# PRELIMINARY
# GEOTECHNICAL INVESTIGATION REPORT

**Prepared For**
**SPower**

**Proposed**
**Estrella Solar**
**Photovoltaic Generation Facility**
**Southwest Corner of Ave A and 90th Street West**
**Lancaster, Los Angeles County, California**


## BRUIN GEOTECHNICAL SERVICES, INC.
**44732 Yucca Avenue**
**Lancaster, California 93534**



**Job No: 20-26**
**February 10, 2021**

SOIL AND MATERIAL
TESTING AND INSPECTIONS

February 10, 2021 J.N. 20-26

Ms. Ashlee Auger P.E.
**S. Power,** Sustainable Power Group
2180 South 1300 East, Suite 600
Salt Lake City, UT 84106

**Subject:** **Preliminary Geotechnical Investigation Report for Proposed Estrella Photovoltaic Generation Facility at the Southwest Corner of Avenue A and 90th Street West, Lancaster, Los Angeles County, California**
**APN 3262-006-002, 003**

Dear Ms. Auger:

Presented herewith is the report of our Geotechnical Investigation Report for the subject project. Our work was performed in accordance with the scope of work outlined in our original proposal dated October 1, 2020.

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

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.**

Ryan D. Duke, P.E.
RDD/mes

REGISTERED PROFESSIONAL ENGINEER RYAN DUKE C79729 CIVIL STATE OF CALIFORNIA

# GEOTECHNICAL INVESTIGATION REPORT

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**Estrella Photovoltaic Generation Facility**
**Southwest Corner of Avenue A and 90th Street West**
**Lancaster, Los Angeles County, California**
**APN 3262-006-002, 003**

## 1.0 INTRODUCTION

This report presents the results of the geotechnical investigation performed by Bruin Geotechnical Services, Inc. for the proposed Photovoltaic Generation Facility based on the assessor's parcel maps and the Site Plan (google KMZ file) provided by the client. This report is specific to the proposed development.

The following Assessors Parcels are included are included in this report:

APN 3262-006-002
APN 3262-006-003

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

The scope of the authorized for this investigation included the following tasks:

- Performing a site reconnaissance
- Conducting a field subsurface exploration through borings and soil sampling
- Performing a field and laboratory soil corrosivity study
- Performing a soil thermal analysis of the native soil
- Laboratory testing program of selected soil samples obtained during drilling
- Performing engineering analyses of the data obtained
- Preparing this 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 development.

## 2.0 SITE LOCATION AND DESCRIPTION

The subject square-shaped site, herein after referred to as Site, is located at the northeast corner of West Avenue A and 90th Street West in the city of Lancaster, Los Angeles County, California, and consists of two (2) parcels totaling approximately 148.98 acres. The subject parcels include:

- APN: 3262-006-002 (79.77 acres)
- APN: 3262-006-003 (69.21 acres)

At the time of Bruin GSI's field investigation, the site was vacant, undeveloped land. The site is surrounded by agricultural parcels to the east, south, and west and residential parcels to the north and southeast. The site contained scattered capped pipes approximately two (2) feet in height and an existing well in the southeast portion of the site. The Site is relatively flat, with dense covering of annual weeds and shrubs with few scattered trees. The intention of the site description is to be illustrative and specifically not intended for use as a legal description of the Site.

The Site topography is relatively flat and level with a gentle slope down to the northeast, with drainage by sheet flow at approximately 1%. The approximate elevation at the site is 2,450 feet above mean sea level.

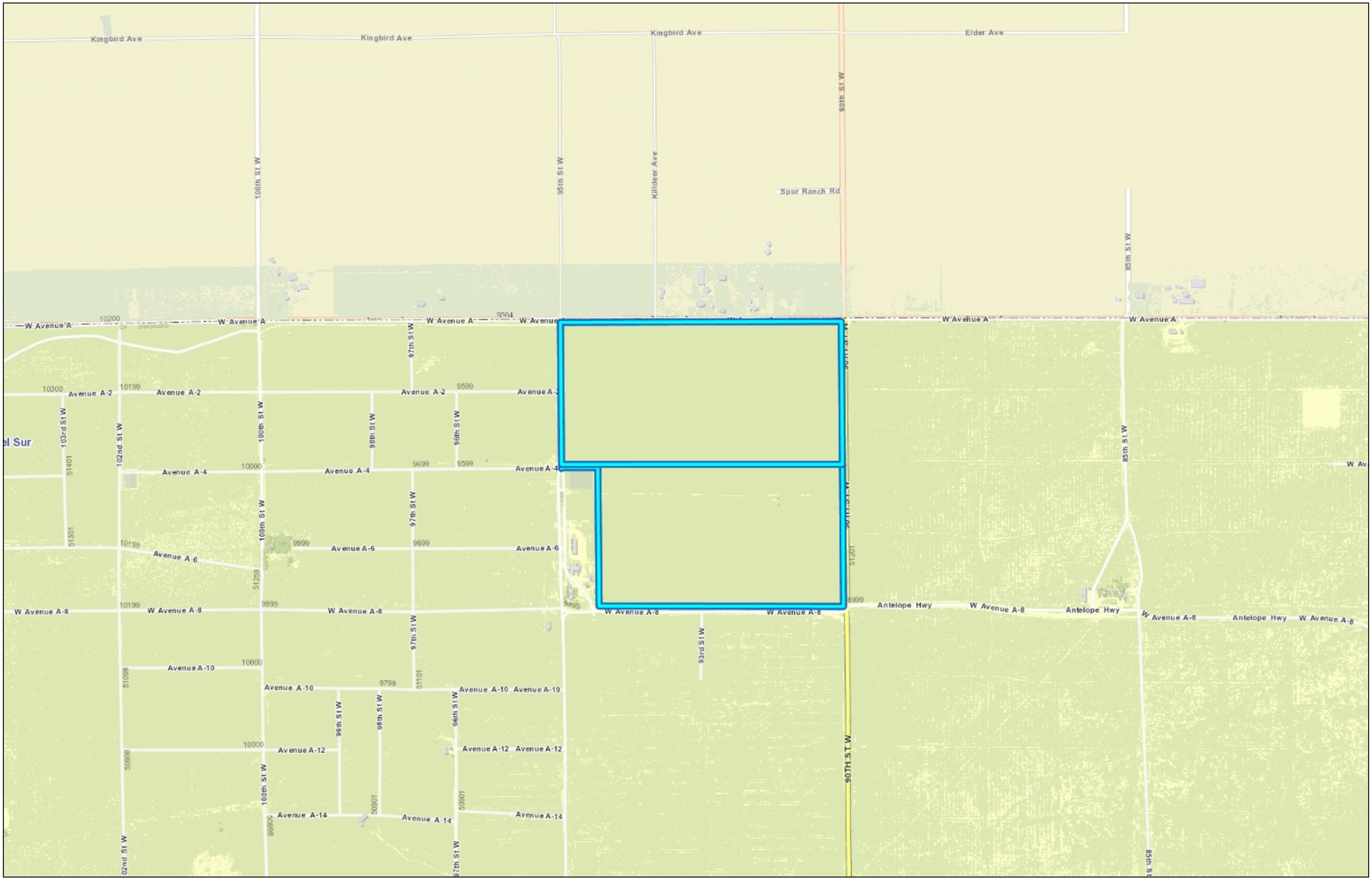
The general location of the subject Site is shown on Figure 1.

## 3.0 FLOOD HAZARD

Bruin GSI reviewed available data regarding the flood potential at the subject site. Based on our FEMA database research, the project Site is located on Map Number 06037C0150F, Panel 150 of 2350. Review of panels indicates the subject site lies within:

Zone X
*Areas determined to be outside 500-year floodplain determined to be outside the 1% and 0.2% annual chance floodplains.*

A Hydrology Study or flood analysis was not a part of our scope of work. However, a hydrology study was prepared for the Site by Kimley-Horn Civil Engineers. The study should be reviewed by the structural engineer to determine the depth of scour of piles (if applicable) located in drainage or basin areas needs to be ignored in determining the final embedment depth of the proposed pile foundations.




0 752 1,505 Feet

# Figure 1 Vicinity Map

Created in GIS-NET Public

Printed: 2/10/21

Disclaimer:This map represents a quick representation of spatial imagery or vector layers using GIS-NET. The map should be interpreted in accordance with the GIS-NET Public disclaimer statement. Printed with permission from the Los Angeles County Dept. of Regional Planning. 

## 4.0 PROPOSED CONSTRUCTION

Based on our conversations with the client and information obtained through review of the proposed development plans, it is our understanding that the proposed project consists of a solar photovoltaic (PV) generation facility and a generation-tie line to an existing Southern California Edison Sub-Stations located nearby. The Project will utilize crystalline silicon, or thin film, PV technology on fixed-tilt or tracker mounting supports on single pole foundation supports (driven H-piles: W6x9, W6x12 are anticipated) with approximately five (5) feet above grade and anticipated embedment depths of eight to twelve (8-12) feet, with thickened concrete mat foundations and driven H-Piles for switchgear equipment and inverter equipment. Construction will also include six (6) infiltration basins throughout the Site approximately eighteen (18) inches below ground surface for the purpose of percolating sheet-flow storm-drain water.

It is anticipated that the proposed earthwork will consist of clearing and grubbing of the vegetation, construction of shallow infiltration basins (less than 2 ft. depth, with 4:1 slopes) 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 interior access are also anticipated.

Although construction details are not available at the time of writing this report, based upon conversations with the client, we anticipate allowable stress design loads for the posts downward (bearing) loads of approximately 4 kips, and wind uplift and lateral loads of approximately 2-3 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 October 1, 2020. 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.

### 5.1 Field Exploration Program

The field exploration program for the geotechnical investigation report was initiated on November 18, 2020, under the technical supervision of our engineer. A total of fifteen (15) exploratory borings were drilled using a CME 75 drill rig with 8" hollow stem auger. The borings were advanced to maximum depths of twenty (20) feet below ground surface (bgs).

The approximate locations of the borings are presented on Figure 2. The borings were approximately located in the field by sighting and pacing from existing streets and landmarks. A hand-held GPS device was utilized to determine the approximate latitude and longitude of the borings. If an exact location of the boring locations is desired, it should be performed by a licensed surveyor.

Logs of subsurface materials encountered in the borings were prepared in the field by a representative of Bruin GSI at the time of drilling and sampling. 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 zero to five (0-5) feet below existing ground surface. The soil samples were returned to the laboratory for analysis and testing.

Final boring logs for the geotechnical investigation were prepared from the field logs and are presented in Appendix A. Stratification lines were approximated by field staff based on observations made at the time of drilling, while actual boundaries between soil types may be gradual and soil conditions may vary at other locations.

## 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 field logs were reviewed, and the soil 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 — ASTM D 2937
- Consolidation potential — ASTM D 2435
- Shear strength — ASTM D 3080
- Expansion index — ASTM D 4829
- Chemical analyses — CA 422/417/643

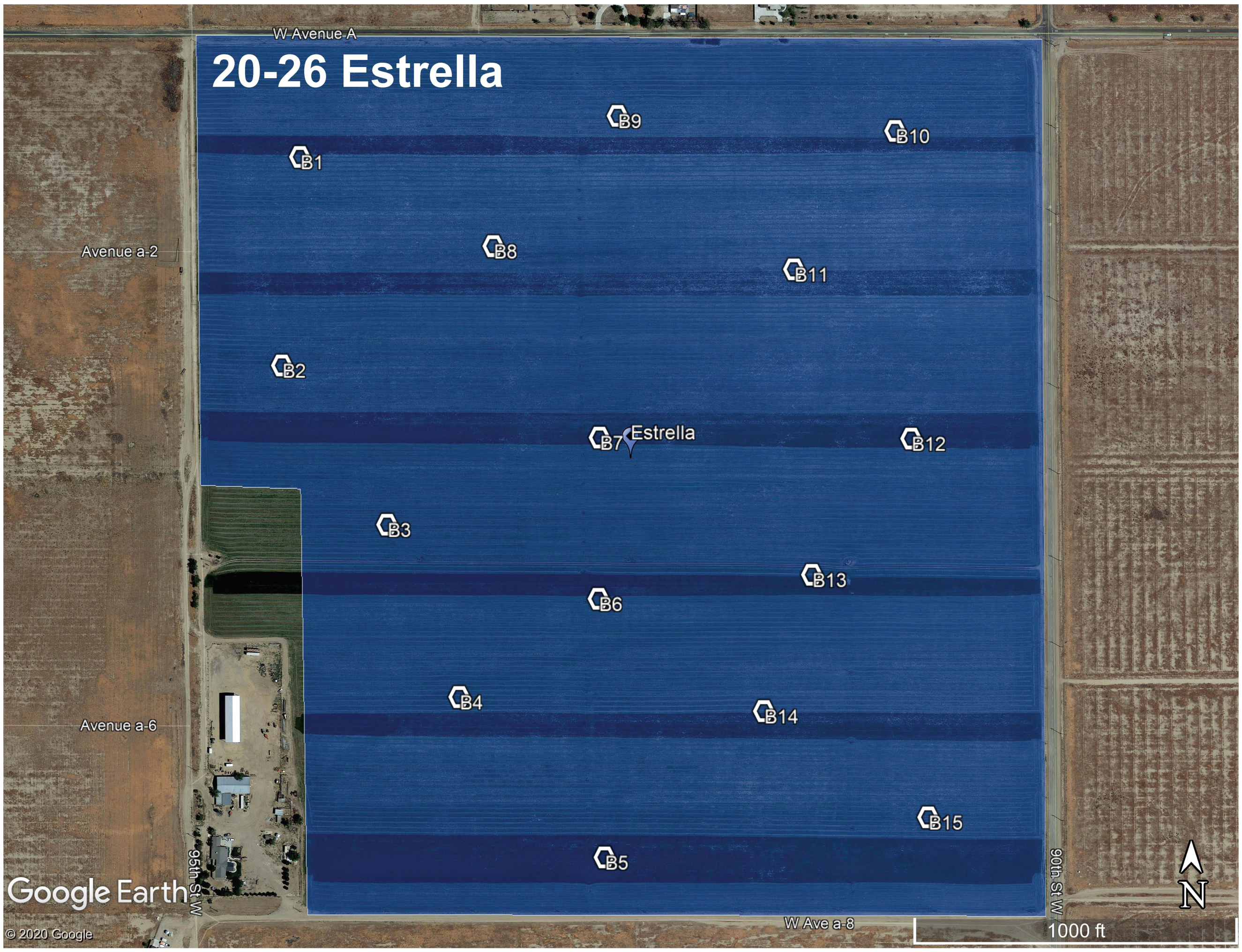
The following classification tests were performed:

- Description and Identification of Soils — ASTM D 2488
- Maximum density – Optimum moisture — ASTM D 1557
- Sieve Analysis of Fine and Coarse Aggregates — ASTM C 136
- Sand Equivalent Value — ASTM D 2419
- Grain Size Analysis (Hydrometer method) — ASTM D 422

**Figure 2**

# Boring Location Map

N.T.S.

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**Project:**

**SPower, Sustainable Power Group**
Estrella
Northeast Corner of 110th Street West & Avenue B
Lancaster, Los Angeles County, California

| **Job Number:** | **Date:** |
| --- | --- |
| 20-26 | 2/10/21 |

Tabular and graphical test results are presented in Appendix B.

### 5.3 Field Resistivity Testing

HDR Corrosion conducted three (3) field resistivity tests at the Site on January 14, 2021, using the Wenner 4-pin method (ASTM G57).

Refer to the corrosion report BY HDR Corrosion is provided in Appendix C. Design for corrosion based on the required lifespan shall be completed by the structural engineer.

### 5.4 Thermal Resistivity Testing

Three (3) bulk soil samples were obtained during drilling. The soil samples are a mixture of soils within the noted depths. The maximum density/ optimum moisture determinations (ASTM D1557 test method) were performed on each sample. The data and soil samples were delivered to Geotherm USA for thermal resistivity testing (RHO), as requested by the client. The selected samples were remolded by Geotherm USA to 90% relative compaction and evaluated for thermal resistivity to determine thermal dry-out curves. Results from Geotherm USA are presented in Appendix D.

## 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 concrete foundations or driven piles may be used for auxiliary structures. However, due to the non-uniform condition of the near surface soils and moderate potential for hydro-consolidation, remedial grading including over-excavation and recompaction is recommended for conventional concrete 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 alluvial materials were encountered within our exploratory borings. The subsurface soil appears relatively uniform across the subject site and the soil encountered in the exploratory borings generally consists of interbedded layers of silty sand (SM) and poorly graded sands (SP) with occasional sandy silt (ML) and cemented soils, to the maximum depth explored of twenty (20) feet bgs.

Based on the blow counts obtained during sampling, and in-situ densities obtained, the native material encountered was noted to be medium dense or firm. The subsurface materials were noted to be dry to slightly moist. No groundwater or perched water was encountered through the depth explored (20 ft. bgs). For more detailed descriptions of the subsurface materials refer to the boring logs in Appendix A.

### 6.2 Groundwater Conditions

The nearest well data for the project site area show that groundwater levels are located approximately 215 feet below the ground surface in the vicinity of the subject site. Well data was gathered from USGS well site name 008N013W05E001S, site number 344848118172301. The seasonal high groundwater elevation is greater than 150 feet below the proposed invert of the infiltration basins.

Historically, groundwater in the Antelope Valley Groundwater Basin flows north from the San Gabriel Mountains and south and east from the Tehachapi Mountains toward Rosamond Lake and Rogers Lake. Because of recent groundwater pumping, groundwater levels and flow have been altered in urban areas such as Lancaster and Edwards Air Force Base. Groundwater pumping has caused subsidence of the ground surface, and by 1992, 292 square miles of Antelope Valley had subsided more than one foot (Sneed and others, 2000). From 1942 through 2004, the groundwater level in the project site vicinity decreased or was lowered by approximately 54 feet.

## 7.0 SITE GEOLOGY

The following sections address the regional geology and seismic hazards, subsurface conditions at the subject site. This information is based on the field exploration and published maps and reports.

### 7.1 Regional Geology and Seismic Hazards Assessment

Our scope of services included a review of published maps and reports to characterize the regional geology and potential for seismic hazards.

### 7.2 Regional Geology

The project site is located in the central portion of the Antelope Valley Basin, which makes up part of the western Mojave Desert Geomorphic province. The Antelope Valley is characterized as a 4,000 $km^2$ sediment filled, closed basin that lies between the San Andreas and Garlock fault zones and forms the westernmost “wedge” of the Mojave Desert geomorphic province (Dibblee, 1967). The Mojave Desert geomorphic province is characterized by broad expanses of desert plains and isolated mountain ranges with elevations ranging from 2,300 to 3,500 feet above mean sea level. Annual rainfall generally ranges between 5 to 10 inches and drains into interior playas (Department of Water Resources, 2003).

Sediments in the central portion of the Antelope Valley are derived from the Transverse Ranges to the south and from the Tehachapi Mountains to the north. The project site contains a thick deposit of alluvium. Similar alluvial deposits are present near or at the ground surface throughout the central Antelope Valley. Modern streams that head in the western Transverse Ranges and the Tehachapi Mountains flow toward a closed basin at Rosamond Lake, northeast of the project site area. The southern and northern margins of the Antelope Valley contain common thrust faults and folds that expose some of the oldest sediment within the basin. The thrust faults and folds are related to activity on the San Andreas and Garlock Fault Zones, which form the southern and northern boundaries of the Mojave Desert geomorphic province in this area.

## 7.3 Site Geology

The site is located on the Little Buttes, CA United States Geological Survey (USGS) 7.5-minute topographic quadrangle. Elevation at the site is approximately 2,450 feet above mean sea level.

