PRELIMINARY
GEOTECHNICAL INVESTIGATION REPORT
FOR
SPOWER
PROPOSED DEL SUR RANCH SOLAR
AVENUE G & 95th STREET WEST
LANCASTER, LOS ANGELES COUNTY
CALIFORNIA

Prepared by:
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1817 East Avenue Q, Unit A1
Palmdale, California 93550

February 26, 2015

J.N. 14-101
February 26, 2015

Mr. Garrett Bean
sPower
2749 East Parley’s Way, Suite 310
Salt Lake City, Utah 84109

Subject: Preliminary Geotechnical Investigation Report for Del Sur Ranch Solar Facility Approximately 740 acres located at the SWC of Avenue G and 95th Street West, Lancaster, Los Angeles County, California
APN 3265-005-001,
APN 3265-007,002,008,023,024,025,026,027
APN 3219-016-027,030,031
APN 3219-017-020

Dear Mr. Bean:

Presented herewith is the report of our Preliminary Geotechnical Investigation Report for the subject project. Our work was performed in accordance with the scope of work outlined in our original proposal dated December 3, 2014.

This report presents the results of our field investigation, laboratory testing and our engineering judgment, opinions, conclusions and recommendations pertaining to the existing structure.

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the contents of this report, or should you require additional information, please contact the undersigned at (661) 273-9078.

Respectfully submitted,

Bruin Geotechnical Services, Inc.

Distribution: 4-Client

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Figure 1 Vicinity Map
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Appendix A Boring Logs and Soil Classification Key
Appendix B Soil Corrosivity Study
Appendix C Laboratory Test Data
Appendix D Engineering Analysis
Appendix E Thermal Analysis
1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical investigation performed by Bruin Geotechnical Services, Inc. for the proposed photovoltaic solar array and auxiliary equipment pads based on the preliminary site plan provided by SPower.

The purpose of this investigation was to evaluate the subsurface soil conditions and to provide geotechnical recommendations relative to earthwork and grading and design parameters for construction of concrete structure foundations and driven H-piles associated with the proposed development.

The scope of the authorized investigation included the following tasks:

- performing a site reconnaissance
- conducting a field subsurface exploration through borings
- Performing a field and laboratory soil corrosivity study
- Performing a soil thermal analysis of the native soil
- laboratory testing program of selected soil samples
- performing engineering analyses of the data
- preparing a Preliminary Geotechnical Investigation Report

This study also includes a review of published and unpublished literature and geotechnical maps with respect to active and potentially active faults located in proximity to the site which may have an impact on the seismic design of the proposed structure.

2.0 SITE LOCATION AND DESCRIPTION

The subject site consists of approximately 740 acres which includes the following Assessor Parcel Numbers:

APN 3265-005-001
APN 3265-007,002,008,023,024,025,026,027
APN 3219-016-027,030,031
APN 3219-017-020

The subject site is located in the city of Lancaster, Los Angeles County, California. The irregular-shaped site is located on the southwest corner of Avenue G (unpaved
road) and 95th Street West (paved road). The site is bounded mostly by vacant land on all sides, with a single-family residence along the east boundary on 95th Street West and a single-family residence along the north boundary, on the north side of Avenue G. There is an existing solar facility and two single-family residences located along a portion of the south boundary, which is Avenue H (unpaved). Access to the site is from Avenue G or Avenue H. The general location of the subject site is shown on Figure 1.

At the time of our investigation, the site was vacant of structures. The topography of the site is relatively flat and level, with slight undulations. The existing ground surface is approximately 2445 feet above mean sea level at the northeast corner of the site (low point). Drainage occurs by sheetflow towards the east/northeast, with an approximate elevation change of 50’ over a distance of approximately 8,150 feet from the southwest corner to the northeast corner of the site. There are small drainage erosion courses traversing the subject site from west to east. Dirt roads also traverse the site, mostly in north/south or east/west directions. A few small agricultural water reservoirs were observed near the center and southeast portion of the site, as it appears that a large portion of the site was used for agricultural purposes in the past. Vegetation at the time of our investigation consisted of native desert flora; sparse grass and low weeds and a few shrubs. No trees were observed. A sparse amount of localized trash which had been dumped was also observed.

3.0 FLOOD HAZARD

Bruin GSI reviewed available data regarding the flood potential at the subject site. Based on our FEMA database research, the subject site is located on Map Number 06037C0400F. Review of panel 400 indicates the subject site contains multiple flood zones. The southern portion of the site is located in Zone A and Zone X (Other Areas) with the north portion of the site located in Zone X. The following descriptions are provided for the appropriate flood zones:

Zone X (Other Areas):
Area determined to be outside the 0.2% annual chance flood plain.

Zone A
Zone A is identified under Special Flood Hazard Areas (SFHAs) subject to inundation by the 1% annual chance flood.

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The special Flood Hazard area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH AO, AR, A99, V and VE. The base Flood Elevation is the water-surface elevation of the 1% annual chance flood. No base flood elevations have been determined for Zone A.
Antelope Acres

V Avenue G

W Avenue J

9th St. W

W Avenue I

110th St. W

VICINITY MAP
(Not to Scale)

Proposed Del Sur Ranch Solar Facility

SPower
SWC of Avenue G and 95th Street West
Lancaster, California

Bruin GSI
1817 E. Ave. Q., Unit A-1
Palmdale, CA 93550
661.273.9078

Job No. 14-101

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

A Hydrology Study or flood analysis was not a part of the scope of work.

4.0 PROPOSED CONSTRUCTION

Based on our conversations and information obtained via email with the client, it is our understanding that the proposed construction consists of a photovoltaic array (fixed tilt and tracker panels) on single pole foundation supports (driven H-piles: W6x7, W6x8.5 and W6x15 are anticipated) with four to five (4-5) feet above grade and anticipated embedment depths of eight to twelve (8-12) feet, and concrete mat foundations or spread foundations with slab-on-grade for auxiliary equipment and inverter pad structures. It is anticipated that the proposed earthwork will consist of clearing and grubbing of the vegetation and minor grading with cuts and fills of less than one (1) foot, maintaining the natural drainage through the site. Dirt or gravel drive areas for access are also anticipated.

Although construction details are not available at the time of this writing, based upon conversations with the client, we anticipate allowable stress design loads for the posts downward (bearing) loads at 3-4 kips, and wind uplift and lateral loads of approximately 1-2 kips for the photovoltaic array and dead loads of 2-3 kips for auxiliary structures.

5.0 GEOTECHNICAL INVESTIGATION

The geotechnical investigation included a field exploration program and a laboratory testing program. These programs were performed in accordance with our proposal for Geotechnical Investigation Report dated December 3, 2014. The scope of work did not include environmental assessment or investigation for the presence or absence of hazardous substances or toxic materials in structures, soil, surface water, groundwater or air, below or around the site. The field exploration and laboratory testing programs are described below.

5.1 FIELD EXPLORATION PROGRAM

The field exploration program was initiated on January 9, 2015, under the technical supervision of our engineer. A total of thirty five (35) exploratory borings were drilled using a CME 75 drill rig with 8” hallow stem auger. The borings were advanced to maximum depths of fifteen (15) feet below ground surface (bgs). The approximate locations of the borings within the area of
the proposed construction are shown on Figure 2. The borings were located in the field with a hand-help GPS device. The approximate latitude and longitude of each boring is shown on the Boring logs. If an exact location of the boring locations is desired, it should be performed by a licensed surveyor.

Logs of subsurface conditions encountered in the borings were prepared in the field by a representative of Bruin GSI. Soil samples were obtained at various depth intervals, consisting of relatively undisturbed brass ring samples (Modified California split-spoon sampler) and Standard Penetration Test (SPT) samples driven by a 140 pound hammer falling 30 inches. Bulk samples were also collected at various depths from 0 to 15 feet below existing ground surface. The soil samples were returned to the laboratory for analysis and testing. Final boring logs were prepared from the field logs and are presented in Appendix A.

Field tests were performed by HDR Schiff to obtain soil corrosion data as determined by the Wenner 4 Pin Method (ASTM G57). Testing procedures and results are discussed in Section 10.0 and presented in Appendix B.

**5.2 LABORATORY TESTING**

Selected samples collected during drilling activities and field work were tested in the laboratory to assist in evaluating the engineering properties of subsurface materials deemed within the structural influence of the site.

The samples were classified in accordance with the Unified Soils Classification System and a testing program was established.

The samples were tested to determine the following:

- In-situ moisture and density determination
- Consolidation potential
- Shear strength
- Expansion index
- Chemical analyses
- Soil Thermal Analysis
- Wenner 4 pin test (corrosivity)

The following classification tests were performed:

- Description and Identification of Soils
- Maximum density – Optimum moisture
- Sieve Analysis of Fine and Coarse Aggregates
- Sand Equivalent Value
BORING LOCATION PLAN
(Not to Scale)

Proposed Del Sur Ranch Solar Facility

SPower
SWC of Avenue G and 95th Street West
Lancaster, California

Bruin GSI
1817 E. Ave. Q., Unit A-1
Palmdale, CA 93550
661.273.9078

Job No. 14-101

FIGURE 2
Tabular and graphical test results are presented in Appendix C.

6.0 CONCLUSIONS

Based on the results of our investigation, it is our professional opinion that the project is feasible from a geotechnical perspective provided that the recommendations provided in this report are incorporated into design.

The use of driven steel H-piles appears to be the most economical support system for the proposed photovoltaic array systems. Conventional shallow spread footings may be more economical for auxiliary structures. However, due to the hydro-consolidating condition of the near surface soils, remedial grading including over-excavation and recompaction is recommended for conventional shallow spread foundations.

The following conclusions for the site are based on the results of the field exploration and laboratory testing programs and represent professional opinions.

6.1 SITE AND SUBSURFACE CONDITIONS

Native materials were encountered within our exploratory borings. The subsurface soil appears relatively uniform across the subject site. The soil encountered in the exploratory borings generally consists of silty sand (SM) poorly-graded sand (SP) and occasional sandy silt (ML), to the ultimate depth explored of fifteen (15) feet bgs.

Based on the blow counts obtained during sampling, and in-situ densities obtained, the excavated materials were noted to be generally medium dense. Some of the soil strata encountered was cemented.

Moisture content was relatively uniform and generally slightly moist to moist.

For more detailed descriptions of the subsurface materials refer to the boring logs in Appendix A.

6.2 GROUNDWATER CONDITIONS

Groundwater was not encountered in our exploratory borings through the maximum depth explored of fifteen (15) feet below existing ground surface. Bruin GSI reviewed available reports and electronic databases to assess historic water level conditions in the vicinity of the proposed site. Sources reviewed included the groundwater data prepared by United States Geological Survey electronic database. Water wells in the surrounding area of the subject site indicate groundwater over 100 feet bgs. Based on the depth of embedment of the proposed piles of approximately ten (10) feet bgs, groundwater should not a design factor for this project.
6.3 SOIL ENGINEERING PROPERTIES

Physical tests were performed on the relatively undisturbed samples to characterize the engineering properties of the native soils. Moisture content and dry unit weight determinations were performed on the sample to evaluate the in-situ unit weights of the different materials. Moisture contents of the surficial soils ranged for 3-7 percent and dry unit weights ranged from 102 to 115 pcf.

The expansion index tests indicate that the surficial soils are within the non-expansion category. Moisture content and dry unit weight results are shown on the boring logs in Appendix A. Sieve analyses were performed on selected samples to evaluate the percent fines of different lithologic layers. Consolidation test results reveal the upper three to four (3-4) feet of soil has a moderate tendency to hydroconsolidate.

7.0 SEISMIC HAZARDS

The project site is locate in a seismically active area typical of Southern California and likely to be subjected to a strong ground shaking due to earthquakes on nearby faults.

The San Andreas Fault zone is the largest active fault rift zone, which is several miles wide, and passes approximately 3 miles southwest of the site, extending from the Gulf of Mexico through the western portion of the State of California to a point at Cape Mendocino in northern California. The San Andreas Fault is predicted to have an event every 100-200 years based on geologic records. The San Andreas Fault has had two major eruptions in the last 150 years: 1) in the Southern California area in 1857, and 2) in San Francisco in 1906. In each event, approximately 320 kilometers of surface rupture has taken place, as well as a horizontal displacement of approximately 9 meters. Additional faulting has occurred adjacent to the San Andreas Fault causing numerous events of various magnitudes throughout the length of the San Andreas Fault.

The project site is located in an area in which active seismic occurrences are recorded on a yearly basis. Seismic studies conducted show a major break along the San Andreas Fault could be responsible for an event of approximately 8.4 on the Richter scale. Events of this magnitude are anticipated to occur approximately every 150 years. The last occurrence of this magnitude was in 1857.

