# Appendix H

Geotechnical Investigation Report

KLEINFELDER
Bright People. Right Solutions.

September 11, 2015
Project No. 20160674.001A

Ms. Darsey Moore
**Sargent & Lundy, LLC**
55 East Monroe Street
Chicago, Illinois 60603

**Subject:** **Geotechnical Investigation**
**Proposed Suncrest SVC Substation**
**And Transmission Line**
**Alpine, California**

Dear Ms. Moore:

This report presents the results of our geotechnical engineering investigation for the proposed Suncrest SVC Substation and Transmission Line.

We appreciate this opportunity to be of service and look forward to continue working with you in the future. If you have any questions about this report or need additional services please contact us at (619) 831-4533.

Respectfully submitted,

**KLEINFELDER**

REGISTERED PROFESSIONAL ENGINEER
KEVIN M. CRENNAN
No. 2511
EXP. 12/31/15
GEOTECHNICAL
STATE OF CALIFORNIA

Kevin M. Crennan, GE 2511
Senior Geotechnical Engineer

REGISTERED GEOLOGIST
SCOTT H. RUGG
NO. 1651
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Scott Rugg, CEG 1651
Project Engineering Geologist

KMC:SR:ws




550 West C Street, Suite 1200, San Diego, CA 92101 p | 619.831.4600 f | 619.232.1039

# GEOTECHNICAL INVESTIGATION
# PROPOSED SUNCREST SVC SUBSTATION AND TRANSMISSION LINE
# ALPINE, CALIFORNIA
# 20160674.001A

**SEPTEMBER 11, 2015**

A Report Prepared for:

Ms. Darsey Moore
Sargent & Lundy, LLC
55 East Monroe Street
Chicago, Illinois 60603

**GEOTECHNICAL INVESTIGATION**
**PROPOSED SUNCREST SVC SUBSTATION**
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**ALPINE, CALIFORNIA**

Prepared by:

REGISTERED GEOLOGIST
SCOTT H. RUGG
NO. 1651
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Scott Rugg, CEG 1651
Project Engineering Geologist

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
KEVIN M. CRENNAN
No. 2511
EXP. 12/31/15
GEOTECHNICAL
STATE OF CALIFORNIA

Kevin Crennan

Kevin M. Crennan, GE 2511
Senior Geotechnical Engineer

**KLEINFELDER**
550 West C Street, Suite 1200
San Diego, California 92101
Phone: 619-831-4600
Fax: 619-232-1039

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## TABLE OF CONTENTS

**Section** **Page**

## TABLES



## FIGURES



## APPENDICES

# 1 INTRODUCTION

This geotechnical report is for the proposed Suncrest SVC Substation and Transmission Line to be located east of Alpine, California. The project is located in an area just east of the existing 500kV Suncrest Substation operated by San Diego Gas and Electric (SDG&E). The location of the project is shown on the attached Vicinity Map, Figure 1. The latitude and longitude coordinates of the SVC Substation are:

Latitude: 32.8122°N

Longitude: 116.6665°W

The proposed transmission line extends approximately 1 mile west from SVC Substation where it will tie into the SDG&E Suncrest Substation. Figure 2, shows the Site Plan for the transmission line alignment and SVC substation.

## 1.1 EXISTING SITE CONDITIONS

The proposed SVC substation site is roughly square in shape and located on the south side of Bell Bluff Truck Trail, approximately 1.9 miles west of the intersection with Japatul Valley Road and 0.8 miles east of Suncrest Substation. It occupies an area of approximately 6 acres of vacant land which was previously used as a materials lay down yard during construction of the Sunrise Power Link project. The site is currently undergoing restoration with regrown of native vegetation.

The topography of the substation site slopes generally downward from the northeast toward the southwest. The elevation ranges from a high of approximately 3087 feet MSL (above mean sea level) on the northeast to a low of approximately 3047 feet MSL at the southwest corner, for a total differential of about 40 feet

The approximate 1-mile long underground transmission line is planned to be buried in an approximate 6-foot deep trench along the northern side of Bell Bluff Truck Trail. The roadway is overlaid with asphalt pavement and generally rises in elevation from the substation site toward the west, a total of approximately 100 feet near the large water tank adjacent to the SDG&E Suncrest substation.

The paved access road adjacent to the proposed transmission line was constructed by primarily cutting into a northerly descending slope, resulting in cut slopes of varying height along with some isolated fill area. Vegetation is typically moderate to thick adjacent to the road.

## 1.2 PROJECT DESCRIPTION

The proposed project will consist of the construction of a new 230kV static var compensator (SVC) substation and approximately 1 mile of underground transmission line which will connect the SVC substation to the existing SDG&E 500kV Suncrest Substation. The substation will be roughly square with side lengths on the order of 330 to 340 feet and the transmission line will extend about 1 mile to the west. The location of the SVC substation and transmission line alignment are shown on Figure 2. Grading for the SVC substation pad will consist of cut/fill type earthwork construction by removing natural material mostly from the east side of the site and placing the excavated soils along the west and southwest sides of the site. A preliminary grading plan for the site by Sargent & Lundy indicates finish elevations ranging from approximately 3,062 feet to 3,064 feet MSL. The grading will result in cuts on the east side of the pad having a maximum depth of approximately 20 feet and fill slopes up to about 10 feet at the southwest. A retaining wall is proposed along the northeastern side of the substation to limit the amount of ground disturbance which would result from a permanent cut slope. The wall will range in height from about 2 feet at the ends to 15 feet in the center. A diversion ditch will be located along the western side of the substation with maximum cuts up to about 13 feet.

Low-impact development (LID)/hydromodification for storm water drainage design will include a storm water detention basin adjacent to the southernmost side of the substation pad. Preliminary plans indicate the basin bottom will be on the order of 200 feet in length and have a bottom elevation of 3,056 feet and a crest elevation of 3,061 feet MSL. This will require cuts up to about 17 feet on the northeast corner and fill up to about 5 feet on the southwest.

The substation will include various types of equipment including an SVC compensator. Details of the equipment and SVC compensator were not provided at the time of this study.

The transmission line will be placed in an approximate 5-foot deep by 30-inch wide trench along the north side of Bell Bluff Truck Trail. A 230kV single circuit duct with four 6-inch and four 2-inch conduits will be constructed in the bottom of the trench. The transmission line will extend up a new steel monopole at the west end of the undergrounding to transfer it aerially into the SDG&E Suncrest Substation.

## 1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of our geotechnical and geologic engineering services was to evaluate the soil and geologic conditions at the site and provide conclusions and recommendations for design of the proposed development. The recommendations for the SVC substation are only preliminary since final design and construction will be performed by and EPC contractor.

The scope of our services for the project consisted of:

- Review of the applicable previous reports, maps and aerial photography for the area.
- A geologic reconnaissance of the project area.
- Field exploration of the subsurface conditions by drilling nine borings, five refraction survey lines, two resistivity surveys, and one infiltration test;
- Laboratory testing of selected samples of soil and geologic materials;
- Engineering analysis of field and laboratory data; and
- Preparation of this report presenting our compiled findings, conclusions, and recommendations.

The recommendations contained within this report are subject to the limitations presented in Section 6.0. An information sheet prepared by ASFE (the Association of Engineering Firms Practicing in the Geosciences) is also included in Appendix D. We recommend that all individuals using this report read the limitations along with the attached document.

# 2 METHODS OF STUDY

## 2.1 BACKGROUND DATA REVIEW

We reviewed readily-available published and unpublished geologic literature and aerial photographs in our files and available agency data published on the internet. In addition, we reviewed the December 21, 2009 geotechnical report prepared by URS for the existing SDG&E Suncrest Substation, as well as planning documents provided by the client. The documents reviewed are presented in Section 7, References.

The URS boring which is pertinent to the current project is B-04 located along Bell Bluff Truck Trail upslope from the existing Suncrest Substation. The boring was drilled by hollow stem auger to a depth of 10 feet and then rock cored to a total depth of 50 feet. This boring is close to the proposed pole which will connect the western end of the underground transmission line to the overhead line into the substation. Of particular note, the rock was highly weathered with a quality designation (RQD) of 0 between depth of 13 and 28 feet. The rock then became moderately weathered at 28 feet and slightly weathered at 30 feet, with RQD of 40, 73, 90, 90 and 92 for the approximate 5-foot intervals between 28 and 50 feet. Laboratory unconfined compressive strength results were 26, 1,949 and 12,871 psi at depths of 10.4, 15.6 and 30 feet, respectively. Two P-wave seismic refraction surveys were also performed in the western portion of the transmission line. These refraction surveys indicate P-wave velocities between 4,600 and 4,800 within the upper approximate 20 feet. However, it should be noted this is an average velocity and it is likely that this generalized layer actually consists of lower over higher velocities. The report did not contain other useful subsurface information pertaining to the proposed substation or underground transmission line. Logs of borings and with photographs of the core are included in Appendix A.2 along with the seismic refraction lines.

## 2.2 FIELD INVESTIGATION

The subsurface conditions at the substation site were investigated by drilling four exploratory geotechnical borings, and performing one infiltration test and two pairs of resistivity surveys. The substation borings were drilled to depths of approximately 15 to 25 feet below the existing ground surface (bgs). The boring for infiltration testing was drilled to a depth of approximately 5 feet bgs adjacent to 20-foot deep Boring B-3. The subsurface conditions along the transmission line alignment were investigated by drilling five borings and performing five P-wave refraction survey lines and one refraction microtremor (ReMi) profile along Bell Bluff Truck Trail just of the northern edge of the road. The alignment borings were drilled to depths of approximately 5 to 17 ½ feet bgs.

All borings were drilled by Pacific Drilling of San Diego, California using an all-terrain truck-mounted Marl M5 drill rig equipped with 6-inch-diameter hollow-stem augers. This work was conducted on July 20 and 21, 2015. A geologist from our office supervised the field operations and logged the borings. Selected bulk and relatively undisturbed samples were retrieved from the borings and transported to our laboratory for further evaluation. The borings were backfilled in accordance with County of San Diego Department of Environmental Health guidelines, which specify grout for borings deeper than 20 feet and allow soil backfill for borings shallower than 20 feet. The backfill material is included on logs of borings in Appendix A. The approximate locations of the current borings and 2009 explorations by URS are presented on Figure 2, Site Plan. The substation is enlarged on Figure 3. A summary of our field investigations is presented in Appendix A.1. Pertinent field data from the 2009 URS investigation is presented in Appendix A.2

Borehole infiltration testing was performed in accordance with Appendix A, Riverside County – Low Impact Development BMP Design Handbook. Based on the Table 1, Infiltration Testing Requirements, and our selection of the percolation test method, we performed one borehole percolation tests in Boring INV-1. The total depth of the boring was approximately 5 feet. At the conclusion of drilling, the augers were removed vertically from the boring to limit the amount of "smearing" of the boring sidewall. Within the boring, approximately 2 inches of gravel was added to the bottom. Perforated pipe was then placed directly on the gravel bottom. Overnight pre-saturation of the borehole subsequently commenced. Testing was performed the following day and consisted of placing approximately 24 inches of water into the test hole and taking readings every 10 minutes for an hour. The results of the testing are discussed in Section 4.12.

Two resistivity tests were performed at the proposed substation site and five refraction survey lines were performed along the transmission line alignment by Southwest Geophysics (SG) of San Diego, California on July 22 and 23, 2015. The resistivity tests were comprised of two separately tested survey lines that crossed roughly perpendicularly and were up to approximately 600 feet long. The refraction survey lines were comprised of one line each and are approximately 125 feet in length. The approximate locations of the lines are presented on Figure 2. A copy of the SG report is included in Appendix A.3 of this report.

All field activities were performed under the observation of a biological/cultural monitor from SWCA Environmental Consultants of Pasadena, California.

## 2.3 GEOTECHNICAL LABORATORY TESTING

Laboratory testing was performed on selected bulk and drive samples to substantiate field classifications and to provide engineering parameters for geotechnical design. Laboratory testing consisted of in-situ moisture content and dry unit weight, sieve analysis, Atterberg limits, expansion index, direct shear, laboratory compaction, R-value, and corrosivity (pH, electrical resistivity, water-soluble sulfates, and water-soluble chlorides). A description of the testing performed and the results are presented in Appendix B.1.

In addition, six samples were tested by Geotherm USA of Livermore, California for thermal property analysis. The tests were conducted in accordance with the IEEE Standard 442 and included a series of thermal resistivity measurements with the moisture contents ranging from as-received to dry conditions. A copy of the Geotherm USA report is included in Appendix C of this report.

## 2.4 GEOTECHNICAL ANALYSES

Field and laboratory data were analyzed in conjunction with the proposed finished grades, structures layout, and estimated structural loads to provide geotechnical recommendations for design and construction of the substation and transmission line. We evaluated foundation systems, lateral earth pressures for retaining structures, pavement design, and earthwork. In addition, potential geologic hazards were evaluated, including surface fault rupture, seismic shaking, ground lurching, liquefaction, seismically induced settlement, slope instability, flooding and seiche, and expansive soils. Seismic design parameters in accordance with the 2013 California Building Code (CBC) are also presented.

A rippability analysis was performed along the transmission alignment to consider the excavation characteristics of the decomposed granitic rock which occurs along the alignment.

## 2.5 REPORT PREPARATION

This report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed project. Our report includes the following items:

- Vicinity map and location plan showing the approximate boring locations and locations of the geologic cross sections;
- Logs of borings (Appendix A.1 and A.2);
- Geophysical resistivity and refraction study (Appendix A.3);
- Results of laboratory tests (Appendix B.1);
- Results of soil thermal resistivity tests (Appendix B.2);
- Discussion of general site conditions;
- Discussion of general subsurface conditions as encountered in our field exploration;
- Discussion of regional and local geology;
- Discussion of geologic and seismic hazards;
- Recommendations for seismic design parameters in accordance with the 2013 CBC;
- Preliminary recommendations for substation foundation design,
- Recommendations for drilled pier design, including MFAD parameters;
- Recommendations for site preparation, earthwork, temporary slope inclinations, fill placement and compaction, and excavation characteristics of subsurface materials;
- Recommendations for support of concrete slabs-on-grade;
- Recommendations for flexible pavement structural sections;
- Discussion of infiltration test results and potential hydromodification; and
- Preliminary evaluation of the corrosion potential of the on-site soils.

# 3 SITE CONDITIONS

## 3.1 GEOLOGIC SETTING

San Diego County is located within the southern portion of California's Peninsular Ranges Geomorphic Province (CGS, 2002). This province is characterized as an assemblage of north-to-northwest-trending, high-relief ranges stretching south from the Santa Monica Mountains in Los Angeles, through San Diego County, and well into Baja California, Mexico. Notable mountain ranges of Southern California include the Santa Ana Mountains, the Laguna Mountains and the Cuyamaca Mountains. The development of this mountainous terrain is closely tied to the transform tectonics of the San Andreas Fault System.

The County encompasses three geomorphic subzones, as depicted in Figure 4 that are set in a series of north-to-northwest trending belts, roughly parallel to the Pacific coastline. From west to east, these zones are composed of a relatively narrow, low-relief coastal plain; a dominant central high-relief mountainous zone; and a low-lying desert zone on the east.

The Coastal Plain subzone ranges from ¼ mile wide in the northern county to approximately 14 miles wide in the central and southern regions and is underlain by relatively undeformed near-shore marine sedimentary rocks deposited during intermittent intervals from late Mesozoic through Quaternary time. The Central Mountainous subzone is west of the coastal plain and is approximately 40 to 50 miles wide. It is composed mostly of Cretaceous-age granitic type igneous rocks of the Southern California Batholith (SCB). The granites are inset with numerous isolated patches of Jurassic to Triassic-age metamorphic rocks and some Jurassic-age granites that are remnants of the former sedimentary cover into which the batholith intruded. The batholith is comprised of numerous plutons of varying composition which trends downward toward the west where it underlies Tertiary-age sedimentary rocks of the coastal plain. The Desert subzone occurs along the extreme eastern edge of the County and extends eastward into Imperial County. This low-lying area is part of the Colorado Desert Geomorphic Province and is commonly referred to as the Salton Trough. This desert basin developed in response to crustal extension and related faulting within the southeastern portion of the San Andreas Fault System.

## 3.2 FAULTING AND SEISMICITY

Much of California straddles the boundary between two global tectonic plates (see Plate 5) known as the North American Plate (on the east) and the Pacific Plate (on the west). The main plate boundary fault is known as the San Andreas fault and it crosses through some of the most densely populated and developed areas of both Southern and Northern California. It stretches northwest from the Gulf of California in Mexico, through the desert region of the Imperial Valley, crossing the San Bernardino region, and traversing up into northern California, where it eventually trends offshore near San Francisco (Jennings, 1994; Jennings and Bryant, 2010). Within southern California, the plate boundary is actually a complex system of numerous faults known as the San Andreas Fault System (SAFS) that spans a 150-mile wide zone from the main San Andreas fault in the Imperial Valley, westward to offshore of San Diego (Powell et al., 1993; and Wallace, 1990). This zone of faulting is depicted on Figure 5. The major faults east of the site (from east to west) include the San Andreas, San Jacinto, and Elsinore faults. Major faults west of San Diego include the Rose Canyon-Newport-Inglewood, Palos Verdes-Coronado Bank, San Diego Trough, and San Clemente faults. Further discussion of faulting relative to the site is provided in the Section 4.

Geodetic measurements reveal that up to 1.9 inches of cumulative lateral displacement occurs per year (in/yr) across the entire SAFS plate boundary. Most of this fault displacement and associated seismic energy release occurs along the fault structures closest to the main plate boundary on the east (i.e., on the Elsinore, San Jacinto, and San Andreas faults), with a combined total displacement of approximately 1.6 in/yr (84 percent). The remaining 0.3 in/yr (16 percent) is accommodated across the faults to the on the west including the Rose Canyon fault. Farther north, a similar amount (0.25-0.3 in/yr) is accommodated east of the San Andreas fault in the Eastern California Shear Zone (Rockwell et al., 2010). Figure 5 shows many of the active faults within an approximate 60-mile radius of the project alignment, along with the locations of epicenters of historical seismic events.

## 3.3 SITE GEOLOGY AND SUBSURFACE CONDITIONS

The geology and subsurface conditions of the project area were interpreted based on data obtained from our field investigation, our geologic mapping and review of various maps, aerial photography and reports. Several earth materials units were identified during our study and these include artificial fill, alluvial deposits, colluvial deposits, granitic rocks and metamorphic rocks. The areal extent of these units in the substation area is depicted on the Geologic Map (Figure 3). Geologic cross sections for the substation are presented on Figures 6 and 7. Detailed descriptions of these units are provided in Appendix A.1 (Boring Logs), and generalized descriptions are provided in the subsequent sections below

### 3.3.1 Artificial Fill (af)

Artificial fill materials are present primarily along isolated areas of the Bell Bluff Truck Trail. The portion of the roadway between the SDG&E Suncrest Substation and Japatul Valley Road was upgraded during the development of that project. This included significant grading effort and paving to provide better access. Between the SDG&E Suncrest Substation and the proposed SVC substation, this grading consisted of construction of both cut and fill embankment. Most of the fill was placed along the north side of the roadway and within drainage features. This fill was generated on-site from cuts made into the native decomposed granitic material. It therefore is anticipated to consist mostly of silty sand, with some clayey sand, sandy silt and sandy clay. Fill was encountered at only one of our boring locations, B-7. It consists of a clayey sand and extended to a depth of approximately 3 feet below ground surface (bgs). Most of the fill is anticipated to be less the five feet in depth, with isolated areas up to a maximum of 10 feet in depth. It is anticipated that the transmission trench will penetrate most of the fill, where present.

Fill is also present along most of the southern edge Bell Bluff Truck Trail, above and to the north of the existing SDG&E substation. Most of this fill was placed during the original construction of the roadway in the early 19th century and is anticipated to range up to five feet in depth. The cut/fill transition is anticipated to trend along the centerline of the roadway. This means that the transmission line is on the cut side of the roadway and for the most part should not be underlain by fill.

### 3.3.2 Alluvial Deposits (Qa)

Holocene age stream deposited alluvium is present along a narrow and isolated areas of Bell Bluff Truck Trail between the SVC and SDG&E substations. Alluvial deposits were not encountered within any of our borings and these deposits were identified based on geologic field observations and review of topography. Alluvial deposits are typically granular in composition and based on our observations are likely less than 5 feet thick where mapped.

### 3.3.3 Colluvial Deposits (Qc)

Late Pleistocene age colluvial deposits are derived from deposition of eroded material carried downslope by surface runoff. It typically accumulates along the base of moderate to steep slopes as a wedge shaped mass. Topsoil, which develops at the ground surface due to natural soil formation processes, is also commonly classified as a colluvial deposit. Colluvial deposits were encountered in all four borings, B-1 through B-4, on the SVC substation site. This unit ranged from approximately 1-foot thick below boring B-1 up to approximately 6 ½ feet thick below boring

B-3. It is comprised of very dark grayish brown to dark yellowish brown silty sand, sandy silt and clayey sand. The upper foot is typically loose (soft) and increases in relative density to a medium dense to dense condition. Most of the substation site is anticipated to be covered with 1 to 2 feet of colluvial deposits. The thickest deposits are anticipated within the low lying area along the west side of the proposed pad, north and south of boring B-3.

Colluvial deposits were also encountered at boring locations B-5 and B-8 along the transmission alignment. It is comprised of dark grayish brown to dark brown sandy silt, silty sand and clayey sand. The colluvium was less than one foot thick at boring B-5 and 5 feet thick at boring B-8.

#### 3.3.4 Granitic Rocks – Corte Madera Monzogranite (Kcm) & Cuyamaca Gabbro (Kc)

Granitic Rocks of the Corte Madera Monzogranite and Cuyamaca Gabbro underlie the surficial units below the entire substation site and transmission alignment and were encountered in all of our borings. The regional geologic map by Todd (2004) indicates that these plutonic rocks are Early Cretaceous in age and range in composition between monzogranite to tonalite for the Corte Madera Monzogranite and gabbro to diorite for the Cuyamaca Gabbro.

Samples of these materials taken from our borings, as well as geologic observations of road cuts, reveal that the majority of this unit is appreciably decomposed. They range from completely weathered where none of the original textural fabric of the rock is discernible to highly weathered. This material is designated as decomposed granite on the boring logs and excavates into a soil material comprised of sand with silt and gravel, silty sand and clayey sand.

The decomposed granite was penetrated to depth of 15 to 25 feet bgs were the borings were terminated at boring locations B-1, B-3, B-4, B-5, B-7, and B-8. Refusal of the augers on hard granitic material occurred at 15 feet bgs at boring B-2, 7 ½ feet bgs at boring B-6 and 5 feet bgs at boring B-9. Less weathered boulders occur at the ground surface and within the roadcuts along portions of the roadway.

#### 3.3.5 Metamorphic Rocks (JTrm)

Jurassic to Triassic age metamorphic rocks occur near the west end of the transmission line alignment. These rocks typically consist of metasedimentary to metavolcanic rocks. They were not encountered in any of our borings. Although they are not anticipated to underlie the transmission trench alignment, it is possible they will be encountered in the western portion. These materials were logged 2009 boring by URS near the proposed western pole location. Kleinfelder could not corroborate whether this the geologic classification is correct.

3.3.6 Groundwater

Groundwater was encountered in some of the air track borings for the 2009 URS investigation below the SDG&E Suncrest Substation at depths from between 44 to 60 feet bgs, which correspond to elevations of between 3,036 to 3,049 feet MSL. A water well near the same area had water at 60 feet bgs corresponding to 3061 feet MSL. Another water well at the toe of a steep hillside in the area of the existing access road to the SDG&E substation had water at 8 to 12 feet bgs, corresponding to 3,139 to 3,135 feet MSL. All of these measurements were made at the time of the original geotechnical study in 2009. It is not known if the observed water represents a groundwater table, a perched condition or seepage within fractured rock.

Water well data obtained from the State of California Department of Water Resources website from three residential sites approximately 2 miles northeast of the proposed SVC substation had water at depths ranging from between 35 to 97 feet bgs.

Groundwater was not encountered in any of the borings drilled for this study. In addition, geologic observations of natural outcrops as well as graded slopes within the project area did not observe areas of obvious water seepage. Groundwater levels are influenced by seasonable variations in rainfall amounts and it should be noted that the field work was performed in the summer months following a several year drought. It is possible that water seepage could occur at isolated locations following significant rainfall events. Areas underlain by drainages would be more susceptible to subsurface water seepage. For the most part, groundwater is not anticipated to significantly affect construction. However, isolated areas of seepage could be encountered, particularly if construction is performed during or soon after the rainy season.

# 4 DISCUSSIONS, ANALYSIS, AND RECOMMENDATIONS

## 4.1 POTENTIAL GEOLOGIC HAZARDS

An assessment of potential geologic hazards has been performed for the project area. The evaluated hazards include surface fault rupture, seismic shaking, ground lurching, liquefaction, seismically induced settlement, slope instability, flooding and seiche, and expansive soils. The following sections discuss these hazards and their potential at this site in more detail:

### 4.1.1 Surface Fault Rupture

Numerous faults have been mapped in the region surrounding the site as shown on the regional geologic map by Todd (2004) and the United States Geologic Survey fault data website (http://earthquake.usgs.gov/learn/kml.php). The closest faults to the site are two structures depicted of the regional fault map, Figure 5. The first of these is located approximately 0.6 miles to the southwest and trends toward the northeast. The second is located approximately 0.6 miles to the north and trends northwest. None of the faults have been identified as active and are not aligned toward the site. They are comprised of short discontinuous structures and are likely related to fracturing during the formation and emplacement of granitic plutons. Aerial imagery was also reviewed to evaluate possible fault related features and nothing conclusive was identified which would indicate obvious signs of faults crossing the project area. The closest active fault to the site is the Elsinore fault which is located approximately 18 miles to the northeast. Based on the data presented above, it is our opinion that the hazard with respect to fault rupture at the site is nominal.

### 4.1.2 Seismic Shaking and CBC Seismic Design Parameters

As is with all of southern California, the project site is located within a seismically active region and can expect to be impacted by shaking from regional earthquakes during the lifetime of the project. The most significant seismic event likely to affect the project site would be an earthquake with a moment magnitude of approximately 7.3M (Petersen et al. 2008) resulting from a rupture on the Julian segment of the Elsinore fault, which is located approximately 18 miles northeast of the site.

Our recommendations for seismic design parameters are in accordance with the 2013 California Building Code (CBC) and ASCE 7-10 (July 2013 errata) Minimum Design Loads for Buildings and Other Structures. Based on our field investigation and using the ASCE 7-10, Section 20.3.1, Table 20.3-1-Site Classification, the substation site can be classified as Site Class C. Based on the results of a surficial geophysical ReMi survey to a depth of 75 feet, the calculated average shear wave velocities within the upper 100 feet is approximately 2,000 feet per second (ft/s). Based on Site Class C, the site is defined as very dense soil and soft rock with average shear wave velocities within the upper 100 feet between 1,200 ft/s to 2,500 ft/s, average SPT N>50, or average undrained shear strength su ≥ 2,000 psf.

Based on the Site Class C designation and on the site locations with respect to mapped spectral acceleration parameters SS and S1, Kleinfelder developed seismic design parameters. The recommended seismic design parameters are summarized in Table 1.

**Table 1**

**Recommended 2013 CBC Seismic Design Parameters**

| DESIGN PARAMETER | SYMBOL | RECOMMENDED VALUE | 2013 CBC / (ASCE 7-10) REFERENCE(S) |
|---|---|---|---|
| Site Class | -- | C | Section 1613.3.2 (Section 11.4.2) |
| Mapped $MCE_R$ (5% damped) spectral acceleration for short periods (Site Class B) | $S_s$ | 1.027 g | Section 1613.3.1 (Section 11.4.1) |
| Mapped $MCE_R$ (5% damped) spectral acceleration for a 1-second period (Site Class B) | $S_1$ | 0.374 g | Section 1613.3.1 (Section 11.4.1) |
| Short Period Site Coefficient | $F_a$ | 1.000 | Table 1613.3.3(1) (Table 11.4-1) |
| Long Period Site Coefficient (at 1-second period) | $F_v$ | 1.426 | Table 1613.3.3(2) (Table 11.4-2) |
| $MCE_G$ Peak Ground Acceleration adjusted for site class effects ($S_M$ at T=0) | $PGA_M$ | 0.39 g | N/A |
| $MCE_R$ (5% damped) spectral response acceleration for short periods adjusted for site class ($F_a$*$S_S$) | $S_{MS}$ | 1.027 g | Section 1613.3.3 / (Section 11.4.3) |
| $MCE_R$ (5% damped) spectral response acceleration at 1-second period adjusted for site class ($F_v$*$S_1$) | $S_{M1}$ | 0.533 g | Section 1613.3.3 / (Section 11.4.3) |
| Design Peak Ground Acceleration ($S_D$ at T=0) | $PGA_D$ | 0.388 g | (Section 11.4.5) |
| Design spectral response acceleration (5% damped) at short periods (2/3*$S_{MS}$) | $S_{DS}$ | 0.685 g | Section 1613.3.4 / (Section 11.4.4) |
| Design spectral response acceleration (5% damped) at 1-second period (2/3*$S_{M1}$) | $S_{D1}$ | 0.355 g | Section 1613.3.4 / (Section 11.4.4) |

Notes: *MCER: Risk-Targeted Maximum Considered Earthquake
*MCEG: Maximum Considered Earthquake Geometric Mean

### 4.1.3 Ground Lurching

Ground lurching is defined as movement of low density materials on a bluff, steep slope, or embankment due to earthquake shaking. Steep fill slopes are particularly prone to lurching. The substation site will have relatively low fill slopes and would not be particularly prone to lurching. The fill along the south side of Bell Bluff Truck trail above the SDG&E Suncrest Substation is along the edge of a steep slope and would be considered prone to lurching.

### 4.1.4 Liquefaction and Seismic Settlement

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. The cohesionless soils most susceptible to liquefaction are loose, saturated sands and some silts.

The majority of the subject site is underlain at depth by very dense soil and weathered rock, with some limited areas of shallow alluvium, colluvium and compacted fill. Groundwater was not encountered within the soil units. Based on the dense nature of the on-site formational deposits, limited extent and depth of surficial soil and absence of a shallow groundwater in these areas, it is our opinion that the potential for liquefaction and seismic related settlement across the majority of the site is low.

### 4.1.5 Slope Instability

Slope instability is manifested by numerous types of failures ranging from small surficial slippage to deep-seated slope collapses. Landslides are deep-seated ground failures (several tens to hundreds of feet deep) in which a large arcuate or block shaped section of a slope detaches and slides downhill. Landslides are not to be confused with minor slope failures (slumps), which are usually limited to the topsoil zone and can occur on slopes composed of almost any geologic material. Landslides can cause damage to structures both above and below the slide mass. Structures above the slide area are typically damaged by undermining of foundations. Areas below a slide mass can be damaged by being overridden and crushed by the failed slope material.

The natural slopes within the project area are composed of granitic material that typically are not prone to landsliding on low to moderate slopes and in most cases even on steep slopes are not prone to deep-seated failures.  Several formations within the San Diego County region are particularly prone to landsliding. This is due to a number of factors related to both its material content, structure and strength parameters.  During our site reconnaissance of the site area, we made observations of the slope surfaces and did not identify signs of past slope instability.  The preliminary grading plan for the SVC substation site shows that the proposed slopes will have a maximum height of approximately 20 feet with typical gradients of 3:1 horizontal to vertical units (H:V).  Based on this, it is our opinion that the hazard with respect to landsliding at the substation site is low.

The most significant slope along the transmission line alignment occurs at the western end above the SDG&E Suncrest Substation.  Above Bell Bluff Truck Trail, the slope consists of a natural hillside with an average gradient of approximately 2:1 and up to approximately 300 feet high.  The slope below the truck trail is a cut slope with a gradient of up to approximately 1.5:1 H/V and up to approximately 40 feet in height.  The cut slope was graded in 2012 and is currently being revegetated.  There were no indications of slope instability at the time of field study.  For the natural slope above the roadway, we also did not observe signs of instability along the lower portion of the slope where visual observations could be made.  Review of the geologic map by Todd (2004) and aerial imagery also do not show apparent signs of past slope instability.  It is likely however that there have been shallow slope failures consisting of surficial slumps and minor debris flows which occurs naturally on all slopes and these should be anticipated in future.  With regards to deep-seated failure, this is a much more unlikely event due primarily to the material composition of the slopes.  The height and steepness of the slope does lend itself to possible isolated areas of deeper surface failure where weaker material may exist.  Based on this, it is our opinion that the hazard with respect to landsliding would be low to moderate.

#### 4.1.6 Flood and Seiche Hazards

According to a Federal Emergency Management Agency (FEMA) flood insurance map panel 06073C1725G, the site is outside of a 100-year and 500 year floodplains and subject to minimal flooding.  Based on review of topographic maps, the site is not located downstream of a dam or within a dam inundation area.  In addition, based on our document review there are no dams or facilities upstream of the site that could cause inundation of the subject site.  Based on this review and our site reconnaissance, the potential for flooding of the site is considered low.

A seiche is an oscillatory wave that develops in an enclosed or partially enclosed body of water, such as a bay or lake, in response to seismic shaking from an earthquake. The nearest body of water to each of the site is Palo Verde Reservoir which is approximately 2.2 miles to the west. The elevation of the reservoir is over 1000 feet lower than the project elevations. Given this elevation differential and the distance from the existing reservoir, the hazard with respects to seiche is considered low.

#### 4.1.7 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, concentrated drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

Three samples of the near surface soils in the substation area were tested for expansion index (UBC Standard 18 2). One of these test results indicated an expansion index (EI) of 4 and two tests were non-expansive. Based on this result and our visual evaluation of topsoil and colluvial soil variability through the site, these materials may be classified in the low expansion range (<20 EI). The granular decomposed granitic materials will be present over the majority of the substation pad and will comprise the majority of cut materials to be used as compacted fill. These granular materials were not tested but are considered to have a very low to low expansion potential.

### 4.2 SITE GRADING

#### 4.2.1 General

Based on our understanding of the project and the results of our investigation, grading for the SVC substation pad will generally consist of making cuts up to approximately 15 to 20 feet along the eastern third of the site and placing fills up to about 5 feet to 10 toward the western side. The maximum cut depth is located in the central portion of the eastern retaining. For the transmission line, the work will include the excavation of approximately 1 mile of trench within the northern portion of Bell Bluff Truck Trial. The trench will be approximately 5 feet deep by 30 inches wide. After installation of the electrical conduit within the bottom of the trench, it will be backfill and finished with an asphalt pavement surface.

All site preparation and earthwork operations should be performed in accordance with applicable codes, including Chapter 15 of the County of San Diego Building Code. All reference to maximum dry density is established in accordance with American Society for Testing and Materials (ASTM) ASTM D 1557. Preliminary guidelines for site earthwork and construction are presented in the attached Guidelines for Earthwork Construction included in Appendix D and the following recommendations.

#### 4.2.2 Pre-construction Conference

We recommend that a pre-construction conference be held. Owner representatives, the civil engineer, geotechnical consultant, and EPC contractor should be in attendance to discuss the plans and construction requirements of the project.

#### 4.2.3 Construction Observation

The recommendations presented in this report are based on our understanding of the proposed project and on our evaluation of the data collected. The interpolated subsurface conditions should be evaluated in the field during construction. Final project drawings and specifications should be reviewed by the project geotechnical consultant prior to the commencement of construction.

A representative from our firm should be present during construction to evaluate the suitability of the various soil types exposed during excavation at the site for use as engineered fill. Also, all site preparation and fill placement should be observed and tested by a representative of our firm. This is especially true during the remedial removal and scarification process so that we can observe whether any undesirable material or conditions are encountered in the construction area.

#### 4.2.4 Excavation Characteristics

Our evaluation of excavation characteristics is based on seismic refraction data and velocity correlations, drilling characteristics with hollow stem auger, and the proposed excavation depths. The construction contractor should review this information along with their experience from previous grading and utility trenching within similar sites to assess excavation characteristics. The choice of excavation method is often a function of economics, level of desired effort, logistics, quality and size of machinery used, permit conditions, and/or contractor convenience.

The boring explorations completed at the SVC substation area indicate the subsurface materials consist of shallow loose to medium dense topsoil/colluvium, over decomposed granitic material. Similar conditions and materials were encountered in the borings and observed in road cuts along Bell Bluff Truck Trail. Most of the surficial units consisting of fill and colluvium are relatively shallow. These materials will excavate with moderate effort with conventional heavy duty excavation equipment. The decomposed granitic material can have highly variable excavation characteristics and can often contain areas of hard rock. This was indicated during our field excavation where refusal was encountered with the auger drill rig at some locations at depths as shallow as 5 feet.

A seismic refraction study consisting of five 100-foot lines was performed at five locations along the 1-mile transmission line alignment to characterize the subsurface seismic P-wave velocity profiles. The study was conducted by Southwest Geophysics and their report is included in Appendix A.3. The locations of the survey lines are also shown on Figures 2 and 3. Based on our experience and local, Table 2 below is a comparison of rippability characteristics in relation to the seismic P-wave velocities as determined from a seismic refraction study. For mass grading, the rippability characteristics are based on excavation using a Caterpillar D-9 tractor, equipped with a single shank hydraulic ripper. For trenching, the estimates are based on use of a Caterpillar 345 excavator.

**Table 2**

**Estimated Rippability from Seismic P-Wave Velocities**

| EXCAVATION MEANS | SEISMIC P-WAVE VELOCITY (FT/SEC) | ESTIMATED RIPPABILITY |
|---|---|---|
| Mass Grading | Less than 4,000 | Rippable |
| Mass Grading | 4,000 to 5,500 | Marginally Rippable (Possible Blasting) |
| Mass Grading | Greater than 5,500 | Non-Rippable (Blasting Necessary) |
| Trenching | Less than 3,500 | Rippable |
| Trenching | 3,500 to 4,500 | Marginally Rippable |
| Trenching | Greater than 4,500 | Non-Rippable |

As shown on the seismic profile plots in the Southwest Geophysics report, the seismic velocities were typically on the order of 3,000 feet per second (fps) to 4,000 fps within the proposed 5-foot excavation depth for the transmission line. Localized areas measured velocities of 5,000 to 7,000 fps. The seismic profiles indicate that the degree of weathering typically decreased with depth and that local less weathered zones or corestones are present.

#### 4.2.5 Site Preparation

Prior to site grading at the substation site, existing trees, shrubs and vegetation will require removal. Existing underground structures and utilities (if any) should be completely removed as required to accommodate the proposed improvements. Excavations for removal of the above items should be dish-shaped and backfilled with properly compacted engineered fill. The actual locations of subsurface utilities should be verified in the field at the time of construction. Abandoned utilities should be completely removed, and the loose backfill removed and replaced. The trenches created by relocating any existing utilities should be backfilled with properly compacted fill.

All deleterious, organic, and inert materials exposed at the surface should be stripped and isolated. The stripping work should include the removal of soil that, in the judgment of the geotechnical engineer or geologist, is uncertified, compressible, collapsible, or contains significant voids. The stripping operation should expose a firm, non-yielding subgrade that is free of voids, organics, and deleterious materials. The subgrade exposed at the bottom of each excavation should be observed by a qualified representative from our office prior to the placement of any fill to observe that potentially unsuitable soils have been removed. Additional removals may be required as a result of observation and testing of the exposed subgrade soils.

Based on our review of the preliminary grading plan, and anticipated remedial grading, cuts and fills up to approximately 20 feet and 10 feet are anticipated, respectively. To avoid potential differential settlement at cut/fill transitions under structural areas, we recommend that remedial grading be performed so that a minimum of 3 feet of formational materials be undercut below typical foundation pad elevation and replaced with properly compacted fill. This also facilitates future small excavations such as duct banks and foundations. As an alternative, the cut portion of the site may be sloped at about 6 horizontal to 1 vertical to transition deeper fill to cut. The limits of the remedial grading for the substation should be 5 feet outside of the proposed perimeter of the pad limits. Final recommendations should be provided upon review of the substation layout and evaluation of differential settlement for specific improvements.