The Site sits on alluvium that emanates from a Portal Ridge that is associated with the base of the northern flank of the San Gabriel Mountains. The Site contains natural alluvial fan, and bar and swale topography. The project site is located along axial valley deposits that are comprised of coalescing alluvial fans. Rock outcrops are not visible on the project site. Dibblee (1967 and 2002) maps alluvium across the project site area as distal alluvial fan deposits. These are young surficial alluvial deposits in this area and are described as valley and terrace deposits of alluvial sand and gravel. At depth, the entire tract is underlain by the Late Pleistocene aged lacustrine deposits.

No springs or areas indicative of shallow ground water were observed on the project site. Surface drainage of the property would be primarily by sheet-flow across the property area, where it would flow northeast toward numerous unnamed northeast flowing tributary drainages.

## 7.4 Seismic Hazards Assessment

The types of geologic and seismic hazards assessed include ground-surface fault rupture and liquefaction. Our scope of services did not include a 50-foot test boring or detailed analysis of liquefaction, however, due to relatively deep (greater that 50' bgs) groundwater, we performed a limited research of published liquefaction study within the area.

The purpose of the Alquist-Priolo Geologic Hazards Zone Act, as summarized in CDMG Special Publication 2 (SP 42), is to "prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture." As indicated by SP 42, "the State Geologist is required to delineate "earthquake fault zones" (EFZs) along known active faults in California. Cities and counties affected by the zones must regulate certain development 'projects' within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting.

Zones of Required Investigation referred to as "Seismic Hazard Zones" in CCR Section 3722, are areas shown on Seismic Hazard Zone Maps where Site investigations are required to determine the need for mitigation of potential liquefaction and/or earthquake-induced landslide ground displacements. The Site is not located in a Landslide and Liquefaction Seismic Hazard Zone as specified by the State of California. No other published liquefaction studies were reviewed.

### 7.5 Liquefaction

Earthquake-induced ground shaking can be the cause of several significant phenomena, including liquefaction of saturated fine sands and silty sands. Loose soils can transform from a solid to a liquid state as a result of increased pore pressure during seismic loading. Liquefaction results in a complete loss of strength and can cause structures to settle or even overturn if it occurs in the bearing zone. If liquefaction occurs beneath sloping ground, a phenomenon known as lateral spreading can occur. Due to the poorly sorted and coarse-grained materials that are anticipated to underlie the Site area and the absence of a shallow groundwater table, the potential for liquefaction is low. The project site has a low susceptibility to liquefaction.

### 7.6 IBC Design Parameters

The following coefficients have been estimated in accordance with the requirements of the 2019 CBC, utilizing the Structural Engineers Association of California and California's Office of Statewide Health Planning and Development Seismic Design Maps Application:

*http://seismicmaps.org /*

The following seismic parameters are provided, based on the approximate latitude and longitude at the southwest corner of the subject site:

Latitude 34.812658°
Longitude -118.298175°

| Type | Value | Period |
|---|---|---|
| *Spectral Response Acceleration, Short Period) – $S_S$* | 1.324g | 0.2(sec) |
| *Spectral Response Acceleration at 1 sec. – $S_1$* | 0.535g | 1.0(sec) |
| *Mapped Spectral Response, Short period – $S_{DS}$* | 0.882g | 0.2(sec) |
| *Mapped Spectral Response at 1 sec. – $S_{D1}$* | * | 1.0(sec) |
| *Site Coefficient – $F_A$* | 1.0 | |
| *Site Coefficient – $F_V$* | * | |
| *Site Modified Spectral Response Acceleration, Short period – $S_{MS}$* | 1.324g | |
| *Site Modified Spectral Response Acceleration, Short period – $S_{M1}$* | * | |

Site Classification (2019 CBC, further defined in ASCE7-16 Chapter 20) = D Stiff Soil

* The actual method of seismic design should be determined by the Structural Engineer in accordance with Section 11.4.8 Site-Specific Ground Motion Procedures of the ASCE 7-16. Refer to Appendix E for the Design Maps Summary Report provided by the Structural Engineers Association of California and California's Office of Statewide Health Planning and Development website.

### 7.7 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 3/4". Differential settlement is anticipated to be on the order of 50% of the total settlement 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

Earthwork is expected to be minimal. Where earthwork is required to achieve design grades, the following procedures shall be implemented during site preparation. 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 thirty (30) inches below existing grade or the bottom of the proposed foundation, 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 bottom of the excavation shall be observed and approved by the Geotechnical Consultant.

Subsequent to approval of the resulting excavated surface by the Geotechnical Consultant, the resulting soil surface shall be scarified an additional twelve (12) inches, properly moisture conditioned or aerated to near optimum moisture content, and mechanically compacted to minimum **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 minimum **95% relative compaction** as determined by ASTM D 1557 test method. **Compaction shall be verified by testing.**

### 8.4 Fill Slope Construction and Stability for Infiltration Basins

Permanent cut slopes at infiltration basin locations may be constructed at a slope ratio not exceeding 4:1 (horizontal: vertical) or flatter. Cut slopes constructed as recommended are expected to be both surficial and grossly stable and anticipated to remain so under normal conditions.

The slopes should be planted with native vegetation 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.

### 8.5 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 minimum relative compaction of 90% **(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.

### 8.6 Native Soil Shrinkage

A shrinkage factor of ten to fifteen (10-15) 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% and may vary depending on contractor methods.

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

### 8.7 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.

### 8.8 Import Soil

Import soil must be free from organic material or deleterious substances. The project specifications shall require the contractor to contact the Geotechnical Consultant to review the proposed import soil for conformance with these recommendations at least two weeks prior to importing to the site.

Imported soil must be non-hazardous and derived from a single, consistent soil type conforming to the following criteria:

- 100% passing a 3-inch sieve
- 65% to 100% passing the #4 sieve
- 20 to 45% passing a #200 sieve

- Expansion index less than 20
- Liquid limit less than 35
- Plasticity index less than 12
- R-value greater than 28
- Low corrosion potential
    - Soluble Sulfates less than 1,500 ppm
    - Soluble Chlorides less than 150 ppm
    - Minimum Resistivity greater than 8,000 ohm-cm

### 8.9 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.

### 8.10 Foundations

Provided the recommendations contained in this report are implemented during design and construction, it is our opinion that at grade structures can be supported on shallow or mat foundations and drilled piers or driven piles.

The structural engineer should evaluate reinforcement, embedment depth based on the requirements for the structural loadings, shrinkage, and temperatures stresses.

### 8.11 Continuous and Isolated Spread Foundations

Continuous and isolated spread footings must have a minimum width of twelve (12) inches and eighteen (18) inches, respectively. The minimum depth of footing embedment is fifteen (15) inches. Continuous footing foundations may be design using a net allowable bearing pressure of 1,500 pounds per square foot (psf). Isolated spread footing foundations may be designed using a net allowable bearing pressure of 1,800 psf. The net allowable bearing pressure applies to the dead load plus live load (DL + LL) conditions; it may be increased by 1/3 for wind or seismic loads.

Total foundation settlements are expected to be less than one (1) inch and differential settlements between similarly loaded (DL + LL) and sized footings are anticipated to be less than one-half (0.5) inches.

### 8.12 Mat Foundations

We understand that the structures (inverter and switchgear equipment pads) may be supported on a concrete mat foundation. The mat foundation may be designed to impose a maximum allowable pressure of 1,500 pounds per square foot (psf) dead plus live loads. This value may be increased by one-third for transient loads such as seismic or wind. The concrete mat foundation should be at least twelve (12) inches thick and satisfy structural considerations.

Based on the results of our laboratory tests and analyses, total static settlements of the mat foundation under the allowable bearing pressure are expected to be approximately three-quarters (3/4) of an inch, and maximum differential settlements are expected to be about 50% of the total settlement.

### 8.13 Lateral Earth Pressures

Provided the Site is prepared as recommended above, the following earth pressure parameters for footings may be used for design purposes. The parameters shown in Table 2 below are for drained conditions of selected non-expansive engineered fill or undisturbed native soil.

**Table 2: Recommended Static Lateral Earth Pressures for Footings [F1]**

| Lateral Pressure Condition | Equivalent Fluid Density (pcf) Drained Condition |
|---|---|
| Active Pressure | 40 |
| At Rest Pressure | 56 |
| Passive Pressure | 300 |

The lateral earth pressures listed herein are obtained by the conventional equation for active, at rest, and passive conditions assuming level backfill and a bulk unit weight of 115 pcf for the Site soils. A coefficient of friction of 0.30 may be used between soil sub-grade and the bottom of footings.

The coefficient of friction and passive earth pressure values given above represent ultimate soil strength values. Geotechnical Consultant recommends that a safety factor consistent with the design conditions be included in their usage in accordance with Sections 1806.3.1 through 18106.3.3 of the 2019 CBC. For stability against lateral sliding that is resisted solely by the passive earth pressure against footings or friction along the bottom of footings, appropriate safety factor should be applied by the structural engineer.

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 1.2 is recommended.

## 8.14 Footing Reinforcement

Reinforcement for cast-in-place foundations 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. Foundations should be reinforced as required by the structural engineer.

## 8.15 Driven H-Pile Foundations

The structure may be supported on pole-type foundations such as driven H-piles or drilled piers. This type of foundation should be designed in accordance with Section 1807.3 of the 2019 CBC.

The project engineer designer may use 131 psf downward allowable skin friction values to determine the required embedment depth for a given pile section. An upward allowable skin friction of 65 psf may be used. The upper one (1) foot of the soil should be omitted when calculating the minimum embedment depth. The skin friction value may change subject to review of results of field pile load testing report, which will be submitted under separate cover upon completion.

H-pile foundations should be spaced a minimum of three (3) diameters apart. The total settlement of pile foundations designed in accordance with these recommendations should not exceed one-half inch.

A minimum of 1% of installed H-piles should be tested during construction.

## 8.16 Soil Interaction Analysis (L-Pile)

L-Pile is a program that allows the foundation designer to model and evaluate the soil conditions encountered during lateral load pile testing. The solution provided by the program describes the behavior of a beam-column with non-linear support.

The program correlates laboratory data such as effective weight of the soil, cohesion and friction angle for different boring depths, and the designer can use a p-modifier to more closely model the soil response to applied loads based on rebound deflections observed in the field during lateral pile testing.

The table below show preliminary input parameters which are provided for the structural engineer to use in their L-Pile analysis. These values include a safety factor of 1.5 for the lateral load capacity of the pile, and as further discussed in section Chapter 18 of the 2018 IBC. The analysis did not include scour or corrosion, however, when performing the L-Pile analysis, the Structural Engineer should consider the pile section properties and include safety factors in relation to scour and corrosion as deemed appropriate, based on the PV system design life. The following preliminary soil parameters may be used in the analysis (*subject to change based upon review of the results of field pile load testing report, which will be submitted under separate cover upon completion*):

| Table 1: L-Pile Input Parameters | |
|---|---|
| p-y curve model | Sand (Reese) |
| Effective Unit Weight | 111 pcf |
| Elastic Subgrade Reaction, K | Default |
| Angle of friction | 29 degrees |
| p-modifier* | 1.3 |

* Modification factor from the ground surface to the top of pile, assuming top of pile is 4 ft. above grade.

## 9.0 CORROSION AND CHEMICAL ATTACK

Three (3) sub-surface bulk soil samples obtained from the Site were tested to provide a preliminary screening of the potential for concrete deterioration or steel corrosion due to attack by soil-borne soluble salts. The test results are presented below in Table 3. The soil was evaluated for minimum resistivity (ASTM 643), sulfate ion concentration (CT 417), chloride ion concentration (CT 422), and pH of soil (ASTM D 4972).

**Table 3: Summary of Corrosion Test Results**

| Sample Location | pH | Sulfate, mg/km | Chloride, mg/km | Minimum Resistivity, ohm-cm |
|---|---|---|---|---|
| B-3 @ 0-5 feet bgs | 8.0 | 145 | 116 | 1,240 |
| B-5 @ 0-5 feet bgs | 7.9 | 69 | 43 | 1,720 |
| B-10 @ 0-5 feet bgs | 8.2 | 82 | 53 | 1,640 |

The water-soluble sulfate content severity class is considered negligible to concrete (Exposure Category S2 per Table 4.2.1 of ACI 318-11); therefore, Type II cement should be used. Representative samples of the Site soil in the vicinity have a minimum resistivity ranging from 1,200 to 1,600 ohm-cm. Buried metal conduits, ferrous metal pipes, and exposed steel should have a protective coating in accordance with the manufacturer's specification. Refer to the Soil Corrosivity Study by HDR in Appendix C.

Corrosivity results should be provided to design team members for their interpretation of results relative to their specific area of design and incorporated accordingly as deemed necessary.

## 10.0 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%. Trench backfill materials should be placed in lifts no greater than approximately eight (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%. A representative of the project geotechnical consultant shall test the backfill to verify adequate compaction.

### 10.1 Excavation Stability

Soils encountered within the depth explored are generally classified as Type C soils in accordance with OSHA (Occupational Safety and Health Administration). The slopes surrounding or along temporary excavations may be vertical for excavations that are less than five feet deep and exhibit no indication of potential caving but should be no steeper than 1.5 H:1V for excavations that are deeper than five (5) feet, up to a maximum depth of fifteen (15) feet. Certified trench shields or boxes may also be used to protect workers during construction in excavations that have vertical sidewalls and are greater than 5 feet deep.

Temporary excavations for the project construction should be left open for as short a time as possible and should be protected from water runoff. In addition, equipment and/or soil stockpiles must be maintained at least ten (10) feet away from the top of the excavations.

Because of variability in soils, Geotechnical Consultant must be afforded the opportunity to observe and document sloping and shoring conditions at the time of construction. Slope height, slope inclination, and excavation depth (including utility trench excavations) must in no case exceed those specified in local, state, or federal safety regulations, (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations).

## 11.0 PRELIMINARY STRUCTURAL SECTION (FLEXIBLE PAVEMENT ENTRANCE)

Asphalt concrete pavements shall be designed per the Caltrans Highway Design Manual based on R-Value and Traffic Index. An R-value of the native soil of 54 was utilized for the preliminary structural pavement section. During grading as soils are mixed, soil samples should be tested for R-Value determination.

For budgetary purposes, the preliminary flexible pavement layer thickness is as follows:

**Table 4: Recommended Asphalt Pavement Section Layer Thickness**

| Pavement Material | Recommended Thickness (TI = 8.0) |
|---|---|
| Asphalt Concrete | 5 |
| Class II Aggregate Base | 8 |
| Compacted Subgrade Soils | 24 |

Asphalt concrete should conform to Sections 203 and 302 of the latest edition of the Standard Specifications for Public Works Construction (“Greenbook”).

Class II aggregate base should conform to Section 26 of the Caltrans Standard Specifications, latest edition. The aggregate base should be compacted to at least 95% of the maximum dry density as determined by ASTM Method D 1557.

Soil samples of the exposed subgrade at entrance approaches and areas requiring flexible pavements should be obtained during construction for R-value determination and final structural section calculations. Structural pavement sections are subject to review approval of the governing agency.

## 12.0 CONSTRUCTION CONSIDERATIONS

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

### 12.1 Temporary Shoring

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

### 12.2 Drainage Considerations

Bruin GSI understands the proposed project incorporates the construction of shallow basins for the purposes of infiltrating runoff water. The control surface drainage in the project areas is an important design consideration. Site drainage is the responsibility of the project civil engineer. Bruin GSI recommends that final grading around shallow foundations must provide for positive and enduring drainage away from the structures, and ponding of water must not be allowed around, or near the shallow foundations, with the exception of piles erected within designated infiltration basin areas. Ground surface profiles next to the shallow foundations other than pile foundations must have at least a 2% gradient away from the structures.

Appropriate drainage considerations should be incorporated into the project design relative to all existing and proposed drainage courses by the project civil engineer. Drainage velocity reducers, swales, riprap, etc. should be implemented as determined by the project civil engineer as deemed necessary to prevent erosion and scouring.

No water should be allowed to flow over fill slopes. A berm should be constructed at the top of the fill slope to divert drainage run-off to an approved area.
Vegetation is an important factor in minimizing erosion due to sheet flow and should be planted as soon as possible. Native indigenous plants should be used to assure sustainability of vegetation during the lifetime of the project.

## 13.0 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.

## 14.0 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, Sustainable Power

Group 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.

## 15.0 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.

## 16.0 REFERENCES

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## APPENDIX A

## Boring Logs and Classification Key

| | | | |
|---|---|---|---|
| Date(s) drilled | 11/18/2020 | LOG OF BORING 1<br>Page 1 of 1 | |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS/Bulk | Total Depth of Borehole | 20' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | ■ | SM | | Grey brown silty fine sand w/ medium sand & caliche<br>Medium dense, moist | 15-23 | 107.1 | 3.0 |
| 5' | | | | | | | |
| | ■ | SM/SP | | Brown slightly silty fine to medium sand w/ coarse sand<br>Medium dense, slightly moist | 9-15 | DIST | 8.9 |
| 10' | ■ | SP | | Brown slightly silty fine to medium sand w/ coarse sand<br>Medium dense, slightly moist | 12-16 | DIST | 1.2 |
| 15' | ■ | SM | | Moderate brown silty fine to coarse sand<br>Medium dense, moist | 13-19 | 109.4 | 3.5 |
| 20' | ■ | SM | | Moderate brown silty fine to coarse sand<br>Medium dense, moist | 12-18 | DIST | 4.2 |
| | | | | Boring terminated @ 20' bgs<br>No groundwater<br>No caving | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 2** | |
| Drilling Contractor | GP Drilling | **Page 1 of 1** | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS | Total Depth of Borehole | 9' bgs |
| Client: SPower | | | |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Project Number: 20-26 | | | |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Project Location: Lancaster, CA | | | |
| Hammer Data | 140#, 30" drop | | |

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | ■ | SM | | Grey brown silty fine sand w/ medium to coarse sand<br>Medium dense, moist | 9-18 | 104.2 | 6 |
| 5' | | | | | | | |
| | ■ | SM | | Grey brown silty fine to coarse sand & occ #4 gravel w/ caliche<br>Dense, moist | 12-19 | 110.8 | 5.4 |
| 10' | | | | | | | |
| | | | | Boring terminated @ 9' bgs<br>No groundwater<br>No caving | | | |
| 15' | | | | | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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# LOG OF BORING 3



| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | | |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | SPT | Total Depth of Borehole | 10' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | X | SM | | Moderate brown silty fine to coarse sand w/ caliche (slightly cemented)<br>Dense, slightly moist | 14-28-28 | | 6.7 |
| 5' | | | | | | | |
| | X | SM/ML | | Moderate brown very silty fine to medium sand w/ coarse sand & clay binder<br>Dense, moist | 22-30-33 | | 8.3 |
| 10' | X | SM/ML | | Dense, moist | 20-19-26 | | 7.7 |
| 15' | | | | Boring terminated @ 10' bgs<br>No groundwater<br>No caving | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 4** | **Page 1 of 1** |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | SPT | Total Depth of Borehole | 10' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: SPower

