Appendix F

Geotechnical Study

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November 12, 2015
Project No. 20154777.001A

Ms. Sarah Marijana
San Diego Gas & Electric
Civil/Structural Engineering
8316 Century Park Court, CP-52G
San Diego, California 90123

Subject: **Geotechnical Study**
SDG&E Ocean Ranch Substation
Pacific Coast Business Park
Oceanside, California

Dear Ms. Marijana:

Kleinfelder is pleased to present this geotechnical study for the proposed Ocean Ranch Substation project. The site is located at the southerly terminus of Rocky Point Drive and northeast of Avenida del Oro, within Parcels 16 and 17 of the existing Pacific Coast Business Park in Oceanside, California. The purpose of our geotechnical study was to evaluate subsurface soil conditions beneath the site and to provide geotechnical recommendations for design and construction. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 6.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact us at (619) 831-4600.

Respectfully submitted,

KLEINFELDER

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GEOTECHNICAL STUDY
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA
20154777.001A

NOVEMBER 12, 2015

A Report Prepared for:

Ms. Sarah Marijana
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GEOTECHNICAL STUDY
SDG&E OCEAN RANCH SUBSTATION
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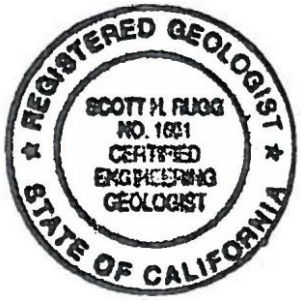

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1 INTRODUCTION

This report presents the results of our geotechnical study for the proposed San Diego Gas and Electric (SDG&E) Ocean Ranch Substation located in Oceanside, California. The approximate location of the project site is presented on Figure 1, Site Vicinity Map. The purpose of our geotechnical study was to evaluate subsurface soil conditions beneath the site and provide geotechnical recommendations for design and construction. The scope of our services was presented in our proposal titled, "Proposal for Update Geotechnical Study, Proposed Ocean Ranch Substation, Pacific Coast Business Park – Parcels 16 and 17, Oceanside, California," dated February 3, 2015. Our services were performed under our master services agreement with Richard Brady & Associates, Inc. (Brady) as part of SDG&E Master Services Agreement (MSA) 6360040035.

Our report includes a description of the work performed, a discussion of the general geotechnical conditions observed at the site, and recommendations developed from our engineering analyses of field and laboratory data.

1.1 SITE AND PROJECT DESCRIPTION

1.1.1 1.1.1 Site Description

Kleinfelder understands SDG&E plans to construct a new 69/12kV substation within Parcels 16 and 17 of the existing Pacific Coast Business Park. The site is also being considered for a new 138kV substation. The proposed configuration based on an ultimate arrangement plan for the 69/12KV station is presented in Figure 2, Boring Location Map.

The site is triangular in shape and has a common property boundary directly south and inline of Rocky Point Drive, which previously separated the parcels. At the time of our siting study in 2012, the parcels were moderately to densely vegetated with native grasses and bushes. However, recent clearing of vegetation was performed at Parcel 16 in the general area where the majority substation improvements will be constructed. The graded area is now covered with both 3/4- and 3-inch sized gravel.

The site has gentle to moderately sloping topography with a gradient that generally slopes to the southwest. An approximate 4- to 7-foot high slope with small trees splits the two parcels. The existing site elevations range from approximately 364 feet MSL at Parcel 16 to about 375 feet MSL at Parcel 17. Existing slopes located on the southern portion of the site appear to have inclinations of about 2H:1V. Two 40- to 50-foot diameter stormwater desilting basins are located

within the southern portion of the site. These desilting basins have corrugated steel stand pipes within the deepest portion. During our site visit we observed erosion gullies on the side slopes on the order of 1 to 3 feet in depth.

The latitude and longitude coordinates for the approximate center of the site are listed below, and the site and vicinity are shown on Figure 1.

Latitude: 33.21071 N

Longitude: -117.29378 W

1.1.2 Project Description

The proposed construction will be primarily situated on Parcel 16 of the existing Pacific Coast Business Park, with future expansion area proposed to the east on Parcel 17. Proposed improvements will consist of transformers, switch stands, circuit breakers, capacitor banks, switchgear, single-story concrete masonry control shelter, and access improvements including new concrete asphalt paved drive lanes. The entire substation pad area will be secured with a 6-foot high privacy wall with gates at several perimeter locations. Other general site improvements will consist of concrete headwalls at two locations and new attenuation/bioretention basins. Based on the referenced civil development plan, the existing western desilting basin will be filled as part of the station pad grading and the existing eastern basin will be modified into a biotention facility.

The proposed finish pad elevations will range from 370 feet at the southwest corner to 375 feet MSL at the northeast side. Grading for the substation pad will mainly consist of placing fill soils across the site, creating fill slopes up to about 10 feet high at the southwest corner of the pad. The site will be accessed from the cul-de-sac area at the south end of Rocky Point Drive via two separate drives entries. An additional access point will be constructed off of Avenida Del Oro to the southwest corner of the pad where cuts up to approximately 10 feet will be required to meet existing elevations along the roadway. Proposed cut and fill slopes will be graded to an inclination of 2:1 (horizontal to vertical).

1.2 SCOPE OF SERVICES

The purpose of our investigation was to evaluate the surface and subsurface soil and geologic conditions at the currently proposed substation and access road area, and to provide geotechnical information and recommendations to facilitate design of the project development.

The scope of our services for this phase of the project consisted of:

- Review of our 2012 preliminary investigation which included four borings and four test pit excavations within the proposed site.
- Field exploration of the subsurface conditions by drilling ten borings;
- 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

Task 1 – Background Data Review. We reviewed readily-available published and unpublished geologic literature and aerial photographs in our files and the files of public agencies. In addition, we reviewed previous geotechnical and as-graded reports provided by SDG&E, and our prior studies. The documents reviewed are presented in Section 7, References.

2.2 FIELD INVESTIGATION

Task 2 – Field Exploration. Subsurface conditions at the site were recently explored by drilling ten geotechnical borings. The borings were drilled to depths of approximately 6½ to 91½ feet below the existing ground surface (bgs) using a truck-mounted drill rig equipped with 6-inch-diameter hollow-stem augers. As part of our prior substation siting study, additional explorations were completed between April 24 and April 26, 2012. Those explorations consisted of three borings to depths ranging between approximately 50 to 80 feet bgs and four test pits ranging from about 5 to 10 feet. The approximate locations of the current and previous borings and test pits are presented on Figure 2, Boring Location Map. A summary of our field investigations are presented in Appendix A and A-1.

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, #200 wash sieve, Atterberg limits, direct shear, 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.

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. We evaluated foundation systems, lateral earth pressures for retaining structures, pavement design, and earthwork. Potential geologic hazards, including ground shaking, liquefaction potential, flood hazard, fault rupture hazard, and seismically-induced

settlement were also evaluated. Seismic design parameters in accordance with the 2013 California Building Code (CBC) are also presented.