The excavated soil should be moisture conditioned, replaced and compacted, as recommended below. We recommend that foundation components of the proposed structures be founded either entirely in undisturbed decomposed granite or entirely in engineered fill materials; foundations of any given structure should not transition between native and fill support. This may be achieved by either overexcavating the cut area and replacing with a similar depth of compacted fill, or by deepening foundation excavations in fill to formational materials and placing a minimum 3-sack sand cement slurry back up to foundation elevation.

We anticipate that on-site materials will primarily be used to complete the grading for the project. The formational materials of the decomposed granite will generally break down fairly well under compactive effort, but some oversize hard rock material will likely remain. Oversize material greater than 6 inches in diameter should be placed a minimum of 8 feet below finish grade in areas outside the substation pad, a minimum of 8 feet from the face of fill slopes, and not in areas where underground construction is planned such as tower foundations or trenches for ducts. Material greater than 3 inches in diameter should not be placed within 2 feet of finished grade.

#### 4.2.6 Recommendations for Treatment of Compressible / Potentially Expansive Soils

The substation site is covered with a variable thickness of potentially compressible topsoil/colluvium. The estimated thickness of the potentially compressible soil will range from about 1 foot to six feet. Existing potentially compressible soils within the limits of site grading should be removed to expose decomposed granitic rock prior to the placement of engineered fill materials. Near-surface soils with an expansion index over 30, if any, may be blended with other granular soils and used as fill. However, blending of expansive materials should be avoided in areas of structural fill below foundations.

#### 4.2.7 Engineered Fill

Fill materials generated from the on-site formational soils are suitable for placement as compacted fill provided they are free of oversized rock, expansive clay, organic materials, and deleterious debris. Rocky material greater than 3 inches in diameter should not be placed within 2 feet of finished grade. Oversize material in excess of 6 inches in diameter should not be used in structural fill within 8 feet of finished grade. Fill soil placed within the upper 4 feet of finished grade in structural areas should consist of granular material with a very low to low expansion index (expansion index of 30 or less) as evaluated by UBC Standard 18-2 (Expansion Index Test). Based on the medium expansion potential (EI=4) of one laboratory test and our geologic logging, the topsoil / colluvium has a low potential for expansion. Additional testing may be performed during grading to further characterize expansion index if clayey soils are encountered.

Fill should be moisture conditioned to or above optimum and be compacted to 90 percent or more relative compaction in general fill areas and 95 percent relative compaction in structural fill areas supporting structures. The maximum dry density of calculating relative compaction should be measured in accordance with ASTM D 1557. Expansive soils with an expansion index greater than 30 should be similarly compacted, but at a moisture content over 2 to 3 percent above optimum. The results of three laboratory modified proctor tests (ASTM D 1557) indicate optimum moisture contents ranging from 7.9 to 9.6 percent. The results of numerous moisture content tests of samples from our investigation indicate an average moisture content of about 4 percent, with a range from 1.5 to 7 percent. The Contractor should anticipate that moisture conditioning of fill will be required to achieve optimum moisture content.

Although the optimum lift thickness for fill soils will be dependent on the type of compaction equipment used, fill should generally be placed in uniform lifts not exceeding approximately 8 inches in loose thickness.

The face of fill slopes should be compacted by back rolling with a sheepsfoot roller as the fill proceeds and track walked with a dozer when the pad grade is achieved.

In pavement areas, the upper 12 inches of subgrade soils should be moisture conditioned to a moisture content of at least optimum and compacted to 95 percent or more of the maximum laboratory dry density, as evaluated by ASTM D 1557.

#### 4.2.8 Import Materials

We recommend that general import material consist of granular, very low to low expansive material (expansion index of 30 or less) as evaluated by UBC Standard 18-2 (Expansion Index Test) and with low corrosivity characteristics. Low corrosivity material is defined as having a minimum resistivity of more than 2,000 ohm-cm when tested in accordance with California Test 643, unless defined otherwise by the corrosion consultant. Import material should be evaluated by the geotechnical consultant at the borrow site for its suitability as fill prior to importation to the project site.

#### 4.2.9 Temporary Slopes

Temporary cut slopes are not anticipated for this project, other than the sides of overexcavations for construction of the substation retaining wall and for removal of colluvium. However, if they become necessary, care should be taken to identify the location and protect subsurface improvements. . For planning purposes, we recommend OSHA soil classifications of Type C be assumed for fill and colluvial soils and Type B for decomposed granitic materials. Except as discussed with regard to utility trench excavation, temporary cut slopes in topsoil/colluvium and granular fill materials should not be steeper than 1.5:1. Cut slopes in clayey fill or underlying decomposed granitic rock to overall excavation depths of 20 feet can be as steep as 1:1. If steeper side slopes should be necessary due to construction restrictions, or excavations are deeper than 25 feet, shoring and bracing should be considered and a specific geotechnical analysis performed. OSHA and Cal-OSHA requirements should be observed for all excavations. If excavations deeper than 25 feet below existing site grades will be made that are not going to be shored or braced, then slopes should be cut at a gradient of 1.5H:1V.

The contractor is responsible for the stability of temporary excavations and his "competent person" should perform regular inspections of any temporary excavations. The contractor should retain a competent geotechnical engineer to develop systems to mitigate the effects of settlement induced by excavations. On a case-by-case basis, the contractor should protect structures which fall on a wedge formed by a 2H:1V slope extending from the bottom of excavation, and on settlement-sensitive structures falling on a wedge 4 horizontal to 1 vertical slope extending from the bottom of the excavation. The protection systems proposed by the contractor should be reviewed by the geotechnical engineer prior to constructing these protective systems.

#### 4.2.10 Permanent Slopes

Plans indicate that cut slopes will have a maximum height of about 20 feet and will be located along the eastern side of the detention pond. Fill slopes will be located around portions of the western, southern and northern sides of the substation pad and have a maximum height of 10 feet at the southern corner. Both cut and fill slopes up to a maximum height of 20 feet can be as steep as 2H:1V. However, due to the potential for long term erosion of the cohesionless sands, fill slope inclinations of 3H:1V may be considered. Benches should be constructed if fill slopes are higher than approximately 30 feet.

New fill slopes should not be constructed above existing topsoil or compressible colluvial soils. Where new fill slopes will be built, the existing topsoil or colluvial soil should be excavated and a keyway constructed into the underlying formational materials. The dimensions and depth of the keyway will depend on final slope configurations and heights. For fill slopes constructed at 2H:1V up to 10 feet high, a keyway having a minimum width of 5 feet and a minimum depth of 2 feet into formational material would be appropriate. Due to the limited height of the fill slopes, benching of the slope face is not required. The base of the keyway should be tilted back at least 2 percent into the slope.

New fill placed on existing slopes that are steeper than 5H:1V should be keyed and benched into the existing hillside. Keyway recommendations are presented in the preceding paragraph.

Benches within the backcut should be a minimum of 10 feet in width and spaced at no more than 4-foot vertical height intervals.

Sliver fills are locations where only several feet of new fill is placed on an existing slope surface. Depending on the specific site and geometric conditions such as subsurface conditions, slope height, thickness of new fill, and site constraints, the width of the key and extend of benching may be modified from those described above by the geotechnical engineer.

Due to the potential for water to perch along the interface of fill and decomposed granitic rock, we recommend that keyways be drained. This may be accomplished by installing a gravel subdrain along the heel of the key and connecting a 4-inch diameter PVC pipe which extends to a slope face at a 2 percent inclination. The subdrain should consist of at least 3 cubic foot per linear foot of permeable drain rock wrapped in Mirifi 140N filter fabric, or equivalent. The gravel drain along the length of the key should have a 2 percent slope to a central or several lowpoints where the PVC pipe is inserted. Permeable drain rock used for subdrainage shall meet the following gradation requirements:

**Table 3**

**Permeable Rock Gradation for Subdrain**

| SIEVE SIZE | PERCENTAGE PASSING |
|---|---|
| 3" | 100 |
| 1-1/2" | 90 - 100 |
| 3/4" | 50 - 80 |
| No. 4 | 24 - 40 |
| No. 100 | 0 - 4 |
| No. 200 | 0 - 2 |

Protection of the discharge location with a concrete headwall or riprap is not required from a geotechnical perspective, as significant flow is not anticipated. However, we do recommend that the pipe protrude at least 12 inches from the slope, the end be secured with wire mesh to prevent rodents from crawling into the pipe, and that the discharge location be marked with a bollard or permanent stake. If any zones of specific seepage are encountered during construction, they should be addressed as recommended by the geotechnical engineer in the field at that time.

4.2.11 Bulking and Shrinkage Factors

Estimates of engineered fill bulking and shrinkage factors are typically based on comparing laboratory compaction tests with the in-place density of the soil material as encountered during the subsurface evaluation. Due to limited lab testing due to high resistance of the sampler, and variations in existing and compacted soil densities, the bulking and shrinkage factors are to be considered very approximate. Based on the results of our laboratory testing and experience, the topsoil/colluvium materials will have an approximate shrinkage factor on the order of 5 to 10 percent when excavated from their existing state and placed as compacted fills. A bulking factor of approximately 3 to 6 percent is anticipated for decomposed granitic materials.

## 4.3 UTILITY TRENCH EXCAVATIONS

### 4.3.1 Temporary Trench Excavations

We recommend that trenches and excavations be designed and constructed in accordance with OSHA regulations. These regulations provide trench sloping and shoring design parameters for trenches up to 20 feet deep based on a description of the soil types encountered. Trenches over 20 feet deep should be designed by the Contractor's engineer based on site-specific geotechnical analyses. For planning purposes, we recommend the following OSHA soil classifications be used in the table below:

**Table 4**
**OSHA Soil Classifications**

| | |
|---|---|
| Fill, Topsoil/Colluvium | Type C |
| Decomposed Granite | Type B |

Temporary excavations should be constructed in accordance with OSHA recommendations. Excavations deeper than 5 feet should be shored or laid back on a slope no steeper than 1.5H:1V (horizontal:vertical) above the decomposed granite and 1H:1V within the decomposed granite. In the case of trench excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes), or by laying back the slopes in accordance with OSHA requirements. Temporary excavations that encounter seepage may require shoring or may be stabilized by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. On site safety of personnel is the responsibility of the contractor, and their designated "competent person" should perform regular inspections of all temporary excavations.

#### 4.3.2 Pipe Bedding and Trench Backfill

Pipe bedding should consist of sand or similar granular material having a sand equivalent value of 30 or less. The sand should be placed in a zone that extends a minimum of 4 inches below and 12 inches above the pipe for the full trench width. The bedding material should be compacted to a minimum of 90 percent of the maximum dry density. Trench backfill above pipe bedding may consist of approved, on-site or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry density. Sand cement slurry is also acceptable.

It will be necessary to keep vibrations away from the immediate excavation area and provide adequate setback of stockpiled materials and construction equipment for a stable condition. It is recommended that the setback distance be one-half the excavation depth. Some minor sloughing may occur as the moisture content of the soils in the excavation walls dry out. Shoring and/or bracing of trenches may be required where construction personnel are working within excavations. Applicable governmental safety codes should be applied for safety of personnel.

### 4.4 FOUNDATIONS AND SLABS FOR STRUCTURES

#### 4.4.1 General

The following sections provide geotechnical parameters that are suitable for preliminary design purposes and bidding purposes. The EPC Contractor should develop their own parameters for final design.

The proposed substation structures and walls may be supported on shallow spread and continuous footings founded entirely on either engineered fill soils or undisturbed formational materials. Drilled pier foundations may also be utilized for some substation equipment and steel pole foundations. Structures may include equipment pads, control house, perimeter screen wall, and possibly short masonry block retaining walls. Foundations for each individual structure should be supported on the same type of material, that is, either entirely supported by engineered fill or undisturbed decomposed granitic rock. Foundations should not be supported on a combination of both materials such as may occur where there is a transition between fill and decomposed granitic rock. The fill soils below the footprint of each improvement should be prepared as stated in Section 4.2.7. All footing excavations should be observed by a representative of the geotechnical engineer prior to placing reinforcing or concrete to verify proper subgrade conditions.

Spread and continuous footings for the substation structures that will be founded on engineered fill soils can be designed using an allowable soil bearing pressure of 2,500 psf, for dead loads plus long-term live loads. These values are based on a minimum depth of 12 inches and minimum width of 18 inches and may be increased by 500 psf for each additional foot of depth or width, up to a maximum of 4,000 psf. Based on an anticipated 3-foot minimum overexcavation across the substation pad, we do not anticipate that foundations will be directly within decomposed granitic rock materials, however, higher bearing values could be provided for foundations on decomposed granitic rock.

Mat foundations for equipment pads that will be founded on engineered fill soils can be designed using an allowable soil bearing pressure of 4,000 psf, for dead loads plus long-term live loads. These values can be increased by one-third for short term loads such as those due to wind and seismic forces. For preliminary design, we recommend an uncorrected static modulus of vertical subgrade reaction (k) for engineered fill of 175 pounds per cubic inch (pci). This value should be adjusted for mat dimensions in final design. Foundations subject to dynamic loading should be evaluated when specific information is provided. During design development, the geotechnical engineer should review the mat deflections and contact pressures developed from structural engineering analyses and reassess the modulus as necessary to finalize the design.

All footings should be extended in depth as necessary so that no existing or proposed utility trenches will extend below a plane having a downward slope of 2H:1V from a line 9 inches above the bottom edge of the closest footing. In addition, no parallel trenches should be within 18 inches from the closest edge of the footing. New footings should not be excavated below the bottom of adjacently located existing building foundations.

#### 4.4.2 Estimated Settlements

Estimated total settlements for the proposed improvements, constructed in accordance with the recommendations contained herein, are anticipated to be less than 1/2 inch. Estimated differential settlement between points 40 feet apart on continuous footings and/or isolated spread footings are anticipated to be less than 1/4 inch.

### 4.4.3 Lateral Resistance

For passive resistance, we recommend using an allowable equivalent fluid weight of 300 pcf for footings or grade beams poured neat against properly compacted select fill or decomposed granitic rock. This lateral pressure assumes a horizontal surface for the soil mass extending at least 10 feet from the face of the footing, or three times the height of the surface generating passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by concrete slabs should not be included in design for passive resistance to lateral loads. The coefficient of friction between the bottom of the footings or grade beams and the prepared soil can be assumed as 0.45. If passive and frictional resistance are combined, the frictional resistance should be reduced to 0.35.

### 4.4.4 Concrete Slabs-On-Grade

Concrete slabs-on-grade can be used for light equipment pads. These pads should be supported by either a minimum of 6 inches of compacted Caltrans Class II aggregate base or compacted fills. The fill or aggregate base should be compacted to at least 90 percent of ASTM D 1557. As a minimum, these slabs should have a thickness of 6 inches and should be reinforced with No. 4 steel rebar placed mid-height and spaced at 12 inches on center in both directions. Additional reinforcement should be placed as required by the structural engineer.

Slab-on-grade floors for the substation control house, should be underlain by engineered fill compacted. To provide uniform subgrade support, a 6 inch layer of clean free-draining sand, gravel or crushed rock conforming to Section 7.1 of Appendix C should be placed between the finished subgrade and the bottom of the concrete. The subgrade should be compacted to at least 90 percent of ASTM D 1557.

## 4.5 DRILLED PIER FOUNDATIONS

Drilled pier lengths should satisfy criteria for downward, uplift and lateral loading. We understand that Sargent & Lundy will utilize the Electric Power Research Institute (EPRI) computer program Moment Foundation Analysis Design (MFAD) to design deep foundations such as drilled piers. We recommend utilizing the preliminary soil parameters in Table 5 for compacted fill and undisturbed decomposed granitic rock. We recommend utilizing the soil parameters in Table 6 for the western pole which will be underlain by decomposed granitic rock with various degrees of weathering. Other than the pole at the western end of the transmission line, the actual location of other poles is not know at this time. Therefore, the depth to formation is not provided at this time. Actual depths may be estimated from the existing topography and final pad elevations, and accounting for the potential depth of remedial grading. Kleinfelder can provide the estimated depth to formation when this information is available.

Axial capacity is a function of pier diameter and depth, depth of compacted fill, degree of weathering of rock, and allowable settlement. The capacity includes both frictional resistance on the perimeter of the pier and end bearing which increased with increasing settlement. To assist in preliminary planning, an allowable capacity of 100 kips is estimated for drilled piers with an assumed depth of 15 feet, diameter of 2 feet and located in areas with about 10 feet of fill or highly weathered rock. This capacity consists of about 50 kips of friction and 50 kips of end bearing for the assumed conditions. Additional estimates can be provided for specified locations, dimensions and loading conditions.

The parameters were developed based on the results of our field and laboratory investigation, engineering analyses, correlations for soil contained the EPRI Manual (1990) and engineering judgment. These values are intended for use in computer program MFAD only, values for other design analyses may be provided upon request.

**Table 5**

**Preliminary Soil Parameters for MFAD Analysis**

| SOIL TYPE | UNIT COHESION (PSF) | FRICTION ANGLE (DEGREES) | MOIST UNIT WEIGHT (PCF) | MOISTURE CONTENT (%) | DEFORMATION MODULUS $E_{PMT}$ (KSI) | STRENGTH REDUCTION FACTOR |
|---|---|---|---|---|---|---|
| FILL<br>Silty Sand (SM) and Clayey Sand (SC) | 0 | 33 | 125 | 9 | 1.2 | 1.0 |
| DECOMPOSED GRANITIC ROCK<br>Sand (SM) | 100 | 36 | 130 | 4 | 5.0 | 1.0 |

## Table 6

**Soil Parameters for MFAD Analysis**

**Pole at West End of Transmission Line**

| SOIL TYPE | DEPTH FROM SURFACE (ft) | UNIT COHESION (psf) | FRICTION ANGLE (degrees) | MOIST UNIT WEIGHT (pcf) | MOISTURE CONTENT (%) | DEFORMATION MODULUS EP (ksi) | STRENGTH REDUCTION FACTOR |
|---|---|---|---|---|---|---|---|
| Completely Weathered Rock | 0 to 20 | 0 | 33 | 125 | 9 | 1.2 | 1.0 |
| Highly Weathered Rock | 20 to 28 | 100 | 36 | 130 | 4 | 5.0 | 1.0 |
| Moderately Weathered Rock | 28 to 38 | 2,500 | 45 | 140 | 4 | 30.0 | 0.45 |
| Slightly Weathered Rock | 38 to 60 | 4,000 | 40 | 150 | 4 | 100.0 | 0.35 |

Note: 1. The upper 2-feet of material should be ignored in design.
2. Reductions in capacity due to proximity of descending slopes should be considered by the designer.

### 4.6 CANTILEVER RETAINING WALLS

Current plans include a retaining wall up to approximately 15 feet in height along the northeastern side of the proposed substation. Lateral pressures acting against retaining walls can be calculated assuming that the backfill soils act as a fluid. The equivalent fluid weight (efw) value would depend on allowable wall movement. Walls which are free to rotate at least 0.5 percent of the wall height can be designed for the active efw. Walls which are restrained at the top or are sensitive to movement and tilting should be designed for the at-rest efw.

Our study indicates that potential fill materials generated from cuts into the decomposed granitic rock are suitable for use as retaining wall backfill. Colluvial soils may be suitable upon review and approval or mixing with more granular materials, however are discouraged given the quantity of fill derived from decomposed granitic rock which should be available. Therefore, the following values assume that non- to low-expansive sandy soils (SP, SM, SC) will be used as backfill. Values given in the table below are in terms of equivalent fluid weight and assume a triangular distribution.

**Table 7**

**Equivalent Fluid Weights (efw)**

**For Calculating Lateral Earth Pressures**

| CONDITION | SLOPE INCLINATION | EQUIVALENT FLUID WEIGHT (PCF) |
|---|---|---|
| Active | Level | 35 |
| | 2:1 | 65 |
| At-Rest | Level | 55 |
| | 2:1 | 90 |

Fifty and thirty percent of any uniform areal surcharge placed at the top of the wall may be assumed to act as a uniform horizontal pressure over the entire wall for the at-rest and active cases, respectively. As a minimum, we recommend that a vertical traffic surcharge equivalent to 240 psf from 2 feet of soil backfill. The resulting horizontal pressure should be assumed to act as a simplified uniform horizontal pressure over the entire height of the wall, H. Supplemental recommendations should be provided for specific point or line loads.

Retaining walls should be designed to resist earthquake loading with the following recommendations. An estimate of lateral pressures due to seismic loading was evaluated using the Mononobe-Okabe method and one-half of the estimated peak ground acceleration. The resultant seismic force (in pounds) for each linear foot of wall can be estimated as $9*H^2$ for level backfill and 11*H2 for the gently sloping site conditions, where H is the height of the wall (in feet) above its base. The resultant seismic force acts at H/3 above the wall base.

Walls should be provided with drains to reduce the potential for build-up of hydrostatic pressure. A typical drainage system could consist of either a prefabricated drainage board or a one- to two-foot-wide zone of Caltrans Class 2 permeable material wrapped in a geotextile filter fabric, placed immediately adjacent to the wall, and with a perforated pipe at the base. The pipe should be discharged to an appropriate outlet, which is protected against erosion and becoming covered or plugged. For the prefabricated drainage board option, the geotextile manufacturer's recommendations should be followed for installation of a drainage fabric system.

Allowable foundation bearing pressure values described in Section 4.4 of this report can be increased by one-third when calculating resistance caused by loads of short duration, such as earthquake loads. Restraining passive pressure and friction values should not be increased by this amount, but a lower factor of safety that is normally applied to static loads could be used. This factor of safety for dynamic load conditions should not be less than 1.2. Backfill for retaining walls should consist of predominately granular materials from on-site excavations. All backfill should be placed in 8-inch loose lifts, moisture conditions to 2 percentage points above optimum moisture content, and compacted to at least 90 percent relative compaction in accordance with ASTM D 1557. For all retaining walls, we recommend a minimum horizontal distance from the outside base of the footing to daylight of 8 feet for slopes of less than 20 feet in height, and 10 feet for slopes of greater heights.

## 4.7 PAVEMENT SECTIONS

For purposes of preliminary analysis of pavements, we performed an R-value test on three soil samples of potential subgrade materials on-site. Our test results indicate R-values of 19, 31 and 42. Due to the uncertainty of what materials will be present at the surface of driveways or access roads, an R-Value of 20 was conservatively assumed for preliminary design. Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations across the site at the completion of the grading operations. This is a typical approach and pavement sections are often revised during grading.

### 4.7.1 Flexible Pavements

Flexible pavement sections have been evaluated in general accordance with the Caltrans method for flexible pavement design. Traffic indices of 4.5, 5.0, and 6.0 were used to calculate the design thickness. Recommendations for other traffic indices can be provided upon request. Recommended flexible pavement sections for these conditions are given in Table 8.

**Table 8**
**Flexible Pavement Sections**
**Assumed R-Value of 20**

| TRAFFIC INDEX | ASPHALT CONCRETE (INCHES) | AGGREGATE BASE (INCHES) |
|---|---|---|
| 4.5 | 3 | 5.5 |
| 5.0 | 3 | 7 |
| 6.0 | 4 | 8 |

The flexible pavement should conform to, and be placed in general accordance with, current Caltrans Standard Specifications. The aggregate base (Class 2) should comply with the specifications in Section 26 of Caltrans Standard Specifications. The aggregate base and the upper 12 inches of subgrade should be compacted to a minimum of 95 percent relative compaction as obtained by the `ASTM D 1557 test procedure. All concrete curbs should extend below the bottom of adjacent aggregate base materials.

#### 4.7.2 Rigid Pavement

Rigid pavements are typically used in truck traffic areas, parking entrances or trash enclosures (typical Traffic Index of 6). The recommended minimum rigid pavement section is 6 inches of Portland cement concrete (PCC) over 12 inches of Class 2 Aggregate Base.

The concrete pavement should be constructed in an approximate 15-foot square grid system. If a square system is impractical, rectangular panels can be used with the longitudinal distance a maximum of 20 feet.

Longitudinal or transverse control joints should be constructed by hand forming or placing a pre-molded filler such as "zip strips." Longitudinal or transverse construction joints should be keyed. Expansion joints should be used to isolate fixed objects abutting or within the pavement area. The expansion joint should extend the full depth of the pavement. Joints should run continuously and extend through integral curbs and thickened edges. We recommend that joint layout be adjusted to coincide with the corners of objects and structures.

The recommended pavement sections for both flexible and rigid pavements are based on the following conditions:

1. Utility trench backfill should be properly placed and adequately compacted to provide a stable subgrade. Trench backfill below the 12 inches of pavement soil subgrade should be compacted to a minimum of 90 percent relative compaction (ASTM D 1557).
2. An adequate drainage system should be provided to prevent surface water from saturating the subgrade soil. Pavements should be sloped at least 1/2 percent to provide positive drainage, and not be allowed to pond.
3. A periodic maintenance program should be incorporated to include sealing cracks and other measures.

4. Aggregate base materials and the upper 12 inches of subgrade below aggregate base should be compacted to a minimum of 95 percent of ASTM D 1557 maximum dry density.
5. The finished subgrade should be brought to a firm and unyielding condition at the time aggregate base is laid and compacted.
6. Asphalt concrete pavement and aggregate base materials should conform to Section 02510, Parts 2 and 3 of the Standard Specifications for Construction of Public Works (Greenbook), current edition. Portland cement concrete pavement should conform to Subsections 201 1 and 302 6 of the Greenbook.
7. Concrete curbs separating pavement from landscaped areas extend at least six inches into the subgrade to reduce movement of moisture into the aggregate base layer. This reduces the risk of pavement failures to subsurface water originating from landscaped areas.
8. Concrete should be cured with a suitable curing compound or be kept continuously moist for a period of at least seven days in general accordance with Greenbook or ACI guidelines.
9. Traffic should be kept off newly placed concrete for at least seven days or until its flexural strength exceeds 600 pounds per square inch.

## 4.8 FLATWORK

To reduce the potential manifestation of distress to exterior concrete flatwork due to movement of the underlying soil, we recommend that such flatwork be constructed with crack-control joints at appropriate spacing as designed by the structural engineer. Subgrade should be prepared in accordance with the earthwork recommendations presented earlier in this report. Positive drainage should be established and maintained adjacent to flatwork.

## 4.9 PRELIMINARY CORROSIVE SOIL SCREENING

A preliminary corrosive soil screening of on-site soil materials was completed to evaluate their potential effect on concrete and ferrous metals. The corrosion potential was evaluated using the results of laboratory testing on five soil samples obtained during our subsurface evaluation. We have also included the result from a test by URS in 2009 near the proposed pole location at the western end of the transmission line. The results are presented in Table 9 below.

**Table 9**

**Corrosion Test Results**

| BORING | DEPTH (ft) | PH | SULFATE (ppm) | CHLORIDE (ppm) | MINIMUM RESISTIVITY (ohm-cm) |
|---|---|---|---|---|---|
| B-1 | 6-7 | 8.0 | 47 | 21 | 2,000 |
| B-2 | 5-7 | 6.5 | 32 | 11 | 6,500 |
| B-6 | 2.5-4.5 | 6.2 | 59 | 64 | 2,600 |
| B-7 | 2.5-4.5 | 5.9 | 54 | 64 | 4,500 |
| B-8 | 2-4 | 6.0 | 46 | 53 | 4,400 |
| INV-1 | 1.5-4 | 6.4 | 32 | 11 | 6,400 |
| B-04 (URS) | 5 | 7.0 | 54 | 75 | 7,200 |

These tests are only an indicator of soil corrosivity for the samples tested. Other soils found on site may be more, less, or of a similar corrosive nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Minimum resistivity values between 1,000 and 3,000 ohm-cm are normally considered highly corrosive to buried ferrous metals (NACE, 2006). The concentrations of soluble sulfates indicate that the potential of sulfate attack on concrete in contact with the on-site soils is "negligible" based on ACI 318-11 Table 4.2.1 (ACI, 2011). Maximum water-cement ratios and cement types are not specified for these sulfate concentrations.

Kleinfelder's scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included. A qualified corrosion engineer could be retained to review the test results for further evaluation and design protective systems, if considered necessary.

## 4.10 SURFACE DRAINAGE

Foundation performance depends greatly on how well the runoff waters drain from the site. This drainage should be maintained both during construction and over the entire life of the project. Final elevations at the site should be planned so that positive drainage is established around structures. Positive drainage is defined as a slope of 2 percent or more for a distance of 5 feet or more away from structure foundations.

## 4.11 SLOPE PROTECTION AND MAINTENANCE

Although graded slopes on this site are anticipated to be grossly stable, the surficial soils may be somewhat erodible due to low cohesion of the sands. For this reason, the finished slopes should be planted as soon as practical after the end of construction. Cut slopes into the decomposed granitic rock may be difficult to plant. Preferably, deep-rooted vegetation adapted to semi-arid climates should be used. In general, runoff water should not be permitted to drain over the edges of slopes and brow ditches should be used.

## 4.12 STORMWATER INFILTRATION AND BIORETENTION

Kleinfelder understands that as part of storm water management for the project, Infiltration Best Management BMPs, such as a detention basin is being considered. Due to site access limitations at the time of our investigation, we only performed one borehole percolation test west of the proposed basin area. The results of this test should be considered preliminary and used to assess feasibility of infiltration. Supplemental testing should be performed when site access to the basin area is provided. We also performed grain-size distribution laboratory tests to assess the grain size. The borehole infiltration tests along with rough correlations with grain-size distribution tests were used to evaluate the infiltration capabilities of the subsurface soils. The methodology of the borehole percolation test was discussed in Section 2.2.

Infiltration testing was performed within INF-1 which was drilled to a depth of 5 feet. This test boring was located adjacent to boring B-3 which was drilled to a depth of 20 feet to assess the underlying soils. Colluvial soils consisting of clayey sand were present at the test boring from a depth of about 2 ½ feet to 6 ½ feet. The colluvium is underlain by decomposed granitic rock. Fines contents passing the No. 200 sieve were between approximately 20 and 46 percent. Based on the results of the borehole infiltration tests, the soil classification and gradation tests, the use of infiltration BMPs, such as detention basins for storm water management are feasible, however, we recommend that the colluvial soils be removed.

The percolation test results provides the short-term infiltration rate of a soil layer. The long-term design infiltration rate is the short term value with a factor of safety of 3 applied. The short and long term infiltration rates are presented below.

**Table 10**

**Preliminary Infiltration Rate**

| LOCATION | DEPTH OF TEST (ft) | SHORT-TERM INFILTRATION RATE (in/hour) | LONG-TERM DESIGN INFILTRATION RATE (in/hour) |
|---|---|---|---|
| INV-1 | 4.8 | 1.5 | 0.5 |

Based on the results of the infiltration tests and the rough correlation of the grain-size distribution with hydraulic conductivity, and considering factors such as site variability, potential for long-term siltation and bio-buildup, a preliminary long-term infiltration rate of approximately 0.5 inches per hour may be used for preliminary design.

## 5 ADDITIONAL STUDIES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The required tests, observations, and consultation by Kleinfelder during construction includes, but is not limited to:

- Supplemental infiltration testing for the detention storm water basins;
- A review of plans and specifications;
- Observation of site clearing;
- Construction observation and density testing of fill material placement, trench backfill and subgrade preparation;
- Observation during retaining wall construction; and
- Observation of foundation excavations and foundation construction.

# 6 LIMITATIONS

This report has been prepared for the exclusive use of Sargent & Lundy LLC, NextEra Energy Resources LLC, and their consultants for specific application to the subject project. The findings, conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made.

The scope of services was limited to the field exploration program described in this report. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on our field exploration, laboratory testing programs, and engineering analyses.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues addressed in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, laboratory tests, and our present knowledge of the proposed construction. It is possible that soil or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, or locations of the improvements, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid until the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

Our geotechnical scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field. Kleinfelder must be retained so that all geotechnical aspects of construction will be monitored on a full-time basis by a representative from Kleinfelder, including site preparation, ground improvement, preparation of foundations, and placement of engineered fill and trench backfill. These services provide Kleinfelder the opportunity to observe the actual soil and groundwater conditions encountered during construction and to evaluate the applicability of the recommendations presented in this report to the site conditions. If Kleinfelder is not retained to provide these services, we will cease to be the engineer of record for this project and will assume no responsibility for any potential claim during or after construction on this project. If changed site conditions affect the recommendations presented herein, Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinion, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

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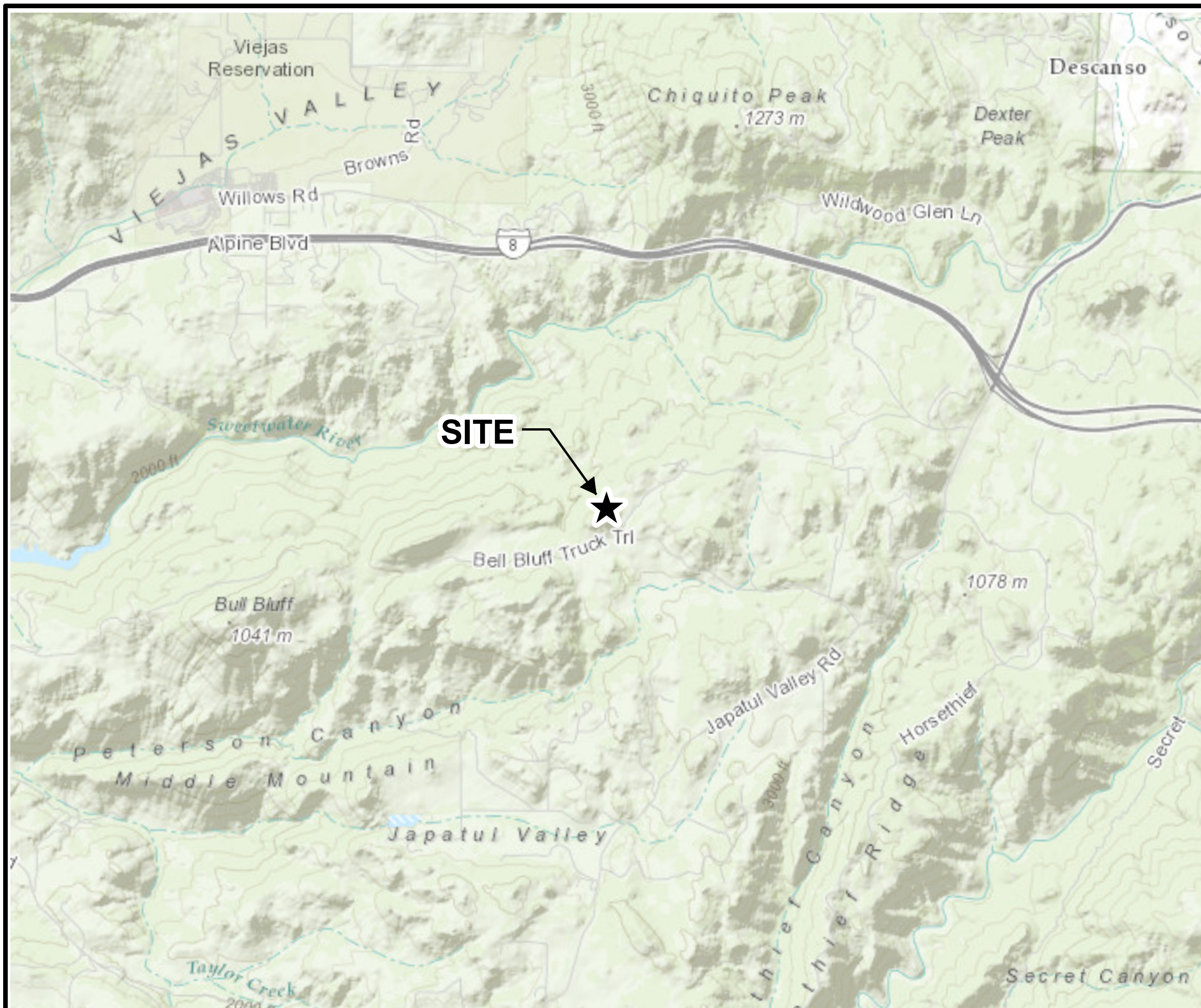
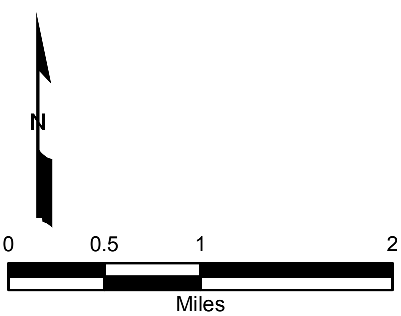
# FIGURES

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| CHECKED BY: | SR |
| FILE NAME: | 20160674_Vicinity.mxd |

**VICINITY MAP**

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE

**1**

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## LEGEND

| | |
|---|---|
| B-9 | BORING LOCATION |
| B-04 | BORING LOCATION (URS, 2009) |
| INF-1 | INFILTRATION TEST LOCATION |
| SL-9 | SEISMIC REFRACTION SURVEY LINE |
| RST-4 | RESISTIVITY SURVEY LINE |
| RSL-07 | REFACTION SURVEY LINE (URS, 2009) |
| ReMi-9 | REFACTION MICROTREMOR SURVEY LINE |
| | PROPOSED SUBSTATION ALIGNMENT |

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| CHECKED BY: | SR |
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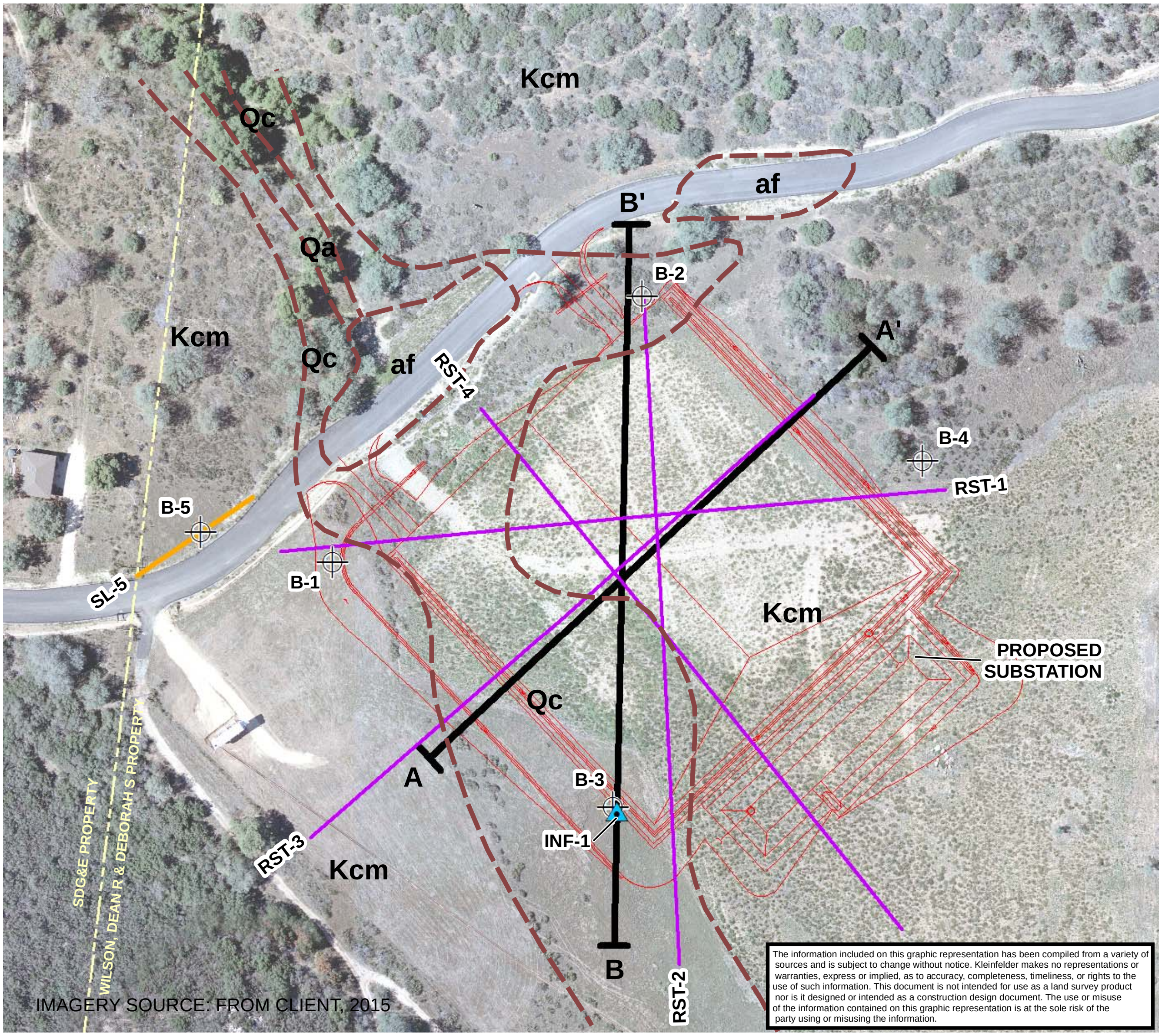
SITE PLAN

