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Freiburg, 21.01.2015

County of San Diego
Planning and Development Services
c/o Mark Wardlaw, Director
5510 Overland Avenue
San Diego, CA 92123

Soitec Solar´s Boulevard Projects: Analysis of potential degradation of ground water resources due to corrosion of steel CPV tracker masts

Dear Director Wardlaw:

Based on my professional opinion, the issue raised in the January 11, 2015, comment letter from Mr. York Heimerdinger is negligible for the following reasons:

1. Geotechnical studies were performed for the soils at both the Rugged and Tierra del Sol solar farms. These studies both sites conclude that based on soil corrosivity tests and Caltrans corrosion guidelines, soils at neither site "would be classified as corrosive." (Exhibit A, Ninyo & Moore, Geotechnical Evaluation Tierra del Sol Solar Project (November 9, 2012; Exhibit B, Ninyo & Moore, Geotechnical Evaluation, Rugged Solar Project (October 17, 2012).

2. CPV tracker masts used are cylindrical and so offer a smaller surface area available for corrosion than typical profiles, such as the H profile used in steel constructions. CPV tracker masts may be galvanized to prevent corrosion, based on final engineering analysis, although the non-corrosive character of onsite soils indicates galvanization is likely unnecessary.

3. CPV modules have an extremely low current leakage unlike other PV module technologies because the CPV module parts carrying current are very well isolated towards the frame.

4. A copper grounding grid is used which is connected to the mast of each system in order to reach equipotential and which has a much lower resistivity than the mast underground. So, any current leakage would not go through the underground section of the mast into the ground, but rather, would follow the copper grounding grid.

5. The use of central inverters with floating potential prevents no current flow between the inverter and the system over the ground. This would further prevent any so called "stray current", which can be a major cause of potentially induced degradation.

6. Based on the conclusions presented in paragraphs 3 - 5, above, no electrolysis of the underground portion of the CPV tracker mast due to current leakage from the CPV module is likely to occur. In addition, based on the lack of corrosivity in Tierra del Sol and Rugged site soils, CPV tracker mast deterioration is also not expected.

My professional credentials are attached as Exhibit C.

Yours sincerely,

Andreas Gombert, PhD
VP System Platform and R&D
Soitec Solar GmbH

Enclosures

Exhibit A:	Ninyo & Moore, [Geotechnical analysis]
Exhibit B:	Ninyo & Moore, [Geotechnical analysis]
Exhibit C:	Curriculum vitae of Andreas Gombert, PhD

Cc: Mr. Clark Crawford, Soitec Solar Development, LLC
Mr. Patrick Brown, Soitec Solar Development, LLC

EXHIBIT A

GEOTECHNICAL EVALUATION
RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PREPARED FOR:
Soitec Solar Development
16550 Via Esprillo
San Diego, California 92127

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
5710 Ruffin Road
San Diego, California 92123

October 17, 2013
Project No. 107269002

October 17, 2013
Project No. 107269002

Mr. Patrick Brown
Soitec Solar Development
16550 Via Esprillo
San Diego, California 92127

Subject: Geotechnical Evaluation
Rugged Solar Project
Boulevard, California

Dear Mr. Brown:

In accordance with your request and authorization, we are providing this geotechnical evaluation for the proposed Rugged Solar Project in Boulevard, California. This report has been prepared in accordance with our work order (dated September 6, 2013) and presents our findings, conclusions, and recommendations regarding the geotechnical aspects of the project. We appreciate the opportunity to be of service on this project.

Sincerely,
NINYO & MOORE

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Distribution: (1) Addressee

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1. INTRODUCTION

In accordance with your request and authorization, we are providing this geotechnical evaluation report for the proposed Rugged Solar project in Boulevard, California (Figure 1). This report has been prepared in accordance with our September 6, 2013 work order. Presented in this report are the results of our background review, field explorations, geotechnical laboratory analyses, our conclusions regarding the geotechnical conditions at the site, and our recommendations for the design and earthwork construction of this project.

2. SCOPE OF SERVICES

Ninyo & Moore's scope of services for this project included review of pertinent background data, performance of a geologic reconnaissance, and engineering analysis with regard to the proposed construction. These services generally follow the scope of work outlined in the work order dated September 6, 2013. Specifically, we performed the following tasks:

- Reviewing background information including readily available geologic maps and topographic maps.
- Performing a site reconnaissance to observe existing conditions and delineate boring and test pit locations.
- Contacting and coordinating with Underground Service Alert (USA) to clear the boring and test pit locations for potential conflicts with underground utilities.
- Performing a subsurface evaluation consisting of drilling 16 exploratory borings and excavating 23 test pits. The soil borings were drilled to depths of up to approximately 20 feet using a truck-mounted drill rig equipped with continuous-flight, hollow-stem augers. The test pits were excavated to depths of up to 16 feet with a wheel mounted backhoe.
- Collecting representative bulk and in-place samples of the soils from the borings and test pits. The samples were then transported to our in-house geotechnical laboratory for analysis.
- Retaining a licensed geophysical subconsultant to perform a non-invasive survey of the site. Services performed by the geophysical subconsultant included 16 field electrical resistivity tests and five seismic refraction lines. Each resistivity test location included soundings in the north-south and east-west directions.
- Performing geotechnical laboratory testing on representative samples to evaluate soil parameters for design and classification purposes.

- Performing engineering analyses of the site geotechnical conditions based on data obtained from our background review, field explorations, and geotechnical and thermal analyses.
- Preparing this geotechnical evaluation report describing the findings and conclusions of our studies regarding site conditions that may affect the proposed development.

Our scope of services did not include environmental consulting services such as hazardous waste sampling or analytical testing at the site. If requested, our office can prepare a scope of services and fee proposal for those services.

3. SITE AND PROJECT DESCRIPTION

The site of the proposed Rugged Solar project is north of Interstate 8 in the vicinity of Ribbonwood Road and McCain Valley Road in the Boulevard area of San Diego County, California. Specifically, the project includes properties located east of Ribbonwood Road that are designated as San Diego County Assessor's Parcel Numbers (APNs) 611-060-04, 611-090-02, 611-090-04, 611-091-03, 611-091-07, 611-100-07, 612-030-01, and 612-030-19 and a property (APN 611-110-01) located adjacent to and east of McCain Valley Road. There are four sites within the Rugged Solar project. From west to east these sites are designated as Vista Oaks, Frank Thibodeau, Harmony Grove, and Waterstone (Figure 2). In total, the project covers approximately 765 acres. Site elevations range from approximately 3,510 feet above mean sea level (MSL) in the easternmost portion of the site, east of McCain Valley Road to approximately 3,680 feet MSL in the northern portion of the site. A shallow drainage, Tule Creek, extends across the majority of the site from near the northwest corner of the site to the southeast. McCain Valley drainage bisects the valley.

The majority of the site is currently undeveloped and is covered by sparse to moderate growth of native chaparral, shrubs, low-lying grasses, and scattered trees. Unpaved roads provide access through the project site, including those roads that were recently constructed to support construction of the Sunrise Powerlink project. Sunrise Powerlink transmission towers cross the project site east of McCain Valley Road. Additionally, the central portion of the project site was previously used as a construction storage and staging area. Other improvements include several residential structures and minor agricultural developments in the western portion of the project area.

The project will include the development of a solar energy facility intended to provide approximately 84 Megawatts (MW) of power using concentrated photovoltaic (CPV) solar trackers. We anticipate that the CPV solar trackers will be supported on foundations approximately 16 feet deep, comprised of either 28-inch diameter driven steel piles or 30-inch diameter auger-drilled reinforced concrete piles. Construction will also include inverter pads, an operation and maintenance building, a substation, fire access and service roads, and other associated improvements.

4. FIELD EXPLORATION

The field exploration for this evaluation included subsurface exploration and geophysical surveying. A summary of the field exploration program is presented in the following sections.

4.1. Subsurface Exploration

Our subsurface exploration was conducted on September 16, 17, and 18, 2013, and included drilling, logging, and sampling of 16 small-diameter borings and 23 test pits. The borings were drilled to depths of up to approximately 20 feet using a truck-mounted, CME 75 drill rig equipped with 8-inch diameter, continuous-flight, hollow-stem augers. The test pits were excavated to depths of up to 16 feet with a wheel mounted, Case Super M 590 backhoe with a 24-inch bucket. Ninyo & Moore personnel logged the borings and test pits in general accordance with the Unified Soil Classification System (USCS). Representative bulk and in-place soil samples were collected at selected depths from within the exploratory borings and test pits, and then returned to our in-house geotechnical laboratory for analysis. Boring logs and test pit logs are presented in Appendices A and B, respectively. The approximate locations of the borings and test pits are presented on Figure 2. GPS coordinates of the borings and test pits are maintained in the project file.

4.2. Field Electrical Resistivity Surveys

A registered geophysical consultant was retained to perform 16 electrical resistivity arrays of the site. The test locations were spaced to provide coverage of the project site and their approximate locations are shown on Figure 2. The test results and a description of the equipment and testing procedures used are presented in Appendix C.

The in-situ field resistivity data was collected in general accordance with the ASTM International (ASTM) G 57 using a Supersting R8 Resistivity Meter and four electrodes in a Wenner configuration. Soil resistivity measurements were collected at electrode spacings of 2, 5, 10, 15, 20, 30, and 40 feet.

In general, the field resistivity data collected are of good quality. With the exception of the shallow readings (small spacings), the measurements collected along the orthogonal soundings were fairly consistent, indicating homogeneous conditions at depth.

4.3. Seismic Refraction Surveys

A registered geophysical consultant was retained to perform five seismic refraction traverses across the site. The test locations were spaced to provide coverage of cut portions of the project site and their approximate locations are shown on Figure 2. The test results and a description of the equipment and testing procedures used are presented in Appendix C.

5. LABORATORY TESTING

Geotechnical laboratory testing was performed on representative soil samples collected during the subsurface exploration. This testing included an evaluation of in-place moisture content and dry density, gradation analysis, shear strength, modified Proctor density, soil corrosivity, and thermal resistivity. The results of the in-situ dry density and moisture content tests are presented on the boring logs in Appendix A. Descriptions of the geotechnical laboratory test methods and the results of the other laboratory tests performed are presented in Appendix D.

6. GEOLOGY AND SUBSURFACE CONDITIONS

Our findings regarding regional and site geology, rippability (excavatability), faulting and seismicity, groundwater conditions, landsliding, and flooding at the site are provided in the following sections.

6.1. Regional Geologic Setting

The project area is situated in the eastern San Diego County section of the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California (Norris and Webb, 1990; Harden, 1998). The province varies in width from approximately 30 to 100 miles. In general, the province consists of rugged mountains underlain by Jurassic metavolcanic and metasedimentary rocks and Cretaceous igneous rocks of the southern California batholith. The portion of the province in San Diego County that includes the project area generally consists of uplifted granitic mountains and alluvial valleys.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending approximately northwest. Several of these faults, shown on Figure 3, are considered active faults. The Elsinore, San Jacinto, and San Andreas faults are active fault systems located northeast of the project area, and the Rose Canyon, Coronado Bank, San Diego Trough, and San Clemente faults are active faults located west of the project area. The Vallecitos fault is an active fault system located in Baja California, Mexico, south of the project site. The Coyote Mountain segment of the Elsinore Fault Zone, the nearest active fault system, has been mapped approximately 10.5 miles northeast of the project site. Major tectonic activity associated with these and other faults within this regional tectonic framework consists primarily of right-lateral, strike-slip movement. Further discussion of faulting relative to the site is provided in the Faulting and Seismicity section of this report.

6.2. Site Geology (Subsurface Conditions)

Based on our geologic reconnaissance and subsurface evaluation, geologic materials at the site consist of fill, alluvium, and granitic rock. Figure 2 shows the distribution of geologic units and where alluvium (deeper than approximately 5 feet) is anticipated to underlie the site. Granitic rock is otherwise expected to underlie the site. A map of the regional geology is included as Figure 4. A brief description of these units, as described in the cited literature or as observed at the site, is presented below. Additional descriptions of the subsurface units are provided on the exploration logs in Appendices A and B.

6.2.1. Fill

Fill soils are expected to underlie portions of the site due to road construction, previous land use, and buried utility lines. We anticipate these fills to be relatively shallow and generally composed of locally derived, reworked decomposed granitic rock and alluvial material.

6.2.2. Alluvium

Alluvial soils were encountered in our subsurface excavations generally in the lower-lying areas of the site to depths between 1 foot and greater than 20 feet. We expect the thickest alluvial soils to exist in the vicinity of Tule Creek. As encountered, the alluvial soils generally consist of light brown to dark brown, damp to wet, loose to medium dense, silty fine to coarse sand with occasional gravel and cobbles, and sparse layers of stiff sandy clay.

6.2.3. Granitic Rock

Granitic bedrock was observed at the surface at several locations and encountered in our borings and test pits. According to published mapping, this bedrock has been designated the Tonalite of La Posta (Todd, 2004). The rock observed in outcrops across the site generally consisted of light brown to light reddish brown, fine- to medium-grained tonalite. Mineral assemblages were observed to consist of quartz and plagioclase, with lesser amounts of biotite and hornblende. Leucocratic and pegmatitic dikes with a general northeast-southwest orientation were observed at several locations across the site. These dikes are generally marked by relatively large quartz and plagioclase crystals.

Individual rounded hard boulders up to 10 feet in diameter were also observed in several areas of the site. Other than boulders, where exposed at the surface, the bedrock was observed to be moderately to intensely weathered.

Granitic rock was encountered in 13 borings (B-1 through B-4, B-6 through B-8, and B-10 through B-15), and in 21 test pits (TP-1 through TP-11 and TP-14 through TP-23) beneath the alluvium to the depths explored. As encountered, the granitic rock generally consisted of yellowish to grayish brown, damp to moist, decomposed to weathered to very hard crystaline, granitic rock. Refusal on granitic rock at shallow depths was met in 7 of the 16 borings (B-3, B-6, B-10, B-11, B-12, B-14, and B-15), as well as 18 of the 23 test pits (TP-1, TP-3 through TP-11, and TP-14 through TP-21).

6.3. Rippability and Excavation Characteristics

Based on the results of our exploratory borings and test pits, seismic refraction traverses, and our experience with similar soils, it is our opinion that the on-site fill and alluvium can be excavated using heavy-duty earthmoving equipment in good working condition. Difficult excavation, heavy ripping, and drilling or other special excavating methods (e.g., coring) should be anticipated in granitic rock.

6.4. Groundwater

Indications of surface water were not observed in Tule Creek, which runs through the west-central portion of the project site. Groundwater was not encountered in our exploratory borings and excavations. Based on a groundwater evaluation performed by others (Geo-Logic, 2010) depths to groundwater in the western portion of Tule Creek range from approximately 28 to 55 feet below ground surface (bgs). However, groundwater was measured in a well on the southern border of the Waterstone site at a depth of 18 feet bgs. Wet conditions were encountered at approximately the same depth in boring B-9.

Groundwater in areas of granitic bedrock typically occurs within joints, fractures and local shear zones (e.g., faults). Fault zones have also been shown to retard the flow of groundwater both vertically and horizontally. The presence of springs may be indicative of groundwater conduction along joints, fractures, or faults. As noted, faults were not observed at the site, but may be hidden. In addition, springs or other evidence of surfacing groundwater (e.g., hydrophilic plants) were not observed at the site. However, drainages are commonly associated with shallow groundwater. In addition, based on a review of the available topographic maps, springs are not present in the immediate vicinity of the site.

6.5. Faulting and Seismicity

Like most of southern California, the project area is considered to be seismically active. Based on our review of the referenced geologic maps and stereoscopic aerial photographs, as well as on our geologic field mapping, the subject site is not underlain by known active or potentially active faults (i.e., faults that exhibit evidence of ground displacement in the last 11,000 years and 2,000,000 years, respectively). However, the site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion is considered significant during the design life of the proposed structure. The nearest known active fault is the Coyote Mountain segment of the Elsinore fault, located approximately 14 miles from the site. Table 1 lists selected principal known active faults that may affect the subject site, their maximum moment magnitudes (M_{max}) and the fault types as published for the California Geological Survey (CGS) by Cao et al. (2003). The approximate fault to site distance was calculated by the computer program FRISKSP (Blake, 2001) or measured on available geologic maps.

Table 1 – Principal Active Faults

Fault	Distance miles (kilometers) [1,2]	Moment Magnitude [1]
Elsinore (Coyote Mountain)	14 (22)	6.8
Elsinore (Julian Segment)	20 (32)	7.1
Laguna Salada	23 (38)	7.0
Earthquake Valley	28 (45)	6.5
San Jacinto (Borrego Segment)	29 (46)	6.6
Superstition Mountain	30 (48)	6.6
Superstition Hills	34 (55)	6.6
Elmore Ranch	34 (55)	6.6
San Jacinto (Coyote Creek Segment)	36 (58)	6.8
San Jacinto (Anza Segment)	41 (66)	7.2
Imperial	44 (72)	7.0
Brawley Seismic Zone	49 (79)	6.4
Rose Canyon	51 (82)	7.2
Coronado Bank	56 (91)	7.6
San Andreas	56 (91)	7.2

Notes:
[1] Blake (2001)
[2] Cao, et al. (2003)

In general, hazards associated with seismic activity include strong ground motion, ground surface rupture, liquefaction, seismically induced settlement, and tsunamis. These hazards are discussed in the following sections.

6.5.1. Strong Ground Motion

The 2010 California Building Code (CBC) (CBSC, 2010) recommends that the design of structures be based on the peak horizontal ground acceleration (PGA) having a 2 percent probability of exceedance in 50 years which is defined as the Maximum Considered Earthquake (MCE). The statistical return period for PGA_{MCE} is approximately 2,475 years. The Design Earthquake (PGA_{DE}) corresponds to ⅔ of the PGA_{MCE}. In evaluating the seismic hazards associated with the project site, we have selected Site Class D for the site. The Site Class selection is based on a review of standard penetration resistance from our borings. The site modified PGA_{MCE} was estimated to be 0.47g using the United States Geological Survey (USGS) (USGS, 2012) ground motion calculator (web-based) and the corresponding PGA_{DE} for the site is 0.32g.

6.5.2. Ground Rupture

Based on our review of the referenced literature and our site reconnaissance, no active faults are known to cross the project vicinity. Therefore, the potential for ground rupture due to faulting at the site is considered low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

6.5.3. Liquefaction and Seismically Induced Settlement

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction. Our evaluation indicates that the majority of the project site is underlain by dense granitic materials and is therefore not susceptible to liquefaction. However, based on relatively shallow groundwater and loose alluvial soils beneath the southern portion of the Waterstone site, the potential for liquefaction or seismically induced settlement exists during a major seismic event in the region.

6.6. Landsliding

Based on our review of the original geotechnical evaluation for the site, other published geologic literature, and aerial photographs and our subsurface evaluation, no landslides or related features underlie or are adjacent to the subject site.

6.7. Flood Hazards

Based on review of a Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FEMA, 1997), the site is mapped as lying outside of the 500-year floodplain. Based on this review, the potential for flooding of the site is considered low. In addition, due to the elevation, topography, and the inland location of the property, the site is not considered susceptible to tsunamis or seiches.