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 substation. 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 and A-1);
- Results of laboratory tests (Appendix B);
- 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;
- Recommendations for shallow foundation design, allowable bearing pressures, and embedment depths;
- Recommendations for drilled pier design, including MFAD parameters, axial capacities and minimum embedment depths;
- Recommendations for site preparation, earthwork, temporary slope inclinations, fill placement and compaction, and excavation characteristics of subsurface soil deposits and formational materials;
- Recommendations for support of concrete slabs-on-grade;
- Recommendations for flexible pavement structural sections; and
- Preliminary evaluation of the corrosion potential of the on-site soils.

3 GEOLOGY AND SOILS

3.1 REGIONAL GEOLOGIC AND GEOTECTONIC SETTING

San Diego County resides within the southern portion of California's Peninsular Ranges Geomorphic Province. 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 south into Baja, California. Some of the notable ranges of Southern California include the Santa Ana Mountains, the Laguna Mountains and the Cuyamaca Mountains. The development of this mountain system is closely tied to the transform tectonisim of the San Andreas Fault System.

The County encompasses three geomorphic sub-zones set in a series of north-to-northwest trending belts, roughly parallel to the coastline. From west to east, these zones are comprised of a relatively narrow, low-relief coastal plain; a central high-relief mountainous zone; and a low-lying desert zone. The coastal plain and mountainous zones are part of a more extensive geomorphic province of the Peninsular Ranges. The desert zone is part of a larger geomorphic province known as the Colorado Desert.

Most of the western portion of San Diego County, including the project site is situated within the eastern side coastal subzone near the transition boundary with central mountainous zone. The coastal subzone is characterized by Quaternary to Mesozoic age sedimentary rock material. The sedimentary deposits are configured in a wedge shape mass which thickens to the west across the coastal plain from the edge of the mountainous terrain toward the coastline. The sediments are comprised of a variety of claystones, siltstones, sandstones and conglomerates. Older granitic and metamorphic bedrock occupies the mountainous terrain toward the east and consists of numerous plutonic igneous masses and smaller patches of metamorphic rock into which the granitic rock intruded.

The landscape was eroded during Pleistocene time by a system of generally west flowing large scale drainage systems and associated tributary drainages which resulted in the formation of the canyons/valleys that dominate the regional terrain of San Diego County. These processes also resulted in the accumulation of alluvial soils along drainage pathways and as wedge shape masses along the bottom of eroding hillslopes specifically described as colluvial deposits.

3.2 REGIONAL FAULTING AND SEISMICITY

Southern California straddles the boundary between two global tectonic plates known as the North American Plate (on the east) and the Pacific Plate (on the west). The main plate boundary is represented by the San Andreas fault which stretches northwest from the Gulf of California in Mexico, through the desert region of the Imperial Valley, through the San Bernardino region, and into Northern California where it eventually trends offshore north of San Francisco (Jennings and Bryant, 2010). Within Southern California, the San Andreas fault is a complex system of numerous faults known as the San Andreas Fault System (SAFS) that span 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; Wallace, 1990). The major faults east of the San Diego region (from east to west) include the San Andreas Fault, the San Jacinto fault, and the Elsinore fault. Major faults west of San Diego include the Palos Verdes-Coronado Bank fault, the San Diego Trough fault, and the San Clemente fault.

The most dominant zone of faulting within the San Diego region are several faults associated with the Rose Canyon Fault Zone (RCFZ), as presented in Figure 4, Regional Fault Map and Earthquake Epicenters. The site is located between the RCFZ approximately 9¼ miles to the southwest and the Elsinore Fault Zone (EFZ) located approximately 18½ miles to the northeast. Although activity on any of the known and unknown faults within the SAFS affect the seismicity of the San Diego region, activity within both the RCFZ and the EFZ dominates most aspects of the seismic hazard at the project site.

Most of the seismic energy and associated fault displacement within the SAFS occurs along the fault structures closest to the plate boundary (i.e., on the Elsinore, San Jacinto, and San Andreas faults) (Powell, et. al. 1993). Approximately 49 millimeters per year (mm/yr) (1.9 inches/year) of overall lateral displacement have been measured geodetically and as fault slip across the plate boundary. Combined, the Elsinore, San Jacinto, and San Andreas faults account for up to 41 mm/yr (1.6 inches/year) of the total plate displacement (84 percent), meaning that the remaining 8 mm/yr (0.3 inch) (16 percent) is accommodated across the faults to the west (Bennett et al., 1996). At the latitude of San Diego, most of this, about 5-8 mm/yr, is accommodated by the coastal and offshore system of faults, including the Rose Canyon fault. Farther north, a similar amount (6-8 mm/yr) is accommodated east of the San Andreas Fault in the eastern California Shear Zone (Rockwell, 2010).

3.3 SITE GEOLOGY AND SUBSURFACE CONDITIONS

Based on our review of the referenced grading reports by others, the project area prior to grading consisted of a northeast trending ridgeline with two natural drainage features trending along the slope sidewalls. One drainage feature was located on the northwest side of the property trending roughly parallel to Avenida Del Oro. The other drainage trended northeast across the middle of the site from Avenida Del Oro, where it merged with the other drainage, toward the northeast property corner. The drainage flow direction was toward the southwest with elevations of approximately 270 feet above mean sea level (MSL) at Avenida Del Oro up to approximately 315 feet MSL at the northeast corner of the site. The highest elevations on the site were approximately 380 feet MSL at the southern corner and 360 feet on the north.

There have been at least two reported phases of earthwork construction at the site which consisted primarily of infilling of the drainage feature with artificial fill. The first earthwork phase consisted of fill placement along the western side of the site for construction of Avenida Del Oro, and along the southeast side of the site during construction of the adjacent subdivision on Avenida De La Plata. That grading resulted in the formation of an enclosed basin in the central portion of the site with a bottom elevation of approximately 304 feet MSL.A subdrain was reportedly installed which allowed the basin to drain toward the southwest.

Two geologic units underlie the fill. The youngest is an alluvial deposit which consists primarily of material shed down the side slopes of the drainage feature and depositing toward the bottom. This type of alluvial deposit being due primarily to slope runoff is more specifically designated as a young colluvial deposit. The underlying bedrock material is comprised of Eocene age Santiago Formation. Descriptions of these units including the aforementioned artificial fill are provided in Appendix A (Boring Logs and Test Pit Excavations), and generalized descriptions are provided in the subsequent sections. The geometry of the subsurface units are depicted on the geologic cross-sections on Figures 5 and 6.

