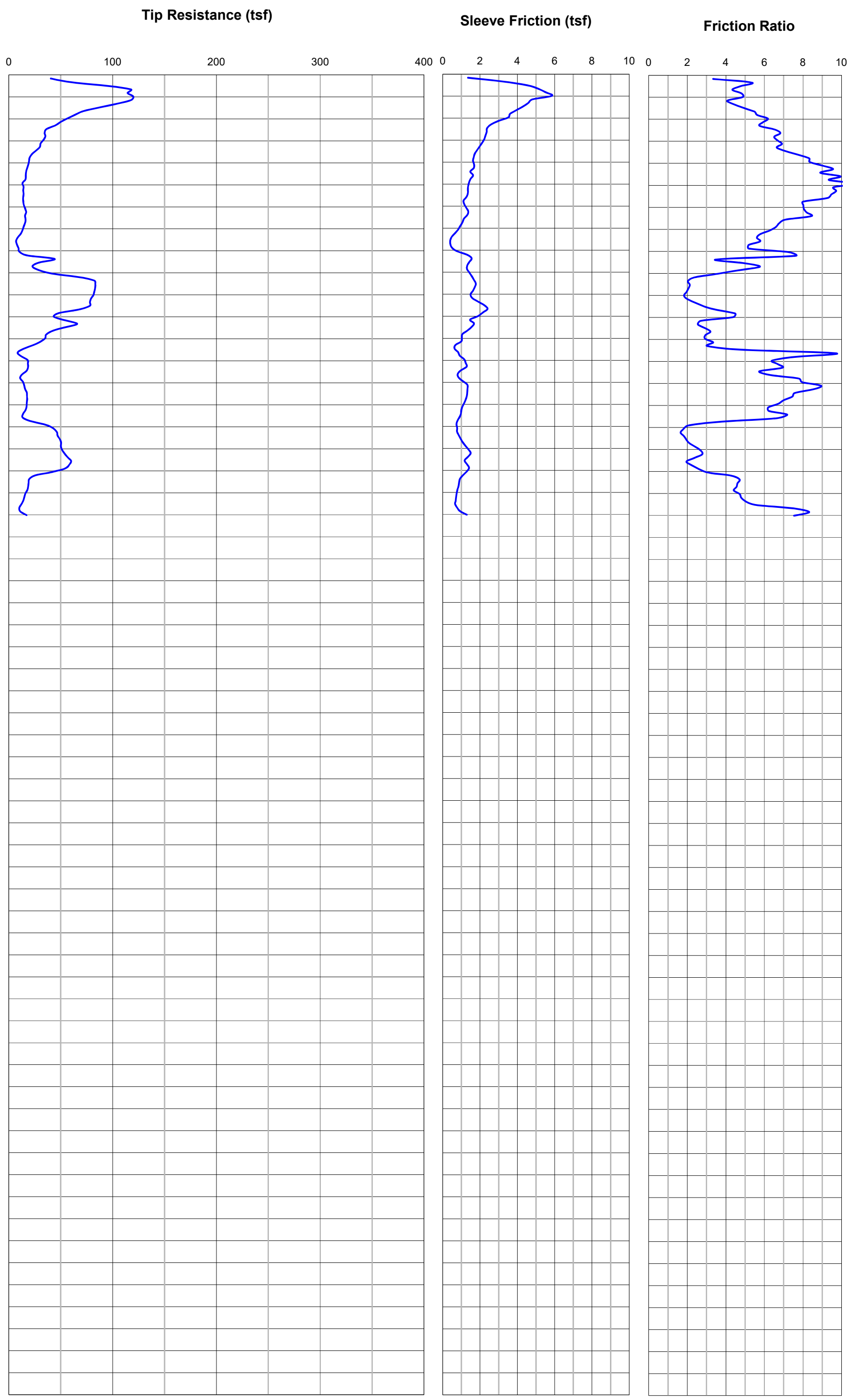
CONE SOUNDING DATA CPT-17

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
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-18

DEPTH

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

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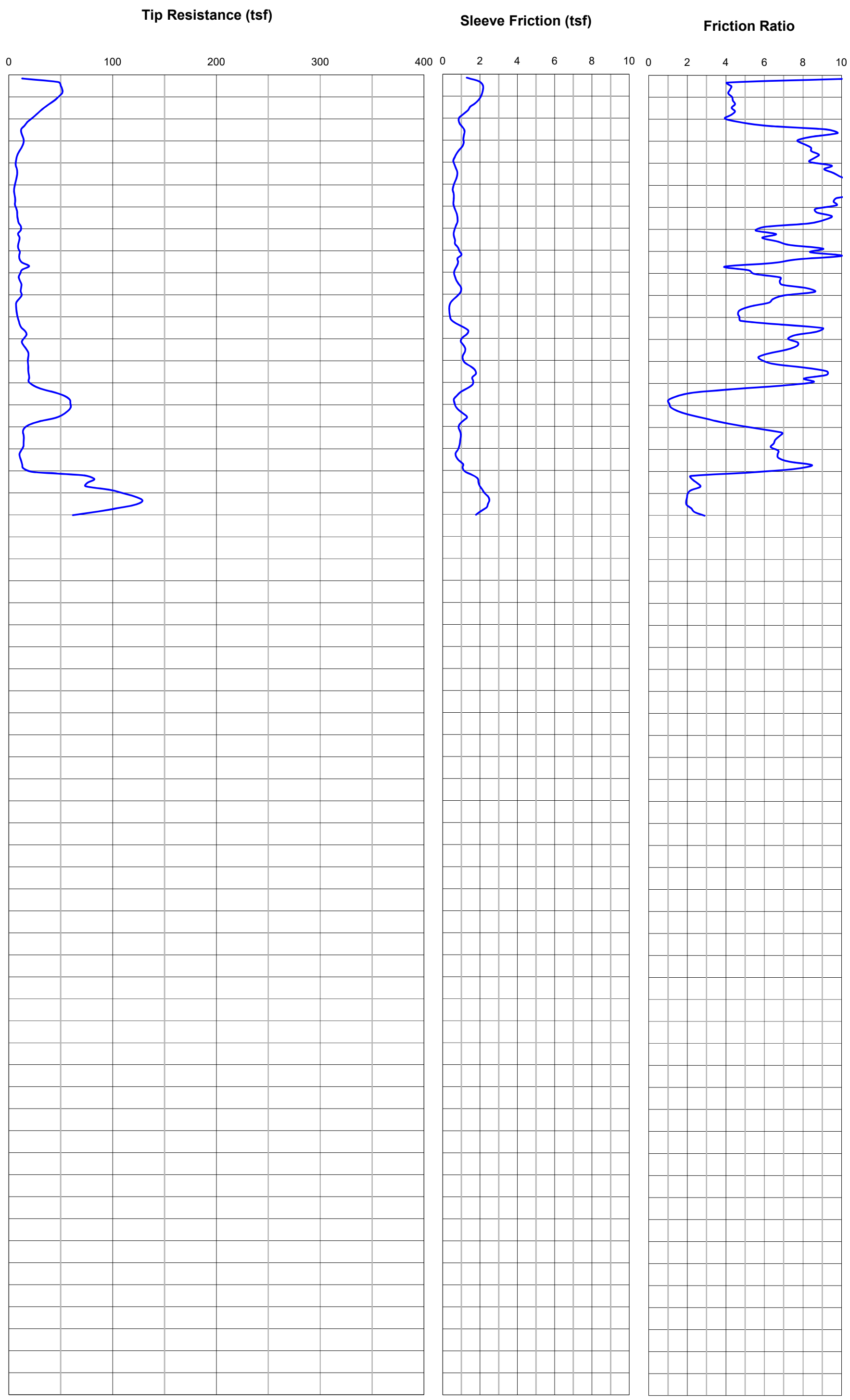


END OF SOUNDING AT 20 ft.

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)

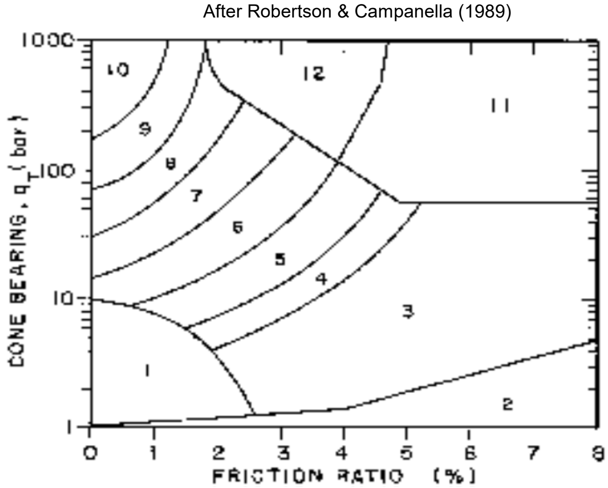
Project: Drew Solar Project -- Calexico, CA **Project No:** LE18150 **Date:** 8/13/2018

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

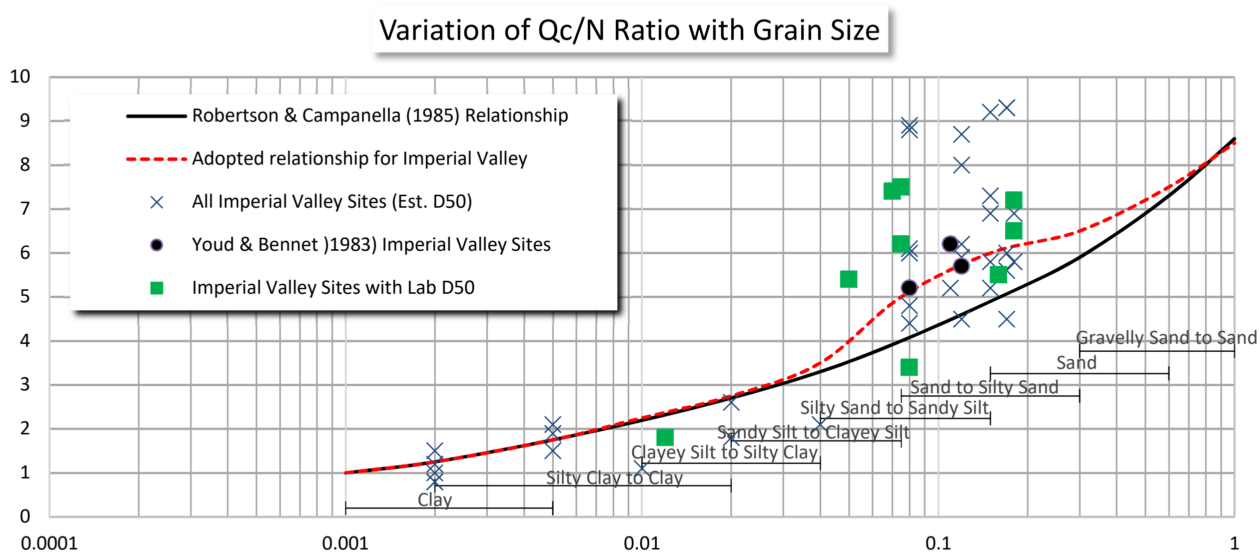
2. Peck, Hansen & Thornburn (1974) N-Phi Correlation

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



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

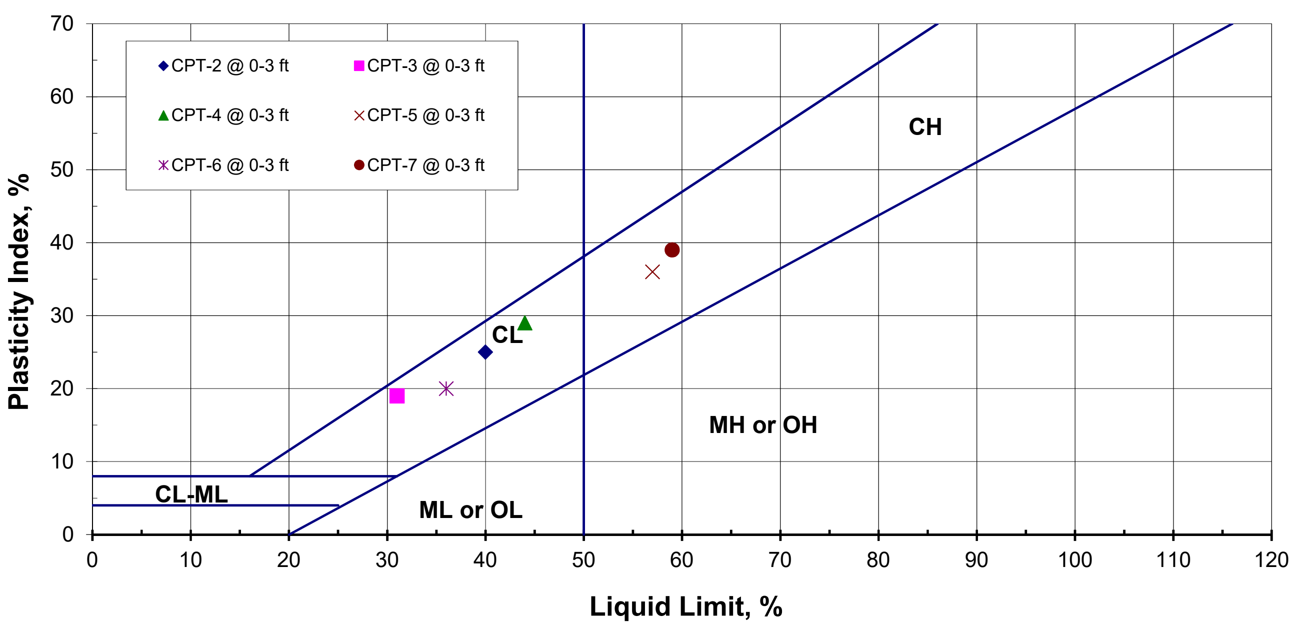
LANDMARK CONSULTANTS, INC.

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

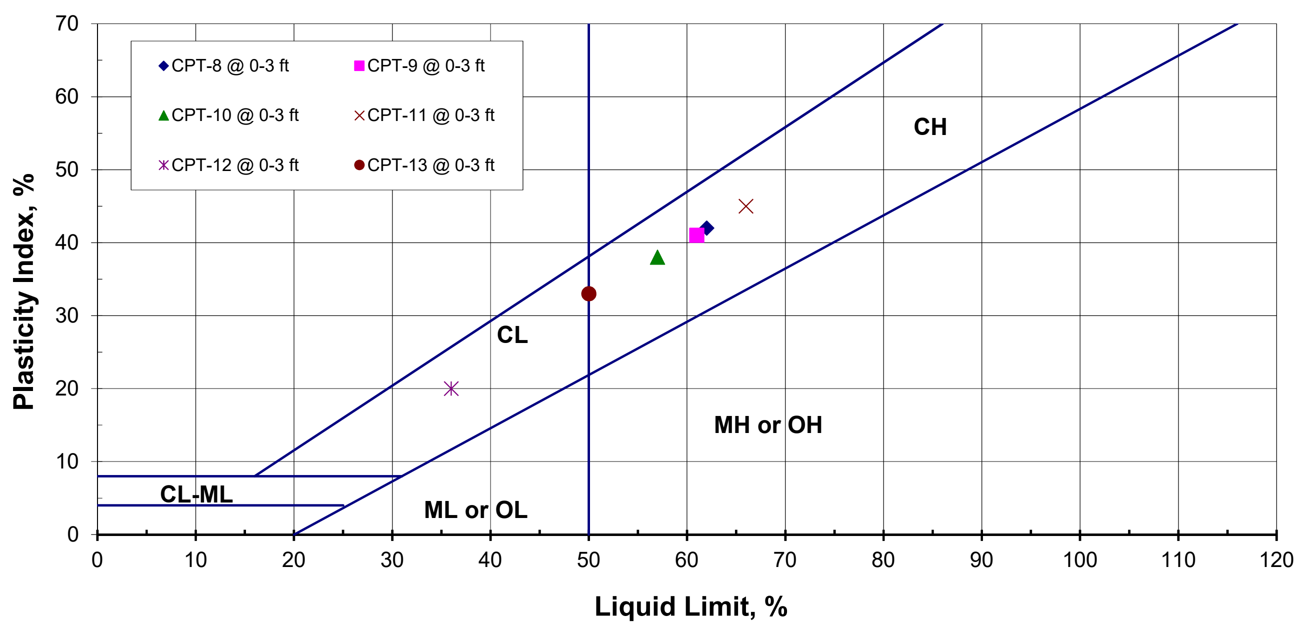
LANDMARK CONSULTANTS, INC.

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



LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Atterberg Limits Test Results

Plate C-2

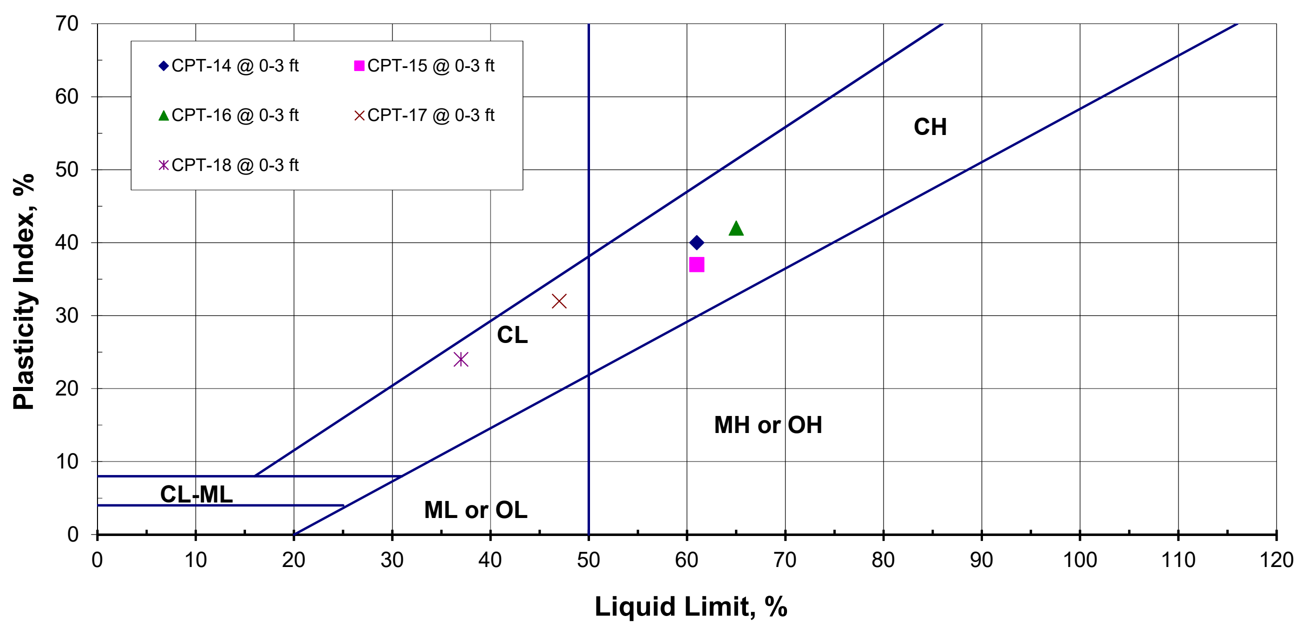
LANDMARK CONSULTANTS, INC.

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

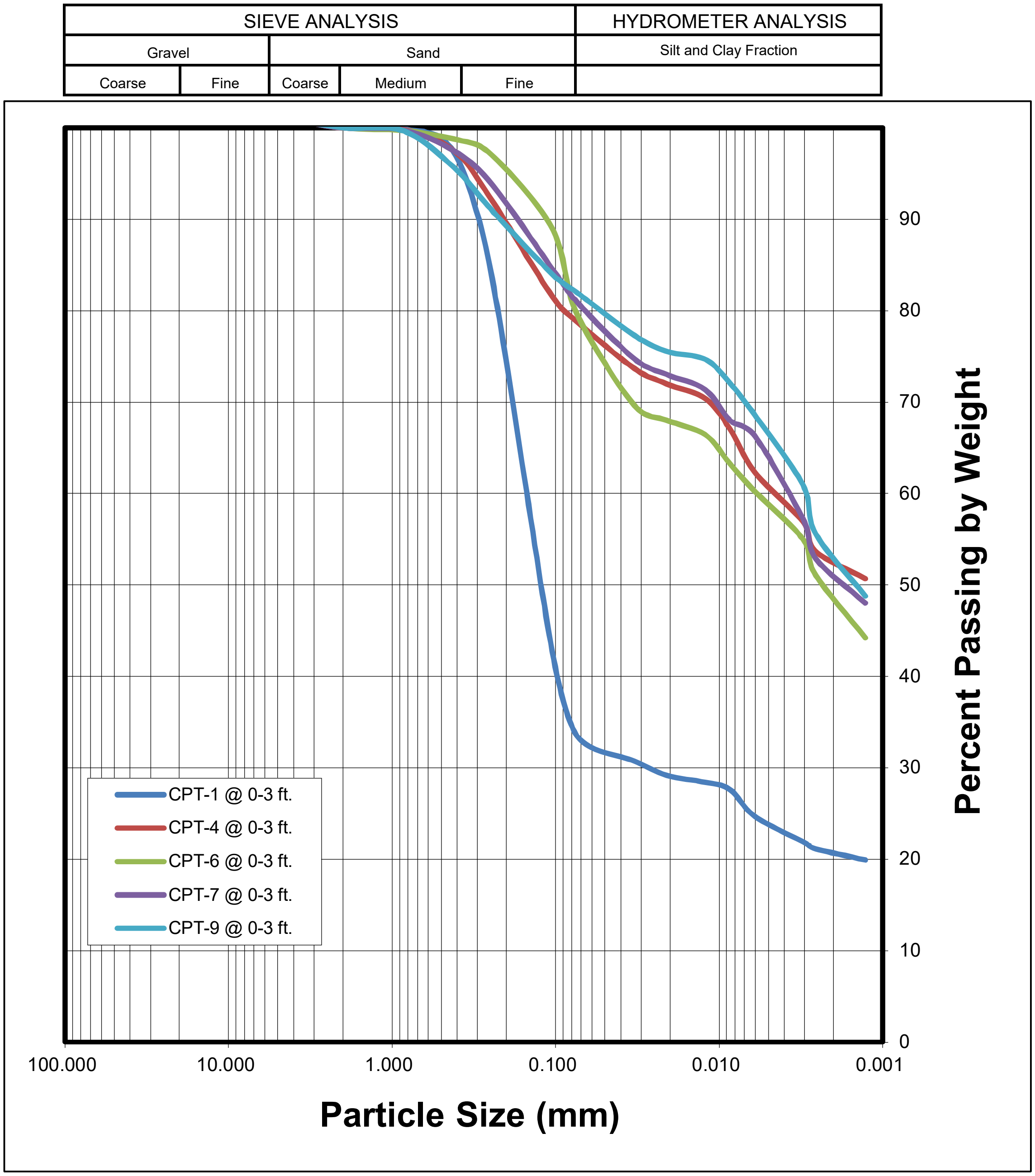


Geo-Engineers and Geologists

Project No.: LE18150

Atterberg Limits Test Results

Plate C-3

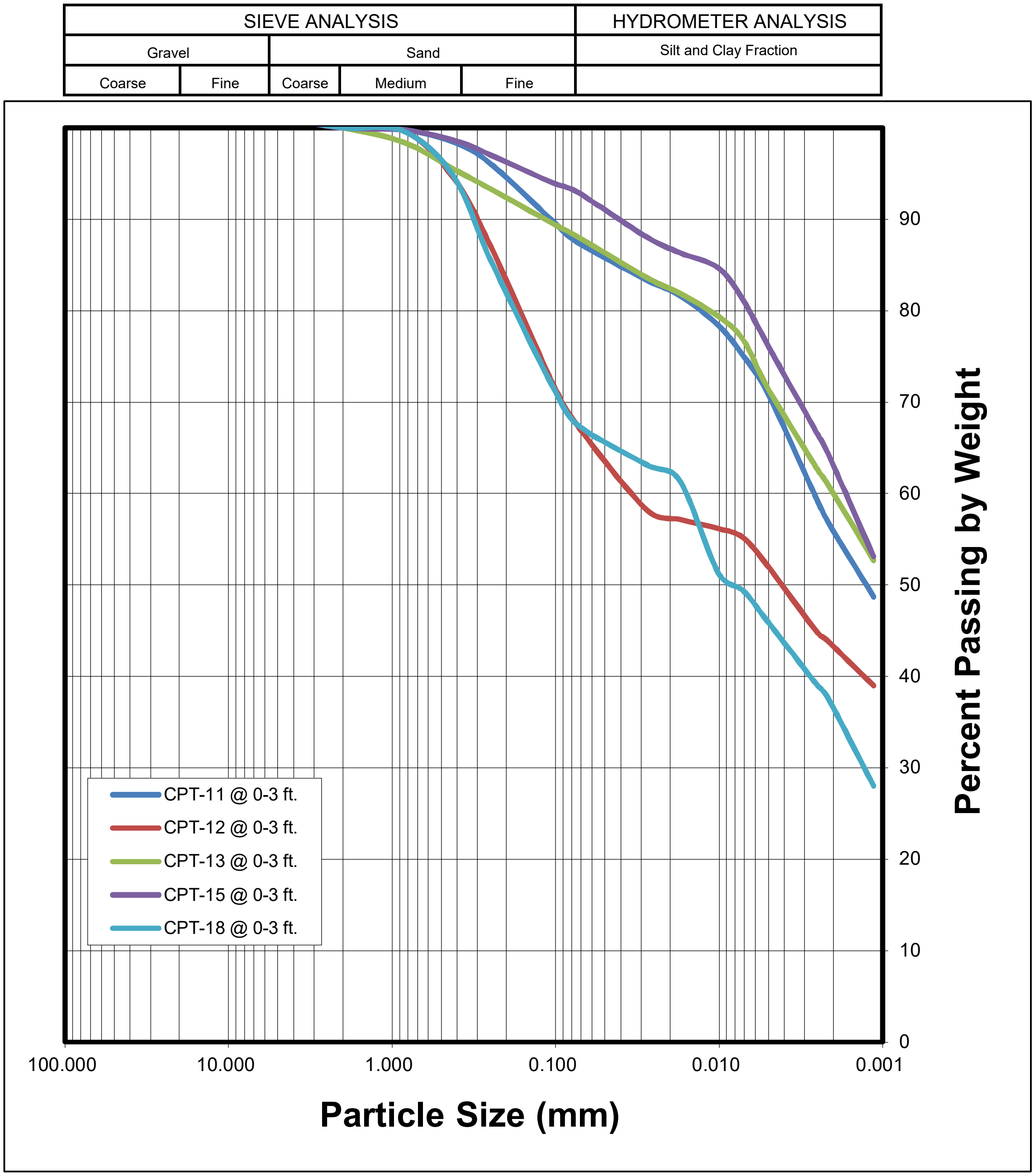


LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Grain Size Analysis

Plate C-4



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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

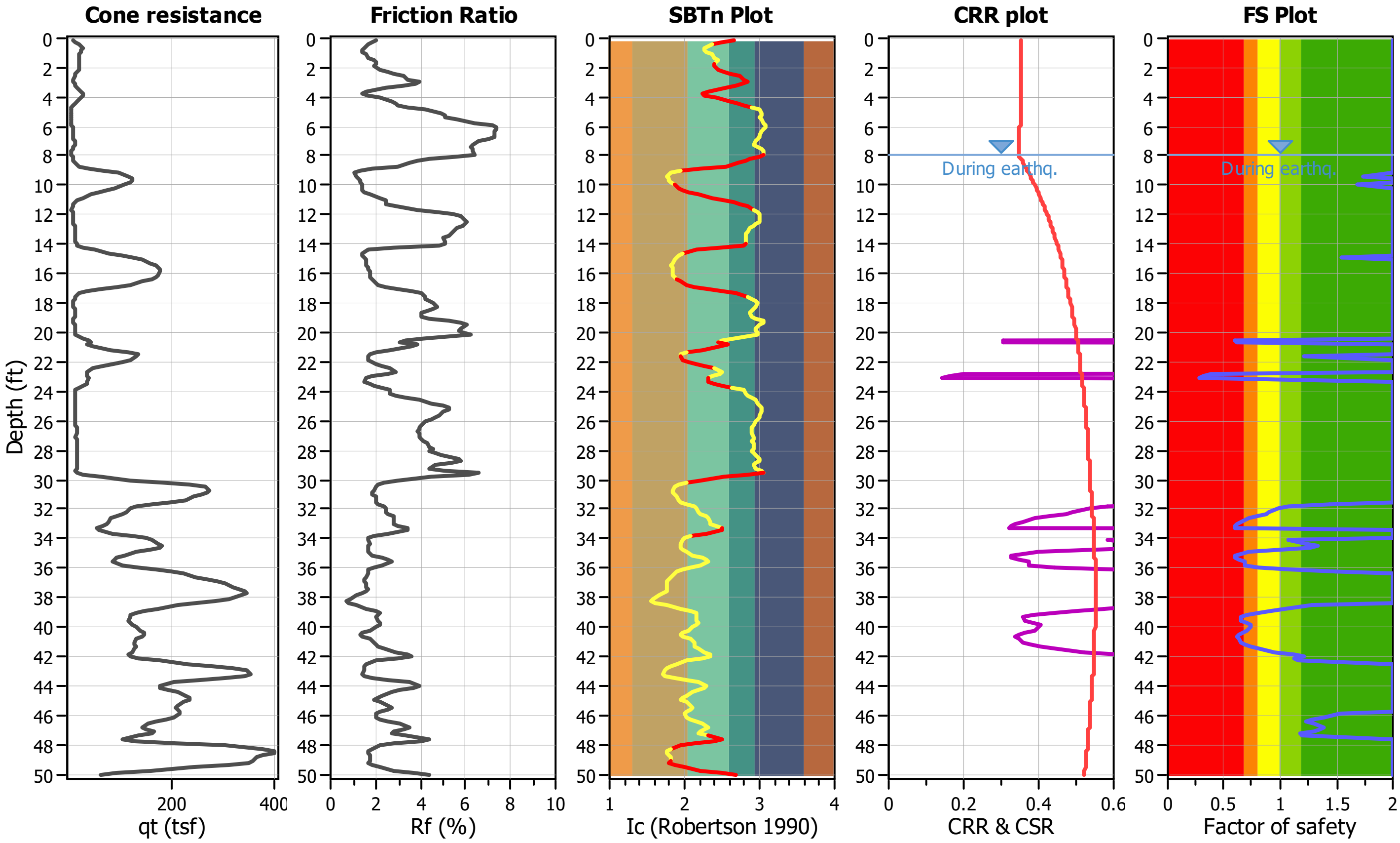
LIQUEFACTION ANALYSIS REPORT

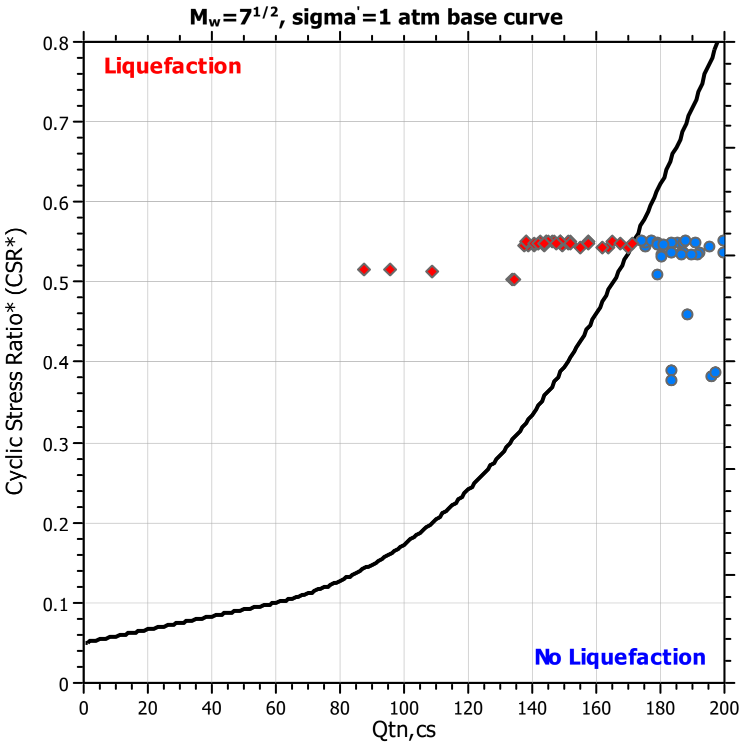
Project title : Drew Solar Project **Location : Calexico, CA**

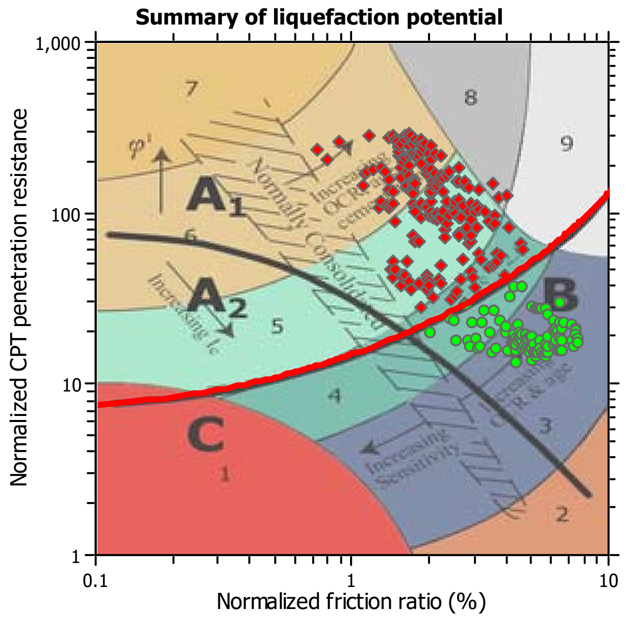
CPT file : CPT-01

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		

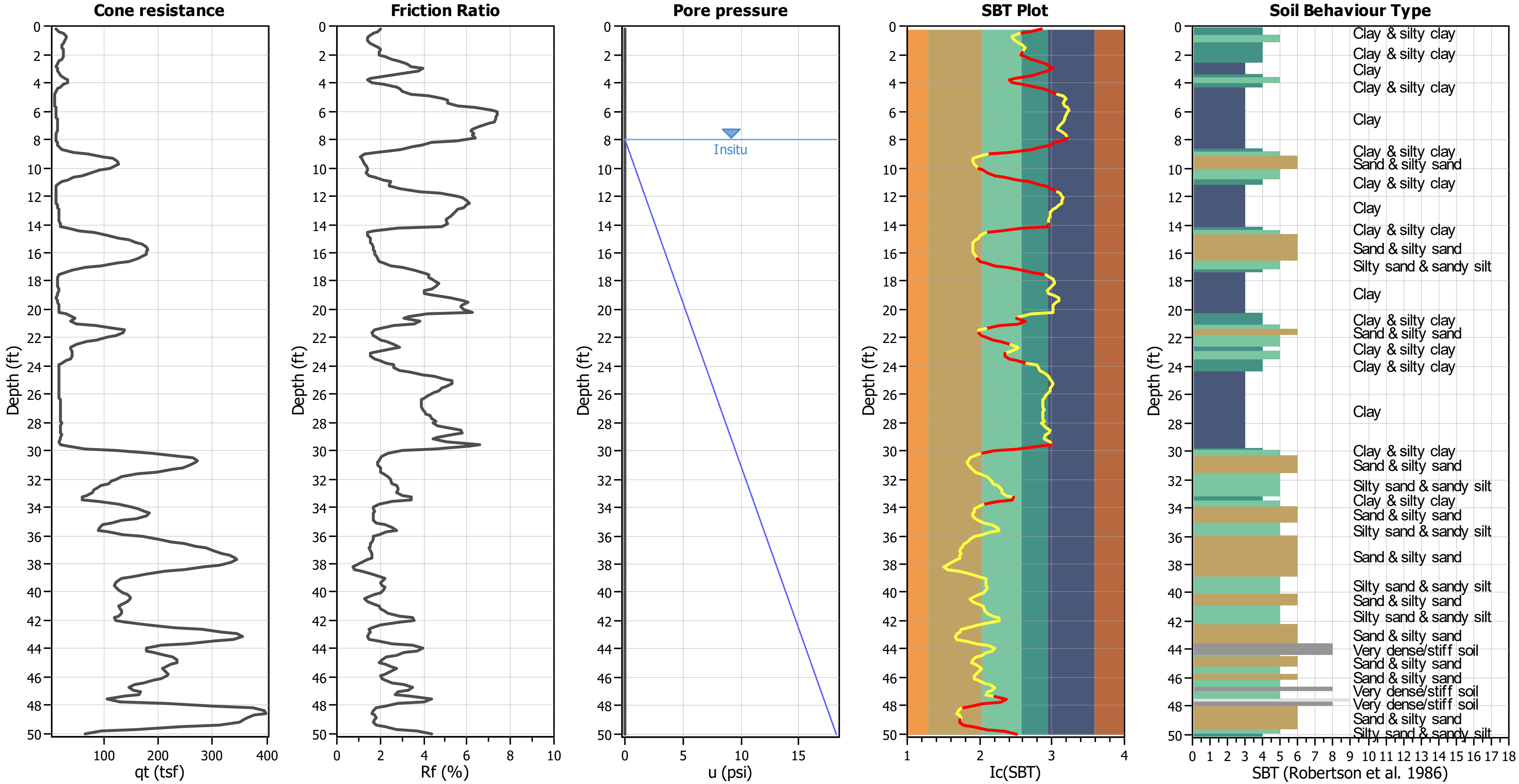






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



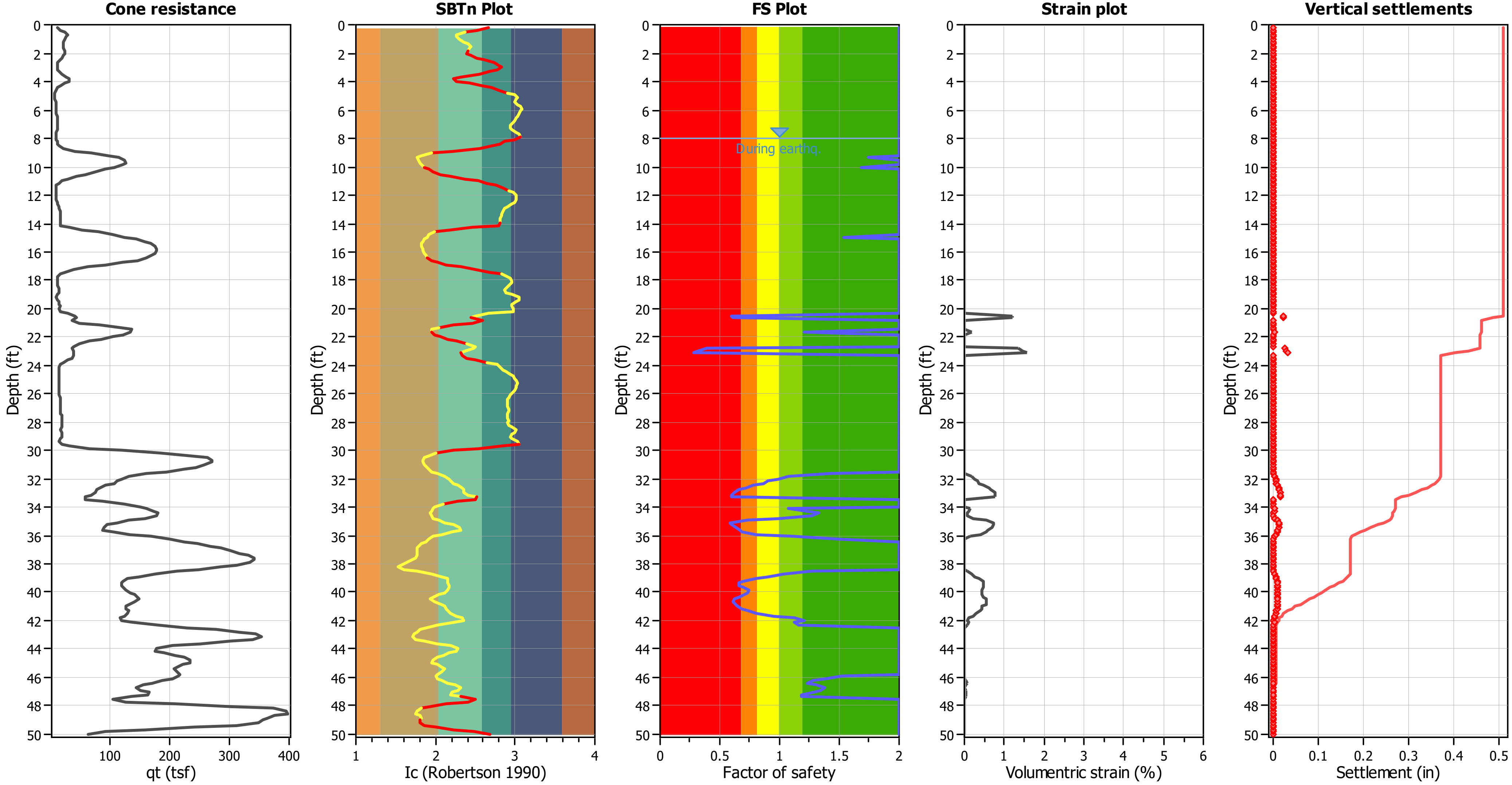
Input parameters and analysis data

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
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
Geo-Engineers and Geologists

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

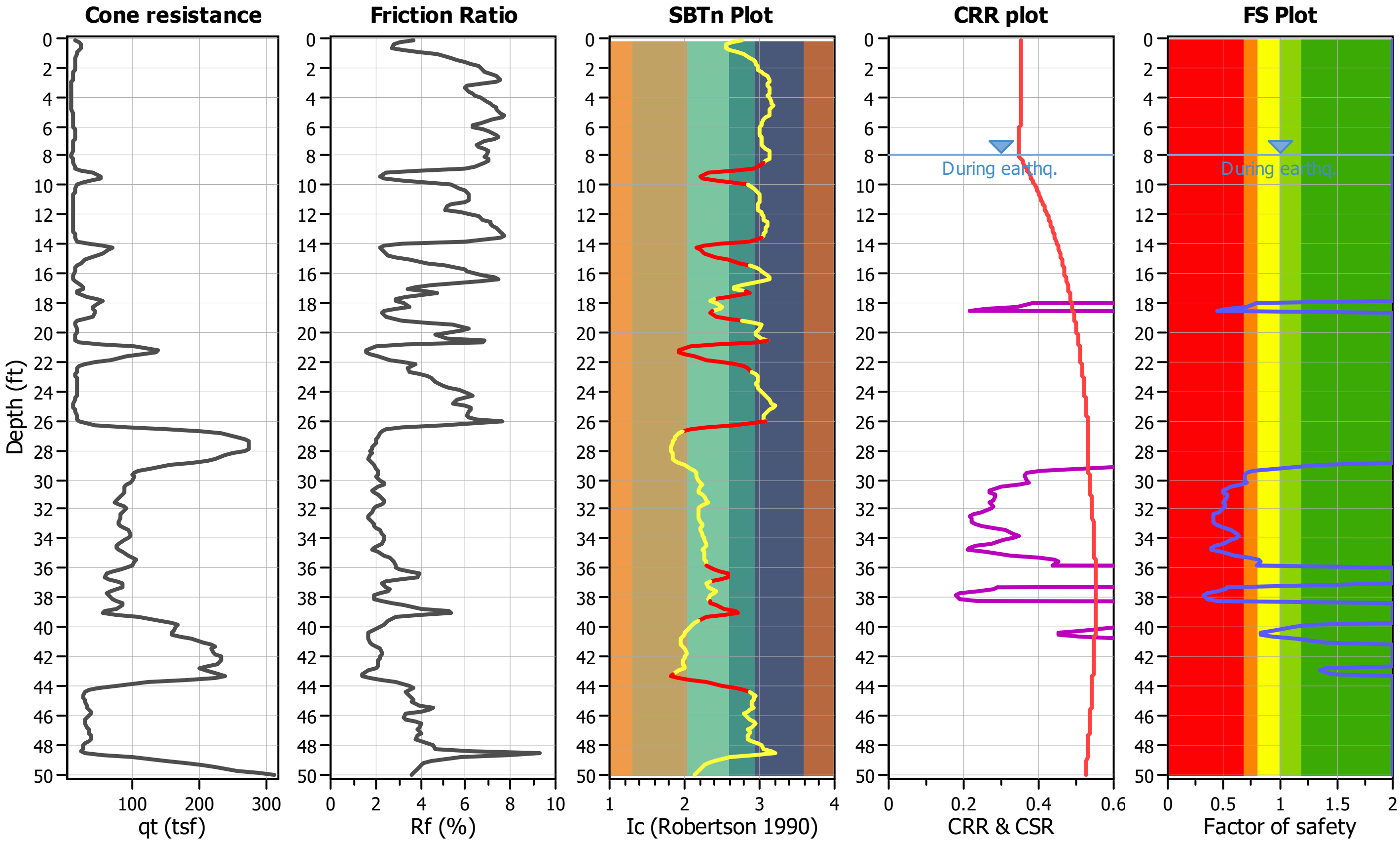
LIQUEFACTION ANALYSIS REPORT

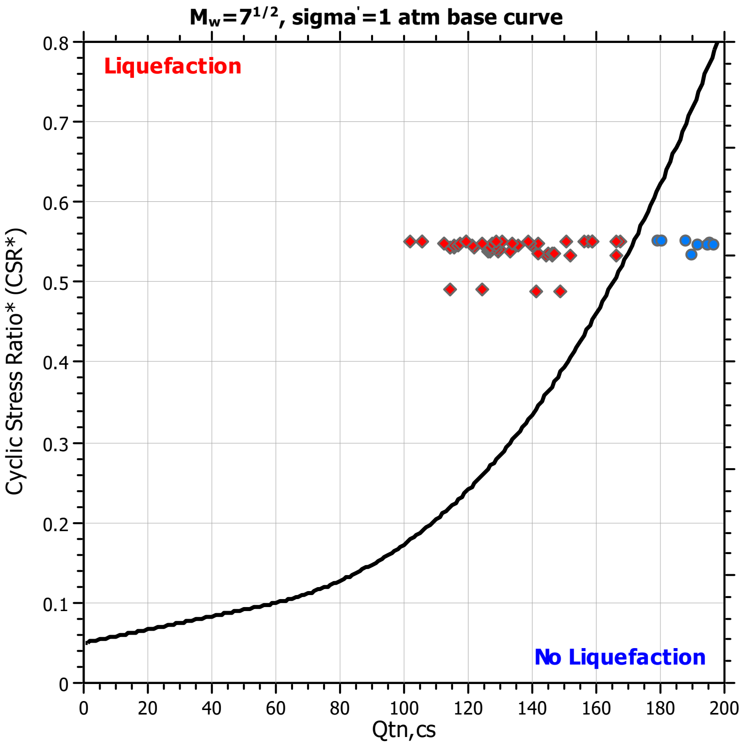
Project title : Drew Solar Project **Location : Calexico, CA**

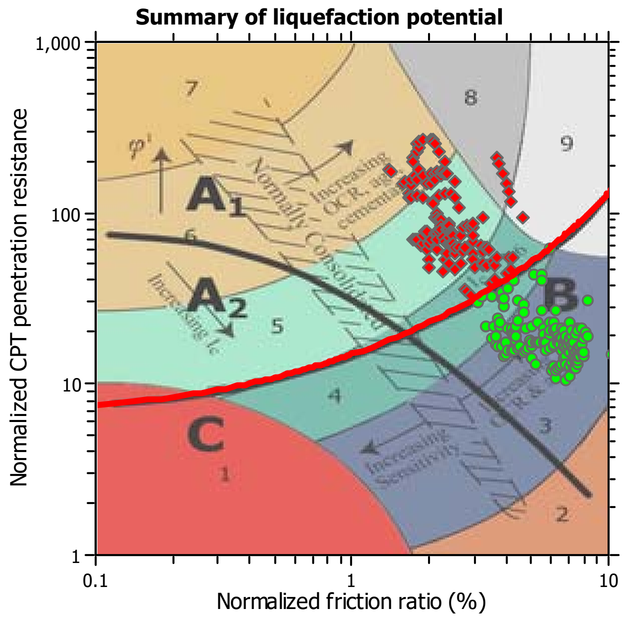
CPT file : CPT-02

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		

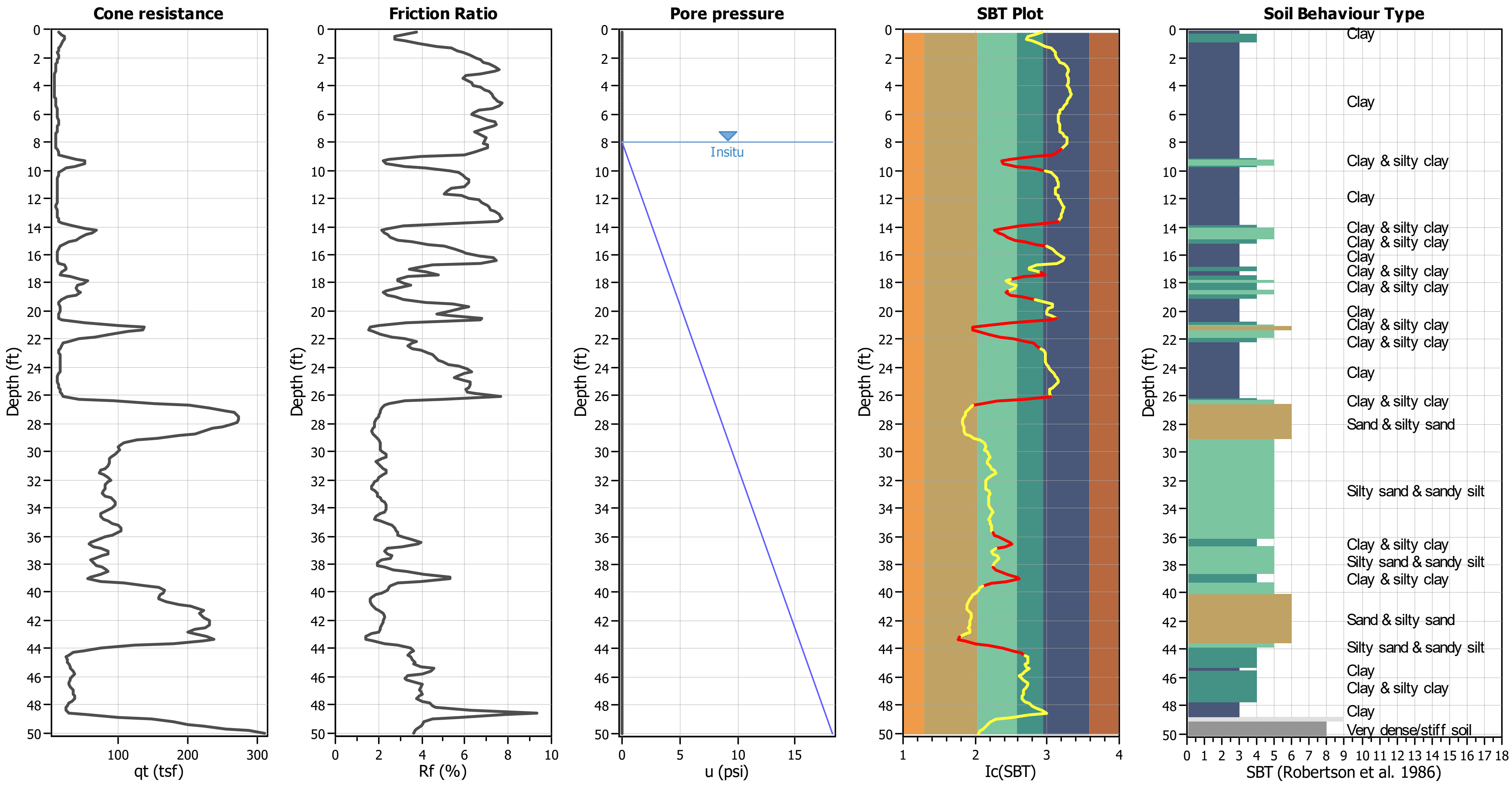






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



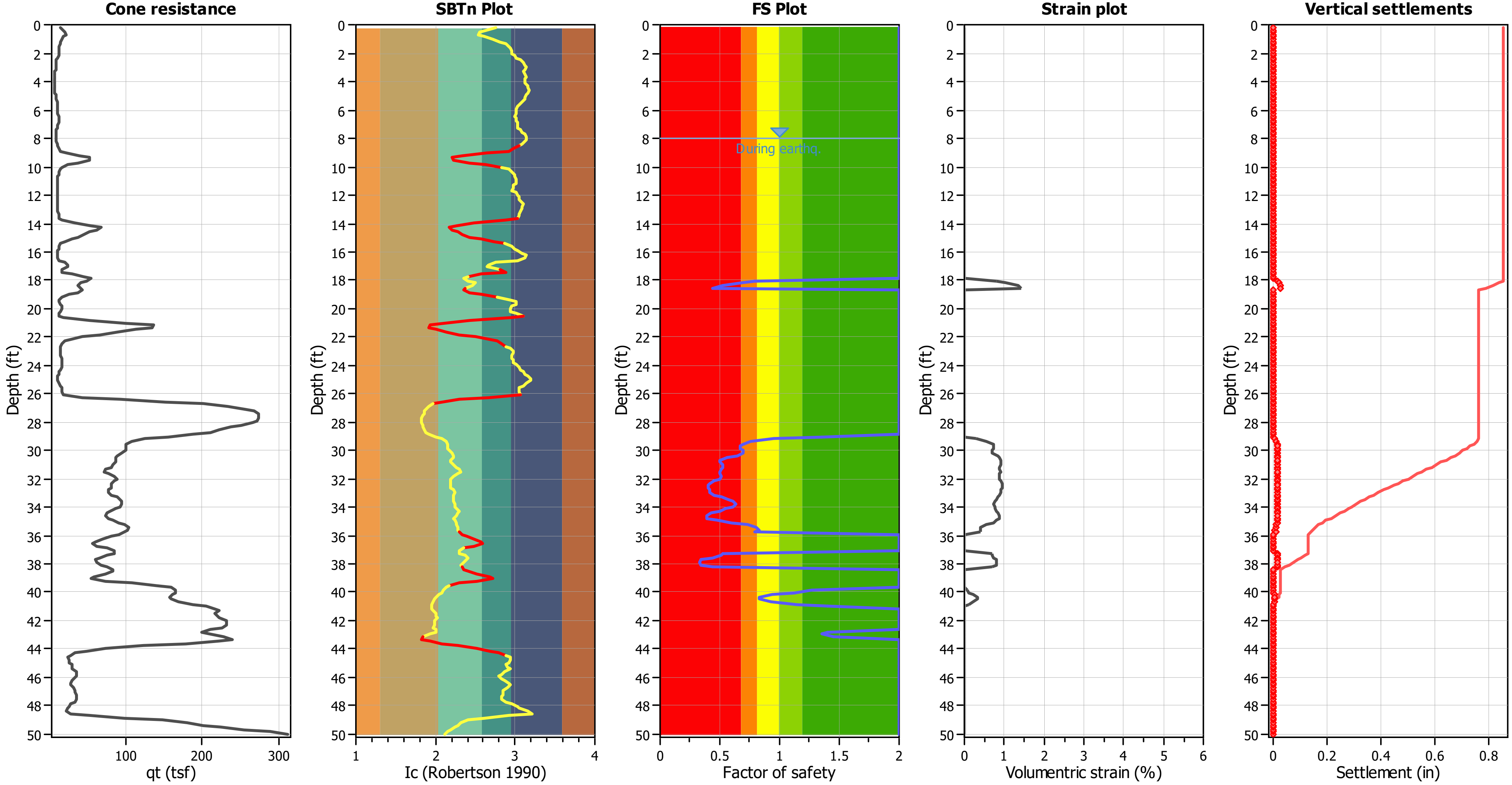
Input parameters and analysis data

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)
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

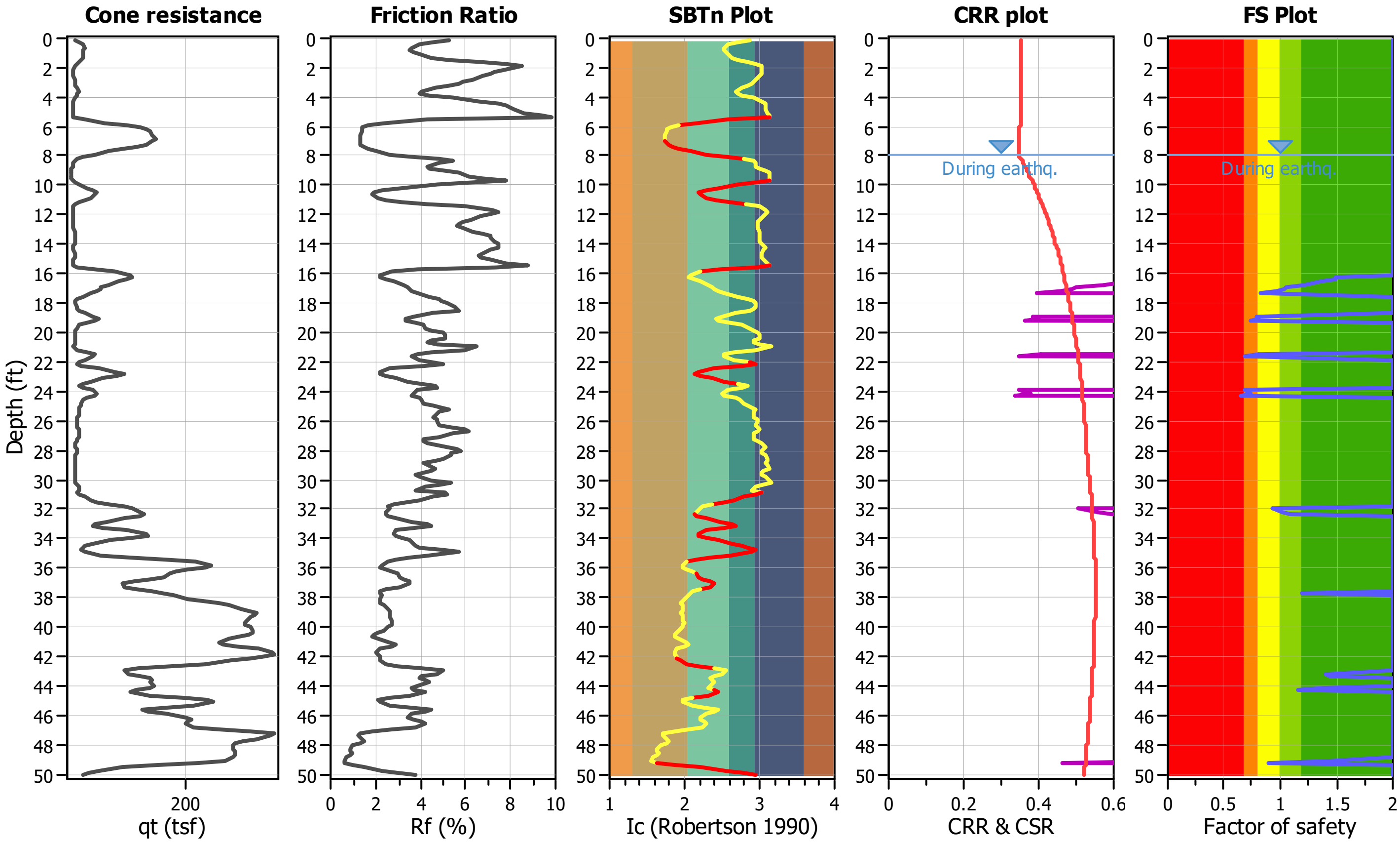
LIQUEFACTION ANALYSIS REPORT

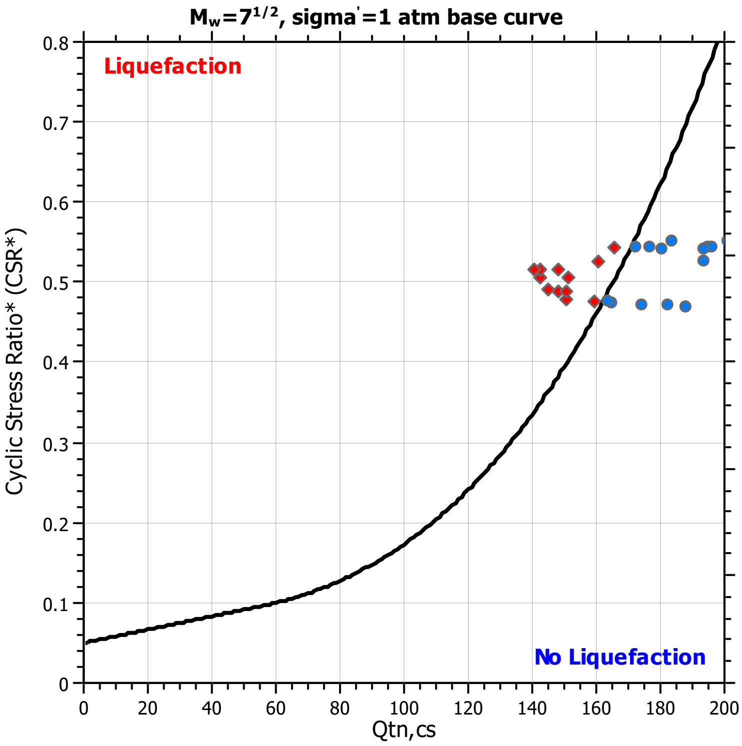
Project title : Drew Solar Project **Location : Calexico, CA**

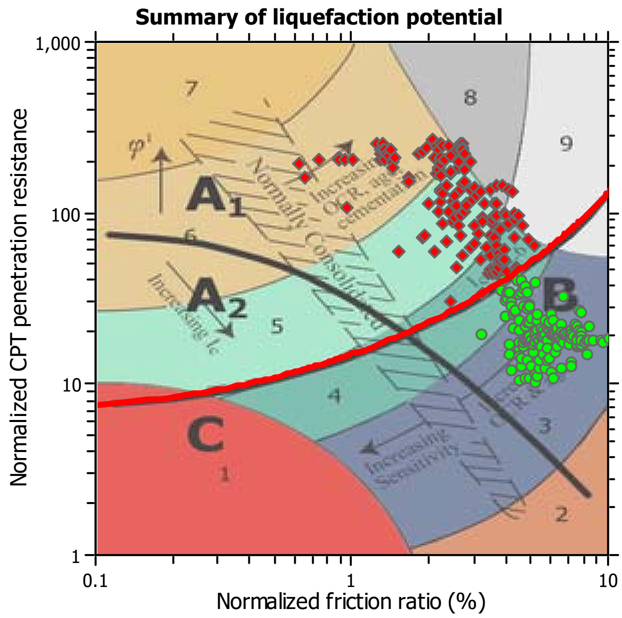
CPT file : CPT-03

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	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		

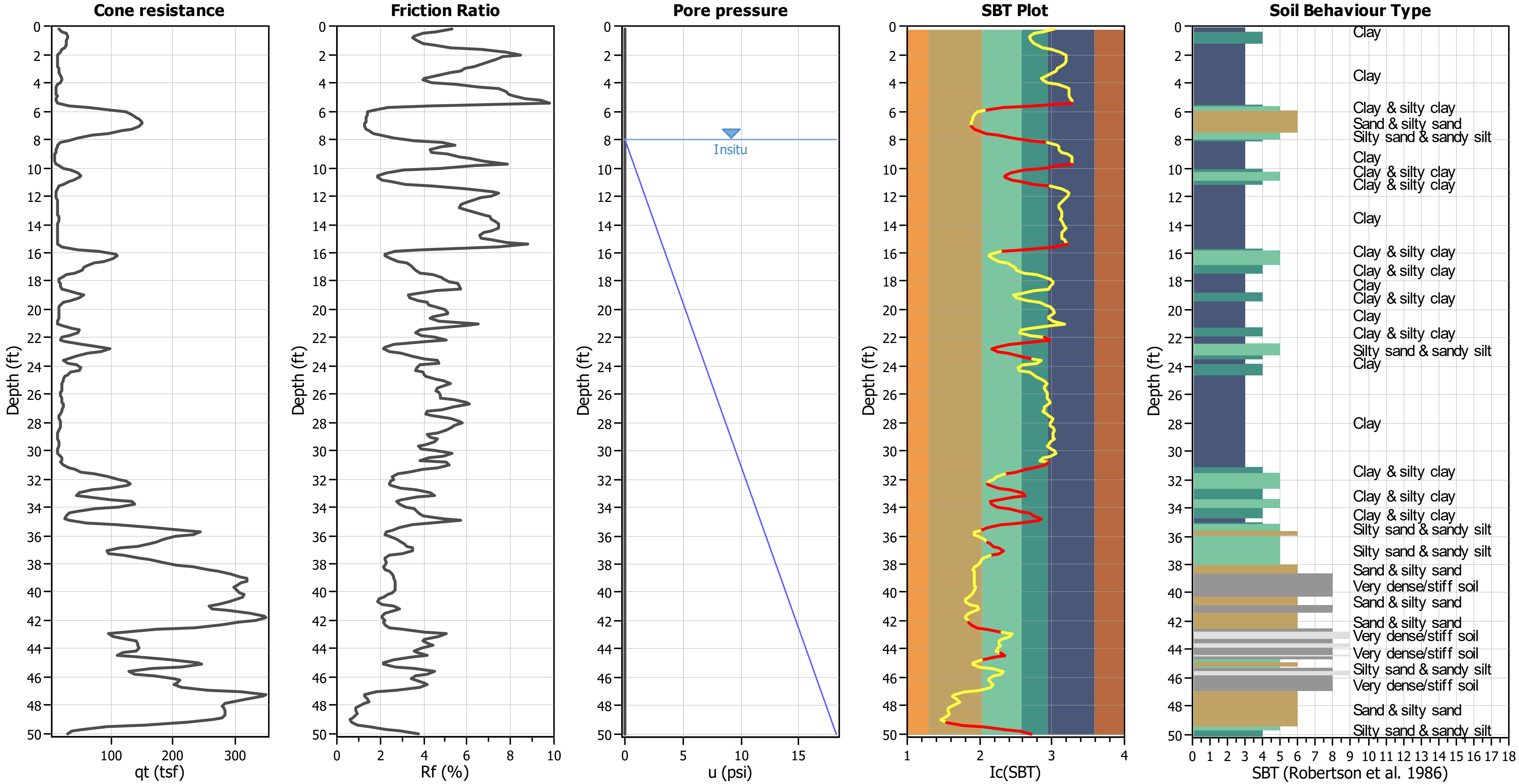






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



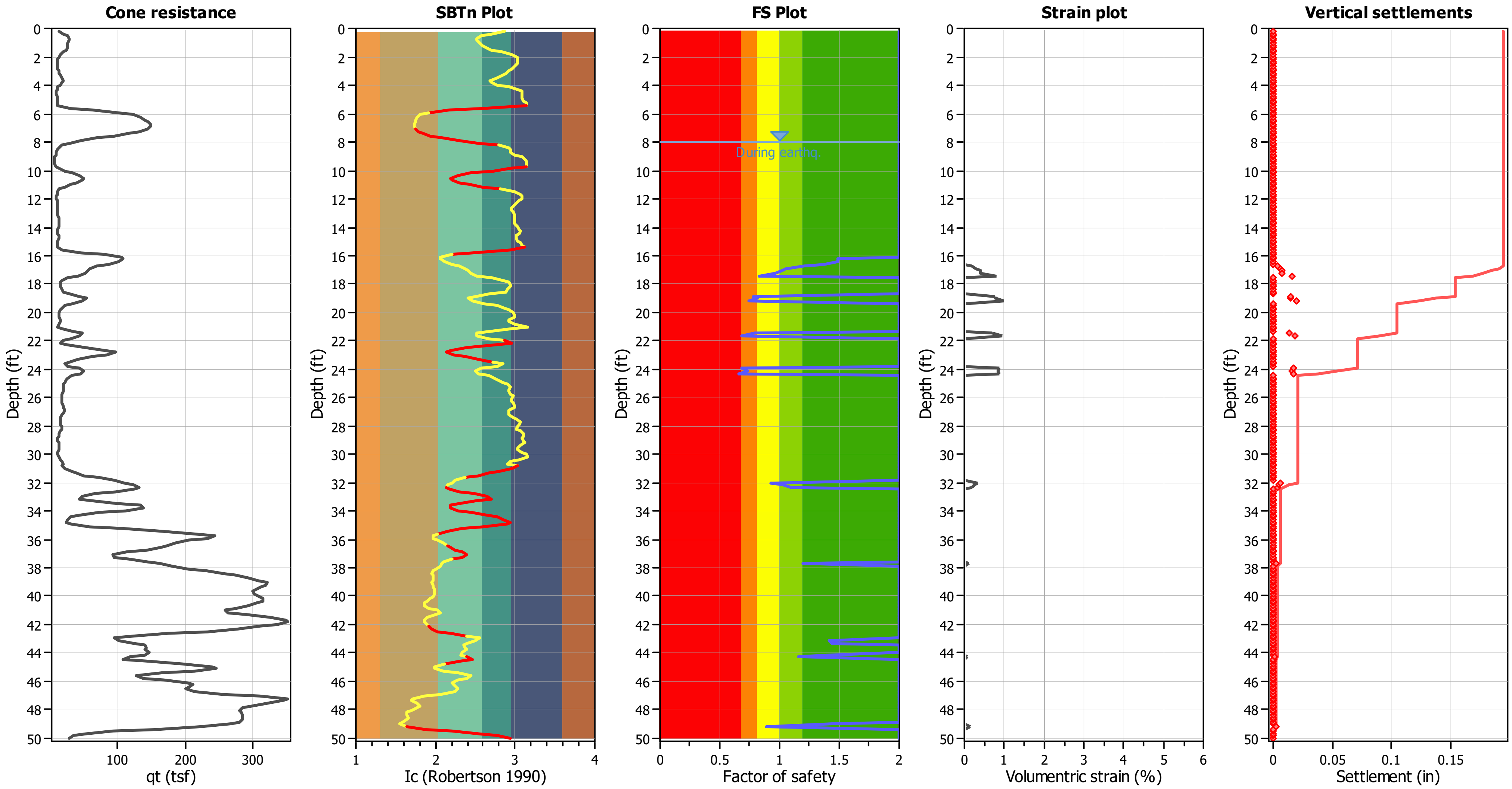
Input parameters and analysis data

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

Estimation of post-earthquake settlements



Abbreviations

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

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

Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)	Depth (ft)	$Q_{tn,cs}$	FS	e_v (%)	DF	Settlement (in)
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
Geo-Engineers and Geologists

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

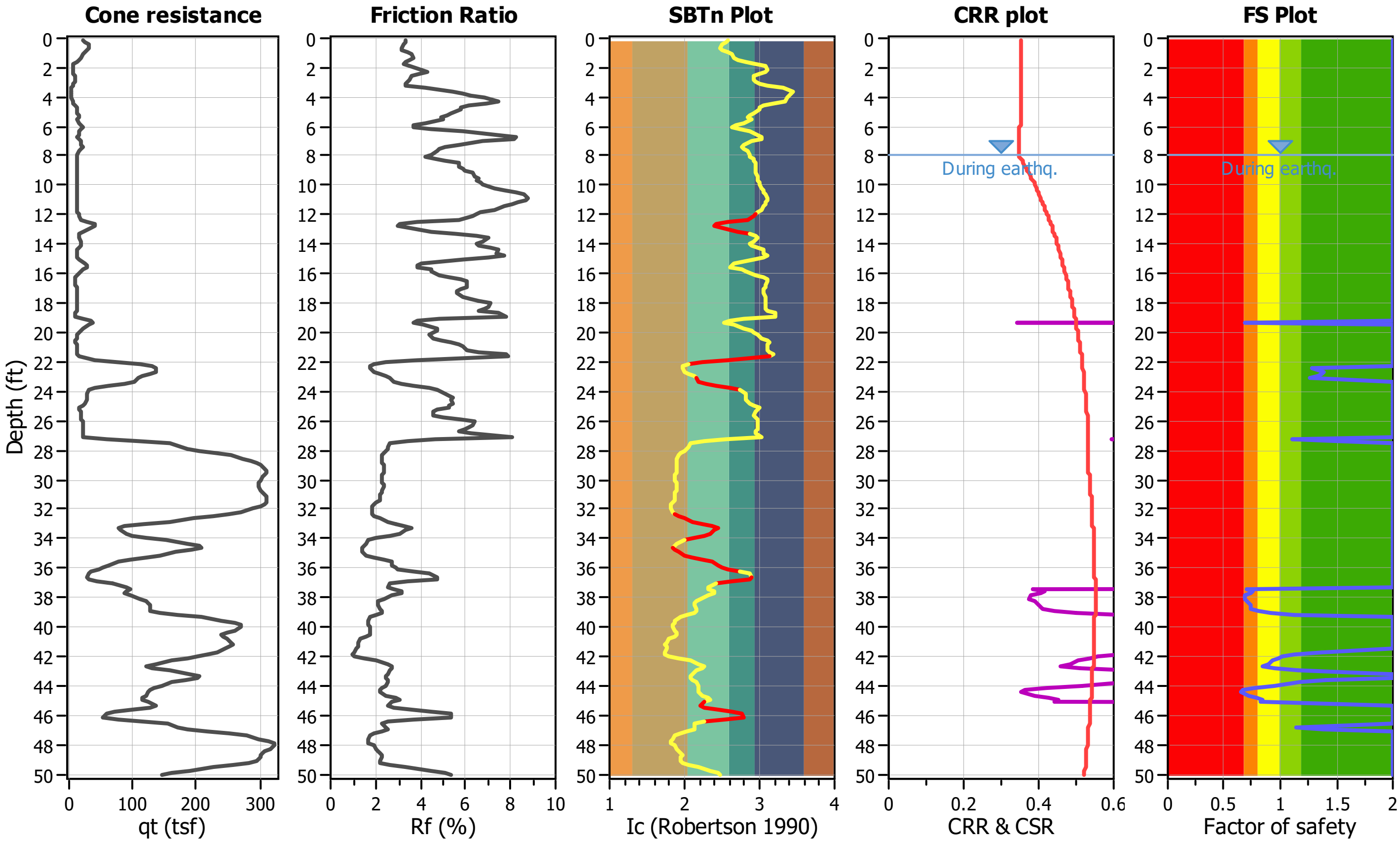
LIQUEFACTION ANALYSIS REPORT

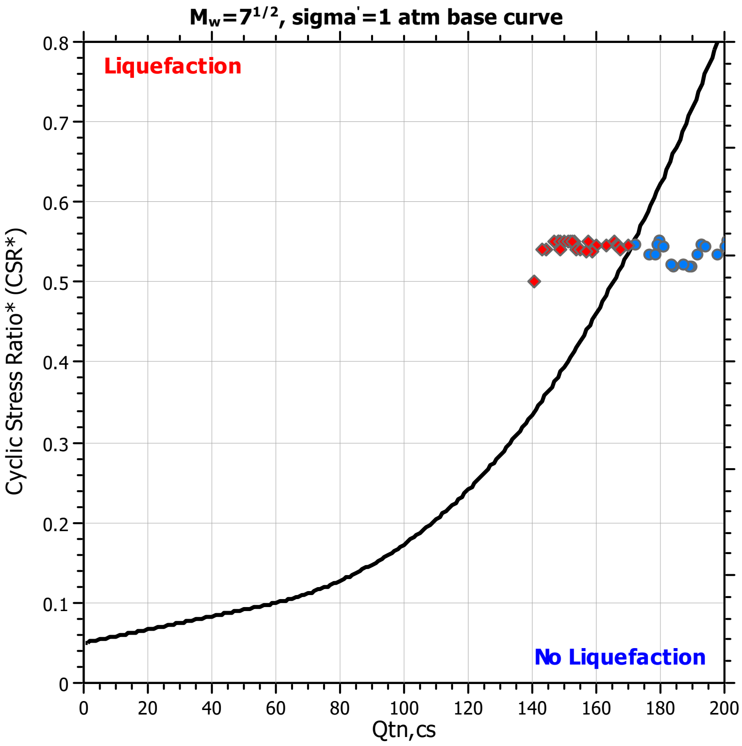
Project title : Drew Solar Project **Location : Calexico, CA**

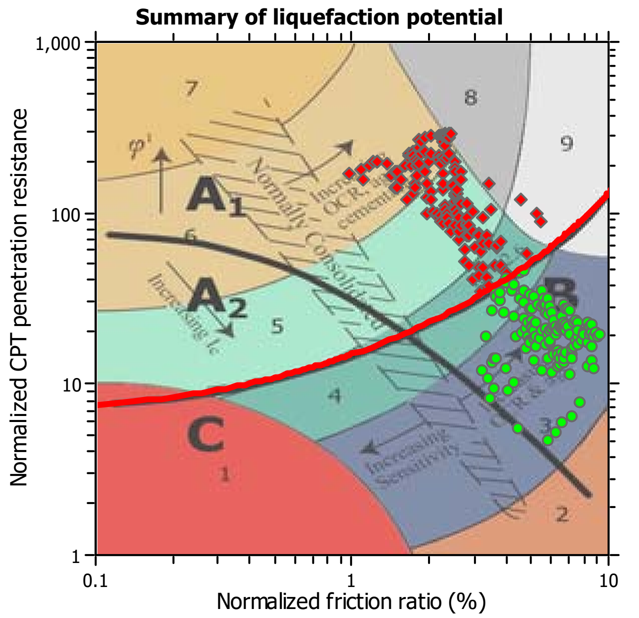
CPT file : CPT-06

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		
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

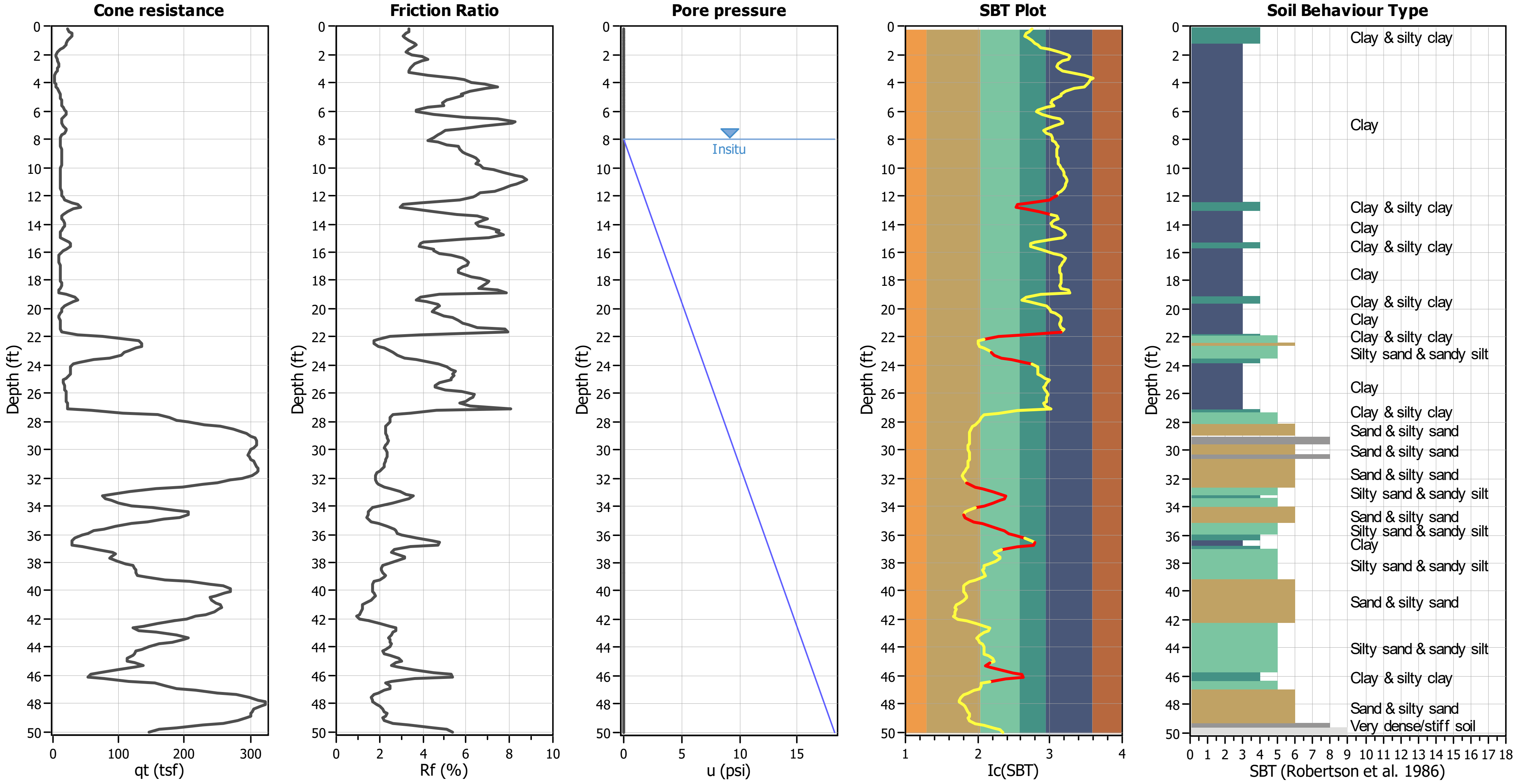






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



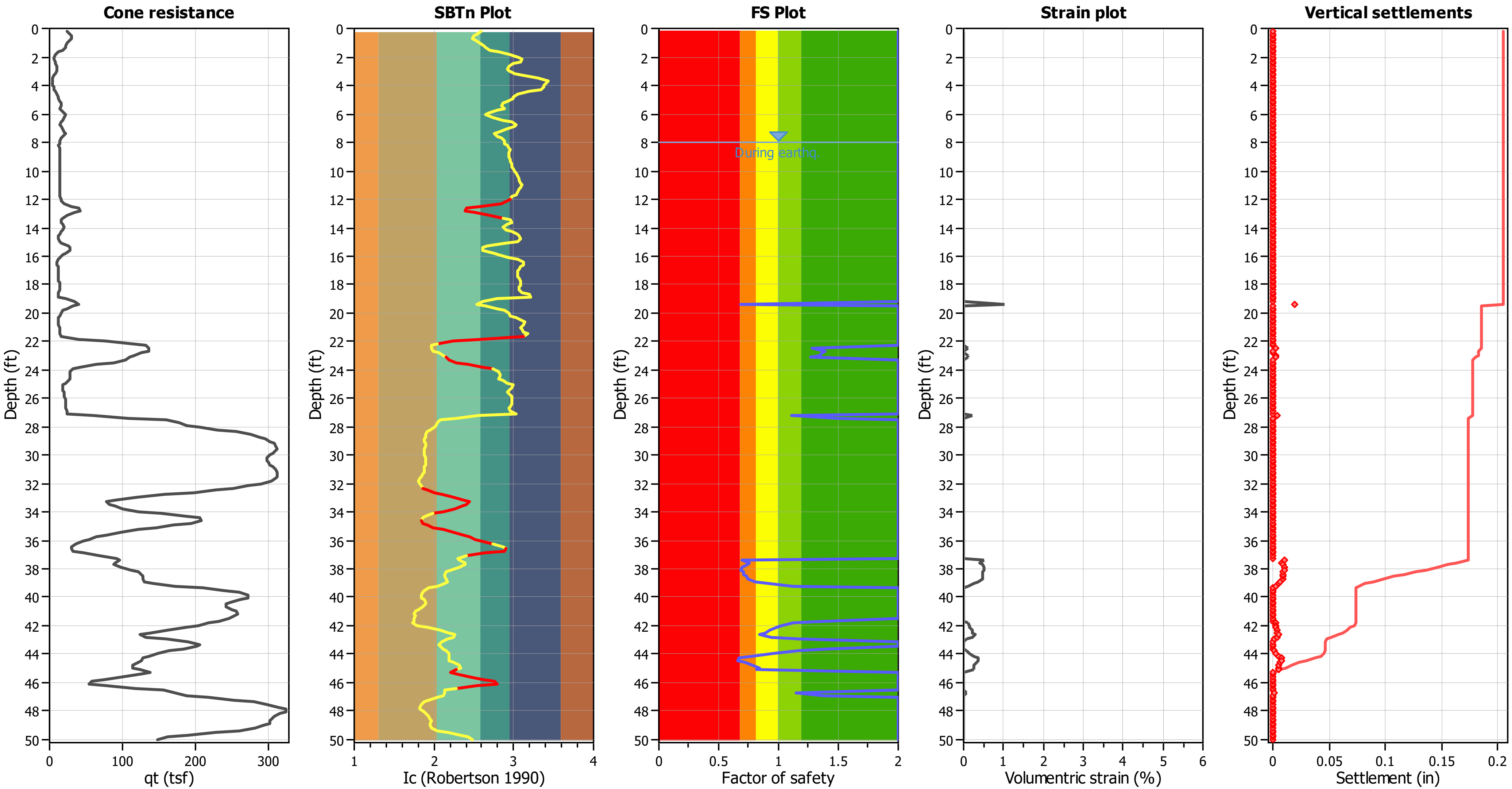
Input parameters and analysis data

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	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.

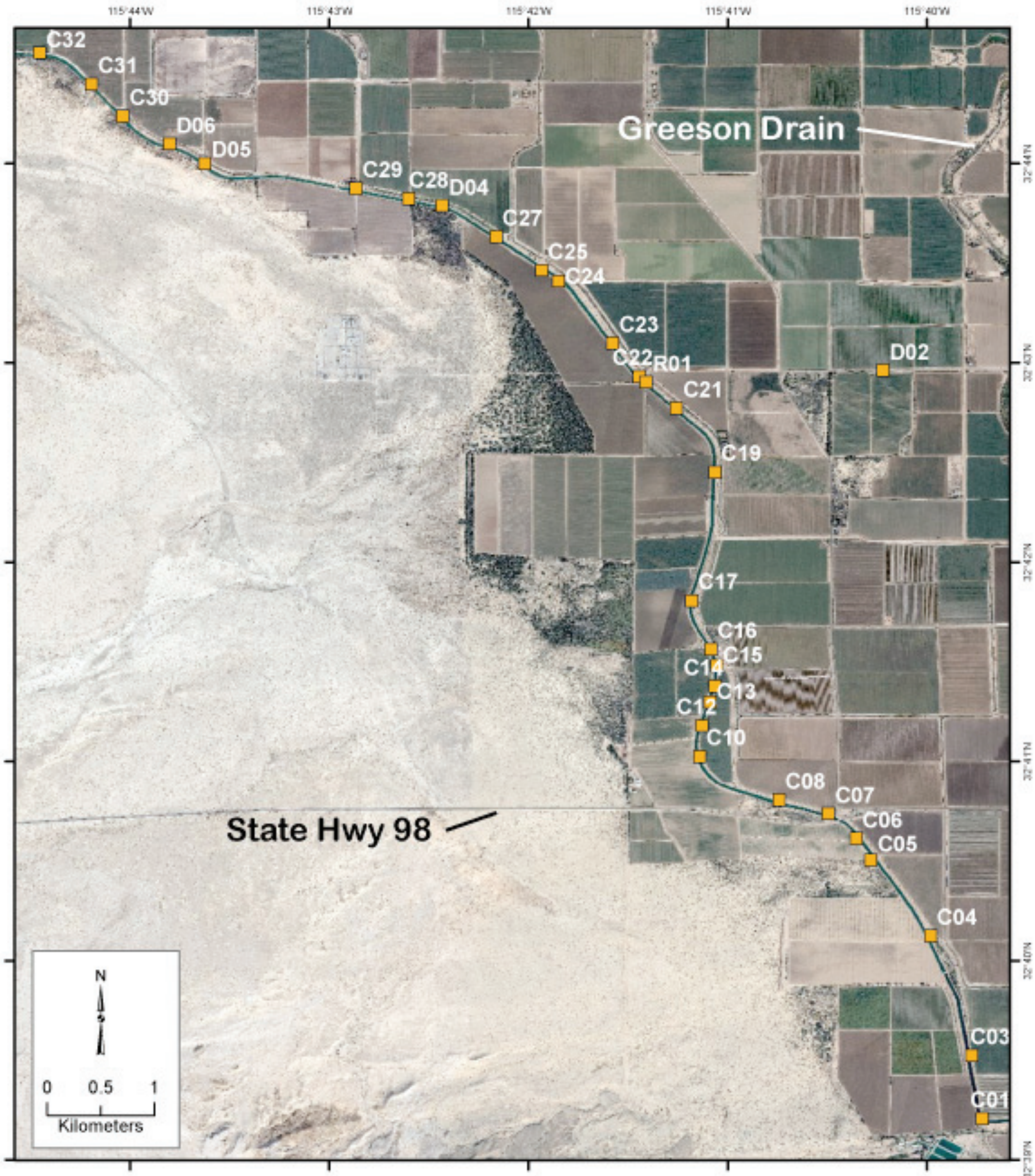


Figure 29. Location of ground failure sites along the southern extent of the Westside Main Canal, from Site C1 in the southeast corner to Site C32 in the northwest. In this reach, the Westside Main Canal skirts the western margin of irrigated land in the southwestern aspect of the Imperial Valley. The 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

RFYeager ENGINEERING

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

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

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

		Soil Resistivity (Ohm-cm)					
Test Site[1]		**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.