7. CONCLUSIONS

Based on our review of the referenced background data, subsurface exploration, geotechnical laboratory testing, and geophysical surveys, it is our opinion that construction of the proposed solar energy project is feasible from a geotechnical standpoint provided the recommendations presented in this report are incorporated into the design and construction of the project. In general, the following conclusions were made:

- Based on the results of our field evaluations, the subsurface soils consist of granular fill, alluvium, and weathered to crystalline granitic rock. The alluvium was generally damp and loose, and varied considerably in depth. The granitic rock was generally weathered, but refusal to drilling or excavation was met in seven borings and 18 test pits.

- Based on our subsurface exploration, excavation of the fill and alluvium should be feasible with heavy-duty excavation equipment in good working condition. However, difficult drilling, excavation, or other special excavating methods (e.g., coring) should be anticipated in granitic rock.

- Groundwater was not encountered during our subsurface evaluation. However, wet conditions were encountered at depth and groundwater could rise to within excavation depths. Consequently, groundwater is anticipated to be a construction consideration. Tremie concrete placement methods may be recommended during construction.

- The active Elsinore fault zone is located approximately 14 miles from the site. Accordingly, the potential for relatively strong seismic ground motions should be considered in the project design.

- Based on the results of our limited soil corrosivity tests and Caltrans corrosion guidelines (2012), the site would not be classified as corrosive.

8. RECOMMENDATIONS

The following recommendations are provided for the design and construction of the proposed project. The proposed site improvements should be constructed in accordance with the requirements of the applicable governing agencies.

8.1. Earthwork

In general, earthwork should be performed in accordance with the recommendations presented in this report. Ninyo & Moore should be contacted for questions regarding the recommendations or guidelines presented herein.

8.1.1. Site Preparation

Site preparation should begin with the removal of existing vegetation, utility lines, and other deleterious debris from areas to be graded. Roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside of the proposed excavation and fill areas. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed of at a legal dumpsite. Soils in areas disturbed by demolition activities should be replaced as compacted fill.

8.1.2. Excavation Characteristics

As noted in a previous section, the on-site fill and alluvium can be excavated using heavy-duty earthmoving equipment in good working condition. Difficult drilling, excavation, or other special excavating methods (e.g., coring) should be anticipated in granitic rock.

8.1.3. Remedial Grading of Surficial Soils

Surficial soils to a depth of approximately 2 feet are relatively loose. In areas where spread footings and/or surface hardscapes will be constructed, remedial grading should include the overexcavation of the upper 3 feet of existing site soils. The overexcavation should extend laterally a horizontal distance of 3 feet beyond the limits of the spread footings and/or surface hardscapes. The resulting removal surface should then be scarified approximately 8 inches, moisture-conditioned to near optimum moisture content, and recompacted to a relative compaction of 90 percent as evaluated by ASTM D 1557. The resulting excavation should then be backfilled with compacted fill derived from the on-site soils. The extent and depths of removals should be evaluated by Ninyo & Moore's representative in the field based on the materials exposed.

Remedial grading of the loose surficial soils is not needed for the construction or design of pile foundations. Design recommendations for the pile foundations that are presented in the following sections account for this condition.

8.1.4. Materials for Fill and Backfill

On-site soils with an organic content of generally less than 3 percent by volume (or 1 percent by weight) are considered suitable for reuse as utility trench backfill or sub-grade soils for concrete pads and pavements. Fill material should generally not contain rocks or lumps over 3 inches in largest dimension, and not more than 30 percent larger than ¾ inch. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or disposed of off-site.

Although not anticipated, imported fill material should generally be granular soils with a low expansion potential (i.e., an expansion index of 50 or less as evaluated by the ASTM D 4829). Import material should also be non-corrosive in accordance with the Caltrans (2003) corrosion guidelines. Materials for use as fill should be evaluated by Ninyo & Moore's representative prior to filling or importing.

8.1.5. Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed ground surface by our office. Unless otherwise recommended, the exposed ground surface of removals or areas to receive fills at existing grades should be scarified to a depth of approximately 8 inches and watered or dried, as needed, to achieve moisture contents generally above the optimum moisture content. The scarified materials should then be compacted to a relative compaction of 90 percent as evaluated in accordance with ASTM D 1557. The evaluation of compaction by Ninyo & Moore should not be considered to preclude any requirements for observation or approval by governing agencies. It is the contractor's responsibility to notify this office and the appropriate governing agency when project areas are ready for observation, and to provide reasonable time for that review.

Fill materials should be moisture-conditioned to generally above the laboratory optimum moisture content prior to placement. The optimum moisture content will vary with material type and other factors. Moisture-conditioning of fill soils should be generally consistent within the soil mass.

Prior to placement of additional compacted fill material following a delay in the grading operations, the exposed surface of previously compacted fill should be prepared to receive fill. Preparation may include scarification, moisture-conditioning, and recompaction.

Compacted fill should be placed in horizontal lifts of approximately 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve a moisture content generally above the laboratory optimum, mixed, and then compacted by mechanical methods to a relative compaction of 90 percent as evaluated by ASTM D 1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved.

8.1.6. Temporary Excavations

For temporary excavations, we recommend that the following Occupational Safety and Health Administration (OSHA) soil classifications be used:

Fill, Alluvium, Weathered Granitic Rock	*Type C*

Upon making the excavations, the soil classifications and excavation performance should be evaluated in the field in accordance with the OSHA regulations. Temporary excavations should be constructed in accordance with OSHA recommendations. For trench or other excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes) or by laying back the slopes to a slope ratio no steeper than 1.5:1 (horizontal:vertical) in fill or alluvium and 1:1 in granitic rock. Temporary excavations that encounter seepage may be shored or stabilized by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. On-site safety of personnel is the responsibility of the contractor.

8.1.7. Drainage

Roof, pad, and slope drainage should be directed such that runoff water is diverted away from slopes and structures to suitable discharge areas by nonerodible devices (e.g., gutters, downspouts, concrete swales, etc.). Positive drainage adjacent to structures should be established and maintained. Positive drainage may be accomplished by providing drainage away from the foundations of the structure at a gradient of 2 percent or steeper for a distance of 5 feet or more outside the building perimeter, and further maintained by a graded swale leading to an appropriate outlet, in accordance with the recommendations of the project civil engineer and/or landscape architect.

Surface drainage on the site should be provided so that water is not permitted to pond. A gradient of 2 percent or steeper should be maintained over the pad area and drainage patterns should be established to divert and remove water from the site to appropriate outlets.

Care should be taken by the contractor during final grading to preserve any berms, drainage terraces, interceptor swales or other drainage devices of a permanent nature on or adjacent to the property. Drainage patterns established at the time of final grading should be maintained for the life of the project. The property owner and the maintenance personnel should be made aware that altering drainage patterns might be detrimental to slope stability and foundation performance.

8.2. Seismic Design Parameters

Design of the proposed improvements should be in accordance with the requirements of governing jurisdictions and applicable building codes. Table 2 presents the seismic design parameters for the site in accordance with CBC (2010) guidelines and mapped spectral acceleration parameters (USGS, 2012).

Table 2 – Seismic Design Factors

Factors	Values
Site Class	D
Site Coefficient, F_a	1.027
Site Coefficient, F_v	1.598
Mapped Short Period Spectral Acceleration, S_S	1.183g
Mapped One-Second Period Spectral Acceleration, S_1	0.402g
Short Period Spectral Acceleration Adjusted For Site Class, S_{MS}	1.215g
One-Second Period Spectral Acceleration Adjusted For Site Class, S_{M1}	0.642g
Design Short Period Spectral Acceleration, S_{DS}	0.810g
Design One-Second Period Spectral Acceleration, S_{D1}	0.428g

8.3. Foundations

Based on the results of our geotechnical evaluation, the site is underlain by fill, alluvium, and granitic rock. The proposed structures may be supported on either shallow foundations, cast-in-drilled-hole (CIDH) piles, or driven piles. Solar trackers typically impose relatively light axial loads on the foundations. We anticipate that the foundation dimensions will be generally controlled by the lateral load or uplift demand.

8.3.1. Shallow Foundations

Shallow, spread footings bearing on compacted fill, may be designed using an allowable bearing capacity of 2,500 pounds per square foot (psf). These allowable bearing capacities may be increased by ⅓ when considering loads of short duration such as wind or seismic forces. Spread footings should be founded 18 inches or more below the lowest adjacent grade. Continuous footings should have a width of 15 inches or more and isolated footings should be 24 inches or more in width. The spread footings should be reinforced in accordance with the recommendations of the project structural engineer.

For resistance of footings to lateral loads, we recommend a passive pressure of 350 psf per foot of depth be used with a value of up to 3,500 psf. This value assumes that the ground is horizontal for a distance of 10 feet, or three times the height generating the passive pressure, whichever is greater. We recommend that the upper 1 foot of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance.

For frictional resistance to lateral loads, we recommend a coefficient of friction of 0.35 be used between soil and concrete. The allowable lateral resistance can be taken as the sum of the frictional resistance and passive resistance provided the passive resistance does not exceed ½ of the total allowable resistance. The passive resistance values may be increased by ⅓ when considering loads of short duration such as wind or seismic forces.

We estimate that the proposed structures, designed and constructed with shallow foundations as recommended herein, will undergo total settlement on the order of 1 inch. Differential settlement on the order of ½ inch over a horizontal span of 40 feet should be expected.

8.3.2. Pile Foundations

We understand that the preferred pile foundations may consist of either CIDH piles or driven pipe piles. Geotechnical recommendations for these foundation options are provided below. However, driven piles may not be suitable for areas mapped with granitic rock or where granitic rock may occur within the tip depth, without pre-drilling. Drilled piles will be difficult to excavate. The type, depth, and size of the foundations should be evaluated by the structural engineer based on the loading conditions, the geotechnical recommendations, and field testing. We recommend that the foundation plans and design submittal be reviewed by this office for general conformance to these recommendations prior to finalizing.

8.3.2.1. Cast-in-Drilled-Hole Piles

If selected for the project, we recommend that the pile dimensions (i.e., diameter and embedment) of CIDH foundations be evaluated by the project structural engineer using the recommendations presented herein. We understand that 30-inch diameter CIDH piles are preferred. As discussed previously, we understand that the CIDH foundations supporting the CPV solar trackers will be embedded approximately 16 feet. At this depth, we recommend that the downward axial capacities of CIDH piles be designed using a side frictional resistance value of 160 psf of area along the perimeter of the pile based on a factor of safety of 2. Uplift capacities should be designed using a frictional resistance value of 120 psf of area along the perimeter of the pile based on a factor of safety of 1.5. The recommended values for downward axial and uplift capacity of a 30-inch diameter, CIDH pile versus pile embedment depth are presented on Figure 5.

Construction of CIDH piles should be observed by personnel from our offices during drilling to evaluate if the piles have been extended to the recommended depths. The drilled holes should be cleaned of loose soil and gravel. It is the contractor's responsibility to take the appropriate measures to provide for the integrity of the drilled holes and to see that the holes are cleaned and straight and that sloughed loose soil is removed from the bottom of the hole prior to the placement of concrete. Drilled CIDH piles should be checked for alignment and plumbness during installation. The amount of acceptable misalignment of a pile is approximately 3 inches from the plan location. It is usually acceptable for a pile to be out of plumb by 1 percent of the depth of the pile. The center-to-center spacing of piles should be no less than three times the nominal diameter of the pile. We recommend that special measures, such as placement of concrete by tremie method, are implemented to see that the aggregate and cement do not segregate during concrete placement. Additionally, the contractor should be prepared to encounter and address issues associated with caving soils and drilling difficulties due to the presence of hard granitic rock.

8.3.2.2. Driven Steel Piles

If selected for the project, we recommend that the pile dimensions (i.e., diameter and embedment) of driven steel foundations be evaluated by the project structural engineer using the recommendations presented herein. We understand that 28-inch diameter steel pipe piles are preferred. We recommend that the downward axial capacities of driven steel piles be designed using a side frictional resistance value of 200 psf of area along the perimeter of the pile based on a factor of safety of 2. Uplift capacities should be designed using a frictional resistance value of 150 psf of area along the perimeter of the pile based on a factor of safety of 1.5. The recommended values for downward axial and uplift capacity of a 28-inch diameter, driven steel pipe pile versus pile embedment depth are presented on Figure 5.

Driven steel piles should be placed in general accordance with the following recommendations, and the recommendations of the project structural engineer. Piles should be checked for alignment and plumbness. The acceptable misalignment of a pile should be no more than 3 inches from the exact location. The plumbness of the pile should be within 2 percent of the plumb position. Piles should be spaced no closer than three times the nominal diameter or dimension of the pile (center-to-center). Additionally, the contractor should be prepared to encounter and address driving difficulties due to the presence of hard granitic rock.

We recommend that prior to production, indicator piles be installed and tested to further evaluate actual pile driving conditions, needed pile lengths and corresponding embedments. Ninyo & Moore should observe the pile driving operations.

8.3.2.3. Lateral Pile Analysis Parameters

For performing lateral pile capacity analysis, we recommend the use of the following parameters:

Table 3 – Lateral Analysis Input Parameters

Unit	Depth (feet)	Soil Type	Unit Weight (pcf)	Friction Angle	Cohesion (pcf)	Subgrade Modulus, k (pci)
Alluvium	0 - 5	Sand	115	33	0	90
Granitic Rock	>5	Sand	125	35	0	225

Notes:
pcf - pounds per cubic foot
pci – pounds per cubic inch

For lateral loading, piles in a group may be considered to act individually when the center-to-center spacing is greater than 3D (where, D is the diameter of the pile) in the direction normal to loading and greater than 5D in the direction parallel to loading. The following table presents the lateral load reduction factors to be applied for various pile spacing for in-line loading.

Table 4 – Lateral Load Group Reduction Factors

Center-to-Center Pile Spacing for In-Line Loading	Reduction Factor*		
	Row 1	Row 2	Row 3 and higher
3D	0.8	0.40	0.3
5D	1.0	0.85	0.7

Note:
* Based on AASHTO LRFD Bridge Design Specifications, 5th Edition, 2010 Interim Revision

8.4. Preliminary Flexible Pavement Design

For design of flexible pavements, we have used Traffic Indices (TI) of 5, 6, and 7 to represent the volume and loading of the traffic for site pavements. If traffic loads are different from those assumed, the pavement design should be re-evaluated. Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils exposed at the finished subgrade elevations once grading operations have been performed.

The resistance (R-value) characteristics of representative site soils were evaluated by conducting laboratory testing on a representative soil sample obtained from our exploratory test pits. The test result indicated an R-value of 60 and was used in our analysis. The preliminary recommended flexible pavement sections are as follows:

Table 5 – Recommended Pavement Sections

Traffic Index	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
5.0	3.0	4.0
6.0	3.0	6.0
7.0	4.0	6.0

We recommend that the upper 12 inches of the subgrade and aggregate base materials be compacted to 95 percent relative compaction as evaluated by ASTM D 1557. The pavement sections should provide an approximate pavement life of 20 years. If traffic loads are different from those assumed, the pavement design should be re-evaluated.

8.5. Preliminary Gravel Road Design

We understand that gravel access roads may be constructed at the site. We recommend that the gravel roads consist of 8 inches of compacted Class 2 aggregate base to accommodate truck and construction equipment loads during the lifespan of the project. We recommend that the upper 12 inches of the subgrade and the aggregate base materials be compacted to 95 percent relative compaction as evaluated by ASTM D 1557. Gravel access roads will require periodic maintenance including additional base material and regrading.

8.6. Preliminary Dirt Road Design

We understand that dirt access roads may be constructed at the site for light trucks and maintenance vehicles. For dirt access roads, we recommend that the upper 12 inches of the subgrade be compacted to 95 percent relative compaction as evaluated by ASTM D 1557. Dirt access roads will require periodic maintenance, particularly following episodes of precipitation and in low lying alluvial areas.

8.7. Corrosion

Laboratory testing was performed on a representative sample of the on-site earth materials to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH and electrical resistivity tests were performed in accordance with the California Test (CT) 643 and the sulfate and chloride content tests were performed in accordance with CT 417 and CT 422, respectively. These laboratory test results are presented in Appendix C.

The results of the corrosivity testing indicated an electrical resistivity of 2,800 to 6,800 ohm-cm, a soil pH of 7.6 to 9.1, a chloride content of 75 to 200 parts per million (ppm) and a sulfate content of 0.002 percent (i.e., 20 ppm). Caltrans corrosion (2012) criteria defines corrosive soils as those with more than 500 ppm chlorides, more than 0.1 percent sulfates, a pH less than 5.5, or an electrical resistivity of 1,000 ohm-cm or less. According to Caltrans criteria, the tested site soils are not considered corrosive.

8.8. Concrete

Concrete in contact with soil or water that contains high concentrations of water-soluble sulfates can be subject to premature chemical and/or physical deterioration. As stated above, the soil sample tested in this evaluation indicated a water-soluble sulfate content of 0.002 percent by weight (i.e., about 20 ppm). According to the American Concrete Institute (ACI) 318-10 building code, the potential for sulfate attack is negligible for a water-soluble sulfate content of between 0.00 and 0.10 percent by weight (i.e., 0 and 100 ppm) in soils. Based on the variability of soils across the site, Type II/V cement should be considered for concrete construction.

8.9. Pre-Construction Conference

We recommend that a pre-construction meeting be held prior to commencement of grading. The owner or his representative, the agency representatives, the architect, the civil engineer, Ninyo & Moore, and the contractor should attend to discuss the plans, the project, and the proposed construction schedule.

8.10. Plan Review and Construction Observation

The conclusions and recommendations presented in this report are based on analysis of observed conditions in widely spaced exploratory borings and test pits. If conditions are found to vary from those described in this report, Ninyo & Moore should be notified, and additional recommendations will be provided upon request. Ninyo & Moore should review the final project drawings and specifications prior to the commencement of construction. Ninyo & Moore should perform the needed observation and testing services during construction operations.

The recommendations provided in this report are based on the assumption that Ninyo & Moore will provide geotechnical observation and testing services during construction. In the event that it is decided not to utilize the services of Ninyo & Moore during construction, we request that the selected consultant provide the client with a letter (with a copy to Ninyo & Moore) indicating that they fully understand Ninyo & Moore's recommendations, and that they are in full agreement with the design parameters and recommendations contained in this report. Construction of proposed improvements should be performed by qualified subcontractors utilizing appropriate techniques and construction materials.

9. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified, and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

10. REFERENCES

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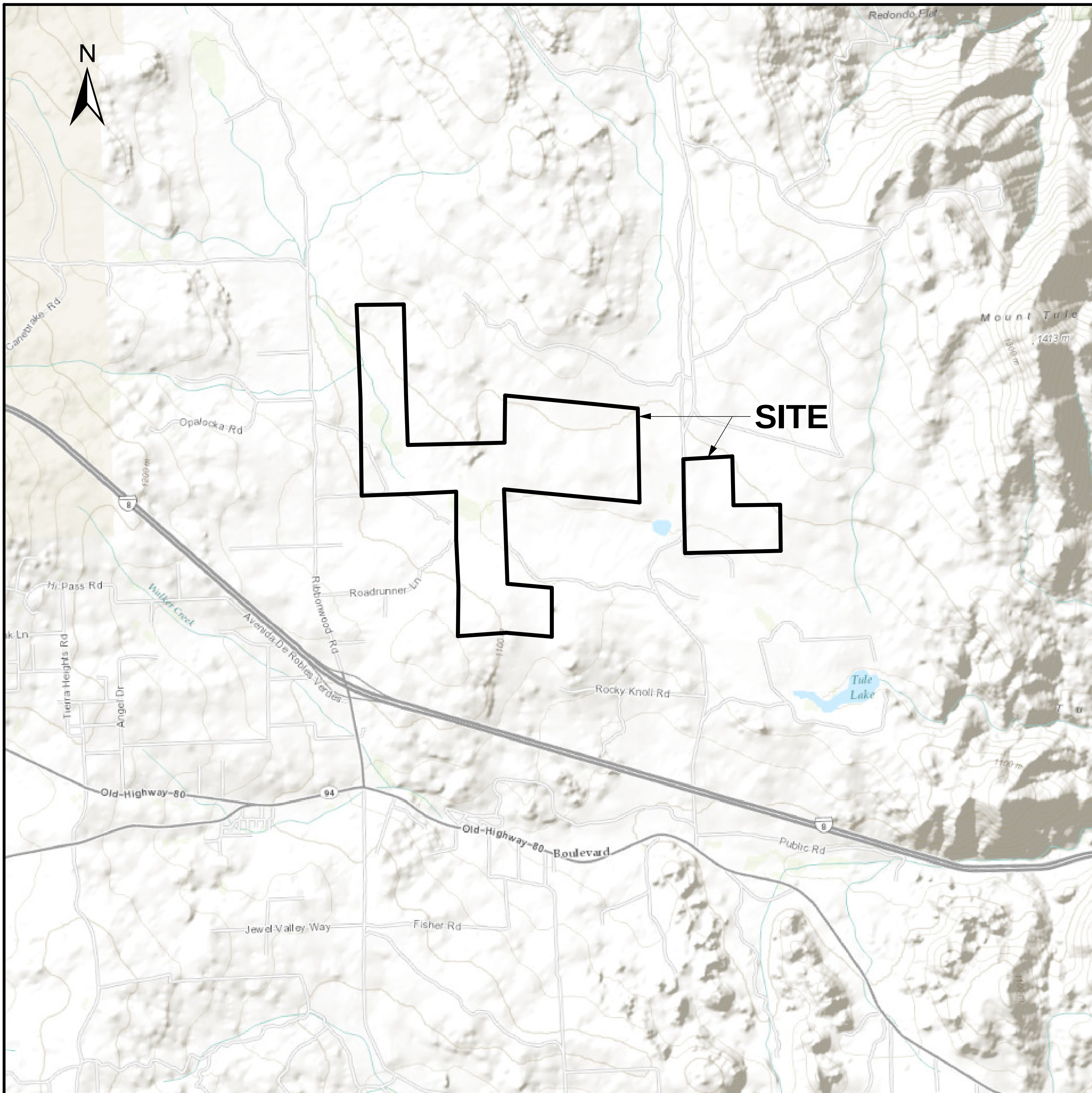
United States Geological Survey, 2012, Seismic Hazard Curves and Uniform Hazard Response Spectra, Java Ground Motion Parameter Calculator – Version 5.1.0: http://earthquake.usgs.gov/research/hazmaps/design.

AERIAL PHOTOGRAPHS

Source	**Date**	**Flight**	**Numbers**	**Scale**
USDA	March 30, 1953	AXN-2M	69 and 70	1:24,000
County of San Diego	1928	75C	4 and 5	1:18,000
County of San Diego	1928	75D	4, 5, and 6	1:18,000



MAP INDEX

SOURCE: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

SCALE IN FEET

0 4,000 8,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore

PROJECT NO.	DATE
107269002	10/13

SITE LOCATION

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

FIGURE

1

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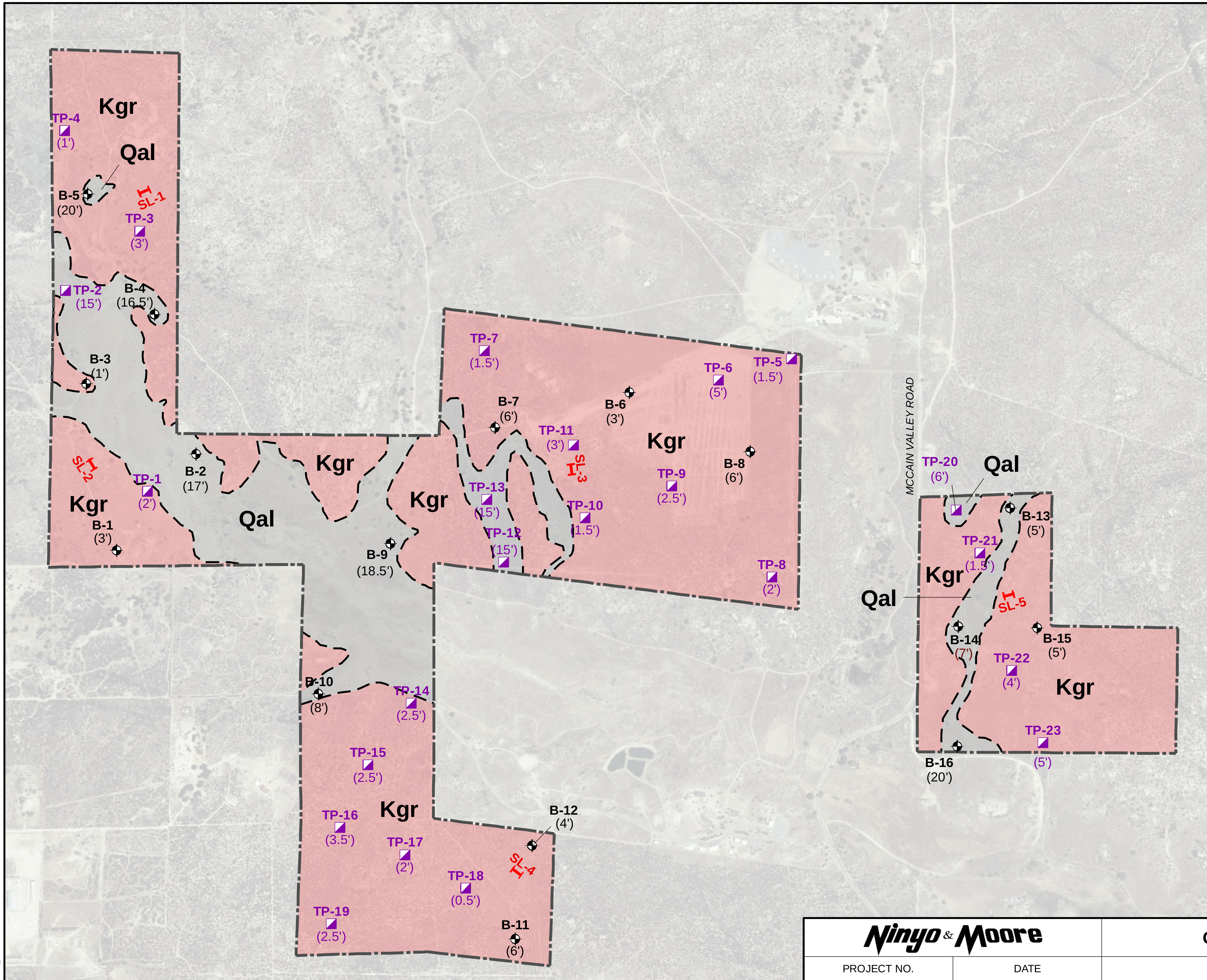


SOURCE: 2012 SAN DIEGO IMAGERY ACQUISITION PARTNERSHIP (FLIGHT DATES: MAY 20 - JUNE 6, 2012)

LEGEND

SITE BOUNDARY

GEOTECHNICAL LOCATIONS

B-16 BORING (DEPTH OF ALLUVIUM IN FEET)

TP-23 TEST PIT (DEPTH OF ALLUVIUM IN FEET)

GEOPHYSICAL SURVEY

R-16 RESISITIVITY LINE

SL-5 SEISMIC LINE

GEOLOGY

Qal ALLUVIUM

Kgr GRANITIC ROCK

GEOLOGIC CONTACT,QUERIED WHERE QUESTIONABLE

N

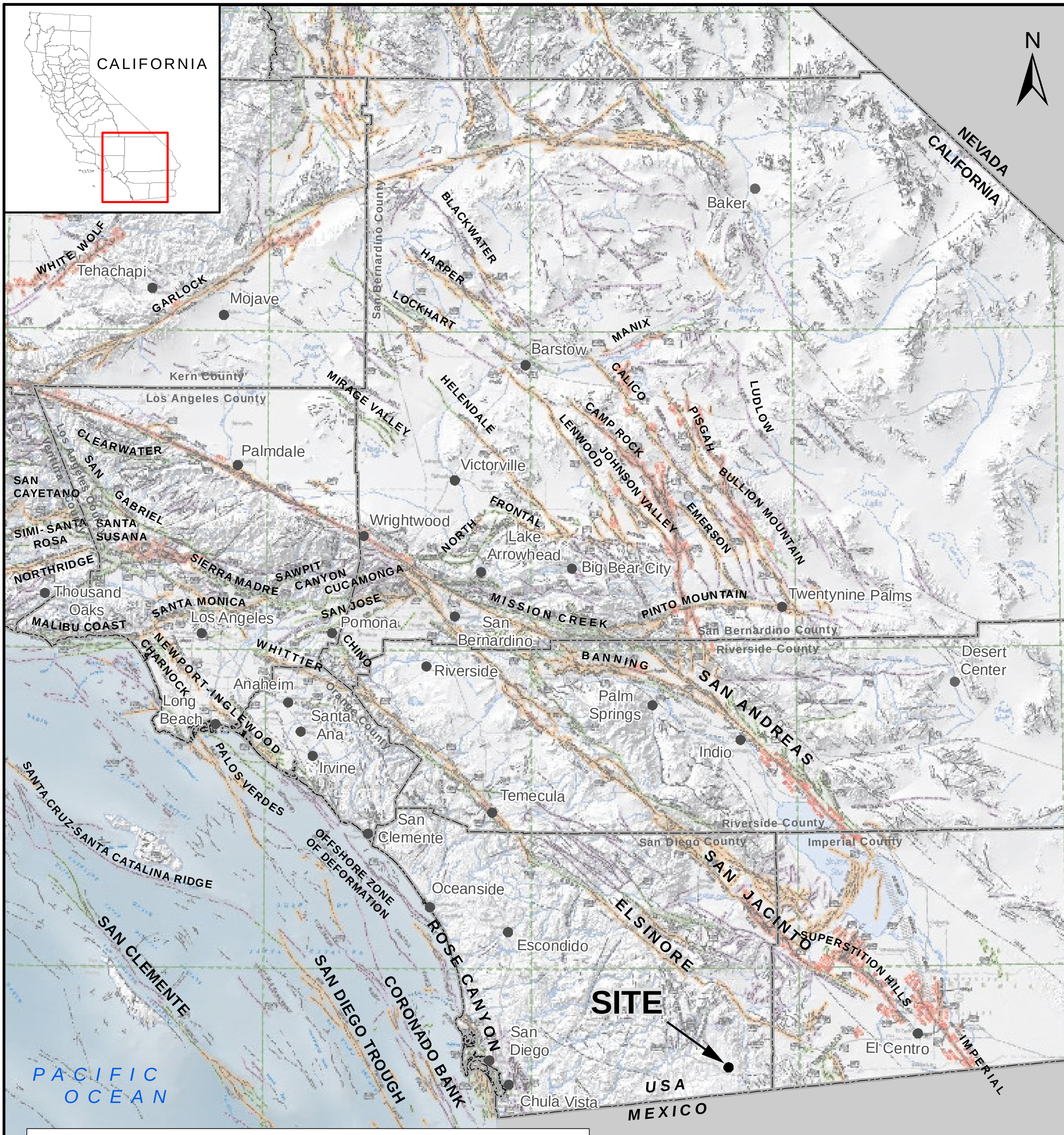
SCALE IN FEET

0 1,000 2,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore		GEOTECHNICAL MAP	FIGURE
PROJECT NO.	DATE	RUGGED SOLAR PROJECT BOULEVARD, CALIFORNIA	2
107269002	10/13		

2_107269002_BL.mxd 10/17/2013 2:50:51 PM JDL



LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

SOURCE: Fault Activity Map of California, 2010, Jennings, C.W., and Bryant, W.A., California Geological Survey.

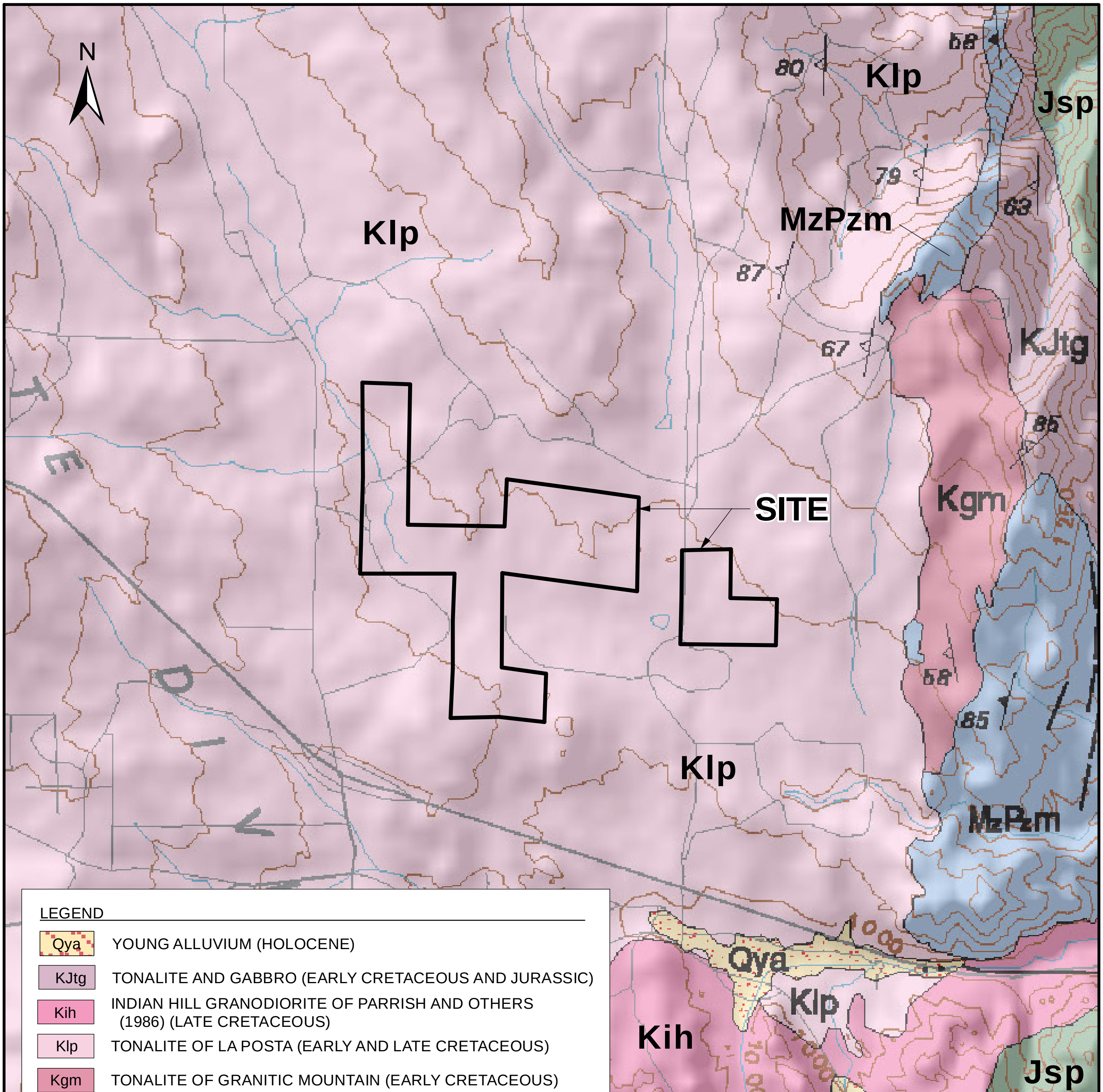
SCALE IN MILES

0 30 60

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

3_107269002_FL.mxd 10/14/2013 JDL

Ninyo & Moore		FAULT LOCATIONS	FIGURE
PROJECT NO.	DATE	RUGGED SOLAR PROJECT BOULEVARD, CALIFORNIA	3
107269002	10/13		



LEGEND

Qya	YOUNG ALLUVIUM (HOLOCENE)
KJtg	TONALITE AND GABBRO (EARLY CRETACEOUS AND JURASSIC)
Kih	INDIAN HILL GRANODIORITE OF PARRISH AND OTHERS (1986) (LATE CRETACEOUS)
Klp	TONALITE OF LA POSTA (EARLY AND LATE CRETACEOUS)
Kgm	TONALITE OF GRANITIC MOUNTAIN (EARLY CRETACEOUS)
Jsp	MIGMATITIC SCHIST AND GNEISS OF STEPHENSON PEAK (LATE AND MIDDLE JURASSIC)
MzPzm	ROCKS OF JACUMBA MOUNTAINS (MESOZOIC AND PALEOZOIC?)
80	STRIKE AND DIP OF FOLIATION, PRIMARY IGNEOUS INCLINED
85	STRIKE AND DIP OF FOLIATION, METAMORPHIC INCLINED
— — —	FAULT - SOLID WHERE ACCURATELY LOCATED, DASHED WHERE APPROXIMATELY LOCATED

SOURCE: TODD, V. R., 2004, GEOLOGIC MAP OF THE EL CAJON 30' X 60' QUADRANGLE, SOUTHERN CALIFORNIA

SCALE IN FEET

0 4,000 8,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore

REGIONAL GEOLOGY

PROJECT NO.	DATE
107269002	10/13

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

FIGURE 4

4_107269002_G.mxd 10/14/2013 JDL

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test Sampler
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1⅜ inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer falling freely from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a 140-pound hammer, in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
							CL	Dashed line denotes material change.
								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
15								
								The total depth line is a solid line that is drawn at the bottom of the boring.
20								

Ninyo & Moore

BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE
	Rev. 11/11	

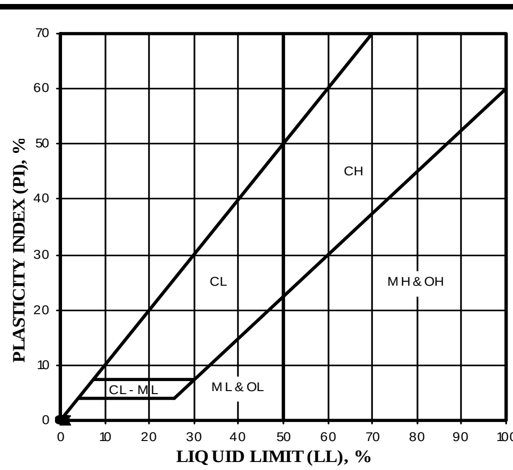
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil > No. 200 Sieve Size)	GRAVELS (More than 1/2 of coarse fraction > No. 4 sieve size	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < No. 4 sieve size	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS Liquid Limit >50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

GRAIN SIZE CHART

CLASSIFICATION	RANGE OF GRAIN	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	306 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.075
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.420
Fine	No. 40 to No. 200	0.420 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