3.3.1 Artificial Fill (af)

Our review of the subdivision grading report (Christian Wheeler 2007) shows that two phases of earthwork construction occurred at the site, with the most recent during 2006 to 2007. Our review of previous topographic maps and site boring data indicates that up to 83 feet of fill was placed below the project site. Christian Wheeler observed and performed compaction testing during the earthwork operations during this phase of work and reported the fill to be a minimum 90 percent relative compaction based on the ASTM D1557 modified proctor maximum dry density. For fills

below 50 feet, they report compaction data showing a minimum of 95 percent relative compaction per ASTM D1557. Standard Penetration Test (SPT) and California Sampler blow counts for fill soils encountered at the two parcels ranged from 9 to 48 blows per foot, which are generally consistent with the reported levels of compaction. The fills were likely derived from the on-site materials and generally consist of loose to dense, olive gray to very dark gray clayey sand to sandy clay, and olive brown to light gray silty sand. The specified Expansion Index for grading was for a maximum EI of 90 within the upper 5 feet.

Review of Christian Wheeler's test data indicates that overexcavation and recompaction of fill from the first phase grading was performed within the bottom area of the site drainage basin. The depth of removal was taken from a the existing surface elevation of approximately 304 feet MSL at that time down to a maximum depth of approximately 287 feet MSL. This removal area is shown on Figure 5, geologic cross-section A-A'. It appears that other areas of the Phase 1 fill were not reworked during the second phase of earthwork. These fills occur primarily below the western and southeastern side of the property and occur below the dotted line labeled "2007 Pre-grading Surface" on both of the geologic cross-sections. We did not review any documentation with regards to observation and testing of the Phase 1 fill.

3.3.2 Young Colluvial Deposits (Qyc)

Young colluvial deposits were encountered in borings B-4, B-5, and B-6 of the 2012 preliminary borings and boring B-4 from the current study. This material ranged in thickness between 3½ to 11½ feet between a low elevation of approximately 291½ MSL at previous boring B-6 to a high of 305 feet MSL at two of the previous borings, B-4 and B-5, and recent boring B-4. It apparently was removed from the area of the Phase 2 overexcavation work and consists of a dark gray to black fat clay and clay with sand and in hard condition. SPT and California Sampler blow counts for these soils ranged from 19 to 87 blows per foot.

3.3.3 Santiago Formation (Tsa)

Cretaceous-age Santiago Formation has been mapped underlying the subject site (Kennedy and Tan, 2005), was identified by Christian Wheeler during grading, and was encountered in our borings where the fill and young colluvial deposits were penetrated. Based on our borings, trenches and field mapping of slopes on and near the site indicate the Santiago Formation consists primarily of interbedded fine to coarse, light gray to brownish yellow, massively bedded sandstone, clayey siltstone, and claystone. The sandstones vary from very highly cemented with thin concretionary beds to moderately cemented and friable. Siltstones are massive to locally

thinly bedded, and moderately well-cemented. Recorded SPT and California Sampler blow counts for the Santiago Formation were relatively high, having a range of penetration of 2 to 5 inches for 50 blows.

3.3.4 Groundwater

Groundwater was not encountered in any of our borings or test pit excavations during either field investigation. The depth to the regional groundwater table is anticipated to be significantly deeper than anticipated grading depths and proposed construction elevations. The groundwater table may fluctuate with seasonal variations and irrigation. Groundwater is not expected to be a constraint to development the site. The groundwater table may fluctuate with seasonal variations and irrigation. A local rise in the groundwater level, localized zones of perched water, and increased soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or adjacent to the site can also cause a fluctuation of local groundwater levels. It should be noted that the borings were completed following several years of below average rainfall and current groundwater levels are likely depressed.

4 SEISMIC AND GEOLOGIC HAZARDS

We have reviewed the site with respect to the presence of potential geologic and/or seismic hazards. These hazards include expansive soils, seismic shaking, liquefaction, seismic compression, fault surface rupture, landslides, and flooding. The following sections discuss these hazards and their potential at this site in more detail.

4.1 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, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

Based on the recommendations provided by Christian Wheeler (2006), selective grading was to be performed for soils placed within the upper 5 feet of the site. The selective grading was recommended to provide a cap of fill material with an expansion index of less than 90. The Christian Wheeler (2007) grading report references an expansion index test result on one sample of fill collected from each parcel. The test results of the samples collected range between 50 and 61, which correspond to low to medium expansion potential. Based on the results of our review, field investigations, and experience with similar materials, the fill soils encountered at the site are expected to have a medium potential for expansive soils. No special mitigation measures for expansive soils are recommended for the site.

4.2 SEISMIC SHAKING/CALIFORNIA BUILDING CODE SEISMIC DESIGN PARAMETERS

The project site, like all Southern California, is a seismically active area and is likely to experience ground shaking as a result of earthquakes on nearby or more distant faults. 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. It should be noted that the seismic provision of the 2013 CBC are based on and refer to (for more requirements) “Minimum Design Loads for Buildings and Other Structures, ASCE Standard 7”.

Based on the soil conditions encountered and the calculated shear wave velocities within the upper 100 feet (Vs30), the project site can be classified as Site Class D. Shear wave velocities within the upper 100 feet are used to determine Site Class D according to ASCE 7-10, Section

20.3.1, Table 20.3-1. Based on our designation of Site Class D, the site is defined as “stiff soil” profile with average shear wave velocities within the upper 100 feet between 600 ft/s (180 m/s) to 1,200 ft/s (360 m/s); average SPT blowcount, 15 < N < 50, blows per foot (bpf); or average undrained shear strength 1,000 < su < 2,000 psf (50 to 100 kPa). Based on the Site Class D designation and on the site location 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	--	D	Section 1613.3.2 (Section 11.4.2)
Mapped MCE_R (5% damped) spectral acceleration for short periods (Site Class B)	S_s	1.053 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	0.411 g	Section 1613.3.1 (Section 11.4.1)
Short Period Site Coefficient	F_a	1.079	Table 1613.3.3(1) (Table 11.4-1)
Long Period Site Coefficient (at 1-second period)	F_v	1.589	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	0.437 g	N/A
MCE_R (5% damped) spectral response acceleration for short periods adjusted for site class (F_a*S_S)	S_{MS}	1.136 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}	0.653 g	Section 1613.3.3 / (Section 11.4.3)
Design spectral response acceleration (5% damped) at short periods (2/3*S_{MS})	S_{DS}	0.757 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}	0.435 g	Section 1613.3.4 / (Section 11.4.4)

4.3 LIQUEFACTION

Earthquake-induced soil liquefaction can be described as a significant loss of soil strength and stiffness caused by an increase in pore water pressure resulting from cyclic loading during shaking. Liquefaction is most prevalent in loose to medium dense, sandy and gravely soils below the groundwater table. The potential consequences of liquefaction to engineered structures include loss of bearing capacity, buoyancy forces on underground structures, ground oscillations or “cyclic mobility”, increased lateral earth pressures on retaining walls, post liquefaction settlement, lateral spreading and “flow failures” in slopes.