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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

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

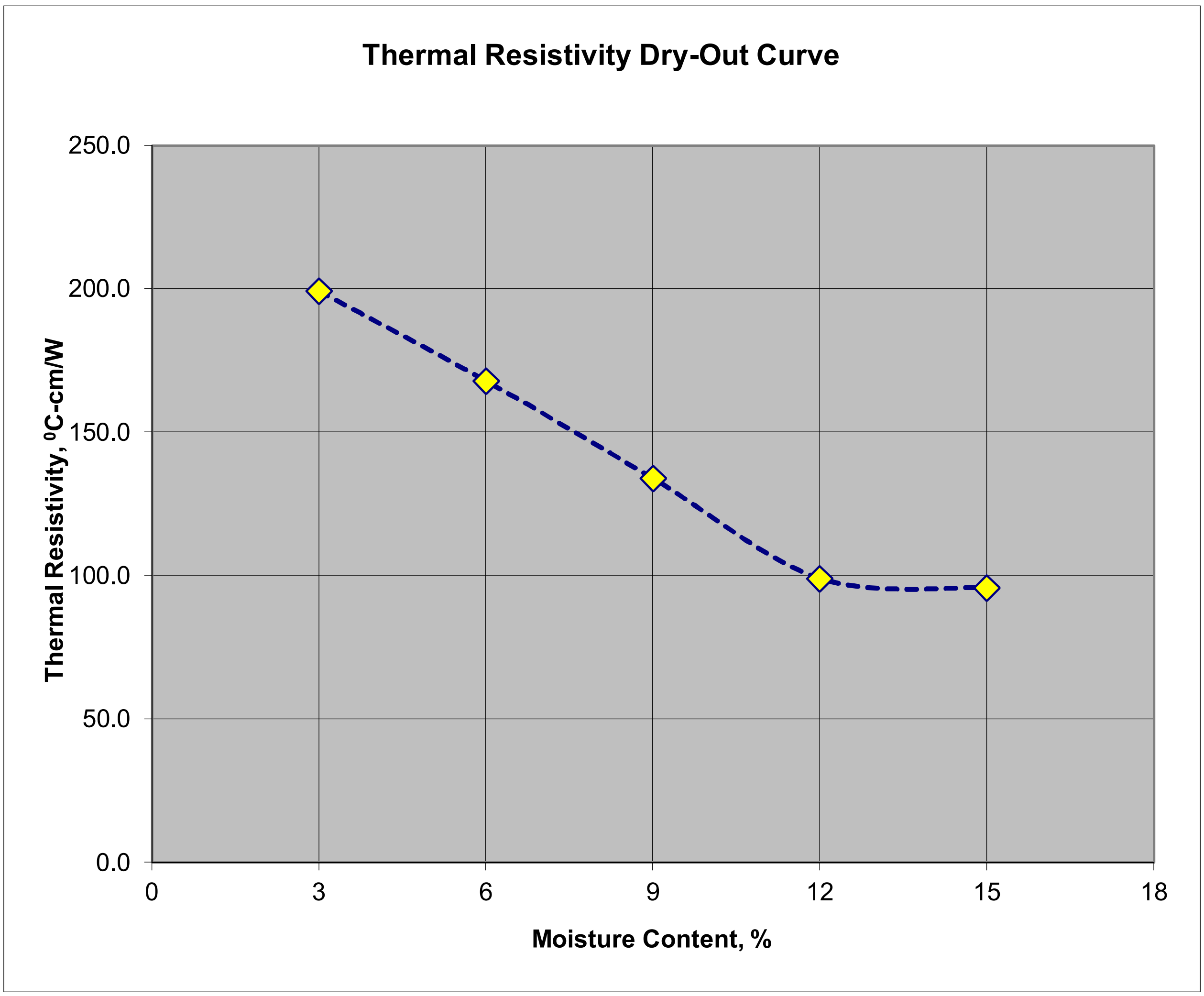
FIGURE 1 – DREW SOLAR SOIL TEST SITES

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

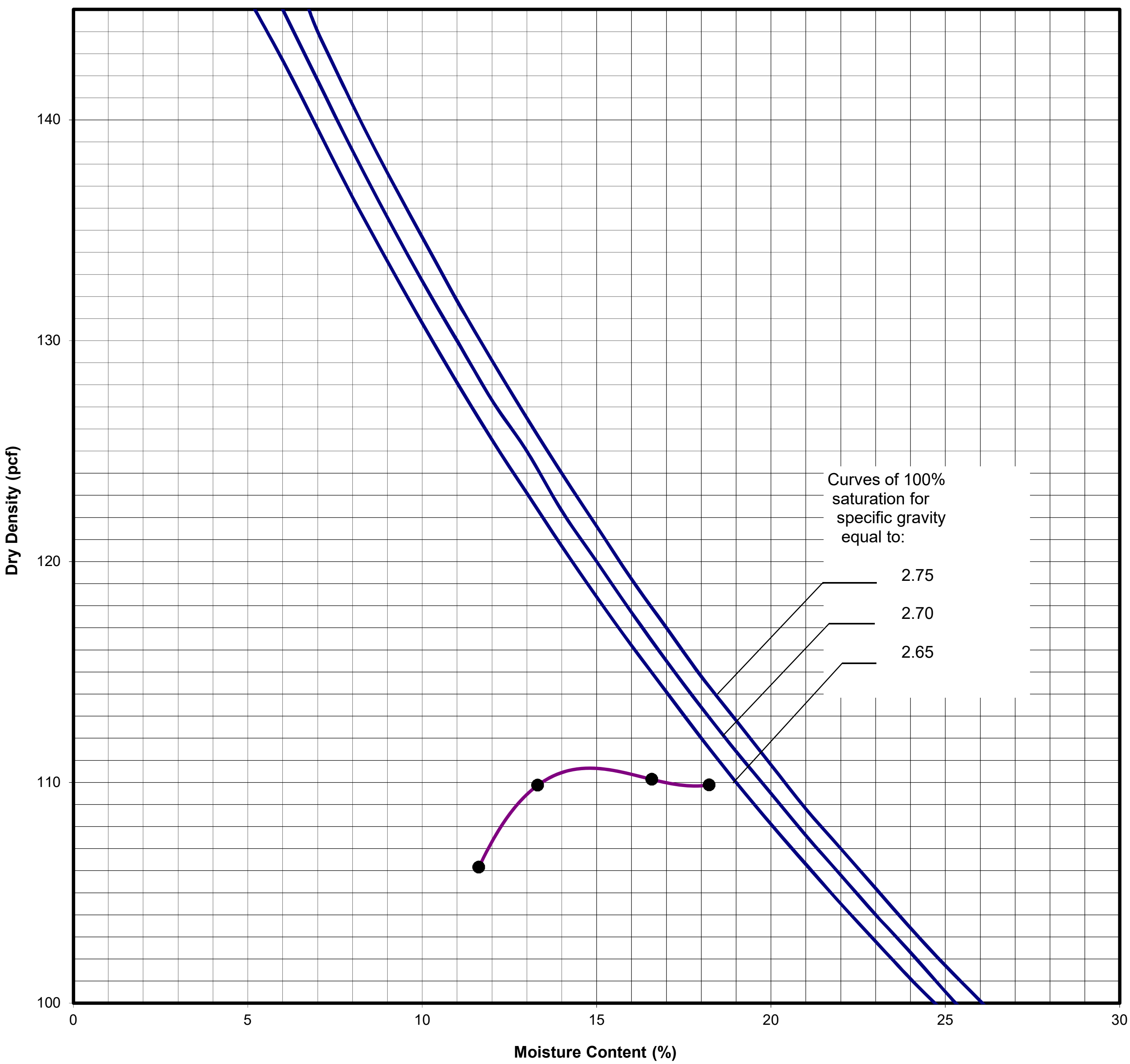


Date: 9.4.2018

RFYeager Engineering

Client:	Drew Solar LLC
Project:	Drew Solar
Project No.:	LE18150
Date:	8/20/2018
Lab. No.:	EC18-625

Soil Description:	Clay (CL)
Sample Location:	TR-1 @ 0-4'
Test Method:	ASTM D-1557-A
Maximum Dry Density (pcf):	**110.6**
Optimum Moisture Content (%):	**14.8**



LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

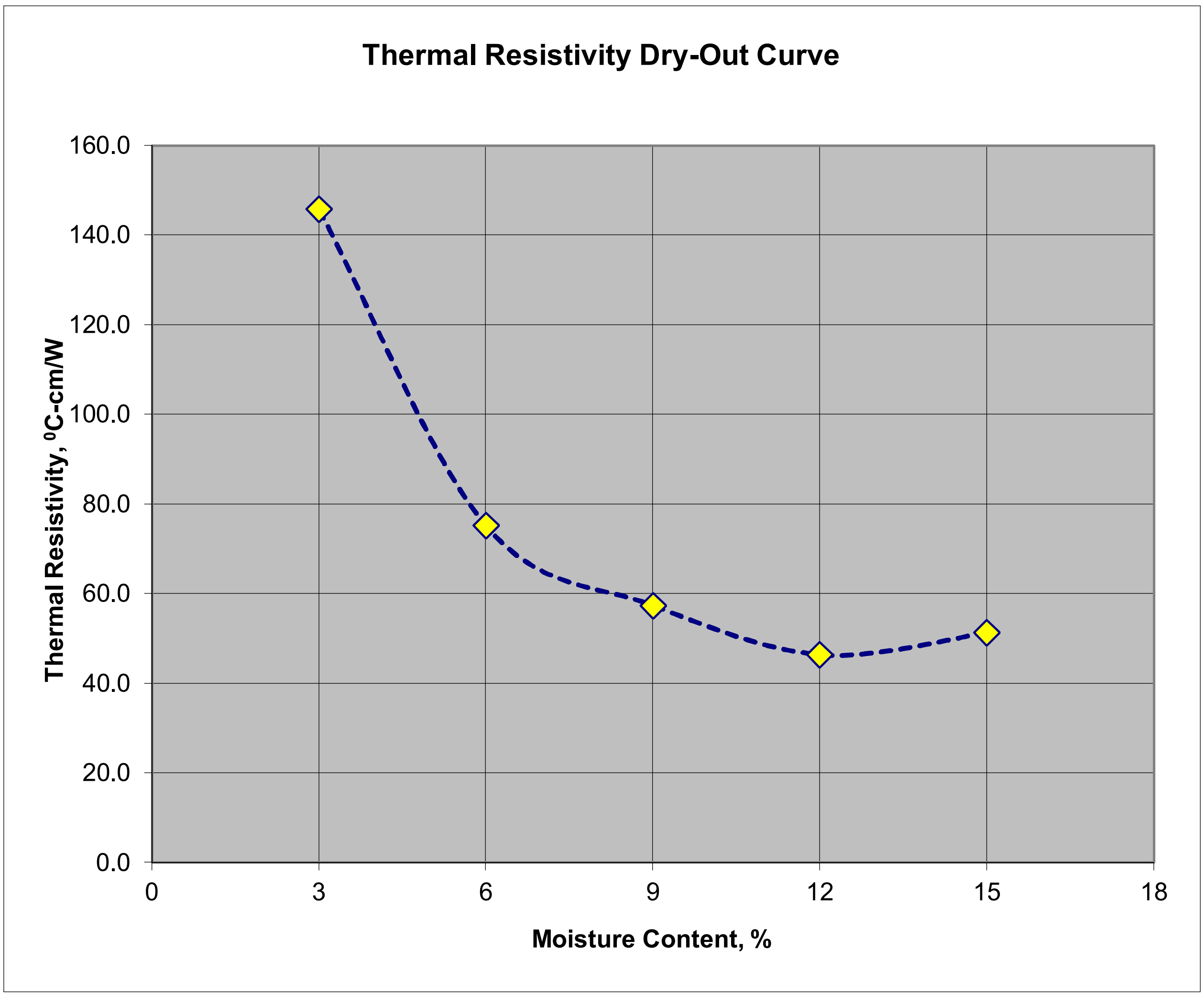
Moisture Density Relationship

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

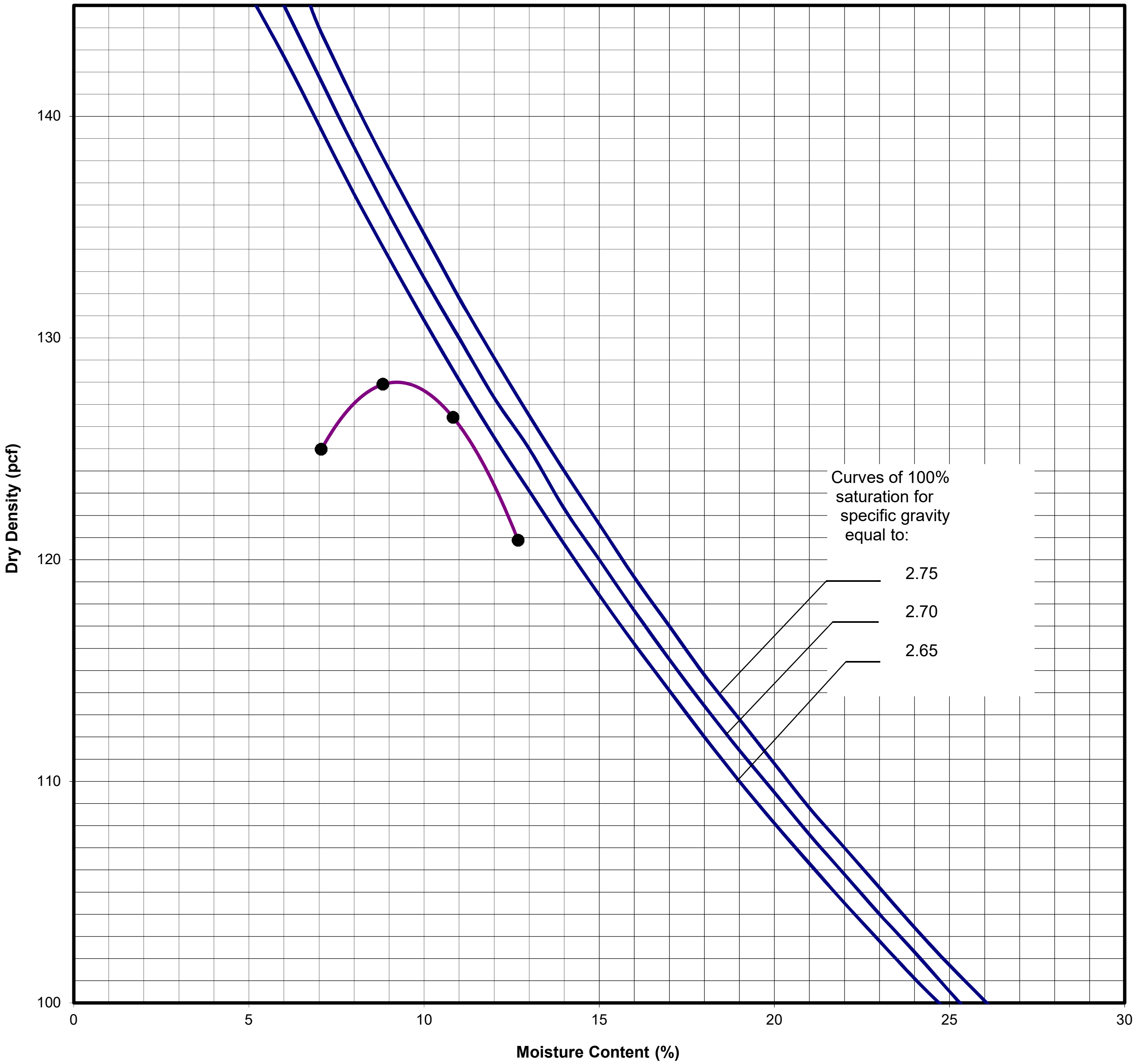
Soil Description: Silt (ML)

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

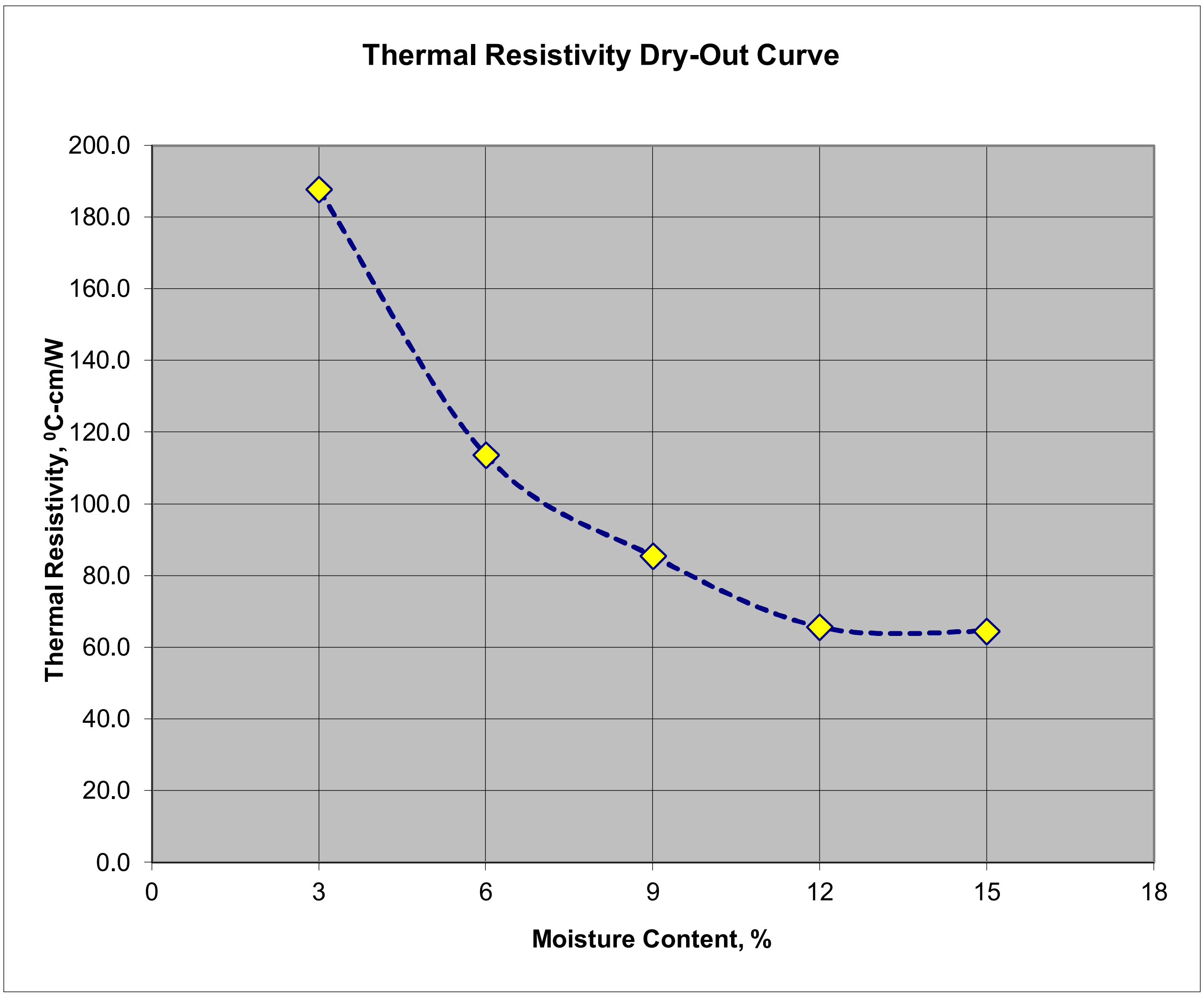
Moisture Density Relationship

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

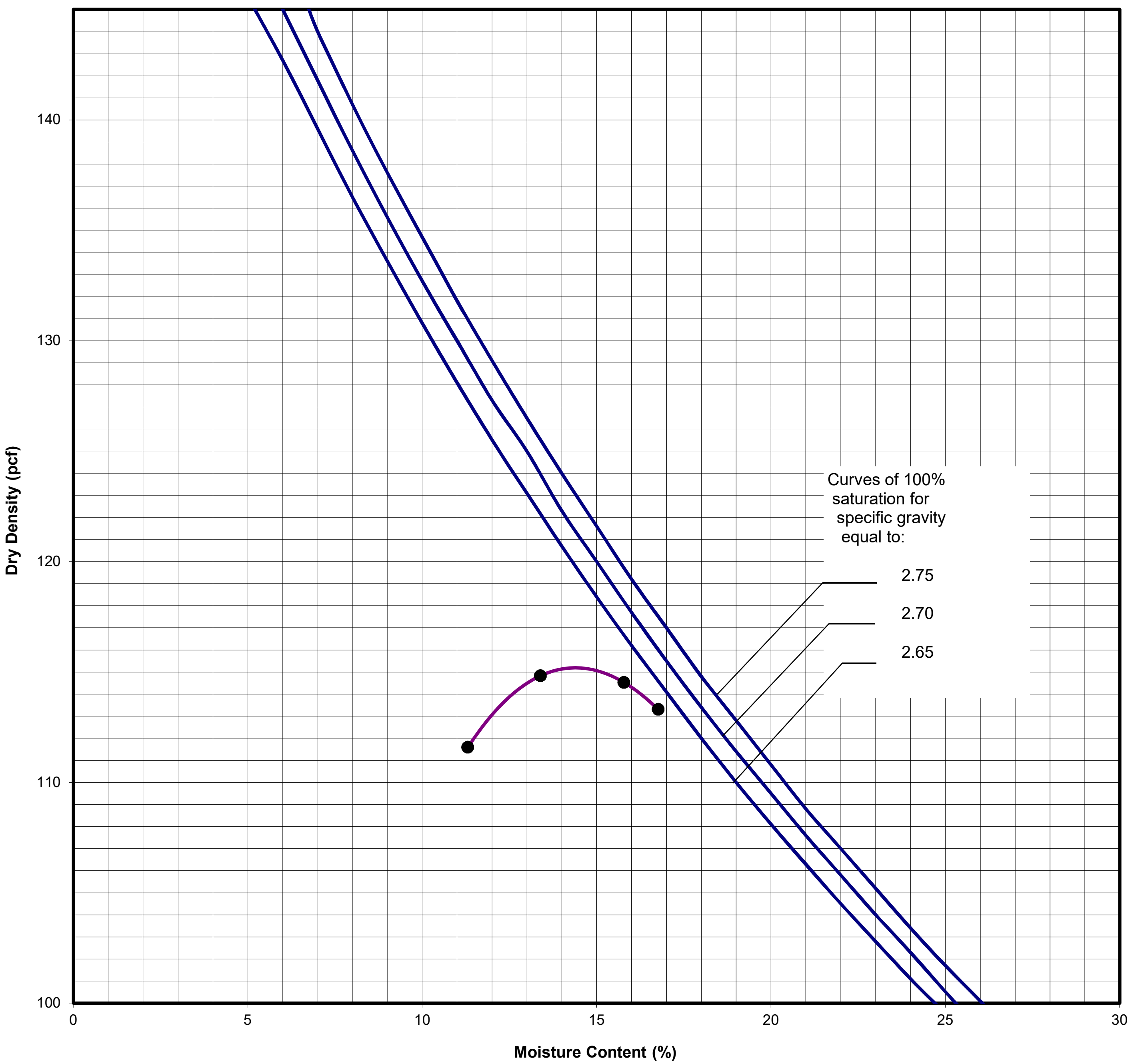


Date: 9.4.2018

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

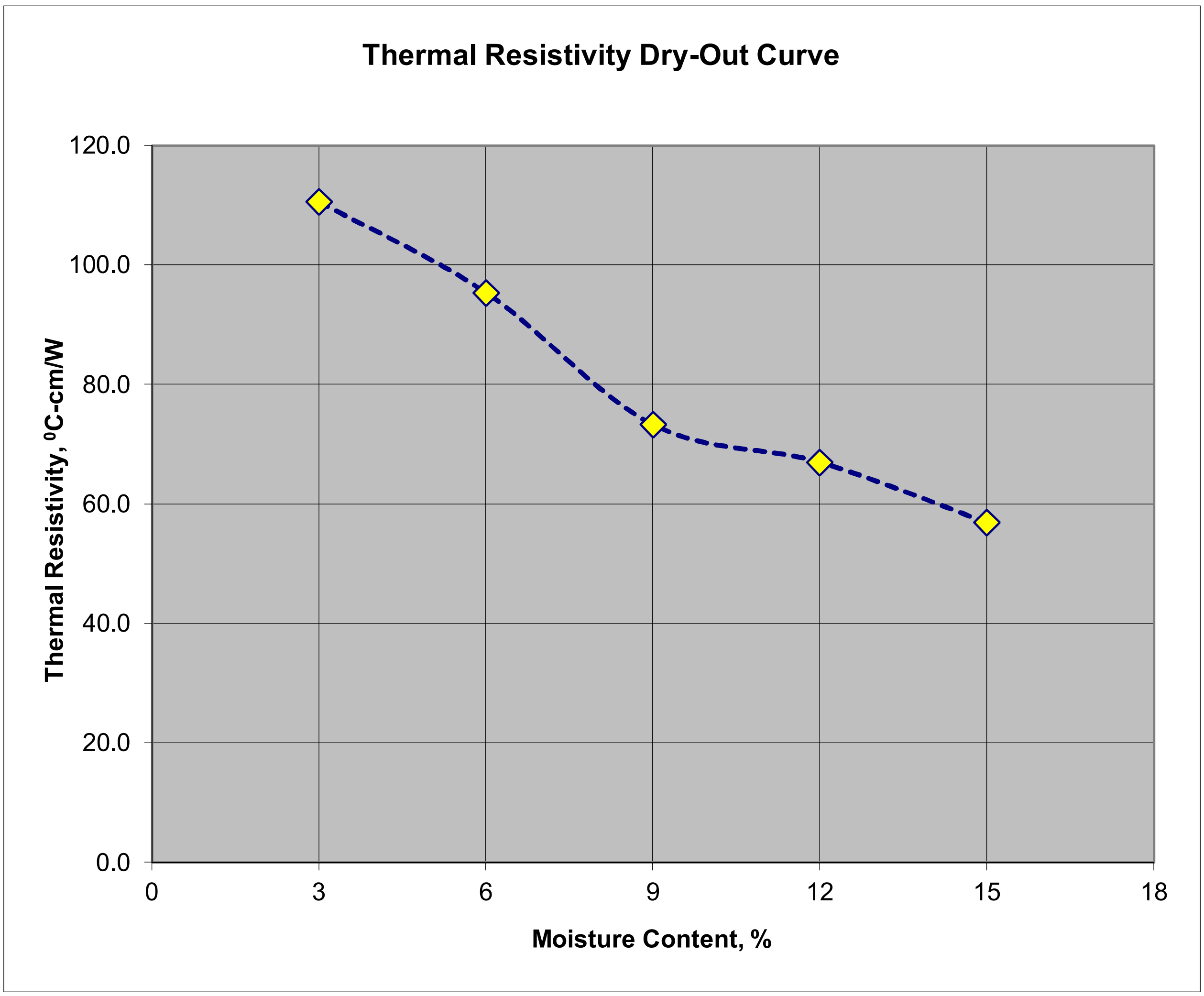
Moisture Density Relationship

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

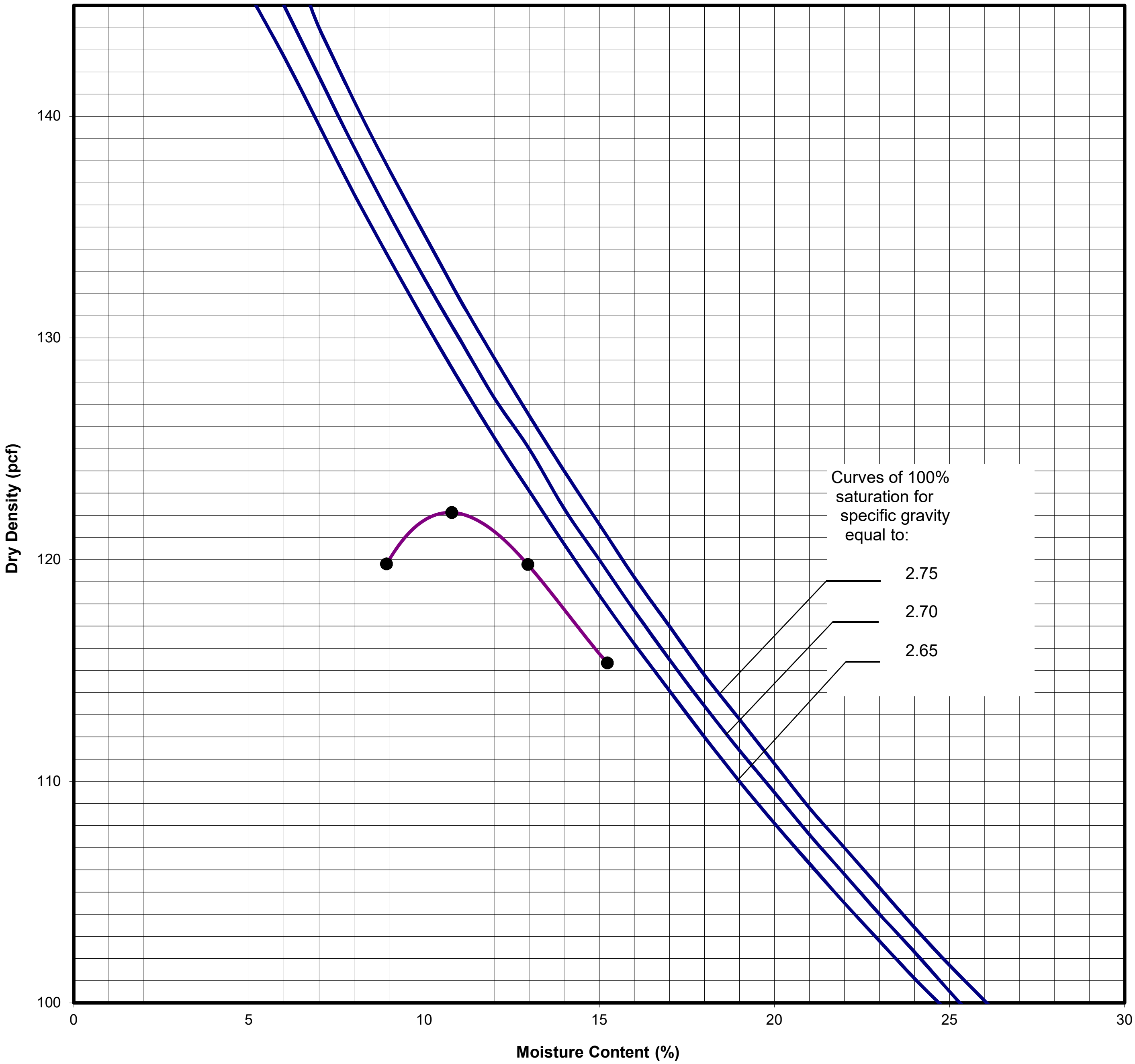


Date: 9.4.2018

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

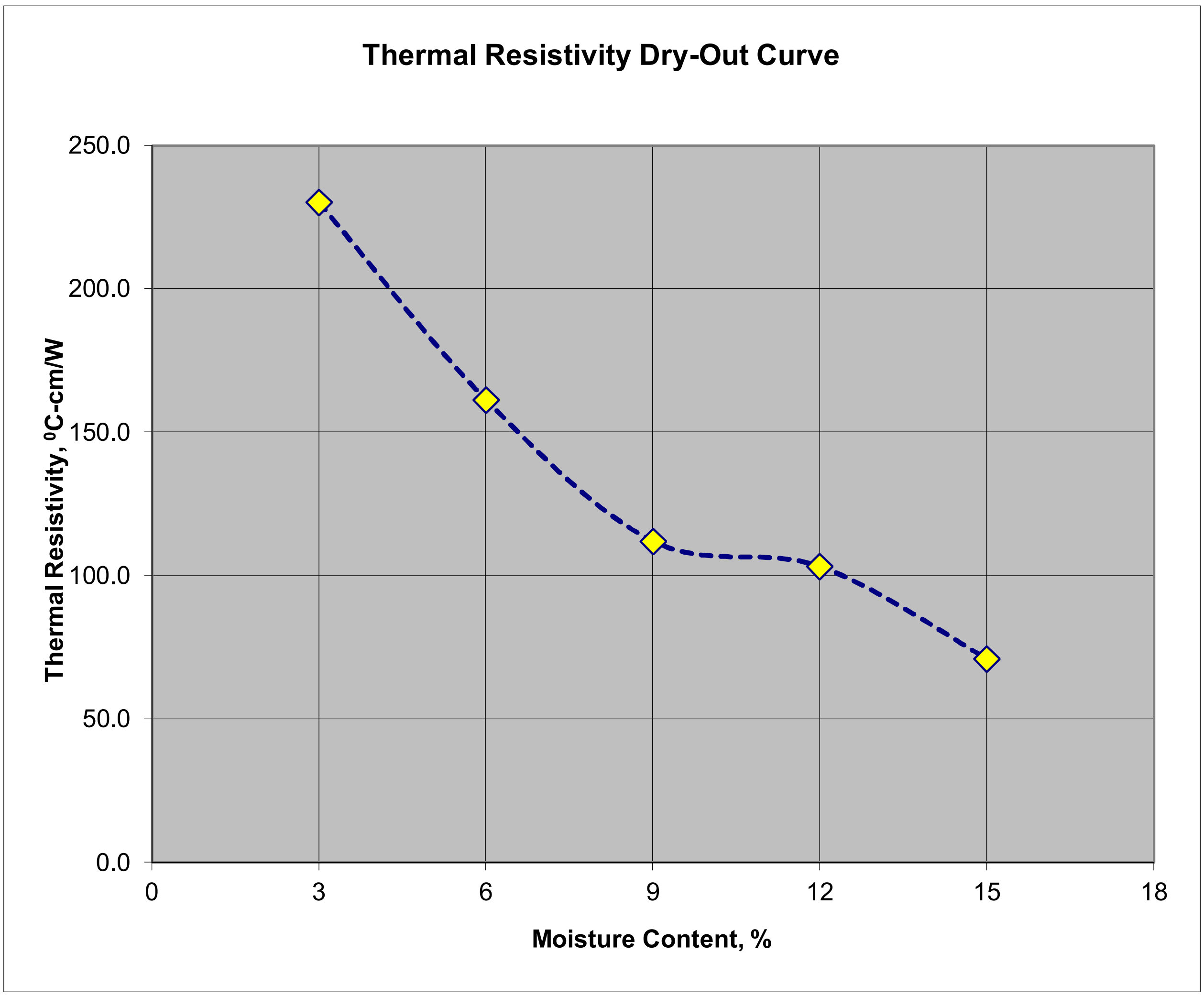
Moisture Density Relationship

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

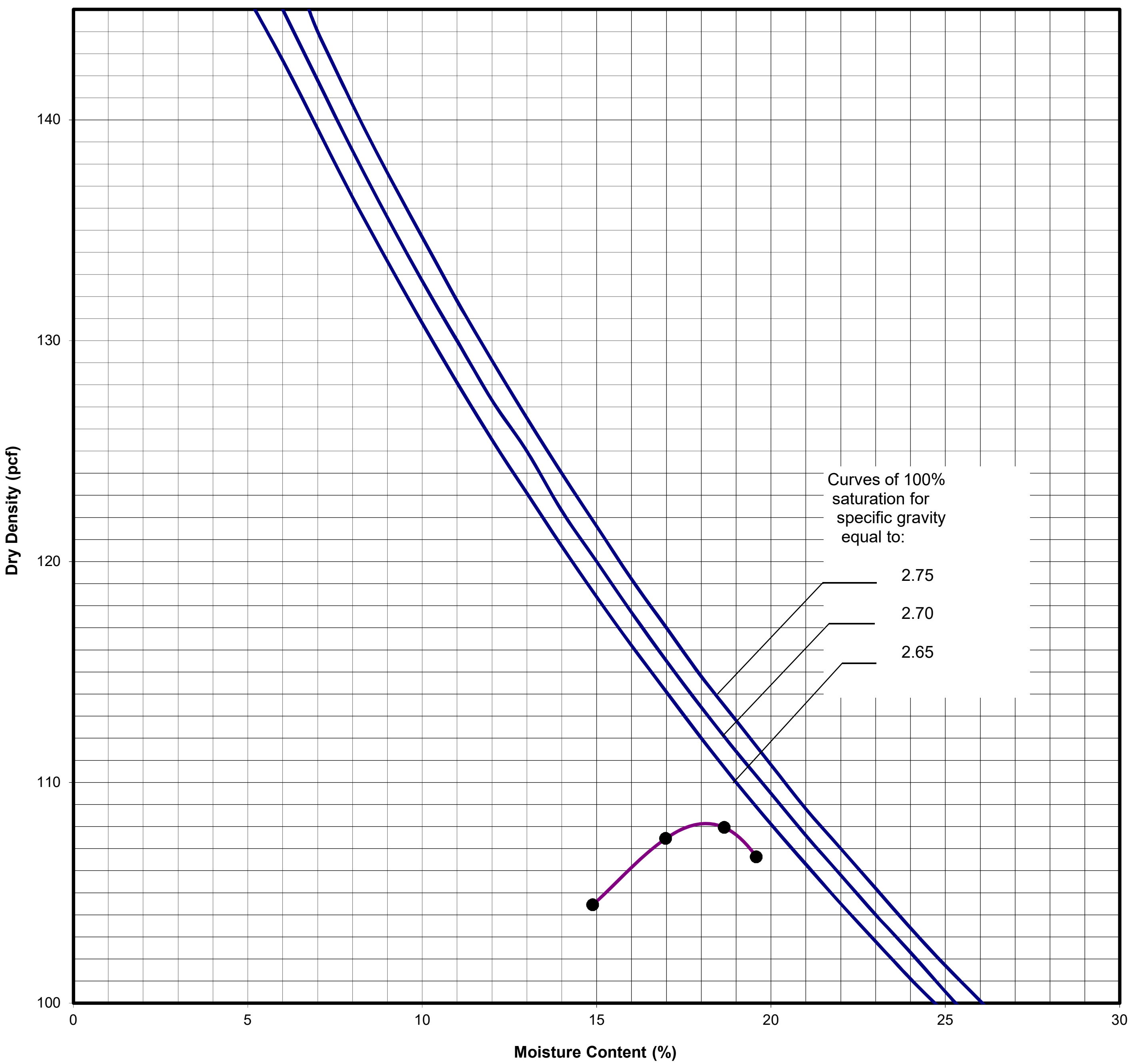


Date: 9.4.2018

RFYeager Engineering

Client: Drew Solar LLC
Project: Drew Solar
Project No.: LE18150
Date: 8/20/2018
Lab. No.: EC18-629

Soil Description: Fat Clay (CH)
Sample Location: TR-5 @ 0-4'
Test Method: ASTM D-1557-A
Maximum Dry Density (pcf): **108.1**
Optimum Moisture Content (%): **18.2**



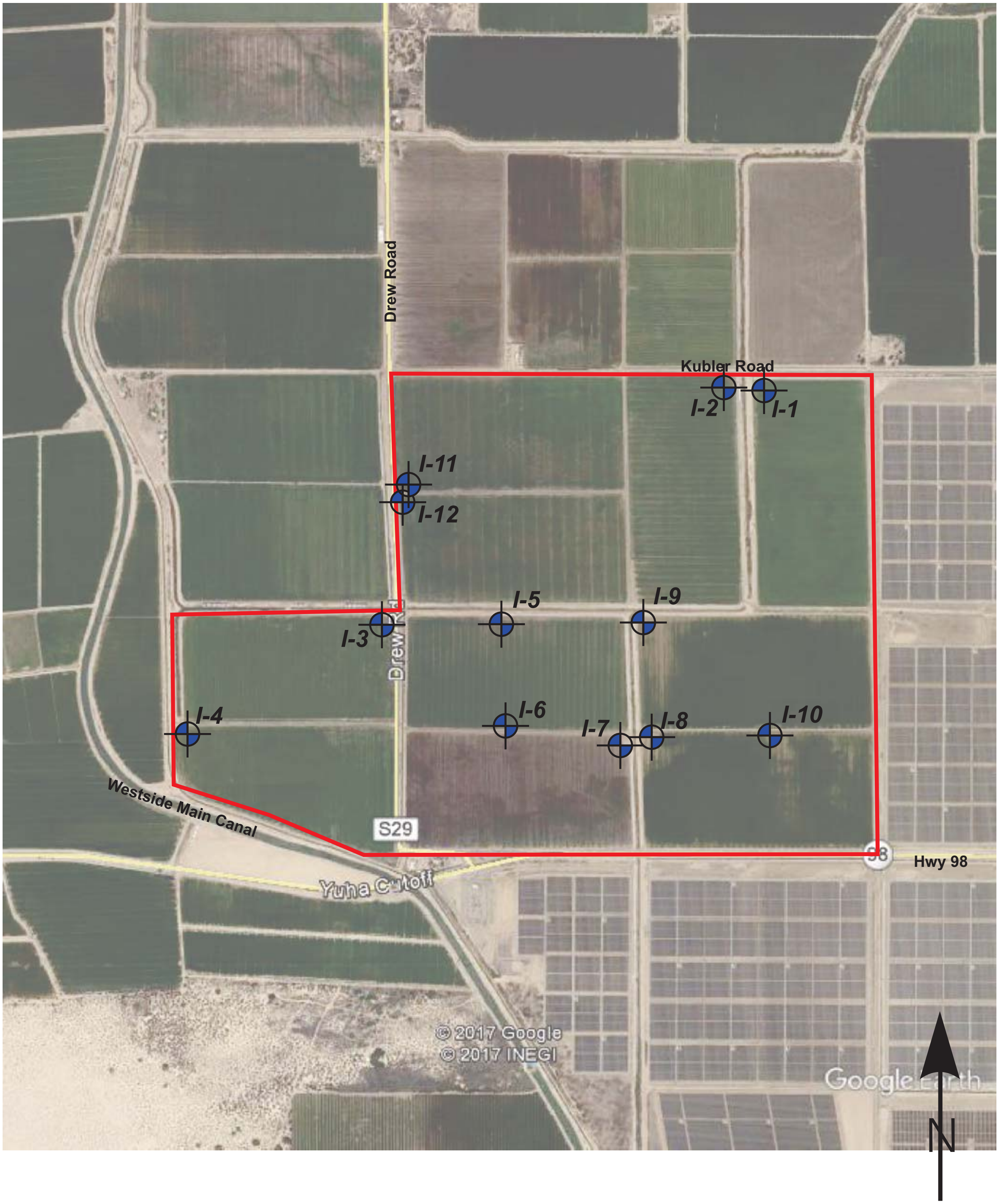
LANDMARK
Geo-Engineers and Geologists

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
Job No: LE18150
Test Hole No: I-1
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 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**

LANDMARK Geo-Engineers and Geologists

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 = $\frac{\textbf{1.5 x 60 x 3}}{\textbf{30 x (3 + 2 x 30.25)}}$ **=** **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 = $\frac{\mathbf{0.375 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 12.8125\ )}}$ **=** **0.08 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate 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 = $\frac{0.75 \times 60 \times 3}{30 \times (3 + 2 \times 30.625)}$ = 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
Job No: LE18150
Test Hole No: I-3
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 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

LANDMARK
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 = $\frac{\textbf{2 x 60 x 3}}{\textbf{10 x (3 + 2 x 30)}}$ **=** **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 = $\frac{\textbf{2.5 x 60 x 3}}{\textbf{10 x (3 + 2 x 11.75)}}$ **= 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 = $\frac{6 \times 60 \times 3}{10 \times (3 + 2 \times 28\ )}$ = 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
G-10

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 = $\frac{\mathbf{0.75 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 30.625\ )}}$ **=** **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 = $\frac{\mathbf{0.5 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 12.75)}}$ **=** **0.11 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate
G-12

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 = $\frac{\mathbf{0.75 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 30.625\ )}}$ **=** **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 = $\frac{\mathbf{0.5 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 12.75)}}$ **= 0.11 in/hr**

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-14

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 = $\frac{0.875 \times 60 \times 3}{30 \times (3 + 2 \times 30.5625\ )}$ = 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
Test Hole No: I-8
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: 09/11/18
Soil Classification: Silty Clay
Date: 09/11/18 Presoak: Yes
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 = $\frac{\textbf{0.5 x 60 x 3}}{\textbf{30 x (3 + 2 x 30.75)}}$ **=** **0.05 in/hr**

LANDMARK Geo-Engineers and Geologists

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 = $\frac{\mathbf{0.75 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 12.625\ )}}$ **= 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 = $\frac{\textbf{2 x 60 x 3}}{\textbf{30 x (3 + 2 x 30)}}$ **=** **0.19 in/hr**

LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-19

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

LANDMARK Geo-Engineers and Geologists

Project No.: LE18150

Percolation Rate Conversion

Plate G-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
G-21

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 = $\frac{\textbf{5 x 60 x 3}}{\textbf{10 x (3 + 2 x 28.5)}}$ = 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 = $\frac{\mathbf{0.75 \times 60 \times 3}}{\mathbf{30 \times (3 + 2 \times 12.625\ )}}$ **= 0.16 in/hr**

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-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 = $\frac{\mathbf{3 \times 60 \times 3}}{\mathbf{10 \times (3 + 2 \times 29.5\ )}}$ **=** **0.87 in/hr**

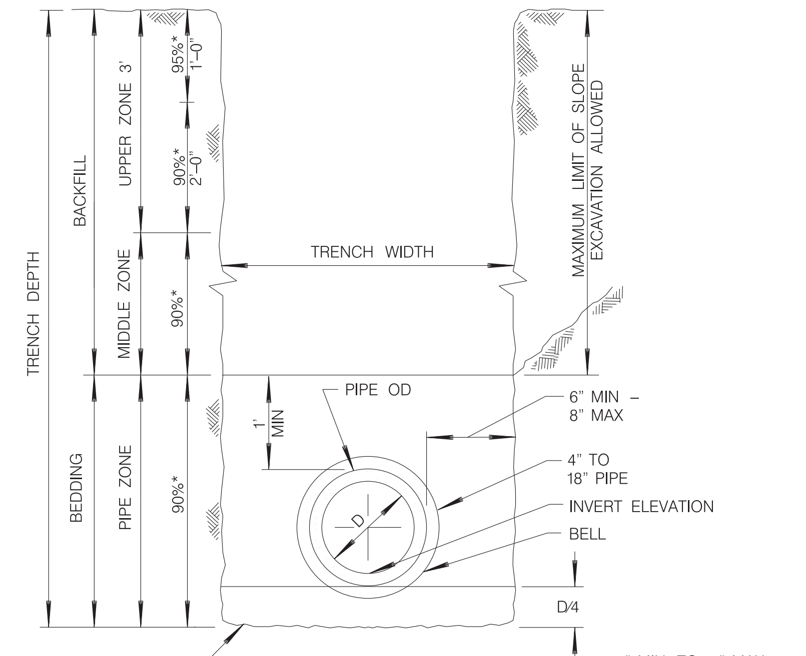
LANDMARK
Geo-Engineers and Geologists

Project No.: LE18150

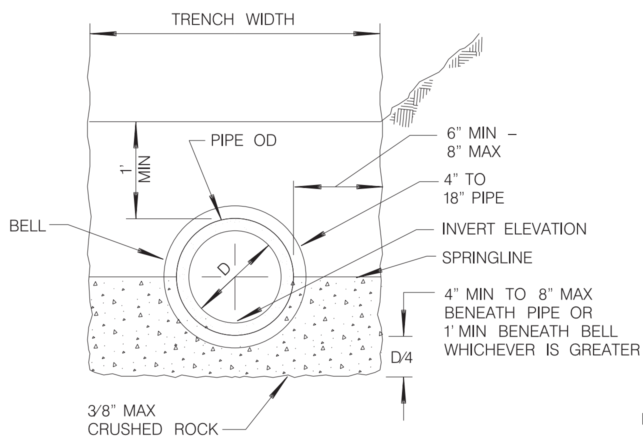
Percolation Rate Conversion

Plate
G-25

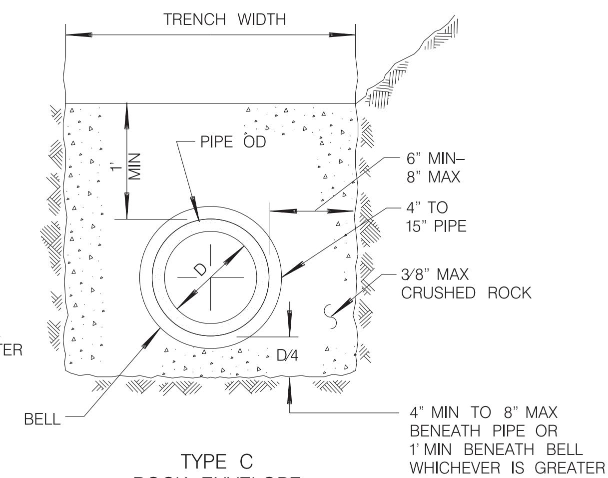
APPENDIX H



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

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APPENDIX F

CULTURAL RESOURCES INVENTORY REPORT

HISTORIC RESOURCE EVALUATION

Cultural Resources Inventory Report for the Drew Solar Project, Imperial County, California

Lead Agency:

Imperial County
801 Main Street
El Centro, California 92243

Project Proponent:

Drew Solar, LLC
P.O. Box 317
El Centro, California 92244

Prepared by:

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605 Third Street
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Angela Pham, MA and Micah J. Hale, PhD, RPA

FEBRUARY 2018
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REVISED JULY 2018

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NATIONAL ARCHAEOLOGICAL DATABASE (NADB) INFORMATION

Authors:	Angela Pham, MA; Micah J. Hale, PhD, RPA
Firm:	Dudek
Project Proponent:	Drew Solar, LLC
Report Date:	February 2018, Revised May 2018, Revised July 2018
Report Title:	Cultural Resources Inventory Report for the Drew Solar Project, Imperial County, California
Type of Study:	Cultural Resources Inventory
Resources:	DS-I-1, DS-I-2, DS-I-3, DS-I-4, DS-I-5, DS-I-6, DS-I-7, DS-I-8, DS-I-9
USGS Quads:	Mount Signal (1976), Township 17S, Range 13E; Sections 7 and 8 of
Acreage:	Approximately 859.3 gross acres (762.8 net acres)
Permit Numbers:	N/A
Keywords:	Irrigation system; intensive pedestrian survey; El Centro,

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MANAGEMENT SUMMARY

Dudek conducted a cultural resources study for the Drew Solar Project (Project), located approximately 6.5 miles southwest of the City of El Centro, Imperial County, California. This study included a records search and literature review, Native American consultation, an intensive-level cultural resources pedestrian survey, and preparation of this cultural resources technical report.

This study was completed under the provisions of local regulations as well as the California Environmental Quality Act (CEQA). Public Resources Code (PRC) Section 5024.1, Title 14 California Code of Regulations (CCR) Section 15064.5 of the CEQA Guidelines, and PRC Sections 21083.2 and 21084.1 were also used as basic guidelines for this cultural resources study (Governor's Office of Planning and Research 1998). PRC Section 5024.1 requires the identification and evaluation of cultural resources to determine their eligibility for the California Register of Historical Resources (CRHR).

Nine newly identified cultural resources, consisting of historic irrigation canals temporarily designated as: DS-I-1, DS-I-2, DS-I-3 (Wormwood Lat 1 segment), DS-I-4, DS-I-5 (Woodbine canal segment), DS-I-6 (Mt. Signal Drain Segment), DS-I-7 (Woodbine Lat 7), DS-I-8, and DS-I-9 (Mt. Signal Drain 1-B) were found within the Project APE during the intensive-level pedestrian survey. No additional cultural resources were documented within the Project APE.

Dudek's Phase I inventory of the Project APE suggests that there is a low potential for the inadvertent discovery of historical resources during Project implementation. Based on available information and in consideration of the topography, there is a low potential for the inadvertent discovery of intact cultural deposits during earth moving activities that will occur within the agricultural fields. The fields have been extensively disturbed by decades of agricultural activities. However, there is a moderate potential for the inadvertent discovery of intact cultural deposits during earth moving activities related to the construction of the Project's generation interconnection (gen-tie). The gen-tie transmission lines are located outside of the agricultural fields and have not been subject to extensive agricultural disturbances. The gen-ties alignment will extend approximately 400 feet south of the southerly limits of the net farmable area of the Project APE. The gen-ties will consist of transmission structures that will require drilling, to a maximum depth of 10 feet, for pole foundations. Following the setting of structures, conductor will be installed via use of pullers and from bucket trucks. Dudek recommends full time archaeological monitoring during drilling activities for the gen-ties. If only disturbed sediments (e.g., fill) or other sediments and formations are identified during construction monitoring that do not have the potential to contain archaeological resources, then monitoring may be reduced or terminated.

Nine newly identified historic age cultural resources were recorded during the intensive pedestrian survey. These new resources consist of irrigation canals and drainages. Based on historic aerials and available date stamps, the canals are historic in age (circa 1950s). The canals are built environment resources and will be addressed in a separate study and included as an addendum to this cultural resources inventory report (Corder and Murray 2018).

1 INTRODUCTION

Dudek conducted a cultural resources study for the Drew Solar Project (Project), located approximately 6.5 miles southwest of the City of El Centro, Imperial County, California. This study included a records search and literature review, Native American consultation, an intensive-level cultural resources survey, and preparation of this cultural resources technical report. The Project site consists of six included parcels (APNs 052-170-031, 052-170-032, 052-170-037, 052-170-039, 052-170-056, and 052-170-067) that total approximately 859.3 gross acres of land, the majority of which has been previously used for agriculture. The entire 859.3 acres consists of the Area of Potential Effects (APE). The APE encompasses all lands where the proposed Project could potentially impact cultural resources.

This study was completed under the provisions of local regulations as well as the California Environmental Quality Act (CEQA). Public Resources Code (PRC) Section 5024.1, Title 14 California Code of Regulations (CCR) Section 15064.5 of the CEQA Guidelines, and PRC Sections 21083.2 and 21084.1 were also used as basic guidelines for this cultural resources study (Governor's Office of Planning and Research 1998). PRC Section 5024.1 requires the identification and evaluation of cultural resources to determine their eligibility for the California Register of Historical Resources (CRHR).

Nine newly identified cultural resources, consisting of historic irrigation canals temporarily designated as: DS-I-1, DS-I-2, DS-I-3 (Wormwood Lat 1 segment), DS-I-4, DS-I-5 (Woodbine canal segment), DS-I-6 (Mt. Signal Drain Segment), DS-I-7 (Woodbine Lat 7), DS-I-8, and DS-I-9 (Mt. Signal Drain 1-B) were found within the Project APE during the intensive-level pedestrian survey. The canals are historic in age and will be addressed in a separate study and included as an addendum to this cultural resources inventory report. No additional cultural resources were documented within the Project APE.

Dudek Archaeological Principal Investigator Micah Hale, M.A., and Registered Professional Archaeologist (RPA) managed the Project and co-authored this report with Dudek archaeologist Angela Pham, M.A., RPA. Dudek archaeologists Angela Pham, Jessica Colston, Patrick Hadel, Javier Hernandez, and William Blodgett conducted the intensive-level pedestrian survey for the Project.

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2 PROJECT DESCRIPTION AND LOCATION

The Drew Solar Project is located in Imperial County, California (Figure 1), approximately 6.5 miles southwest of the city of El Centro, California, and 7.5 miles directly west of Calexico, California. The Project site is generally located south of Kubler Road, east of Westside Main Canal, north of State Route 98, and west of Pulliam Road. The U.S./Mexico border is approximately 1.85 miles south of the Project area. The Project is located on agricultural land owned by Imperial Irrigation District (IID). Specifically, the Project is located in Township 17 South, Range 13 East, Sections 7 and 8 of the Mount Signal, California USGS 7.5 Minute Series Quadrangles (Figure 1).

The Project site covers approximately 859.3 gross acres or 762.8 net farmable acres of land, the majority of which has been previously used for agriculture. The Project site is located on Assessor Parcel Numbers (APNs) 052-170-031, 052-170-032, 052-170-037, 052-170-039, 052-170-056, and 052-170-067.

The Project will use solar photovoltaic (PV) technology to convert sunlight directly into direct current (DC) electricity. The Project may include only one PV technology or a combination of various PV technologies, including but not limited to crystalline silicon-based systems, thin-film systems, and perovskites, and may include energy storage. The Project would also construct generation interconnection (gen-tie) transmission lines from the south end of the Project site running south across Drew Road and State Route 98 into the existing Drew Switchyard located on APN 052-190-039. The gen-ties alignment will extend approximately 400 feet south of the southerly limits of the net farmable area of the Project APE. The gen-ties will consist of transmission structures that will require drilling, to a maximum depth of 10 feet, for pole foundations and a work area being established around the perimeter of the structure. Following the setting of structures, conductor will be installed via use of pullers and from bucket trucks. The Project also includes a utility scale energy storage system.

Site preparation would be planned and designed to minimize the amount of earth movement required for the Project to the extent feasible. The hydrology design would be given first priority in order to protect the Project's facilities and adjacent facilities including any IID/County facilities from large storm events. It is the intent of the Project to support the panels on driven piles. Additional compaction of the soil in order to support the building and traffic loads as well as the PV module supports may be required and is dependent on final project engineering design.

The on-site drainage patterns would be maintained to the greatest extent possible. It will be necessary to remove, relocate and/or fill in portions of some of the existing private drainage ditches or delivery canals to accommodate the final panel layout for the Project. As for IID facilities, the drain and canal connections will be modified based on the final engineering design for these facilities in accordance with IID and County standards.

During construction, temporary facilities would be developed on site to facilitate the construction process. These facilities may include construction trailers, a temporary septic system or holding tank, parking areas, material receiving / storage areas, water storage ponds, construction power service, recycling / waste handling areas, and others. These facilities would be located at the construction areas designated on the final site plan(s).

2.1 Regulatory Context

This project is subject to state and local regulations regarding cultural resources. The following section provides a summary of the applicable regulations, policies, and guidelines relating to the proper management of cultural resources for this project.

2.1.1 State Level Regulations

The California Register of Historic Resources (Public Resources Code section 5020 et seq.)

In California, the term "historical resource" includes but is not limited to "any object, building, structure, site, area, place, record, or manuscript which is historically or archaeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California" (California Public Resources Code section 5020.1(j)). In 1992, the California legislature established CRHR "to be used by state and local agencies, private groups, and citizens to identify the state's historical resources and to indicate what properties are to be protected, to the extent prudent and feasible, from substantial adverse change" (California Public Resources Code section 5024.1(a)). A resource is eligible for listing in the CRHR if the State Historical Resources Commission determines that it is a significant resource and that it meets any of the following National Register of Historic Places (NRHP) criteria:

- Associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
- Associated with the lives of persons important in our past.
- Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
- Has yielded, or may be likely to yield, information important in prehistory or history.

(California Public Resources Code section 5024.1(c).) Resources less than 50 years old are not considered for listing in the CRHR, but may be considered if it can be demonstrated that sufficient time has passed to understand the historical importance of the resource (see 14 CCR, section 4852(d)(2)).

FIGURE 1
Project Location
Cultural Resources Report for the Drew Solar Project

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The CRHR protects cultural resources by requiring evaluations of the significance of prehistoric and historic resources. The criteria for the CRHR are nearly identical to those for the NRHP, and properties listed or formally designated as eligible for listing on the NRHP are automatically listed on the CRHR, as are the state landmarks and points of interest. The CRHR also includes properties designated under local ordinances or identified through local historical resource surveys. The State Historic Preservation Officer maintains the CRHR.

2.1.2 Native American Historic Cultural Sites (California Public Resources Code section 5097 et seq.)

State law addresses the disposition of Native American burials in archaeological sites and protects such remains from disturbance, vandalism, or inadvertent destruction; establishes procedures to be implemented if Native American skeletal remains are discovered during construction of a project; and establishes the NRHP to resolve disputes regarding the disposition of such remains. In addition, the Native American Historic Resource Protection Act makes it a misdemeanor punishable by up to 1 year in jail to deface or destroy an Indian historic or cultural site that is listed or may be eligible for listing in the CRHR.

2.1.3 California Native American Graves Protection and Repatriation Act

The California Native American Graves Protection and Repatriation Act (California Repatriation Act), enacted in 2001, required all state agencies and museums that receive state funding and that have possession or control over collections of human remains or cultural items, as defined, to complete an inventory and summary of these remains and items on or before January 1, 2003, with certain exceptions. The California Repatriation Act also provides a process for the identification and repatriation of these items to the appropriate tribes.

2.1.4 California Environmental Quality Act

As described further below, the following CEQA statutes and CEQA Guidelines are of relevance to the analysis of archaeological and historic resources:

1. California Public Resources Code section 21083.2(g): Defines "unique archaeological resource."
2. California Public Resources Code section 21084.1 and CEQA Guidelines section 15064.5(a): Define historical resources. In addition, CEQA Guidelines section 15064.5(b) defines the phrase "substantial adverse change in the significance of an historical resource;" it also defines the circumstances when a project would materially impair the significance of a historical resource.

3. California Public Resources Code section 5097.98 and CEQA Guidelines section 15064.5(e): Set forth standards and steps to be employed following the accidental discovery of human remains in any location other than a dedicated cemetery.
4. California Public Resources Code sections 21083.2(b)-(c) and CEQA Guidelines section 15126.4: Provide information regarding the mitigation framework for archaeological and historic resources, including options of preservation-in-place mitigation measures; preservation-in-place is the preferred manner of mitigating impacts to significant archaeological sites because it maintains the relationship between artifacts and the archaeological context, and may also help avoid conflict with religious or cultural values of groups associated with the archaeological site(s).

Under CEQA, a project may have a significant effect on the environment if it may cause "a substantial adverse change in the significance of an historical resource" (California Public Resources Code section 21084.1; CEQA Guidelines section 15064.5(b)). If a site is either listed or eligible for listing in the CRHR, or if it is included in a local register of historic resources, or identified as significant in a historical resources survey (meeting the requirements of California Public Resources Code section 5024.1(q)), it is a "historical resource" and is presumed to be historically or culturally significant for purposes of CEQA (California Public Resources Code section 21084.1; CEQA Guidelines section 15064.5(a)). The lead agency is not precluded from determining that a resource is a historical resource even if it does not fall within this presumption (California Public Resources Code section 21084.1; CEQA Guidelines section 15064.5(a)).

A "substantial adverse change in the significance of an historical resource" reflecting a significant effect under CEQA means "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired" (CEQA Guidelines section 15064.5(b)(1); California Public Resources Code section 5020.1(q)). In turn, the significance of a historical resource is materially impaired when a project:

1. Demolishes or materially alters in an adverse manner those physical characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for, inclusion in the California Register; or
2. Demolishes or materially alters in an adverse manner those physical characteristics that account for its inclusion in a local register of historical resources pursuant to section 5020.1(k) of the Public Resources Code or its identification in an historical resources survey meeting the requirements of section 5024.1(g) of the Public Resources Code, unless the public agency reviewing the effects of the project establishes by a preponderance of evidence that the resource is not historically or culturally significant; or

3. Demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its eligibility for inclusion in the California Register as determined by a lead agency for purposes of CEQA.

2.1.5 California Health and Safety Code section 7050.5

California law protects Native American burials, skeletal remains, and associated grave goods, regardless of their antiquity, and provides for the sensitive treatment and disposition of those remains. Health and Safety Code section 7050.5 requires that if human remains are discovered in any place other than a dedicated cemetery, no further disturbance or excavation of the site or nearby area reasonably suspected to contain human remains shall occur until the County coroner has examined the remains (section 7050.5b). If the coroner determines or has reason to believe the remains are those of a Native American, the coroner must contact the NAHC within 24 hours (section 7050.5c). The NAHC will notify the Most Likely Descendant. With the permission of the landowner, the Most Likely Descendant may inspect the site of discovery. The inspection must be completed within 24 hours of notification of the Most Likely Descendant by the NAHC. The Most Likely Descendant may recommend means of treating or disposing of, with appropriate dignity, the human remains and items associated with Native Americans.

2.1.6 Senate Bill 18

California Senate Bill 18 (SB 18), which took effect on March 1, 2005, requires local (city and county) governments to consult with California Native American tribes identified by the Native American Heritage Commission (NAHC) for the purpose of protecting, and/or mitigating impacts to cultural places in creating or amending general plans, including specific plans (Government Code section 65352.3).

2.1.7 Assembly Bill 52

California Assembly Bill 52 (AB 52), which took effect July 1, 2015, establishes a consultation process between California Native American Tribes and lead agencies in order to address tribal concerns regarding project impacts and mitigation to “tribal cultural resources” (TCR). Public Resources Code section 21074(a) defines TCRs and states that a project that has the potential to cause a substantial adverse change to a TCR is a project that may have an adverse effect on the environment. A TCR is defined as a site, feature, place, cultural landscape, sacred place, and object with cultural value to a California Native American tribe that is either:

1. listed or eligible for listing in the CRHR or a local register of historical resources, or
2. determined by a lead agency to be a TCR.

2.1.8 Traditional Cultural Properties

Native American Heritage Values

Federal and state laws mandate that consideration be given to the concerns of contemporary Native Americans with regard to potentially ancestral human remains, associated funerary objects, and items of cultural patrimony. Consequently, an important element in assessing the significance of the study site has been to evaluate the likelihood that these classes of items are present in areas that would be affected by the proposed project.

Also potentially relevant to prehistoric archaeological sites is the category termed Traditional Cultural Properties in discussions of cultural resource management (CRM) performed under federal auspices. According to Patricia L. Parker and Thomas F. King (1998), “Traditional” in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. The traditional cultural significance of a historic property, then, is significance derived from the role the property plays in a community’s historically rooted beliefs, customs, and practices. Examples of properties possessing such significance include:

1. A location associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world;
2. A rural community whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents;
3. An urban neighborhood that is the traditional home of a particular cultural group, and that reflects its beliefs and practices;
4. A location where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice; and
5. A location where a community has traditionally carried out economic, artistic, or other cultural practices important in maintaining its historic identity.

A Traditional Cultural Property, then, can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community.

2.1.9 County of Imperial

Section III(B) of the Imperial County Conservation and Open Space Element describes the cultural resources, goals and objectives to protect such resources (County of Imperial 2016). The planning goals and objectives are described below.

Goal 3 of the goals and objectives section of the Imperial County Conservation and Open Space Element addresses the preservation of cultural resources. Goal 3 states that the County will "preserve the spiritual and cultural heritage of the diverse communities of Imperial County." (County of Imperial 2016). Three objectives are enumerated to assist in implementation of the goal:

- **Objective 3.1:** Project and preserve sites of archaeological, ecological, historical, and scientific value, and/or cultural significance.
- **Objective 3.2:** Develop management strategies to preserve the memory of important historic periods, including Spanish, Mexican, and early American settlements of Imperial County.
- **Objective 3.3:** Engage all local Native American Tribes in the protection of tribal cultural resources, including prehistoric trails and burials sites.

2.2 Project Personnel

Micah Hale, PhD, RPA, served as project manager and Principal Investigator, and co-authored the technical report. Angela Pham, MA, served as field director and co-authored the technical report. Archaeologists Jessica Colston, Patrick Hadel, Javier Hernandez, and William Blodgett acted as field crew members.

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3 SETTING

3.1 Natural Setting

The Drew Solar Project is located in the Colorado Desert. The Project APE is bordered by the Westside Main Canal to the west; Greeson Drain to the east, Kubler road to the north, and the U.S. - Mexico international border to the south. It is mostly comprised of agricultural land and open space considered part of the Imperial Valley.

For detailed discussion relating to the environmental context of this area, please consult the biological, geological, and other technical studies prepared for Drew Solar Project.

3.2 Cultural Setting

The general cultural sequence for the Colorado Desert can be viewed in terms of three or more time periods based on the evolutionary stages proposed by Willey and Phillips (1958). Among contemporary archaeologists and cultural resource managers, the Paleoindian and Archaic evolutionary stages of Willey and Phillips (1958) have evolved into time periods and, in southern California, their Formative stage became the Late Prehistoric time period. For this report, actual geological time periods and the evolutionary stage labels intended by Willey and Phillips will be employed. Within the time periods, various archaeological complexes occur on a regional basis. Various labels such as horizon, pattern and culture have been used, but the more universal term “complex” is preferred for this effort.

3.2.1 Late Pleistocene

Several researchers posit a Pre-Projectile Point Period that occurred in the late Pleistocene prior to the much better documented Clovis, San Dieguito, Lake Mojave complexes (e.g., Begole 1974; Childers 1980; Hayden 1976). Archaeological material from the Greater Southwest dating to this posited Pre-Projectile Point Period is often called the Malpais Complex. Malpais is a term that was adapted from the early work of Malcolm Rogers, who used it to refer to what is now the first portion of the San Dieguito Lake Mojave Complex. The term was resurrected by Hayden (1976) to refer to a tool assemblage including choppers, scrapers, and other crude, core-based tools typically found on old desert pavements in the Sonoran Desert and in the Sierra Pinacate. These materials generally are heavily weathered, very darkly patinated and found deeply embedded in desert pavements. Lacking subsurface deposits, Hayden depended to a large degree upon the amount of patination and relative dates of geological formations to obtain relative dates. He argued that most of the Malpais Complex dates to some time prior to an altithermal that occurred about 20,000 years ago. At a shell scatter on a sand dune near Adair Bay on the Gulf of California, he was able to obtain, through radiocarbon dating, two subsurface dates on shell that were greater than 37,000 years before present (B.P.). He also obtained a surface date there of approximately 33,950 B.P. (corrected) (Hayden 1976). These very early dates are rather troubling to traditional "Clovis First" archaeologists and many are skeptical of the existence of this period (e.g., Schaefer 1994). Obtaining corroborating radiocarbon dates to support or refute this very early age for the Malpais continues to prove elusive.

3.2.2 Terminal Pleistocene-Very Early Holocene

The earliest well-documented sites in the southern Alta California desert region belong to the San Dieguito Complex, which is thought to date from approximately 11,000 to 9,300 B.P. to perhaps as late as 7,500 B.P. (Justice 2002; Warren et al. 1998). Beginning in 1924, Malcolm Rogers, of the San Diego Museum of Man, conducted surveys in the Colorado Desert during which he noted what became known as the San Dieguito Complex. Eventually, Rogers documented San Dieguito materials in the Mojave Desert, in Arizona, and as far south as San Quintin, in Baja California. The Project area is within Roger's Central Aspect for the San Dieguito (Rogers 1966).

Closely related to the San Dieguito are materials that have been identified in the Mojave Desert and in the Great Basin called the Lake Mojave Complex (Warren and Crabtree 1986; Warren et al. 1998). No San Dieguito radiocarbon dates have been published for the Colorado Desert, although many surface sites have been reported (Schaefer 1994).

Elsewhere, materials associated with human bone excavated on Santa Rosa Island were dated to 11,500 years B.P. (Johnson et al. 1999). Materials at Daisy Cave on San Miguel Island were also radiocarbon dated from approximately 11,600 to 11,000 B.P. (Erlandson 2007). Radiocarbon dated cultural deposits going back to approximately 15,000 B.P. have just been reported from the Debra L. Friedkin Site in Texas by Michael Waters (Ehrenberg 2011). While these scholars have substantiated the notion of terminal Pleistocene occupations in the American West, the relationships among these early sites and the San Dieguito Lake Mojave complex in the Colorado Desert are not yet understood.

The San Dieguito assemblage is typically dominated by finely flaked scrapers, planes, choppers and leaf-shaped projectile points made of slate-green felsite of the Santiago Peak Formation or fine-grained basalt. Evidence of seed grinding technology (manos and metates) is scarce or absent. Desert assemblages often contain Lake Mojave and Silver Lake projectile points that are rare along the coast. These points appear in the California deserts from about 11,000 to about 7,000 B.P. (Justice 2002:91; Warren and Crabtree 1986:184). San Dieguito sites in the deserts are typically found around dry Pleistocene playas and above ancient stream channels, not modern water sources. Rogers and many others have found numerous trails and cleared circles that they attribute to the San Dieguito in the Colorado Desert. The cleared circles are typically somewhat circular, but ovals and rectangles are also noted. These are also known as sleeping circles.

Despite the problem with geometry, the terms cleared circles and sleeping circles are very well established in the archaeological literature. They are commonly interpreted as house or windbreak remains or just a smooth place to sleep. The desert site locations and assemblages suggest a subsistence emphasis on lacustrine resources, but the coastal San Dieguito sites seem to reflect a more generalized hunting and gathering economy with a special emphasis on marine resources, especially shellfish (Erlandson and Colten 1991; Warren et al. 1998).

3.2.3 Mid-Holocene

During the early and mid-Holocene, a generalized hunting and gathering economy, based to a large degree on collecting and grinding grasses and other hard seeds, appeared in the California deserts and along the coast. Beginning at approximately 8,500 years ago in southern Alta California, the assemblage is dominated by portable basin metates, manos, and crudely-fashioned core-based scrapers, choppers, and hammerstones. In the California deserts, Pinto series projectile points appear at about 8,000 B.P. and continue to about 4,000 B.P. (Justice 2002:135). Gypsum series points begin to appear in desert sites at approximately 4,000 B.P. with the Elko series appearing shortly thereafter (Justice 2002: 294, 304). This assemblage suggests the mid-Holocene economy was more diversified and focused on gathering hard seeds and grasses, and hunting small and big game. Near the Project area, McDonald (1992) found mid-Holocene cultural deposits in her excavation of Indian Hill rock shelter. Located in the Jacumba Mountains northwest of the current Project area, this is the only published excavation of a mid-Holocene archaeological site in the Colorado Desert. McDonald posits that the site was first occupied at about 5,000 B.P. She recovered 21 Elko dart points, one Gypsum Cave point, and four dart points that she was unable to type. She suggests that Indian Hill rock shelter functioned as a hunting camp for the mid-Holocene occupants (McDonald 1992).

3.2.4 Late Holocene

Around 2,000 B.P., patterns begin to emerge that suggest cultural links to the peoples found in the Colorado Desert at the time of the Spanish explorers (e.g., Alarcón and Diaz, in 1540 A.D.). This Late Holocene period is often referred to as the Late Prehistoric. The archaeological complex at this time in the Colorado Desert is referred to as the Yuman or Patayan Complex. It is recognized archaeologically by the presence of smaller projectile points, signaling the advent of the bow and arrow, the replacement of flexed inhumations with cremations, the introduction of ceramics, and an emphasis on plant food collection and processing, especially acorns and mesquite (Kroeber 1925; Schaefer 1994; Schaefer and Laylander 2007). Semi-sedentary rancherias were established along the Colorado River and around springs. These rancherias were not compact villages, but were loose collections of residences and agricultural plots. Surrounding desert and mountain areas were seasonally occupied to exploit mesquite, acorns, and pinyon nuts. Mortars for mesquite and acorn processing become common for the first time in the area and bedrock milling features (slicks, basins, and mortars) first appear (Schaefer and Laylander 2007).

The most numerous archaeological resources in the Imperial Valley date to the Late Holocene. Most sites are small processing loci, associated with the grinding of plant resources. Larger habitation sites were less common, but displayed a wider range of activities and longer periods of occupation (Jefferson 1974; Schaefer and Laylander 2007). The typical Late Prehistoric assemblage includes Desert Side-Notched series and Cottonwood Triangular arrow points and Lower Colorado Buffware and Tizon Brownware ceramics. In the vicinity of the Project area, Salton Brownware ceramics are also found (Schaefer and Laylander 2007). Lithic artifacts are typically made from chert, volcanics, metavolcanics, or quartz materials (Jefferson 1974). The economy along the Colorado River and its sloughs, the Alamo River and New River, was based on mesquite collecting and flood plain horticulture. Corn, beans, and squash were the primary crops, but mesquite was the mainstay of the Kamia diet, even in years of good horticultural production (Castetter and Bell 1951; Gifford 1931).

During the Late Holocene, there were four or more events when Lake Cahuilla filled the Salton Sink up to the 40-foot elevation. As noted previously, Lake Cahuilla occurred periodically when the Colorado River filled up its river bed with silt in the area south of Pilot Knob. At these times the river changed course out of its silt-elevated channel and, instead of flowing into the Upper Gulf of California, flowed west down the Alamo River and New River, then north into the Salton Sink (Schaefer 1994; Singer 2011).

When Lake Cahuilla was full or filling, the entire flow of the Colorado River was probably diverted and the area from Pilot Knob south to the Gulf was dry. Since Alarcón estimated (or overestimated) about 20,000 people living south of Pilot Knob in 1540, it was presumably densely populated during the Late Prehistoric as well (Forbes 1965). These people had to migrate when the Colorado River flowed into Lake Cahuilla, and they may have been the people who left the huge number of archaeological sites around the southern shore of Lake Cahuilla (Schaefer and Laylander 2007; Underwood 2007, 2008). The southwestern shoreline of Lake Cahuilla lies approximately 12 miles east of Ocotillo. Although the shoreline of this huge freshwater lake was outside the Project area, the lake would have had a profound influence on prehistoric Indians within the Project area.

3.2.5 Ethnohistoric Period

According to early ethnographers (e.g., Gifford 1931, Kroeber 1925) the Project area was in the traditional territory of the Kamia or Desert Kumeyaay. Their neighbors to the north are the Cahuilla whose territory extended to meet the Kamia at the San Felipe or Scissors Crossing area (where CR-S2 meets State Route 78). To the east of the Project area are the Quechan who live along the Colorado River just west of Yuma (Forde 1931). The traditional territory of the Cocopah, their neighbors to the southeast, lies at the head of the Gulf of California (Gifford 1931, Kelly 1977); to the west are the Kumeyaay proper.

It is important to understand that the Kamia did not occupy all of their traditional territory at one time. They tended to occupy a few farming rancherias or camping places within their territory at any given time, based largely on the availability of water. The Kamia were quite friendly with the Quechan, who lived in the vicinity of Yuma, and some bands occasionally lived with them on the Colorado. They also were very closely related to the Kumeyaay and shared clans or lineages with them (Gifford 1931). The Kumeyaay rancheria of Jacum, near the town of Jacumba today, was perhaps the easternmost Kumeyaay settlement. Jacumba is about 19 miles southwest of Ocotillo. Ethnographic sources indicate that the cold season was a favorite time for the Kumeyaay who lived in the mountains bordering the desert to visit the Kamia (Gifford 1931:17). Kroeber noted that Diegueno (Kumeyaay) clans spent winter "in mixed groups in the eastern foothills, at the desert's edge" (Kroeber 1925"720). Also, the Indians who lived in the Mount Laguna area wintered in the desert around Vallecitos, Agua Caliente, and Mason Valley (Cline 1979).

The Kamia lived primarily along the Alamo River and New River and along other sloughs of the Colorado River in what is now Mexico as far south as Volcano Lake. The nearest documented Kamia rancheria was Xachupai. This was a loose collection of farmsteads scattered along the north-south trending New River for several miles. Xachupai extended both north and south of where I-8 intersects the river today (Gifford 1931; Forbes 1965; Kroeber 1925; Shipek 1982).

3.2.6 Historic Period

The first Spanish exploration of what is now Imperial County occurred in 1540, when Hernando de Alarcón ascended the Colorado River probably up to where Yuma and Winterhaven are today. Juan Cabrillo was the first Spanish explorer to visit coastal southern Alta California, when he anchored in what would become known as San Diego Bay in 1542. Both explorers claimed Alta California for the king of Spain, thus initiating the Spanish Period in Alta California. Spanish explorers visited what was to become Imperial Valley on a sporadic basis from that time on. Travel in the vicinity of the Project area began when Juan Bautista de Anza of the Spanish Army and Francisco Garcés of the Franciscan Order established what became known as the Anza Trail in 1774 during the first Anza Expedition. Their guide was Sebastian Taraval, an Indian from Baja California who also served as translator. Captain Juan Bautista de Anza was the commanding officer of the presidio at Tubac, south of Tucson. The Anza Trail passed east of the Project area from Yuha Wells onward to San Francisco. The Yuha Wells were used by Anza, who called them Santa Rosa de las Lajas (Flat Rocks) (Bolton 1930). They are on the southwest side of Dunaway Road about 12 miles east of Ocotillo. Anza's observations establish the fact that prehistoric wells were dug by the Kamia, at least in the Yuha Desert. This suggests that other wells may also have been dug in washes to support prehistoric Indian camps in the Project area.

In 1770, Pedro Fages was appointed military governor of California Nueva, which later became known as Alta California. In 1772, he discovered an Indian trail in the mountains of eastern San Diego County near Cuyamaca State Park. It passed down Oriflamme Canyon and then connected with a north trending trail. This trail went north through the Warner's Springs area. Fages continued on to Mission San Gabriel de Arcangel, founded in 1771 in what is now San Gabriel Valley. Later, a trail was discovered that split from the Anza Trail in the vicinity of Yuha Wells and passed north through Vallecito and Agua Caliente. This linked up with the Fages Trail at the foot of Oriflamme Canyon, southeast of where the town of Julian is today. This combined Fages and Anza Trail became the principal route linking Sonora and Alta California in the late 18th and early 19th centuries. This route, followed today by CR-S2, became known as the Sonora Trail (Guerrero 2006).

In addition to the well-known Franciscan missions along the coast of Alta California, missions were also founded at Concepción, in the vicinity of present-day Yuma and San Pablo near Pilot Knob in 1780. A number of Spanish settlers accompanied the Franciscans and a small number of Spanish Army personnel; however, no presidio was established. Friction between the Spanish and the Quechan rapidly developed. The missions and settlements were destroyed in the successful Quechan Revolt of 1781. Padre Garcés and some 50 Spanish settlers were killed in that revolt. The dead included Fernando Rivera y Moncada, who led the first overland party of the Portolá Expedition to reach San Diego in 1769 and had been the military governor of Alta California in 1777 (Forbes 1965:185-202).

The Mexican people chafed under Spanish rule in the late 1700s and early 1800s. After a long struggle, the Spanish were expelled from Mexico in 1821. The Mexican Republic retained many Spanish institutions and laws, but they were very concerned about the abuses of the Catholic Church. Several reforms were passed, including the secularization of the mission system in 1834. Large tracts of former church land were granted to individuals and families and the Alta California rancho system flourished. Cattle ranching dominated the economy. The hide and tallow trade with Yankee ships increased during the 1830s. The Pueblo of Los Angeles, established in 1781, began to grow rapidly during this period and Native American influence and control greatly declined (Starr 2007).

The Mexican Republic had encouraged Americans to settle in Tejas in the 1820s and by the 1830s, the Americans greatly outnumbered the Mexicans. Friction developed between the two cultures and in 1835, Texas fought and won its independence. Disputes continued over the placement of the border and Mexico never recognized the legitimacy of the new Texas Republic. The US Congress admitted Texas to the Union in 1845 and provoked Mexico into a disastrous war. Many Americans, including Abraham Lincoln and John Quincy Adams, denounced the rush to war as a Southern ploy to expand slavery.

Early in the war, Colonel Stephen Watts Kearney was dispatched to take charge of what became known as the Army of the West. After taking Santa Fe without a shot, Kearney headed west at the head of a column of dragoons. Captain Philip St. George Cook took charge of the Mormon Battalion, whose task was to follow behind Kearney's column and build a wagon road from Santa Fe to San Diego (Starr 2007; Guerrero 2006).

The dragoons under Kearney and the Mormon Battalion under Cook both used the Old Sonora Trail in 1846. The war ended with the Treaty of Guadalupe Hidalgo on February 2, 1848 and as part of the treaty, Mexico ceded Alta California to the US. At that time, the Mexican territory of Alta California also included southern Nevada, southern Utah, and most of Arizona. By the time Alta California was admitted to the Union in 1850 as the State of California, it was only a small fraction of its former self. Gold had been discovered in what is now known as the Mother Lode of California prior to the end of the war. However, it was not made public until March 1848, when the Americans were firmly in control. The sudden influx of American and Europeans quickly drowned out much of the old Californio culture of the Spanish-speaking Catholics born in California prior to 1848.

Tens of thousands of gold seekers (“49ers”) flooded into California over the Old Sonora Trail and through passes in the Sierra Nevada to the north. The Old Sonora Trail became known as the Southern Emigrant Trail during this period. This influx of gold-seekers and adventurers hastened the decline of the Indians, particularly in the Mother Lode area (Phillips 1996). In southern California, the rancho system prospered for several years by supplying beef to the tens of thousands of “49ers” flooding the Mother Lode (Starr 2007:111). These little known California cattle drives preceded the better known Texas drives by about 15 years.

In the 1850s, communication and trade between California and the other states remained expensive, time-consuming, and difficult. In 1857, congress authorized the first transcontinental mail, known as the San Antonio and San Diego Mail. Today, it is sometimes called the Birch Overland Mail after its founder James E. Birch (Lake 1957; Van Wormer et al. 2007). The Birch Overland Mail used the Southern Emigrant Trail (formerly the western reach of the Santa Fe Trail) through the Project area along what is now CR-S2. It branched off of the Southern Emigrant Trail at Oriflamme Canyon and headed west to San Diego. In the next year, a bigger mail contract was awarded to the Butterfield Overland Mail. This bypassed San Diego and continued north through Los Angeles and on to San Francisco. These historic mail and stage lines used the same route in this area passing through the Ocotillo vicinity (Van Wormer et al. 2007).

As mentioned previously, Yuha Wells were first noted by Anza, who called them Santa Rosa de las Lajas. These wells are sometimes confused with Coyote Wells, southeast of Ocotillo. Coyote Wells were “discovered” by James E. Mason of the Birch Overland Mail in 1857 (Lake 1957; Van Wormer et al. 2007). It is highly likely that these wells were originally dug by the Kumeyaay. Coyote Wells is not listed as a stage stop and presumably was used as an auxiliary water source by the mail lines and packers.

During the American Period, the homestead system rapidly increased American settlement beyond the coastal plain, which subsequently accelerated the decline of the California Indians (Philips 1996). Under Mexican rule, full property and civil rights were provided for women and people of color including Indians. The Treaty of Guadalupe Hidalgo preserved these rights, although the American and California state governments ignored these provisions completely in the case of the Indians and forced the Californio land holders to abandon their vast landholdings through lengthy, expensive, and complicated legal proceedings. In less than 20 years, very few ranchos in Alta California remained intact (Starr 2007:104-105). However, Spanish remained one of the two official languages of California until 1879 (Starr 2007: 93).

The Colorado Desert area remained largely unaffected by the transition to American control until after 1904, when the Imperial Canal brought water to the Imperial Valley. A small boom in farming and homesteading began, but in 1905, the Colorado River breached the head gate of the Imperial Canal and began to fill the Salton Sink. This created the Salton Sea and threatened to fill the entire valley, re-creating Lake Cahuilla. The river was brought under control in 1907 after a heroic effort led by the Southern Pacific Railroad. In 1935, Hoover Dam was completed finally ending the dramatic floods, and containing the Colorado River which paved the way for other dams and more dependable canal systems.

U.S. Route 80 (US-80) linked El Centro and San Diego in 1915, and the portion of the San Diego Eastern and Arizona Railroad between these towns was completed in 1919. US-80 and the railroad facilitated the transport of farm products from Imperial Valley and were a benefit to the local economy.

No factor contributed more to the development of the Imperial Valley than irrigation. The following historical information is summarized from IID: The First 40 Years (Dowd 1956). This manuscript presents the history of the Imperial Irrigation District and the subsequent development of the Imperial Valley from early development to the 1940’s, and identified important periods, events, and patterns of development for Imperial Valley.

It was on one of the railroad corridor expeditions in 1853, led by Lieutenant R. S. Williamson of the U.S. Topographical Engineers, that geologist Dr. W. P. Blake discovered the possibility of irrigating Imperial Valley from the Colorado River. Blake observed a region of fertile soil capable of sustaining agriculture but lacking in water. He measured the dry bed of the Salton Sea at below sea level, a fact that made feasible the cutting of a canal from the Colorado River to the interior of the desert which would bring with it a constant supply of water. Dr. Oliver Wozencraft, a proponent of irrigating Imperial Valley, lobbied support from the California legislature, who, in turn, asked Congress to convey six million acres to Wozencraft. He endeavored to secure action by Congress on his plan to bring potable water to the desert for over thirty years without success. Despite Wozencraft's failed attempts at reclamation, by his death in 1887, settlers and developers alike were eager to bring water to Imperial Valley.

Preliminary investigations into the feasibility of irrigating the Colorado Desert began in 1893 with the Colorado River Irrigation Company, but inability to procure financing quickly led to the company's demise. In 1896, the California Development Company was organized, under the direction of Charles Rockwood and George Chaffey, to take hold of the project. The proposed canal route would run from the diversion point at the Colorado River through lower California, Mexico, and back into the United States in order to reach Imperial Valley. To gain title to the Mexican lands, the California Development Company organized a Mexican subsidiary company in 1898 known as La Sociedad de Yrrigacion y Terrenos de la Baja California, S. A. With plans to colonize the region, the California Development Company divided Imperial Valley into districts of varying size, each with its own mutual water company.

By August 1900, construction of the first diversion canal and irrigation system was underway. The canal was excavated from the point of diversion from the Colorado River south about 4 miles into Mexico where it swung west and connected for forty miles within the Alamo River channel until it reached Sharp's Heading and turned north to the Salton Sea. A series of main canals was constructed to divert from Sharp's Heading into various stretches of Imperial Valley: Central Main, Boundary, West Side Main, and East Side Main. The Central Main Canal continued from the international boundary line and traveled north through the present cities of Brawley and Imperial; the Boundary Canal diverted west towards Calexico; the West Side Main Canal traveled west towards Calexico then north; and the East Side Main Canal traveled east then north to the eastern Salton Sea. Water delivery reached Calexico through the Boundary Canal less than one year after the start of construction. That same year, nearly 1,500 acres of land was put under crops.

Few natural resources existed for potable water prior to the construction of the irrigation system. Domestic use water had to be hauled to the Valley via the Southern Pacific Railroad. Once considered a barren wasteland, Imperial Valley was making good progress with colonization by the early 1900's. The Imperial Land Company, under the direction of the California Development Company, began laying out townsites in Imperial Valley based primarily on the density of purchased water stock. The town of Imperial was the first to be laid out with settlement commencing in 1901. Over a period of ten years from 1901 to 1911, irrigable land in

Imperial Valley jumped from 1,500 acres to 220,000 acres. As the water flowed into the Valley, so did the people. In 1902, a year after the first water reached Calexico, nearly 2,000 settlers came to Imperial Valley. The population grew to seven times that amount within four years. To accommodate the growing population, the Southern Pacific Railroad constructed the Niland to Calexico branch rail. At the same time, the newly developed Imperial Valley broke apart from San Diego County to form its own government as Imperial County, with El Centro being designated as the County Seat.

The rapid colonization of Imperial Valley in the early 1900’s strained the relationship between settlers and the California Development Company. Initial land and soil surveys were inaccurate leading to discrepancies with land titles, and water rights held by the California Development Company were called into question. The Reclamation Act was proposed in 1902 to take the Imperial Valley project from the California Development Company and organize it under Government control. Further dissatisfaction with California Development Company arose after hurried and negligible attempts to correct the heavily silt laden waters of the Colorado River ultimately led to grave damage to Imperial Valley following the massive flooding events of 1905 and 1906. The River break destroyed nearly 12,000 acres of cultivated land and over 30,000 acres of irrigable land, caused immense damage to Southern Pacific Company railroad lines; and severed the ties between settlers and the California Development Company. The River break took two years to repair, during which time the Salton Sea filled and expanded to a length of 50 miles and a width of 10 to 15 miles.

Preceding litigation brought to the California Development Company following the flood ultimately resulted in bankruptcy. In 1911, a petition for formation of an irrigation district was presented to the Imperial County Board of Supervisors. The IID was formed to acquire properties of the bankrupt California Development Company and its Mexican subsidiary. Over the span of a decade, IID completed improvements and repairs to the canal and distribution system, rebuilt the entire Westside Main Canal, received deeds to all of the properties of the California Development Corporation, and acquired 13 mutual water companies. Within a few years of acquiring the mutual companies, IID was delivering water to nearly 550,000 acres of Imperial Valley. Over a century later, IID is still servicing communities of the Imperial Valley. IID is the largest irrigation district in the nation and Imperial County ranks among the top ten agricultural counties in the nation. Ninety-eight percent of the water IID transports is used for agriculture and the remaining two percent is treated potable and delivered to the nine Imperial Valley cities (IID 2015).

4 METHODS

4.1 South Coastal Information Center Records Search

An examination of existing maps, records, and reports was conducted by Dudek to determine if the Drew Solar LLC could potentially impact previously recorded cultural resources. Dudek conducted a records search in November 2017 at the South Coastal Information Center (SCIC) at San Diego State University. The search encompassed the APE and a 1-mile buffer around the APE. The purpose of the records search is to identify any previously recorded resources that may be located in or adjacent to the project area and to identify previous studies in the project vicinity. In addition to a review of previously prepared site records and reports, the records search also reviewed historical maps of the project area, ethnographies, the NRHP, the CRHR, the California Historic Property Data File, and the lists of California State Historical Landmarks, California Points of Historical Interest, and Archaeological Determinations of Eligibility.

4.2 NAHC Sacred Lands File Search

On November 16, 2017, Dudek requested a search of the Sacred Lands Files from the Native American Heritage Commission (NAHC). A response letter was received via email from the NAHC on November 17, 2017, stating that the results of the Sacred Lands File search failed to indicate the presence of Native American cultural resources in the Project APE. The NAHC also provided a list of Native American groups and individuals who may have knowledge of cultural resources in the Project area. Letters were sent to each of the representatives November 28, 2017 for any knowledge of resources in the Project APE (Appendix B). A response letter, dated December 20, 2017, has been received from the Viejas Band of Kumeyaay Indians. The Tribe states that the Project area may contain sacred sites to the Kumeyaay people and requests that the sites, if inadvertently discovered, be avoided with adequate buffer zones and treated accordingly. No additional responses have been received to date. If responses are received, they will be forwarded to the lead agency. The coordination conducted here does not constitute formal AB 52 or SB 18 consultation.

Under CEQA, the lead agency is required to perform formal government-to-government consultation with Native American Tribes under AB 52 and SB 18.

4.3 Survey

Dudek archaeologists conducted an intensive-level pedestrian survey of the Project APE from November 20 to November 22, 2017 using standard archaeological procedures and techniques (Figure 2). All field practices met the Secretary of Interior’s standards and guidelines for a cultural resources inventory (NPS 2018). The intensive-level survey methods consisted of a pedestrian survey conducted in parallel transects spaced no more than 15 meters apart over the entire Project APE. The proposed gen-tie line was surveyed within a 100-foot corridor (two transects) measured from the center line. Within each transect, the ground surface was examined for prehistoric artifacts (e.g., flaked stone tools, tool-making debris, stone milling tools, ceramics, fire- affected rock), soil discoloration that might indicate the presence of a cultural midden, soil depressions, features indicative of the current or former presence of structures or buildings (e.g., standing exterior walls, post holes, foundations), and historic artifacts (e.g., metal, glass, ceramics, building materials). Ground disturbances such as burrows, cut banks, and drainages were also visually inspected for exposed subsurface materials. No artifacts were collected during the surveys. Nine newly identified cultural resources, consisting of historic age irrigation canals and drainages, were identified within the Project APE (Figure 3 provided in Confidential Appendix C). The resources are temporarily designated as: DS-I-1, DS-I-2, DS-I-3 (Wormwood Lat 1 segment), DS-I-4, DS-I-5 (Woodbine canal segment), DS-I-6 (Mt. Signal Drain Segment), DS-I-7 (Woodbine Lat 7 segment), DS-I-8, and DS-I-9 (Mt. Signal Drain 1-B). The resources were recorded on DPR 523 series forms.

All fieldwork was documented using field notes and iPad technology with close-scale field maps, and aerial photographs. Location-specific photographs were taken using an Apple 3rd Generation IPad equipped with eight (8) mega-pixel (MP) resolution and georeferenced PDF maps of the Project site. Accuracy of this device ranged between 3 and 10 meters. All field notes, photographs, and records related to the current study are on file at Dudek’s Encinitas, California office.

Documentation of DS-I-1, DS-I-2, DS-I-3, DS-I-4, DS-I-5, DS-I-6, DS-I-7, DS-I-8, and DS-I-9 (Mt. Signal Drain 1-B) complied with the Office of Historic Preservation (OHP) and Secretary of the Interior’s Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716-44740) and the California Office of Historic Preservation Planning Bulletin Number 4(a). The DPR Form will be submitted to the SCIC and is included in Confidential Appendix C.

FIGURE 2

Study Area

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5 RESULTS

5.1 South Coastal Information Center Records Search

On November 15, 2017, Dudek conducted a search of the California Historical Resources Information System (CHRIS) at the South Coastal Information Center (SCIC), located on the campus of San Diego State University, California. The search included any previously recorded cultural resources and investigations within a one-mile radius of the Project APE. The CHRIS search also included a review of the NRHP, the CRHR, the California Points of Historical Interest list, the California Historical Landmarks list, the Archaeological Determinations of Eligibility list, and the California State Historic Resources Inventory list. Confidential Appendix A provides the records search results maps and a complete bibliography of all prior cultural resources studies occurring within one mile of the Project APE.

5.1.1 Previously Conducted Cultural Resources Studies

Thirteen (13) cultural resources studies have been previously conducted within one mile of the Project area. None of these are located within the Project APE. All 13 studies were conducted between 1975 and 2012. Two studies (IM-01442 and IM-01515) that were conducted adjacent to the Drew Solar Project are detailed in Table 1 and are discussed in the section below.

Table 1
Previous Cultural Resources Studies within the Project APE

Year	Author	SCIC Report ID	Report Title
Outside of the Project APE			
1979	Gallegos, Dennis	IM-00203	Class II Cultural Resource Inventory East Mesa and West Mesa Regions Imperial Valley, California, Volume I
1980	Davis, Emma Lou	IM-00207	Class II Cultural Resource Inventory East Mesa and West Mesa Regions Imperial Valley, California
1980	Von Werlhof, Jay and Karen McNitt	IM-00210	Archaeological Examinations of the Republic Geothermal Field, East Mesa, Imperial County
1999	Hupp, Jill	IM-00698	Historical Architectural Survey Report Pavement Rehabilitation and Shoulder, Bridge, Culvert Widening Project, Imperial County, California
1999	Schaeffer, Jerry, Drew Pallette, Collin O'Neill, and Jim Eighmey	IM-00766	Extended Phase I Study of Eight Archaeological Sites (Ca-Imp-1427, -3969, -6914, -6915, -6916, -6918, -6920, -6923) On State Route 98, Imperial County, California
1990	Pigniolo, Andrew, Roxanna Phillips, and Dennis Gallegos	IM-1057	Cultural Resource Study of the Mount Signal and Dixie Ranch Imperial County Prison Alternatives Imperial County, California
1975	Ritter, Eric W.	IM-01275	An Analysis of Culture Resources Along the Proposed Yuha Desert Orv Courses

Table 1
Previous Cultural Resources Studies within the Project APE

Year	Author	SCIC Report ID	Report Title
2011	Mitchell, Patricia T.	IM-01464	Inventory Report of The Cultural Resources Within the Centinela Solar Energy Gen-Tie Line, Imperial County, California
2011	Pigniolo Andrew, Carol Serr, Jose Aguilar, and Frank Dittmer	IM-01442	Cultural Resource Survey For A Portion of the Centinela Solar Energy, LLC Project Area Imperial County, California
2012	Mitchell, Patricia	IM-01490	Evaluation Letter Report for the Centinela Solar Energy Gen-Tie Line Project, Imperial County, California
2011	Glenny, Wayne	IM-01498	Draft Archaeological Survey Investigation For The San Diego County Water Authority Fish Pond Imperial County, California
2011	Davis, Shannon, Jennifer Krintz, Shelby Gunderman, and Sinead Ni Ghabhlain	IM-01515	Inventory, Evaluation, and Analysis of Effects On Historic Resources Within The Area of Potential Effect of the Centinela Solar Energy, LLC Imperial County, California
2011	Davis, Shannon	IM-01516	Final Inventory, Evaluation and Analysis of Effects On Historic Built Environment Properties Within The Area of Potential Effect of The Imperial Solar Energy Center South Imperial County, California

IM-01442

Laguna Mountain Environmental conducted an archaeological survey of approximately 2,165 acres of agricultural land as part of the Centinela Solar Energy (CSE) Project, Imperial County, in 2011. The CSE project is located directly east of the proposed Drew Solar project. The study addressed the CSE project portions that are located on private lands. The archaeological investigation included a records search of the project area and a one-mile buffer around the project, at the SCIC, literature review, historic maps, and an intensive pedestrian survey.

The records search indicated that nine cultural resources have been identified within a one-mile radius of the project area; two of which are located within the project (CA-IMP-6641, a lithic and ceramic scatter associated with the past shoreline of Lake Cahuilla, and P-13-008983, a segment of a historic age agricultural irrigation canal). The field survey identified 13 previously unrecorded historic-age cultural resources within the project area. The resources include segments of the Woodbine Canal and Laterals (P-13-013073,-013074,-013075,-013076,-013077), portions of the Brockman Drain (P-13-013078), portions of the Mt. Signal Drain (P-13-013079 and P-13-013080), the Carpenter Drain (P-13-013081), the Wells Drain (P-13-013082), two historic residential structures (P-13-013083 and P-13-013084), and a historic isolate (P-13-

13085). The archaeological crew relocated one (P-13-008983) of the two previously recorded cultural resources during the field survey.

Archaeological monitoring was recommended during all ground disturbing activities due to the presence of CA-IMP-6631 within the project area. No formal evaluations of the various irrigation canals or the residential structures were conducted by Laguna Mountain Environmental. Laguna Mountain Environmental recommended that impacts to the irrigation structures be avoided during CSE Project implementation and that the resources should be incorporated into open space easements. If the structures could not be avoided during the CSE Project implementation, additional documentation and recording was recommended to evaluate and mitigate impacts to the resources.

IM-01515

ASM Affiliates Inc. conducted a survey and evaluation for historic resources for the Centinela Solar Energy, (CSE) LLC Project, Imperial County, California, in 2011. The CSE project is located directly east of the proposed Drew Solar project. The study identified and evaluated historic resources within the project area for eligibility for inclusion in the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR).

The study identified sixteen (16) historic resources that are more than 45 years old located within the Project APE: the Westside Main Canal, Wormwood (P-13-8983) and Woodbine (P-13-13073) Canals, the town of Mount Signal, three (3) farm complexes, an agricultural building, and eight (8) residential buildings,. One NRHP eligible historic resource was identified, the Westside Main Canal (CA-IMP-7834). ASM's evaluation determined that the CSE Project would have no direct or indirect (e.g., visual) impacts the Westside Main Canal during project implementation. The other fifteen (15) historic resources were determined ineligible for listing in the NRHP and the CRHR.

5.1.2 Previously Recorded Cultural Resources

The SCIC records indicate that no previously recorded cultural resources are located within the Project APE. The records also indicate that an additional sixteen (16) cultural resources have been recorded within the one-mile search buffer of the proposed Project (Table 2). Three of the previously recorded resources (P-13-8983, P-13-13073, and P-13-13079) and are located directly adjacent to the current Project. These three resources are discussed below in the next section. Of the sixteen cultural resources, three (P-13-8334, P-13-8983, and P-13-13073) have been evaluated and have been determined not eligible for listing on the CRHR and the NRHP.

Table 2
Previously Recorded Cultural Resources Within One-Mile of the Project APE

Primary Number	Trinomial	Resource Type	Description	Recorded By/Date	NRHP/CRHR Status
P-13-115	CA-IMP-115	Prehistoric	Habitation Site	Malcom Rogers, 1920s; Judy Berryman, 2001	No Formal Recommendation
P-13-913	CA-IMP-913	Prehistoric	Lithic Isolate	H.E. Pretchett, 1976	No Formal Recommendation
P-13-4499	CA-IMP-4499	Prehistoric	Small Ceramic Scatter	R. Nagel, 1981	No Formal Recommendation
P-13-4500	CA-IMP-4500	Prehistoric	Lithic Isolate	P. Ainsworth, 1981	No Formal Recommendation
P-13-6641	CA-IMP-6641	Prehistoric	Sparse Lithic and Ceramic Scatter	Archaeological Survey Association, 1956	No Formal Recommendation
P-13-8334	CA-IMP-8334	Historic	Westside Main Canal	AECOM, 2011	Not Eligible
P-13-8983	-	Historic	Wormwood Canal, Lateral-7	Jill Hupp, 1999; Frank Dittmaer and Alette van den Hazelkamp, 2010;Jennifer Krintz, 2011	Not Eligible
P-13-13073	-	Historic	Woodbine Canal and Laterals 2,4,7,8	Andrew Pigniolo, 2010; Jennifer Krintz, 2011	Not Eligible
P-13-13074	-	Historic	Woodbine Lateral 7	Andrew Pigniolo, 2010	No Formal Recommendation
P-13-13075	-	Historic	Woodbine Lateral 7A	Pepe Aguilar, 2010	No Formal Recommendation
P-13-13078	-	Historic	Brockman Drain	Pepe Aguilar, 2010	No Formal Recommendation
P-13-13079	-	Historic	Mount Signal Drain	Andrew Pigniolo, 2010	No Formal Recommendation
P-13-13081	-	Historic	Carpenter Drain	Frank Dittmer, 2010	No Formal Recommendation
P-13-13083	-	Historic	Single Family Residence	Pepe Aguilar, 2010	No Formal Recommendation
P-13-13084	-	Historic	Single Family Residence	Pepe Aguilar, 2010	No Formal Recommendation
P-13-13837	CA-IMP-11784	Historic	Historic Refuse Scatter	M. Bray, 2011	No Formal Recommendation
P-13-13843	CA-IMP-11788	Prehistoric	Sparse Lithic Scatter	Patricia Mitchell, Heather Thomson, Erica Maier, 2012	No Formal Recommendation

P-13-8983 (Wormwood Canal, Lateral 7 and Drain)

This irrigation canal was originally recorded by Jill Hupps of Caltrans in 1999. This section of the Wormwood Canal, which was first built in 1911, was evaluated and recommended not eligible for listing in the NRHP because it was realigned and lined with concrete, replacing its original earthen lining, thereby affecting the resource's integrity. ASM Affiliates Inc. revisited and evaluated the canal in 2011 for the Centinela Solar Energy Project. ASM concurred with Caltrans findings and recommended that the Wormwood Canal and Drain are not eligible for listing in the NRHP and the CRHR.

P-13-13073 (Woodbine Canal)

Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Woodbine Canal in 2010. According to Pigniolo, the canal was one of the earliest irrigation canals in the Imerpial Valley as it is shown on the 1915 El Centro 15- minute USGS topographic quad map. ASM Affiliates Inc. revisited and evaluated the canal in 2011 for the Centinela Solar Energy Project. ASM determine that the canal was not significant because it was lined with concrete in the 1950s and 1960s. The integrity of the original 1915 craftsmanship was not retained, therefore the canal was not recommended eligible for the NRHP or the CRHR.

P-13-13079 (Mt. Signal Drain)

Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Mt. Signal Drain in 2010. Pigniolo noted that no historic age features were observed associated with the drain and that the drain is part of a larger historic age agricultural system. No formal evaluation was conducted for the resource.

5.1.3 Historic Archival Research

Historic aerial photographs (years available: 1953, 1996, 2002, 2005, 2009, 2010, and 2012) reveal that the Project APE has been utilized for agricultural development since 1953. The irrigation canals located within the Project site date to at least 1953. The photographs reveal that the canal locations have not changed since 1953. No other historic age structures are located within the Project APE in the photos.

5.2 Survey Results

The majority of the Project APE is located within agricultural fields. The Project's gen-ties are proposed from the south end of the Project APE running south across Drew Road and State Route 98 into the existing Drew Switchyard. Ground surface visibility was poor (0–20) within areas with dense vegetation present (non-native grasses and alfalfa fields) and within paved roads.

Visibility was excellent (80–100 %) in areas with no vegetation and within dirt access roads. Vegetation was not present in the southwestern field (APN 052-170-067) of the Project. Transects spaced approximately 15 meters apart were utilized to ensure adequate coverage of the entire APE. Archaeologists observed that the APE has been heavily disturbed by years of agricultural activities as evidenced by plow scars, irrigation canals and drainages, and the presence of non-native grass and alfalfa fields.

During the field survey, nine historic age irrigation canal/drainage segments were identified (Figure 3 provided in Confidential Appendix C). These irrigation canals have not been previously recorded or evaluated. The canals were recorded and documented on DPR 523 series forms during the survey (Confidential Appendix C). No additional cultural resources or materials were identified during the pedestrian survey.

5.2.1 Newly Identified Resources

Nine newly identified historic age cultural resources were recorded during the current survey. These new resources consist of irrigation canals and drainages. Based on historic aerials and available date stamps, the canals are historic in age. The canals are built environment resources and will be addressed in a separate study and included as an addendum to this cultural resources inventory report (Corder and Murray 2018).

DS-I-1

This newly discovered resource was identified during the intensive pedestrian survey and consists of a historic age irrigation canal. The canal is earthen and runs east to west. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately half-mile long. A crossing with a concrete pipe, measuring approximately two feet in diameter and twelve feet in length, is located in the center of the canal. Discarded terra cotta bricks and concrete fragments are present at the pipe location. No visible date stamp is available for the canal or the pipe.

DS-I-2

This newly discovered resource was identified during the intensive pedestrian survey and consists of a historic age irrigation canal. The canal is earthen and runs east to west. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately half-mile long. A crossing with a concrete pipe, measuring two feet in diameter and ten feet in length, is located in the center of the canal. No visible date stamp is available for the canal or the pipe.

DS-I-3

This newly discovered resource was identified during the intensive pedestrian survey and consists of a segment of the Wormwood Lateral 1 irrigation canal. The canal is concrete lined and runs north to south. The southern portion of the canal extends under County Highway S29 (S29) and continues south. The canal is approximately ten feet wide and six feet in depth. The entire canal is approximately half-mile long. A concrete wall with the text stamp "Wormwood LAT 1" and two concrete and wood gates (gates lat-1 and 11) are located at the southern end of the canal. A third concrete and wood gate (gate 13) is located just south of S29. The southern gates have a date stamp of 1957. Two additional concrete and wood gates (gates 11A and 12) are located within the center on the canal. These gates have a date stamp of 1953.

DS-I-4

This newly discovered resource was identified during the intensive pedestrian survey and consists of a historic age irrigation canal. The canal is concrete lined and runs east to west. The canal is approximately eight feet wide and four feet in depth. The entire canal is approximately half-mile long, and connects to DS-I-7 (Woodbine Lat 7 Canal) to the east at gate 42. Small metal gates, measuring approximately 12 inches, are located along the northern portion of the canal in fifty foot intervals. These gates appear to feed water to the field located to the north of the canal. No visible date stamp is available for the canal.

DS-I-5

This newly discovered resource was identified during the intensive pedestrian survey and consists of a historic age irrigation canal. The canal is concrete lined and runs east to west. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately half-mile long. A concrete gate (gate 57) is located at the east end of the canal. The gate has a date stamp of 1959. This canal segment connects to the Woodbine Canal at gate 57 to the north.

DS-I-6

This newly discovered resource was identified during the intensive pedestrian survey and consists of a segment of the Mount Signal Drain and Mount Signal Drain 1. Mount Signal Drain is earthen and runs north to south. Mount Signal Drain 1 runs east to west from the Mount Signal Drain. The drainage is approximately eight feet wide and ten feet in depth. The length of the drain is approximately two miles. No visible date stamp is available for the drain.

DS-I-7

This newly discovered resource was identified during the intensive pedestrian survey and consists of a segment of the Woodbine Lateral 7 irrigation canal. The canal is concrete lined and runs north to south. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately one-mile long. DS-I-4 connects to this canal at gate 42. No visible date stamp is available for this segment of the canal.

DS-I-8

This newly discovered resource was identified during the intensive pedestrian survey and consists of a historic age irrigation drainage. The drainage is earthen and runs east to west. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately 0.25-miles long. No visible date stamp is available for the canal.

DS-I-9

This newly discovered resource was identified during the intensive pedestrian survey and consists of a historic age irrigation drainage. The canal is earthen and runs east to west; with the western end curving and continuing towards the south. The canal is approximately ten feet wide and five feet in depth. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately 0.70-miles long. No visible date stamp is available for the canal.

6 RESOURCE MANAGEMENT RECOMMENDATIONS

Dudek's Phase I cultural resources inventory of the Project APE suggests that there is a very low potential for the inadvertent discovery of intact cultural deposits during earth moving activities that will occur within agricultural fields. The fields have been extensively disturbed by decades of agricultural activities. Any archaeology that was present would have been disturbed by continuous agricultural activities and would no longer remain intact. However, there is a moderate potential for the inadvertent discovery of intact cultural deposits during earth moving activities related to the construction of the Project's generation interconnections (gen-tie). The gen-tie transmission lines are located outside of the agricultural fields and have not been subject to the same extensive agricultural disturbances. The gen-ties will be located at the south end of the Project site running south across Drew Road and State Route 98 into the existing Drew Switchyard located on APN 052-190-039. The gen-ties alignment will extend approximately 400 feet south of the southerly limits of the net farmable area of the Project APE. The gen-ties will consist of transmission structures that will require drilling to a maximum depth of 10 feet for pole foundations. Dudek recommends full time archaeological monitoring during drilling activities for the gen-tie. During archaeological monitoring for the gen-ties, if only disturbed sediments (e.g., fill) or other sediments and formations are identified that do not have the potential to contain archaeological resources, then monitoring may be reduced or terminated.