No known active faults have been mapped across the subject site. The potential hazards due to active fault ground rupture are considered minimal. According to current publications by the State of California, the project site is not located within the Alquist-Priolo special studies zone.
7.1 IBC DESIGN PARAMETERS

The following coefficients have been estimated in accordance with the requirements of the 2009 IBC, utilizing the USGS Earth Quake Ground Motion Parameters Version 5.1.0. The following values are provided, based on the southwest corner of the subject site, closest to the San Andreas Fault Zone:

Latitude  34.7183°
Longitude  118.3200°

Spectral Response Acceleration - $SD_S$  1.000g  0.2 (sec)
Spectral Response Acceleration - $SD_1$  0.696g  1.0 (sec)
Mapped Spectral Acceleration - $S_S$  1.500g  0.2 (sec)
Mapped Spectral Acceleration – $S_1$  0.696g  1.0 (sec)

Site Classification (2010 CBC Table 16513.5.2) = D

The actual method of seismic design should be determined by the Structural Engineer based on the requirements of the governing agency.

7.2 LIQUEFACTION POTENTIAL

Liquefaction is a seismic phenomenon in which loose, saturated, granular (non-cohesive) soils react as a fluid when subject to high-intensity ground shaking. Research and historical data indicate loose to medium dense granular soils with a specific range of grain size distribution, saturated by a relatively shallow groundwater table are most susceptible to liquefaction.

The effects of liquefaction on level ground include settlement, sand boils and bearing capacity failures below structures.

In view of the silty sand (SM) encountered in the borings, relative densities and depth to groundwater (over 100’ bgs), our preliminary liquefaction analysis indicates the potential for on-site liquefaction or seismically induced dynamic settlement is not probable. The subject site is not located within a possible liquefaction area as indicated on the State of California, Seismic Hazards Zones Map.

7.2.1 OTHER LIQUEFACTION ASSOCIATED HAZARDS

Potential hazards associated with liquefaction include lateral spreading and slow slides, foundation bearing failure, and ground
surface settlement. Considering the upper 50 feet of the native soils are not likely to liquefy, these hazards are not considered to be design factors for this project.

7.3 DIFFERENTIAL SOIL SETTLEMENT

Differential soil settlement occurs when supporting soils are not uniform in density or soil type and one portion of soil settles more than the other. When unaccounted for in design, such settlement can result in damage to structures, pavement and subsurface utilities. Based on the subsurface data obtained during the investigation, the on-site soils are relatively uniform, consisting of predominantly medium dense soils that should not be prone to differential settlement.

Re-compaction of the upper site soils is intended to remedy the potential for surficial differential settlement due to auxiliary structures supported on non-uniform thickness of compacted fill.

Settlement of auxiliary structures founded on compacted fill will be relatively small, less than 1”. Differential settlement is anticipated to be on the order of ¼” in a thirty foot span. Most settlement is anticipated to take place during construction.

8.0 GEOTECHNICAL RECOMMENDATIONS

Based upon the results of our investigation, the proposed development is considered feasible from a geotechnical standpoint provided the recommendations presented herein are incorporated into the design and construction. If changes in the design of the structure are made or variations of changed conditions are encountered during construction, Bruin GSI should be contacted to evaluate their effects on these recommendations. The following geotechnical engineering recommendations for the proposed development are based on observations from the field investigation program and the test results and our experience with sites of similar conditions.

The local Department of Building and Safety should be contacted prior to start of construction to assure the project is properly permitted and inspected during construction.

Field observations and testing during construction operations should be provided by Bruin GSI so a decision can be formed regarding the adequacy of the site preparation, the acceptability of fill materials, and the extent to which the earthwork construction and the degree of compaction comply with the project geotechnical specifications. Any work related to grading performed without the full knowledge of,
and under the supervision of the Geotechnical Consultant, may render the recommendations of this report invalid.

The Geotechnical Consultant shall observe and approve all removals prior to fill placement. Additional recommendations may be necessary at the time of grading.

8.1 EARTHWORK FOR STRUCTURES

The existing vegetation and deleterious materials shall be removed from the area to be graded and shall not be incorporated into the engineered fill.

8.2 REMEDIAL GRADING FOR CONVENTIONAL SPREAD OR MAT FOUNDATIONS (AUXILIARY STRUCTURES)

Subsequent to removals of the vegetation and deleterious materials in the areas to be graded, the exposed surface shall be excavated a minimum of four (4) feet below existing grade or finish grade, whichever is lower. The horizontal limits of the excavation shall extend a minimum of five (5) feet beyond the limits of the proposed foundations.

The Geotechnical Consultant shall inspect the resulting surfaces prior to scarification and fill placement. For uniform support relative to the compacted fill thickness, a minimum of twenty four (24) inches of compacted fill is required beneath the proposed foundations.

Subsequent to approval of the resulting excavated surface by the Geotechnical Consultant, the resulting soil surfaces shall be scarified an additional twelve (12) inches, properly moisture conditioned or aerated to optimum moisture content, and mechanically compacted to 90% relative compaction as determined by ASTM D 1557 test method. Compaction shall be verified by testing.

8.3 REMEDIAL GRADING FOR ACCESS DRIVE AREAS

Subsequent to clearing and grubbing the site, the existing native soils shall be scarified twelve (12) inches below existing grade or finish grade, whichever is lower. The Geotechnical Consultant shall inspect the resulting surfaces prior to fill placement.

Subsequent to approval of the resulting surface by the Geotechnical Consultant, the resulting soil surface shall be properly moisture conditioned or aerated to near optimum moisture content, and mechanically compacted to 95% relative compaction as determined by ASTM D 1557 test method. Compaction shall be verified by testing.
8.4 FILL PLACEMENT AND COMPACTION REQUIREMENTS

Native soils may be used as engineered fill. Materials for engineered fill should be free of organic material, debris, and other deleterious substances, and should not contain rocks greater than 3 inches in maximum dimension.

All native soil fill should be placed in 8-inch-thick maximum lifts, moisture conditioned or air dried as necessary to achieve optimum moisture condition, and then compacted in place to a maximum relative compaction of 90 percent (95% for drive areas) as determined in accordance with ASTM D 1557 test method.

A representative of the project consultant should be present on-site during grading operations to verify proper placement and compaction of all fill, as well as to verify compliance with the other geotechnical recommendations presented herein.

8.5 NATIVE SOIL SHRINKAGE

A shrinkage factor of thirteen to seventeen (13-17) percent may be utilized for earthwork quantity calculations. This estimate is based on the limited data collected from the subsurface exploration and laboratory test data with an average degree of compaction of 92 percent and may vary depending on contractor methods.

During compaction, an additional 0.1-foot subsidence of the underlying soil is estimated. Losses from site clearing and grubbing operations may effect quantity calculations and should be taken into account. Actual shrinkage of the soil may vary.

8.6 FILL SLOPE CONSTRUCTION AND STABILITY

Provided all material is properly compacted as recommended, fill slopes may be constructed at a 2:1 (horizontal to vertical) gradient or flatter. Permanent cut slopes may be constructed at 2:1 or flatter. Fill slopes constructed as recommended at a slope ratio not exceeding 2:1 (horizontal:vertical), are expected to be both grossly and surficially stable and are expected to remain so under normal conditions.

Proper drainage should be planned so water is not allowed to flow over the tops of slopes. The slopes should be planted as soon as possible to minimize erosion and maintenance.

If slopes are planned steeper than 2:1, the Geotechnical Consultant shall be notified for slope stability determinations.
8.7 GRADING OBSERVATIONS AND TESTING

The grading of the site shall be observed and tested by the Geotechnical Consultant to verify compliance with the recommendations. Any grading performed without full knowledge of the Geotechnical Consultant may render the recommendations of this report invalid.

8.8 POLE TYPE FOUNDATIONS

The proposed photovoltaic array may be supported on pole-type foundations as determined by the structural engineer. Vertical support for the driven piles will primarily be derived from skin friction between the sides of the piles and the surrounding soil.

Frictional resistance in the upper one foot should be neglected when assessing the vertical capacity of piles. The total settlement of pile foundations designed in accordance with these recommendations should not exceed one-half (1/2) inch.

The upper one foot should not be used for lateral capacity design of the piles unless the loose material is removed to a depth of one foot.

8.9 H-PILE ANALYSIS

It is our understanding that the project Structural Engineer will design the proposed foundations. Using “All Pile” program, an analysis was performed in-house utilizing the soil data obtained from the subsurface investigation and factored load parameters provided by the client.

The following soil parameters were used in the analysis:

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Depth, ft.</th>
<th>Unit Weight Lbs./ft³</th>
<th>Friction Angle, deg.</th>
<th>Cohesion Lbs/ft³</th>
<th>Constant of Horizontal Subgrade Reaction, pci</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silty sand</td>
<td>1-15</td>
<td>110</td>
<td>33</td>
<td>90</td>
<td>45</td>
</tr>
</tbody>
</table>
The following pile loads were used in the pile analysis, as provided by the client:

<table>
<thead>
<tr>
<th>Pile Size</th>
<th>Top of Pile above grade (feet)</th>
<th>Downward Load (kips)</th>
<th>Uplift Load (kips)</th>
<th>Lateral Load (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W6x7</td>
<td>4</td>
<td>3.96</td>
<td>1.76</td>
<td>2.80</td>
</tr>
<tr>
<td>W6x8.5</td>
<td>5</td>
<td>3.97</td>
<td>2.59</td>
<td>2.44</td>
</tr>
<tr>
<td>W6x15</td>
<td>5</td>
<td>3.10</td>
<td>1.90</td>
<td>2.16</td>
</tr>
</tbody>
</table>

Refer to the Boring Logs in Appendix A for blow count data ("N" values) acquired thru SPT sampling.

The depth of embedment based on the analysis is eleven (11) feet below ground surface. Actual pile design and embedment shall be performed by the project structural engineer and include pile deflection tolerances. A test program should be performed to study drivability of piles and perform load tests.

8.10 ULTIMATE PILE CAPACITIES

Vertical pile capacity analysis of driven piles was performed based on the geotechnical data and different pile sizes indicated by the client. The pile sizes used in the analysis are W6x7, W6x8.5 and W6x15. The Ultimate Capacities vs. Foundation Depth of the given piles is presented in graphic form in Appendix D. The appropriate factor of safety shall be determined by the project structural engineer.

Engineering analysis is presented in Appendix D.

9.0 CONVENTIONAL FOUNDATION DESIGN RECOMMENDATIONS

Provided the recommendations in this report are incorporated into site development, foundation for load bearing for shallow spread foundations may be designed as follows:

9.1 BEARING CAPACITY FOR SPREAD FOUNDATIONS

Foundations for the proposed structures may be proportioned for the following values:
**Design Values:** Based upon the foundation embedment depth of fifteen inches, and a foundation width of twelve inches, a bearing capacity of 1,500 psf can be used. An additional increase of 200 psf for each additional foot in depth may be used up to an ultimate value of 2,100 psf.

Actual depth, width, and reinforcement requirements for foundations will be dependent on applicable sections of the governing building code and requirements of the structural engineer.

### 9.2 LATERAL LOAD RESISTANCE AND FRICTIONAL RESISTANCE

Provided the site is prepared as recommended in this report, the following earth pressures for foundations may be used for design purposes. Parameters shown are for drained conditions of engineered fill.

<table>
<thead>
<tr>
<th>Lateral Pressures (Drained Conditions)</th>
<th>Equivalent Fluid Pressure (PCF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Pressure*</td>
<td>250</td>
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</tbody>
</table>

Based on Poisson’s ratio, a coefficient of friction of 0.25 may be used between soil subgrade and footings and slabs.

The coefficient of friction and passive earth pressure values given above represent ultimate soils strength values. Bruin GSI recommends a safety factor consistent with the design conditions be included in their usage. For stability against lateral sliding that is resisted solely by the passive earth pressure against footings or friction along bottom of footings, a minimum safety factor of 1.5 is recommended. For stability against lateral sliding that is resisted by combined passive pressure and frictional resistance, a minimum safety factor of 2.0 is recommended. For lateral stability against seismic loading conditions, a minimum safety factor of 1.3 is recommended.

### 9.3 FOOTING REINFORCEMENT

Reinforcement for footings should be designed by the structural engineer based on the anticipated loading conditions and expansion index of the supporting soil. Preliminary expansion index for the native soil is categorized as “very low” as determined by ASTM D 4829. Footings should be reinforced as required by the structural engineer.

Based on the chemical (sulfate) test results, foundation concrete shall consist of type II cement with compressive strength determined by the structural engineer. Additional soil chemical analysis during grading is recommended.
9.4 FOUNDATION SETBACKS

Footings of existing structures located above an excavation having a total height of 10 feet or less should have a minimum setback of 5 feet, measured from the outside edge of the footing bottom along a horizontal line to the face of the slope. For footings above an excavation having a total height greater than 10 feet, the setback should be, at minimum, equal to one third of the total height of the slope but need not exceed 40 feet. Refer to the IBC Table 1805.3.1.

10.0 CORROSION AND CHEMICAL ATTACK

HDR Schiff performed field and laboratory testing (ASTM G57), chemical analysis (soluble sulfate, pH, resistivity and chloride concentration tests) of the native soil to determine soil corrosivity and electrical resistivity. The resistivity test results at the site and laboratory testing indicated that on-site soils are mildly to moderately corrosive.