PLASTICITY CHART



Ninyo & Moore	U.S.C.S. METHOD OF SOIL CLASSIFICATION

Updated Nov. 2011

DATE DRILLED	9/17/13	BORING NO.	B-1
GROUND ELEVATION	3,570' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY BTM	LOGGED BY BTM	REVIEWED BY	FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Brown, damp, medium dense, silty SAND.
								GRANITIC ROCK: Light brown to light gray, damp, weathered GRANITIC ROCK.
		X	50/5"					
10		X	50/4"					
		X	50/2"					
		X	50/4"					
20								Total Depth = 19.3 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
30								
40								

Ninyo & Moore

BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-1

DATE DRILLED 9/17/13 BORING NO. B-2

GROUND ELEVATION 3,560' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Brown, damp, loose to medium dense, silty SAND.
		X	14	1.6	104.0			Fine to coarse sand.
10		X	6					Moist; loose; fine to medium sand; micaceous.
							CL	Brown, moist, very stiff, sandy CLAY.
		X	22	13.0	111.3			
							SM	Brown, moist, medium dense, silty SAND with clay.
								GRANITIC ROCK: Light gray, moist, weathered GRANITIC ROCK.
		X	66					
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/17/13.
								Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-2

DATE DRILLED	9/17/13	BORING NO.	B-3
GROUND ELEVATION	3,580' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY BTM	LOGGED BY BTM	REVIEWED BY	FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	ALLUVIUM: Brown, damp, medium dense, silty SAND.
								GRANITIC ROCK: Light brown to light gray, damp, weathered GRANITIC ROCK.
		■	50/4"					
								Total Depth = 5 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-3

DATE DRILLED 9/17/13 BORING NO. B-4

GROUND ELEVATION 3,590' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Light brown, damp, medium dense, silty SAND.
		X	18	2.2	105.1			
10		X	4					Loose.
		X	35	12.1	111.8			Medium dense.
								GRANITIC ROCK: Light brown to light gray, damp, weathered GRANITIC ROCK.
		X	50/4"					Total Depth = 18.8 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/17/13.
20								Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-4

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	Bulk						SM	ALLUVIUM: Light brown, damp, medium dense, silty SAND.
		Driven	23					
10		Driven	13	5.8	100.4			Loose.
		Driven	12					
		Driven	7					Loose to medium dense.
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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DATE DRILLED 9/17/13 BORING NO. B-5

GROUND ELEVATION 3,600' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-5

DATE DRILLED	9/16/13
BORING NO.	B-6
GROUND ELEVATION	3,620' ± (MSL)
SHEET	1 OF 1
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration
DRIVE WEIGHT	140 lbs. (Auto-Trip)
DROP	30"
SAMPLED BY	BTM
LOGGED BY	BTM
REVIEWED BY	FOM

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	Bulk					SM	ALLUVIUM: Light brown, damp, medium dense, silty SAND.
	Driven	83/11"	3.5	121.8			GRANITIC ROCK: Light brown to light gray, damp, weathered, GRANITIC ROCK.
	Driven	50/3"					
10							
	Driven	50/4"					Damp to moist.
							Total Depth = 14 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-6

DATE DRILLED	9/16/13	BORING NO.	B-7
GROUND ELEVATION	3,575' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY	BTM	LOGGED BY BTM	REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Brown, damp, medium dense, silty SAND.
		X	79/8"	6.4	116.0			
								GRANITIC ROCK: Light brown, damp, weathered, GRANITIC ROCK.
10		X	46					
		X	50/3"					Light brown to light gray.
		X	50/6"					
20								Total Depth = 19 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-7

DATE DRILLED	9/16/13	BORING NO.	B-8
GROUND ELEVATION	3,595' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY	BTM	LOGGED BY BTM	REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Brown, moist, medium dense, silty SAND.
		X	39	1.9	110.3			
								GRANITIC ROCK: Light brown to light gray, damp to moist, weathered GRANITIC ROCK.
10		X	50/2"					
		X	50/4"					
		X	50/1"					
20								Total Depth = 19.1 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13.
								Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-8

DATE DRILLED 9/17/13 BORING NO. B-9

GROUND ELEVATION 3,545' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Brown, damp to moist, loose, silty SAND.
	X	X	10					
		X	8	6.1	102.3			
10								
		X	12					Moist.
		X	11	18.5	105.4			@ 18.5': Wet.
20								Total Depth = 19 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-9

DATE DRILLED 9/18/13 BORING NO. B-10

GROUND ELEVATION 3,550' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Brown, moist, medium dense, silty SAND.
		X	26	5.0	110.6			
								GRANITIC ROCK: Light brown to light gray, damp, weathered GRANITIC ROCK.
10		X	50/1					
								Total Depth = 11 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-10

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	■						SM	ALLUVIUM: Brown, damp, medium dense, silty SAND.
		⊠	50/2"					
								GRANITIC ROCK: Light brown to light gray, damp, weathered GRANITIC ROCK.
10		◤	50/2"					
								Total Depth = 13 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/18/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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DATE DRILLED 9/18/13 BORING NO. B-11

GROUND ELEVATION 3,555' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-11

DATE DRILLED	9/18/13	BORING NO.	B-12
GROUND ELEVATION	3,545' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY BTM	LOGGED BY BTM	REVIEWED BY	FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X							ALLUVIUM: Brown, damp, medium dense, silty SAND.
								GRANITIC ROCK: Light brown to light gray, damp, weathered GRANITIC ROCK.
		X	50/3"					
10		X	50/2"					
		X	50/1"					
20								Total Depth = 18 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/18/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-12

DATE DRILLED 9/16/13 BORING NO. B-13

GROUND ELEVATION 3,595' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	ALLUVIUM: Light brown, damp, medium dense, silty SAND.
		■	49	2.4	111.0			Dense.
								GRANITIC ROCK: Light brown to light gray, damp, weathered, GRANITIC ROCK.
		■	50/3"					
10								
		■	50/4"					
		■	73					Damp to moist.
20								Total Depth = 19 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-13

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 9/16/13 BORING NO. B-14 GROUND ELEVATION 3,555' ± (MSL) SHEET 1 OF 1 METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30" SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM **DESCRIPTION/INTERPRETATION**
0							SM	<u>ALLUVIUM:</u> Light brown, damp, medium dense, silty SAND.
			32					
								<u>GRANITIC ROCK:</u> Light brown, damp, weathered, GRANITIC ROCK.
10			83/10"	5.5	120.1			Light brown to light gray; damp to moist.
			26					Moist.
								Total Depth = 17 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. <u>Note:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-14

DATE DRILLED 9/16/13 BORING NO. B-15

GROUND ELEVATION 3,570' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-75) Baja Exploration

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	ALLUVIUM: Light brown, damp, medium dense, silty SAND.
		■	73	3.5	125.6			GRANITIC ROCK: Light brown, damp, weathered, GRANITIC ROCK.
10		⊠	50/2"					
		⊠	50/1"					Total Depth = 15.1 feet. (Refusal) Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-15

DATE DRILLED	9/16/13	BORING NO.	B-16		
GROUND ELEVATION	3,510' ± (MSL)	SHEET	1	OF	1
METHOD OF DRILLING	8" Diameter Hollow Stem Auger (CME-75) Baja Exploration				
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"		
SAMPLED BY	BTM	LOGGED BY	BTM	REVIEWED BY	FOM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	ALLUVIUM: Light brown, damp, medium dense, silty SAND.
		X	22					
10		X	12					Loose.
		X	8					Damp to moist; scattered gravel.
								Moist.
		X	9					
20								Total Depth = 20 feet. Groundwater not encountered during drilling. Backfilled with bentonite and soil on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE	FIGURE
107269002	10/13	A-16

APPENDIX B

TEST PIT LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory excavations **(and/or borings)**. The samples were bagged and transported to the laboratory for testing.

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Explanation of Test Pit, Core, Trench and Hand Auger Log Symbols

PROJECT NO.	DATE

EXCAVATION LOG EXPLANATION SHEET

DEPTH (FEET)	SAMPLES: Bulk / Driven / Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	
0				SM	FILL:
					Bulk sample.
				ML	Dashed line denotes material change.
					Drive sample.
1					Sand cone performed.
					Seepage
					Groundwater encountered during excavation.
					No recovery with drive sampler.
2					Groundwater encountered after excavation.
					Sample retained by others.
		xx/xx			Shelby tube sample. Distance pushed in inches/length of sample recovered in inches
3					No recovery with Shelby tube sampler.
				SM	ALLUVIUM:
					Solid line denotes unit change.
					Attitude: Strike/Dip
					b: Bedding
4					c: Contact
					j: Joint
					f: Fracture
					F: Fault
					cs: Clay Seam
5					s: Shear
					bss: Basal Slide Surface
					sf: Shear Fracture
					sz: Shear Zone
					sbs: Sheared Bedding Surface
					The total depth line is a solid line that is drawn at the bottom of the excavation log.

SCALE: 1 inch = 1 foot

FIGURE

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TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

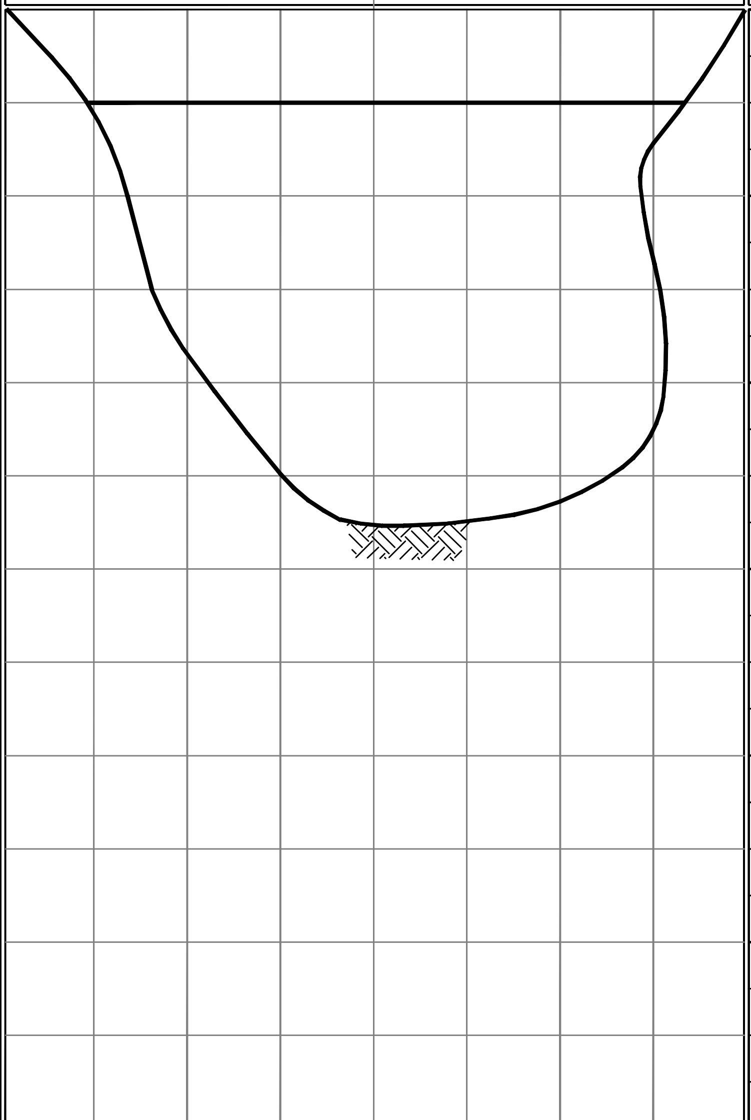
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-1

GROUND ELEVATION 3,555'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Greenish brown, damp, loose, silty, fine to coarse SAND; micaceous; some organics (roots).
							GRANITIC ROCK: Grayish brown, damp, decomposed GRANITIC ROCK.
4							
							Weathered; scattered pieces of granitic rock.
8							
							Total Depth = 11 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

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TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

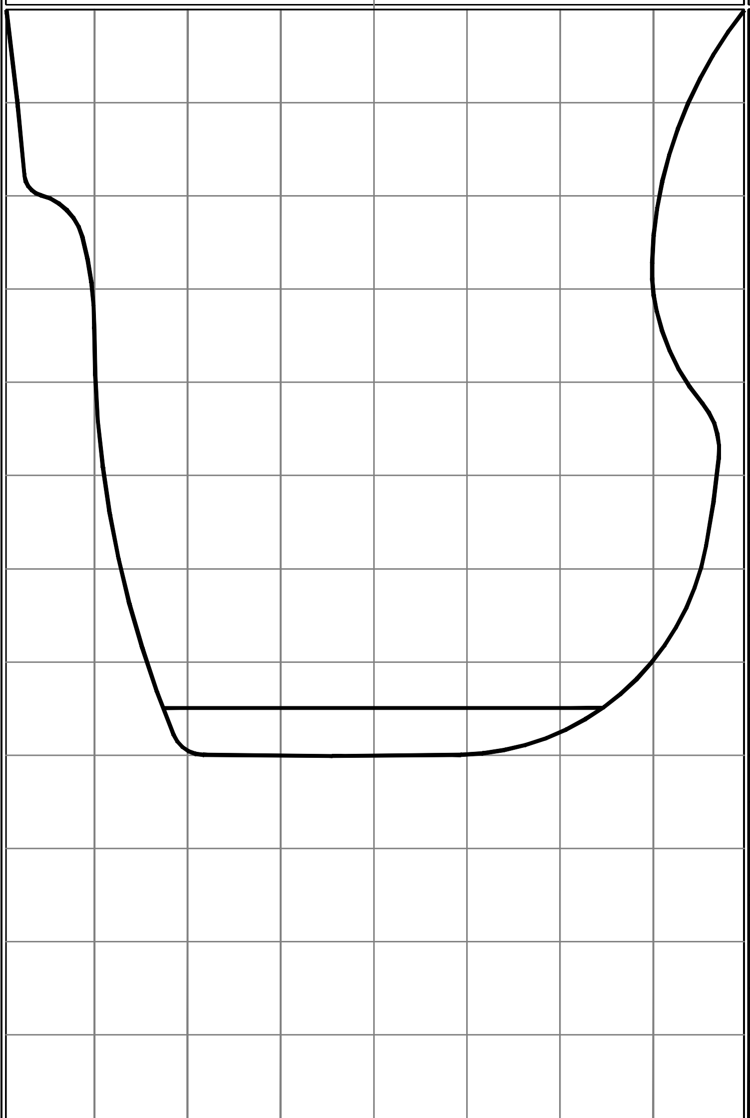
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-2

GROUND ELEVATION 3,565'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp to moist, loose, silty, fine to coarse SAND; micaceous; some organics (roots).
8	■ (8–10)						Moist.
15							GRANITIC ROCK: Grayish brown, moist, decomposed GRANITIC ROCK.
16							Total Depth = 16 feet. Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
20							
24							

SCALE = 1 in./4 ft.

FIGURE

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TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

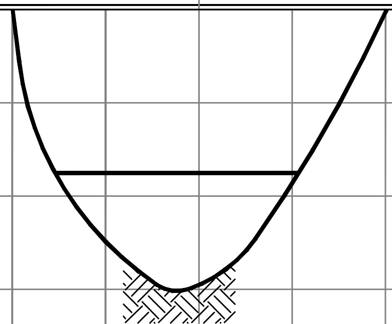
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-3

GROUND ELEVATION 3,565' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, moist, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
2–3	■						
3.5							GRANITIC ROCK: Yellowish brown and white, damp to moist, weathered GRANITIC ROCK.
6							Total Depth = 6 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

Depth scale: 0, 4, 8, 12, 16, 20, 24

SCALE = 1 in./4 ft.

FIGURE

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TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

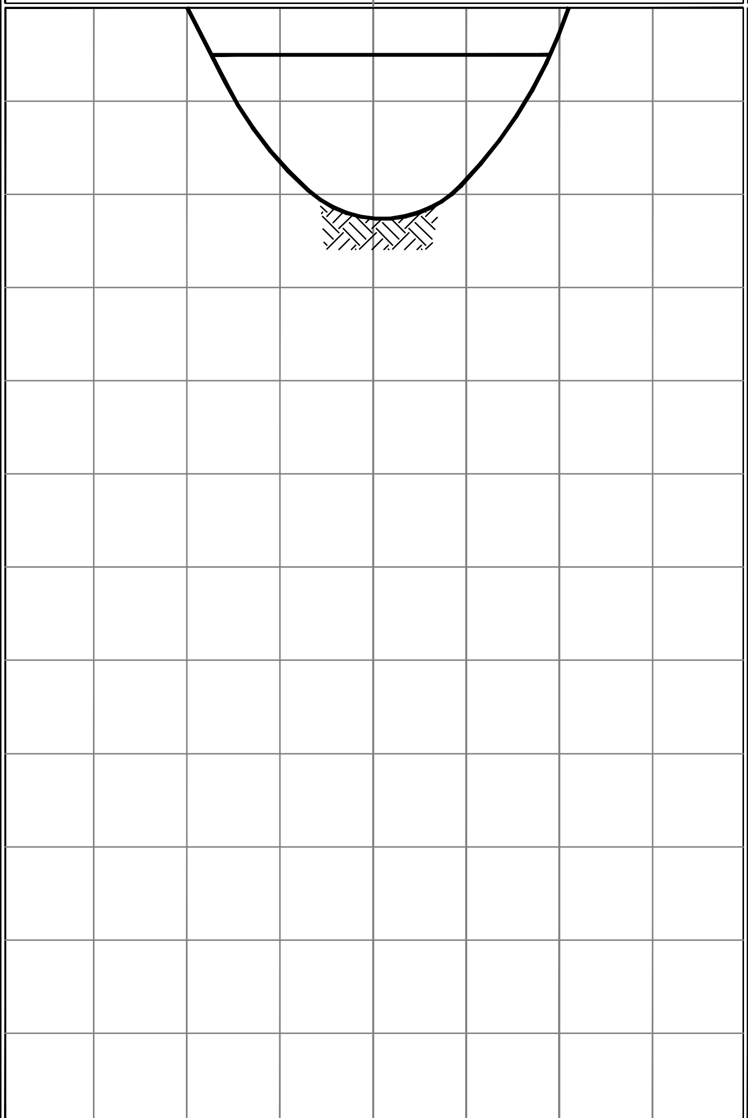
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-4

GROUND ELEVATION 3,600'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Light brown, damp, medium dense, silty fine to coarse SAND; micaceous; some organics (roots).
	■						GRANITIC ROCK: Yellowish brown and white, damp, weathered GRANITIC ROCK.
4							Total Depth = 4.5 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
8							
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

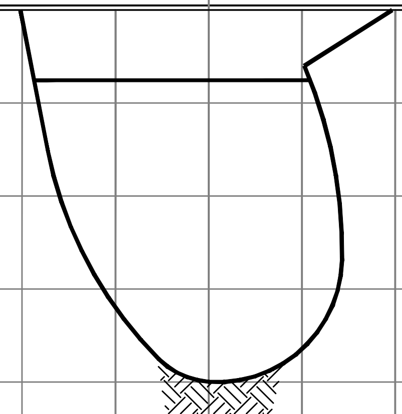
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-5