Nine newly identified historic age cultural resources were recorded during the intensive pedestrian survey. These new resources consist of irrigation canals and drainages. Based on historic aerials and available date stamps, the canals are historic in age (circa 1950s). The canals are built environment resources and will be addressed in a separate study and included as an addendum to the current cultural resources inventory report (Corder and Murray 2018).

Unanticipated Discovery of Archaeological Resources

In the event that archaeological resources (sites, features, or artifacts) are exposed during construction activities for the Project, all construction work occurring within 100 feet of the find shall immediately stop until a qualified archaeologist meeting the Secretary of the Interior's Professional Qualification Standards can evaluate the significance of the find and determine whether or not additional study is warranted. If the discovery is clearly not significant (e.g., and isolate) the archaeologist may simply record the find and allow work to continue. If the discovery proves potentially significant under CEQA, additional work such as preparation of an archaeological treatment plan, testing, or data recovery may be warranted.

Unanticipated Discovery of Human Remains

In accordance with Section 7050.5 of the California Health and Safety Code, if human remains are found, the County Coroner shall be immediately notified of the discovery. No further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent remains shall occur until the County Coroner has determined, within 2 working days of notification of the discovery, the appropriate treatment and disposition of the human remains. If the County Coroner determines that the remains are, or are believed to be, Native American, he or she shall notify the NAHC in Sacramento within 24 hours. In accordance with California Public Resources Code Section 5097.98, the NAHC must immediately notify those persons it believes to be the MLD from the deceased Native American. The MLD shall complete inspection within 48 hours of being granted access to the site. The designated Native American representative would then determine, in consultation with the property owner, the disposition of the human remains.

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CONFIDENTIAL APPENDIX A

SCIC Records Search Results

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CALIFORNIA HISTORICAL RESOURCES INFORMATION SYSTEM
CLIENT IN-HOUSE RECORDS SEARCH

Company: Dudek

Company Representative: Angie Pham

Date: 11/15/2017

Project Identification: Drew Solar

Search Radius: 1 mile

Historical Resources: SELF

Trinomial and Primary site maps have been reviewed. All sites within the project boundaries and the specified radius of the project area have been plotted. Copies of the site record forms have been included for all recorded sites.

Previous Survey Report Boundaries: SELF

Project boundary maps have been reviewed. National Archaeological Database (NADB) citations for reports within the project boundaries and within the specified radius of the project area have been included.

Historic Addresses: SELF

A map and database of historic properties (formerly Geofinder) has been included.

Historic Maps: SELF

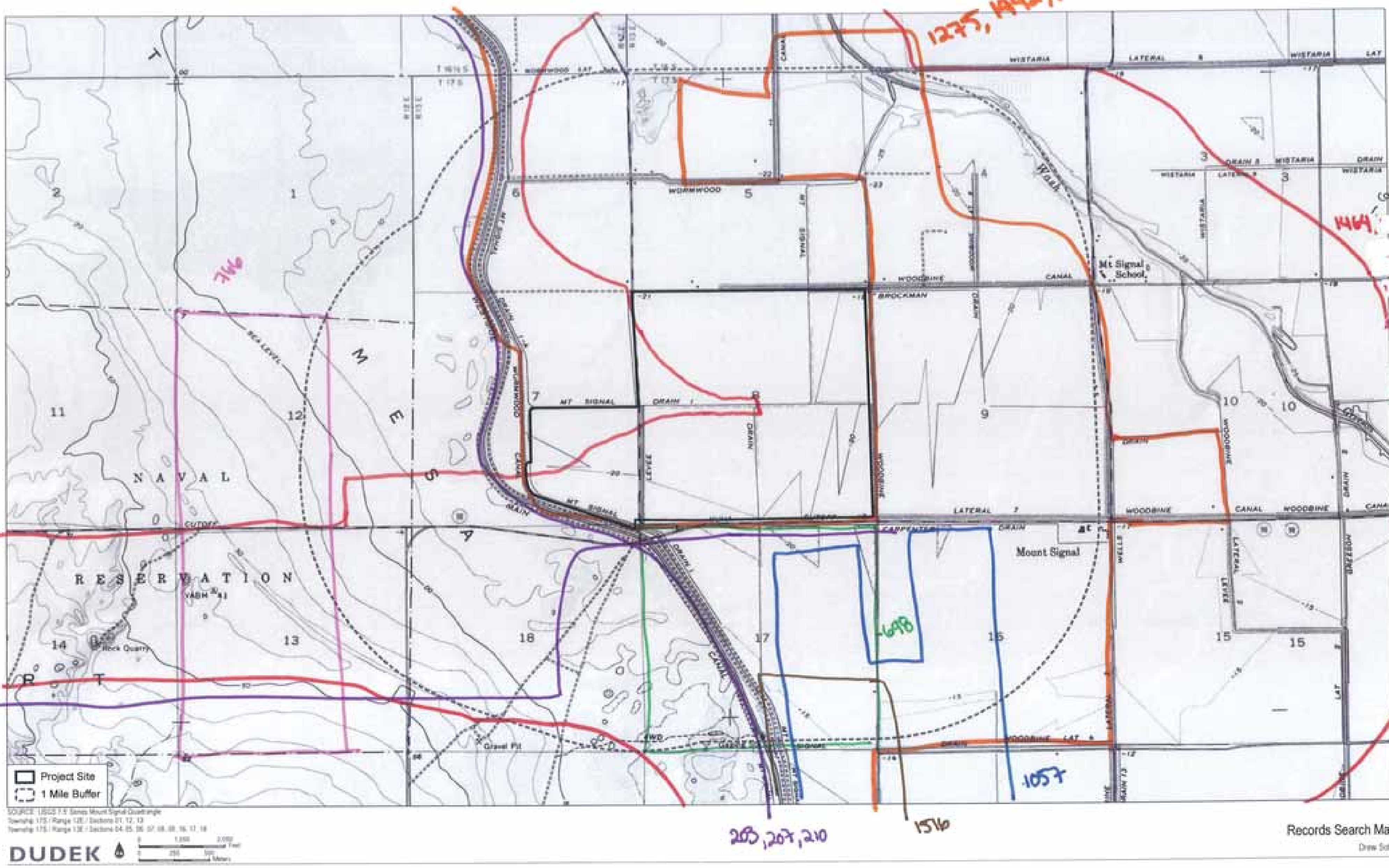
The historic maps on file at the South Coastal Information Center have been reviewed, and copies have been included.

Copies: 17

Hours: 1.5

This is not an invoice. Please pay from the monthly billing statement

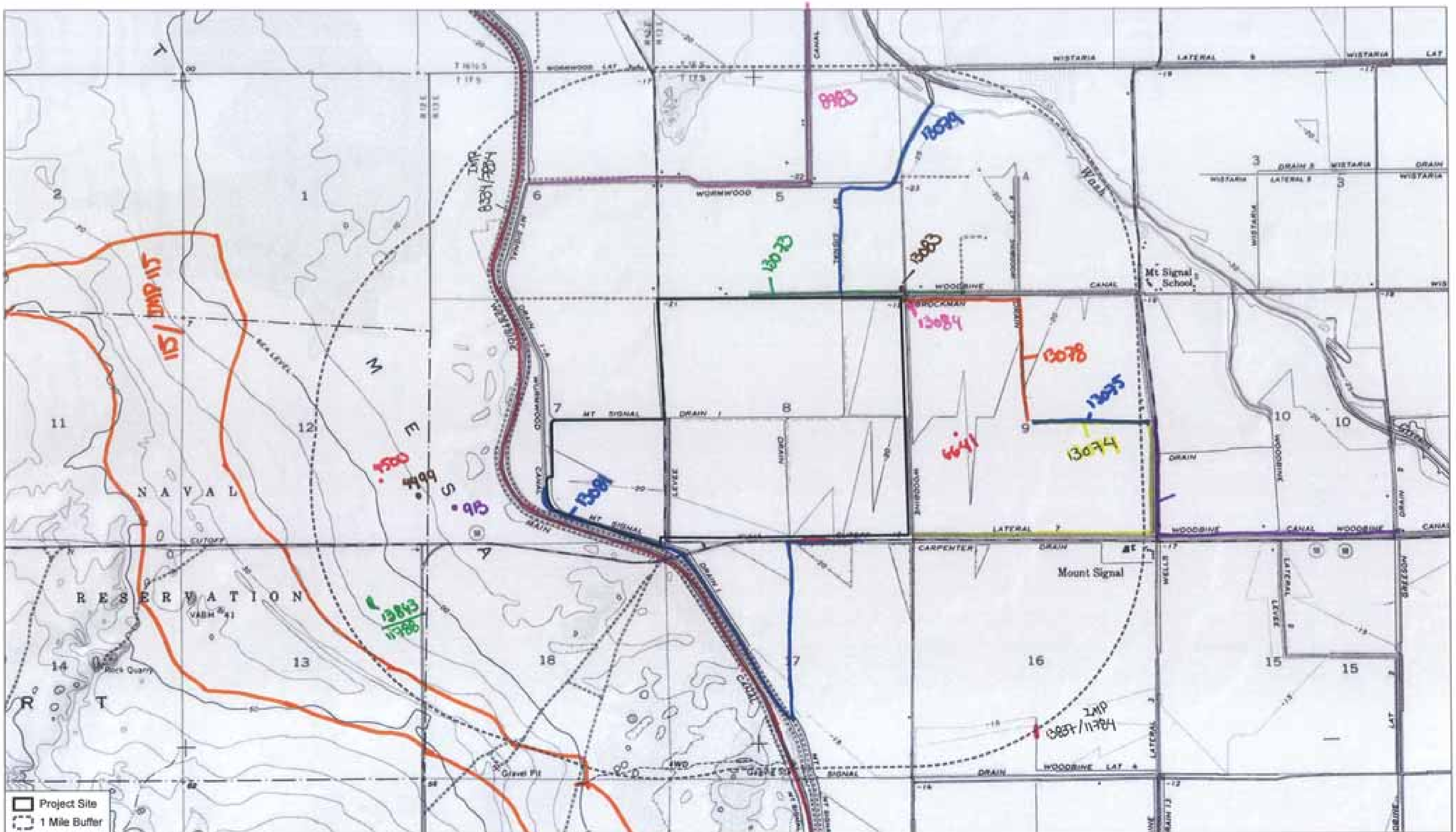
Report ID: 1464 w/i project area
1515, 1442 adjacent



Records Search Map

Drew Solar

Resources: 17, outside/adjacent to project area



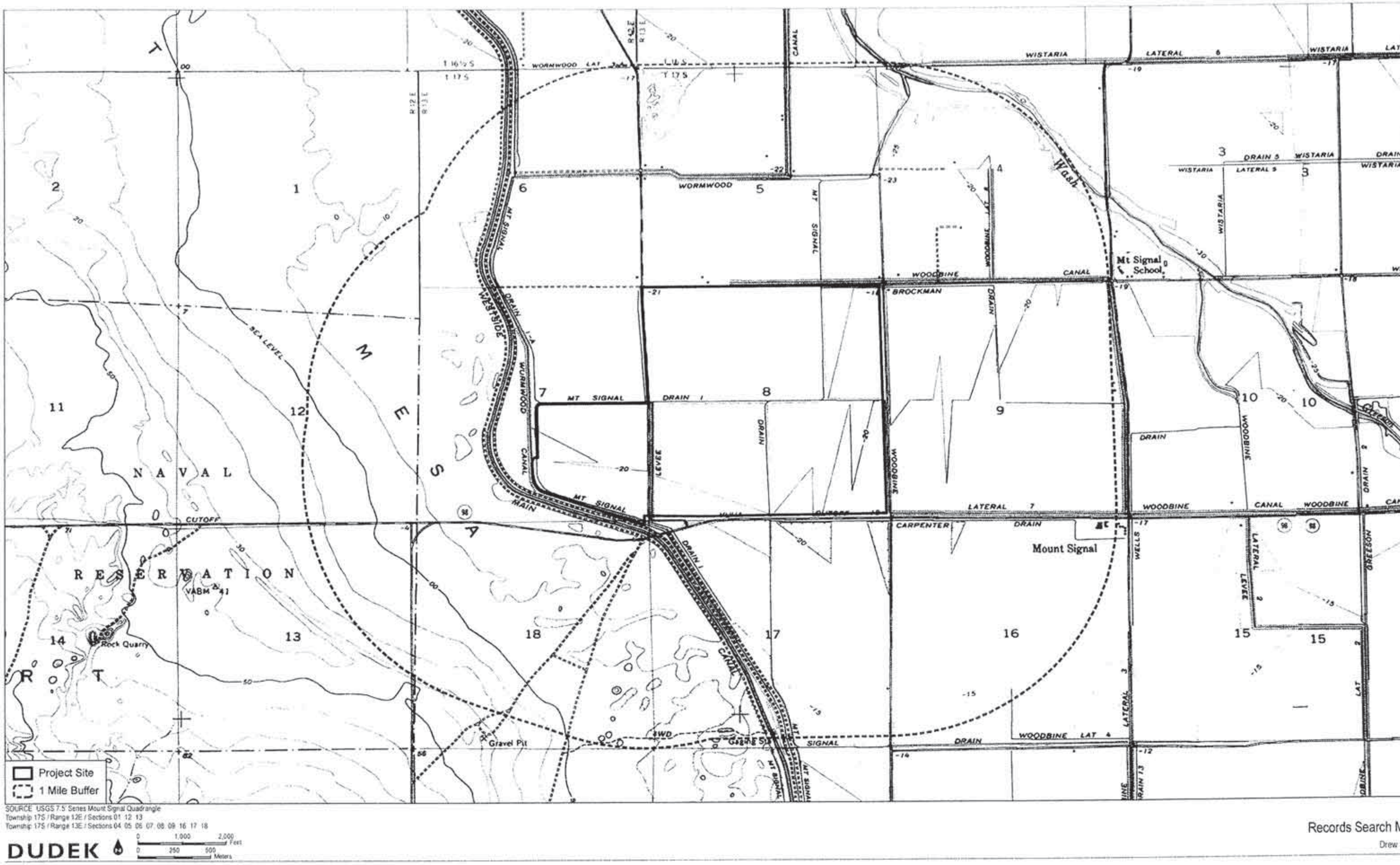
SOURCE: USGS 7.5' Series Mount Signal Quadrangle
Township 17S / Range 13E / Sections 01, 12, 13
Township 17S / Range 13E / Sections 04, 05, 06, 07, 08, 09, 16, 17, 18

DUDEK

Records Search Map

Drew Solar

Historic addresses: None



SOURCE: USGS 7.5' Series Mount Signal Quadrangle
Township 17S / Range 12E / Sections 01 12 13
Township 17S / Range 13E / Sections 04 05 06 07 08 09 16 17 18

DUDEK

Records Search Map
Drew Solar

ReportNum	DocAddlCitLetter	IsVoided	IsMissing	IDs	Xrefs
IM-00203		No	No	NADB-R - 1100203; Voided - GALLED01	
IM-00207		No	No	NADB-R - 1100207; Voided - DAVISE03	
IM-00210		No	No	NADB-R - 1100210; Voided - VONWEJ114	
IM-00698		No	No	NADB-R - 1100698; Voided - HUPPJ01	
IM-00766		No	No	NADB-R - 1100766; Voided - SCHAEJ37	
IM-01057		No	No	NADB-R - 1101057; Voided - PIGNIA04	

IM-01275		No	No	NADB-R - 1101275; Voided - RITTEE04	
IM-01442		No	No	NADB-R - 1101442; Voided - PIGNIA10	
IM-01464		No	No	NADB-R - 1101464; Voided - MITCHPA01	
IM-01490		No	No	NADB-R - 1101490; Voided - MITCHPA06	
IM-01498		No	No	NADB-R - 1101498; Voided - GLENNYW01	

IM-01515		No	No	NADB-R - 1101515; Voided - DAVISSH01	
IM-01516		No	No	NADB-R - 1101516; Voided - DAVISSH02	

Authors	CitYear	CitMonth
GALLEGOS, DENNIS	1979	
DAVIS, EMMA LOU	1980	
VON WERLHOF, JAY and KAREN MCNITT	1980	
HUPP, JILL	1999	
SCHAEFER, JERRY, DREW PALLETTE, COLLIN O'NEILL, and JIM EIGHMEY	1999	
PIGNIOLO, ANDREW, ROXANNA PHILLIPS, and DENNIS GALLEGOS	1990	

RITTER, ERIC W.	1975	
PIGNIOLO, ANDREW R., CAROL SERR, JOSE "PEPE" AGUILAR, and FRANK DITTMER	2011	
MITCHELL, PATRICIA T.	2011	
MITCHELL, PATRICIA T.	2012	
GLENNY, WAYNE	2011	

DAVIS, SHANNON, JENNIFER KRINTZ, SHELBY GUNDERMAN, and SINEAD NI GHABHLAIN	2011	
DAVIS, SHANNON	2011	

CitTitle	CitPublisher
CLASS II CULTURAL RESOURCE INVENTORY EAST MESA AND WEST MESA REGIONS IMPERIAL VALLEY, CALIFORNIA, VOLUME I	WESTEC SERVICES, INC.
CLASS II CULTURAL RESOURCE INVENTORY EAST MESA AND WEST MESA REGIONS IMPERIAL VALLEY, CALIFORNIA	WESTEC SERVICES, INC.
ARCHAEOLOGICAL EXAMINATIONS OF THE REPUBLIC GEOTHERMAL FIELD, EAST MESA, IMPERIAL COUNTY	IMPERIAL VALLEY COLLEGE MUSEUM
HISTORICAL ARCHITECTURAL SURVEY REPORT PAVEMENT REHABILITATION AND SHOULDER, BRIDGE, CULVERT WIDENING PROJECT, IMPERIAL COUNTY, CALIFORNIA	CALIFORNIA DEPARTMENT OF TRANSPORTATION
EXTENDED PHASE I STUDY OF EIGHT ARCHAEOLOGICAL SITES (CA-IMP-1427, -3969, -6914, -6915, -6916, -6918, -6920, -6923) ON STATE ROUTE 98, IMPERIAL COUNTY, CALIFORNIA	ASM AFFILIATES
CULTURAL RESOURCE STUDY OF THE MOUNT SIGNAL AND DIXIE RANCH IMPERIAL COUNTY PRISON ALTERNATIVES IMPERIAL COUNTY, CALIFORNIA	ERC ENVIRONMENTAL AND ENERGY SERVICES COMPANY, INC

AN ANALYSIS OF CULTURE RESOURCES ALONG THE PROPOSED YUHA DESERT ORV COURSES	
CULTURAL RESOURCE SURVEY FOR A PORTION OF THE CENTINELA SOLAR ENERGY, LLC PROJECT AREA IMPERIAL COUNTY, CALIFORNIA	LAGUNA MOUNTAIN ENVIRONMENTAL, INC.
INVENTORY REPORT OF THE CULTURAL RESOURCES WITHIN THE CENTINELA SOLAR ENERGY GEN-TIE LINE, IMPERIAL COUNTY, CALIFORNIA	KP ENVIRONMENTAL, LLC
EVALUATION LETTER REPORT FOR THE CENTINELA SOLAR ENERGY GEN-TIE LINE PROJECT, IMPERIAL COUNTY, CALIFORNIA	KP ENVIRONMENTAL, LLC
DRAFT ARCHAEOLOGICAL SURVEY INVESTIGATION FOR THE SAN DIEGO COUNTY WATER AUTHORITY FISH POND IMPERIAL COUNTY, CALIFORNIA	AECOM

INVENTORY, EVALUATION, AND ANALYSIS OF EFFECTS ON HISTORIC RESOURCES WITHIN THE AREA OF POTENTIAL EFFECT OF THE CENTINELA SOLAR ENERGY, LLC IMPERIAL COUNTY, CALIFORNIA	ASM AFFILIATES, INC.
FINAL INVENTORY, EVALUATION AND ANALYSIS OF EFFECTS ON HISTORIC BUILT ENVIRONMENT PROPERTIES WITHIN THE AREA OF POTENTIAL EFFECT OF THE IMPERIAL SOLAR ENERGY CENTER SOUTH IMPERIAL COUNTY, CALIFORNIA	ASM AFFILIATES, INC.

CitPages	CitMaps	ReportType	InventorySize
		Archaeological, Evaluation, Other research	
		Archaeological, Evaluation, Other research	
		Archaeological, Evaluation, Other research	
		Archaeological, Evaluation, Other research	
		Archaeological, Evaluation, Other research	
		Archaeological, Evaluation, Other research	

Archaeological, Evaluation, Other research	
Archaeological, Evaluation, Other research	
Archaeological, Evaluation, Other research	267 ACRES
Archaeological, Evaluation, Other research	
Archaeological, Evaluation, Other research	

Archaeological, Evaluation, Other research	
Archaeological, Evaluation, Other research	

InventoryDisclosure	InventoryCollections	InventoryNotes	Resources	ResourceCount
		[NADB Keywords: DIGITAL REPORT, UNKNOWN FINDINGS]		0
		[NADB Keywords: UNKNOWN FINDINGS]		0
		[NADB Keywords: UNKNOWN FINDINGS]		0
		[NADB Keywords: UNKNOWN FINDINGS]		0
		[NADB Keywords: CHIPPING STATIONS, LITHIC SCATTERS, UNKNOWN FINDINGS]	13-001427, 13-003969, 13-006914, 13-006915, 13-006916, 13-006920, 13-006923	7
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		[NADB Keywords: UNKNOWN FINDINGS]		0
		[NADB Keywords: ANCIENT LAKE CAHUILLA, COLORADO DESERT, DIGITAL REPORT, HISTORIC IRRIGATION SYSTEM STRUCTURES, HISTORIC RESIDENTIAL STRUCTURES, UNKNOWN FINDINGS]		0
		[NADB Keywords: CAHUILLA, CERAMIC SCATTER, COCOPAH, DIGITAL REPORT, GLASS MEDICINE BOTTLE, HABITATION SITE, HISTORIC, ISOLATES, KAMAI/KUMEYAAY, LITHIC SCATTER, LITHICS, MILK CAN, PEDESTRIAN SURVEY, POTTERY, PREHISTORIC, QUECHAN, UNKNOWN FINDINGS]	13-001403, 13-003999, 13-004246, 13-006681, 13-008405, 13-013548, 13-013552, 13-013553, 13-013554, 13-013555, 13-013556, 13-013557, 13-013558, 13-013559, 13-013560	15
		[NADB Keywords: CHERT DEBITAGE, DIGITAL REPORT, NEGATIVE FINDINGS, QUARTZ FLAKE, VOLCANIC FLAKE]	13-003999, 13-013842	2
		[NADB Keywords: DIGITAL REPORT, NEGATIVE SURVEY, SURVEY]		0

		[NADB Keywords: ATMOSPHERIC EFFECTS, DIGITAL REPORT, HISTORIC, POSITIVE FINDINGS, PREHISTORIC, STRUCTURES, SURVEY]		0
		[NADB Keywords: ALL-AMERICAN CANAL, BUILT-ENVIRONMENT INVENTORY, DIGITAL REPORT, SURVEY, UNKNOWN FINDINGS, WESTSIDE MAIN CANAL]		0

HasInformals	Counties	Maps	Addresses	PLSS
No	Imperial	Acolita, Amos, Bonds Corner, Cactus, Coyote Wells, Glamis NW, Glamis SE, Glamis SW, Grays Well, Holtville East, Holtville NE, Midway Well, Midway Well NW, Mount Signal, Painted Gorge, Plaster City, Yuha Basin		
No	Imperial	Acolita, Amos, Bonds Corner, Cactus, Coyote Wells, Glamis NW, Glamis SE, Glamis SW, Grays Well, Holtville East, Holtville NE, Midway Well, Midway Well NW, Mount Signal, Painted Gorge, Plaster City, Yuha Basin		
No	Imperial	Acolita, Amos, Bonds Corner, Cactus, Coyote Wells, Glamis NW, Glamis SE, Glamis SW, Grays Well, Holtville East, Holtville NE, Midway Well, Midway Well NW, Mount Signal, Painted Gorge, Plaster City, Yuha Basin		
No	Imperial	Heber, Holtville East, Mount Signal, Nine Mile Wash		
No	Imperial	Coyote Wells, Durmid, In-Ko-Pah Gorge, Iris Pass, Mount Signal, Nine Mile Wash		
No	Imperial	Mount Signal, Plaster City		

No	Imperial	Coyote Wells, Durmid, Mount Signal, Nine Mile Wash, Painted Gorge, Palo Verde, Plaster City, Plaster City NW, Yuha Basin		
No	Imperial	Mount Signal		
No	Imperial	Mount Signal		
No	Imperial	Mount Signal		
No	Imperial	Wister		

No	Imperial	Heber, Mount Signal		
No	Imperial	Mount Signal, Plaster City, Seeley, Yuha Basin		

State of California—The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

CONTINUATION SHEET

UPDATE

Primary #
HRI #
Trinomial 4-IMP-115 UPDATE

Page 1 of 1 *Resource Name or #: (Assigned by recorder) (C-180)

*Recorded By Judy Berryman/RECON *Date 4-23-01 ☐ Continuation ☒ Update

Site 4-IMP-115 (C-180) was recorded by Malcolm Rogers in the 1920's and described as Yuman II occupation along the 40' contour of the upper Blake Sea (Cahuilla Lake). The generalized site form noted scatter occupation along the edge of the extinct lake, with some evidence of depressed house floors, fire-affected sandstone, and lithic and ceramic scatters. Many of the sites recorded by later researchers can be included within the generalized C-180 location.

C-180 22:6 4 IMP 115 ~~122~~

C-180

LOCATION: R-12-E-T-17-S
R-13-E-T-17-S
Southwestern Imperial Co.

CULTURES: Yuman II

NAME: Signal Mt. Region

WATER CONDITIONS: Permanant lake.

AREA: Four mile strip from Signal Mt. to the International wash.

ARCHITECTURE: Some evidence of Depressed house floors and a few sandstone flag hearths.

TYPE: Blake Sea terrace of sand.

BURIALS: none found

PETROGRAPHY: none

INTRUSIVES:

HISTORY: First occupation is on the upper Blake Sea beach level. Lower lev poorly preserved, and the occupation on them is of an indefinite nature. The flooded level gives some indication in the way of travertine covered hearth stones and one metate.

REMARKS: Occupation is very scattered, but continuous without concentration Sandstone metates and manos prevelant, and one pestle found. Stucco ware is scarce, as is stone flaking. Many concretations found around the house site Relic hunters have looted this area thoroughly before we worked it.

C-180

Site Number 4-Imp-115

Date issued ______ by ______
Date typed 12-8-80 by Renee Taylor
T & R Book by
Site Classification Card by
Mapped by L.C.
Encoded by L.C.
Copy to SHPO

IMPERIAL VALLEY COLLEGE MUSEUM

52/37

ARCHAEOLOGICAL SITE SURVEY RECORD

1. Map Mt. Signal 7.5 Year 57 2. County Imperial

3. T. 17s R. 13E : ___ ¼ of ___ ¼ of NE ¼ of SE ¼ of ___ ¼ of Section 18

4. Location Four mile strip from Signal Mt. to the International wash UTM Grid

5. Previous designation C 180, 4IMP122 6. Temporary field number

7. UTM: Zone 11, North 3615560, East 624310 8. Elevation -8'

9. Owner BLM Address 333 S. Waterman

City El Centro State Calif Zip 92243 Phone 352-5842

10. Present tenant

11. Type of site and description Occupational site on the Upper Black Sea beach level some evidence of Depressed house floors and a few sandstone flag hearths

12. Dimensions: N-S 5 m, E-W 4 m 13. Depth

14. Height ______ m 15. Flora

16. Fauna

17. Hydrology resource Permanent Lake

18. Soil of site Sand

19. Surrounding soil type Sand

20. Previous excavation ______ 21. Cultivation

22. Buildings, roads, etc.

23. Erosion

4/20/80

Site Number 4-IMP-115

24. Integrity of site: L____, M____, H____ Explain: ____________________

25. Possibility of destruction Relic hunters have looted this area thoroughly before we worked it

26. Cleared circles ____________________

27. Other features ____________________

28. Burial or cremation evidence None

29. Artifacts travertine covered hearth stones and one metate manos and one pestle found Stucco ware is scarce as is Stone flaking

30. Remarks ____________________

31. Published reference ____________________

32. IVCM Accession No. ____________________ 33. Sketch map ____________________

34. Photos ______ by ____________________ 35. Photo Call # ____________________

36. Date recorded ____________________ 37. Recorded by Malcom Rogers

38. Address ____________________ Phone ____________________

39. Survey crew ____________________

40. Site record update ____________________ by ____________________

CA-IMP-115
2849 III NE (YUHA BASIN)
Y U H A D E S E R T
W E S T M E S A
N A V A L R E S E R V A T I O N
Pinto Wash
Well
Gravel Pit
Gravel Pits
Rock Quarry
VABM 41
YUHA CUTOFF
SEA LEVEL
WORMWOOD CANAL
MAIN CANAL
MT SIGNAL
DRAIN 1
Gaging Sta
4WD
115
Mount Signal 7.5 1957 (1976)
T 17S
R 12E & 13E
Sec. 1, 2, 3, 10, 11,
12, 13, 14, 18 &
19

MAPPED
copy - BLM - ✓
913 - V

Imperial Valley College Museum

Site No. 4-Imp-~~1136~~

527.557

ARCHAEOLOGICAL SITE SURVEY RECORD

1. Map Mount Signal 2849B57 2. County Imperial

3. Twp. 17 S Range 13 E : ___ 1/4 of ___ 1/4 of SW 1/4 of SW 1/4 of Sec. 7

4. Location 200m north of Highway 98 approx. 3/4mi west of West side Main Canal.

UTM 3616600N, 622980E

5. On contour elevation - 10 feet

6. Previous designations for site HP-12/20/76-#1 4-IMP-1136

7. Owner not available 8. Address not available

City N/A Zip N/A 10. Phone N/A

11. Present tenant not available

12. Description and type of site single tool at mesquite hummoch.

Isolate

1X1 meter

13. Area Not available 14. Depth Not available 15. Height Not available

16. Vegetation mesquite creosote

16a. Animal Life rodents, rabbits

17. Nearest water Yuha Well

18. Soil of site sand

19. Surrounding soil type sand

20. Previous excavation none

21. Cultivation none 22. Erosion wind, rain

23. Buildings, roads, etc. Hiway 98

24. Possibility of destruction Pothunters

25. House pits none

913

Site No 4-IMP ~~1136~~

26. Other features None

27. Burial or cremation evidence none

28. Artifacts finger knife

29. Remarks None

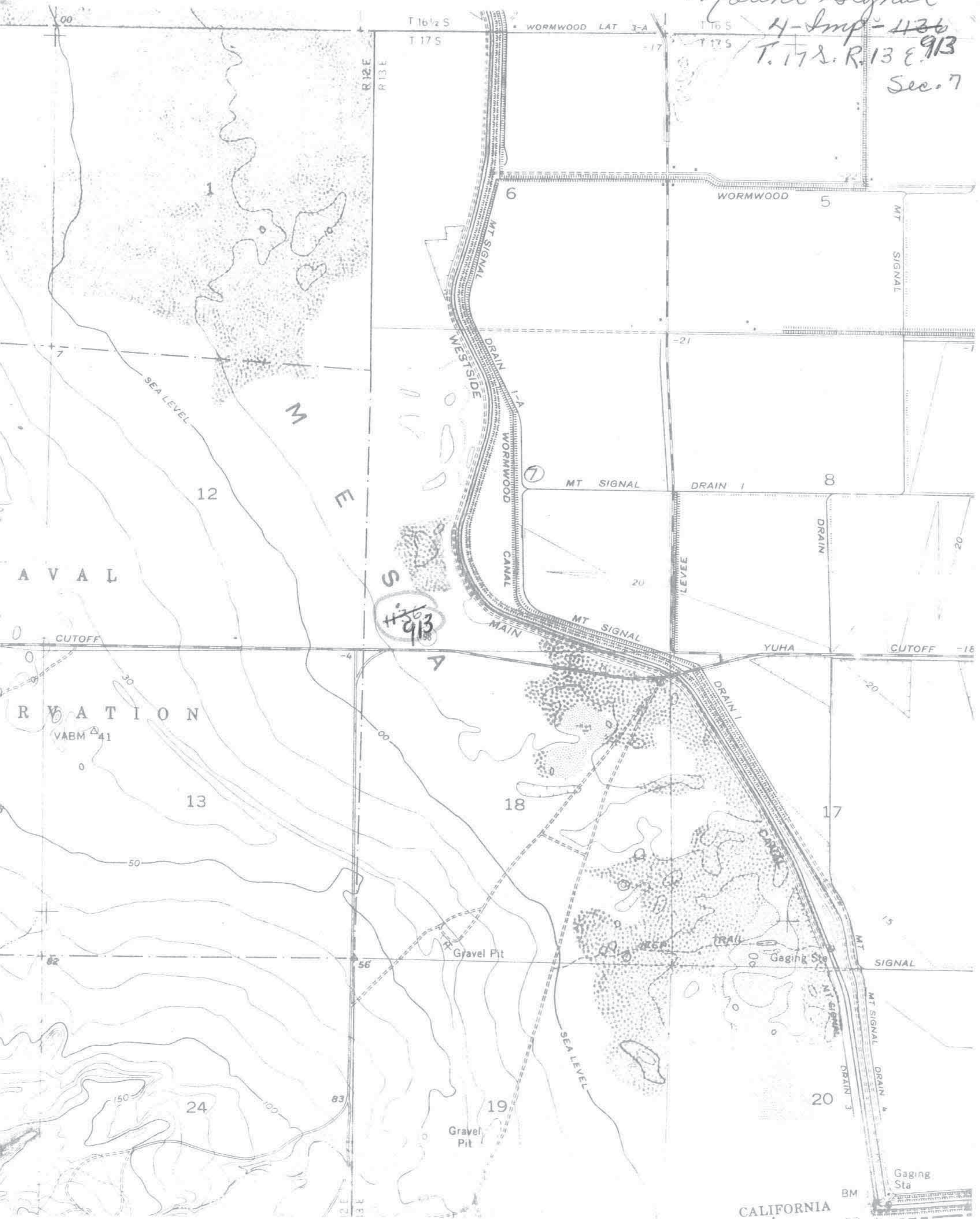
30. Published references none

31. IVCM Accession No. none 32. Sketch Map no 33. Photos no

34. Date 12-20-76 35. Recorded by H.E. Pretchett

36. Address El Centro CA 37. Phone 352-3692

Mount Signal
4-Imp-~~436~~ 913
T. 17 S. R. 13 E.
Sec. 7



4-IMP-4499

Site Number ___

Date issued 8-6-81 by E. C.
Date typed ___ by ___
T & R Book by Michael Stevenson
Site Classification Card by ___
Mapped by E. C. 8-10-81
Encoded by E. Collins
Copy to SHPO 1-10-82

IMPERIAL VALLEY COLLEGE MUSEUM

ARCHAEOLOGICAL SITE SURVEY RECORD

1. Map Mount Signal, Calif. 7.5' Year PI 1972 2. County Imperial

3. T. 17S R. 12E : ___ ¼ of ___ ¼ of SE ¼ of NE ¼ of SE ¼ of Section 12

4. Location Aprox. 580 meters West of Westside Main Canal and 400 meters North of Highway 98.

5. Previous designation None 6. Temporary field number R11-1

7. UTM: Zone 11, North 3616700, East 622720 8. Elevation -10 AMSL

9. Owner BLM Address 333 Waterman Avenue

City El Centro State CA Zip 92243 Phone 714-352-5842

10. Present tenant None

11. Type of site and description 16, ~~Isolate:~~ 4 pot sherds.

12. Dimensions: N-S 1 m, E-W 3 m 13. Depth Unknown/surface

14. Height N/A m 15. Flora Creosote bursage plant community.

16. Fauna --

17. Hydrology resource Receding Lake Cahuilla shoreline.

18. Soil of site Lacustrine sands.

19. Surrounding soil type Same

20. Previous excavation None 21. Cultivation None

22. Buildings, roads, etc. ORV activity

23. Erosion Sheet wash.

Site Number 4-IMP-4499

24. Integrity of site: L____, M X, H____ Explain: Sheet wash has probably moved this pot drop.

25. Possibility of destruction Slight orv activity.

26. Cleared circles None evident.

27. Other features None evident.

28. Burial or cremation evidence None observed.

29. Artifacts 4 Colorado Buff sherds.

30. Remarks

31. Published reference Report on file at CSRI

32. IVCM Accession No. ____ 33. Sketch map None

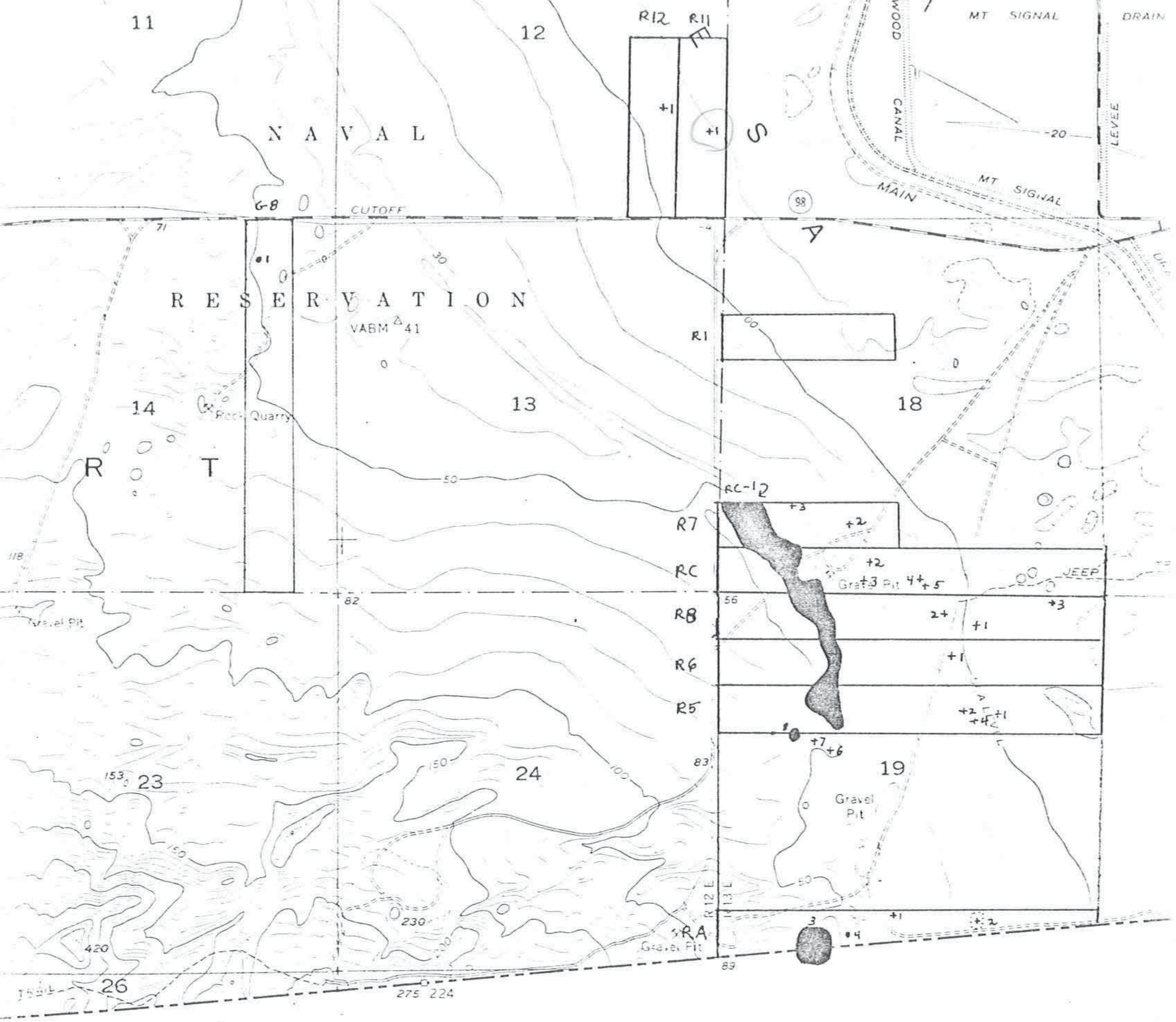
34. Photos No by ____ 35. Photo Call # ____

36. Date recorded 3 June 1981 37. Recorded by R. Nagle

38. Address CSRI, 8148 H Ronson Rd., San Diego, CA 92111 Phone 565-6332

39. Survey crew R. Nagle, L. Kline, K. Palmer, C. Lucas

40. Site record update ____ by ____



4-IMP-4496

MOUNT SIGNAL QUADRANGLE
CALIFORNIA–IMPERIAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 HEBER 15' QUADRANGLE

Site Number 4-IMP-4500

Date issued 8-6-81 by E. C.
Date typed ____ by ____
T & R Book by Michael Stevenson
Site Classification Card by ____
Mapped by E. C. 8-10-81
Encoded by E. Collins
Copy to SHPO 1-10-82

'ERIAL VALLEY COLLEGE MUSEUM

ARCHAEOLOGICAL SITE SURVEY RECORD

1. Map Mount Signal, Calif. 7.5' Year PI 1976 2. County Imperial
3. T. 17S R. 12E : ____ ¼ of ____ ¼ of SE ¼ of NE ¼ of SE ¼ of Section 12
4. Location Aprox. 780 meters West of Westside Main Canal and 500 meters North of Highway 98.
5. Previous designation None 6. Temporary field number R12-1
7. UTM: Zone 11, North 3616800, East 622500 8. Elevation -8 AMSL
9. Owner BLM Address 333 Waterman Avenue
City El Centro State CA Zip 92243 Phone 714-352-5842
10. Present tenant ____
11. Type of site and description 16, Isolate: Flake
12. Dimensions: N-S NA m, E-W NA m 13. Depth None evidenced
14. Height NA m 15. Flora Creosote bursage community.
16. Fauna --
17. Hydrology resource Relic receding Lake Cahuilla shoreline
Natural sink to North (see remarks)
18. Soil of site Sands and silts of lacustrine origin.
19. Surrounding soil type Same
20. Previous excavation None 21. Cultivation None
22. Buildings, roads, etc. Recent historic trash in vicinity on orv activity.
23. Erosion Sheet wash.

Site Number 4-IMP-44500

24. Integrity of site: L____, M____, H X Explain: No observable impacts.

25. Possibility of destruction Slight

26. Cleared circles None observed

27. Other features None observed

28. Burial or cremation evidence None observed

29. Artifacts 1 Felsite Flake primary decordal, slightly wind blasted, no patination, no varnish.

30. Remarks A series of very shallow sinks has formed behind a line of dunes that run along the zero contour. These sand dunes (Creosote anchored and Morman tea) may reflect a recessional shore stand of Lake Cahuilla.

31. Published reference Report on file at CSRI

32. IVCM Accession No. _____ 33. Sketch map No

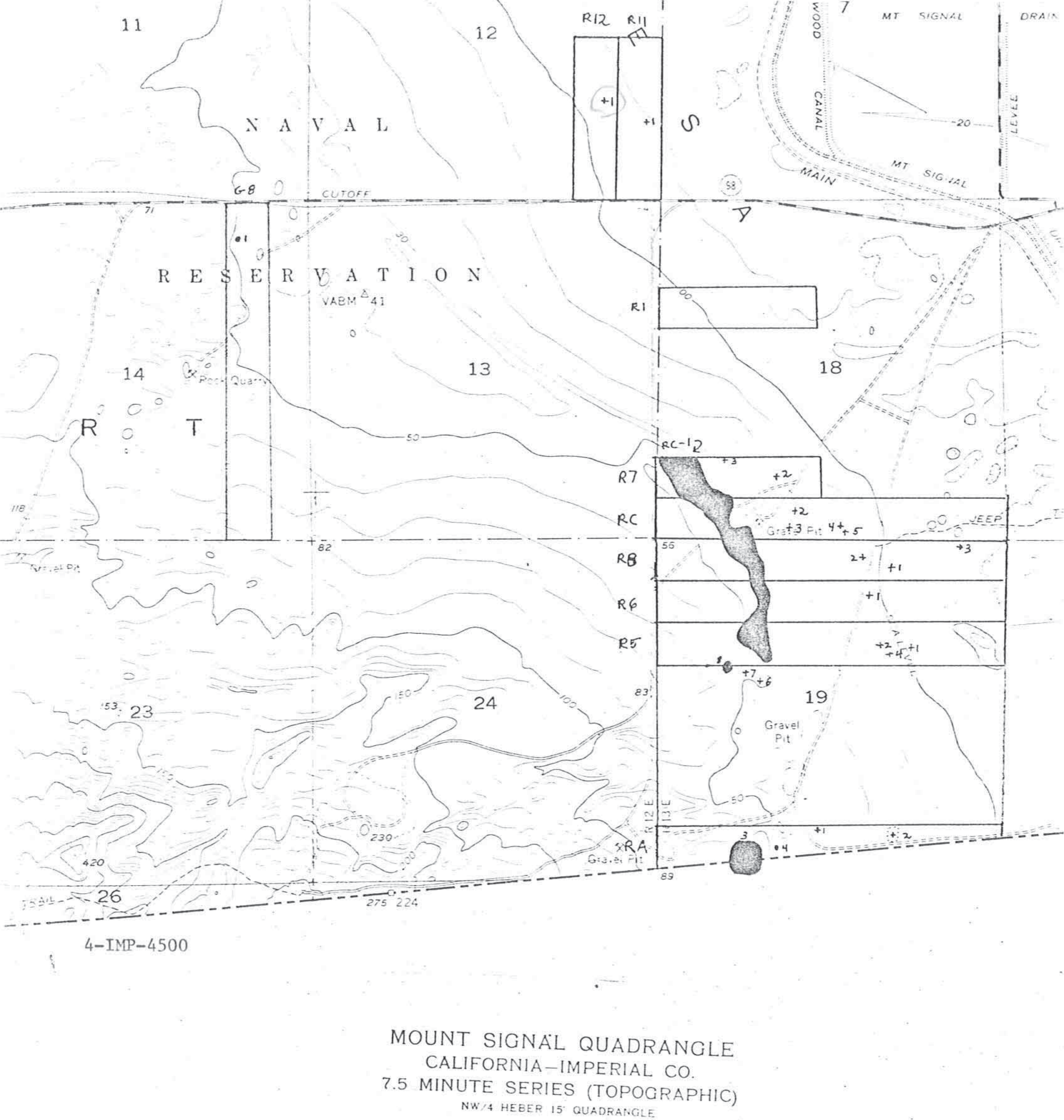
34. Photos Yes by D. Lavlander - Roll 2/26-2F 35. Photo Call # _____

36. Date recorded 3 June 1981 37. Recorded by P. Ainsworth

38. Address CSRI, Ronson Rd., San Diego, CA 92111 Phone 565-6332

39. Survey crew P. Ainsworth, B. Hill, D. Lavlander, F. Nelson

40. Site record update _____ by _____



4-IMP-4500

MOUNT SIGNAL QUADRANGLE
CALIFORNIA–IMPERIAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 HEBER 15' QUADRANGLE

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

ARCHEOLOGICAL SITE RECORD

Permanent Trinomial: 4-IMP-6641 10/91 **Supplement** ☐

Other Designations: ASA - 101

1. County: Imperial

2. USGS Quad: Mt. Signal (7.5') 57 (15') Photorevised 76

3. UTM Coordinates: Zone 11 626360 m Easting 3617160 m Northing ( )

4. Township 17S Range 13E ; SE ¼ of SE ¼ of NW ¼ of SW ¼ of Section 9 Base Mer. SBM ( )

5. Map Coordinates: 297 mmS 381 mmE (from NW corner of map) 6. Elevation 18 feet BMSL ( )

7. Location: 9.6 miles west of Calixico, California on Highway 98; .4 mile north. ( )

8. Prehistoric XX Historic ____ Protohistoric ____ 9. Site Description Low density lithic and ceramic scatter. ( )

10. Area Unknown m( )x Unknown m( ) ____ m².

Method of Determination: Unknown ( )

11. Depth: Unknown cm Method of Determination: Unknown ( )

12. Features: Unknown ( )

13. Artifacts: COLLECTED: 5 San Diego Brown I rim sherds; 4 Hakum Brown sherds; 1 unidentified buff drilled sherd; 35 unidentified sherds; 1 quartzite hammerstone; 1 fine grained volcanic core; 1 fine grained volcanic conves side scraper; 1 fine grained volcanic hammerstone; 2 chert flakes; 4 quartz flakes; 1 petrified wood flake; 3 fine grained volcanic flakes; 1 porphyry flake; 1 quartzite flake. ( )

14. Non-Artifactual Constituents and Faunal Remains: Unknown ( )

15. Date Recorded: 1956 16. Recorded By: Archaeological Survey Association ( )

17. Affiliation and Address University of California Redlands ( )

See Continuation Sheet (X)

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Permanent Trinomial: 4-IMP-6641 10 | 91
Mo. Yr.

ARCHEOLOGICAL SITE RECORD

Other Designations: ASA - 101

18. Human Remains: Unknown ( )

19. Site Disturbances: Unknown ( )

20. Nearest Water (type, distance and direction): Receeding ancient Lake Cahuilla at site. ( )

21. Vegetation Community (site vicinity): Lower Sonoran Desert Scrub Plant List ( )

22. Vegetation (on site): Same as line 21. ( )

23. Site Soil: Unknown ( )

24. Surrounding Soil: Unknown ( )

25. Geology: Unknown ( )

26. Landform: Unknown ( )

27. Slope: Unknown ( ) 28. Exposure: Unknown ( )

29. Landowner(s) (and/or tenants) and Address: Unknown ( )

30. Remarks: ( )

31. References: ( )

32. Name of Project: ASA Lake Cahuilla Shoreline Survey Project ( )

33. Type of Investigation: Unknown ( )

34. Site Accession Number: 1991-135 Curated At: IVC Museum ( )

35. Photos: Unknown ( )

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

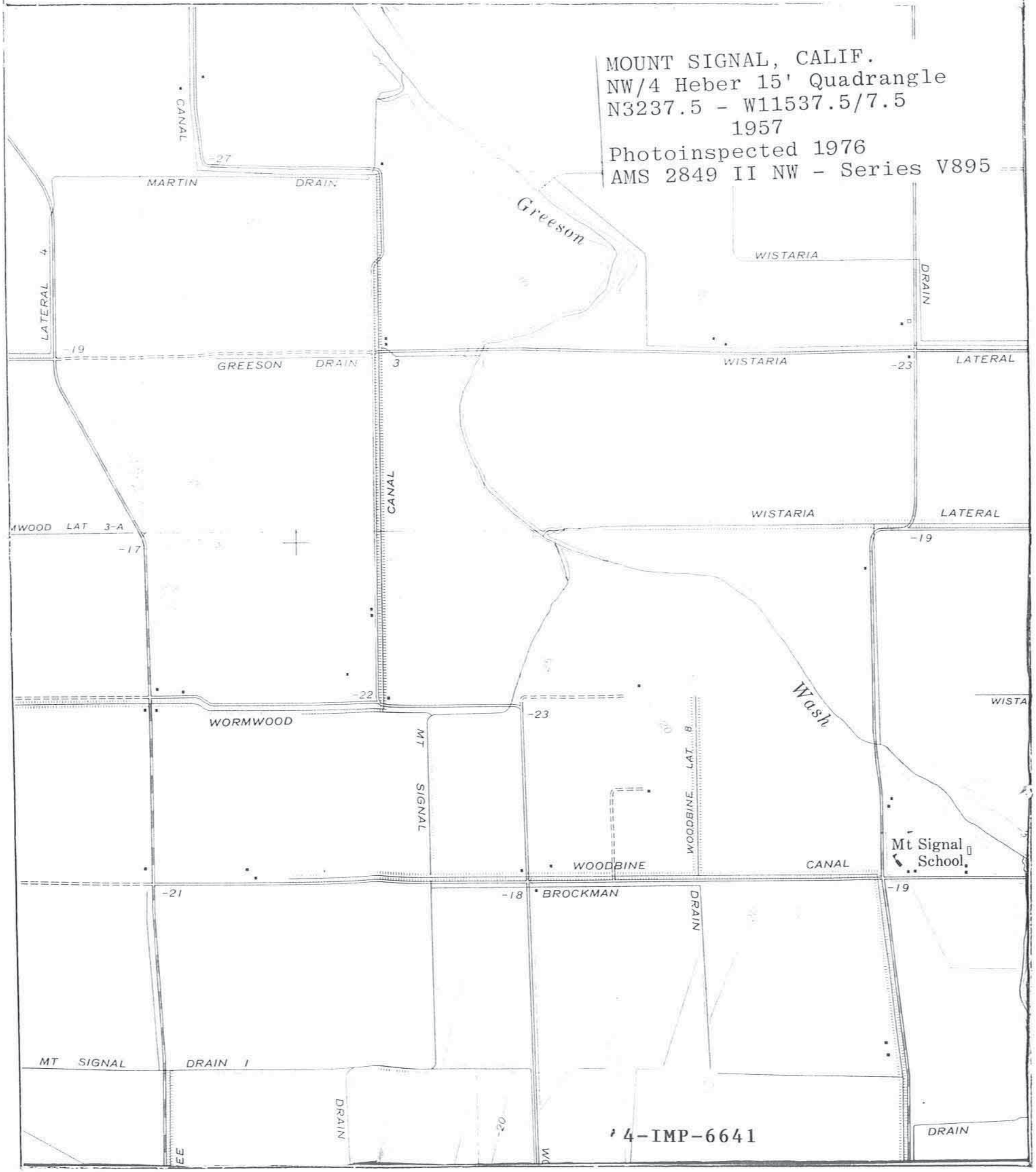
ARCHEOLOGICAL SITE LOCATION MAP

Page 3 of 3.

Permanent Trinomial: 4-IMP-6641 / 10/91 (mo. / yr.)

Temporary Number: ASA - 101

Agency Designation:



State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

MASTER FILE

ARCHEOLOGICAL DATA ENCODING SHEET

1. Site No.: CA – IMP – 6641 ____
2. Previous Designations: ASA-101
3. USGS Quad Map No. 52 Scale 7.5 Yr. 76
4. Base Meridan: ___1)MDM ___2)HBM ✓ 3)SBM
5. T 17S R 13E ¼¼Sec NW ¼Sec SW Sec 9
6. Latitude: ____ ° ____ ' ____ "
   Longitude: ____ ° ____ ' ____ "
7. UTM

UTM	Zone	Easting	Northing
A			
B			
C			
D			
Center	11	626360	3617160

8. Elevation: 18 ft. ____ m. Est. ____

For State Use Only

9. NR Class Category: ___1)district ___2)site ___3)building ___4)structure ___5)object
10. NR Status: ___1)listed ___Yr. ___Mo. ___2)eligible ___Yr. ___Mo. ___3)meets criteria ___4)undetermined ___5)ineligible
11. Other Registration: ___1)HABS ___2)HAER ___3)NHL ___4)SHP ___5)SCP ___6)CHL ___7)CPHI ___8)Local Listing ___9)County/Region. Pk. ___10)other

12. Type of Ownership: ✓ 1)unknown ___2)federal ___3)state ___4)private ___5)county ___6)city ___7)special district
13. Date Site Recorded: 56 Yr. – Mo
    Recorder: ASA
    RO IUCM
14. Site Record Update: ____ Yr. ____ Mo
    Recorder: ____
    RO ____
15. Ref. in Documented Survey ____ Yr. ____ Mo.
    Author: ____
16. Dimensions: N-S – . m E-W – . m
17. Area: ___.___ acres ___.___ hectares
18. Depth: ___.___ m
19. Site Attributes (Prehistoric): ___1)unknown ✓ 2)lithic scatter ✓ 3)ceramic scatter ___4)BRM/mill. feat. ___5)petroglyphs ___6)pictographs ___7)architec. feat. ___8)stone features ___9)burials ___10)caches ___11)hearths/pits ___12)quarry ___13)lineal features ___14)rock shelter/cave ___15)habitation debris ___16)other
20. Site Attributes (Historic): ___1)unknown ___2)foundations ___3)landscaping ___4)privy pits/dumps ___5)wells/cisterns ___6)water conveyance ___7)roads/R/R beds ___8)dams ___9)mines ___10)machinery ___11)walls/fences ___12)graves/cemetery ___13)wharfs ___14)ships/barges ___15)standing structures ___16)other
21. Historic Site Date: ____ – ____ (range)
22. Prehistoric Site Date: ____ – ____ (range)
23. Ethnic Association: ___1)unknown ✓ 2)Native American ___3)Asian-American ___4)Russian ___5)Afro-American ___6)Hispanic ___7)Euro-American ___8)other
24. Era: ___1)unknown ___2)ethnographic ___3)historic ✓ 4)prehistoric
25. Current Information Base: ___1)unknown ✓ 2)surface survey ✓ 3)surface collection ___4)subsurface testing ___5)excavation ___6)analysis ___7)other
26. Condition of Site: ✓ 1)unknown ___2)part. vandalized ___3)inundated ___4)part. eroded ___5)buried ___6)destroyed ___7)part. disturbed ___8)no impact ___9)other
27. Easement: ✓ 1)unknown ___2)yes ___3)no

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-008334 Update
HRI #
Trinomial
NRHP Status Code
Other Listings
Review Code Reviewer Date

 ***Resource Name or #** Westside Main Canal

P1. Other Identifier: Westside Main Canal
***P2. Location:** ☐ Not for Publication ☒ Unrestricted ***a. County** Imperial County
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
***b. USGS 7.5'** Plaster City **Quad Date** 1979 **T R**; ¼ **of Sec** 7; SB **B.M.**
c. Address City Zip
d. UTM: Zone 11S; 613474.85 mE/ 3628580.65 mN (Northern terminus within the APE)
Zone 11S; 615427.74 mE/ 3628580.65 mN (Southern terminus within the APE)
e. Other Locational Data:

***P3a. Description:**
This site form updates a 7 mile segment of the forty mile Westside Main Canal alignment. The Westside Main Canal is an irrigation canal that runs though agricultural land in the Imperial Valley section of Imperial County. The northern terminus of the recorded segment is located .25 miles east of Centinela State Prison in Imperial, CA (UTMs Zone 11S; 613474.85_mE/ 3628580.65_mN). After the canal passes under Interstate 8 the route orients to the southeast. The remainder of the route curves and the southern terminus of the recorded segment ends .25 miles east of the intersection at Mandrapa and Liebert in Imperial, CA (UTMs Zone 11S; 615427.74_mE/ 3628580.65 mN). The canal is approximately 75 feet wide. It is banked by earthen levees of vegetation and is unlined. Dirt access roads run along the levees on both sides of the canal for maintenance and dredging access.

***P3b. Resource Attributes:** HP. 20 Canal/Aqueduct
***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5b. Description of Photo:
Camera facing south; 07/20/2011; DSCN_9772

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
c. 1906/*IMP-98 HASR*, 1999.

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd
Imperial, CA 92251

***P8. Recorded by:**
AECOM
1420 Kettner Blvd., Suite 500
San Diego, CA 92101

***P9. Date Recorded:** 07/20/2011

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** *BUILT ENVIRONMENT SURVEY REPORT ADDENDUM TO THE CULTURAL RESOURCES INVESITGATIONS CLASS III REPORT FOR THE IID DIXIELAND 230 kV TRANSMISSION LINE AND SUBSTATION EXPANSION PROJECT, IMPERIAL COUNTIES, CALIFORNIA*, AECOM 2012
***Attachments:** NONE ☒ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☒ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (list)

L1. Historic and/or Common Name: Westside Main Canal

L2a. Portion Described: ☐ Entire Resource ☒ Segment ☐ Point Observation **Designation:**

b. Location of point or segment:

The northern terminus of the recorded segment can be reached from El Centro by taking Interstate 8 west for 7 miles and exit towards Seeley traveling on Drew Road for one mile. Turn left on Drew Road and go west for 4 miles. The northern terminus of the recorded segment begins .25 miles east of Centila State Prison at UTMs Zone 11S; 613474.85_mE/ 3628580.65_mN.

L3. Description:

This site form updates a 7 mile segment of the forty mile Westside Main Canal alignment. The Westside Main Canal is an irrigation canal that runs though agricultural land in the Imperial Valley section of Imperial County. The northern terminus of the recorded segment enters the Area of Potential Effects (APE) .25 miles east of Centinela State Prison in Imperial, CA (UTMs Zone 11S; 613474.85_mE/ 3628580.65 mN). After the canal passes under Interstate 8 the route orients to southeast. The remainder of the route curves and the southern terminus of the recorded segment ends .25 miles east of the intersection at Mandrapa and Liebert in Imperial, CA (UTMs Zone 11S; 615427.74_mE/ 3628580.65_mN). The canal is approximately 75 feet wide running perpendicular to Hwy 80. It is banked by earthen levees of vegetation and is unlined. Dirt access roads run along the levees on both sides of the canal for maintenance and dredging access.

L4e. Sketch of Cross-Section (include scale) Facing:

L4. Dimensions:

a. Top Width 75 feet
b. Bottom Width unknown
c. Height or Depth 10 feet
d. Length of Segment 7 miles

L5. Associated Resources:

The Fox Glove Canal runs parallel to the Westside Main Canal.

L6. Setting:

Located in between Plaster City and Seeley, the canal is surrounded by primarily irrigated agricultural land. A variety of crops grow along this segment, as well as rural vegetation along its banks. Dirt access roads run parallel to the canal along its berms.

L7. Integrity Considerations:

The canal is currently in use and is regularly maintained to keep the banks properly groomed and the quantity of silt minimal.

L8b. Description of Photo, Map, or Drawing: Camera facing south; 07/20/2011; DSCN_8771

L9. Remarks:

L10. Form Prepared by:

AECOM
1420 Kettner Blvd., Suite 500
San Diego, CA 92101

L11. Date:

07/20/2011

State **of California – The Resources Agency** **DEPARTMENT OF PARKS AND RECREATION** **CONTINUATION SHEET**	**Primary #** P-13-008334 Update **HRI #** **Trinomial**

 ***Resource Name or #** Westside Main Canal

***Recorded by** AECOM ***Date** 07/20/2011 ☐ Continuation ☒ Update

This site form updates the 7-mile recorded segment of the larger 40 mile Westside Main Canal. P-13-008334 was recorded by Jill Hupp in 1999. During the current survey effort, the portion of the canal within the project area is earthen lined and is still in use today. While the canal has been recommended eligible for the National Register of Historic Places (NRHP), the portion of the canal within the proposed project area was examined in 1997 and 1998 and was recommended not eligible for the NRHP due to lack of integrity (Hupp 1999). Caltrans also evaluated a portion of the canal as it crosses under I-8. Caltrans determined that, under California Environmental Quality Act (CEQA), the portion of the canal under I-8 is not a historic resource and therefore is not eligible for the NRHP (Hupp 1999).

Bowden-Renna, Cheryl
2010 *Cultural Resources Investigations Class III Report for the IID Dixieland 230 kV Transmission Line and Substation Expansion Project, Imperial County, California*. Prepared by AECOM

Hupp, Jill
1999 P-13-008334 Site Form. Form on file at the South Coastal Information Center.

UPDATE

State of California – The Resources Agency **DEPARTMENT OF PARKS AND RECREATION** **CONTINUATION SHEET**	Primary #: P-13-008334 HRI# Trinomial CA-IMP-7834

Page 1 **of** 1 ***Resource Name or #:** (Assigned by recorder)

***Recorded by:** C. Bowden-Renna ***Date:** 1/2010 ☐ Continuation ■ Update

Site P-13-008334 was recorded by Jill Hupp in 1999. This site is the Westside Main Canal, which was built about 1906 as a part of the Imperial Irrigation District canal system within Imperial Valley. During the current survey effort, the portion of the canal within the project area is earthen lined and is still in use today. While the canal has been recommended eligible for the National Register of Historic Places (NRHP), the portion of the canal within the proposed project area was examined in 1997 and 1998 and was recommended not eligible for the NRHP due to lack of integrity (Hupp 1999). Caltrans also evaluated a portion of the canal as it crosses under I-8. Caltrans determined that, under California Environmental Quality Act (CEQA), the portion of the canal under I-8 is not a historic resource and therefore is not eligible for the NRHP (Hupp 1999).

Bowden-Renna, Cheryl

2010 *Cultural Resources Investigations Class III Report for the IID Dixieland 230 kV Transmission Line and Substation Expansion Project, Imperial County, California.* Prepared by AECOM.

Hupp, Jill

1999 P-13-008334 Site Form. Form on file at the South Coastal Information Center.

State of California — The Resources Agency **DEPARTMENT OF PARKS AND RECREATION** **PRIMARY RECORD**		**Primary #** P-13-008334 Update **HRI #** **Trinomial** CA-IMP-7834 Update **NRHP Status Code**
Other Listings **Review Code**	**Reviewer**	**Date**

Page 1 **of** 6 *__Resource Name or #:__ Westside Main Canal

P1. Other Identifier: Westside Main Canal

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted** ***a. County:** Imperial

***b. USGS 7.5' Quad:** Mount Signal **Date:** 2010 **T** 17S;**R** 12E/13E; of **Sec** 3, 2, 11, 12, 13, 24, 19, 20, 17, 21, **;S.B.B.M.**

c. Address: N/A City: N/A Zip: N/A

d. UTM: Zone: 11N; North end:620445mE/ 625496mN; South end: 625496mE/3613610mN (G.P.S.) NAD 83

e. Other Locational Data: Elevation: -7 m below sea level

Approximately seven miles west of El Centro along Hwy 8 is the intersection of Drew Road. When traveling west on Hwy 8 towards this intersection, take exit 107 for Drew Road toward Seeley. Merge onto Drew Road heading south bound. Continue along Drew Road for 2.3 miles to reach W Wixom Road. Turn west onto W Wixom Road and continue on this road for 1.4 miles to reach Liebert Road. Turn south onto Liebert Road and continue for 0.6 miles to reach Mandrapa Road. Turn west on Mandrapa Road; the Westside Main Canal flows adjacent to Mandrapa Road.

***P3a. Description:** Constructed in 1907, Site 13-8334 the Westside Main Canal, is part of the earliest irrigation system in the Imperial Valley, and was later integrated into the All-American Canal during the late 1930s. The All-American canal runs in an east-west direction just north of the international border with the U.S. and Mexico. The portion of the Westside Main canal as it passes through the APE is approximately 8 feet deep and 40 feet wide and is earthen lined. The portion of the Westside Main Canal that was surveyed includes a segment along the south side of Mandrapa Rd., between North Hyde Rd. to the west and Drew Rd. to the east. The Westside Main Canal was updated by Jennifer Krintz of ASM Affiliates in April 2011. The condition of the canal has not changed since its update by ASm Affiliates in April 2011.

***P3b. Resource Attributes:** HP20 Canal/Aqueduct

***P4. Resources Present:** ☐Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☒Other (Isolates, etc.)

P5a. Photo

P5b. Description of Photo: Westside Main Canal Facing east

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Boulevard
Imperial, CA 92251

***P8. Recorded by:**
C.Bodmer, B. Bartram, B. Johnson
T. Murphy, S. Wintergerst
Chambers Group Inc.,
5 Hutton Centre Drive, Ste. 750,
Santa Ana, CA 92707

***P9. Date Recorded:** 11/19/2011

***P10. Survey Type:** Pedestrian survey(15 meter transect intervals)

***P11. Report Citation:** A Class III Cultural Resources Inventory For The Agile Energy, Inc. Silverleaf Photovoltaic Solar Project Near The City Of El Centro, Imperial County, California

***Attachments:** ☐NONE ☒Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

Primary #
HRI#

BUILDING, STRUCTURE, AND OBJECT RECORD

***NRHP Status Code**

***Resource Name or #** (Assigned by recorder) Westside Main Canal

B1. Historic Name: Westside Main Canal
B2. Common Name: Westside Main Canal
B3. Original Use: Irrigation Ditch
B4. Present Use: Irrigation Ditch
***B5. Architectural Style:** N/A
***B6. Construction History:** The Westside Main Canal was constructed in 1908 as an earthen canal, banked by earthen levees, approximately 25 feet wide and 10 feet deep. Throughout the early twentieth century, the general alignment of this portion of the Westside Main Canal was not significantly altered. Based on the 1915 El Centro 15-minute USGS quadrangle maps, Albert G. Thurston's Imperial Valley Tract Map (1914), Blackburn's Map of Imperial County, California (1919, 1929, 1936, 1943, 1955 editions), the 1949 and 1976 USDA Aerial Collection, the 1957 Painted Gorge 7.5-Minute USGS quadrangle map, and the 1964 Western Portion of Blackburn's Map of Imperial County, the general course of the canal has remained consistent for most of its history.

***B7. Moved?** ☒**No** ☐**Yes** ☐**Unknown** **Date:** N/A **Original Location:** N/A
***B8. Related Features:** None

B9a. Architect: N/A
b. Builder: Imperial Irrigation District
***B10. Significance: Theme:** N/A **Area:** West El Centro, Imperial County
Period of Significance: N/A **Property Type:** Irrigation Ditch **Applicable Criteria:** N/A

In 1849, Dr. Oliver M Wozencraft, on his way to the gold fields of San Bernardino from New Orleans, traveled through the Imperial Valley and noted the region's soil fertility and potential for arability. He was likely the first person to recognize the Imperial Valley's potential for agriculture. Wozencraft believed he could construct a gravity canal from the Colorado River to the Imperial Valley, because the river was at a higher elevation than the valley (Garnholz 1991). Wozencraft's opinion of the fertile valley was reaffirmed in 1853 when Jefferson Davis, U.S. Secretary of the War Department, ordered a scientific expedition along the Colorado River for the placement of fortifications. In this expedition, led by Lieutenant R. S. Williamson and Professor William Phipps Blake, the particular fertility of the alluvial soil at the southern end of the Salton Sink was noted. Blake prophetically noted, "it is indeed a serious question, whether a canal would not cause the overflow once more of a vast surface, and refill, to a certain extent, the dry valley of the ancient lake" (Garnholz 1991). Blake's expedition scientifically described how the Colorado River had meandered through the valley, delivered enough silt to block the mouth of the Gulf of California, and recognized that the banks of the current Colorado River course were much higher than that of Imperial Valley (Smith 1979). During the nineteenth century, the Colorado River historically flooded the valley several times, specifically in 1840, 1842, 1852, 1859, and 1867 (Garnholz 1991). SEE CONTINUATION SHEET 523L (PAGE 3 AND 4).

B11. Additional Resource Attributes: (List attributes and codes) N/A

***B12. References:**
See Continuation Sheet 523L (Page 6)

B13. Remarks:

***B14. Evaluator:** Jeremy Hollins

***Date of Evaluation:** 04 / 2011

(This space reserved for official comments.)

(Sketch Map with north arrow required.)

See Continuation Sheet 523L (Page 5)

***Resource Name or #** (Assigned by recorder) Westside Main Canal

***Recorded by:** URS Corporation ***Date:** 05/2009 ☒ Continuation ☐ Update

With the information gathered from the scientific expedition, Wozencraft pressed California into granting him approximately 1,600 square miles or roughly ten million square acres (which included present-day Imperial County and portions of present-day Riverside County). However, the federal government retained title to the land in this region of California and Wozencraft was unable to convince Congress, even with the results of the scientific analysis of the valley, to support his efforts. Wozencraft then approached George Chaffey to finance the project. Chaffey, who would successfully spearhead irrigation projects in San Bernardino County and Australia, was also unconvinced and noted that the "Imperial Valley was to [sic] hot for white men to prosper" (Garnholz 1991). Chaffey would later change his mind and near the end of the nineteenth century led the effort to irrigate the valley. Still undeterred, Wozencraft hired the Los Angeles County surveyor, Ebenezeer Hadley, in 1860 to draw up a plan to irrigate the valley by diverting the Colorado River through the Alamo River (Garnholz 1991). Wozencraft eventually left California for Washington, D.C. to lobby Congress. He died several years later without ever convincing Congress and never seeing his dream fulfilled. While Wozencraft failed to create an irrigation network, his efforts during the mid-nineteenth century led the way for future development efforts.

In 1896, a group of investors formed the California Development Company (CDC) and followed Wozencraft's earlier attempts to irrigate the Imperial Valley. The group was led by Engineer Charles R. Rockwood and George Chaffey and they wanted to establish a canal, referred to as the "main channel," constructed from the Colorado River through the Imperial Valley using an ancient overflow channel of the Colorado known as the Alamo River (Sperry 1975). Chaffey, to avoid conflict with the Mexican government over land development since the canal was to be developed almost entirely on the south side of the border, established a subsidiary to the CDC known as the Sociedad de Irrgación y Terrenos de la Baja California (Smith 1979). By 1901, portions of the Imperial Valley were irrigated and attracted many new settlers and farmers from the Midwest.

One of the main problems throughout the entire canal venture project was constant silting, which needed consistent dredging of muck. The solution was to build a wooden, although supposedly temporary, structure referred to as the "Chaffey Gate" (Sperry 1975; Tout 1932). The year the gate was constructed (1904) was one of the wetter years on record and the gate was constructed too high on the riverbank. Arguments at the time seem to suggest that Chaffey had the gate constructed correctly, but that because the water level was high at the time, the engineer in charge of the project placed several removable flashboards in the bottom of the gate, which silted over rapidly (Sperry 1975). The next few years were very dry causing the canals' water level to drop precipitating the construction of more diversion and gates around the Chaffey gate. The year 1905, however, was extremely wet causing several flooding episodes with the fifth one completely destroying all remaining gates and dams along the canal network system. The Colorado River, originally flowing toward the Gulf of Californian, had changed its course and started flooding the Alamo River to the Salton Sink in Imperial Valley.

By 1905, over 80 miles of irrigation canals had been built, with more than 100,000 acres under cultivation. However, the design and construction of several poorly planned canals and ditches made water delivery service unreliable and inefficient. Large quantities of silt would block the canals' intakes and reduce the amount of water reaching Imperial Valley crops. A widespread flood in the winter of 1905-1906 caused extensive damage to railroad property, farmlands, and the newly constructed canal system. The CDC did not believe it was practical to reconstruct several of the canals, and as an alternative decided to enlarge the Westside Main Canal, which at the time was a wooden flume conveyance system located south in Mexico and known as the Encina Canal (Hupp 1999). The extension of the Westside Canal into the United States in approximately 1906 was intended to alleviate irrigation problems and spark development of the county west of the New River. By 1908, the Westside Main Canal extended into the Dixieland area of Imperial County. It was constructed as an earthen canal, banked by earthen levees, approximately 25 feet wide and 10 feet deep. Throughout the early twentieth century, the general alignment of the Westside Main Canal within the Dixieland area of Imperial County was not significantly altered. Based on the 1915 El Centro 15-minute USGS quadrangle maps, Albert G. Thurston's Imperial Valley Tract Map (1914), Blackburn's Map of Imperial County, California (1919, 1929, 1936, 1943, 1955 editions), the 1949 and 1976 USDA Aerial Collection, the 1957 Painted Gorge 7.5-Minute USGS quadrangle map, and the 1964 Western Portion of Blackburn's Map of Imperial County, the general course of the canal has remained consistent for most of its history.

By 1907, the Southern Pacific Railroad Company threatened a lawsuit against the CDC for flooding their railroad line along the Salton Sink. A year later, CDC reorganized and the board was taken over by Southern Pacific men, including Epes Randolph, who was the assistant to the president of the Southern Pacific (Sperry 1975). The task of returning the Colorado to its natural course heading toward the Gulf of California was such a daunting and expensive quest that the Southern Pacific eventually ended its association with the CDC. The Southern Pacific did, however, request over $3 million from the U.S. government for expenses incurred in turning the Colorado back toward the Gulf; the government awarded them $1 million 22 years later (Sperry 1975; Tout 1932). Only the construction of the Hoover Dam (then known as the Boulder Dam) in 1935 allowed for more effective control of the Colorado River for irrigation purposes.

The Imperial Irrigation District (IID) was organized in 1911 to acquire the land rights of the California Development Company (CDC), and its Mexican subsidiary Sociedad de Irrigacion y Terrenos de la Baja California, from the Southern Pacific. By the mid-1920s, IID was delivering water to over 500,000 acres of arable land (Imperial Irrigation District 1998). The Boulder Canyon Act, passed in 1928, authorized the Bureau of Reclamation to construct the Boulder Dam, completed in 1935, along the Colorado River. The Imperial Valley and IID benefited greatly as the Act and the dam provided immediate hydroelectric power to the valley. The Act also provided for the construction of the All-American Canal. In 1932, the Secretary of the Interior and IID signed an agreement to allow IID the utilization of hydroelectric power from the canal system for repaying the costs of the canal construction. The All-American Canal was begun in 1934 and the first diesel-generating plant was constructed near Brawley in 1936 (Imperial Irrigation District 1998). Subsequent hydroelectric plants were constructed in 1941. The All-American Canal was completed in 1941, and the Westside Main Canal was incorporated into the All-American Canal System upon its completion. The portions of the Westside Main Canal within Mexico were removed from the IID system.

***Resource Name or #** (Assigned by recorder) Westside Main Canal

***Recorded by:** URS Corporation   ***Date:** 03/2010   ☒ Continuation   ☐ Update

The Westside Main Canal system distributes irrigation water throughout Imperial County using a large network of smaller canals and drains. By the 1950s, regular dredging and widening of the canals were needed to alleviate problems from silt and other build-ups. This altered the structures' profiles, depth, and width, and improvements were also made to the canals' ceramic drain tiles and ditches. By the 1960s, IID had implemented a plan to start lining its earthen canals with concrete (Hupp 1999). Through the 1970s, due to IIDs ongoing preventive and reactive maintenance, many original construction materials and features were replaced. These alterations have impacted the canals' historic setting, but were necessary for the agriculture industry's expansion and success (Henderson 1968).

Based on Caltrans' earlier 1999 assessment, the Westside Main Canal, as a whole, reflects the development associated with the construction and operation of the All-American Canal between 1941 and 1950, which is primarily when the system was widened, shortened (portions in Mexico were removed from service), and modernized. The canal appears to be significant under Criterion A and C of the NRHP and Criterion 1 and 3 of the CRHR for its association with the development of irrigated commercial agriculture in the Imperial County west of the New River and as a good example of an early large-scale irrigation canal system. It does not appear to be associated with the lives of significant people or likely to yield important information in prehistory or history. Therefore, it does not appear to be significant under Criterion B and D of the NRHP and Criterion 2 and 4 of the CRHR. The canal was associated only for a short period with the CDC, from 1905 to 1911, nearly ten years after the company was established. Additionally, the canal was already in operation upon the forming of the IID, and does not reflect or convey the contributions of the IID to Imperial County.

Overall though, research conducted as part of Caltrans' 1999 assessment of the system found that the canal as a whole (while significant) does not retain a sufficient amount of its historic integrity to convey its significance due to regular dredging, grading, widening, and reconstruction that has occurred since the 1950s, though, an intensive survey of the entire canal has not occurred. The portion of the Westside Main Canal within the historic architecture APE also does not appear to possess sufficient integrity of workmanship, design, setting, feeling, and association (though it still retains sufficient historic integrity aspects of location and materials). Accordingly, it does not appear to be a contributing element or significant related feature/component to the larger linear Westside Main Canal system or individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA. While still earthen, extensive dredging and grading since the 1960s has changed the basic configuration of the canal, which has impacted its design, setting, and feeling. The canal currently has a U-shaped profile, whereas historically it was trapezoidal.

The addition of a non-historic period pipeline, and highway and railroad crossings over the canal in the historic architecture APE disrupt the property's integrity aspects of setting and feeling, since these elements are outside of the property's period of significance, 1941 to 1950. Accordingly, due to these alterations, the workmanship and association of the historic-period property in the APE has been lost, since there is little physical evidence of the crafts of a particular culture or people from the period of significance, and the property is not sufficiently intact to convey the direct link between significant events and the canal.

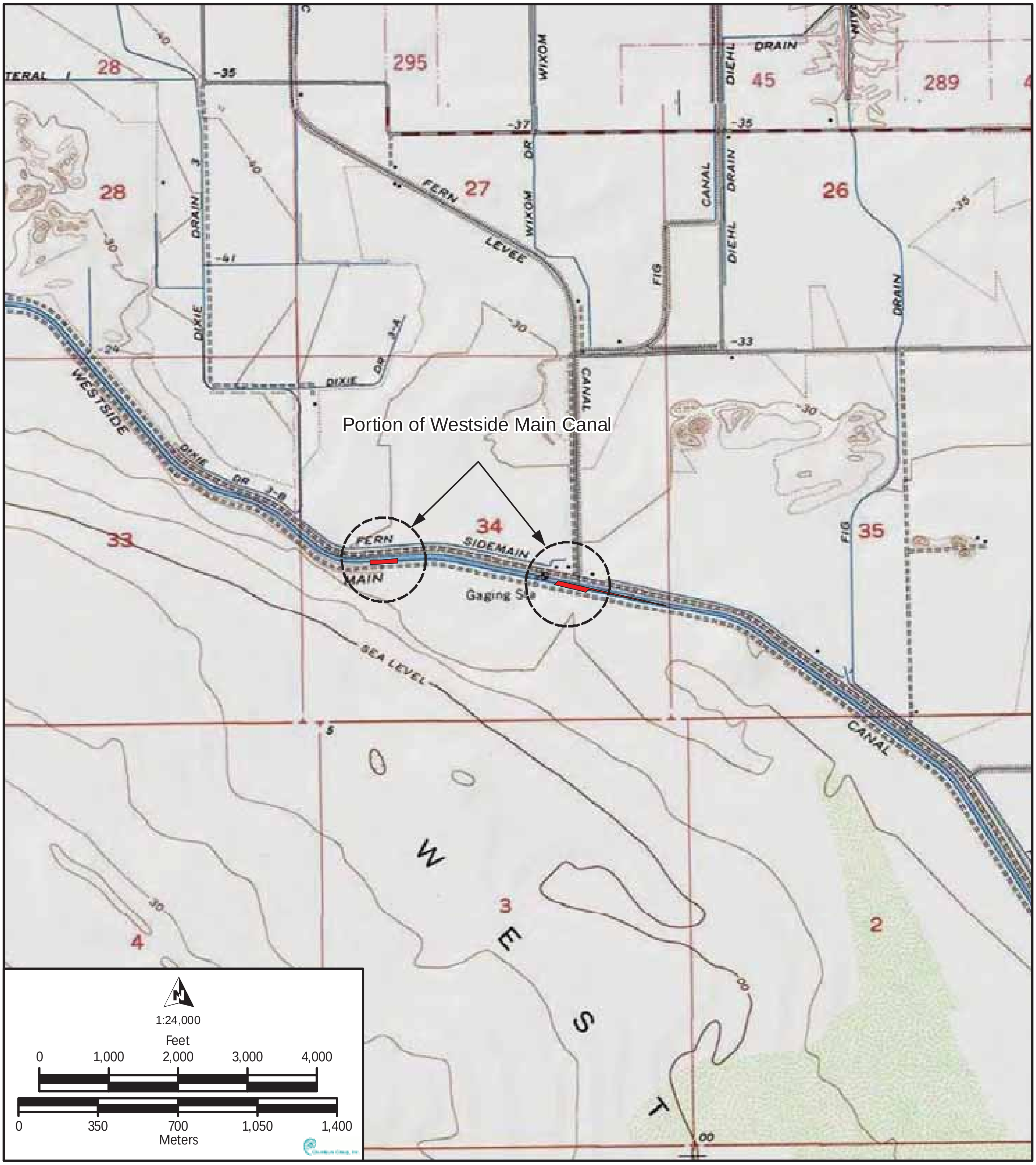
In summary, the portion of the Westside Main Canal within the historic architecture APE does not appear to be individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA, and does not appear to be a contributing element or significant related feature/component to the larger linear Westside Main Canal system (if it is determined that such a resource exists). Further, the addition of a proposed Solar Farm adjacent or perpendicular to the existing structure would not create a new adverse effect or significant impact.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LOCATION MAP

Primary # 13-8334
HRI#
Trinomial CA-IMP-7834

***Resource Name or #:** Westside Main Canal

***Map Name:** Mount Signal ***Scale:** 1:24,000 ***Date of Map:** 2010



***Resource Name or #** (Assigned by recorder) Westside Main Canal

***Recorded by:** URS Corporation ***Date:** 05/2009 ☒ Continuation ☐ Update

B12. References

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USGS. 1908. El Centro USGS Quadrangle Map.

USGS. 1915. El Centro 15-minute USGS Quadrangle Map.

USGS. 1943, 1957. Painted Gorge 7.5-minute USGS Quadrangle Maps.

USGS. 1940. Plaster City 15-Minute USGS Quadrangle Map.

USGS. 1943, 1944. Plaster City 1 to 62,500 Scale Map.

USGS. 1940. Brawley 15-minute USGS Quadrangle Map.

USGS. 1957. Brawley 7.5-minute USGS Quadrangle Map.

USGS. 1957, 1979. Seeley 7.5- minute USGS Quadrangle Map.

 *Resource Name or # (Assigned by recorder) Westside Main Canal – Pump 6

*Recorded by: Trish Mitchell, Erica Maier, and Heather Thomson: kp environmental, LLC and Alan Hatcher: Native American Monitor, Cocopah *Date: 01/24/2012 ☒ Continuation ☒ Update

CA-IMP-7834 was first recorded in 1999 by Jill Hupp who conducted extensive background research documenting the history of the Westside Main Canal. This resource has been recorded, evaluated, re-recorded, updated and re-evaluated nine times since it was first recorded in 1999. Each time only the portion of the canal within the project right-of-way was documented and ultimately evaluated for significance. As of 2011 (Davis et al. 2011; Mitchell 2011) the segments of the Westside Main Canal within the Campo Verde Solar Facility APE is determined eligible for listing in the NRHP and CRHR under Criterion A/1 for its significance in the development of the Imperial Valley. In 2001 the Bureau of Reclamation and the California SHPO concurred that the All-American canal is eligible for the NRHP under Criterion A and by extension the Westside Main Canal is as well (Hunt 2008). Davis concurred with this determination for the Campo Verde Solar Facility APE (Davis et al. 2011; Mitchell 2011). The Pump 6 segment of the Westside Main Canal that is recorded in the current survey area was not a part of Davis' 2011 evaluation. Chambers Group (2011) relocated the Pump 6 portion of the site during their November 2011 survey as previously recorded. KPE updated the Pump 6 site location to include a segment on the western end of the canal where the canal turns northwest and extends for another 900 feet.

Mitchell, Patricia T. 2012. Inventory Report of the Cultural Resources Recorded within the Campo Verde Solar Project BLM Gen-Tie Option Alternatives, Imperial County, California.

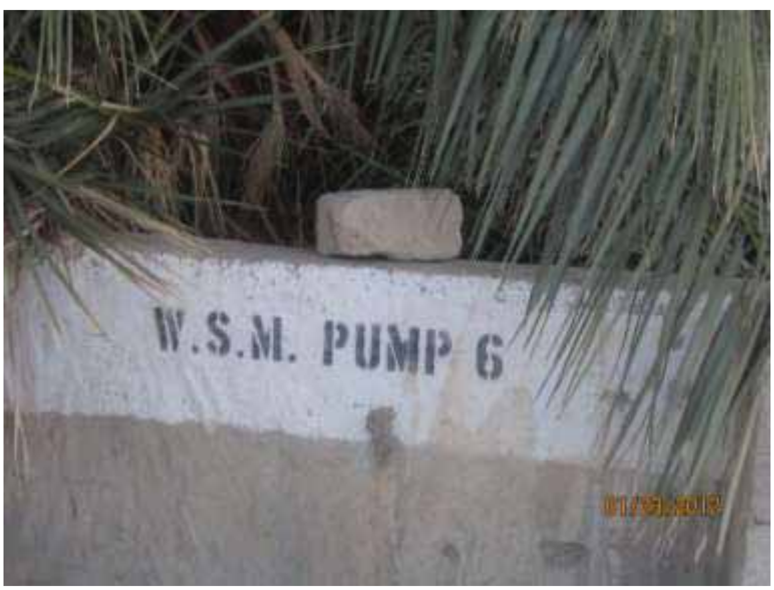
Chambers Group, Inc. 2011. Draft - A Class III Cultural Resources Inventory for the Silverleaf Photovoltaic Solar Project Imperial County, California.

Davis, Shannon, Jennifer Krintz, Sarah Stringer-Bowsher, and Sinéad Ní Ghabhláin. 2011. Impacts on Historic Resources on Private Lands, Campo Verde Solar Project, Imperial County, California.

Hunt, Kevin. 2008. Cultural Resources Survey of Alternatives for the Sunrise Powerlink Project in Imperial, Orange, Riverside, and San Diego Counties, California. SWCA Environmental Consultants. Report submitted to Bureau of Land Management, California Desert District, Moreno Valley, California.

Mitchell, Patricia T. 2011. Inventory Report of the Cultural Resources Recorded within the Campo Verde Solar Project, Imperial County, California.

IMG 3385: Canal corner where it turns NW for 900 feet, View to E.



IMG 3387: Westside Main Canal Pump 6, View down.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PHOTOGRAPH RECORD

Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834

Page 3 of 5

Resource Name or #: Westside Main Canal – Pump 6
Year 2011

Camera Format: Digital – Canon Powershot SD1300 IS Digital ELPH 12.1 megapixel
Negatives Kept at: kp environmental, LLC. 2387 Montgomery Ave, Cardiff By The Sea, CA 92007

Mo.	Day	Frame	Subject/Description	View
1	23	3385	Canal corner where it turns NW for 900 feet.	E
1	23	3387	Westside Main Pump 6	D
1	23	3388	Westside Main Pump 6	S
1	23	3392	Siphon	E
1	23	3393	Siphon	W

SKETCH MAP

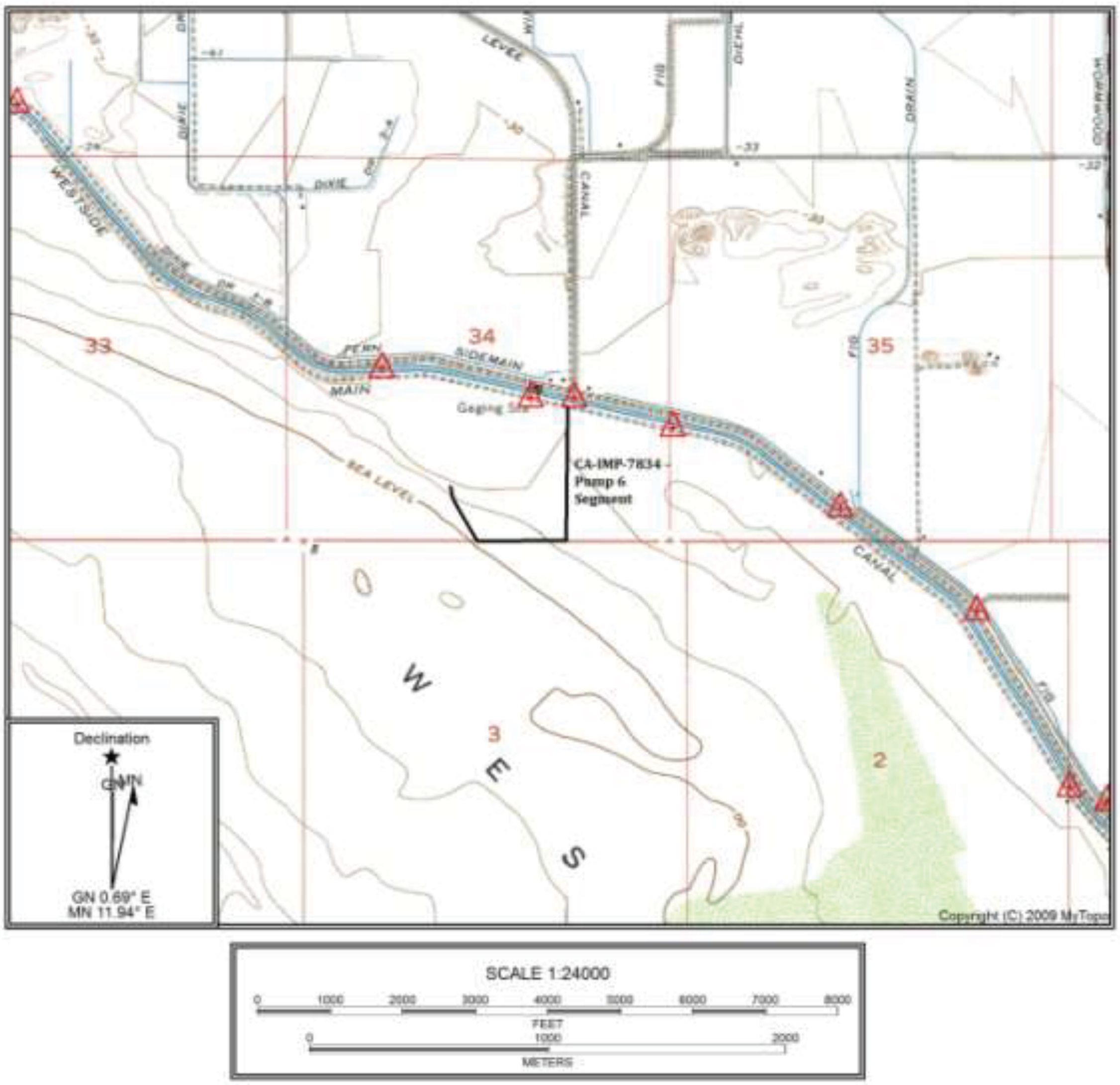
*Resource Name or # (Assigned by recorder) Westside Main Canal - Pump 6

*Drawn By: Trish Mitchell *Date: 1/24/2012

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LOCATION MAP

Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834

***Map Name:** Mount Signal, Calif. ***Scale:** 1: 24,000 ***Date of Map:** 1957 (1976)



*Resource Name or # (Assigned by recorder) Westside Main Canal
*Recorded by: H. Thomson *Date: 11/03/2011 ☐ Continuation ☒ Update

P-13-08334 (CA-IMP-7834) is the West Side Main Canal, an irrigation feature. The canal was first recorded in 1999 by Jill Hupp who conducted extensive background research documenting the history of the Westside Main Canal. Later site updates have basically regurgitated this information, tailoring it to fit the project. As part of a historical context study focusing on Water Conveyance Systems in California, JRP and Caltrans nicely sums up the Imperial Valley canal history as follows:

> *"…..The newly named Imperial Valley begins to develop widespread irrigated agriculture after 1898-1899, when C. R. Rockwood and George Chaffey took an interest in the area.Even Chaffey's efforts in the Imperial Valley did not succeed totally until the federal Reclamation Service became involved. Chaffey and Rockwood's California Development Company built a canal to serve the Imperial Valley in 1900-1902. Because of unstable sandy soil west of the Colorado River, part of the canal alignment had to be constructed south of the border, and it ran through Mexican land before turning north into the Imperial Valley. Farmers irrigated 25,000 acres the first season, and 100,000 acres by the next.*
>
> *In an effort to avoid water rights issues raised by a hostile federal Reclamation Service, and to get around large accumulations of silt at the out-take on the Colorado River, on the American side of the border, the California Development Company cut a wide outlet with no head gate in the riverbank inside Mexico. Unusually high flood waters tore open this outlet in the winter of 1905, overwhelming the main canal.*
>
> *On and off for the next two years, the Colorado River flowed through the main canal, flooding large areas of the Imperial Valley, destroying many farms and parts of some communities, and ultimately filling the Salton Sink, creating the Salton Sea.*
>
> *As work developing the valley went ahead, the company organized smaller mutual water companies to build ditch systems drawing off the main canals. By 1906, over 130,000 acres were under irrigation, growing to 180,000 acres in 1910, but Chaffey and Rockwood's company had gone into receivership in 1909. As demand for an irrigation district grew among remaining settlers, the Imperial Irrigation District was created in 1911. It encompassed more than 600,000 acres, by far the largest in the state. The Southern Pacific railroad purchased the California Development Company's works in February 1916, and then sold them in turn to the Imperial Irrigation District in June. By 1919, total irrigated acreage in the valley reached 400,000 acres, dropping to 300,000 at the beginning of the Great Depression, and in 1960 climbed to 565,000 acres.*
>
> *The massive works of the Imperial Irrigation District encompass an elaborate 75-gate heading on the Colorado River, a main canal running through to Calexico, and a web of over 2,400 miles of canals and laterals, with attendant gates, checks, drops, and miscellaneous structures. In the 1920s, the canals were unlined. Until most of the district's canals and laterals were straightened and lined with concrete beginning in the 1950s, they were plagued by silting problems. For example, in 1927, the district cleaned sand and silt from 3,274 miles of canals and surface drains.*
>
> *Among the reasons for the USBR's involvement in irrigation development in the Imperial Valley was the constant danger of the canal system's being washed out during high water stages in the Colorado River. In addition, the canal alignment located partly in Mexico left the system vulnerable to international disputes. During the late 1930s the USBR headed the All-American Canal project to construct a new canal north of the border. When completed, the All-American Canal brought water to the Imperial Valley south of the Salton Sea, and a branch called the Coachella Canal irrigated the Coachella Valley north of the Salton Sea…."*

Previous Site Records

This resource has been recorded, evaluated, re-recorded, updated and re-evaluated seven times since it was first recorded in 1999. Each time only the portion of the canal within the project right-of-way was documented and ultimately evaluated for significance. A summary of past recordation's follows.

May 24, 1999
Jill Hupp, Caltrans Environmental Program
The project APE was the area where State Route 98 crosses the Westside Canal. The site record shows a NRHP status code of 6. The significance statement is as follows:

> *…West side Main canal today, like the IID irrigation system overall, reflects the development that occurred as a result of the construction of the All American Canal in 1941, after which the system was considerably expanded and modernized. The Westside Main Canal appears to possess significance under criteria A and C for its association with the development of irrigated commercial agriculture in the Imperial Valley west of New River in the early 1900's and as a good example of an early large scale irrigation canal system. However, research to date appears to indicate that the canal as a whole, while significant, would not possess the requisite degree of integrity due to reconstruction and dredging activities since the 1950's, but no survey of the canal in its entirety has yet been undertaken. Caltrans architectural historian Frank Lortie, after an extensive study of the IID system in 1997, concluded that the elements in the IID that retain integrity for the period 1941-1950 could be contributors to a potentially eligible National Register historic district. The segment within the project vicinity does not appear to possess sufficient integrity of workmanship, design, setting, feeling, and association to represent the canals significance in itself or as a contributor to a larger property. While sill earthen, extensive dredging since the 1960's has changed the basic configuration of the canal, because modern dredging equipment created a different ditch profile, more U-shaped and with steeper sides. The canal was extended and widened over time as the IID attempted to keep up with its ever-expanding service area. Because of these alterations it reflects neither the period of significance outlined by Lortie (1941-1950) nor the earlier period of the canal systems history (1901-1907)…."*

June 2000
N. Harris and Michael Oberndorgf; HDR Engineering
The project APE was located approximately 1300' south of Dixieland at the ROW of the San Diego and Eastern Railroad. The site form states as follows:

> *"…As part of the All American Canal System, this canal is eligible for NRHP inclusion….The canal is part of the historic system of canals that make up the extensive hydraulic irrigation system in the Imperial Valley. These canals profoundly influenced the Euro-American land use, settlement patterns, economy, and the cultural landscape of southern California and continues to do so today."*

February 28, 2007
Jeanette A. McKenna
McKenna updated the site record at this time stating that the canal was considered a significant resource and as part of the All American Canal System, was recommended eligible for inclusion on the National Register of Historic Places. She recommended that monitoring be required during construction of the proposed pipeline and that the project be designed to avoid impacts to the resource during construction as well as maintenance activities.

April 19, 2007
SWCA Environmental Consultants

SWCA examined a 300-foot long segment of the canal during survey activities conducted for alternatives related to the Sunrise Powerlink Project. The SWCA update for this resource states as follows:

> *"The Westside Main Canal has not been altered or modified since its last update 1999 (Jill Hupp), when it was found not eligible for listing in the National Register (NHRP) as a separate property or as a contributor to a district. However in 2001 the Bureau of Reclamation and California State Historic Preservation Officer concurred that the All American Canal is ELIGIBLE for the NRHP; by extension the Westside Main Canal is now recommended ELIGIBLE for NRHP and California Register of Historic Resources (CRHR) under Criterion A/1 for its significance in association of the Imperial Valley".*

In addition, resources associated with the Westmain Canal, the Fox Glove Canal and Dixie Drain were recommended eligible for inclusion as part of the NRHP-eligible All-American Canal System.