In general, the subject site is underlain by loose to medium dense fill, medium dense to very dense, or hard to very hard, colluvium, and at depth by very dense formational soils. Based on the nature of these deposits, and the absence of shallow groundwater, it is our opinion that the potential for liquefaction across the site is low.

4.4 SEISMIC COMPRESSION

Seismic compression results from the accumulation of contractive volumetric strains in unsaturated soil during earthquake shaking. Loose to medium dense granular material with no fines, or with low plasticity fines, are most susceptible to seismic compression.

Based on the stratigraphy and generally high SPT blow counts in the borings performed at the project site, the seismic related settlement of the soil above groundwater is less than ½ inch. Therefore, no mitigation measures are recommended.

4.5 FAULT SURFACE RUPTURE

Review of readily available geologic and fault maps does not show any active or potentially active fault features passing through or nearby the site. An active fault is one which has undergone displacement within the last approximate 11,000 years. A potentially active fault (aka: Pre-Holocene fault) is one in which movement has occurred at sometime between 1.6 million years and 11,000 years before present. The closest active fault to the site is the Rose Canyon Fault, which is located approximately 9.2 kilometers offshore to the southwest. The site is not located within an Alquist-Priolo Earthquake Fault Zone. The closest potentially active fault is located approximately 0.5 miles to the southeast (Kennedy and Tan 2005). This is small discontinuous structure and does not trend toward the site. Based on these relationships, the hazard with respect to fault rupture is considered low.

4.5.1 Landslides and Slope Stability

Landslides are deep-seated ground failures in which a large section (tens to hundreds of feet deep) of a slope detaches and slides downhill. Landslides are not to be confused with minor surficial 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. Undermining of foundations can occur to structures above the slide area. Areas below a slide can be damaged by being overridden and crushed by the failed slope material.

Several formations within the San Diego region are particularly prone to landsliding on steep slope surfaces. One of these is the Santiago Formation which underlies the site. These formations generally have high clay content and mobilize when they become saturated with water. However, the previous grading has resulted in a relatively flat-lying surface topography all around the site. No surficial indications of deep-seated landsliding were noted at the site during our field reconnaissance or in topographic maps we reviewed. There were no reported mapped landslides in the geologic literature we reviewed. Due to this low-lying surface condition within and around the site, the hazard with respect to landsliding is considered low.

Kleinfelder performed static and seismic slope stability analyses for the existing fill slopes along areas of the site adjacent to existing slopes as depicted by the two cross-section lines shown on Figure 2, A-A' and B-B'. The external static and seismic factors of safety calculated from the slope stability analyses were above the generally accepted minimum factors of safety of 1.5 and 1.1, respectively. Based on the results of our review, field investigation and engineering evaluations indicating the calculated factors of safety exceed the industry minimum, it is our opinion that the potential for significant large-scale slope instability is considered low.

4.5.2 Tsunami, Seiche and Flooding

Tsunamis are large sea waves that are most often generated by displacement of the ocean floor along submarine faults. They can also develop in response to other events, such as submarine landslides. The State of California through the California Emergency Management Agency, (2009), publishes a set of tsunami inundation maps for the California coastline. Review of the San Luis Rey quadrangle shows the maximum tsunami inundation line closest to the site is approximately 3.4 miles to the southwest at the eastern end of Buena Vista Lagoon.

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 the site is Guajome Lake which is approximately 2.6 miles to the northeast. Based in this distance, the hazard with respect to seiche inundation is low.

The flood hazard potential at the site was evaluated based on flood hazard maps available through the FEMA Map Service Center Web site. Based on FEMA Map Number, 06073C0758G, the proposed development area of the Ocean Ranch substation site is not located within a mapped flood area. The closest flood area is located approximately 0.5 miles south of the site and is designated as a high flood risk. The project site is well outside of this area and at a significantly higher elevation. Therefore, the hazard with respect to flooding is low.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Based on the results of our field exploration, laboratory testing and engineering analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this report are incorporated into the project design and construction. We identified the following key geotechnical considerations during our study.

- The site is mostly underlain by deep fill, colluvium and Santiago formational soils at depth.
- Groundwater was not encountered at the site within any of the exploratory borings or test pits.
- The site is located in the seismically active Southern California area. The structures should be designed in accordance with the American Society of Civil Engineers (ASCE) 113 Substation Structure Design Guide.
- There are no known active or potentially active faults crossing the site. Based on this information it is our opinion that the hazard with respect to fault rupture is low.
- Foundations supporting the proposed improvements should be constructed upon recompacted and engineered fill soils.
- The on-site soils are suitable for re-use as engineered fill, provided highly expansive soils are kept below 3 feet of finished grade elevation, are properly moisture conditioned, and oversize or deleterious material are removed.

The following opinions, conclusions, and recommendations are based on the properties of the materials encountered in the borings, the results of the laboratory-testing program, and our engineering analyses. If the design grades are substantially different than what was assumed in our analyses or the proposed improvements configuration changes, our recommendations will have to be modified accordingly. Final project drawings and specifications should be reviewed by Kleinfelder Inc. prior to the commencement of construction.

5.2 SITE AND SUBGRADE PREPARATION

5.2.1 General

Site preparation and earthwork operations should be performed in general accordance with applicable codes, including SDG&E Specifications for Site Development, County of San Diego Municipal Code, 2013 California Building Code (CBC) and Standard Specifications for Public Works Construction (Greenbook, latest edition). All reference in this report to maximum dry density is established in accordance with American Society for Testing and Materials (ASTM) ASTM D 1557.

5.2.2 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. A representative from our firm should be present during site preparation, fill placement, and foundation construction to evaluate the suitability of the various soils types exposed during excavation, and to evaluate the minimum recommended compaction of the fills is achieved.

5.2.3 Excavation Characteristics

The results of our field exploration program indicate the project site is underlain by fill and colluvium over formational soils at depth. Fill soils should excavate with typical heavy-duty earthwork equipment. Excavations are anticipated for installation of utility lines and the construction of new foundations for the proposed improvements. Most excavations will likely be in the existing and recommended engineered fill.

5.2.4 Site Preparation

Based on the results of our investigation and review of the referenced site improvement plan, foundation excavations for site improvements will be within existing fill soils and or newly placed fill material. Therefore, we recommend that existing fill beneath proposed new fill or improvements be excavated to a minimum depth of 2 feet and be replaced by engineered fill compacted to a minimum relative compaction of 90%. In addition, existing fill soils may require deeper removals where erosion and rutting is present within existing basins.

Proposed fill slopes should be properly keyed and benched into firm materials. Benches should be a minimum of 10 feet in width and spaced at no more than 4-foot vertical height intervals.

Excavations may also be extended deeper for removal and recompaction of existing wash ravines around the basin areas. Additional fill should be placed in order to extend fill depths horizontally, approximately 4 feet to 5 feet. After final grading is completed, the additional fill soils should be trimmed back to expose the newly compacted fill for the finish slope grade.