GROUND ELEVATION 3,620' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Light brown, damp, medium dense to dense, silty, fine to coarse SAND; micaceous; little organics (roots).
							GRANITIC ROCK: Yellowish brown and white, damp, decomposed GRANITIC ROCK.
4							Weathered.
7–8	■						
8							Total Depth = 8 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

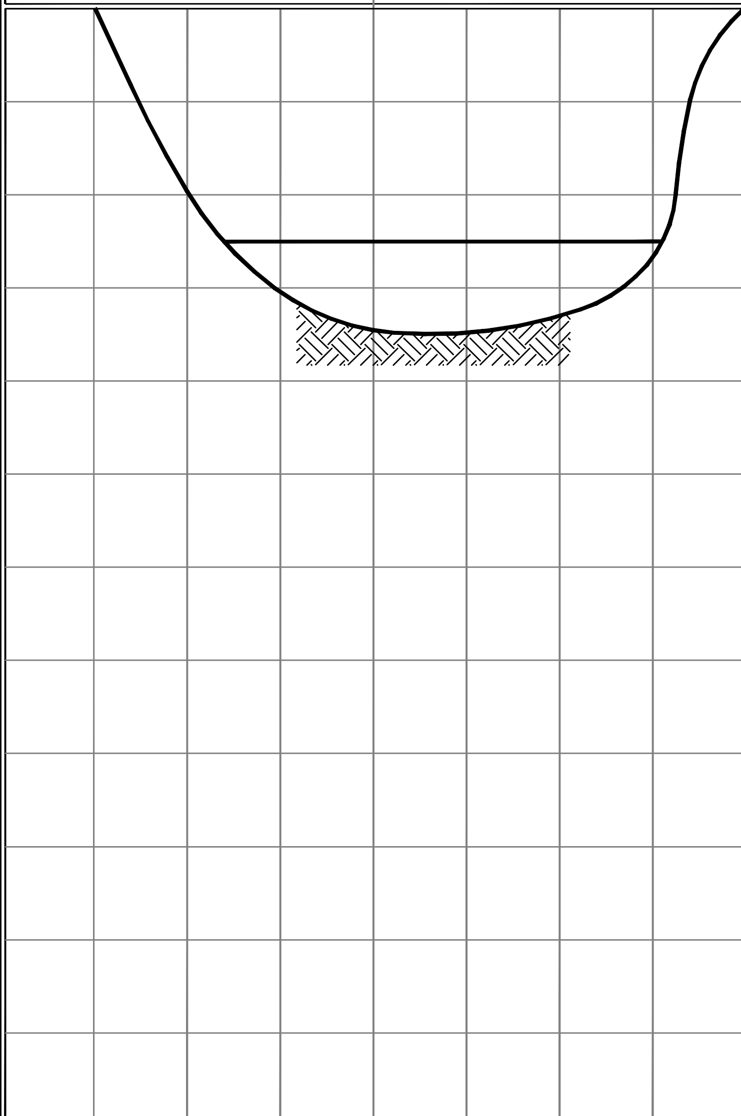
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-6

GROUND ELEVATION 3,605' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	<u>ALLUVIUM</u>: Dark brown, damp, medium dense, silty, fine to coarse SAND; some organics (roots); micaceous. Moist.
2–5	■						
5							<u>GRANITIC ROCK</u>: Yellowish brown to tan, moist, weathered GRANITIC ROCK.
7							Total Depth = 7 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. <u>Note:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

Depth scale: 0, 4, 8, 12, 16, 20, 24

SCALE = 1 in./4 ft.

FIGURE

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

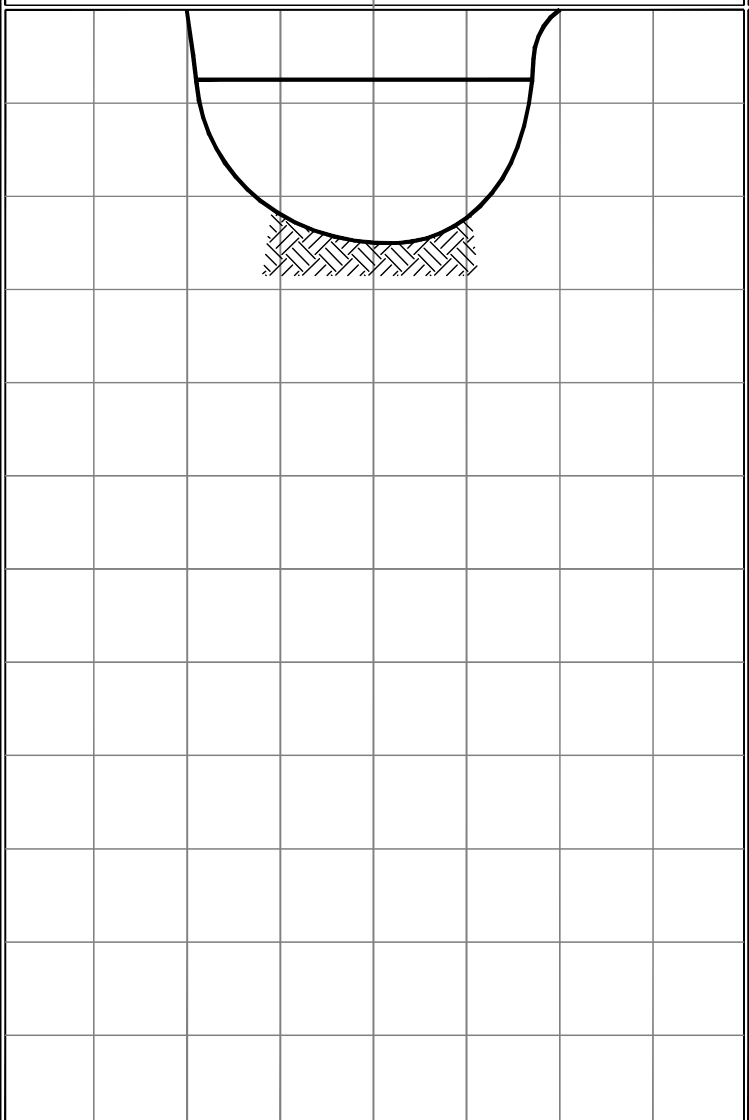
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-7

GROUND ELEVATION 3,625'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Dark brown, damp, medium dense, silty fine to coarse SAND; micaceous; some organics (roots); scattered gravel and cobbles.
	■ (approx. 3–4 ft)						GRANITIC ROCK: Yellowish brown and white, damp, weathered GRANITIC ROCK.
5							Total Depth = 5 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

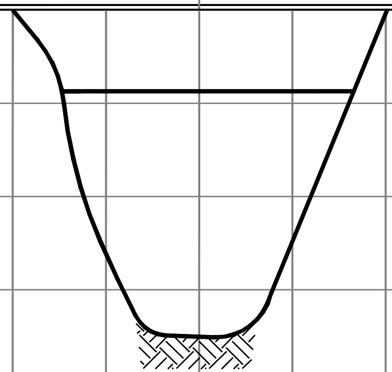
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-8

GROUND ELEVATION 3,560' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
	■						GRANITIC ROCK: Yellowish brown and white, damp, decomposed GRANITIC ROCK.
4							Weathered.
8							Total Depth = 7 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

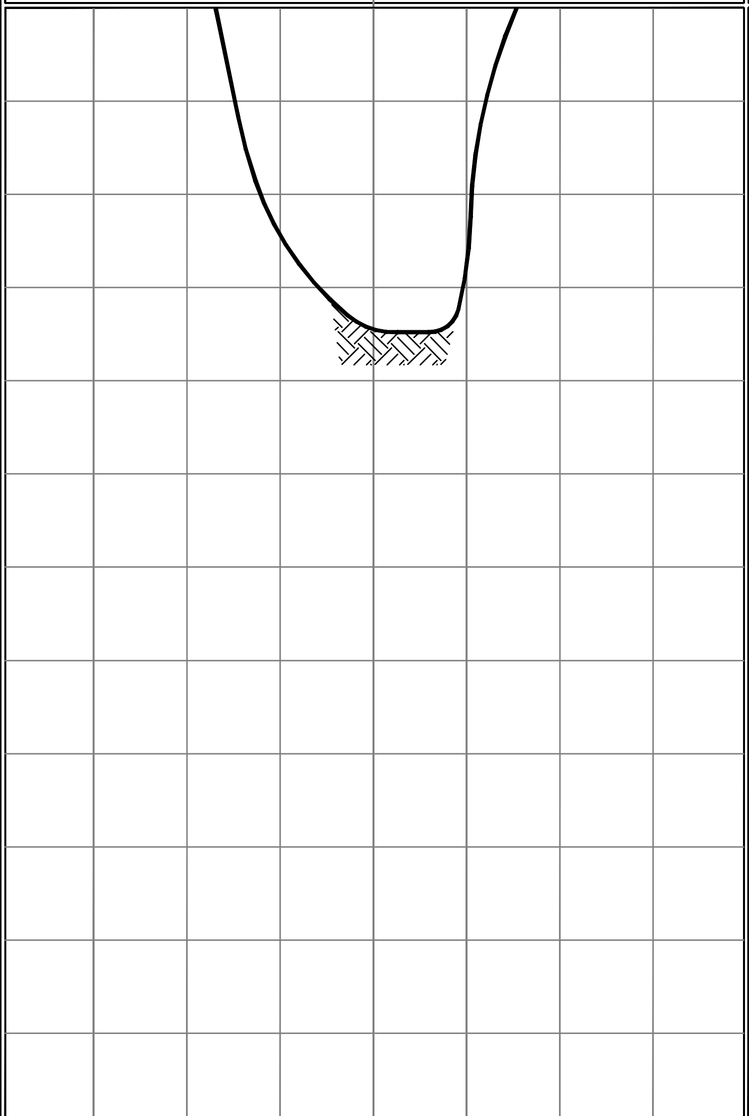
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-9

GROUND ELEVATION 3,610' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Dark brown, damp, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
4	■ (approx. 5–7 ft)						GRANITIC ROCK: Yellowish brown, damp, weathered, GRANITIC ROCK.
8							Total Depth = 7 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

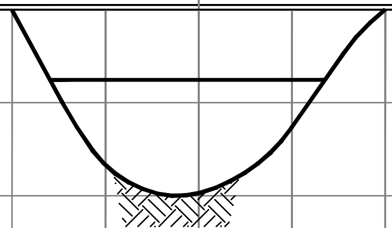
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-10

GROUND ELEVATION 3,555'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
							GRANITC ROCK: Yellowish brown and white, damp, weathered GRANITIC ROCK.
4							Total Depth = 4 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
8							
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

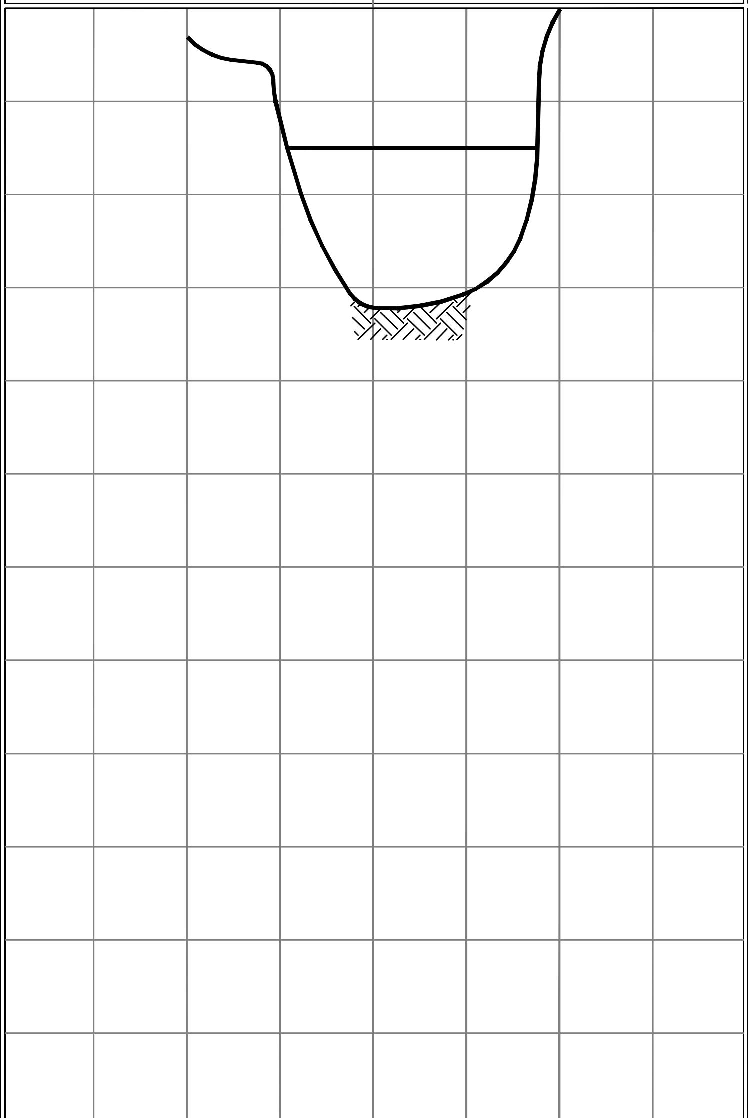
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-11

GROUND ELEVATION 3,615' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Dark brown, damp, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots); scattered gravel and cobbles.
4	■ (5.0–6.5)						GRANITIC ROCK: Yellowish brown and white, damp, weathered GRANITIC ROCK.
8							Total Depth = 6.5 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

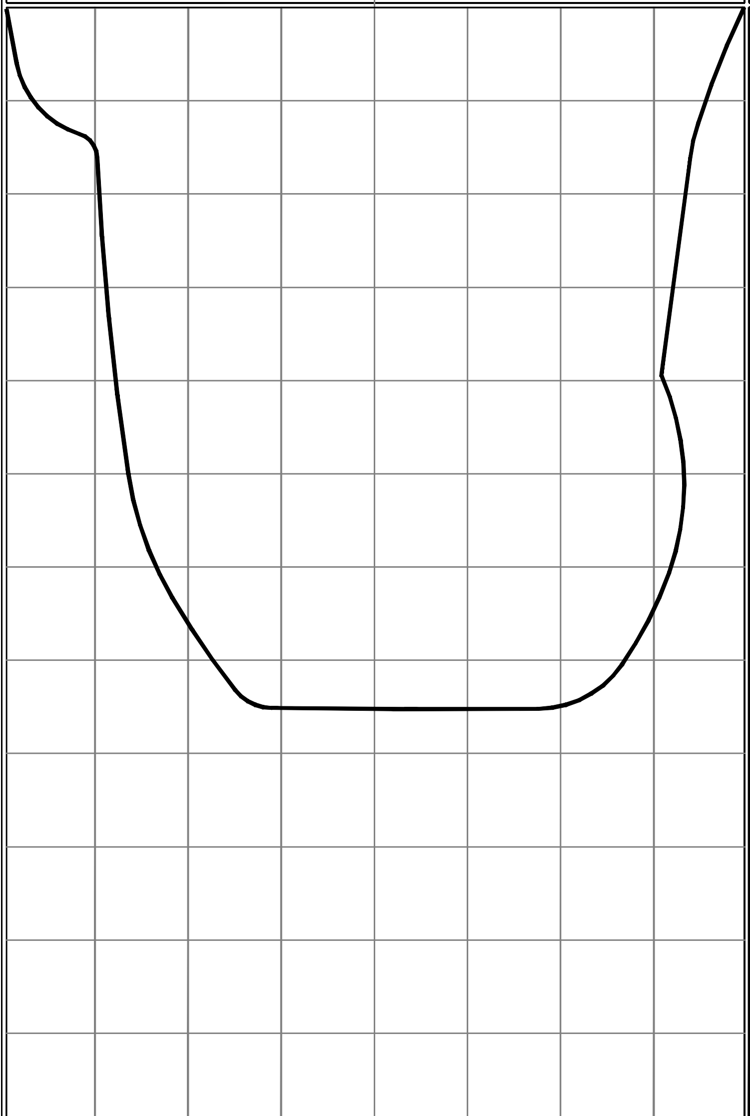
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-12

GROUND ELEVATION 3,515'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp to moist, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
4							Dense.
5–6	■						
8							
10							Moist.
12							
15							Total Depth = 15 feet. Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-13

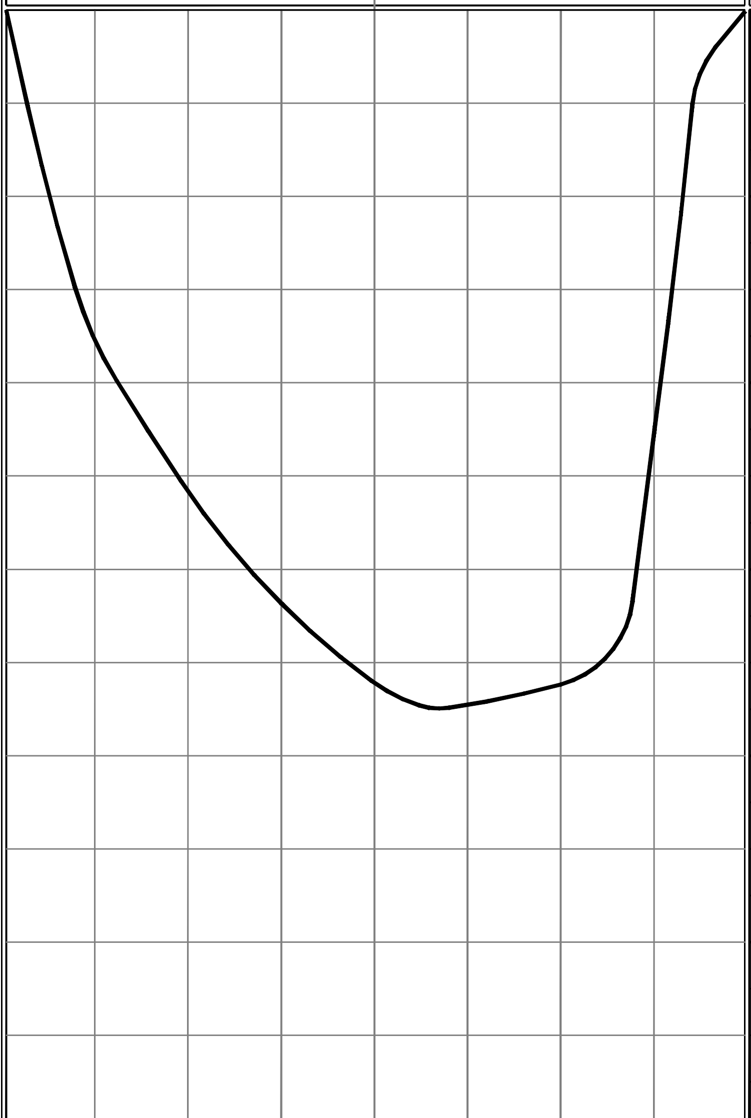
GROUND ELEVATION 3,550'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp, medium dense, silty, fine to coarse SAND; micaceous; little organics (roots).
12–15	■						
15							Total Depth = 15 feet. Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

Depth scale: 0, 4, 8, 12, 16, 20, 24



SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

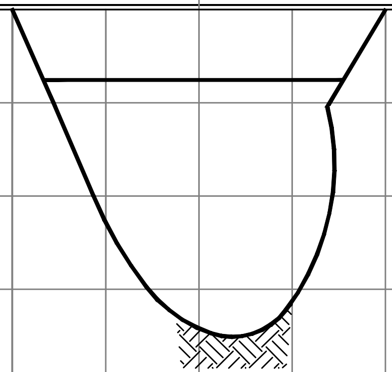
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-14