December 12, 2007
EPG

Robert A. Rowe evaluated a portion of the canal located within the APE of the Mount Signal Solar Hybrid Plant. Additionally, EPG identified and recorded several features related to the Westside Main canal system. A site record update for P-13-008334 includes: Fig Canal, Fern Canal, Wixom Drain, Diehl Drain, Fern Side Drain, Fig Drain, Dixie Drain 3, Dixie Drain 3A and Dixie Drain 3C. In addition, EPG includes other contributing elements such as concrete laterals and spiles. Regarding significance, EPG determined that the Westside Main canal is eligible under Criterion A, for its potential to provide information about the settlement and economic development in the area and thus the transition of desert lands into irrigated area, thus affecting the local economy and subsistence.

December 2009
URS Corporation

URS Corporation visited the canal during a Class III inventory related to a proposed solar project. Along with fieldwork, URS also examined and compared numerous historic maps of the area, including the 1915 El Centro 15-minute USGS quadrangle maps, Albert G. Thurston's Imperial Valley Tract Map (1914), Blackburn's Map of Imperial County, California (1919, 1929, 1936, 1943, 1955 editions), the 1949 and 1976 USDA Aerial Collection, the 1957 Painted Gorge 7.5-Minute USGS quadrangle map, and the 1964 Western Portion of Blackburn's Map of Imperial County. It was determined that the general course of the canal has remained consistent for most of its history.
Jeremy Hollins of URS evaluated the resource as follows:

> *"…Based on Caltrans' earlier 1999 assessment, the Westside Main Canal, as a whole, reflects the development associated with the construction and operation of the All-American Canal between 1941 and 1950, which is primarily when the system was widened, shortened (portions in Mexico were removed from service), and modernized. The canal appears to be significant under Criterion A and C of the NRHP and Criterion 1 and 3 of the CRHR for its association with the development of irrigated commercial agriculture in the Imperial County west of the New River and as a good example of an early large-scale irrigation canal system. It does not appear to be associated with the lives of significant people or appears to be likely to yield important information in prehistory or history. Therefore, it does not appear to be significant under Criterion B and D of the NRHP and Criterion 2 and 4 of the CRHR. The canal was associated only for a short period with the CDC, from 1905 to 1911, nearly ten years after the company was established. Additionally, the canal was already in operation upon the forming of the IID, and does not reflect or convey the contributions of the IID to Imperial County.*

Overall though, research conducted as part of Caltrans' 1999 assessment of the system found that the canal as a whole (while significant) does not retain a sufficient amount of its historic integrity to convey its significance due to regular dredging grading, widening, and reconstruction that has occurred since the 1950s, though, an intensive survey of the entire canal has not occurred. The portion of the Westside Main Canal within the historic architecture APE also does not appear to possess sufficient integrity of workmanship, design, setting, feeling, and association (though it still retains sufficient historic integrity aspects of location and materials). Accordingly, it does not appear to be a contributing element or significant related feature/component to the larger linear Westside Main Canal system or individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA. While still earthen, extensive dredging and grading since the 1960s has changed the basic configuration of the canal, which has impacted its design, setting, and feeling. The canal currently has a U-shaped profile, whereas historically it was trapezoidal. The addition of a non-historic period pipeline and highway and railroad crossings over the canal in the historic architecture APE disrupt the property's integrity aspects of setting and feeling, since these elements are outside of the property's period of significance, 1941 to 1950. Accordingly, due to these alterations, the workmanship and association of the historic-period property in the APE has been lost, since there is little physical evidence of the crafts of a particular culture or people from the period of significance, and the property is not sufficiently intact to convey the direct link between significant events and the canal…"

"…..In summary, the portion of the Westside Main Canal within the historic architecture APE does not appear to be individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA, and does not appear to be a contributing element or significant related feature/component to the larger linear Westside Main Canal system (if it is determined that such a resource exists)."

The significance statement for each of these resources regurgitates the same information found on the form for the Westside Main, inserting the name of the currently discussed resource.
The statement is as follows:

"…Overall, the _______________ does not appear to retain a sufficient amount of its historic integrity to convey its significance due to improvements and reconstruction that may have occurred since the 1950s, though, an intensive survey of the entire _______has not occurred. The portion of _________ also does not appear to possess sufficient integrity of workmanship, design, setting, feeling, and association (Though, it still retains sufficient historic integrity aspects of location and materials). Based upon historical documentation, regular dredging and widening of canals and drains were necessary and often performed to alleviate problems of silt and build-up. Due to these and other improvements over time, the workmanship and association of the historic-period property has been lost, since there is little physical evidence of the crafts of a particular culture or people from the period of significance. Accordingly, it does not appear to be a contributing element or significant related feature/component to the larger linear All-American Canal or Westside Main Canal system or individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA.
In summary, the portion of ___________does not appear to be individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA, and does not appear to be a contributing element or significant related feature/component to the larger linear All-American or Westside Main Canal system (if it is determined that such a resource exists). Further, the addition of a proposed water line adjacent or perpendicular to the existing _________would not create a new adverse effect or significant impact to the portion of the historic-period property that bisects the Evan Hewes Highway".

*Resource Name or # (Assigned by recorder) Westside Main Canal
*Recorded by: H. Thomson *Date: 11/03/2011 ☐ Continuation ☒ Update

January, 2010
C. Bowden-Renna
The canal was once again visited during a survey conducted by AECOM related to the IID Dixieland 230 kV Transmission Line and Substation Expansion Project. The resource was described as follows:

> *"…Site P-13-008334 was recorded by Jill Hupp in 1999. This site is the Westside Main Canal, which was built about 1906 as a part of the Imperial Irrigation District canal system within Imperial Valley. During the current survey effort, the portion of the canal within the project area is earthen lined and is still in use today. While the canal has been recommended eligible for the National Register of Historic Places (NRHP), the portion of the canal within the proposed project area was examined in 1997 and 1998 and was recommended not eligible for the NRHP due to lack of integrity (Hupp 1999). Caltrans also evaluated a portion of the canal as it crosses under I-8. Caltrans determined that, under California Environmental Quality Act (CEQA), the portion of the canal under I-8 is not a historic resource and therefore is not eligible for the NRHP (Hupp 1999").*

November 04, 2011
Heather Thomson
The canal was revisited again in November 2011 during a cultural resource survey related to the Campo Verde Solar Project. An approximately 341' section of the canal falls within the survey area. The section of canal inspected consists of an earthen, unlined canal. In addition, a turnout with concrete wing walls provides water to a large concrete block reservoir, which in turn flows into a lateral canal located west of the Westside Main. This lateral, the reservoir and the remains of an electrical panel and tin shed roof appear abandoned and no longer in use.

The Westside Main Canal joins the All-American Canal near the western edge of the Imperial Valley and serves the western part of the IID water service area. Water is released from the Westside Main canal into the heading of each lateral canal. From the lateral canals, zanjeros measure and divert the required amount of water from the lateral canal through individual customer delivery gates.

The All American Canal is eligible for State inclusion on the NRHP and by extension, the Westside Main Canal as well. The portion of Westside Main Canal inspected during the current survey found the resource appeared to retain sufficient historic integrity aspects of location and materials.

This resource has not been surveyed in its entirety; however, Shannon Davis (ASM Affiliates, Inc.) did evaluate the segments within the Campo Verde Solar Project APE and found that the Westside Main Canal "is eligible for listing in the NRHP and CRHR under Criterion A/1 for its significance in the development of the Imperial Valley. The earthen canal was integral to the development of irrigated commercial agriculture since its construction in the early 1900s. Under the themes of agriculture and economic development, ASM's professional, independent recommendation is that this section of the Westside Main Canal is eligible for the NRHP and CRHR on the local and state levels."

Davis, Shannon, Jennifer Krintz, Sarah Stringer-Bowsher, and Sinéad Ní Ghabhláin. 2011. Impacts on Historic Resources on Private Lands, Campo Verde Solar Project, Imperial County, California.

Mitchell, Patricia T. 2011. Inventory Report of the Cultural Resources Recorded within the Campo Verde Solar Project, Imperial County, California.

PHOTOGRAPH RECORD

Resource Name or #: Westside Main Canal
Year 2011

Camera Format: Digital – Canon Powershot SD1300 IS Digital ELPH 12.1 megapixel
Negatives Kept at: kp environmental, LLC. 2387 Montgomery Ave, Cardiff By The Sea, CA 92007

Mo.	Day	Frame	Subject/Description	View
11	04	2820	West bank of Westside drain	
11	04	2821	Isolated white glassware no point	D
11	04	2822	Dr. Pepper bottle in bank of Westside Drain	D/E
11	04	2823	East end of concrete irrigation canal runs e-w	
11	04	2824	Mushrooms for Erica	
11	04	2825	West end west side drain	E
11	04	2826	West end of concrete irrigation canal fed by gate 1 on Forget me not	W
11	04	2827	Forget me not gate 2 feeds east-west concrete irrigation ditch to eat	W
11	04	2827	Irrigation ditch west end	W
11	04	2828/2829	Square box culvert on SW corner of Hyde and Hardy	
11	04	2830/2831	West main east bank	S/W
11	04	2832-2834	West side of west main concrete block reservoir feeds east-west concrete irrigation canal to west. It is no longer in use. Old tin shed roof and electric panel no longer in use	W-S
11	04	2835	Gate on west bank of west main	

 *Resource Name or # (Assigned by recorder) Westside Main Canal

*Recorded by: H. Thomson *Date: 11/03/2011 ☐ Continuation ☒ Update

IMG_2830 view to south.
Westmain Canal taken from east bank.

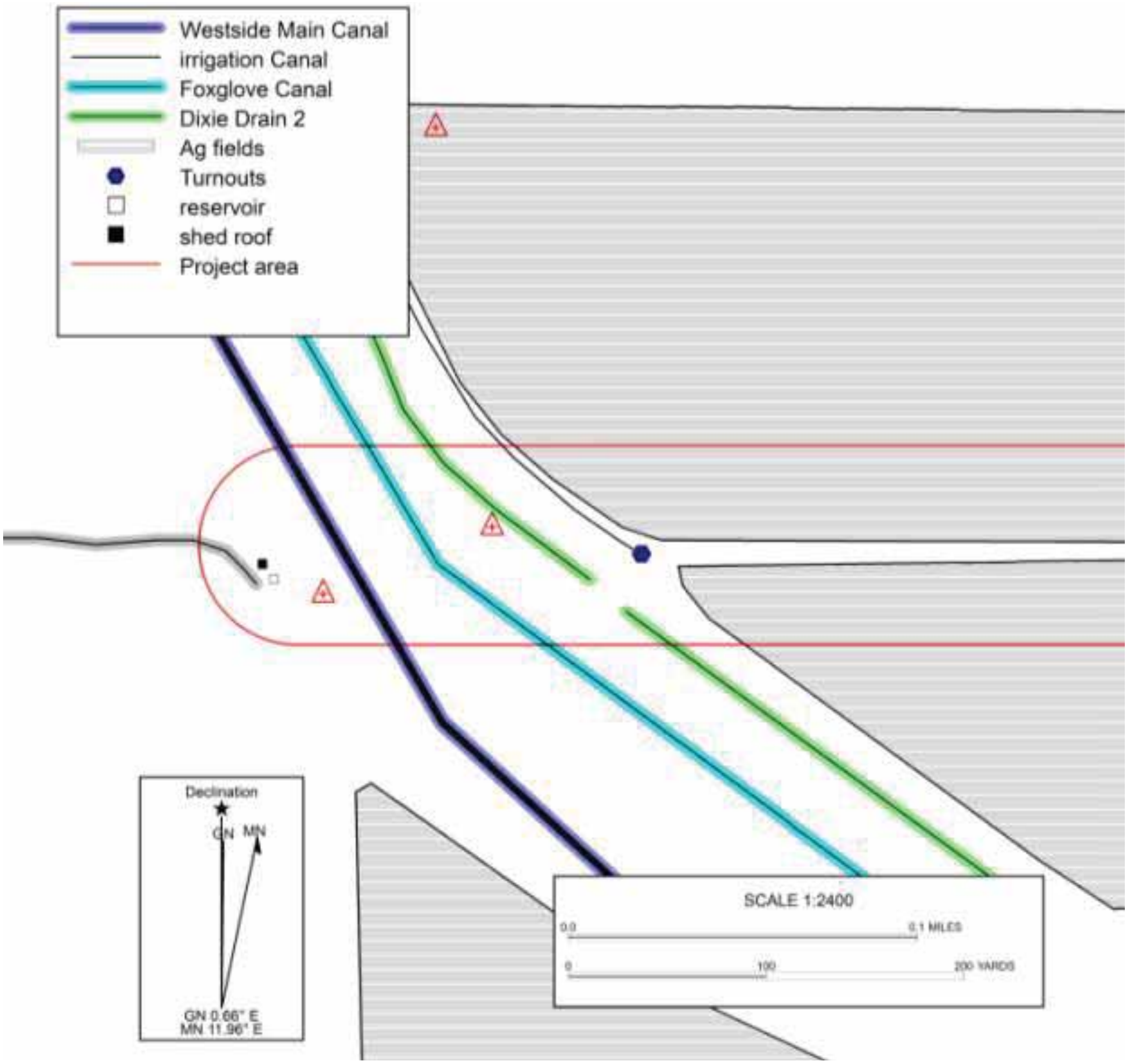
IMG_2832 view to west.
Reservoir, shed roof and panel.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
SKETCH MAP

Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834

Page 8 of 9 *Resource Name or # (Assigned by recorder) Westside Main Canal (portion)

*Drawn By: Heather Thomson *Date: 11/07/2011

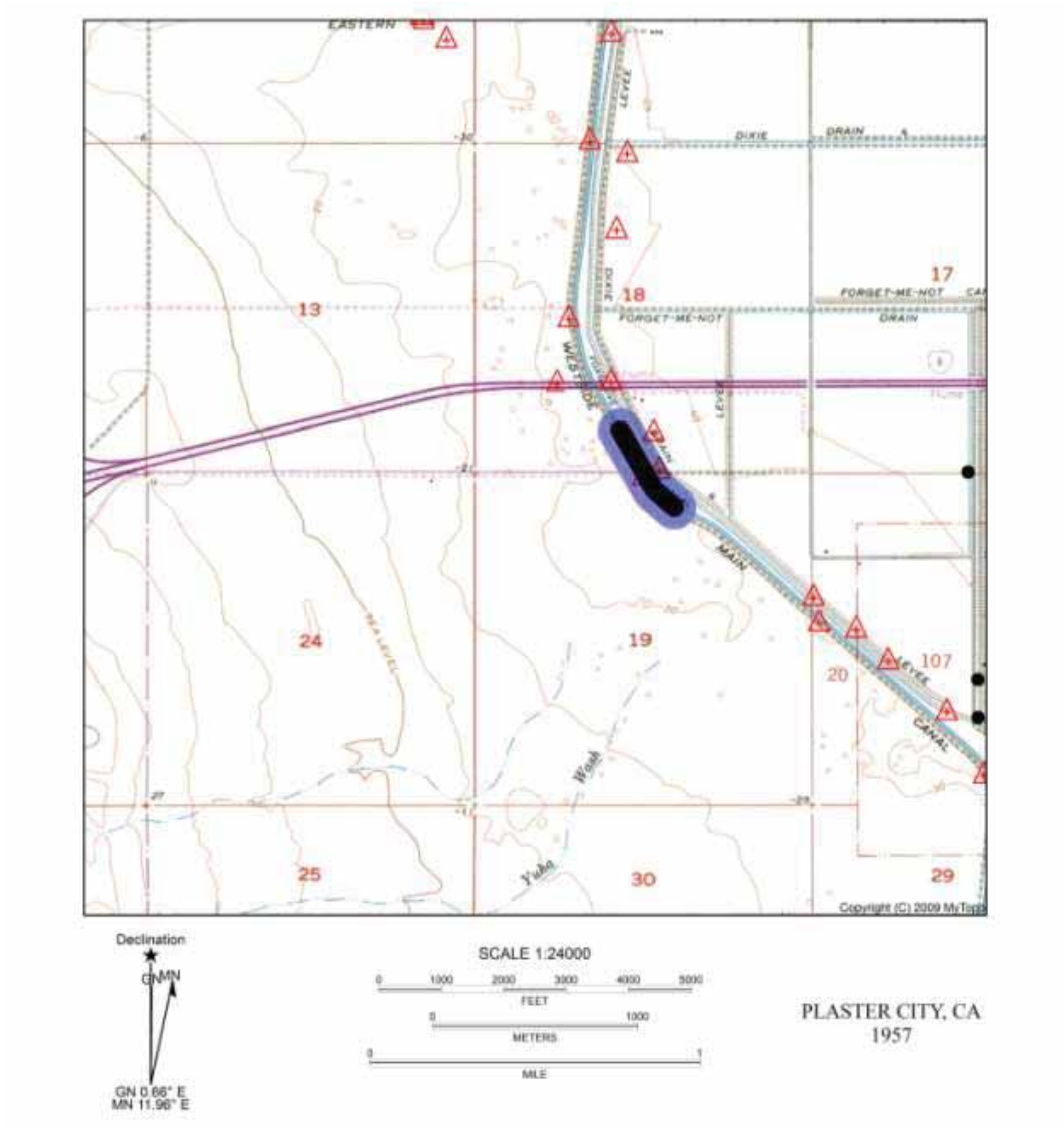


Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834

LOCATION MAP

 *Resource Name or # (Assigned by recorder) Westside Main Canal (portion)

*Drawn By: Heather Thomson *Date: 11/07/2011



P1. Other Identifier: *P2. Location: ☐ Not for Publication ☒ Unrestricted
***a. County:** Imperial
***b. USGS 7.5' Quad:** Plaster City, Seeley, Yuha Basin, Mount Signal **Date:** 1957; **T** 16S; **R** 11E; **of Sec.** Plaster City 7, 18, 19, 20, 107; Seeley 107; Yuha Basin 29; Mount Signal 29, 28, 33, 34, 35; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; North end: 614961.43 **mE** / 3628012.34 **mN**; South end: 621656.46 **mE** / 3621746.51 **mN**

***P3a. Description:** Westside Main Canal was constructed in circa 1907 as one of four canals constructed for the earliest irrigation system in the Imperial Valley, in Imperial County, California It was later connected to the All-American Canal which extends westward from Yuma, Arizona north of the U.S.-Mexico border and terminates at the Westside Main Canal. The segment of the Westside Main Canal documented is approximately 5.5 mi. long, beginning just north of its intersection with Interstate extending southeast approximately .5 mi. past its intersection with Liebert Road and the Fern Canal in Imperial County, California. The canal is approximately 8 feet deep and approximately 40 feet wide. The integrity is good. The canal system also includes drains that remove the salinity from the agricultural lands the canal and its laterals irrigate.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct

P5a. Photograph or Drawing:

P5b. Description of Photo: View of Westisde Main Canal at Leibert Rd. looking south from northern side of the canal towards the Imperial Valley Substation; Picture taken November 2, 2011

***P6. Date Constructed/Age and Sources:** Circa 1907, 1909 El Centro 15-minute US Army Corps Topo map,

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

***P8. Recorded By:**
Jennifer Krintz, Architectural Historian
ASM Affiliates, Inc.
260 S. Los Robles Avenue Suite 106
Pasadena, CA 91107
***P9. Date Recorded:** November 2011
***P10. Survey Type:** Intensive
P11. Report Citation: Inventory, Evaluation, and Analysis of Impacts on Historic Resources On Private Lands within the Area of Potential Effect of the Campo Verde Solar Project, Imperial County, California, ASM Affiliates, November 2011.
***B10. Significance: Theme:** Agricultural Canal **Area:** Imperial County, CA
Period of Significance: 1907-1950 **Property Type:** Waterway **Applicable Criteria:** A/1
In 2007, J. Burkard, H. Thompson, and J. Covert of SWCA Environmental Consultants recommended the segment of the Westside Main Canal eligible for the National Register of Historic Places as a contributor to a larger National Historic District to include the All-American Canal. ASM concurs with this finding and recommends the Westside Main Canal eligible for the National Register of Historic Places and the California Register of Historic Resources under criteria A and 1, respectively for its association with the irrigation of the Imperial Valley.

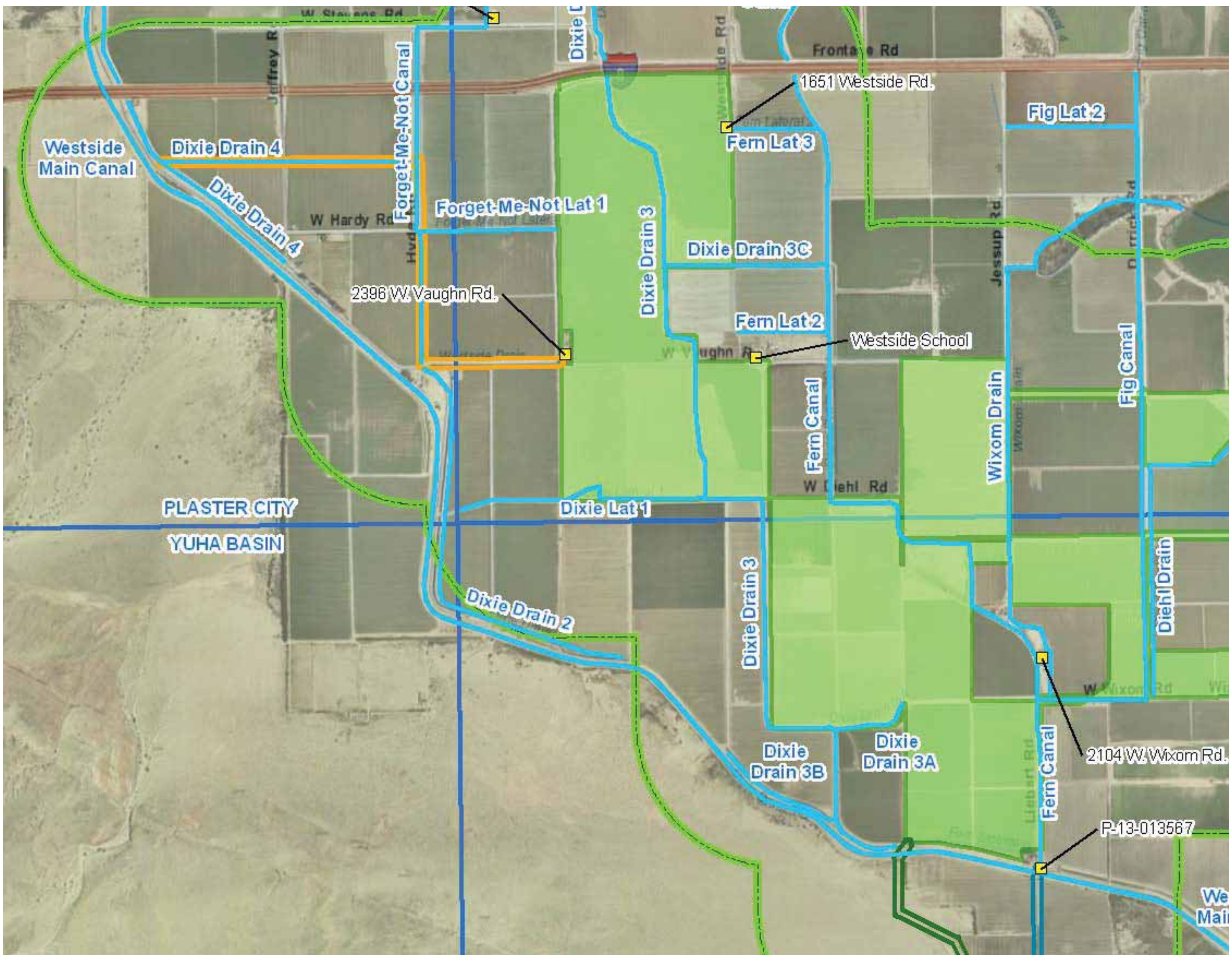
P5a. Photograph or Drawing:

P5b. Description of Photo: View of part of the canal taken looking south from the northern part of the property area; Picture taken March 22, 2011

State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **CONTINUATION SHEET**	**Primary #** P-13-008334 UPDATE (Westside Main Canal) **HRI #** **Trinomial** CA-IMP-7834 UPDATE (Westside Main Canal) **NRHP Status Code:** 3D (Westside Main Canal) 6Z (Westside Drain)

Page 3 of 3 ***Resource Name or # (Assigned by recorder)** Westside Main Canal and Drain
Recorded by: Jennifer Krintz, Architectural Historian **Date:** November 2011
☐ Continuation ☒Update

Location Map of the Westside Main Canal and Drain



UPDATE

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008334 UPDATE
HRI #
Trinomial CA-IMP-7834 UPDATE
NRHP Status Code: 3D

 ***Resource Name or # (Assigned by recorder)** Westside Main Canal
Recorded by: Jennifer Krintz, Architectural Historian **Date:** April 5, 2011
☐ Continuation ☒Update

P1. Other Identifier: Westside Main Canal
***P2. Location:** ☐ Not for Publication ☒ Unrestricted
***a. County:** Imperial
***b. USGS 7.5' Quad:** Mount Signal **Date:** 1957; **T** 17S; **R** 12E/13E; **of Sec.** 3, 2, 11, 12, 13, 24, 19, 20, 17, 21; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; North end: 620445.09 **mE** / 3622260.40 **mN**; South end: 625496.13 **mE** / 3613610.51 **mN**

***P3a. Description:** Westside Main Canal was constructed ca. 1907 as part of the earliest irrigation system in the Imperial Valley. It was later connected to the All-American Canal which runs east-west north of the international U.S.-Mexican borderline, as one of three main canals that receive water from the All-American Canal. This segment of the Westside Main Canal is approximately 5 miles long, with the northern end point southeast of Liebert Road and the southern end point where the canal intersects with the All-American Canal in Imperial County, California. The canal is approximately 8 feet deep and approximately 40 feet wide. The integrity is good.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct

P5a. Photograph or Drawing:

P5b. Description of Photo: View of part of the canal taken looking south from the northern end of the property area; Picture taken March 22, 2011

***P6. Date Constructed/Age and Sources:**
Circa 1907

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

***P8. Recorded By:**
Jennifer Krintz, Architectural Historian
ASM Affiliates, Inc.
260 S. Los Robles Avenue Suite 106
Pasadena, CA 91107

***P9. Date Recorded:** April 5, 2011

***P10. Survey Type:** Reconnaissance

P11. Report Citation: Inventory, Evaluation, and Analysis of Effect on Historic Built Environment Properties within the Area of Potential Effect of the Imperial Solar Energy Center South, Imperial County, California

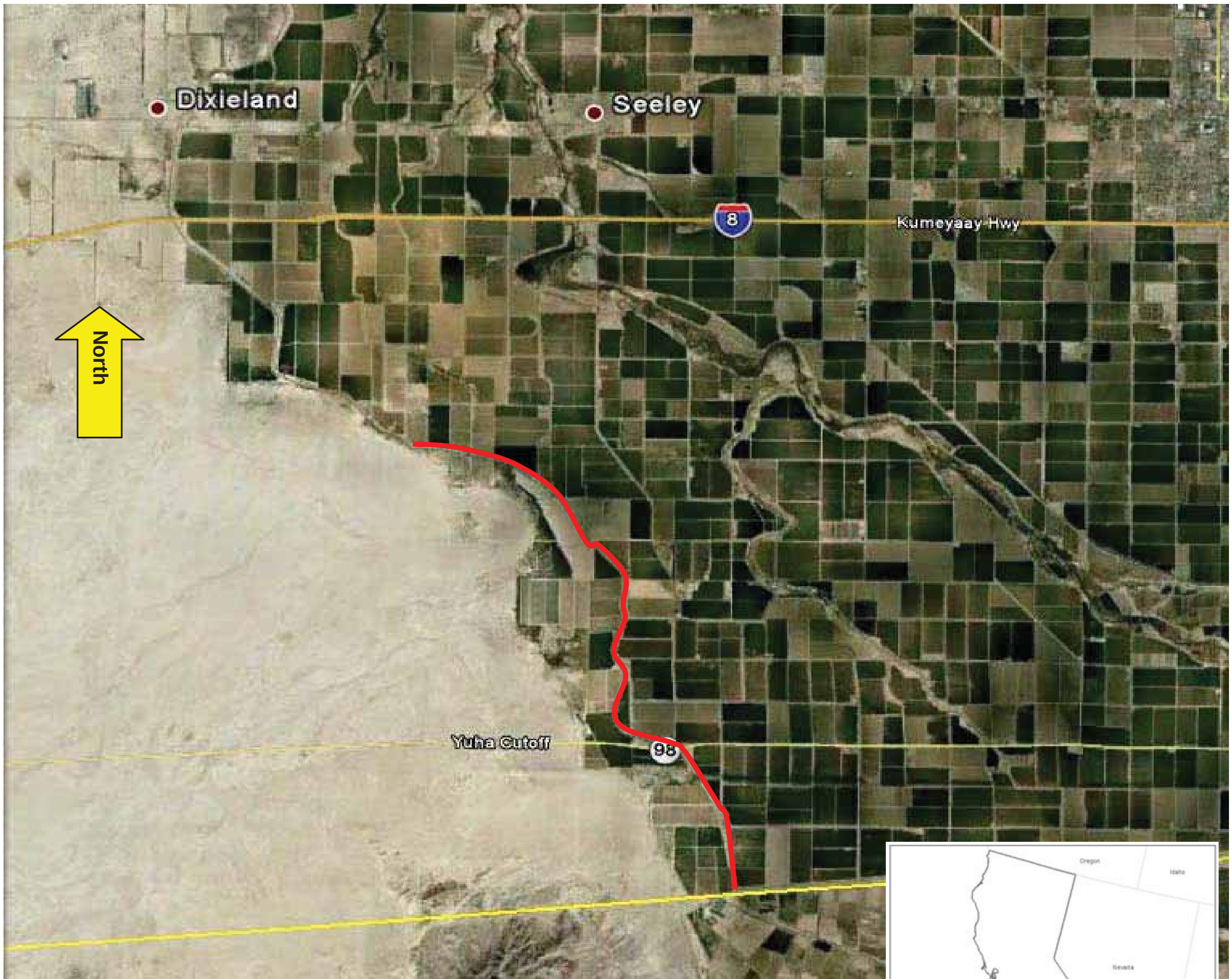
***B10. Significance: Theme:** Agricultural Canal **Area:** Imperial County, CA
Period of Significance: Property Type: Waterway **Applicable Criteria:** A/1
In 2007, J. Burkard, H. Thompson, and J. Covert of SWCA Environmental Consultants recommended the segment of the Westside Main Canal eligible for the National Register of Historic Places as a contributor to a larger National Historic District to include the All-American Canal. ASM concurs with this finding and recommends the Westside Main Canal eligible for the National Register of Historic Places and the California Register of Historic Resources under criteria A and 1, respectively for its association with the irrigation of the Imperial Valley.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008334 UPDATE
HRI #
Trinomial CA-IMP-7834 UPDATE
NRHP Status Code: 3D

 ***Resource Name or # (Assigned by recorder)** Westside Main Canal
Recorded by: Jennifer Krintz, Architectural Historian **Date:** April 5, 2011
☐ Continuation ☒Update

Location Map of Westside Main Canal



Red line indicates subject property
Map courtesy of Google Earth

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008334 UPDATE
HRI #
Trinomial CA-IMP-7834 UPDATE
NRHP Status Code: 3D

 ***Resource Name or # (Assigned by recorder)** Westside Main Canal
Recorded by: Jennifer Krintz, Architectural Historian **Date:** March 28, 2011
☐ Continuation ☒Update

P1. Other Identifier: Westside Main Canal
***P2. Location:** ☐ Not for Publication ☒ Unrestricted
***a. County:** Imperial
***b. USGS 7.5' Quad:** Plaster City, Seeley, Yuha Basin, Mount Signal **Date:** 1957; **T** 16S; **R** 11E; **of Sec.** Plaster City 7, 18, 19, 20, 107; Seeley 107; Yuha Basin 29; Mount Signal 29, 28, 33, 34, 35; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; North end: 614961.43 **mE** / 3628012.34 **mN**; South end: 621656.46 **mE** / 3621746.51 **mN**

***P3a. Description:** Westside Main Canal was constructed in circa 1907 as part of a larger canal system in the Imperial Valley which started with the construction of the All-American Canal which runs east-west north of the international U.S.-Mexican borderline. The segment of the Westside Main Canal is approximately 5 miles long, with the northern end point just south of the community of Dixieland and the southern end point 1 mile southeast of Liebert Road in Imperial County, California. The canal is approximately 8 feet deep and approximately 40 feet wide. The integrity is good.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct

P5a. Photograph or Drawing:

P5b. Description of Photo: View of part of the canal taken looking south from the middle of the property area; Picture taken March 22, 2011

***P6. Date Constructed/Age and Sources:**
Circa 1907

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

***P8. Recorded By:**
Jennifer Krintz, Architectural Historian
ASM Affiliates, Inc.
260 S. Los Robles Avenue Suite 106
Pasadena, CA 91107

***P9. Date Recorded:** March 28, 2011

***P10. Survey Type:** Reconnaissance

P11. Report Citation: Assessment of Visual Impacts on the Historic Built Environment Properties within the APE of the Imperial Valley Solar Farm Project West Imperial County, California

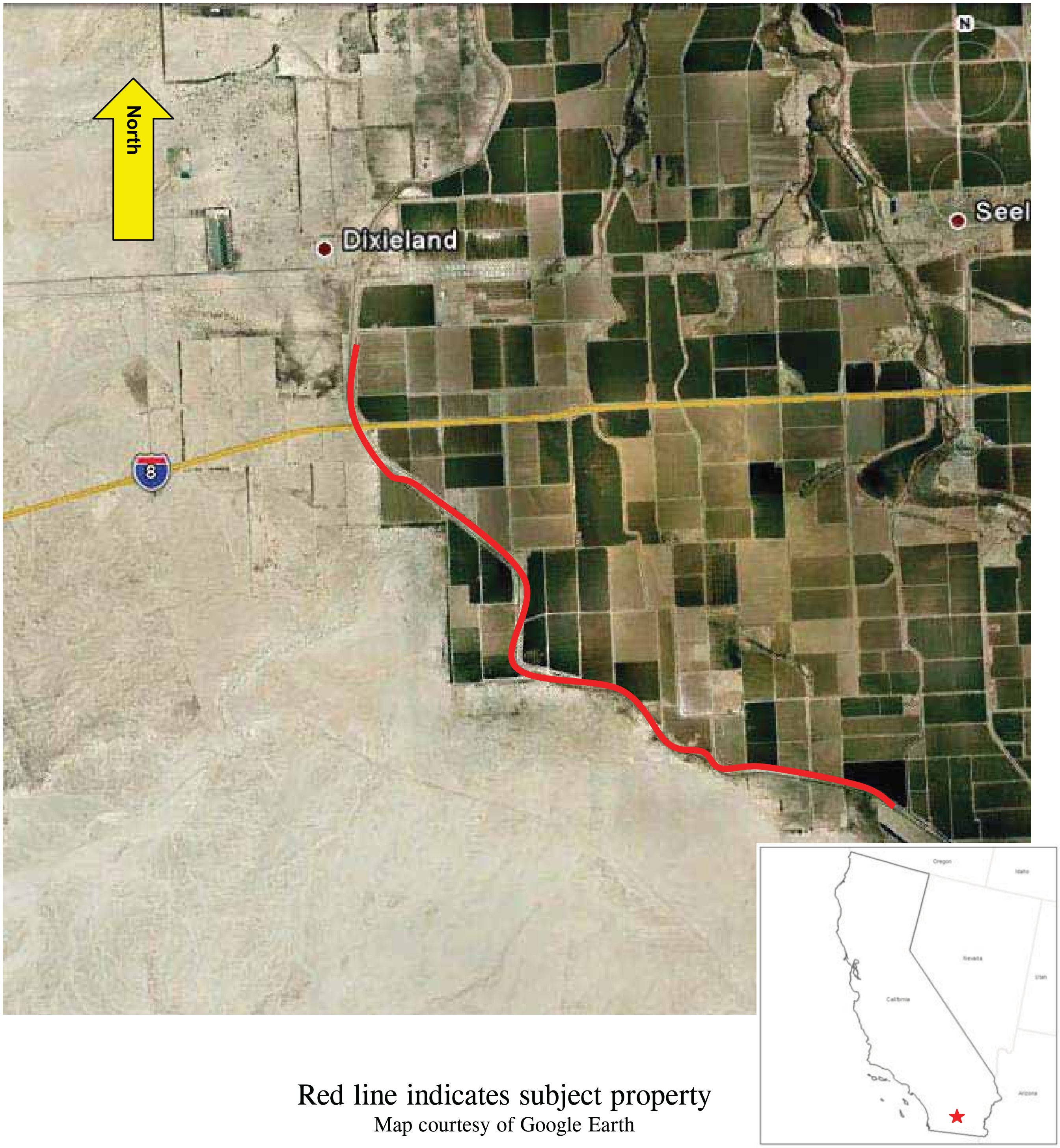
***B10. Significance: Theme:** Agricultural Canal **Area:** Imperial County, CA
Period of Significance: Property Type: Waterway **Applicable Criteria:** A/1
In 2007, J. Burkard, H. Thompson, and J. Covert of SWCA Environmental Consultants recommended the segment of the Westside Main Canal eligible for the National Register of Historic Places as a contributor to a larger National Historic District to include the All-American Canal. ASM concurs with this finding and recommends the Westside Main Canal eligible for the National Register of Historic Places and the California Register of Historic Resources under criteria A and 1, respectively for its association with the irrigation of the Imperial Valley.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008334 UPDATE
HRI #
Trinomial CA-IMP-7834 UPDATE
NRHP Status Code: 3D

***Resource Name or # (Assigned by recorder)** Westside Main Canal
Recorded by: Jennifer Krintz, Architectural Historian
Date: March 28, 2011
☐ Continuation ☒ Update

Location Map of Westside Main Canal



Red line indicates subject property
Map courtesy of Google Earth

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

CONTINUATION SHEET

Page ___ **of** ___

***Resource Name or #:**

***Recorded by:**

***Date:**

☐ ■

Cultural Resources Investigations Class III Report for the IID Dixieland 230 kV Transmission Line and Substation Expansion Project, Imperial County, California.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #
HRI #
Trinomial CA-IMP-7834H UPDATE
NRHP Status Code

Other Listings
Review Code Reviewer Date

***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)

P1. Other Identifier: N/A

***P2. Location:** ☐ Not for Publication ☒ Unrestricted **and** (P2c, P2e, and P2b or P2d. Attach a Location Map as necessary.)

* a. **County** Imperial
* b. **USGS 7.5'** Plaster City **Date** 1976 **T** 16S **R** 12E ; ¼ ¼ of S7 ; SB **B.M.**
c. Address N/A City N/A Zip N/A
d. UTM: (Give more than one for large and/or linear resources) Zone 11 , 615024 mE/ 3628650 mN
e. Other Locational Data: (e.g., parcel I, directions to resource, elevation, etc., as appropriate)

The portion of the Westside Main Canal (CA-IMP-7834H) surveyed is approximately one mile long and runs north-south within the Dixieland area of Imperial County. The TRS and UTM provided above are the approximate centerpoint of the portion of the canal surveyed.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

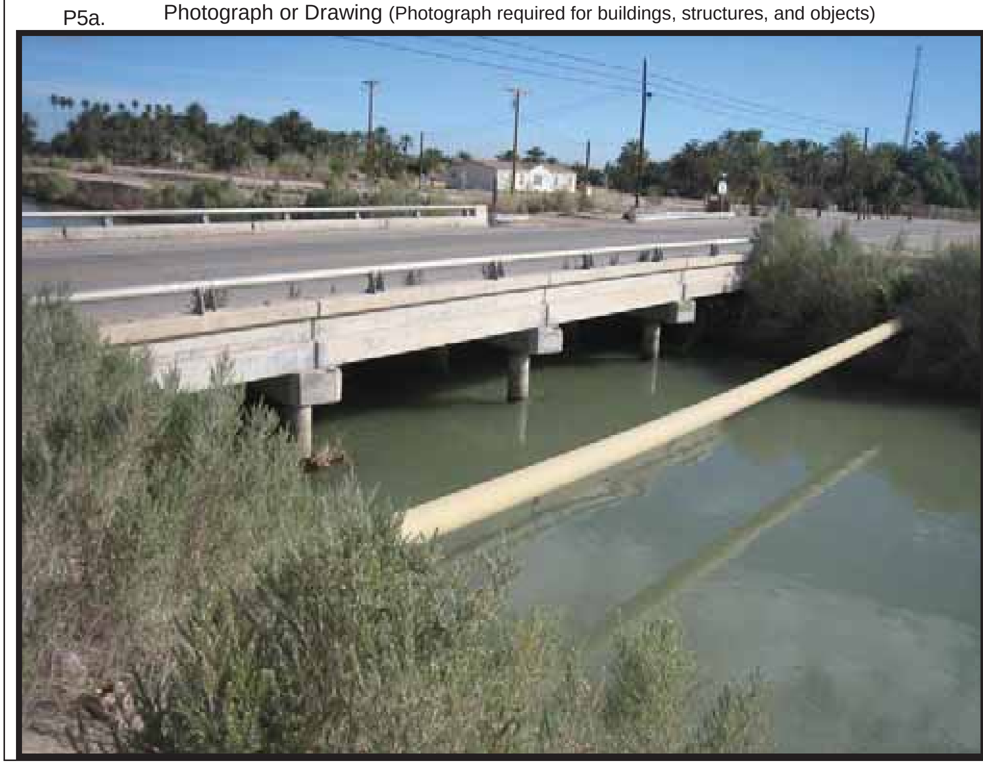
The portion of the Westside Canal in the historic architecture APE is a small portion of a much larger 20-mile historic-period linear property that ultimately travels from the International Border area to the Brawley-Westmoreland area. Accordingly, formal recordation of the entire Westside Canal was considered unnecessary and outside of the project scope, since the project would not directly affect (e.g., alter, remove, change use or physical features, cause deterioration) the entire 20-mile historic-period property. Rather, the portion of the historic-period property within the historic architecture APE was studied within the context of the whole property only.

This portion of the Westside Main Canal is an earthen-bank irrigation canal that is approximately 25 feet wide and 10 feet deep (portions of the canal outside of the APE feature concrete-lining). It primarily has a U-shaped form. SEE CONTINUATION SHEET 523L (PAGE 3).

***P3b. Resource Attributes:** (List attributes and codes) HP20. Canal/Aqueduct

***P4. Resources Present:** ☐ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other (Isolates, etc.)

P5a. Photograph or Drawing (Photograph required for buildings, structures, and objects)



P5b. Description of Photo: (view, date, accession #)
View to northeast, Evan Hewes Highway Crossing, March 2009

***P6. Date Constructed/Age and Source:**
☒ Historic ☐ Prehistoric ☐ Both
Approximately 1908
1908 El Centro map

***P7. Owner and Address:**
Bureau of Reclamation
27708 Jefferson Ave., Ste. 202
Temecula, CA 92590

***P8. Recorded by:** (name, affiliation, and address)
URS Corporation
1615 Murray Canyon Rd., Suite 1000
San Diego, CA 92108

***P9. Date Recorded:** 12/2009

***P10. Survey Type:** (Describe)
Pedestrian Survey

***P11. Report Citation:** (Cite survey report and other sources, or enter "none")

Mutaw, Robert J. (Ph.D.), Elizabeth B. Roberts, Gordon C. Tucker Jr., Ph.D., Brian Shaw, Terrie Bagwell, Colin O'Hanlon, Rachael Nixon, Gary Fink, Jeremy Hollins, Mark Neal. 2010 Draft Final Class III Confidential Cultural Resources Technical Report for the Imperial Valley Solar (formerly Solar 2), Imperial Valley County. URS Corporation. Technical report prepared for Tessera Solar (Applicant). Submitted to the Bureau of Land Management – El Centro Field Office, El Centro, CA. Copies available from the Bureau of Land Management – El Centro Field Office, El Centro, CA.

***Attachments:** ☐ NONE ☐ Location Map ☒ Continuation Sheet ☒ Building, Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #
HRI #
Trinomial CA-IMP-7834H UPDATE

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code 6Z

 *Resource Name or #: (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)

B1. Historic Name: Encina Canal
B2. Common Name: Westside Main Canal
B3. Original Use: Irrigation Ditch B4. Present Use: Irrigation Ditch
***B5. Architectural Style:** N/A
***B6. Construction History:** (Construction date, alterations, and date of alterations)
Actual construction date of this portion of the Westside Canal is unknown at present. However, by 1908, this portion of the Westside Main Canal was constructed. It was constructed as an earthen canal, banked by earthen levees, approximately 25 feet wide and 10 feet deep. Throughout the early twentieth century, the general alignment of this portion of the Westside Main Canal was not significantly altered. Based on the 1915 El Centro 15-minute USGS quadrangle maps, Albert G. Thurston's Imperial Valley Tract Map (1914), Blackburn's Map of Imperial County, California (1919, 1929, 1936, 1943, 1955 editions), the 1949 and 1976 USDA Aerial Collection, the 1957 Painted Gorge 7.5-Minute USGS quadrangle map, and the 1964 Western Portion of Blackburn's Map of Imperial County, the general course of the canal has remained consistent for most of its history.

***B7. Moved?** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** N/A **Original Location:** N/A

***B6. Related Features:**
There is one related feature, the West side Main (WSM) Pump 6. The WSM Pump 6 is located in Township 17 South, Range 12 East, Section 3 and runs north-south from the south side of Mandrapa Road for approximately 0.34 miles, then east-west for approximately 0.25 miles. The WSM Pump 6 appears to be part of the larger West Side Main Canal and Fern Canal systems, which traverse the Dixieland area and converge in El Centro. SEE CONTINUATION SHEET 523L (PAGE 6)

B9. Architect: N/A b. Builder: Unknown
***B10. Significance: Theme** N/A **Area** Imperial County
Period of Significance N/A **Property Type** Irrigation Ditch **Applicable Criteria** N/A
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)
In 1849, Dr. Oliver M Wozencraft, on his way to the gold fields of San Bernardino from New Orleans, traveled through the Imperial Valley and noted the region's soil fertility and potential for arability. He was likely the first person to recognize the Imperial Valley's potential for agriculture. Wozencraft believed he could construct a gravity canal from the Colorado River to the Imperial Valley, because the river was at a higher elevation than the valley (Garnholz 1991). Wozencraft's opinion of the fertile valley was reaffirmed in 1853 when Jefferson Davis, U.S. Secretary of the War Department, ordered a scientific expedition along the Colorado River for the placement of fortifications. In this expedition, led by Lieutenant R. S. Williamson and Professor William Phipps Blake, the particular fertility of the alluvial soil at the southern end of the Salton Sink was noted. Blake prophetically noted, "it is indeed a serious question, whether a canal would not cause the overflow once more of a vast surface, and refill, to a certain extent, the dry valley of the ancient lake" (Garnholz 1991). Blake's expedition scientifically described how the Colorado River had meandered through the valley, delivered enough silt to block the mouth of the Gulf of California, and recognized that the banks of the current Colorado River course were much higher than that of Imperial Valley (Smith 1979). During the nineteenth century, the Colorado River historically flooded the valley several times, specifically in 1840, 1842, 1852, 1859, and 1867 (Garnholz 1991). SEE CONTINUATION SHEET 523L (PAGE 3 AND 4).

B11. Additional Resource Attributes: (List attributes and codes) N/A

***B12. References:**
SEE CONTINUATION SHEET 523L (PAGE 6)

B13. Remarks:
None

(Sketch Map with north arrow required)
SEE CONTINUATION SHEET 523L (PAGE 5)

***B14. Evaluator:** Jeremy Hollins
***Date of Evaluation:** 12/2009

(This space reserved for official comments)

*Resource Name or #: (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)

*Recorded by: URS Corporation * Date: 12/2009

☐ Continuation ☒ Update

P3a. Description (Continued)

This portion runs perpendicular to Evan Hewes Highway (SH 80) and a San Diego and Arizona Railroad crossing (known as Union Pacific crossing 921-452D).

The banks feature earthen levees of natural vegetation, which have been reshaped and widened by modern dredging and grading activities. This portion is gravity-fed (since no control infrastructure was identified in the vicinity). Of note, immediately south of the Evan Hewes Highway crossing is a non-historic period gas pipeline (approximately one foot in diameter) which bisects the canal.

This pipeline disrupts the feeling, setting, visual narrative, and historic viewshed of this portion of the canal. Additionally, along the west bank are two non-historic period pumps, which are most likely used to divert water to/from nearby agricultural fields. The crossing at Evan Hewes Highway is an example of a non-historic period reinforced concrete girder bridge, characterized by a simple span, five abutments/bents (supported by five cylindrical columns), a metal guardrail, and square piers at the bridge portals. The crossing appears to be 40 years old. The crossing is in poor condition due to environmental effects (sun and heat exposure), exposed rebar, and a minimally-maintained travel surface. The crossing shows evidence of chipping, cracking, and spalling. The San Diego and Arizona Railroad crossing is also a non-historic period reinforced concrete girder bridge, and appears to be constructed within the past 30 years. The grade separation features a simple span, four abutments/bents (supported by three angular cylindrical columns), and cable-wire guardrails. The grade separation shows evidence of chipping and cracking, and shows extensive damage from insect infestation and environmental effects (sun and heat exposure). Overall, the portion of the Westside Main Canal is in good condition, but has been affected by dredging and grading activities and non-historic period construction and features, including the pipeline and the crossings.

B10. Significance (Continued)

With the information gathered from the scientific expedition, Wozencraft pressed California into granting him approximately 1,600 square miles or roughly ten million square acres (which included present-day Imperial County and portions of present-day Riverside County). However, the federal government retained title to the land in this region of California and Wozencraft was unable to convince Congress, even with the results of the scientific analysis of the valley, to support his efforts. Wozencraft then approached George Chaffey to finance the project. Chaffey, who would successfully spearhead irrigation projects in San Bernardino County and Australia, was also unconvinced and noted that the “Imperial Valley was to [sic] hot for white men to prosper” (Garnholz 1991). Chaffey would later change his mind and near the end of the nineteenth century led the effort to irrigate the valley. Still undeterred, Wozencraft hired the Los Angeles County surveyor, Ebenezeer Hadley, in 1860 to draw up a plan to irrigate the valley by diverting the Colorado River through the Alamo River (Garnholz 1991). Wozencraft eventually left California for Washington, D.C. to lobby Congress. He died several years later without ever convincing Congress and never seeing his dream fulfilled. While Wozencraft failed to create an irrigation network, his efforts during the mid-nineteenth century led the way for future development efforts.

In 1896, a group of investors formed the California Development Company (CDC) and followed Wozencraft’s earlier attempts to irrigate the Imperial Valley. The group was led by Engineer Charles R. Rockwood and George Chaffey and they wanted to establish a canal, referred to as the “main channel,” constructed from the Colorado River through the Imperial Valley using an ancient overflow channel of the Colorado known as the Alamo River (Sperry 1975). Chaffey, to avoid conflict with the Mexican government over land development since the canal was to be developed almost entirely on the south side of the border, established a subsidiary to the CDC known as the Sociedad de Irrgación y Terrenos de la Baja California (Smith 1979). By 1901, portions of the Imperial Valley were irrigated and attracted many new settlers and farmers from the Midwest.

One of the main problems throughout the entire canal venture project was constant silting, which needed consistent dredging of muck. The solution was to build a wooden, although supposedly temporary, structure referred to as the “Chaffey Gate” (Sperry 1975; Tout 1932). The year the gate was constructed (1904) was one of the wetter years on record and the gate was constructed too high on the riverbank. Arguments at the time seem to suggest that Chaffey had the gate constructed correctly, but that because the water level was high at the time, the engineer in charge of the project placed several removable flashboards in the bottom of the gate, which silted over rapidly (Sperry 1975). The next few years were very dry causing the canals’ water level to drop precipitating the construction of more diversion and gates around the Chaffey gate. The year 1905, however, was extremely wet causing several flooding episodes with the fifth one completely destroying all remaining gates and dams along the canal network system. The Colorado River, originally flowing toward the Gulf of Californian, had changed its course and started flooding the Alamo River to the Salton Sink in Imperial Valley.

By 1905, over 80 miles of irrigation canals had been built, with more than 100,000 acres under cultivation. However, the design and construction of several poorly planned canals and ditches made water delivery service unreliable and inefficient. Large quantities of silt would block the canals’ intakes and reduce the amount of water reaching Imperial Valley crops. A widespread flood in the winter of 1905-1906 caused extensive damage to railroad property, farmlands, and the newly constructed canal system. The CDC did not believe it was practical to reconstruct several of the canals, and as an alternative decided to enlarge the Westside Main Canal, which at the time was a wooden flume conveyance system located south in Mexico and known as the Encina Canal (Hupp 1999). The extension of the Westside Canal into the United States approximately 1906 was intended to alleviate irrigation problems, and spark development of the county west of the New River. By 1908, the Westside Main Canal extended into the historic architecture APE. It was constructed as an earthen canal, banked by earthen levees, approximately 25 feet wide and 10 feet deep. Throughout the early twentieth century, the general alignment of the Westside Main Canal within the historic architecture APE was not significantly altered.

The Southern Pacific Railroad Company threatened a lawsuit against the CDC for flooding their railroad line along the Salton Sink in 1907. A year later, CDC reorganized and the board was taken over by Southern Pacific men, including Epes Randolph, who was the assistant to the president of the Southern Pacific (Sperry 1975). The task of returning the Colorado to its natural course heading toward the Gulf of California was such a daunting and expensive quest that the Southern Pacific eventually ended its association with the CDC. The Southern Pacific did, however, request over $3 million from the U.S. government for expenses incurred in turning the Colorado back toward the Gulf; the government awarded them $1 million 22 years later (Sperry 1975; Tout 1932). Only the construction of the Hoover Dam (then known as the Boulder Dam) in 1935 allowed for more effective control of the Colorado River for irrigation purposes.

B10. Significance (Continued)

The Imperial Irrigation District (IID) was organized in 1911 to acquire the land rights of the California Development Company (CDC), and its Mexican subsidiary Sociedad de Irrigación y Terrenos de la Baja California, from the Southern Pacific. By the mid-1920s, IID was delivering water to over 500,000 acres of arable land (Imperial Irrigation District 1998). The Boulder Canyon Act, passed in 1928, authorized the Bureau of Reclamation to construct the Boulder Dam, completed in 1935, along the Colorado River. The Imperial Valley and IID benefited greatly as the Act and the dam provided immediate hydroelectric power to the valley.

The Act also provided for the construction of the All-American Canal. In 1932, the Secretary of the Interior and IID signed an agreement to allow IID the utilization of hydroelectric power from the canal system for repaying the costs of the canal construction. The All-American Canal was begun in 1934 and the first diesel-generating plant was constructed near Brawley in 1936 (Imperial Irrigation District 1998). Subsequent hydroelectric plants were constructed in 1941. The All-American Canal was completed in 1941, and the Westside Main Canal was incorporated into the All-American Canal System upon its completion. The portions of the Westside Main Canal within Mexico were removed from the IID system.

By the 1950s, regular dredging and widening of the canals were needed to alleviate problems from silt and other build-ups. This altered the structures' profiles, depth, and width, and improvements were also made to the canals' ceramic drain tiles and ditches. For example, the Fern Canal features several culverts and other structural improvement s from the 1950s through the 1980s. By the 1960s, IID had implemented a plan to start lining its earthen canals with concrete (Hupp 1999). Through the 1970s, due to IIDs ongoing preventive and reactive maintenance, many original construction materials and features were replaced. These alterations have impacted the canals' historic setting, but were necessary for the agriculture industry's expansion and success (Henderson 1968).

Based on Caltrans' earlier 1999 assessment, the Westside Main Canal, as a whole, reflects the development associated with the construction and operation of the All-American Canal between 1941 and 1950, which is primarily when the system was widened, shortened (portions in Mexico were removed from service), and modernized. The canal appears to be significant under Criterion A and C of the NRHP and Criterion 1 and 3 of the CRHR for its association with the development of irrigated commercial agriculture in the Imperial County west of the New River and as a good example of an early large-scale irrigation canal system. It does not appear to be associated with the lives of significant people or appears to be likely to yield important information in prehistory or history. Therefore, it does not appear to be significant under Criterion B and D of the NRHP and Criterion 2 and 4 of the CRHR. The canal was associated only for a short period with the CDC, from 1905 to 1911, nearly ten years after the company was established. Additionally, the canal was already in operation upon the forming of the IID, and does not reflect or convey the contributions of the IID to Imperial County.

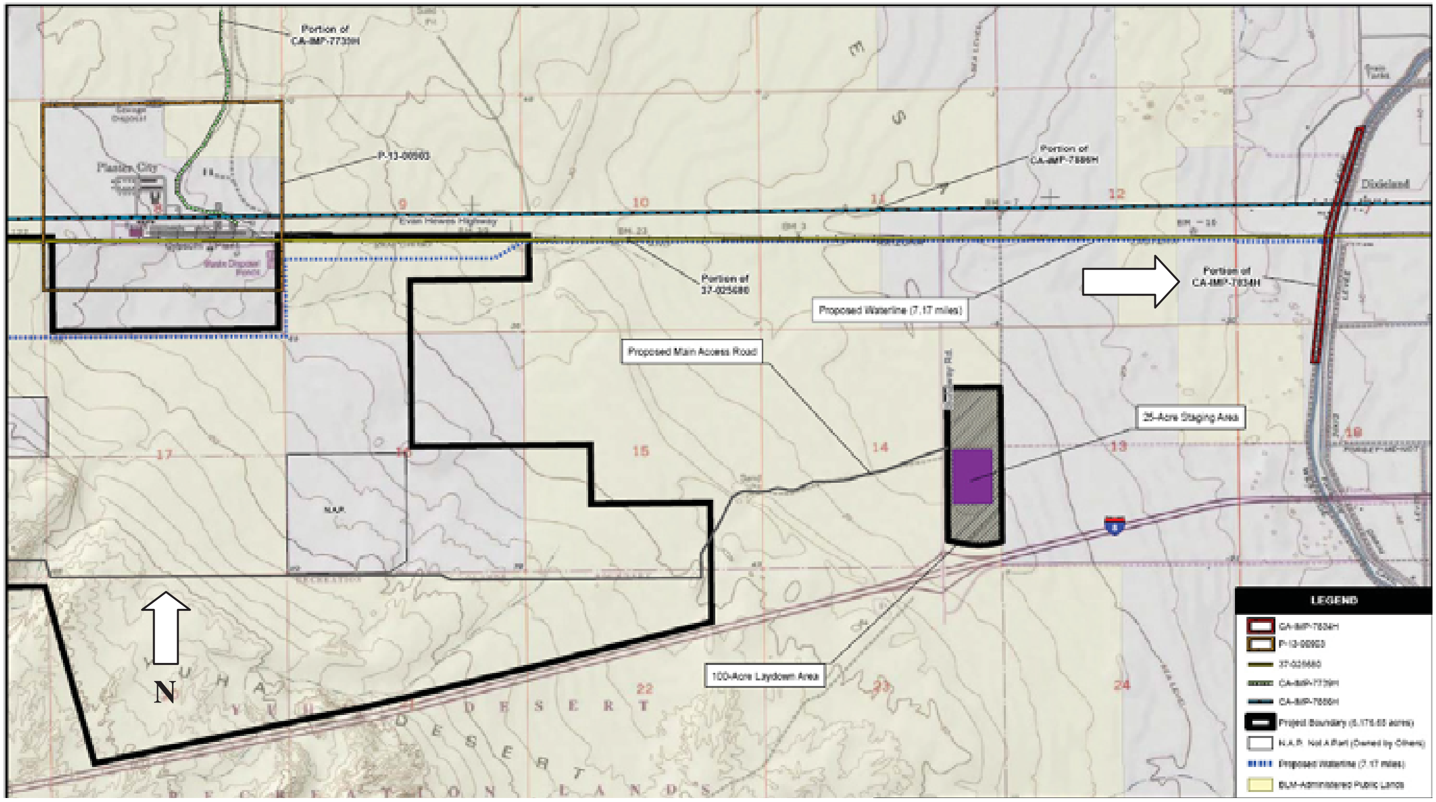
Overall though, research conducted as part of Caltrans' 1999 assessment of the system found that the canal as a whole (while significant) does not retain a sufficient amount of its historic integrity to convey its significance due to regular dredging grading, widening, and reconstruction that has occurred since the 1950s, though, an intensive survey of the entire canal has not occurred. The portion of the Westside Main Canal within the historic architecture APE also does not appear to possess sufficient integrity of workmanship, design, setting, feeling, and association (though it still retains sufficient historic integrity aspects of location and materials). Accordingly, it does not appear to be a contributing element or significant related feature/component to the larger linear Westside Main Canal system or individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA. While still earthen, extensive dredging and grading since the 1960s has changed the basic configuration of the canal, which has impacted its design, setting, and feeling. The canal currently has a U-shaped profile, whereas historically it was trapezoidal. The addition of a non-historic period pipeline, and highway and railroad crossings over the canal in the historic architecture APE disrupt the property's integrity aspects of setting and feeling, since these elements are outside of the property's period of significance, 1941 to 1950. Accordingly, due to these alterations, the workmanship and association of the historic-period property in the APE has been lost, since there is little physical evidence of the crafts of a particular culture or people from the period of significance, and the property is not sufficiently intact to convey the direct link between significant events and the canal.

In summary, the portion of the Westside Main Canal within the historic architecture APE does not appear to be individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA, and does not appear to be a contributing element or significant related feature/component to the larger linear Westside Main Canal system (if it is determined that such a resource exists).

 ***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)
***Recorded by:** URS Corporation *** Date:** 12/2009
☐ Continuation ☒ Update

Sketch Map:

Not to scale



B12. References

Blackburn, O.V. 1919, 1929, 1936 & 1955 editions. Blackburn's Map of Imperial County, California.

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Garnholz, Derek Brandon. 1991. The Salton Sea: a narrative and political history. Unpublished Master's Thesis, San Diego State University.

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Sperry, Robert L. 1975. When the Imperial Valley Fought for its Life. The Journal of San Diego History, 21(1). Located at: http://www.sandiegohistory.org/journal/75winter/imperial.htm. Website last visited on 27 April 2007.

Thurston, Albert G. 1914. Imperial Valley Tract Map.

Tout, Otis B., 1932. The First Thirty Years—1901-1931: History of Imperial Valley, Southern California, U.S.A. San Diego: Otis B. Tout.

USDA. 1949 & 1976. Aerial Survey of Imperial County. On file at UCSD Maps and Government Publications.

USGS. 1915. El Centro 15-minute USGS Quadrangle Map.

USGS. 1943, 1957. Painted Gorge Plaster City 7.5-minute USGS Quadrangle Maps.

B6. Related Features (Continued)

However, formal recordation of the entire Westside Main Canal and Fern Canal systems was considered unnecessary and outside of the project scope, since the project would not directly affect (e.g., alter, remove, change use or physical features, cause deterioration) the historic-period properties.

The north-south portion of the WSM Pump 6 is a concrete-lined channel that appears to be approximately five-feet wide and three-feet deep with concrete levees and earthen banks. This portion of the WSM Pump 6 is covered with dense, overgrown vegetation consisting of wild grasses and weeds. Due to the density of the vegetation, the shape of the channel is difficult to discern, but appears to be trapezoidal. This north-south channel shows evidence of heavy chipping, cracking, and spalling due to use and environmental effects. The north-south portion of the WSM Pump 6 terminates approximately 0.34 miles south of Mandrapa Road in a concrete ring culvert, which directs the flows westward through an inverted siphon into the east-west portion of the WSM Pump 6 (per conversation with Stephen Castillo from the Imperial Irrigation District on March 16, 2010). A metal drum pumping station is located at this terminus. Similar to the north-south portion, the east-west portion of the WSM Pump 6 is a trapezoidal concrete-lined channel that appears to be approximately five-feet wide and three-feet deep with concrete levees and earthen banks.

A metal check with slide gate is located at the origin of the east-west channel. Immediately west of the metal check, the channel bends slightly to the south then heads west again. This portion of the WSM Pump 6 is also covered with vegetation, although less overgrown than the north-south portion, and is in better condition. To the south of the origin of the east-west portion of the WSM Pump 6, there is a concrete-line structure appears to be a spillway or an intake structure, which has been filled with silt and dense vegetation, and is no longer in use.

The exact construction date of the WSM Pump 6 is unknown. However, the WSM Pump 6 appears on the 1953 aerial maps of the area but not on the 1949 aerial maps. Based on this information, it can be assumed that The WSM Pump 6 was constructed sometime between 1949 and 1953. The Imperial Irrigation District (IID) has records of a request to line the channels with concrete in 1956; thus, it can be assumed that prior to 1956, the WSM Pump 6 was an earthen channel.

In summary, the WSM Pump 6 does not appear to be individually eligible for listing to the NRHP, CRHR, or considered a historical resource for purposes of CEQA, and does not appear to be a contributing element or significant related feature/component to the larger linear All-American or Westside Main Canal system (if it is determined that such a resource exists). Further, the WSM Pump 6 is not located within the project APE and would not be affected.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary #
HRI #
Trinomial CA-IMP-7834H UPDATE

Page 7 of 14 ***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)
***Recorded by:** URS Corporation *** Date:** 12/2009
☐ Continuation ☒ Update

Additional Photos/Images:

Westside Main Canal, SD-AZ RR Crossing, View to the North

Westside Main Canal, View to the South

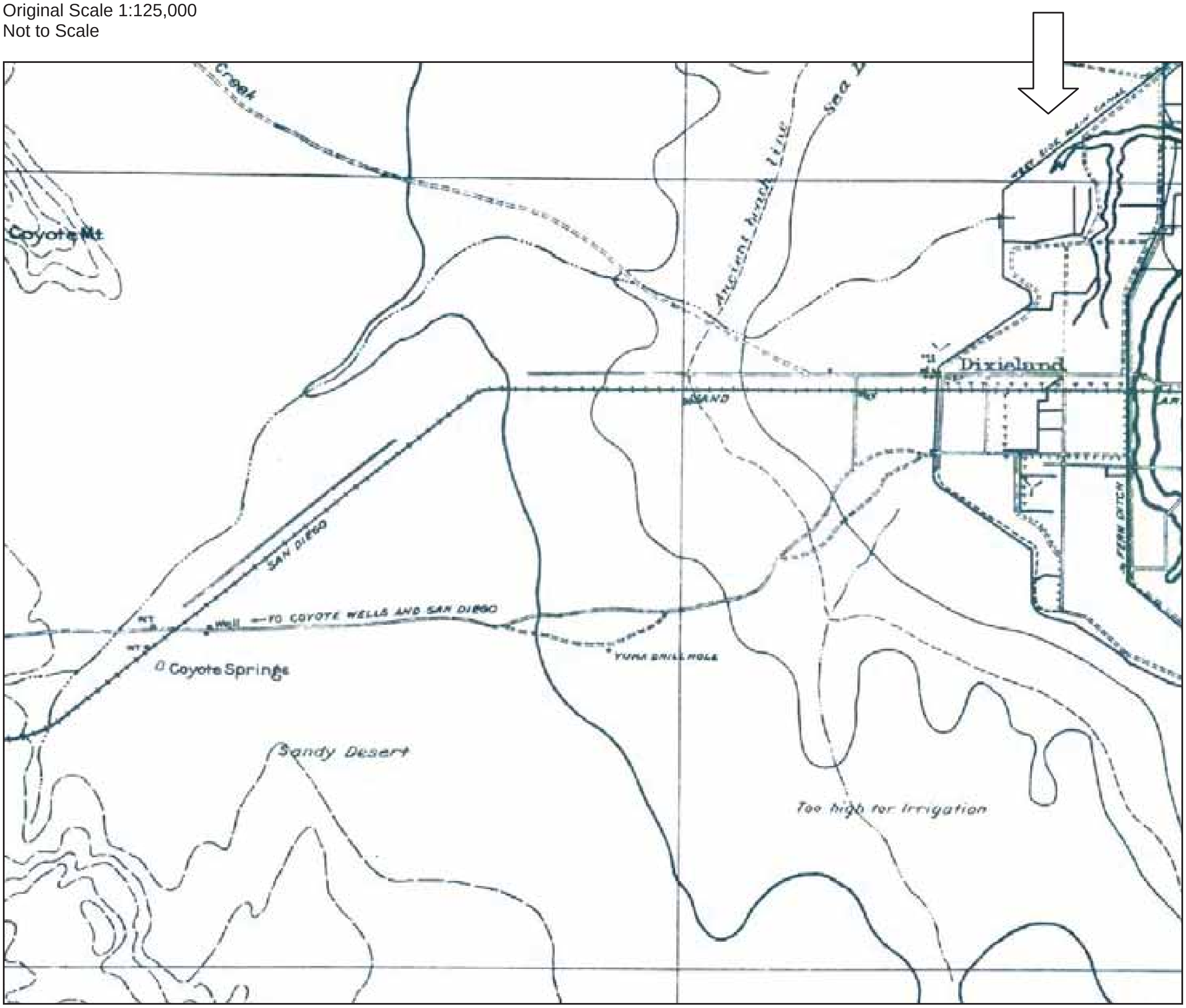
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary #
HRI #
Trinomial CA-IMP-7834H UPDATE

***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)
***Recorded by:** URS Corporation *** Date:** 12/2009
☐ Continuation ☒ Update

Additional Photos/Images:

El Centro 1908
Original Scale 1:125,000
Not to Scale



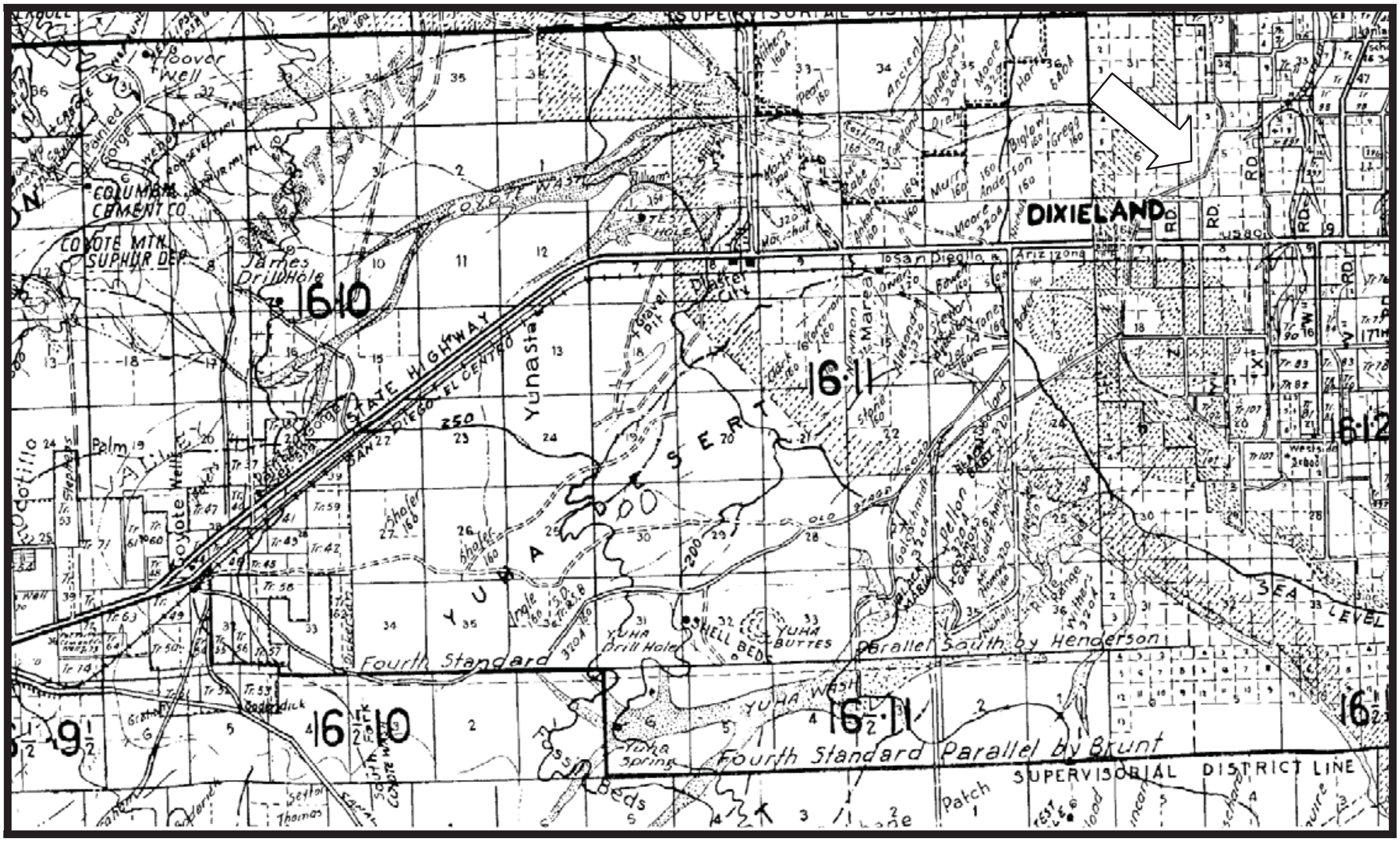
***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)

***Recorded by:** URS Corporation *** Date:** 12/2009

☐ Continuation ☒ Update

Additional Photos/Images:

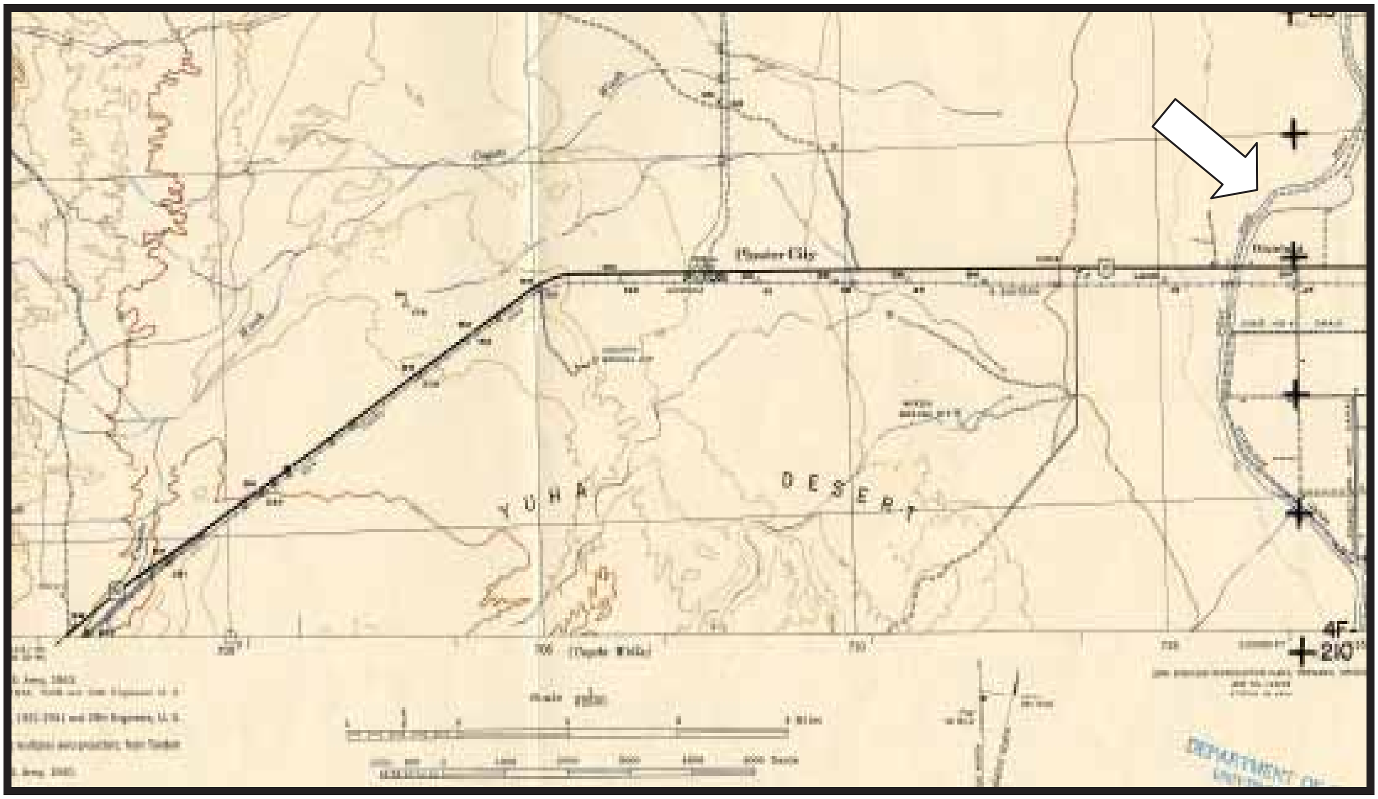
Western Portion of Blackburn's Map of Imperial County, 1936
Not to Scale



Page 10 **of** 14 ***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)
***Recorded by:** URS Corporation *** Date:** 12/2009
☐ Continuation ☒ Update

Additional Photos/Images:

Plaster City map, 1943
Original Scale 1:62,500
Not to scale.



State of California — The Resources Agency **DEPARTMENT OF PARKS AND RECREATION** **CONTINUATION SHEET**	Primary # HRI # Trinomial	 CA-IMP-7834H UPDATE

Page 11 **of** 14 ***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)

***Recorded by:** URS Corporation *** Date:** 12/2009

☐ Continuation ☒ Update

Additional Photos/Images:

View from just north of the WSM Pump 6, looking north towards Mandrapa Road

Looking south at the terminus and the north-south portion of WSM Pump 6

DPR 523L (1/95) *** Required information**

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary #
HRI #
Trinomial CA-IMP-7834H UPDATE

Page 12 **of** 14 ***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)
***Recorded by:** URS Corporation *** Date:** 12/2009
☐ Continuation ☒ Update

Additional Photos/Images:

At the east-west portion of WSM Pump 6, looking west

At the origin of the east-west portion of WSM Pump 6, looking west at the metal check

***Resource Name or #:** (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)

***Recorded by:** URS Corporation *** Date:** 12/2009

☐ Continuation ☒ Update

Additional Photos/Images:

At the origin of the east-west portion looking south at concrete-lined structure

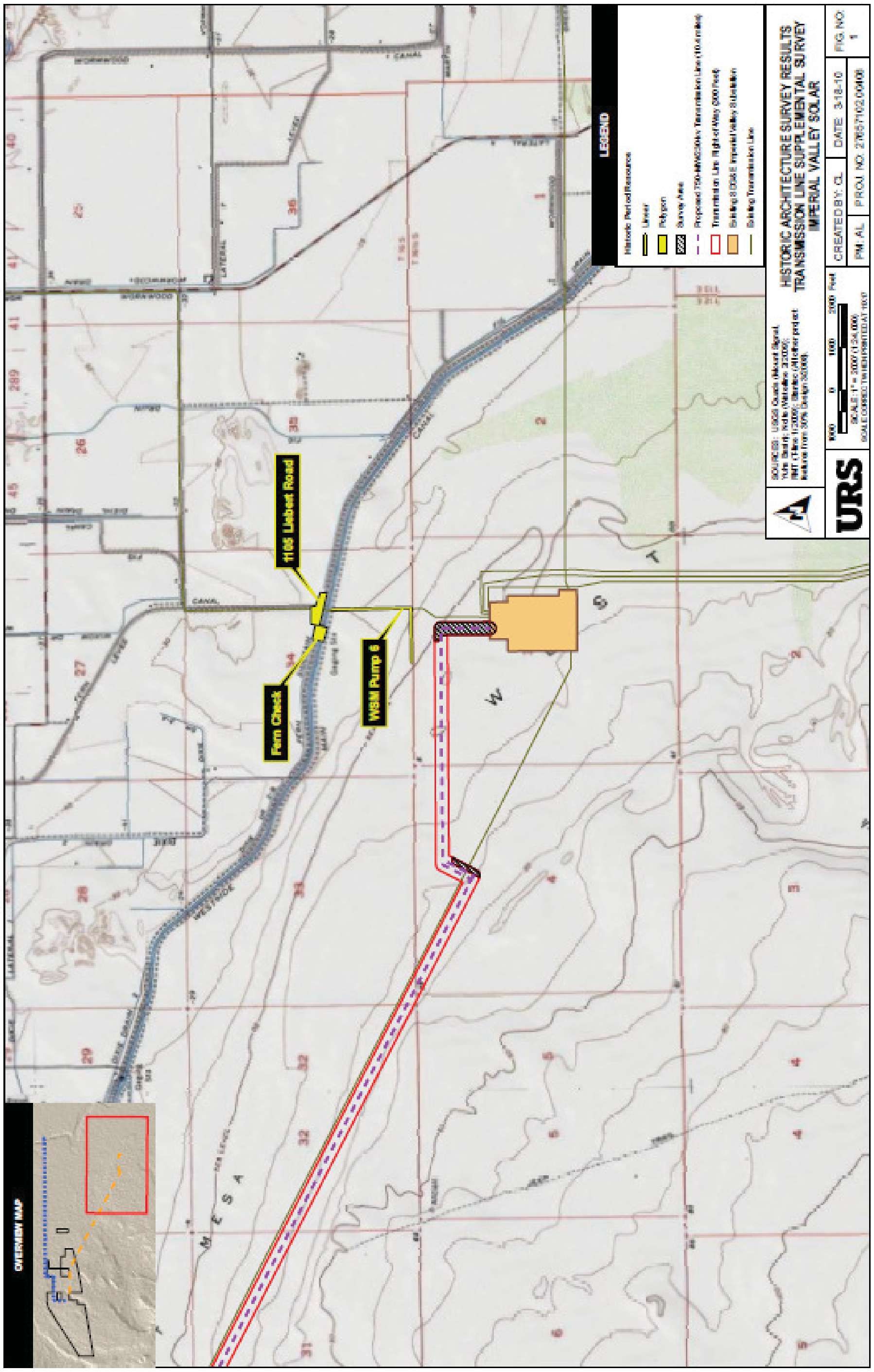
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary #
HRI #
Trinomial CA-IMP-7834H UPDATE

Page 14 of 14 *Resource Name or #: (Assigned by recorder) Portion of Westside Canal (CA-IMP-7834H)
*Recorded by: URS Corporation * Date: 12/2009
☐ Continuation ☒ Update

Additional Photos/Images:

Sketch map of WSM Pump 6
Not to scale



State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-008334 UPDATE
HRI #
Trinomial CA-IMP-7834 UPDATE
NRHP Status Code 3D/CD

Other Listings
Review Code Reviewer Date

 *Resource Name or #: Westside Main Canal

P1. Other Identifier: CA-IMP-7834, P-13-008334, Westside Main Canal

***P2. Location:** ■ Not for Publication ☐ Unrestricted *a. County: Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)

*b. USGS 7.5' Quad: Seeley, CA Date: 1957 (P. 1979) T 16S; R 12E; NW ¼ of SE ¼ of Sec 21; S.B. B.M.

c. Address: City: Zip:

d. UTM: Zone: 11S; 618511 mE/ 3635113 mN (G.P.S.) NAD 83

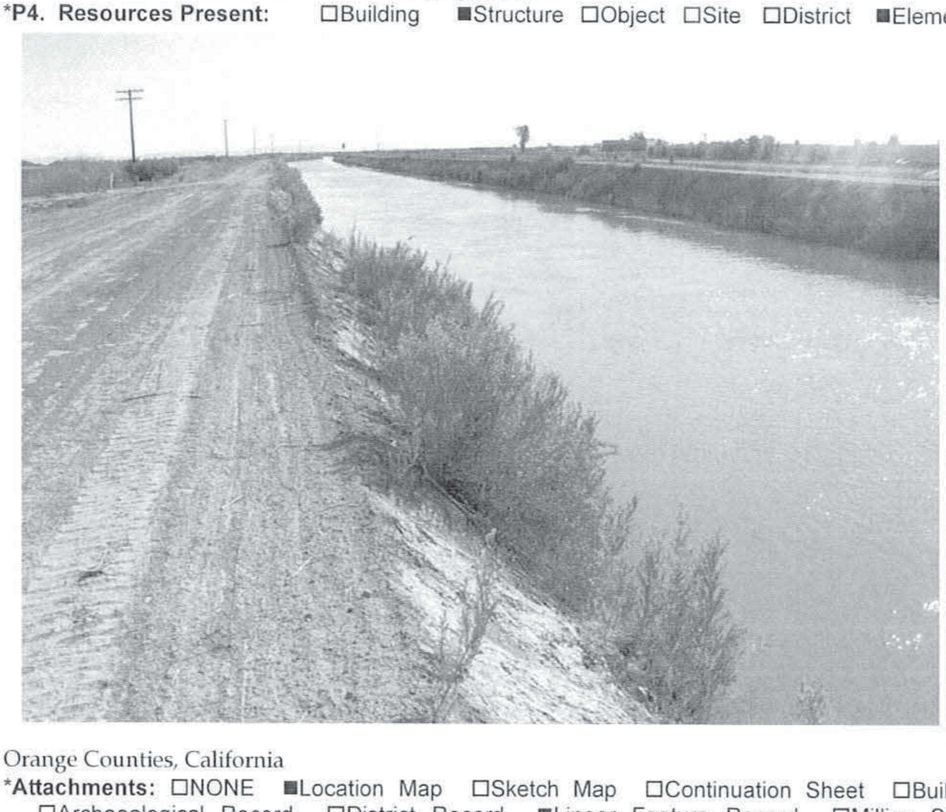
e. Other Locational Data: Starting in the City of El Centro, travel west on Interstate 8 and exit at Drew Road. Travel north on Drew Road for approximately 1.5 miles before turning left onto Evan Hewes Highway (old US 80). Travel west on Even Hewes Highway for approximately 2 miles and make a right turn onto Huff Road. Travel north on Huff Road for approximately 5 miles and make a left turn onto Boley Road. Travel west on Boley Road for approximately 1 mile and park. Proceed on foot, in a northeast direction, along the West Main Canal to where a 1.2 kilometer segment of the canal was surveyed starting at UTM coordinate 618511 mE / 3635113 mN and an ending at 619491 mE / 3635877 mN.

***P3a. Description:** This site form updates a 300-foot-long segment of the Westside Main Canal, part of the larger All-American Canal water conveyance system in Imperial County. Because the current project's survey corridor includes part of this canal, only that length within the survey corridor is documented, described, and evaluated.

The Westside Main Canal was built about 1907 as part of the larger Imperial Valley irrigation system, and later integrated into the All-American Canal system during its construction between 1934 and 1940. The Westside Main Canal has not been altered or modified since its last update in 1999 (Jill Hupp), when it was found not eligible for listing in the National Register (NRHP) as a sparate property or as a contributor to a district. However, in 2001 the Bureau of Reclamation and California State Historic Preservation Officer concurred that the All-American Canal is ELIGIBLE for the NRHP; by extension the Westside Main Canal is now recommended ELIGIBLE for the NRHP and California Register of Historical Resources (CRHR) under Criterion A/1 for its significance in association with development of the Imperial Valley.

***P3b. Resource Attributes:** HP20. Canal/aqueduct

***P4. Resources Present:** ☐Building ■Structure ☐Object ☐Site ☐District ■Element of District ☐Other (Isolates, etc.)



P5b. Description of Photo: Photograph # 1599, Westside Main Canal looking northeast.

***P6. Date Constructed/Age and Sources:** ■Historic ☐Prehistoric ☐Both
Main canal- 1907 with alterations

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd
Imperial, CA 92251

***P8. Recorded by:** J. Burkard, H. Thompson, J. Covert
SWCA Environmental Consultants
625 Fair Oaks Avenue, Suite 190
South Pasadena, California 91030

***P9. Date Recorded:** 4 / 19 / 2007

***P10. Survey Type:** Intensive Survey - 15 meter transects

***P11. Report Citation:** SWCA Environmental Consultants and Applied EarthWorks 2008: Cultural Resources Survey of Alternatives for the Sunrise Powerlink Project, San Diego, Imperial, Riverside, and Orange Counties, California

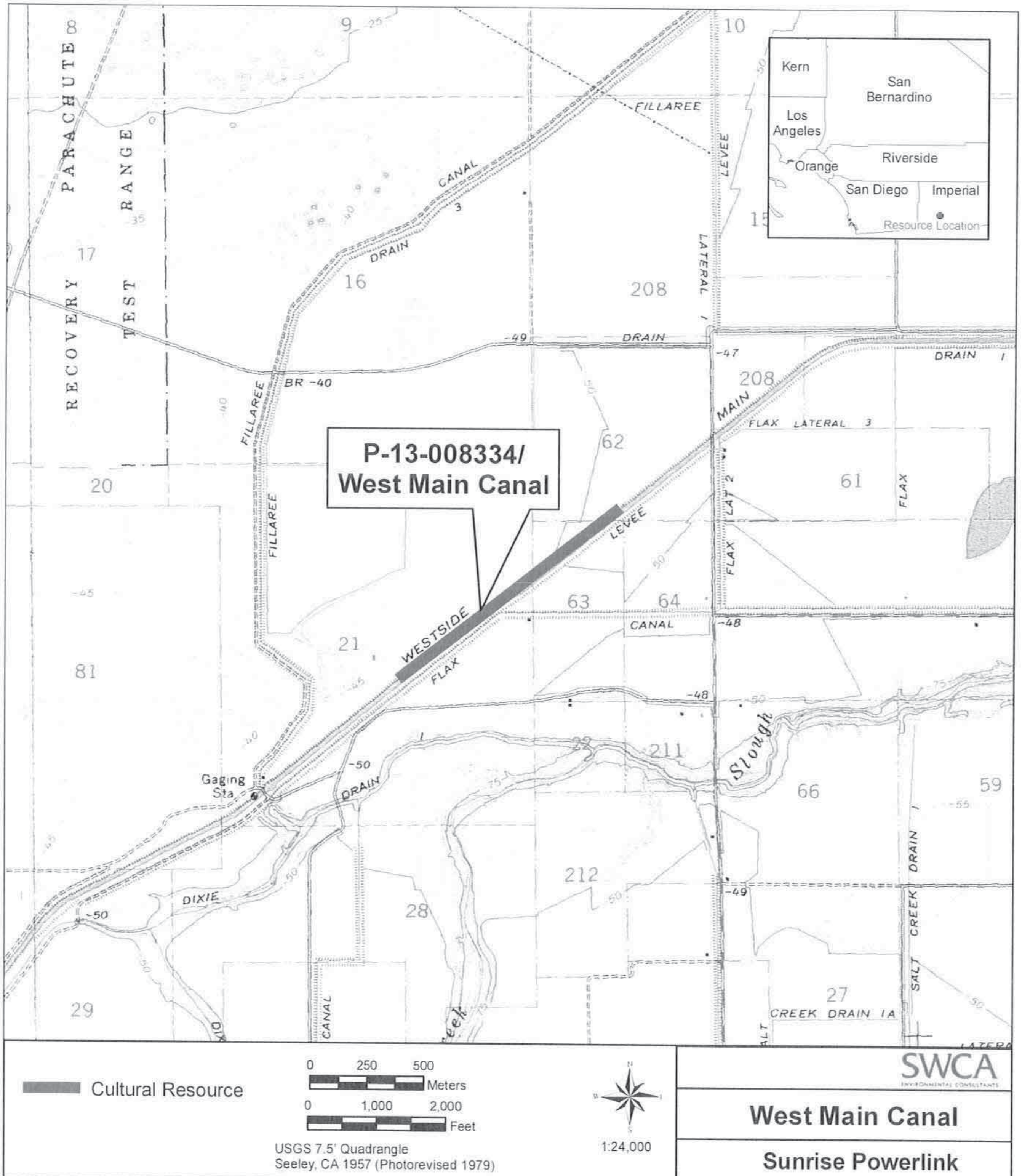
***Attachments:** ☐NONE ■Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐District Record ■Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ■Photograph Record ☐ Other (List):

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
LOCATION MAP

Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834 UPDATE

 *Resource Name or #: Westside Main Canal

*Map Name: Seeley, CA *Scale: 1:24,000 *Date of Map: 1957 (Photorevised 1979)



 *Required information

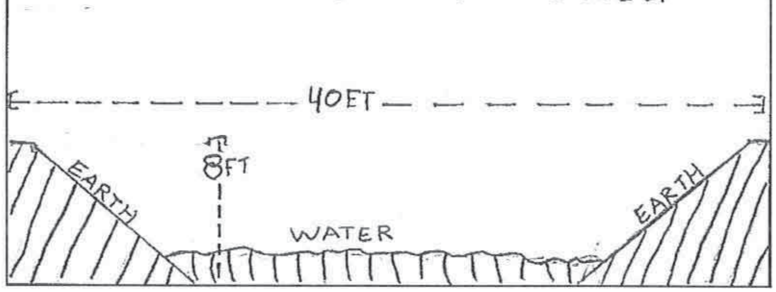
Resource Name or #: Westside Main Canal

L1. Historic and/or Common Name: CA-IMP-7834, P-13-008334, Westside Main Canal
L2a. Portion Described: ☐ Entire Resource ■ Segment ☐ Point Observation **Designation:** Segment of Westside Main Canal
b. Location of point or segment: Starting in the City of El Centro, travel west on Interstate 8 and exit at Drew Road. Travel north on Drew Road for approximately 1.5 miles before turning left onto Evan Hewes Highway (old US 80). Travel west on Even Hewes Highway for approximately 2 miles and make a right turn onto Huff Road. Travel north on Huff Road for approximately 5 miles and make a left turn onto Boley Road. Travel west on Boley Road for approximately 1 mile and park. Proceed on foot, in a northeast direction, along the West Main Canal to where a 1.2 kilometer segment of the canal was surveyed starting at UTM coordinate 618511 mE / 3635113 mN and an ending at 619491 mE / 3635877 mN.

L3. Description: Westside Main Canal was built about 1907 and is earth-lined in this specific section. It forms part of the larger All-American Canal System, which provides water for irrigation within Imperial County since its completion in 1940.

L4. Dimensions:
- **a. Top Width:** 40 feet
- **b. Bottom Width:** unknown
- **c. Height or Depth:** 8 feet
- **d. Length of Segment:** 3,937 feet

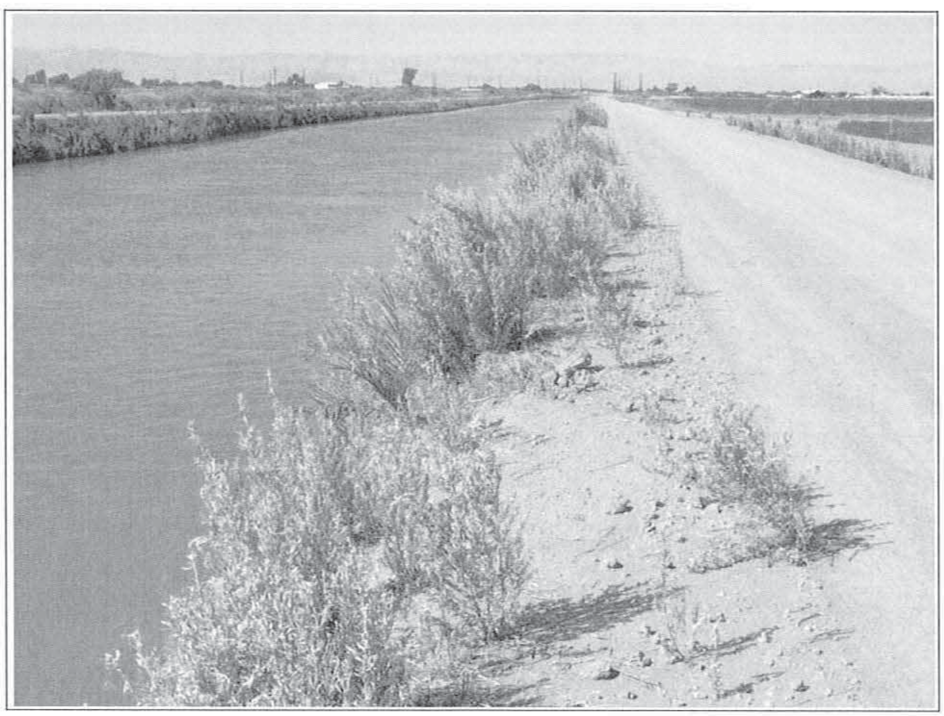
L4e. Sketch of Cross-Section (include scale) **Facing:** WEST



L5. Associated Resources: The Fox Glove Canal and Dixie Drain are both nearby, serving respectively as irrigation delivery and storm drainage for the Westside Main Canal. All three resources are part of the NRHP-eligible All-American Canal system.

L6. Setting: The canal is surrounded by local agriculture, and has played a significant role in bringing agriculture and people to the desert of Imperial County. A variety of crops grow along this segment, as well as ruderal vegetation along its banks. Dirt access roads run parallel to the canal along its berms.

L7. Integrity Considerations: The surveyed length of the canal is in working order, and appears to have been regularly maintained to keep the banks properly groomed and the quantity of silt minimal.



L8b. Description of Photo, Map, or Drawing: Photograph #1601, West Main Canal, looking southwest

L9. Remarks: The Westside Main Canal was previously recorded in 1999 by Jill Hupp for the Caltrans Environmental Program. Their mailing address is P.O. Box 942874, Sacramento, California 94274.

L10. Form Prepared by:
J. Burkard , G. Connel, J. Covert
SWCA Environmental Consultants
625 Fair Oaks Avenue,Suite 190
South Pasadena, California 91030

L11. Date: 4 / 19 / 07

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PHOTOGRAPH RECORD

Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834 UPDATE

 Resource Name or #: Westside Main Canal UPDATE Year 2007

Camera Format: Digital
Lens Size:
Film Type and Speed: Digital
Negatives Kept at: SWCA Environmental Consultants, South Pasadena office

Mo.	Day	Time	Exp./Frame	Subject/Description	View Toward	Accession #
4	19	-	1599	Westside Main Canal	Northeast	N/A
4	19	-	1600	Westside Main Canal	Southwest	N/A
4	19	-	1601	Westside Main Canal, facing southwest down survey corridor	Southwest	N/A
4	19	-	1602	Westside Main Canal	Northeast	N/A

State of California - The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008334 UPDATE
HRI#
Trinomial CA-IMP-7834 (Update)

 * Resource Name or # (Assigned by recorder) CA-IMP-7834 (Update)

CA-IMP-7834 was recorded by Harris of HDR in 2000. This site is described as the Westside Main Canal built in the 1920s and incorporated into the All American Canal System (CA-IMP-7130H, built between 1933 and 1938). The Westside Canal is a forty mile canal alignment that, as part of the All American Canal System, has been determined eligible for listing in the National Register of Historic Places and as a California Historic Resource. The proposed pipeline alignment will connect to the Westside Main Canal.

The Westside Canal is a forty mile canal alignment that, as part of the All American Canal System, has been determined eligible for listing in the National Register of Historic Places and as a California Historic Resource. The proposed pipeline alignment will connect to the Westside Main Canal and, therefore, the proposed project has the potential to adversely impact a significant resource. McKenna et al. recommends that the area be monitored during construction and that the design, construction, and maintenance of the proposed pipeline be planned to avoid adverse impacts to the Canal.

Jeanette A. McKenna
February 28, 2007

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #: P-13-008334 UPDATE
HRI #:
Trinomial: CA-IMP-7834
NRHP Status Code:

Other Listings:
Review Code: Reviewer: Date:

Page 1 of 3

Resource Name or #: (Assigned by recorder). SDY-S-10: Westside Main Canal

P1. Other Identifier: None

P2. **Location:** ■Not for Publication ☐Unrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad**: Plaster City Date: 1957 photorevised 1979 T 16S ; R 12E ; Section 18; S.B.M.
c. Address: - City: - Zip: -
d. UTM: Zone 11; 615200 mE/ 3625820 mN to 3628400 mN
e. Other Locational Data (e.g., parcel #, directions to resource, elevation, etc., as appropriate): The Westside Main Canal crosses Old Hwy 80 in a northward direction at Dixieland; it intersects the project area approximately 1300' south of Dixieland at the ROW of the San Diego and Eastern Railroad. Elevation here is about 35' above sea level.

P3a. **Description** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries): The Westside Main Canal is an older canal, built in the 1920s, that was incorporated into the All American Canal System (CA-IMP-7130H), constructed between 1933 and 1938, and opened in 1940. The Westside Main begins at the western terminus of the All American Canal and extends northward in a general "Z" shape for about forty miles. It ends about 5 miles west of the town of Westmorland. As part of the All American Canal System, this canal is eligible for NRHP inclusion.

P3b. **Resource Attributes** (List attributes and codes): HP20 - Canal

P4. **Resources Present:** ☐Building ■Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photograph or Drawing (Photo required for buildings, structures, and objects)

P6. **Age and Sources:** ■Historic ☐Prehistoric ☐Both

P7. **Owner and Address:**

P8. **Recorded by** (Name, affiliation, and address): N. Harris, HDR ,9444 Farnham, San Diego ,CA 92123

P9. **Date Recorded:** June, 2000

P10. **Survey Type** (Describe): Intensive Surface Inventory

P11. **Report Citation** (Cite survey report and other sources, or enter "none") Cultural Resources Survey for the Level (3) Communications Fiber Optic Network Between City of San Diego, California, and the California/Arizona State Line at the Colorado River, Near Yuma, Arizona; on file with the BLM, Riverside, CA.