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE

2

J:_clients\SunCrest\20160674\MXD\20160674_SitePlan.mxd




**LEGEND**

| | |
|---|---|
| B-9 | BORING LOCATION |
| INF-1 | INFILTRATION TEST LOCATION |
| SL-9 | SEISMIC REFRACTION SURVEY LINE |
| RST-4 | RESISTIVITY SURVEY LINE |
| RSL-07 | REFACTION SURVEY LINE (URS, 2009) |
| ReMi-9 | REFACTION MICROTREMOR SURVEY LINE |
| | APPROXIMATE LOCATION OF GEOLOGIC CONTACT |
| | PROPOSED SUBSTATION ALIGNMENT |
| af | ARTIFICIAL FILL |
| Qa | ALLUVIAL DEPOSITS |
| Qc | COLLUVIAL DEPOSITS |
| Kcm | CORTE MADERA MONZOGRANITE |
| B B' | APPROXIMATE LOCATION OF GEOLOGIC CROSS SECTION |

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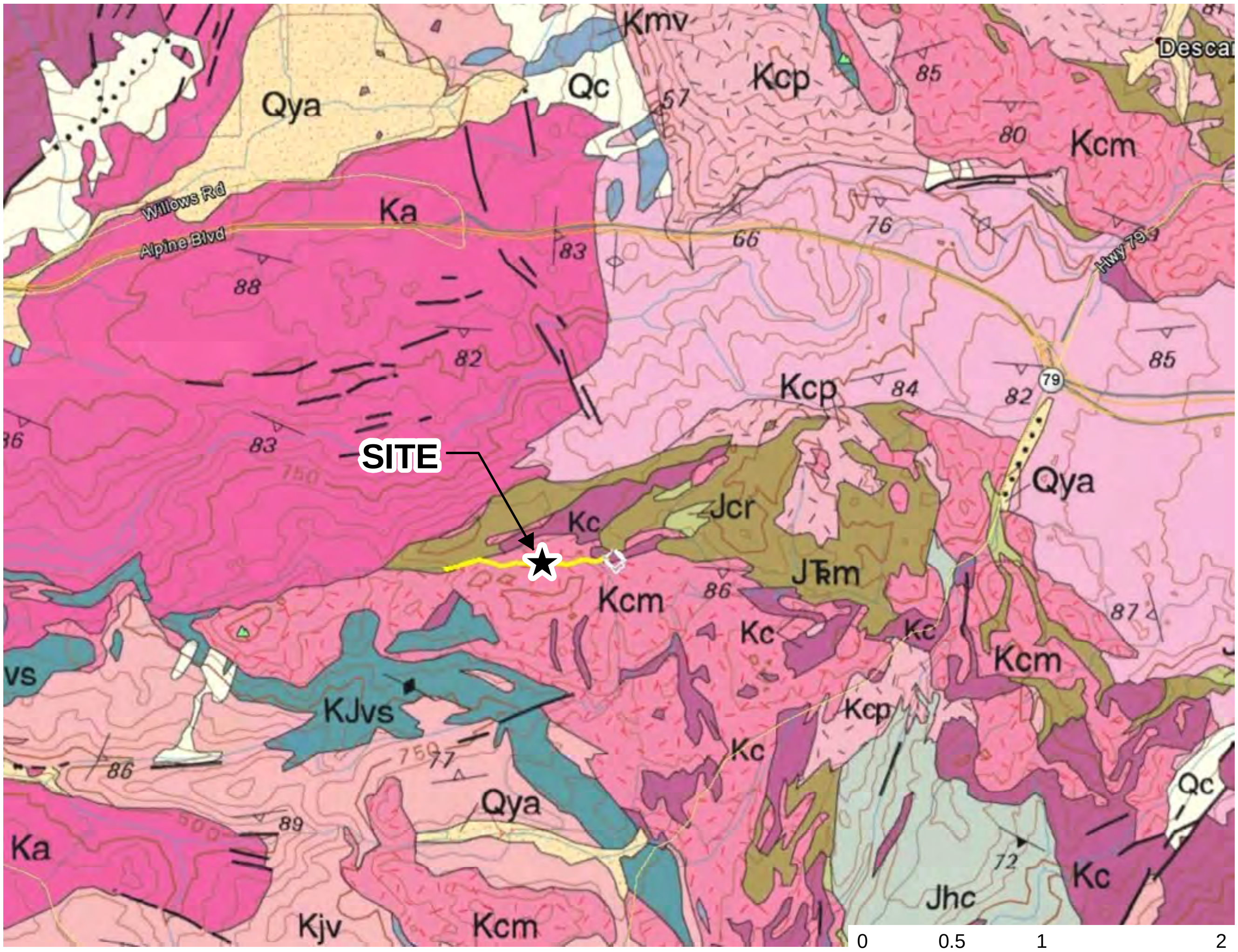
| FILE NAME: | 20160674_SiteGeo.mxd |

GEOLOGIC MAP
SVC SUBSTATION SITE

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE
3

J:_clients\SunCrest\20160674\MXD\20160674_SiteGeo.mxd




0 0.5 1 2

Miles

## LEGEND

| | |
|---|---|
| **Qya** | Young alluvium (Holocene) |
| **Qc** | Colluvium (Holocene and Pleistocene) |
| **Klb** | Tonalite of Las Bancas (Early Cretaceous) |
| **Kc** | Cuyamaca Gabbro (Early Cretaceous) |
| **Kcm** | Corte Madera Monzogranite (Early Cretaceous) |
| **Kcp** | Chiquito Peak Monzogranite (Early Cretaceous) |
| **Kjv** | Japatul Valley Tonalite (Early Cretaceous) |
| **Ka** | Tonalite of Alpine (Early Cretaceous) |
| **Jcr** | Granodiorite of Cuyamaca Reservoir (Late and MiddleJurassic) |
| **Jhc** | Gneiss of Harper Creek (Late and Middle Jurassic) |
| **Kmv** | Metavolcanic rocks (Early Cretaceous) |
| **KJvs** | Metavolcanic and metasedimentary rocks (Cretaceous and Jurassic?) |
| **JTrm** | Metasedimentary and metavolcanic rocks (Jurassic and Triassic) |
| | Fault |
| | Fault- Inferred |



SOURCE:
Preliminary Geologic Map of the El Cajon 30' x 60' Quadrangle, Southern California, Version 1.0, compiled by Victoria R. Todd, 2004

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REGIONAL GEOLOGIC MAP

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE

4

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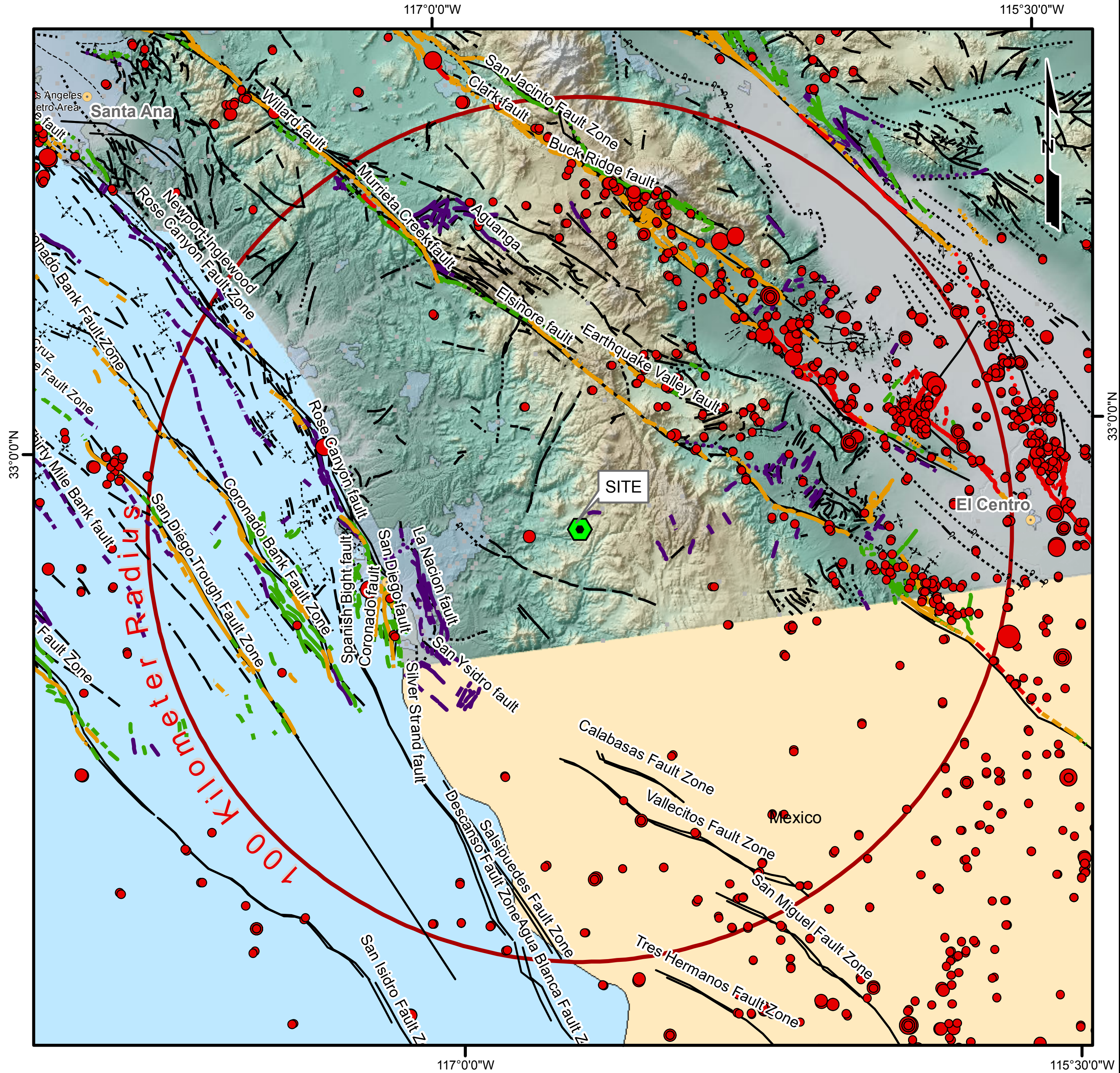


## Faulting Legend

**Quaternary Faults (Bryant, 2005; USGS, 2009)**

**Historic displacement (< 200 years)**
- Mapped Fault Location
- Dashed were Approximated
- Concealed

**Holocene displacement (< 11,000 years)**
- Mapped Fault Location
- Dashed were Approximated
- Concealed

**Late Quaternary displacement (< 750,000 years)**
- Mapped Fault Location
- Dashed were Approximated
- Concealed

**Quaternary displacement (< 1,600,000 years)**
- Mapped Fault Location
- Dashed were Approximated
- Concealed

**Pre-Quaternary Geologic Structures (CGS, 2000)**
- fault, approx. located
- fault, approx. located, queried
- fault, certain
- fault, concealed
- fault, concealed, queried
- fault, inferred, queried

**ANSS Earthquakes**

**Magnitude**
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9

35 17.5 0 35 Kilometers



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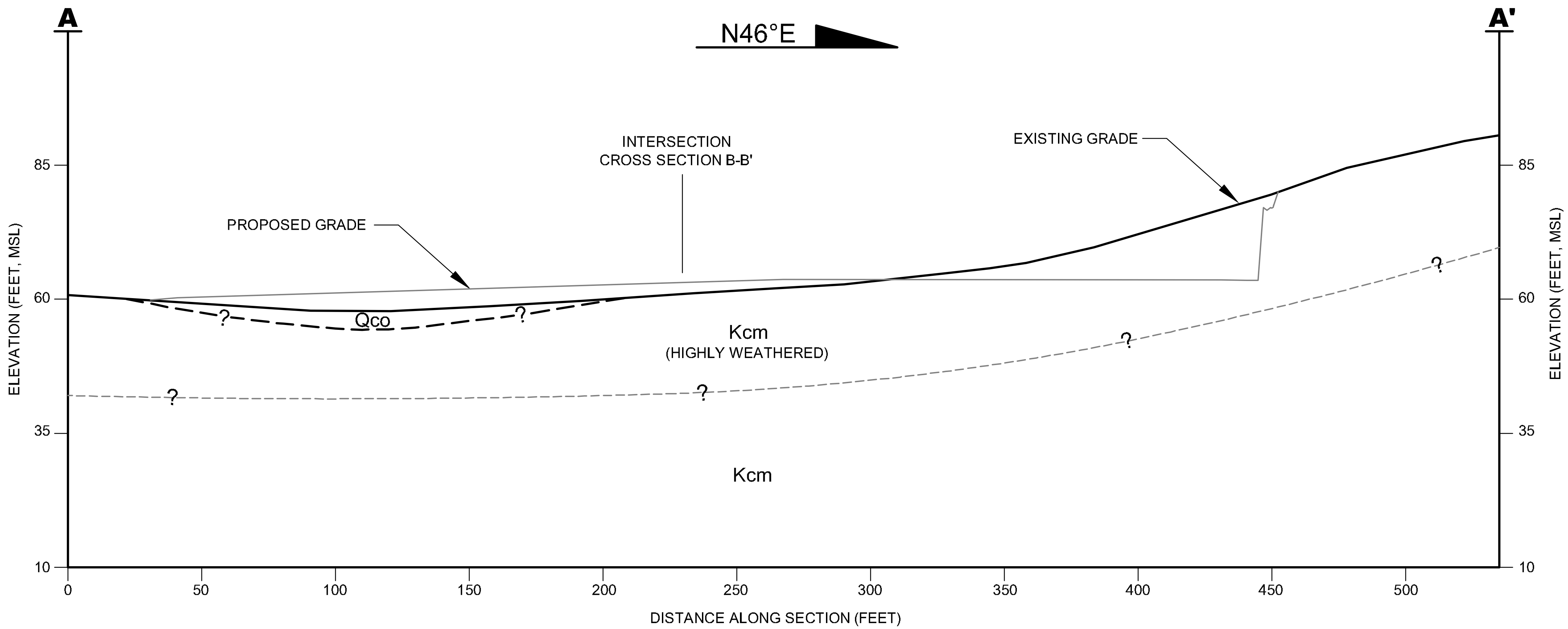
| | |
|---|---|
| PROJECT NO. | 20160674 |
| DRAWN: | 08/05/15 |
| DRAWN BY: | LM |
| CHECKED BY: | SR |
| FILE NAME: | 20160674_EQ_Map.pdf |

# REGIONAL FAULT AND EARTHQUAKE EPICENTER MAP (1800 - MAY 2015)

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE
**5**




## LEGEND

| | |
|---|---|
| Qco | COLLUVIAL DEPOSITS |
| Kcm | CORTE MADERA MONZOGRANITE |
| — ? — | APPROXIMATE LOCATION OF GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN |
| B-3, TD = 20' | APPROXIMATE LOCATION OF BORING, SHOWING BORING ID AND TOTAL BORING DEPTH IN FEET |

50 25 0 50
APPROXIMATE HORIZONTAL SCALE (feet)

25 0 25
APPROXIMATE VERTICAL SCALE (feet)



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| | |
|---|---|
| PROJECT NO. | 20160674 |
| DRAWN: | 9-10-2015 |
| DRAWN BY: | JP |
| CHECKED BY: | SR |
| FILE NAME: | 20160674_Sections.dwg |

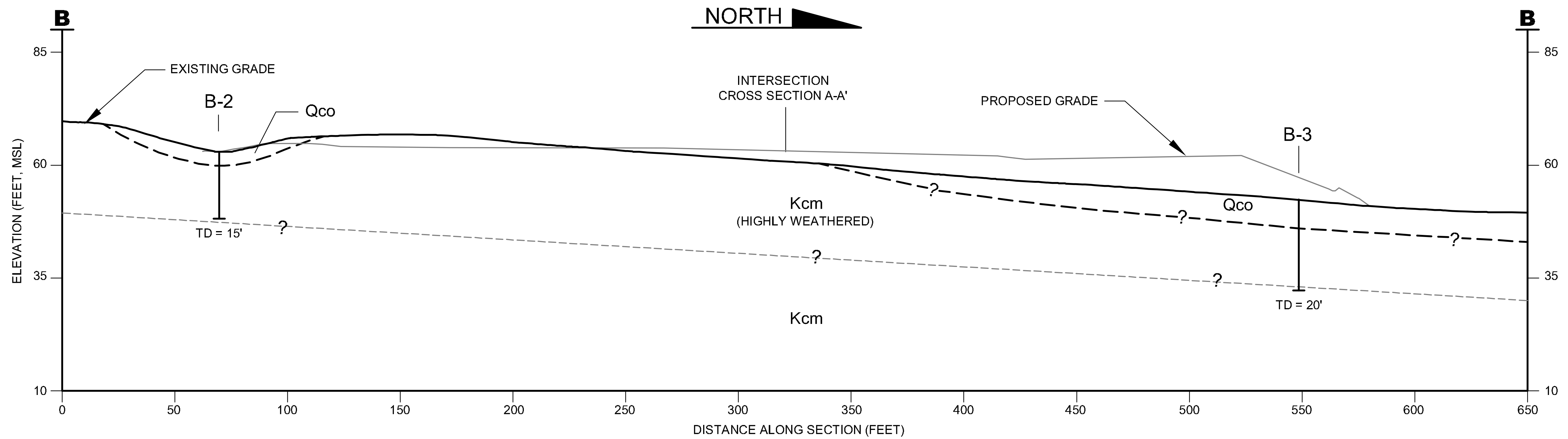
**GEOLOGIC CROSS SECTION A-A'**

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE
**6**

ATTACHED IMAGES:
ATTACHED XREFS:

CAD FILE: J:_clients\SunCrest\20160674\MXD\ LAYOUT: Layout2 PLOTTED: 09 Sep 2015, 11:43am, jpatay




## LEGEND

| | |
|---|---|
| Qco | COLLUVIAL DEPOSITS |
| Kcm | CORTE MADERA MONZOGRANITE |
| — ? — | APPROXIMATE LOCATION OF GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN |
| B-3 TD = 20' | APPROXIMATE LOCATION OF BORING, SHOWING BORING ID AND TOTAL BORING DEPTH IN FEET |

50 25 0 50
APPROXIMATE HORIZONTAL SCALE (feet)

25 0 25
APPROXIMATE VERTICAL SCALE (feet)



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| | |
|---|---|
| PROJECT NO. | 20160674 |
| DRAWN: | 9-9-2015 |
| DRAWN BY: | JP |
| CHECKED BY: | SR |
| FILE NAME: | 20160674_Sections.dwg |

**GEOLOGIC CROSS SECTION B-B'**

SUNCREST 230KV SVC TRANSMISSION LINE
AND SVC SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA

FIGURE
**7**

# APPENDIX A

# FIELD INVESTIGATION

# APPENDIX A
# FIELD INVESTIGATION

The subsurface conditions at the substation site were investigated by drilling four exploratory geotechnical borings, and performing one infiltration test and two pairs of resistivity surveys. The substation borings were drilled to depths of approximately 15 to 25 feet below the existing ground surface (bgs). The boring for infiltration testing was drilled to a depth of approximately 5 feet bgs adjacent to 20-foot deep Boring B-3.

The subsurface conditions for the transmission line alignment were investigated by drilling five exploratory geotechnical borings and performing five P-wave refraction survey lines and one refraction microtremor (ReMi) profile were performed along Bell Bluff Truck Trail just off the northern edge of the road. The transmission alignment borings were drilled to depths of approximately 5 to 17 ½ feet bgs.

All borings were drilled by Pacific Drilling of San Diego, California using an all-terrain truck-mounted Marl M5 drill rig equipped with 6-inch-diameter hollow-stem augers. This work was conducted on July 20 and 21, 2015. A geologist from our office supervised the field operations and logged the borings. Selected bulk and relatively undisturbed samples were retrieved from the borings and transported to our laboratory for further evaluation. The borings were backfilled in accordance with County of San Diego Department of Environmental Health guidelines. The approximate locations of the current borings and previous URS boring are presented on Figure 2, Site Plan.

A Unified Soil Classification System (USCS) chart and a Boring Log Legend are presented as Figures A1 and A2, respectively. The Logs of Borings are presented as Figures A3 through A12. The Log of Boring performed in 2009 by URS for boring B-04 is provided in Appendix A.2.

The Logs of Borings describe the earth materials encountered, samples obtained, and show field and laboratory tests performed. The logs also show the general location, boring number, drilling date, and the names of the logger and drilling subcontractor. The borings were logged by an engineer/geologist using the USCS. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and intact samples of representative earth materials were obtained from the borings. The borings were backfilled using bentonite chips for borings deeper than 20 feet or soil cuttings for borings shallower than 20 feet per DEH guidelines and any remaining soil cuttings were spread out in the vicinity of the boring location.

In-place soil samples were obtained at the test boring locations using a California penetration sampler driven a total of 18-inches (or until practical refusal), into the undisturbed soil at the bottom of the boring. The soil sampled by the California sampler (3-inch O.D., 2.4 inches I.D.) was retained in 6-inch long brass tubes for laboratory testing. An additional 2-inches of soil from each drive remained in the cutting shoe and was usually discarded after visually classifying the soil. The samplers were driven using a 140 pound automatic hammer falling 30-inches. The total number of hammer blows required to drive the sampler the final 12-inches is termed the blow count and is recorded on the Logs of Borings. For clarification, the blow counts presented on the Logs are raw and have not been adjusted for the effects of overburden pressure, input driving energy, rod length, sampler correction, or boring diameter correction. This is the typical way to present information on borings logs and the mentioned corrections are performed for analysis purposes.

Geophysical testing included two pairs of resistivity tests performed at the proposed substation site and five P-wave refraction survey lines and one refraction microtremor (ReMi) profile performed along the transmission line alignment. The geophysical testing was performed by Southwest Geophysics of San Diego, California on July 22 and 23, 2015. The resistivity tests were comprised of two separately tested survey lines that crossed roughly perpendicularly and were up to approximately 600 feet long. The resistivity data were collected in general accordance with ASTM G57 using an Advanced Geosciences, Inc. (AGI) MiniSting earth resistivity meter and four stainless steel electrodes in a Wenner configuration. Soil resistance measurements were collected at electrode spacings of approximately 2, 3, 5, 7, 10, 20, 30, 50, 70, 100 and 200 feet. The soundings were performed along four different orientations in order to assess possible lateral variations in resistivity. The P-wave refraction survey lines were comprised of one line each and are approximately 125 feet in length. One ReMi line (R-1) was conducted along refraction line SL-1. The purpose of R-1 was to obtain additional subsurface data in this area, since there was a potential for interference from the presence of a storm drain line and nearby asphalt road. The results were also used to calculate the shear wave velocity in the upper 100 feet of the site. The approximate locations of the survey lines are presented on Figure 2 and Figure 3. A copy of the Southwest Geophysics geophysical report is included in Appendix A.3 of this report.

# APPENDIX A.1

# LOGS OF KLEINFELDER FIELD EXPLORATION

## SAMPLE/SAMPLER TYPE GRAPHICS

- BULK SAMPLE
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

## GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

## NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

## UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

| | | | | | |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve) | GRAVELS (More than half of coarse fraction is larger than the #4 sieve) | CLEAN GRAVEL WITH <5% FINES | $Cu \geq 4$ and $1 \leq Cc \leq 3$ | GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | | $Cu < 4$ and/ or $1 > Cc > 3$ | GP | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | GRAVELS WITH 5% TO 12% FINES | $Cu \geq 4$ and $1 \leq Cc \leq 3$ | GW-GM | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES |
| | | | | GW-GC | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES |
| | | | $Cu < 4$ and/ or $1 > Cc > 3$ | GP-GM | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES |
| | | | | GP-GC | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES |
| | | GRAVELS WITH > 12% FINES | | GM | SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | | | | GC-GM | CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES |
| | SANDS (More than half of coarse fraction is smaller than the #4 sieve) | CLEAN SANDS WITH <5% FINES | $Cu \geq 6$ and $1 \leq Cc \leq 3$ | SW | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | | $Cu < 6$ and/ or $1 > Cc > 3$ | SP | POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | SANDS WITH 5% TO 12% FINES | $Cu \geq 6$ and $1 \leq Cc \leq 3$ | SW-SM | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES |
| | | | | SW-SC | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES |
| | | | $Cu < 6$ and/ or $1 > Cc > 3$ | SP-SM | POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES |
| | | | | SP-SC | POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES |
| | | SANDS WITH > 12% FINES | | SM | SILTY SANDS, SAND-GRAVEL-SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES |
| | | | | SC-SM | CLAYEY SANDS, SAND-SILT-CLAY MIXTURES |

| | | | |
|---|---|---|---|
| FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve) | SILTS AND CLAYS (Liquid Limit less than 50) | ML | INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY |
| | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | CL-ML | INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | OL | ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS (Liquid Limit greater than 50) | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT |
| | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| | | OH | ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY |

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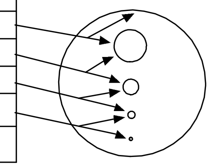
| | | | |
|---|---|---|---|
| PROJECT NO.: 20160674 | GRAPHICS KEY | PLATE |
| DRAWN BY: | | |
| CHECKED BY: | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | A-1 |
| DATE: | | |
| REVISED: - | | |

## GRAIN SIZE

| DESCRIPTION | | SIEVE SIZE | GRAIN SIZE | APPROXIMATE SIZE |
|---|---|---|---|---|
| Boulders | | >12 in. (304.8 mm.) | >12 in. (304.8 mm.) | Larger than basketball-sized |
| Cobbles | | 3 - 12 in. (76.2 - 304.8 mm.) | 3 - 12 in. (76.2 - 304.8 mm.) | Fist-sized to basketball-sized |
| Gravel | coarse | 3/4 -3 in. (19 - 76.2 mm.) | 3/4 -3 in. (19 - 76.2 mm.) | Thumb-sized to fist-sized |
| | fine | #4 - 3/4 in. (#4 - 19 mm.) | 0.19 - 0.75 in. (4.8 - 19 mm.) | Pea-sized to thumb-sized |
| Sand | coarse | #10 - #4 | 0.079 - 0.19 in. (2 - 4.9 mm.) | Rock salt-sized to pea-sized |
| | medium | #40 - #10 | 0.017 - 0.079 in. (0.43 - 2 mm.) | Sugar-sized to rock salt-sized |
| | fine | #200 - #40 | 0.0029 - 0.017 in. (0.07 - 0.43 mm.) | Flour-sized to sugar-sized |
| Fines | | Passing #200 | <0.0029 in. (<0.07 mm.) | Flour-sized and smaller |

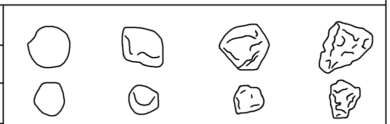


## Munsell Color

| NAME | ABBR |
|---|---|
| Red | R |
| Yellow Red | YR |
| Yellow | Y |
| Green Yellow | GY |
| Green | G |
| Blue Green | BG |
| Blue | B |
| Purple Blue | PB |
| Purple | P |
| Red Purple | RP |
| Black | N |

## ANGULARITY

| DESCRIPTION | CRITERIA |
|---|---|
| Angular | Particles have sharp edges and relatively plane sides with unpolished surfaces |
| Subangular | Particles are similar to angular description but have rounded edges |
| Subrounded | Particles have nearly plane sides but have well-rounded corners and edges |
| Rounded | Particles have smoothly curved sides and no edges |



Rounded Subrounded Subangular Angular

## Particles Present

| Amount | Percentage |
|---|---|
| trace | <5 |
| few | 5-10 |
| little | 15-25 |
| some | 30-45 |
| and | 50 |
| mostly | 50-100 |

## PLASTICITY

| DESCRIPTION | LL | FIELD TEST |
|---|---|---|
| Non-plastic | NP | A 1/8-in. (3 mm.) thread cannot be rolled at any water content. |
| Low (L) | < 30 | The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit. |
| Medium (M) | 30 - 50 | The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit |
| High (H) | > 50 | It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit |

## MOISTURE CONTENT

| DESCRIPTION | FIELD TEST |
|---|---|
| Dry | Absence of moisture, dusty, dry to the touch |
| Moist | Damp but no visible water |
| Wet | Visible free water, usually soil is below water table |

## REACTION WITH HYDROCHLORIC ACID

| DESCRIPTION | FIELD TEST |
|---|---|
| None | No visible reaction |
| Weak | Some reaction, with bubbles forming slowly |
| Strong | Violent reaction, with bubbles forming immediately |

## APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

| APPARENT DENSITY | SPT-$N_{60}$ (# blows/ft) | MODIFIED CA SAMPLER (# blows/ft) | CALIFORNIA SAMPLER (# blows/ft) | RELATIVE DENSITY (%) |
|---|---|---|---|---|
| Very Loose | <4 | <4 | <5 | 0 - 15 |
| Loose | 4 - 10 | 5 - 12 | 5 - 15 | 15 - 35 |
| Medium Dense | 10 - 30 | 12 - 35 | 15 - 40 | 35 - 65 |
| Dense | 30 - 50 | 35 - 60 | 40 - 70 | 65 - 85 |
| Very Dense | >50 | >60 | >70 | 85 - 100 |

NOTE: AFTER TERZAGHI AND PECK, 1948

## CONSISTENCY - FINE-GRAINED SOIL

| CONSISTENCY | UNCONFINED COMPRESSIVE STRENGTH ($q_u$)(psf) | CRITERIA |
|---|---|---|
| Very Soft | < 1000 | Thumb will penetrate soil more than 1 in. (25 mm.) |
| Soft | 1000 - 2000 | Thumb will penetrate soil about 1 in. (25 mm.) |
| Firm | 2000 - 4000 | Thumb will indent soil about 1/4-in. (6 mm.) |
| Hard | 4000 - 8000 | Thumb will not indent soil but readily indented with thumbnail |
| Very Hard | > 8000 | Thumbnail will not indent soil |

## STRUCTURE

| DESCRIPTION | CRITERIA |
|---|---|
| Stratified | Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness |
| Laminated | Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness |
| Fissured | Breaks along definite planes of fracture with little resistance to fracturing |
| Slickensided | Fracture planes appear polished or glossy, sometimes striated |
| Blocky | Cohesive soil that can be broken down into small angular lumps which resist further breakdown |
| Lensed | Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness |
| Homogeneous | Same color and appearance throughout |

## CEMENTATION

| DESCRIPTION | FIELD TEST |
|---|---|
| Weakly | Crumbles or breaks with handling or slight finger pressure |
| Moderately | Crumbles or breaks with considerable finger pressure |
| Strongly | Will not crumble or break with finger pressure |

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PROJECT NO.: 20160674
DRAWN BY:
CHECKED BY:
DATE:
REVISED: -

SOIL DESCRIPTION KEY

SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION
SAN DIEGO, CALIFORNIA

PLATE A-2

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/20/2015 | **Drilling Company:** | Pac Drill | | **BORING LOG B-1** |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby | | |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger | | |
| **Weather:** | Cloudy | **Exploration Diameter:** | 6 in. O.D. | | |

FIELD EXPLORATION / LABORATORY RESULTS

Northing: 1,875,557.103
Easting: 6,433,380.886
Approximate Ground Surface Elevation (ft.): 3,063.0
Surface Condition: Grass

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Colluvial Deposits (Qc)**<br>**Silty SAND (SM)**: dark grayish brown (10YR 4/2), dry, medium dense, (Topsoil) | | | | | | | | | | | |
| 3060 | | **Decomposed GRANITE (Kcm)**; excavates as **Clayey GRAVEL with Sand (GC)**: fine to coarse-grained, angular, yellow (10YR 7/6), moist, very dense | | BC=50 | 6" | GC | 3.8 | 110.6 | 49 | 13 | | | Rocky material in shoe |
| | 5 | Excavates as **Clayey SAND (SC)**: fine to medium-grained, yellow (10YR 7/6)<br>- observed iron oxide and manganese coatings on grain and fracture surface, small percentage of mafic minerals below 5 feet | | BC=13 25 33 | 12" | SC | | | 92 | 18 | 27 | 12 | Expansion Index=4; R-value=19; DS; LC; CORR |
| 3055 | 10 | | | BC=24 50 | 12" | | | | | | | | |
| 3050 | 15 | Excavates as **Well-graded SAND with Silt and Gravel (SW-SM)**: fine to coarse-grained sand, <3/4" dia. gravel, angular, brownish yellow (10YR 6/6), moist, very dense, some manganese oxide staining | | BC=23 35 30 | 18" | | | | | | | | Very hard drilling at 15 feet |
| 3045 | 20 | - observed iron oxide on grain surface, approximately 15-20% mafic minerals below 20 feet | | BC=40 50 | 12" | | | | | | | | |
| 3040 | 25 | - becomes yellowish brown (10YR 5/6) below 25 feet | | BC=50/5" | | | | | | | | | Rod bounced entire drive |
| 3035 | | | | | | | | | | | | | |

The boring was terminated at approximately 25.5 ft. below ground surface. The exploration was backfilled with bentonite on July 20, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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| | | | |
|---|---|---|---|
| PROJECT NO.: 20160674 | BORING LOG B-1 | | PLATE |
| DRAWN BY: MAP | | | |
| CHECKED BY: SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | | A-3 |
| DATE: 8/11/2015 | | | |
| REVISED: - | | | PAGE: 1 of 1 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/20/2015 | **Drilling Company:** | Pac Drill | | **BORING LOG B-2** |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby | | |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger | | |
| **Weather:** | Cloudy | **Exploration Diameter:** | 6 in. O.D. | | |

FIELD EXPLORATION / LABORATORY RESULTS

Northing: 1,875,795.517
Easting: 6,433,658.638
Approximate Ground Surface Elevation (ft.): 3,063.0
Surface Condition: Grass

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Colluvial Deposits (Qc)**: 3", silty, dark gray brown, (Topsoil) | | | | | | | | | | | |
| | | | **Sandy SILT (ML)**: low plasticity, yellowish brown (10YR 5/6), dry, soft | | | | | | | | | | | |
| 3060 | | | **Decomposed GRANITE (Kcm):** excavates as **Clayey GRAVEL with Sand (GC)**: fine to coarse-grained sand, some gravel, sub-angular to angular, low plasticity, mottled dark yellowish brown (10YR 4/6) with white (10YR 8/1) and black (10YR 2/1), dry, very dense | | BC=26 50/5" | 9" | GC | | | 49 | 13 | | | |
| | 5 | | Excavates as **Silty Clayey SAND (SC-SM)**: fine to medium-grained, dark yellowish brown (10YR 4/6) - non-plastic, sample has interlocking granular texture below 5 feet | | BC=50/6" | 4" | SC-SM | 1.5 | 115.0 | 97 | 18 | 26 | 7 | Expansion Index=0; R-value=42; DS; LC; CORR |
| 3055 | | | | | | | | | | | | | | |
| | 10 | | - becomes dark yellowish brown (10YR 3/6), alternating fine grain and coarse texture in sample, large quartz crystals, possible pegmatite dike below 10 feet | | BC=27 50/6" | 12" | | | | | | | | |
| 3050 | | | | | | | | | | | | | | Refusal at 15 feet. Moved 3 feet east, refusal at 13 feet. Moved 3 feet west, refusal at 14 feet. |
| | 15 | | | | BC=50/0" | NR | | | | | | | | |
| 3045 | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | |
| 3040 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | |
| 3035 | | | | | | | | | | | | | | |

The boring was terminated because of practical auger refusal (↑) at approximately 15 ft. below ground surface. The exploration was backfilled with auger cuttings on July 20, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20160674 | BORING LOG B-2 | PLATE |
| | DRAWN BY: MAP | | A-4 |
| | CHECKED BY: SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | |
| | DATE: 8/11/2015 | | |
| | REVISED: - | | PAGE: 1 of 1 |

PLOTTED: 08/14/2015 08:13 AM BY: stena

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/20/2015 | **Drilling Company:** | Pac Drill | | **BORING LOG B-3** |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby | | |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger | | |
| **Weather:** | Cloudy | **Exploration Diameter:** | 6 in. O.D. | | |

FIELD EXPLORATION

Northing: 1,875,336.923
Easting: 6,433,632.751
Approximate Ground Surface Elevation (ft.): 3,053.0
Surface Condition: Grass

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | **Colluvial Deposits(Qc)** **Sandy SILT (ML)**: fine-grained sand, low plasticity, very dark grayish brown (10YR 3/2), dry, soft, (Topsoil) | | | | | | | | | | |
| 3050 | 2.5 | **Clayey SAND with Gravel (SC)**: fine to medium-grained sand, sub-angular to sub-rounded, low plasticity, dark yellowish brown (10YR 4/6), moist, dense | BC=8 10 11 | 18" | | | | | | | | |
| | 5 | | BC=12 22 31 | 18" | SC | 6.7 | 125.3 | 82 | 25 | | | |
| 3045 | 6.5 | **Decomposed GRANITE (Kcm):** excavates as **Clayey SAND (SC)**: fine to medium-grained sand, sub-angular, low plasticity, pale olive (5Y 6/4), moist, very dense | | | | | | | | | | |
| | 10 | Excavates as **Silty SAND with Gravel (SM)**: fine to medium-grained sand, sub-angular to angular, low plasticity, strong brown (7.5YR 4/6) to dark yellowish brown (10YR 4/6), moist, very dense, interlocking granular texture | BC=28 26 25 | 10" | SM | | | 77 | 17 | | | |
| 3040 | | | | | | | | | | | | Drilling becomes difficult at 14 feet |
| | 15 | - cuttings become pale olive (5Y 6/4) | BC=50/2" | NR | | | | | | | | |
| 3035 | 20 | | BC=50/0" | NR | | | | | | | | Sampler rod bouncing |

The boring was terminated at approximately 20 ft. below ground surface. The exploration was backfilled with auger cuttings on July 20, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | | |
|---|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20160674 | BORING LOG B-3 | | PLATE |
| | DRAWN BY: MAP | | | |
| | CHECKED BY: SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | | A-5 |
| | DATE: 8/11/2015 | | | |
| | REVISED: - | | | PAGE: 1 of 1 |

| | | | | |
|---|---|---|---|---|
| **Date Begin - End:** 7/20/2015 | **Drilling Company:** Pac Drill | | **BORING LOG B-4** |
| **Logged By:** S. Rugg | **Drill Crew:** Gordy & Toby | | |
| **Hor.-Vert. Datum:** NAD83 | **Drilling Equipment:** Marl 5 | | **Hammer Type - Drop:** 140 lb. Auto - 30 in. |
| **Plunge:** -90 degrees | **Drilling Method:** Hollow Stem Auger | | |
| **Weather:** Cloudy | **Exploration Diameter:** 6 in. O.D. | | |

FIELD EXPLORATION

Northing: 1,875,647.952
Easting: 6,433,910.782
Approximate Ground Surface Elevation (ft.): 3,079.0
Surface Condition: Grass