A representative from our firm should be present during construction to evaluate the suitability of the various soils types exposed during excavation at the site for use as engineered fill, and to evaluate the recommended depth of overexcavation and recompaction.

Prior to placing engineered fill, all surficial vegetation and deleterious material should be stripped and completely removed. The stripping work should include the removal of soil that is dry, compressible, collapsible, or contains significant voids in the judgment of Kleinfelder's geotechnical engineer or geologist.

Man-made structures, including buried pipes, utilities, etc., should be completely removed within the improvement areas. The excavations for removal of any man-made improvements should be backfilled with properly compacted engineered fill per Section 5.2.5. Abandoned utilities (if any) should be completely removed, and the loose backfill removed and replaced. Any trench created by relocating the existing utilities should be backfilled with properly compacted fill.

5.2.5 Engineered Fill

Fill soils within the upper 3 feet below structural foundations should consist of granular material. In general, the onsite fill soils can be reused as materials for placement as compacted fill, provided they have a very low to low expansion index (expansion index of 50 or less), are free of oversized rock, clay clods, organic materials, and deleterious debris.

Material greater than 3 inches in maximum dimension should not be placed within the upper 3 feet of the improvement areas. The onsite soil placed as engineered fill should be moisture conditioned between 0 and 3 percent above optimum moisture content, and compacted to a minimum of 90 percent relative compaction based on ASTM D 1557. The upper 12 inches of subgrade and overlying aggregate base course should be compacted to a minimum of 95 percent.

Although the optimum lift thickness for fill soils will be dependent on the size and type of compaction equipment utilized, fill should generally be placed in uniform lifts not exceeding approximately 8 inches in loose thickness. Oversized material, rocks, or hard clay lumps greater than 6 inches in dimension should not be used in compacted fills.

5.2.6 Import Materials

We recommend that import material consist of granular, very low to low expansive material (expansion index of 50 or less) as evaluated by ASTM D 4829, minimum R-value of 15, no greater than 30 percent of the particles passing the No. 200 sieve, no particles greater than 3 inches in dimension, 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.

5.3 UTILITY TRENCH EXCAVATIONS

5.3.1 Temporary Trench Excavations

We recommend that trenches and excavations be designed and constructed in accordance with Cal-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. For planning purposes, we recommend the OSHA soil Type C be used for fill soils and OSHA Type B for the Santiago Formation.

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). 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 should be evaluated in the field by our geologist or engineer to develop suitable recommendation alternatives. On-site safety of personnel is the responsibility of the contractor, and their designated “competent person” should perform regular inspections of all temporary excavations.

Heavy construction loads, such as those resulting from stockpiles and equipment, should be kept a sufficient distance away from the top of the excavation or shoring to prevent unanticipated surcharge loading. All surface water should be diverted away from excavations.

5.3.2 Pipe Bedding and Trench Backfill

Pipe bedding should consist of sand or similar granular material having a sand equivalent (SE) value of 30 or more. The sand should be placed in the pipe zone which extends a minimum of 6 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. The sand should be brought up evenly on each side of the pipe to avoid unbalanced loads. Onsite silty and clayey sand materials will generally not meet bedding requirements. Compaction by jetting or flooding is not recommended. Trench backfill above pipe zone may consist of approved onsite or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry density.

Based on our experience with other substation projects, deep excavations greater than 5 feet may be required for electrical conduit. We understand that conduits may be encased in a cement slurry and that a firm bottom is not needed. However, aggregate base and/or a geotextile filter fabric may be beneficial to provide a firm bottom if soft or unstable soils are encountered to support other construction activity during installation of the conduits. As with many substation sites, a cement slurry is typically used as backfill above the pipe zone to within about 12- to 24-inches of the ground surface and is acceptable fill from a geotechnical perspective.

5.4 SHALLOW FOUNDATION AND SLAB RECOMMENDATIONS

5.4.1 General

The proposed equipment pads for the substation expansion may be supported on shallow spread, mat or continuous footings founded within either engineered fill or undisturbed formational soils. The soils below the improvements should be prepared in accordance with the recommendations in Section 5.2. We have also included parameters for structures to be supported by drilled piers in Section 5.8.

5.4.2 Shallow Foundations

Based on current grading plans, the majority of the proposed structures will be founded on engineered fill. However, any improvement with shallow foundations to be constructed along the most northwestern portion of the site in the area of test pits TP-4 and TP-5 may encounter dense formational material and should be evaluated during construction. We recommend footings founded entirely in compacted fill soils be designed for an allowable soil contact pressure of 3,000 pounds per square foot (psf). This allowable pressure is based on a Safety Factor of 3. The

recommended design bearing value may be increased by 1/3 for transient loading (due to seismic or wind loading). Shallow foundations should contain reinforcing steel as determined by the project structural engineer. Foundations should have a minimum width of 18 inches and a minimum depth of embedment of 12 inches below the lowest adjacent grade.

Resistance to horizontal loadings should be developed by passive earth pressure on the sides of footings and frictional resistance developed along the footing bottoms. Passive resistance to lateral earth pressures may be calculated using an equivalent fluid unit weight of 350 pcf. An allowable frictional coefficient of 0.30 may be used along the footing bottoms. Frictional and passive pressures may be combined without reduction.

Based on our understanding of the proposed improvements and the allowable soil bearing pressure recommendations discussed above, total settlements are expected to be 1/2 inch or less, while differential settlements over a 40-foot span are not expected to exceed 75 percent of the total settlement. Footings may experience a reduction in bearing capacity or an increased potential to settle when located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the footings on the utility lines may cause cracking, collapse, and/or loss of serviceability of the utility. To reduce this risk, utility excavations should not extend below a 2H:1V plane projected downward from 9 inches above the bottom of the outside edge of the footing. Also, no parallel utility excavations should be made within a lateral distance of 18 inches outside the footing.

Footing excavations should be cleaned of all debris, loose or soft soil, and/or water prior to placing reinforcing steel or concrete. All footing excavations should be observed by a representative of the project geotechnical engineer immediately prior to placement of reinforcing steel and concrete to evaluate the soil bearing conditions and verify that the recommendations contained in this report are implemented during construction.

5.4.3 Exterior Concrete Slabs-On-Grade

Concrete slabs-on-grade can be used for housekeeping pads adjacent to equipment pads or for light equipment pads to support structure improvements. These pads should be supported by a minimum of 18-inches of approved engineered fill. The engineered fill material should be compacted to at least 90 percent of ASTM D 1557. SDG&E housekeeping pads typically omit reinforcing with steel rebar and only utilized fiber within the concrete. Additional reinforcement should be placed as required by the structural engineer.