Attachments: NONE ■Location Map ☐Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐Other (List):

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
ARCHAEOLOGICAL SITE RECORD

Primary #: P-13-008334 UPDATE
Trinomial: CA-IMP-7834

Resource Name or #: (Assigned by recorder): Westside Main Canal

A1. **Dimensions:** a. Length: ca. 40 miles b. Width: unknown
Method of Measurement: ☐ Paced ☐Taped ☐Visual estimate■ Other: Derived from map
Method of Determination (check any that apply.): ☐ Artifacts ☐Features ☐Soil ☐Vegetation ☐Topography ☐Cut bank ☐Animal burrow ☐Excavation ☐Property boundary ■Other (Explain): Imperial Irrigation District map
Reliability of Determination: ☐High ■Medium ☐Low Explain: Measured off map
Limitations (check any that apply): ☐Restricted access ☐Paved/built over ☐Site limits incompletely defined ☐Disturbances ☐Vegetation ☐Other (Explain):

A2. Depth: ☐None ■Unknown Method of Determination:

A3. **Human Remains:** ☐Present ■Absent ☐Possible ☐Unknown (Explain):

A4. **Features** (Number, briefly describe, indicate size, list associated cultural constituents, and show location of each feature on sketch map.): Canal channel, headgates, drops, etc.

A5. **Cultural Constituents** (Describe and quantify artifacts, ecofacts, cultural residues, etc., not associated with features.): None noted.

A6. **Were Specimens Collected?** ■No ☐Yes (If yes, attach Artifact Record or catalog and identify where specimens are curated.)

A7. **Site Condition:** ■Good ☐Fair ☐Poor (Describe disturbances.): Operational canal

A8. **Nearest Water** (Type, distance, and direction.): n/a

A9. **Elevation**: ca. 35 feet above sea level

A10. Environmental Setting (Describe culturally relevant variables such as vegetation, fauna, soils, geology, landform, slope, aspect, exposure, etc.): Agricultural properties on the east side, and creosote, ocotillo, cactus, grasses, mesquite, shrubs, forbs on the west side; soils are light brown alluvial sandy silt loams and sand dunes on the western edge of the cultivated portion of the Imperial Valley.

A11. Historical Information: The Westside Main Canal is an older canal, built in the 1920s, that was incorporated into the All American Canal System (CA-IMP-7130H), constructed between 1933 and 1938, and opened in 1940. The Westside Main begins at the western terminus of the All American Canal and extends northward in a general "Z" shape for about forty miles. It ends about 5 miles west of the town of Westmorland. As part of the All American Canal System, this canal is eligible for NRHP inclusion.

A12. **Age:** ☐Prehistoric ☐Protohistoric ☐1542-1769 ☐1769-1848 ☐1848-1880 ☐1880-1914 ■1914-1945 ☐Post 1945 ☐Undetermined (**Describe position in regional prehistoric chronology or factual historic dates if known**):

A13. Interpretations (Discuss data potential, function(s), ethnic affiliation, and other interpretations): The canal is part of the historic system of canals that make up the extensive hydraulic irrigation system in the Imperial Valley. These canals profoundly influenced the Euro-American land use, settlement patterns, economy, and the cultural landscape of southern California, and continues to do so today.

A14. Remarks. None.

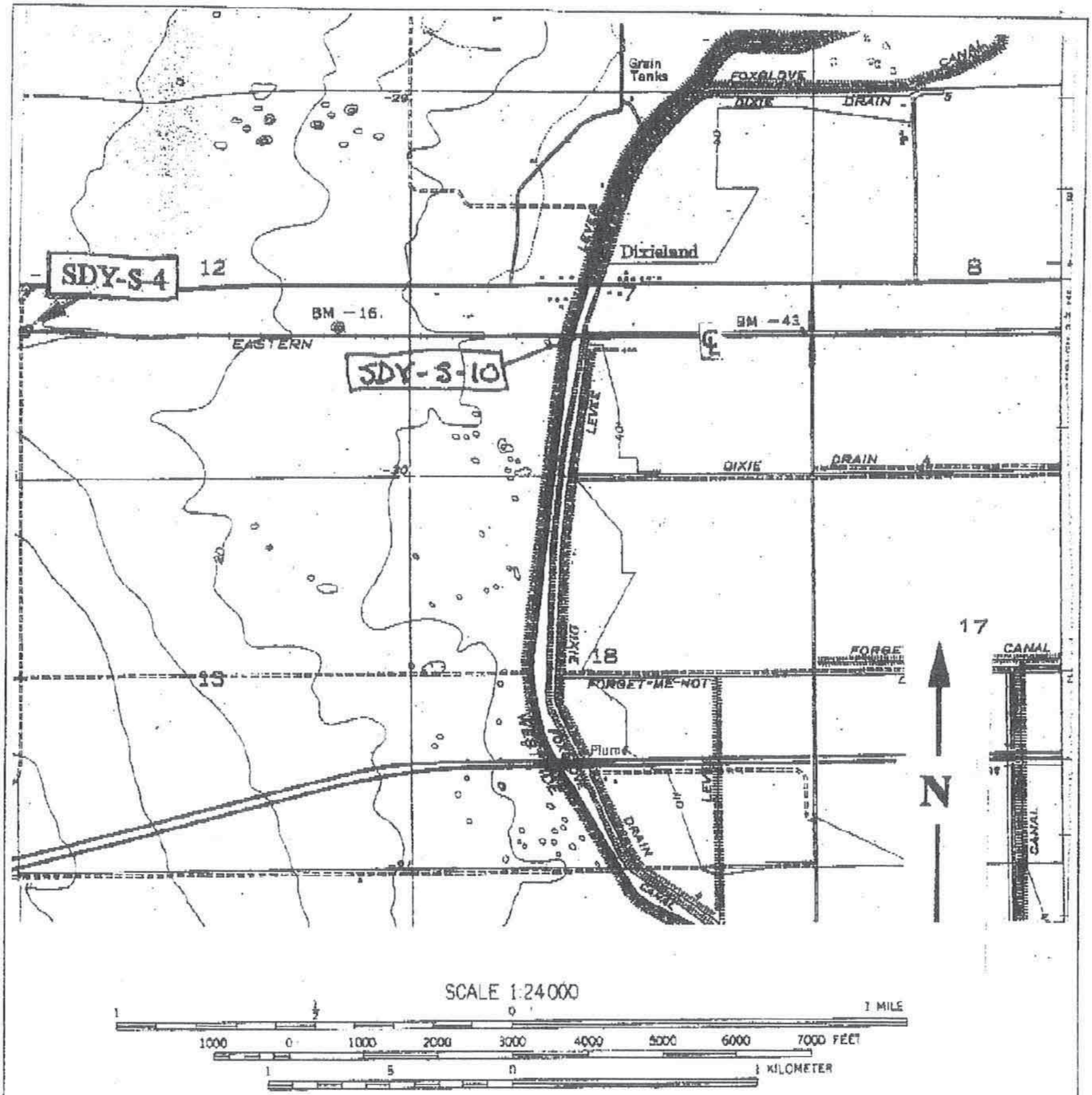
A15. References (Documents, informants, maps, and other references): None.

A16. Photographs (List subjects, direction of view, and accession numbers or attach a Photograph Record):
Kept at:

A17. Form Prepared by Michael Oberndorf Date: 12/4/2000
Affiliation and Address: HDR Engineering, Inc.
9444 Farnham Street, Suite 300
San Diego, CA 92123

CA-IMP-7834 P-13-008334 UPDATE

Resource Name or #: SDY-S-10



Plaster City, California USGS 7.5' Quadrangle

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #: P-13-008334
HRI #:
Trinomial: CA-IMP-7834

NRHP Status Code: 6
Other Listings:
Review Code ____ Reviewer ____ Date ____

County/Route/Postmile: 11-IMP-98, P.M. 0.3-30.3/K.P 0.5-48.8

Map Reference No.: 1

*Resource Name or #: Westside Main Canal

P1. Other Identifier: N/A

*P2. Location: *a. County Imperial

b. Address SR 98 at Postmile 22.02 City Calexico Zip 92231

*c. USGS 7.5 Quad: d. UTM:

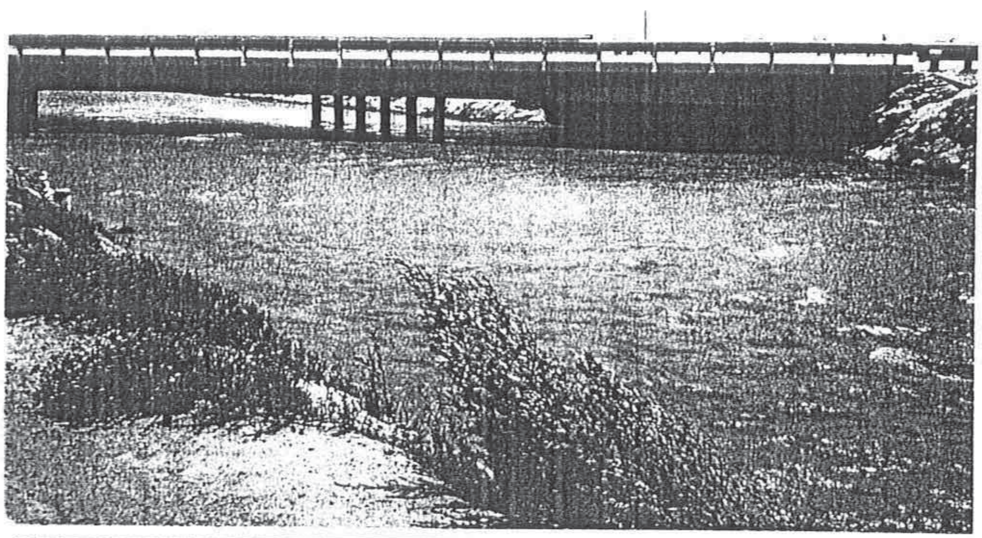
*e. Other Locational Data: (e.g. parcel #, directions to resource, elevation, etc., as appropriate)
Segment within the APE crosses SR 98 at P.M. 22.02 (K.P. 35.23) just west of Drew Rd.

*P3a. Description:
The Westside Main Canal is a wide irrigation canal that runs through agricultural land in the Imperial Valley section of Imperial County. It enters the current project area where State Route 98 crosses the canal at Postmile 22.02 (K.P. 35.23) west of Drew Road. At this point the canal is approximately 25 feet wide (7.62 m) and about 10 feet deep (3.04 m), running perpendicular to the highway in a northwest-southeast direction. It is banked by earthen levees of natural vegetation and is unlined. Dirt access roads run along the levees on both sides of the canal to precipitate maintenance and dredging operations. The Westside Main Canal as a whole is primarily earthen lined and subject to regular dredging. Rigorous dredging has reshaped the canal's banks and inner surface.

Originating at the All-American Canal along the International Boundary, Westside Canal extends northwest roughly 11 miles (17.8 km), where it becomes the Tamarack Canal. At this point (between Brawley and Westmoreland) Westside branches off to the west, terminating at the Trifolium Canal, which continues northwest a short distance to the boundary of the Imperial Irrigation District, with laterals serving a considerable area lying south of Salton Sea. Bridge #58-274, constructed in 1955, carries SR 98 across the canal. Parallel to Westside Main is a smaller waterway, the concrete-lined Wormwood Canal. The surrounding area consists primarily of irrigated cropland.

*P3b. Resource Attributes: HP20 (Canal/Aqueduct)

P5. Photograph or Drawing (Photograph required for buildings, structures, and objects.)



*P4. Resources Present: ☐ Building ■ Structure ☐ Object ☐ Site ☐ District ☐ Element of District

P5b. Description of Photo: 4/28/99. Canal segment N of SR 98 looking S.

*P6. Date Constructed/Age: c.1906; recent modifications
☐ Prehistoric ■ Historic ☐ Both

*P7. Owner and Address:
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

*P8. Recorded by:
Jill Hupp
Caltrans Environmental Program
PO Box 942874
Sacramento, CA 94274-0001
(916) 654-3567

*P9. Date Recorded: 4/28/99

*P10. Type of Survey: ■ Intensive ☐ Reconnaissance ☐ Other

*P11. Report Citation: IMP-98 HASR, 11-IMP-98, P.M. 0.3/30.3, EA 173400

*Attachments: ☐ NONE ☐ Map Sheet ☐ Continuation Sheet ■ Building, Structure, and Object Record ☐ Linear Resource Record ☐ Archaeological Record ☐ District Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

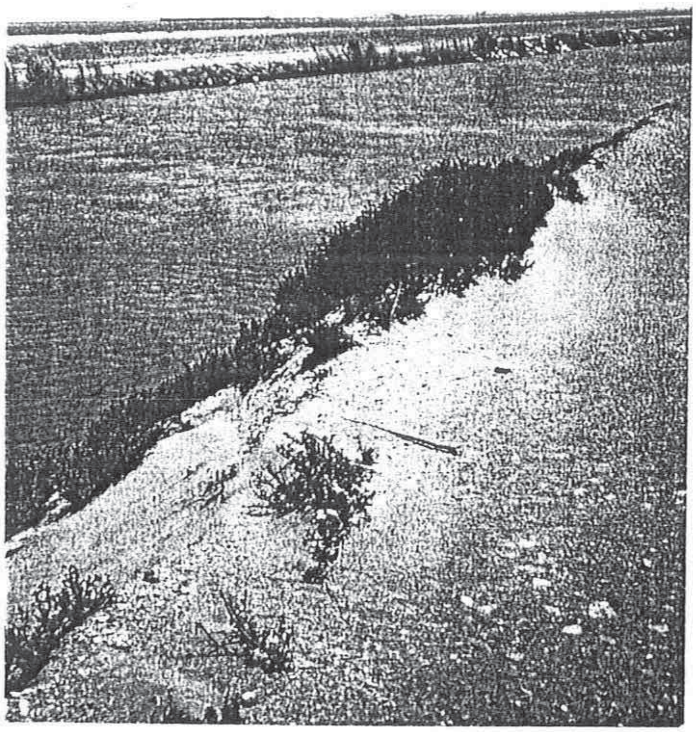
Primary # P-13-008334
HRI #/ Trinomial CA-IMP-7834

Resource Name or #: Westside Main Canal

■ Continuation ☐ Update

County/Route/Postmile: 11-IMP-98, P.M. 0.3/30.3

P5b. Description of Photo (continued)



4/28/99. Westside Main Canal segment north of SR 98, looking NW.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary # P-13-008334
HRI#/Trinomial CA-IMP-7834

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code: 6

*Resource Name or #: Westside Main Canal

B1. Historic Name: Westside Main Canal
B2. Common Name: Westside Main Canal   County/Route/Postmile: 11-IMP-98, P.M. 0.3/30.3
B3. Original Use: Irrigation ditch   B4. Present Use: Irrigation ditch
*B5. Architectural Style: N/A
*B6. Construction History: built c. 1906 as part of the Imperial canal system with recent modifications.
*B7. Moved? ■ No ☐ Yes ☐Unknown   Date: N/A   Original Location: N/A
*B8. Related Features: None
B9a. Architect: N/A   B9b. Builder: Calif. Devel. Co., Southern Pacific Co., I.I.D.
*B10. Significance: N/A   Theme: N/A   Area: N/A
Period of Significance: N/A   Property Type: N/A   Applicable Criteria: N/A

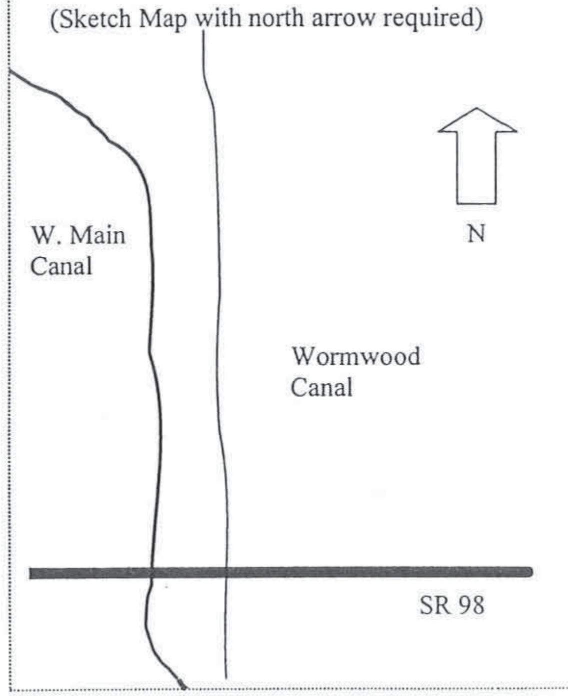
Westside Main Canal was built about 1906 as part of the expansive Imperial irrigation system, which transformed the Colorado Desert into fertile farmland. The movement to reclaim this seemingly inhospitable wasteland for agrarian purposes had originated with Dr. O. M. Wozencraft in the 1850s. Wozencraft was convinced that the area had unlimited agricultural potential, if only a potable water supply could be established; he believed that this could be accomplished by means of a single gravity-flow canal, by which several hundred acres could be irrigated. Despite Wozencraft's best efforts, no progress was made on the project during his lifetime. In 1896 a group of investors formed the California Development Company (CDC), determined to take on the challenge of desert irrigation. Headed by civil engineers Charles Rookwood and George Chaffey, the company began constructing a canal that would divert water from the Colorado River into the dry channels of the Alamo and New rivers, which would in turn carry the water north to the Colorado Desert (now the Imperial Valley). In early 1902, the first irrigation water was delivered. A CDC subsidiary, the Imperial Land Company, promoted colonization of the area and handled land sales. Under Chaffey's direction, several mutual water companies were organized as well, and the CDC built most of the distribution systems, main canals and laterals needed to service these newly developed areas. By 1905, 80 miles of main canals had been built, with more than 100,000 acres under cultivation. Water delivery service was unreliable however, the canals being poorly designed and maintained. The muddy Colorado River had a tendency to deposit heavy loads of silt, which soon blocked the canal's intake, thereby reducing the amount of water reaching Valley crops. In an attempt to combat this, the CDC cut a bypass channel in the riverbank four **(See Continuation Sheet)**

B11. Additional Resource Attributes: N/A
B12. References: Clement 1996: primary record 1; Lortie, 1997: 6, 8-10, 13-17; IID website: 1, 6; Tout 1990: 110, 114-115; Fisher 1998: 11-14.

B13. Remarks: N/A
B14. Evaluator: Jill Hupp
Caltrans Environmental Program
PO Box 942874
Sacramento, CA 94274-0001
(916) 654-3567

*Date of Evaluation: 5/24/99

(Sketch Map with north arrow required)



(This space reserved for official comments)

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008334
HRI #/ Trinomial CA-IMP-7834

Resource Name or #: Westside Main Canal ■ Continuation □ Update

County/Route/Postmile: 11-IMP-98, P.M. 0.3/30.3

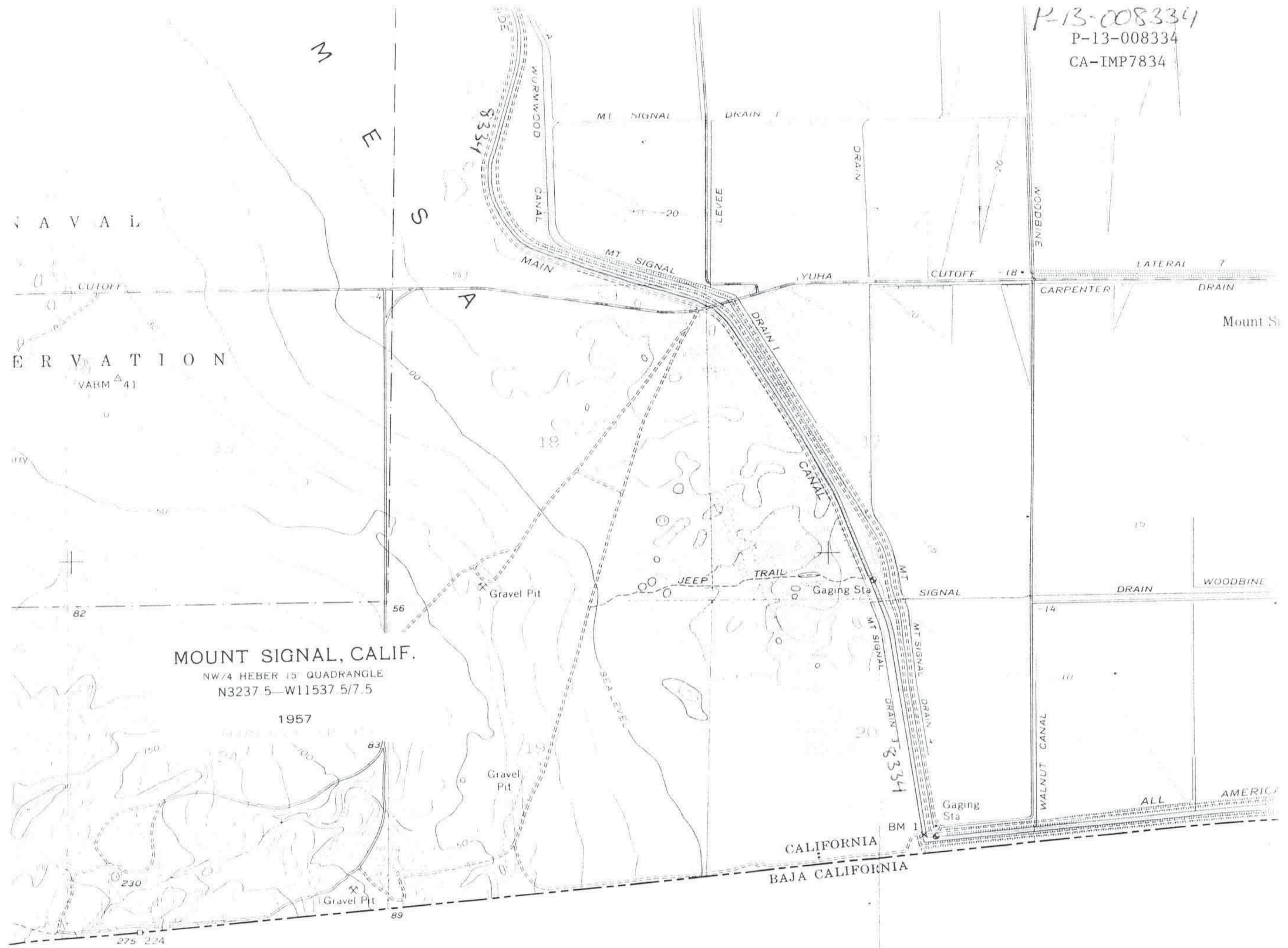
B10. Significance (continued) miles south of the border, without legal authority or adequate gates to control the force of the water. Widespread flooding in the winters of 1905-06 and 1907 as a result of this action caused extensive damage to farmland and railroad property, as well as to the canal system itself. The wooden flume that had carried the Encina (Westside Main) Canal across New River in Mexico was destroyed in the floods, as was a similar flume across New River 20 miles north of the border. It was not deemed practical to rebuild the latter, as the floodwaters had greatly increased the width and depth of the New River Channel at that locale. As an alternative, the CDC decided to enlarge Westside Main Canal (then located primarily within Mexico) and extend it north into the United States. By the end of 1907, a new enlarged wooden flume with a length of some 1,860 feet carried the canal across New River in Mexico. The extended Westside Main Canal was designed to serve all of the area lying west of New River, which had not yet been developed.

Unable to recover from its huge financial losses after the floods, the CDC was forced into bankruptcy. Southern Pacific (as the CDC's main creditor) assumed management of the company, and water delivery service continued without interruption. Between 1912-1916, development work in Imperial Valley in the way of canal extensions and territorial improvements advanced at an accelerated pace. The Imperial Irrigation District (IID) purchased the existing canal system in 1916, and in 1922 the region's smaller mutual water companies were absorbed by the District. By 1930 the district was operating some 1,700 miles of canals and laterals, with a service area of 550,000 acres. As an agricultural center, the Imperial Valley was particularly hard-hit by the Depression; maintenance and expansion work on the canals slowed to a near-standstill as economic conditions worsened. To Valley residents, the completion of Hoover Dam on the lower Colorado River in 1935 seemed an indication of better times to come. This massive Federal undertaking would help reduce the volume of silt carried by the river, and prevent the possibility of another devastating flood in the Imperial Valley. The All-American Canal was finished in 1941 as part of the same project as Hoover Dam, fulfilling the long-held ambition of Valley farmers and IID officials to build a new canal that was entirely within the boundaries of the United States. Improvements were made to the existing canal system as well, particularly the drain ditches, which were widened and fitted with drain tiles to help alleviate the problem of salt build-up in Valley soil.

Beginning in the 1960s, the IID endeavored to line all of its earthen canals with concrete. The section of Westside Main Canal within the project area is earthen, although other segments are now concrete. The canal originally lay primarily within Mexico, but was considerably widened and extended within the United States in 1907, and again between 1912-1916. More extensive improvements were made after the completion of the All-American Canal in 1941, and the sections of Westside Canal located south of the border were no longer part of the IID system. The earthen sections have been subject to regular dredging operations since the 1950s.

Westside Main Canal today, like the IID irrigation system overall, reflects the developments that occurred as a result of the construction of the All-American Canal in 1941, after which the system was considerably expanded and modernized. The Westside Main Canal appears to possess significance under criteria A and C for its association with the development of irrigated commercial agriculture in the Imperial Valley west of New River in the early 1900s and as a good example of an early large-scale irrigation canal system. However, research to date appears to indicate that the canal as a whole, while significant, would not possess the requisite degree of integrity due to reconstruction and dredging activities since the 1950s, but no survey of the canal in its entirety has yet been undertaken. Caltrans architectural historian Frank Lortie, after an extensive study of the IID system in 1997, concluded that the elements in the IID that retain integrity for the period 1941-1950 could be contributors to a potentially eligible National Register historic district. The segment of Westside Main Canal within the project vicinity does not appear to possess sufficient integrity of workmanship, design, feeling and association to represent the canal's significance in itself or as a contributor to a larger property. While still earthen, extensive dredging since the 1960s has changed the basic configuration of the canal, because modern dredging equipment created a different ditch profile, more U-shaped and with steeper sides. The canal was extended and widened over time as the IID attempted to keep up with its ever-expanding service area. Because of these alterations it reflects neither the period of significance outlined by Lortie (1941-1950) or the earlier period of the canal system's history (1901-1907).

In July 1997 and April 1998, segments of several canals within the IID system (including portions of Westside Main) were examined and found ineligible due to loss of integrity. The segment of Westside Main Canal within the current project area also appears to lack integrity to be individually eligible for the National Register of Historic Places or to be a contributing element of the canal as a whole, should the entire canal constitute an eligible property. There is no evidence of a possible historic district or historic landscape which might include this segment of the canal as a contributing element. Likewise, Caltrans has evaluated the canal in accordance with Section 15064.5 (a)(2)-(3) of the CEQA Guidelines, using criteria outlined in Section 5024.1 of the California Public Resources Code, and determined that the canal is not a historical resource for the purposes of CEQA.


P-13-008334
P-13-008334
CA-IMP7834
MOUNT SIGNAL, CALIF.
NW/4 HEBER 15' QUADRANGLE
N3237.5—W11537.5/7.5
1957
NAVAL
RESERVATION
VABM 41
MESA
8334
WURMWOOD CANAL
MT SIGNAL DRAIN 1
LEVEE
DRAIN
WOODBINE
MAIN
MT SIGNAL
YUHA
CUTOFF
LATERAL 7
CARPENTER
DRAIN
Mount Signal
DRAIN 1
CANAL
JEEP TRAIL
Gaging Sta
MT SIGNAL DRAIN 3
MT SIGNAL DRAIN 4
8334
SIGNAL
WOODBINE DRAIN
WALNUT CANAL
ALL AMERICAN
SEA LEVEL
Gravel Pit
Gravel Pit
Gravel Pit
Gaging Sta
BM 1
CALIFORNIA
BAJA CALIFORNIA

P-13-008334

P-13-008334
CA-IMP-7834

P-13-008334

CA-IMP-7834

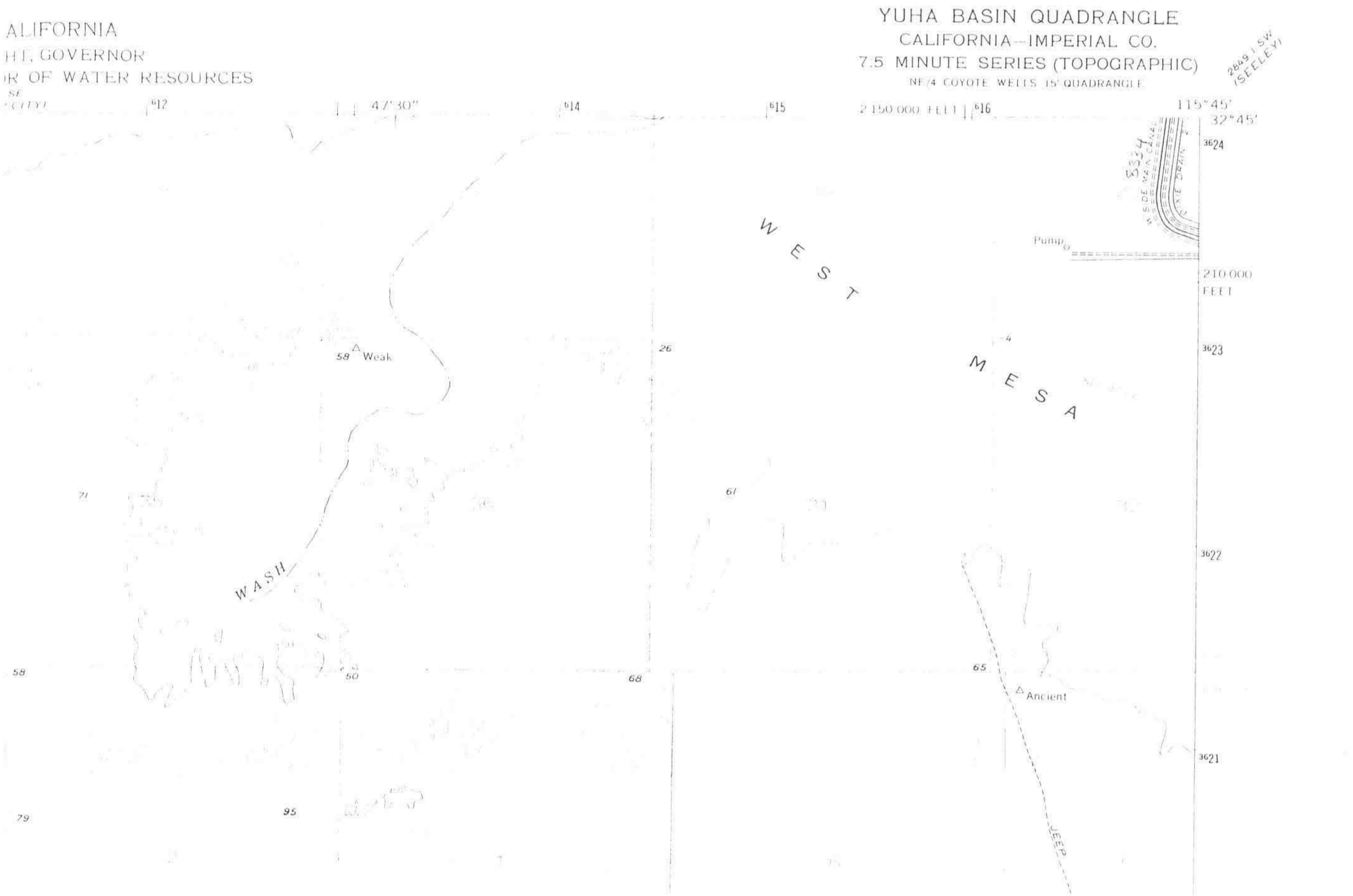
STATE OF
DEPARTMENT OF

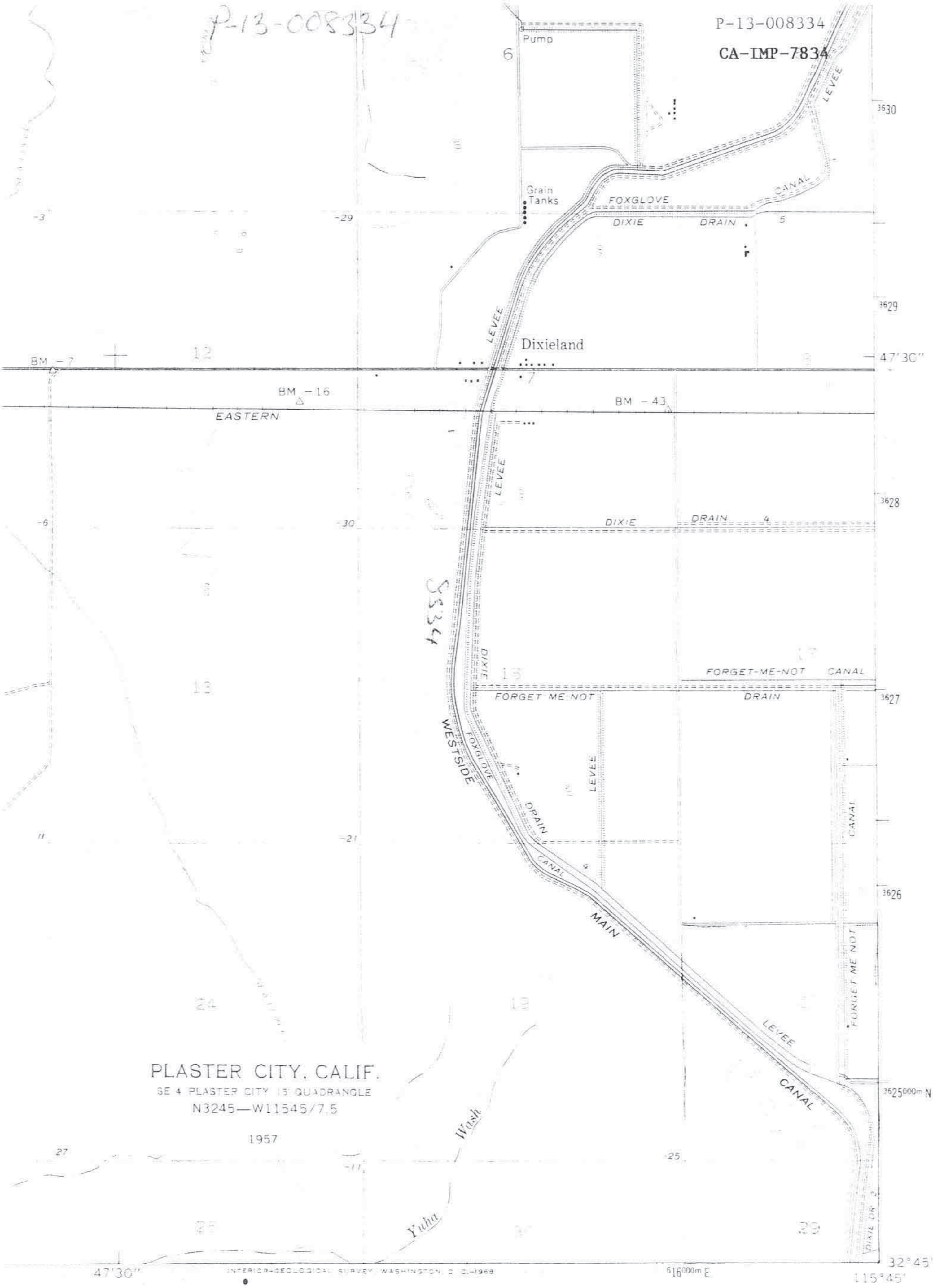
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MOUNT SIGNAL, CALIF.

P-13-008334

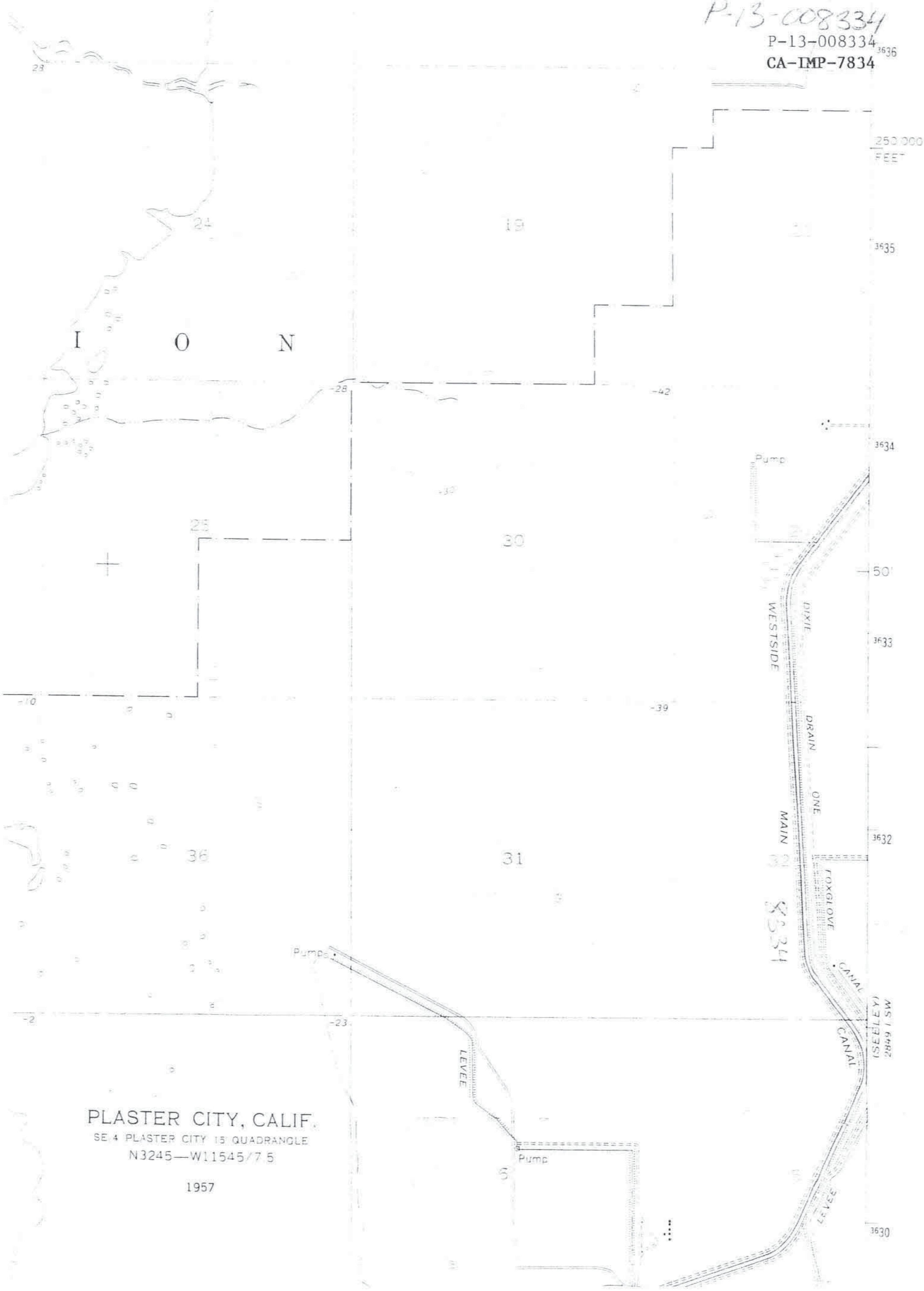
P-13-008334
CA-IMP-7834





P-13-008334
P-13-008334
CA-IMP-7834
Pump
6
LEVEE
3630
Grain Tanks
FOXGLOVE
CANAL
DIXIE
DRAIN
5
-3
-29
3629
LEVEE
Dixieland
BM -7
12
47'30"
BM -16
BM -43
EASTERN
LEVEE
3628
-6
-30
DIXIE
DRAIN
4
8334
DIXIE
13
FORGET-ME-NOT
CANAL
FORGET-ME-NOT
DRAIN
3627
WESTSIDE
FOXGLOVE
LEVEE
DRAIN
CANAL
-21
CANAL
4
3626
MAIN
24
19
LEVEE
FORGET ME NOT
CANAL
3625000m N
PLASTER CITY, CALIF.
SE 4 PLASTER CITY 15' QUADRANGLE
N3245—W11545/7.5
1957
Wash
27
-25
Yuha
29
DIXIE DR 2
47'30"
INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1968
616000m E
32°45'
115°45'

P-13-008334
CA-IMP-7834



P-13-008334

P-13-008334

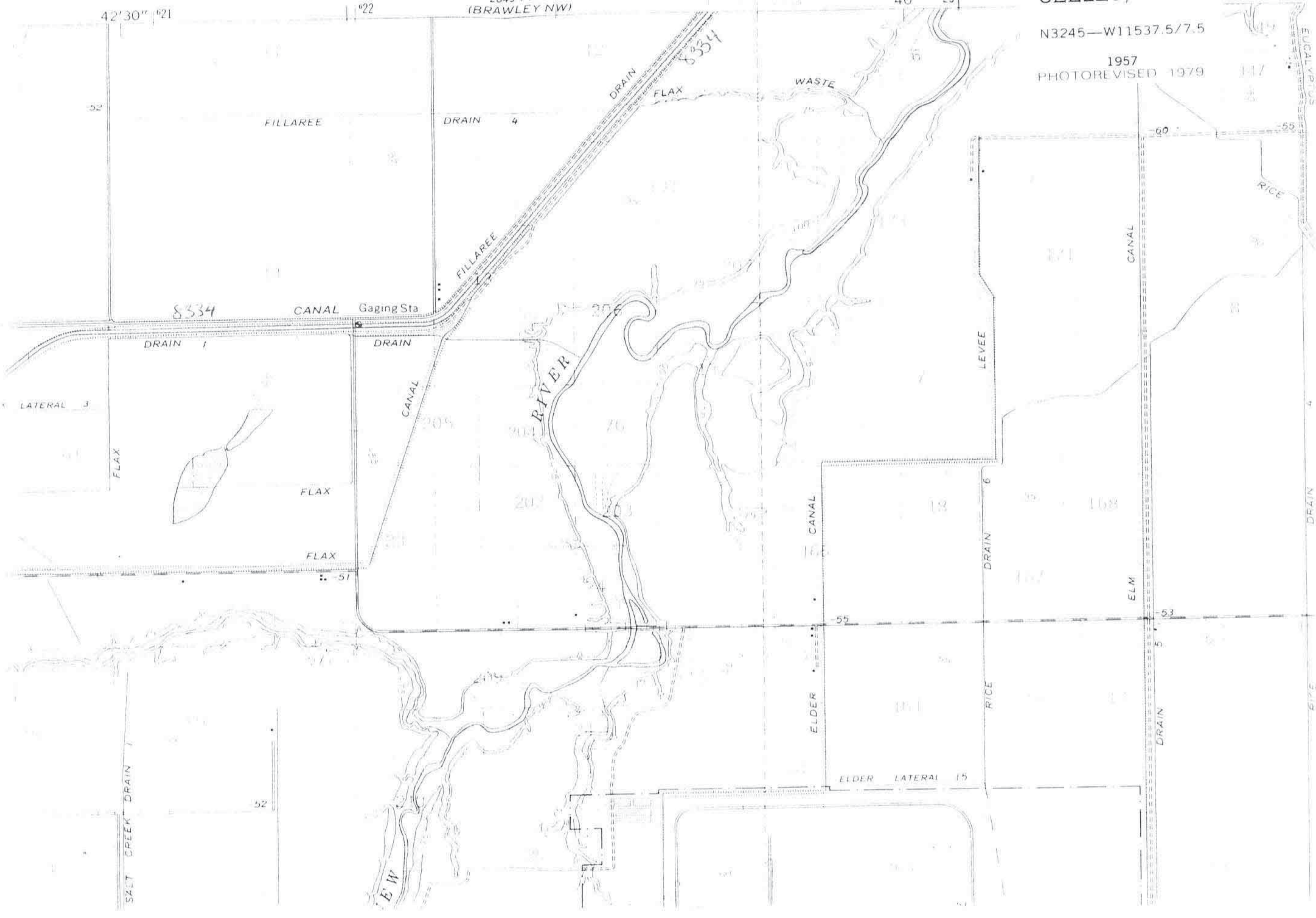
CA-IMP-7834

SEELEY, CALIF.

N3245—W11537.5/7.5

1957
PHOTOREVISED 1979

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

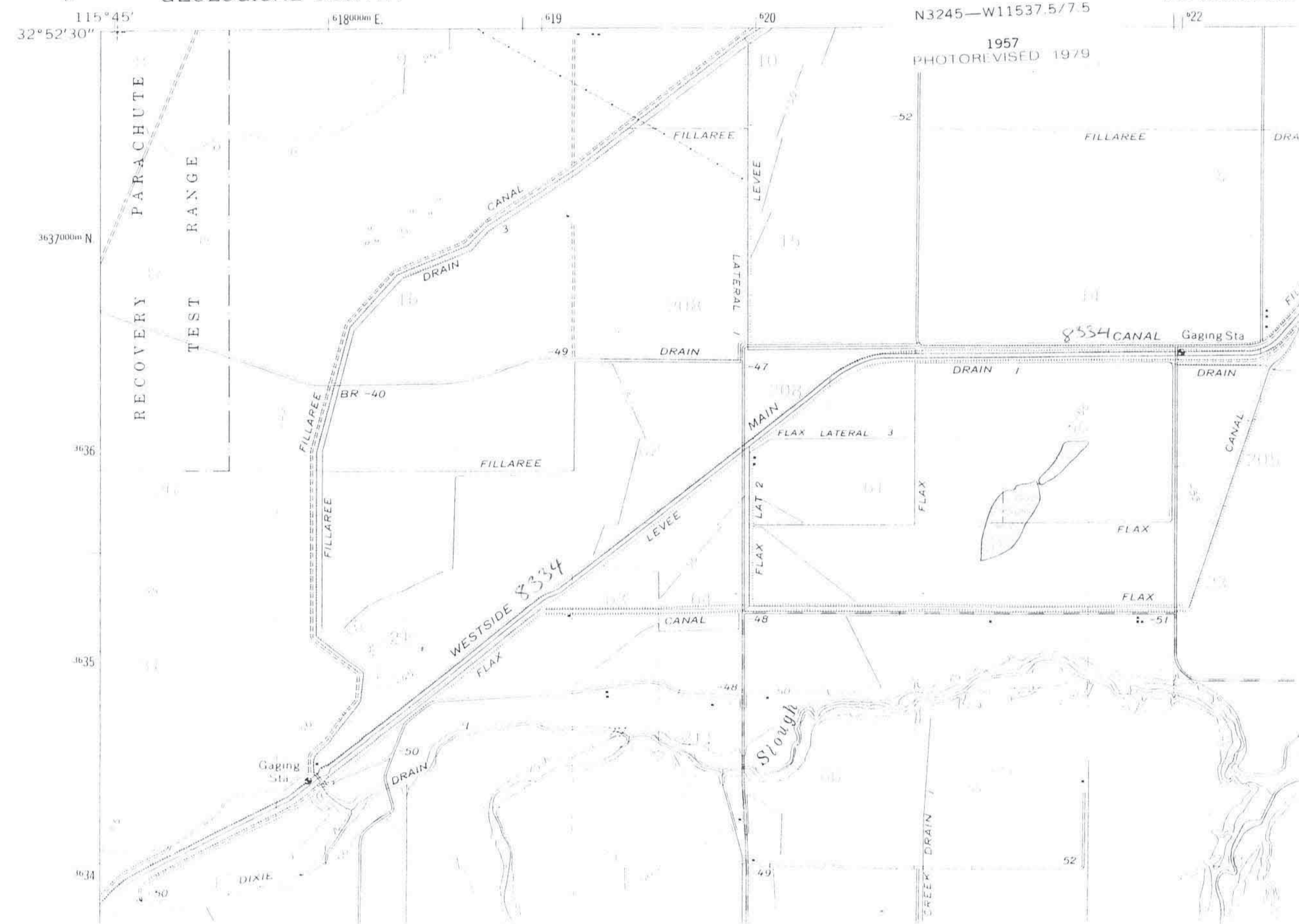


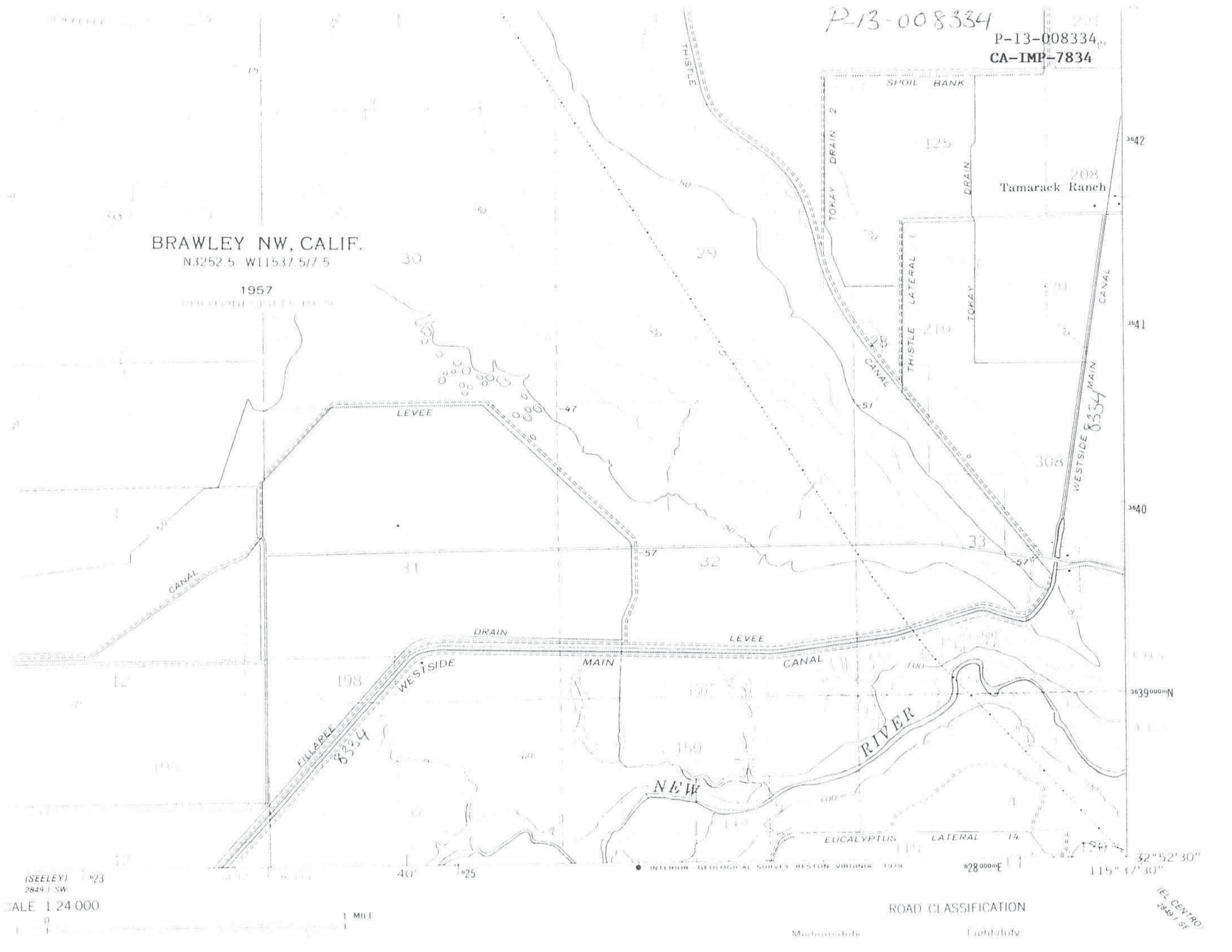
P-13-008334
P-13-008334
CA-IMP-7834

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

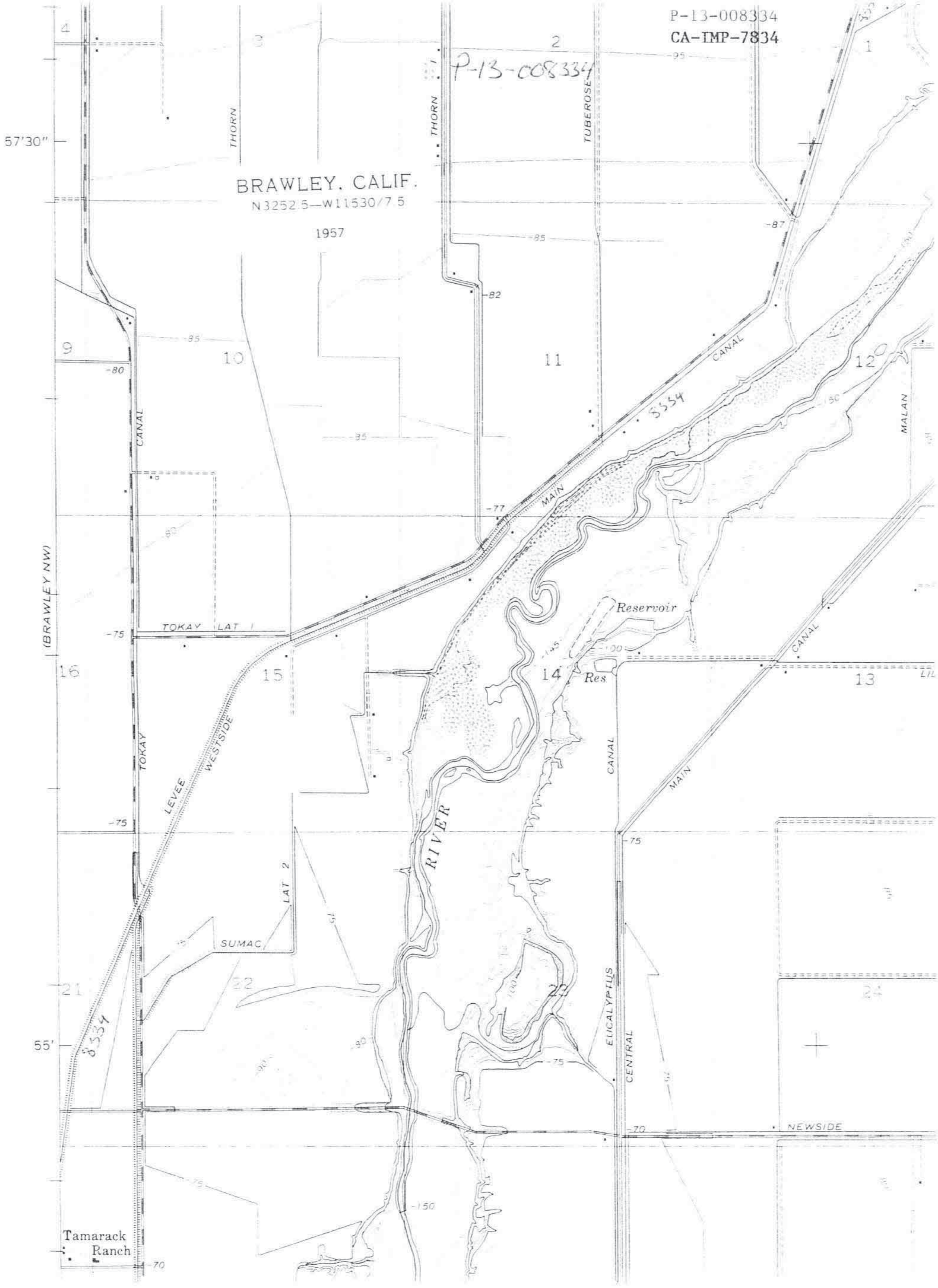
SEELEY, CALIF.

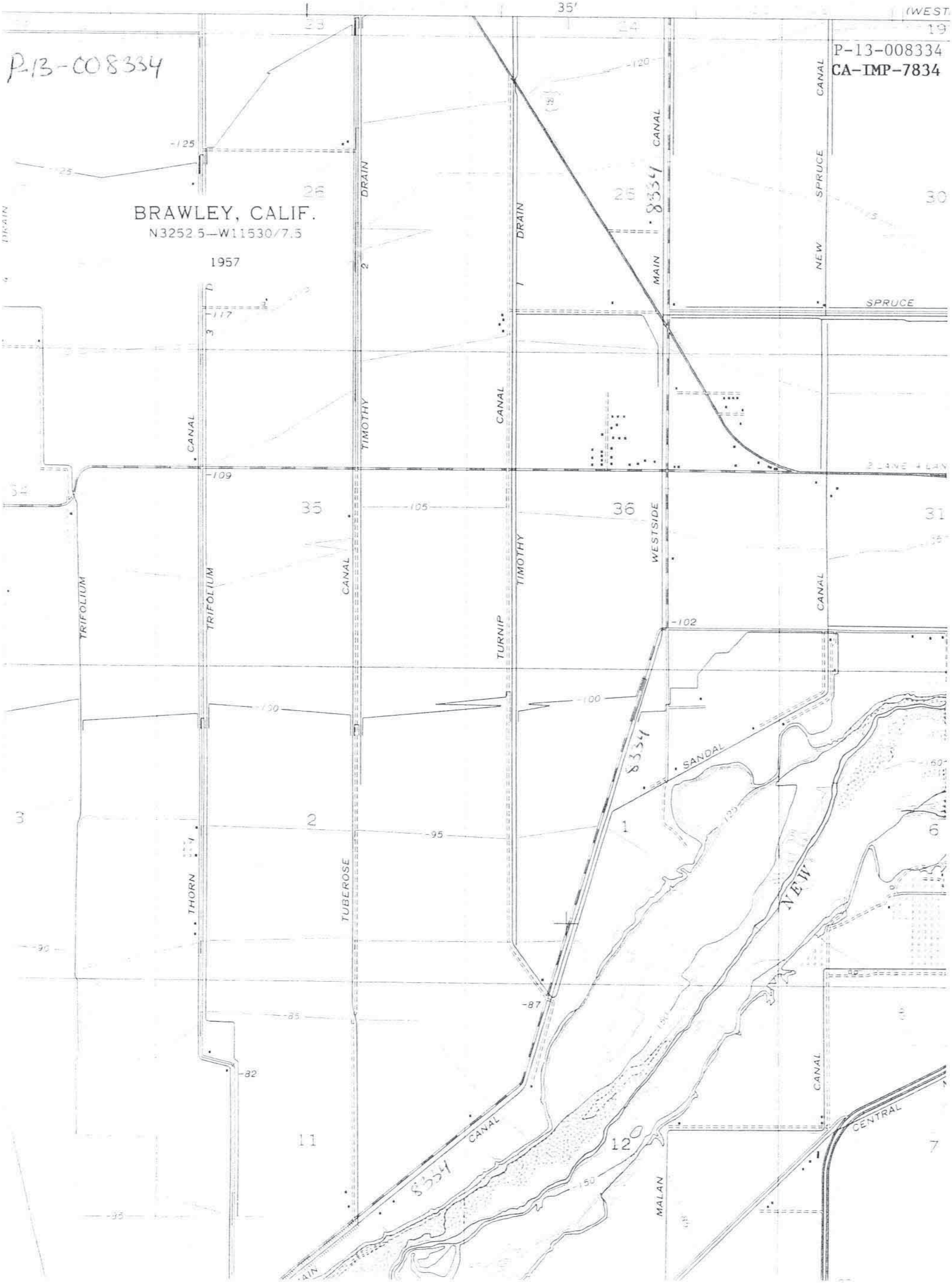
STATE
DEPARTMENT




P-13-008334
P-13-008334
CA-IMP-7834
BRAWLEY NW, CALIF.
N3252.5—W11537.5/7.5
1957
SPOIL BANK
TOKAY DRAIN 2
THISTLE LATERAL 1
TOKAY DRAIN
THISTLE
CANAL
Tamarack Ranch
WESTSIDE MAIN CANAL
8334
LEVEE
DRAIN
LEVEE
WESTSIDE MAIN CANAL
FILLAREE
8334
NEW RIVER
EUCALYPTUS LATERAL 14
29
30
31
32
33
28
208
308
198
150
(SEELEY) 2849 I SW
SCALE 1:24 000
1 MILE
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1979
ROAD CLASSIFICATION
32°52'30"
115°37'30"
(EL CENTRO) 2849 I SE
3642
3641
3640
3639000mN
628000mE

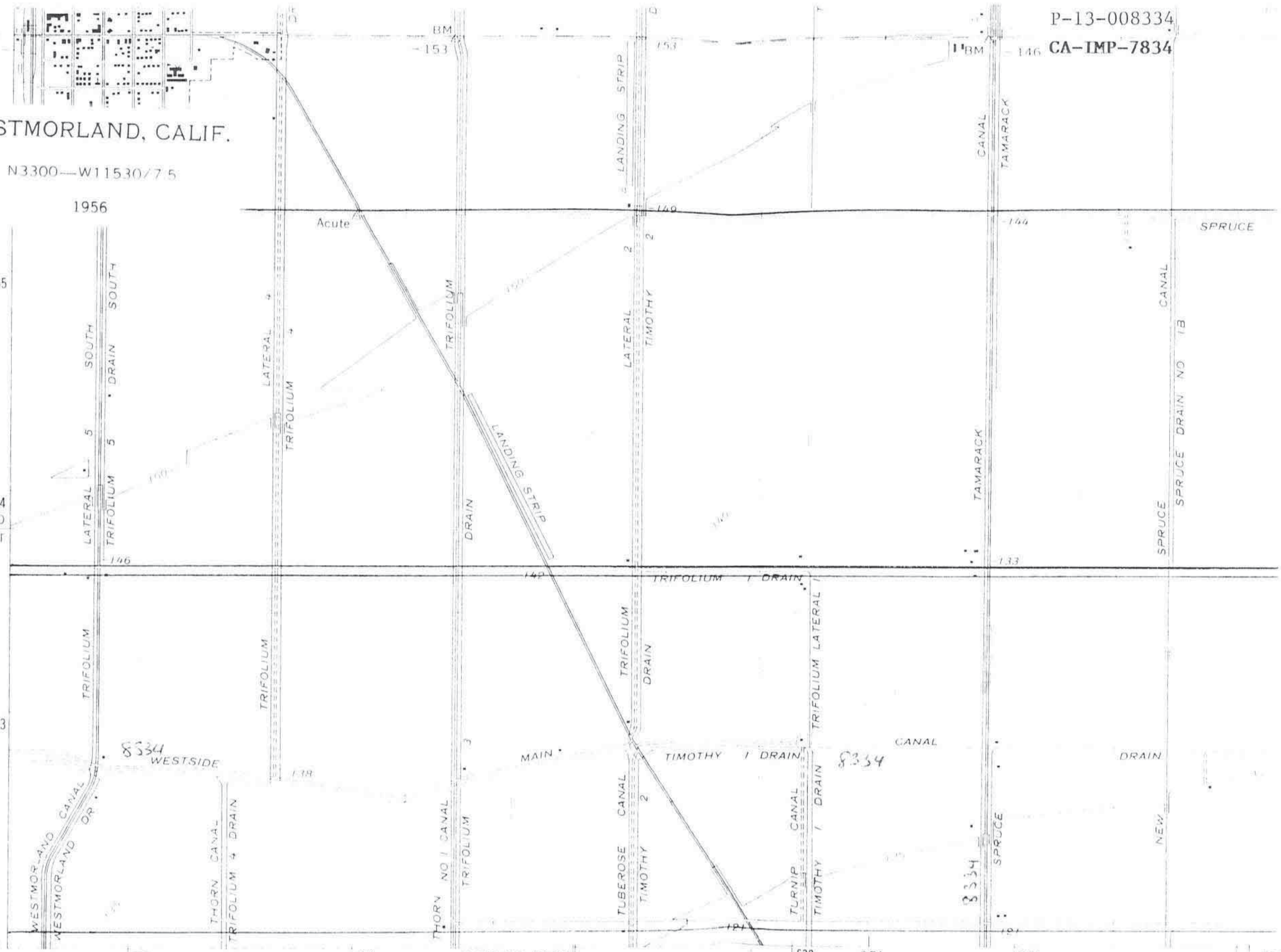
P-13-008334
CA-IMP-7834




P-13-C08334
P-13-008334
CA-IMP-7834
BRAWLEY, CALIF.
N3252.5—W11530/7.5
1957
35'
(WEST
23
24
19
26
25
30
35
36
31
3
2
1
6
11
12
7
DRAIN
CANAL
MAIN
CANAL
NEW
SPRUCE
CANAL
SPRUCE
TIMOTHY
CANAL
TRIFOLIUM
TRIFOLIUM
CANAL
TURNIP
TIMOTHY
WESTSIDE
CANAL
SANDAL
THORN
TUBEROSE
NEW
CANAL
CANAL
CENTRAL
MALAN
8334
8334
8334
-125
-120
-117
-109
-105
-102
-100
-95
-90
-87
-85
-82

P-13-008334

P-13-008334
CA-IMP-7834



WESTMORLAND, CALIF.

N3300—W11530/7.5

1956

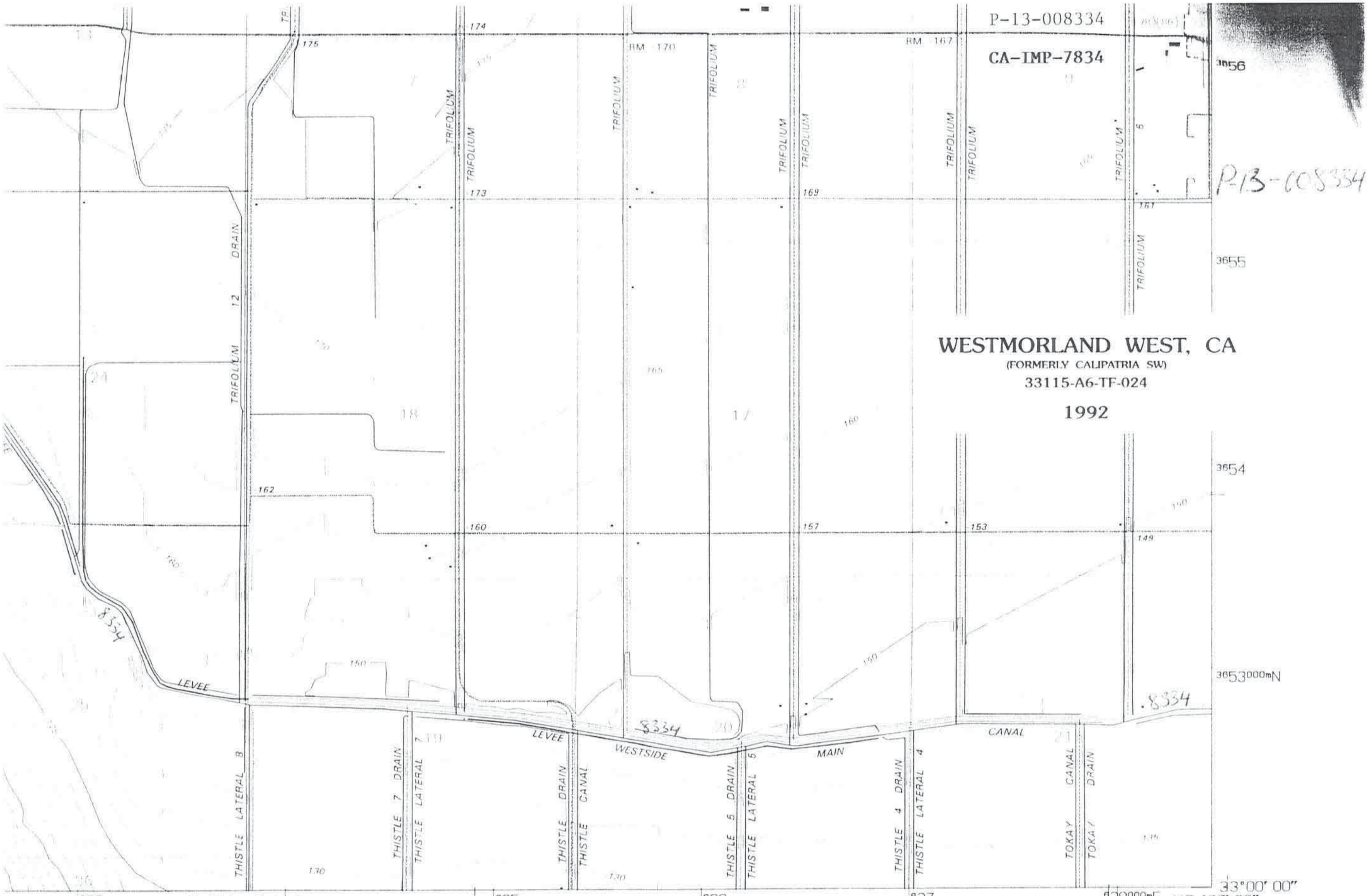
(BRAWLEY NW)
2840 I NW

Mapped, edited, and published by the Geological Survey

Control by USGS, USC&GS, and State of California

Culture and drainage compiled from aerial photographs taken 1953 Topography by planetable surveys 1956

Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system,



INTERIOR - GEOLOGICAL SURVEY, RESTON, VIRGINIA - 1995

:24 000

1000 2000

5000 6000 7000 8000 9000 10000

CA

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway hard surface ....

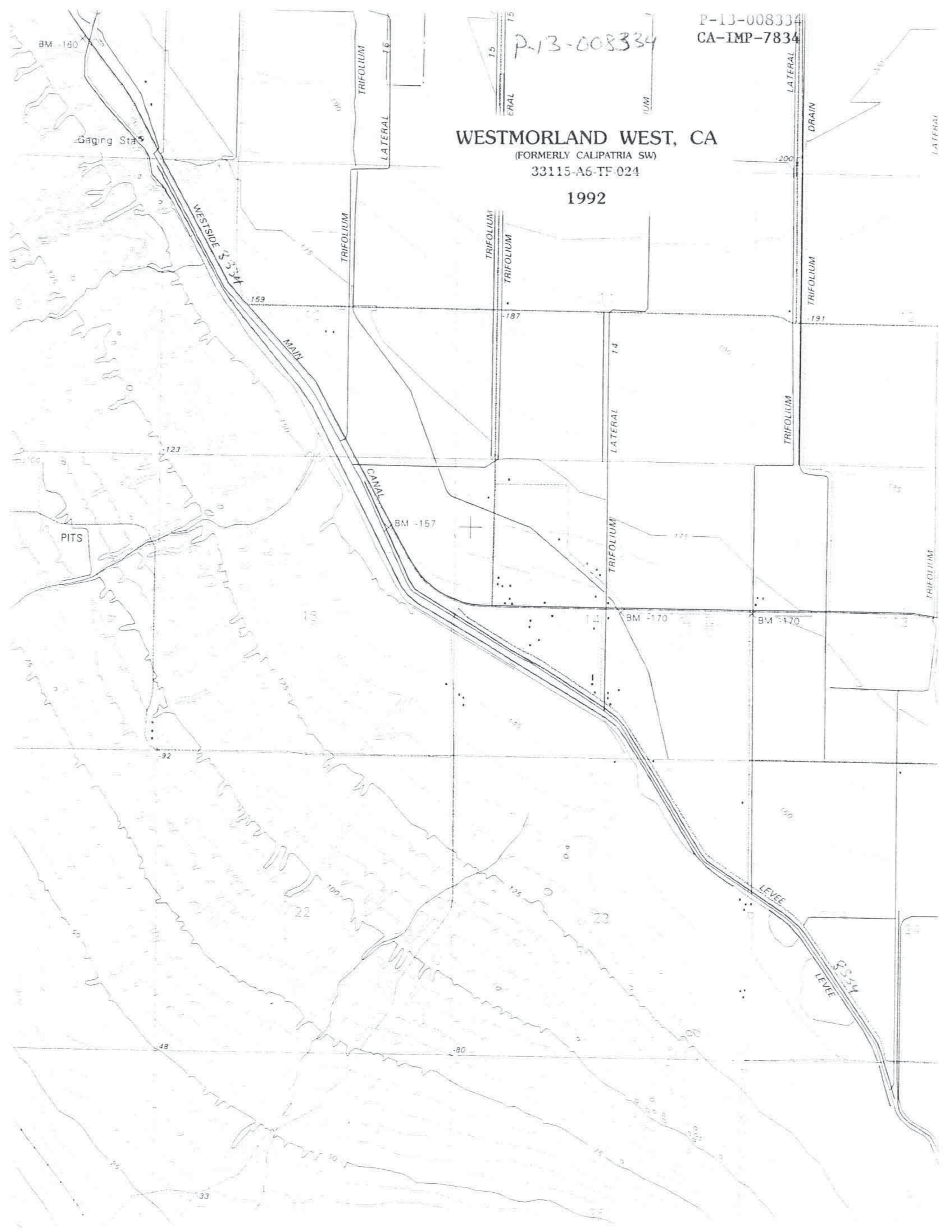
Light-duty road, hard or improved surface ......

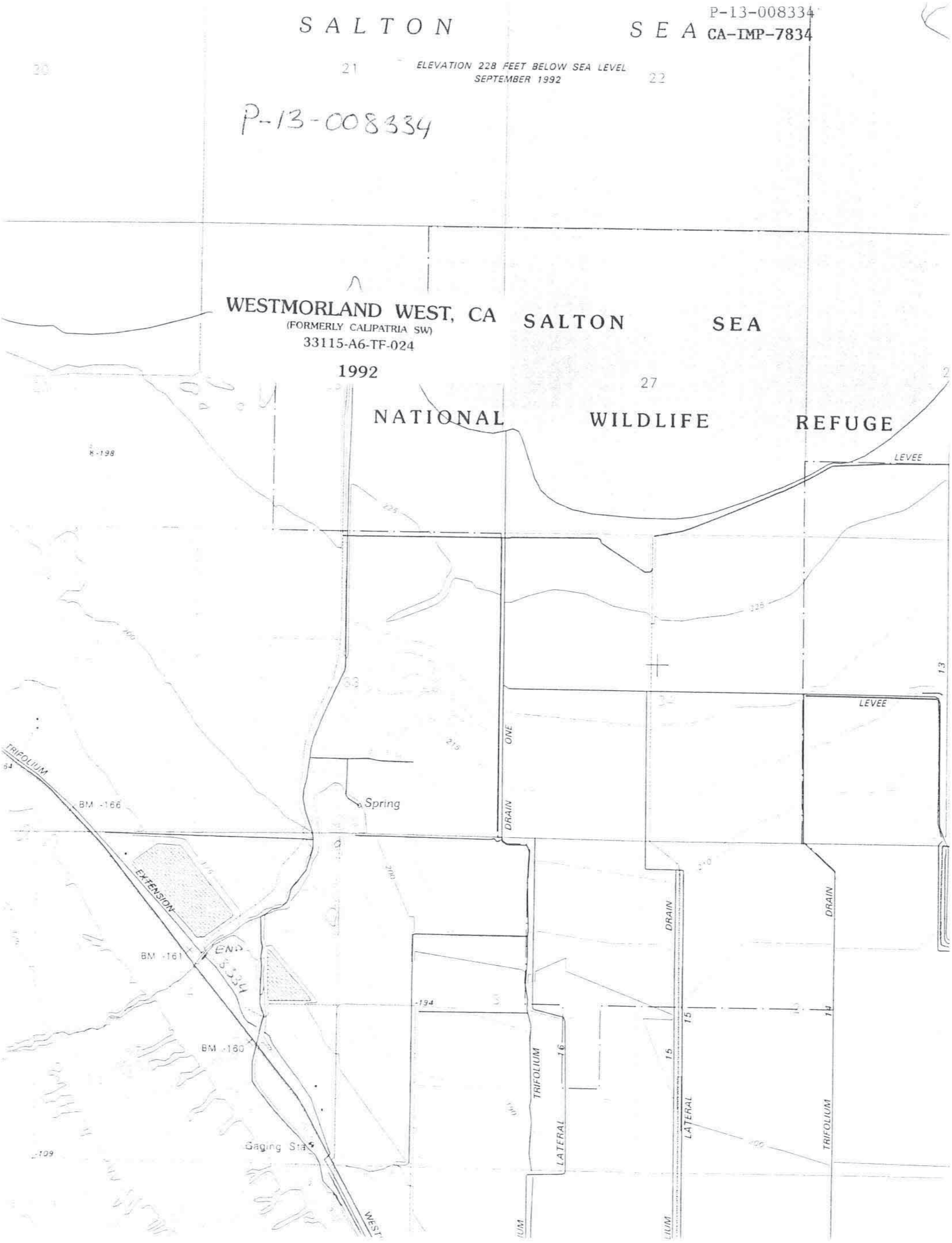
Secondary highway hard surface ....

Unimproved road ......

Interstate Route U.S. Route State Route

P-13-008334
CA-IMP-7834




P-13-008334
CA-IMP-7834
SALTON SEA
ELEVATION 228 FEET BELOW SEA LEVEL
SEPTEMBER 1992
P-13-008334
WESTMORLAND WEST, CA
(FORMERLY CALIPATRIA SW)
33115-A6-TF-024
1992
SALTON SEA
NATIONAL WILDLIFE REFUGE
LEVEE
LEVEE
DRAIN ONE
Spring
TRIFOLIUM
EXTENSION
BM -166
BM -161
END 3334
BM -160
Gaging Sta
DRAIN
DRAIN
TRIFOLIUM
LATERAL
LATERAL
TRIFOLIUM
WEST

Ogilby, Cal., May 14, 1901

A. M. Chaffey, 244 Stowell Block, Los Angeles. -- Water turned through gate at 11 a.m. Everything all right.

George Chaffey

The first delivery of water in the United States occurred in June, 1901, when delivery was made as far as Calexico through the Boundary Canal. Some 1500 acres was put under crops in the fall of that year.

Additional Mutual Water Companies

As already noted, Imperial Water Company No. 1 was organized in 1900. Later in the same year, Imperial Water Company No. 4 (20,000 acres) was organized, followed in 1901 by Imperial Water Companies No. 5 (100,000 acres) and No. 6 (20,000 acres), and in 1902 by No. 7 (18,000 acres) and No. 8 (45,000 acres). Tri-Party contracts were entered into by each, which in general, except for that of No. 6 Co., were similar to the one heretofore described for No. 1 Company. No. 7 Company bought its water rights from the C. D. Company for a lump sum cash payment of $50,000 and built its own distribution system; the C. D. Company built the distribution systems for the others.

No more water companies were organized until 1908. These are discussed at a later point.

Additional Construction

Canals

The Central Main Canal was continued on from the international boundary line through No. 1 Company to its north limits (No. 4 Heading), a few miles to the southwest of the present city of Brawley, and put into service in March 1902. From this point, water service was furnished to Water Company No. 4. A branch canal from the Central Main, with a crossing by flume of what was then the relatively narrow and shallow channel of New River, was constructed to provide service to Water Company No. 8.

The Encina Canal - now West Side Main - was constructed in Lower California from Sharp's Heading to the south, crossing New River channel in a flume, then swinging to the west and north to the international boundary line at a point about ten miles west of Calexico, for providing service to Water Co. No. 6.

Diverting from the Alamo Canal about 1-½ miles upstream from Sharp's Heading, the East Side Main Canal was constructed north to the international boundary line (Allison Heading) to serve Water Co. No. 7.

For service to Water Co. No. 5, the original plan utilized the old Alamo River channel as a canal from Sharp's Heading to Holtville, where an earthern dam was constructed in the channel to raise the water high enough to make delivery. However, the dam failed within a short time, and No. 5 Company built a main canal from Allison Heading north to its lands; this became known as the Low Line or No. 5 Main Canal.

By January 1, 1905, there had been constructed eighty miles of main canals in the Imperial and Mexicali Valleys belonging to the C. D. Company and the Mexican Company and some seven hundred miles of distribution canals in Imperial Valley.

Structures

In addition to the Chaffey Gate and other structures already mentioned, major structures built during the first years included: head gates for the Central Main and Encina Canals and a waste gate to the Alamo River, all at Sharp's Heading, and the 134 Waste Gate on the Central Main Canal in Mexico about two miles downstream from Sharp's Heading, which discharged into a side channel of New River.

Holton Power Plant

From a point on the No. 5 Main Canal southeast of Holtville known as No. 5 Heading, W. F. Holt, developer of No. 7 Water Company, the town of Holtville, and other enterprises, built a canal to the Alamo River where he installed a small hydroelectric plant in 1903-04 with a head of about 20 feet. This was the start of the Holton Power Company and supplied the first electric service to Holtville and El Centro. Water for the plant was secured from the C. D. Company by a special contract and when available up to 150 second-feet was used for power purposes. The deepening of the Alamo River by flood waters from the river break of 1905-07 increased the available head at the plant about 25 feet, and a second hydro plant was built to utilize the increased head. The two plants had a capacity of about 1500 kilowatts.

Concession from Mexican Government

From the discussion which has been given of the Mexican Company relating to the various contracts in which it became involved, as well as its intended purpose of selling or leasing water to serve lands in Mexico in addition to those it owned, it can be seen that the Company was, in fact, a public utility; but the right to operate as such had not been granted by the Mexican Government. Moreover, as will be referred to at a later point, questions arose as to the right of the C. D. Company to appropriate water from the Colorado River under California State law, since the River was considered navigable and such right had not been recognized by the United States Government; hence it appeared desirable to the C. D. Company to secure the right, if possible, to divert water from the River in Mexico.

These were among the reasons why the C. D. Company, through its subsidiary, the Mexican Company, sought a concession from the Mexican Government to legalize all of the activities of the latter Company.

Such a concession, or contract, was obtained under date of May 17, 1904, being approved by action of the Mexican Congress and the President under date of June 7, 1904.

The concession authorized the Mexican Company to carry through its canal system in Mexico, 284 cubic meters per second (10,000 second-feet) of water to be diverted from the Colorado River in the United States by the C. D. Company and turned over to the Mexican Company at the international boundary line. It also authorized the Mexican Company to divert from the Colorado River in Mexico, 284 cubic meters per second (10,000 second-feet) of water to be carried through its canal system, provided that such diversion did not injure the completed in March of that year.

Complications With Work in Mexico

One of the complicating factors in connection with all work carried on in Mexico was that neither the C. D. Company nor the Southern Pacific Company, as such, could do any work in Mexico under their own names. At a later date, the U. S. Federal Government ran into a similar complication when it undertook to construct river levees in Mexico. It was therefore necessary that the work in connection with the canal system and the closing of the break be carried on in the name of La Sociedad de Yrrigation y Terrenos de la Baja California, S. A., the Mexican Company, with funds advanced by the C. D. Company or the Southern Pacific Company.

Damages from the Break

Erosion of New and Alamo Rivers

During the break, the large flow of water through the Alamo Canal caused an overflow for many miles and created a very serious situation. The larger part of the water overflowed the south bank and collected in New River channel in Lower California and thence passed down the west side of Imperial Valley to Salton Sea. At the closure of the Break, New River, which had been a rather shallow channel, had become a gorge 40 to 60 feet deep through Imperial Valley and extending for some six or eight miles into Lower California.

It was possible, through the use of the Alamo Wasteway at Sharp's Heading, to control the flow at that point during the River break, so that most of the area in the Valley east of New River received a continuous water supply. However, the large amounts of water which, to maintain control at Sharp's Heading, had to be wasted through the Alamo Wasteway to the Alamo River and thence to Salton Sea widened the River and deepened it as much as 20 to 30 feet in some places; but the resulting channel was small compared to that of New River.

It is estimated that some 13,000 acres of irrigable land, part of which was in crop, was destroyed by the erosion of the Alamo and New Rivers.

Salton Sea

Salton Sea, which had been practically dry, reached an elevation of approximately 195 feet below sea level by the time the break was closed in February, 1907. The surface area of the Sea at that time was about 500 square miles, (285,000 acres) with a length of 50 miles and a width of some 10 to 15 miles.

Flumes Over New River

In addition to the damage caused to the Alamo Canal, the water from the break destroyed the wooden flume which carried the Encina (West Side Main) Canal across New River in Mexico, and a similar flume across New River some 20 miles to the north of the international boundary line which supplied No. 8 Water Company.

Inasmuch as it was not practical to rebuild the No. 8 flume because of the greatly increased width and depth of the New River channel in that locality created by the flood, it was decided to enlarge the West Side Main Canal in Mexico and same vicinity, to the west into Imperial Valley, was imminent at the time. As a matter of fact, such a natural diversion did occur in 1908-09 about twenty miles downstream at a point in the River about opposite the lower (Arizona - Mexico) international boundary line. The end had come to the peaceful meandering of the River along the east side of its delta in Mexico, which had existed over the previous five hundred years. While the 1905 break was a bitter and costly experience, still the knowledge gained from it and the realization of the need for a levee system, perhaps saved Imperial Valley from a far worse disaster at a later time through the River diverting itself into the Valley.

Permanent Hanlon Heading

Original Structure

The loan of $200,000 made to the C. D. Company by the Southern Pacific Company in the early part of 1905 was primarily for the construction of permanent head works to replace the wooden Chaffey Gate and to construct the Alamo waste gate at Sharp's Heading. Work on the new head gate, known as Hanlon Heading, was started in December 1905 and completed in June 1906. The new structure was constructed on solid rock where a spur of Pilot Knob Mountain extended out near the River channel, the location of the structure being somewhat to the north and a short distance to the west of the Old Chaffey Gate. A new intake canal was excavated from the River to the new structure. Hanlon Heading had 11 gate openings each 12 feet wide and 10 feet high, the flow through them being controlled by radial gates. The designed capacity was 10,000 cubic feet per second at low-flow stages of the River, with the sill of the gate placed at a much lower elevation than that of the Chaffey Gate. There was also a "navigation pass" 10 feet 3 inches wide at the east end of the structure for the purpose of passing small power boats through the structure.

Addition to Hanlon Heading

In 1913, a "Stoney" gate was added to the west side of Hanlon Heading, occupying three of the original gate openings. This gate has a single opening of 25 feet by 14 feet, with the sill 5 feet lower than that of the main structure and was completed in May of that year. The purpose was to improve diversion conditions during low-flow periods of the River.

Repairs and Improvements to Canal System

Following the closure of the break, in addition to the rebuilding of the Encina (West Side Main) flume over New River and extension of that canal in the United States, other work was undertaken.

The banks of the Alamo Canal were repaired and strengthened and the work of straightening and confining the channel was commenced.

At a point on the Alamo River west of Holtville, a large concrete drop structure - known as Rositas Wasteway - was constructed to raise the water in the River for service to the Mesquite Lake area through the Rose Canal, for which a concrete head gate was also installed. In this way, reuse was made of the water discharged from the Holton Power Plant, as well as that which was passed through the Alamo Wasteway at Sharp's Heading in Mexico.

The Rositas Wasteway was designed for a capacity of 2,000 second-feet. The

The appropriation was used to extend the existing levee - C. D. Levee - along the River for a distance of about twenty-five miles in Mexico, which carried it across and for several miles below the break of the old channel into Bee River, the new levee being named Ockerson Levee. The work was completed in May 1911, but floods a short time later breached the new levee at the Bee River break and at many other points. The result was an almost total loss of the work, and the River was again flowing through Bee River into the Volcano Lake area.

United States Government Withdraws

In 1912, a part of the unexpected funds remaining from the 1910 appropriation was used in repairing numerous breaks in the upstream section of the Ockerson Levee, and again the work had to be carried on in the name of the Colorado River Land Company. In 1913, the remainder of the 1910 appropriation was used in repairing a break in the C. D. Levee a few miles below the international boundary line in Mexico, to which cost $30,000 was contributed by Imperial Irrigation District.

By the start of 1915, the general situation as to flood control was chaotic. The C. D. Company and the Mexican Company were bankrupt and in the hands of Receivers with insufficient funds available, and Imperial Irrigation District was not yet in position to take over because of legal complications. In view of these conditions, a further appeal was made to the Congress for assistance, and the sum of $100,000 was appropriated in March of that year, with the provision that Imperial Irrigation District contribute a like amount, which it did. These funds were expended in raising, strengthening, and extending the Volcano Lake Levee about four miles, and in rock revetting the parts of the C. D. Levee then under attack by the River. This was the last expenditure of funds by the United States Government on flood-protection work for Imperial Valley; the people of the Valley were left to their own fate, being faced with a flood menace far more critical than had existed up to that time.

Additions and Betterments to the Canal System

Receiver's Certificates

When the Receiver for the C. D. Company took over in December 1909, he found there were no funds available with which to operate. To secure the necessary funds, he obtained an order from the Court to issue Receiver's Certificates, and to April 1918, $315,000 of such Certificates were sold at par to the Southern Pacific Company. This money, together with subsequent collections for water delivered to the mutual water companies, financed the operations of the Receiver.

Major Structures

Mention has already been made of the Stoney gate attached to Hanlon Heading, which was installed during the receivership. Other important canal structures built during this period included Cudahy Check, Laurence Heading (this was on the Alamo Canal in Mexico at the point of diversion for the new East Highline Canal), and a new head gate for the West Side Main (Encina) Canal at Sharp's Heading.

Due to a washout of the West Side Main Canal at the upstream end of the a field survey of an All-American Canal.

Cierro Prieto Canal

One of the first improvements undertaken by the District was the construction of the Cierro Prieto Canal diverting from Volcano Lake through a head gate constructed in the Volcano Lake Levee near its lower end at Black Butte. The canal was built to the northwest and then north, a total distance of some sixteen miles, keeping to the south of New River, to a junction with the West Side Main Canal near Wistaria Check.

There were several reasons for building this canal. By diverting water from Volcano Lake, the demand on the Alamo Canal would be reduced. Also, because much of the silt in the River was being deposited in the Volcano Lake region, the silt content of the water diverted would be materially reduced, which would result in a saving to both the District and the landowners in the cost of water service. Moreover, the entire west side of the Valley was dependent upon the flume which carried the West Side Main over New River, and any accident to the flume, such as had occurred in the past, might cause not only great inconvenience to the water users, but severe damage to their crops. The Cierro Prieto Canal would furnish another source of supply, independent of the flume, for the west side of the Valley.

The canal was completed in August 1916 at an initial cost, including the head gate, of about $300,000. Tule Check, on the Cierro Prieto Canal was constructed in the spring of 1917, and the canal enlarged to a capacity of 1,200 second-feet, at a cost of about $125,000.

The water surface of Volcano Lake varied with the amount of flow in the River, and during the periods of lowest flow it was not possible to divert to the Cierro Prieto Canal. For this reason, diversion was made from the Lake to the canal for about twenty days in August, 1916 and intermittently thereafter until September, 1921. The diversion of the River through the Pescadero Cut and out of the Volcano Lake region, made by the District in 1922, dried up the Lake, making further diversion into the canal impossible. After 1917, the canal was served primarily by the Solfatara Canal, discussed at a later point.

Board of Consulting Engineers

In view of conditions on the River and the very serious problem of maintaining an adequate water supply, the District Board of Directors, by resolution of September 26, 1916, appointed a Board of Consulting Engineers to make an investigation and recommend what should be done to cope with the critical situation. The Board consisted of G. G. Anderson and C. E. Grunsky, both of whom were well known for their ability and long experience in connection with Colorado River irrigation matters.

Report No. 1

The Consulting Board issued its Report No. 1 under date of October 25, 1916. This was of a preliminary nature and contained eight recommendations to be carried out immediately. These included a new head gate and intake canal at Andrade, with the use of large suction dredgers for handling heavy silt in the intake canal; improvements to the Alamo canal; and an upstream extension of the Cierro Prieto Canal to a connection with the Alamo Canal.

ed from a point about two miles below its Volcano Lake heading, to the north a distance of sixteen miles to the Alamo Canal at Cudahy Check, the extension being known as the Solfatara Canal. As has been pointed out, diversions to the Cierro Prieto Canal from Volcano Lake could be made only during the higher stages of the flow of the River. So the first purpose of the new canal was to assure a constant supply to the Cierro Prieto, and thus to the west side of Imperial Valley. The upper end of the new canal was located adjacent to and on the westerly side of the Volcano Lake Levee. Excavation from this section was used to raise and strengthen the Volcano Lake Levee. The lower portion of the canal veered away from the Volcano Lake Levee and crossed extensive alkali flats. The area between the canal and the levee was silted in, which not only provided good material for raising the levee, but also gave it backing and increased its stability.

Cudahy Check had been constructed in 1914 with funds provided by the Imperial Development Company, which owned a large tract of land in the vicinity, the check being used for diversion of water for the development of that tract. When the Solfatara Canal was constructed, its heading was located on the Alamo Canal immediately upstream from Cudahy Check, and the District reimbursed the Imperial Development Company in the sum of $43,000 on the cost of the check.

The canal was completed in 1917 at a cost of $171,000.

4. Improvements to the Alamo Canal

Considerable work was done on the Alamo Canal, including the cutting off of bends to improve alignment, widening of certain sections to increase capacity, and channelizing of a number of sections to prevent excessive deposition of heavy silt. On this work, a total of $625,000 was expended.

5. Improvements to Levee System

In accordance with the Consulting Board's recommendation, $500,000 was expended on the protective levee system, principally in extending, raising and revetting the Saiz and Volcano Lake Levees. Conditions which required this work will be discussed at a later point, under the heading of "Pescadero Cut".

6. Other Items of Construction

Among other major items constructed in accordance with the recommendations of the Consulting Board was the replacement of the Alamo Waste Gate at Sharp's Heading. This was a large wooden structure and was the main control not only for the several canals diverting from the Alamo Canal at Sharp's Heading, but also for the regulation of the entire Alamo Canal. It diverted surplus water to the Alamo River and was used in sluicing the lower end of the Alamo Canal. It was originally constructed in 1903, and although the Consulting Board had recommended that it be replaced with a concrete structure, this was not done, the replacement being a similar type of wooden structure costing $86,500.

Also, a concrete wasteway structure was installed on the east side of the West Side Main Canal at Wistaria Heading in Mexico, discharging into a channel leading into New River. The cost of the structure was $45,000.

In addition, there were a number of miscellaneous structures built, such as canal headings, small sluiceways and wasteways, both in Mexico and in the Imperial Valley, which completed the expenditure of funds from the second bond issue.

Construction of Deep Drains

The major portion of the work was carried on with the $2,500,000 made available from the fourth bond issue, and by 1929, when these funds were exhausted, there had been completed a total of 190 miles of deep drain outlets. In addition, General Fund monies had been used in the construction of 44 miles of such drains, making the total 234 miles at the end of 1929.

Soils of Imperial Valley

These main drains were but a start toward solving the drainage problem of Imperial Valley. While such a system of deep drains had to be provided in any event, yet it was found that in most instances their effect did not extend to a very great distance laterally, for reasons which will be explained.

The soils of the delta portion of Imperial Valley - the area then developed are made up of alluvial deposits of fine textured clays, silts, and sands laid down by the Colorado River, the thickness and type of a stratum at any particular location having been determined by the course of the River and the type of silt it was carrying when the deposit occurred. The result is a very greatly stratified soil, made up of lenses or pockets of varying size and type of material, and this condition tends to retard natural drainage. There are no gravel and sand water-bearing strata and hence no "general" underground water table such as is found under many western irrigation projects. In most parts of the Valley, the water table is perched on underlying relatively impervious strata, so that drainage by deep-well pumping, successfully used in many projects, is ruled out.

These conditions made the problem of adequate drainage of the lands in the delta portion of Imperial Valley one of the most difficult of solution of any to be found in the West. Drainage methods which have been successful in areas of homogenous soils are not adapted to the stratified, alluvial and lacustrine soils of Imperial Valley.

Expansion of Drainage System

It became apparent that the answer to the problem was a drainage system that would meet the varying soil conditions on the individual farms. To this end, the District began an expansion of its drainage system, as rapidly as funds would permit, to reach each 160 acres of land throughout the Valley. Such would then provide an outlet for whatever additional drainage facilities as might be required on the individual farm to give it adequate drainage.

The program required the development of a lateral drain system by the deepening of existing surface drains to a depth of 6 or 8 feet and the construction of additional deep drains to serve as outlets. Also as a part of the program, the District adopted a policy of cooperating with the individual landowner in the making of a detailed survey and examination of his land, from which facilities to provide adequate drainage could be designed, and, if the landowner proceeded with the installation, furnishing all the engineering work required, all without expense to the landowner, but the latter was required to pay all other costs of the installation. As further assistance in getting the work underway, the District purchased two tile-laying machines, the use of which it furnished to the landowner at cost.

1929, which provided that the Imperial District would construct all of the works, with the Niland District paying for the excavation and Imperial standing the cost of the necessary structures. Work performed by Imperial in 1929 under this contract included the extension of the East Highline Canal for 2½ miles and the construction of five laterals extending westerly to Salton Sea, totalling 32 miles in length, together with parallel surface drains from the Southern Pacific Railroad to the Sea. In subsequent years, Imperial continued construction until the proposed work was completed.

Miscellaneous Canal System Improvements

The Thistle Canal on the west side of the Valley west of Brawley was enlarged and its laterals extended to make possible the development of several thousand acres of new land. Also, the Trifolium (West Side Main) Canal was extended for several miles to the western boundary of the District, with laterals to the north to serve a considerable area lying south of Salton Sea.

In addition to funds provided by bond issues for work on realigning and controlling the Alamo Canal in Mexico, the District expended a considerable amount from General Funds for this purpose.

Commencing about six miles downstream from Cudahy Check, a section of the Alamo Canal some three or four miles in length, known as Alamo Mocho, gave particular trouble. Bed silt depositing in this section caused a continuous rise of the bottom of the Canal and hence of the water surface, requiring raising of the canal banks. This rise in water surface averaged between one-half and one foot per year.

It was also noted that, year by year, the bed silt was gradually moving farther into the main canals and laterals in the Imperial Valley, necessitating more dredging and, hence, increasing the cost of maintenance to the District. Sluicing of the canals into the Alamo and New Rivers was of benefit in removing bed silt, but still large amounts of this type and most of the suspended silt were carried through to the farms, causing added expense to the water users too.

Silt Problem

As an illustration of the seriousness of the silt problem to the Imperial Valley, conditions in the year 1923 are cited.

From tests made during that year, it was determined that about 25,000 acre-feet of silt passed through Rockwood Heading into the Alamo Canal; this equals 40,000,000 cubic yards but did not include all of the bedload or sand which was carried along the bottom of the canal and out of reach of the silt-sampling apparatus. Of this total quantity of silt, it was estimated, in round figures that 1,000,000 cubic yards was removed from the intake canal by suction dredging; 3,000,000 cubic yards was excavated in cleaning, by various methods, the remainder of the canal system; 10,500 cubic yards were disposed of by sluicing the canals and laterals; and deliveries of water to lands in Mexico carried 5,500,000 cubic yards onto those lands. The total of the foregoing amounts is 20,000,00 cubic yards, or one-half of the total of 40,000,000 cubic yards. This means that the other half, or at least 20,000,000 cubic yards of silt, was carried onto the irrigated lands in Imperial Valley.

Other Events to 1940

Improved Situation

With the Plan of Composition becoming effective, the District's financial position very greatly improved. However, it had been a most difficult decade through which the District and its people had had to operate; but on the bright side, several events had taken place which offered much encouragement.

During the period prior to storage in Lake Mead in 1935, there had been no large river floods; hence expenditures required for flood protection were at a minimum. The silt content of the water, which had been excessive for several years prior to 1931, greatly increasing the cost of canal maintenance, had returned to normal, which assisted in carrying out the retrenchment program.

As had been anticipated, this very severe retrenchment program in the early thirties resulted in a deterioration of the canal and drainage systems, but toward the latter part of the period it was possible to catch up on a considerable part of the delayed work. Also, with the monies made available to the Drainage Fund under the Plan of Composition, drainage construction was going forward at a much increased pace. Moreover, after 1932 the District issued no more registered warrants and had maintained its cash position for current expenditures.

Commencing on February 1, 1935, storage of water in Lake Mead behind Hoover Dam had begun, which removed the major flood danger and assured an ample water supply for the Valley. Construction of the All-American Canal had started in 1934, the head works had been dedicated in 1938, and service to the Valley was to be commenced in a short time. The Canal not only would eliminate the international difficulties and diversion problems which had previously existed, but, together with Hoover Dam, would in time largely eliminate the silt problem. In May, 1936, the District's power system had gone into operation and was rapidly being expanded to cover the entire Valley. Revenue from power sales was increasing rapidly, and an additional source of power would soon be available from plants then under construction by the District on the All-American Canal. Lastly, to all of the foregoing should be added the effect from the rapidly improving market for agricultural products, both as to prices and demand, which had developed in the latter part of the period.

1939 Storm

But mention should be made of two serious events which the District had to meet, one of which occurred in 1939 and the other in 1940.

In September, 1939, a storm resulting from a hurricane off the west coast of Mexico swept up through the trough of the Colorado River Valley, and during one week in which rain fell in Imperial Valley almost continuously, there was nearly 7 inches of precipitation - not only the maximum amount for any one storm but more than the total amount for any one year, in the history of the Valley.

Great damage was done to both the canal and drainage systems. The West Side Main Canal and the north end of the East Highline Canal were broken in many places and canal banks were seriously damaged over a length of many miles.

A large number of lateral headings and drop and delivery structures were destroyed, as well as a number of miles of lateral canal banks. Several major drainage structures were washed out, and other serious damage to the drainage system occurred at many points.