GROUND ELEVATION 3,530' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
	■						GRANITIC ROCK: Brown, damp, decomposed GRANITIC ROCK.
4							Weathered.
8							Total Depth = 7 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

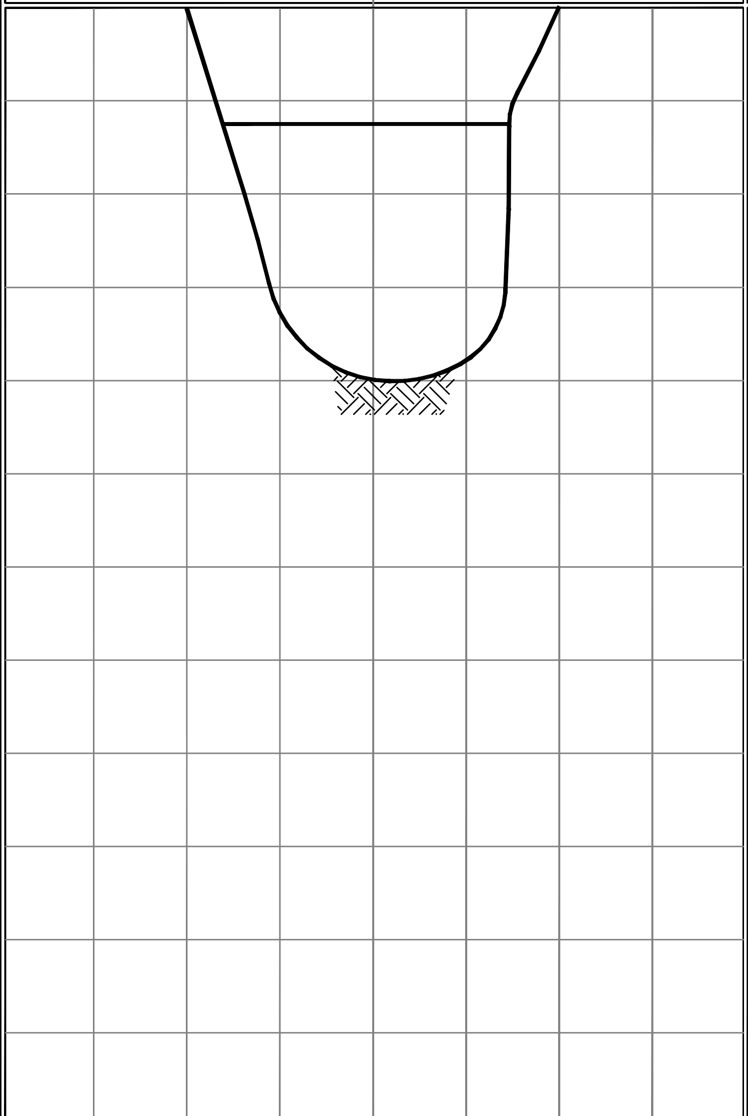
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-15

GROUND ELEVATION 3,540' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp to moist, medium dense, silty, fine to coarse SAND; micaceous; little organics (roots).
4	■ (5–6)						GRANITIC ROCK: Brown, damp, decomposed GRANITIC ROCK. Weathered.
8							Total Depth = 8 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

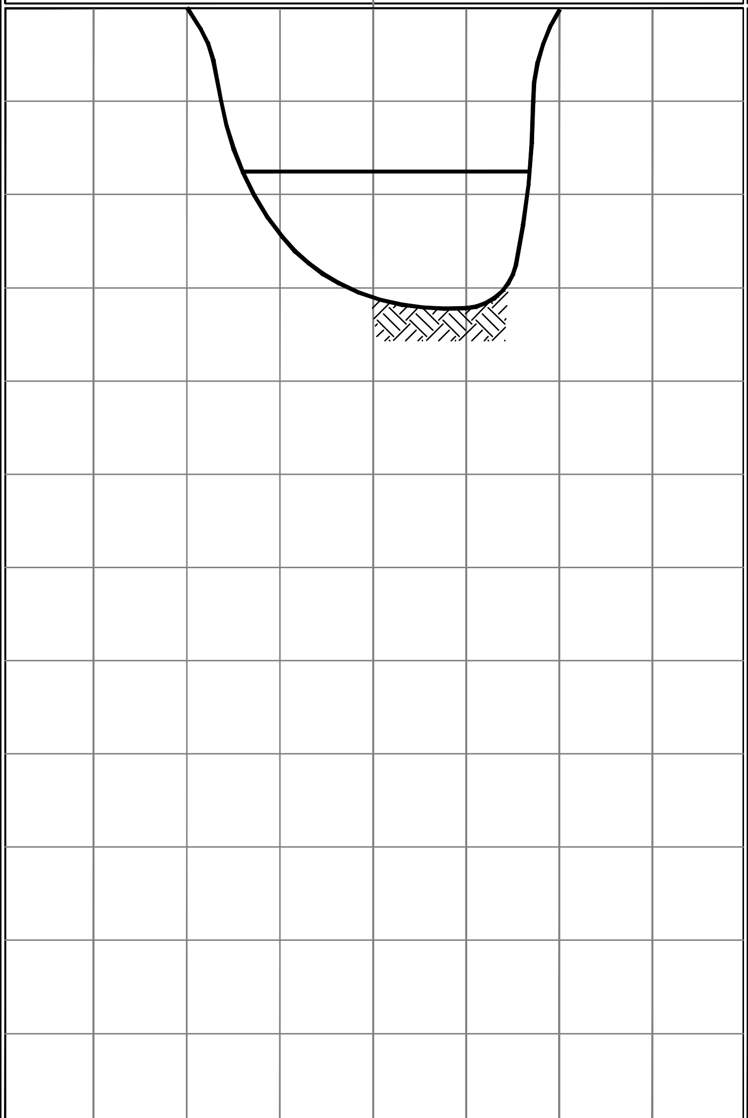
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-16

GROUND ELEVATION 3,590' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0–2	■					SM	ALLUVIUM: Brown, damp, medium dense, silty, fine to coarse SAND; micaceous; little organics (roots).
4							GRANITIC ROCK: Yellowish brown and white, damp, weathered, GRANITIC ROCK.
8							Total Depth = 6.5 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

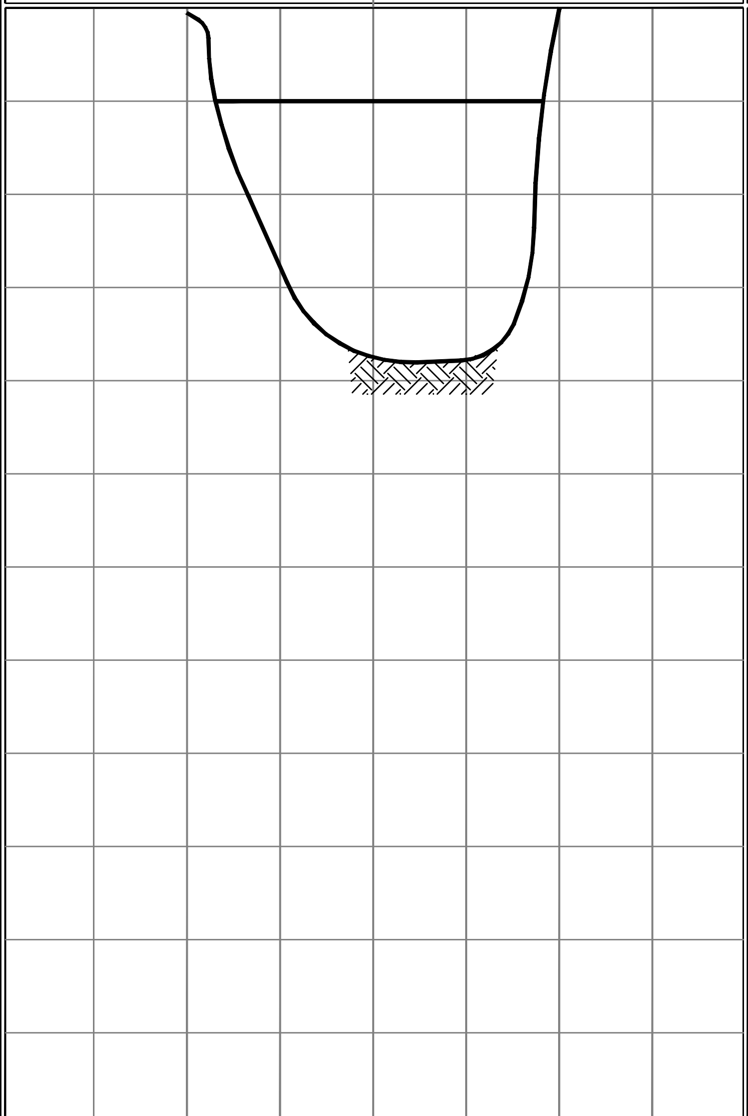
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-17

GROUND ELEVATION 3,590' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Light brown, damp to moist, medium dense, silty, fine to coarse SAND; micaceous; few organics (roots).
2							GRANITIC ROCK: Yellowish brown, damp to moist, weathered, GRANITIC ROCK.
4							Damp.
6.5–7.5	■						
7.5							Total Depth = 7.5 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
8							
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

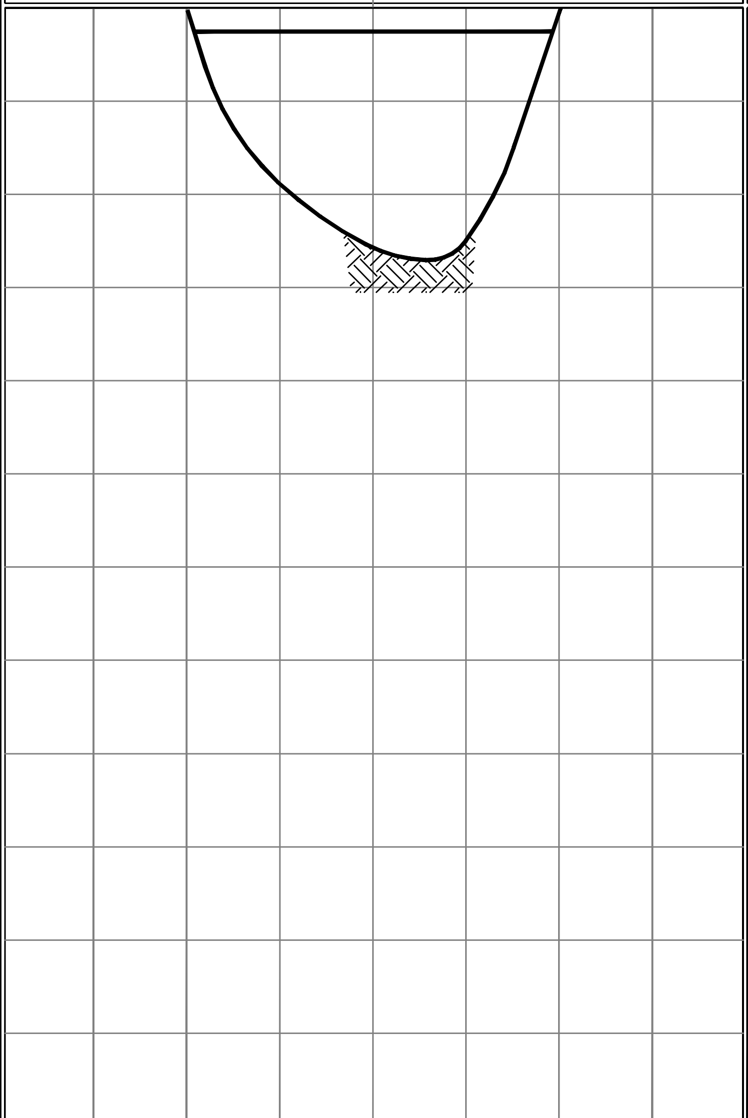
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/17/13 TEST PIT NO. TP-18

GROUND ELEVATION 3,575' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0	■					SM	ALLUVIUM: Brown, damp, medium dense, silty, fine to coarse SAND; micaceous; few organics (roots).
2							GRANITIC ROCK: Brown, damp, decomposed GRANITIC ROCK.
4							Moist; weathered.
5.5							Total Depth = 5.5 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
8							
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

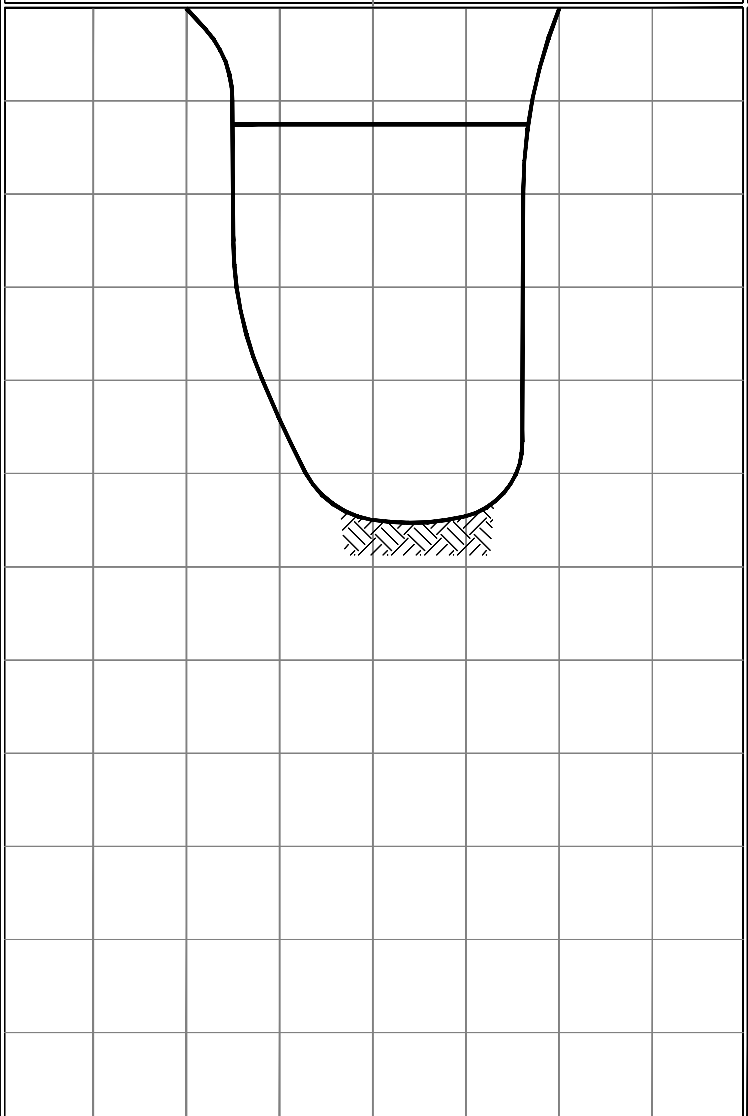
Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED: 9/17/13
TEST PIT NO.: TP-19
GROUND ELEVATION: 3,660'± (MSL)
LOGGED BY: AQP
METHOD OF EXCAVATION: 24" Bucket on Backhoe
LOCATION: Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Brown, damp to moist, medium dense, silty, fine to coarse SAND; micaceous; some organics (roots).
4	■						GRANITIC ROCK: Yellowish brown, damp, weathered GRANITIC ROCK.
							Total Depth = 11 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/17/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

Depth scale: 0, 4, 8, 12, 16, 20, 24

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

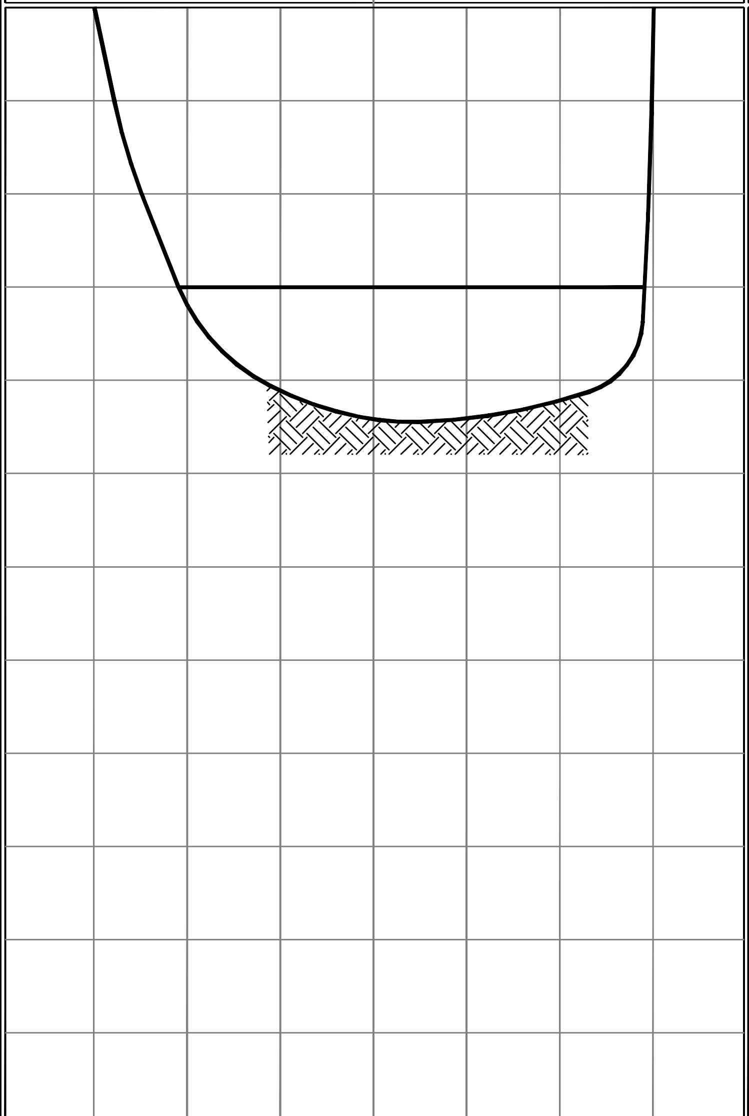
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-20

GROUND ELEVATION 3,590'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Dark brown, damp, medium dense, silty, fine to coarse SAND; some organics (roots); scattered gravel and cobbles; micaceous.
4	■						
6							GRANITIC ROCK: Yellowish brown and white, damp, weathered GRANITIC ROCK.
9							Total Depth = 9 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

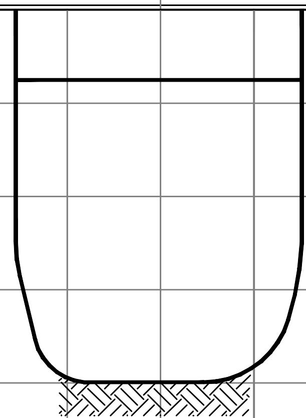
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-21

GROUND ELEVATION 3,570'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket Excavator (24" Bucket on Backhoe)

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0	Bulk (0–1.5)					SM	<u>ALLUVIUM</u>: Dark brown, damp, medium dense, silty fine to coarse SAND; micaceous; scattered gravel and cobbles; some organics (roots).
	Bulk (1.5–5)						<u>GRANITIC ROCK</u>: Yellowish brown with white, damp, GRANITIC ROCK. @ 3': Weathered.
4							
8							Total Depth = 8 feet. (Refusal) Groundwater not encountered. Backfilled and compacted on 9/16/13. <u>Note:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
12							
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