5.5 INTERIOR CONCRETE SLABS-ON-GRADE

Subgrade soil supporting concrete slabs should be prepared in accordance with the recommendations of Section 5.2 of this report. A subgrade modulus, k, of 150 pounds per cubic inch (pci) may be used for engineered fill soils supporting the slabs. Floor slabs should be designed by the project structural engineer. However, we recommend a minimum thickness of 5 inches and a minimum reinforcement of No. 3 bars at 18-inch spacing in both directions. The reinforcement should be placed near the center of the concrete slab. We strongly recommend that concrete used in slabs-on-grade have a maximum water cement ratio of 0.45. To reduce the effects of cracking, we recommend that expansion relief joints be spaced no greater than 15 feet in both directions. We recommend that all concrete placement, joint spacing, and curing operations be performed in accordance with the recommended guidelines of the American Concrete Institute (ACI).

In cases where the floor may have a vapor/moisture sensitive coverings, may be in a humidity controlled environment, or may likely have one or both of these conditions in the future, we recommend a polyolefin vapor barrier membrane be utilized between the prepared subgrade and the bottom of the floor slab. Based on our experience with other substation structures, proposed switch houses for the substations will not have any floor covering. Thus, a vapor barrier will not be required to reduce moisture vapor transmission through the slab. If moisture protection is desired in selected floor slab areas, an impermeable membrane (minimum 10 mil polyethylene sheeting) should be placed over the compacted subgrade. Care should be taken to properly lap and seal the membrane, particularly around utilities, to provide a uniform barrier.

To promote more uniform curing of the slab and provide protection of the membrane during construction, fine-to-medium-grained clean sand (SP or SW), 2- to 4-inches thick, should be placed on top of the membrane prior to placing slab concrete. This sand should be moistened immediately prior to concrete placement.

5.6 RECOMMENDATIONS FOR RETAINING WALLS

Masonry block barrier/retaining walls may be supported on shallow continuous footings per the foundation recommendations in Section 5.4. Lateral pressures acting against masonry and poured-in-place concrete retaining walls can be calculated using soil equivalent fluid weight (efw). The efw value used for design depends on allowable wall movement. Walls that are free to rotate at least 0.5 percent of the wall height can be designed for the active efw. Retaining walls that are

restrained at the top (such as basement walls), or are sensitive to movement and tilting should be designed for the at-rest efw.

Values given in Table 2 below are in terms of equivalent fluid weight and assume a triangular distribution for fill soils. These values assume that imported, sandy soils (SP, SM, SC) will be used as backfill, and the backfill is well drained. If walls with undrained backfill are to be used, Kleinfelder should be consulted for additional evaluation and recommendations.

Table 2
Equivalent Fluid Weights (efw)
For Calculating Lateral Earth Pressures

CONDITIONS	LEVEL BACKFILL	2:1 SLOPING BACKFILL
At-Rest	55 pcf	80 pcf
Active	30 pcf	55 pcf

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. for the at-rest and active cases, respectively. As a minimum, a traffic surcharge equivalent to 120 psf may be assumed to act as a uniform horizontal pressure over the retained height of the wall, H. We should be contacted where point or line loads are expected so we can provide recommendations for additional wall stresses.

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. Based on the design peak horizontal ground acceleration of 0.4g discussed in Section 4.2, the resultant seismic force (in pounds) for each linear foot of wall can be estimated as 9*H2 within fill soils with a level backfill, 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.

Allowable bearing pressure values described in previous sections 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 than is normally applied to static loads could be used. The factor of safety for dynamic load conditions should not be less than 1.2.

5.7 WALL DRAINAGE

Drainage should be provided for walls which retain soil to prevent the development of hydrostatic forces behind the wall. Either a geosynthetic composite drainage mat or crushed stone wrapped in filter fabric can be used for drainage. If a geosynthetic composite drainage mat is used, the PVC pipe or composite drainage should be routed to discharge at a suitable location that is protected from erosion. If crushed stone drainage if used, it should consist of a zone of crushed, open-graded, ¾-inch gravel at least 12 inches wide from the base of the wall to within 2 feet of the ground surface. The gravel should be separated from all soil with Mirafi 140N geosynthetic fabric or an approved equivalent. A 4-inch diameter Schedule 40 PVC pipe should be placed at the bottom of the gravel zone and sloped to drain at 1 percent. The pipe should have two rows of 3/8-inch diameter holes spaced at about 6 inches and on an arc of 120 degrees, facing downward. Kleinfelder should be notified to observe the final tie-in of the outlet pipe to its discharge point.

The wall designer should determine the damp proofing requirements.

5.8 DRILLED PIER FOUNDATIONS

Drilled pier lengths should be designed based on downward, uplift and lateral loading. We understand that proposed pier lengths are typically governed by lateral loading and that SDG&E will utilize computer program Moment Foundation Analysis Design (MFAD) for design. The recommended soil values below are based on average soil conditions in the generalized layer and the best fit line in Figures 5-8 and 5-14 of the EPRI Manual on Estimating Soil Parameters for Foundation Design (1990). Due to the wide scatter in correlations of pressuremeter modulus data to SPT blow counts and the limited data collected in our study, designers may consider use of more conservative modulus values than the best fit line. These values are intended for use in computer program MFAD only and should be applicable for all versions of the program.. Design values for other methods of analyses can be provided upon request.

The locations for transmission poles were not specified at the time of this report and the substation limits cover a large area. Due to the variable depth of compacted fill over Santiago Formation, the estimated depth of fill at a specific pole location can be provided by Kleinfelder in and addendum when the location is specified. However, we are providing a range of values for the large substation area based on the conditions depicted on the geologic cross-sections between borings. As shown on Figures 5 and 6 respectively, depths of the fill material within the proposed substation varies between 74 and 83 feet (B5, B5 and B6) along cross-section line A-A’ in a

northwest direction through the substation limits and are between 37 and 80 feet (B2, B3 and B5) along cross-section line B-B' from west to east. The depth of fill likely exceeds the depth of most if not all foundations. We are providing design parameters for both anticipated geologic units.

Table 3

Recommended Soil Parameters for MFAD Analysis

SOIL TYPE	UNIT COHESION (PSF)	FRICTION ANGLE (DEGREES)	UNIT WEIGHT (PCF)	DEFORMATION MODULUS E_{PMT} (KSI)	STRENGTH REDUCTION FACTOR
Fill	0	32	125	1.0	1.0
Santiago Formation	0	38	130	4.0	1.0

Notes: Surficial discount of 2 feet is recommended.

Figures 7 and 8 provide allowable capacity curves for both compression and uplift, respectively. End bearing is included in the provided curves but should be neglected if design lengths encounter groundwater. The potential presence of groundwater may be further addressed in project planning and construction but was not observed during either field investigation for the proposed substation. It should be noted that our borings were completed following several years of drought conditions and could fluctuate if piers are constructed following seasonal precipitation.

5.9 CORROSION POTENTIAL

The subsurface soils that may be in contact with foundations and buried utilities are anticipated to be locally derived fill, however, the majority of the site will receive imported fill to attain proposed finish grade elevations. Laboratory testing was performed to evaluate soluble chloride, soluble sulfate content and pH of soil. Corrosion test results are summarized in Table 4.