Corrosion test results indicate that the surficial soils at the site have negligible sulfate attack potential on concrete, according to the ACI 318 Table 4.3.1. Type II cement should be used in all concrete that may be in contact with the on-site soils. The minimum concrete compressive strength should be determined by the structural engineer.

Refer to Appendix B for the Soil Corrosivity Study prepared by HDR Schiff for laboratory and field testing results as well as recommendations regarding general corrosion control for underground utility piping and concrete structures.

11.0 THERMAL ANALYSIS

Geotherm USA performed a thermal dryout characterization test on one bulk sample of the native soil. The test was performed in accordance with IEEE Standard 442. Refer to Appendix E for the results of the laboratory testing and results and thermal dryout curve table.

12.0 EXCAVATIONS AND BACKFILL

The attention of contractors, particularly the underground contractors, should be drawn to the State of California Construction Safety Orders for “Excavations, Trenches, and Earthwork.” Trenches or excavations greater than five (5) feet in depth should be shored or sloped back in accordance with OSHA Regulations prior to entry.
Soil backfill around foundations or behind walls below grade should be placed in lifts not exceeding eight (8) inches, moisture conditioned to optimum moisture content and mechanically compacted to 90% relative compaction as determined by ASTM D 1557 test method. **No flooding or jetting will be allowed.**

Trench backfill shall be moisture conditioned to near optimum moisture content, placed in lifts not exceeding six (6) inches, and mechanically compacted to 90% relative compaction as determined by ASTM D 1557 test method. **No flooding or jetting will be allowed**

For purposes of this section of the report, “bedding” is defined as material placed in a trench up to one (1) foot above a utility pipe, and “backfill” is all material placed in the trench above the bedding. Unless concrete bedding is required around utility pipes, free-draining sand should be used as bedding. Sand proposed for use as bedding should be tested in our laboratory to verify its suitability and measure its compaction characteristics. **Bedding sand should be compacted by mechanical means to achieve at least 90% relative compaction based on ASTM D 1557.**

Backfill operations should be observed and tested by the Geotechnical Consultant to monitor compliance with these recommendations.

All utility trench backfill should be compacted to a minimum relative compaction of 90 percent. Trench backfill materials should be placed in lifts no greater than approximately 8 inches in thickness, watered or air-dried as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant shall test the backfill to verify adequate compaction.

### 13.0 CONSTRUCTION CONSIDERATIONS

Based on our field exploration program, earthwork may be performed with conventional construction equipment.

#### 13.1 TEMPORARY DEWATERING

Groundwater was not encountered in the exploratory borings. Based on the anticipated excavation depths, the need for temporary dewatering is considered negligible.

#### 13.2 CONSTRUCTION SLOPES

Excavations during construction should be conducted so that slope failure and excessive ground movement will not occur. The short-term stability of excavation depends on many factors, including slope angle, engineering characteristics of the subsoils, height of the excavation and length of time the
excavation remains unsupported and exposed to equipment vibrations, rainfall and desiccation.

Where spacing permits, and providing that adjacent facilities are adequately supported, open excavations may be considered. In general, unsupported slopes for temporary construction excavations should not be expected to stand at an inclination steeper than 1.5:1 (horizontal:vertical).

Surcharge loads should be kept away from the top of temporary excavations a horizontal distance equal to at least one-half the depth of excavation. Surface drainage should be controlled along the top of temporary excavations to preclude wetting of the soils and erosion of the excavation faces. Even with the implementation of the above recommendations, sloughing of the surface of the temporary excavations may still occur, and workers should be adequately protected from such sloughing.

13.3 TEMPORARY SHORING

If shoring is considered, it shall be designed by a registered Civil Engineer in accordance with current Cal-OSHA requirements.

14.0 ADDITIONAL SERVICES

Final project plans and specifications should be reviewed prior to construction to confirm that the full intent of the recommendations presented herein have been applied to design and construction. This report is based on the assumption that an adequate testing and inspection program along with client consultation will be performed during final design and construction phases to verify compliance with the recommendations of this report. Retaining Bruin GSI as the geotechnical consultant to provide additional services from preliminary design through project completion will assure continuity of services.

Additional services may include:

- Consultation during design stages of the project.
- Review of the grading and structural plans.
- Observation and testing during grading and trench backfill
- Field pile testing
- Deputy Inspection of structural members
- Consultation as required during construction.

Cost estimates can be prepared if requested. Please contact our office.
15.0 LIMITATIONS AND UNIFORMITY CONDITIONS

This report is based on the development plans provided to our office. If structure design changes or structure locations changes occur, the conclusion and recommendations in this report may not be considered valid unless the changes are reviewed and the conclusions of this report are modified or approved by the Geotechnical Consultant.

The subsurface conditions and characteristics described herein have been projected from individual borings placed across the subject property. Actual variations in the subsurface conditions and characteristics may occur.

If conditions encountered during construction differ from those described in this report, this office should be notified so as to consider the necessity for modifications. No responsibility for construction compliance with the design concepts, specifications, or recommendations is assumed unless on-site construction review is performed during the course of construction, which pertains to the specific recommendations contained herein.

It is recommended that Bruin GSI be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design specifications. If Bruin GSI is not accorded the privilege of making this recommended review, Bruin GSI can assume no responsibility for misinterpretation of the recommendations contained in this report.

This report has been prepared in accordance with generally accepted practice and standards in this community at this time. No warranties, either expressed or implied, are made as to the professional advice provided under the terms of the agreement and included in this report. This report has been prepared for the exclusive use of SPower, and their authorized agents. Unauthorized reproduction of any portion of this report without expressed written permission is prohibited.

If parties other than Bruin GSI are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

16.0 CLOSURE

The conclusions, recommendations, and opinions presented herein are: (1) based upon our evaluation and interpretations of the limited data obtained from our field and laboratory programs; (2) based upon an interpolation of soil conditions between and beyond the borings; (3) are subject to confirmation of the actual conditions.
encountered during construction; and, (4) are based upon the assumption that sufficient observation and testing will be provided during the grading, infrastructure installation and building phases of site development.
APPENDIX A

Boring Logs and Classification Key
# Boring Log: 1

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 15' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Date:** 1-9-2015  
**Latitude:** 34.7220  
**Longitude:** 118.3071

### Depth
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Boring Terminated @ 15' bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS = Cal. Split Spoon  
N/A = Not Analyzed  
SPT = Standard Penetration Test  
Dist = Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
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<td>Dist= Disturbed</td>
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**Boring Terminated @ 15' bgs**

No caving

No free ground water encountered
**Boring Log: 3**

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-9-2015  
**Latitude:** 34.7206  
**Longitude:** 118.3196

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Boring Terminated @ 10' bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 4

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 15' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-9-2015  
**Latitude:** 34.7207  
**Longitude:** 118.3173

#### SOIL DESCRIPTIONS

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**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

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Notes:
- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

Boring Terminated @ 10' bgs
No caving
No free ground water encountered
**SOIL DESCRIPTIONS**

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Boring Terminated @ 10’ bgs
No caving
No free ground water encountered

**Notes:**
CSS = Cal. Split Spoon
N/A = Not Analyzed
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Dist = Disturbed

**BRUIN GEOTECHNICAL SERVICES INC.**
# Boring Log: 7

## Client: SPower

## Project No: 14-101

## Project: Del Sur Ranch

## Drill Type: CME 75

## Location: Ave. G & 95th St. W

## Total Depth: 15' bgs

## Drive Weight: 140 #

## Logged By: DBM

## Hole Diameter: 8"

## Drop: 30"

## Date: 1-10-2015

## Latitude: 34.7208

## Longitude: 118.3151

### SOIL DESCRIPTIONS

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</tr>
<tr>
<td>5'</td>
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### Notes:

CSS= Cal. Split Spoon
N/A= Not Analyzed
SPT= Standard Penetration Test
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
## Boring Log: 8

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7207  
**Longitude:** 118.3123

---

### SOIL DESCRIPTIONS

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<th>Graphic Symbol</th>
<th>Blow Counts</th>
<th>Dry Density</th>
<th>Moisture %</th>
<th>Sample Type</th>
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<tr>
<td>5'</td>
<td>SM</td>
<td></td>
<td>Yellowish brown very silty fine to medium sand &amp; occ. coarse sand (slightly cemented) moist, med. dense</td>
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<td>4-6-9</td>
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<tr>
<td>10'</td>
<td>SM</td>
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<td>Moderate brown silty fine to medium sand (cemented) moist, med. dense</td>
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<td></td>
<td>6-9-13</td>
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<td>SPT</td>
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</table>

Boring Terminated @ 10' bgs  
No caving  
No free ground water encountered

---

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
**Boring Log: 9**

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<tr>
<td>5'</td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown slightly silty fine to medium sand w/ coarse sand moist, loose</td>
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<td>105.2</td>
<td>4.8</td>
<td>CSS</td>
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<tr>
<td>10'</td>
<td>SM</td>
<td>SM</td>
<td>Light brown slightly silty fine to medium w/ coarse sand moist, med. dense</td>
<td>5-7</td>
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<td>5.8</td>
<td>CSS</td>
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<tr>
<td>15'</td>
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<td>SM</td>
<td>Yellowish brown slightly silty fine to coarse sand &amp; occ. #4 gravel &amp; caliche stringers moist, med. dense</td>
<td>8-9</td>
<td>109.1</td>
<td>6.3</td>
<td>CSS</td>
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<tr>
<td>15'</td>
<td>SM</td>
<td>SM</td>
<td>Light brown slightly silty fine to coarse sand w/ #4 to 1/2&quot; gravel &amp; clay binder moist, med. dense</td>
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<td>112.4</td>
<td>5.4</td>
<td>CSS</td>
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<tr>
<td>15'</td>
<td>SM</td>
<td>SM</td>
<td>Light brown slightly silty fine to coarse sand w/ #4 to 1/2&quot; gravel &amp; clay binder moist</td>
<td>12-16</td>
<td>Dist.</td>
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**Notes:**
- CSS= Cal. Split Spoon
- N/A= Not Analyzed
- SPT= Standard Penetration Test
- Dist= Disturbed

**Boring Terminated @ 15' bgs**

No caving

No free ground water encountered

---

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 10

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs

**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7193  
**Longitude:** 118.3036

#### SOIL DESCRIPTIONS

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<td>5'</td>
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<td>SM</td>
<td>Light brown silty fine to medium sand &amp; occ. coarse sand moist, med. dense</td>
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<td>5-7-9</td>
<td>SPT</td>
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<td>10'</td>
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<td>10-12-12</td>
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</table>
| 15'   |        |      | Boring Terminated @ 10' bgs  
No caving  
No free ground water encountered |   |   | |
| 20'   |        |      |                       |   |   | |
| 25'   |        |      |                       |   |   | |
| 30'   |        |      |                       |   |   | |

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 11

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<td>5'</td>
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<td>SM</td>
<td>Moderate brown silty fine to medium sand</td>
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<tr>
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<td>#4 gravel</td>
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<td>#4 - #1 gravel</td>
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<tr>
<td></td>
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<td>slightly moist, med. dense</td>
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</tr>
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<td>slightly moist, med. dense</td>
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</table>

**Notes:**
- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

Boring Terminated @ 15' bgs
No caving
No free ground water encountered

---

**BRUIN GEOTECHNICAL SERVICES INC.**
### SOIL DESCRIPTIONS

<table>
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<tr>
<th>Depth</th>
<th>Sample</th>
<th>USCS</th>
<th>Soil Description</th>
<th>Graphic Symbol</th>
<th>Blow Count</th>
<th>Dry Density</th>
<th>Moisture %</th>
<th>Sample Type</th>
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<tr>
<td>5'</td>
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<td>SM</td>
<td>Moderate brown slightly silty fine to medium sand w/ coarse sand, moist, loose</td>
<td></td>
<td>3-5</td>
<td>105.2</td>
<td>4.8</td>
<td>CSS</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>SM</td>
<td>Light brown slightly silty fine to medium sand w/ coarse sand, moist, med. dense</td>
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<td>5-7</td>
<td>110.3</td>
<td>5.8</td>
<td>CSS</td>
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<td>10'</td>
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<td>SM</td>
<td>Yellowish brown slightly silty fine to coarse sand, #4 gravel, caliche stringers</td>
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<td>8-9</td>
<td>109.1</td>
<td>6.3</td>
<td>CSS</td>
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<td></td>
<td>SM</td>
<td>SM</td>
<td>Light brown slightly silty fine to coarse sand w/ #4 to 1/2&quot; gravel, moist, med. dense</td>
<td></td>
<td>11-13</td>
<td>112.4</td>
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<td>CSS</td>
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<tr>
<td>15'</td>
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<td>Light brown slightly silty fine to coarse sand w/ #4 to 1/2&quot; gravel, moist</td>
<td></td>
<td>12-16</td>
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<td>CSS</td>
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Boring Terminated @ 15' bgs  
No caving  
No free ground water encountered