Project Number: 20-26

Project Location: Lancaster, CA

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 5' | | SM | | Grey brown silty fine to medium sand w/ coarse sand<br>Medium dense, slightly moist | 5-6-7 | | 2.2 |
| | | SP | | Moderate brown fine to coarse sand w/ occ 3/8" gravel<br>Medium dense, slightly moist | 5-7-7 | | 1.1 |
| 10' | | SP | | Moderate brown fine to coarse sand w/ occ 3/8" gravel<br>Medium dense, slightly moist | 5-8-11 | | 4.1 |
| 15' | | | | Boring terminated @ 10' bgs<br>No groundwater<br>No caving | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

| | | |
|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 5** |
| Drilling Contractor | GP Drilling | **Page 1 of 1** |
| Drilling Method | Hollow Stem Auger | |
| Drill Rig Type | CME 75 | Logged By: DM |
| Drill Bit Size/Type | 8" | Checked By: MS |
| Sampling Method(s) | CSS/Bulk | Total Depth of Borehole: 10' bgs |
| Groundwater | None Encountered | Boring Location: See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: |
| Hammer Data | 140#, 30" drop | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | ■ | SM | | Greyish brown very silty fine to medium sand w/ occ coarse sand<br>Medium dense | 11-18 | DIST | 2.5 |
| 5' | ■ | SM | | Greyish brown very silty fine to medium sand w/ caliche (slightly cemented)<br>Medium dense, slightly moist | 19-32 | 108.0 | 4.2 |
| 10' | ■ | SM/ML | | Greyish brown very silty fine to medium sand w/ caliche (slightly cemented)<br>Medium dense, slightly moist | 13-26 | 103.1 | 5.0 |
| 15' | | | | Boring terminated @ 10' bgs<br>No groundwater<br>No caving | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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# LOG OF BORING 6



| | |
|---|---|
| Date(s) drilled | 11-18-2020 |
| Drilling Contractor | GP Drilling |
| Drilling Method | Hollow Stem Auger |
| Drill Rig Type | CME 75 |
| Drill Bit Size/Type | 8" |
| Sampling Method(s) | CSS |
| Groundwater | None Encountered |
| Borehole Backfill | Native/ Cuttings |
| Hammer Data | 140#, 30" drop |
| Logged By: | DM |
| Checked By: | MS |
| Total Depth of Borehole | 15' bgs |
| Boring Location: | See Figure 2 |
| Notes: | |
| Client: | SPower |
| Project Number: | 20-26 |
| Project Location: | Lancaster, CA |

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 5' | ■ | SM | | Moderate brown silty fine to coarse sand w/ #4 gravel & occ 1/2" gravel<br>Dense, moist | 19-26 | 121.8 | 1.7 |
| 10' | ■ | SP | | Moderate brown fine to medium sand w/ coarse sand & occ 3/8" gravel<br>Medium dense, slightly moist | 7-11 | 103.1 | 1.1 |
| 15' | ■ | SM | | Moderate brown silty fine to coarse sand w/ #4 gravel<br>Medium dense, moist | 10-13 | 109.1 | 2.3 |
| 20' | | | | Boring terminated @ 15' bgs<br>No groundwater<br>No caving | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 7** | **Page 1 of 1** |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS | Total Depth of Borehole | 9' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | ■ | SM | | Moderate brown silty fine to medium sand w/ occ #4-3/8" gravel<br>Dense, moist | 30-36 | 118.9 | 5.0 |
| 5' | ■ | SM/SP | | Brown fine to medium sand w/ coarse sand<br>Medium dense, slightly moist | 8-12 | 114.6 | 3.1 |
| | ■ | SP | | Brown fine to medium sand w/ coarse sand<br>Medium dense, moist | 11-12 | 113.6 | 4.7 |
| 10' | | | | | | | |
| | | | | Boring terminated @ 9' bgs<br>No groundwater<br>No caving | | | |
| 15' | | | | | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 8** | |
| Drilling Contractor | GP Drilling | Page 1 of 1 | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | SPT | Total Depth of Borehole | 8' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: **SPower**

Project Number: 20-26

Project Location: Lancaster, CA

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 5' | X | SM | | Greyish-brown very silty fine to medium sand w/ occ #4 gravel (slightly cemented)<br>Medium dense, moist | 18-26-23 | | 3.2 |
| | X | SM | | Moderate brown silty fine to medium sand w/ occ coarse sand (slightly cemented)<br>Medium dense, slightly moist | 9-11-11 | | 2.3 |
| 10' | | | | | | | |
| 15' | | | | Boring terminated @ 8' bgs<br>No groundwater<br>No caving | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

# LOG OF BORING 9



| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | | |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS | Total Depth of Borehole | 10' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

| | |
|---|---|
| Client: | SPower |
| Project Number: | 20-26 |
| Project Location: | Lancaster, CA |

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 5' | ■ | SM | | Greyish brown silty fine sand w/ medium to coarse sand & occ #4 gravel<br>Medium dense, moist | 14-18 | 113.4 | 2.4 |
| | ■ | SM/ML | | Moderate brown very silty fine to medium sand w/ coarse sand & slight caliche<br>Medium dense, slightly moist | 8-13 | 112.9 | 7.4 |
| 10' | | | | | | | |
| | | | | Boring terminated @ 10' bgs<br>No groundwater<br>No caving | | | |
| 15' | | | | | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

| | | |
|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 10** |
| Drilling Contractor | GP Drilling | **Page 1 of 1** |
| Drilling Method | Hollow Stem Auger | |
| Drill Rig Type | CME 75 | Logged By: DM |
| Drill Bit Size/Type | 8" | Checked By: MS |
| Sampling Method(s) | SPT/Bulk | Total Depth of Borehole: 9' bgs |
| Groundwater | None Encountered | Boring Location: See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: |
| Hammer Data | 140#, 30" drop | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | | SM/ML | | Light brown very silty fine sand w/ medium sand & occ coarse sand<br>Medium dense, slightly moist | 11-17-25 | | 4.7 |
| 5' | | ML/SM | | Greyish brown fine sandy silt w/ occ medium to coarse sand & caliche<br>Medium firm, moist | 7-11-12 | | 3.3 |
| | | SM | | Greyish brown silty fine sand w/ medium to coarse sand & occ #4 gravel<br>Medium dense, moist | 8-12-16 | | 5.7 |
| 10' | | | | | | | |
| | | | | Boring terminated @ 9' bgs<br>No groundwater<br>No caving | | | |
| 15' | | | | | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

BRUIN GEOTECHNICAL SERVICES INC. est. 2004 ™

# LOG OF BORING 11



| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | | |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS | Total Depth of Borehole | 7' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | ■ | ML | | Grey fine sandy silt (cemented) w/ clay binder<br>Firm, moist | 11-12 | 106.9 | 7.9 |
| 5' | | | | | | | |
| | ■ | SM | | Greyish brown silty fine sand w/ occ medium to coarse sand<br>Medium dense, slightly moist | 9-12 | 99.1 | 2.8 |
| 10' | | | | | | | |
| | | | | Boring terminated @ 7' bgs<br>No groundwater<br>No caving | | | |
| 15' | | | | | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 12** | |
| Drilling Contractor | GP Drilling | **Page 1 of 1** | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | SPT | Total Depth of Borehole | 9' bgs |
| Client: SPower | Groundwater: None Encountered | Boring Location: | See Figure 2 |
| Project Number: 20-26 | Borehole Backfill: Native/ Cuttings | Notes: | |
| Project Location: Lancaster, CA | Hammer Data: 140#, 30" drop | | |

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | SPT | SM | | Brown silty fine to medium sand w/ coarse sand & occ #4 gravel<br>Medium dense, slightly moist | 7-11-16 | | 3.1 |
| 5' | | | | | | | |
| | SPT | SM/SP | | Moderate brown slightly silty fine to coarse sand w/ occ #4-3/8" gravel<br>Medium dense, slightly moist | 9-9-10 | | 4.1 |
| 10' | | | | | | | |
| 15' | | | | Boring terminated @ 9' bgs<br>No groundwater<br>No caving | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 13** | |
| Drilling Contractor | GP Drilling | **Page 1 of 1** | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS | Total Depth of Borehole | 15' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

| | |
|---|---|
| Client: | SPower |
| Project Number: | 20-26 |
| Project Location: | Lancaster, CA |

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| | ■ | ML/CL | | Pale brown fine sandy silt w/ clay binder (cemented)<br>Very firm, moist | 25-50/6" | 118.8 | 3.7 |
| 5' | | | | | | | |
| | ■ | SM | | Moderate brown slightly silty fine to medium sand w/ occ coarse sand<br>Medium dense, slightly moist | 9-16 | Dist. | 1.3 |
| | ■ | SM/SP | | Moderate brown slightly silty fine to medium sand w/ occ coarse sand<br>Medium dense, slightly moist | 10-14 | 105.8 | 2.6 |
| 10' | | | | | | | |
| 15' | ■ | SM | | Moderate brown silty fine to coarse sand<br>Medium dense, slightly moist | 12-19 | 108.3 | 3.2 |
| | | | | Boring terminated @ 15' bgs<br>No groundwater<br>No caving | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

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| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 14** | Page 1 of 1 |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | SPT | Total Depth of Borehole | 20' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: SPower

Project Number: 20-26

Project Location: Lancaster, CA

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 5' | | SM | | Moderate brown silty fine to medium sand w/ occ coarse sand (cemented) & caliche<br>Medium dense, moist | 7-7-8 | | 5.7 |
| 10' | | SM | | Greyish brown very silty fine to medium sand & occ #4 gravel<br>Medium dense, moist | 6-10-15 | | 8.8 |
| 15' | | SM | | Medium dense, moist | 8-12-20 | | 7.5 |
| 20' | | SM | | Medium dense, moist | 10-15-18 | | 7.2 |
| 25' | | | | Boring terminated @ 20' bgs<br>No groundwater<br>No caving | | | |
| 30' | | | | | | | |

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

| | | | |
|---|---|---|---|
| Date(s) drilled | 11-18-2020 | **LOG OF BORING 15** | **Page 1 of 1** |
| Drilling Contractor | GP Drilling | | |
| Drilling Method | Hollow Stem Auger | | |
| Drill Rig Type | CME 75 | Logged By: | DM |
| Drill Bit Size/Type | 8" | Checked By: | MS |
| Sampling Method(s) | CSS | Total Depth of Borehole | 8' bgs |
| Groundwater | None Encountered | Boring Location: | See Figure 2 |
| Borehole Backfill | Native/ Cuttings | Notes: | |
| Hammer Data | 140#, 30" drop | | |

Client: **SPower**

Project Number: **20-26**

Project Location: **Lancaster, CA**

| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 5' | ■ | SM | | Greyish brown silty fine to coarse sand w/ occ #4 gravel<br>Dense, moist | 15-26 | 113.5 | 5.7 |
| | ■ | SM/SP | | Yellowish brown slightly silty fine to medium sand w/ coarse sand & occ #4 gravel<br>Dense, slightly moist | 15-19 | 110.9 | 2.9 |
| 10' | | | | | | | |
| | | | | Boring terminated @ 8' bgs<br>No groundwater<br>No caving | | | |
| 15' | | | | | | | |
| 20' | | | | | | | |
| 25' | | | | | | | |
| 30' | | | | | | | |

## SOIL CLASSIFICATION KEY

| MAJOR DIVISIONS | | | SYMBOL | | TYPICAL NAMES |
|---|---|---|---|---|---|
| **Coarse Grained Soils** 50% or more larger than #200 sieve | **Gravels** More than half coarse-fraction is larger than No. 4 sieve size | Clean gravels with little or no fines | GW | | Well graded gravels, gravel-sand mixtures |
| | | | GP | | Poorly graded gravels, gravel-sand mixtures |
| | | Gravel with over 12% fines | GM | | Silty gravels, poorly graded gravel-sand-silt mixtures |
| | | | GC | | Clayey gravels, poorly graded gravel-sand-clay mixtures |
| | **Sands** More than half coarse-fraction is smaller than No. 4 sieve size | Clean sands with little or no fines | SW | | Well graded sands, gravelly sands |
| | | | SP | | Poorly graded sands, gravelly sands |
| | | Sands with over 12% fines | SM | | Silty sands, poorly graded sand-silt mixtures |
| | | | SC | | Clayey sands, poorly graded sand-clay mixtures |
| **Fine Grained Soils** 50% or more smaller than #200 sieve | **Silts and Clays** Liquid limit less than 50 | | ML | | Inorganic silts, rock flour, clayey silts |
| | | | CL | | Inorganic clays of low to medium plasticity, sandy clays, silty clays |
| | | | OL | | Organic clays and organic silty clays of low plasticity |
| | **Silts and Clays** Liquid limit greater than 50 | | MH | | Inorganic silts, micaceous or diatomaceous fine sandy/silty soils, elastic silts |
| | | | CH | | Inorganic clays with high plasticity, fat clays |
| | | | OH | | Organic clays of medium to high plasticity, organic silts |
| **Highly Organic Soils** | | | Pt | | Peat and other highly organic soils |

CLASSIFICATION SYSTEM BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM



44732 Yucca Avenue
Tel (661) 273-9078
Lancaster, California 93534
www.bruingsi.net

# Boring Log Key



| Depth | Sample | USCS | Graphic Log | Material Description | Penetration Resistance (Blows/6") | Dry Unit Weight pcf | Water Content % |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

**COLUMN DESCRIPTIONS**

| | | | |
|---|---|---|---|
| 1 | Depth in feet below the ground surface | 5 | Description of the material encountered. May include consistency, moisture, color, and other descriptors |
| 2 | Sampling Method see "symbols" below | 6 | Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval |
| 3 | USCS symbol | 7 | Dry weight per unit volume of soil sample measured in laboratory units in pounds per cubic foot |
| 4 | Graphic depiction of the subsurface material | 8 | Water content of the sample expressed as a percentage of the dry weight of the sample |

**ABBREVIATIONS**

| | | | | | |
|---|---|---|---|---|---|
| DIST | = | Disturbed Sample | N/A | = | Not Analyzed |
| N/R | = | No Recovery | | | |
| CHEM | = | Chemical Test | | | |

**SAMPLING METHOD SYMBOLS**

California Split Spoon (CSS)

Standard Penetration Test (SPT)

Bulk Sample

Grab Sample

**GENERAL NOTES**

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.

2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

# APPENDIX B

## Laboratory Test Results

# SUMMARY OF LABORATORY TEST RESULTS

**SIEVE ANALYSIS**

Percent passing individual sieves

| Sample I.D. | 1/2" | 3/8" | #4 | #10 | #40 | #100 | #200 |
|---|---|---|---|---|---|---|---|
| B10@3 | 100 | 100 | 100 | 99 | 98 | 83 | 62 |
| B2@4 | 100 | 96 | 94 | 86 | 80 | 72 | 61 |
| B8@4 | 100 | 98 | 98 | 98 | 97 | 80 | 52 |
| B12@4 | 100 | 100 | 100 | 99 | 97 | 73 | 50 |
| B7@6 | 100 | 100 | 100 | 95 | 87 | 57 | 27 |
| B4@7 | 100 | 100 | 99 | 96 | 83 | 24 | 5 |
| B13@7 | 100 | 100 | 100 | 98 | 89 | 44 | 15 |
| B6@8 | 100 | 100 | 99 | 98 | 91 | 38 | 5 |
| B10@9 | 100 | 100 | 100 | 99 | 95 | 73 | 50 |
| B1@10 | 100 | 100 | 100 | 99 | 95 | 29 | 9 |
| B14@10 | 100 | 100 | 99 | 98 | 95 | 79 | 60 |

# SUMMARY OF LABORATORY TEST RESULTS

## SAND EQUIVALENT

| Sample I.D. | Sand Equivalent |
|---|---|
| B10@6 | 19 |
| B3@7 | 6 |
| B6@8 | 27 |
| B15@8 | 20 |
| B13@9 | 17 |
| B5@10 | 6 |

## EXPANSION INDEX

| Sample | Expansion Index | Classification |
|---|---|---|
| B3@0-5’ | 0 | Non-Expansive |
| B5@0-5’ | 0 | Non-Expansive |
| B10@0-5’ | 0 | Non-Expansive |

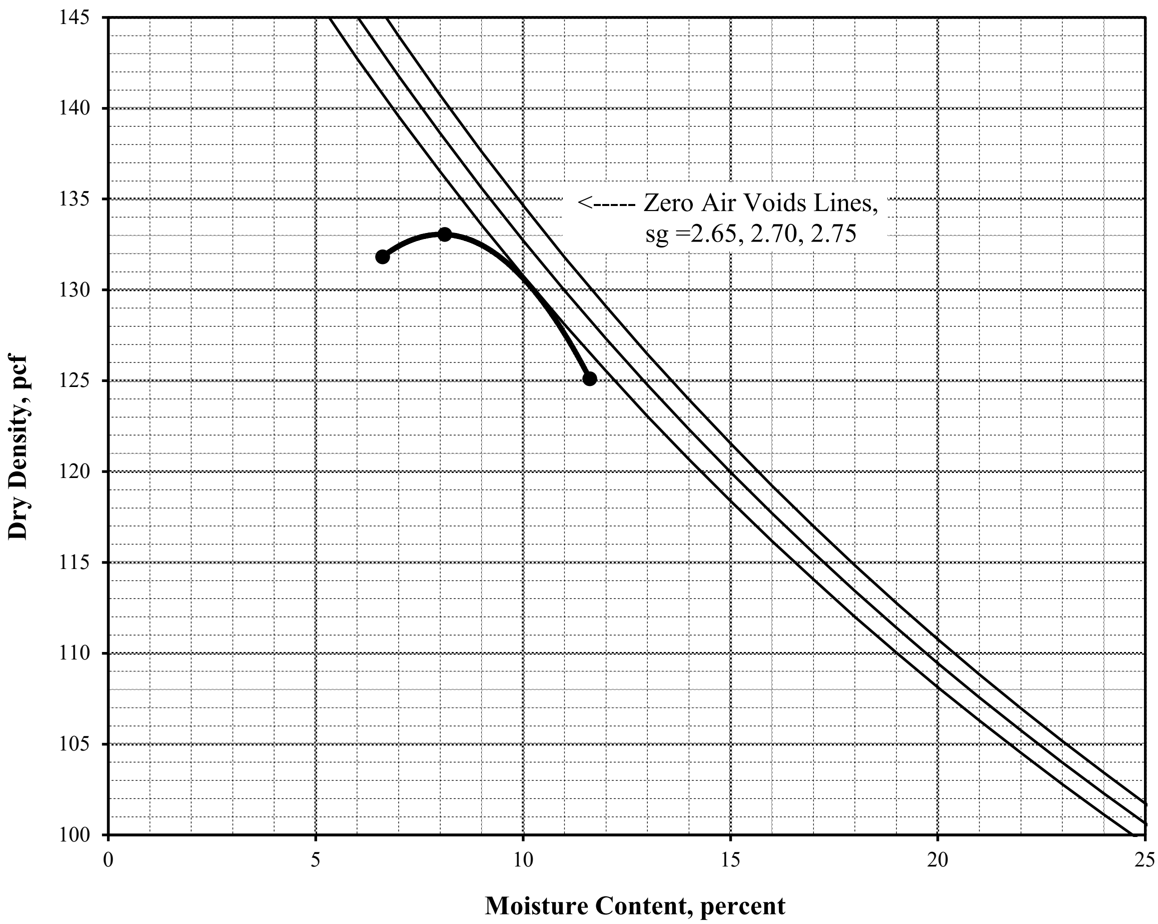
# Bruin Geotechnical Services Inc.