The cost of repairing the damage to the canal and drainage systems amounted to about $110,000. A part of this cost was met with funds from the newly created Emergency Fund provided for by the 1939 Plan of Composition and the balance from the General Fund.

1940 Earthquake

The second disastrous event was the earthquake of May 18, 1940 - the most severe since the development of the Valley commenced. It was caused by a movement of the San Jacinto fault, which passes through the Valley, from the northwest to the southeast, a few miles to the west of Brawley and several miles to the east of El Centro and Calexico. The epicenter was located approximately on the international boundary line, and it was possible to trace the fault for a distance of some forty to fifty miles, commencing in Mexico near Volcano Lake and extending through Lower California and on through Imperial Valley to north of Brawley. The maximum slippage was over 14 feet near the international boundary line.

The principal damage occurred to the canal system in Mexico. For several miles below Tortuoso Drop the Solfatara Canal was completely destroyed. The large flume carrying the West Side Main over New River was completely wrecked and large longitudinal cracks were opened up in many miles of the Alamo and other canals.

In Imperial Valley, the East Highline Canal was cracked in many places, and the Ash Canal and its laterals were severely damaged. Along the fault itself, the shift caused an offset in the canals it crossed, and in several cases structures were destroyed.

The earthquake also caused very extensive damage in most of the cities and towns of the Valley, and several people lost their lives. The remarkable thing is that great numbers were not killed or severely injured.

The entire water supply to the District's canal system had to be cut off for several days until repairs were completed and service re-established to most of the canal system. With the loss of the Solfatara Canal and the New River Flume in Lower California, the entire water supply for the west side of Imperial Valley was cut off. However, the All-American Canal had been completed from the Central Main Canal east of Calexico to the West Side Main Canal and, with water from the Central Main Canal, was put into service to supply the west side of the Valley. Had this not been available, there would have been considerable loss of crops in that area.

The Solfatara Canal was rebuilt and, together with the partial use of the All-American Canal, supplied the west side of the Valley until the balance of the All-American Canal was completed and put into service. As it was known that water would soon be available through the All-American Canal, the New River Flume in Lower California was not rebuilt.

P1. Other Identifier:
***P2. Location:** ☐ Not for Publication ☒ Unrestricted
***a. County:** Imperial
***b. USGS 7.5' Quad:** Mount Signal **Date:** 1957; **T** 17S; **R** 13E; **of Sec.** 6,7; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; North end: 623340.61 **mE /** 3619020.88 **mN**; South end: 623517.44 **mE** / 3616761.21 **mN**

***P3a. Description:** The Wormwood Canal is an irrigation canal constructed circa 1911. It is located east of the Westside Main Canal and flows east and south in the Imperial Valley in Imperial County, CA. The canal is approximately 10 feet wide and about 6 feet deep. Dirt roads access the canal from Old Highway 80, SR 98, and I-8. The canal is lined with concrete. It was originally constructed in 1911 and extended years later. Modifications were added to the canal in the 1960s. The entire canal is approximately 6 miles long and terminates at the northern end at the Wormwood Drain and at the southern end at the intersection of Drew Road and SR98.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct
P5a. Photograph or Drawing:

P5b. Description of Photo:
Looking southeast at the canal.
Picture taken May 4, 2011.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
Circa 1911,
1999 DPR 523 Form, Jill Hupp
1914 Imperial Valley Tract Map. El Centro.

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008983 (Wormwood Canal)
HRI #
Trinomial
NRHP Status Code: 6Z

***Resource Name or # (Assigned by recorder)** Wormwood Canal, Lateral 7 and Drain Update
Recorded by: Jennifer Krintz, Architectural Historian **Date:** November 2011
☐ Continuation ☒ Update

***b. USGS 7.5' Quad** Mount Signal **Date** 1957; 1976 **T** 16S **R** 13E; **¼ of** **of Sec** 36; S.B.
c. Address Graham and Drew Roads City El Centro Zip 92243
d. UTM: (give more than one for large and/or linear resources) Zone 11S, 622691.78 mE/ 3623217.68 mN;

***P3a. Description:** The Wormwood Lateral 7 is an irrigation canal constructed in 1950. It is located east of the Westside Main Canal and flows east and south in the Imperial Valley in Imperial County, CA. The canal is approximately 10 feet wide and about 6 feet deep. The lateral is lined with concrete. The entire lateral is approximately 1 mile long and terminates at the Wormwood Canal to the east.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct
P5a. Photograph or Drawing:

P5b. Description of Photo:
View of Wormwood Lateral 7 looking south
Photo taken November 2, 2011.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
1950,
1949 Imperial County Aerials, US Dept of Agriculture
1957 Seeley 7.5-minute USGS quad map

***P7. Owner and Address:**
Imperial Irrigation District
333 East Barioni Blvd.
Imperial, CA 92251

***b. USGS 7.5' Quad:** Seeley **Date:** 1957; **T** 16 S; **R** 12 E; **of Sec.** 90; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; 616764.98**mE /** 3626776.20**mN**;
***P3a. Description:** The Wormwood Drain is an irrigation canal constructed circa 1909, one of the earliest drains in the Imperial Valley. It is located northeast of the Westside Main Canal and flows north and south in the Imperial Valley in Imperial County, CA. The drain is approximately 10-20 feet wide and about 10 feet deep. It is an earthen dug ditch. The entire drain is approximately 1.5 miles long and expels to New River to the north.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct
P5a. Photograph or Drawing:

P5b. Description of Photo:
Photo of the Wormwood Drain looking south.
Photo taken November 2, 2011.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
Circa 1909,
1909 El Centro 15-minute US Army Corps Topo map,

***P7. Owner and Address:**
Imperial Irrigation District
333 East Barioni Blvd.
Imperial, CA 92251

***P8. Recorded By:**
Jennifer Krintz, Architectural Historian
ASM Affiliates, Inc.
260 S. Los Robles Avenue Suite 106
Pasadena, CA 91107

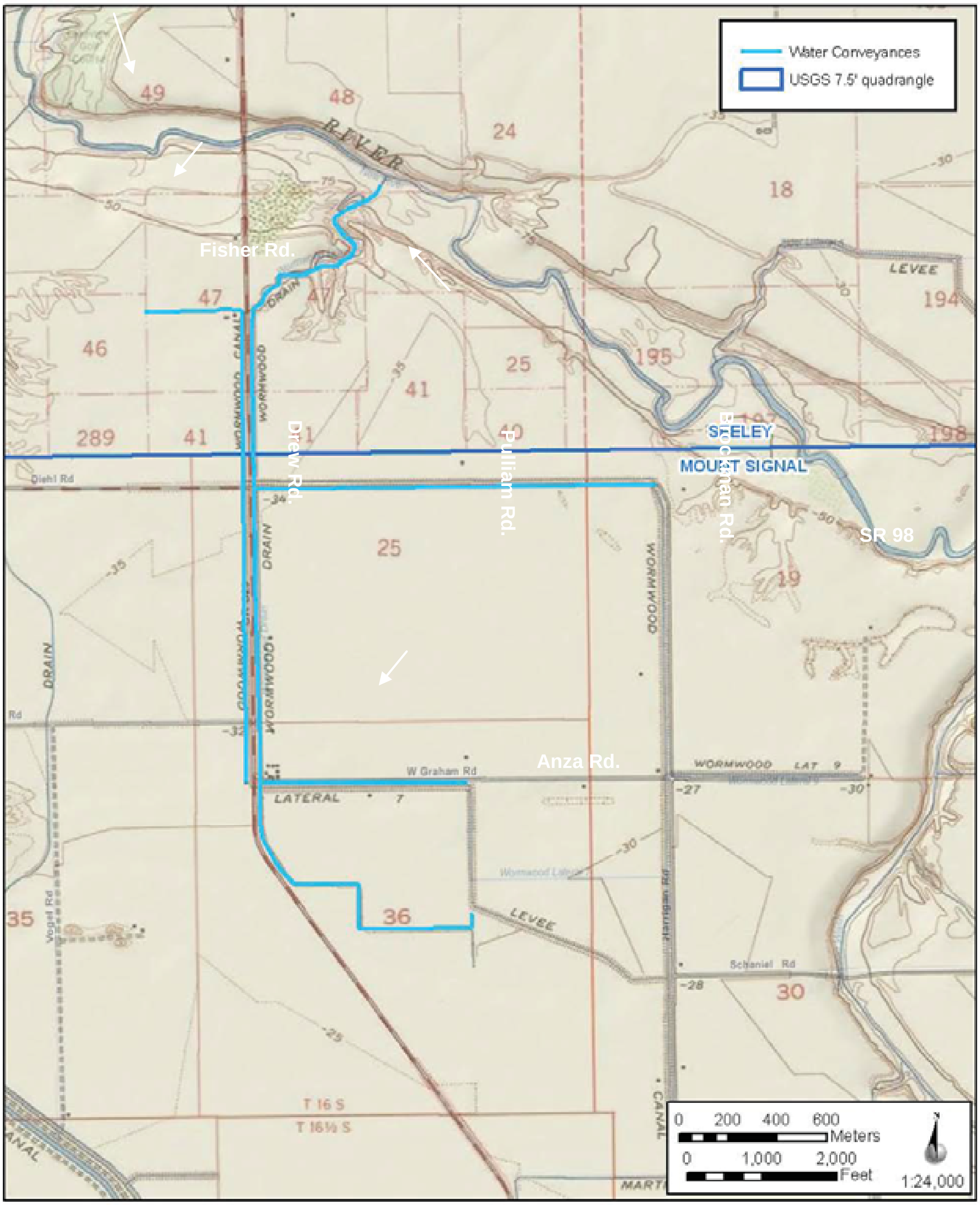
***P9. Date Recorded:** November 2011
***P10. Survey Type:** Intensive
P11. Report Citation: INVENTORY, EVALUATION, AND ANALYSIS OF IMPACTS ON HISTORIC RESOURCES ON PRIVATE LANDS WITHIN THE AREA OF POTENTIAL EFFECT OF THE CAMPO VERDE SOLAR PROJECT, IMPERIAL COUNTY, CALIFORNIA, ASM Affiliates, November 2011.

***B10. Significance: Theme:** Irrigation Water Conveyance Systems **Area:** Imperial Valley

Period of Significance: N/A **Property Type:** Irrigation System **Applicable Criteria:** N/A
The Wormwood Canal was one of the earliest irrigation canals in the Imperial Valley, constructed in 1911, with the Wormwood Drain constructed even earlier in 1909, while Lateral 7 was constructed much later in 1950. According to a previous evaluation by Caltrans, the Wormwood Canal was recommended not eligible for listing in the NRHP because the canal was realigned and lined with concrete from its original earthen materials. Therefore the canal does not retain enough integrity to convey its significance as one of the original irrigation canals for the Imperial Valley. ASM concurs with this finding and recommends the Wormwood Canal as not eligible for listing in the NRHP and the CRHR. Although the canal is associated with the early irrigation system of the Imperial Valley, and the important local theme of agricultural development, this particular canal, nor the early Wormwood Drain on its own, convey that theme as well as other similar resources such as the Westside Main and the All-American canals. Therefore, the Wormwood Canal is recommended not eligible for the National Register of Historic Places nor the California Register of Historic Resources.

***Resource Name or # (Assigned by recorder)** Wormwood Canal, Lateral 7 and Drain Update
Recorded by: Jennifer Krintz, Architectural Historian **Date:** November 2011
☐ Continuation ☒Update

Location Map of the Wormwood Canal, Lateral 7 and Drain



State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008983 update
HRI#
Trinomial

 *Resource Name or # (Assigned by recorder) Wormwood Canal
*Recorded by: H. Thomson, M. Adame *Date: 07/15/2011 ☐ Continuation ☒ Update

P-13-08983, the Wormwood Canal, was first recorded by Hupp in 1999. A bridge crossing over SR98 was recorded during this survey and inspection of the canal was limited to the portion adjacent to the bridge.
The site record was updated in December 2010 by archaeologists with Laguna Mountain Environmental. Two previously unrecorded segments of the Wormwood Canal were documented at this time. These segments are located to the south of the current project area.

An additional 2272' segment of canal was recently documented by KPE archaeologists. The segment identified is situated on the west side of and runs parallel to Drew Road, north of the intersection with West Diehl Road. The Wormwood Canal is channeled beneath Drew Road from the east to a check. A check is a structure built to regulate or raise the water level and in this case, combines the functions of both a check and a drop: the water level may be raised upstream of a gate and is dropped on the downstream side. Gate 88 is also located here and this supplies water to the Wormwood Lateral 7 which is adjacent to the west and to the south. The segment inspected, begins 617' north of West Diehl, and ends 2.19 miles south at the intersection of Drew Road and West Wixom Road. There are several gates, associated with these canals. These include Gate 94 a turnout to ag fields to the west and a check gate about half way up the portion of the lateral within the project area on Wormwood Lateral 7 and on the Wormwood Canal, Gate 88 located at the southern end, is situated at the intersection of Wormwood and Drew, and 90, 90A and 90B are at a check in the north. Wormwood Lateral 7 turns into a ditch and terminates just south of this spot. There are also several concrete irrigation canals and ditches located around the perimeters of the ag fields to the west. Wormwood Lateral 7 has a date stamp of 1954 with the initials JP next to the date in the south and a date of 1950 with the initial P next to the date in the north. Wormwood Canal has a date stamp of 1984 as well as a stamp with the text, Rykerson and the date 1984.


IMG_1846-view to north
Wormwood Lateral 7 at Wixom Road


IMG_1847- view
Wormwood Lateral 7 at Gate 94

*Resource Name or # (Assigned by recorder) Wormwood Canal

*Recorded by: H. Thomson, M. Adame *Date: 07/15/2011 ☐ Continuation ☒ Update

Huff determined that the 1911 Wormwood Canal, like the IID irrigation system overall, reflects the developments that occurred as a result of the construction of the All American Canal in 1941. Huff determined that although important for its association with the development of agriculture in the Imperial Valley, it did not possess the requisite degree of integrity due to reconstruction since the 1950's.
Laguna stated that the portions they documented retained good integrity. Further, Caltrans historian Frank Lorrie conducted an extensive study of the system in 1997 and concluded that the elements in the Imperial Irrigation District that retain sufficient integrity for the period 1941-1950 could be contributors to a potentially eligible National Register District.

This resource has not been surveyed in its entirety; however, Shannon Davis (ASM Affiliates, Inc.) did evaluate the segments within the Campo Verde Solar Project APE and recommended the Wormwood Canal not eligible for the NRHP and CRHR. Although the Wormwood Canal is associated with the early irrigation system of the Imperial Valley, and the important local theme of agricultural development, it does not convey that theme as well as other similar resources such as the Westside Main and the All-American canals, in part due to their loss of integrity (Davis et al. 2011; Mitchell 2011).

Davis, Shannon, Jennifer Krintz, Sarah Stringer-Bowsher, and Sinéad Ní Ghabhláin. 2011. Impacts on Historic Resources on Private Lands, Campo Verde Solar Project, Imperial County, California.

Mitchell, Patricia T. 2011. Inventory Report of the Cultural Resources Recorded within the Campo Verde Solar Project, Imperial County, California.

IMG_1849- View to NNE
Wormwood Canal at West Diehl Road.

*Resource Name or # (Assigned by recorder) Wormwood Canal

*Recorded by: H. Thomson, M. Adame *Date: 07/15/2011 ☐ Continuation ☒ Update

IMG_1851
Wormwood Lateral 7 at West Diehl

IMG_1850
Wormwood Canal at West Diehl

PHOTOGRAPH RECORD

Resource Name or #: Wormwood Canal

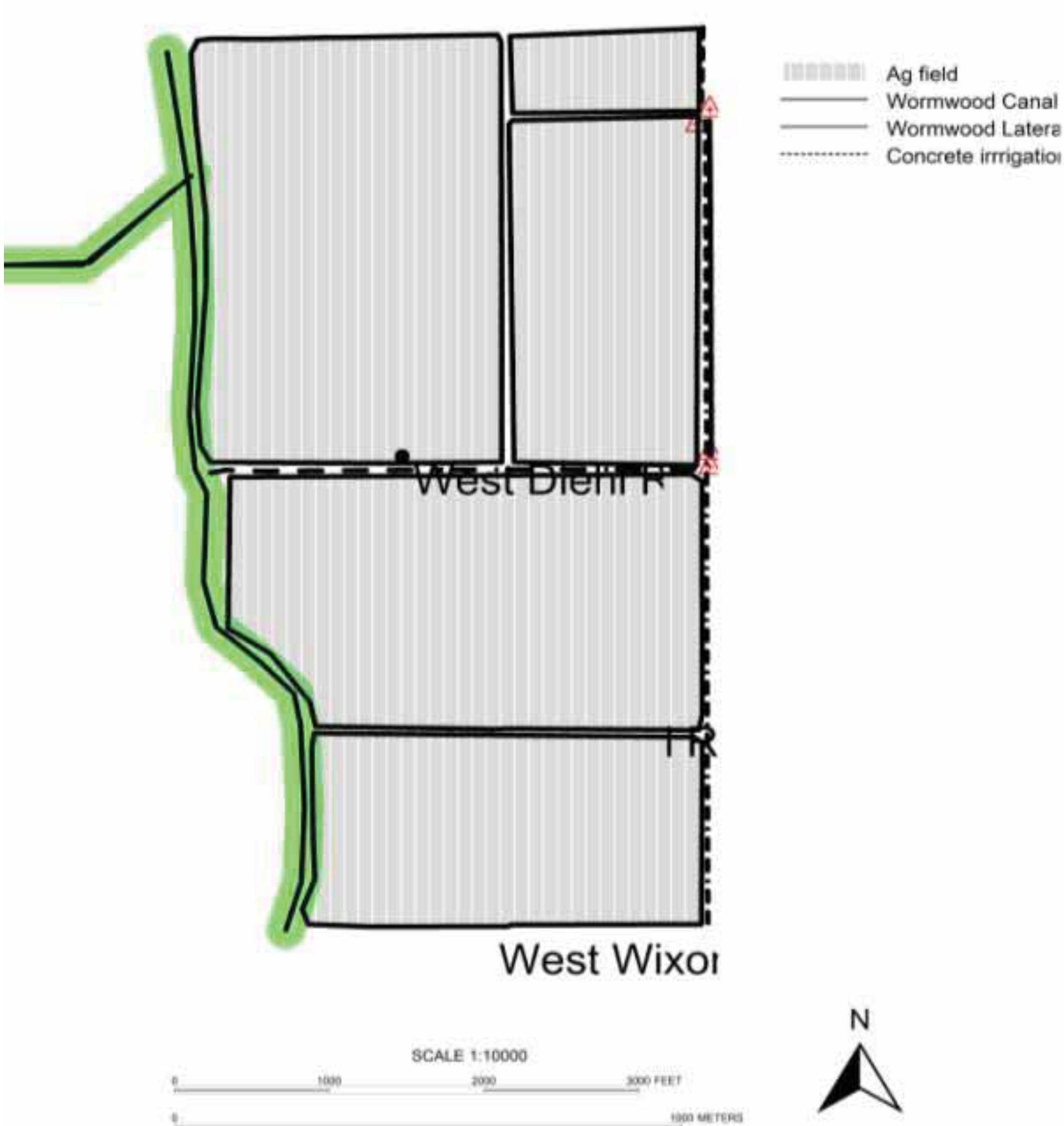
Year 2011

Camera Format: Digital – Canon Powershot SD1300 IS Digital ELPH 12.1 megapixel
Negatives Kept at: kp environmental, LLC. 2387 Montgomery Ave, Cardiff by the Sea, CA 92007

07	15	1846	/	Wormwood lateral at Wixom Road 1954 date	D
07	15	1847	/	1954 date and initials FP	
07	15	1848	/	Wormwood check and turnout	NW
07	15	1849	/	Wormwood at Diehl	
07	15	1850	/	Date of 1984	NE
07	15	1851	/	Wormwood Canal at West	N
07	15	1852	/	Fig Drain at West Diehl	NW
07	15	1853	/	Fig Drain at Diehl south side	SE
07	15	1854	/	Shoe cemetery	
07	15	1855	/	Fig drain field crossing north side	W
07	15	1856	/	Fig drain south side	NW
07	15	1857	/	North middle corner siphon and turnout	SW
07	15	1858	/	North end of canal next to wormwood	
07	15	1859	/	Fig drain at southern end of western area	SE
07	15	1860	/	Same as above with tile line sign	
07	15	1861	/	East-west lateral at Derrick Drive & Wixom concrete ditch, check is out of project area on other side of road.	
07	15	1863	/	owl	
07	16	1873	/	Rykerson 1966	
07	16	1874	/	Overview at NE corner of west area turnouts 26 & 27	ESE
07	16	1875	/	Turnout 27	
07	16	1876	/	Bone	D
07	16	1877	/	Bone	D
07	16	1878	/	Bone	D
07	18	1879	Site 6	1-Yellow ceramic fragment with part of handle	D
07	18	1880	Site 6	2- can with external friction lid and piece of cut bone pork?	D
07	18	1881	Site 6	-3 bottle base	D
07	18	1882	Site 6	-4 Metal hinge and piece of milled lumber	D
07	18	1883	Site 6	5- light green bottle fragment	D
07	18	1884	Site 6	6- white ceramic fragment	D
07	18	1885	Site 6	Sherd and pipe stem	D
07	18	1886	Site 6	Sherd	D
07	18	1887	Site 6	pipe stem	D

*Resource Name or # **(Assigned by recorder)** Wormwood Canal

*Drawn By: H. Thomson, kp environmental, LLC, 2387 Montgomery Ave. Cardiff By The Sea, CA 92007
*Date: 07/15/2011



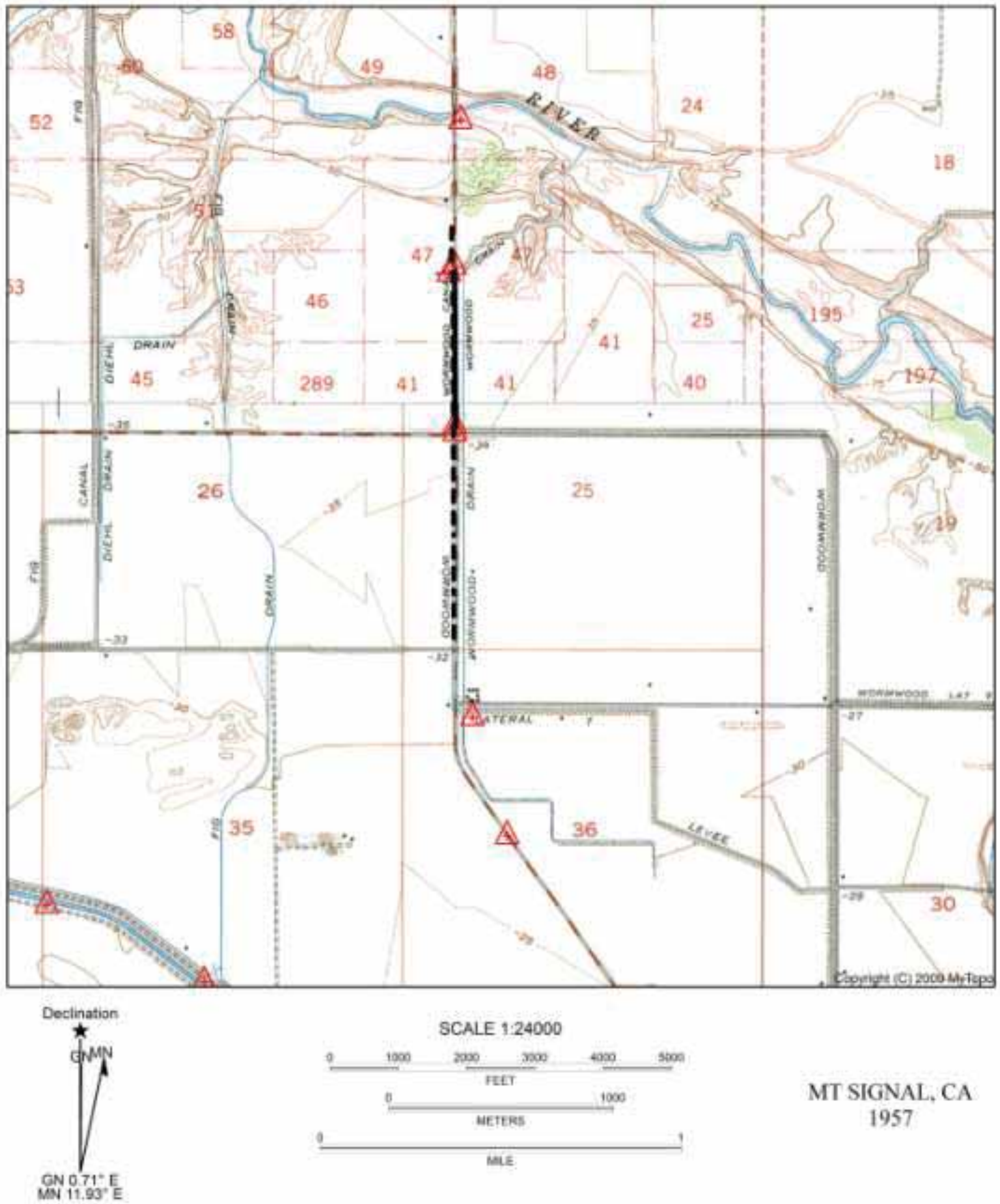
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LOCATION MAP

Primary # P-13-008983 update
HRI#
Trinomial

Page 6 **of** 6 ***Resource Name or #:** Wormwood Canal

***Map Name:** Mt. Signal, Calif. ***Scale:** 1:24,000 ***Date of Map:** 1957



***Resource Name or # (Assigned by recorder)** Wormwood Canal Update
Recorded by: Jennifer Krintz, Architectural Historian **Date:** May 2011
☐ Continuation ☒ Update

P1. Other Identifier:
***P2. Location:** ☐ Not for Publication ☒ Unrestricted
***a. County:** Imperial
***b. USGS 7.5' Quad:** Mount Signal **Date:** 1957; **T** 17S; **R** 13E; **of Sec.** 6,7; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; North end: 623340.61 **mE /** 3619020.88 **mN**; South end: 623517.44 **mE** / 3616761.21 **mN**

***P3a. Description:** The Wormwood Canal is an irrigation canal constructed circa 1911. It is located east of the Westside Main Canal and flows east and south in the Imperial Valley in Imperial County, CA. The canal is approximately 10 feet wide and about 6 feet deep. Dirt roads access the canal from Old Highway 80, SR 98, and I-8. The canal is lined with concrete. It was originally constructed in 1911 and extended years later. Modifications were added to the canal in the 1960s. The entire canal is approximately 6 miles long and terminates at the northern end at the Wormwood Drain and at the southern end at the intersection of Drew Road and SR98.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct

P5a. Photograph or Drawing:

P5b. Description of Photo:
Looking southeast at the canal.
Picture taken May 4, 2011.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
Circa 1911,
1999 DPR 523 Form, Jill Hupp

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

***P8. Recorded By:**
Jennifer Krintz, Architectural Historian
ASM Affiliates, Inc.
260 S. Los Robles Avenue Suite 106
Pasadena, CA 91107

***P9. Date Recorded:** May 2011
***P10. Survey Type:** Intensive

P11. Report Citation: Draft Inventory, Evaluation and Analysis of Effects on Historic Built Environment Properties Within the Area of Potential Effect of the Centinela Solar Energy Project, Imperial County, CA

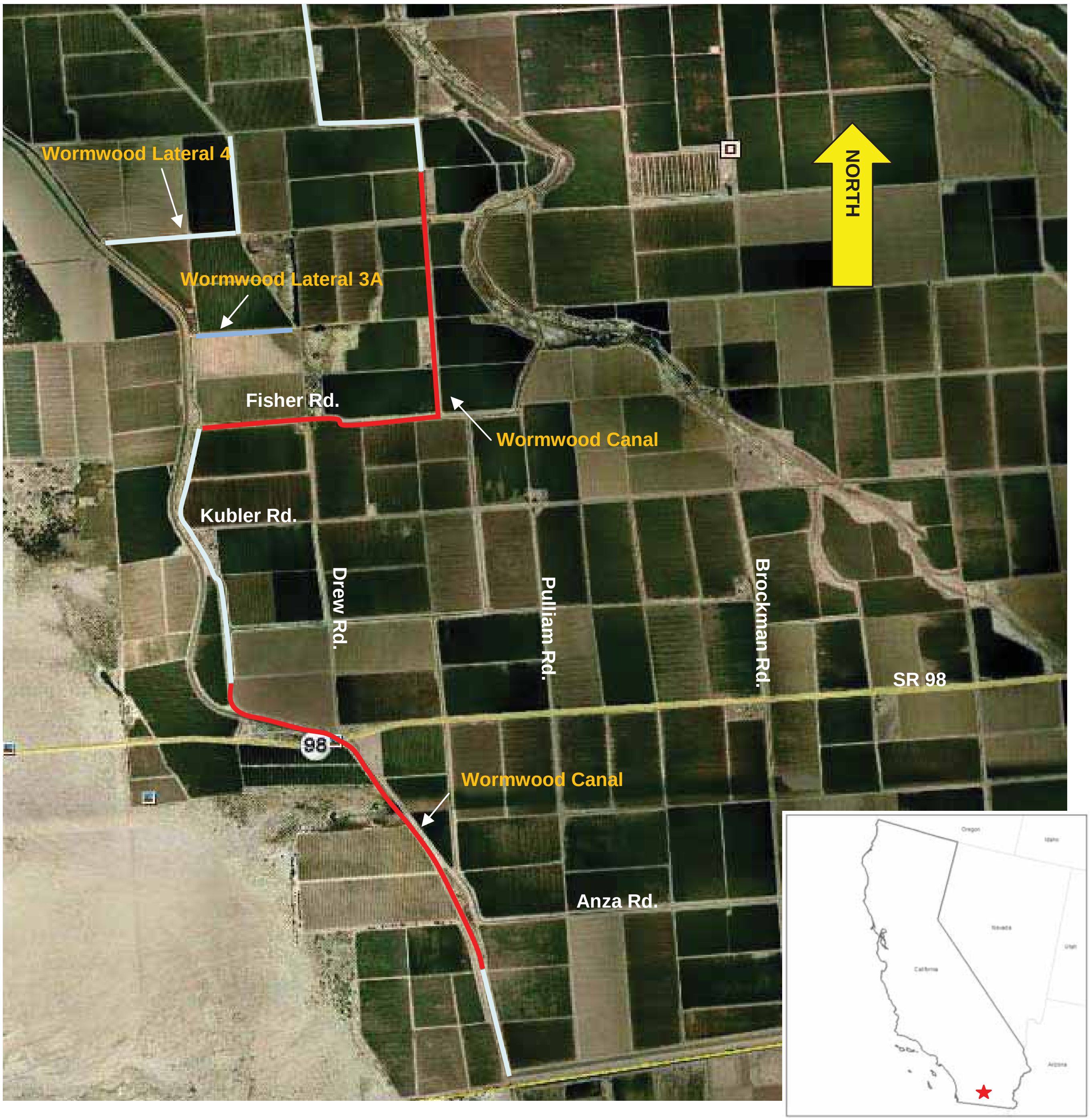
***B10. Significance: Theme:** Irrigation Canal of the Imperial Valley **Area:** Imperial Valley, CA
Period of Significance: 1911-1930 **Property Type:** N/A **Applicable Criteria:** None
In 1999, Judy Hupp of Caltrans recommended the Wormwood Canal not eligible for the National Register of Historic Places because the canal was realigned and lined with concrete from its original earthen materials. Therefore the canal does not retain enough integrity to convey its significance as one of the original irrigation canals for the Imperial Valley. Although the canal is associated with the early irrigation system of the Imperial Valley, this particular canal does not convey the significance of the irrigation system as well as the Westside Main Canal or the All-American Canal. While it was part of this larger canal system, it alone is not individually significant.ASM concurs with this finding and recommends the Wormwood Canal not eligible for the National Register of Historic Places nor the California Register of Historic Resources.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-008983 UPDATE
HRI #
Trinomial
NRHP Status Code: 6Z

Page 2 of 2 ***Resource Name or # (Assigned by recorder)** Wormwood Canal Update
Recorded by: Jennifer Krintz, Architectural Historian **Date:** May 2011
☐ Continuation ☒ Update

Location Map of the Wormwood Canal



Red outline indicates the canal segments within the survey area
Blue outline indicates the canal laterals within the survey area

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-008983 **UPDATE**
HR #:
Trinomial:
NRHP Status Code:
Other Listings:
Review Code: Reviewer: Date:

 Resource Name or #: Wormwood Canal (other portions not recorded on 1999 site form)

P1. Other Identifier: Wormwood Canal
P2. **Location**: ■ Not for Publication ☐ Unrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad:** Mt. Signal Date: 1997. **N portion:** T17S; R13E; NE ¼ of Section 5; T16S; R13E; SE ¼ of Section 31; **Southern portion:** T17S; R13E; NW & SE ¼ of Section 7; T17S; R13E; NE ½ of Section 17; S.B. BM
c. Address: None
d. UTM: Zone 11; NAD 83; **N portion:** South: 625277mE/3619009mN; North: 625260mE/3620234mN; APN #052-170-050/ 052-430-009; **Southern portion:** North: 623231mE/3618203mN; South: 625137mE/3615323mN: APN #052-190-007
e. Other Locational Data. This resource is located south of Interstate 8, southwest of El Centro. The **northern portion** is situated between Drew Rd. and Pulliam Rd. extending northward from Fisher Rd.; (with another segment paralleling Fisher Rd. to the west); the **southern portion** is situated west of the upper portion west of Drew Rd. paralleling Mandrapa Rd. immediately to the east. This portion of the canal extends south of St Route 98 for nearly 2 mi. where it connects with the All-American Canal along the Mexican border (1 mi. is outside of current survey area). Elevation in the northern portion varies from 21 to 25 ft. below sea level portion (from south to north) and from 13 to 9 ft. below sea level portion (from north to south) in the southern.

P3a.**Description:** Two additional segments of the previously recorded Wormwood Canal were recorded during survey of agricultural property (for a proposed solar project), roughly 1.4 mi. apart (SW to NE). The north-south aligned 0.75 mi. long **northern** portion parallels the east side of Wormwood Rd. on the western border of parcels #052-170-050 and 052-430-009, north of Fisher Rd. This segment continues northward out of the survey area for several miles towards Seeley (the east-west segment heading west is south of Fisher Rd. and outside the current survey area).
The **southern** portion within the current survey area is an irregular alignment roughly 2.3 mi. long (east of the major Westside Main Canal) starting approximately 117 ft. west of the western end of Kubler Rd. at the north, heading south paralleling Mandrapa Rd. then crossing SR 98 some 1.5 mi. south of Kubler Rd, and extending south-southeast another 0.8 mi. along the western edge of the survey area (a small portion is within BLM land however).
A "1964" date stamp was noted on a flow gate along the northern portion, but no other date stamps were observed. The canal varies in width from roughly 11 to 15 ft. across at the top (depth is unknown since the canal was full of water). The canal segments appear to be well-maintained and the integrity is good in spite of the recent earthquake activity in the area.

P3b.**Resource Attributes:** H20; Canal/aqueduct
P4. **Resources Present:** ☐ Building ☐ Structure ☐ Object ■ Site ☐ District ☐ Element of District ☐ Other:

P5b. Description of Photo: Canal overview (southern portion), looking north, 0.2 mi. north of SR 98, where canal turns northward no longer paralleling the Westside Main Canal (white flow gate is 500 ft. due east of West Main Canal); Mandrapa Rd. is dirt farm road along east side; 12/20/10; PR-03131-022

P6. **Age and Sources**
■ Historic ☐ Prehistoric ☐ Both

P7. **Owner and Address:**
Unknown

P8. **Recorded by**:
Frank Dittmer and Alette van den Hazelkamp
Laguna Mountain Environmental, Inc.
7969 Engineer Road, Suite 208
San Diego, CA 92111

P9. **Date Recorded:** Dec. 8 & 20, 2010

P10. **Survey Type**: Intensive Pedestrian

P11. **Report Citation**: 2011 Pigniolo, Andrew, and Pepe Aguilar. *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California*. Prepared for kp environmental, Carlsbad, California.

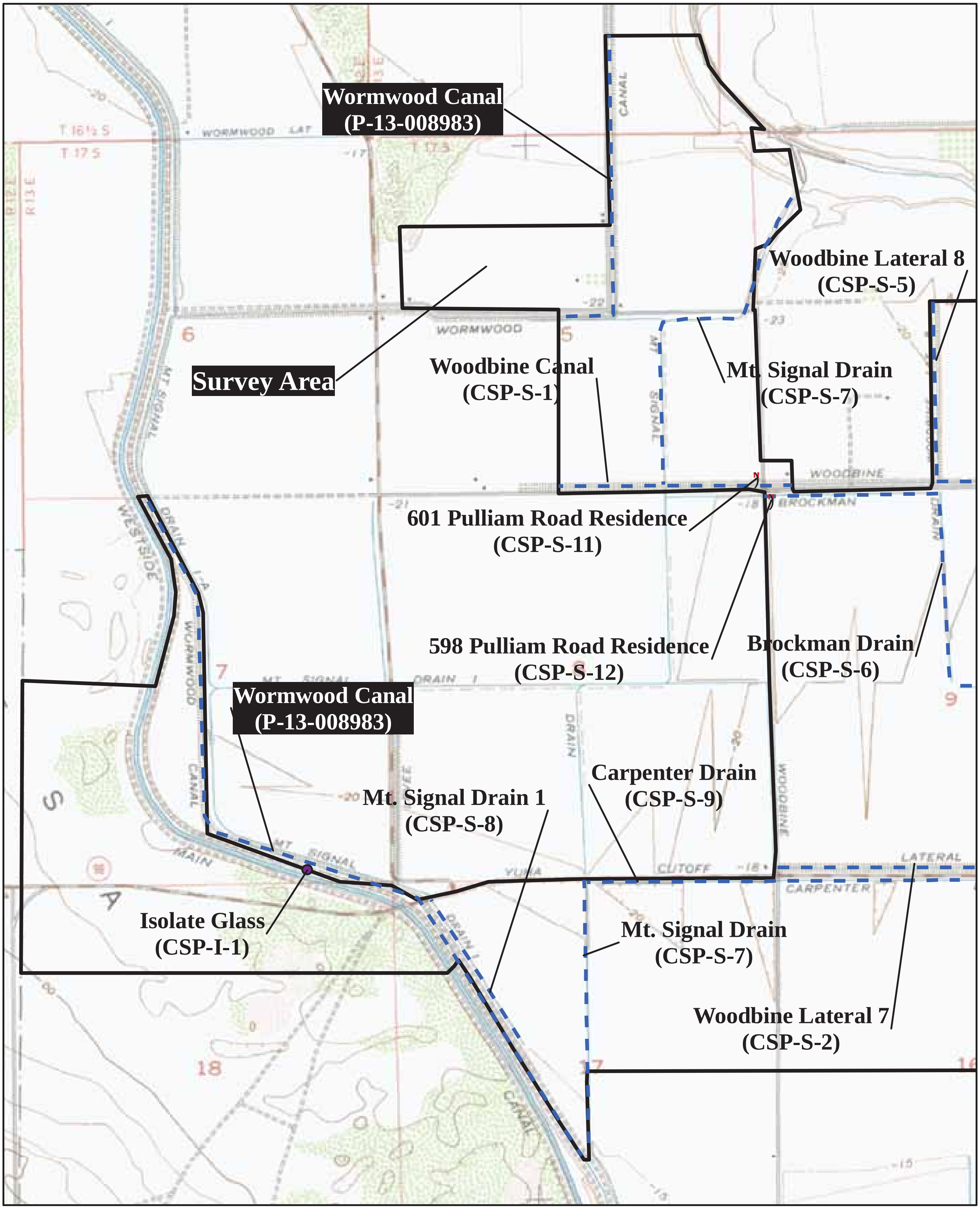
Attachments: ☐ NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building ☐ Structure, and Object Record
☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record
☐ Artifact Record ☐ Photograph Record ☐ Other (List):

Primary #: ______________________
Trinomial: ____________________

LOCATION MAP

Resource Name or #: P-13-008983

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-008983
HRI #:
Trinomial:

NRHP Status Code: 6
Other Listings:
Review Code ____ Reviewer ____ Date ____

***Resource Name or #:** Wormwood Canal **Map Reference No.:** 2

P1. Other Identifier: N/A

County/Route/Postmile: 11-IMP-98, P.M. 0.3-30.3/K.P 0.5-48.8

***P2. Location: *a. County** Imperial

b. Address SR 98 at Postmile 22.07 **City** Calexico **Zip** 92231

***c. USGS 7.5 Quad:** **d. UTM:**

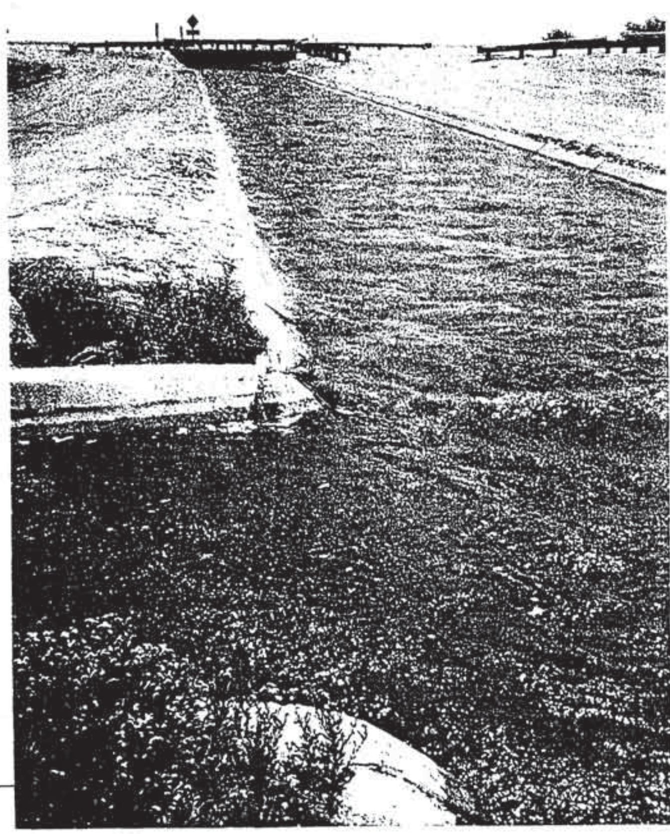
***e. Other Locational Data:** (e.g. parcel #, directions to resource, elevation, etc., as appropriate)
Segment within the APE crosses SR 98 at P.M. 22.07 (K.P. 35.31) just west of Drew Rd.

***P3a. Description:**

The Wormwood Canal is an irrigation ~~ditch~~ canal that runs through agricultural land in the Imperial Valley section of Imperial County. It enters the current project area where State Route 98 crosses the canal at Postmile 22.07 (K.P. 35.31) west of Drew Road. At this point the canal is approximately 10 feet wide (3.04 m) and about 6 feet deep (1.82 m), running perpendicular to the highway in a northwest-southeast direction. It is concrete lined with a trapezoidal shaped profile. Dirt access roads run along the levees on both sides of the canal to precipitate maintenance and dredging operations. Originating at the All-American Canal along the U.S.-Mexican border, Wormwood Canal extends northwest roughly 6 miles (9.65 km), terminating at Wormwood Drain, roughly 2.8 miles (4.5 km) south of Seeley. Bridge #58-275, constructed in 1955, carries SR 98 across the canal.

Built around 1911, Wormwood Canal parallels the much larger Westside Main Canal; a dirt access road runs between the two. Just north of the project APE, Wormwood Lateral 1 intersects its parent canal. The surrounding area consists primarily of irrigated cropland.

P5. Photograph or Drawing (Photograph required for buildings, structures, and objects.)



***P3b. Resource Attributes:** HP20 (Canal/Aqueduct)

***P4. Resources Present:** ☐ Building ■ Structure ☐ Object ☐ Site ☐ District ☐ Element of District

P5b. Description of Photo: 4/28/99. Canal segment S of SR 98 looking SW.

***P6. Date Constructed/Age:** c.1911; recent modifications
☐ Prehistoric ■ Historic ☐ Both

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

***P8. Recorded by:**
Jill Hupp
Caltrans Environmental Program
PO Box 942874
Sacramento, CA 94274-0001
(916) 654-3567

***P9. Date Recorded:** 4/28/99

***P10. Type of Survey:** ■ Intensive ☐ Reconnaissance ☐ Other

***P11. Report Citation:** IMP-98 HASR, 11-IMP-20, P.M. 0.3/30.3, EA 173400

***Attachments:** ☐ NONE ☐ Map Sheet ☐ Continuation Sheet ■ Building, Structure, and Object Record ☐ Linear Resource Record ☐ Archaeological Record ☐ District Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary # P-13-008983
HRI#/Trinomial

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code: 6

*Resource Name or #: Wormwood Canal

B1. Historic Name: Wormwood Canal
B2. Common Name: Wormwood Canal   County/Route/Postmile: 11-IMP-98, P.M. 0.3/30.3
B3. Original Use: Irrigation ditch   B4. Present Use: Irrigation ditch
*B5. Architectural Style: N/A
*B6. Construction History: built c. 1911 as part of the Imperial canal system with recent modifications.
*B7. Moved? ■ No ☐ Yes ☐Unknown   Date: N/A   Original Location: N/A
*B8. Related Features: None
B9a. Architect: N/A   B9b. Builder: Southern Pacific Co., I.I.D.
*B10. Significance: N/A   Theme: N/A   Area: N/A
Period of Significance: N/A   Property Type: N/A   Applicable Criteria: N/A

Wormwood Canal was built about 1911 as part of the expansive Imperial irrigation system, which transformed the Colorado Desert into fertile farmland. The movement to reclaim this seemingly inhospitable wasteland for agrarian purposes had originated with Dr. O. M. Wozencraft in the 1850s. Wozencraft was convinced that the area had unlimited agricultural potential, if only a potable water supply could be established; he believed that this could be accomplished by means of a single gravity-flow canal, by which several hundred acres could be irrigated. Despite Wozencraft's best efforts, no progress was made on the project during his lifetime. In 1896 a group of investors formed the California Development Company (CDC), determined to take on the challenge of desert irrigation. Headed by civil engineers Charles Rookwood and George Chaffey, the company began constructing a canal that would divert water from the Colorado River into the dry channels of the Alamo and New rivers, which would in turn carry the water north to the Colorado Desert (now the Imperial Valley). In early 1902, the first irrigation water was delivered. A CDC subsidiary, the Imperial Land Company, promoted colonization of the area and handled land sales. Under Chaffey's direction, several mutual water companies were organized as well, and the CDC built most of the distribution systems, main canals and laterals needed to service these newly developed areas. By 1905, 80 miles of main canals had been built, with more than 100,000 acres under cultivation. Water delivery service was unreliable however, the canals being poorly designed and maintained. The muddy Colorado River had a tendency to deposit heavy loads of silt, which soon blocked the canal's intake, thereby reducing the amount of water reaching Valley crops. In an attempt to combat this, the CDC cut a bypass channel **(See Continuation Sheet)**

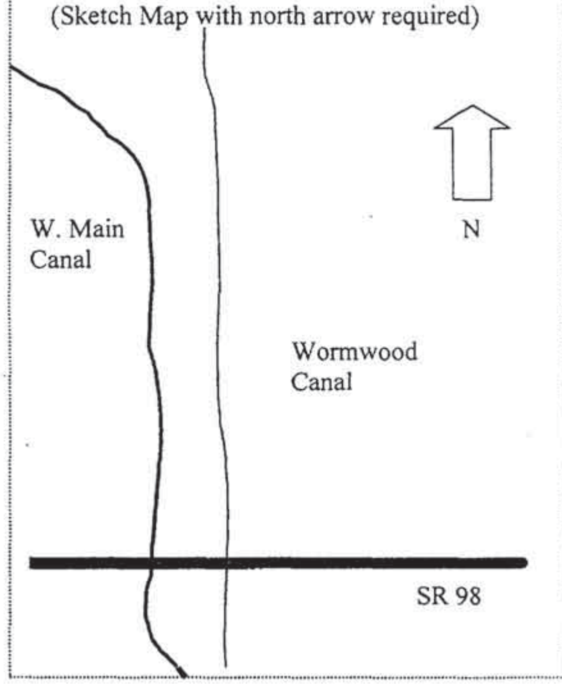
B11. Additional Resource Attributes: N/A
B12. References: Clement 1996: primary record 1;
Lortie, 1997: 6, 8-10, 13-17;
IID website: 1, 6; Tout 1990: 110, 114-115;
Fisher 1998: 11-14.

B13. Remarks: N/A
B14. Evaluator: Jill Hupp
Caltrans Environmental Program
PO Box 942874
Sacramento, CA 94274-0001
(916) 654-3567

*Date of Evaluation: 5/26/99

(This space reserved for official comments)

(Sketch Map with north arrow required)



Resource Name or #: Wormwood Canal ■ Continuation ☐ Update

County/Route/Postmile: 11-IMP-98, P.M. 0.3/30.3

B10. Significance (continued) in the riverbank four miles south of the border, without legal authority or adequate gates to control the force of the water. Widespread flooding in the winters of 1905-06 and 1907 as a result of this action caused extensive damage to farmland, railroad property, as well as to the canal system itself. After the floodwaters subsided, the decision was made to enlarge Westside Main Canal, then located primarily within Mexico, and extend it north into the United States. Completed by the end of 1907, the canal would serve all the formerly undeveloped land west of New River. Wormwood canal, running parallel to Westside Main, was added to the system around 1911. Initially, the canal drew its water from Westside Main but by 1913 it had been extended into Mexico.

Unable to recover from its huge financial losses after the floods, the CDC was forced into bankruptcy. Southern Pacific (as the CDC's main creditor) assumed management of the company, and water delivery service continued without interruption. Between 1912-1916, development work in Imperial Valley in the way of canal extensions and territorial improvements advanced at an accelerated pace. A number of canals, laterals and drains were added to the area between New River and Westside Main Canal. The Imperial Irrigation District (IID) purchased the existing canal system in 1916, and in 1922 the region's smaller mutual water companies were absorbed by the District. By 1930 the IID was operating some 1,700 miles of canals and laterals, with a service area of 550,000 acres. As an agricultural center, the Imperial Valley was particularly hard-hit by the Depression; maintenance and expansion work on the canals slowed to a near-standstill as economic conditions worsened. To Valley residents, the completion of Hoover Dam on the lower Colorado River in 1935 seemed an indication of better times to come. This massive Federal undertaking would help reduce the volume of silt carried by the river, and prevent the possibility of another devastating flood in the Imperial Valley. The All-American Canal was finished in 1941 as part of the same project as Hoover Dam, fulfilling the long-held ambition of Valley farmers and IID officials to build a new canal that was entirely within the boundaries of the United States. Improvements were made to the existing canal system as well, particularly the drain ditches, which were widened and fitted with drain tiles to help alleviate the problem of salt build-up in Valley soil. Wormwood Canal now originated at the All-American Canal; sections of the waterway located in Mexico were no longer part of the IID system. Beginning in the 1960s, the IID endeavored to line all of its earthen canals and laterals with concrete, including the Wormwood Canal. Laterals were extensively resurveyed and straightened before being lined with concrete.

The Wormwood Canal today, like the IID irrigation system overall, reflects the developments that occurred as a result of the construction of the All-American Canal in 1941, after which the system was considerably expanded and modernized. Research to date appears to indicate that Wormwood Canal as a whole, although important for its association with the development of agriculture in the Imperial Valley, would not possess the requisite degree of integrity due to reconstruction since the 1950s, but no survey of the entire canal has yet been undertaken. Caltrans architectural historian Frank Lortie, after an extensive study of the IID system in 1997, concluded that the elements in the IID that retain integrity for the period 1941-1950 could be contributors to a potentially eligible National Register historic district. The segment of Wormwood Canal within the project vicinity does not appear to possess sufficient integrity of workmanship, design, feeling and association to represent the canal's significance in itself or as a contributor to a larger property. Enlarging the canal and lining it with concrete in recent decades has changed its basic configuration; originally the conduit would have been more U-shaped, with a flat bottom, rather than the trapezoidal profile it bears today. It does not reflect the period of significance identified by Lortie (1941-1950), and it was built after the canal system's earlier period of significance (1901-1907). Nor does it embody any distinctive characteristics of type, period, or method of construction under Criterion C. Further, the canal is neither associated with a historical event under Criterion A nor associated with persons significant in history under Criterion B.

In July 1997 and April 1998, segments of other canals within the IID system were examined and found ineligible because of loss of integrity. The section of Wormwood Canal within the current project area also appears to lack integrity to be individually eligible for the National Register of Historic Places or to be a contributing element of the canal, as a whole, should the canal constitute an eligible property. There is no evidence of a possible historic district or historic landscape which might include this segment of the canal as a contributing element. Likewise, Caltrans has evaluated the resource in accordance with Section 15064.5 (a)(2)-(3) of the CEQA Guidelines, using criteria outlined in Section 5024.1 of the California Public Resources Code, and determined that the canal is not a historical resource for the purposes of CEQA.

P-13-008983

BRIDGE EVALUATION FORM

(To be appended to the HPSR)

Note: This form is only to be used for structure types listed in the Caltrans/FHWA/SHPO Memorandum of Understanding dated December 12, 1980.

Location: Attach Map showing structure location.

File: EA 173400 ENVR **Fed. No.:**

Road: 11-IMP-98 **Location:** SR 98 at Postmile 25.56

(K.P. 41.13) Calexico, Imperial Co. **Bridge Number:** 58-132

Description: Attach at least one side photo and one view of the deck along the center line.

Type (circle one): **Temporary** **Standard** **Culvert**

Type of superstructure: None

Type of substructure: Concrete slab; 14.3 feet long, 13.3 feet wide.

History: **Date of construction/designer:** 1990/ Division of Structures

Other historical information (persons, events—e.g. WPA/CCC) Structure replaced an older bridge at this location, built c. 1955.

Prepared by: Jill Hupp

Position: Environmental Planner-Architectural History

Date: May 27, 1999

Reviewed by:

Gregory P. King CHIEF, HISTORY, ARCHITECTURE & COMMUNITY STUDIES BRANCH

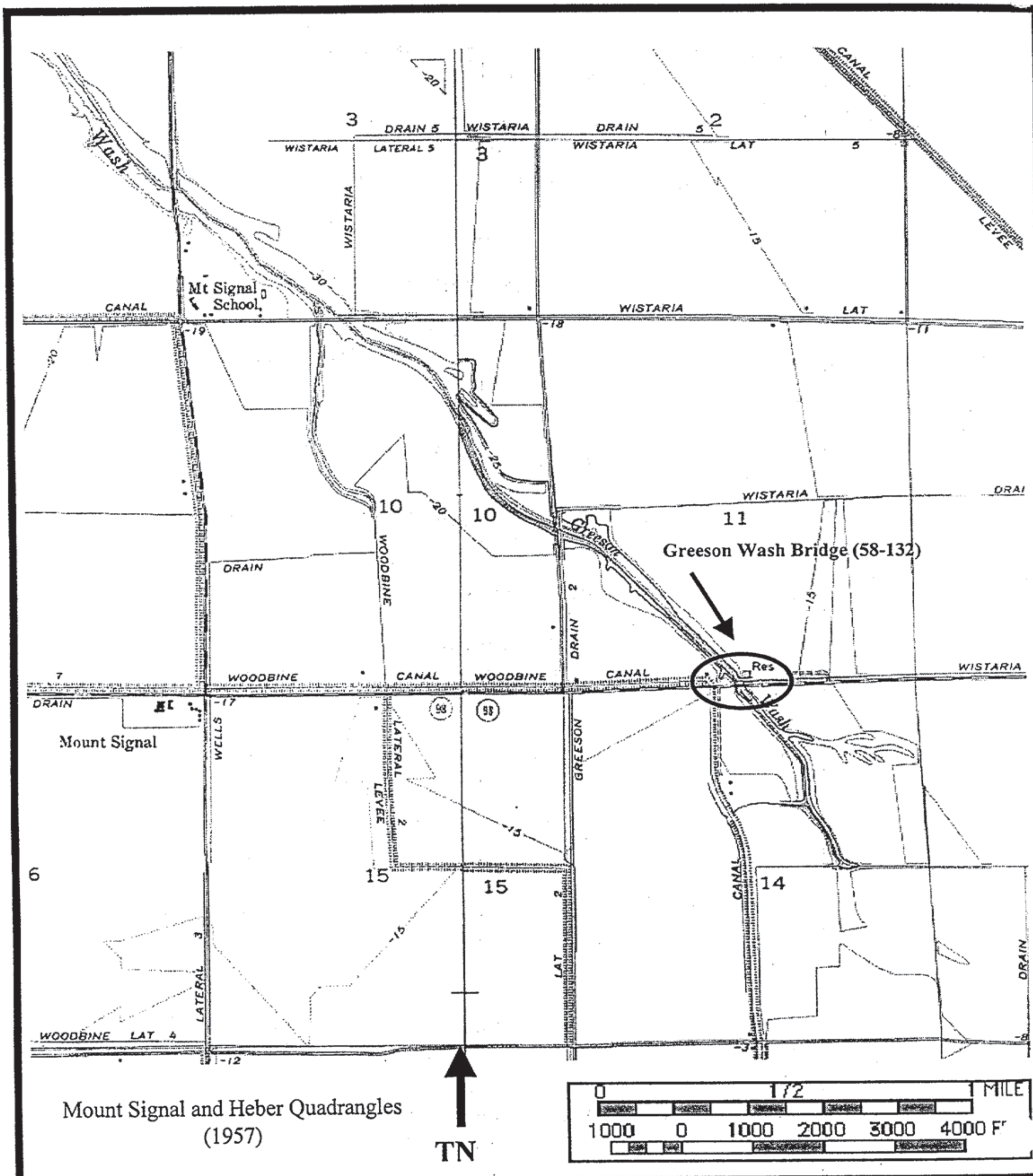
(Name/Title)

Greeson Wash Bridge—#58-132

P-13-008983

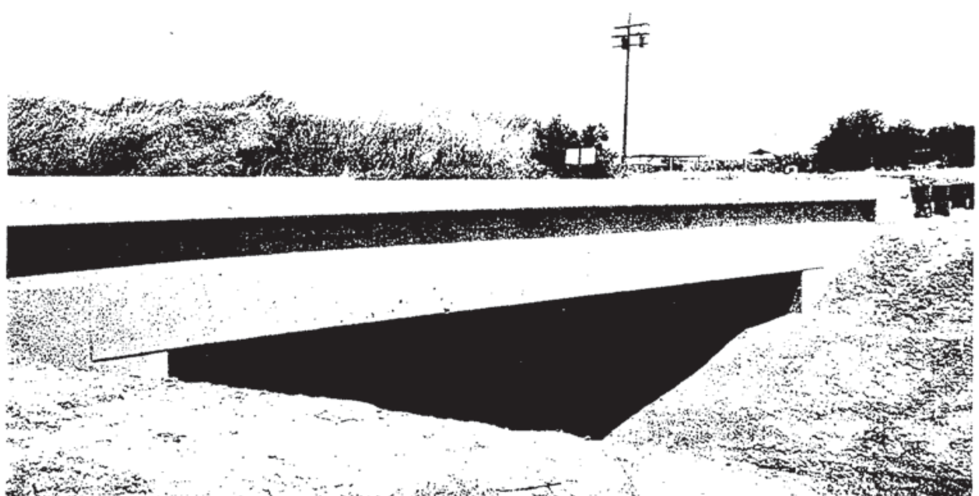
FIGURE 4. Bridge #58-132 Location

11-IMP-98
K.P. R0.5-48.8/P.M. R0.3-30.3
EA 173400



Mount Signal and Heber Quadrangles (1957)

DECK VIEW LOOKING EAST



SIDE VIEW LOOKING NORTHEAST

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-013073 UPDATE
HRI #
Trinomial
NRHP Status Code:

Page 1 of 2 ***Resource Name or # (Assigned by recorder)** Woodbine Canal Update
Recorded by: Jennifer Krintz, Architectural Historian **Date:** May 2011 ☐ Continuation ☒Update

P1. Other Identifier:
***P2. Location:** ☐ Not for Publication ☒ Unrestricted
***a. County:** Imperial
***b. USGS 7.5' Quad:** Mount Signal **Date:** 1957; **T** 17S; **R** 13E; **of Sec.** 5, 4, 8, 9, 10, 16, 15, 10, 11, 14; S.B. **B.M**
c. Address: N/A **City:** Imperial **Zip:** N/A
d. UTM: Zone 11S; North end: 626303.85 **mE /** 3618459.89 **mN**; South end: 627671.18 **mE** / 3614946.70 **mN;**
West end: 625062.70 **mE/** 3618232.97 **mN;** East end: 629950.24 **mE/** 3616313.20 **mN**

***P3a. Description:** The Woodbine Canal is an irrigation canal constructed circa 1915. It is located east of the Westside Main Canal and flows east and south in the Imperial Valley in Imperial County, CA. The canal is approximately 10 feet wide and about 6 feet deep. Dirt roads access the canal from Old Highway 80, SR 98, and I-8. The canal is lined with concrete. The Woodbine Canal appears as early as 1915 on the El Centro 15' USGS quad map. However, modifications such as the concrete lining were added to the canal in the 1950s/1960s as well as date stamps from the time of these modifications. One date stamp is labeled 1961 on the Woodbine Canal that runs east/west from the Greeson Wash along SR98; another date stamp labeled 1955 is on Woodbine Lateral 3 facing south. The entire canal is approximately 3 miles long with several associated laterals.

***P3b. Resource Attributes:** HP20. Canal/Aqueduct

P5a. Photograph or Drawing:
P5b. Description of Photo:
Looking west at the canal just north of Kubler Road. Picture taken May 4, 2011.

***P6. Date Constructed/Age and Sources:**
☒ Historic ☐ Prehistoric ☐ Both
Circa 1915, El Centro 15' USGS quad map, Andrew Pigniolo, Laguna Mountain Environmental, Inc., Sept. 2010

***P7. Owner and Address:**
Imperial Irrigation District
333 E. Barioni Blvd.
Imperial, CA 92251

***P8. Recorded By:**
Jennifer Krintz, Architectural Historian
ASM Affiliates, Inc.
260 S. Los Robles Avenue Suite 106
Pasadena, CA 91107

***P9. Date Recorded:** May 2011
***P10. Survey Type:** Intensive
P11. Report Citation: Draft Inventory, Evaluation and Analysis of Effects on Historic Built Environment Properties Within the Area of Potential Effect of the Centinela Solar Energy Project, Imperial County, CA

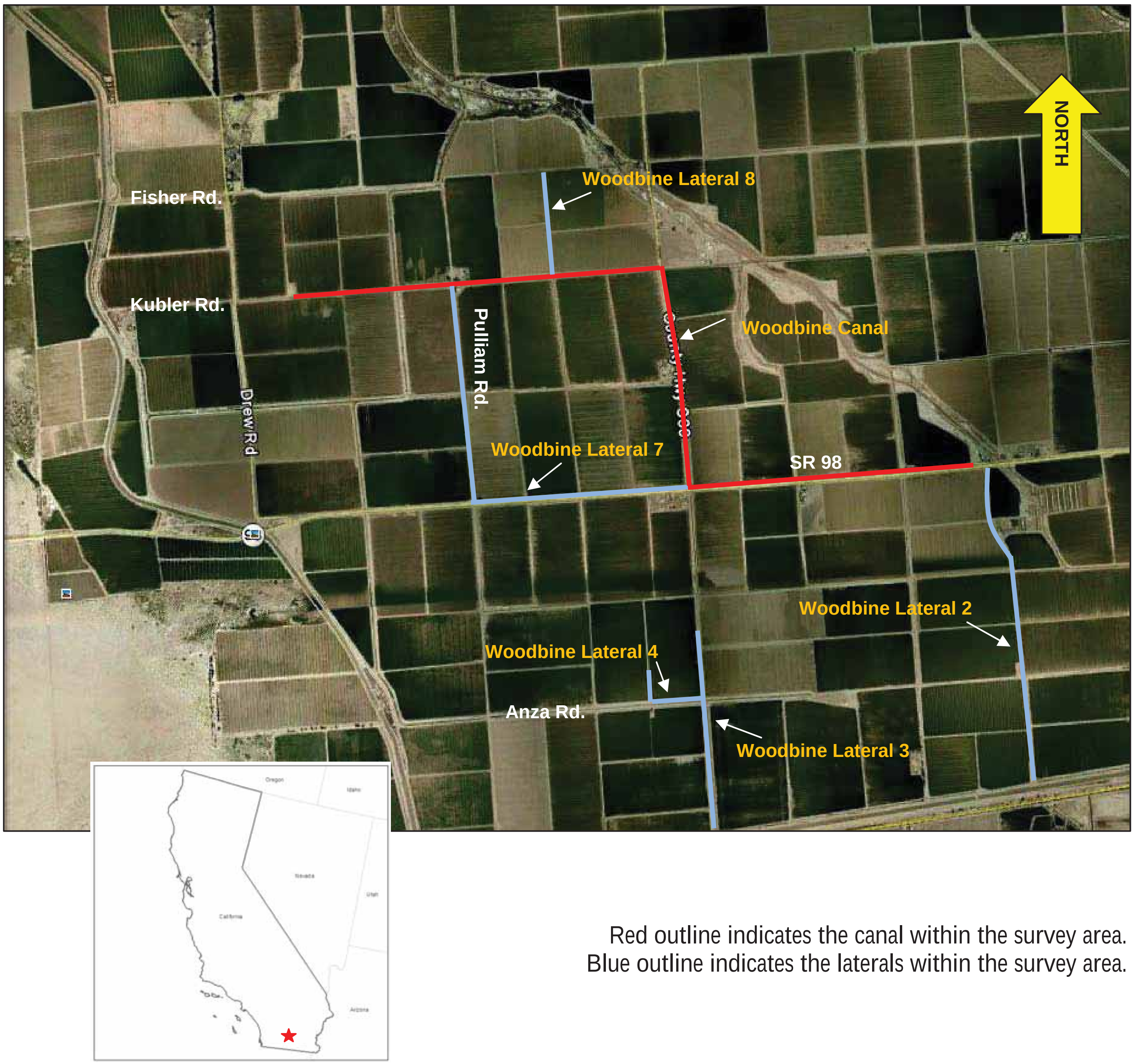
***B10. Significance: Theme:** Irrigation Canal of the Imperial Valley **Area:** Imperial Valley, CA
Period of Significance: 1915-1930 **Property Type:** N/A **Applicable Criteria:** None
The Woodbine Canal was one of the earliest irrigation canals in the Imperial Valley. According to a previous inventory record by Andrew Pigniolo of Laguna Mountain Environmental, Inc., the Woodbine Canal was shown on the 1915 El Centro 15' USGS quad map. However, later date stamps marked from the 1950s and 1960s were labeled on the canal and laterals when they were lined with concrete. Although the canal is associated with the early irrigation system of the Imperial Valley, this particular canal does not convey the significance of the irrigation system as well as the Westside Main Canal or the All-American Canal. While it was part of this larger canal system, it alone is not individually significant. Additionally, the integrity of the original materials and craftsmanship of the 1915 canal system was not retained and therefore the Woodbine Canal is recommended not eligible for the National Register of Historic Places nor the California Register of Historic Resources.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary # P-13-013073 UPDATE
HRI #
Trinomial
NRHP Status Code:

***Resource Name or # (Assigned by recorder)** Woodbine Canal Update
Recorded by: Jennifer Krintz, Architectural Historian
Date: May 2011
☐ Continuation ☒ Update

Location Map of the Woodbine Canal



Red outline indicates the canal within the survey area.
Blue outline indicates the laterals within the survey area.

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #: P-13-013073
HR #:
Trinomial:
NRHP Status Code:
Other Listings:
Review Code: Reviewer: Date:

 Resource Name or #: CSP-S-1

P1. Other Identifier: Woodbine Canal

P2. **Location**: ■ Not for Publication ☐ Unrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad:** Mt. Signal Date: 1997. T17S; R13E; S edge of Sec. 4 & 5; E edge of Sec. 9; S edge of Sec. 10; S.B. BM
c. Address: None
d. UTM: Zone 11; NAD 83; W end: 625036mE/3618255mN; E end: 625924mE/3618262mN; APN #052-170-018 & -019
West end: 626695mE/3618272mN; East end: 627501mE/3618280mN; APN #052-170-068
North end: 627502mE/ 3618276mN; South end: 627622mE/3616593mN; APN #052-170-034 & -035
West end: 627622mE/3616589mN; East end: 629300mE/3616593mN; APN #052-180-033 & -032
e. Other Locational Data. This resource is located south of Interstate 8, southwest of El Centro, adjacent to Kubler Rd. and Brockman Rd. (Co. Highway S30), and also north of or adjacent to State Route (SR) 98, at an elevation of approximately 15 to 17 feet below sea level.

P3a.**Description:** Two portions of the western portion of the Woodbine irrigation canal were recorded during survey of agricultural property (for a proposed solar project). The east-west aligned 0.5 mi. long western-most segment parallels the north side of Kubler Rd. on the southern border of Section 5, east of Drew Rd. Another 0.5 mi. east-west aligned portion was recorded starting 0.5 mi. to the east and ending at the (former) Mt. Signal School property southwest corner. The north-south oriented segment runs from the intersection of Kubler Rd. and Brockman Rd. (SW corner) down the west side of Brockman Rd. for just a little over 1 mi. (due to eastward 'bulge' in section line). At SR 98, the canal heads east paralleling the north side of the highway. A 1 mi. east-west segment between Brockman Rd. and Rockwood Rd. was recorded during this survey, but the canal continues eastward for over 7 mi. to Anza Rd.
The Woodbine Canal is shown on the 1915 El Centro 15' USGS quad. map, however, the canal channel was lined with concrete at a later date, sometime in the late 1950s/early1960s. There is a "1957" date stamp on a small elevation drop at the northwestern corner of Brockman Rd. and SR 98, and two gates along the north-south segment have "1979" date stamps. The segment of the canal between the two 1979 dated gates has concrete of a different appearance indicating an even more recent replacement. The segment of the canal is roughly 13 ft. across at the top, but depth is unknown since the canal was full of water. Features associated with the canal include a small elevation drop, a gate opening to Woodbine Lateral 7, a gate along the canal itself, and the Brockman Road undercrossing. The canal segments appear to be well-maintained and the integrity of the features is good.

P3b.**Resource Attributes:** H20; Canal/aqueduct
P4. **Resources Present:** ☐ Building ☐ Structure ☐ Object ■ Site ☐ District ☐ Element of District ☐ Other:

P5b. Description of Photo: View of Woodbine Canal looking west (Kubler Rd. at left) from Brockman Rd.; 9-1-10; PR-03055-011

P6. **Age and Sources**
■ Historic ☐ Prehistoric ☐ Both

P7. **Owner and Address:**
Unknown

P8. **Recorded by**:
Andrew Pigniolo
Laguna Mountain Environmental, Inc.
7969 Engineer Road, Suite 208
San Diego, CA 92111

P9. **Date Recorded:** June 21, Aug. 25, Sept. 1, 2010

P10. **Survey Type**: Intensive Pedestrian

P11. **Report Citation**: 2011 Pigniolo, Andrew, and Pepe Aguilar. *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California*. Prepared for kp environmental, Carlsbad, California.

Attachments: ☐ NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building ☐ Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

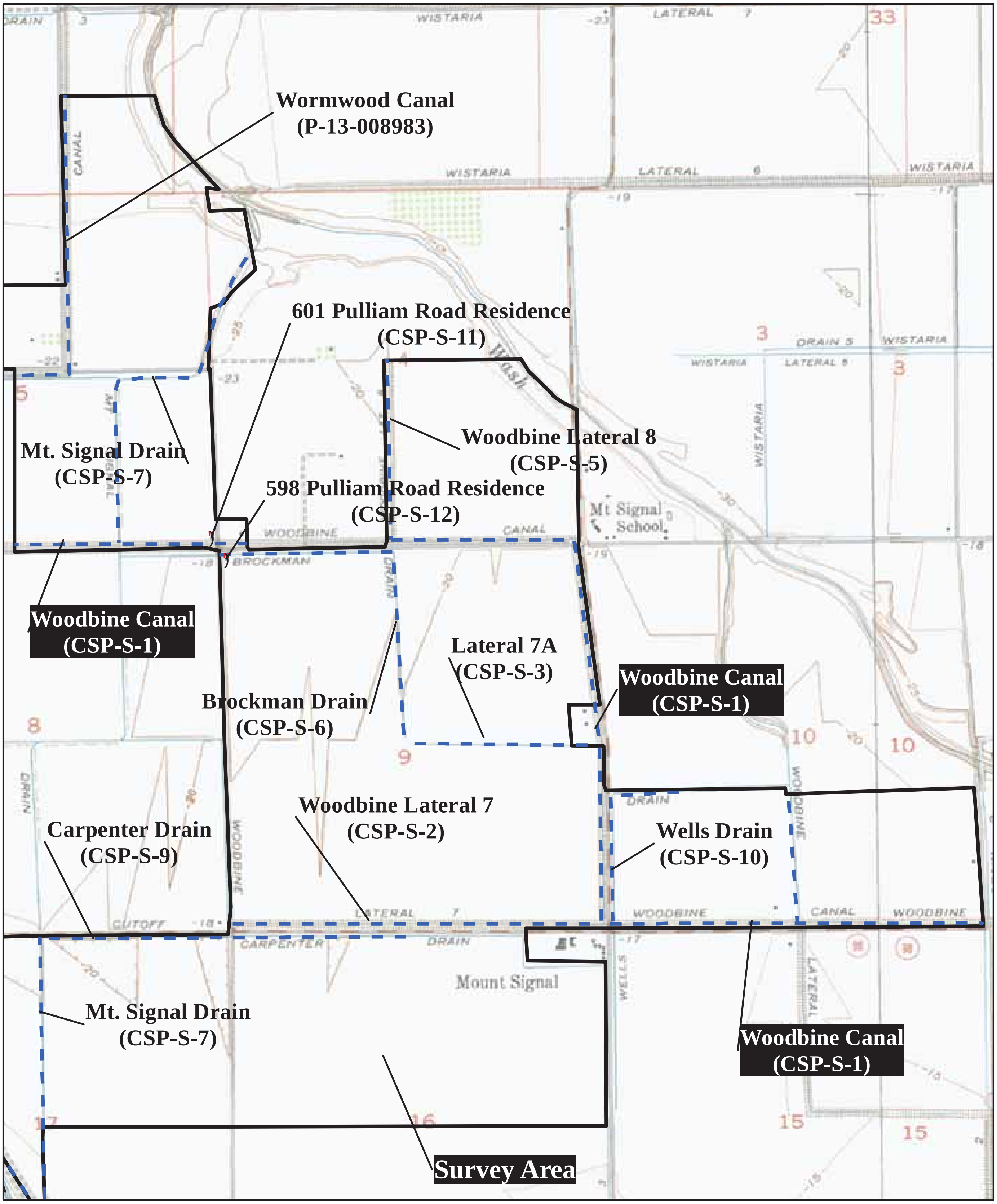
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-013073
Trinomial:

LOCATION MAP

Resource Name or #: CSP-S-1

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-013074
HR #:
Trinomial:
NRHP Status Code:
Other Listings:
Review Code: Reviewer: Date:

 Resource Name or #: CSP-S-2

P1. Other Identifier: Woodbine Lateral 7

P2. **Location**: ■ Not for Publication ☐ Unrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad:** Mt. Signal Date: 1997. T17S; R13E; S edge of Section 9; S.B. BM
c. Address: None
d. UTM: Zone 11; NAD 83; West end: 625996mE/3616590mN; East end: 627617mE/ 3616588mN
e. Other Locational Data. This resource is located south of Interstate 8, southwest of El Centro, just east of Brockman Rd. (Co. Highway S30), and immediately north of State Route (SR) 98, along the southern boundary of parcels APN #052-170-035, -036 & -078, at an elevation of approximately 14 to 16 feet below sea level.

P3a.**Description:** The Woodbine Lateral 7 irrigation canal was recorded during survey of agricultural property (for a proposed solar project). The east-west aligned 1 mi. long lateral, coming off the main Woodbine Canal to the east, is situated on the north side of SR 98 along the southern border of Section 9, between Pulliam Rd. on the west and Brockman Rd. at the east. The canal continues to the north for 0.5 mi. but in the next parcel to the west, outside of the current survey boundary.

This canal system was lined with concrete sometime in the late 1950s/early1960s. There is a "1957" date stamp in the concrete of a flow gate at the northeastern corner of Pulliam Rd. and SR 98; a second gate to the east appears contemporaneous, but is unmarked. A "1979" date stamp is present where the lateral connects to the main Woodbine Canal to the east. The canal is roughly 11.5 ft. across at the top. Depth is unknown since the canal was full of water. The integrity of the canal is good in spite of the earthquake activity that has been occurring in the area.

P3b.**Resource Attributes:** AH6. Water Conveyance

P4. **Resources Present:** ☐ Building ☐ Structure ☐ Object ■ Site ☐ District ☐ Element of District ☐ Other:

P5b. Description of Photo: Easterly view down Woodbine Lateral 7 (SR 98 at right, in distance); 6-21-10; PR-02991-037

P6. **Age and Sources**
■ Historic ☐ Prehistoric ☐ Both

P7. **Owner and Address:**
unknown

P8. **Recorded by**:
Andrew Pigniolo
Laguna Mountain Environmental, Inc.
7969 Engineer Road, Suite 208
San Diego, CA 92111

P9. **Date Recorded:** April 21 & June 21, 2010

P10. **Survey Type**: Intensive Pedestrian

P11. **Report Citation**: 2011 Pigniolo, Andrew, and Pepe Aguilar. *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California*. Prepared for kp environmental, Carlsbad, California.

Attachments: ☐ NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building ☐ Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

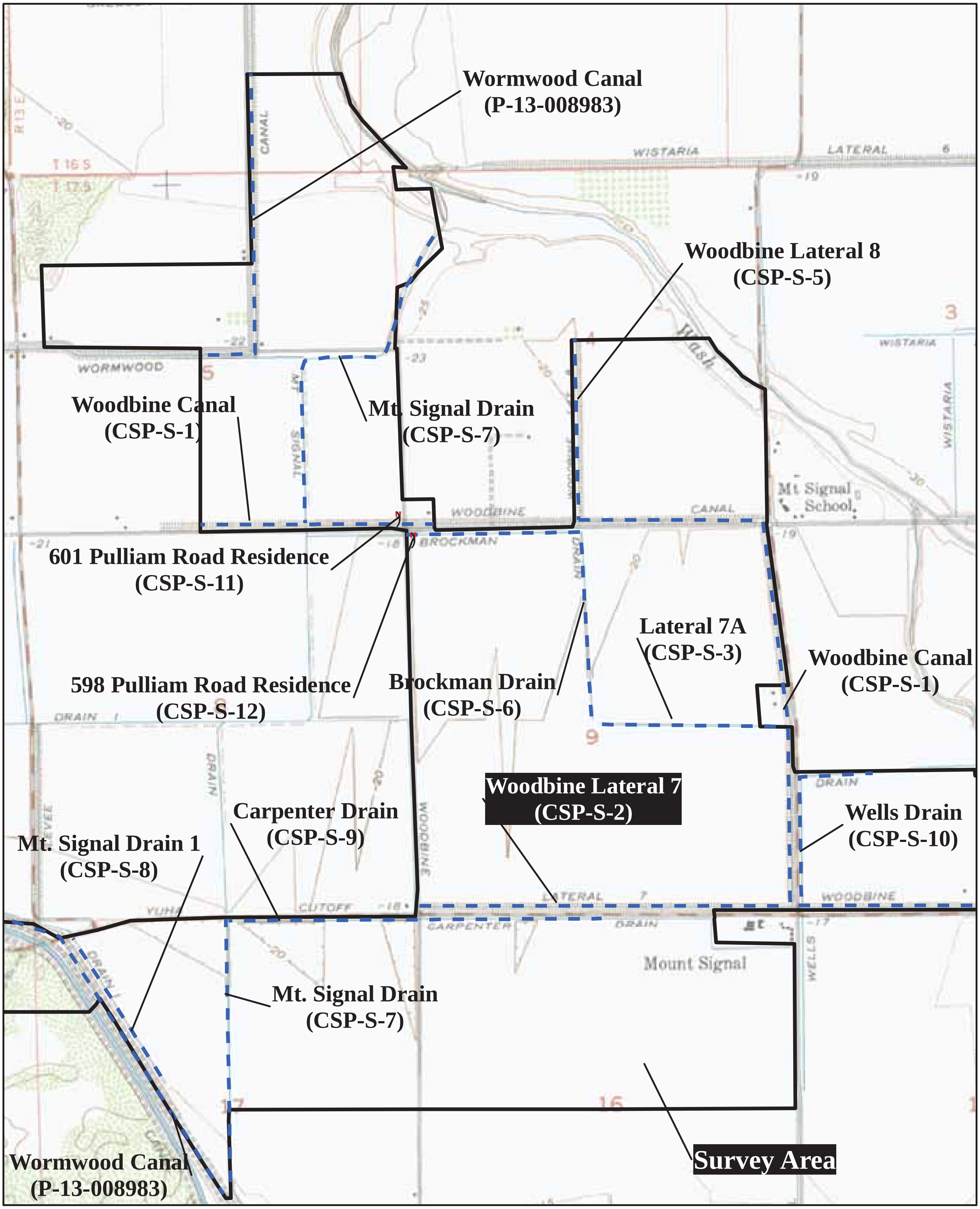
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-013074
Trinomial: ____________________

LOCATION MAP

Resource Name or #: CSP-S-2

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



Required Information is bold

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #: P-13-01307□
HR #:
Trinomial:
NRHP Status Code:
Other Listings:
Review Code: Reviewer: Date:

Page 1 of 2 **Resource Name or #:** CSP-S-3

P1. Other Identifier: □oodbine Lateral 7A

P2. **Location**: ■ Not for Publication ☐ □nrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad:** Mt. Signal Date: 1997. T17S□R13E□E 1□2 of Section 9□S.B. BM
c. Address: None
d. □TM: □one 11□NAD 83□□ est end: 626787mE□361738□mN□East end: 627609mE□361737□mN
e. Other Locational Data. This resource is located south of Interstate 8, southwest of El Centro, south of Kubler Rd., and immediately west of Brockman Rd. (Co. Hwy S30), at an elevation of 16 ft. below sea level.

P3a.**Description:** This appro□imately 2,78□ft. long supplemental canal segment was recorded during survey of agricultural property (for a proposed solar project). This earthen channel e□tends west from the main □oodbine Canal at Brockman Rd., situated on the southern border of parcels APN #0□2-170-077 & -034 and the northern border of parcels APN #0□2-170-078 & -03□. It appears to be occasionally maintained by e□cavation and removal of sediment although it is currently overgrown in some areas. The top of the channel maintains an average width of 10 ft. Just over 0.2□mi. west of Brockman Rd. are two concrete control gates. One of these has a date stamp of "19□4" but the other gate us unmarked. The integrity of the canal is fair.

P3b.**Resource Attributes:** AH6. □ater Conveyance

P4. **Resources Present:** ☐ Building ☐ Structure ☐ Object ■ Site ☐ District ☐ Element of District ☐ Other:

P□b. Description of Photo: □iew of earthen canal and gates, looking northwest□6-21-10□PR-02991-018

P6. **Age and Sources**
■ Historic ☐ Prehistoric ☐ Both

P7. **Owner and Address:**
□nknown

P8. **Recorded by**:
Pepe Aguilar
Laguna Mountain Environmental, Inc.
7969 Engineer Road, Suite 208
San Diego, CA 92111

P9. **Date Recorded:** June 21, 2010

P10. **Survey Type**: Intensive Pedestrian

P11. **Report Citation**: 2011 Pigniolo, Andrew, and Pepe Aguilar. *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California*. Prepared for kp environmental, Carlsbad, California.

Attachments: ☐ NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building ☐ Structure, and Object Record
☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record
☐ Artifact Record ☐ Photograph Record ☐ Other (List):

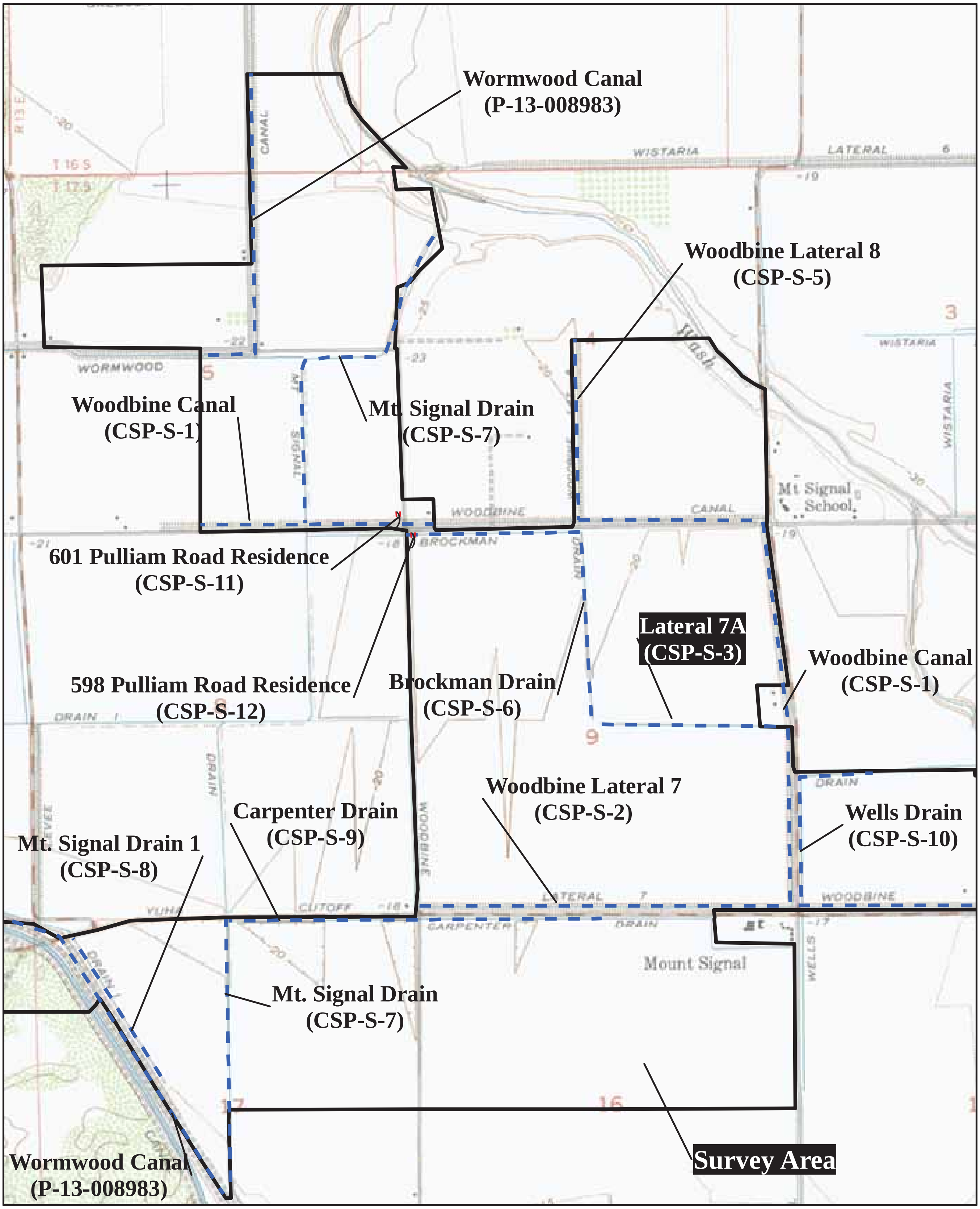
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-013070
Trinomial: ______________________

LOCATION MAP

Resource Name or #: CSP-S-3

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-013078
HR #:
Trinomial:
NRHP Status Code:

Other Listings:
Review Code: Reviewer: Date:

 Resource Name or #: CSP-S-6

P1. Other Identifier: Brockman Drain

P2. **Location**: ■ Not for Publication ☐ □nrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad:** Mt. Signal Date: 1997. T17S□R13E□N□ & middle of Section 9□S.B. BM
c. Address: None
d. □TM: □one 11□NAD 83□□ est end: 62□941mE□3618227mN□East end: 626703mE□3618228mN□APN #0□2-170-076
North end: 62670□mE□3618229mN□South end: 6267□2E□3617409mN□APN #0□2-170-076 & -077
e. Other Locational Data. This resource is located south of Interstate 8, southwest of El Centro, immediately south of Kubler Rd., between Pulliam Rd. and Brockman Rd., at an elevation of appro□imately 17 feet below sea level.

P3a.**Description:** Two segments of the Brockman Drain irrigation drainage channel were recorded during survey of agricultural property (for a proposed solar project). This earthen channel appears to begin in the center of Section 9, at appro□imately -16 ft. in elevation (ground surface), e□tending north for appro□imately 2,740 ft. to -18 ft. where it turns west for appro□imately 2,410 ft. and then goes under Pulliam Rd. and outside of the study area. Based on □S□S and aerial maps (and elevation slant), this drainage channel continues to the west of Pulliam Rd. for appro□imately 1,327 ft., draining into the larger Mt. Signal Drain. The channel appears to be occasionally maintained by e□cavation and removal of sediment although it is currently overgrown in some areas. The top of the channel maintains an average width of 10 ft. Concrete culverts are present at road undercrossings (and where the channel changes directions). None of the concrete gates have a date stamp, so construction period is uncertain. The integrity of the drain is fair.

P3b.**Resource Attributes:** AH6. □ ater Conveyance

P4. **Resources Present:** ☐ Building ☐ Structure ☐ Object ■ Site ☐ District □ Element of District ☐ Other:

P□b. Description of Photo: No photo

P6. **Age and Sources**
■ Historic ☐ Prehistoric ☐ Both

P7. **Owner and Address:**
□nknown

P8. **Recorded by**:
Pepe Aguilar
Laguna Mountain Environmental, Inc.
7969 Engineer Road, Suite 208
San Diego, CA 92111

P9. **Date Recorded:** August 2□, 2010

P10. **Survey Type**: Intensive Pedestrian

P11. **Report Citation**: 2011 Pigniolo, Andrew, and Pepe Aguilar. *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California*. Prepared for kp environmental, Carlsbad, California.

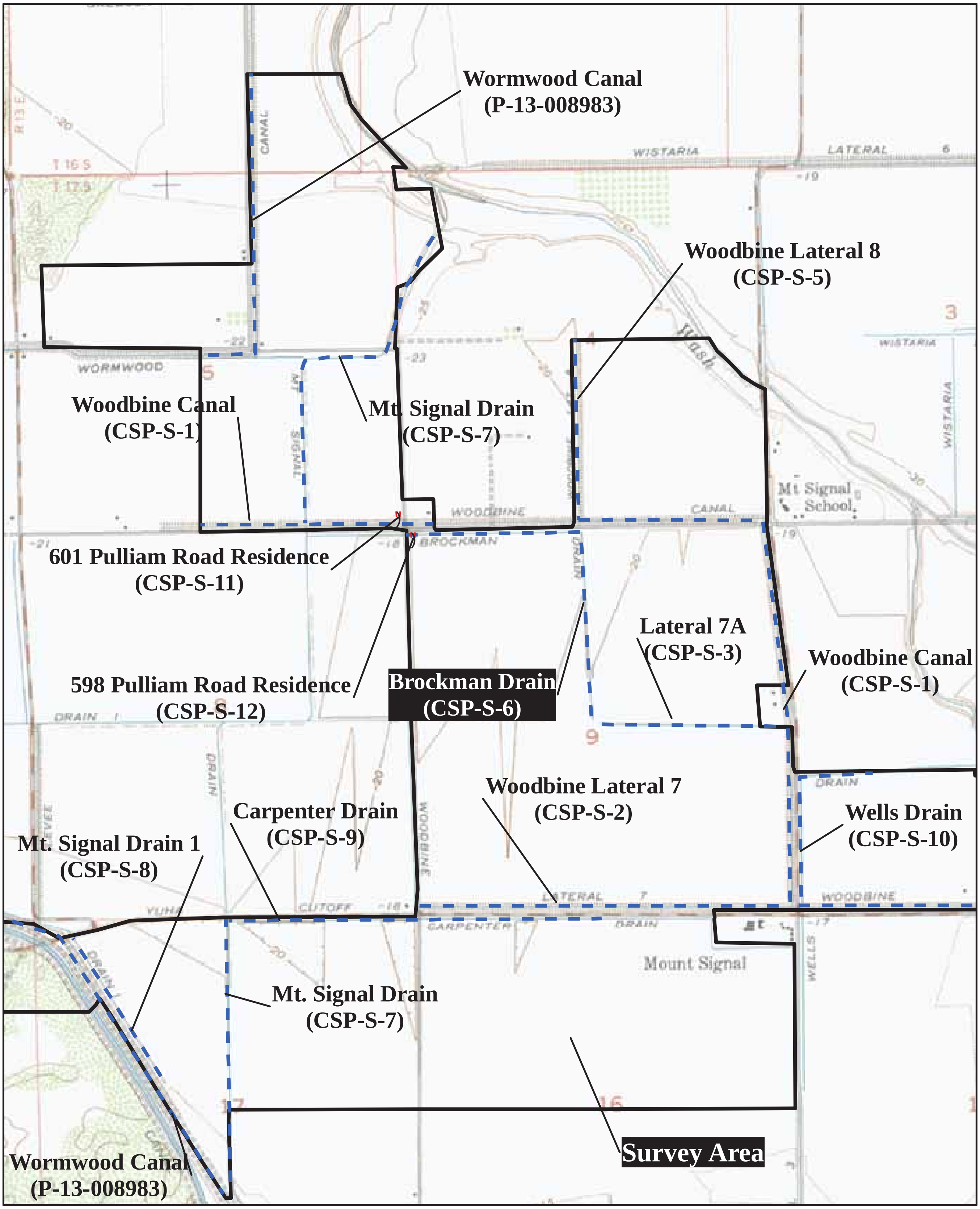
Attachments: ☐ NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building ☐ Structure, and Object Record
☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record
☐ Artifact Record ☐ Photograph Record ☐ Other (List):

Primary #: P-13-013078
Trinomial:

LOCATION MAP

Resource Name or #: CSP-S-6

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #: P-13-013079
HR #:
Trinomial:
NRHP Status Code:
Other Listings:
Review Code: Reviewer: Date:

 Resource Name or #: CSP-S-7

P1. Other Identifier: Mt. Signal Drain

P2. **Location**: ■ Not for Publication ☐ □nrestricted **a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
b. **USGS 7.5' Quad:** Mt. Signal Date: 1997. T17S□R13E□N□ □ of Sec. 4□SE □ of Sec. □□N □ (mid) of Sec. 17S.B. BM
c. Address: None
d. □TM: □one 11□NAD 83□S□ end: 62□8□4mE□361903□mN□NE end: 626089mE□3619□6□mN□APN #0□2-170-0□2
(middle section) □ est end: 62□494mE□3618981mN□East end: 62□824mE□3618999mN□APN #0□2-170-018
North end: 62□488mE□3618973mN□South end: 62□494E□3618270mN□APN #0□2-170-090 & -018
Southern portion: North end: 62□149mE□3616□29mN□South end: 62□168E□361□3□9mN□APN #0□2-190-007
e. Other Locational Data. This resource is located south of Interstate 8, southwest of El Centro. The northern portion is situated about 0.6 mi. south of Lyons Rd. and east of □ ormwood Rd., and continues south of Fisher Rd. ending at Kubler Rd. and varies in elevation of appro□imately 17 to 26 ft. below sea level. The southern portion e□tends south from St. Route (SR) 98 for 0.7□ mi. to Mandrapa Rd. This segment varies in elevation (north to south) of appro□imately 17 to 7 ft. below sea level.

P3a. **Description:** The Mt. Signal Drain is shown on the □S□S □uad. map to meander for nearly 4 mi. beginning south of SR 98 (at -6 ft. elev.) and emptying into □reeson □ ash about 0.6 mi. south of Lyons Rd.(at -4□ ft. elev.). Only two portions of this earthen irrigation drainage channel occur within the current survey area of agricultural property (for a proposed solar project). The **northern portion** has a northeasterly aligned 2,□00 ft. segment, starting at Fisher Rd. on the border between sections 4 & □ (along the eastern boundary of parcel 0□2-170-0□2) that is nearly 6□ ft. across -- from bank to bank. An east-west segment just south of Fisher Rd. (immediately west of Pulliam Rd.) is appro□imately 1,190 ft. long and varies from 60-7□ ft. across. The channel turns south at the boundary between parcels 0□2-170-019 & 0□2-170-018 where it narrows to about □□ ft. across. This segment e□tends appro□imately 2,390 ft. north□south (within the project area) to Kubler Rd. The drain continues to the south outside the project APE. The **southern portion** within the APE begins south of SR 98 (between Drew and Pulliam roads) and e□tends along the east side of parcel #0□2-190-007 to its southern end. Here (outside the APE) the channel turns southeast before heading eastward. No historic-age features were observed within these portions of the drain, but it is part of the larger historic-age agricultural system. The drain appears to retain good integrity and is probably maintained by regular clearing with a backhoe.

P3b. **Resource Attributes:** AH6. □ ater Conveyance
P4. **Resources Present:** ☐ Building ☐ Structure ☐ Object ■ Site ☐ District ☐ Element of District ☐ Other:

P□b. Description of Photo: □iew of Mt. Signal Drain (south portion) channel looking south from SR 98□12-9-10□PR-03129-028

P6. **Age and Sources**
■ Historic ☐ Prehistoric ☐ Both

P7. **Owner and Address:**
□nknown

P8. **Recorded by**:
Andrew Pigniolo
Laguna Mountain Environmental, Inc.
7969 Engineer Road, Suite 208
San Diego, CA 92111

P9. **Date Recorded:** July 9 & Dec. 9, 2010

P10. **Survey Type**: Intensive Pedestrian

P11. **Report Citation**: 2011 Pigniolo, Andrew, and Pepe Aguilar. *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California*. Prepared for kp environmental, Carlsbad, California.