Notes:  
CSS = Cal. Split Spoon  
N/A = Not Analyzed  
SPT = Standard Penetration Test  
Dist = Disturbed

BRUIN GEOTECHNICAL SERVICES INC.
Boring Log: 12

Client: SPower
Project No: 14-101
Project: Del Sur Ranch
Drill Type: CME 75
Location: Ave. G & 95th St. W
Total Depth: 15' bgs
Drive Weight: 140 #
Logged By: DBM
Hole Diameter: 8"  Drop: 30"  Date: 1-10-2015
Latitude: 34.7239  Longitude: 118.2955

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<td>12-13</td>
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<td>5.3</td>
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Boring Terminated @ 15' bgs
No caving
No free ground water encountered

Notes:
CSS= Cal. Split Spoon  N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

BRUIN GEOTECHNICAL SERVICES INC.
### SOIL DESCRIPTIONS

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<th>Graphic Symbol</th>
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<td>9-10-10</td>
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Boring Terminated @ 10' bgs
No caving
No free ground water encountered

Notes:
- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
# Boring Log: 14

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 15' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7251  
**Longitude:** 118.3055

### Soil Descriptions

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</tbody>
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**Notes:** CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

*BRUIN GEOTECHNICAL SERVICES INC.*
## Boring Log: 15

**Client:** SPower  **Project No:** 14-101

**Project:** Del Sur Ranch  **Drill Type:** CME 75

**Location:** Ave. G & 95th St. W  **Total Depth:** 15' bgs

**Drive Weight:** 140 #  **Logged By:** DBM

**Hole Diameter:** 8”  **Drop:** 30”  **Date:** 1-10-2015

**Latitude:** 34.7281  **Longitude:** 118.3059

### Soil Descriptions

<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample</th>
<th>USCS</th>
<th>SOIL DESCRIPTIONS</th>
<th>Graphic Symbol</th>
<th>Blow Counts</th>
<th>Dry Density</th>
<th>Moisture %</th>
<th>Sample Type</th>
</tr>
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<tr>
<td>5’</td>
<td>SM</td>
<td>Moderate brown silty fine to medium sand</td>
<td>4-6-7</td>
<td>SPT</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>very moist, med. dense</td>
<td></td>
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</tr>
<tr>
<td>10’</td>
<td>SM</td>
<td>Moderate brown silty fine to medium sand w/ coarse sand &amp; occ. #4 gravel</td>
<td>6-7-8</td>
<td>SPT</td>
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<tr>
<td>15’</td>
<td>SM</td>
<td>Yellowish brown silty fine to medium sand w/ coarse sand &amp; occ. #4 - 1/2” gravel</td>
<td>4-5-4</td>
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<td>Boring Terminated @ 15’ bgs</td>
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<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>No free ground water encountered</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Notes:**
- CSS= Cal. Split Spoon
- N/A= Not Analyzed
- SPT= Standard Penetration Test
- Dist= Disturbed

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**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 16

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7285  
**Longitude:** 118.3009

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<th>Dry Density</th>
<th>Moisture %</th>
<th>Sample Type</th>
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<tr>
<td>5'</td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown slightly silty fine to medium sand moist, loose</td>
<td>5-8</td>
<td>Dist.</td>
<td>6.3</td>
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<tr>
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<td></td>
<td>Yellowish brown slightly silty fine to medium sand w/ coarse sand &amp; occ. #4 gravel (slightly cemented) moist, med. dense</td>
<td>13-15</td>
<td>107.2</td>
<td>5.1</td>
<td>CSS</td>
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<tr>
<td>10'</td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown silty fine to coarse sand &amp; occ. #4 - 1/2&quot; gravel traces of caliche moist, med. dense</td>
<td>12-15</td>
<td>112.1</td>
<td>6.1</td>
<td>CSS</td>
<td></td>
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</tbody>
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Boring Terminated @ 10' bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUI N GEOTECHNICAL SERVICES INC.**
**Boring Log: 17**

**Client:** SPower  
**Project No:** 14-101

**Project:** Del Sur Ranch  
**Drill Type:** CME 75

**Location:** Ave. G & 95th St. W  
**Total Depth:** 10’ bgs

**Drive Weight:** 140 #  
**Logged By:** DBM

**Hole Diameter:** 8”  
**Drop:** 30”  
**Date:** 1-10-2015

**Latitude:** 34.7320  
**Longitude:** 118.3001

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<th>Moisture %</th>
<th>Sample Type</th>
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<td>SM</td>
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<td>5-12-9</td>
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<td>SPT</td>
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<tr>
<td>10’</td>
<td>SM</td>
<td>SM</td>
<td>Yellowish brown silty fine to medium sand w/ coarse sand slightly moist, loose</td>
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<td>4-5-7</td>
<td>3.7</td>
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<tr>
<td>15’</td>
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<td>SM</td>
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<td></td>
<td>12-14-13</td>
<td>6.9</td>
<td>SPT</td>
<td></td>
</tr>
</tbody>
</table>

Boring Terminated @ 10’ bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS = Cal. Split Spoon  
N/A = Not Analyzed  
SPT = Standard Penetration Test  
Dist = Disturbed

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 18

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7317  
**Longitude:** 118.3056

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<td>15'</td>
<td></td>
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<td>SM</td>
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<tr>
<td>20'</td>
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</tbody>
</table>
| 25'   |        |      |                   | Boring Terminated @ 10' bgs  
No caving  
No free ground water encountered |  |  |  |
| 30'   |        |      |                   |  |  |  |  |

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
# Boring Log: 19

**Client:** SPower  
**Project No:** 14-101

**Project:** Del Sur Ranch  
**Drill Type:** CME 75

**Location:** Ave. G & 95th St. W  
**Total Depth:** 15' bgs

**Drive Weight:** 140 #  
**Logged By:** DBM

**Hole Diameter:** 8”  
**Drop:** 30”  
**Date:** 1-10-2015

**Latitude:** 34.7284  
**Longitude:** 118.3084

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<th>Moisture %</th>
<th>Sample Type</th>
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<td>SM</td>
<td>Moderate brown slightly silty fine to medium sand</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>very moist, loose</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>5'</td>
<td></td>
<td>SM</td>
<td>Yellowish brown silty fine to coarse sand &amp; occ. #4 to 1&quot; gravel</td>
<td></td>
<td>3-4-6</td>
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<td></td>
<td>moist, med. dense</td>
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<tr>
<td>10'</td>
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<td>SM</td>
<td>Light brown silty fine to coarse sand &amp; occ. #4 - 1/2&quot; gravel</td>
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<td>5-7-7</td>
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<tr>
<td>15'</td>
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<td>SM</td>
<td>Yellowish brown silty fine sand w/ medium sand</td>
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<td></td>
<td>(slightly cemented) moist, med. dense</td>
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Boring Terminated @ 15' bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
Client: SPower
Project No: 14-101
Project: Del Sur Ranch
Drill Type: CME 75
Location: Ave. G & 95th St. W
Total Depth: 15' bgs
Drive Weight: 140 #
Logged By: DBM
Hole Diameter: 8"
Drop: 30"
Date: 1-10-2015
Latitude: 34.7285
Longitude: 118.3126

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<td>Moderate brown silty fine to medium sand &amp; occ. coarse sand moist, med. dense</td>
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<td>SM</td>
<td>Moderate brown silty fine to medium sand w/sl. coarse sand &amp; occ. #4 gravel moist, med. dense</td>
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<td>5.8</td>
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<td>Moderate brown fine to coarse sand &amp; occ. #4 - 1/2&quot; gravel moist, med. dense</td>
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Boring Terminated @ 15' bgs
No caving
No free ground water encountered

Notes: CSS= Cal. Split Spoon
       N/A= Not Analyzed
       SPT= Standard Penetration Test
       Dist= Disturbed

BRUIN GEOTECHNICAL SERVICES INC.
### Boring Log: 21

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<td>1-2-2</td>
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<td>5'</td>
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<td>SM</td>
<td>Moderate brown silty fine to medium sand (slightly cemented) moist, med. dense</td>
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<td>7-9-12</td>
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Boring Terminated @ 10’ bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
**Boring Log: 22**

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<td>Moderate brown silty fine to medium sand</td>
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<td>Moderate brown silty fine to medium sand</td>
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<td>5-7-8</td>
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<tr>
<td>15'</td>
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<td>Moderate brown silty fine to medium sand</td>
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<tr>
<td>20'</td>
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<td>Yellowish brown silty fine to medium sand</td>
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<td>SPT</td>
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<td>w/ coarse sand &amp; occ. #4 - 1/2&quot; gravel</td>
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</table>

**Notes:**
- Boring Terminated @ 15' bgs
- No caving
- No free ground water encountered

---

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 15' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7286  
**Longitude:** 118.3149  

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 23

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7279  
**Longitude:** 118.3195

**SOIL DESCRIPTIONS**

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<th>Soil Description</th>
<th>Graphic Symbol</th>
<th>Blow Counts</th>
<th>Dry Density</th>
<th>Moisture %</th>
<th>Sample Type</th>
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<tr>
<td>5’</td>
<td>SM</td>
<td>SM</td>
<td>Strong brown silty fine to medium sand w/ coarse sand (cemented) moist, med. dense</td>
<td>12-14</td>
<td>104.2</td>
<td>6.8</td>
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<td>10’</td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown slightly silty fine to medium sand w/ coarse sand moist, med. dense</td>
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<td>5.9</td>
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</tr>
<tr>
<td>10’</td>
<td>SM</td>
<td>SM</td>
<td>Light brown silty fine to medium sand &amp; occ. coarse sand moist, med. dense</td>
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<tr>
<td>10’</td>
<td>SM</td>
<td>SM</td>
<td>Yellowish brown slightly silty fine to medium sand w/ coarse sand slightly moist, med. dense</td>
<td>10-12</td>
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**Boring Terminated @ 10’ bgs**  
No caving  
No free ground water encountered

**Notes:**  
CSS = Cal. Split Spoon  
N/A = Not Analyzed  
SPT = Standard Penetration Test  
Dist = Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
# Boring Log: 24

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 15’ bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8”  
**Drop:** 30”  
**Date:** 1-10-2015  
**Latitude:** 34.7266  
**Longitude:** 118.3175

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<td>Yellowish brown very silty fine to medium sand &amp; occ. coarse sand</td>
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<td>Yellowish brown silty fine sand w/slight caliche (cemented)</td>
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<td>SPT</td>
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<td>Yellowish brown silty fine sand w/ medium sand &amp; occ. coarse sand &amp; slight caliche stringers</td>
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<tr>
<td>15’</td>
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<td>Strong brown sandy silt &amp; occ. medium sand very moist, stiff</td>
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<td></td>
<td>9-12-17</td>
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Boring Terminated @ 15’ bgs  
No caving  
No free ground water encountered

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

**BRUIN GEOTECHNICAL SERVICES INC.**
Client: SPower  
Project No: 14-101  
Project: Del Sur Ranch  
Drill Type: CME 75  
Location: Ave. G & 95th St. W  
Total Depth: 10’ bgs  
Drive Weight: 140 3  
Logged By: DBM  
Hole Diameter: 8"  
Drop: 30"  
Date: 1-10-2015  
Latitude: 34.7258  
Longitude: 118.3144

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<td></td>
<td></td>
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<tr>
<td>10'</td>
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<td>Moderate brown silty fine to coarse sand w/ #4 gravel &amp; occ. 1/2&quot; gravel moist,</td>
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<td>5-6-8</td>
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<td>SPT</td>
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<tr>
<td></td>
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<td>med. dense</td>
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</table>

Notes:  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed  

Boring Terminated @ 10’ bgs  
No caving  
No free ground water encountered
# Boring Log: 26

## General Information
- **Client:** SPower
- **Project No.:** 14-101
- **Project:** Del Sur Ranch
- **Drill Type:** CME 75
- **Location:** Ave. G & 95th St. W
- **Total Depth:** 15’ bgs
- **Drive Weight:** 140 #
- **Logged By:** DBM
- **Hole Diameter:** 8”
- **Drop:** 30”
- **Date:** 1-10-2015
- **Latitude:** 34.7250
- **Longitude:** 118.3121

## Soil Descriptions

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<th>Sample Type</th>
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<td>Moderate brown silty fine to medium sand &amp; occ. coarse sand</td>
<td>9-13</td>
<td>105.1</td>
<td>8.9</td>
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<tr>
<td>5’</td>
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<td>M</td>
<td>Yellowish brown silty fine to medium sand w/ coarse sand &amp; occ.#4 gravel moist, med. dense</td>
<td>8-10</td>
<td>110.3</td>
<td>6.6</td>
<td>CSS</td>
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<tr>
<td>10’</td>
<td>SM</td>
<td>M</td>
<td>Light brown slightly silty fine to coarse sand w/#4 gravel moist, med. dense</td>
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<tr>
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<td>9-13</td>
<td>112.7</td>
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Boring Terminated @ 15’ bgs
No caving
No free ground water encountered