44732 Yucca Avenue
Lancaster, CA  93534
661-273-9078

## Maximum Density/Optimum Moisture Proctor ASTM D698/D1557

| | | |
|---|---|---|
| Project Number: | 20-26 | December 28, 2020 |
| Project Name: | Spower/Estrella | ASTM D-1557 C |
| Lab ID Number: | B3 bulk | Rammer Type: 10# |
| Sample Location: | B3 0'-5' | |
| Description: | Greyish brown silty fine to coarse sand w/occ # 4 gravel. | |

| | | Sieve Size | % Retained |
|---|---|---|---|
| **Maximum Density:** | **133 pcf** | 3/4" | |
| **Optimum Moisture:** | **8%** | 3/8" | |
| | | #4 | |



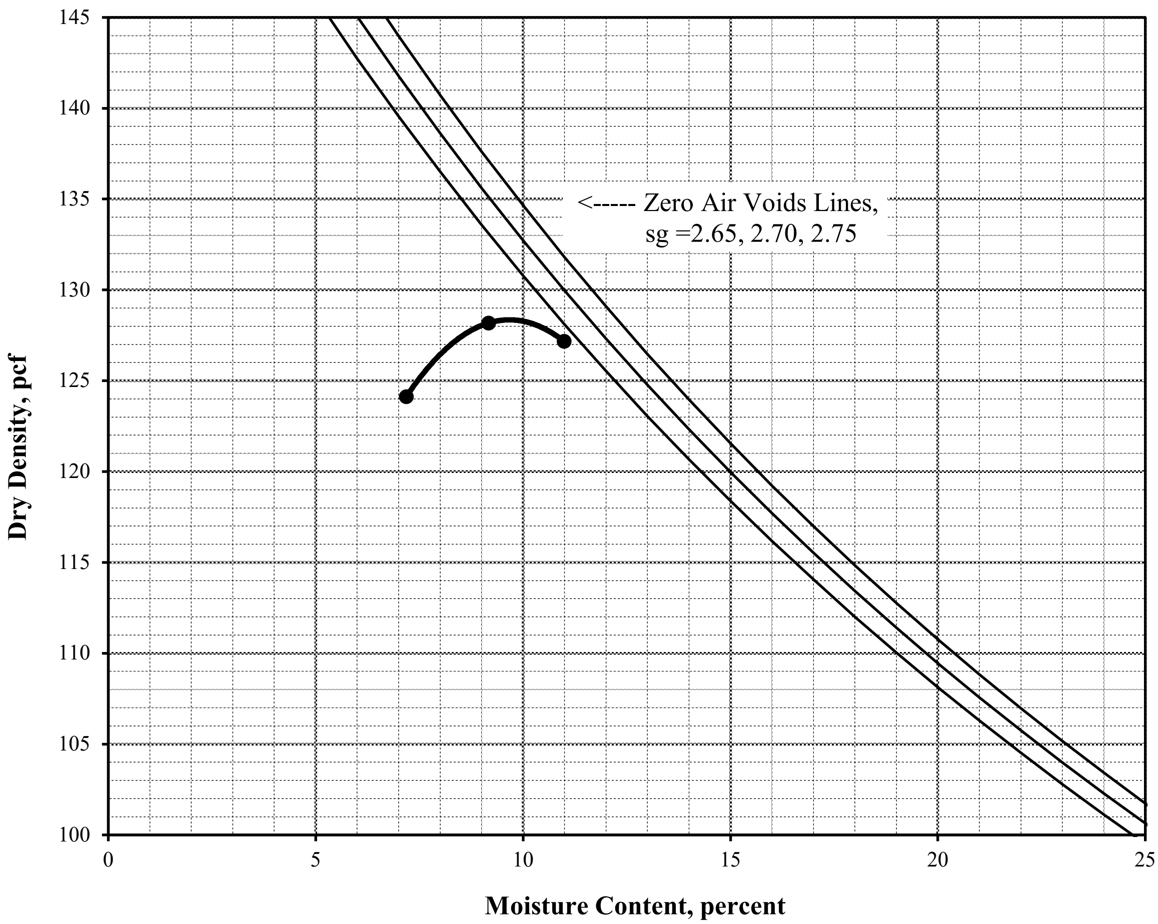
## Bruin Geotechnical Services Inc.

44732 Yucca Avenue
Lancaster, CA 93534
661-273-9078


### Maximum Density/Optimum Moisture Proctor ASTM D698/D1557

| | | |
|---|---|---|
| Project Number: | 20-26 | December 30, 2020 |
| Project Name: | Spower/Estrella | ASTM D-1557 C |
| Lab ID Number: | B5 bulk | Rammer Type: 10# |
| Sample Location: | B5 0'-5' | |
| Description: | Light yellowish brown very silty fine to coarse sand w/occ # 4 - 3/8" grvl. | |

| | | Sieve Size | % Retained |
|---|---|---|---|
| **Maximum Density:** | **128.5 pcf** | 3/4" | |
| **Optimum Moisture:** | **9.5%** | 3/8" | |
| | | #4 | |



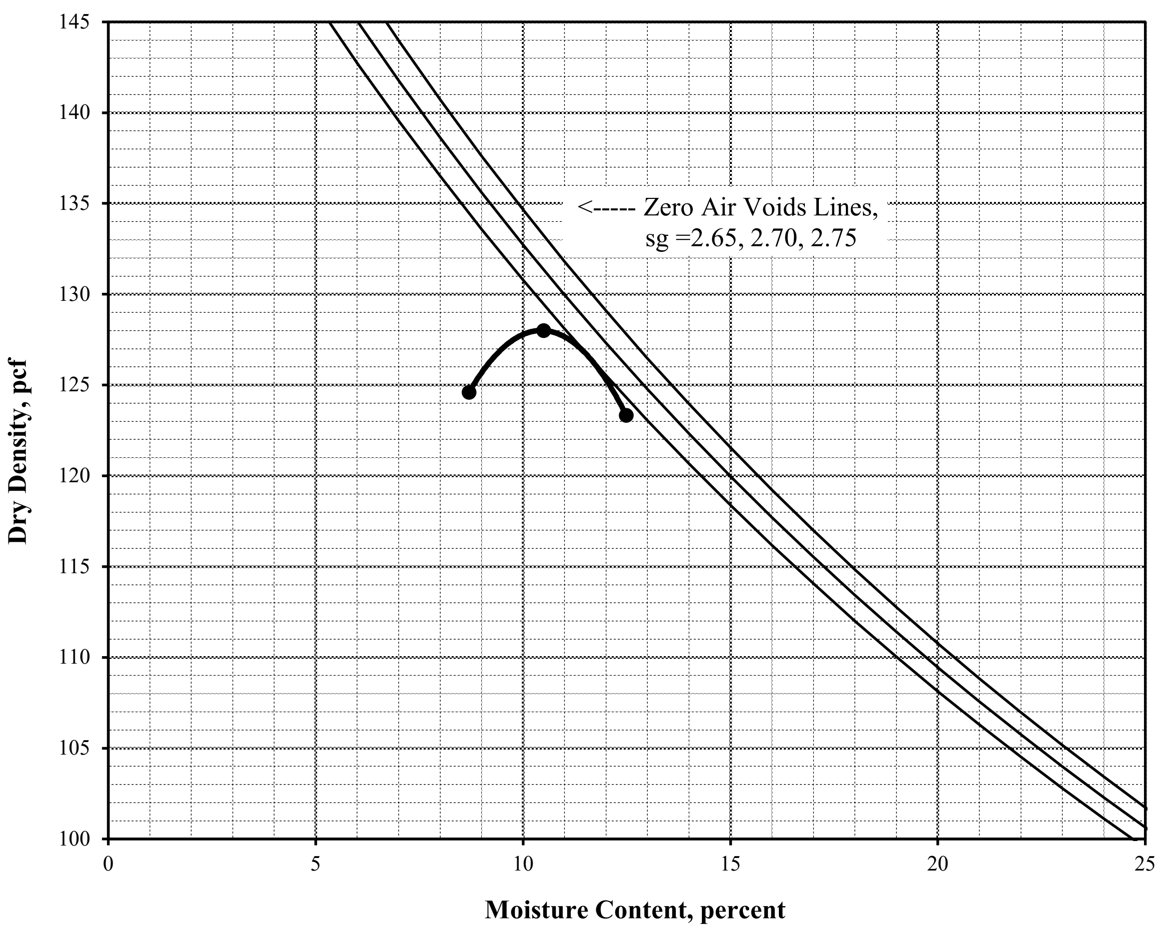
## Bruin Geotechnical Services Inc.

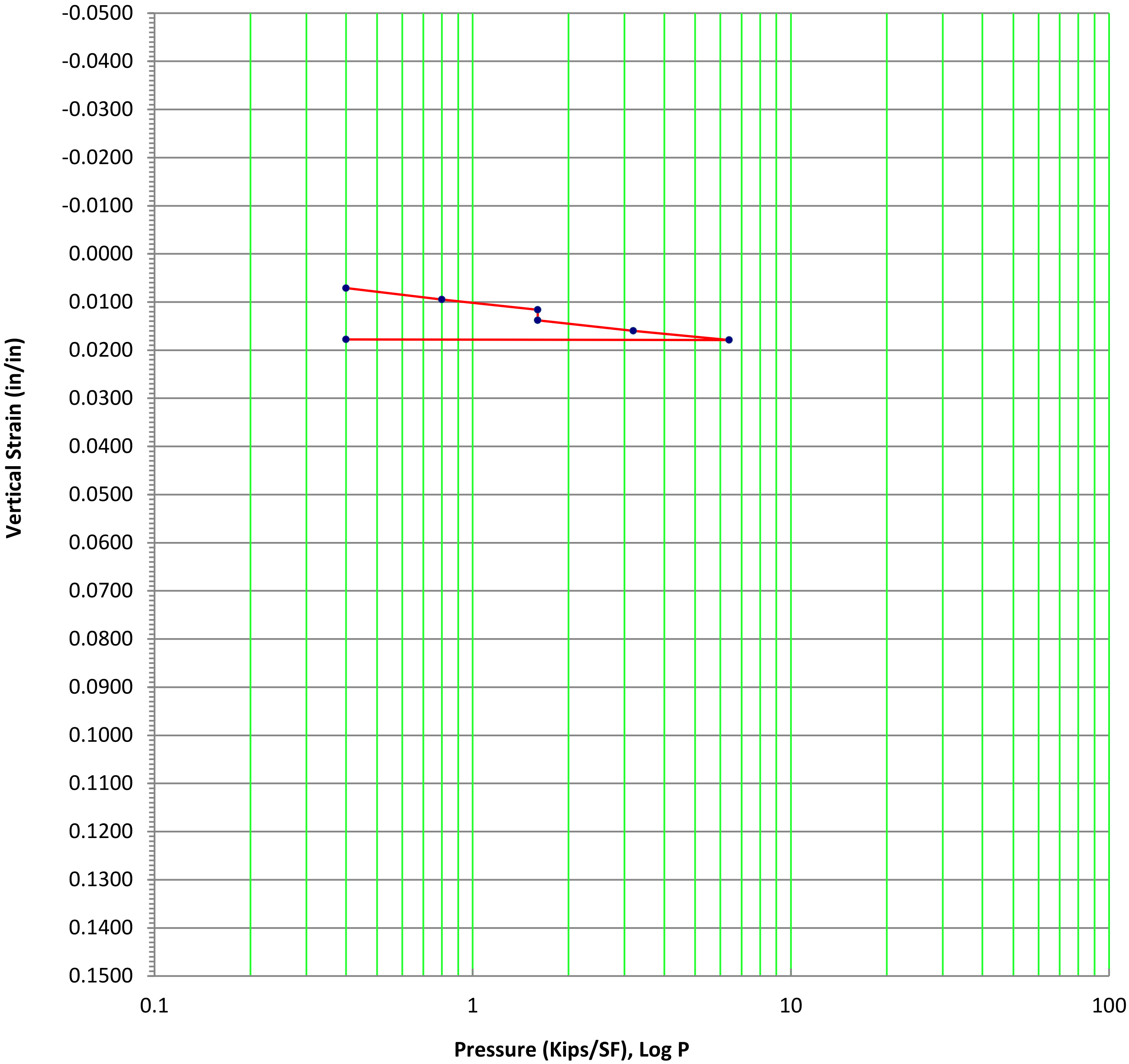
44732 Yucca Avenue
Lancaster, CA 93534
661-273-9078

### Maximum Density/Optimum Moisture Proctor ASTM D698/D1557

| | | |
|---|---|---|
| Project Number: | 20-26 | December 30, 2020 |
| Project Name: | Spower/Estrella | ASTM D-1557 C |
| Lab ID Number: | B10 bulk | Rammer Type: 10# |
| Sample Location: | B10 0'-5' | |
| Description: | Light yellowish brown very silty fine to coarse sand | |

| | | Sieve Size | % Retained |
|---|---|---|---|
| **Maximum Density:** | **128 pcf** | 3/4" | |
| **Optimum Moisture:** | **10.5%** | 3/8" | |
| | | #4 | |






| | | |
|---|---|---|
| Sample location: | B5@5' | |
| Material: | SM | |
| Initial Dry Density: | 108.0 | PCF |
| Moisture Content: | 4.2 | % |
| % Hydroconsolidation: | 0.2 | % |

* Test Method: ASTM D-2435

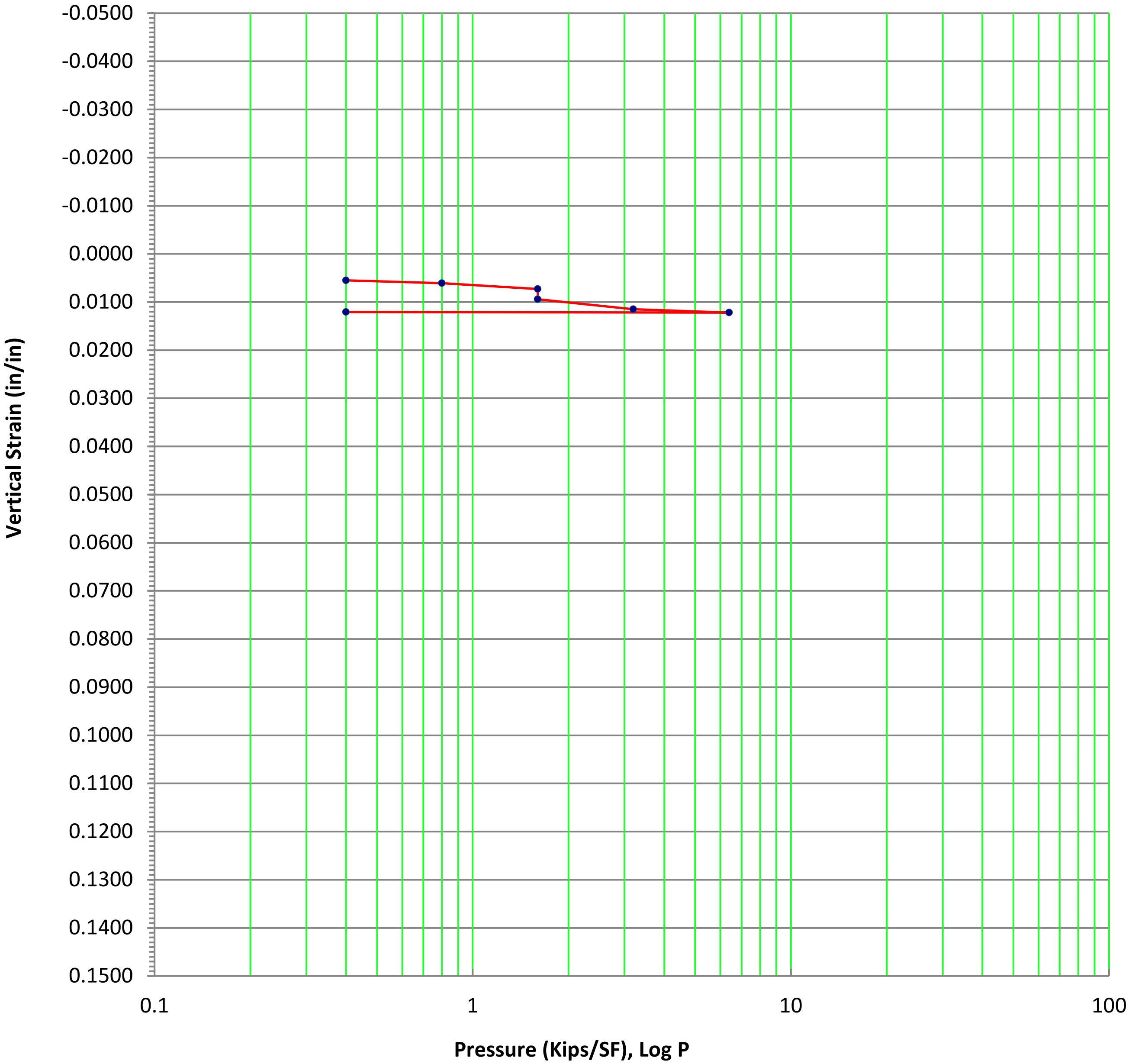
## Consolidation Test

**Spower - Estrella**

**Lancaster, CA**

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

| | |
|---|---|
| **1/10/2021** | **20-26** |




# Consolidation Test

**Spower - Estrella**

**Lancaster, CA**

| | | |
|---|---|---|
| Sample location: | B9@5' | |
| Material: | SM | |
| Initial Dry Density: | 113.4 | PCF |
| Moisture Content: | 2.4 | % |
| % Hydroconsolidation: | 0.2 | % |

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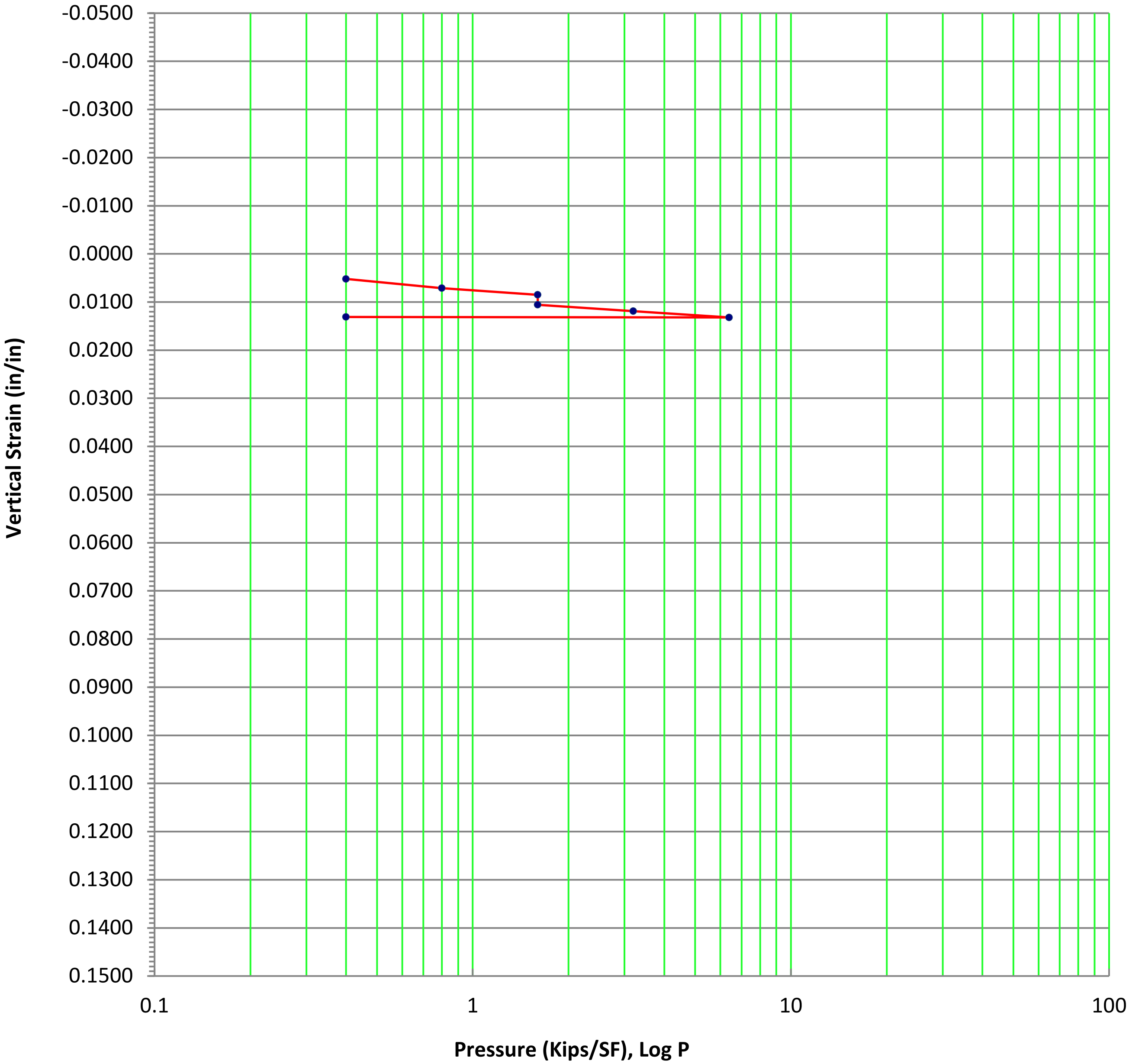
* Test Method: ASTM D-2435

| **1/10/2021** | **20-26** |
|---|---|




| | | |
|---|---|---|
| Sample location: | B6@8' | |
| Material: | SP | |
| Initial Dry Density: | 103.1 | PCF |
| Moisture Content: | 1.1 | % |
| % Hydroconsolidation: | 0.2 | % |