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Colluvial Deposits (Qc)**: 3", silty, dark grayish brown, (Topsoil) | | | | | | | | | | | |
| | | | **Silty SAND (SM)**: fine to coarse-grained sand, sub-angular to sub-rounded, low plasticity, strong brown (7.5YR 4/6), moist, very dense | | BC=19 35 44 | 15" | | | | | | | | |
| 3075 | 5 | | **Decomposed GRANITE (Kcm):** excavates as **Clayey SAND (SC)**: coarse to very coarse-grained sand, angular, low plasticity, mottled white (7.5YR 8/1) with black (7.5YR 2.5/1) and reddish yellow (7.5YR 6/8), moist, very dense, sample has interlocking granular texture | | BC=21 39 50/5" | 14" | SC | 3.5 | 124.2 | 99 | 28 | | | |
| 3070 | 10 | | **Decomposed GRANITE (Kcm):** excavates as **Silty SAND (SM)**: coarse to very coarse-grained sand, angular, low plasticity, mottled white (7.5YR 8/1) with black (7.5YR 2.5/1) and reddish yellow (7.5YR 6/8), moist, very dense, sample has interlocking granular texture<br>- becomes fine to coarse-grained sand, sub-angular to angular, mottled light gray (2.5Y 7/2) and black (2.5Y 2.5/1) below 10 feet | | BC=50/6" | 6" | SM | 2.2 | 114.9 | 89 | 13 | | | |
| 3065 | 15 | | - becomes dark yellowish brown (10YR 4/6) below 15 feet | | BC=50/5" | 1" | | | | | | | | |
| 3060 | 20 | | | | BC=50/0" | NR | | | | | | | | |
| 3055 | 25 | | | | | | | | | | | | | |
| 3050 | | | | | | | | | | | | | | |

The boring was terminated at approximately 20 ft. below ground surface. The exploration was backfilled with auger cuttings on July 20, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



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| | | | |
|---|---|---|---|
| PROJECT NO.: 20160674 | BORING LOG B-4 | PLATE |
| DRAWN BY: MAP | | |
| CHECKED BY: SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | A-6 |
| DATE: 8/11/2015 | | |
| REVISED: - | | PAGE: 1 of 1 |

KLEINFELDER - 550 West C Street, Suite 1200 | San Diego, CA 92101 | PH: 858.320.2000 | FAX: 858.320.2001 | www.kleinfelder.com

| | | | | |
|---|---|---|---|---|
| **Date Begin - End:** | 7/20/2015 | **Drilling Company:** | Pac Drill | **BORING LOG B-5** |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby | |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 | **Hammer Type - Drop:** 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger | |
| **Weather:** | Cloudy | **Exploration Diameter:** | 6 in. O.D. | |

FIELD EXPLORATION

Northing: 1,875,584.161
Easting: 6,433,262.241
Approximate Ground Surface Elevation (ft.): 3,071.0
Surface Condition: Grass

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3070 | 0 | | **Colluvial Deposits (Qc)**: 6", silty, dark grayish brown, (Topsoil) | | | | | | | | | | | |
| | | | **Decomposed GRANITE (Kcm);** excavates as **Clayey SAND (SC)**: fine to coarse-grained sand, angular to sub-angular, mottled dark yellowish brown (10YR 4/6) with white (10YR 8/1) and black (10YR 2/1), dry, very dense, interlocking granular texture. | | BC=16 24 21 | 15" | | | | | | | | TR |
| 3065 | 5 | | - becomes dark brown (7.5YR 3/4) below 5 feet | | BC=50/6" | 6" | SC | 6.9 | 128.8 | 97 | 24 | | | TR |
| | | | **Decomposed GRANITE (Kcm);** excavates as **Silty SAND (SM)**: fine to coarse-grained, angular to sub-angular, mottled dark yellowish brown (10YR 4/6) with white (10YR 8/1) and black (10YR 2/1), dry, very dense, interlocking granular texture. | | | | | | | | | | | |
| 3060 | 10 | | - texture becomes finer grain, higher mafic mineral content, increased fine content below 10 feet | | BC=50/4" | 1" | | | | | | | | |
| 3055 | 15 | | - coarse-grained trace gravel, some clay, dark yellowish brown (10YR 3/6), moist below 15 feet | | BC=25 50/3" | 7" | | | | | | | | |
| 3050 | 20 | | | | | | | | | | | | | |
| 3045 | 25 | | | | | | | | | | | | | |

The boring was terminated at approximately 15.8 ft. below ground surface. The exploration was backfilled with auger cuttings on July 20, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20160674 | BORING LOG B-5 | PLATE |
| | DRAWN BY: MAP | | |
| | CHECKED BY: SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | A-7 |
| | DATE: 8/11/2015 | | |
| | REVISED: - | | PAGE: 1 of 1 |

| Date Begin - End: | 7/21/2015 | Drilling Company: | Pac Drill | | **BORING LOG B-6** |
|---|---|---|---|---|---|
| Logged By: | S. Rugg | Drill Crew: | Gordy & Toby | | |
| Hor.-Vert. Datum: | NAD83 | Drilling Equipment: | Marl 5 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Hollow Stem Auger | | |
| Weather: | Foggy | Exploration Diameter: | 6 in. O.D. | | |

FIELD EXPLORATION

Northing: 1,875,460.501
Easting: 6,432,056.19
Approximate Ground Surface Elevation (ft.): 3,128.0
Surface Condition: Dirt

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Decomposed GRANITE (Kcm):** excavates as **Clayey SAND (SC)**: fine to medium-grained sand, low to medium plasticity, strong brown (7.5YR 4/6), dry, hard. | | | | | | | | | | | |
| 3125 | | | | | BC=20 30 40 | 15" | SC | 3.3 | 118.6 | 97 | 31 | | | CORR |
| | 5 | | Excavates as **Clayey SAND (SC)**: low plasticity, mottled pinkish white (7.5YR 8/2) and reddish yellow (7.5YR 6/6), dry, very dense, interlocking texture apparent | | BC=50/6" | 6" | SC | 2.3 | 106.3 | 94 | 27 | | | Very hard drilling at 5 feet |
| | | | | | | | | | | | | | | Refusal at 7.5 feet on first attempt, moved south, refusal at 4 feet |
| 3120 | | | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | | |
| 3115 | | | | | | | | | | | | | | |
| | 15 | | | | | | | | | | | | | |
| 3110 | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | |
| 3105 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | |
| 3100 | | | | | | | | | | | | | | |

The boring was terminated because of practical auger refusal (↑) at approximately 7.5 ft. below ground surface. The exploration was backfilled with auger cuttings on July 21, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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| PROJECT NO.: | 20160674 | BORING LOG B-6 | PLATE |
|---|---|---|---|
| DRAWN BY: | MAP | | A-8 |
| CHECKED BY: | SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | |
| DATE: | 8/11/2015 | | |
| REVISED: | - | | PAGE: 1 of 1 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/21/2015 | **Drilling Company:** | Pac Drill |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger |
| **Weather:** | Foggy | **Exploration Diameter:** | 6 in. O.D. |

**Hammer Type - Drop:** 140 lb. Auto - 30 in.

**BORING LOG B-7**

FIELD EXPLORATION / LABORATORY RESULTS

Northing: 1,875,483.721
Easting: 6,430,804.737
Approximate Ground Surface Elevation (ft.): 3,155.0
Surface Condition: Dirt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium-grained sand, low to medium plasticity, strong brown (7.5YR 4/6), dry, very stiff, mottled texture, roots | | | | | | | | | | |
| | | | BC=11 22 31 | 15" | SC | 3.7 | 115.9 | 99 | 40 | | | CORR; TR |
| | | **Decomposed GRANITE (Kcm):** excavates as **Clayey SAND (SC)**: fine to coarse-grained sand, sub-angular to angular, low plasticity, mottled very pale brown (10YR 8/3) with yellowish brown (10YR 5/6) and black (10YR 2/1), dry, very dense, interlocking granular texture. | | | | | | | | | | |
| 3150 | 5 | | BC=30 50 | 9" | | | | | | | | TR |
| | | Excavates as **Silty SAND (SM)**: fine to coarse-grained sand, sub-angular to angular, low plasticity, very pale brown (10YR 8/3) with black (10YR 2/1), dry, very dense | | | | | | | | | | |
| 3145 | 10 | | BC=50/4" | 3" | | | | | | | | |
| 3140 | 15 | - fine to medium-grained sand, very dark grayish brown (10YR 3/2) with mottled very pale brown (10YR 8/3) below 15 feet | BC=50/1" | 1" | | | | | | | | |
| 3135 | 20 | | | | | | | | | | | |
| 3130 | 25 | | | | | | | | | | | |

The boring was terminated at approximately 15.1 ft. below ground surface. The exploration was backfilled with auger cuttings on July 21, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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| | |
|---|---|
| PROJECT NO.: | 20160674 |
| DRAWN BY: | MAP |
| CHECKED BY: | SHR |
| DATE: | 8/11/2015 |
| REVISED: | - |

BORING LOG B-7

SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION
SAN DIEGO, CALIFORNIA

PLATE
A-9



KLEINFELDER - 550 West C Street, Suite 1200 | San Diego, CA 92101 | PH: 858.320.2000 | FAX: 858.320.2001 | www.kleinfelder.com

| Date Begin - End: | 7/21/2015 | Drilling Company: | Pac Drill | BORING LOG B-8 |
|---|---|---|---|---|
| Logged By: | S. Rugg | Drill Crew: | Gordy & Toby | |
| Hor.-Vert. Datum: | NAD83 | Drilling Equipment: | Marl 5 | Hammer Type - Drop: 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Hollow Stem Auger | |
| Weather: | Foggy | Exploration Diameter: | 6 in. O.D. | |

FIELD EXPLORATION: Northing: 1,875,541.553; Easting: 6,429,877.143; Approximate Ground Surface Elevation (ft.): 3,151.0; Surface Condition: Dirt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3150 | | **Colluvial Deposits (Qc)** **Silty SAND (SM)**: fine to coarse-grained sand, sub-angular to sub-rounded, low plasticity, dark brown (10YR 3/2) mottled yellowish red (5YR 5/6), dry, medium dense, pinhole voids (Topsoil) | | BC=6 11 16 | 15" | SC | 2.3 | 105.6 | 99 | 24 | | | CORR TR |
| | | **Clayey SAND (SC)**: fine to coarse-grained sand, sub-rounded, low plasticity, brown (7.5YR 4/4), dry, dense | | | | | | | | | | | |
| 3145 | 5 | **Decomposed GRANITE (Kcm):** excavates as **Silty SAND (SM)**: fine to coarse-grained sand, sub-angular to angular, low plasticity, mottled very pale brown (10YR 8/3) and black (10YR 2/1) and yellowish brown (10YR 5/6), dry, very dense | | BC=50/6" | 6" | | | | | | | | TR |
| 3140 | 10 | - becomes pale yellow (2.5Y 7/4) below 10 feet | | BC=31 50/4" | 10" | | | | | | | | |
| | | Excavates as **Silty SAND with Gravel (SM)**: fine to coarse-grained sand, angular, low plasticity, brown (10YR 4/3), dry, very dense | | | | | | | | | | | |
| 3135 | 15 | | | BC=50/4" | | | | | | | | | |
| 3130 | 20 | | | | | | | | | | | | |
| 3125 | 25 | | | | | | | | | | | | |

The boring was terminated at approximately 15.3 ft. below ground surface. The exploration was backfilled with auger cuttings on July 21, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



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| PROJECT NO.: | 20160674 | BORING LOG B-8 | PLATE |
|---|---|---|---|
| DRAWN BY: | MAP | | A-10 |
| CHECKED BY: | SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | |
| DATE: | 8/11/2015 | | |
| REVISED: | - | | PAGE: 1 of 1 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/21/2015 | **Drilling Company:** | Pac Drill | | **BORING LOG B-9** |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby | | |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger | | |
| **Weather:** | Foggy | **Exploration Diameter:** | 6 in. O.D. | | |

Northing: 1,875,482.628
Easting: 6,429,445.521
Approximate Ground Surface Elevation (ft.): 3,138.0
Surface Condition: Dirt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | FIELD EXPLORATION: Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | LABORATORY RESULTS: USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Decomposed GRANITE (Kcm):** excavates as **Silty SAND (SM)**: fine to coarse-grained sand, sub-angular, reddish brown (5YR 4/4) | | | | | | | | | | | Drilling at toe of 5 foot high cut |
| 3135 | | | | | BC=25 28 38 | 16" | SM | 4.0 | 132.8 | 99 | 14 | | | |
| | 5 | | | | | | | | | | | | | Refusal at 5 feet on first attempt, moved ~3' east, refusal at 4.5 feet |
| 3130 | | | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | | |
| 3125 | | | | | | | | | | | | | | |
| | 15 | | | | | | | | | | | | | |
| 3120 | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | |
| 3115 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | |
| 3110 | | | | | | | | | | | | | | |

The boring was terminated because of practical auger refusal (↑) at approximately 5 ft. below ground surface. The exploration was backfilled with auger cuttings on July 21, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.



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| | |
|---|---|
| PROJECT NO.: | 20160674 |
| DRAWN BY: | MAP |
| CHECKED BY: | SHR |
| DATE: | 8/11/2015 |
| REVISED: | - |

BORING LOG B-9

SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION
SAN DIEGO, CALIFORNIA

PLATE
A-11

| | | | | | | |
|---|---|---|---|---|---|---|
| **Date Begin - End:** | 7/20/2015 | **Drilling Company:** | Pac Drill | | | **BORING LOG INV-1** |
| **Logged By:** | S. Rugg | **Drill Crew:** | Gordy & Toby | | | |
| **Hor.-Vert. Datum:** | NAD83 | **Drilling Equipment:** | Marl 5 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. | |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hollow Stem Auger | | | |
| **Weather:** | Cloudy | **Exploration Diameter:** | 6 in. O.D. | | | |

FIELD EXPLORATION

Northing: 1,875,333.141
Easting: 6,433,636.203
Approximate Ground Surface Elevation (ft.): 3,053.0
Surface Condition: Grass

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Colluvial Deposits (Qc)** **Sandy SILT (ML)**: low plasticity, very dark grayish brown (10YR 3/2), dry, soft, (Topsoil) | | | | | | | | | | | |
| 3050 | | | **Clayey SAND (SC)**: fine to medium-grained sand, sub-angular to sub-rounded, low plasticity, dark yellowish brown (10YR 4/6) mottled strong brown and black, dry, dense | | | | SC | | | 96 | 37 | 25 | 11 | Expansion Index=0; R-value=31; DS; LC; CORR |
| | 5 | | | | BC=19 27 | | SC | 7.0 | 120.0 | 93 | 43 | | | |
| 3045 | | | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | | |
| 3040 | | | | | | | | | | | | | | |
| | 15 | | | | | | | | | | | | | |
| 3035 | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | |
| 3030 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | |
| 3025 | | | | | | | | | | | | | | |

The boring was terminated at approximately 5.2 ft. below ground surface. The exploration was backfilled with auger cuttings on July 20, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
Placed 2" gravel in bottom of borehole and a 4" dia. 5' casing.
The exploration location and elevation are approximate and were estimated by Kleinfelder.



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| | | | |
|---|---|---|---|
| PROJECT NO.: 20160674 | BORING LOG INV-1 | PLATE |
| DRAWN BY: MAP | | A-12 |
| CHECKED BY: SHR | SUNCREST 230KV SVC TRANSMISSION LINE AND SVC SUBSTATION SAN DIEGO, CALIFORNIA | |
| DATE: 8/11/2015 | | |
| REVISED: - | | PAGE: 1 of 1 |

# APPENDIX A.2

# LOGS OF 2009 URS FIELD EXPLORATION

**Project: SDG&E - Suncrest Substation**
**Project Location: Bell Bluff, San Diego County, California**
**Project Number: 27669017.00002**

# Log of Boring B-04



| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled | 01/19/09 | Logged By | P. McDonald | Checked By | J. Nevius/C. Goetz |
| Drilling Method | Hollow Stem Auger/HQ3 Core | Drill Bit Size/Type | 8" finger bit/HQ3 #6 | Total Depth Drilled | 50.0 feet |
| Drill Rig Type | Deitrich D120 | Drilling Contractor | Tri County Drilling | Approx. Surface Elevation | 3087 feet MSL |
| Groundwater Level | None encountered | Location | N32° 48.682', W116° 40.968' | Inclination from Horizontal/Bearing | 90° |
| Borehole Completion | Bentonite grout | | | Hammer Data | 140 lbs/30" drop |

| Elevation, feet | Depth, feet | Run No. | Box No. | Recovery,% | Fractures per Foot | R Q D, % | Fracture Drawing Number | Lithology | MATERIAL DESCRIPTION | Soil Sample Type | Soil Sample Number | Blows/foot | Drill Time and Rate (ft/hr) | REMARKS AND LAB TESTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | | | | METASEDIMENTARY ROCK<br>Light brown, medium grained, completely weathered, extremely to very weak. Fragments to very dense, dry, clayey to silty SAND (SC-SM) | | 1 | 17 | | SA(20), WC(9), DUW(121), DS |
| 3086 | 1 | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | 2 | 38 | | WA(24), WC(6) |
| 3084 | 3 | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | 3 | 50/3" | | SA(21), WC(4) |
| 3082 | 5 | | | | | | | | | | | | | |
| | 6 | | | | | | | | | | 4 | | | SA(29), WC(5), COMP |
| 3080 | 7 | | | | | | | | Becomes pale yellowish brown | | | | | |
| | 8 | | | | | | | | | | | | | |
| 3078 | 9 | | | | | | | | | | 5 | 50/3" | | SA(29), WA(4) |
| | 10 | | | | | | M | | Becomes completely to highly weathered | | | | 1108 | |
| | | | | | 0 | | | | | | | | | DUW(122), UCS |
| 3076 | 11 | 1 | 1 | 90 | 0 | 90 | | | | | | | 20 | |
| | 12 | | | | 0 | | | | | | | | | |
| 3074 | 13 | | | | | | | | | | | | 1115 | |



URS

**Figure A-5**

| Elevation, feet | Depth, feet | ROCK CORE: Run No. | Box No. | Recovery, % | Fractures per Foot | R Q D, % | Fracture Drawing Number | Lithology | MATERIAL DESCRIPTION | SOIL SAMPLES: Type | Number | Blows/foot | Drill Time and Rate (ft/hr) | REMARKS AND LAB TESTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3074 | 13 | | | | 1 | | 1 | | 1: 15°, J, T, No, N, Pl, Sr | | | | 1120 | |
| | 14 | | | | 0 | | 1 | | | | | | | |
| 3072 | 15 | 2 | | 68 | 1 | 0* | 2 | | 2: 10°, J, T, No, N, Wa, Sr | | | | | DUW(165), UCS |
| | 16 | | | | 1 | | 3, 4 | | 3: 15° J, T, Cl, Sp, Wa, Sr<br>4: 15° J, T, Cl, Sp, Wa, Sr | | | | 14 | *Rock does not meet soundness requirements |
| 3070 | 17 | | | | 2 | | NR | | | | | | 1142 | |
| | 18 | | | | 3 | | 1, 2, 3, M | | | | | | 1146 | |
| 3068 | 19 | | 1 | | 0 | | NR, M, M | | 1: 35°, J, N, Cl, Sp, Pl, S<br>2: 5°, J, N, Cl, Sp, Ir, R<br>3: 60-70°, J, N, Mn, Su, Wa, R | | | | | |
| | 20 | 3 | | 73 | 0 | 0* | | | | | | | 20 | |
| 3066 | 21 | | | | 0 | | M | | | | | | | |
| | 22 | | | | -- | | NR | | | | | | 1201 | |
| 3064 | 23 | | | | 2 | | 1, 2, 3 | | 1: 10°, Fo, Vn, Fe, Su, Pl, Sr<br>2: 15°, J, N, Fe, Su, Ir, R<br>3: 45°, J, N, Fe+Mn, Su, Pl, S | | | | 1210 | |
| | 24 | | | | 1 | | M, M, M | | | | | | | |
| 3062 | 25 | 4 | | 50 | -- | 0* | | | | | | | 15 | |
| | 26 | | | | -- | | NR | | | | | | | |
| 3060 | 27 | | | | -- | | | | | | | | 1230 | |
| | 28 | | 2 | 92 | 9 | 40 | 1, 2, 3, M | | Becomes moderately weathered, moderately strong to strong<br>1: 10°, J, Py, Pa, Pl, S<br>2: 45°, J, N, Fe+Mn, Su, Pl, S<br>3: 80°, J, N, Fe+Mn, Su, Pl, S<br>4: 75°, J, N, Mn, Su, Pl, S | | | | 1233 | |
| 3058 | 29 | | | | | | | | | | | | | |

**Project:** SDG&E - Suncrest Substation
**Project Location:** Bell Bluff, San Diego County, California
**Project Number:** 27669017.00002

# Log of Boring B-04



| Elevation, feet | Depth, feet | Run No. | Box No. | Recovery, % | Fractures per Foot | R Q D, % | Fracture Number | MATERIAL DESCRIPTION | Soil Samples: Type | Soil Samples: Number | Soil Samples: Blows/foot | Drill Time and Rate (ft/hr) | REMARKS AND LAB TESTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3058 | 29 | | | | 6 | | M, 4, 5, 6, M | 5: 5°, J, N, Cl+Py, Fi, Pl, S | | | | | |
| | 30 | 5 | | 92 | 4 | 40 | 7, 8, 9, 10, 11, 12 | Becomes slightly weathered, strong, fine grained, light gray<br>6: 8-10°, J, N, Cl, Fi, Pl, S<br>7: 10°, J, N, Cl, Fi, Pl, S<br>8: 10°, J, Mw, Cl+Sd, Fi, Pl, S<br>9: 10°, J, N, Cl+Sd, Fi, Pl, S<br>10: 30°, J, N, Fe, Sp, Wa, R<br>11: 20°, J, N, Fe, Sp, Wa, R<br>12: 60-70°, J, N, Fe, SP, Wa, R | | | | 6 | DUW(174), UCS |
| 3056 | 31 | | | | 1 | | | | | | | | |
| | 32 | | | | | | NR | | | | | 1325 | |
| 3054 | 33 | | | | 0 | | | | | | | 1330<br>5 | |
| | 34 | | 2 | | 0 | | | | | | | | |
| 3052 | 35 | 6 | | 100 | 0 | 73 | | 1: 45-50°, J, Fe, Su, Pl, Sr | | | | | |
| | 36 | | | | 5 | | | | | | | | |
| 3050 | 37 | | | | 5 | | 2 | 2: 10-30°, J, N, Fe, Su, Wa, R | | | | 1424 | |
| | 38 | | | | 5 | | 1, 2 | 1: 10°, J, N, Mn, Pl, Sr<br>2: 5°, J, N, Mn, Pl, Sr | | | | 1430 | |
| 3048 | 39 | | | | 3 | | 3, 4 | 3: 30°, J, N, Fe, Su, Wa, R<br>4: 30°, J, N, Fe, Su, Pl, Sr | | | | | |
| | 40 | 7 | | 100 | 0 | 90 | | | | | | 5 | |
| 3046 | 41 | | | | 1 | | 5 | 5: 65-70°, J, N, Fe, Su, Wa, R | | | | | |
| | 42 | | | | 0 | | | | | | | 1530 | |
| 3044 | 43 | | 3 | | 0 | | | | | | | 1536 | |
| | 44 | | | 100 | 1 | 90 | M | | | | | 7 | |
| 3042 | 45 | | | | | | | | | | | | |



URS

**Project: SDG&E - Suncrest Substation**
**Project Location: Bell Bluff, San Diego County, California**
**Project Number: 27669017.00002**

# Log of Boring B-04



| Elevation, feet | Depth, feet | Run No. | Box No. | Recovery, % | Fractures per Foot | R Q D, % | Fracture Drawing Number | Lithology | MATERIAL DESCRIPTION | Soil Samples Type | Number | Blows/foot | Drill Time and Rate (ft/hr) | REMARKS AND LAB TESTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3042 | 45 | 8 | 3 | 100 | 6 | 90 | 1, 3, 4 | | 1: 5-15°, N, No, Su, Wa, R<br>2: 40°, J, Fe, Sp, Pl, S<br>3: 75°, J, Fe, Sp, Wa, R<br>4: 40-70°, J, Fe, Sp, Ir, V, R<br>5: 15-20°, J, Fe, Sp, St, R | | | | | |
| | 46 | | | | 2 | | | | ←Near vertical gneiss banding up to 3/4" wide | | | | 7 | |
| 3040 | 47 | | | | 1 | | 5 | | | | | | | |
| | 48 | | | | 1 | | | | | | | | 1618<br>0730 | |
| 3038 | 49 | 9 | | 100 | 3 | 92 | 1, 2, 3 | | 1: 70°, J, Fe +H, Fi, Wa, R<br>2: 15°, J, Fe, Su, Wa, R<br>3: 15°, J, R, Fe, Su, Wa, R<br>4: 15°, J, No, No, Ir, Vr | | | | 4<br>0800 | |
| | 50 | | | | | | | | Bottom of boring at 50 feet | | | | | |
| 3036 | 51 | | | | | | | | | | | | | |
| | 52 | | | | | | | | | | | | | |
| 3034 | 53 | | | | | | | | | | | | | |
| | 54 | | | | | | | | | | | | | |
| 3032 | 55 | | | | | | | | | | | | | |
| | 56 | | | | | | | | | | | | | |
| 3030 | 57 | | | | | | | | | | | | | |
| | 58 | | | | | | | | | | | | | |
| 3028 | 59 | | | | | | | | | | | | | |
| | 60 | | | | | | | | | | | | | |
| 3026 | 61 | | | | | | | | | | | | | |



URS


Boring B-04, Depth Interval 9.6 to 28.0 feet


Boring B-04, Depth Interval 28.0 to 42.3 feet

| CORE PHOTOGRAPHS<br>BORING B-04 | URS |
|---|---|
| Suncrest Substation<br>27669017.00002 | Date: 2-19-09<br>Figure: A-70 |


Boring B-04, Depth Interval 42.3 to 50.0 feet

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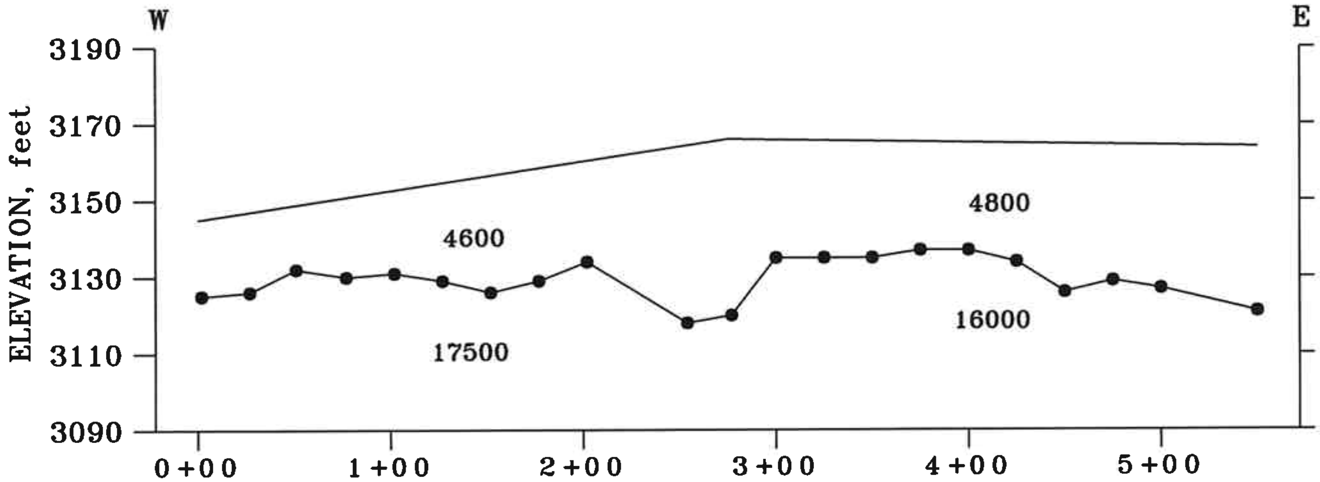
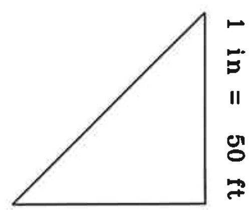
| CORE PHOTOGRAPHS BORING B-04 | URS |
|---|---|
| Suncrest Substation | Date: 2-19-09 |
| 27669017.00002 | Figure: A-71 |

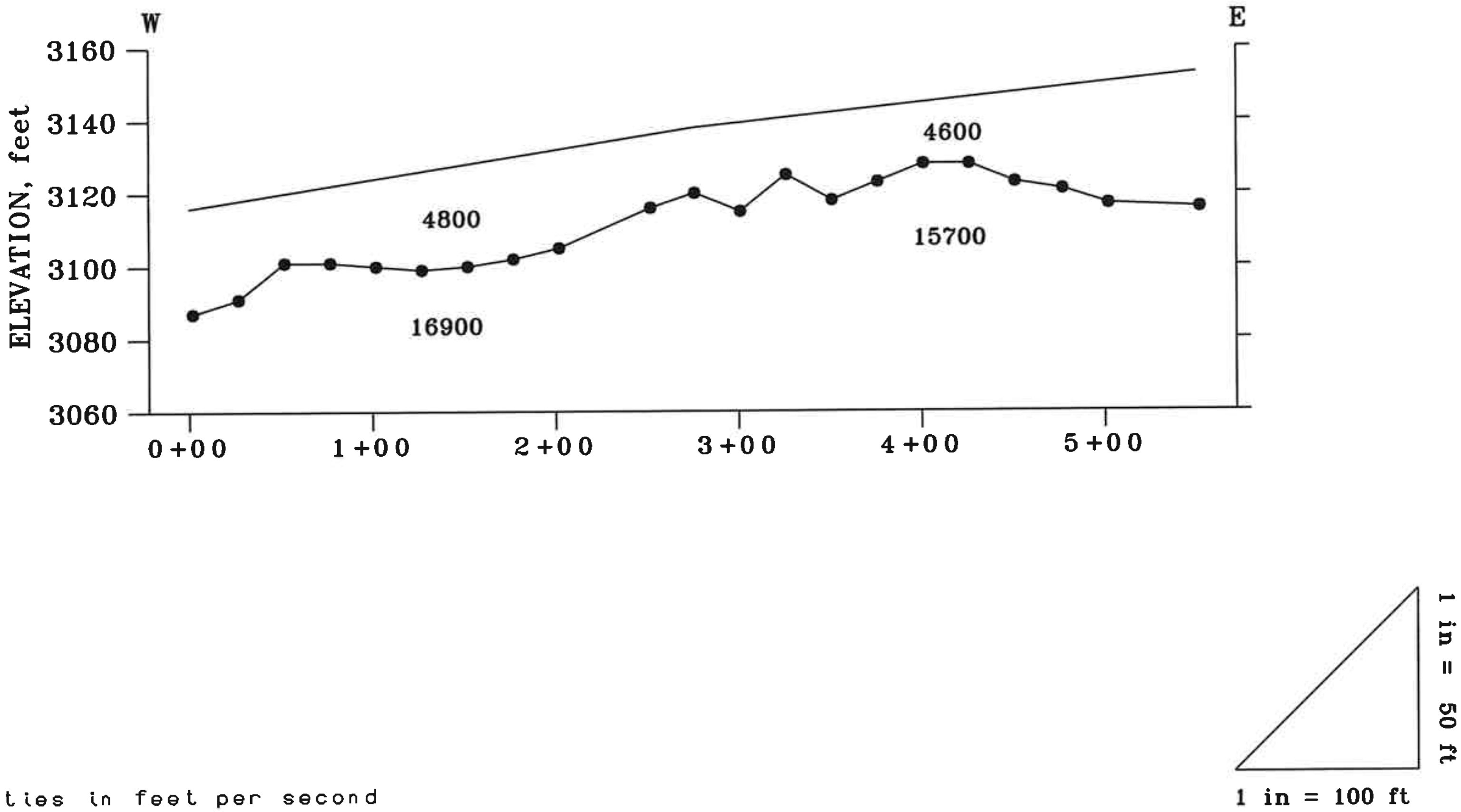



P-wave velocities in feet per second




RS08-6

| | | | |
|---|---|---|---|
| Project No. 27669017 | Date: 11-24-08 | Project: Suncrest Substation | Fig. B-6 |




P-wave velocities in feet per second

| | | | |
|---|---|---|---|
| RS08-7 | | | |
| Project No. 27669017 | Date: 11-24-08 | Project: Suncrest Substation | Fig. B-7 |

# APPENDIX A.3

# GEOPHYSICAL REPORT BY SOUTHWEST GEOPHYSICS

**GEOPHYSICAL SURVEY**
**SVC SUN CREST**
**ALPINE, CALIFORNIA**

**PREPARED FOR:**
Kleinfelder
550 West C Street
San Diego, CA 92101

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

August 5, 2015
Project No. 115336

SOUTHWEST GEOPHYSICS, INC.
YOUR SUBSURFACE SOLUTION

August 5, 2015
Project No. 115336

Mr. Scott Rugg
Kleinfelder
550 West C Street
San Diego, CA 92101

Subject: Geophysical Survey
SVC Sun Crest
Alpine, California

Dear Mr. Rugg:

In accordance with your authorization, we have performed a geophysical evaluation pertaining to the SVC Sun Crest project located in Alpine, California. Specifically, our survey consisted of performing five P-wave refraction traverses, one refraction microtremor (ReMi) profile, and electrical resistivity soundings at four test locations at the subject site. The purpose of our study was to characterize the subsurface conditions in the study area. This data report presents our survey methodology, equipment used, analysis, and results.

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

Sincerely,
**SOUTHWEST GEOPHYSICS, INC.**

Patrick Lehrmann

Patrick Lehrmann, P.G., P.Gp.
Principal Geologist/Geophysicist

Hans van de Vrugt

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

PFL/HV/hv

REGISTERED GEOPHYSICIST
PATRICK F. LEHRMANN
No. 1043
Exp. 1/31/16
STATE OF CALIFORNIA

Distribution: Addressee (electronic)

## TABLE OF CONTENTS

## 1. INTRODUCTION

In accordance with your authorization, we have performed a geophysical evaluation pertaining to the SVC Sun Crest project located in Alpine, California (Figure 1). Specifically, our survey consisted of performing five P-wave refraction traverses, one refraction microtremor (ReMi) profile, and electrical resistivity soundings at four test locations at the subject site. The purpose of our study was to characterize the subsurface conditions in the study area. This data report presents our survey methodology, equipment used, analysis, and results.

## 2. SCOPE OF SERVICES

Our scope of services included:

- Performance of five seismic P-wave refraction lines: SL-1 through SL-5.
- Performance of one ReMi profile: R-1.
- Performance of electrical resistivity soundings at four locations: RL-1 through RL-4.
- Compilation and analysis of the data collected.
- Preparation of this illustrated data report presenting our results.

## 3. SITE DESCRIPTION AND PROJECT DESCRIPTION

The subject site is generally located near the west end of Bell Bluff Truck Trail, just east of it's intersection with Japatul Valley Road in Alpine, California (Figure 1). The seismic survey was conducted along the north side of an asphalt paved access road. The profiles were conducted generally from west to east. The electrical resistivity soundings were conducted in an open field south of the access road. Figures 2a through 2d and Figures 3a and 3b depict the locations of the lines as well as the general site conditions.

Based on our discussions with you, it is our understanding your office is conducting a geotechnical evaluation of the site for the proposed excavation of an electrical trench along the access road, and the construction of a new substation in the open field south of the access road. The results of our survey will be used in the design and construction of the project.

## 4. SURVEY METHODOLOGY

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

### 4.1 P-wave Refraction Survey

The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves (compression waves) generated at the surface are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component 14-Hz geophones, and recorded with a 24-channel Geometrics Geode seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information of the subsurface materials. In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the traverse. The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not generally be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by buried boulders, fractures, dikes, etc. can result in the misinterpretation of the subsurface conditions.

Five 125-foot long seismic traverses, SL-1 through SL-5, were conducted in the area of the proposed electrical trench. Multiple shot points (signal generator locations) were conducted at the ends and intermediate points along the lines. The P-wave signal (shot) was generated using a 20-pound hammer and an aluminum plate. The locations of the profiles, which were selected by your office, are depicted on Figures 2a through 2d.

In general, the seismic P-wave velocity of a material can be correlated to rippability (see Table 1 below), or to some degree "hardness." Table 1 is based on published information from the Caterpillar Performance Handbook (Caterpillar, 2011) as well as our experience with similar materials, and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock quality or rippability.

**Table 1 – Rippability Classification**

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

### 4.2 ReMi Survey

The refraction microtremor technique uses recorded surface waves (specifically Rayleigh waves) which are contained in the background noise to develop a shear wave velocity profile of the site down to a depth, in this case, up to approximately 75 feet. Fifteen records, 32 seconds long were collected with a 24-channel Geometrics Geode seismograph and 4.5-Hz vertical component geophones. Unlike the refraction method, described above, the ReMi method does not require an increase of material velocity with depth. Therefore, low velocity zones (velocity inversions) are detectable with ReMi. The depth of exploration is dependent on the length of the line and the frequency content of the background noise. The results of the ReMi method are displayed as a one dimensional sounding which represents the average condition across the length of the line.

One ReMi line (R-1) was conducted along refraction line SL-1. The purpose of R-1 was to obtain additional subsurface data in this area, since there was a potential for interference from the presence of a storm drain line and nearby asphalt road.

### 4.3 Electrical Resistivity Survey

Electrical resistivity data were collected at four test locations selected by your office. The data were collected in general accordance with ASTM G57 using an Advanced Geosciences, Inc. (AGI) MiniSting earth resistivity meter and four stainless steel electrodes in a Wenner configuration. The MiniSting can generate up to 800 volts (V) and 500 milliamps (mA) and allows for the direct measurement of resistance. Soil resistance measurements were collected at electrode spacings of approximately 2, 3, 5, 7, 10, 20, 30, 50, 70, 100 and 200 feet. Stainless steel electrodes were hammered into place and the soils surrounding the electrodes were moistened with water where necessary. The soundings were performed along four different orientations in order to assess possible lateral variations in resistivity. Figure 2d illustrates the approximate locations of the lines.

## 5. DATA ANALYSIS

The following sections provide a summary of our data analysis.

### 5.1 P-wave Refraction Data

The collected P-wave refraction data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008). SeisOpt Pro uses first arrival picks and elevation data to produce subsurface velocity models through a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions. Figures 4a through 4e presents the results from the P-wave refraction survey.

### 5.2 ReMi Survey

Collected ReMi data were processed using SeisOpt® ReMi™ software (Optim, 2005), which uses the refraction microtremor method (Louie, 2001). The program generates phase-velocity dispersion curves for each record and provides an interactive dispersion modeling tool where the users determines the best fitting model. The result is a one-dimensional shear-wave velocity model of the site with roughly 5 to 15 percent accuracy. Figure 5 displays the results for R-1.

### 5.3 Electrical Resistivity Survey

The resistivity results are presented on Figure 6. In general, the quality of the collected data is very good. The standard deviation between multiple readings is 0.3 percent or less.

## 6. RESULTS

The purpose of our evaluation was to characterize the subsurface conditions and to provide parameters for use in the design and construction of the proposed project through the collection of seismic and electrical data. The results from our P-wave refraction, ReMi, and resistivity surveys are presented on Figures 4a through 4e, Figure 5, and Figure 6, respectively. In addition, the ReMi results are shown on Table 2.

The P-wave and ReMi models reveal distinct layers/zones in the near surface that likely represent fill soil overlying bedrock with varying degrees of weathering. Some vertical and lateral velocity variations are evident in the P-wave models. These inhomogeneities are likely related to the presence of boulders, intrusions and differential weathering of the bedrock. It is also evident in the P-wave models that the depth to bedrock varies across the site.