Table 4

Soil Corrosion Test Results

BORING / SAMPLE NO.	DEPTH (FEET)	MINIMUM RESISTIVITY (OHM-CM)	PH	SULFATE CONTENT (PPM)	CHLORIDE CONTENT (PPM)
B-3 / 1	0.5 to 5	480	8.7	210	160
B-4 / 1	0.5 to 5	870	8.9	50	50
B-5 / 1	0.5 to 5	550	8.3	70	160

For reference, Caltrans considers a site to be aggressive if one or more of the following conditions exist for the representative soil samples taken at the site: chloride concentration is 500 parts per million (ppm) or greater, sulfate concentration is 2,000 ppm or greater, or the pH is 5.5 or less.

The Portland Cement Association correlates sulfate content to potential sulfate attack as presented on below:

Sulfate Content, ppm	Sulfate Attack Potential
0 to 1,000	Negligible
1,000 to 2,000	Moderate
2,000 to 20,000	Severe
Over 20,000	Very Severe

A commonly accepted correlation between soil resistivity and corrosivity towards unprotected ferrous metals (National Association of Corrosion Engineers (NACE), 1984) is provided below:

Minimum Resistivity, ohm-cm	Corrosion Potential
0 to 1,000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
Over 10,000	Mildly Corrosive

Based on the measured minimum resistivities between 480 and 550 ohm-cm, the soils tested at boring locations B-3, B-4 and B-5 are considered severely corrosive to ferrous metals by the

NACE criteria. The soluble sulfate and pH test results did not indicate adverse soil conditions per Caltrans and the Portland Cement Association (PCA) criteria. Based on the laboratory test results, we recommend that Type II or V cement with a maximum water cement ratio of 0.45 should be used for structural concrete structures in contact with soil.

We have performed preliminary laboratory corrosion screening as an initial indicator of soil corrosivity at the site. Performing corrosion engineering is excluded from Kleinfelder's scope. Based on the test results, we recommend that a corrosion engineer be retained to evaluate corrosivity at the site and to provide corrosion resistant design recommendations.

5.10 ASPHALT CONCRETE PAVEMENT

The required asphalt concrete (AC) pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. Site specific traffic indices (TI) for the site were not provided, however, we have assumed a TI of 4.5 for interior access roads within the substation and 6.0 for entrance driveways and other heavy traffic areas.

We performed resistance R-value tests on bulk soil samples of the near-surface soils from two boring locations to evaluate pavement support characteristics of the onsite soils. The R value tests were performed in general accordance with ASTM D 2844. The test results for samples collected at Borings B-7 and B-10 were 11 and 9, respectively. Due to the unknown distribution of each material, we recommend that the pavement be designed for and R-value of 9.The pavement thickness may be adjusted during design if the higher values are prevalent and the area can be delineated. Table 5 presents recommended pavement sections based on the described design criteria.

Table 5

Recommended Asphalt Concrete Pavement Sections

TRAFFIC USE	TRAFFIC INDEX, TI	ASPHALT CONCRETE (INCHES*)	AGGREGATE BASE (INCHES*)
Interior Substation	4.5	3.0	8.0
Driveway and Heavy Traffic Areas	6.0	4.0	11.0
		Or 5.0	9.0

* Table values were rounded up to the nearest 1/2 inch.

Flexible pavement sections have been evaluated in general accordance with the Caltrans method for flexible pavement design criteria, design R-value of 9 based on the R-value testing, the calculated Traffic Indices, and a theoretical design life of 20 years. The pavement sections provided above are contingent on the following recommendations being implemented during construction:

- The pavement subgrade should be prepared as recommended in earthwork section of this report.
- Aggregate base materials should be compacted to at least 95 percent relative compaction per ASTM D 1557 (Modified Proctor).
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become saturated. This includes sloping pavement surfaces to promote drainage.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base. Alternatively, the aggregate base course could meet the specifications for untreated base materials (crushed aggregate base or crushed miscellaneous base) as defined in Section 200-2 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).
- Asphalt paving materials and placement methods meet current Caltrans specifications for asphalt concrete or Section 400 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. A representative of Kleinfelder should be on-site during paving operations to observe and test the subgrade preparation, compaction of the aggregate base, and testing of the asphalt concrete materials.

5.11 WATER INFILTRATION AND PERCOLATION

Per the scope of services for the project, no infiltration testing was performed as part of the field study. Due to the extensive depth of existing fill soils at the site (approximately 80 feet) and potential for inducing hydraulic settlement by water from the site, impermeable liners are recommended for all attenuation/bioretention basin areas.

5.12 SURFACE DRAINAGE

Foundation performance is a function of how well the runoff waters drain from the site. 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 the control house and other future proposed 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.

6 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by Client. If Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations.

The scope of services was limited to the evaluation of the proposed improvements at the site. 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 subsurface exploration including borings drilled to a maximum depth of 91½ feet, laboratory testing, 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 covered 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, rock or groundwater conditions could vary between or beyond the points explored. If soil, rock 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, including the estimated loads, and the design depths or locations of the foundations, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder. Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field.