## Notes
- CSS= Cal. Split Spoon
- N/A= Not Analyzed
- SPT= Standard Penetration Test
- Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 27

**Client:** SPower

**Project No:** 14-101

**Project:** Del Sur Ranch

**Drill Type:** CME 75

**Location:** Ave. G & 95th St. W

**Total Depth:** 15' bgs

**Drive Weight:** 140 #

**Logged By:** DBM

**Hole Diameter:** 8" **Drop:** 30"

**Date:** 1-10-2015

**Latitude:** 34.7228 **Longitude:** 118.3140

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<td>Moderate brown silty fine to medium sand &amp; caliche inclusions (slightly cemented) moist, med. dense</td>
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<td>5'</td>
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<td>Brown slightly silty fine to coarse sand &amp; occ. #4 gravel slightly loose moist</td>
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<td>10'</td>
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<td>7.0</td>
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<tr>
<td>15'</td>
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<td>Yellowish brown fine sandy silt w/ trace clay very moist, stiff</td>
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<td></td>
<td>12.8</td>
<td>SPT</td>
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</table>

Boring Terminated @ 15' bgs

No caving

No free ground water encountered

**Notes:**

- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
**Boring Log: 28**

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10’ bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8”  
**Drop:** 30”  
**Date:** 1-10-2015  
**Latitude:** 34.7265  
**Longitude:** 118.3097

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<tr>
<td>5'</td>
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<td>SM</td>
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<td>4-5-5</td>
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<td>8-11-12</td>
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<td>SPT</td>
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**Boring Terminated @ 10’ bgs**  
No caving  
No free ground water encountered

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

**BRUIN GEOTECHNICAL SERVICES INC.**
**Boring Log: 29**

**Client:** SPower

**Project:** Del Sur Ranch

**Location:** Ave. G & 95th St. W

**Drive Weight:** 140 #

**Hole Diameter:** 8”

**Date:** 1-10-2015

**Logged By:** DBM

**Total Depth:** 10’ bgs

---

### Soil Descriptions

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<td>Yellowish brown silty fine to medium sand  (slightly cemented)</td>
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<td>5.1</td>
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<td>110.3</td>
<td>4.7</td>
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**Notes:**

- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

**Boring Terminated @ 10’ bgs**

**No caving**

**No free ground water encountered**

---

**BRUIN GEOTECHNICAL SERVICES INC.**
**Boring Log: 30**

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7271  
**Longitude:** 118.2999  

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<tr>
<td>5'</td>
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<td>Moderate brown silty fine to medium sand w/ coarse sand (cemented) moist, med. dense</td>
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Boring Terminated @ 15' bgs
No caving
No free ground water encountered

**Notes:**
- CSS= Cal. Split Spoon
- N/A= Not Analyzed
- SPT= Standard Penetration Test
- Dist= Disturbed

BRUIN GEOTECHNICAL SERVICES INC.
### Soil Descriptions

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</tbody>
</table>

**Notes:**
- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
### Boring Log: 32

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 10' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7240  
**Longitude:** 118.3029

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<td>Yellowish brown very fine to medium sand w/ coarse sand moist, firm</td>
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<td>10'</td>
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<td>25'</td>
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<td></td>
<td>No free ground water encountered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
CSS = Cal. Split Spoon  
N/A = Not Analyzed  
SPT = Standard Penetration Test  
Dist = Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
### Depth  | Sample  | USCS  | Notes  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0'</td>
<td>SM</td>
<td>Strong brown silty fine to medium sand very moist, loose</td>
<td></td>
</tr>
<tr>
<td>5'</td>
<td>SM</td>
<td>Moderate brown silty fine to medium sand (slightly cemented) moist, med. dense</td>
<td></td>
</tr>
<tr>
<td>10'</td>
<td>SM</td>
<td>Moderate brown silty fine to medium sand w/ occ. coarse sand (slightly cemented) moist, med. dense</td>
<td></td>
</tr>
<tr>
<td>15'</td>
<td>SM</td>
<td>Light brown silty fine to coarse sand &amp; occ. #4 - 1&quot; gravel med. dense</td>
<td></td>
</tr>
<tr>
<td>15'</td>
<td>SM</td>
<td>Yellowish brown slightly silty fine to coarse sand w/ #4 gravel med. dense</td>
<td></td>
</tr>
</tbody>
</table>

Boring Terminated @ 15' bgs
No caving
No free ground water encountered

**Notes:**
- CSS = Cal. Split Spoon
- N/A = Not Analyzed
- SPT = Standard Penetration Test
- Dist = Disturbed

**BRUIN GEOTECHNICAL SERVICES INC.**
**Boring Log: 34**

**Client:** SPower  
**Project No:** 14-101  
**Project:** Del Sur Ranch  
**Drill Type:** CME 75  
**Location:** Ave. G & 95th St. W  
**Total Depth:** 15' bgs  
**Drive Weight:** 140 #  
**Logged By:** DBM  
**Hole Diameter:** 8"  
**Drop:** 30"  
**Date:** 1-10-2015  
**Latitude:** 34.7207  
**Longitude:** 118.3011

<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample</th>
<th>USCS</th>
<th>SOIL DESCRIPTIONS</th>
<th>Graphic</th>
<th>Blow Count</th>
<th>Dry Density</th>
<th>Moisture</th>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SM</td>
<td>Strong brown silty fine sand w/ medium sand &amp; occ. coarse sand</td>
<td></td>
<td>6-8-12</td>
<td></td>
<td></td>
<td>SPT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SM</td>
<td>(slightly cemented) moist, med. dense</td>
<td>moor.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5'</td>
<td></td>
<td>SM</td>
<td>Light brown silty fine to medium sand &amp; occ. coarse sand</td>
<td>moist, med. dense</td>
<td>5-7-10</td>
<td></td>
<td></td>
<td>SPT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SM</td>
<td>Light brown silty fine to medium sand &amp; occ. coarse sand</td>
<td>moist, med. dense</td>
<td>5-8-11</td>
<td></td>
<td></td>
<td>SPT</td>
</tr>
<tr>
<td>10'</td>
<td></td>
<td>SM</td>
<td>Yellowish brown silty fine to coarse sand &amp; occ. #4 - gravel</td>
<td>moist, med. dense</td>
<td>7-12-15</td>
<td></td>
<td></td>
<td>SPT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SM</td>
<td>Yellowish brown silty fine to coarse sand &amp; occ. #4 - gravel</td>
<td>moist, med. dense</td>
<td>8-10-15</td>
<td></td>
<td></td>
<td>SPT</td>
</tr>
<tr>
<td>15'</td>
<td></td>
<td>SM</td>
<td>Boring Terminated @ 15' bgs</td>
<td>No caving</td>
<td>No free ground water encountered</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**  
CSS= Cal. Split Spoon  
N/A= Not Analyzed  
SPT= Standard Penetration Test  
Dist= Disturbed

---

**BRUIN GEOTECHNICAL SERVICES INC.**
<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample</th>
<th>USCS</th>
<th>Soil Description</th>
<th>Graphic Symbol</th>
<th>Blow Counts</th>
<th>Dry Density</th>
<th>Moisture %</th>
<th>Sample Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown silty fine to medium sand w/ coarse sand moist, med. dense</td>
<td>5-15</td>
<td>104.2</td>
<td>4.4</td>
<td>CSS</td>
<td></td>
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<tr>
<td>5'</td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown silty fine to medium sand w/ coarse sand moist, med. dense</td>
<td>6-9</td>
<td>106.3</td>
<td>5.2</td>
<td>CSS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>SM</td>
<td>Olive brown slightly silty fine to coarse sand w/ #4 gravel moist, med. dense</td>
<td>7-10</td>
<td>110.2</td>
<td>4.3</td>
<td>CSS</td>
<td></td>
</tr>
<tr>
<td>10'</td>
<td>SM</td>
<td>SM</td>
<td>Moderate brown fine to coarse sand w/ #4 gravel &amp; occ. 1/2&quot; gravel sl. moist med. dense</td>
<td>12-15</td>
<td>109.3</td>
<td>3.7</td>
<td>CSS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>SM</td>
<td>Reddish brown slightly silty medium to coarse sand w/ #4 gravel &amp; occ. 1/2&quot; gravel &amp; clay, binder moist</td>
<td>18-26</td>
<td>112.1</td>
<td>5.7</td>
<td>CSS</td>
<td></td>
</tr>
<tr>
<td>20'</td>
<td></td>
<td></td>
<td>Boring Terminated @ 15' bgs</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No caving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No free ground water encountered</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25'</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>30'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: CSS = Cal. Split Spoon  
N/A = Not Analyzed  
SPT = Standard Penetration Test  
Dist = Disturbed
<table>
<thead>
<tr>
<th>Major Divisions</th>
<th>Typical Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels</td>
<td></td>
</tr>
<tr>
<td>More than half coarse-fraction is larger than No. 4 sieve size</td>
<td>Clean gravels with little or no fines</td>
</tr>
<tr>
<td>GW</td>
<td>Well graded gravels, gravel-sand mixtures</td>
</tr>
<tr>
<td>GP</td>
<td>Poorly graded gravels, gravel-sand mixtures</td>
</tr>
<tr>
<td>GM</td>
<td>Silty gravels, poorly graded gravel-sand-silt mixtures</td>
</tr>
<tr>
<td>GC</td>
<td>Clayey gravels, poorly graded gravel-sand-clay mixtures</td>
</tr>
<tr>
<td>Sand with over 12% fines</td>
<td></td>
</tr>
<tr>
<td>SW</td>
<td>Well graded sands, gravelly sands</td>
</tr>
<tr>
<td>SP</td>
<td>Poorly graded sands, gravelly sands</td>
</tr>
<tr>
<td>SM</td>
<td>Silty sands, poorly graded sand-silt mixtures</td>
</tr>
<tr>
<td>SC</td>
<td>Clayey sands, poorly graded sand-clay mixtures</td>
</tr>
<tr>
<td>Coarse Grained Soils</td>
<td></td>
</tr>
<tr>
<td>50% or more larger than #200 sieve</td>
<td></td>
</tr>
<tr>
<td>Silts and Clays</td>
<td></td>
</tr>
<tr>
<td>Liquid limit less than 50</td>
<td></td>
</tr>
<tr>
<td>ML</td>
<td>Inorganic silts, rock flour, clayey silts</td>
</tr>
<tr>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, sandy clays, silty clays</td>
</tr>
<tr>
<td>OL</td>
<td>Organic clays and organic silty clays of low plasticity</td>
</tr>
<tr>
<td>Silts and Clays</td>
<td></td>
</tr>
<tr>
<td>Liquid limit greater than 50</td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td>Inorganic silts, micaceous or diatomaceous fine sandy/silty soils, elastic silts</td>
</tr>
<tr>
<td>CH</td>
<td>Inorganic clays with high plasticity, fat clays</td>
</tr>
<tr>
<td>OH</td>
<td>Organic clays of medium to high plasticity, organic silts</td>
</tr>
<tr>
<td>Fine Grained Soils</td>
<td></td>
</tr>
<tr>
<td>50% or more smaller than #200 sieve</td>
<td></td>
</tr>
<tr>
<td>Highly Organic Soils</td>
<td></td>
</tr>
<tr>
<td>Pt</td>
<td>Peat and other highly organic soils</td>
</tr>
</tbody>
</table>

Sample Locations/Designations

In-situ sample/ Cal. Split Spoon or SPT

Bulk sample

CLASSIFICATION SYSTEM BASED ON UNIFIED SOIL CLASSIFICATION SYSTEM
APPENDIX B

Soil Corrosivity Study
February 18, 2015 via email: Mark@bruingsi.net

BRUIN GEOTECHNICAL SERVICES, INC.
1817 East Avenue Q, Unit A-1
Palmdale, CA 93550

Attention: Mr. Mark Stevens

Re: Soil Corrosivity Study
SPower - Del Sur Ranch
Lancaster, California
HDR #248444, BGSI #14-101

Introduction
Field and laboratory tests have been completed for the SPower Del Sur Ranch project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed structure consists of one solar power facility approximately 0.5 acres. The site is located near the intersection of Avenue G and 95th Street West and the water table is reportedly more than 100 feet deep.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR’s recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Test Procedures
The electrical resistivity of the soil was measured in place at three locations using the Wenner Four Pin Method per ASTM G57. This procedure gives the average resistivity to a depth equal to the spacing between the pins. Approximate pin spacings of 2, 5, 10, 20 and 40 feet were used so that variations with depth could be evaluated. Strata resistivities were
calculated from resistance data using the Barnes Procedure. The test results are shown in the attached Table 1.

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B. Laboratory analysis was performed under HDR laboratory number 15-0078SCS and the test results are shown in the attached Table 2.