* Test Method: ASTM D-2435

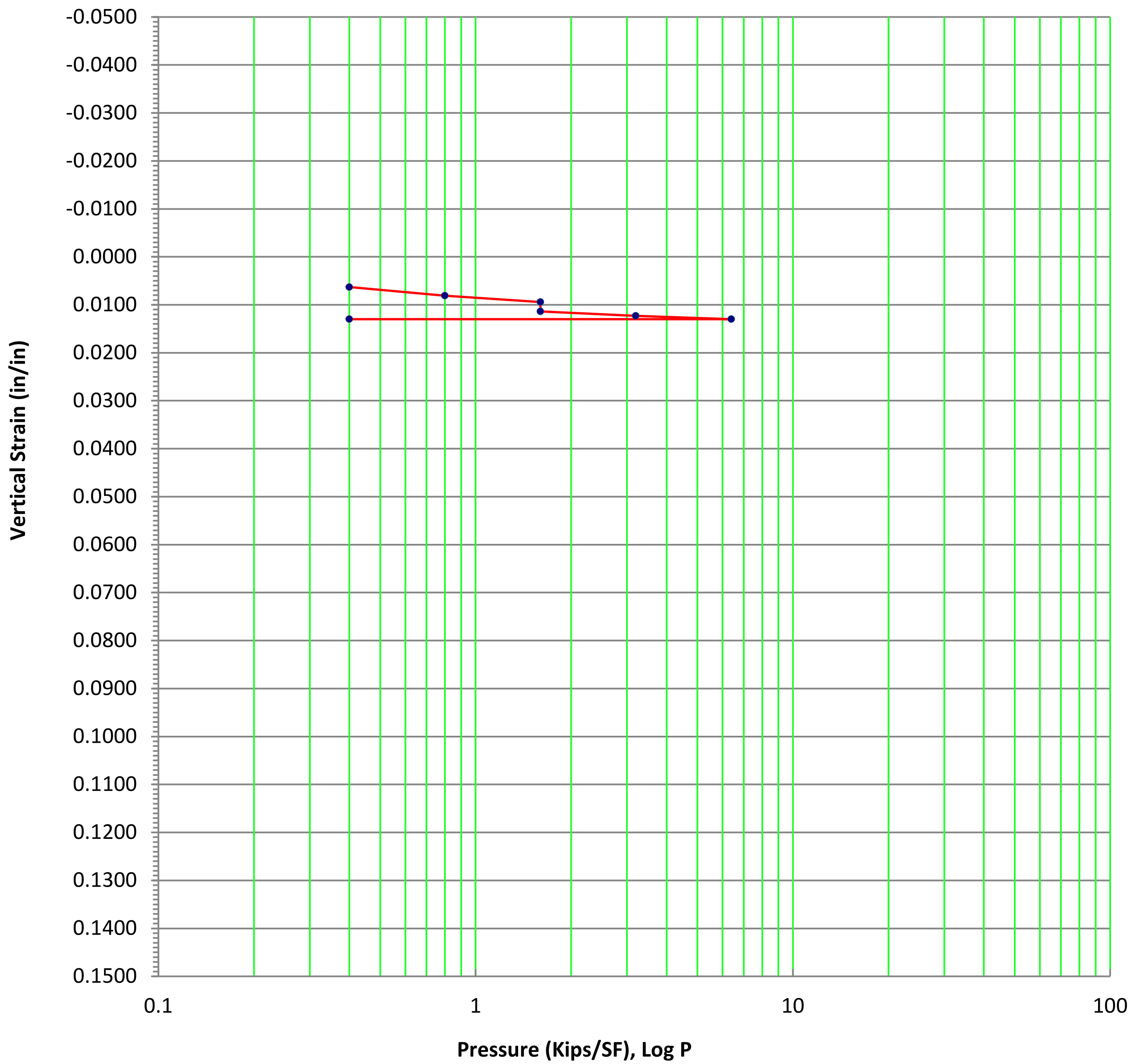
## Consolidation Test

**Spower - Estrella**

**Lancaster, CA**

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

| | |
|---|---|
| 1/10/2021 | 20-26 |




# Consolidation Test

## Spower - Estrella

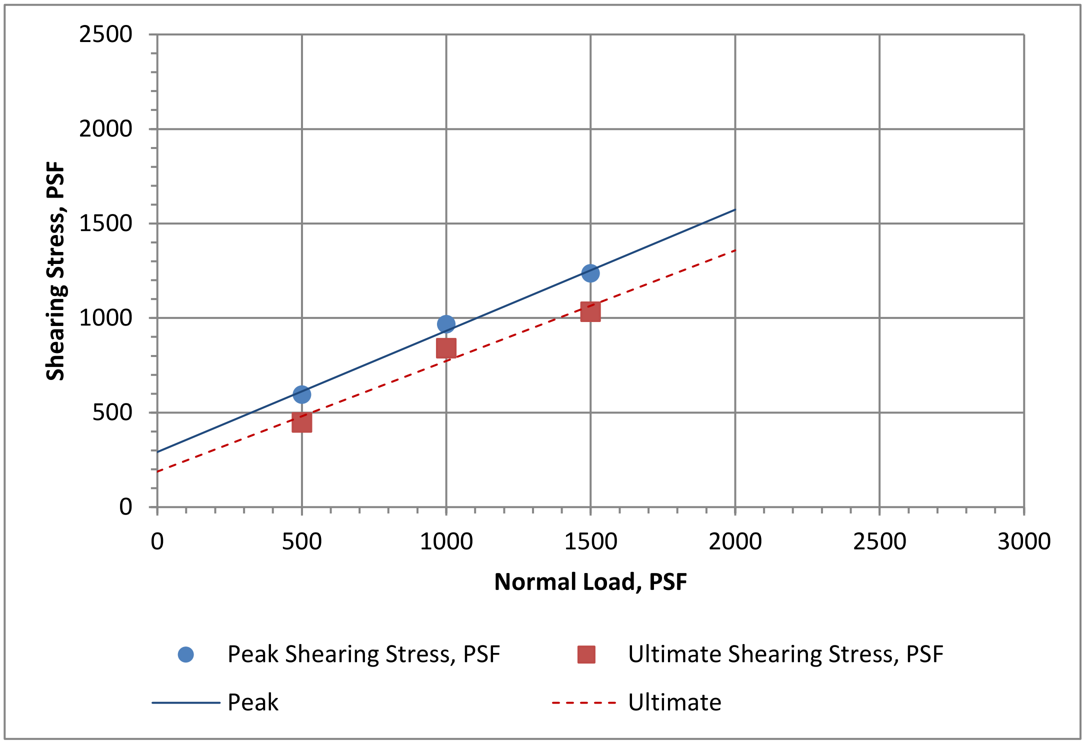
## Lancaster, CA

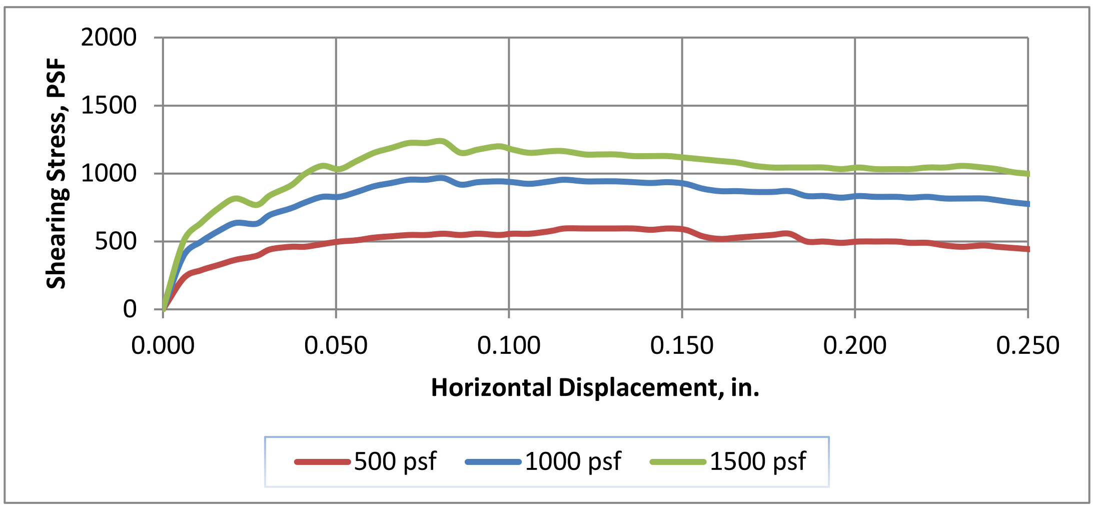
| | | |
|---|---|---|
| Sample location: | B13@9' | |
| Material: | SM/SP | |
| Initial Dry Density: | 105.8 | PCF |
| Moisture Content: | 2.6 | % |
| % Hydroconsolidation: | 0.2 | % |

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

* Test Method: ASTM D-2435

| 1/10/2021 | 20-26 |
|---|---|




**Sample Description:** Light brown very silty fien to medium sand w/occ coarse sand

**DIRECT SHEAR DATA (Per ASTM D-3080)**

| Sample ID | Symbol | Depth, feet | Dry Density, PCF | Average deg. of saturation |
|---|---|---|---|---|
| B5 | ● | 5 | 108 | 99 |
| | | | | |
| | | | Peak | Ultimate |
| Angle of friction, (degrees) | | | 33 | 30 |
| Cohesive Strength (PSF) | | | 292 | 188 |

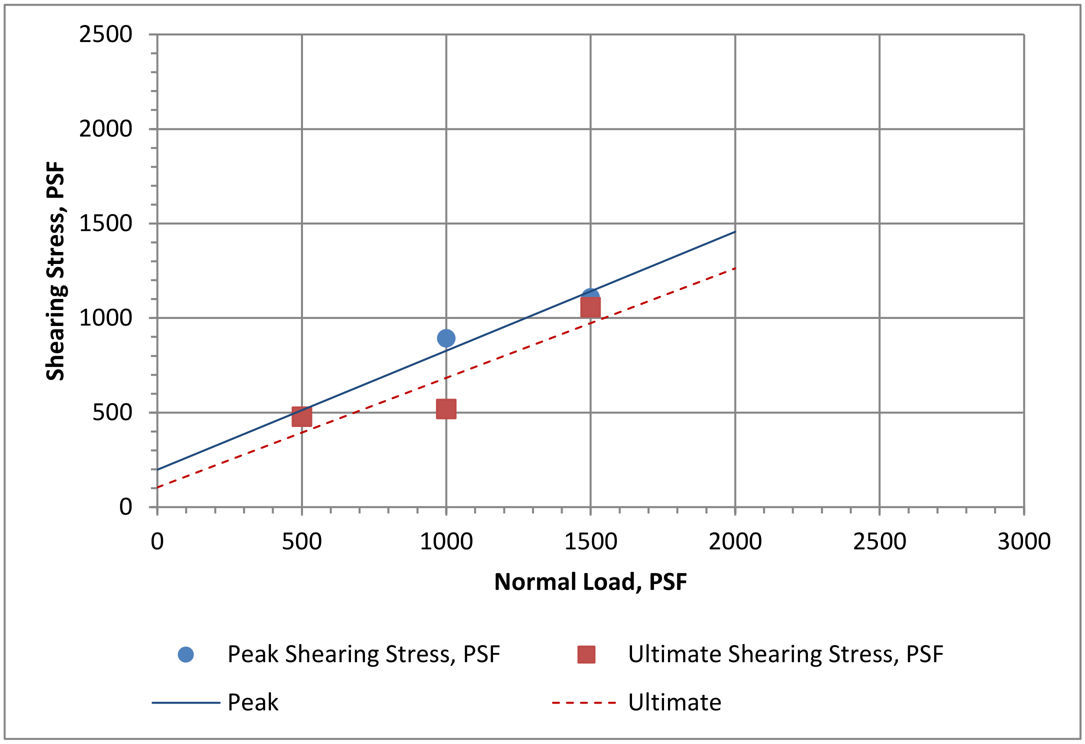
**Direct Shear Test**

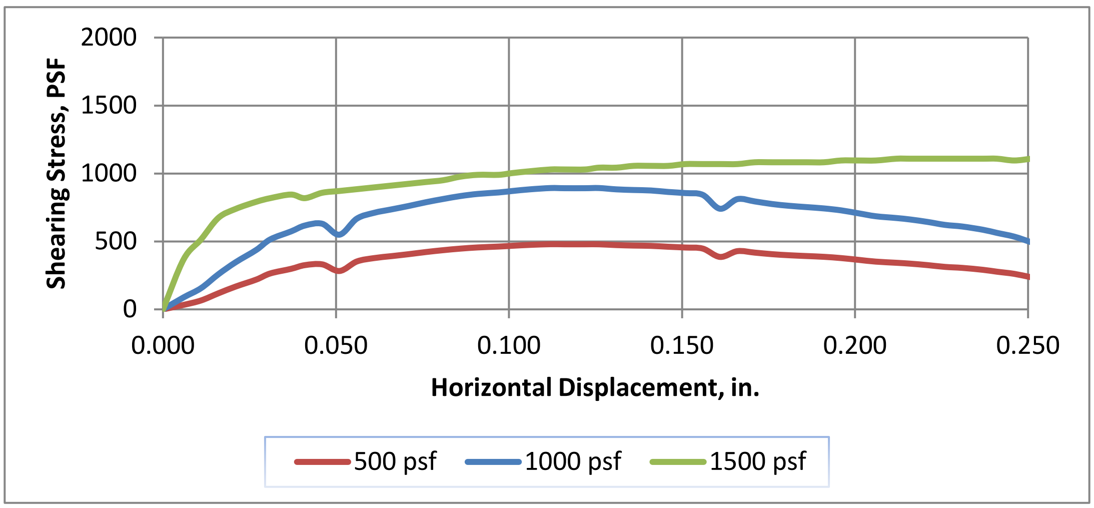
**SPower - Estrella**

**Lancaster, CA**

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

**1/12/2021** | **20-26**




**Sample Description:** Brown silty fine to medium sand w/ coarse sand

**DIRECT SHEAR DATA (Per ASTM D-3080)**

| Sample ID | Symbol | Depth, feet | Dry Density, PCF | Average deg. of saturation |
|---|---|---|---|---|
| B7 | ● | 6 | 113 | 97 |
| | | | | |
| | | | Peak | Ultimate |
| Angle of friction, (degrees) | | | 32 | 30 |
| Cohesive Strength (PSF) | | | 490 | 104 |

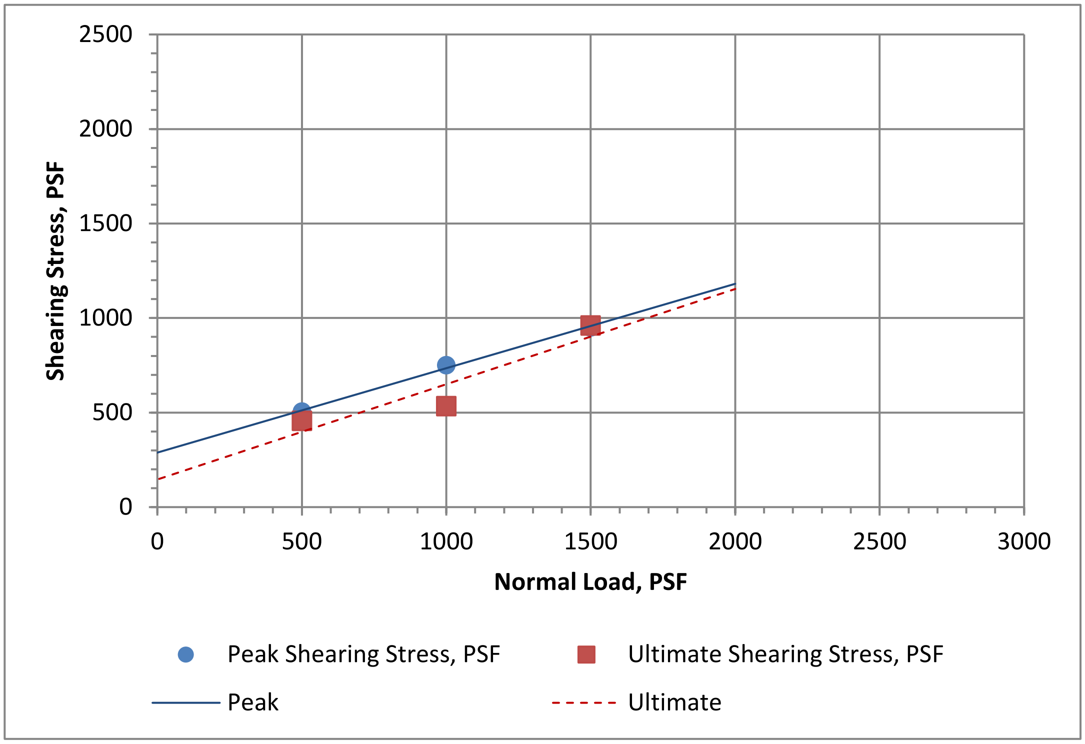
# Direct Shear Test

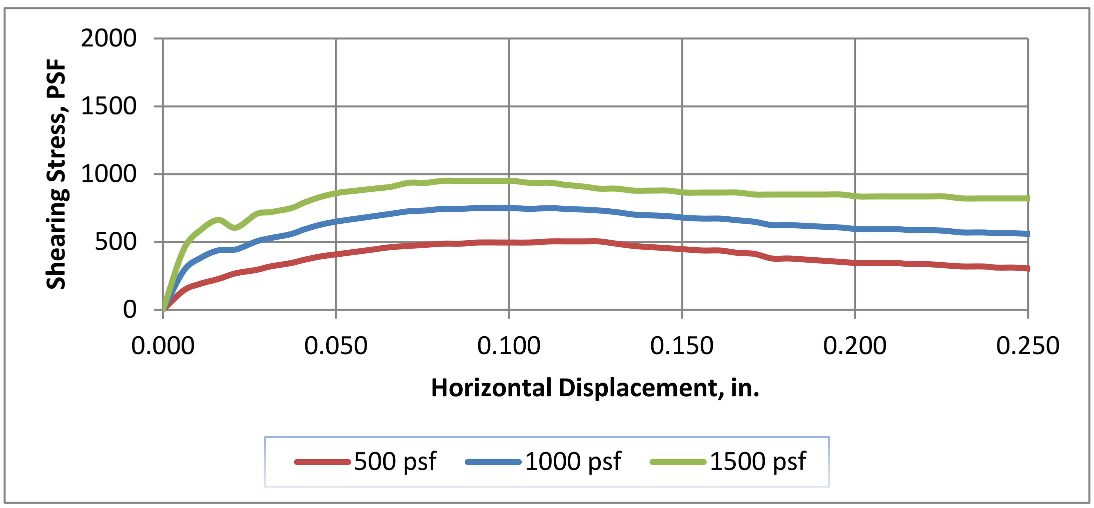
**SPower - Estrella**

**Lancaster, CA**

BRUIN
GEOTECHNICAL SERVICES INC.
est. 2004

| | |
|---|---|
| **1/12/2021** | **20-26** |




**Sample Description:** Greyish brown very silty fine sand w/occ medium to coarse sand 3/8" gravel

**DIRECT SHEAR DATA (Per ASTM D-3080)**

| Sample ID | Symbol | Depth, feet | Dry Density, PCF | Average deg. of saturation |
|---|---|---|---|---|
| B9 | ● | 8 | 113 | 99 |
| | | | Peak | Ultimate |
| Angle of friction, (degrees) | | | 24 | 27 |
| Cohesive Strength (PSF) | | | 342 | 146 |