As previously indicated, the ReMi data were collected along refraction line SL-1 in order to assess the possible interference from an existing storm rain line and nearby roadway on the seismic data. In general the P-wave and Remi results are somewhat consistent with respect to the depth of bedrock, although the ReMi results reveal a low velocity zone (inversion) roughly between 15 and 20 feet below the ground surface. The specific cause and extent of this inversion is unknown. It should be emphasized that the ReMi survey provides a 1-dimensional model that represents an average across the profile length.

In general, the results of the resistivity survey are fairly consistent along soundings RL-1, RL-3 and RL-4. The results for the shorter spacings along RL-2 reveal the presence of more resistive material in the near surface. The specific cause of this variation is unknown, but is likely related to changes in geology and/or bioturbation of the near surface soils.

| Table 2 – ReMi Results | | |
|---|---|---|
| **Line No.** | **Depth (feet)** | **Shear Wave Velocity (feet/second)** |
| RL-1 | 0 – 3 | 551 |
| | 3 – 5 | 605 |
| | 5 – 8 | 1,235 |
| | 7.5 – 15 | 1,426 |
| | 15 – 21 | 816 |
| | 21 – 43 | 2,097 |
| | 43 – 66 | 2,247 |
| | 66 – 75 | 4,208 |

## 7. LIMITATIONS

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

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

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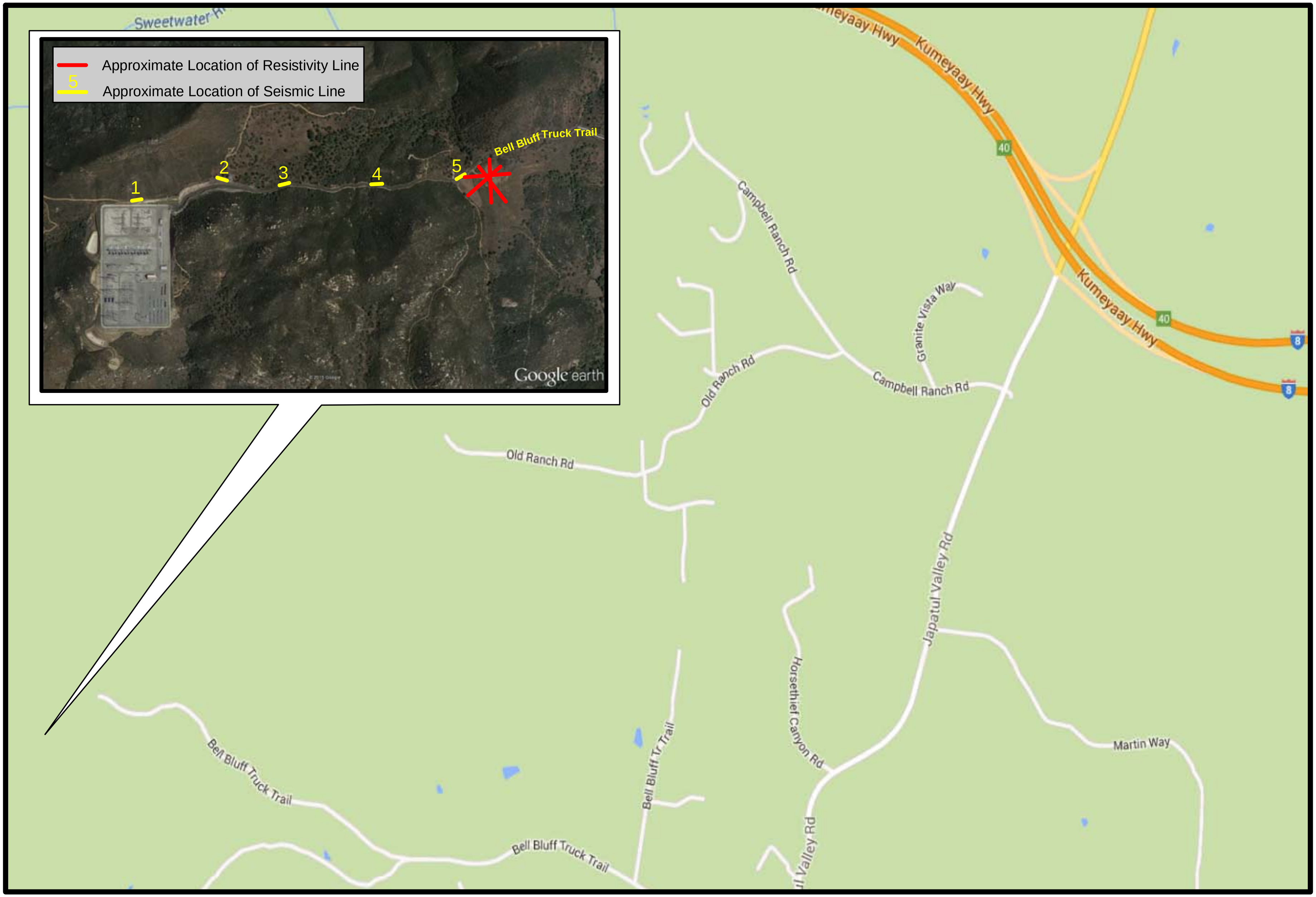
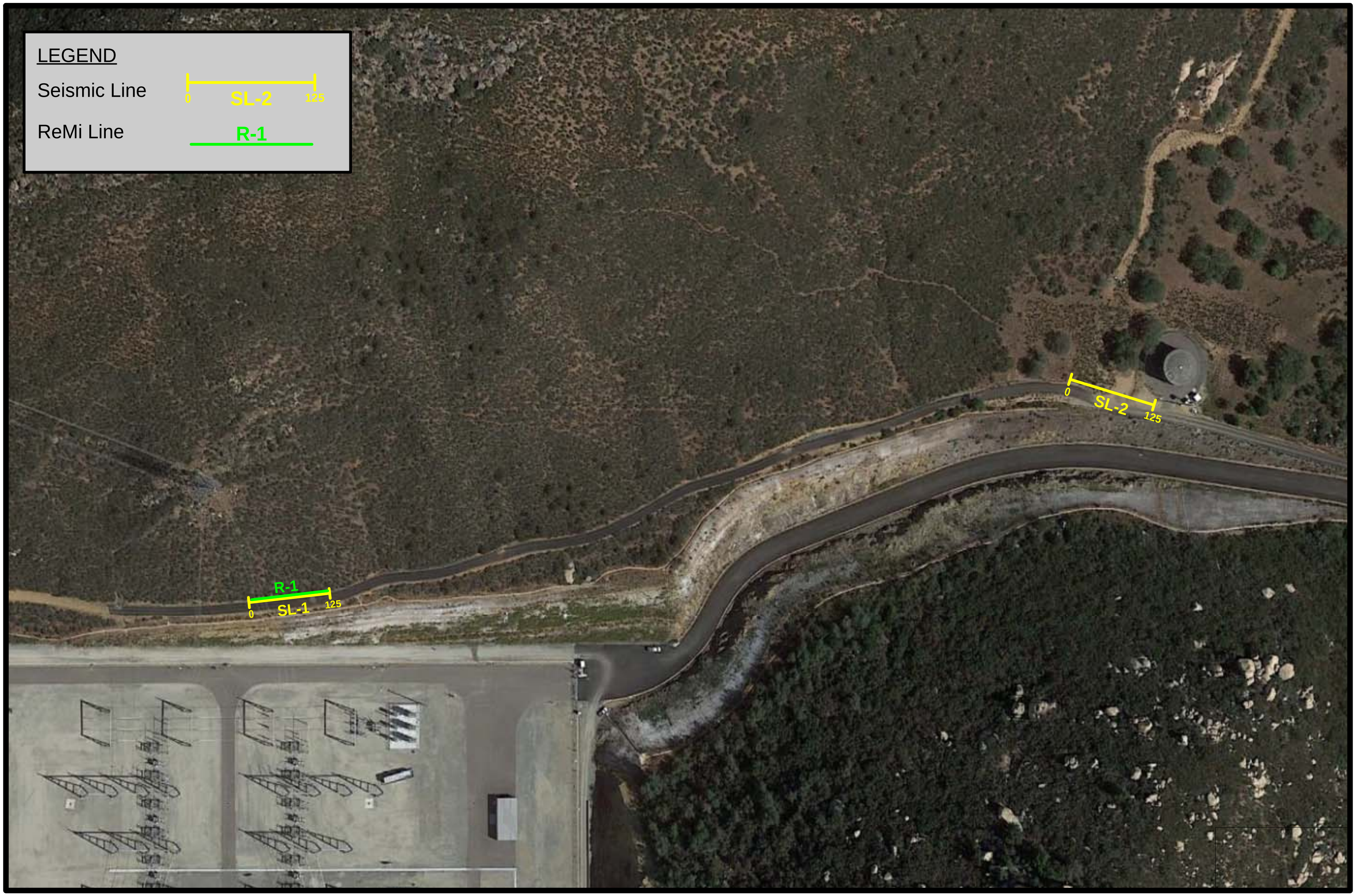
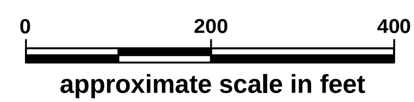



| | | | |
|---|---|---|---|
| **SITE LOCATION MAP** | N | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 — Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 1 |




# LINE LOCATION MAP
**(SL-1, SL-2, and and R-1)**

N

SVC Sun Crest
Alpine, California

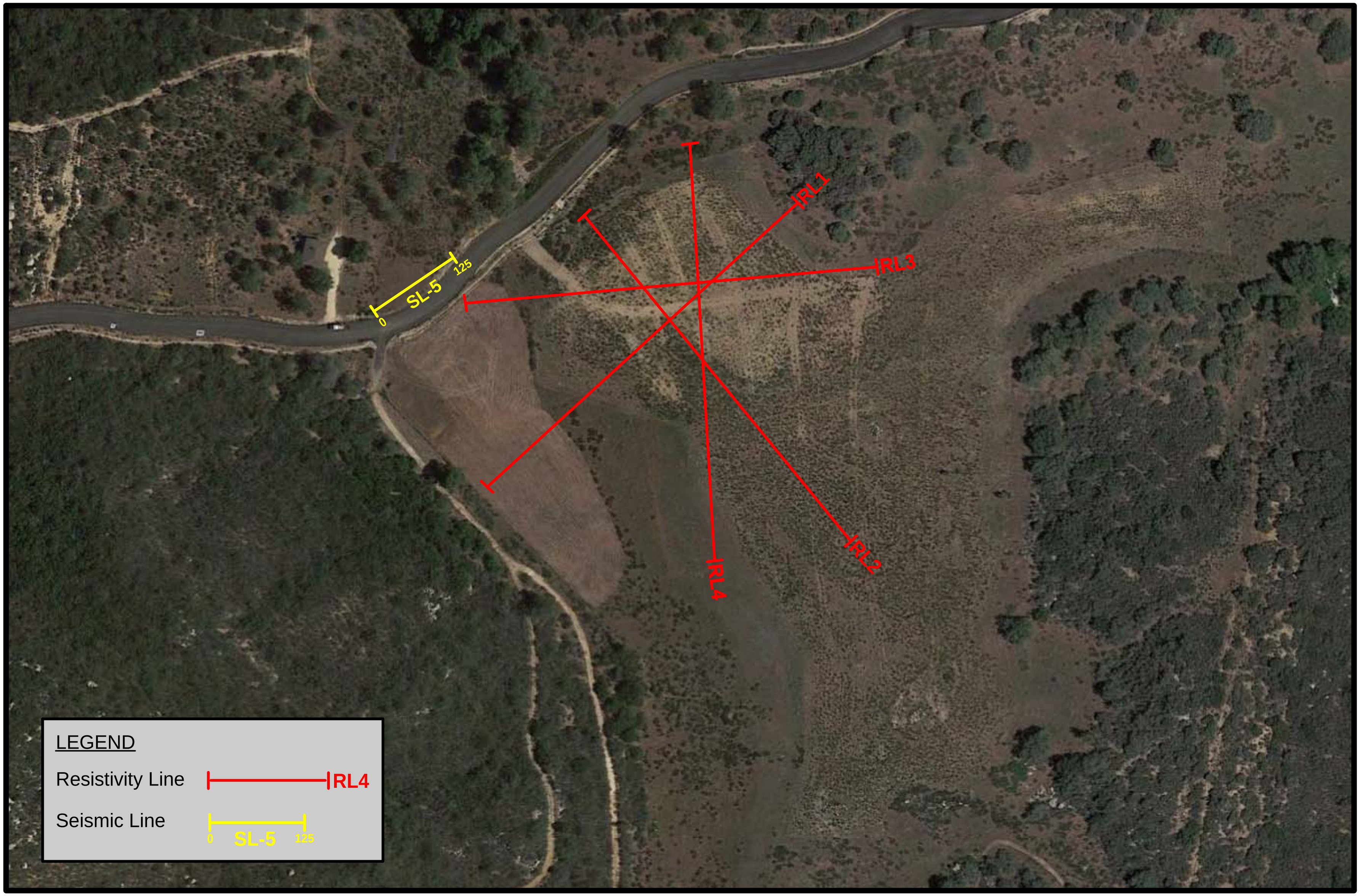
Project No.: 115336 | Date: 08/15

SOUTHWEST GEOPHYSICS INC.

Figure 2a


| | | | | |
|---|---|---|---|---|
| **LINE LOCATION MAP** **(SL-3)** | N | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 — Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 2b | 0 100 200<br>**approximate scale in feet** |


| | | | | |
|---|---|---|---|---|
| **LINE LOCATION MAP** (SL-4 and SL-5) | N | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 / Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 2c | 0 200 400<br>**approximate scale in feet** |




**LINE LOCATION MAP**
**(SL-5 and RL-1 through RL-4)**

N

SVC Sun Crest
Alpine, California

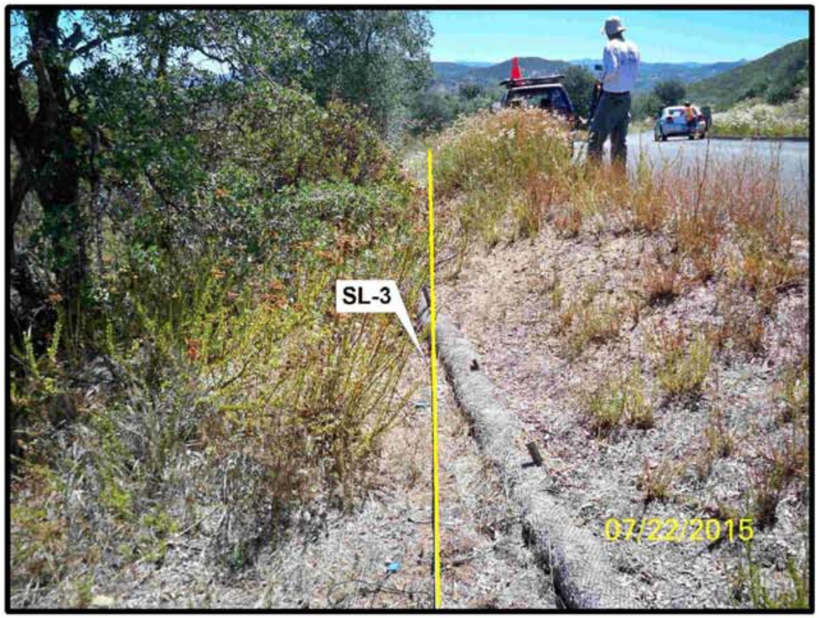
Project No.: 115336 | Date: 08/15

SOUTHWEST GEOPHYSICS INC.

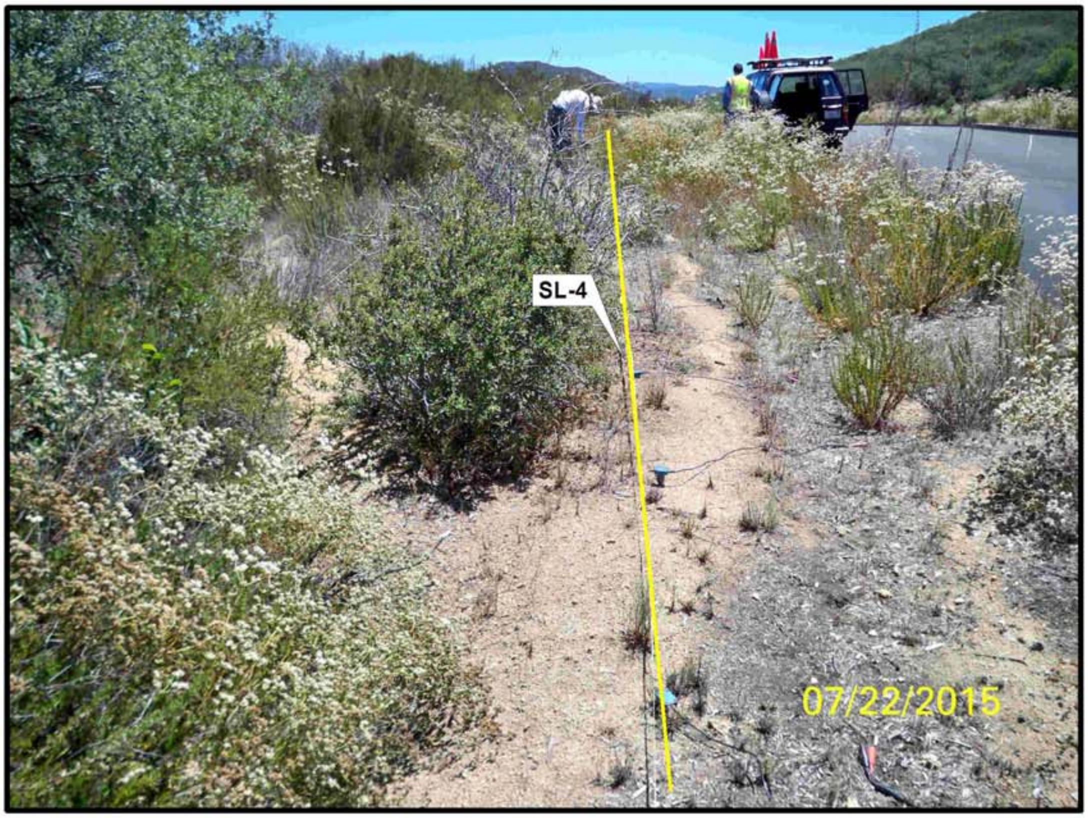
Figure 2d

0 200 400
**approximate scale in feet**





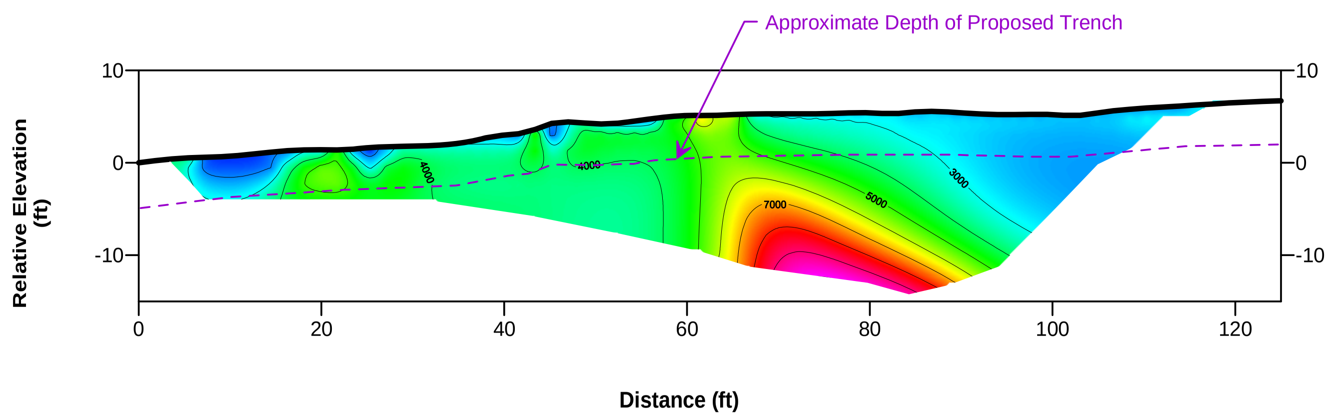

| | | |
|---|---|---|
| **SITE PHOTOGRAPHS** | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 — Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 3a |

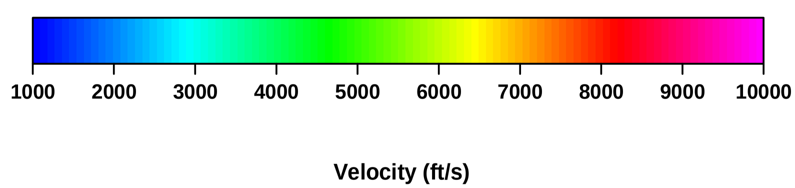




| SITE PHOTOGRAPHS | SVC Sun Crest<br>Alpine, California | | SOUTHWEST GEOPHYSICS INC. |
|---|---|---|---|
| | Project No.: 115336 | Date: 08/15 | Figure 3b |

# TOMOGRAPHY MODEL

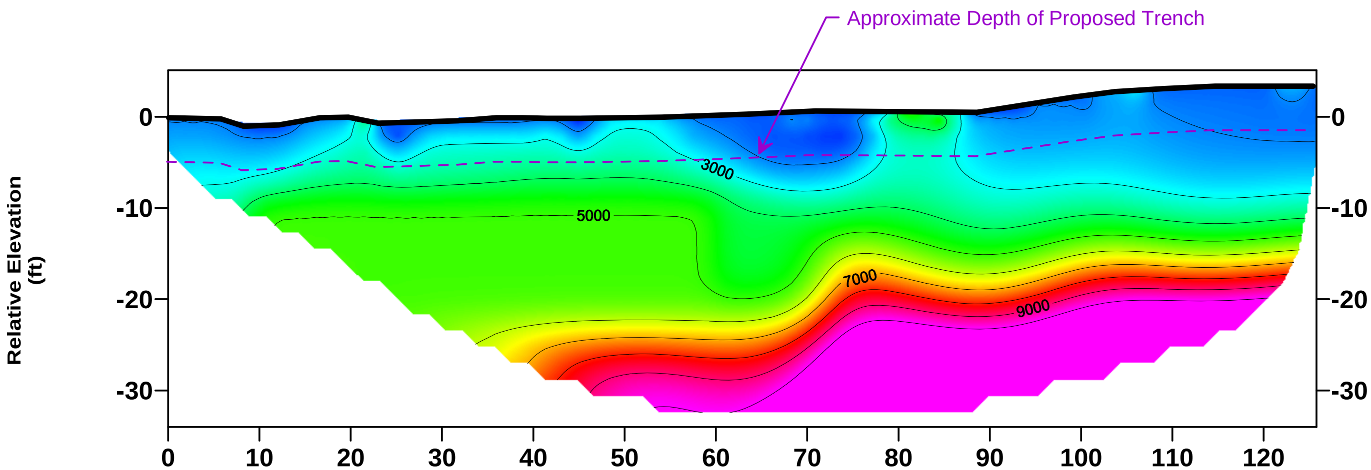



| | | |
|---|---|---|
| **SEISMIC PROFILE SL-1** | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 / Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 4a |

**Note: Contour Interval = 1,000 feet per second**

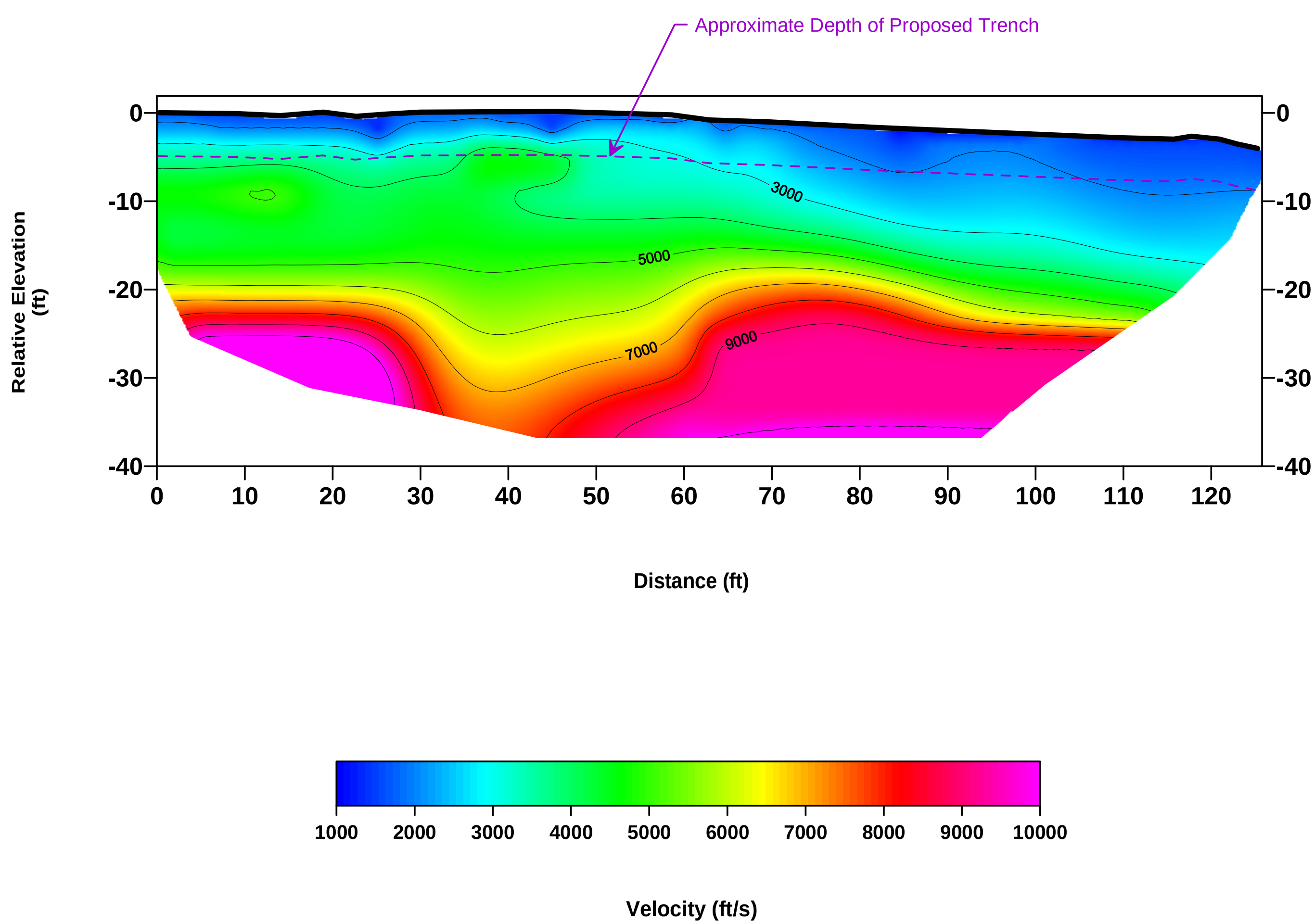
# TOMOGRAPHY MODEL




Velocity (ft/s)

| | | | |
|---|---|---|---|
| **SEISMIC PROFILE SL-2** | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 / Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 4b | **Note: Contour Interval = 1,000 feet per second** |

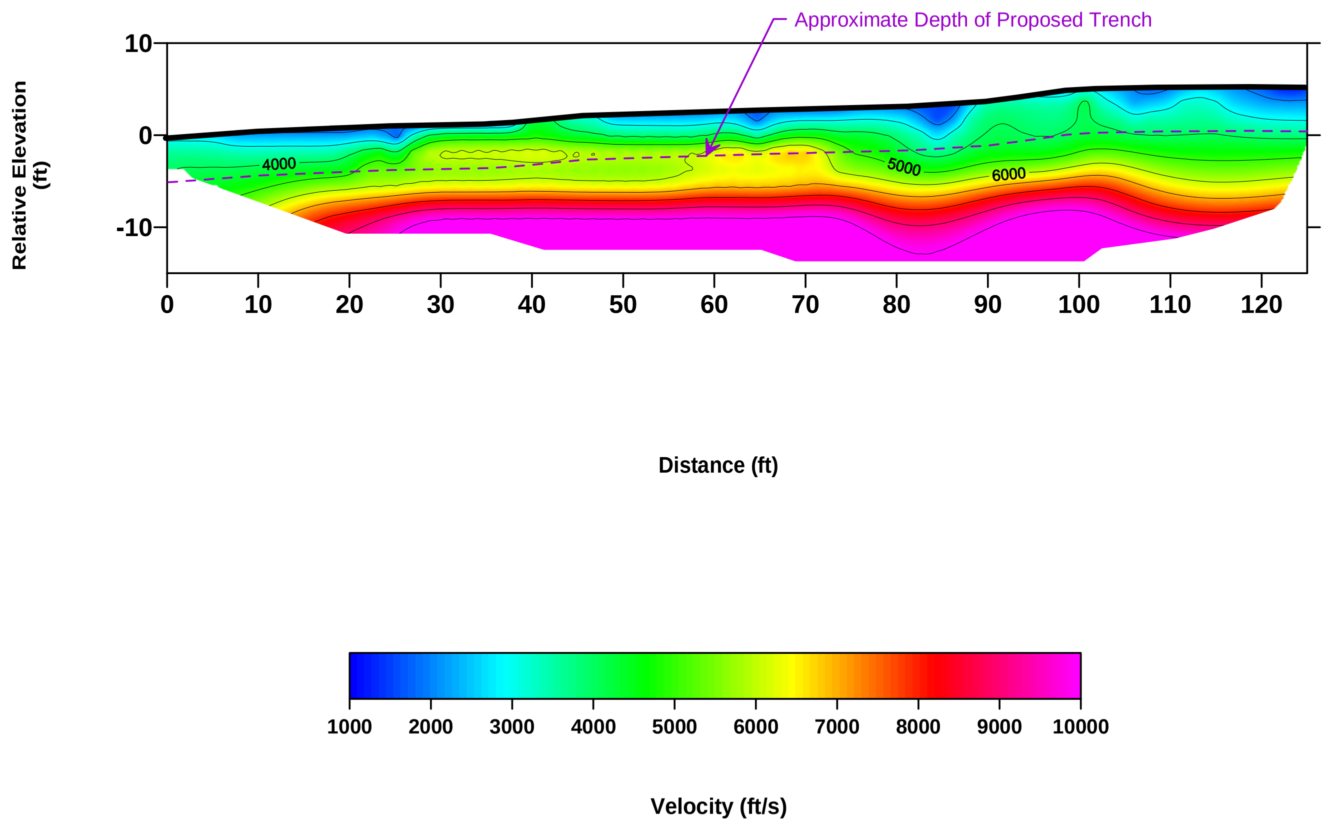
# TOMOGRAPHY MODEL




| SEISMIC PROFILE SL-3 | SVC Sun Crest<br>Alpine, California | SOUTHWEST GEOPHYSICS INC.<br>Figure 4c |
|---|---|---|
| | Project No.: 115336 — Date: 08/15 | |

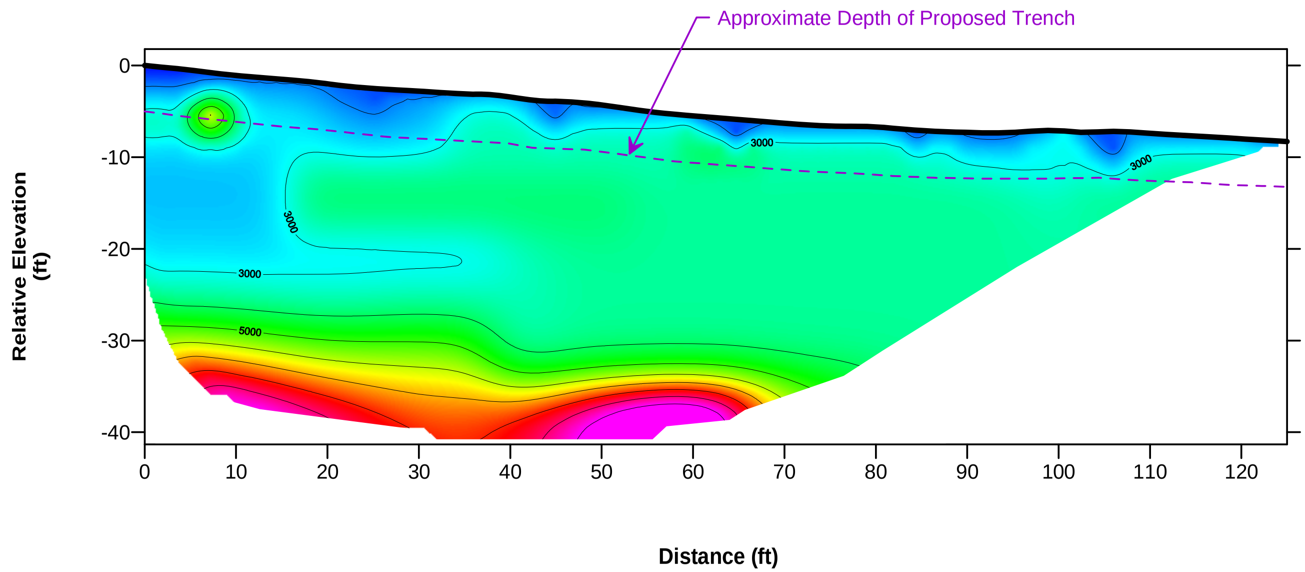
**Note: Contour Interval = 1,000 feet per second**

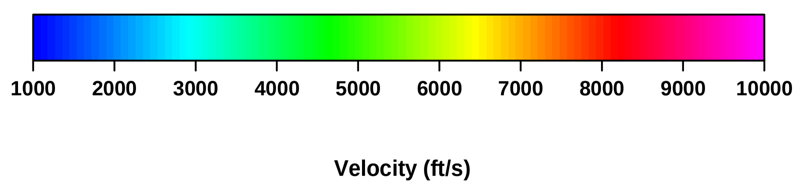
# TOMOGRAPHY MODEL




| | | | |
|---|---|---|---|
| **SEISMIC PROFILE SL-4** | SVC Sun Crest<br>Alpine, California | SOUTHWEST GEOPHYSICS INC.<br>Figure 4d | **Note: Contour Interval = 1,000 feet per second** |
| | Project No.: 115336   Date: 08/15 | | |

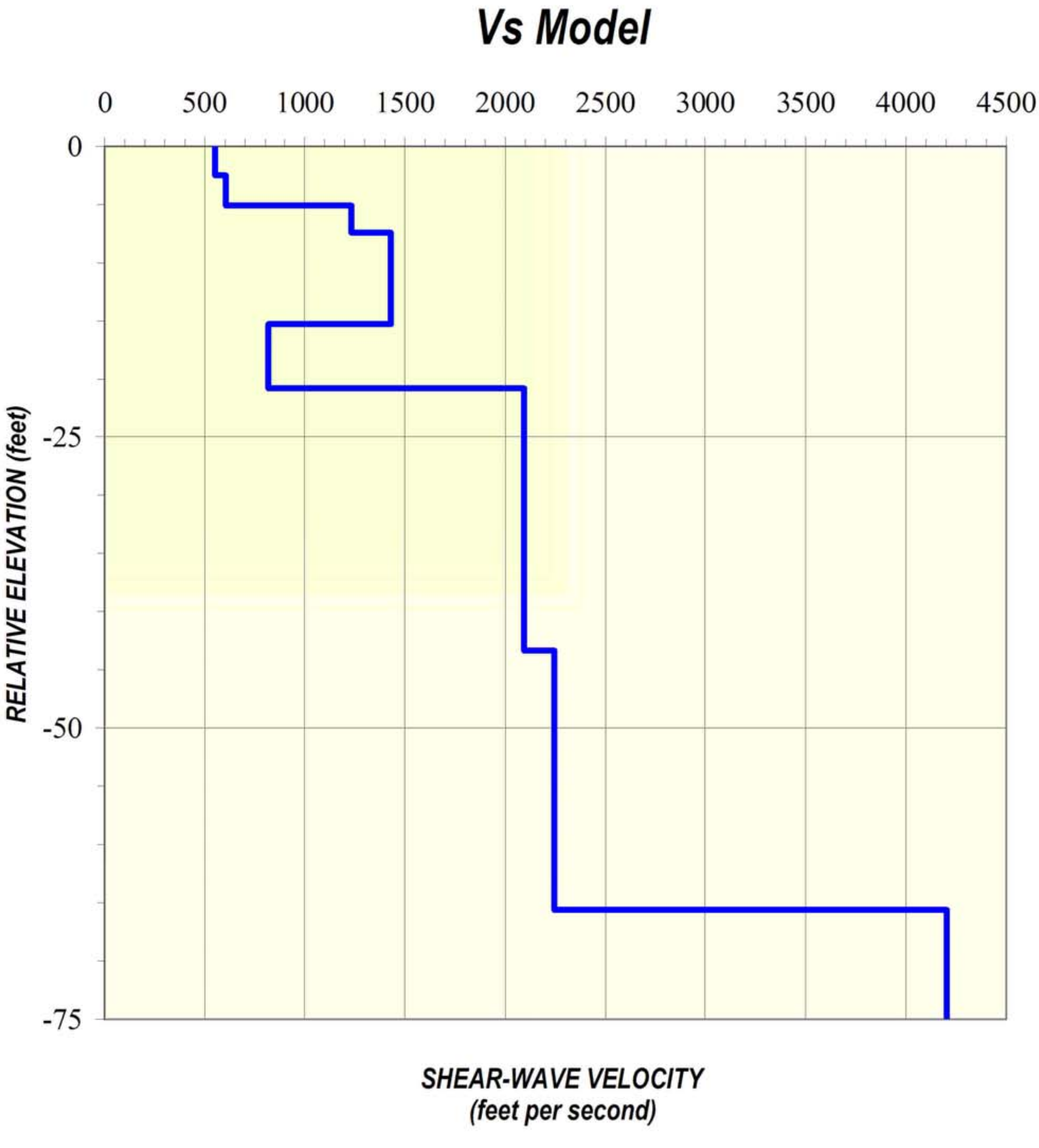
# TOMOGRAPHY MODEL




| SEISMIC PROFILE SL-5 | SVC Sun Crest<br>Alpine, California<br>Project No.: 115336 Date: 08/15 | SOUTHWEST GEOPHYSICS INC.<br>Figure 4e |
|---|---|---|

Note: Contour Interval = 1,000 feet per second




**ReMi RESULTS**
**RL-1**

SVC Sun Crest
Alpine, California

Project No.: 115336

Date: 08/15

SOUTHWEST GEOPHYSICS INC.