**Soil Corrosivity**

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm’s Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:

<table>
<thead>
<tr>
<th>Soil Resistivity in ohm-centimeters</th>
<th>Corrosivity Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 10,000</td>
<td>Mildly Corrosive</td>
</tr>
<tr>
<td>2,001 to 10,000</td>
<td>Moderately Corrosive</td>
</tr>
<tr>
<td>1,001 to 2,000</td>
<td>Corrosive</td>
</tr>
<tr>
<td>0 to 1,000</td>
<td>Severely Corrosive</td>
</tr>
</tbody>
</table>

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

---


The average and stratum resistivities measured in the field were in the mildly and moderately corrosive categories.

Electrical resistivities were in the mildly corrosive category with as-received moisture. When saturated, the resistivities were in the mildly to moderately corrosive categories. The resistivities dropped considerably with added moisture because the samples were dry as-received.

Soil pH values varied from 7.1 to 7.5. This range is neutral to mildly alkaline. These values do not particularly increase soil corrosivity.

The soluble salt content of the samples was low.

Ammonium and nitrate were detected in low concentrations.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as moderately corrosive to ferrous metals.

**Corrosion Control Recommendations**

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

---

Steel Pipe

Implement all the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and the possible future application of cathodic protection.

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the possible future application of cathodic protection:
   a. At each end of the pipeline.
   b. At each end of all casings.
   c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the possible future application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:
   a. Dissimilar metals.
   b. Dissimilarly coated piping (cement-mortar vs. dielectric).
   c. Above ground steel pipe.
   d. All existing piping.

4. Choose one of the following corrosion control options:

   OPTION 1
   a. Apply a suitable dielectric coating intended for underground use such as:
      i. Polyurethane per AWWA C222 or
      ii. Extruded polyethylene per AWWA C215 or
      iii. A tape coating system per AWWA C214 or
      iv. Hot applied coal tar enamel per AWWA C203 or
      v. Fusion bonded epoxy per AWWA C213.
b. Although it is customary to cathodically protect bonded dielectrically coated structures, cathodic protection is not recommended at this time due to moderately corrosive soils. Joint bonds, test stations, and insulated joints should still be installed and will facilitate the application of cathodic protection in the future if needed to control leaks.

OPTION 2

a. As an alternative to dielectric coating and possible future cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of ASTM C150 Portland cement. Joint bonds, test stations, and insulated joints are still recommended for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement all the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the possible future application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.

2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and possible future application of cathodic protection.

3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the possible future application of cathodic protection:
   a. At each end of the pipeline.
   b. At each end of any casings.
   c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

**OPTION 1**

a. Apply a suitable coating intended for underground use such as:
   i. Polyethylene encasement per AWWA C105; or
   ii. Epoxy coating; or
   iii. Polyurethane; or
   iv. Wax tape.

   NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Although it is customary to cathodically protect coated structures, cathodic protection is not recommended at this time due to moderately corrosive soils. Joint bonds, test stations, and insulated joints should still be installed and will facilitate the application of cathodic protection in the future if needed to control leaks.

**OPTION 2**

a. As an alternative to coating systems described in Option 1 and possible future cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using ASTM C150 Portland cement.

**Copper Tubing**

Implement all the following measures:

1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.
2. Electrically insulate cold water piping from hot water piping systems.
3. Place cold water copper tubing in an 8-mil polyethylene sleeve or encase in double 4-mil thick polyethylene sleeves and bed and backfill with clean sand at least 2 inches thick surrounding the tubing. Clean sand should have a minimum resistivity
of no less than 3,000 ohm-cm, and a pH of 6.0–8.0. Copper tubing for cold water can also be treated the same as for hot water.

4. Hot water tubing may be subject to a higher corrosion rate. Protect hot copper tubing by one of the following measures:
   a. Preventing soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing with PVC pipe with solvent-welded joints. or
   b. Applying cathodic protection per NACE SP0169. The amount of cathodic protection current needed can be minimized by coating the tubing.

Plastic and Vitrified Clay Pipe
   1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.
   2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe
   1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.
   2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete
   1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.10 percent.\(^4\,5,\,6\)

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\(^4\) 2012 International Building Code (IBC) Section 1904.3

\(^5\) 2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1

\(^6\) 2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1
2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration\(^7\) found onsite.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples and a limited field investigation. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be notified immediately so that further evaluation and supplemental recommendations can be provided.

HDR’s services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Jose Peña

Enc: Table 1 - Field Resistivity Results
Table 2 - Laboratory Test Results
Figure 1 - Field Test Locations

\(^7\)Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65
Table 1 - Soil Resistivity Field Tests

*Del Sur Site*

*Bruin Geotechnical Services, Inc.*

*28-Jan-15*

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DEPTH (feet)</th>
<th>MEASURED RESISTANCE (ohms)</th>
<th>AVERAGE RESISTIVITY TO DEPTH (ohm-cm)</th>
<th>STRATUM RESISTIVITY (ohm-cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION 1</td>
<td>2.0</td>
<td>30.00</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>North-South</td>
<td>5.0</td>
<td>10.60</td>
<td>10,600</td>
<td>9,835</td>
</tr>
<tr>
<td></td>
<td>10.0</td>
<td>3.30</td>
<td>6,600</td>
<td>4,792</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>2.30</td>
<td>9,200</td>
<td>15,180</td>
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<tr>
<td></td>
<td>40</td>
<td>1.00</td>
<td>8,000</td>
<td>7,077</td>
</tr>
<tr>
<td>LOCATION 1</td>
<td>2.0</td>
<td>20.00</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>East-West</td>
<td>5.0</td>
<td>9.50</td>
<td>9,500</td>
<td>10,857</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3.70</td>
<td>7,400</td>
<td>6,060</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>2.30</td>
<td>9,200</td>
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<td></td>
<td>40</td>
<td>1.00</td>
<td>8,000</td>
<td>7,077</td>
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<td>32.00</td>
<td>12,800</td>
<td>12,800</td>
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<tr>
<td>North-South</td>
<td>5.0</td>
<td>16.00</td>
<td>16,000</td>
<td>19,200</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>13.00</td>
<td>26,000</td>
<td>69,333</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>4.90</td>
<td>19,600</td>
<td>15,728</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>1.00</td>
<td>8,000</td>
<td>5,026</td>
</tr>
</tbody>
</table>
Table 1 - Soil Resistivity Field Tests

*Del Sur Site*
*Bruin Geotechnical Services, Inc.*
*28-Jan-15*

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DEPTH (feet)</th>
<th>MEASURED RESISTANCE (ohms)</th>
<th>AVERAGE RESISTIVITY TO DEPTH (ohm-cm)</th>
<th>STRATUM RESISTIVITY (ohm-cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location 2</td>
<td>2.0</td>
<td>28.00</td>
<td>✏️ 11,200</td>
<td>✏️ 11,200</td>
</tr>
<tr>
<td>East-West</td>
<td>5.0</td>
<td>21.00</td>
<td>✏️ 21,000</td>
<td>✏️ 50,400</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10.20</td>
<td>✏️ 20,400</td>
<td>✏️ 19,833</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>6.70</td>
<td>✏️ 26,800</td>
<td>✏️ 39,051</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>1.30</td>
<td>✏️ 10,400</td>
<td>✏️ 6,452</td>
</tr>
<tr>
<td>Location 3</td>
<td>2.0</td>
<td>21.00</td>
<td>✏️ 8,400</td>
<td>✏️ 8,400</td>
</tr>
<tr>
<td>North-South</td>
<td>5.0</td>
<td>10.70</td>
<td>✏️ 10,700</td>
<td>✏️ 13,089</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>7.10</td>
<td>✏️ 14,200</td>
<td>✏️ 21,103</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>3.80</td>
<td>✏️ 15,200</td>
<td>✏️ 16,352</td>
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<td></td>
<td>40</td>
<td>1.40</td>
<td>✏️ 11,200</td>
<td>✏️ 8,867</td>
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<td>Location 3</td>
<td>2.0</td>
<td>18.00</td>
<td>✏️ 7,200</td>
<td>✏️ 7,200</td>
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<tr>
<td>East-West</td>
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<td>12.00</td>
<td>✏️ 12,000</td>
<td>✏️ 21,600</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>7.30</td>
<td>✏️ 14,600</td>
<td>✏️ 18,638</td>
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<tr>
<td></td>
<td>20</td>
<td>3.90</td>
<td>✏️ 15,600</td>
<td>✏️ 16,747</td>
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<tr>
<td></td>
<td>40</td>
<td>1.50</td>
<td>✏️ 12,000</td>
<td>✏️ 9,750</td>
</tr>
</tbody>
</table>
### Table 2 - Laboratory Tests on Soil Samples

**Bruin Geotechnical Services, Inc.**  
**SPower - Del Sur Ranch**  
*Your #14-101, HDR Lab #15-0078LAB*  
*29-Jan-15*

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>B1 @ 0-5'</th>
<th>B11 @ 0-5'</th>
<th>B23 @ 0-5'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistivity</td>
<td><strong>Units</strong></td>
<td><strong>as-received ohm-cm</strong></td>
<td>48,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>minimum ohm-cm</strong></td>
<td>6,080</td>
</tr>
<tr>
<td>pH</td>
<td>7.1</td>
<td>7.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td>mS/cm</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Chemical Analyses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>calcium</td>
<td>Ca$^{2+}$</td>
<td>mg/kg</td>
<td>23</td>
</tr>
<tr>
<td>magnesium</td>
<td>Mg$^{2+}$</td>
<td>mg/kg</td>
<td>3.4</td>
</tr>
<tr>
<td>sodium</td>
<td>Na$^{+}$</td>
<td>mg/kg</td>
<td>36</td>
</tr>
<tr>
<td>potassium</td>
<td>K$^{+}$</td>
<td>mg/kg</td>
<td>6.7</td>
</tr>
<tr>
<td>Anions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>carbonate</td>
<td>CO$_3^{2-}$</td>
<td>mg/kg</td>
<td>ND</td>
</tr>
<tr>
<td>bicarbonate</td>
<td>HCO$_3^{-}$</td>
<td>mg/kg</td>
<td>64</td>
</tr>
<tr>
<td>fluoride</td>
<td>F$^{-}$</td>
<td>mg/kg</td>
<td>3.2</td>
</tr>
<tr>
<td>chloride</td>
<td>Cl$^{-}$</td>
<td>mg/kg</td>
<td>4.3</td>
</tr>
<tr>
<td>sulfate</td>
<td>SO$_4^{2-}$</td>
<td>mg/kg</td>
<td>22</td>
</tr>
<tr>
<td>phosphate</td>
<td>PO$_4^{3-}$</td>
<td>mg/kg</td>
<td>6.5</td>
</tr>
<tr>
<td>Other Tests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ammonium</td>
<td>NH$_4^{+}$</td>
<td>mg/kg</td>
<td>0.4</td>
</tr>
<tr>
<td>nitrate</td>
<td>NO$_3^{-}$</td>
<td>mg/kg</td>
<td>12</td>
</tr>
<tr>
<td>sulfide</td>
<td>S$^{2-}$</td>
<td>qual</td>
<td>na</td>
</tr>
<tr>
<td>Redox</td>
<td>mV</td>
<td>na</td>
<td>na</td>
</tr>
</tbody>
</table>

Minimum resistivity per CTM 643, Chlorides per CTM 422, Sulfates per CTM 417  
Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.  
mg/kg = milligrams per kilogram (parts per million) of dry soil.  
Redox = oxidation-reduction potential in millivolts  
ND = not detected  
ND = not analyzed
APPENDIX C

Laboratory Test Data
### SUMMARY OF LABORATORY TEST RESULTS

#### SIEVE ANALYSIS

Percent passing individual sieves

<table>
<thead>
<tr>
<th>Sample I.D.</th>
<th>3/4&quot;</th>
<th>1/2&quot;</th>
<th>3/8&quot;</th>
<th>#4</th>
<th>#10</th>
<th>#40</th>
<th>#100</th>
<th>#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>B5@ 2'</td>
<td>100</td>
<td>99</td>
<td>99</td>
<td>98</td>
<td>82</td>
<td>43</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>B9@ 3'</td>
<td></td>
<td></td>
<td></td>
<td>97</td>
<td>85</td>
<td>48</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>B3@4'</td>
<td></td>
<td></td>
<td></td>
<td>99</td>
<td>84</td>
<td>52</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>B8@4'</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>98</td>
<td>87</td>
<td>68</td>
<td>49</td>
</tr>
<tr>
<td>B18@4'</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>98</td>
<td>90</td>
<td>61</td>
<td>34</td>
</tr>
<tr>
<td>B10@5'</td>
<td>100</td>
<td>98</td>
<td>97</td>
<td>90</td>
<td>53</td>
<td>30</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>B13@5'</td>
<td>100</td>
<td>99</td>
<td>91</td>
<td>65</td>
<td>31</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B19@6'</td>
<td>100</td>
<td>99</td>
<td>97</td>
<td>84</td>
<td>50</td>
<td>29</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>B11@6'</td>
<td>100</td>
<td>97</td>
<td>85</td>
<td>47</td>
<td>83</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1@7'</td>
<td>100</td>
<td>99</td>
<td>84</td>
<td>42</td>
<td>18</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B9@7'</td>
<td>100</td>
<td>99</td>
<td>98</td>
<td>95</td>
<td>78</td>
<td>35</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>B5@9'</td>
<td>100</td>
<td>99</td>
<td>97</td>
<td>82</td>
<td>49</td>
<td>41</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>B19@9'</td>
<td>100</td>
<td>99</td>
<td>98</td>
<td>94</td>
<td>71</td>
<td>30</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>B7@10'</td>
<td>100</td>
<td>96</td>
<td>81</td>
<td>29</td>
<td>10</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B9@15'</td>
<td>100</td>
<td>98</td>
<td>88</td>
<td>63</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### PROCTOR CURVE