Attachments: ☐ NONE ■ Location Map ☐ Sketch Map ☐ Continuation Sheet ☐ Building ☐ Structure, and Object Record ☐ Archaeological Record ☐ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record ☐ Artifact Record ☐ Photograph Record ☐ Other (List):

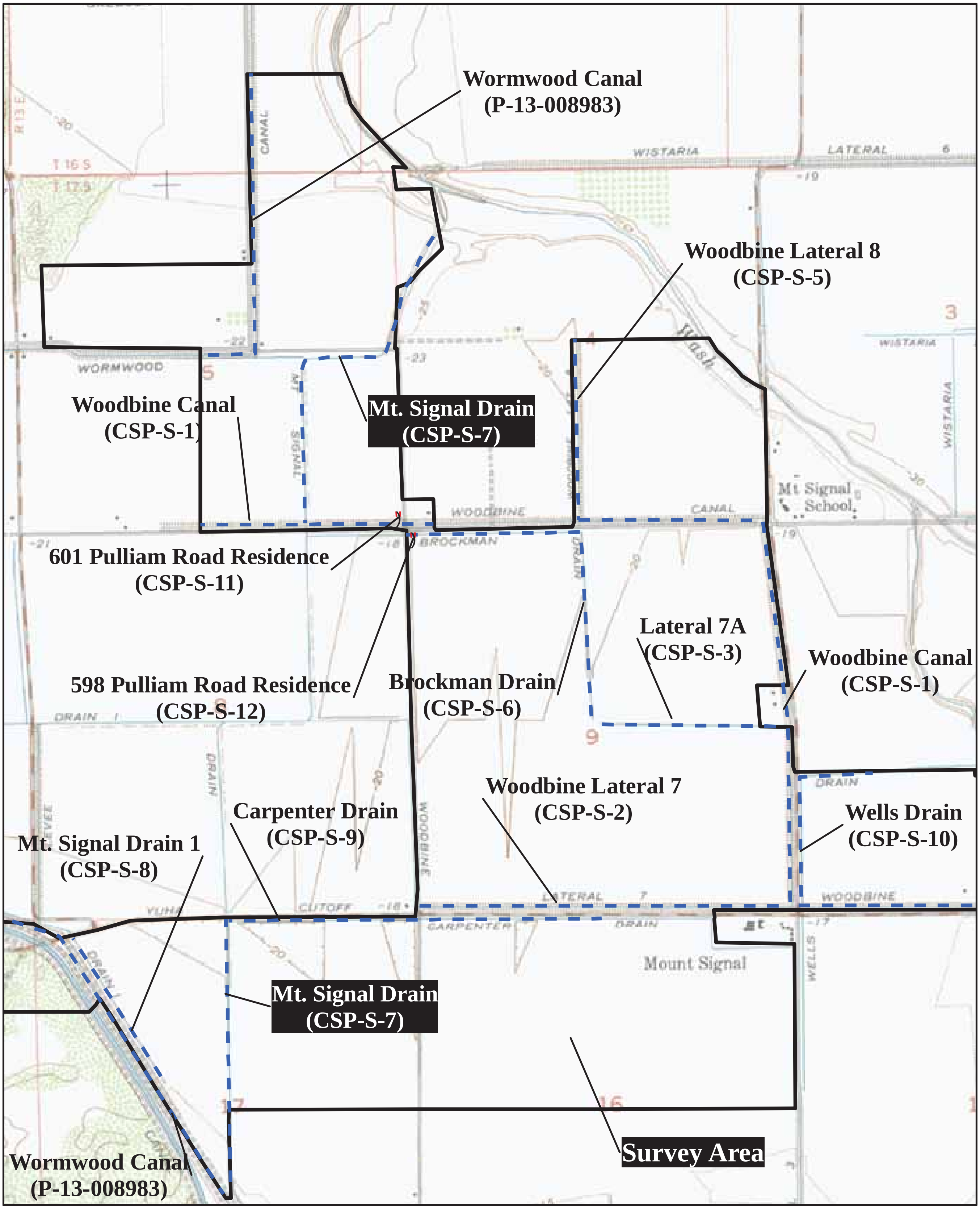
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-013079
Trinomial:

LOCATION MAP

Resource Name or #: CSP-S-7

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



P-13-0130 1

PRIMARY RECORD

P 1 **Resource Name or #:** P- -9

P1

P **Location** a. **County:**

USGS 7.5' Quad: 1997 17 13 1 17

11 3 1 3 3 1 7 7 3 1 33

0

0 9

0 -190-00 0 -190-009 1

P3 **Description:**

- 1

- -

- 19 0

P3 **Resource Attributes:**

P **Resources Present:**

P P P 1 -0 - 010 P -031 9-0

P **Age and Sources**

P7 **Owner and Address:**

P **Recorded by**

79 9 0

9 111

P9 **Date Recorded:** 010

P10 **Survey Type** P

P11 **Report Citation** 011 P P *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California* P

Attachments:

P

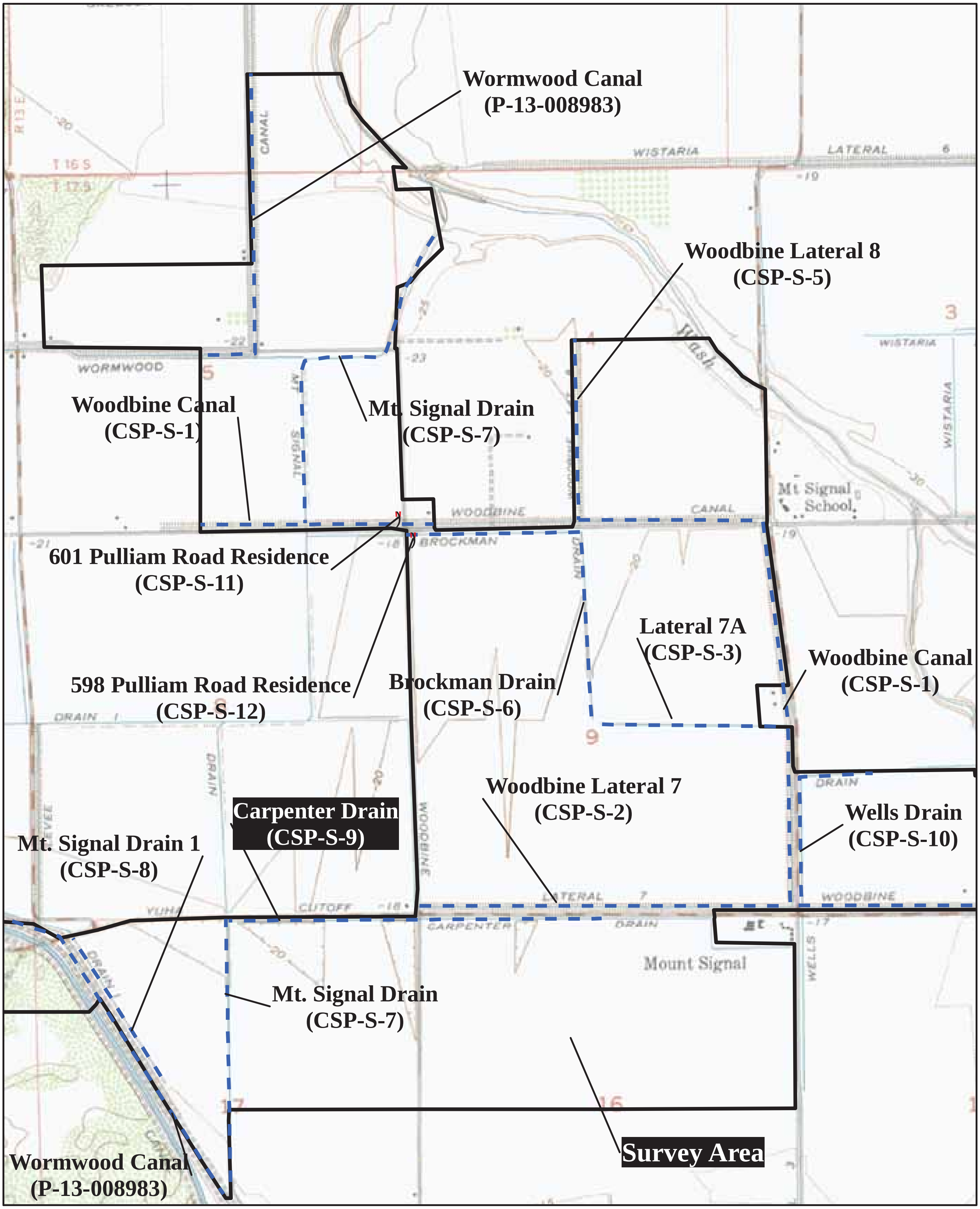
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-0130□1
Trinomial: ______________________

LOCATION MAP

Resource Name or #: CSP-S-9

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



 Required Information is bold

P-13-0130 3

PRIMARY RECORD

P 1 **Resource Name or #:** P- -11

P1

P **Location** ■ P ☐ **a. County:**

P P P

USGS 7.5' Quad: 1997 17 13

01 P 9 31

11 3 90 3 1 90

P 0 -170-01 17

P3 **Description:** 01 P 191 19 0 - 70 1 0 - - 130

P3 **Resource Attributes:** P

P **Resources Present:** ☐ ☐ ☐ ■ ☐ ☐

P P 1 00

P **Age and Sources**

■ ☐ P ☐

P7 **Owner and Address:**

P **Recorded by**

P

79 9 0

9 111

P9 **Date Recorded:** 9 010

P10 **Survey Type** P

P11 **Report Citation** 011 P P *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California* P

Attachments: ☐ ■ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ P ☐

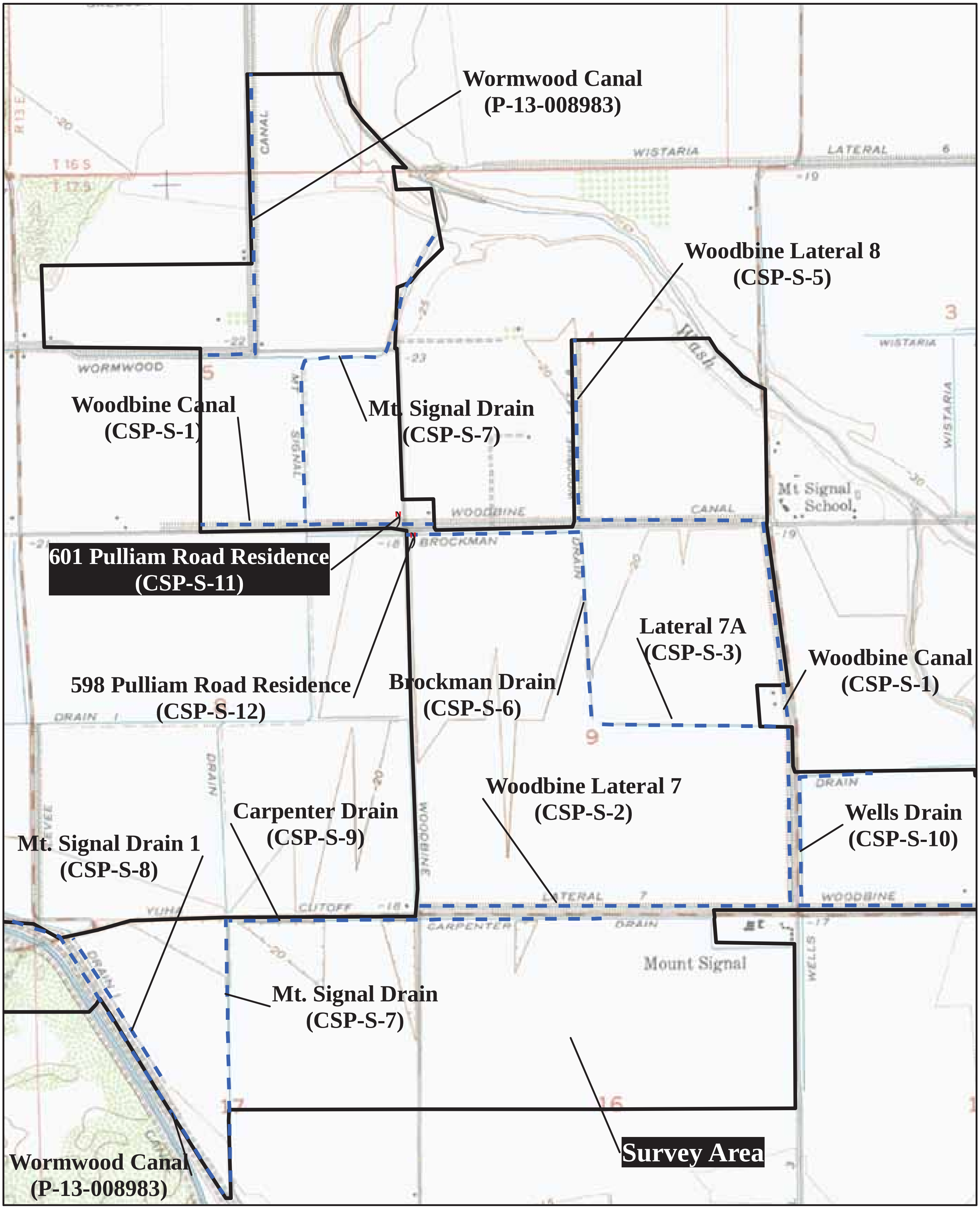
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-0130□3
Trinomial:

LOCATION MAP

Resource Name or #: CSP-S-11

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



 Required Information is bold

PRIMARY RECORD

P 1 **Resource Name or #:** P- -1

P1

P **Location** ■ P ☐ **a. County:**

P P P

USGS 7.5' Quad: 1997 17 13 9

9 P 9 31

11 3 9 9 3 1 199

P 0 -170-019 17

P3 **Description:** 9 P 191 P 70 - 19 0 - - - 130

P3 **Resource Attributes:** P

P **Resources Present:** ☐ ☐ ☐ ■ ☐ ☐ ☐

P P 7 9 10 P -03011-01

P **Age and Sources**
■ ☐ P ☐

P7 **Owner and Address:**

P **Recorded by**
P
79 9 0
9 111

P9 **Date Recorded:** 9 010

P10 **Survey Type** P

P11 **Report Citation** 011 P P *Cultural Resource Survey for a Portion of the Centinela Solar Project Area, Imperial County, California* P

Attachments: ☐ ■ ☐ ☐ ☐ ☐
☐ ☐ ☐ ☐ ☐
☐ ☐ P ☐

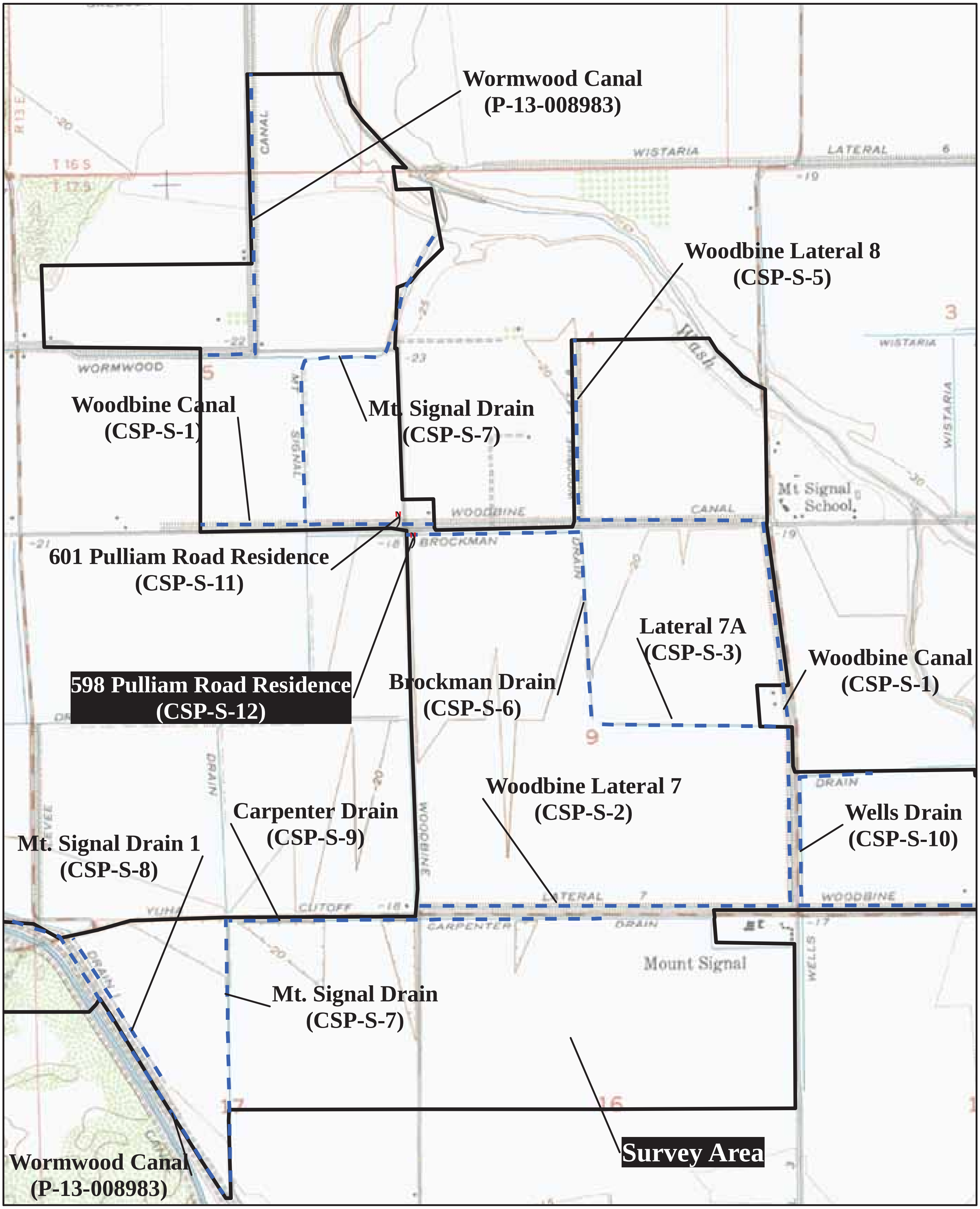
State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary #: P-13-0130
Trinomial:

LOCATION MAP

Resource Name or #: CSP-S-12

Map Name: USGS Mount Signal Quadrangle **Scale: 1:24,000** **Date of Map: 1957/1976**



DPR 5231 (1/95) **Required Information is bold**

State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **PRIMARY RECORD**	Primary # HRI # Trinomial NRHP Status Code	P-13-013837 CA-IMP-11784
Other Listings Review Code	Reviewer	Date

Page 1 **of** 4 *__Resource Name or #:__ ESA-CAL-1

P1. Other Identifier:

***P2. Location:** ☒ **Not for Publication** ☐ **Unrestricted** ***a. County:** Imperial

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad:** Mount Signal **Date:** 1957 **T** 17S; **R** 13E ; SW **¼ of** SE **¼ of Sec** 16**;** S.B.**B.M.**

c. Address: City: Zip:

d. UTM: Zone: 11S; 626834 mE/ 3615229 mN (G.P.S.)

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation: -15 ft

From Calexico, drive 8.64 miles west on Highway 98. Turn south on an unnamed dirt road and continue for .75 miles. The site is 960 feet north of Anza Road and 0.5 miles west of Brockman Road.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

This is a sparse historic artifact scatter, measuring 200 feet north-south by 23 feet east-west, located within an elevated roadbed between a concrete-lined irrigation canal and an agricultural field. Over 100 artifacts were recorded including glass fragments, whiteware fragements, and one whole glass jar.

***P3b. Resource Attributes:** (List attributes and codes) AH4

***P4. Resources Present:** ☐Building ☐Structure ☐Object ☒Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)

P5b. Description of Photo: (View, date, accession #) IMG_079, 10/ 12/ 11, facing south

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both

***P7. Owner and Address:**
Unknown

***P8. Recorded by:** (Name, affiliation, and address)
M. Bray
ESA
626 Wilshire Blvd. Ste 1100
Los Angeles, CA 90017

***P9. Date Recorded:** 10/ 12/ 11

***P10. Survey Type:** (Describe)
Intensive pedestrian

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") ESA, *Calexico Solar and Mount Signal Solar Farms, Calexico, Imperial County: Phase I Archaeological Survey Report*, prepared for 8minutenergy Renewables, LLC, 2011.

***Attachments:** ☐NONE ☒Location Map ☒Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☒Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

***Resource Name or #:** ESA-CAL-1

***A1. Dimensions: a. Length:** 200 feet **(N/S) × b. Width:** 23 feet **(E/W)**

Method of Measurement: ☐ Paced ☐ Taped ☐ Visual estimate ■ Other: GPS

Method of Determination (Check any that apply.): ■ Artifacts ☐ Features ☐ Soil ☐ Vegetation ☐ Topography ☐ Cut bank ☐ Animal burrow ☐ Excavation ☐ Property boundary ☐ Other (Explain):

Reliability of Determination: ☐ High ■ Medium ☐ Low Explain:

Limitations (Check any that apply): ☐ Restricted access ☐ Paved/built over ☐ Site limits incompletely defined ☐ Disturbances ☐ Vegetation ☐ Other (Explain):

A2. Depth: ☐ None ■ Unknown Method of Determination:

***A3. Human Remains:** ☐ Present ■ Absent ☐ Possible ☐ Unknown (Explain):

***A4. Features** (Number, briefly describe, indicate size, list associated cultural constituents, and show location of each feature on sketch map.):
None

***A5. Cultural Constituents (**Describe and quantify artifacts, ecofacts, cultural residues, etc., not associated with features.):
One small complete glass jar, colorless with an iridescent patina, measuring 4x1.5 in. The bottle is machine made and has a bead neck finish. There is an embossed maker's mark on the base, but it is not legible.
75+ fragments of colorless glass
4 fragments of opaque white glass with an embossed floral design
One colorless glass milk bottle rim
12 fragments amethyst-colored solarized glass
8 fragments aqua glass
1 fragment green glass
2 fragements brown glass
One colorless glass bottle neck fragment, with a double ring finish.
5 fragments white-glazed whiteware ceramic
Unglazed orange ceramic fragments
One large white-glazed whiteware rim sherd
Glass base with the makers mark "333" within a diamond
Large colorless glass base with the maker's mark "Bishop's California"

***A6. Were Specimens Collected?** ■ No ☐ Yes (If yes, attach Artifact Record or catalog and identify where specimens are curated.)

***A7. Site Condition:** ☐ Good ■ Fair ☐ Poor (Describe disturbances.): Site is located within a dirt access road, which appears to be frequently used by vehicles and agricultural machinery. The road is elevated several feet above the surrounding fields, and it is likely that the artifacts are in a disturbed context and were possibly imported to this location when the road was constructed.

***A8. Nearest Water** (Type, distance, and direction.)**:** New River, 21,800 feet NE; numerous 20th century agricultural canals nearby.

***A9. Elevation:** -15 feet

A10. Environmental Setting (Describe culturally relevant variables such as vegetation, fauna, soils, geology, landform, slope, aspect, exposure, etc.)**:** Disturbed dirt road between canal and agricultural field. Slope is flat, exposure is open.

A11. Historical Information: the maker's mark "Bishop's California" may refer to Bishop & Co., a food manufacturer based in Los Angeles that operated from 1887 to 1930, when it was acquired by Nabisco (Los Angeles Downtown News, 12/22/2008). Bishop sold products such as "Bishop's California Preserves". The maker's mark "333" within a diamond is likely an Illinois Glass Co. mark, dating between 1900-1929 (Lockhart et al. 2005, Lockhart and Whitten 2006).

***A12. Age:** ☐ Prehistoric ☐ Protohistoric ☐ 1542-1769 ☐ 1769-1848 ☐ 1848-1880 ☐ 1880-1914 ■ 1914-1945 ☐ Post 1945 ☐ Undetermined **Describe position in regional prehistoric chronology or factual historic dates if known:**

A13. Interpretations (Discuss data potential, function[s], ethnic affiliation, and other interpretations):

A14. Remarks:

A15. References (Documents, informants, maps, and other references):
Los Angeles Downtown News, "Rise and Fall of a Candy Empire", December 22, 2008. http://www.ladowntownnews.com/news/the-rise-and-fall-of-a-candy-empire/article_2fa83e47-536b-58ae-9edd-011022651f95.html, accessed Oct 20, 2011.

Lockhart, Bill, Bill Lindsay, David Whitten, Carol Serr, *The Dating Game: The Illinois Glass Company,* Bottles and Extras 16(1):54-60 Winter 2005.

Lockhart, Bill, Bill David Whitten, The Dating Game, Bottles and Extras 17(1):36-43 Winter 2006. http://www.sha.org/bottle/pdffiles/BLockhart_FHGW.pdf

A16. Photographs (List subjects, direction of view, and accession numbers or attach a Photograph Record.):
Original Media/Negatives Kept at:

***A17. Form Prepared by:** Madeleine Bray **Date:** 10/20/11

Affiliation and Address: ESA, 626 Wilshire Blvd. Ste. 1100, Los Angeles, CA 90017

State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LOCATION MAP

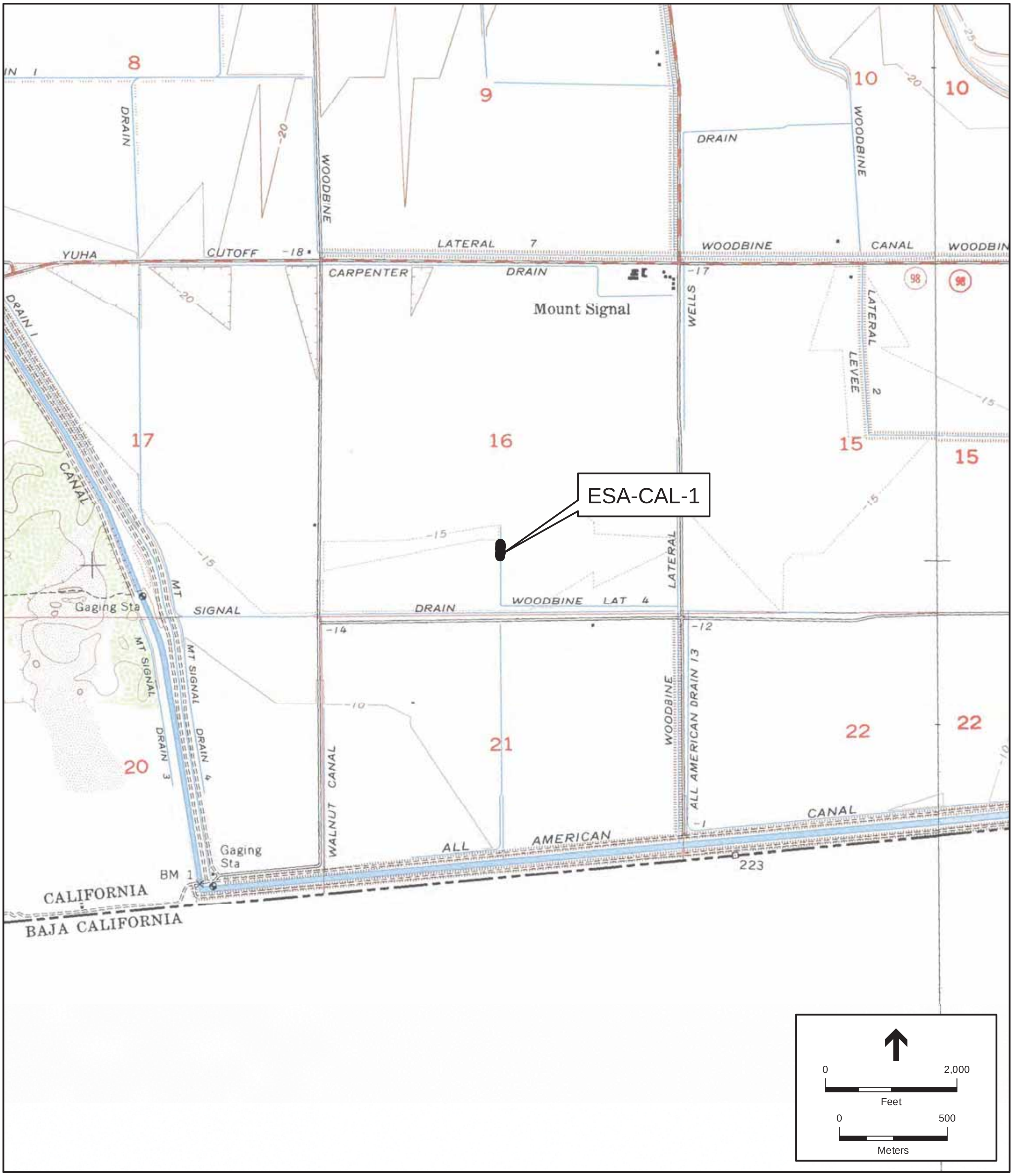
Primary #
HRI #
Trinomial

P-13-013837
CA-IMP-11784

* Resource Name or Number: ESA-CAL-1

*Map name: Mount Signal (1957)

*Scale: 1:24000

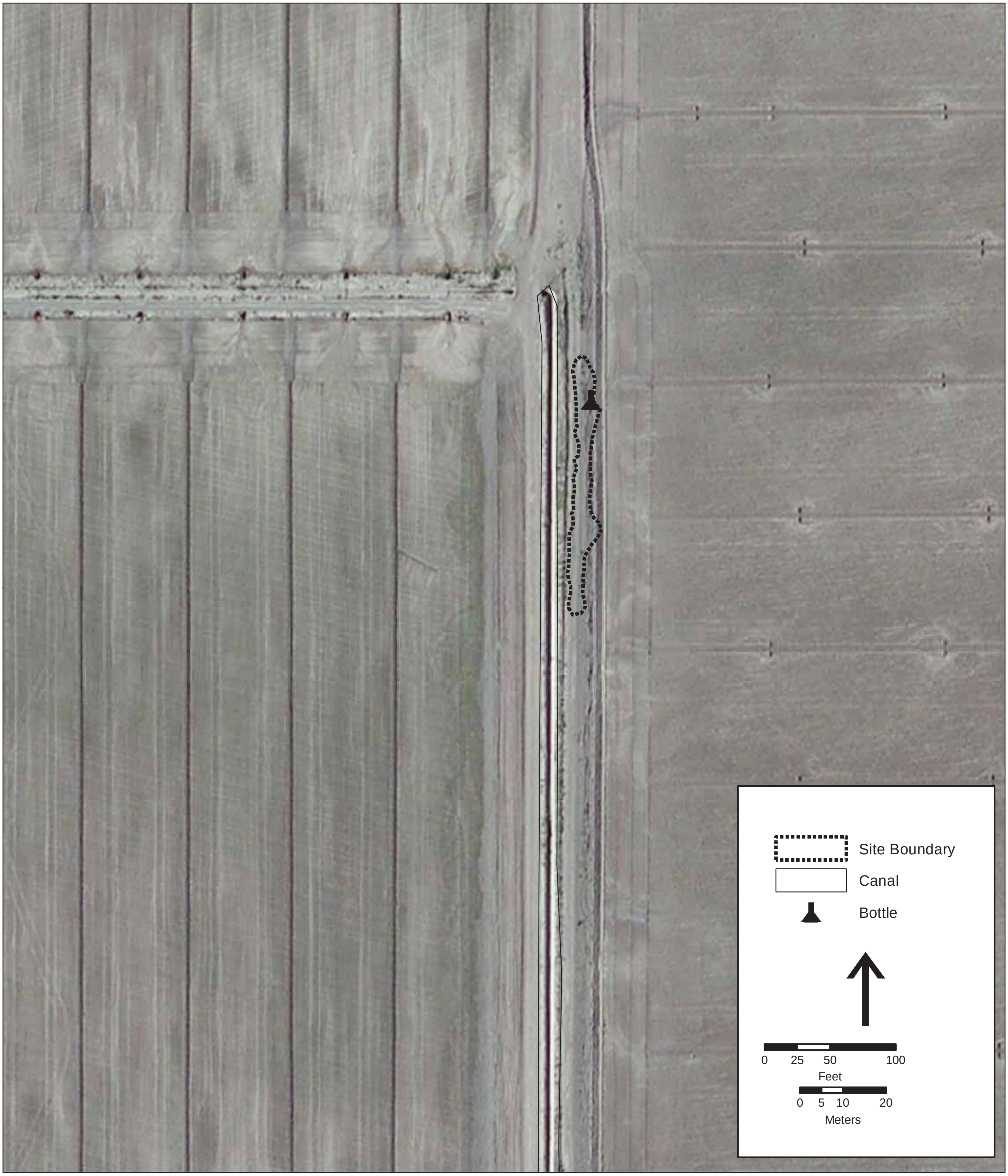


* Required Information

State of California- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
SKETCH MAP

Primary #
HRI #
P-13-013837
Trinomial: CA-IMP-11784

 * Resource Name or Number: ESA-CAL-1



*Drawn By: B. Marks

*Date: 10/20/11

* Required Information

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # P-13-013843
HRI # CA-IMP-11788
Trinomial
NRHP Status Code

Other Listings
Review Code   Reviewer   Date

*Resource Name or #: TS 2

P1. Other Identifier:
***P2. Location:** ☒ **Not for Publication** ☐ **Unrestricted** ***a. County:** Imperial
and (P2b and P2c or P2d. Attach a Location Map as necessary.)
*b. USGS 7.5' Quad: Mt Signal; Date: 1957 (1976) T 17S; R 12E; NE¼ **of** NE¼ **of** Sec 13; M.D. San Bernardino B.M.
c. Address: City: Zip:
d. UTM: Zone: 11 ; (NW) 622272 mE/ 3616133 mN; (NE) 622292 mE/ 3616133 mN; (SW) 622285 mE/ 3616086 mN; (SE) 622311 mE/ 3616098 mN; (G.P.S.) NAD 83

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation: AMSL
The site is located in the West Mesa area of the Yuha Desert in Imperial Valley. It is approximately 3 ½ miles west of the community of Mt. Signal. The site can be reached via Hwy 98. Coming from El Centro on the I-8, take Drew Road south to Hwy 98. Take Hwy 98 west for approximately one mile and turn left on to Mount Signal Road (dirt road). Go ¼ mile south to a Border Patrol dirt access road on the west side of the road and turn right. Go ¼ mile. The site is immediately north of the dirt access road.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)
The site consists of eight lithic artifacts. The artifacts included three cores, one with an associated flake (one black volcanic and two green porphyritic volcanic); two primary flakes (green porphyritic volcanic); a flake scraper (green porphyritic volcanic); a secondary flake (green porphyritic volcanic); and a piece of debitage (black porphyritic volcanic).

***P3b. Resource Attributes:** (List attributes and codes) AP2 (Lithic Scatter)
***P4. Resources Present:** ☐Building ☐Structure ☐Object ☒Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5b. Description of Photo: (View, date, accession #)
View to N, 01/26/2012, CSE 012612 009
***P6. Date Constructed/Age and Sources:**
☐Historic ☒Prehistoric ☐Both

***P7. Owner and Address:**
BLM El Centro Field Office
1661 South 4th St.
El Centro CA 92243

***P8. Recorded by:** (Name, affiliation, and address)
Patricia Mitchell, Heather Thomson, Erica Maier
kp environmental, LLC
2387 Montgomery Ave
Cardiff By The Sea, CA 92007
Frank Brown, Viejas Band of Kumeyaay Indians
***P9. Date Recorded:** 01/26/2012
***P10. Survey Type:** Limited test excavation

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.")
Mitchell, Patricia T. 2012. Testing Letter Report for the Centinela Solar Energy Gen-tie Line Project, Imperial County, California.

***Attachments:** ☐NONE ☒Location Map ☒Sketch Map ☐Continuation Sheet ☐Building, Structure, and Object Record ☒Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☒Photograph Record ☐ Other (List):

***A1. Dimensions: a. Length:** 50 **(**N-S**)** × **b. Width:** 26 **(E-W)**

Method of Measurement: ☐Paced ☐ Taped ☐ Visual estimate ☒ Other: GPS (Trimble)

Method of Determination (Check any that apply.): ☒ Artifacts ☐ Features ☐ Soil ☐ Vegetation ☐ Topography ☐ Cut bank ☐ Animal burrow ☐ Excavation ☐ Property boundary ☒ Other (Explain): Border Patrol dirt road through south end of the site.

Reliability of Determination: ☐ High ☒ Medium ☐ Low Explain: Erosional processes may expose additional artifacts in the future.

Limitations (Check any that apply): ☐ Restricted access ☐ Paved/built over ☐ Site limits incompletely defined ☒ Disturbances ☐ Vegetation ☐ Other (Explain): Border Patrol dirt road through south end of the site.

A2. Depth: ☐ None ☒ Unknown Method of Determination:

***A3. Human Remains:** ☐ Present ☐ Absent ☐ Possible ☒ Unknown (Explain): No human remains observed.

***A4. Features** (Number, briefly describe, indicate size, list associated cultural constituents, and show location of each feature on sketch map.): None observed.

***A5. Cultural Constituents (**Describe and quantify artifacts, ecofacts, cultural residues, etc., not associated with features.): The TS 2 artifacts found on the surface included three cores, one with an associated flake (one black volcanic and two green porphyritic volcanic); two primary flakes (green porphyritic volcanic); a flake scraper (green porphyritic volcanic); a secondary flake (green porphyritic volcanic); and a piece of debitage (black porphyritic volcanic). No artifacts were were recovered from nearby shovel test pit 6 between the 0-30 cm levels.

***A6. Were Specimens Collected?** ☒ No ☐ Yes (If yes, attach Artifact Record or catalog and identify where specimens are curated.)

***A7. Site Condition:** ☐ Good ☒ Fair ☐ Poor (Describe disturbances.): Adjacent to Border Patrol dirt road and road cuts through south end of the site.

***A8. Nearest Water** (Type, distance, and direction.)**:** Pinto Wash, approximately two miles west.

***A9. Elevation:** 8'

A10. Environmental Setting (Describe culturally relevant variables such as vegetation, fauna, soils, geology, landform, slope, aspect, exposure, etc.)**:** The site is situated below the shoreline of ancient Lake Cahuilla. Soils in the area are typically composed of lacustrine silt and sands. Wind and water erosion often exposes underlying alluvial gravel and clay surface that has been carried into the area via the Colorado River, and over time becomes desert pavement. The topography is relatively flat and is crossed by several washes. Vegetation in the vicinity consists of creosote scrub brush community.

A11. Historical Information:

***A12. Age:** ☒ Prehistoric ☐ Protohistoric ☐ 1542-1769 ☐ 1769-1848 ☐ 1848-1880 ☐ 1880-1914 ☐ 1914-1945 ☐ Post 1945 ☐ Undetermined **Describe position in regional prehistoric chronology or factual historic dates if known:**

A13. Interpretations (Discuss data potential, function[s], ethnic affiliation, and other interpretations): Pending formal evaluation, and in order to minimize damage from evaluation efforts, KPE recommends that site TS 2 be treated as eligible for listing in the National Register under Criterion D.

A14. Remarks:

A15. References (Documents, informants, maps, and other references):

A16. Photographs (List subjects, direction of view, and accession numbers or attach a Photograph Record.): Attached.
Original Media/Negatives Kept at: kp environmental, LLC, 2387 Montgomery Ave. Cardiff By The Sea, CA 92007

***A17. Form Prepared by: Patricia Mitchell** **Date:** 01/26/2012
Affiliation and Address: kp environmental, LLC, 2387 Montgomery Ave. Cardiff By The Sea, CA 92007

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PHOTOGRAPH RECORD

Primary # P-13-013843
HRI# CA-IMP-11788
Trinomial

Page 3 **of** 5 **Resource Name or #: TS 2** **Year** 2012

Camera Format: Sony Cyber-shot Digital Camera & Canon PowerShot SD1300 IS Digital ELph 12.1 megapixels
Negatives Kept at: kp environmental, LLC. 2387 Montgomery Ave. Cardiff By The Sea, CA 92007

Mo.	Day		Frame	subject/description	VIEW
1	4	CSE 010412	016	TS 2 core and flake	D
1	4	CSE 010412	017	TS 2 core and flake	D
1	4	CSE 010412	018	TS 2 flake scraper	D
1	4	CSE 010412	019	TS 2 flake scraper	D
1	4	CSE 010412	020	TS 2 flake scraper (edge)	D
1	4	CSE 010412	021	TS 2 flake scraper (edge)	D
1	4	CSE 010412	022	TS 2 core	D
1	4	CSE 010412	023	TS 2 core	D
1	26		3472	TS 2 primary flake	D
1	26		3473	TS 2 core	D
1	26		3474	TS 2 debitage	D
1	26		3475	TS 2 debitage	D
1	26		3476	TS 2 primary flake	D
1	26		3477	TS 2 primary flake	D
1	26		3478	TS 2 secondary flake	D
1	26		3479	TS 2 secondary flake	D
1	26		3480	TS 2 secondary flake	D

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
SKETCH MAP

Primary # P-13-013843
HRI# CA-IMP-11788
Trinomial

Page **4** of **5**
Drawn by: **Trish Mitchell**

*Resource Name or #: **TS 2**
Date: **01/26/2012**

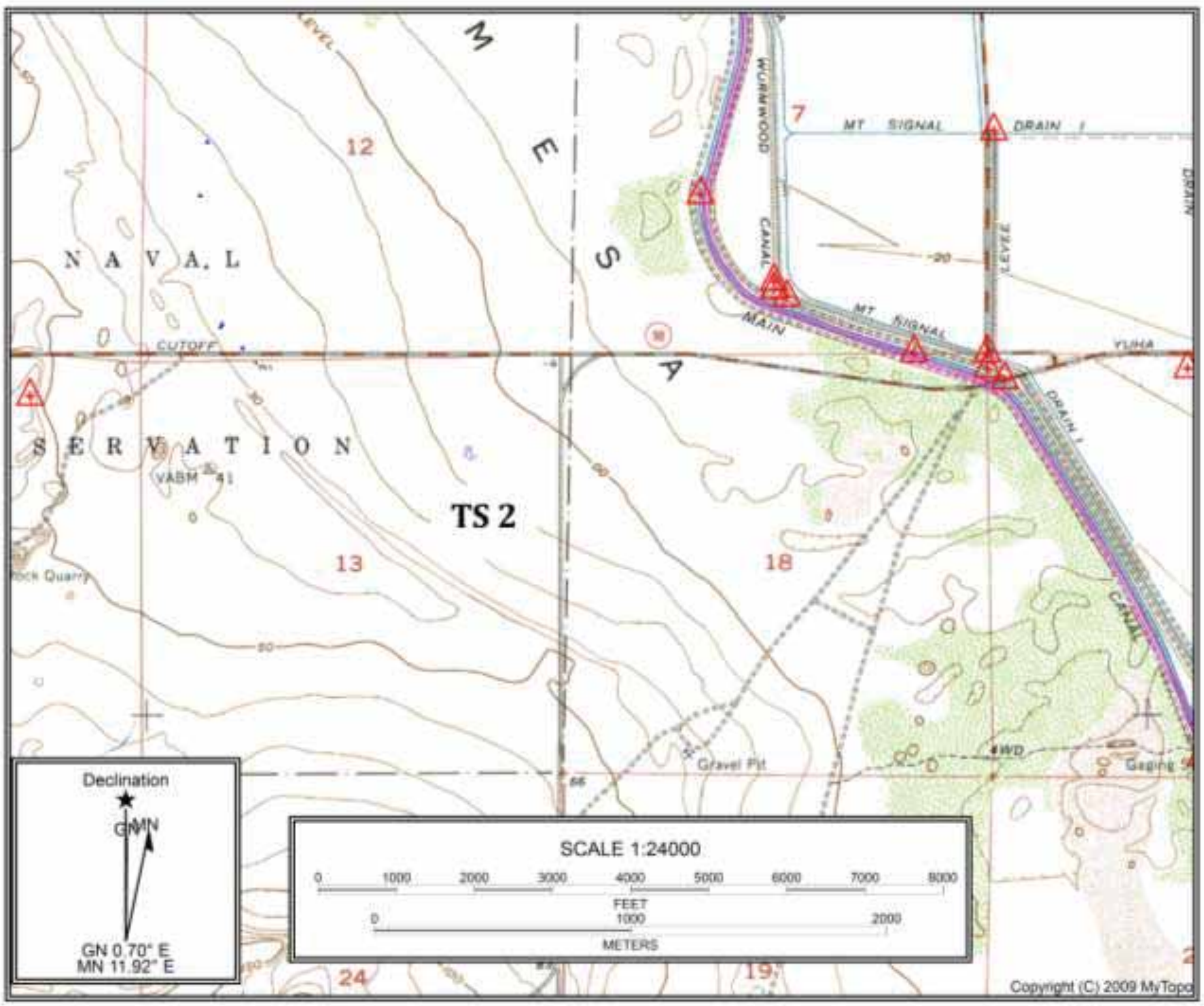
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

Primary # P-13-013843
HRI# CA-IMP-11788
Trinomial

LOCATION MAP

***Resource Name or #:** TS 2

***Map Name:** Mt Signal ***Scale:** 1:24,000 ***Date of Map:** 1957 (1976)



APPENDIX B

NAHC Sacred Lands File Search Results and Tribal Correspondence

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 16, 2017

NAHC Staff
Associate Government Program Analyst
Native American Heritage Commission

Subject: ***NAHC Sacred Lands File Records Search Request for the Drew Solar Project, Imperial County, California***

Dear NAHC Staff,

The Drew Solar Project is being proposed in Imperial County, California. The project proposes to develop 762.8 acres into a solar field. This area falls within the following PLSS area: Township 17S/ Range 13E - Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

Dudek is requesting a NAHC search for any sacred sites or other Native American cultural resources that may fall within the proposed project location or a surrounding one-mile buffer. Please provide a Contact List with all Native American tribal representatives that may have traditional interests in this parcel or the surrounding search area. The results of this search can be faxed to 760-632-0164.

If you have any questions relating to this investigation, please contact me directly by email or phone.

Regards,

Angela Pham, M.A., RPA
Archaeologist
DUDEK
Phone: (760) 942-3814
Cell: (760) 274-3056
Email: apham@dudek.com

Attachments:
Figure 1. SLF Records Search Request Map

NATIVE AMERICAN HERITAGE COMMISSION
Environmental and Cultural Department
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691
(916) 373-3710

November 17, 2017

Angela Pham
Dudek

Sent by E-mail: apham@dudek.com

RE: Proposed Drew Solar Project, near the City of Calexico; Mount Signal USGS Quadrangle, Imperial County, California

Dear Ms. Pham:

A record search of the Native American Heritage Commission (NAHC) *Sacred Lands File* was completed for the area of potential project effect (APE) referenced above with negative results however the area is sensitive for cultural resources. Please note that the absence of specific site information in the *Sacred Lands File* does not indicate the absence of Native American cultural resources in any APE.

Attached is a list of tribes culturally affiliated to the project area. I suggest you contact all of the listed Tribes. If they cannot supply information, they might recommend others with specific knowledge. The list should provide a starting place to locate areas of potential adverse impact within the APE. By contacting all those on the list, your organization will be better able to respond to claims of failure to consult. If a response has not been received within two weeks of notification, the NAHC requests that you follow-up with a telephone call to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from any of these individuals or groups, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact via email: gayle.totton@nahc.ca.gov.

Sincerely,

Gayle Totton, M.A., PhD.
Associate Governmental Program Analyst
(916) 373-3714

Native American Heritage Commission
Native American Contact List
Imperial County
11/17/2017

Barona Group of the Capitan Grande
Edwin Romero, Chairperson
1095 Barona Road — Kumeyaay
Lakeside, CA, 92040
Phone: (619) 443 - 6612
Fax: (619) 443-0681
cloyd@barona-nsn.gov

Campo Band of Mission Indians
Ralph Goff, Chairperson
36190 Church Road, Suite 1 — Kumeyaay
Campo, CA, 91906
Phone: (619) 478 - 9046
Fax: (619) 478-5818
rgoff@campo-nsn.gov

Cocopah Indian Reservation
H. McCormick, Tribal Archaeologist
County 15th & Avenue G — Cocopah
Sommerton, AZ, 85350
Phone: (928) 530 - 2291
culturalres@cocopah.com

Ewiiaapaayp Tribal Office
Michael Garcia, Vice Chairperson
4054 Willows Road — Kumeyaay
Alpine, CA, 91901
Phone: (619) 445 - 6315
Fax: (619) 445-9126
michaelg@leaningrock.net

Ewiiaapaayp Tribal Office
Robert Pinto, Chairperson
4054 Willows Road — Kumeyaay
Alpine, CA, 91901
Phone: (619) 445 - 6315
Fax: (619) 445-9126

Iipay Nation of Santa Ysabel
Virgil Perez, Chairperson
P.O. Box 130 — Kumeyaay
Santa Ysabel, CA, 92070
Phone: (760) 765 - 0845
Fax: (760) 765-0320

Iipay Nation of Santa Ysabel
Clint Linton, Director of Cultural Resources
P.O. Box 507 — Kumeyaay
Santa Ysabel, CA, 92070
Phone: (760) 803 - 5694
cjlinton73@aol.com

Inaja Band of Mission Indians
Rebecca Osuna, Chairperson
2005 S. Escondido Blvd. — Kumeyaay
Escondido, CA, 92025
Phone: (760) 737 - 7628
Fax: (760) 747-8568

Jamul Indian Village
Erica Pinto, Chairperson
P.O. Box 612 — Kumeyaay
Jamul, CA, 91935
Phone: (619) 669 - 4785
Fax: (619) 669-4817

Kwaaymii Laguna Band of Mission Indians
Carmen Lucas,
P.O. Box 775 — Kumeyaay
Pine Valley, CA, 91962
Phone: (619) 709 - 4207

La Posta Band of Mission Indians
Javaughn Miller, Tribal Administrator
8 Crestwood Road — Kumeyaay
Boulevard, CA, 91905
Phone: (619) 478 - 2113
Fax: (619) 478-2125
jmiller@LPtribe.net

La Posta Band of Mission Indians
Gwendolyn Parada, Chairperson
8 Crestwood Road — Kumeyaay
Boulevard, CA, 91905
Phone: (619) 478 - 2113
Fax: (619) 478-2125
LP13boots@aol.com

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed Drew Solar Project, Imperial County.

Native American Heritage Commission
Native American Contact List
Imperial County
11/17/2017

Manzanita Band of Kumeyaay Nation
Angela Elliott Santos, Chairperson
P.O. Box 1302 — Kumeyaay
Boulevard, CA, 91905
Phone: (619) 766 - 4930
Fax: (619) 766-4957

Mesa Grande Band of Mission Indians
Mario Morales, Cultural Resources Representative
PMB 366 35008 Pala Temecula Rd. — Kumeyaay
Pala, CA, 92059
Phone: (760) 622 - 1336

Mesa Grande Band of Mission Indians
Virgil Oyos, Chairperson
P.O Box 270 — Kumeyaay
Santa Ysabel, CA, 92070
Phone: (760) 782 - 3818
Fax: (760) 782-9092
mesagrandeband@msn.com

San Pasqual Band of Mission Indians
Allen E. Lawson, Chairperson
P.O. Box 365 — Kumeyaay
Valley Center, CA, 92082
Phone: (760) 749 - 3200
Fax: (760) 749-3876
allenl@sanpasqualtribe.org

San Pasqual Band of Mission Indians
John Flores, Environmental Coordinator
P. O. Box 365 — Kumeyaay
Valley Center, CA, 92082
Phone: (760) 749 - 3200
Fax: (760) 749-3876
johnf@sanpasqualtribe.org

Sycuan Band of the Kumeyaay Nation
Cody J. Martinez, Chairperson
1 Kwaaypaay Court — Kumeyaay
El Cajon, CA, 92019
Phone: (619) 445 - 2613
Fax: (619) 445-1927
ssilva@sycuan-nsn.gov

Sycuan Band of the Kumeyaay Nation
Lisa Haws, Cultural Resources Manager
1 Kwaaypaay Court — Kumeyaay
El Cajon, CA, 92019
Phone: (619) 312 - 1935
lhaws@sycuan-nsn.gov

Viejas Band of Kumeyaay Indians
Robert Welch, Chairperson
1 Viejas Grade Road — Kumeyaay
Alpine, CA, 91901
Phone: (619) 445 - 3810
Fax: (619) 445-5337
jhagen@viejas-nsn.gov

Viejas Band of Kumeyaay Indians
Julie Hagen,
1 Viejas Grade Road — Kumeyaay
Alpine, CA, 91901
Phone: (619) 445 - 3810
Fax: (619) 445-5337
jhagen@viejas-nsn.gov

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources assessment for the proposed Drew Solar Project, Imperial County.

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. John Flores, Environmental Coordinator
San Pasqual Band of Indians
P.O. Box 365
Valley Center, CA 92082

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Flores:

Drew Solar LLC has retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

As part of the cultural resources study prepared for the proposed project, Dudek contacted the California Native American Heritage Commission (NAHC) to request a Sacred Lands File (SLF) search and a list of Native American individuals and/or tribal organizations who may have knowledge of cultural resources in or near the proposed project area. The NAHC emailed a response on November 17, 2017, which stated that the SLF search failed to indicate the presence of Native American cultural resources in the immediate project area.

The NAHC recommended that we contact you regarding your knowledge of the presence of cultural resources that may be impacted by this project. If you have any knowledge of cultural resources that may exist within or near the proposed project area, please contact me directly at (760) 479-4855 or at apham@dudek.com within 30 days of receipt of this letter.

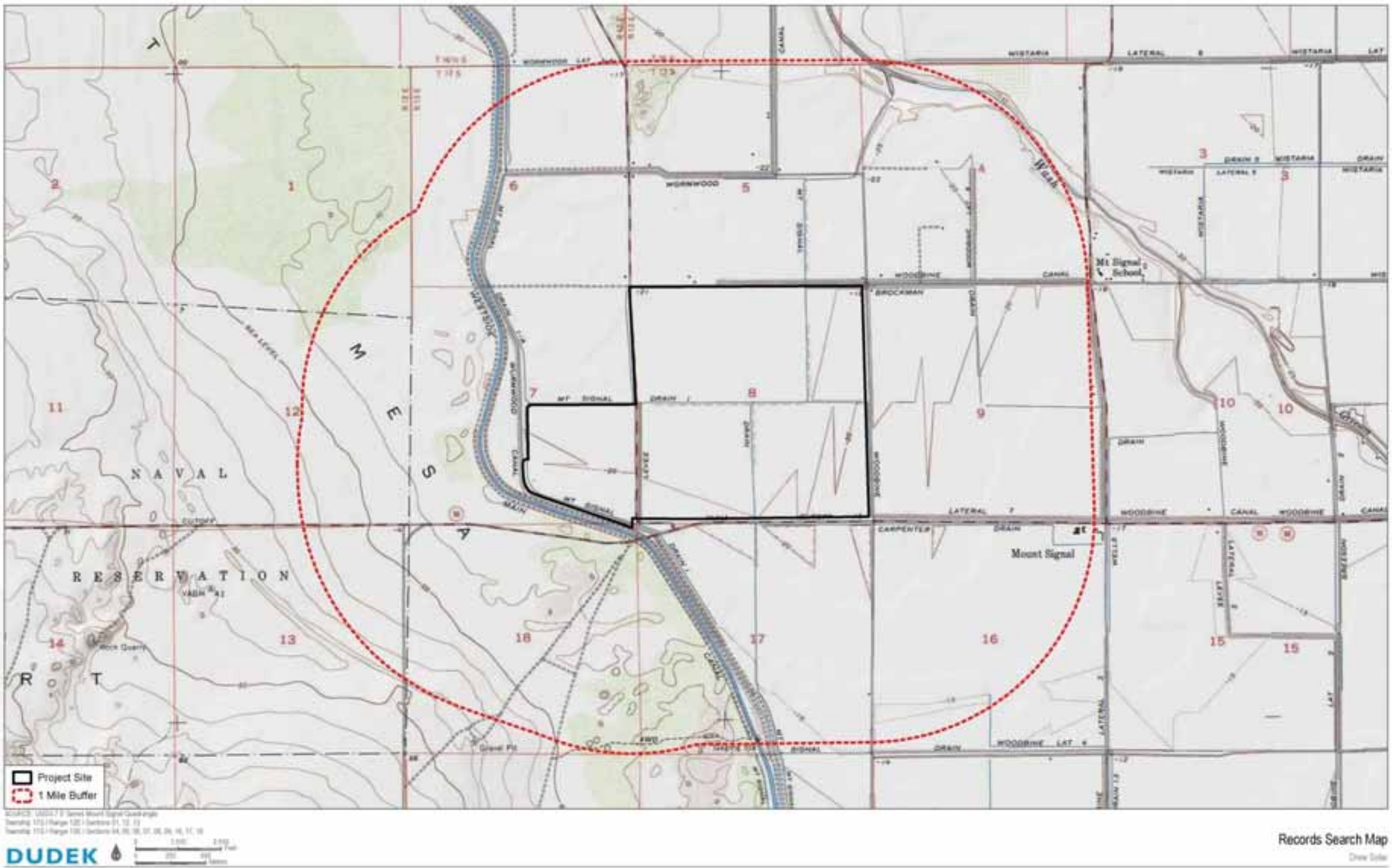
Please note that this letter does not constitute Assembly Bill (AB) 52 notification or initiation of consultation. AB 52 is a process between the lead agency and California Native American Tribes concerning potential impacts to tribal cultural resources. Tribes that wish to be notified of projects for the purposes of AB 52 must contact the lead agency, Drew Solar LLC, in writing (pursuant to Public Resources Code Section 21080.3.1 (b)).

Thank you for your assistance.

Sincerely,

Angela Pham, M.A., RPA
Archaeologist

Attachments: *Project Location Map*


Project Site
1 Mile Buffer
DUDEK
Records Search Map
Mount Signal
Mt Signal School
NAVAL
RESERVATION
MESA
WORMWOOD
WOODBINE
CARPENTER
BROCKMAN
WISTARIA
LATERAL
DRAIN
CANAL
MT SIGNAL
Gravel Pit
Rock Quarry

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. Michael Garcia, Vice Chairperson
Ewiiaapaayp Tribal Office
4054 Willows Road
Alpine, CA 91901

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Garcia:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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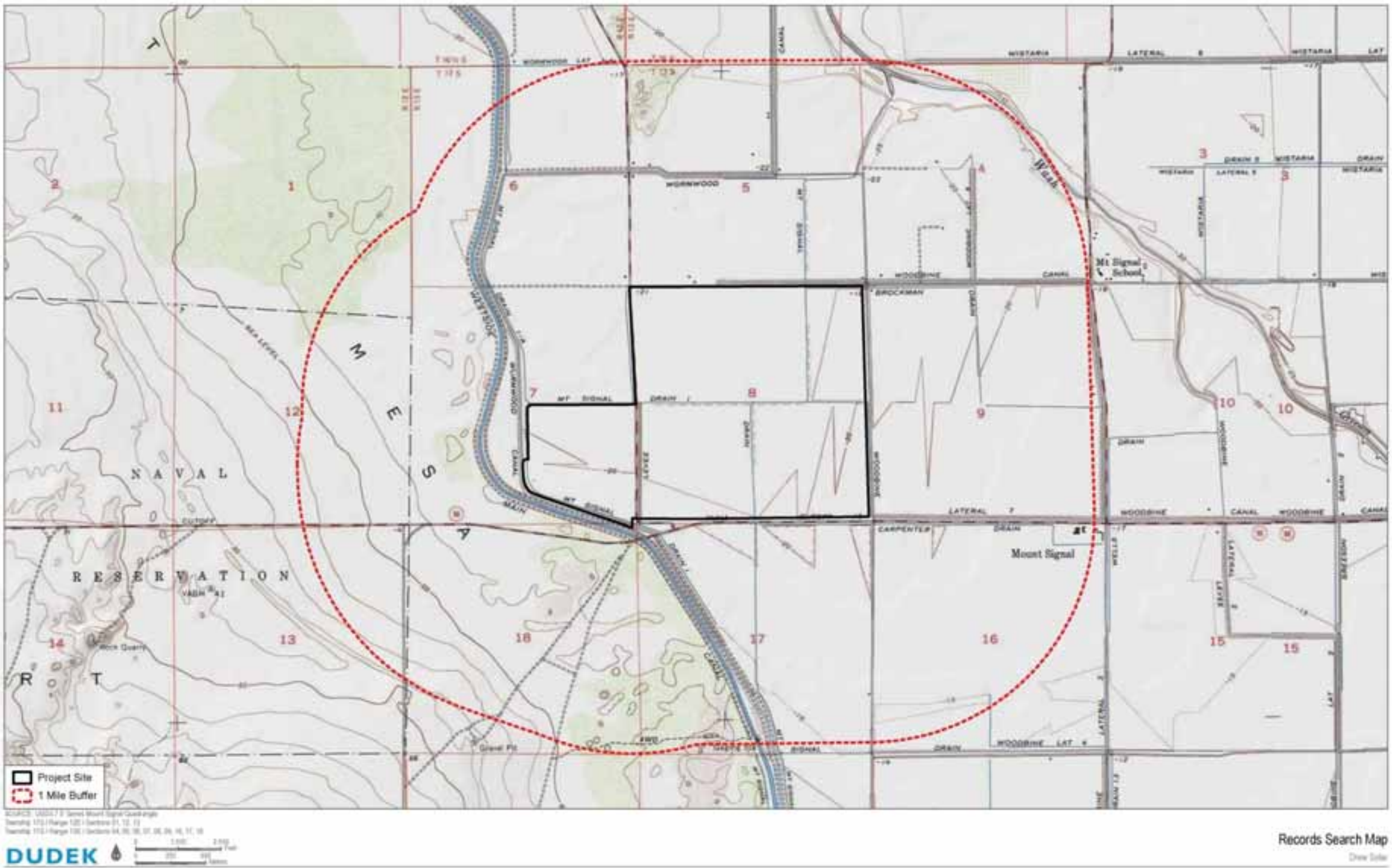
Thank you for your assistance.

Sincerely,

Angela Pham, M.A., RPA
Archaeologist

Attachments: Project Location Map



Records Search Map

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. Ralph Goff, Chairperson
Campo Band of Mission Indians
36190 Church Road, Suite 1
Campo, CA 91906

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Goff:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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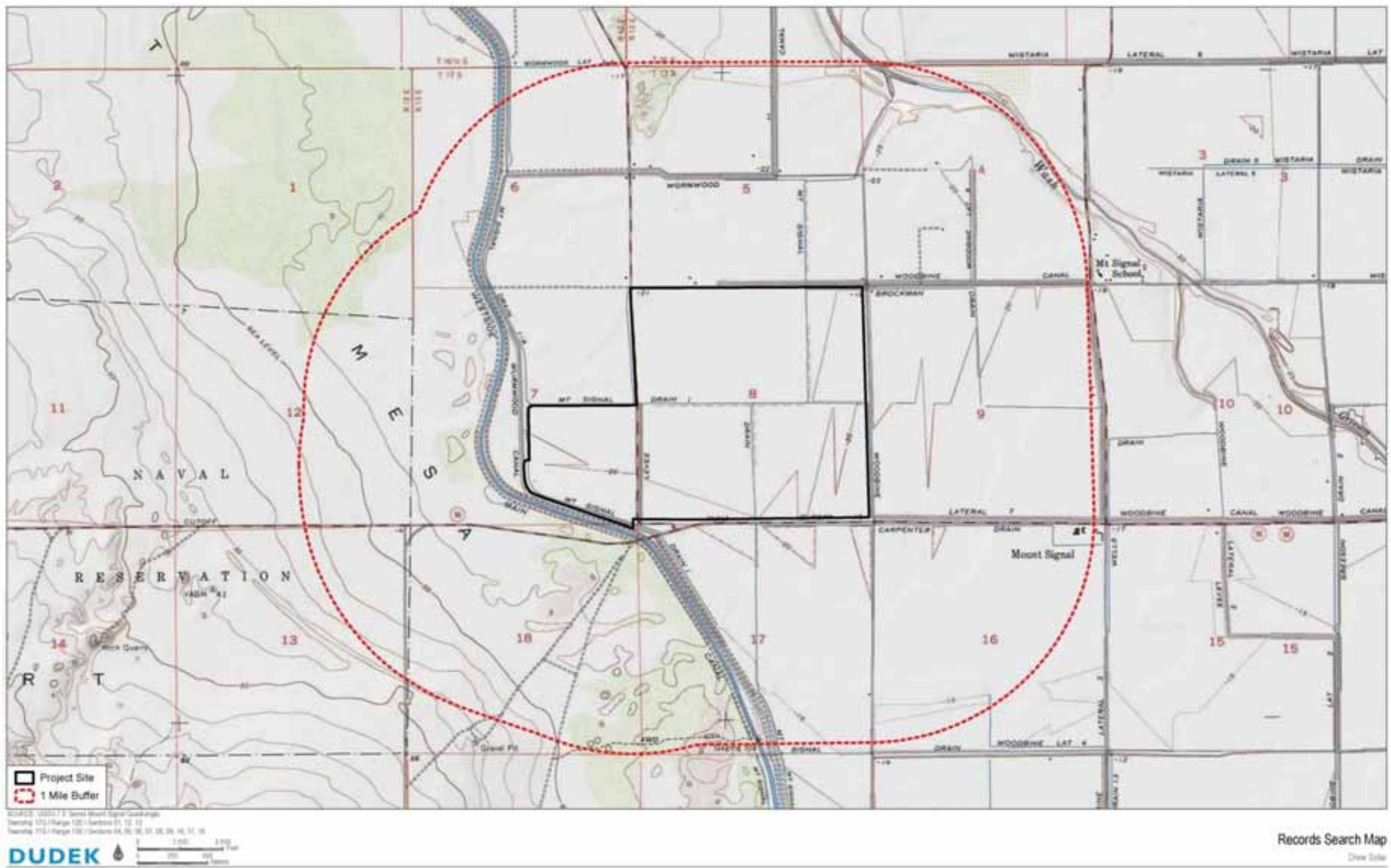
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November 28, 2017 10756.001-02

Ms. Julie Hagen, Cultural Resources
Viejas Band of Kumeyaay Indians
P.O. Box 908
Alpine, CA 91903

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Hagen:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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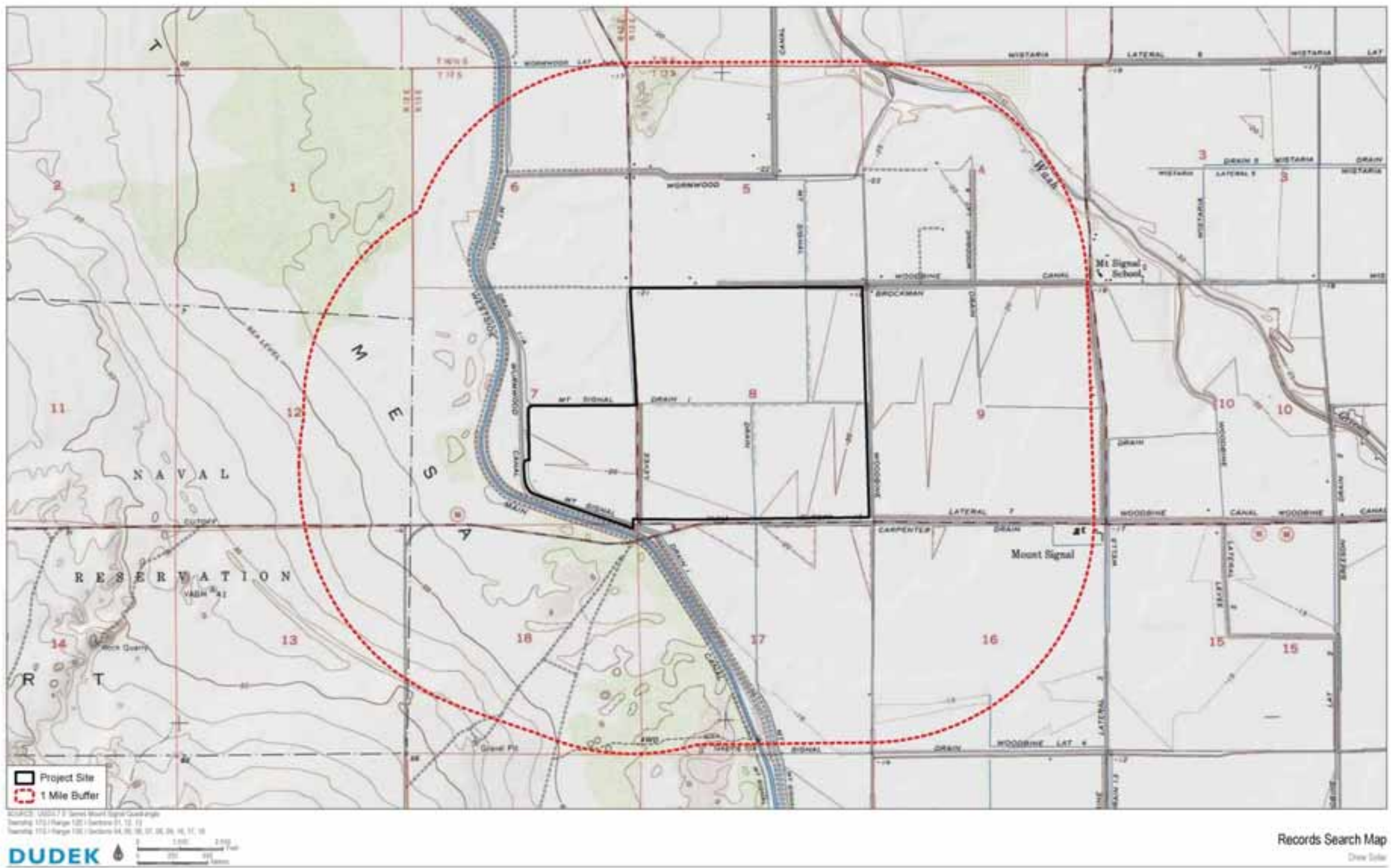
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November 28, 2017 10756.001-02

Ms. Lisa Haws, Cultural Resource Manager
Sycuan Band of the Kumeyaay Nation
1 Kwaaypaay Court
El Cajon, CA 92019

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Haws:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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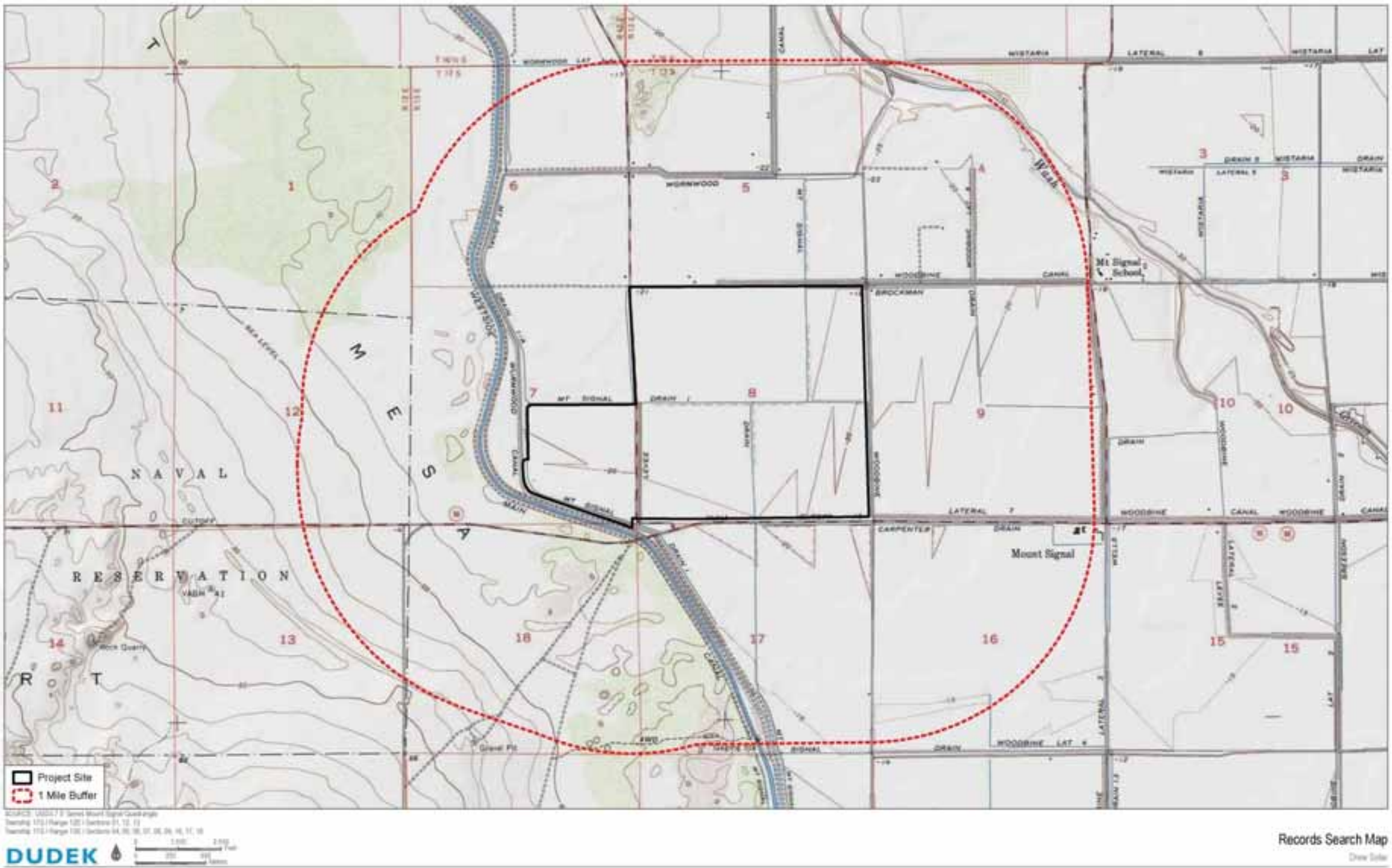
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November 28, 2017 10756.001-02

Mr. Allen E. Lawson, Chairperson
San Pasqual Band of Mission Indians
P.O. Box 365
Valley Center, CA 92082

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Lawson:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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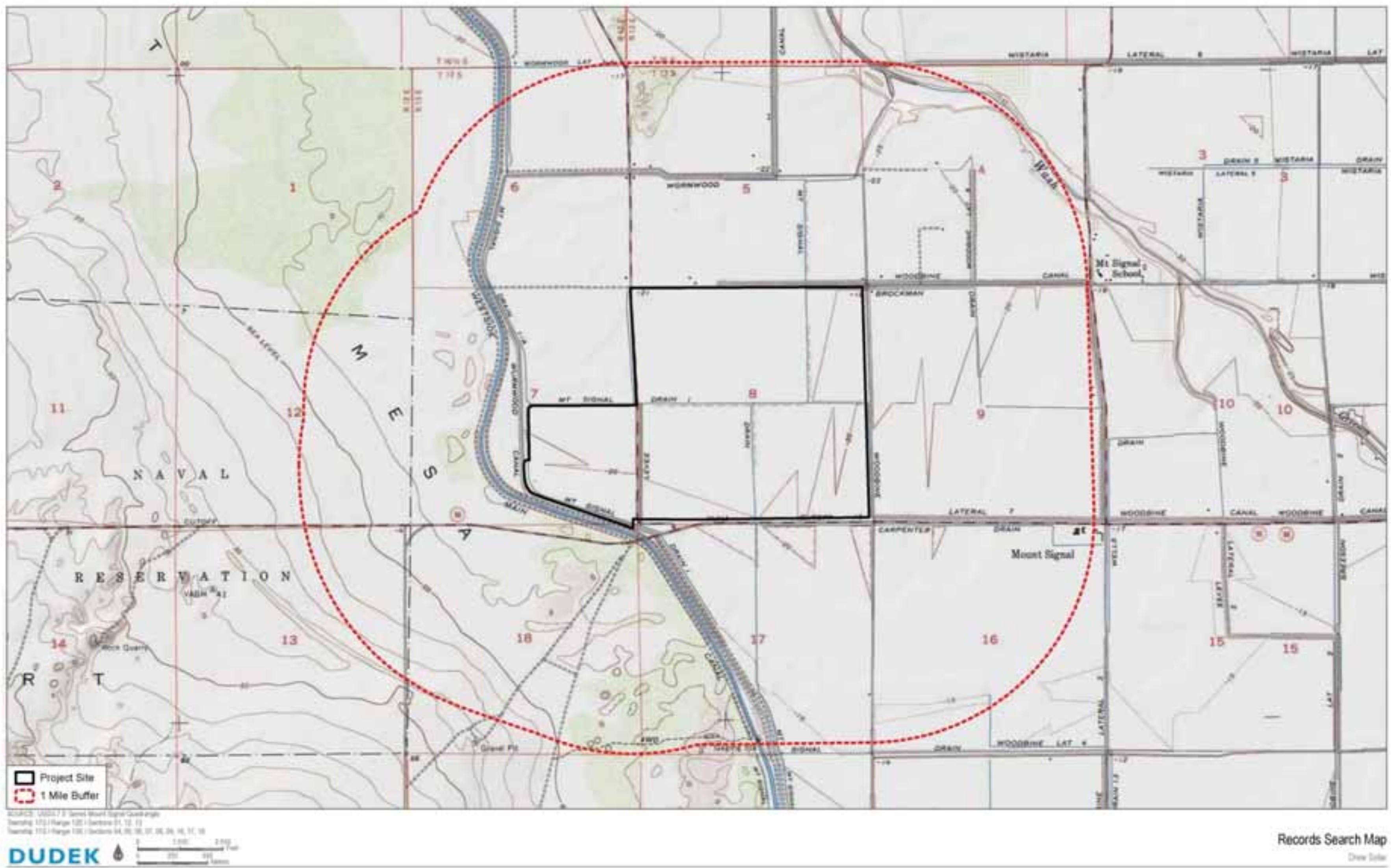
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November 28, 2017 10756.001-02

Mr. Clint Linton, Director of Cultural Resources
Ipay Nation of Santa Ysabel
P.O. Box 507
Santa Ysabel, CA 92070

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Linton:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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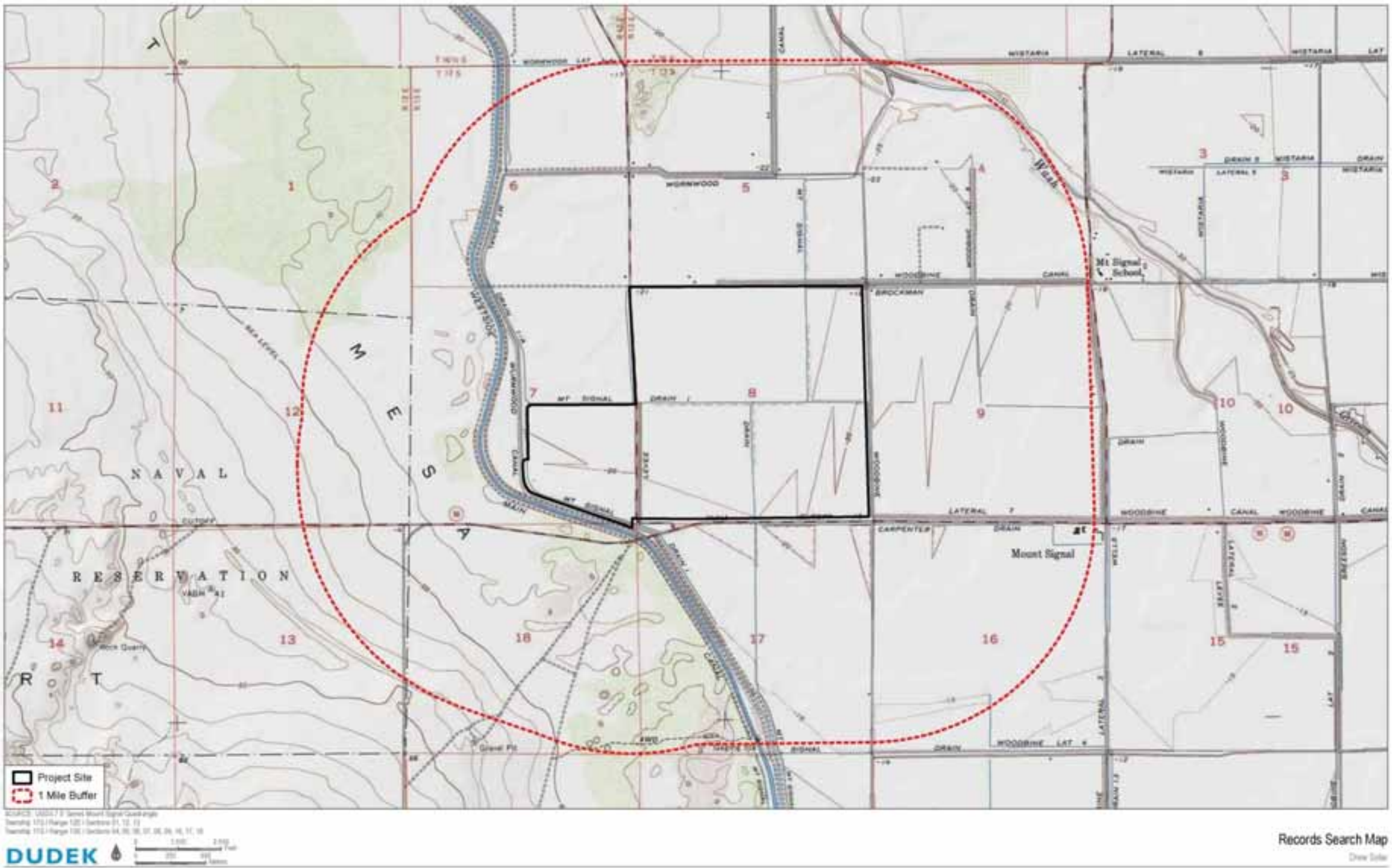
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November 28, 2017 10756.001-02

Ms. Carmen Lucas,
Kwaaymii Laguna Band of Mission Indians
P.O. Box 775
Pine Valley, CA 91962

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Lucas:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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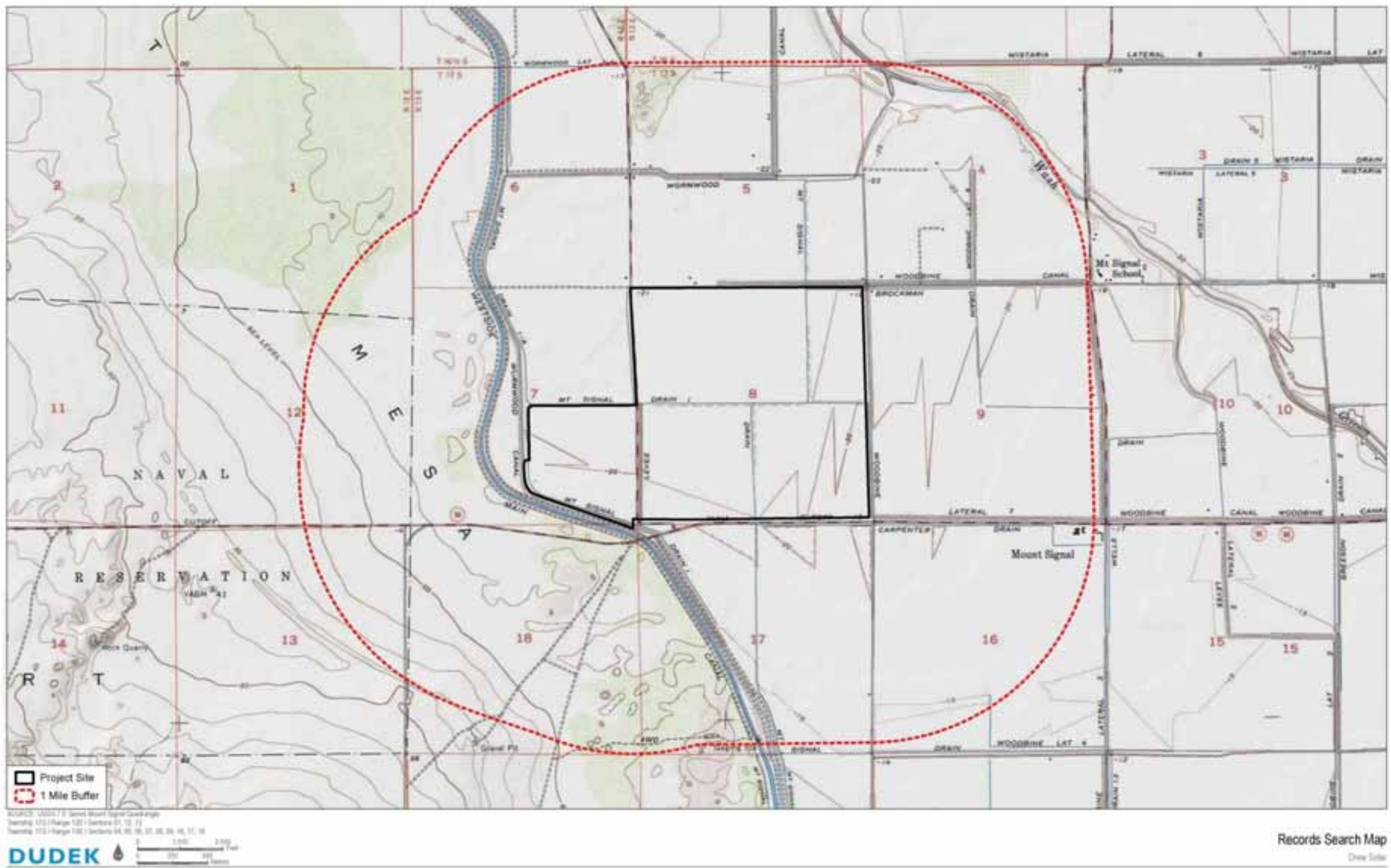
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T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. Cody Martinez, Chairperson
Sycuan Band of the Kumeyaay Nation
1 Kwaaypaay Court
El Cajon, CA 92019

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Martinez:

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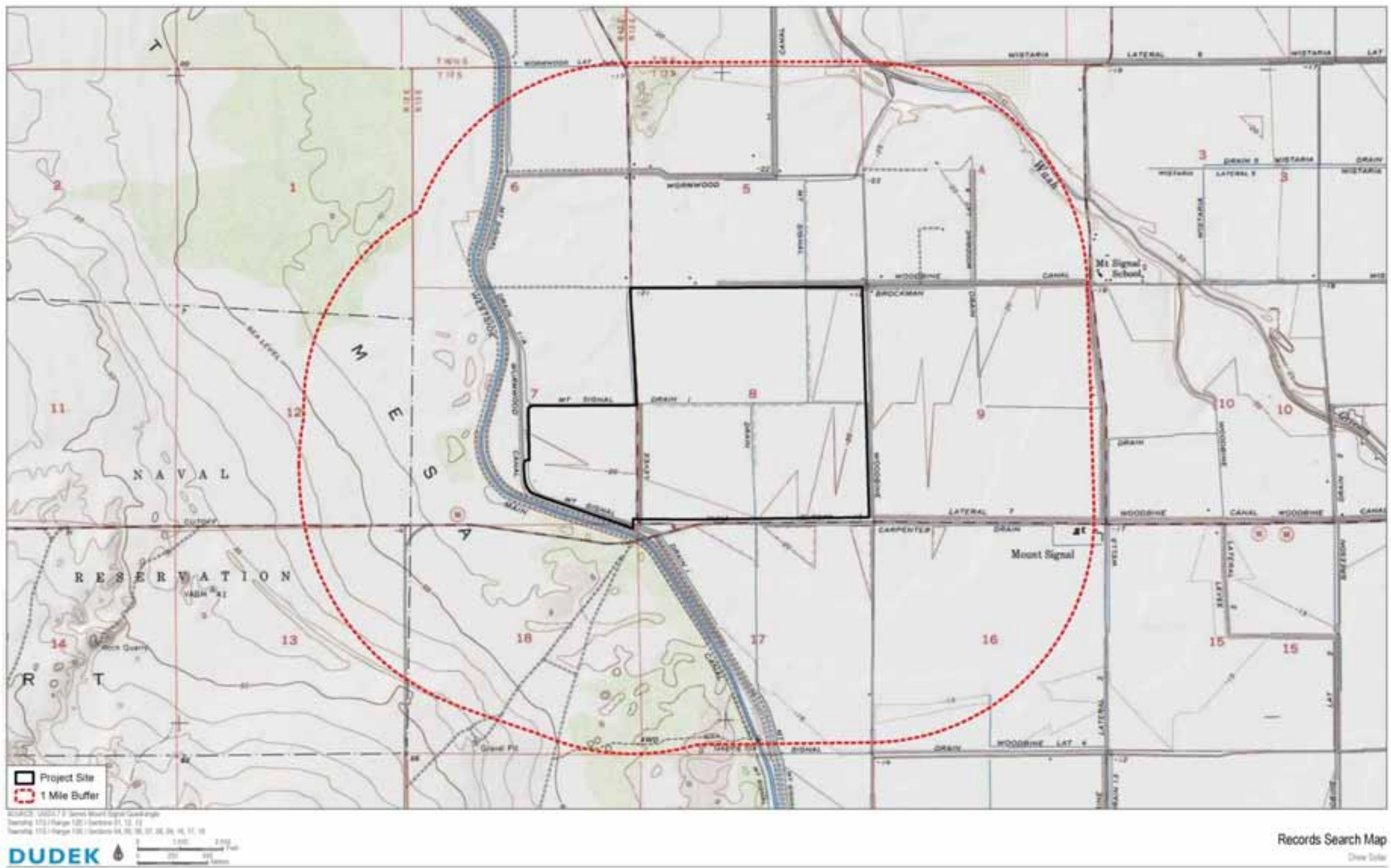
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November 28, 2017 10756.001-02

Mr. H. McCormick, Tribal Archaeologist
Cocopah Indian Reservation
County 15th & Avenue G
Sommerton, AZ 85350

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. McCormick:

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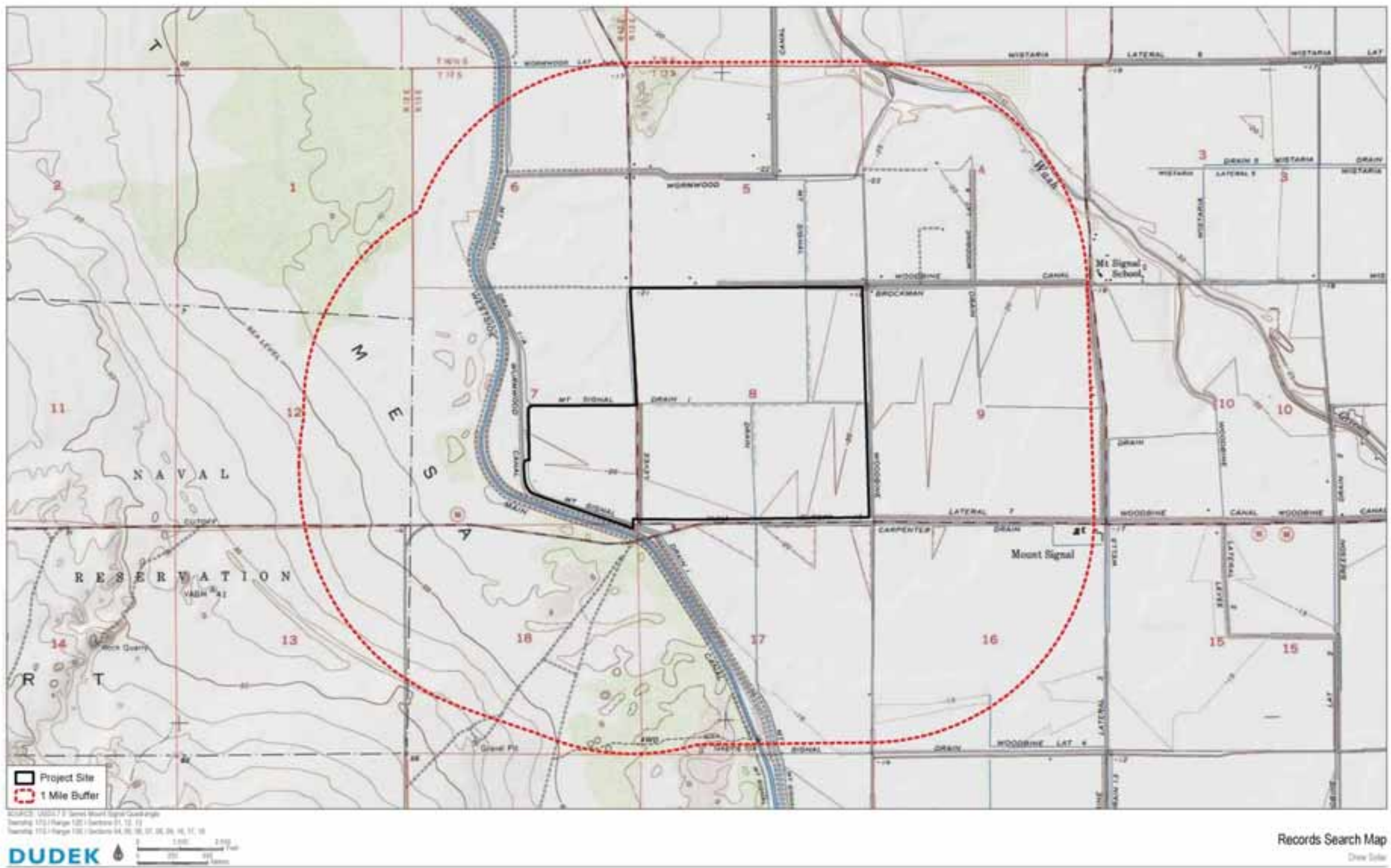
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November 28, 2017 10756.001-02

Ms. Javaughn Miller,
La Posta Band of Mission Indians
8 Crestwood Rd.
Boulevard, CA 91905

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Miller:

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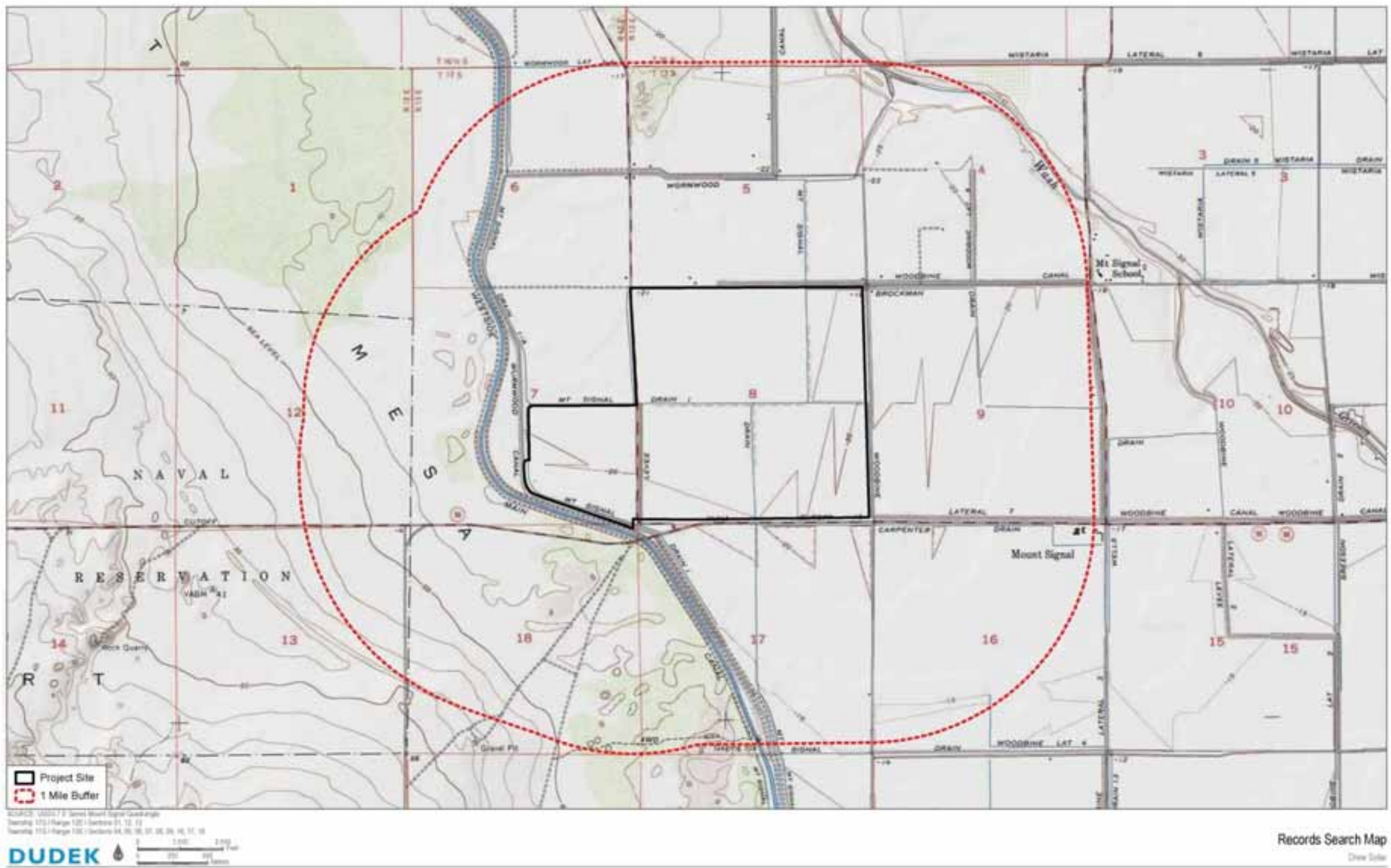
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November 28, 2017 10756.001-02

Mr. Mario Morales, Cultural Resources Rep
Mesa Grande Band of Mission Indians
35008 Pala Temecula Rd. #366
Pala, CA 92059

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Morales:

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Thank you for your assistance.

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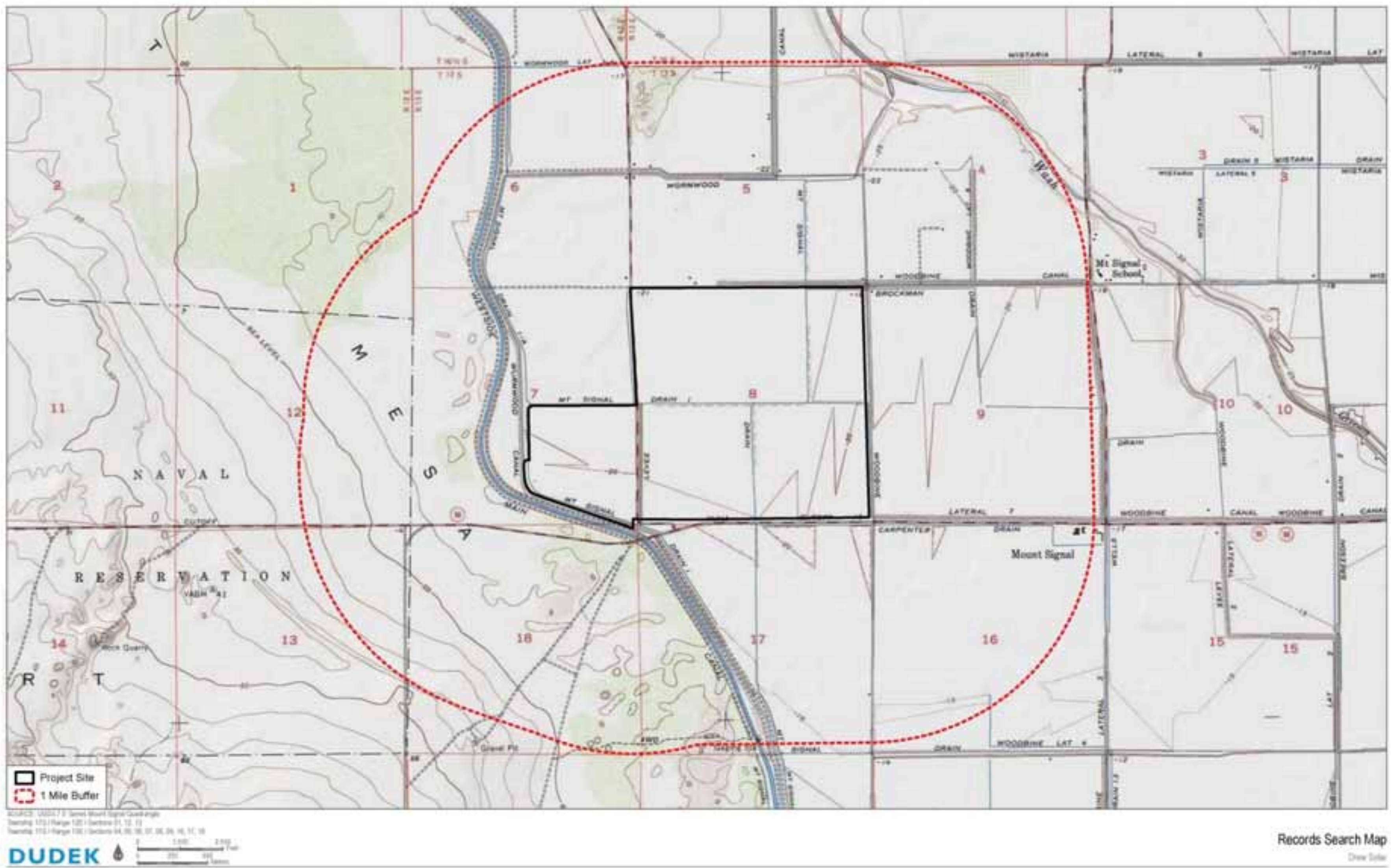
Angela Pham, M.A., RPA
Archaeologist

Attachments: *Project Location Map*


Project Site
1 Mile Buffer
DUDEK
Records Search Map
Mount Signal
Mt Signal School
NAVAL RESERVATION
MESA

November 28, 2017 10756.001-02

Ms. Rebecca Osuna, Chairman
Inaja Band of Mission Indians
2005 S. Escondido Blvd.
Escondido, CA 92025

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Osuna:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

As part of the cultural resources study prepared for the proposed project, Dudek contacted the California Native American Heritage Commission (NAHC) to request a Sacred Lands File (SLF) search and a list of Native American individuals and/or tribal organizations who may have knowledge of cultural resources in or near the proposed project area. The NAHC emailed a response on November 17, 2017, which stated that the SLF search failed to indicate the presence of Native American cultural resources in the immediate project area.

The NAHC recommended that we contact you regarding your knowledge of the presence of cultural resources that may be impacted by this project. If you have any knowledge of cultural resources that may exist within or near the proposed project area, please contact me directly at (760) 479-4855 or at apham@dudek.com within 30 days of receipt of this letter.