Figure 5

| Line No. (Orientation) | Spacing (ft) | Current (mA) | Resistance (Ohms) | Error (%) | Apparent Resistivity (ohm-cm) | Apparent Resistivity (ohm-ft) |
|---|---|---|---|---|---|---|
| RL-1 | 2 | 2 | 54.93 | 0.1 | 21039 | 690 |
| (SW-NE) | 3 | 2 | 24.42 | 0.0 | 14030 | 460 |
| | 5 | 2 | 10.25 | 0.0 | 9815 | 322 |
| | 7 | 2 | 6.03 | 0.1 | 8082 | 265 |
| | 10 | 2 | 3.74 | 0.0 | 7161 | 235 |
| | 20 | 2 | 2.01 | 0.0 | 7691 | 252 |
| | 30 | 2 | 1.81 | 0.1 | 10388 | 341 |
| | 50 | 2 | 1.74 | 0.1 | 16633 | 546 |
| | 70 | 2 | 1.82 | 0.1 | 24425 | 801 |
| | 100 | 2 | 1.88 | 0.1 | 36023 | 1182 |
| | 200 | 2 | 1.63 | 0.3 | 62586 | 2053 |
| | | | | | | |
| RL-2 | 2 | 2 | 175.80 | 0.0 | 67335 | 2209 |
| (NW-SE) | 3 | 2 | 108.80 | 0.0 | 62509 | 2051 |
| | 5 | 2 | 48.33 | 0.0 | 46279 | 1518 |
| | 7 | 2 | 23.19 | 0.0 | 31088 | 1020 |
| | 10 | 2 | 11.63 | 0.0 | 22273 | 731 |
| | 20 | 2 | 5.67 | 0.0 | 21714 | 712 |
| | 30 | 2 | 4.53 | 0.0 | 26021 | 854 |
| | 50 | 2 | 3.66 | 0.0 | 35008 | 1149 |
| | 70 | 2 | 3.17 | 0.1 | 42523 | 1395 |
| | 100 | 2 | 2.31 | 0.1 | 44277 | 1453 |
| | 200 | 2 | 1.86 | 0.0 | 71395 | 2342 |
| | | | | | | |
| RL-3 | 2 | 2 | 54.32 | 0.0 | 20806 | 683 |
| (NW-SE) | 3 | 2 | 38.34 | 0.0 | 22028 | 723 |
| | 5 | 2 | 16.54 | 0.0 | 15838 | 520 |
| | 7 | 2 | 11.88 | 0.0 | 15926 | 523 |
| | 10 | 2 | 6.84 | 0.1 | 13105 | 430 |
| | 20 | 2 | 3.84 | 0.1 | 14689 | 482 |
| | 30 | 2 | 3.06 | 0.0 | 17558 | 576 |
| | 50 | 2 | 2.60 | 0.2 | 24868 | 816 |
| | 70 | 2 | 2.58 | 0.1 | 34600 | 1135 |
| | 100 | 2 | 2.52 | 0.1 | 48318 | 1585 |
| | 200 | 2 | 2.07 | 0.0 | 79401 | 2605 |
| | | | | | | |
| RL-4 | 2 | 2 | 45.37 | 0.0 | 17378 | 570 |
| (NE-SW) | 3 | 2 | 30.69 | 0.0 | 17632 | 578 |
| | 5 | 2 | 16.57 | 0.0 | 15867 | 521 |
| | 7 | 2 | 10.33 | 0.1 | 13848 | 454 |
| | 10 | 2 | 6.50 | 0.0 | 12450 | 408 |
| | 20 | 2 | 3.40 | 0.1 | 13023 | 427 |
| | 30 | 2 | 2.85 | 0.1 | 16363 | 537 |
| | 50 | 2 | 2.52 | 0.1 | 24092 | 790 |
| | 70 | 2 | 2.64 | 0.0 | 35391 | 1161 |
| | 100 | 2 | 2.17 | 0.0 | 41635 | 1366 |
| | 200 | 2 | 1.45 | 0.1 | 55347 | 1816 |

# ELECTRICAL RESISTIVITY RESULTS

SVC Sun Crest
Alpine, California

Project No.: 115336 | Date: 08/15

SOUTHWEST GEOPHYSICS INC.

Figure 6

# APPENDIX B

# LABORATORY TEST RESULTS

# APPENDIX B
# LABORATORY TEST RESULTS

Laboratory tests were performed on selected bulk and drive samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in accordance with ASTM Standards for Soil Testing, latest revisions.

## MOISTURE CONTENT AND DRY UNIT WEIGHT

Natural moisture content and dry unit weight tests were performed on twelve drive samples in accordance with ASTM D 2216 and D 2937, respectively. The results of these tests are presented on the Logs of Borings in Appendix A and on Figure B-1.

## SIEVE ANALYSIS

Sixteen sieve analyses were performed on representative samples of the materials encountered at the site to evaluate the gradation characteristics of the soil and to aid in classification. The tests were performed in general accordance with ASTM Test Method D 6913. The results are presented on Figures B-2 through B-17.

## ATTERBERG LIMITS

Atterberg limits test consists of the evaluation of liquid limit, plastic limit, and plasticity index. Atterberg limit tests were performed on three soil samples from the site to evaluate the plasticity characteristics of the soil and to aid in its classification. The test was performed in general accordance with ASTM Test Method D4318. The results are presented on Figure B-18.

## EXPANSION INDEX TEST

Three expansion index tests were performed on representative soil samples. Test procedures were in general accordance with ASTM D4829. The results are presented in Figures B-19 through B-21.

## COMPACTION TEST

The maximum dry density and optimum moisture content of one soil sample was evaluated by performing a compaction test in general conformance with ASTM test procedure D 1557. The results of these tests are shown on Table B-1.

**Table B-1**

**Compaction Test Results**

| BORING | SAMPLE | DEPTH (ft) | MAXIMUM DRY UNIT WEIGHT (psf) | OPTIMUM WATER CONTENT (%) |
|---|---|---|---|---|
| B-1 | 3 | 6-7 | 128.1 | 9.6 |
| B-2 | 3 | 5-7 | 128.1 | 8.2 |
| INV-1 | 1 | 1.5-4 | 129.1 | 7.9 |

## DIRECT SHEAR TEST

Three direct shear tests were performed on representative soil samples. The test procedures were in general accordance with the ASTM D 3080. The results are presented in Figures B-22 through B-24. The samples were remolded to about 90 percent of the maximum dry density determined by ASTM D 1557.

## R-VALUE TESTS

R-value testing was performed on three samples of the potential subgrade soil. The test was performed in general accordance with Caltrans Standard Test Method 301. The test results are presented on Figures B-25 through B-27.

## CORROSION TESTS

A series of chemical tests were performed on six samples to estimate pH, resistivity and sulfate and chloride contents. The test results presented by our subcontractor, Clarkson Laboratories, are presented in Table B-2 and attached at the end of this appendix.

**Table B-2**

**Corrosion Test Results**

| BORING | DEPTH (FT) | pH | SULFATE (ppm) | CHLORIDE (ppm) | MINIMUM RESISTIVITY (ohm-cm) |
|---|---|---|---|---|---|
| B-1 | 6-7 | 8.0 | 47 | 21 | 2,000 |
| B-2 | 5-7 | 6.5 | 32 | 11 | 6,500 |
| B-6 | 2.5-4.5 | 6.2 | 59 | 64 | 2,600 |

**Table B-2 (continued)**

**Corrosion Test Results**

| BORING | DEPTH (FT) | pH | SULFATE (ppm) | CHLORIDE (ppm) | MINIMUM RESISTIVITY (ohm-cm) |
|---|---|---|---|---|---|
| B-7 | 2.5-4.5 | 5.9 | 54 | 64 | 4,500 |
| B-8 | 2-4 | 6.0 | 46 | 53 | 4,400 |
| INV-1 | 1.5-4 | 6.4 | 32 | 11 | 6,400 |

Date Tested : 7/28-29/2015

| Boring # | Sample # | Depth (ft) | Dry Density (pcf) | Moisture Content (%) | Description |
|---|---|---|---|---|---|
| B1 | 1 | 2-2.5 | 110.6 | 3.8% | light yellow clayey gravel with sand |
| B2 | 2 | 5-5.5 | 115.0 | 1.5% | light yellowish brown silty sand |
| B3 | 2 | 6-6.5 | 125.3 | 6.7% | dark yellowish brown clayey sand |
| B4 | 1 | 6-6.5 | 124.2 | 3.5% | reddish yellow silty sand |
| B4 | 3 | 10-10.5 | 114.9 | 2.2% | light brown silty sand |
| B5 | 2 | 5.5-6 | 128.8 | 6.9% | light brown clayey sand |
| B6 | 1 | 2.5-3 | 118.6 | 3.3% | light reddish brown clayey sand |
| B6 | 3 | 5-5.5 | 106.3 | 2.3% | light brown clayey sand |
| B7 | 1 | 3-3.5 | 115.9 | 3.7% | light brown clayey sand |
| B8 | 1 | 3-3.5 | 105.6 | 2.3% | brown clayey sand |
| B9 | 1 | 2.5-3 | 132.8 | 4.0% | red silty sand |
| INV-1 | 2 | 4.5-5 | 120.0 | 7.0% | brown clayey sand |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Performed in General Accordance with ASTM D7263 B and D2216

KLEINFELDER
Bright People. Right Solutions.

CHECKED BY: TECH: Uly

JOB NUMBER: 20160674 DATE: 12-Aug-15

**Dry Density and Moisture Content**

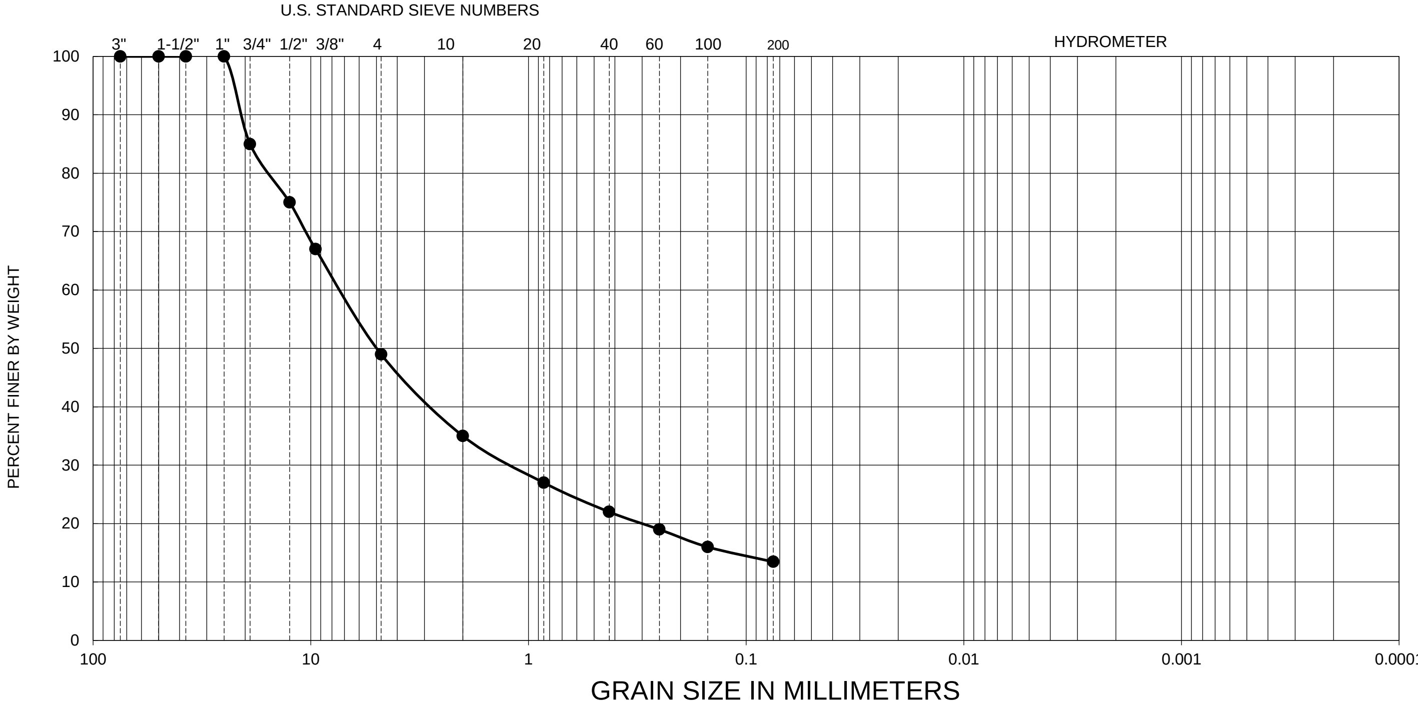
**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-1**

Date Tested: **7/31/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B1** | 1 | 2-2.5 | 13.4 | GC |

| **Sample Description** | light yellow Clayey gravel with sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 85 |
| | 1/2" | 12.5 mm | 75 |
| | 3/8" | 9.5 mm | 67 |
| | No. 4 | 4.75 mm | 49 |
| | No. 10 | 2.0 mm | 35 |
| | No. 20 | 0.85 mm | 27 |
| | No. 40 | 0.425 mm | 22 |
| | No. 60 | 0.25 mm | 19 |
| | No 100 | 0.15 mm | 16 |
| | No 200 | .075 mm | 13.4 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

**GRADATION TEST RESULTS**

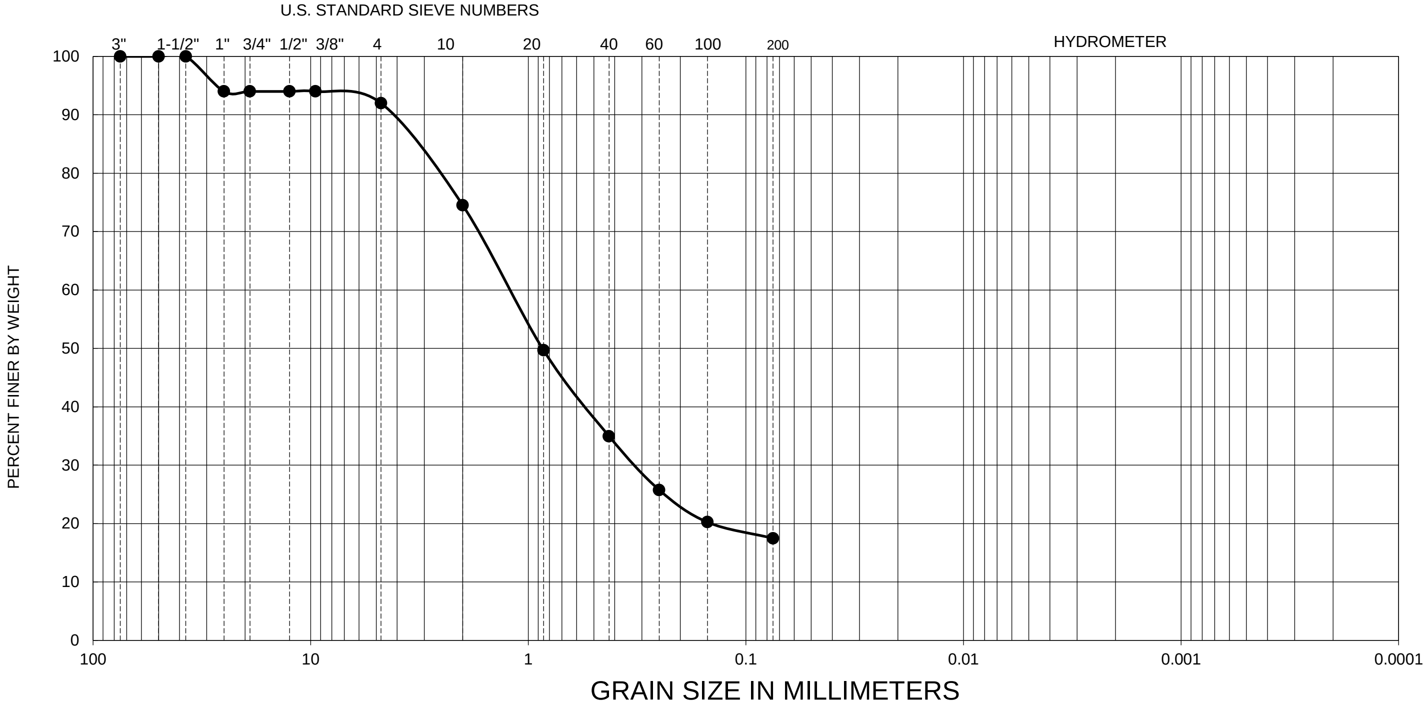
**Suncrest SVC Substation and Transmission Line**

FIGURE **B-2**

| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

Date Tested: **8/5/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B1** | 2 | 5-6 | 17.5 | SC |

| Sample Description | yellow Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 94 |
| | 3/4" | 19 mm | 94 |
| | 1/2" | 12.5 mm | 94 |
| | 3/8" | 9.5 mm | 94 |
| | No. 4 | 4.75 mm | 92 |
| | No. 10 | 2.0 mm | 75 |
| | No. 20 | 0.85 mm | 50 |
| | No. 40 | 0.425 mm | 35 |
| | No. 60 | 0.25 mm | 26 |
| | No 100 | 0.15 mm | 20 |
| | No 200 | .075 mm | 17.5 |

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| Tested by: | M.O. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

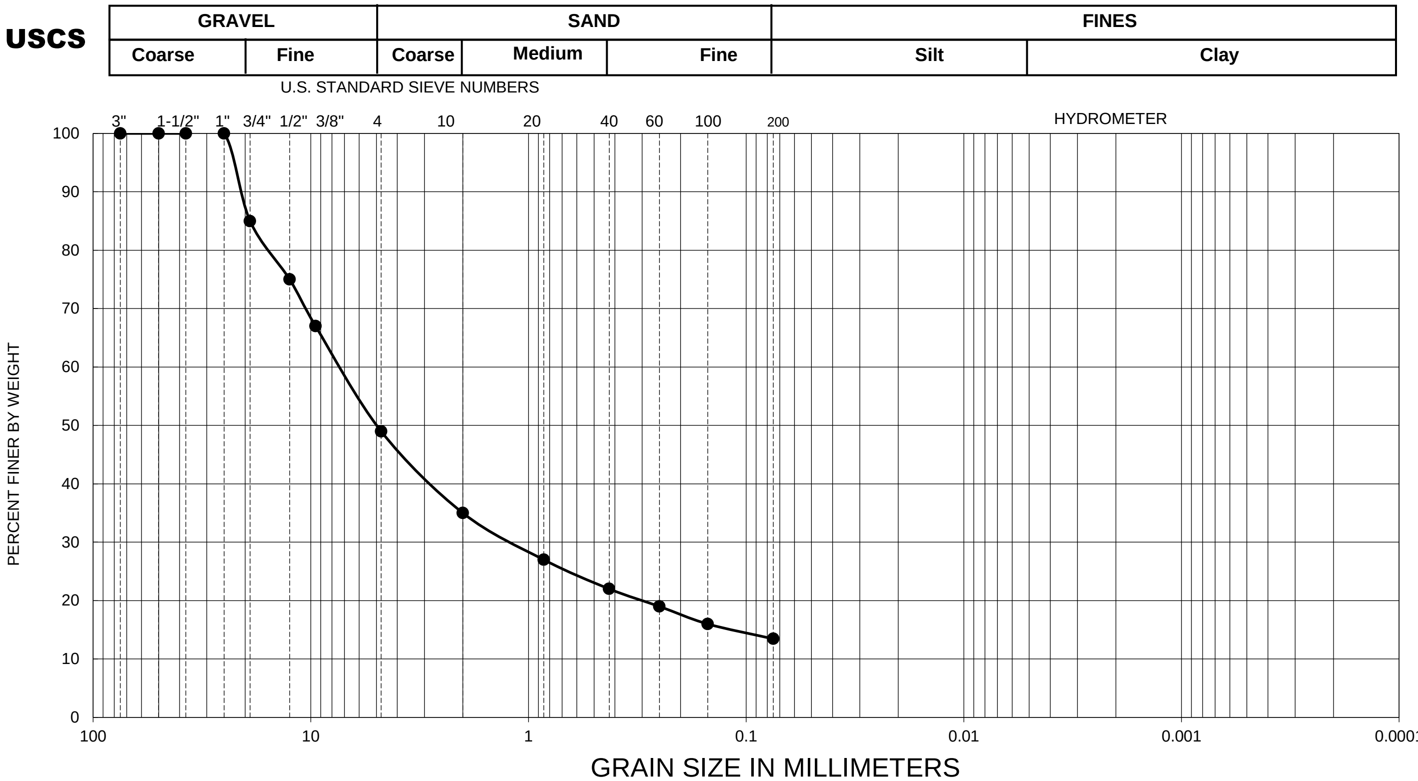
## GRADATION TEST RESULTS

**Suncrest SVC Substation and Transmission Line**

FIGURE

# B-3

Date Tested: **7/31/2015**




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B2** | 1 | 2.5-3 | 13.4 | GC |

| **Sample Description** | light yellow Clayey gravel with sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 85 |
| | 1/2" | 12.5 mm | 75 |
| | 3/8" | 9.5 mm | 67 |
| | No. 4 | 4.75 mm | 49 |
| | No. 10 | 2.0 mm | 35 |
| | No. 20 | 0.85 mm | 27 |
| | No. 40 | 0.425 mm | 22 |
| | No. 60 | 0.25 mm | 19 |
| | No 100 | 0.15 mm | 16 |
| | No 200 | .075 mm | 13.4 |

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| | | | |
|---|---|---|---|
| Tested by: | Uly P. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

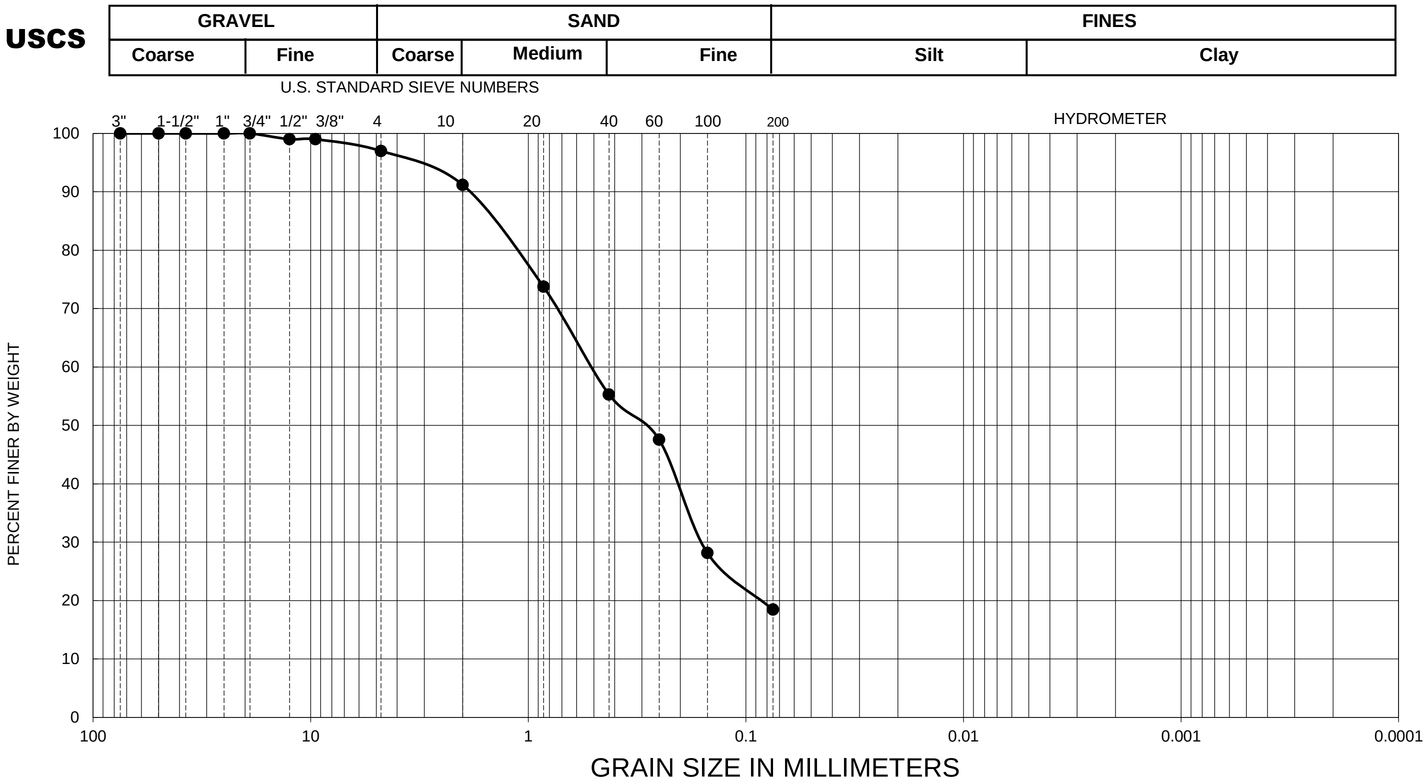
**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-4**

Date Tested: **8/5/2015**




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B2** | 3 | 5-7 | 18.4 | SC-SM |

| | |
|---|---|
| **Sample Description** | reddish brown silty, clayey sand |

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 99 |
| | 3/8" | 9.5 mm | 99 |
| | No. 4 | 4.75 mm | 97 |
| | No. 10 | 2.0 mm | 91 |
| | No. 20 | 0.85 mm | 74 |
| | No. 40 | 0.425 mm | 55 |
| | No. 60 | 0.25 mm | 48 |
| | No 100 | 0.15 mm | 28 |
| | No 200 | .075 mm | 18.4 |

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KLEINFELDER
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| | | | |
|---|---|---|---|
| Tested by: | Uly P. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

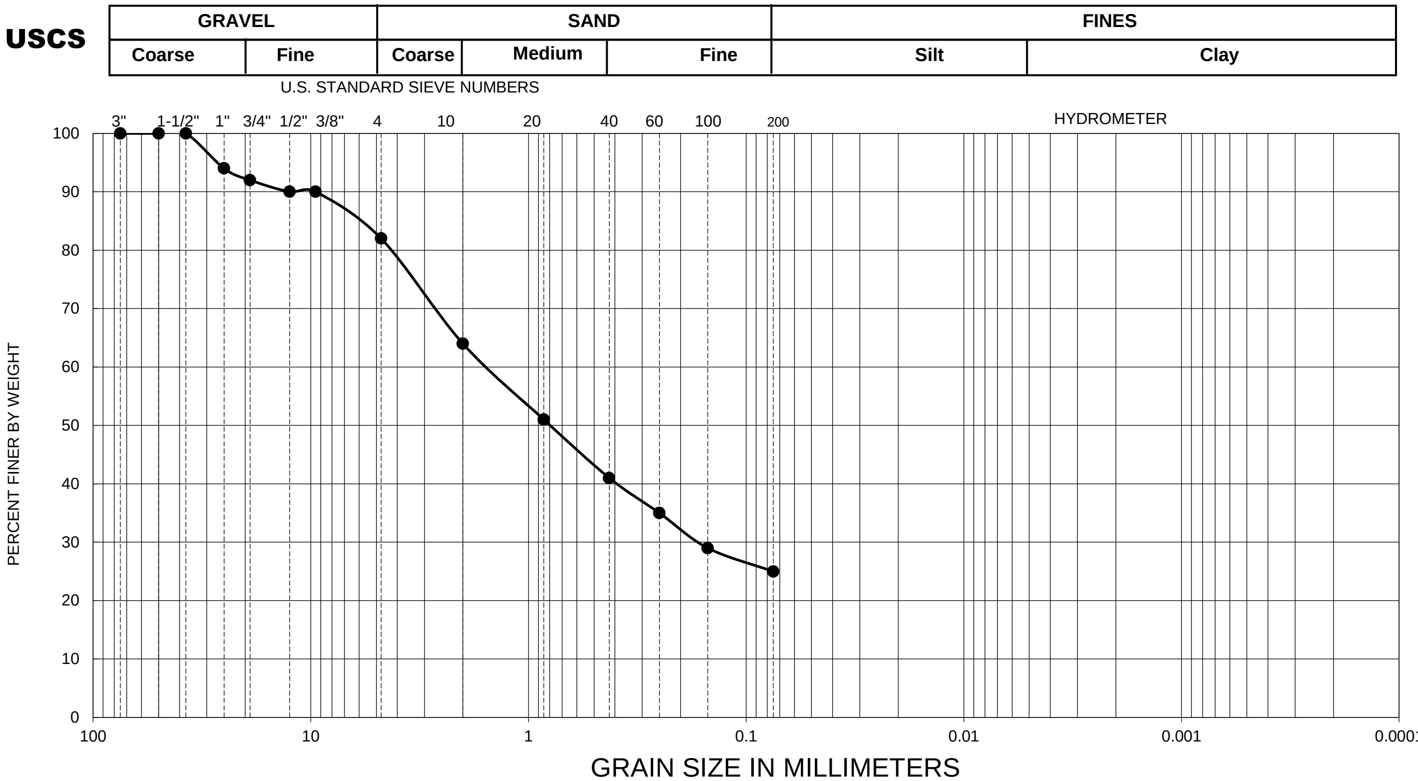
## GRADATION TEST RESULTS

## Suncrest SVC Substation and Transmission Line

FIGURE

# B-5

Date Tested: 7/31/2015




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B3** | 2 | 6-6.5 | 25.0 | SC |

| | | |
|---|---|---|
| **Sample Description** | dark yellowish brown | Clayey sand with gravel |

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 94 |
| | 3/4" | 19 mm | 92 |
| | 1/2" | 12.5 mm | 90 |
| | 3/8" | 9.5 mm | 90 |
| | No. 4 | 4.75 mm | 82 |
| | No. 10 | 2.0 mm | 64 |
| | No. 20 | 0.85 mm | 51 |
| | No. 40 | 0.425 mm | 41 |
| | No. 60 | 0.25 mm | 35 |
| | No 100 | 0.15 mm | 29 |
| | No 200 | .075 mm | 25.0 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| Tested by: | Uly P. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

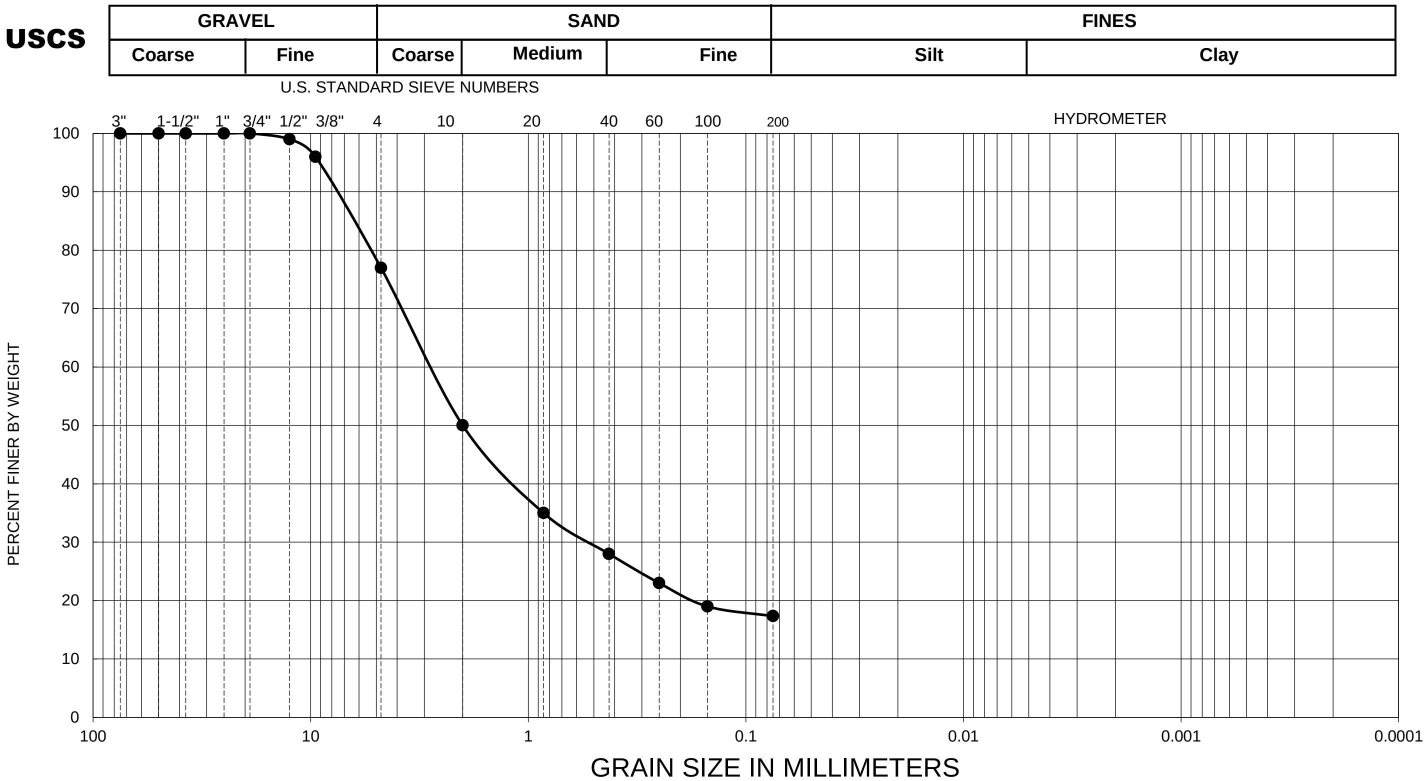
**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-6**

Date Tested: **7/31/2015**




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B3** | 3 | 10-11.5 | 17.3 | SM |

| **Sample Description** | brown Silty sand with gravel |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 99 |
| | 3/8" | 9.5 mm | 96 |
| | No. 4 | 4.75 mm | 77 |
| | No. 10 | 2.0 mm | 50 |
| | No. 20 | 0.85 mm | 35 |
| | No. 40 | 0.425 mm | 28 |
| | No. 60 | 0.25 mm | 23 |
| | No 100 | 0.15 mm | 19 |
| | No 200 | .075 mm | 17.3 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

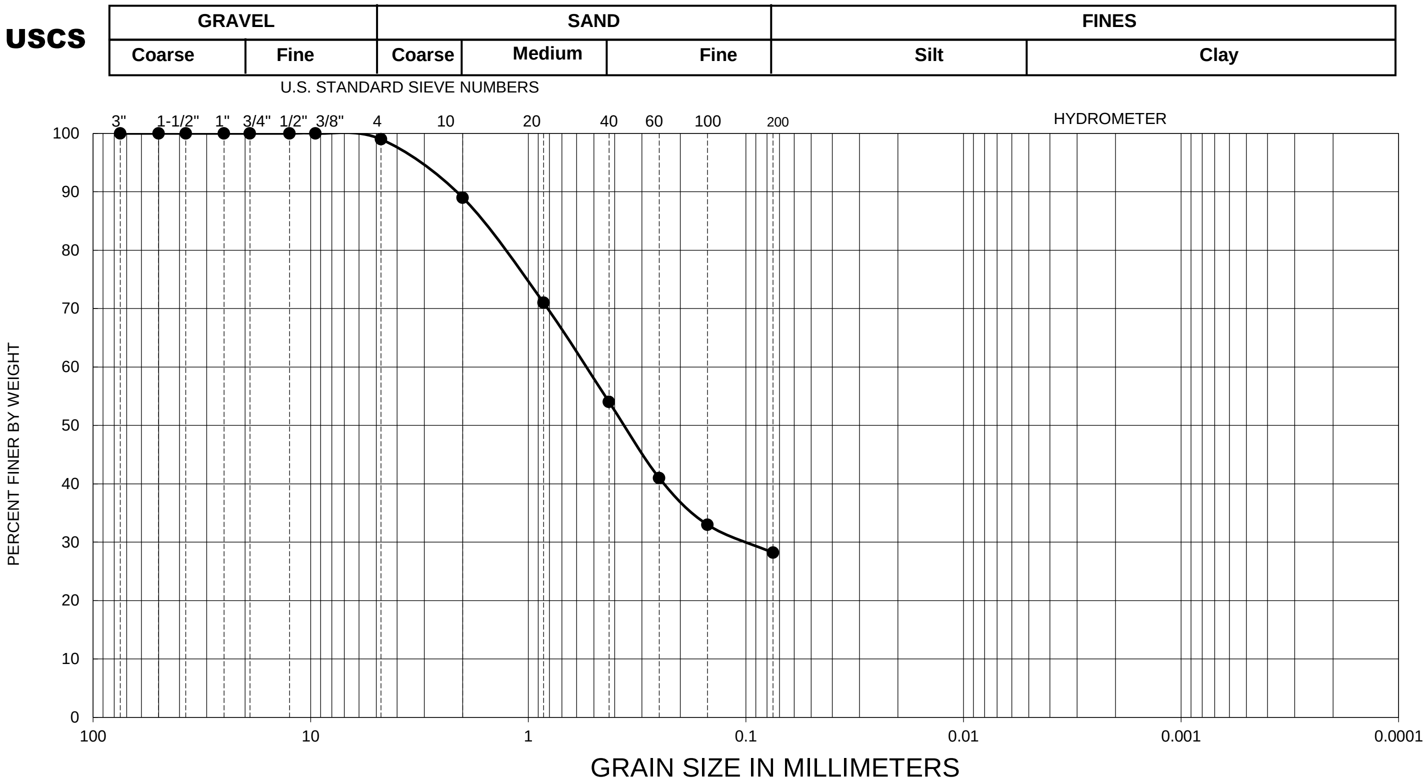
**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-7**

Date Tested: **7/31/2015**




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B4** | 1 | 6-6.5 | 28.2 | SC |

| **Sample Description** | rediish brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 99 |
| | No. 10 | 2.0 mm | 89 |
| | No. 20 | 0.85 mm | 71 |
| | No. 40 | 0.425 mm | 54 |
| | No. 60 | 0.25 mm | 41 |
| | No 100 | 0.15 mm | 33 |
| | No 200 | .075 mm | 28.2 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
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**GRADATION TEST RESULTS**

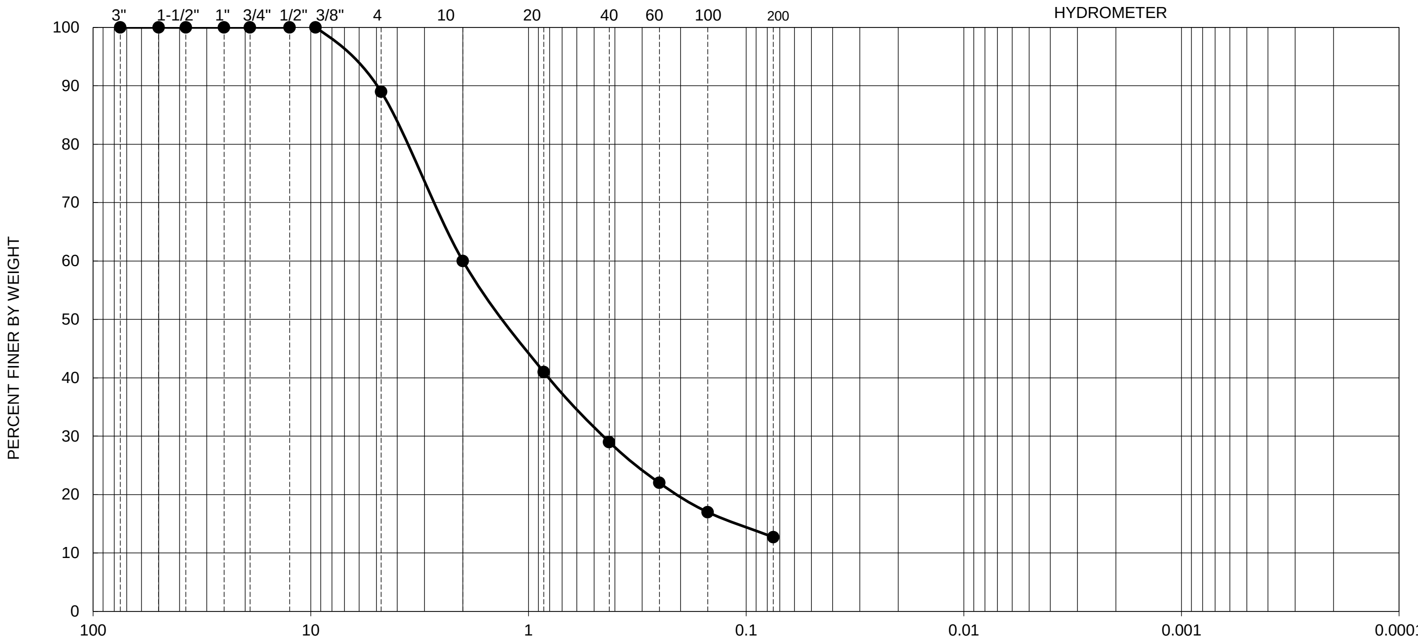
**Suncrest SVC Substation and Transmission Line**

FIGURE **B-8**

| | | | |
|---|---|---|---|
| Tested by: | Uly P. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

Date Tested: **8/3/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




GRAIN SIZE IN MILLIMETERS

| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B4** | 3 | 10-10.5 | 12.7 | SM |

| Sample Description | light brown Silty sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 89 |
| | No. 10 | 2.0 mm | 60 |
| | No. 20 | 0.85 mm | 41 |
| | No. 40 | 0.425 mm | 29 |
| | No. 60 | 0.25 mm | 22 |
| | No 100 | 0.15 mm | 17 |
| | No 200 | .075 mm | 12.7 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