Maximum density/optimum moisture determination

<table>
<thead>
<tr>
<th>Soil Description</th>
<th>Maximum Density</th>
<th>Optimum Moisture</th>
<th>Sample I.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark yellowish brown silty fine to medium sand (SM)</td>
<td>132.5 pcf</td>
<td>9.0%</td>
<td>B11@ 0-5'</td>
</tr>
<tr>
<td>Dark yellowish brown silty fine to medium sand (SM)</td>
<td>133.0 pcf</td>
<td>8.5%</td>
<td>B23 @ 0-5'</td>
</tr>
</tbody>
</table>

ASTM D 1557
### SAND EQUIVALENT

<table>
<thead>
<tr>
<th>Sample I.D.</th>
<th>Sand Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>B33 @ 1'</td>
<td>13</td>
</tr>
<tr>
<td>B30 @ 3'</td>
<td>15</td>
</tr>
<tr>
<td>B20 @ 3'</td>
<td>16</td>
</tr>
<tr>
<td>B18 @ 4'</td>
<td>22</td>
</tr>
<tr>
<td>B3 @ 4'</td>
<td>27</td>
</tr>
<tr>
<td>B9 @ 5'</td>
<td>26</td>
</tr>
<tr>
<td>B24 @ 5'</td>
<td>12</td>
</tr>
<tr>
<td>B11 @ 6'</td>
<td>14</td>
</tr>
<tr>
<td>B29 @ 7'</td>
<td>16</td>
</tr>
<tr>
<td>B9 @ 7'</td>
<td>28</td>
</tr>
<tr>
<td>B12 @ 7'</td>
<td>11</td>
</tr>
<tr>
<td>B2 @ 8'</td>
<td>33</td>
</tr>
<tr>
<td>B21 @ 9'</td>
<td>22</td>
</tr>
<tr>
<td>B18 @ 10'</td>
<td>29</td>
</tr>
<tr>
<td>B34 @ 10'</td>
<td>18</td>
</tr>
<tr>
<td>B27 @ 10'</td>
<td>16</td>
</tr>
</tbody>
</table>
Sample Location: B7 @ 1'
Material: Silty Sand (SM)
Initial Dry Density: 102.7 PCF
Moisture Content: 5.5%
Percent Hydroconsolidation: 2.5%

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

* Test Method: ASTM D-2435
Sample Location: B1 @ 3'
Material: Silty Sand (SM)
Initial Dry Density: 108.6 PCF
Moisture Content: 6.6%
Percent Hydroconsolidation: 1.7%

* Test Method: ASTM D-2435

Consolidation Test

Del Sur Ranch Solar Facility

Avenue G and 95th Street West, Lancaster

1/28/2015 14-101
Sample Location:  B9 @ 3'
Material:  Silty Sand (SM)
Initial Dry Density:  105.2 PCF
Moisture Content:  4.8%
Percent Hydroconsolidation:  2.2%

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

* Test Method: ASTM D-2435

1/28/2015  14-101
Material: Silty Sand (SM)
Initial Dry Density: 106.9 PCF
Moisture Content: 5.2%
Percent Hydroconsolidation: 2.2%

Sample Location: B12 @ 4'

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

1/28/2015 14-101

* Test Method: ASTM D-2435
Sample Location: B16 @ 4'
Material: Silty Sand (SM)
Initial Dry Density: 107.2 PCF
Moisture Content: 5.1%
Percent Hydroconsolidation: 1.9%

* Test Method: ASTM D-2435
Sample Location: B29 @ 4'
Material: Silty Sand (SM)
Initial Dry Density: 108.6 PCF
Moisture Content: 4.3%
Percent Hydroconsolidation: 1.3%

* Test Method: ASTM D-2435
Material: Silty Sand (SM)
Initial Dry Density: 107.2 PCF
Moisture Content: 5.8%
Percent Hydroconsolidation: 1.9%

Sample Location: B4 @ 5'

Consolidation Test

Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

* Test Method: ASTM D-2435
Material: Silty Sand (SM)
Initial Dry Density: 110.9 PCF
Moisture Content: 6.0%
Percent Hydroconsolidation: 0.9%

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

* Test Method: ASTM D-2435
**Consolidation Test**

**Del Sur Ranch Solar Facility**

Avenue G and 95th Street West, Lancaster

Sample Location: B26 @ 5'
Material: Silty Sand (SM)
Initial Dry Density: 110.3 PCF
Moisture Content: 6.6%
Percent Hydroconsolidation: 1.0%

* Test Method: ASTM D-2435

1/28/2015 | 14-101
Sample Location:  B32 @ 6'
Material:  Silty Sand (SM)
Initial Dry Density:  111.5 PCF
Moisture Content:  4.2%
Percent Hydroconsolidation:  0.8%

* Test Method: ASTM D-2435
Sample Location:  B23 @ 7
Material:  Silty Sand (SM)
Initial Dry Density:  109.2 PCF
Moisture Content:  4.8%
Percent Hydroconsolidation:  1.5%

* Test Method: ASTM D-2435

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

1/28/2015  14-101
Sample Location: B16 @ 8'
Material: Silty Sand (SM)
Initial Dry Density: 112.1 PCF
Moisture Content: 6.1%
Percent Hydroconsolidation: 0.7%

* Test Method: ASTM D-2435

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

1/28/2015 | 14-101
Material: Silty Sand (SM)
Initial Dry Density: 111.4 PCF
Moisture Content: 4.1%
Percent Hydroconsolidation: 0.7%

* Test Method: ASTM D-2435
Sample Location: B26 @ 10'
Material: Silty Sand (SM)
Initial Dry Density: 108.4 PCF
Moisture Content: 5.1%
Percent Hydroconsolidation: 1.7%

* Test Method: ASTM D-2435

Consolidation Test

Del Sur Ranch Solar Facility

Avenue G and 95th Street West, Lancaster

1/28/2015 | 14-101
Sample Location: B29 @ 10’
Material: Silty Sand (SM)
Initial Dry Density: 110.3 PCF
Moisture Content: 4.7%
Percent Hydroconsolidation: 0.9%

Consolidation Test
Del Sur Ranch Solar Facility
Avenue G and 95th Street West, Lancaster

* Test Method: ASTM D-2435

1/28/2015 14-101
Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Density (PCF)</th>
<th>Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'</td>
<td>106.3</td>
<td>37</td>
<td>190</td>
</tr>
</tbody>
</table>

Boring Symbol Depth Density Angle of Cohesion
B4 ● 3' 106.3 37 190

J.N 14-101
## Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12</td>
<td>●</td>
<td>4'</td>
<td>106.9</td>
<td>33</td>
<td>230</td>
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</tbody>
</table>

J.N 14-101
## Direct Shear Data

### Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Normal Load (KIPS/sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>1.5</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>2.5</td>
</tr>
</tbody>
</table>

### Shearing Stress in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Shearing Stress (KIPS/sq ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>1.5</td>
</tr>
<tr>
<td>2.0</td>
</tr>
</tbody>
</table>

### Boring Data

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>○</td>
<td>5'</td>
<td>113.4</td>
<td>39</td>
<td>90</td>
</tr>
</tbody>
</table>

J.N 14-101
Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B7</td>
<td></td>
<td>5'</td>
<td>111.4</td>
<td>35</td>
<td>190</td>
</tr>
</tbody>
</table>

J.N 14-101
B14  5'  111.4  35  180

J.N 14-101
Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B20</td>
<td>•</td>
<td>5'</td>
<td>110.9</td>
<td>37</td>
<td>200</td>
</tr>
</tbody>
</table>

J.N 14-101
Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B9</td>
<td>●</td>
<td>7'</td>
<td>109.1</td>
<td>38</td>
<td>40</td>
</tr>
</tbody>
</table>

J.N 14-101
Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B23</td>
<td>•</td>
<td>7'</td>
<td>109.2</td>
<td>35</td>
<td>50</td>
</tr>
</tbody>
</table>
**Direct Shear Data**

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B16</td>
<td>●</td>
<td>8'</td>
<td>112.6</td>
<td>39</td>
<td>60</td>
</tr>
</tbody>
</table>

*J.N 14-101*
Direct Shear Data

Normal Load in KIPS per Square Foot

<table>
<thead>
<tr>
<th>Boring</th>
<th>Symbol</th>
<th>Depth (feet)</th>
<th>Dry Density (PCF)</th>
<th>Angle of Friction (degrees)</th>
<th>Cohesion (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B7</td>
<td></td>
<td>10'</td>
<td>111.4</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

J.N 14-101
APPENDIX D

Engineering Analysis
W6x7 at 4’ above grade

Worst-Case Factored Fixed-Tilt Axial Loads
Downward: 3.96 kips
Uplift: 1.76 kips

Worst-Case Factored Fixed-Tilt Lateral Load
Total Load: 2.80 kips
**Loads:**
- Load Factor for Vertical Loads = 1.0
- Load Factor for Lateral Loads = 1.0
- Loads Supported by Pile Cap = 0 %
- Shear Condition: Static

(With Load Factor)
- Vertical Load, Q = 4.0 -kp
- Shear Load, P = 2.8 -kp
- Moment, M = 0.0 -kp-ft

**Profile:**
- Pile Length, L = 15.0 -ft
- Top Height, H = 4 -ft
- Slope Angle, As = 0
- Batter Angle, Ab = 0

**Soil Data:**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Gamma</th>
<th>Phi</th>
<th>C</th>
<th>K</th>
<th>e50 or Dr</th>
<th>Nspt</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-lb/f3</td>
<td>-%</td>
<td>-kp/2</td>
<td>-bf/3</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>110</td>
<td>33</td>
<td>0.090</td>
<td>45.0</td>
<td>34.78</td>
<td>10</td>
</tr>
</tbody>
</table>

**Pile Data:**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Width</th>
<th>Area</th>
<th>Per.</th>
<th>I</th>
<th>E</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-in</td>
<td>-in2</td>
<td>-in4</td>
<td>-in</td>
<td>-kp/2</td>
<td>-kp/f</td>
</tr>
<tr>
<td>0.0</td>
<td>3.9</td>
<td>2.04</td>
<td>15</td>
<td>12.13</td>
<td>29000</td>
<td>0.01</td>
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<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vertical Capacity:**
- Weight above Ground = 0.04 Total Weight = 0.15-kp  *Soil Weight is not included*
- Side Resistance (Down) = 3.971-kp Side Resistance (Up) = 2.711-kp
- Tip Resistance (Down) = 0.361-kp Tip Resistance (Up) = 0.000-kp
- Total Ultimate Capacity (Down) Qult = 4.331-kp Total Ultimate Capacity (Up) = 2.861-kp
- Total Allowable Capacity (Down) Qallow = 4.331-kp Total Allowable Capacity (Up) Qallow = 2.861-kp
- OK! Qallow > Q

**Settlement Calculation:**
- At Q = 3.96-kp Settlement = 0.00662-in
- At Qallow = 1.00-in Qallow = 99999.00000-kp

*Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.*
LATERAL PILE CAPACITY WITH RESPECT TO THE STRONG AXIS

DEFLECTION, \( y_t \) -in

MOMENT, \( k_p \)-ft

SHEAR, \( k_p \)-ft

Ground

Top at 8.5 ft

Top at 9.3 ft

Top at 11.0 ft

Top at 18.4 ft

Top at 5.1 ft

Top at 2.8 ft

Top at 0.0 ft

Top at 0.0 ft

Max. St = -0.049

Max. \( y_t \) = 3.61E+0

Max. Moment = 18.4

Max. Shear = 5.1

DEFLECTION, \( y_t \) -in

MOMENT, \( k_p \)-ft

SHEAR, \( k_p \)-ft

Sand/Gravel

Last Section: \( E - k_p / k_i^2 = 29,000 \)

Last Section: \( I'_i = 12 \)

DEL SUR JN 14-101 W 6 x 7

Figure 2
LATERAL ANALYSIS

Loads:
- Load Factor for Vertical Loads = 1.0
- Load Factor for Lateral Loads = 1.0
- Loads Supported by Pile Cap = 0 %
- Shear Condition: Static

(with Load Factor)
- Vertical Load, Q = 4.0 kip
- Shear Load, P = 2.8 kip
- Moment, M = 0.0 kip-ft

Profile:
- Pile Length, L = 15.0 ft
- Top Height, H = 4 ft
- Slope Angle, As = 0
- Batter Angle, Ab = 0

Driving Steel Pile (Open end)

Soil Data:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Gamma</th>
<th>Phi</th>
<th>C</th>
<th>K</th>
<th>e50 or Dr</th>
<th>Nspt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>110</td>
<td>33</td>
<td>0.090</td>
<td>45.0</td>
<td>34.78</td>
<td>10</td>
</tr>
</tbody>
</table>

Pile Data:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Width</th>
<th>Area</th>
<th>Per.</th>
<th>I</th>
<th>E</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.9</td>
<td>2.04</td>
<td>15</td>
<td>12.13</td>
<td>29000</td>
<td>0.01</td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Single Pile Lateral Analysis:
- Top Deflection, yt = 3.61000-in
- Max. Moment, M = 18.42-kip-ft
- Top Deflection Slope, St = -0.04900
N/G: Top Deflection, 3.61000-in, Exceeds the Allowable Deflection= 1.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.
W6x8.5 at 5’ above grade (tracker bearing pile loads)

Worst-Case Factored Tracker Bearing Axial Loads
Downward: 3.97 kips
Uplift: 2.59 kips

Worst-Case Factored Tracker Bearing Lateral Loads
Total Load: 2.44 kips
APPENDIX E

Thermal Analysis
February 9, 2015

Bruin Geotechnical Services, Inc.
1817 E. Avenue Q, Unit A-1
Palmdale, California  93550
Attn: Mark E. Stevens

Re: Thermal Analysis of Soil Samples - Del Sur Solar - Job Number 14-101

The following is the report of thermal dryout characterization tests conducted on two (2) bulk samples of native soil from the referenced project received at our laboratory.