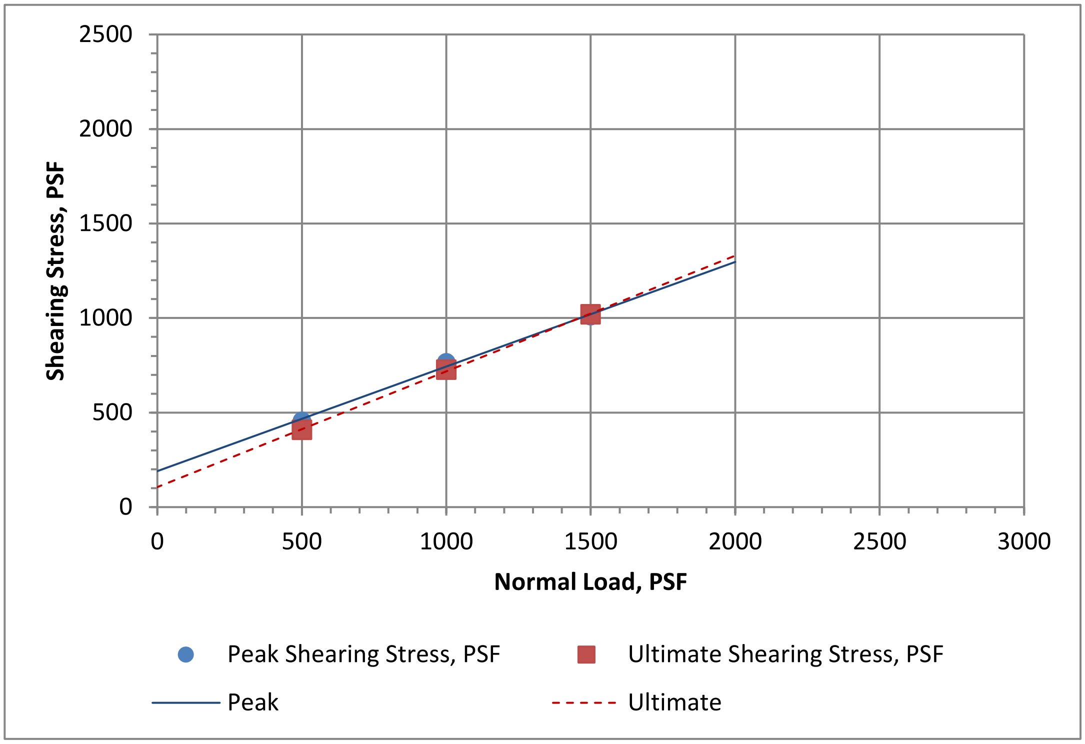
## Direct Shear Test

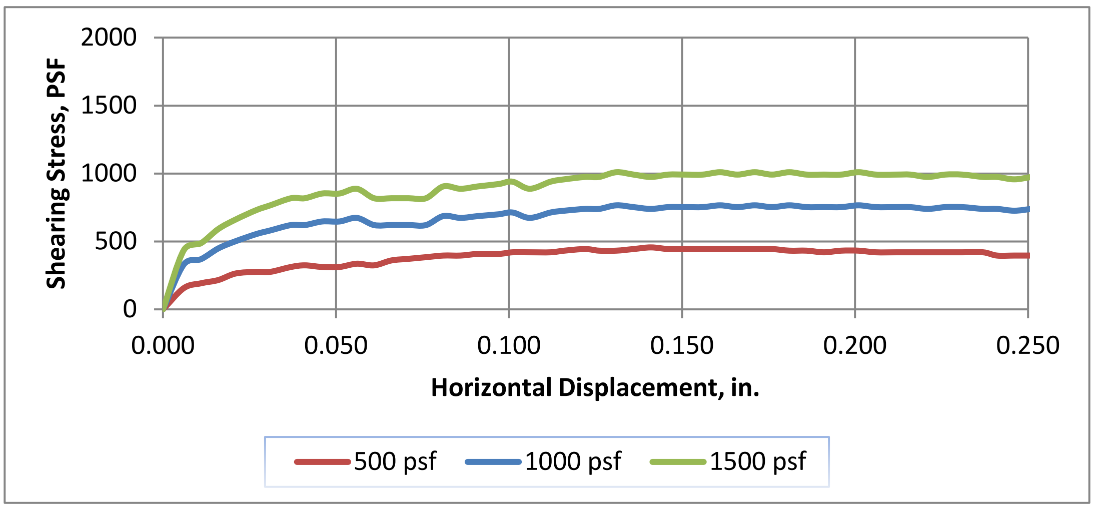
**SPower - Estrella**

**Lancaster, CA**

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

| | |
|---|---|
| **1/15/2021** | **20-26** |




**Sample Description:** Brown very silty fine to medium sand w/occ # 4 gravel

**DIRECT SHEAR DATA (Per ASTM D-3080)**

| Sample ID | Symbol | Depth, feet | Dry Density, PCF | Average deg. of saturation |
|---|---|---|---|---|
| B11 | ● | 7 | 135 | 91 |
| | | | | |
| | | | Peak | Ultimate |
| Angle of friction, (degrees) | | | 29 | 31 |
| Cohesive Strength (PSF) | | | 190 | 106 |

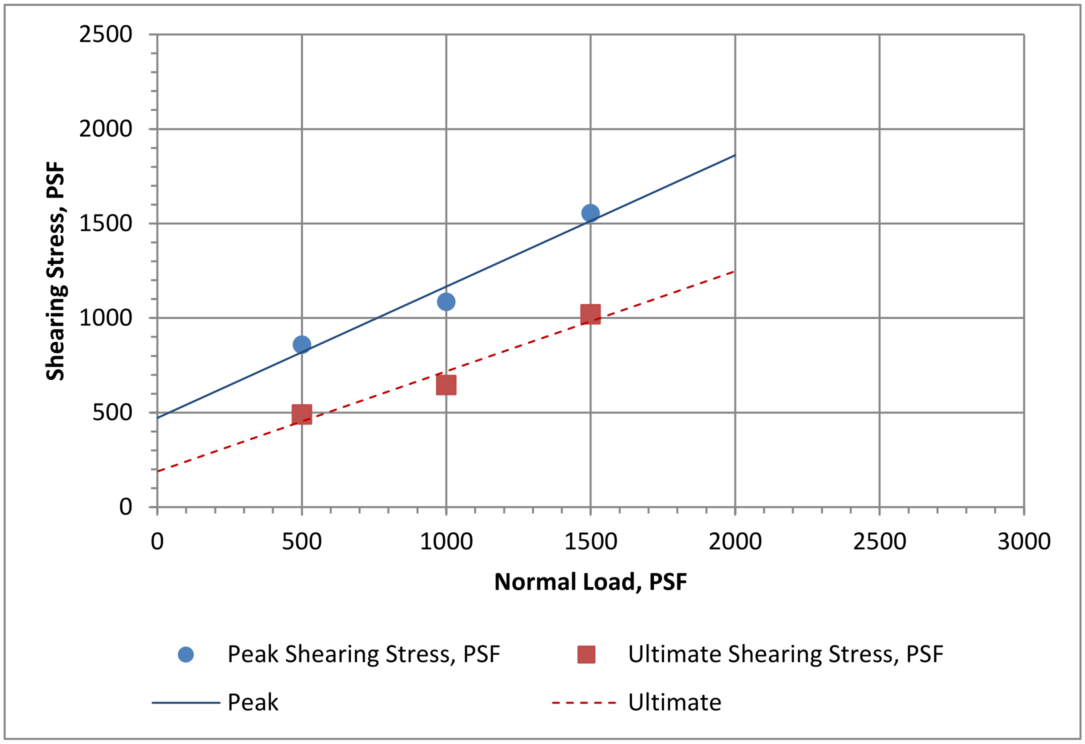
## Direct Shear Test

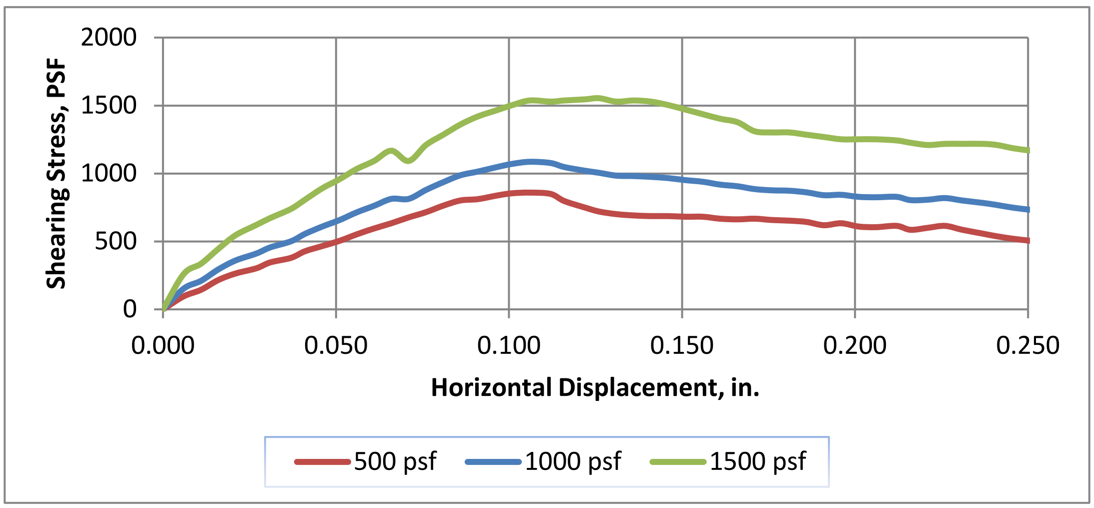
**SPower - Estrella**

**Lancaster, CA**

BRUIN GEOTECHNICAL SERVICES INC. est. 2004

| | |
|---|---|
| **1/15/2021** | **20-26** |




**Sample Description:** Light greyish brown very silty fine to medium sand w/ coarse sand

**DIRECT SHEAR DATA (Per ASTM D-3080)**

| Sample ID | Symbol | Depth, feet | Dry Density, PCF | Average deg. of saturation |
|---|---|---|---|---|
| B13 | ● | 3 | 119 | 95 |
| | | | Peak | Ultimate |
| Angle of friction, (degrees) | | | 35 | 28 |
| Cohesive Strength (PSF) | | | 472 | 188 |

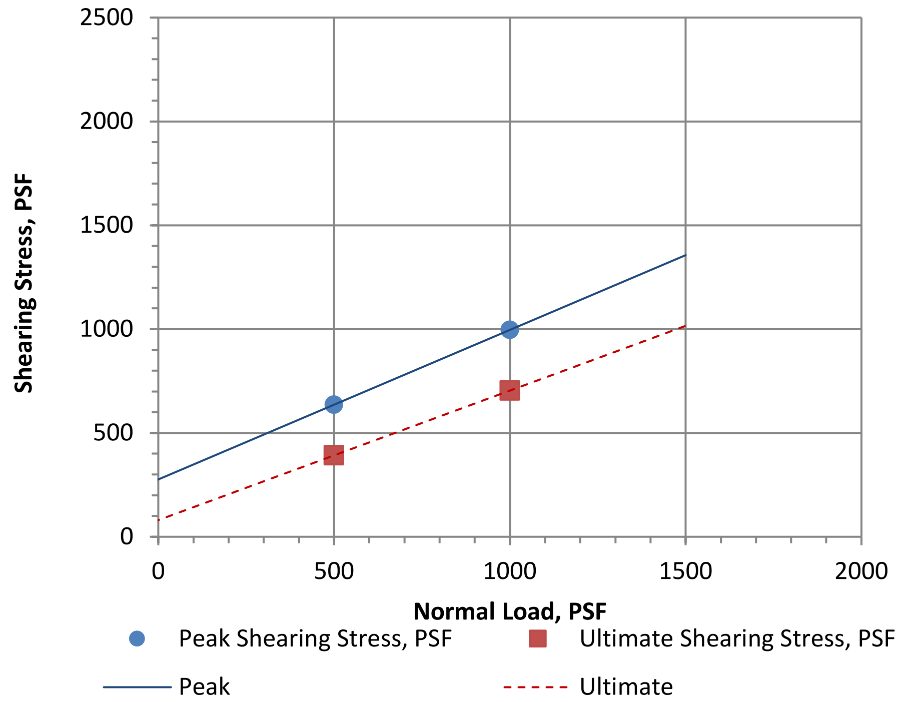
# Direct Shear Test

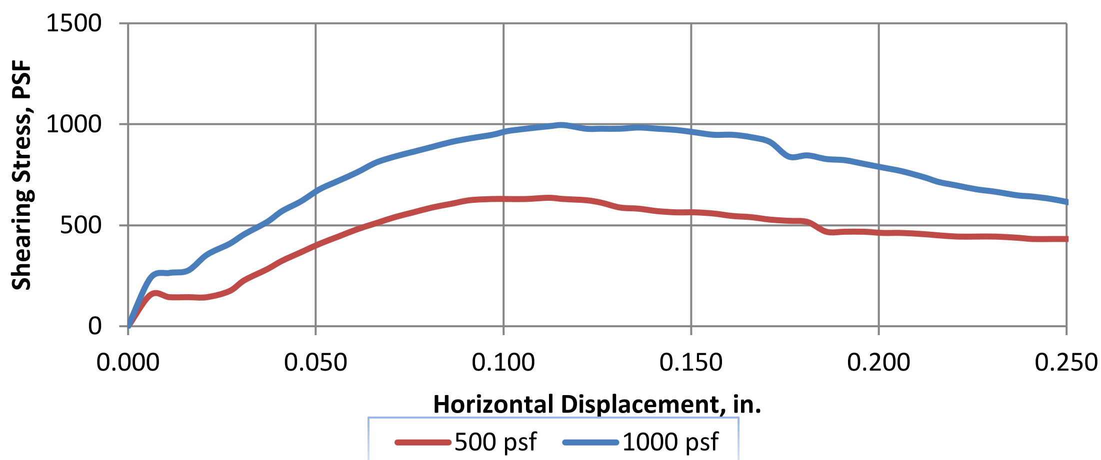
**SPower - Estrella**

**Lancaster, CA**

BRUIN GEOTECHNICAL SERVICES INC.

**1/12/2021** | **20-26**




Soil Classifcation: SM

Soil Description: Greyish brown fine to coarse sand w/occ # 4 gravel

**SHEAR DATA**

| Sample ID | Symbol | Depth, feet | Dry Density, PCF * | Average deg. of saturation % |
|---|---|---|---|---|
| B3 Bulk | ● | 0 | 120 | 100 |

* Sample remolded to 90% relative compaction as determined by ASTM D-1557 Test Method

| | Peak | Ultimate |
|---|---|---|
| Angle of friction, (degrees) | 36 | 32 |
| Cohesive Strength (PSF) | 276 | 104 |

## Direct Shear Test

**SPower - Estrella**

**Lancaster, CA**

BRUIN

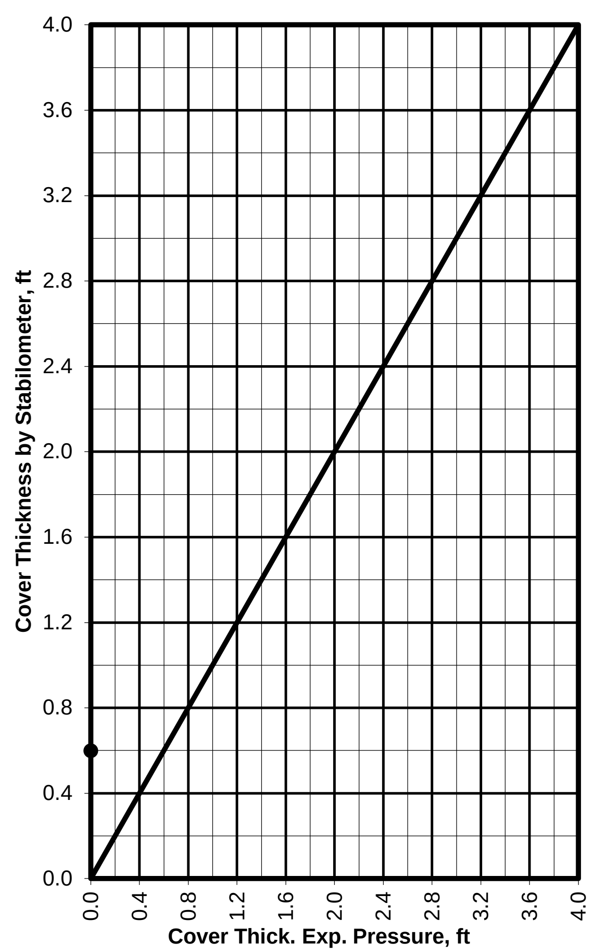
**12/28/2020** | **20-26**

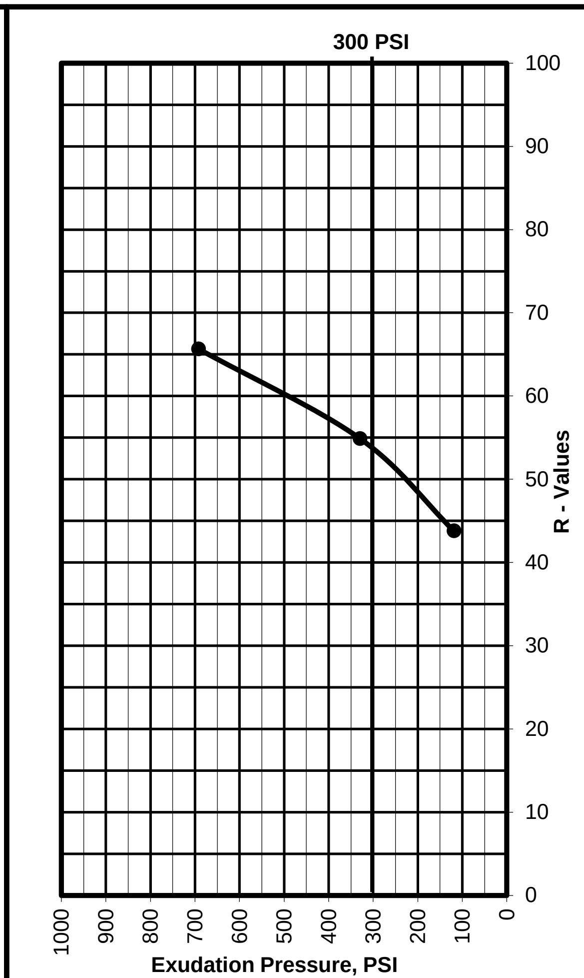
# R - VALUE TEST
# ASTM D - 2844 / CAL 301

| | | |
|---|---|---|
| Project Number | : | 12621002 |
| Project Name | : | APN 3262-006-002,003 #2026 |
| Date | : | 1/8/2021 |
| Sample Location/Curve Number | : | B12 Bulk (0-5') |
| Soil Classification | : | F-M Silty Sand |

| TEST | A | B | C |
|---|---|---|---|
| Percent Moisture @ Compaction, % | 15.8 | 14.4 | 14.0 |
| Dry Density, lbm/cu.ft. | 115.8 | 125.6 | 113.0 |
| Exudation Pressure, psi | 119 | 330 | 692 |
| Expansion Pressure, (Dial Reading) | 0 | 0 | 0 |
| Expansion Pressure, psf | 0 | 0 | 0 |
| Resistance Value R | 44 | 55 | 66 |

| | |
|---|---|
| **R Value at 300 PSI Exudation Pressure** | **54** |
| **R Value by Expansion Pressure (TI =): 5** | **Expansion Pressure nil** |




**Krazan Testing Laboratory**

**APPENDIX C**

**Corrosion Report**
**JDH Corrosion**

February 3, 2021 via email: mark@bruingsi.net

Bruin Geotechnical Services, Inc.
44732 Yucca Avenue
Lancaster, CA, 93534

Attention: Mr. Mark Stevens

Re: Soil Corrosivity Study
S Power / Estrella
Lancaster, CA
HDR #21-0028SCS, BGSI #20-26

# Introduction

Field and laboratory tests have been completed for the S Power / Estrella project. Laboratory tests have been completed on three soil samples provided to HDR for the referenced project. The purpose of these tests was to determine whether the soils are likely to have deleterious effects on underground utility piping and concrete structures. HDR assumes that the provided samples are representative of the most corrosive soils at the site.