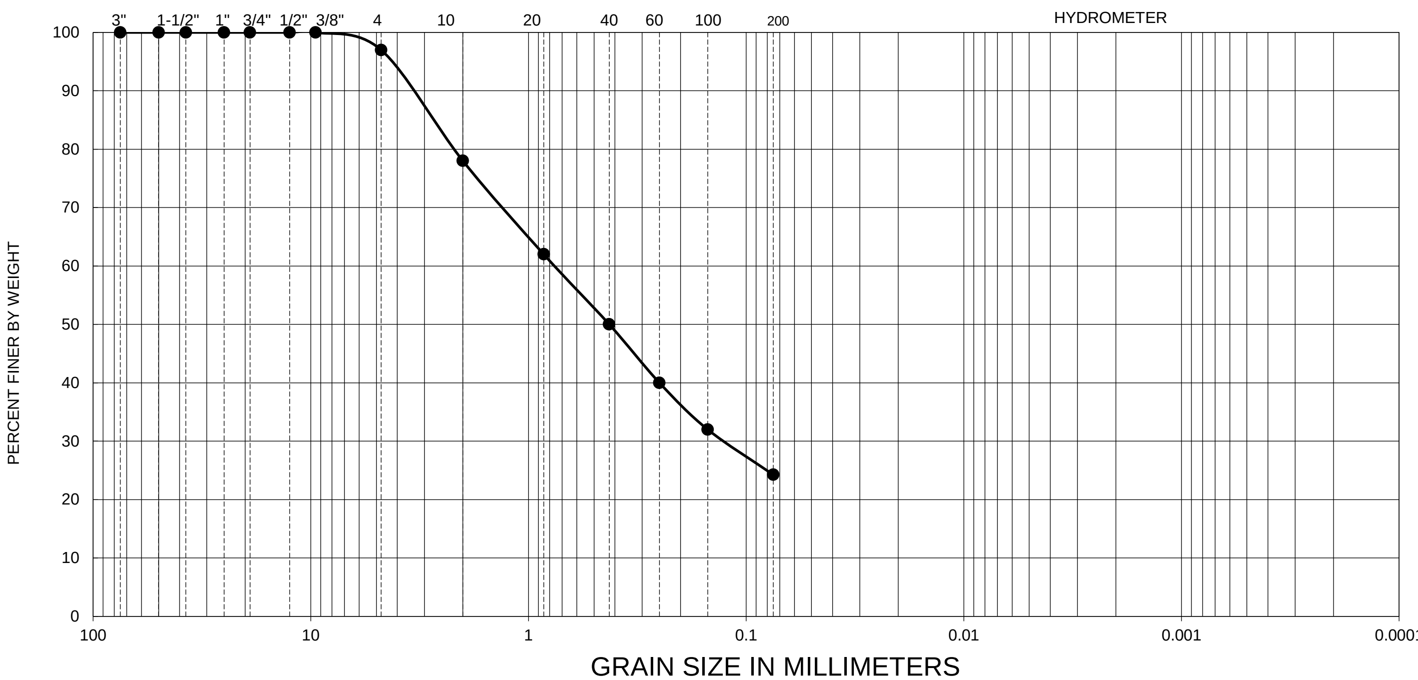
FIGURE

**B-9**

| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

Date Tested: **8/3/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B5** | 2 | 5-5.5 | 24.3 | SC |

| **Sample Description** | light brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 97 |
| | No. 10 | 2.0 mm | 78 |
| | No. 20 | 0.85 mm | 62 |
| | No. 40 | 0.425 mm | 50 |
| | No. 60 | 0.25 mm | 40 |
| | No 100 | 0.15 mm | 32 |
| | No 200 | .075 mm | 24.3 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

**GRADATION TEST RESULTS**

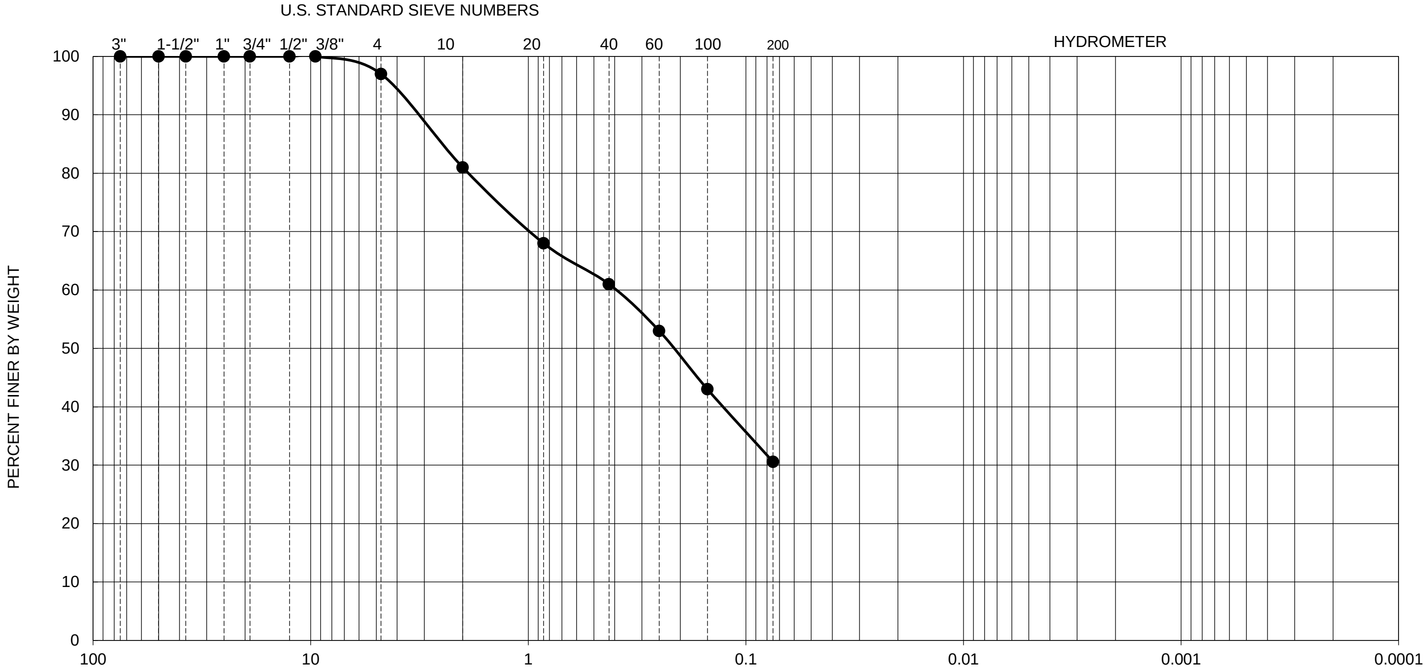
**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-10**

Date Tested: **8/3/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B6** | 1 | 2.5-3 | 30.6 | SC |

| **Sample Description** | light reddish brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 97 |
| | No. 10 | 2.0 mm | 81 |
| | No. 20 | 0.85 mm | 68 |
| | No. 40 | 0.425 mm | 61 |
| | No. 60 | 0.25 mm | 53 |
| | No 100 | 0.15 mm | 43 |
| | No 200 | .075 mm | 30.6 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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| | | | |
|---|---|---|---|
| Tested by: | Uly P. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

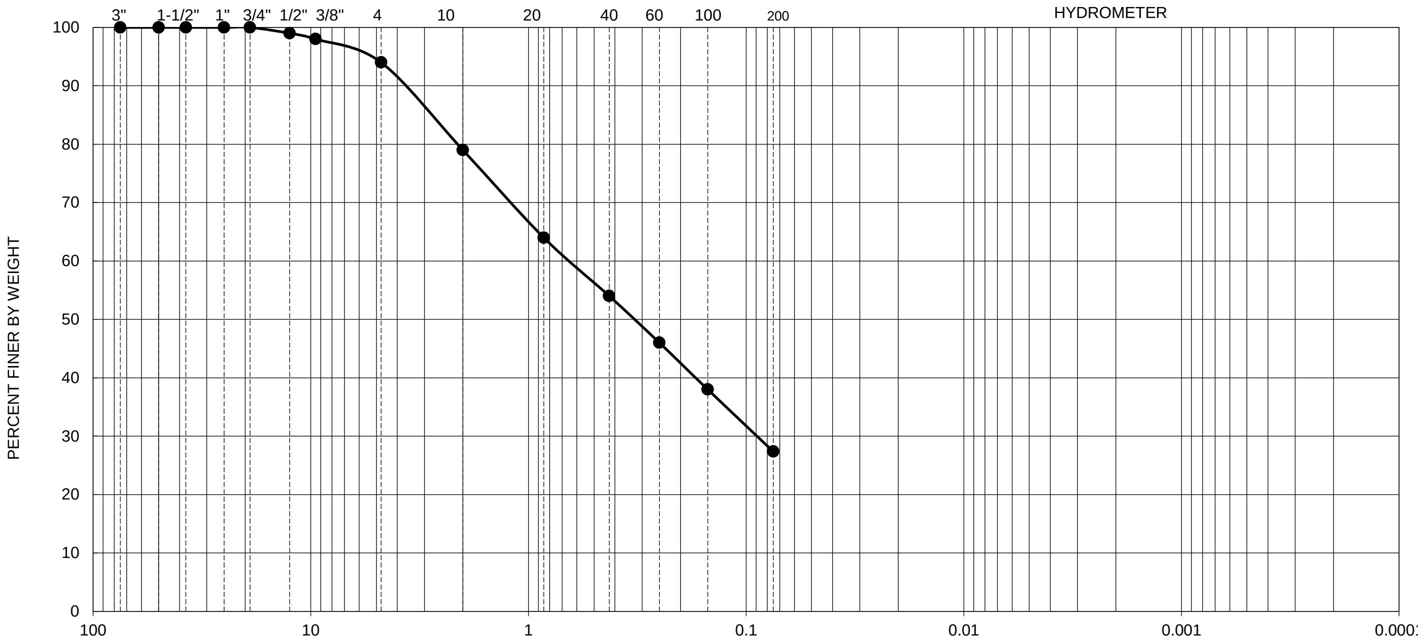
FIGURE

**B-11**

Date Tested: **8/3/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |

U.S. STANDARD SIEVE NUMBERS




GRAIN SIZE IN MILLIMETERS

| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B6** | 3 | 5-5.5 | 27.4 | SC |

| Sample Description | light brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 99 |
| | 3/8" | 9.5 mm | 98 |
| | No. 4 | 4.75 mm | 94 |
| | No. 10 | 2.0 mm | 79 |
| | No. 20 | 0.85 mm | 64 |
| | No. 40 | 0.425 mm | 54 |
| | No. 60 | 0.25 mm | 46 |
| | No 100 | 0.15 mm | 38 |
| | No 200 | .075 mm | 27.4 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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**GRADATION TEST RESULTS**

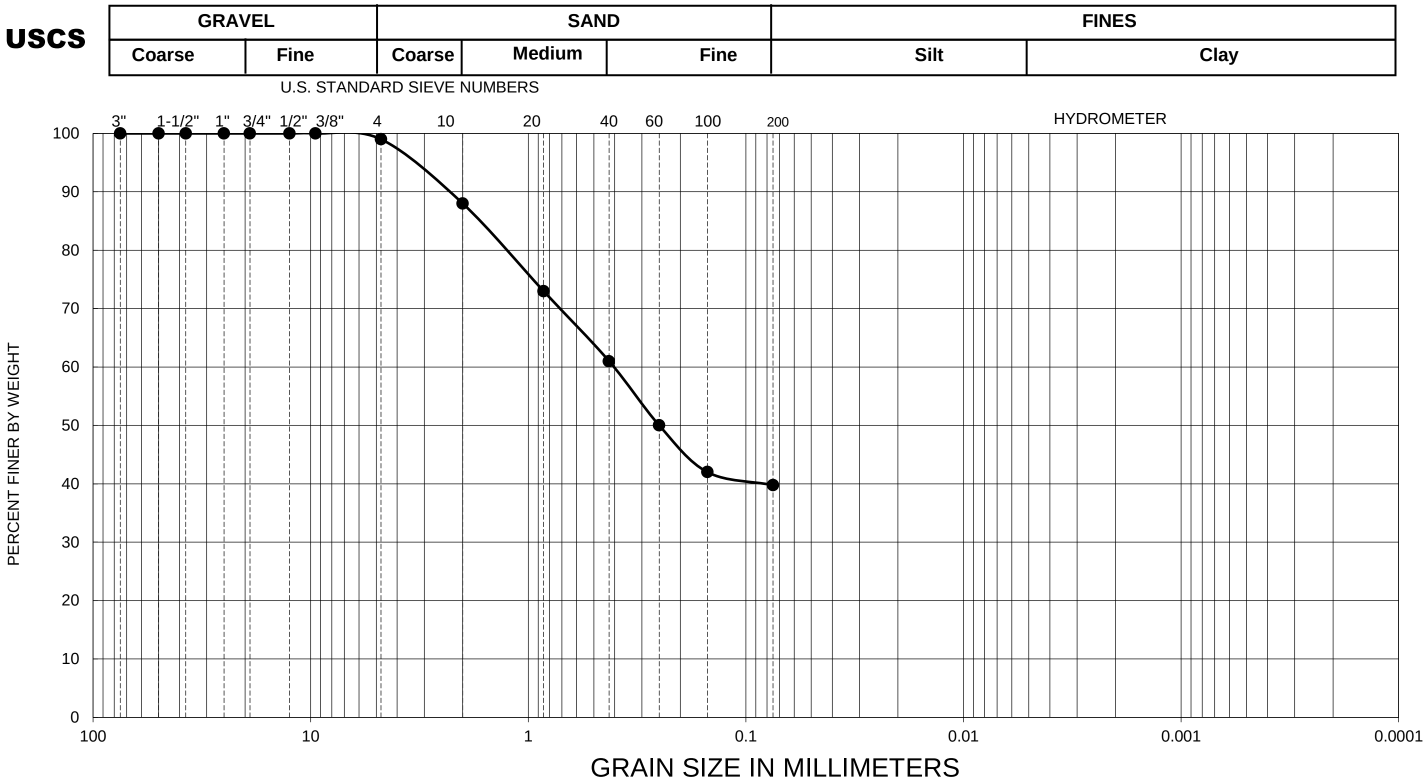
**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-12**

| | | | |
|---|---|---|---|
| Tested by: | Uly P. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

Date Tested: **8/4/2015**




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| B7 | 1 | 3-3.5 | 39.8 | SC |

| Sample Description | light brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| Sieve Analysis | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 99 |
| | No. 10 | 2.0 mm | 88 |
| | No. 20 | 0.85 mm | 73 |
| | No. 40 | 0.425 mm | 61 |
| | No. 60 | 0.25 mm | 50 |
| | No 100 | 0.15 mm | 42 |
| | No 200 | .075 mm | 39.8 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

**GRADATION TEST RESULTS**

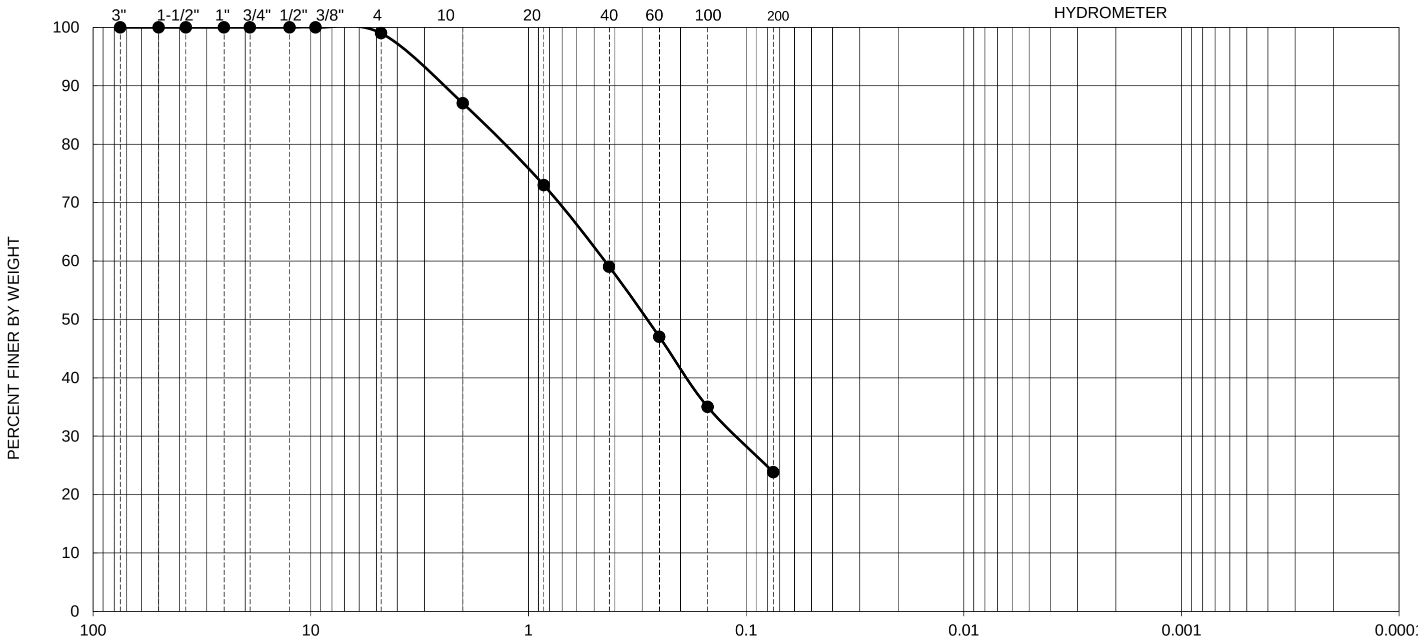
**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-13**

Date Tested: **8/4/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




GRAIN SIZE IN MILLIMETERS

| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B8** | 1 | 3-3.5 | 23.8 | SC |

| Sample Description | light brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 99 |
| | No. 10 | 2.0 mm | 87 |
| | No. 20 | 0.85 mm | 73 |
| | No. 40 | 0.425 mm | 59 |
| | No. 60 | 0.25 mm | 47 |
| | No 100 | 0.15 mm | 35 |
| | No 200 | .075 mm | 23.8 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

## GRADATION TEST RESULTS

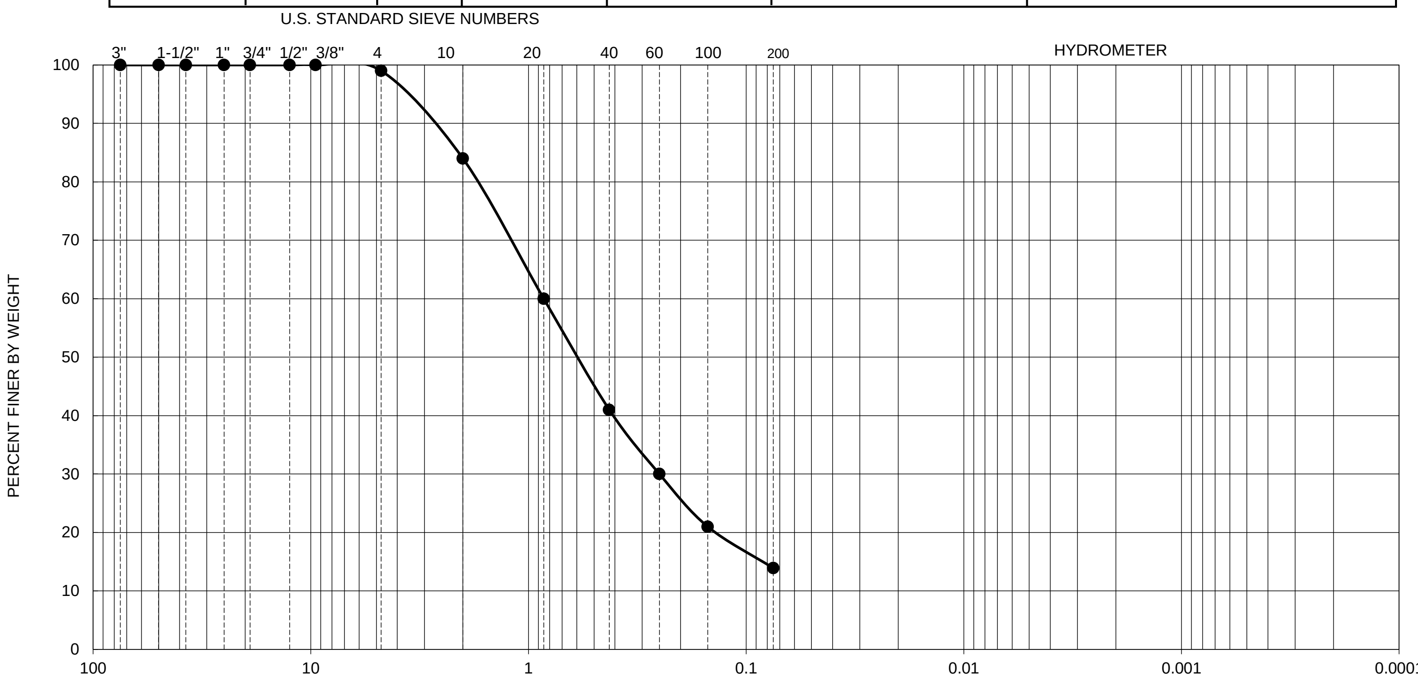
## Suncrest SVC Substation and Transmission Line

FIGURE

# B-14

Date Tested: **8/4/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **B9** | 1 | 2.5-3 | 13.9 | SM |

| **Sample Description** | light brown Silty sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 99 |
| | No. 10 | 2.0 mm | 84 |
| | No. 20 | 0.85 mm | 60 |
| | No. 40 | 0.425 mm | 41 |
| | No. 60 | 0.25 mm | 30 |
| | No 100 | 0.15 mm | 21 |
| | No 200 | .075 mm | 13.9 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

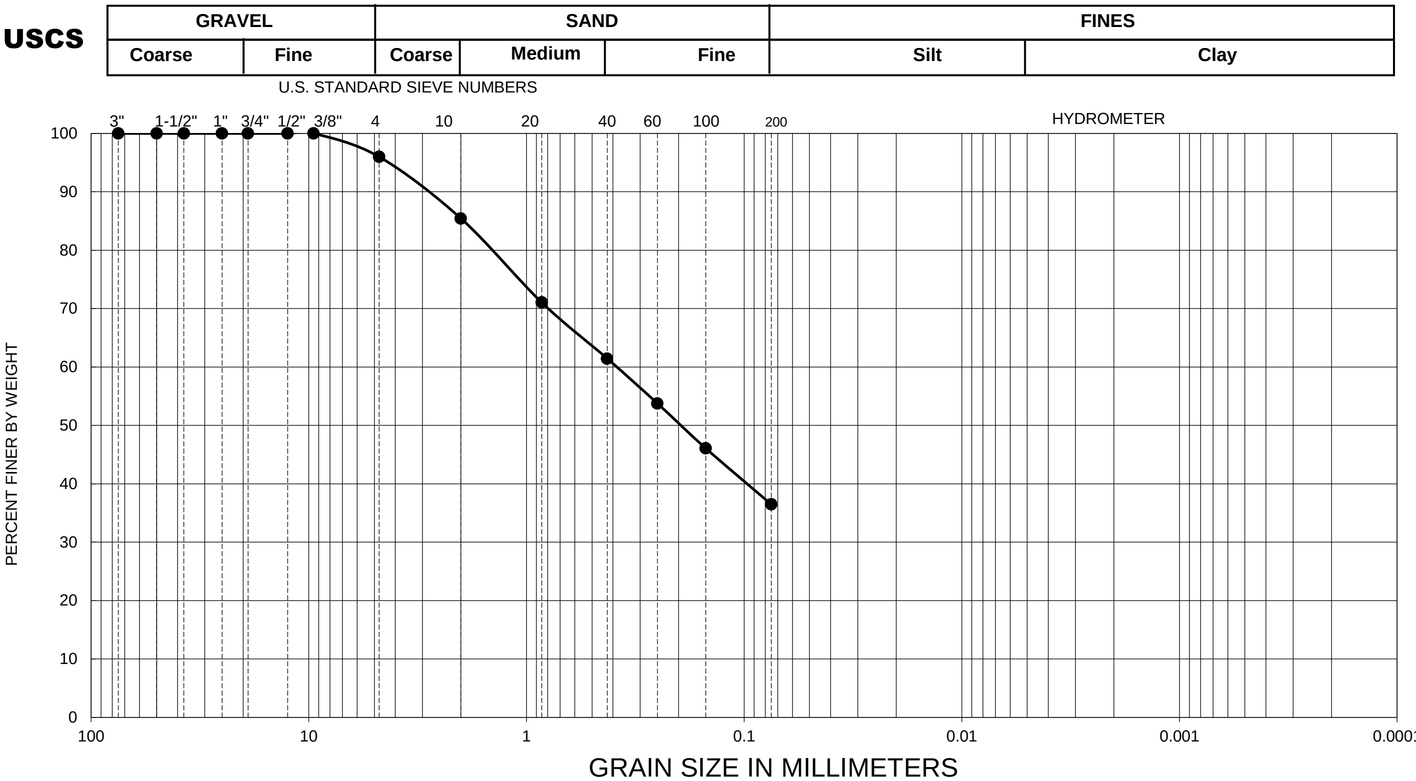
**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-15**

Date Tested: **8/5/2015**




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| **INV-1** | 1 | 1.5-4 | 36.5 | SC |

| | |
|---|---|
| **Sample Description** | dark yellowish brown Clayey sand |

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 100 |
| | 3/8" | 9.5 mm | 100 |
| | No. 4 | 4.75 mm | 96 |
| | No. 10 | 2.0 mm | 85 |
| | No. 20 | 0.85 mm | 71 |
| | No. 40 | 0.425 mm | 61 |
| | No. 60 | 0.25 mm | 54 |
| | No 100 | 0.15 mm | 46 |
| | No 200 | .075 mm | 36.5 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

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| | | | |
|---|---|---|---|
| Tested by: | M.O. | | |
| Project No. | 20160674 | Date: | 12-Aug-15 |

**GRADATION TEST RESULTS**

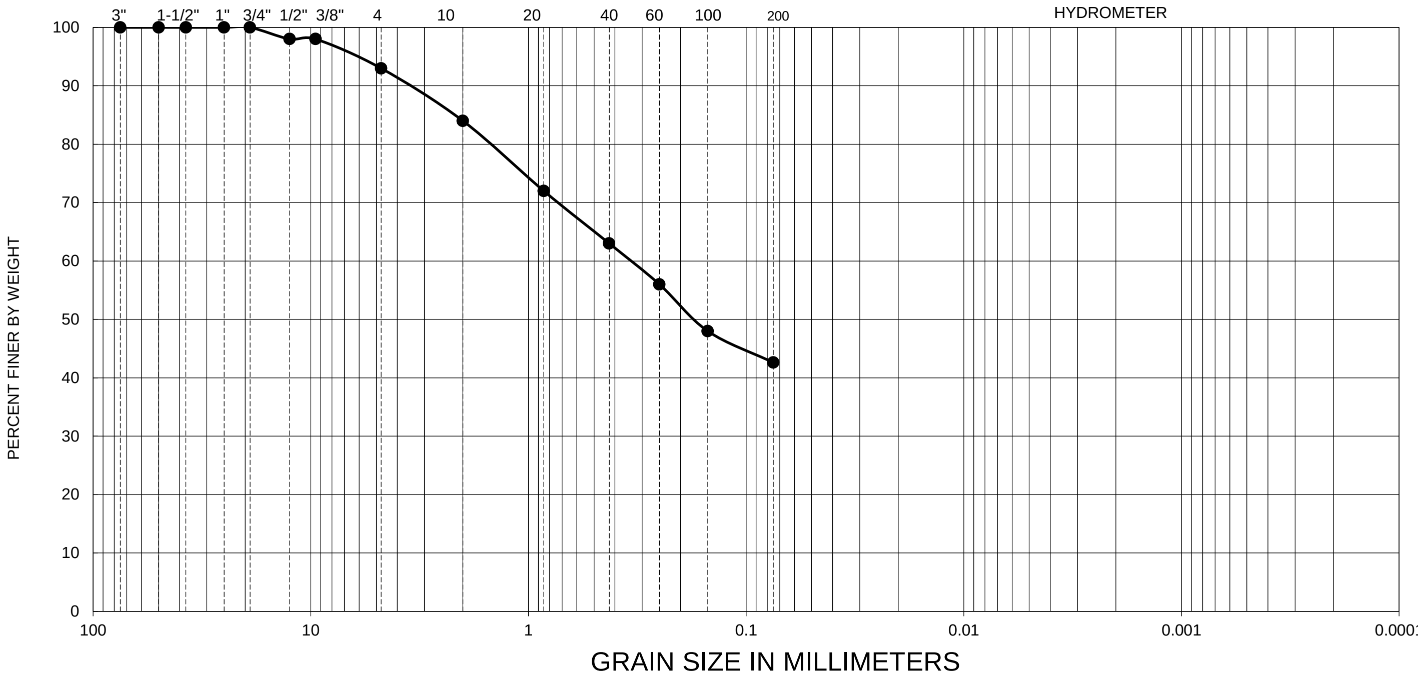
**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-16**

Date Tested: **8/4/2015**

| USCS | GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |




| Boring No. | Sample No. | Depth (ft) | Passing 200 (%) | USCS Classification |
|---|---|---|---|---|
| INV-1 | 2 | 4.5-5 | 42.6 | SC |

| Sample Description | brown Clayey sand |
|---|---|

| | Sieve Size | | % Passing |
|---|---|---|---|
| **Sieve Analysis** | 3" | 75 mm | 100 |
| | 2" | 50 mm | 100 |
| | 1.5" | 37.5 mm | 100 |
| | 1" | 25 mm | 100 |
| | 3/4" | 19 mm | 100 |
| | 1/2" | 12.5 mm | 98 |
| | 3/8" | 9.5 mm | 98 |
| | No. 4 | 4.75 mm | 93 |
| | No. 10 | 2.0 mm | 84 |
| | No. 20 | 0.85 mm | 72 |
| | No. 40 | 0.425 mm | 63 |
| | No. 60 | 0.25 mm | 56 |
| | No 100 | 0.15 mm | 48 |
| | No 200 | .075 mm | 42.6 |

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
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| Tested by: | Uly P. | | |
|---|---|---|---|
| Project No. | 20160674 | Date: | 12-Aug-15 |

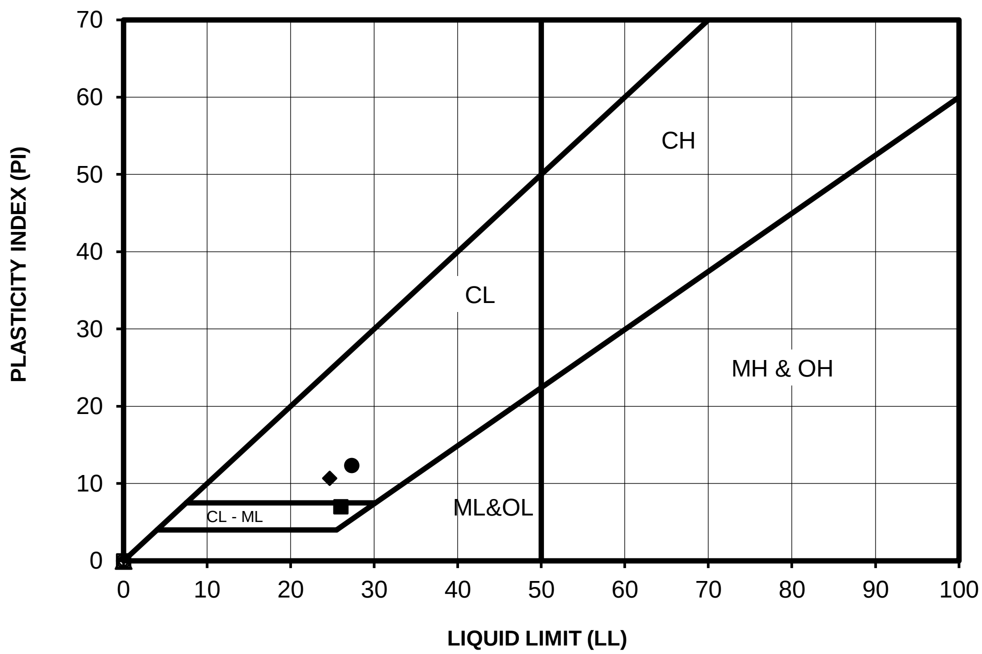
**GRADATION TEST RESULTS**

**Suncrest SVC Substation and Transmission Line**

FIGURE **B-17**

**Date Tested : 8/5-10/2015**

| SYMBOL | SAMPLE NAME | DEPTH (ft) | LL | PL | PI | USCS CLASSIFICATION (Minus No. 40 Sieve Fraction) | USCS (Entire Sample) |
|---|---|---|---|---|---|---|---|
| ● | B-1-3 | 6'-7' | 27 | 15 | 12 | CL | SC |
| ■ | B-2-3 | 5'-7' | 26 | 19 | 7 | CL-ML | SC-SM |
| ◆ | INV-1-1 | 1.5'-4' | 25 | 14 | 11 | CL | SC |
| ○ | | | | | | | |
| □ | | | | | | | |
| △ | | | | | | | |
| + | | | | | | | |
| ◇ | | | | | | | |
| | | | | | | | |




PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Limitations: Pursuant to applicable codes, the results presented in this report are for the exclusive use of the client and the registered design professional in responsible charge. The results apply only to the samples tested. If changes to the specification were made and not communicated to Kleinfelder, Kleinfelder assumes no responsibility for pass/fail statements (meets/did not meet), if provided. This report may not be reproduced, except in full, without written approval of Kleinfelder.

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | | ATTERBERG LIMITS TEST RESULTS | FIGURE |
| Tested by: Uly P. | | Suncrest SVC Substation and Transmission Line | B-18 |
| PROJECT NO: 20160674 | 12-Aug-15 | | |

| Boring No. | Sample No. | Depth (ft) | Sample Description |
|---|---|---|---|
| B1 | 3 | 6'-7' | yellowish brown clayey sand |

| Density Determination | Trial #1 | Trial #2 |
|---|---|---|
| Weight Compacted Sample and Ring | 774.5 | |
| Weight of Ring | 362.6 | |
| Net Weight of Sample | 411.9 | |
| Wet Density, pcf | 124.8 | |
| Dry Density, pcf | 115.3 | |

| Moisture Determination | | |
|---|---|---|
| Wet Weight of Sample, g | 206.9 | |
| Dry Weight of Sample, g | 191.1 | |
| Moisture Content, % | 8.3% | |

| | | |
|---|---|---|
| Expansion Index | 4 | |
| **Corrected Expansion Index** | **4** | **(VERY LOW)** |
| **% Saturation** | 48.3 | |

**Expansion Readings**

| DATE | TIME | READING | |
|---|---|---|---|
| 8/4/2015 | 12:40PM | 0.2046 | |
| 8/4/2015 | 12:50PM | 0.2040 | << Add Water |
| | | | |
| | | | |
| 8/5/2015 | 7:35AM | 0.2076 | << Final |

**Moisture Content after Test**

| | |
|---|---|
| Wet+Ring | **796.5** |
| Dry | 380.4 |
| | **14.1%** |

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| | |
|---|---|
| CHECKED BY: | TECH: Uly |
| JOB NUMBER 20160674 | DATE: 8/12/2015 |

**Expansion Index (ASTM D4829)**

**Suncrest SVC Substation and Transmission Line**

FIGURE
**B-19**

| Boring No. | Sample No. | Depth (ft) | Sample Description |
|---|---|---|---|
| B2 | 3 | 5'-7' | reddish brown clayey sand |

| Density Determination | Trial #1 | Trial #2 |
|---|---|---|
| Weight Compacted Sample and Ring | 793.6 | |
| Weight of Ring | 362.5 | |
| Net Weight of Sample | 431.1 | |
| Wet Density, pcf | 130.7 | |
| Dry Density, pcf | 121.7 | |

| Moisture Determination | | |
|---|---|---|
| Wet Weight of Sample, g | 289.4 | |
| Dry Weight of Sample, g | 269.5 | |
| Moisture Content, % | 7.4% | |

| | | |
|---|---|---|
| Expansion Index | 0 | |
| **Corrected Expansion Index** | **0** | **(VERY LOW)** |
| **% Saturation** | 51.7 | |

**Expansion Readings**

| DATE | TIME | READING | |
|---|---|---|---|
| 8/7/2015 | 4:05pm | 0.2393 | |
| 8/7/2015 | 4:15pm | 0.2389 | << Add Water |
| | | | |
| | | | |
| 8/10/2015 | 7:01am | 0.2376 | << Final |

**Moisture Content after Test**

| | |
|---|---|
| Wet+Ring | **809.9** |
| Dry | 401.5 |
| | **11.4%** |

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| | |
|---|---|
| CHECKED BY: | TECH: Uly |
| JOB NUMBER 20160674 | DATE: 8/12/2015 |

**Expansion Index (ASTM D4829)**

**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-20**

| Boring No. | Sample No. | Depth (ft) | Sample Description |
|---|---|---|---|
| INV | 1 | 1.5'-4' | dark yellowish brown clayey sand |

| Density Determination | Trial #1 | Trial #2 |
|---|---|---|
| Weight Compacted Sample and Ring | 796.1 | |
| Weight of Ring | 366.4 | |
| Net Weight of Sample | 429.7 | |
| Wet Density, pcf | 130.2 | |
| Dry Density, pcf | 121.2 | |

| Moisture Determination | | |
|---|---|---|
| Wet Weight of Sample, g | 239.4 | |
| Dry Weight of Sample, g | 222.8 | |
| Moisture Content, % | 7.5% | |

| | | |
|---|---|---|
| Expansion Index | 0 | |
| **Corrected Expansion Index** | **0** | **(VERY LOW)** |
| **% Saturation** | 51.5 | |

**Expansion Readings**

| DATE | TIME | READING | |
|---|---|---|---|
| 8/7/2015 | 4:35PM | 0.2139 | |
| 8/7/2015 | 4:45PM | 0.2136 | << Add Water |
| | | | |
| | | | |
| 8/10/2015 | 7:10AM | 0.2138 | << Final |

**Moisture Content after Test**

| | |
|---|---|
| Wet+Ring | **810.1** |
| Dry | 399.9 |
| | **11.0%** |

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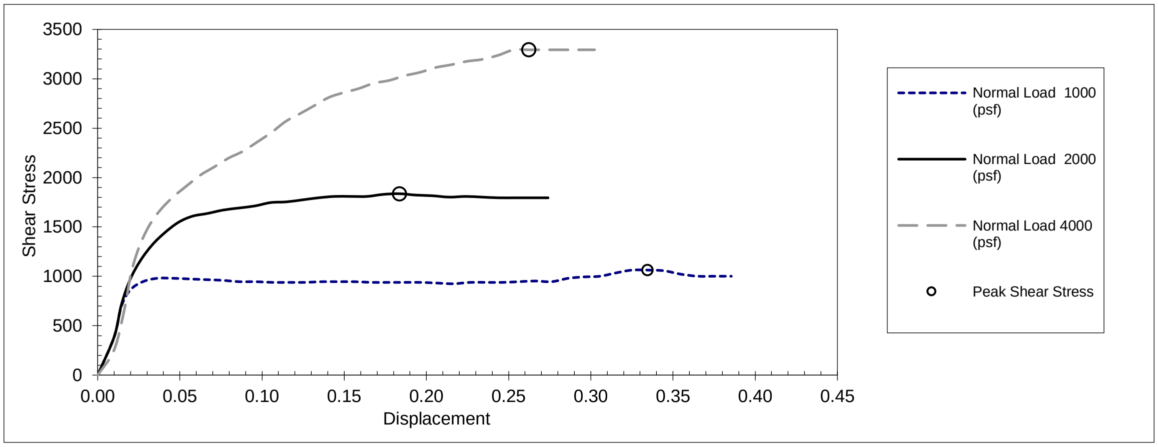
| | |
|---|---|
| CHECKED BY: | TECH: Uly |
| JOB NUMBER 20160674 | DATE: 8/12/2015 |