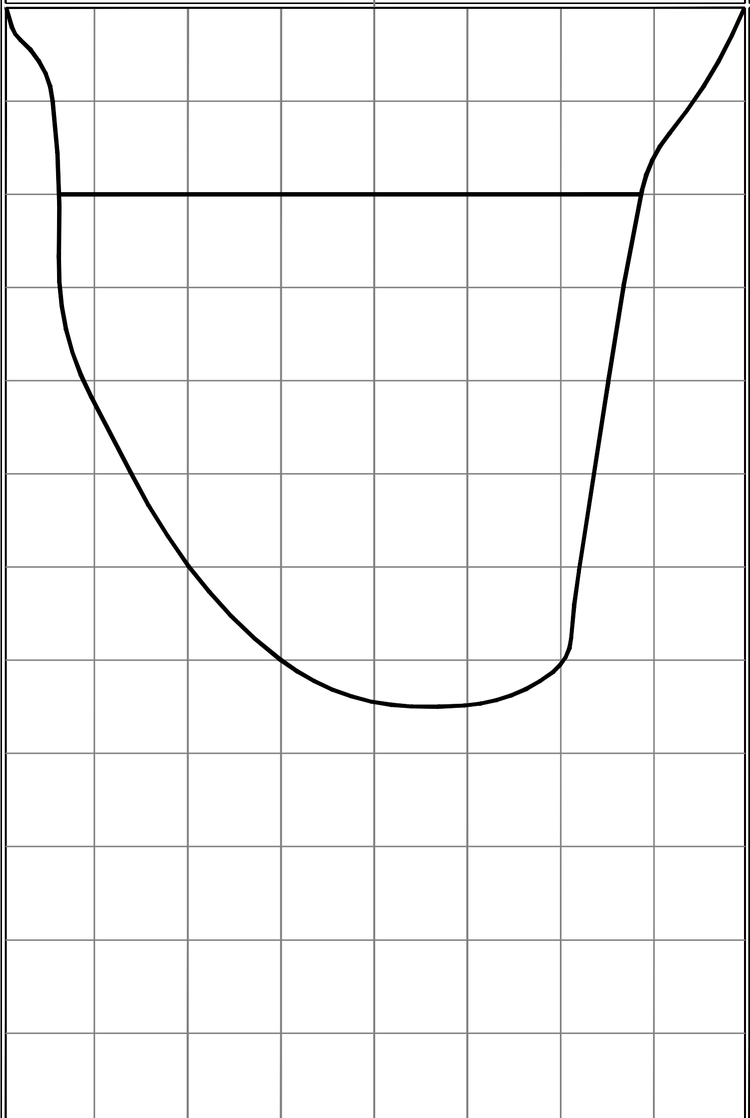
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-22

GROUND ELEVATION 3,525'± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Dark brown, damp, medium dense, silty, fine to coarse SAND; some organics (roots); scattered gravel and cobbles; micaceous.
4							GRANITIC ROCK: Yellowish brown and white, damp, decomposed GRANITIC ROCK.
	■ (approx. 5–7 ft)						
8							
							Moist; weathered.
12							
15							Total Depth = 15 feet. Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
16							
20							
24							

SCALE = 1 in./4 ft.

FIGURE

Ninyo & Moore

TEST PIT LOG

RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

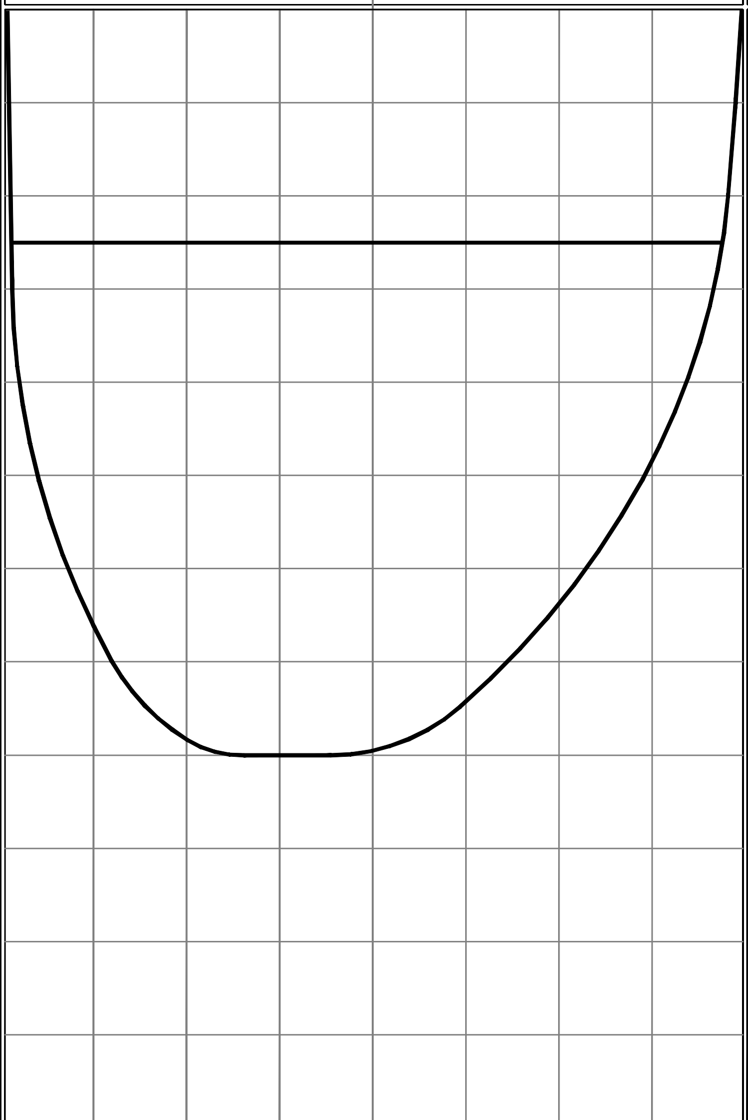
PROJECT NO.	DATE
107269002	10/13

DATE EXCAVATED 9/16/13 TEST PIT NO. TP-23

GROUND ELEVATION 3,530' ± (MSL) LOGGED BY AQP

METHOD OF EXCAVATION 24" Bucket on Backhoe

LOCATION Ribbon Wood Road and Road Runner Lane



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						SM	ALLUVIUM: Light brown, damp, medium dense, silty, fine to coarse SAND; some organics (roots); scattered gravel and cobbles; micaceous.
5							GRANITIC ROCK: Yellowish brown and white, damp, decomposed GRANITIC ROCK.
8							Weathered.
10							Moist.
16							Total Depth = 16 feet. Groundwater not encountered. Backfilled and compacted on 9/16/13. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

Depth scale: 0, 4, 8, 12, 16, 20, 24

SCALE = 1 in./4 ft.

FIGURE

APPENDIX C

GEOPHYSICAL EVALUATION

GEOPHYSICAL SURVEY
RUGGED SOLAR PROJECT
BOULEVARD, CALIFORNIA

PREPARED FOR:
Ninyo & Moore
5710 Ruffin Road
San Diego, CA 92123

PREPARED BY:
Southwest Geophysics, Inc.
8057 Raytheon Road, Suite 9
San Diego, CA 92111

October 8, 2013
Project No. 113353

SOUTHWEST GEOPHYSICS, INC.
YOUR SUBSURFACE SOLUTION

October 8, 2013
Project No. 113353

Mr. Frank Moreland
Ninyo & Moore
5710 Ruffin Road
San Diego, CA 92123

Subject: Geophysical Survey
Rugged Solar Project
Boulevard, California

Dear Mr. Moreland:

In accordance with your authorization, we have performed a geophysical evaluation pertaining to the Rugged Solar Project in Boulevard, California. Specifically, our services consisted of performing five seismic P-wave refraction profiles, and electrical resistivity soundings at 16 locations at the subject site. The purpose of our services was to evaluate the apparent rippability of the subsurface materials, develop a subsurface velocity model, and to collect in-situ electrical resistivity measurements for use in the design and construction of proposed improvements. This report presents our survey methodology, equipment used, analysis, and results.

We appreciate the opportunity to be of service on this project. Should you have any questions related to this report, please contact the undersigned at your convenience.

Sincerely,
SOUTHWEST GEOPHYSICS, INC.

Aaron T. Puente
Senior Staff Geologist/Geophysicist

Hans van de Vrugt, C.E.G., P.Gp.
Principal Geologist/Geophysicist

REGISTERED GEOPHYSICIST
Hans van de Vrugt
No 1012
Exp. 2/28/14
STATE OF CALIFORNIA

ATP/HV/hv
Distribution: Addressee (electronic)

TABLE OF CONTENTS

1. INTRODUCTION

In accordance with your authorization, we have performed a geophysical evaluation pertaining to the Rugged Solar Project in Boulevard, California (Figure 1). Specifically, our services consisted of performing five seismic P-wave refraction profiles, and electrical resistivity soundings at 16 locations at the subject site. The purpose of our services was to evaluate the apparent rippability of the subsurface materials, develop a subsurface velocity model, and to collect in-situ electrical resistivity measurements for use in the design and construction of proposed improvements. This report presents our survey methodology, equipment used, analysis, and results.

2. SCOPE OF SERVICES

Our scope of services included:

- Performance of five seismic P-wave refraction profiles.
- Performance of electrical resistivity soundings at 16 locations.
- Compilation and analysis of the data collected.
- Preparation of this report presenting our findings and conclusions.

3. SITE AND PROJECT DESCRIPTION

The general project site is located north of Interstate 8 between Ribbonwood Road and McCain Valley Road in Boulevard, California (Figure 1). Terrain in the survey areas consists of relatively flat ground and small hills. Vegetation consists of annual grass, brush, scattered trees. Numerous outcrops of weathered granitic rock are also present onsite. The general site conditions in the survey areas are depicted on Figures 2a through 2g, and 3a through 3d.

It is our understanding that your office is conducting a geotechnical evaluation for the proposed solar facility. Information acquired during our study (i.e., depth to bedrock, rippability, electrical properties, etc.) are to be used in the design and construction of the proposed improvements.

4. SURVEY METHODOLOGY

As previously indicated, the primary purpose of our services was to characterize the subsurface conditions at pre-selected locations through the collection of seismic and electrical resistivity data. The following sections provide an overview of the methodologies used during our study.

4.1. Seismic P-wave Refraction Survey

A seismic P-wave (compression wave) refraction survey was conducted at the site to evaluate the apparent rippability characteristics of the subsurface materials and to develop a subsurface velocity profile of the study area. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves generated at the surface, using a hammer and plate, are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component geophones, and recorded with a 24-channel Geometrics Geode seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials. Five seismic profiles (labeled SL-1 through SL-5) were conducted at the site. The locations and line numbers were selected by your office. Figures 2a, 2b, 2c, 2e and 2f depict the general location of the lines. Shot points were conducted at the ends and intermediate points along the lines.

The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above may not be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by core stones, dikes, etc. can result in the misinterpretation of the subsurface conditions.

In general, seismic wave velocities can be correlated to material density and/or rock hardness. The relationship between rippability and seismic velocity is empirical and assumes a homogenous mass. Localized areas of differing composition, texture, and/or structure may affect both the measured data and the actual rippability of the mass. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

The rippability values presented in Table 1 are based on our experience with similar materials and assume that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock rippability. These characteristics may also vary with location and depth.

For trenching operations, the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in a narrow trench, should be anticipated.

Table 1 – Rippability Classification	
Seismic P-wave Velocity	**Rippability**
0 to 2,000 feet/second	Easy
2,000 to 4,000 feet/second	Moderate
4,000 to 5,500 feet/second	Difficult, Possible Blasting
5,500 to 7,000 feet/second	Very Difficult, Probable Blasting
Greater than 7,000 feet/second	Blasting Generally Required

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook (Caterpillar, 2011). Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

Collected P-wave data were processed using SIPwin (Rimrock Geophysics, 2003) and SeisOpt® Pro™ (Optim, 2008). SIPwin was used to evaluate first arrival times and SeisOpt® Pro™ was used for interpretation. SeisOpt® Pro™ uses a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity models provide a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography models. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

4.2. Electrical Resistivity Survey

Thirty-two electrical resistivity soundings were performed at 16 test locations selected by your office. Specifically we conducted two intersecting resistivity soundings in each location. The "a" profiles (i.e., R-1a) were conducted in roughly a north-south direction and the "b" profiles (i.e., R-1b) were conducted in roughly an east-west direction. The purpose of the crossing profiles was to assess lateral variations in resistivity. Figures 2a through 2g illustrate the approximate locations of the lines.

The data were collected in general accordance with ASTM G 57 using an Advanced Geosciences, Inc. (AGI) SuperSting R8 earth resistivity meter and four stainless steel electrodes in a Wenner configuration. The SuperSting can generate up to 800 volts and 2 amps and allows for the direct measurement of resistance. Soil resistance measurements were collected at electrode spacings of approximately 2, 5, 10, 15, 20, 30 and 40 feet. The electrodes were hammered into place. Special care was exercised to ensure firm contact with the soil. When contact resistance values were high, the electrode hole was moistened with water to improve contact with the ground.

5. RESULTS

The following is a summary of our findings:

5.1. Seismic P-wave Refraction Survey

As previously indicated, two seismic traverses were conducted as part of our study. The collected data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008). SeisOpt Pro uses first arrival picks and elevation data to produce subsurface velocity models through a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

Figures 4a through 4c present the velocity models generated from our study. The approximate locations of the seismic refraction traverses are shown on the Line Location Maps (Figures 2a, 2b, 2c, 2e and 2f). In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the traverse.

5.2. Electrical Resistivity Survey

The resistivity results are presented on Figure 5a through 5f. In general, the quality of the collected data is very good. The standard deviation between multiple readings is 0.1 percent or less. The measurements collected along orthogonal soundings are also fairly consistent indicating subsurface homogeneous conditions in each test location.

6. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface surveying will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Southwest Geophysics, Inc. should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