The proposed structure is a solar farm. The site is located at West Avenue A and 90th Street West in Lancaster, California. The water table depth is unknown; as such, its effect on site corrosivity could not be accounted for in this analysis and report.

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.

# Soil Corrosivity Testing

## Field Testing

The electrical resistivity of the soil was measured in place at three locations with two orientations using the Wenner Four Pin Method per ASTM International (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 50 feet were used so that variations with depth could be evaluated. Strata resistivities were calculated from resistance data using the Barnes Procedure.

The full set of test results are shown in the attached Table 1. Field testing locations are shown in the attached Figure 1.



431 West Baseline Road, Claremont, CA 91711-1608
(909) 626-0967

## Laboratory Testing

The electrical resistivity of each sample was measured in a soil box in its as-received condition and again per California Test Method (CTM) 643 with incremental additions of distilled water. The pH of the saturated samples was measured per ASTM G51. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per CTM 422, CTM 417, ASTM D4327, ASTM D6919, and American Public Health Association (APHA) Standard Method 2320-B.

The laboratory analyses were performed under HDR laboratory number 21-0028SCS. The full set of test results are shown in the attached Table 2.

# Discussion

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 shown in Table 1.[1]

**Table 1: Soil Corrosivity Categories.**

| Soil Resistivity (ohm-cm) | Corrosivity Category |
|---|---|
| Greater than 10,000 | Mildly Corrosive |
| 2,001 to 10,000 | Moderately Corrosive |
| 1,001 to 2,000 | Corrosive |
| 0 to 1,000 | Severely Corrosive |

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 corrosive to corrosive categories. Average resistivities decreased with increasing depth at two locations and increased with increasing depth at one location.

Electrical resistivities were in the mildly corrosive category with as-received moisture. When saturated, the resistivities were in the corrosive category. The resistivities dropped considerably with added moisture because the samples were dry as-received. A wide variations in soil resistivity can create concentration type corrosion cells that increase corrosion rates above what would be expected from the chemical characteristics alone.

Soil pH values varied from 7.9 to 8.2. This range is moderately alkaline.[2] These values do not particularly increase soil corrosivity.

The soluble salt content of the samples was moderate. Chloride and sulfate were found in low concentrations.

[1] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*
[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

Nitrate was detected in low concentration. Ammonium was not detected.

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

Variation in soil resistivity of an order of magnitude or more can create differential-aeration corrosion cells that would affect all metals.

In conclusion, these soil samples are classified as 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 evaluation of soil corrosivity described above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

## 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 American Water Works Association (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.
3. To prevent differential aeration corrosion cells, provide at least 2 inches of pipe bedding or backfill material all around metallic piping, including the bottom. Do not lay pipe directly on undisturbed soil.

## Steel Pipe

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 cathodic protection.
2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the 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 application of cathodic protection, electrically isolate each buried steel pipeline per NACE International (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. Apply cathodic protection to steel piping as per NACE SP0169.

   **OPTION 2**
   a. As an alternative to the coating systems described in Option 1 and cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or 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 any type of ASTM C150 cement. Install joint bonds, test stations, and insulated joints to provide for corrosion monitoring and/or the future application of cathodic protection if needed.

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.

## Cast Iron Soil Pipe

1. Protect cast iron soil pipe with either a double wrap 4-mil or single wrap 8-mil polyethylene encasement per AWWA C105.
2. It is not necessary to bond the pipe joints or apply cathodic protection.
3. Provide 6 inches of clean sand backfill all around the pipe. Use the following parameters for clean sand backfill:
   a. Minimum saturated resistivity of no less than 3,000 ohm-cm; *and*
   b. pH between 6.0 and 8.0.
   c. All backfill testing should be performed by a corrosion engineering laboratory.

## Copper Tubing

1. Use Type K or Type L copper tubing as required by the applicable local plumbing code. Type M tubing should not be used for buried applications.[3]
2. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286. Sleeve copper pipe through footings and foundations to prevent pH concentration cells and prevent leaks caused by settlement.
3. Electrically insulate cold water piping from hot water piping systems.
4. Protect cold water pipe using all of the following measures:
    a. Place cold water copper tubing in an 8-mil polyethylene sleeve or encase in double 4-mil thick polyethylene sleeves. Ensure that sleeves are intact and free of cuts, tears, punctures, or other damage.
    b. Remove any construction debris, rocks, wood, or organic matter from the trench prior to backfill.
    c. Bed and backfill with at least 2 inches of clean sand all around the tubing, including the bedding. Use the following parameters for clean sand backfill:
        i. Minimum saturated resistivity of no less than 3,000 ohm-cm; and
        ii. pH between 6.0 and 8.0.
        iii. All backfill testing should be performed by a corrosion engineering laboratory.
    d. Copper tubing for cold water can also be treated the same as for hot water.
5. Hot water tubing may be subject to a higher corrosion rate. Protect hot copper tubing using one of the following measures:
    a. Prevent soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing with PVC pipe with solvent-welded joints. Either seal the PVC pipe at both ends using ammonia- and methanol-free caulk, or terminate both ends above-grade in a manner that doesn’t allow water to infiltrate; *or*
    b. Applying cathodic protection per NACE SP0169. The amount of cathodic protection current needed can be minimized by coating the tubing with a suitable dielectric coating that is compatible with cathodic protection, such as Polyken 930.

## Plastic and Vitrified Clay Pipe

1. No special corrosion control measures are required for plastic and vitrified clay piping placed underground.
2. Protect all metallic fittings and valves with wax tape per AWWA C217, or with epoxy and appropriately designed cathodic protection system per NACE SP0169.

[3] *2016 California Plumbing Code (CPC), July 1, 2018 Supplement, Section 604.3.*

## Concrete Structures and Pipe

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, from 0 to 0.10 percent. Use a minimum strength of 2,500 psi per applicable codes.[4,5,6]

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 concentrations found onsite.[7] Limit the water-soluble chloride ion content in the concrete mix design to less than 0.3 percent by weight of cement.

## Steel Piles

1. Steel piles are most susceptible to corrosion in disturbed soil where oxygen is available. Choose one of the following corrosion control options:
    a. **Option 1: Coat the Pile.** Coat the piles with coal tar epoxy or polyurethane recommended by the manufacturer for the steel piles; apply to 25-mil thickness per manufacturer's recommendations.

    b. **Option 2: Coat Upper Portion of Pile.** Coat the piles from the top to 10 feet below the water table. For the remainder use a corrosion allowance of 0.05 inches.

    c. **Option 3: Provide Corrosion Allowance for Bare Piles.** Corrosion rates in disturbed soil, such as fill and loose native soil, and/or within 3 feet of the water table are estimated to be 0.0025 inches per year. Therefore, for a 25-year design life provide a corrosion allowance of 0.125 inches above what is required for structural capacity for H-piles and 0.062 inches for pipe piles. In undisturbed soil use a corrosion allowance of 0.05 inches.

2. Avoid connection to any other grounded metal, including reinforcing steel if concrete pads are placed, and to the concrete itself should concrete pads be constructed, to eliminate the formation of unfavorable corrosion cells such as galvanic and pH concentration cells. If connection of the steel piles with other metallic structures cannot be avoided, then provide a dielectric coating for those metal surfaces. Abrasive blast and apply at least 12-mil dry film thickness of polyurethane or coal tar epoxy intended for underground use, or coat with mastic such as Polyken 900 12-mil tape wrap with a 1027 primer. Irregular shaped surfaces that can't be coated with the tape wrap can be coated with wax tape per AWWA C217. The coating should be allowed to cure at least hard enough to prevent damage by the placement of reinforcing steel and concrete before those materials are placed.

3. Steel pipe pile interiors may be protected by filling them with concrete or hermetically sealing the ends.

---

*[4] 2018 International Building Code (IBC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1*
*[5] 2015 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1*
*[6] 2016 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1*
*[7] Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

4. Consider the installation of electrical bonding wires between each of the piles in order to make them electrically continuous with each other. This will allow for the possible future application of cathodic protection to the piles, if warranted in the future.
5. Prevent corrosion cells between the steel piles and the grounding system by incorporating AC/DC decoupling devices.

## Electrical Grounding Systems

1. Refer to the attached Table 1 for average soil resistivity values to depth for design of electrical ground grids and ground rods for the proposed site.
2. All below grade connections should be copper-to-copper and coated to prevent moisture intrusion to the connections.
3. Prevent corrosion cells between the steel piles and grounding system by incorporating AC/DC decoupling devices.
4. Conduct ground impedance testing after installation is complete.

# Closure

The analysis and recommendations presented in this report are based upon data obtained from field tests and laboratory samples. 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.

REGISTERED PROFESSIONAL ENGINEER
MARC E. N. WEGNER
No. C73862
Exp. 06/30/21
CIVIL
STATE OF CALIFORNIA

Steven Pierce, EIT
*Corrosion EIT*

Marc E N Wegner, PE
*Sr Corrosion Project Manager*

Enc: Table 1 – Soil Resistivity Field Tests
Table 2 – Laboratory Tests on Soil Samples
Figure 1 – Estrella Wenner Four Pin Test Locations

# Table 1 - Soil Resistivity Field Tests

***Bruin Geotechnical Services, Inc.***
***Estrella Wenner***
***Your #20-26, HDR# 21-0028SCS***
***14-Jan-21***

| LOCATION | DEPTH (feet) | MEASURED RESISTANCE (ohms) | AVERAGE RESISTIVITY TO DEPTH (ohm-cm) | STRATUM RESISTIVITY (ohm-cm) | DEPTH TO PIPE CENTERLINE (feet) |
|---|---|---|---|---|---|
| **B3** North-South. Dry, soft soil with lots of brush. | 2.0 | 70.9 | 28,380 | 28,380 | |
| | 5.0 | 14.5 | 14,480 | 10,920 | |
| | 10.0 | 3.1 | 6,180 | 3,930 | |
| | 20 | 0.9 | 3,490 | 2,430 | |
| | 50 | 0.43 | 4,290 | 5,070 | |
| **B3** East-West. Dry, soft soil with lots of brush. | 2.0 | 51.8 | 20,720 | 20,720 | |
| | 5.0 | 10.7 | 10,660 | 8,050 | |
| | 10.0 | 1.8 | 3,690 | 2,230 | |
| | 20 | 0.4 | 1,670 | 1,080 | |
| | 50 | 0.33 | 3,260 | 8,890 | |
| **B5** North-South. Dry, soft soil with lots of brush. | 2.0 | 21.9 | 8,760 | 8,760 | |
| | 5.0 | 8.5 | 8,500 | 8,330 | |
| | 10.0 | 4.8 | 9,550 | 10,900 | |
| | 20 | 2.6 | 10,360 | 11,310 | |
| | 50 | 1.59 | 15,870 | 24,600 | |

| CORROSIVITY LEGEND (FERROUS METALS) | | | |
|---|---|---|---|
| Mildly | Moderately | Corrosive | Severely |

[www.hdrinc.com](http://www.hdrinc.com)

## Table 1 - Soil Resistivity Field Tests

***Bruin Geotechnical Services, Inc.***
***Estrella Wenner***
***Your #20-26, HDR# 21-0028SCS***
***14-Jan-21***

| LOCATION | DEPTH (feet) | MEASURED RESISTANCE (ohms) | AVERAGE RESISTIVITY TO DEPTH (ohm-cm) | STRATUM RESISTIVITY (ohm-cm) | DEPTH TO PIPE CENTERLINE (feet) |
|---|---|---|---|---|---|
| | | | | 8,360 | |
| **B5** | 2.0 | 20.9 | 8,360 | | |
| East-West | | | | 11,740 | |
| | 5.0 | 10.1 | 10,110 | | |
| Dry, soft soil with lots | | | | 6,440 | |
| of brush. | 10.0 | 3.9 | 7,870 | | |
| Parallel to irrigation | | | | 16,470 | |
| line 10 feet away. | 20 | 2.7 | 10,650 | | |
| | | | | 22,720 | |
| | 50 | 1.56 | 15,630 | | |
| | | | | 16,970 | |
| **B10** | 2.0 | 42.4 | 16,970 | | |
| North-South | | | | 8,030 | |
| | 5.0 | 10.2 | 10,170 | | |
| Dry, soft soil with lots | | | | 5,430 | |
| of brush and gopher | 10.0 | 3.5 | 7,080 | | |
| holes. | | | | 8,760 | |
| | 20 | 2.0 | 7,830 | | |
| | | | | 5,470 | |
| | 50 | 0.62 | 6,220 | | |
| | | | | 19,610 | |
| **B10** | 2.0 | 49.0 | 19,610 | | |
| East-West | | | | 6,850 | |
| | 5.0 | 9.3 | 9,260 | | |
| Dry, soft soil with lots | | | | 4,840 | |
| of brush and gopher | 10.0 | 3.2 | 6,350 | | |
| holes. | | | | 4,320 | |
| | 20 | 1.3 | 5,140 | | |
| | | | | 6,670 | |
| | 50 | 0.60 | 5,960 | | |

| CORROSIVITY LEGEND (FERROUS METALS) | | | |
|---|---|---|---|
| Mildly | Moderately | Corrosive | Severely |

# Table 2 - Laboratory Tests on Soil Samples

***Bruin Geotechnical Services, Inc.***
***Estrella Wenner***
***Your #20-26, HDR Lab #21-0028SCS***
***18-Jan-21***

| **Sample ID** | | | B3 Bulk @ 0-5' | B5 Bulk @ 0-5' | B10 Bulk @ 0-5' |
|---|---|---|---|---|---|
| **Resistivity** | | **Units** | | | |
| as-received | | ohm-cm | 23,600 | 48,000 | 33,200 |
| minimum | | ohm-cm | 1,240 | 1,720 | 1,640 |
| **pH** | | | 8.0 | 7.9 | 8.2 |
| **Electrical Conductivity** | | mS/cm | 0.26 | 0.21 | 0.21 |
| **Chemical Analyses** | | | | | |
| **Cations** | | | | | |
| calcium | $Ca^{2+}$ | mg/kg | 69 | 76 | 59 |
| magnesium | $Mg^{2+}$ | mg/kg | 21 | 20 | 19 |
| sodium | $Na^{1+}$ | mg/kg | 138 | 102 | 132 |
| potassium | $K^{1+}$ | mg/kg | 2.2 | 2.4 | 0.8 |
| ammonium | $NH_4^{1+}$ | mg/kg | ND | ND | ND |
| **Anions** | | | | | |
| carbonate | $CO_3^{2-}$ | mg/kg | 50 | 38 | 68 |
| bicarbonate | $HCO_3^{1-}$ | mg/kg | 186 | 308 | 256 |
| fluoride | $F^{1-}$ | mg/kg | 2.9 | 3.4 | 3.8 |
| chloride | $Cl^{1-}$ | mg/kg | 116 | 43 | 53 |
| sulfate | $SO_4^{2-}$ | mg/kg | 145 | 69 | 82 |
| nitrate | $NO_3^{1-}$ | mg/kg | 12 | 21 | 9.5 |
| phosphate | $PO_4^{3-}$ | mg/kg | ND | ND | ND |
| **Other Tests** | | | | | |
| sulfide | $S^{2-}$ | qual | na | na | na |
| Redox | | mV | na | na | na |

Minimum resistivity and pH per CTM 643, Chloride per CTM 422, Sulfate per CTM 417

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

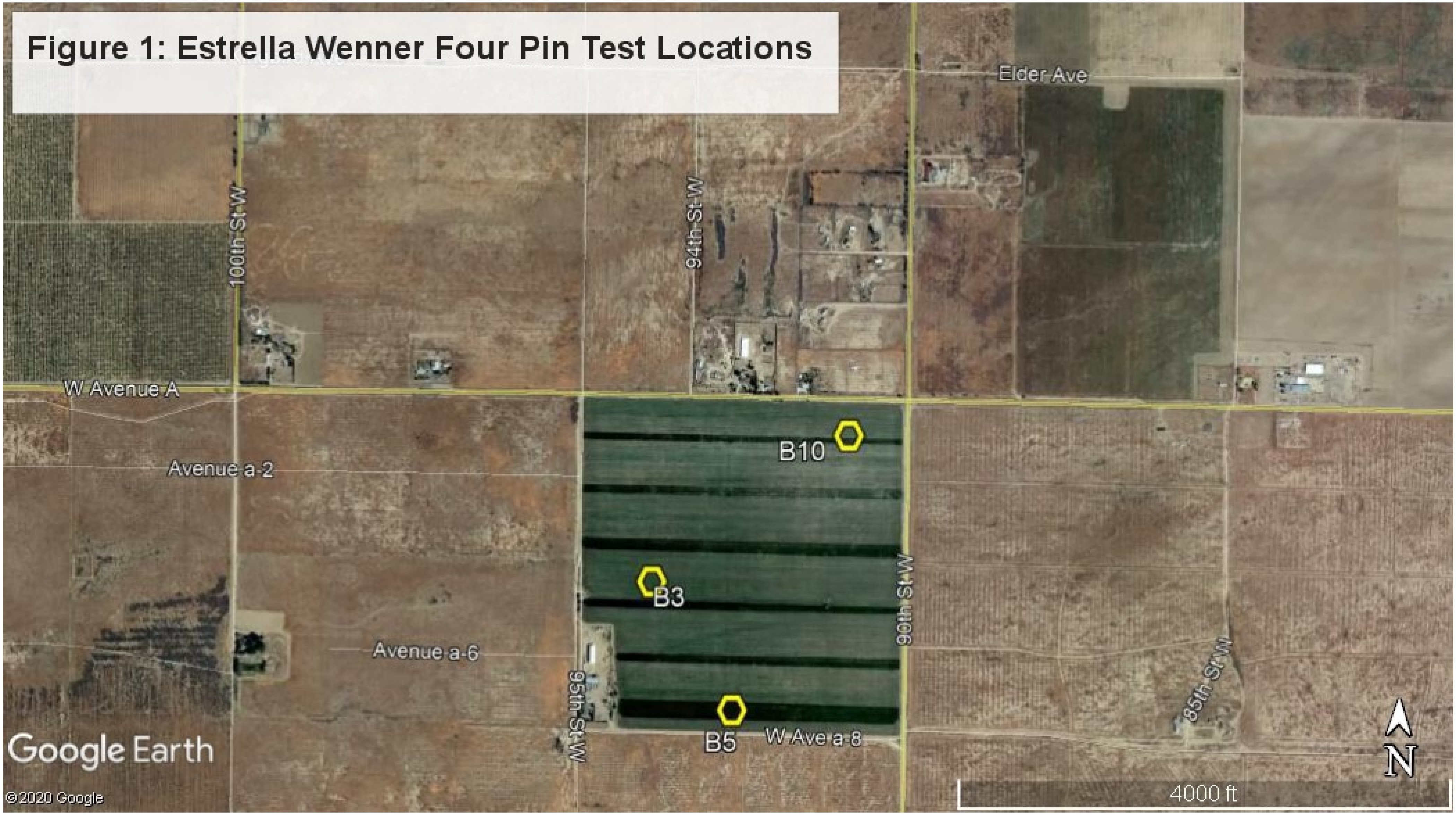
Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316

# Figure 1: Estrella Wenner Four Pin Test Locations



# APPENDIX D

## Results from Geotherm USA

21239 FM529 Rd., Bldg. F
Cypress, TX 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
http://www.geothermusa.com

**February 01, 2021**

**Bruin Geotechnical Services Inc.**
44732 Yucca Avenue
Lancaster, CA 93534
**Attn: Mark Stevens**

**Re: Thermal Analysis of Soil Samples**
**S Power/Estrella - Lancaster, CA (Project No. 20-26)**

The following is the report of thermal dryout characterization test conducted on three (3) bulk samples of native soil from the referenced project received at our laboratory.