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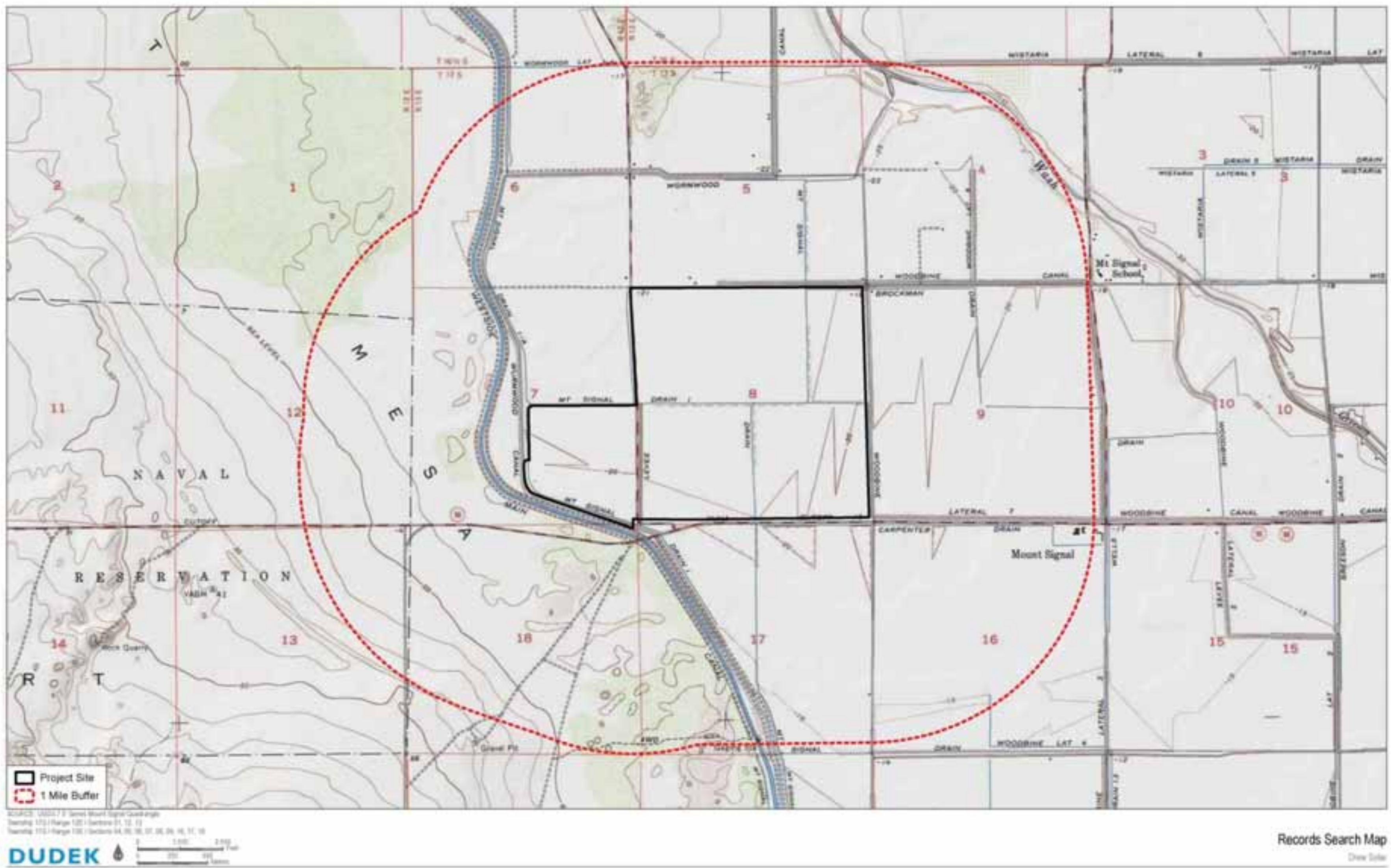
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MT SIGNAL
WESTSIDE
MAIN
Wash
Rock Quarry
Gravel Pit
DUDEK
Records Search Map

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. Virgil Oyos, Chairperson
Mesa Grande Band of Mission Indians
P.O. Box 270
Santa Ysabel, CA 92070

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Oyos:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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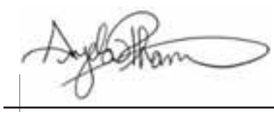

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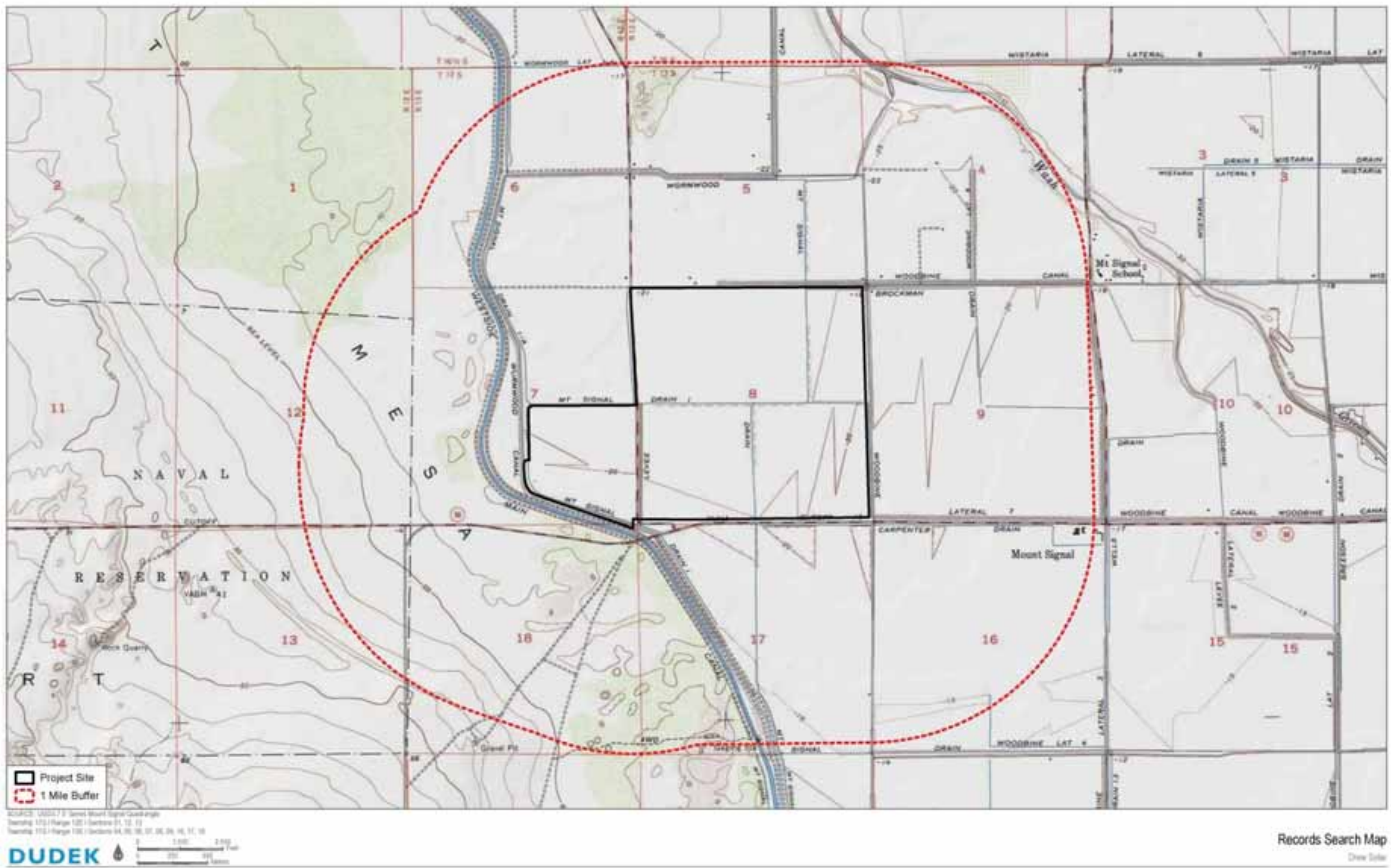
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Gravel Pit
CUTOFF

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Ms. Gwendolyn Parada, Chairperson
La Posta Band of Mission Indians
8 Crestwood Rd.
Boulevard, CA 91905

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Parada:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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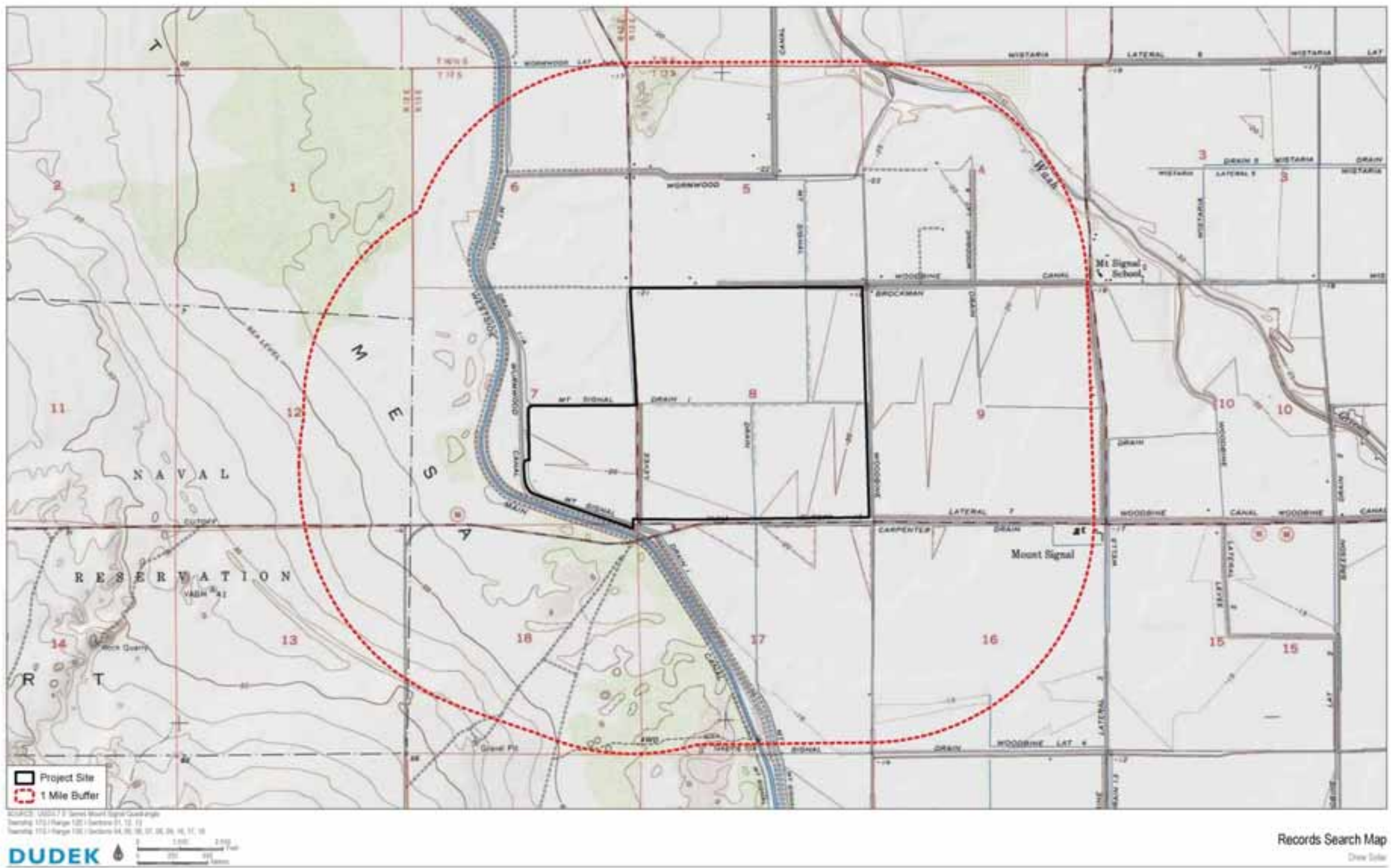
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November 28, 2017 10756.001-02

Mr. Virgil Perez, Chairperson
Iipay Nation of Santa Ysabel
P.O. Box 130
Santa Ysabel, CA 92070

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Perez:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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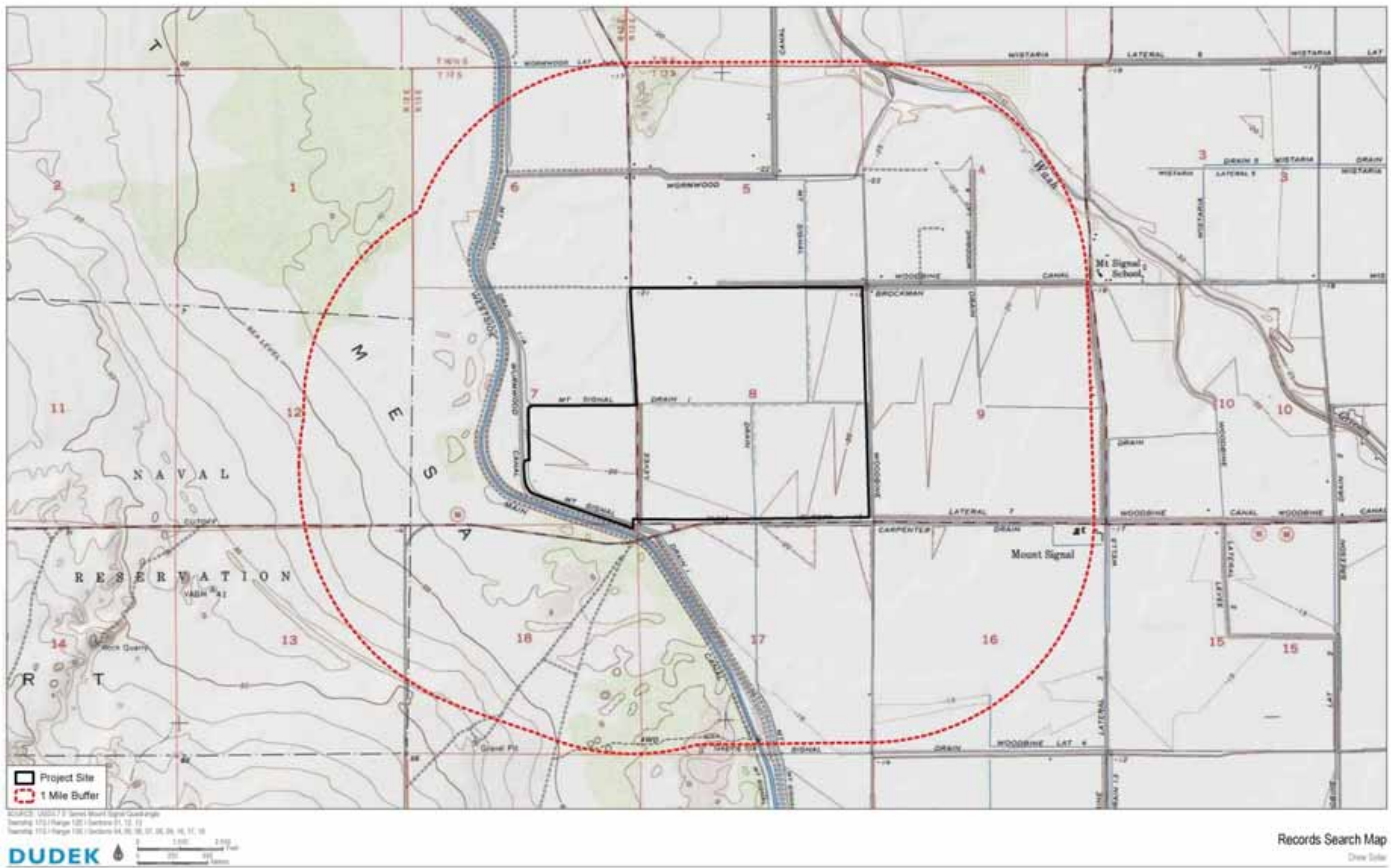
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Rock Quarry
Gravel Pit
DUDEK
Records Search Map

November 28, 2017 10756.001-02

Ms. Erica Pinto, Chairperson
Jamul Indian Village
P.O. Box 612
Jamul, CA 91935

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Pinto:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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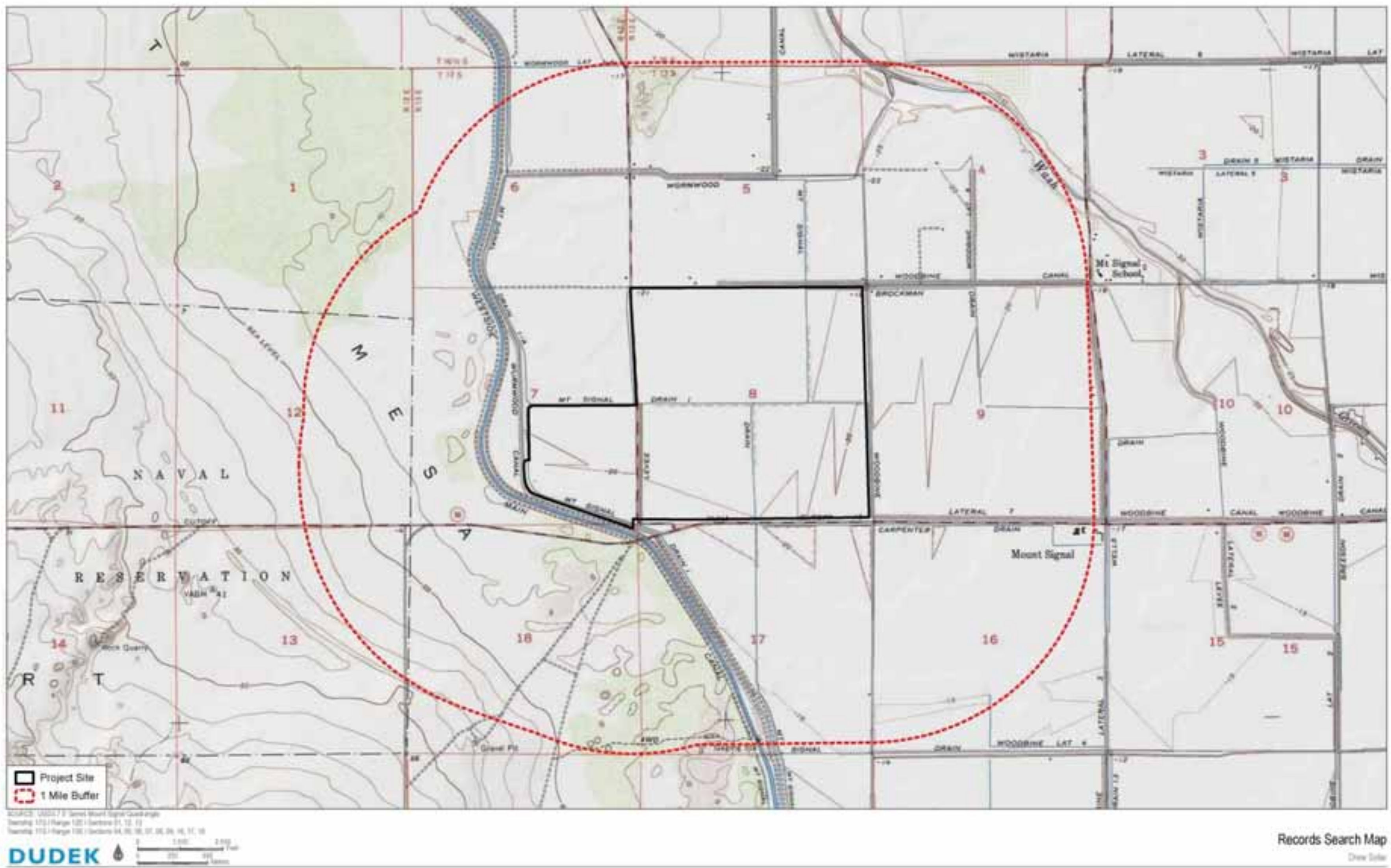
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DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. Robert Pinto, Sr., Chairperson
Ewiaapaayp Tribal Office
4054 Willow Rd.
Alpine, CA 91901

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Pinto, Sr.:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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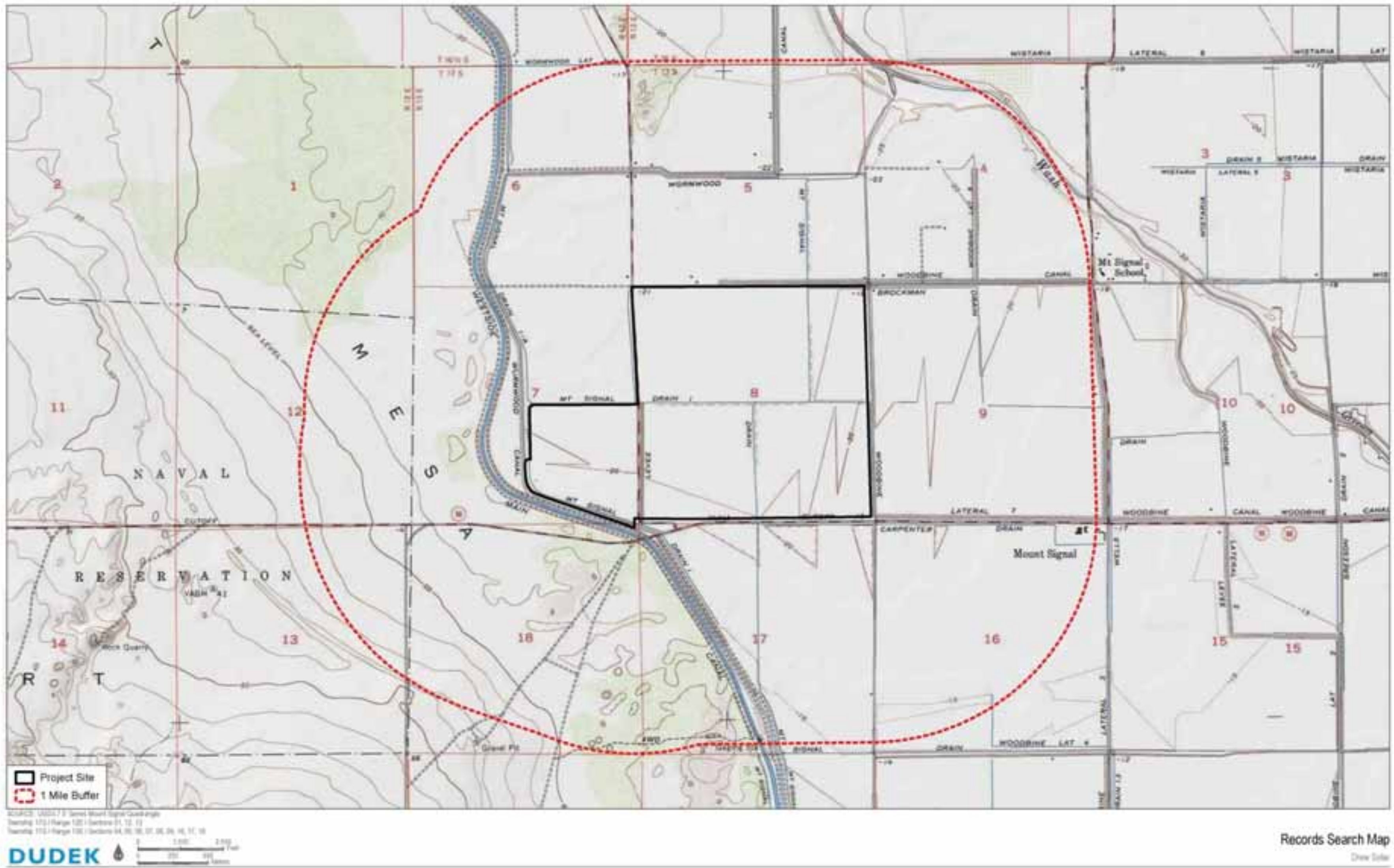
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ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Mr. Edwin (Thorpe) Romero, Chairperson
Barona Group of the Capitan Grande
1095 Barona Road
Lakeside, CA 92040

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Romero:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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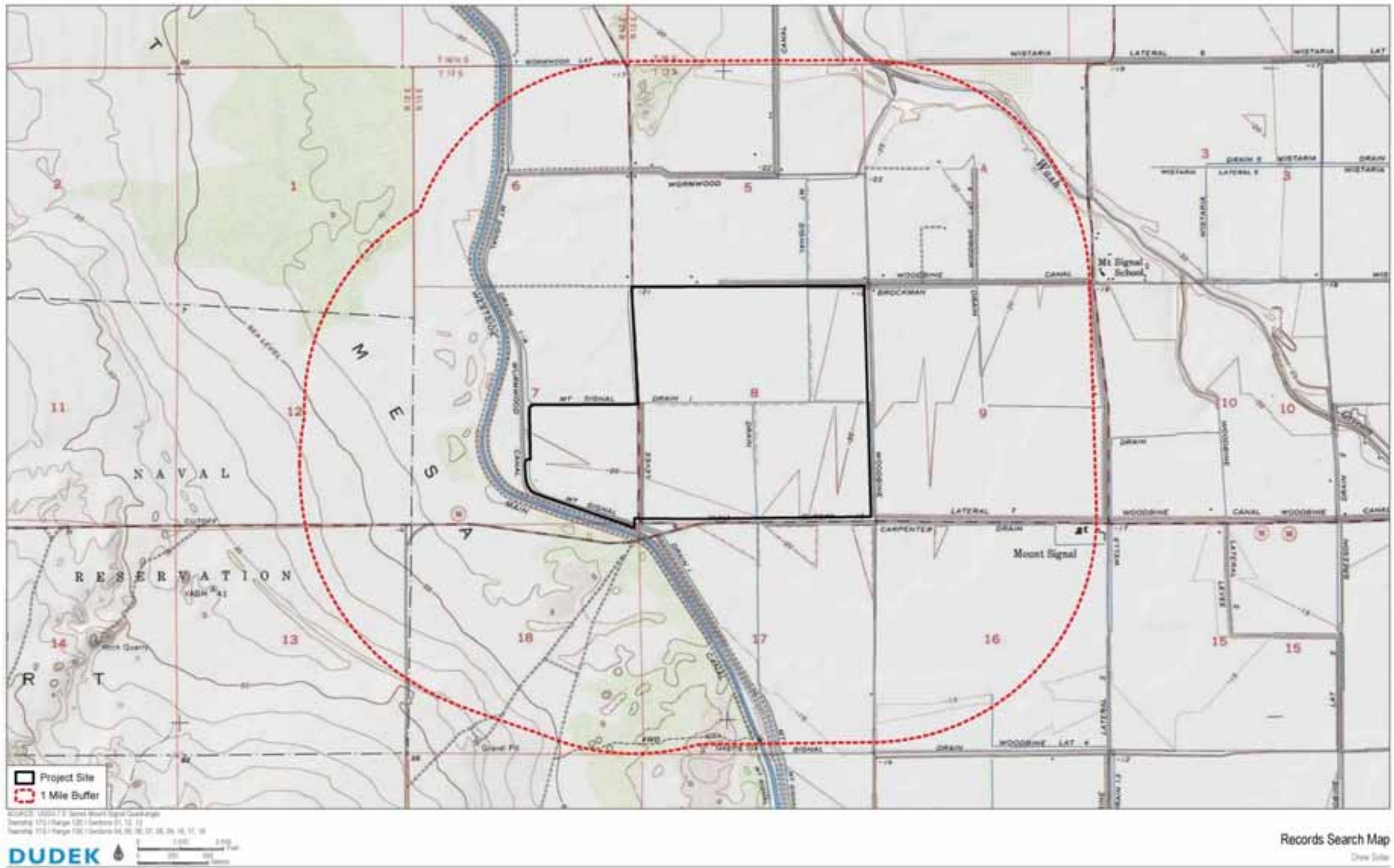
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DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

November 28, 2017 10756.001-02

Ms. Angela Elliott Santos, Chairperson
Manzanita Band of Kumeyaay Nation
P.O. Box 1302
Boulevard, CA 91905

Subject: The Drew Solar Project, Imperial County, California

Dear Ms. Santos:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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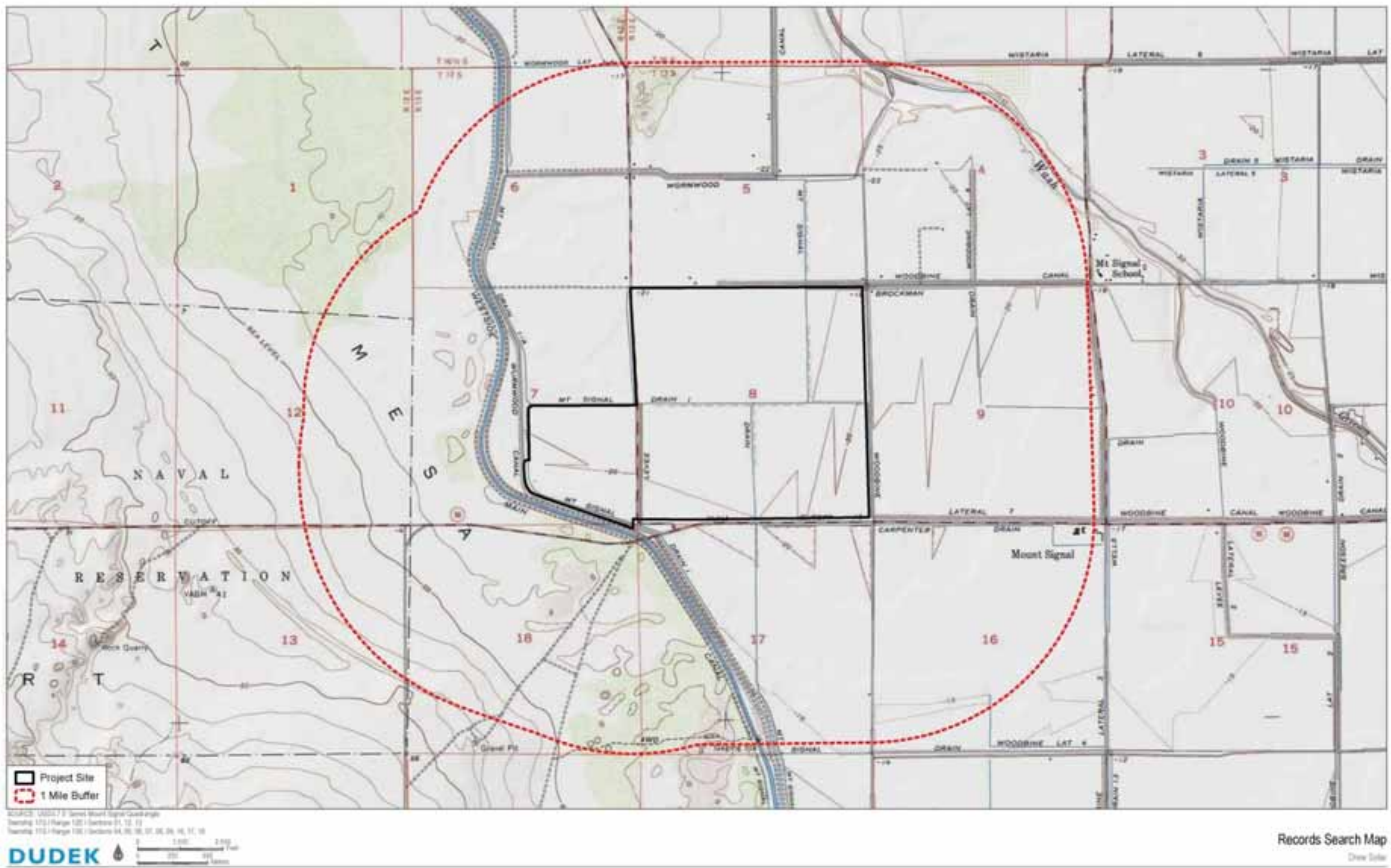
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November 28, 2017 10756.001-02

Mr. Robert J. Welch, Jr., Chairperson
Viejas Band of Kumeyaay Indians
1 Viejas Grade Rd.
Alpine, CA 91901

Subject: The Drew Solar Project, Imperial County, California

Dear Mr. Welch, Jr.:

Drew Solar LLC retained Dudek to conduct a cultural resources study in support of the proposed Drew Solar Project (project) located west of Pullman Road, east of Mandrapa Road, and south of Kubler Road, approximately 6.5 miles southwest of the city of El Centro in Imperial County, California. The proposed project would involve the conversion and construction of approximately 800 acres of previously utilized agricultural lands to a solar farm. The project area currently has an historic-age reservoir located within the central portion of the site. The project falls within the following PLSS area: Township 17S/ Range 13E – Sections 7 and 8; Mount Signal, CA 1:24,000 USGS maps (Figure 1).

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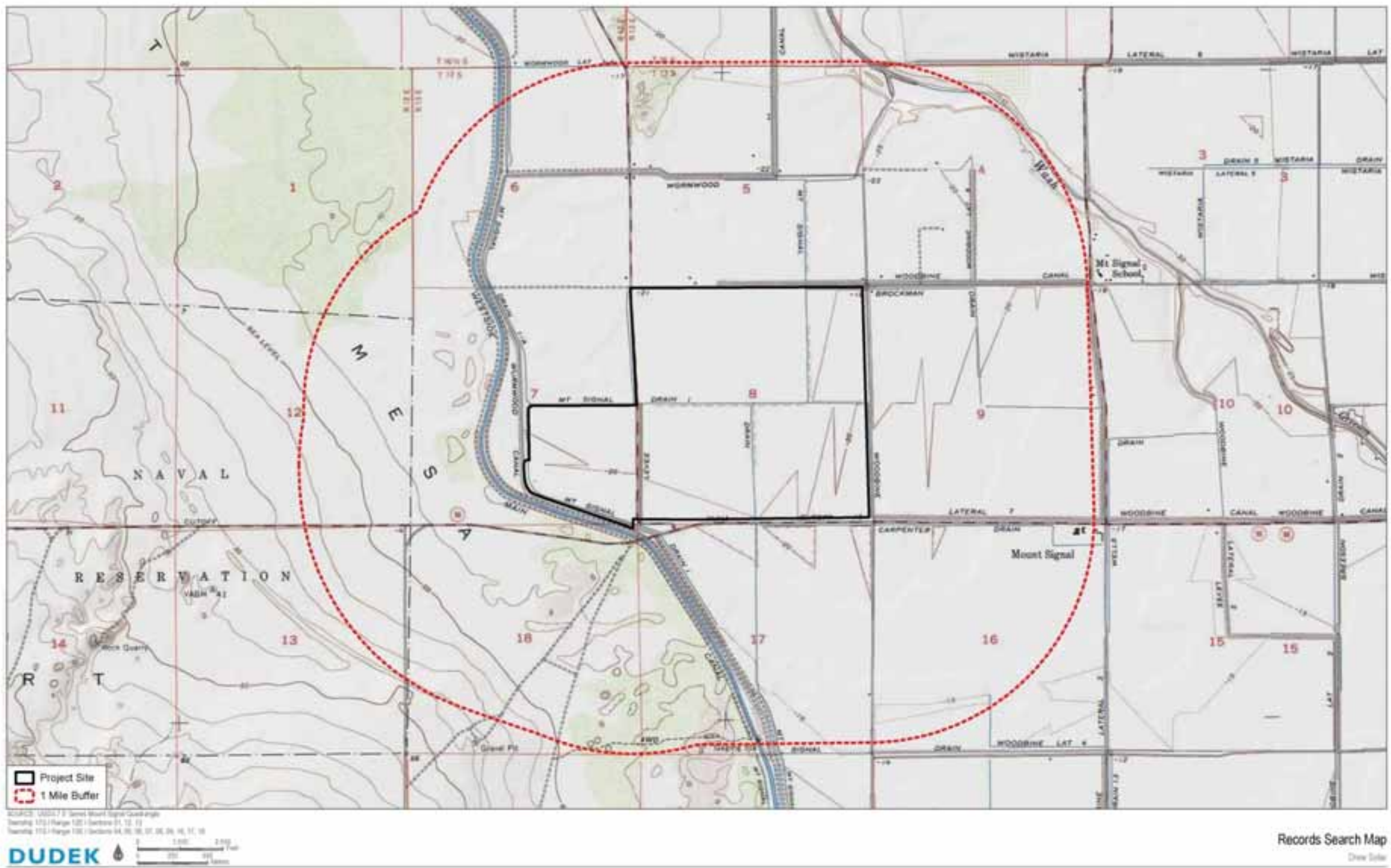
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November 28, 2017 10756.001-02

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Viejas Band of Kumeyaay Indians
1 Viejas Grade Rd.
Alpine, CA 91901

Subject: The Drew Solar Project, Imperial County, California

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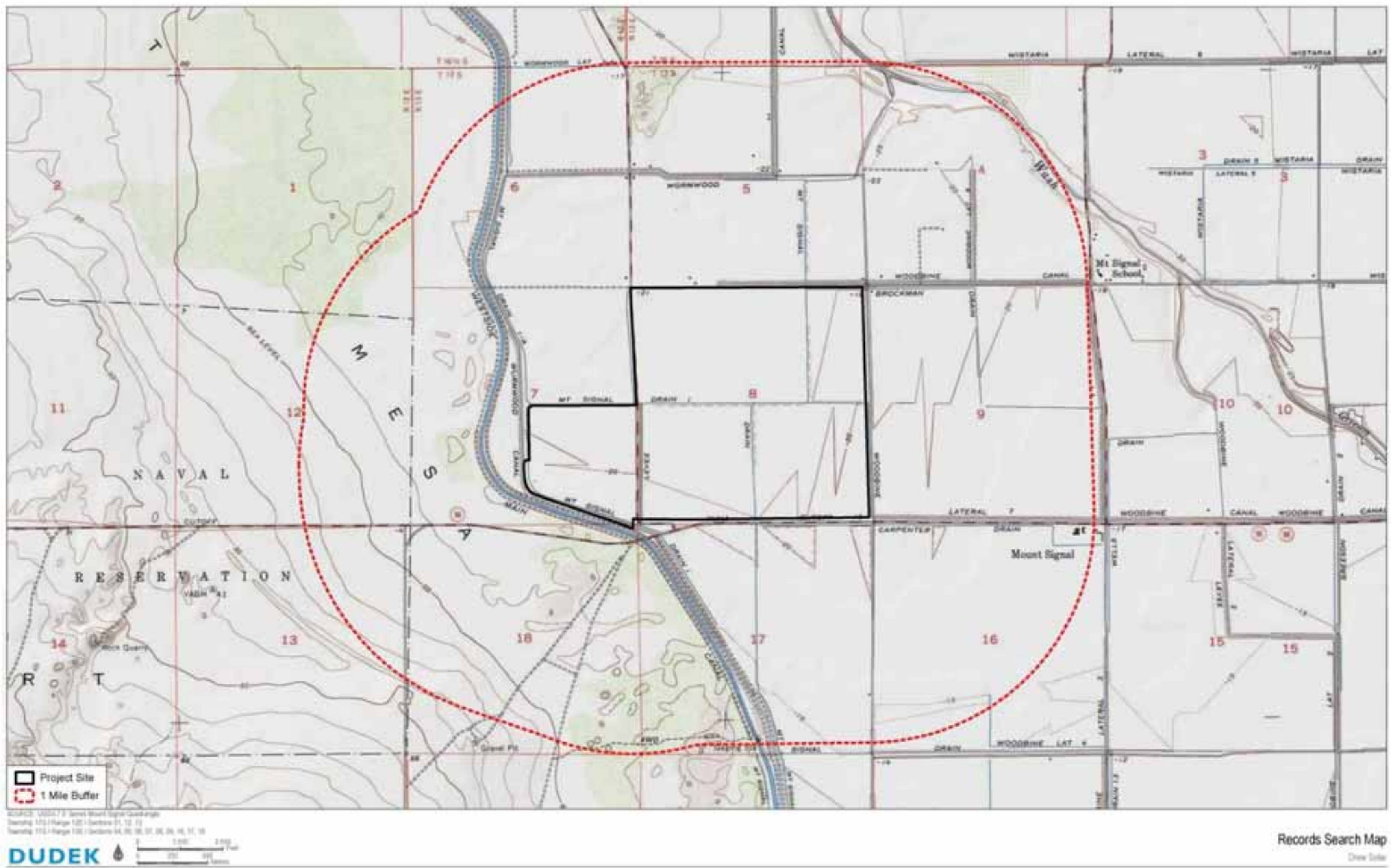
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VIEJAS
TRIBAL GOVERNMENT

P.O Box 908
Alpine, CA 91903
#1 Viejas Grade Road
Alpine, CA 91901

Phone: 6194453810
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viejas.com

December 20, 2017

Angela Pham
M.A, RPA
Dudek
605 Third Street
Encinitas, CA 92024

RE: The Drew Solar Project, Imperial County

Dear Ms. Pham,

In reviewing the above referenced project the Viejas Band of Kumeyaay Indians ("Viejas") would like to comment at this time.

The project area may contain many sacred sites to the Kumeyaay people. We request that these sacred sites be avoided with adequate buffer zones.

Additionally, Viejas is requesting, as appropriate, the following:

- All NEPA/CEQA/NAGPRA laws be followed
- Immediately contact Viejas on any changes or inadvertent discoveries.

Thank you for your collaboration and support in preserving our Tribal cultural resources. I look forward to hearing from you. Please call me at 619-659-2312 or Ernest Pingleton at 619-659-2314, or email, rteran@viejas-nsn.gov or epingleton@viejas-nsn.gov, for scheduling. Thank you.

Sincerely,

Ray Teran, Resource Management
VIEJAS BAND OF KUMEYAAY INDIANS

CONFIDENTIAL APPENDIX C

Cultural Resources Overview Map and New DPR Forms

DUDEK

MAIN OFFICE
605 THIRD STREET
ENCINITAS, CALIFORNIA 92024
T 760.942.5147 T 800.450.1818 F 760.632.0164

July 18, 2018 10756

Drew Solar
1166 Avenue for the Americas, Ninth Floor
New York, New York, 10036

Subject: Historic Resource Evaluation for the Drew Solar Project, Imperial County, California

To whom it may concern:

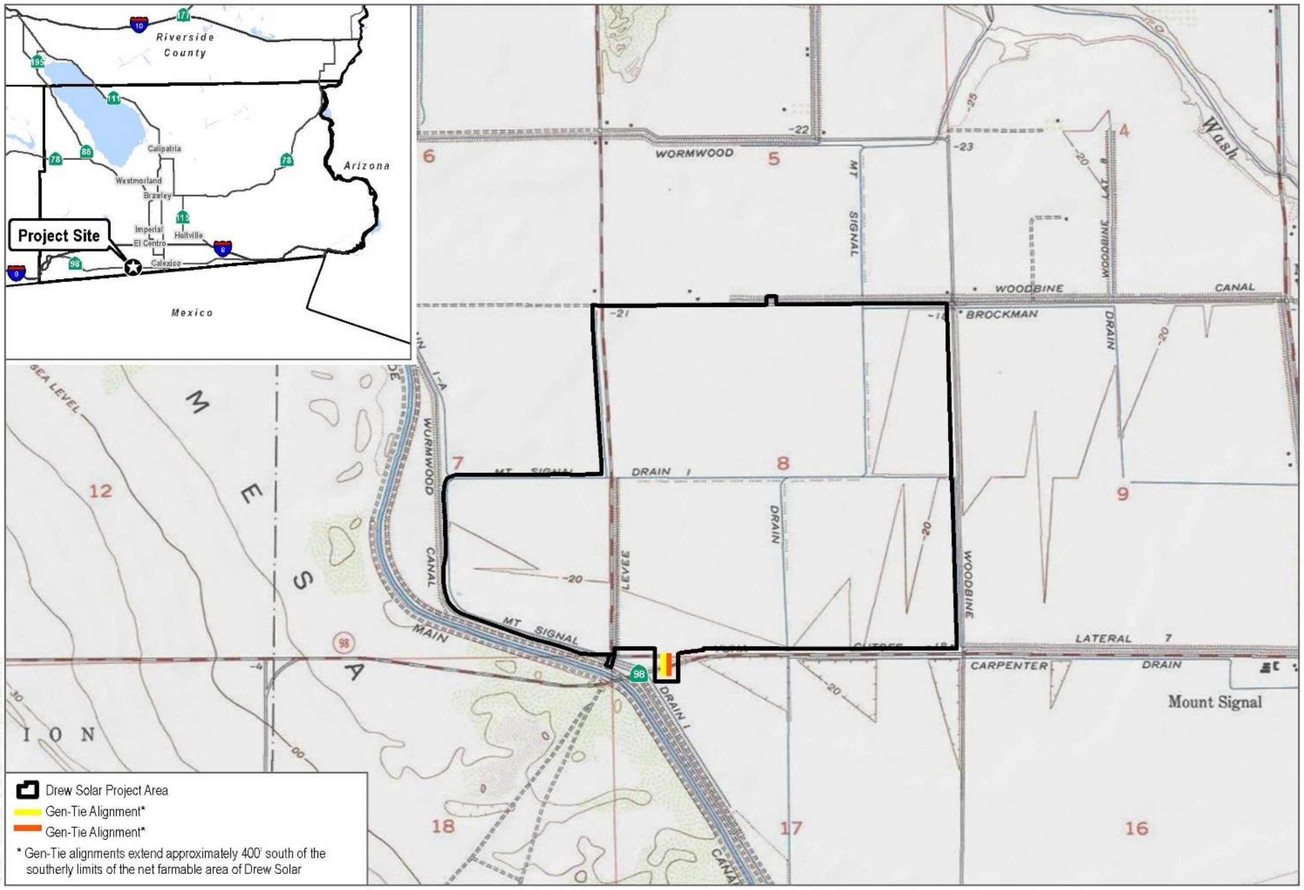
Dudek prepared a historic resource evaluation report for the Drew Solar Project (project), located approximately 6.5 miles southwest of the City of El Centro, Imperial County, California (Figure 1). This study included an intensive-level cultural resources survey, archival research, and evaluation of nine (9) irrigation canal/drainage ditch segments (Figure 2) in consideration of National Register of Historic Places (NRHP) and California Register of Historical Resources (CRHR) designation criteria and integrity requirements. The Project site consists of six Assessor's Parcel Numbers (APNs 052-170-031, 052-170-032, 052-170-037, 052-170-039, 052-170-056, and 052-170-067) that total approximately 859.3 gross acres (762.8 net acres) of land that was previously used for agriculture. The entire 859.3 gross acres (762.8 net acres) constitutes the cultural resources project area.

This study was completed under the provisions of local regulations as well as the California Environmental Quality Act (CEQA). Public Resources Code (PRC) Section 5024.1, Title 14 California Code of Regulations (CCR) Section 15064.5 of the CEQA Guidelines, and PRC Sections 21083.2 and 21084.1 were also used as basic guidelines for this cultural resources study (Governor's Office of Planning and Research 1998). PRC Section 5024.1 requires the identification and evaluation of cultural resources to determine their eligibility for the CRHR.

Nine cultural resources, consisting of historic irrigation canals designated as: DS-I-1, DS-I-2, DS-I-3 (Wormwood Lateral 1 segment), DS-I-4, P-13-013073 (Woodbine canal segment), P-13-013079 (Mt. Signal Drain Segment), P-13-013074 (Woodbine Lateral 7), DS-I-8 (Carr Drain), and DS-I-9 (Mt. Signal Drain No. 1-B) were identified within the project area during the intensive-level pedestrian survey conducted by Dudek on November 20, 2017 and February 21, 2018

This evaluation report was prepared by Dudek architectural historians Sarah Corder, MFA and Samantha Murray, MA, both of whom meet the Secretary of the Interior's Professional Qualification Standards for architectural history.

Figure 1. Project Location Map



SOURCE: Revolution Labs, 2018; USGS 7.5-Minute Series Mount Signal Quadrangle

DUDEK 0 1,000 2,000 Feet

FIGURE 1

Project Location

Cultural Resources Report for the Drew Solar Project

Figure 2. Canal/Drainage Segments within the Project Area

Figure 3. Cultural Resources Overview Map

FIGURE 3
Canal/Drainage Segments within the Project Area
Cultural Resources Report for the Drew Solar Project

PROJECT DESCRIPTION AND LOCATION

The Drew Solar Project is located in Imperial County, California, approximately 6.5 miles southwest of the city of El Centro, California, and 7.5 miles directly west of Calexico, California. The Project site is generally located south of Kubler Road, east of Westside Main Canal, north of State Route 98, and west of Pulliam Road. The U.S./Mexico border is approximately 1.85 miles south of the Project area. The project is located on agricultural land owned by Imperial Irrigation District (IID). Specifically, the project is located in Township 17 South, Range 13 East, Sections 7 and 8 of the Mount Signal, California USGS 7.5 Minute Series Quadrangles (Figure 1).

The project site consists of approximately 859.3 gross acres (762.8 net acres) of land that have been previously used for agriculture. The Project site is located on APNs 052-170-031, 052-170-032, 052- 170-037, 052-170-039, 052-170-056, and 052-170-067.

The project will use solar photovoltaic (PV) technology to convert sunlight directly into direct current (DC) electricity. The Project may include only one PV technology or a combination of various PV technologies, including but not limited to crystalline silicon-based systems, thin-film systems, perovskites, and may include energy storage. The project also proposes to construct the Project's generation interconnection (gen-tie) transmission lines from the south end of the Project site running south across Drew Road and State Route 98 into the existing Drew Switchyard located on APN 052-190-039. The gen-ties alignment will extend approximately 400 feet south of the southerly limits of the net farmable area of the Project APE. The gen-ties will consist of transmission structures that will require drilling, to a maximum depth of 10 feet, for pole foundations. Following the setting of structures, conductor will be installed via use of pullers and from bucket trucks. The Project also includes a utility scale energy storage system.

Site preparation would be planned and designed to minimize the amount of earth movement required for the Project to the extent feasible. The hydrology design would be given first priority in order to protect the Project's facilities and adjacent facilities including any IID/County facilities from large storm events. It is the intent of the project to support the panels on driven piles. Additional compaction of the soil in order to support the building and traffic loads as well as the PV module supports may be required and is dependent on final project engineering design.

The on-site drainage patterns would be maintained to the greatest extent possible. It will be necessary to remove, relocate and/or fill in 30 x 30 foot portions of the existing private drainage ditches or delivery canals to accommodate the final panel layout for the Project (as indicated by the pink dots shown on Figure 2). As for IID facilities, the drain and canal connections will be modified based on the final engineering design for these facilities in accordance with IID and the County standards to be sure that the purpose for the facilities would still be met.

During construction, temporary facilities would be developed on site to facilitate the construction process. These facilities may include construction trailers, a temporary septic system or holding tank, parking areas, material receiving / storage areas, water storage ponds, construction power service, recycling / waste handling areas, and others. These facilities would be located at the construction areas designated on the final site plan(s).

REGULATORY SETTING

While there is no federal nexus for this project, the subject property was evaluated in consideration of the National Register of Historic Places (NRHP) designation criteria and integrity requirements.

National Register of Historic Places

The NRHP is the United States' official list of districts, sites, buildings, structures, and objects worthy of preservation. Overseen by the National Park Service, under the U.S. Department of the Interior, the NRHP was authorized under the National Historic Preservation Act, as amended. Its listings encompass all National Historic Landmarks, as well as historic areas administered by the National Park Service.

NRHP guidelines for the evaluation of historic significance were developed to be flexible and to recognize the accomplishments of all who have made significant contributions to the nation's history and heritage. Its criteria are designed to guide state and local governments, federal agencies, and others in evaluating potential entries in the NRHP. For a property to be listed in or determined eligible for listing, it must be demonstrated to possess integrity and to meet at least one of the following criteria:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

Integrity is defined in NRHP guidance, "How to Apply the National Register Criteria," as "the ability of a property to convey its significance. To be listed in the NRHP, a property must not only be shown to be significant under the NRHP criteria, but it also must have integrity". NRHP guidance further asserts that properties be completed at least 50 years ago to be considered for eligibility. Properties completed fewer than 50 years before evaluation must be proven to be "exceptionally important" (criteria consideration G) to be considered for listing.

State

California Register of Historical Resources

In California, the term "historical resource" includes but is not limited to "any object, building, structure, site, area, place, record, or manuscript which is historically or archaeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California" (California Public Resources Code Section 5020.1(j)). In 1992, the California legislature established the CRHR "to be used by state and local agencies, private groups, and citizens to identify the state's historical resources and to indicate what properties are to be protected, to the extent prudent and feasible, from substantial adverse change" (California Public Resources Code Section 5024.1(a)). The criteria for listing resources on the CRHR were expressly developed to be in accordance with previously established criteria developed for listing in the NRHP, enumerated below. According to California Public Resources Code Section 5024.1(c)(1–4), a resource is considered historically significant if it (i) retains "substantial integrity," and (ii) meets at least one of the following criteria:

(1) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.

(2) Is associated with the lives of persons important in our past.

(3) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.

(4) Has yielded, or may be likely to yield, information important in prehistory or history.

In order to understand the historic importance of a resource, sufficient time must have passed to obtain a scholarly perspective on the events or individuals associated with the resource. A resource less than 50 years old may be considered for listing in the CRHR if it can be demonstrated that sufficient time has passed to understand its historical importance (see 14 CCR 4852(d)(2)).

The CRHR protects cultural resources by requiring evaluations of the significance of prehistoric and historic resources. The criteria for the CRHR are nearly identical to those for the NRHP, and properties listed or formally designated as eligible for listing in the NRHP are automatically listed in the CRHR, as are the state landmarks and points of interest. The CRHR also includes properties designated under local ordinances or identified through local historical resource surveys.

California Environmental Quality Act

As described further below, the following CEQA statutes and CEQA Guidelines are of relevance to the analysis of archaeological, historic, and tribal cultural resources:

- California Public Resources Code Section 21083.2(g) defines "unique archaeological resource."
- California Public Resources Code Section 21084.1 and CEQA Guidelines Section 15064.5(a) define "historical resources." In addition, CEQA Guidelines Section 15064.5(b) defines the phrase "substantial adverse change in the significance of an historical resource." It also defines the circumstances when a project would materially impair the significance of an historical resource.
- California Public Resources Code Section 21074(a) defines "tribal cultural resources."
- California Public Resources Code Section 5097.98 and CEQA Guidelines Section 15064.5(e) set forth standards and steps to be employed following the accidental discovery of human remains in any location other than a dedicated ceremony.
- California Public Resources Code Sections 21083.2(b)-(c) and CEQA Guidelines Section 15126.4 provide information regarding the mitigation framework for archaeological and historic resources, including examples of preservation-in-place mitigation measures; preservation-in-place is the preferred manner of mitigating impacts to significant archaeological sites because it maintains the relationship between artifacts and the archaeological context and may also help avoid conflict with religious or cultural values of groups associated with the archaeological site(s).

More specifically, under CEQA, a project may have a significant effect on the environment if it may cause "a substantial adverse change in the significance of an historical resource" (California Public Resources Code Section 21084.1; CEQA Guidelines Section 15064.5(b).) If a site is either listed or eligible for listing in the CRHR, or if it is included in a local register of historic resources or identified as significant in a historical resources survey (meeting the requirements of California Public Resources Code Section 5024.1(q)), it is a "historical resource" and is presumed to be historically or culturally significant for purposes of CEQA (California Public Resources Code Section 21084.1; CEQA Guidelines Section 15064.5(a)). The lead agency is not precluded from determining that a resource is a historical resource even if it does not fall within this presumption (California Public Resources Code Section 21084.1; CEQA Guidelines Section 15064.5(a)).

A "substantial adverse change in the significance of an historical resource" reflecting a significant effect under CEQA means "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired" (CEQA Guidelines Section 15064.5(b)(1); California Public Resources Code Section 5020.1(q)). In turn, CEQA Guidelines section 15064.5(b)(2) states the significance of an historical resource is materially impaired when a project:

1. Demolishes or materially alters in an adverse manner those physical characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for, inclusion in the California Register of Historical Resources; or
2. Demolishes or materially alters in an adverse manner those physical characteristics that account for its inclusion in a local register of historical resources pursuant to section 5020.1(k) of the Public Resources Code or its identification in an historical resources survey meeting the requirements of section 5024.1(g) of the Public Resources Code, unless the public agency reviewing the effects of the project establishes by a preponderance of evidence that the resource is not historically or culturally significant; or
3. Demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its eligibility for inclusion in the California Register of Historical Resources as determined by a lead agency for purposes of CEQA.

Pursuant to these sections, the CEQA inquiry begins with evaluating whether a project site contains any "historical resources," then evaluates whether that project will cause a substantial adverse change in the significance of a historical resource such that the resource's historical significance is materially impaired.

If it can be demonstrated that a project will cause damage to a unique archaeological resource, the lead agency may require reasonable efforts be made to permit any or all of these resources to be preserved in place or left in an undisturbed state. To the extent that they cannot be left undisturbed, mitigation measures are required (California Public Resources Code Section 21083.2[a], [b], and [c]).

California Public Resources Code Section 21083.2(g) defines a unique archaeological resource as an archaeological artifact, object, or site about which it can be clearly demonstrated that without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1. Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.

2. Has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. Is directly associated with a scientifically recognized important prehistoric or historic event or person.

Impacts to non-unique archaeological resources are generally not considered a significant environmental impact (California Public Resources Code section 21083.2(a); CEQA Guidelines Section 15064.5(c)(4)). However, if a non-unique archaeological resource qualifies as tribal cultural resource (California Public Resources Code Section 21074(c), 21083.2(h)), further consideration of significant impacts is required.

CEQA Guidelines Section 15064.5 assigns special importance to human remains and specifies procedures to be used when Native American remains are discovered. As described below, these procedures are detailed in California Public Resources Code Section 5097.98.

Local

Imperial County

Section III(B) of the Imperial County Conservation and Open Space Element describes the cultural resources, goals and objectives to protect such resources (County of Imperial 2016). The planning goals and objectives are described below.

Goal 3 of the goals and objectives section of the Imperial County Conservation and Open Space Element addresses the preservation of cultural resources. Goal 3 states that the County will "preserve the spiritual and cultural heritage of the diverse communities of Imperial County." (County of Imperial 2016). Three objectives are enumerated to assist in implementation of the goal:

- Objective 3.1: Project and preserve sites of archaeological, ecological, historical, and scientific value, and/or cultural significance.
- Objective 3.2: Develop management strategies to preserve the memory of important historic periods, including Spanish, Mexican, and early American settlements of Imperial County.
- Objective 3.3: Engage all local Native American Tribes in the protection of tribal cultural resources, including prehistoric trails and burials sites.

BACKGROUND RESEARCH

This study consisted of pre-field, background, and resource-specific research from a variety of sources, including a records search at the South Coastal Information Center (SCIC) at San Diego State University and research conducted of the IID archives.

CHRIS Records Search

On November 15, 2017, Dudek conducted a search of the California Historical Resources Information System (CHRIS) at the SCIC, located on the campus of San Diego State University, California. The search included any previously recorded cultural resources and investigations within a one-mile radius of the project area. The CHRIS search also included a review of the NRHP, the CRHR, the California Points of Historical Interest list, the California Historical Landmarks list, the Archaeological Determinations of Eligibility list, and the California State Historic Resources Inventory list. Confidential Attachment A provides the records search results maps and a complete bibliography of all prior cultural resources studies occurring within one-mile of the project area.

Previous Cultural Resources Studies

Thirteen (13) cultural resources studies have been previously conducted within one-mile of the Project area. None of these are located within the project area. All studies have been conducted within one-mile of the Project area between 1975 and 2012. Relevant studies to the Project detailed in Table 1 and are discussed in the section below.

Table 1
Previous Cultural Resources Studies within the Project Area

Year	Author	SCIC Report ID	Report Title
1979	Gallegos, Dennis	IM-00203	Class II Cultural Resource Inventory East Mesa and West Mesa Regions, Imperial Valley, California, Volume I
1980	Davis, Emma Lou	IM-00207	Class II Cultural Resource Inventory East Mesa and West Mesa Regions, Imperial Valley, California
1980	Von Werlhof, Jay and Karen McNitt	IM-00210	Archaeological Examinations of the Republic Geothermal Field, East Mesa, Imperial County
1999	Hupp, Jill	IM-00698	Historical Architectural Survey Report Pavement Rehabilitation and Shoulder, Bridge, Culvert Widening Project, Imperial County, California
1999	Schaeffer, Jerry, Drew Pallette, Collin O'Neill, and Jim Eighmey	IM-00766	Extended Phase I Study of Eight Archaeological Sites (VA-IMP-1427, -3969, -6914, -6915, -6916, -6918, -6920, -6923) on State Route 98, Imperial County, California
1990	Pigniolo, Andrew, Roxanna Phillips, and Dennis Gallegos	IM-1057	Cultural Resources Study of the Mount Signal and Dixie Ranch Imperial County Prison Alternatives Imperial County, California
1975	Ritter, Eric W.	IM-01275	An Analysis of Cultural Resources Along the Proposed Yuha Desert ORV Courses

Table 1
Previous Cultural Resources Studies within the Project Area

Year	Author	SCIC Report ID	Report Title
2011	Pigniolo Andrew, Carol Serr, Jose Aguilar, and Frank Dittmer	IM-01442	Cultural Resource Survey for a Portion of the Centinela Solar Energy, LLC Project Area, Imperial County, California
2011	Mitchell, Patricia T.	IM-01464	Inventory Report of the Cultural Resources within the Centinela Solar Energy Gen Tie Line, Imperial County, California
2012	Mitchell, Patricia	IM-01490	Evaluation Letter Report for the Centinela Solar Energy Gen-Tie Line Project, Imperial County, California
2011	Glenny, Wayne	IM-01498	Draft Archaeological Survey Investigation for the San Diego County Water Authority Fish Pond, Imperial County, California
2011	Davis, Shannon, Jennifer Krintz, Shelby Gunderman, and Sinead Ni Ghabhlain	IM-01515	Inventory, Evaluation, and Analysis of Effects on Historic Resources within the Area of Potential Effect of the Centinela Solar Energy, LLC, Imperial County, California
2011	Davis, Shannon	IM-01516	Final Inventory, Evaluation, and Analysis of Effects on Historic Built Environment Properties within the Area of Potential Effect of the Imperial Solar Energy Center, South Imperial County, California

IM-01442

Laguna Mountain Environmental conducted an archaeological survey of approximately 2,165 acres of agricultural land as part of the Centinela Solar Energy (CSE), LLC Project, Imperial County, in 2011. The CSE project is located directly east of the proposed Drew Solar project. The study addressed the CSE project portions that are located on private lands. The archaeological investigation included a records search of the project area and a one-mile buffer around the project, at the SCIC, literature review, historic maps, and an intensive pedestrian survey.

The records search indicated that nine cultural resources have been identified within a one-mile radius of the project area; two of which are located within the project (CA-IMP-6641, a lithic and ceramic scatter associated with the past shoreline of Lake Cahuilla, and P-13-008983, a segment of a historic age agricultural irrigation canal). The field survey identified 13 previously unrecorded historic-age cultural resources within the project area. The resources include segments of the Woodbine Canal and Laterals (P-13-013073,-013074,-013075,-013076,-013077), portions of the Brockman Drain (P-13-013078), portions of the Mt. Signal Drain (P-13-013079 and P-13-013080), the Carpenter Drain (P-13-013081), the Wells Drain (P-13-013082), two historic residential structures (P-13-013083 and P-13-013084), and a historic isolate (P-13-13085). The archaeological crew relocated one (P-13-008983) of the two previously recorded cultural resources during the field survey.

Archaeological monitoring was recommended during all ground disturbing activities due to the presence of CA-IMP-6631 within the project area. No formal evaluations of the various irrigation canals or the residential structures were conducted by Laguna Mountain Environmental. It was recommended that impacts to the irrigation structures be avoided and that the resources should be incorporated into open space easements. If the structures could not be avoided during project implementation, additional documentation and recording was recommended to evaluate and mitigate impacts to the resources.

IM-01515

ASM Affiliates Inc. conducted a survey for historic resources for the Centinela Solar Energy, (CSE) LLC Project, Imperial County, California, in 2011. The CSE project is located directly east of the proposed Drew Solar project. The study identified and evaluated historic resources within the project area for eligibility for inclusion in the NRHP and the CRHR.

The study identified sixteen (16) historic resources that are more than 45 years old located within the project area: the Westside Main Canal, Wormwood (P-13-8983) and Woodbine (P-13-13073) Canals, the town of Mount Signal, three (3) farm complexes, an agricultural building, and eight (8) residential buildings,. One NRHP eligible historic resource was identified, the Westside Main Canal (CA-IMP-7834). No significant visual, auditory, or atmospheric effects were identified as the result of the evaluation of indirect effects on the Westside Main Canal. The other fifteen (15) historic resources were determined ineligible for listing in the NRHP and the CRHR.

Previously Recorded Cultural Resources

The SCIC records indicate that no previously recorded cultural resources are located within the project area. The records also indicate that an additional sixteen (16) cultural resources have been recorded within the one-mile search buffer of the proposed Project (Table 2). Three of the previously recorded resources (P-13-008983, P-13-013073, and P-13-013079) are located directly adjacent to the current Project. These three resources are discussed below in the next section. Of the sixteen cultural resources, three (P-13-008334, P-13-008983, and P-13-013073) have been evaluated and have been determined not eligible for listing on the CRHR and the NRHP.

Table 2
Previously Recorded Cultural Resources Within One-Mile of the Project Area

Primary Number	Trinomial	Resource Type	Description	Recorded By/Date	NRHP/CRHR Status
P-13-008334	CA-IMP-8334	Historic	Westside Main Canal	AECOM, 2011	Not Eligible
P-13-008983	-	Historic	Wormwood Canal, Lateral-7	Jill Hupp, 1999; Frank Dittmaer and Alette van den Hazelkamp, 2010;Jennifer Krintz, 2011	Not Eligible
P-13-013073	-	Historic	Woodbine Canal and Laterals 2,4,7,8	Andrew Pigniolo, 2010; Jennifer Krintz, 2011	Not Eligible
P-13-013074	-	Historic	Woodbine Lateral 7	Andrew Pigniolo, 2010	No Formal Recommendation
P-13-013075	-	Historic	Woodbine Lateral 7A	Pepe Aguilar, 2010	No Formal Recommendation
P-13-013078	-	Historic	Brockman Drain	Pepe Aguilar, 2010	No Formal Recommendation
P-13-013079	-	Historic	Mount Signal Drain	Andrew Pigniolo, 2010	No Formal Recommendation
P-13-013081	-	Historic	Carpenter Drain	Frank Dittmer, 2010	No Formal Recommendation
P-13-013083	-	Historic	Single Family Residence	Pepe Aguilar, 2010	No Formal Recommendation
P-13-013084	-	Historic	Single Family Residence	Pepe Aguilar, 2010	No Formal Recommendation
P-13-013837	CA-IMP-11784	Historic	Historic Refuse Scatter	M. Bray, 2011	No Formal Recommendation

P-13-008983 (Wormwood Canal, Lateral 7 and Drain)

This irrigation canal was originally recorded by Jill Hupps of Caltrans in 1999. This section of the Wormwood Canal, which was first built in 1911, was evaluated and recommended not eligible for listing in the NRHP because it was realigned and lined with concrete, replacing its original earthen lining, thereby affecting the resource’s integrity. ASM Affiliates Inc. revisited and evaluated the canal in 2011 for the Centinela Solar Energy Project. ASM concurred with Caltrans findings and recommended that the Wormwood Canal and Drain are not eligible for listing in the NRHP and the CRHR.

P-13-013073 (Woodbine Canal)

Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Woodbine Canal in 2010. According to Pigniolo, the canal was one of the earliest irrigation canals in the Imperial Valley as it is shown on the 1915 El Centro 15- minute USGS topographic quad map. ASM Affiliates Inc. revisited and evaluated the canal in 2011 for the Centinela Solar Energy Project. ASM determine that the canal was not significant because it was lined with concrete in the 1950s and 1960s. The integrity of the original 1915 craftsmanship was not retained, therefore the canal was not recommended eligible for the NRHP or the CRHR.

P-13-013074 (Woodbine Lateral 7 Canal)

Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Woodbine Canal in 2010. Pigniolo noted that no historic age features were observed associated with the drain and that the drain is part of a larger historic age agricultural system. No formal evaluation was conducted for the resource.

P-13-013079 (Mt. Signal Drain)

Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Mt. Signal Drain in 2010. Pigniolo noted that no historic age features were observed associated with the drain and that the drain is part of a larger historic age agricultural system. No formal evaluation was conducted for the resource.

Historic Archival Research

Historic Aerial Photographs

Historic aerial photographs (years available: 1953, 1996, 2002, 2005, 2009, 2010, and 2012) reveal that the project area has been utilized for agricultural development since 1953. The irrigation canals located within the project site date to at least 1953. The photographs reveal that the canal locations have not changed since 1953. No other historic age structures are located within the project area in the photos.

Imperial Irrigation District Archival Research

The IID maintains a webpage of previously prepared historic content related to the broad scale water distribution and irrigations systems attributed to the development of Imperial Valley. These documents were used in preparation of the historic context provided in this report, and include:

- A Century of Service: Imperial Irrigation District (IID 2011)

- IID: The First 40 Years (Dowd 1956)
- IID Water History (IID 2015)

Of particular relevance to the current project was Dowd's 1956 manuscript, which details the historic development of the IID and subsequent rise of the City of Imperial. This manuscript was used as a baseline source for development of the historic context.

Dudek also contacted with Sherry L. O'Malley, Water Vault – Procurator and Water Engineer at the IID on January 3, 2018 to inquire about original dates of construction for all irrigation components within the project area. Ms. O'Malley responded on January 8, 2018 and stated she would research the archives for drawings. This report will be updated upon receipt of any consequential information from the IID water vault archives.

HISTORIC CONTEXT

Water Conveyance in Imperial Valley

The rapid development and sustainability of Imperial Valley rests solely on water conveyance systems. As stated by Dowd (1956), "There are few, if any, other areas in the United States which are so dependent upon the importation of water for all their requirements." Historically, Imperial Valley was considered an inhospitable place. It is located within the large enclosed basin of the Colorado Desert and confined between the western Coast Range Mountains and the eastern Chocolate Mountains. The high temperatures and low average rainfall of the area proved to many of the first European explorers that the Imperial Valley was worthless and irreclaimable land (Farr 1918). Although the first European exploration of what is now Imperial County was accomplished by the Spanish in 1540, when Hernando de Alarcón ascended the Colorado River likely up to present day Yuma and claimed Alta (upper) California for the king of Spain, the area remained largely unexplored for the two centuries that followed (Lawton 1976; Warren 1984).

It was not until the 1770's that travel through Imperial Valley resumed with the onset of the de Anza expedition. In 1774, Captain Juan Bautista de Anza of the Spanish Army sought to provide a major land use route for the Spanish colonization of California. His overland route departed from Sonora Mexico (south of present day Arizona) to the future city of Los Angeles. The epic expedition successfully crossed the Colorado River from the west, traveled along the modern California/Mexico border, passed through Imperial Valley, and ended at its destination at the Mission San Gabriel Arcángel. The expedition brought with it achievement by which other Spanish and Mexican settlers followed. Subsequent use of the Anza Trail was interrupted by the 1781 Quechan revolt, but resumed in the early nineteenth century (Lawton 1976; Warren 1984).

This overland route was the first of many historic events that brought interest to Imperial Valley over the coming century. The Mexican-American war of 1846-1848, the Gold Rush in northern California, the development of the Butterfield Stage route, and explorations of potential railroad routes through the Colorado Desert opened the region up to possibilities of its development (Schaefer and Gunderman 2009). However, none of these events had as much impact on the development of Imperial Valley as did the possibility of harnessing water for the arid yet potentially fertile region.

Bringing Irrigation to Imperial Valley

The following historical information is summarized from IID: The First 40 Years (Dowd 1956), which was prepared by Mr. Dowd, Consulting Engineer and Executive Officer to the Board of Directors, Imperial Irrigation District. This manuscript presents the history of the Imperial Irrigation District and the subsequent development of the Imperial Valley from early development to the 1940's, and identified important periods, events, and patterns of development for Imperial Valley.

It was on one of the railroad corridor expeditions in 1853; led by Lieutenant R. S. Williamson of the U.S. Topographical Engineers, that geologist Dr. W. P. Blake discovered the possibility of irrigating Imperial Valley from the Colorado River. Blake observed a region of fertile soil capable of sustaining agriculture but lacking in water. He measured the dry bed of the Salton Sea at below sea level, a fact that made feasible the cutting of a canal from the Colorado River to the interior of the desert, which would bring with it a constant supply of water. Dr. Oliver Wozencraft, a proponent of irrigating Imperial Valley, lobbied support from the California legislature, who, in turn, asked Congress to convey six million acres to Wozencraft. He endeavored to secure action by Congress on his plan to bring potable water to the desert for over thirty years without success. Despite Wozencraft's failed attempts at reclamation, by his death in 1887, settlers and developers alike were eager to bring water to Imperial Valley.

Preliminary investigations into the feasibility of irrigating the Colorado Desert began in 1893 with the Colorado River Irrigation Company, but inability to procure financing quickly led to the company's demise. In 1896, the California Development Company was organized, under the direction of Charles Rockwood and George Chaffey, to take hold of the project. The proposed canal route would run from the diversion point at the Colorado River through lower California, Mexico, and back into the United States in order to reach Imperial Valley. To gain title to the Mexican lands, the California Development Company organized a Mexican subsidiary company in 1898 known as La Sociedad de Yrrigacion y Terrenos de la Baja California, S. A. With plans to colonize the region, the California Development Company divided Imperial Valley into districts of varying size, each with its own mutual water company.

By August 1900, construction of the first diversion canal and irrigation system was underway. The canal was excavated from the point of diversion from the Colorado River south about 4 miles into Mexico where it swung west and connected for forty miles within the Alamo River channel until it reached Sharp's Heading and turned north to the Salton Sea. A series of main canals was constructed to divert from Sharp's Heading into various stretches of Imperial Valley: Central Main, Boundary, West Side Main, and East Side Main. The Central Main Canal continued from the international boundary line and traveled north through the present cities of Brawley and Imperial; the Boundary Canal diverted west towards Calexico; the West Side Main Canal traveled west towards Calexico then north; and the East Side Main Canal traveled east then north to the eastern Salton Sea. Water delivery reached Calexico through the Boundary Canal less than one year after the start of construction. That same year, nearly 1,500 acres of land was put under crops.

Few natural resources existed for potable water prior to the construction of the irrigation system. Domestic use water had to be hauled to the Valley via the Southern Pacific Railroad. Once considered a barren wasteland, Imperial Valley was making good progress with colonization by the early 1900's. The Imperial Land Company, under the direction of the California Development Company, began laying out townsites in Imperial Valley based primarily on the density of purchased water stock. The town of Imperial was the first to be laid out with settlement commencing in 1901. Over a period of ten years from 1901 to 1911, irrigable land in Imperial Valley jumped from 1,500 acres to 220,000 acres. As the water flowed into the Valley, so did the people. In 1902, a year after the first water reached Calexico, nearly 2,000 settlers came to Imperial Valley. The population grew to seven times that amount within four years. To accommodate the growing population, the Southern Pacific Railroad constructed the Niland to Calexico branch rail. At the same time, the newly developed Imperial Valley broke apart from San Diego County to form its own government as Imperial County, with El Centro being designated as the County Seat.

The rapid colonization of Imperial Valley in the early 1900's strained the relationship between settlers and the California Development Company. Initial land and soil surveys were inaccurate leading to discrepancies with land titles, and water rights held by the California Development Company were called into question. The Reclamation Act was proposed in 1902 to take the Imperial Valley project from the California Development Company and organize it under Government control. Further dissatisfaction with California Development Company arose after hurried and negligible attempts to correct the heavily silt laden waters of the Colorado River ultimately led to grave damage to Imperial Valley following the massive flooding events of 1905 and 1906. The River break destroyed nearly 12,000 acres of cultivated land and over 30,000 acres of irrigable land, caused immense damage to Southern Pacific Company railroad lines; and severed the ties between settlers and the California Development Company. The River break took two years to repair, during which time the Salton Sea filled and expanded to a length of 50 miles and a width of 10 to 15 miles.

Preceding litigation brought to the California Development Company following the flood ultimately resulted in bankruptcy. In 1911, a petition for formation of an irrigation district was presented to the Imperial County Board of Supervisors. The IID was formed to acquire properties of the bankrupt California Development Company and its Mexican subsidiary. Over the span of a decade, IID completed improvements and repairs to the canal and distribution system, rebuilt the entire Westside Main Canal, received deeds to all of the properties of the California Development Corporation, and acquired 13 mutual water companies. Within a few years of acquiring the mutual companies, IID was delivering water to nearly 550,000 acres of Imperial Valley. Over a century later, IID is still servicing communities of the Imperial Valley. IID is the largest irrigation district in the nation and Imperial County ranks among the top ten agricultural counties in the nation. Ninety-eight percent of the water IID transports is used for agriculture and the remaining 2% is treated potable and delivered to the nine Imperial Valley cities (IID 2015).

Drainages and Laterals

Around the mid 1910's, there was a growing realization that drainage of the land in Imperial Valley was becoming necessary. High water tables were developing in several areas and crop production was at a loss due to inundation and saturation. Some of the mutual water companies started constructing miles of shallow ditches at the lower end of fields to drain surplus irrigation water; however, the surface waste ditches were considered a quick fix for a much larger drainage problem.

By the 1920's, investigations into ground water drainage solutions were sorely needed. The IID hired a consulting drainage engineer to plan the drainage system. What developed was a grid system of lines north-south and east-west, spaced at one mile intervals, and laid out over the entire Valley. Included in the design were observation wells used for noting elevation of the ground water table with required monthly checks of the wells. A comprehensive system of main drain outlets was installed in areas with a high water table. While 234 miles of deep drains were constructed by 1929, the drainage problem continued, due in part to the fact that the water table was perched on a compact and impervious geological strata in select portions of the Valley.

IID implemented an intensive program to initiate the development of a lateral drain system. The system consisted of deepening existing surface drains to a depth of 6 or 8 feet and constructing additional deep drains to serve as outlets. The drain systems were tailored to meet the needs of individual landowner following a survey and examination of their land. The use of farm tile drains was also implemented. The intensive program paid off; within one year, the IID had added 740 miles of lateral drains and 10 miles of tile drains to the drainage system.

HISTORIC RESOURCE EVALUATIONS

Nine cultural resources, consisting of historic irrigation canals and drainages designated as: DS-I-1, DS-I-2, DS-I-3 (Wormwood Lateral 1 segment), DS-I-4, P-13-013073 (Woodbine canal segment), P-13-013079 (Mt. Signal Drain Segment), P-13-013074 (Woodbine Lateral 7), DS-I-8 (Carr Drain), and DS-I-9 (Mt. Signal Drain No. 1-B) were identified within the project area during the intensive-level pedestrian surveys conducted by Dudek on November 20, 2017 and February 21, 2018. According to information obtained from the ParcelQuest online property information system on February 22, 2018, all of the nine cultural resources are owned by the IID-Trust Lands.

DS-I-1

Located between APN 052-170-039 and 052-170-067. The resource is bound by fallow agricultural land to the north and south, Drew Road to the east, and the Westside Main Canal to the west. The resource consists of a historic-age earthen canal that runs east to west. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately half-mile long. A crossing with a concrete pipe, measuring approximately two feet in diameter and twelve feet in length, is located in the center of the canal. Discarded terra cotta bricks and concrete fragments are present at the pipe location. No visible date stamp is available for the canal or the pipe. The canal is in fair condition (See Figure 4).

Figure 4. DS-I-1 – Overview of canal and concrete pipe drain looking west, 11/20/17, IMG_00001.

Evaluation of the DS-I-1 under NRHP/CRHR criteria included archival research. The date of construction for the earthen irrigation canal was not found during archival research, but a review of historic aerial photographs indicates that the canal was present in 1953 (NETR 2017). No previous recordings or evaluations of this canal segment were identified as a result of the CHRIS records research.

Despite the association with irrigation history and agricultural development in Imperial County, the lack of clear association with larger canals in the area suggests that this was a canal used by a single property owner for agricultural purposes and not part of a larger and more complex infrastructure. Thus, it does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The earthen canal segment is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, and it represents a ubiquitous piece of infrastructure seen throughout Imperial Valley. Therefore, DS-I-1 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, DS-I-1 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the concrete lateral canal segment retains requisite integrity of location, design, setting, workmanship, feeling, and association, it has no important historical associations and lacks architectural merit. As such, DS-I-1 is recommended not eligible under all NRHP and CRHR designation criteria.

DS-I-2

Located on APN 052-170-056. The resource is bound by fallow agricultural land to the north and south, Drew Road to the west, and Mount Signal Drain to the east. This resource consists of a historic age irrigation canal. The canal is earthen and runs east to west. The canal is approximately ten feet wide and five feet in depth. The entire canal is approximately half-mile long. A crossing with a concrete pipe and gate, measuring two feet in diameter and ten feet in length, is located in the center of the canal. No date stamp was observed for the canal or the pipe during the survey. The canal is in good condition and is likely maintained regularly (see Figure 5)

Figure 5. DS-I-2 – Overview of canal and concrete gate looking northeast, 11/20/17, IMG_00008.

Evaluation of the DS-I-2 under NRHP/CRHR criteria included archival research. The date of construction for the earthen irrigation canal was not found during archival research, but a review of historic aerial photographs indicates that the canal was present in 1953 (NETR 2017). No previous recordings or evaluations of this canal segment were found during the course of archival research. Despite the association with irrigation history and agricultural development history in Imperial County, the lack of clear association with larger canals in the area suggests that this was a canal used by a single property owner for agricultural purposes and not part of a larger and more complex infrastructure thus it does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The earthen canal segment is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, and it represents a ubiquitous piece of infrastructure seen throughout Imperial Valley. Therefore, DS-I-2 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, DS-I-2 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the earthen canal retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association it has no important historical associations and lacks architectural merit. As such, DS-I-2 is recommended not eligible under all NRHP and CRHR designation criteria.

DS-I-3 (Wormwood Lateral 1 segment)

Located on APN 052-170-056, this historic resource consists of a segment of the Wormwood Lateral 1 irrigation canal. The canal runs parallel and east of Drew Road. The southern portion of the canal ends at SR-98. This is an earthen canal and runs north to south. It measures approximately ten feet wide by six feet in depth. The entire canal is approximately one half-mile long. A concrete wall with the text stamp "Wormwood LAT 1" and two concrete and wood gates (gates lat-1 and 11) are located at the southern end of the canal. The southern gates have a date stamp of 1957. Two additional concrete and wood gates (gates 11A and 12) are located within the center on the canal. These gates have a date stamp of 1953. The canal is in good condition and is likely maintained regularly (See Figure6).

Figure 6. DS-I-3 – Overview of canal and gate 12 looking northeast, 11/20/17, IMG_00017.

Evaluation of the DS-I-3 under NRHP/CRHR criteria included archival research and review of previous evaluations of sections of the Wormwood Canal and the surrounding area. Constructed in 1911, the Wormwood Canal was one of the early canals in the Imperial County Irrigation District. In 1999, a section of Wormwood Canal was evaluated by Caltrans and recommended not eligible for listing in the NRHP due to alterations including lining the canal with concrete and realignment of the canal. In 2011, ASM evaluated Wormwood Canal again and concurred with the 1999 Caltrans finding of ineligibility. For the purposes of this evaluation, Dudek evaluated a segment of the Wormwood Lateral 1. Despite the clear association with irrigation history and agricultural development history in Imperial County, a single segment of a larger canal does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Canals, like many other types of linear features, have significance because they are parts of a larger and oftentimes complex system. Therefore, the significance of the canal is not tied to a specific segment, but to the canal as a whole. For this reason, many linear features are listed on the NRHP as historic districts with contributing and non-contributing segments and related infrastructure. Canal segments can have individual eligibility when associated with a particular farmstead or show a significant engineering or architectural feature. However, archival research did not identify any significant associations and this segment does not display any innovative architectural or engineering features that set it apart from other canal segments in the area. This canal segment further lacks the required significance for individual eligibility, as it is representative of a ubiquitous irrigation structure seen throughout the Imperial Valley. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The earthen canal, while associated with the Wormwood Canal is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, as it is part of a vast network of drainage canals of a similar type throughout the Imperial Valley. This resource represents a small segment of a much larger canal, and it represents a ubiquitous piece of infrastructure seen throughout Imperial Valley. Therefore, DS-I-3 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, DS-I-3 is recommended not eligible under NRHP/CRHR Criterion D/4. While DS-I-3 retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association it has no important historical associations and lacks architectural merit. As such, DS-I-3 is recommended not eligible under all NRHP and CRHR designation criteria.

DS-I-4

Located on APN 052-170-037, this resource consists of a historic age irrigation canal. The canal is bound by fallow agricultural fields to the north and south. The southern portion of the canal ends at Woodbine Lateral 7 Canal, adjacent to Pulliam Road to the east. The canal is concrete lined and runs east to west. It is approximately eight feet wide by four feet in depth. The entire canal is approximately one half-mile long, and connects to Woodbine Lateral 7 Canal to the east at gate 42. Small metal gates, measuring approximately 12 inches, are located along the northern portion of the canal in 50-foot intervals. These gates appear to feed water to the field located to the north of the canal. No date stamp was observed during the survey. The canal is in good condition and is likely maintained regularly (See Figure 7).

Figure 7. DS-I-4 – Overview of canal looking east, 11/20/17, IMG_00028.

Evaluation of the DS-I-4 under NRHP/CRHR criteria included archival research. The date of construction for the concrete irrigation canal was not found during archival research, but a review of historic aerial photographs indicates that the canal was not present in 1953 (NETR 2017). Given the use of concrete lining in this segment and the popularity of lining canals with concrete in the 1950s and 1960s throughout Imperial County suggests this date is likely accurate. No previous recordings or evaluations of this canal segment were found during the course of archival research. For the purposes of this evaluation, Dudek evaluated the canal segment that terminates at the Woodbine Lateral 7 Canal. Despite the association with irrigation history and agricultural development history in Imperial County, the lack of clear association with larger canals in the area suggests that this was a canal used by a single property owner for agricultural purposes and not part of a larger and more complex infrastructure thus it does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The concrete lined lateral canal segment is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, and it represents a ubiquitous piece of infrastructure seen throughout Imperial Valley. Therefore, DS-I-4 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, DS-I-4 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the concrete lateral canal segment retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association it has no important historical associations and lacks architectural merit. As such, DS-I-4 is recommended not eligible under all NRHP and CRHR designation criteria.

P-13-013073 (Woodbine canal segment)

Located on APN 052-170-031, this resource consists of a historic age irrigation canal. The resource runs parallel and south of Kubler Road. The western end of the canal is located at the intersection of Drew and Kubler Roads. The canal is concrete lined and runs east to west. The canal is approximately ten feet wide by five feet in depth. The entire canal is approximately one half-mile long. A concrete gate (gate 57) is located at the east end of the canal. The gate has a date stamp of 1959. This canal segment connects to the Woodbine Canal at gate 57 to the north. The canal is in good condition and is likely maintained regularly (See Figure 8).

> Two portions of the western portion of the Woodbine irrigation canal were recorded during survey of agricultural property (for a proposed solar project). The east-west aligned 0.5 mi. long western-most segment parallels the north side of Kubler Rd. on the southern border of Section 5, east of Drew Rd. Another 0.5 mi. east-west aligned portion was recorded starting 0.5 mi. to the east and ending at the (former) Mt. Signal School property southwest corner. The north-south oriented segment runs from the intersection of Kubler Rd. and Brockman Rd. (SW corner) down the west side of Brockman Rd. for just a little over 1 mi. (due to eastward „bulge‟ in section line). At SR 98, the canal heads east paralleling the north side of the highway. A 1 mi. east-west segment between Brockman Rd. and Rockwood Rd. was recorded during this survey, but the canal continues eastward for over 7 mi. to Anza Rd. The Woodbine Canal is shown on the 1915 El Centro 15‟ USGS quad. map, however, the canal channel was lined with concrete at a later date, sometime in the late 1950s/early1960s. There is a “1957” date stamp on a small elevation drop at the northwestern corner of Brockman Rd. and SR 98, and two gates along the north-south segment have “1979” date stamps. The segment of the canal between the two 1979 dated gates has concrete of a different appearance indicating an even more recent replacement. The segment of the canal is roughly 13 ft. across at the top, but depth is unknown since the canal was full of water. Features associated with the canal include a small elevation drop, a gate opening to Woodbine Lateral 7, a gate along the canal itself, and the Brockman Road

undercrossing. The canal segments appear to be well-maintained and the integrity of the features is good (Laguna Mountain 2010a)

Figure 8. P-13-013073 – Overview of concrete lined canal looking east, 11/21/17, IMG_00046.

Evaluation of P-13-013073 under NRHP/CRHR criteria included archival research and review of previous evaluations of this segment of the Woodbine Canal and the surrounding area. Constructed circa 1915, the Woodbine Canal was one of the early canals in the Imperial County. While it would have originally been an earthen canal, it was lined with concrete at some point during the 1950s and 1960s based on date stamps noted in previous recordings of sections of the canal. In 2010, Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Woodbine Canal and determined that it was one of the earliest irrigation canals in the Imperial Valley based on its appearance on the 1915 El Centro 15- minute USGS topographic quad map. In 2011, ASM evaluated this segment of the canal again founded the canal was not recommended eligible for the NRHP or the CRHR due to alterations that included concrete lining of the canal in the 1950s-1960s. For the purposes of this evaluation, Dudek evaluated the segment of the Woodbine Canal that runs along the northern boundary of the project area. Despite the clear association with irrigation history and agricultural development history in Imperial County, a single segment of a larger canal does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Canals, like many other types of linear features, have significance because they are parts of a larger and oftentimes complex system. Therefore, the significance of the canal is not tied to a specific segment, but to the canal as a whole. For this reason, many linear features are listed on the NRHP as historic districts with contributing and non-contributing segments and related infrastructure. Canal segments can have individual eligibility when associated with a particular farmstead or show a significant engineering or architectural feature. However, archival research did not identify any significant associations and this segment does not display any innovative architectural or engineering features that set it apart from other canal segments in the area. This canal segment further lacks the required significance for individual eligibility, as it is representative of a ubiquitous irrigation structure seen throughout the Imperial Valley. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The concrete lined drainage ditch, while associated with the Woodbine Canal is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, as it is part of a vast network of drainage canals of a similar type throughout the Imperial Valley. This resource represents a small segment of a much larger canal, and it represents a ubiquitous piece of infrastructure seen throughout Imperial Valley. The canal segment has been altered from its original materials and any evidence of original craftsmanship or artistic value would have been lost during the alterations. Therefore, P-13-013073 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, P-13-013073 is recommended not eligible under NRHP/CRHP Criterion D/4. Furthermore, it lacks the requisite integrity of materials, design and craftsmanship to be considered eligible due to significant alterations including concrete lining of the canal. As such, the segment of P-13-013073 is recommended not eligible under all NRHP and CRHR designation criteria.

P-13-013079 (Mt. Signal Drain Segment)

This resource consists of a segment of the Mount Signal Drain and Mount Signal Drain 1. The segment is located on APN 052-170-032 and between APNs 052-170-031, 052-170-056, 052-170-037, 052-170-056, and north of 052-170-039. The drain starts from the north from Kubler Road and runs south. The western portion of the drain crosses Drew Road and ends at Mandrapa Road. The southern drain ends at SR-98. Mount Signal Drain is earthen and runs north to south. Mount Signal Drain 1 runs east to west from the Mount Signal Drain. The drainage is approximately eight feet wide by ten feet in depth. The drain is approximately two miles in length. The drain is in good condition and is likely maintained regularly (See Figure 9).

> The Mt. Signal Drain is shown on the USGS quad. map to meander for nearly 4 mi. beginning south of SR 98 (at -6 ft. elev.) and emptying into Greeson Wash about 0.6 mi. south of Lyons Rd.(at -45 ft. elev.). Only two portions of this earthen irrigation drainage channel occur within the current survey area of agricultural

property (for a proposed solar project). The northern portion has a northeasterly-aligned 2,500 ft. segment, starting at Fisher Rd. on the border between sections 4 & 5 (along the eastern boundary of parcel 052-170-052) that is nearly 65 ft. across -- from bank to bank. An east-west segment just south of Fisher Rd. (immediately west of Pulliam Rd.) is approximately 1,190 ft. long and varies from 60-75 ft. across. The channel turns south at the boundary between parcels 052-170-019 & 052-170-018 where it narrows to about 55 ft. across. This segment extends approximately 2,390 ft. north/south (within the project area) to Kubler Rd. The drain continues to the south outside the project area. The southern portion within the project area begins south of SR 98 (between Drew and Pulliam roads) and extends along the east side of parcel #052-190-007 to its southern end. Here (outside the project area) the channel turns southeast before heading eastward. No historic-age features were observed within these portions of the drain, but it is part of the larger historic-age agricultural system. The drain appears to retain good integrity and is probably maintained by regular clearing with a backhoe (Laguna Mountain 2010b).

Figure 9. P-13-013079 – Overview of drain looking west, 11/21/17, IMG_00042.

Evaluation of P-13-013079 under NRHP/CRHR criteria included archival research and review of previous evaluations of this segment of the Mt. Signal Drain Segment and the surrounding area. A date of construction for the Mt. Signal Drain was not found during archival research. In 2010, Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Mt. Signal Drain and noted no historic features and made no determination of eligibility under NRHP/CRHR. For the purposes of this evaluation, Dudek evaluated a segment of the Mt. Signal Drain. Despite the clear association with irrigation history and agricultural development history in Imperial County, a single segment of a larger irrigation drainage channel does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Canals and drainages, like many other types of linear features, have significance because they are part of a larger and oftentimes complex system. Therefore, the significance of the drain is not tied to a specific segment, but to the drainage as a whole. For this reason, many linear features are listed on the NRHP as historic districts with contributing and non-contributing segments and related infrastructure. Drain segments can have individual eligibility when associated with a particular farmstead or show a significant engineering or architectural feature. However, archival research did not identify any significant associations and this segment does not display any innovative architectural or engineering features that set it apart from other drain segments in the area. This drain segment further lacks the required significance for individual eligibility, as it is representative of a ubiquitous irrigation structure seen throughout the Imperial Valley. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The earthen drainage channel is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, as it is part of a vast network of drainage channels of a similar type throughout the Imperial Valley. Therefore, P-13-013079 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, P-13-013079 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the earthen drainage channel retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association; the earthen drainage channel has no important historical associations and lacks architectural merit. As such, the segment of P-13-013079 is recommended not eligible under all NRHP and CRHR designation criteria.

P-13-013074 (Woodbine Lateral 7)

Located on APN 052-170-032 and 052-170-037, this resource consists of a segment of the Woodbine Lateral 7 irrigation canal. The canal runs parallel to the west of Pulliam Road. The canal is concrete lined and runs north to south. It is approximately ten feet wide by five feet in depth. The entire canal is approximately one-mile long. The segment connects to another canal that runs west to east at gate 42. No date stamps were observed during the survey. The canal is in good condition and is likely maintained regularly (See Figure 10).

The Woodbine Lateral 7 irrigation canal was recorded during survey of agricultural property (for a proposed solar project). The east-west aligned 1 mi. long lateral, coming off the main Woodbine Canal to the east, is situated on the north side of SR 98 along the southern border of Section 9, between Pulliam Rd. on the west and Brockman Rd. at the east. The canal continues to the north for 0.5 mi. but in the next parcel to the west, outside of the current survey boundary.

This canal system was lined with concrete sometime in the late 1950s/early1960s. There is a "1957" date stamp in the concrete of a flow gate at the northeastern corner of Pulliam Rd. and SR 98; a second gate to the east appears contemporaneous, but is unmarked. A "1979" date stamp is present where the lateral connects to the main Woodbine Canal to the east. The canal is roughly 11.5 ft. across at the top. Depth is unknown since the canal was full of water. The integrity of the canal is good in spite of the earthquake activity that has been occurring in the area (Laguna Mountain 2010c).

Figure 10. P-13-013074 – Overview of canal looking south, 11/21/17, IMG_00036.

Evaluation of the P-13-013074 under NRHP/CRHR criteria included archival research and review of previous evaluations of this segment of the Woodbine Lateral 7 Canal and the surrounding area. Constructed circa 1915, the Woodbine Canal was one of the early canals in the Imperial County. While the Woodbine Canal was constructed circa 1915, construction of the Woodbine Lateral segments took place later in the development period of the Woodbine Canal. Date stamps on Woodbine Lateral & Canal indicate a possible date of construction or concrete lining of the canal in 1957. Given the use of concrete lining in this segment and the popularity of lining canals with concrete in the 1950s and 1960s throughout Imperial County suggests this date would be feasible. In 2010, Andrew Pigniolo of Laguna Mountain Environmental recorded this segment of the Woodbine Lateral 7 Canal and determined there were no historic resources present. For the purposes of this evaluation, Dudek evaluated a segment of the Woodbine Lateral 7 Canal. Despite the clear association with irrigation history and agricultural development history in Imperial County, a single segment of a larger canal does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Canals, like many other types of linear features, have significance because they are parts of a larger and oftentimes complex system. Therefore, the significance of the canal is not tied to a specific segment, but to the canal as a whole. For this reason, many linear features are listed on the NRHP as historic districts with contributing and non-contributing segments and related infrastructure. Canal segments can have individual eligibility when associated with a particular farmstead or show a significant engineering or architectural feature. However, archival research did not identify any significant associations and this segment does not display any innovative architectural or engineering features that set it apart from other canal segments in the area. This canal segment further lacks the required significance for individual eligibility, as it is representative of a ubiquitous irrigation structure seen throughout the Imperial Valley. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The concrete lined lateral canal segment, while associated with the Woodbine Canal is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, as it is part of a vast network of drainage canals of a similar type throughout the Imperial Valley. Therefore, P-13-013074 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, P-13-013074 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the concrete lateral canal segment retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association it has no important historical associations and lacks architectural merit. As such, the segment of P-13-013074 is recommended not eligible under all NRHP and CRHR designation criteria.

DS-I-8 (Carr Drain)

Located between Assessor's Parcel No. 052-170-032 (North) and 052-170-037 (south), this resource consists of a historic age earthen irrigation drain. The drain is located west of Pulliam Road and runs east to west. The drain is approximately ten feet wide by five feet in depth. The entire drain is approximately 0.25-miles long (See Figure 11).

Figure 11. DS-I-8– Overview of drain looking east, 2/22/18 (IMG_0341)).

Evaluation of the DS-I-8 under NRHP/CRHR criteria included archival research. The date of construction for the earthen irrigation drain was not found during archival research, but a review of historic aerial photographs indicates that the channel was present in 1953 (NETR 2017). No previous recordings or evaluations of this drain segment were found during the course of archival research. During the course of research, the IID plat book sheet 32 from 2011 identified the drain as the Carr Drain. Despite the association with irrigation history and agricultural development history in Imperial County, the lack of clear association with larger canals in the area suggests that this was a drain used by a single property owner for agricultural purposes and not part of a larger and more complex infrastructure thus it does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The earthen drain segment is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, and it represents a ubiquitous piece of infrastructure seen throughout Imperial Valley. Therefore, DS-I-8 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, DS-I-8 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the earthen drain retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association it has no important historical associations and lacks architectural merit. As such, the segment of DS-I-8 is recommended not eligible under all NRHP and CRHR designation criteria.

DS-I-9 (Mt. Signal Drain No. 1-B)

Located between Assessor's Parcel No. 052-170-030 (west) and 052-170-031 (east), this resource consists of a historic age earthen irrigation drain. The drain is located west of Drew Road. It is earthen and runs east to west; with the western end curving and continuing towards the south. The drain is approximately ten feet wide and five feet in depth. The drain is approximately ten feet wide and five feet in depth. The entire drain is approximately 0.70-miles long (See Figure 12).

Figure 12. DS-I-9– Overview of drain looking north, 2/22/18 (IMG_0327)).

Evaluation of the DS-I-9 under NRHP/CRHR criteria included archival research. The date of construction for the earthen irrigation drain was not found during archival research, but a review of historic aerial photographs indicates that the drain was present in 1953 (NETR 2017). No previous recordings or evaluations of this canal segment were found during the course of archival research. During the course of research, the IID plat book sheet 32 from 2011 identified the canal as the Mt. Signal Drain No. 1-B. Despite the clear association with irrigation history and agricultural development history in Imperial County, a single segment of a larger irrigation drainage channel does not rise to the level of significance required for either the NRHP or the CRHR under Criterion A/1. Canals and drainages, like many other types of linear features, have significance because they are parts of a larger and oftentimes complex system. Therefore, the significance of the drain is not tied to a specific segment, but to the drainage as a whole. For this reason, many linear features are listed on the NRHP as historic districts with contributing and non-contributing segments and related infrastructure. Drain segments can have individual eligibility when associated with a particular farmstead or show a significant engineering or architectural feature. However, archival research did not identify any significant associations and this segment does not display any innovative architectural or engineering features that set it apart from other canal segments in the area. This drain segment further lacks the required significance for individual eligibility, as it is representative of a ubiquitous irrigation structure seen throughout the Imperial Valley. Archival research also failed to establish any associations to significant persons important on the local, state, or national level, thus making it not eligible under Criterion B/2. The subject property does not embody the distinctive characteristics of a type, period, region, or method of construction. The earthen drainage channel is not representative of a specific and significant infrastructure or architectural style. There is no evidence to suggest that it was constructed or conceived by an important creative individual, as it is part of a vast network of drainage canals of a similar type throughout the Imperial Valley. Therefore, DS-I-9 does not appear eligible under NRHP/CRHR Criteria C/3. There is no evidence to suggest that this property has the potential to yield information important to state or local history, nor is it associated with a known archaeological resource. Therefore, DS-I-9 is recommended not eligible under NRHP/CRHP Criterion D/4. Although the earthen drainage channel retains the requisite integrity of location, design, setting, materials, workmanship, feeling, and association; the earthen drainage channel has no important historical associations and lacks architectural merit. As such, DS-I-9 is recommended not eligible under all NRHP and CRHR designation criteria.

FINDINGS AND CONCLUSIONS

All historic age canal/drainage resources evaluated as part of the current study are recommended not eligible for the NRHP and CRHR based on a lack of historical significance, and in some cases, a lack of integrity. Therefore, this study finds that the proposed project will have a less-than-significant impact on historical resources under CEQA. No further management recommendations are required.

Please feel free to contact us with any questions.

Sincerely,

Sarah Corder, MFA
Architectural Historian

Samantha Murray, MA
Historic Built Environment Lead

Att A: Confidential Records Search Results
Att B.: DPR Forms (to be provided in final document)

cc: Micah Hale, Dudek

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ATTACHMENT A

Confidential Records Search Results

ATTACHMENT B

DPR Forms (to be provided in final document)