**Thermal Resistivity Tests:** For thermal dryout characterization the samples were tested at the ‘optimum’ moisture content and 90% of the density provided by Bruin Geotechnical. A series of thermal resistivity measurements were made in stages with moisture content ranging from the ‘wet’ to the totally dry condition. The tests were conducted in accordance with the IEEE standard. The results are tabulated below and the thermal dryout curves are presented in **Figure 1**.

**Sample ID, Description, Thermal Resistivity, Moisture Content and Density**

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Visual Description</th>
<th>Thermal Resistivity (°C-cm/W)</th>
<th>Moisture Content (%)</th>
<th>Dry Density (lb/ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B11 @ 0’ - 5’</td>
<td>Moderate Yellowish Brown Silty Fine to Medium Sand (SM)</td>
<td>62, 133</td>
<td>9</td>
<td>119</td>
</tr>
<tr>
<td>B23 @ 0’ - 5’</td>
<td>Moderate Brown Silty Fine to medium Sand with coarse sand (SM)</td>
<td>61, 127</td>
<td>8.7</td>
<td>120</td>
</tr>
</tbody>
</table>

**Comments:** The thermal characteristics depicted in the dryout curves apply for the soils at their respective test dry density.

Please contact us if you have any questions or if we can be of further assistance.

**Geotherm USA**

Nimesh Patel
THERMAL DRYOUT CURVES

Native Soil

- B11 @ 0' - 5'
- B23 @ 0' - 5'

THERMAL RESISTIVITY (°C-cm/W)
MOISTURE CONTENT (% DRY WEIGHT)

Bruin Geotechnical Services, Inc.

Thermal Analysis of Native Soil Samples

Del Sur Solar - Job Number 14-101

February 2015

Figure 1
**Loads:**
- Load Factor for Vertical Loads = 1.0
- Load Factor for Lateral Loads = 1.0
- Loads Supported by Pile Cap = 0 %
- Shear Condition: Static

(With Load Factor)
- Vertical Load, \( Q = 4.0 \text{ -kp} \)
- Shear Load, \( P = 2.4 \text{ -kp} \)
- Moment, \( M = 0.0 \text{ -kp-f} \)

**Profile:**
- Pile Length, \( L = 14.0 \text{ -ft} \)
- Top Height, \( H = 5 \text{ -ft} \)
- Slope Angle, \( A_s = 0 \)
- Batter Angle, \( A_b = 0 \)

**Soil Data:**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Gamma (lb/ft^3)</th>
<th>Phi (degrees)</th>
<th>C (lb/ft)</th>
<th>K (lb/ft^3)</th>
<th>e50 or Dr (%)</th>
<th>Nspt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>110</td>
<td>33</td>
<td>0.090</td>
<td>45.0</td>
<td>34.78</td>
<td>10</td>
</tr>
</tbody>
</table>

**Pile Data:**

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Width (in)</th>
<th>Area (in^2)</th>
<th>Per. (in)</th>
<th>I (in^4)</th>
<th>E (kp/ft)</th>
<th>Weight (kp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.9</td>
<td>2.7</td>
<td>19.7</td>
<td>16.4</td>
<td>29000</td>
<td>0.01</td>
</tr>
<tr>
<td>14.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vertical Capacity:**
- Weight above Ground = 0.05 Total Weight = 0.14-kp  *Soil Weight is not included*
- Side Resistance (Down) = 4.016-kp Side Resistance (Up) = 2.788-kp
- Tip Resistance (Down) = 0.478-kp Tip Resistance (Up) = 0.000-kp
- Total Ultimate Capacity (Down) Qult = 4.494-kp Total Ultimate Capacity (Up) Qult = 2.928-kp
- Total Allowable Capacity (Down) Qallow = 4.494-kp Total Allowable Capacity (Up) Qallow = 2.928-kp
- OK! Qallow > Q

**Settlement Calculation:**
- At Q = 3.97-kp Settlement = 0.00527-in
- At Qallow = 1.00-in Settlement = 99999.00000-kp

**Note:** If the program cannot find a result or the result exceeds the upper limit, the result will be displayed as 99999.
LATERAL PILE CAPACITY WITH RESPECT TO THE STRONG AXIS

Ground
Tip

Top

Max. Moment = 18.3
Top Shear = 4.9

Del Sur JN 14-101 W 6 x 8.5

Figure 2
Loads:
- Load Factor for Vertical Loads = 1.0
- Load Factor for Lateral Loads = 1.0
- Loads Supported by Pile Cap = 0 %
- Shear Condition: Static

(with Load Factor)
- Vertical Load, Q = 4.0 - kp
- Shear Load, P = 2.4 - kp
- Moment, M = 0.0 - kp-ft

Profile:
- Pile Length, L = 14.0 - ft
- Top Height, H = 5 - ft
- Slope Angle, As = 0
- Batter Angle, Ab = 0

Soil Data:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Gamma</th>
<th>Phi</th>
<th>C</th>
<th>K</th>
<th>e50 or Dr</th>
<th>Nspt</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-lb/ft³</td>
<td>-lb/ft³</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>110</td>
<td>33</td>
<td>0.090</td>
<td>45.0</td>
<td>34.78</td>
<td>10</td>
</tr>
</tbody>
</table>

Pile Data:

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<tr>
<th>Depth</th>
<th>Width</th>
<th>Area</th>
<th>Per.</th>
<th>I</th>
<th>E</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-in</td>
<td>-in²</td>
<td>-in⁴</td>
<td>-kip/2</td>
<td>-kip²</td>
<td>-kip²</td>
</tr>
<tr>
<td>0.0</td>
<td>3.9</td>
<td>2.7</td>
<td>19.7</td>
<td>16.4</td>
<td>29000</td>
<td>0.01</td>
</tr>
<tr>
<td>14.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Single Pile Lateral Analysis:
- Top Deflection, yₜ = 3.21000-in
- Max. Moment, Mₜ = 18.25-kp-ft
- Top Deflection Slope, Sₜ = -0.03920
- N/G: Top Deflection, 3.2100-in, Exceeds the Allowable Deflection = 1.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.

The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.
W6x15 at 5' above grade (tracker gearbox pile loads)

Worst-Case Factored Tracker Gearbox Axial Loads
Downward: 3.10 kips
Uplift: 1.90 kips

Worst-Case Factored Tracker Gearbox Lateral Loads
Total Load: 2.16 kips

ULTIMATE CAPACITY vs FOUNDATION DEPTH
VERTICAL ANALYSIS

Loads:
  Load Factor for Vertical Loads = 1.0
  Load Factor for Lateral Loads = 1.0
  Loads Supported by Pile Cap = 0 %
  Shear Condition: Static

(with Load Factor)
  Vertical Load, \( Q = 3.1 \) -kp
  Shear Load, \( P = 2.2 \) -kp
  Moment, \( M = 0.0 \) -kp-ft

Profile:
  Pile Length, \( L = 15.0 \) -ft
  Top Height, \( H = 5 \) -ft
  Slope Angle, \( \alpha = 0 \)
  Batter Angle, \( \beta = 0 \)

Soil Data:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Gamma</th>
<th>Phi</th>
<th>C</th>
<th>K</th>
<th>e50 or Dr</th>
<th>Nspt</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-lb/ft³</td>
<td>-lb/ft³</td>
<td>%</td>
<td></td>
<td>-lb/i³</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>110</td>
<td>33</td>
<td>0.090</td>
<td>45.0</td>
<td>34.78</td>
<td>10</td>
</tr>
<tr>
<td>15.0</td>
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<td></td>
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Pile Data:

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<thead>
<tr>
<th>Depth</th>
<th>Width</th>
<th>Area</th>
<th>Per.</th>
<th>I</th>
<th>E</th>
<th>Weight</th>
</tr>
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<tbody>
<tr>
<td>-ft</td>
<td>-in</td>
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<td>0</td>
<td>4.0</td>
<td>4.7</td>
<td>20.6</td>
<td>32.1</td>
<td>29000</td>
<td>0.02</td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vertical Capacity:
  Weight above Ground = 0.10 Total Weight = 0.30-kp  *Soil Weight is not included
  Side Resistance (Down) = 4.866-kp Side Resistance (Up) = 3.339-kp
  Tip Resistance (Down) = 0.852-kp Tip Resistance (Up) = 0.000-kp
  Total Ultimate Capacity (Down) Qult = 5.718-kp Total Ultimate Capacity (Up) = 3.639-kp
  Total Allowable Capacity (Down) Qallow = 5.718-kp Total Allowable Capacity (Up) Qallow = 3.639-kp
  OK! Qallow > Q

Settlement Calculation:
  At Q = 3.10-kp Settlement = 0.00270-in
  At Qallow = 1.00-in Qallow = 99999.00000-kp

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
LATERAL PILE CAPACITY WITH RESPECT TO THE STRONG AXIS

PILE DEFLECTION & FORCE vs DEPTH
Single Pile, Khead=1, Kbc=1

Deflection, $y_t$, in
Moment, $k_p$-ft
Shear, $k_p$-in

Ground
Tip $y_t=-1.3\times10^{-2}$
Top $y_t=1.46\times10^0$
Max. $y_t=1.46\times10^0$
Top St $=-1.75\times10^{-2}$
Max. St $=0$
Top Moment $=0$
Max. Moment $=15.4$
Top Shear $=2.2$
Max. Shear $=3.5$

Sand/Gravel
Last Section: $E-kp/i^2=29000$

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Del Sur JN 14-101 W 6 x 15
Figure 2
Loads:
Load Factor for Vertical Loads = 1.0
Load Factor for Lateral Loads = 1.0
Loads Supported by Pile Cap = 0 %
Shear Condition: Static

(vertical Load Factor)
Vertical Load, Q = 3.1 - kp
Shear Load, P = 2.2 - kp
Moment, M = 0.0 - kp-f

Profile:
Pile Length, L = 15.0 - ft
Top Height, H = 5 - ft
Slope Angle, As = 0
Batter Angle, Ab = 0

Driving Steel Pile (Open end)

Soil Data:
<table>
<thead>
<tr>
<th>Depth</th>
<th>Gamma</th>
<th>Phi</th>
<th>C</th>
<th>K</th>
<th>e50 or Dr</th>
<th>Nspt</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-lb/ft3</td>
<td>-kp/ft2</td>
<td>-lb/ft3</td>
<td>%</td>
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<tr>
<td>0</td>
<td>110</td>
<td>33</td>
<td>0.090</td>
<td>45.0</td>
<td>34.78</td>
<td>10</td>
</tr>
<tr>
<td>15.0</td>
<td></td>
<td></td>
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Pile Data:
<table>
<thead>
<tr>
<th>Depth</th>
<th>Width</th>
<th>Area</th>
<th>Per.</th>
<th>I</th>
<th>E</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ft</td>
<td>-in</td>
<td>-in2</td>
<td>-in</td>
<td>-in4</td>
<td>-kp/ft2</td>
<td>-kp/ft</td>
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<tr>
<td>0.0</td>
<td>4.0</td>
<td>4.7</td>
<td>20.6</td>
<td>32.1</td>
<td>29000</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Single Pile Lateral Analysis:
Top Deflection, y = 1.46000-in
Max. Moment, M = 15.42-kp-f
Top Deflection Slope, St = -0.01750
N/G: Top Deflection, 1.46000-in, Exceeds the Allowable Deflection = 1.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.