**Thermal Resistivity Tests:** The samples were tested at 'optimum' moisture content and 90% of the density provided by **Bruin**. The tests were conducted in accordance with the IEEE Standard 442-2017. The results are tabulated below, and the thermal dryout curves are presented in **Figures 1 to 3.**

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

| Sample ID (0' - 5') | Description (Bruin Geotech) | Thermal Resistivity (°C-cm/W) | | Moisture Content (%) | Dry Density (lb/ft$^3$) |
|---|---|---|---|---|---|
| | | Wet | Dry | | |
| B-3 | Greyish brown silty fine to coarse sand with occ #4 gravel | 65 | 162 | 8 | 120 |
| B-5 | Light yellowish brown v-silty fine to coarse sand with occ #4 - 3/8" gravel | 68 | 164 | 10 | 116 |
| B-10 | Light yellowish brown v-silty fine to coarse sand | 65 | 154 | 11 | 115 |

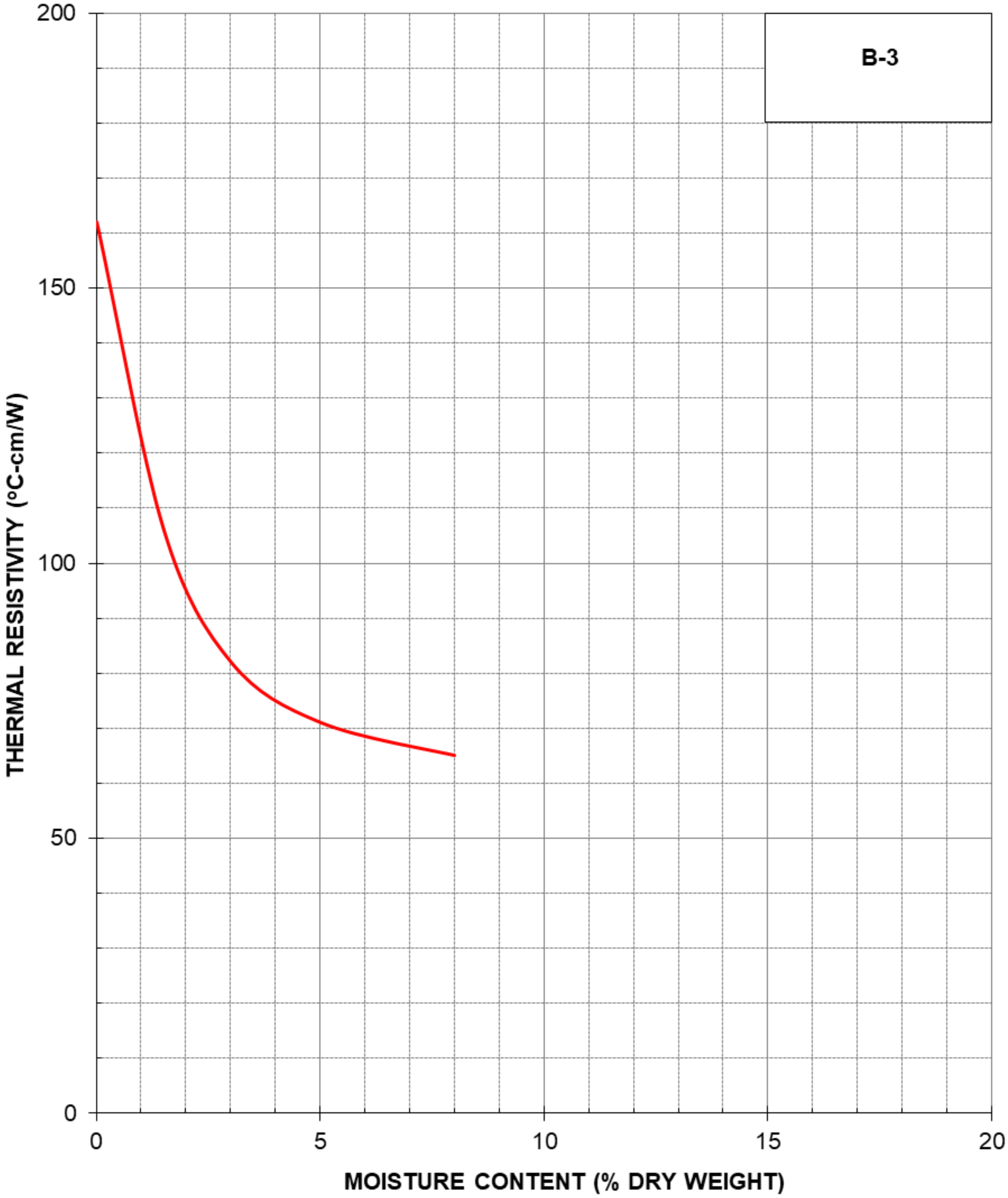
Please contact us if you have any questions or if we can be of further assistance.

**Geotherm USA**

Deepak Parmar

Geotherm USA

# THERMAL DRYOUT CURVE



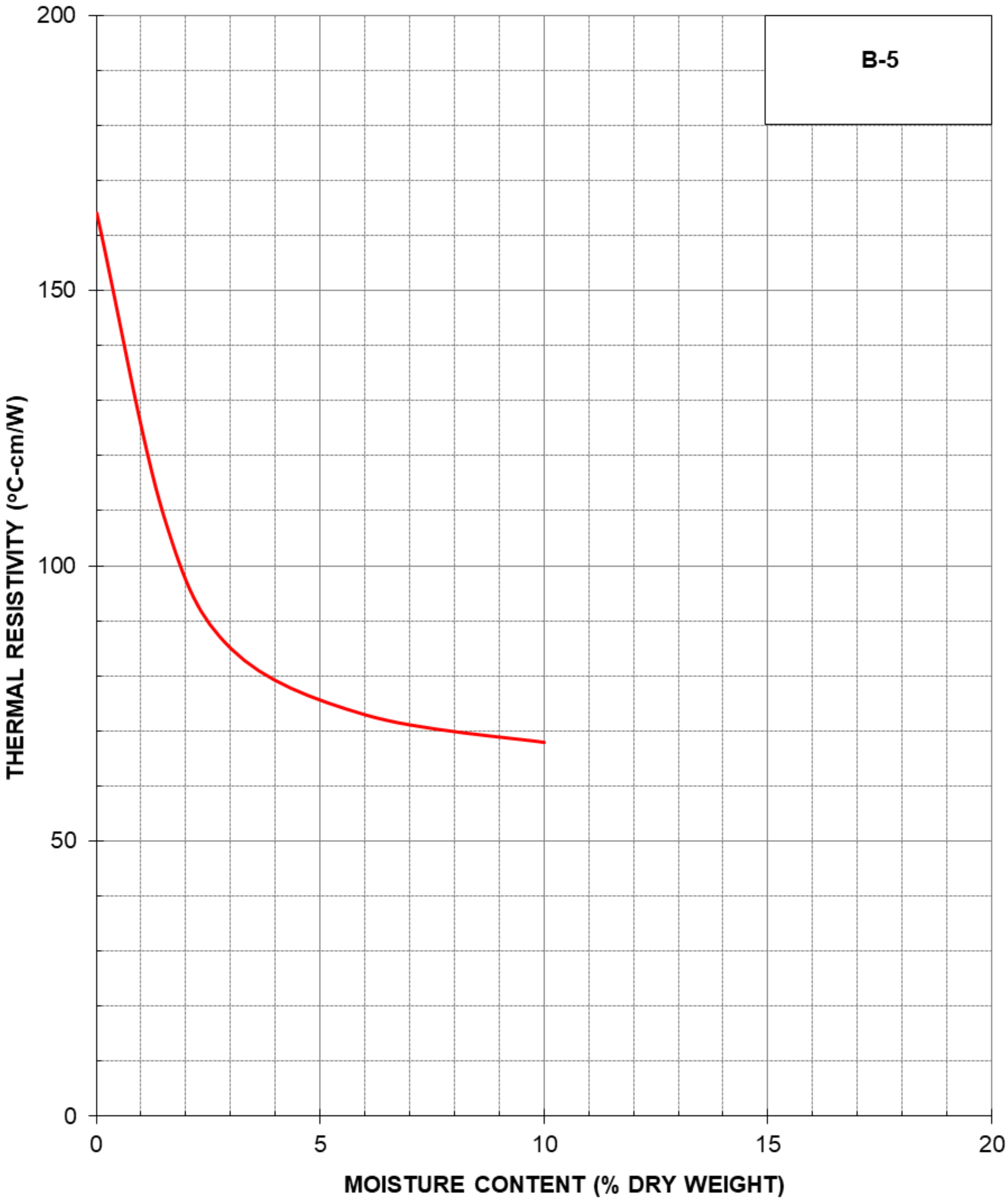

**Bruin Geotechnical Services, Inc. (Project No. 20-26)**

**Thermal Analysis of Soil Samples**

**SPower/Estrella - Lancaster, CA**

**February 2021** **Figure 1**

## THERMAL DRYOUT CURVE

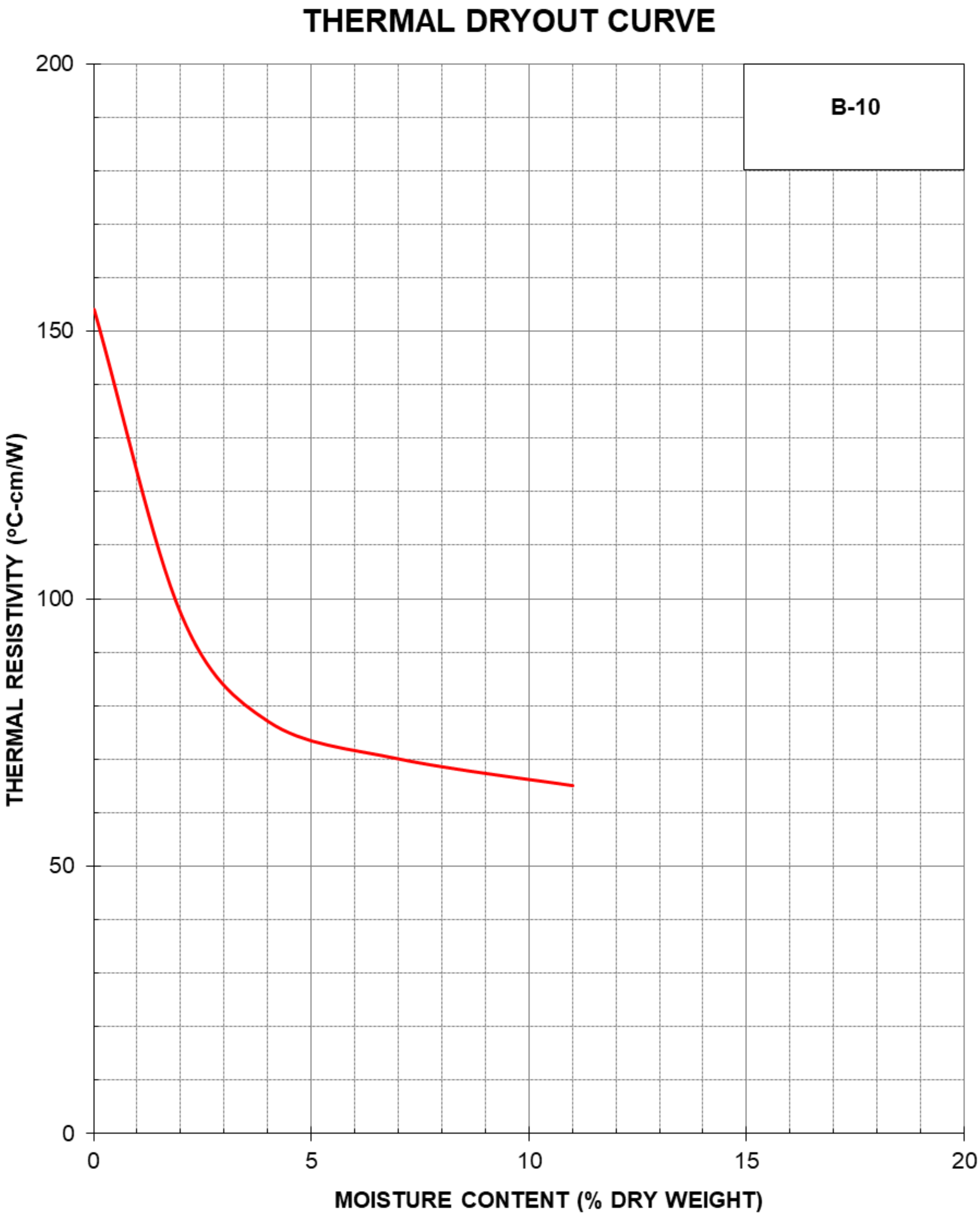



**Bruin Geotechnical Services, Inc. (Project No. 20-26)**

**Thermal Analysis of Soil Samples**

**SPower/Estrella - Lancaster, CA**

**February 2021** **Figure 2**




**Bruin Geotechnical Services, Inc. (Project No. 20-26)**

**Thermal Analysis of Soil Samples**

**SPower/Estrella - Lancaster, CA**

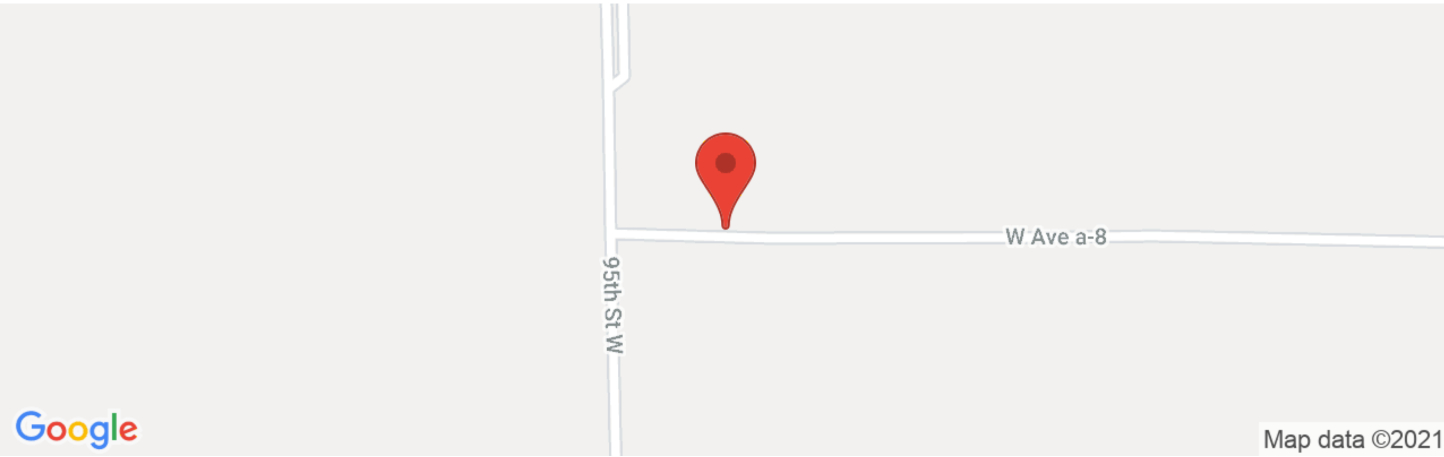
**February 2021** **Figure 3**

# APPENDIX E

## US Seismic Design Maps

# JN 20-26 S-POWER/ESTRELLA

**Latitude, Longitude: 34.812658, -118.298175**




| | |
|---|---|
| **Date** | 2/8/2021, 9:47:20 AM |
| **Design Code Reference Document** | ASCE7-16 |
| **Risk Category** | II |
| **Site Class** | D - Stiff Soil |

| Type | Value | Description |
|---|---|---|
| $S_S$ | 1.324 | $MCE_R$ ground motion. (for 0.2 second period) |
| $S_1$ | 0.535 | $MCE_R$ ground motion. (for 1.0s period) |
| $S_{MS}$ | 1.324 | Site-modified spectral acceleration value |
| $S_{M1}$ | null -See Section 11.4.8 | Site-modified spectral acceleration value |
| $S_{DS}$ | 0.882 | Numeric seismic design value at 0.2 second SA |
| $S_{D1}$ | null -See Section 11.4.8 | Numeric seismic design value at 1.0 second SA |

| Type | Value | Description |
|---|---|---|
| SDC | null -See Section 11.4.8 | Seismic design category |
| $F_a$ | 1 | Site amplification factor at 0.2 second |
| $F_v$ | null -See Section 11.4.8 | Site amplification factor at 1.0 second |
| PGA | 0.5 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1.1 | Site amplification factor at PGA |
| $PGA_M$ | 0.55 | Site modified peak ground acceleration |
| $T_L$ | 12 | Long-period transition period in seconds |
| SsRT | 1.324 | Probabilistic risk-targeted ground motion. (0.2 second) |
| SsUH | 1.476 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration |
| SsD | 1.5 | Factored deterministic acceleration value. (0.2 second) |
| S1RT | 0.535 | Probabilistic risk-targeted ground motion. (1.0 second) |
| S1UH | 0.604 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration. |
| S1D | 0.6 | Factored deterministic acceleration value. (1.0 second) |
| PGAd | 0.5 | Factored deterministic acceleration value. (Peak Ground Acceleration) |
| $C_{RS}$ | 0.897 | Mapped value of the risk coefficient at short periods |
| $C_{R1}$ | 0.886 | Mapped value of the risk coefficient at a period of 1 s |

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# APPENDIX F

## General Earthwork and Grading Guidelines

# Earthwork and Grading Specifications for Rough Grading

## 1.0 General

**1.1** **Intent:** These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

**1.2** **The Geotechnical Consultant of Record:** Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observations, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

**1.3** **The Earthwork Contractor:** The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultants, unsatisfactory conditions, such as unsuitable soil, improper moisture-condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in the specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

## 2.0 Preparation of Areas to be Filled

**2.1** **Clearing and Grubbing:** Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 10 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminant dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

**2.2** **Processing:** Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free from oversize material and the working surface is reasonably uniform, flat, and free from uneven features that would inhibit uniform compaction.

**2.3** **Overexcavation:** In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading pan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

**2.4** **Benching:** Where fills are to be places on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter that 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

**2.5** **Evaluation/Acceptance of Fill Areas:** All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observes, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

## 3.0 Fill Material

**3.1** **General:** Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

**3.2** **Oversize:** Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

**3.3** **Import:** If importing of fill material is required for grading, proposed import material shall meet the requirements of the geotechnical report(s). The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so the suitability can be determined and appropriate tests performed.

## 4.0 Fill Placement and Compaction

**4.1** **Fill Layers:** Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates that grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

**4.2** **Fill Moisture Conditioning:** Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain relatively uniform moisture content within 2% of optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

**4.3** **Compaction of Fill:** After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

**4.4** **Compaction of Fill Slopes:** In addition to normal compaction procedures specified above, compaction of slopes, shall be accomplished by backrolling of slopes with sheepfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

**4.5** **Compaction Testing:** Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

**4.6** **Frequency of Compaction Testing:** Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

**4.7** **Compaction Test Locations:** The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less then 5 feet apart from potential test locations shall be provided.

## 5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical repot(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land survey/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

## 6.0 Excavation

Excavations, as well we over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

## 7.0 Trench Backfills

**7.1** The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

**7.2** All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding Material shall have a Sand Equivalent greater then 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

**7.3** The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

**7.4** The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

**7.5** Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.