7. SELECTED REFERENCES

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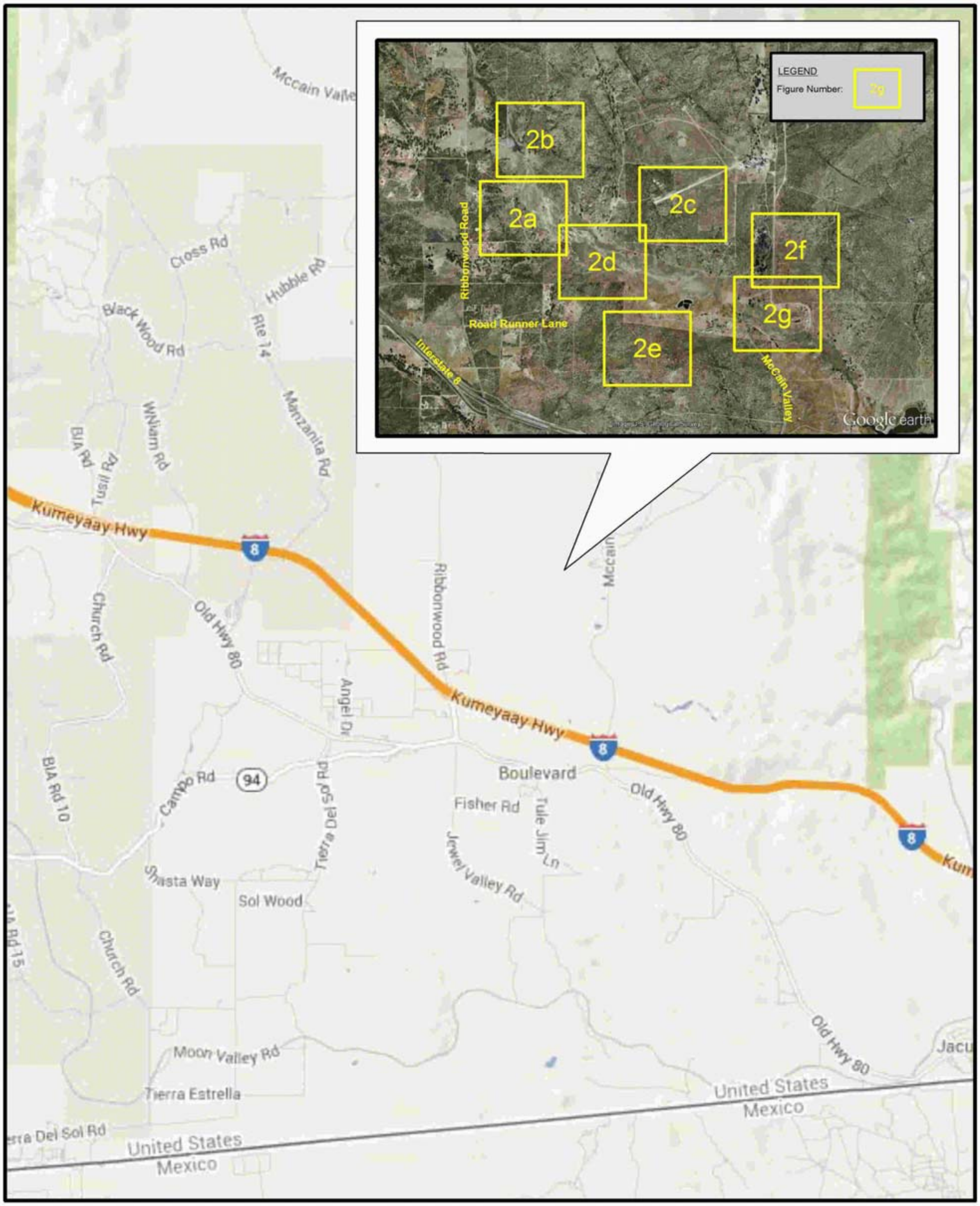
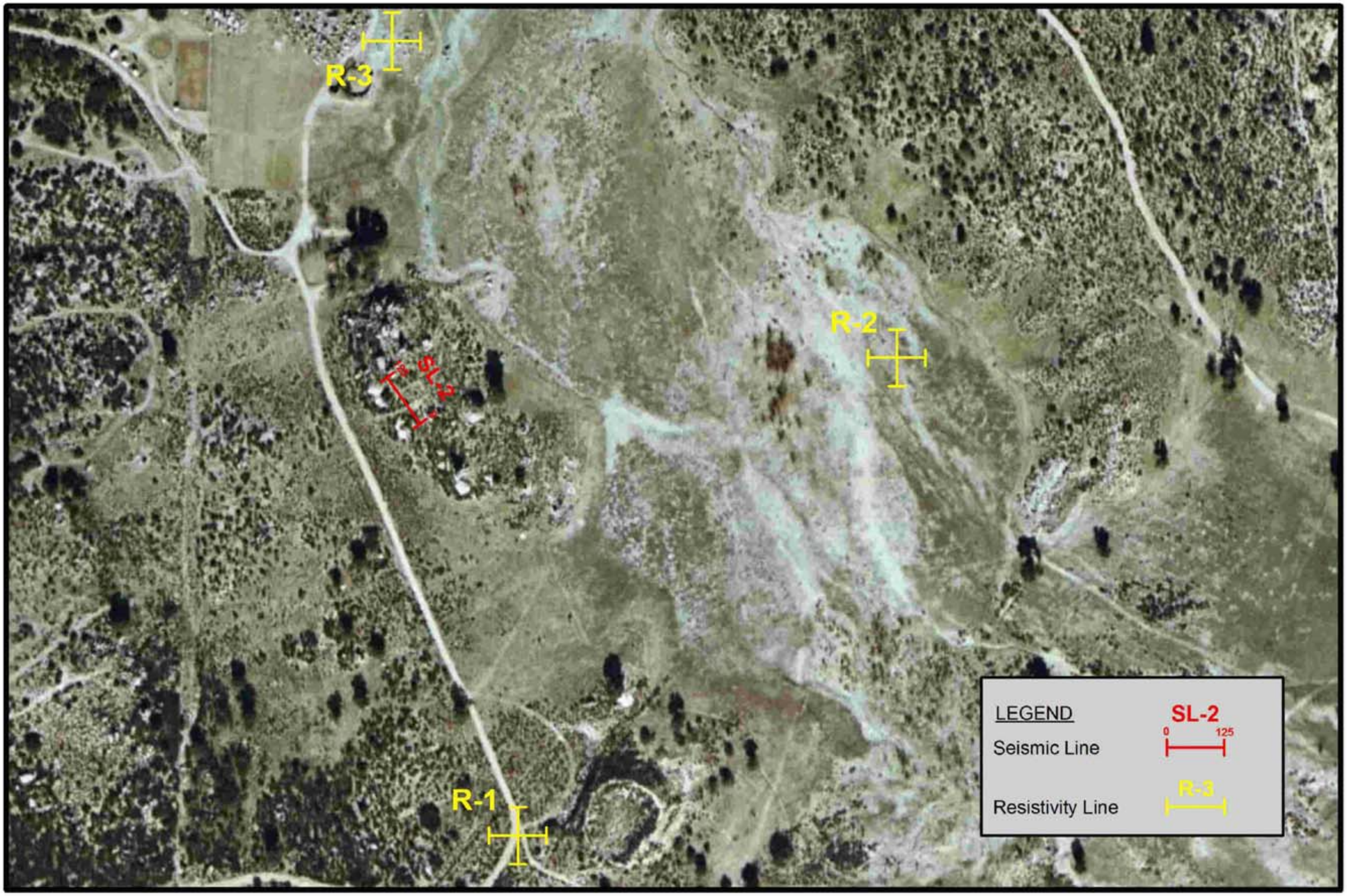
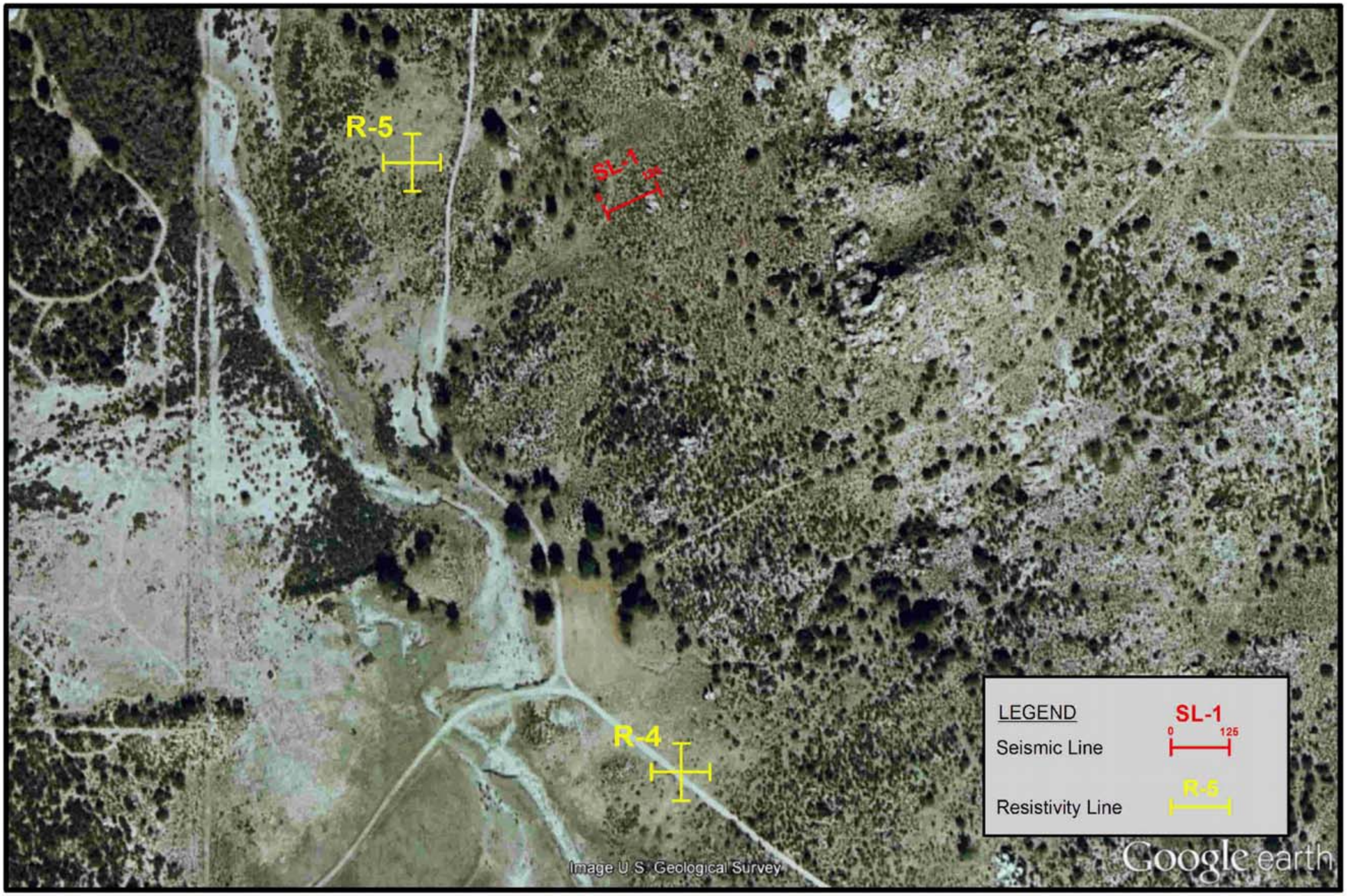


SITE LOCATION MAP	N	Rugged Solar Project Boulevard, California		SOUTHWEST GEOPHYSICS INC. Figure 1
		Project No.: 113353	Date: 10/13	

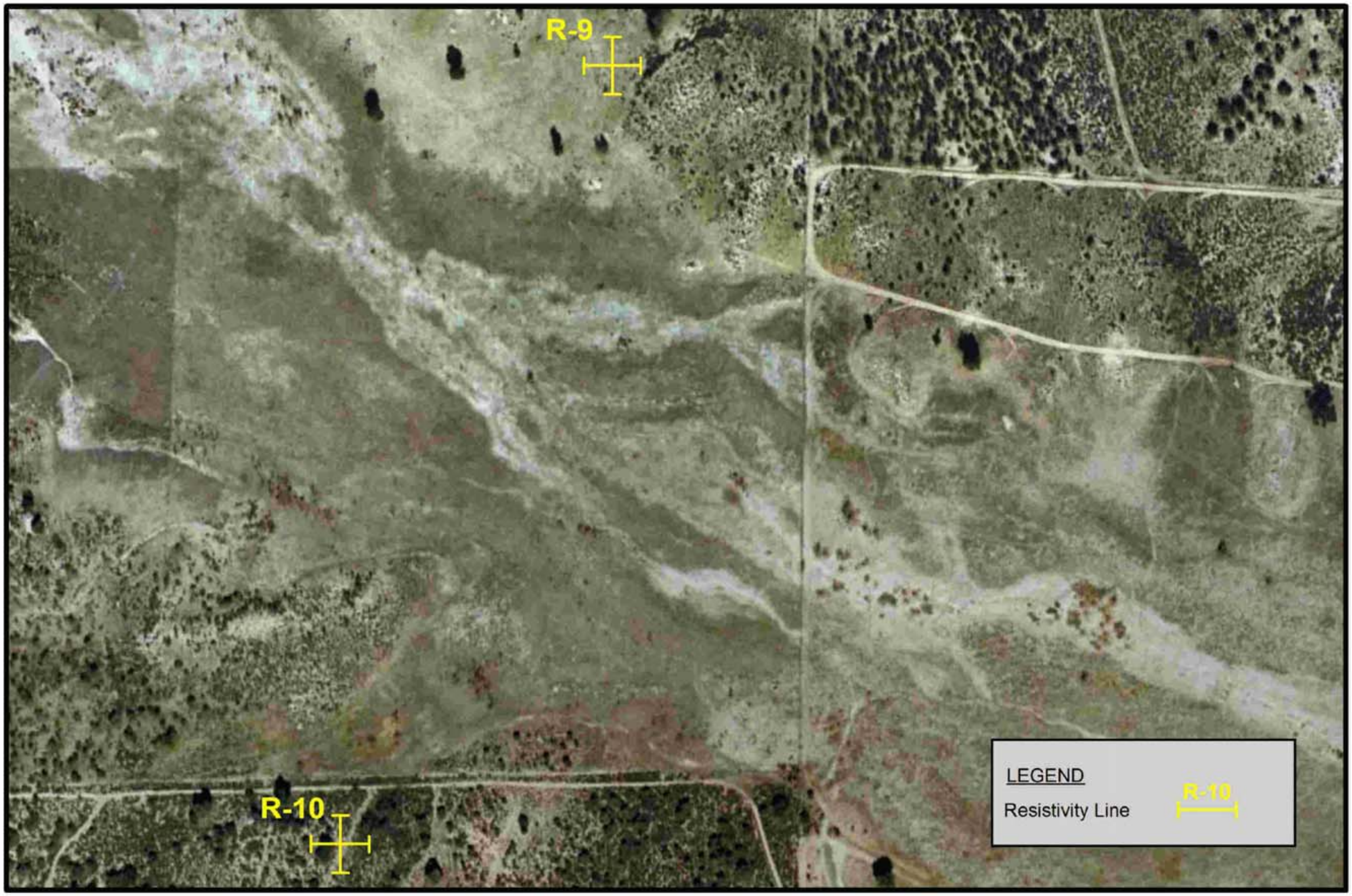


LINE LOCATION MAP	N	Rugged Solar Project Boulevard, California Project No.: 113353 / Date: 10/13	SOUTHWEST GEOPHYSICS INC. Figure 2a	0 300 600 approximate scale in feet



LINE LOCATION MAP	N	Rugged Solar Project Boulevard, California Project No.: 113353 Date: 10/13	SOUTHWEST GEOPHYSICS INC. Figure 2b	0 300 600 approximate scale in feet

LINE LOCATION MAP	N	Rugged Solar Project Boulevard, California Project No.: 113353 — Date: 10/13	SOUTHWEST GEOPHYSICS INC. Figure 2c	0 — 300 — 600 approximate scale in feet



LINE LOCATION MAP

N

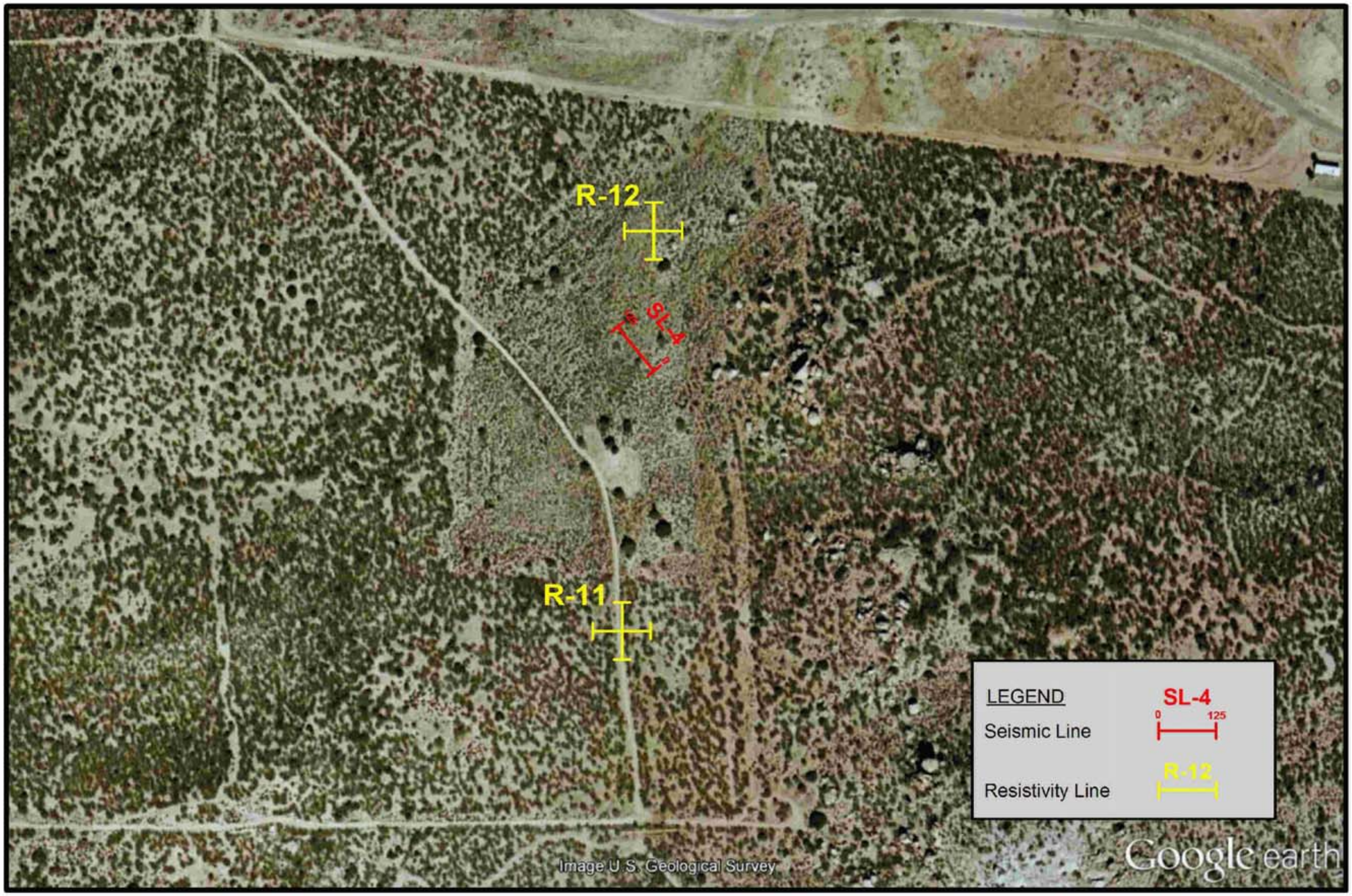
Rugged Solar Project
Boulevard, California

Project No.: 113353 | Date: 10/13

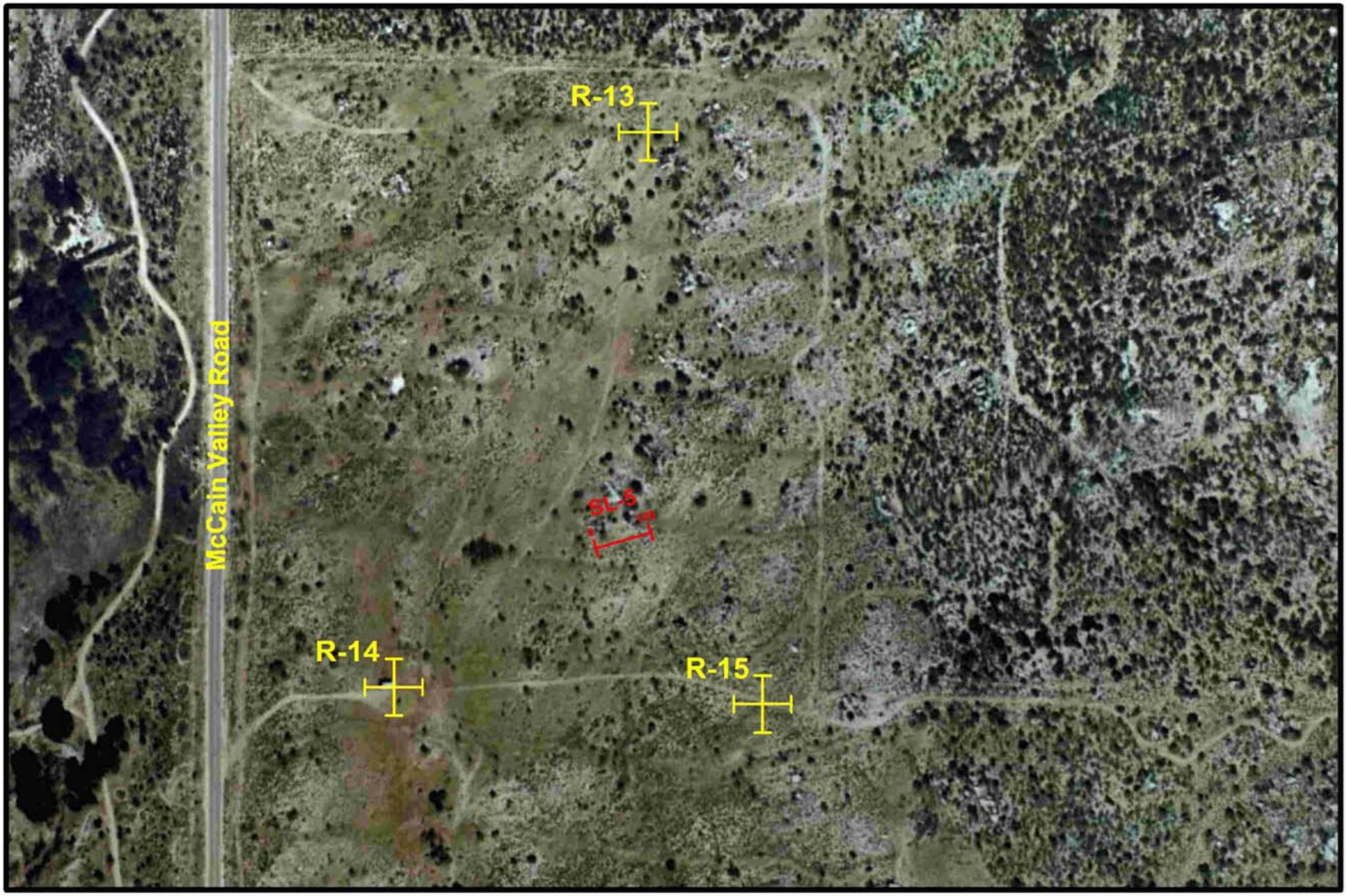
SOUTHWEST GEOPHYSICS INC.

Figure 2d

0 300 600
approximate scale in feet



LINE LOCATION MAP	N	Rugged Solar Project Boulevard, California Project No.: 113353 Date: 10/13	SOUTHWEST GEOPHYSICS INC. Figure 2e	0 300 600 approximate scale in feet



LINE LOCATION MAP	N	Rugged Solar Project Boulevard, California Project No.: 113353 Date: 10/13	SOUTHWEST GEOPHYSICS INC. Figure 2f	0 300 600 approximate scale in feet