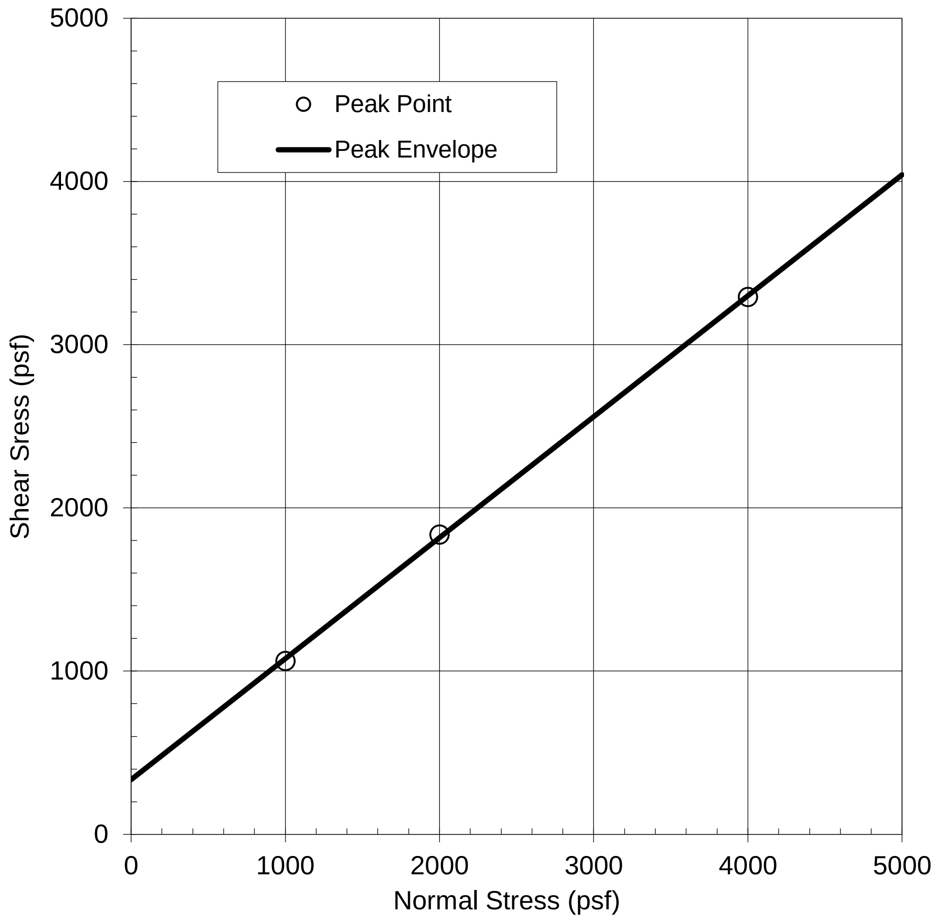
**Expansion Index (ASTM D4829)**

**Suncrest SVC Substation and Transmission Line**

FIGURE

**B-21**



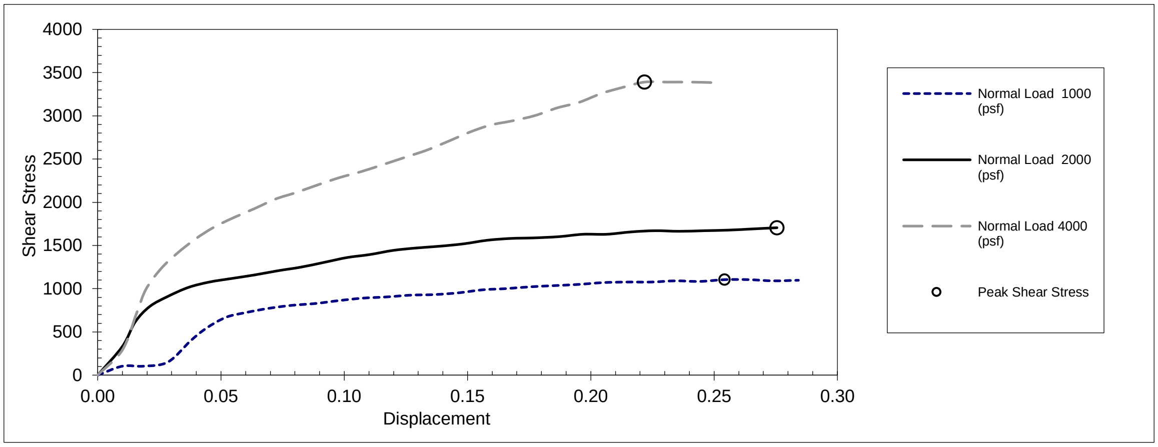

Strain Rate = 0.0118 inch/min

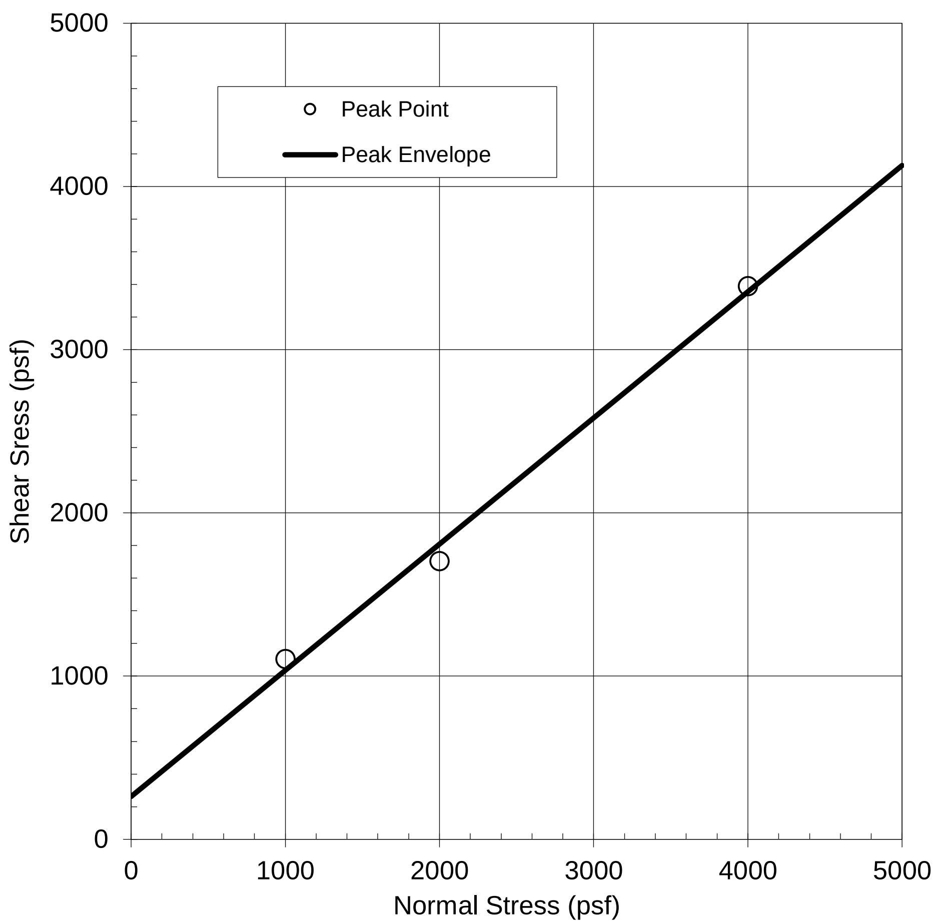
Date Tested: 8/3/2015

| | | | | Interpreted Shear Strength | | | |
|---|---|---|---|---|---|---|---|
| | | | | Peak | | | |
| Boring No. | Sample No. | Depth | UCSC | Cohesion (psf) | Friction Angle (deg) | | |
| B1 | 3 | 6'-7' | SM | 335 | 36.5 | | |

Sample description: light yellowish brown clayey sand

| | | |
|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | **Remolded Direct Shear Test Results (ASTM D 3080)** | Figure |
| Checked By: / Tech : Uly | **Suncrest SVC Substation and Transmission Line** | **B-22** |
| Project # 20160674 / 12-Aug-15 | | |




Strain Rate = 0.0118 inch/min
Date Tested: 8/6/2015

| | | | | Interpreted Shear Strength | | | |
|---|---|---|---|---|---|---|---|
| | | | | Peak | | | |
| Boring No. | Sample No. | Depth | UCSC | Cohesion (psf) | Friction Angle (deg) | | |
| B2 | 3 | 5'-7' | SC | 262 | 37.7 | | |

Sample description: reddish brown clayey sand

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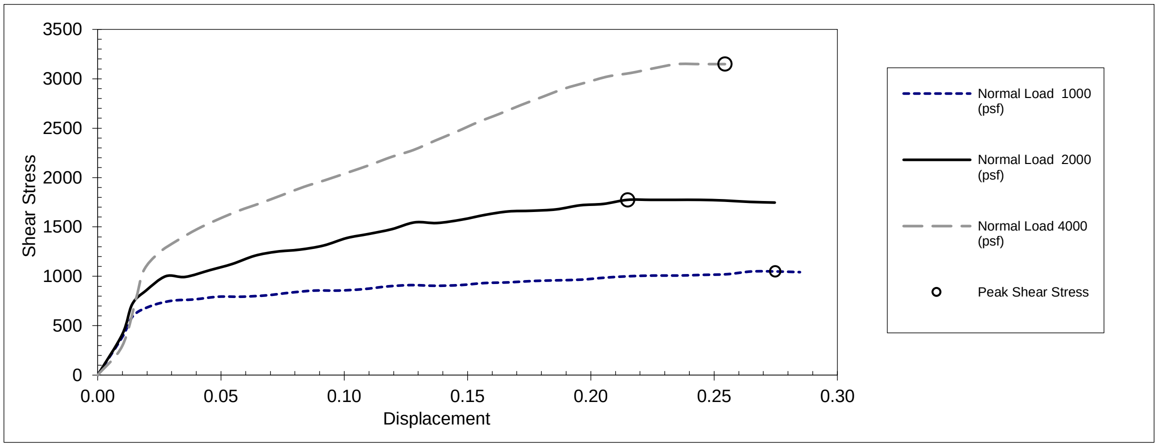
| | |
|---|---|
| Checked By: | Tech : Uly |
| Project # 20160674 | 12-Aug-15 |

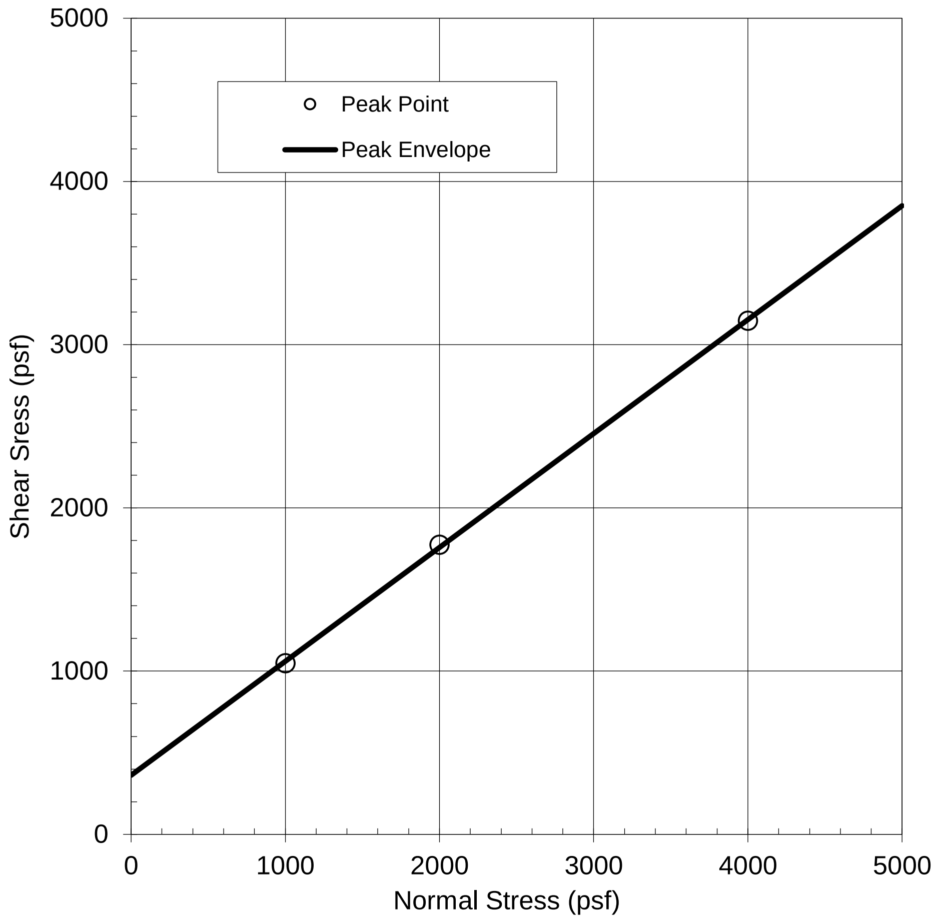
**Remolded Direct Shear Test Results (ASTM D 3080)**

**Suncrest SVC Substation and Transmission Line**

Figure

**B-23**




Strain Rate = 0.0118 inch/min

Date Tested: 8/7/2015

| | | | | Interpreted Shear Strength | | | |
|---|---|---|---|---|---|---|---|
| | | | | Peak | | | |
| Boring No. | Sample No. | Depth | UCSC | Cohesion (psf) | Friction Angle (deg) | | |
| INV-1 | 1 | 1.5'-4' | SC | 362 | 34.9 | | |

Sample description: dark yellowish brown clayey sand

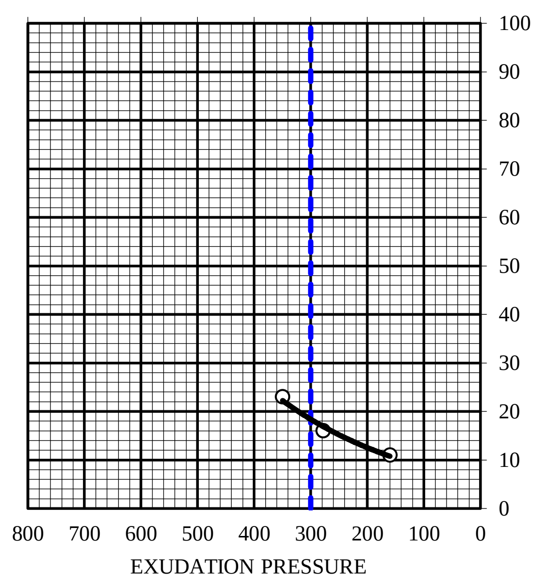
| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | | Remolded Direct Shear Test Results (ASTM D 3080) | Figure |
| Checked By: | Tech : Uly | Suncrest SVC Substation and Transmission Line | B-24 |
| Project # 20160674 | 12-Aug-15 | | |

| Boring No. | Sample No. | Depth | Description | Date Tested |
|---|---|---|---|---|
| B1 | 3 | 6'-7' | light yellowish brown clayey sand | 8/3-4/2015 |

| TEST SPECIMEN | | | | |
|---|---|---|---|---|
| MOLD NO. | 5 | 7 | 2 | |
| FOOT PRESSURE, psi | **50** | **60** | **80** | |
| INITIAL MOISTURE, % | 7.7 | 7.7 | 7.7 | |
| "AS-IS" WEIGHT, g | 1200 | 1200 | 1200 | |
| DRY WEIGHT, g | 1114.0 | 1114.0 | 1114.0 | |
| WATER ADDED, ml | **75** | **55** | **40** | |
| COMPACTION MOISTURE, % | 14.4 | 12.7 | 11.3 | |
| HEIGHT OF BRIQUETTE, in. | **2.51** | **2.47** | **2.5** | |
| WEIGHT BRIQUETTE/MOLD, | **3230.7** | **3225.8** | **3252.6** | |
| WEIGHT OF MOLD, g | **2107.9** | **2104.9** | **2109.2** | |
| WEIGHT OF BRIQUETTE, g | 1122.8 | 1120.9 | 1143.4 | |
| DRY DENSITY, pcf | 118.5 | 122.2 | 124.6 | |
| STABILOMETER, 1000 lbs | **65** | **51** | **44** | |
| 2000lbs | **138** | **126** | **109** | |
| DISPLACEMENT, in | **3.31** | **3.57** | **3.91** | |
| EXUDATION LOAD, lbs | **2011** | **3492** | **4392** | |
| EXUDATION PRESSURE, psi | 160.1 | 278.0 | 349.7 | |
| R-VALUE | 11 | 16 | 23 | |
| **CORRECTED R-VALUE** | 11 | 16 | 23 | |
| DIAL READING, END | 0.0291 | 0.0200 | 0.0191 | |
| DIAL READING, START | 0.0300 | 0.0209 | 0.0200 | |
| DIFFERENCE | -0.0009 | -0.0009 | -0.0009 | |
| EXPANSION PRESSURE, PSF | 0.0 | 0.0 | 0.0 | |

| **INITIAL MOISTURE** | |
|---|---|
| | |
| WET WEIGHT, g | 617.0 |
| DRY WEIGHT, g | 572.8 |
| WEIGHT OF WATER | |
| WEIGHT OF SAMPLE | |
| MOISTURE CONTENT % | 7.7 |

| R-VALUE: | **19** |
|---|---|
| Location: | |

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**R-Value (ASTM D2844)**

Suncrest SVC Substation and Transmission Line

FIGURE

B-25

Tested By: Uly P.

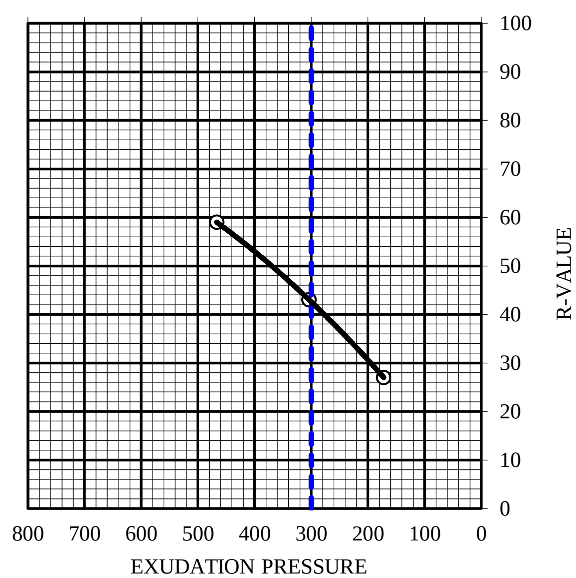
Job Number: 20160674 DATE: 12-Aug-15

| Boring No. | Sample No. | Depth | Description | Date Tested |
|---|---|---|---|---|
| B2 | 3 | 5'-7' | light yellowish brown clayey sand | 8/7&10/2015 |

| TEST SPECIMEN | | | | |
|---|---|---|---|---|
| MOLD NO. | 6 | 9 | 5 | |
| FOOT PRESSURE, psi | **350** | **250** | **110** | |
| INITIAL MOISTURE, % | 7.7 | 7.7 | 7.7 | |
| "AS-IS" WEIGHT, g | 1200 | 1200 | 1200 | |
| DRY WEIGHT, g | 1114.4 | 1114.4 | 1114.4 | |
| WATER ADDED, ml | **5** | **15** | **30** | |
| COMPACTION MOISTURE, % | 8.1 | 9.0 | 10.4 | |
| HEIGHT OF BRIQUETTE, in. | **2.45** | **2.45** | **2.45** | |
| WEIGHT BRIQUETTE/MOLD, | **3255.3** | **3262** | **3244.3** | |
| WEIGHT OF MOLD, g | **2100.9** | **2111.4** | **2109.2** | |
| WEIGHT OF BRIQUETTE, g | 1154.4 | 1150.6 | 1135.1 | |
| DRY DENSITY, pcf | 132.2 | 130.7 | 127.3 | |
| STABILOMETER, 1000 lbs | **23** | **30** | **39** | |
| 2000lbs | **46** | **68** | **96** | |
| DISPLACEMENT, in | **4.23** | **4.46** | **4.48** | |
| EXUDATION LOAD, lbs | **5863** | **3815** | **2162** | |
| EXUDATION PRESSURE, psi | 466.8 | 303.7 | 172.1 | |
| R-VALUE | 59 | 43 | 27 | |
| **CORRECTED R-VALUE** | 59 | 43 | 27 | |
| DIAL READING, END | 0.0179 | 0.0375 | 0.0205 | |
| DIAL READING, START | 0.0179 | 0.0379 | 0.0207 | |
| DIFFERENCE | 0.0000 | -0.0004 | -0.0002 | |
| EXPANSION PRESSURE, PSF | 0.0 | 0.0 | 0.0 | |

| **INITIAL MOISTURE** | |
|---|---|
| | |
| WET WEIGHT, g | 371.6 |
| DRY WEIGHT, g | 345.1 |
| WEIGHT OF WATER | |
| WEIGHT OF SAMPLE | |
| MOISTURE CONTENT % | 7.7 |

| | |
|---|---|
| R-VALUE: | **42** |
| Location: | |

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**R-Value (ASTM D2844)**

Suncrest SVC Substation and Transmission Line

FIGURE

B-26

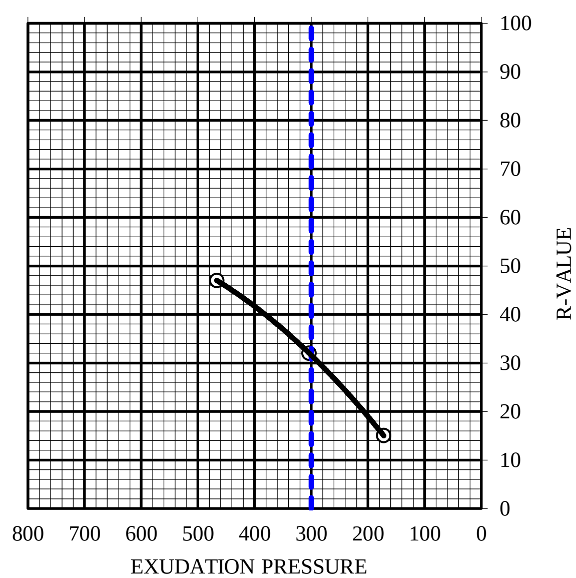
| | |
|---|---|
| Tested By: Uly P. | |
| Job Number: 20160674 | DATE: 12-Aug-15 |

| Boring No. | Sample No. | Depth | Description | Date Tested |
|---|---|---|---|---|
| INV-1 | 1 | 1.5'-4' | dark yellowish brown clayey sand | 8/7&10/2015 |

| TEST SPECIMEN | | | | |
|---|---|---|---|---|
| MOLD NO. | 4 | 2 | 7 | |
| FOOT PRESSURE, psi | **150** | **110** | **60** | |
| INITIAL MOISTURE, % | 6.6 | 6.6 | 6.6 | |
| "AS-IS" WEIGHT, g | 1200 | 1200 | 1200 | |
| DRY WEIGHT, g | 1125.2 | 1125.2 | 1125.2 | |
| WATER ADDED, ml | **20** | **35** | **50** | |
| COMPACTION MOISTURE, % | 8.4 | 9.8 | 11.1 | |
| HEIGHT OF BRIQUETTE, in. | **2.5** | **2.5** | **2.6** | |
| WEIGHT BRIQUETTE/MOLD, | **3266.8** | **3258** | **3282.8** | |
| WEIGHT OF MOLD, g | **2112.7** | **2109.2** | **2104.9** | |
| WEIGHT OF BRIQUETTE, g | 1154.1 | 1148.8 | 1177.9 | |
| DRY DENSITY, pcf | 129.1 | 127.0 | 123.7 | |
| STABILOMETER, 1000 lbs | **30** | **40** | **53** | |
| 2000lbs | **75** | **102** | **122** | |
| DISPLACEMENT, in | **3.18** | **3.03** | **4.41** | |
| EXUDATION LOAD, lbs | **5863** | **3815** | **2162** | |
| EXUDATION PRESSURE, psi | 466.8 | 303.7 | 172.1 | |
| R-VALUE | 47 | 32 | 15 | |
| **CORRECTED R-VALUE** | 47 | 32 | 15 | |
| DIAL READING, END | 0.0295 | 0.0300 | 0.0198 | |
| DIAL READING, START | 0.0300 | 0.0302 | 0.0200 | |
| DIFFERENCE | -0.0005 | -0.0002 | -0.0002 | |
| EXPANSION PRESSURE, PSF | 0.0 | 0.0 | 0.0 | |

| **INITIAL MOISTURE** | |
|---|---|
| | |
| WET WEIGHT, g | 337.1 |
| DRY WEIGHT, g | 316.1 |
| WEIGHT OF WATER | |
| WEIGHT OF SAMPLE | |
| MOISTURE CONTENT % | 6.6 |

| R-VALUE: | **31** |
|---|---|
| Location: | |

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**R-Value (ASTM D2844)**

Suncrest SVC Substation and Transmission Line

FIGURE B-27

| | | |
|---|---|---|
| Tested By: | Uly P. | |
| Job Number: | 20160674 | DATE: 12-Aug-15 |

# APPENDIX C

# THERMAL RESISTIVITY TEST REPORT BY GEOTHERM USA

4370 Contractors Common
Livermore, CA 94551
Tel: 925-999-9232
Fax: 925-999-8837
info@geothermusa.com

**August 7, 2015**

**Kleinfelder**
5761 Copley Drive, Suite 100
San Diego, CA 92111
**Attn: Kevin Crennan, PE, GE**

**Re: Thermal Analysis of Native Soil Samples**
**Suncrest SVC Transmission Line- San Diego County (PO 20160674.1001A 02-0000)**

The following is the report of thermal dryout characterization tests conducted on 6 undisturbed tube samples sent to our laboratory.

**Thermal Resistivity Tests:** The samples were tested 'as received'. A series of thermal resistivity measurements were made in stages, with moisture contents ranging from the 'as received' to totally dry condition. The tests were conducted in accordance with the IEEE Standard 442. The results are tabulated below and the thermal dryout curves are presented in **Figure 1.**

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

| Sample Info | | Visual Description (Kleinfelder) | Thermal Resistivity (°C-cm/W) | | Moisture Content (%) | Dry Density ($lb/ft^3$) |
|---|---|---|---|---|---|---|
| ID | Depth | | Wet | Dry | | |
| B-5 | 3'-3.5' | Silty sand | 67 | 143 | 6 | 123 |
| | 5'-5.5' | Silty sand | 83 | 159 | 5 | 118 |
| B-7 | 2.5'-3' | Silty sand | 124 | 209 | 4 | 108 |
| | 5.5'-6' | Silty sand | 77 | 147 | 4 | 120 |
| B-8 | 2.5'-3' | Silty sand | 145 | 212 | 3 | 106 |
| | 5'-5.5' | Silty sand | 137 | 187 | 2 | 122 |

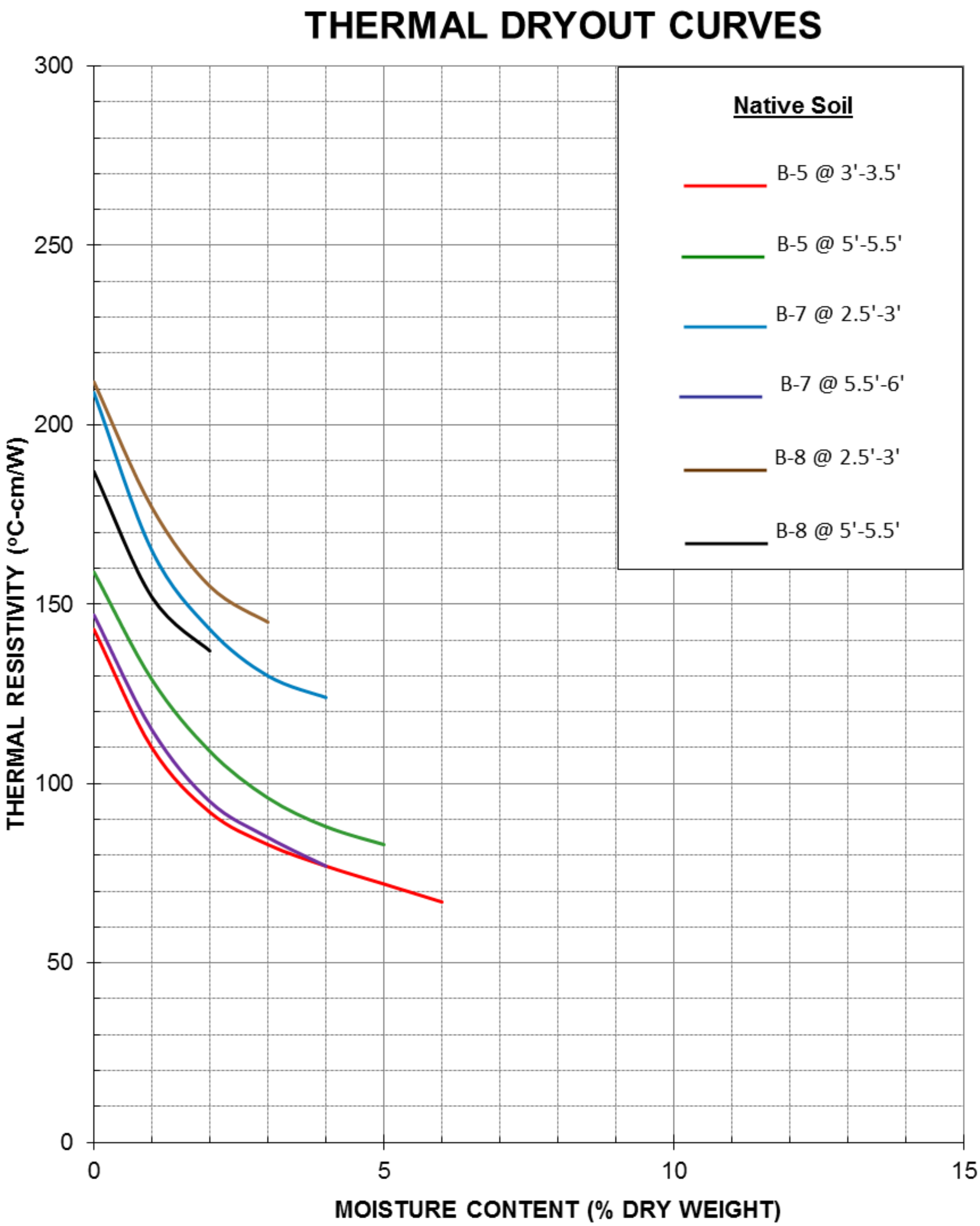
**Comments:** The thermal characteristic depicted in the dryout curves applies for the soils at the respective test dry density.

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

***Geotherm USA***

Deepak Parmar

***Please Note: All samples will be disposed of after 5 days from date of report.***




**Kleinfelder**

**Thermal Analysis of Native Soils**

**Suncrest SVC Transmission Line- San Diego County**

**August 2015** **Figure 1**

# APPENDIX D

# SUGGESTED GUIDELINES FOR EARTHWORK CONSTRUCTION

## APPENDIX D
## SUGGESTED GUIDELINES FOR EARTHWORK CONSTRUCTION

### 1.0 GENERAL

1.1 **Scope** - The work done under theses specifications shall include clearing, stripping, removal of unsuitable material, excavation, preparation of natural soils, placement and compaction of on-site and imported fill material and placement and compaction of pavement materials.

1.2 **Contractor's Responsibility** - The Contractor shall attentively examine the site in such a manner that he can correlate existing surface conditions with those presented in the geotechnical evaluation report. He shall satisfy himself that the quality and quantity of exposed materials and subsurface soil or rock deposits have been satisfactorily represented by the Geotechnical Engineer's report and project drawings. Any discrepancy of prior knowledge to the Contractor to that is revealed through his evaluations shall be made known to the Owner. It is the Contractor's responsibility to review the report prior to construction. The selection of equipment for use on the project and the order of the work shall similarly be the Contractor's responsibility. The Contractor shall be responsible for providing equipment capable of completing the requirements included in the following sections.

1.3 **Geotechnical Engineer** - The work covered by these specifications shall be observed and tested by Kleinfelder, the Geotechnical Engineer, who shall be hired by the Owner. The Geotechnical Engineer will be present during the site preparation and grading to observe the work and to perform the tests necessary to evaluate material quality and compaction. The Geotechnical Engineer shall submit a report to the Owner, including a tabulation of tests performed. The costs of re-testing unsuitable work installed by the Contractors shall be deducted by the Owner from the payments to the Contractor.

1.4 **Standard Specifications** - Where referred to in these specifications, "Standard Specifications" shall mean the State of California Standard Specifications for Public Works Construction, with Regional Supplement Amendments for San Diego County, 2000 Edition.

1.5 **Compaction Test Method** - Where referred to herein, relative compaction shall mean the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D 1557 Compaction Test Procedure. Optimum moisture content shall mean the moisture content at the maximum dry density determined above.

## 2.0 SITE PREPARATION

2.1 **Clearing** - Areas to be graded shall be cleared and grubbed of all vegetation and debris. These materials shall be removed from the site by the Contractor.

2.2 **Stripping** - Surface soils containing roots and organic matter shall be stripped from areas to be graded and stockpiled or discarded as directed by the Owner. In general, the depth of stripping of the topsoil will be approximately 3 inches. Deeper stripping, where required to remove weak soils or accumulations of organic matter, shall be performed when determined necessary by the Geotechnical Engineer. Stripped material shall be removed from the site or stockpiled at a location designated by the Owner.

2.3 **Removal of Existing Fill** - Existing fill soils, trash and debris in the areas to be graded shall be removed prior to the placing of any compacted fill. Portions of any existing fills that are suitable for use in new compacted fill may be stockpiled for future use. All organic materials, topsoil, expansive soils, oversized rock or other unsuitable material shall be removed from the site by the Contractor or disposed of at a location on-site, if so designated by the Owner.

2.4 **Ground Surface** - The ground surface exposed by stripping shall be scarified to a depth of 6 inches, moisture conditioned to the proper moisture content for compaction and compacted as required for compacted fill. Ground surface preparation shall be approved by the Geotechnical Engineer prior to placing fill.

## 3.0 EXCAVATION

3.1 **General** - Excavations shall be made to the lines and grades indicated on the plans. The data presented in the Geotechnical Engineer's report is for information only and the Contractor shall make his own interpretation with regard to the methods and equipment necessary to perform the excavation and to obtain material suitable for fill.

3.2 **Materials** - Soils which are removed and are unsuitable for fill shall be placed in nonstructural areas of the project, or in deeper fills at locations designated by the Geotechnical Engineer.

All oversize rocks and boulders that cannot be incorporated in the work by placing in embankments or used as rip-rap or for other purposes shall be removed from the site by the Contractor.

3.3 **Treatment of Exposed Surface** - The ground surface exposed by excavation shall be scarified to a depth of 6 inches, moisture conditioned to the proper moisture content for compaction and compacted as required for compacted fill. Compaction shall be approved by the Geotechnical Engineer prior to placing fill.

3.4 **Rock Excavation** - Where solid rock is encountered in areas to be excavated, it shall be loosened and broken up so that no solid ribs, projections or large fragments will be within 6 inches of the surface of the final subgrade.

## 4.0 COMPACTED FILL

4.1 **Materials** - Fill material shall consist of suitable on-site or imported soil. All materials used for structural fill shall be reasonably free of organic material, have an Expansion Index of 50 or less, 100% passing the 3 inch sieve and less than 30 percent passing the #200 sieve.

4.2 **Placement** - All fill materials shall be placed in layers of 8 inches or less in loose thickness and uniformly moisture conditioned. Each lift should then be compacted with a sheepsfoot roller or other approved compaction equipment to at least 90 percent relative compaction in areas under structures, utilities, roadways and parking areas. No fill material shall be placed, spread or rolled while it is frozen or thawing, or during unfavorable weather conditions.

4.3 **Compaction Equipment** - The Contractor shall provide and use sufficient equipment of a type and weight suitable for the conditions encountered in the field. The equipment shall be capable of obtaining the required compaction in all areas.

4.4 **Recompaction** - When, in the judgment of the Geotechnical Engineer, sufficient compactive effort has not been used, or where the field density tests indicate that the required compaction or moisture content has not been obtained, or if pumping or other indications of instability are noted, the fill shall be reworked and recompacted as needed to obtain a stable fill at the required density and moisture content before additional fill is placed.

4.5 **Responsibility** - The Contractor shall be responsible for the maintenance and protection of all embankments and fills made during the contract period and shall bear the expense of replacing any portion which has become displaced due to carelessness, negligent work or failure to take proper precautions.

## 5.0 UTILITY TRENCH BEDDING AND BACKFILL

5.1 **Material** - Pipe bedding shall be defined as all material within 4 inches of the perimeter and 12 inches over the top of the pipe. Material for use as bedding shall be clean sand, gravel, crushed aggregate or native free-draining material, having a Sand Equivalent of not less than 30.

Backfill should be classified as all material within the remainder of the trench. Backfill shall meet the requirements set forth in Section 4.2.7 for compacted fill.

5.2 **Placement and Compaction** - Pipe bedding shall be placed in layers not exceeding 8 inches in loose thickness, conditioned to the proper moisture content for compaction and compacted to at least 90 percent relative compaction. All other trench backfill shall be placed and compacted in accordance with Section 306-1.3.2 of the Standard Specifications for Mechanically Compacted Backfill. Backfill shall be compacted as required for adjacent fill. If not specified, backfill shall be compacted to at least 90 percent relative compaction in areas under structures, utilities, roadways, parking areas and concrete flatwork.

## 6.0 SUBSURFACE DRAINAGE

6.1 **General** - Subsurface drainage shall be constructed as shown on the plans. Drainage pipe shall meet the requirements set forth in the Standard Specifications.

6.2 **Materials** - Permeable drain rock used for subdrainage shall meet the following gradation requirements:

| SIEVE SIZE | PERCENTAGE PASSING |
|---|---|
| 3" | 100 |
| 1-1/2" | 90 - 100 |
| 3/4" | 50 - 80 |
| No. 4 | 24 - 40 |
| No. 100 | 0 - 4 |
| No. 200 | 0 - 2 |

6.3 **Geotextile Fabric** - Filter fabric shall be placed between the permeable drain rock and native soils. Filter cloth shall have an equivalent opening size greater than the No. 100 sieve and a grab strength not less than 100 pounds. Samples of filter fabric shall be submitted to the Geotechnical Engineer for approval before the material is brought to the site.

6.4 **Placement and Compaction** - Drain rock shall be placed in layers not exceeding 8 inches in loose thickness and compacted as required for adjacent fill, but in no case, to be less than 85 percent relative compaction. Placement of geotextile fabric shall be in accordance with the manufacturer's specifications and shall be checked by the Geotechnical Engineer.

## 7.0 AGGREGATE BASE BENEATH INTERIOR CONCRETE SLABS

7.1 **Materials** - Aggregate base beneath concrete slabs shall consist of clean free-draining sand, gravel or crushed rock conforming to the following gradation requirements:

| SIEVE SIZE | PERCENT PASSING |
|---|---|
| 1" | 100 |
| 3/8" | 30 – 100 |
| No. 20 | 0 – 10 |

7.2 **Placement** - Aggregate base shall be compacted and kept moist until placement of concrete. Compaction shall be by suitable vibrating compactors. Aggregate base shall be placed in layers not exceeding 8 inches in loose thickness. Each layer shall be compacted by at least four passes of the compaction equipment or until 95 percent relative compaction has been obtained.

# APPENDIX E

# ASFE INSERT

# Important Information about Your

# Geotechnical-Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*While you cannot eliminate all such risks, you can manage them. The following information is provided to help.*

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## A Geotechnical-Engineering Report Is Based on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical-engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical-engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold-prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

## Rely, on Your GBA-Member Geotechncial Engineer for Additional Assistance

Membership in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontaton techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBA-member geotechnical engineer for more information.

GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org