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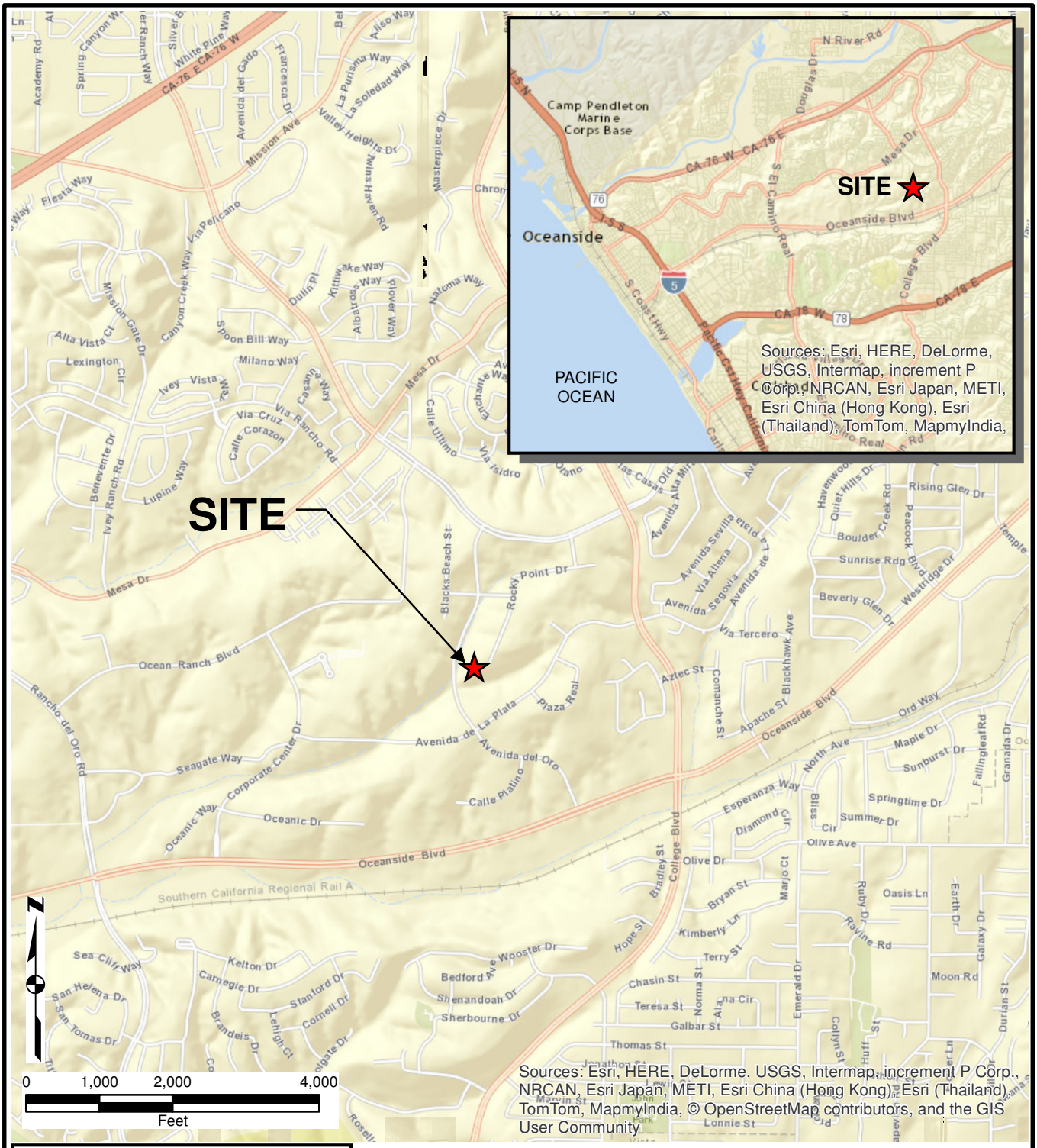
FIGURES



SOURCE:
ESRI ArcGIS Online Map Service, Streets

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FILE NAME:	20154777_oRanchVic.mxd

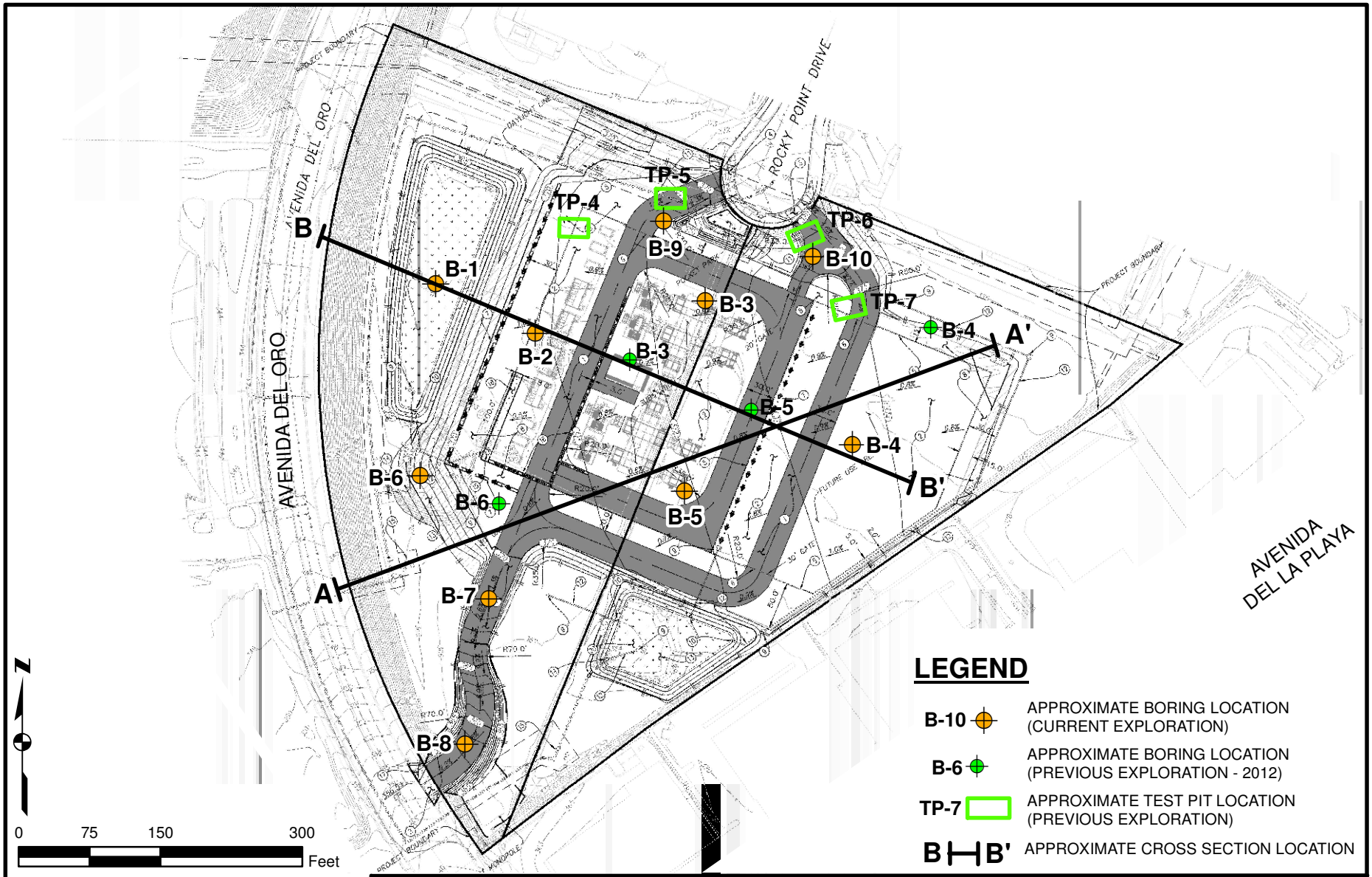
SITE VICINITY MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
1

Date: 6/9/2015 User: jpatay Name: 20154777_oRanchVic Path: J:_clients\SanDiegoGasAndElectric\20154777\20154777_oRanchVic.mxd

J:_clients\SanDiegoGasAndElectric\20154777\20154777_oRanchBor.mxd 6/12/2015



LEGEND

B-10	APPROXIMATE BORING LOCATION (CURRENT EXPLORATION)
B-6	APPROXIMATE BORING LOCATION (PREVIOUS EXPLORATION - 2012)
TP-7	APPROXIMATE TEST PIT LOCATION (PREVIOUS EXPLORATION)
B B'	APPROXIMATE CROSS SECTION LOCATION

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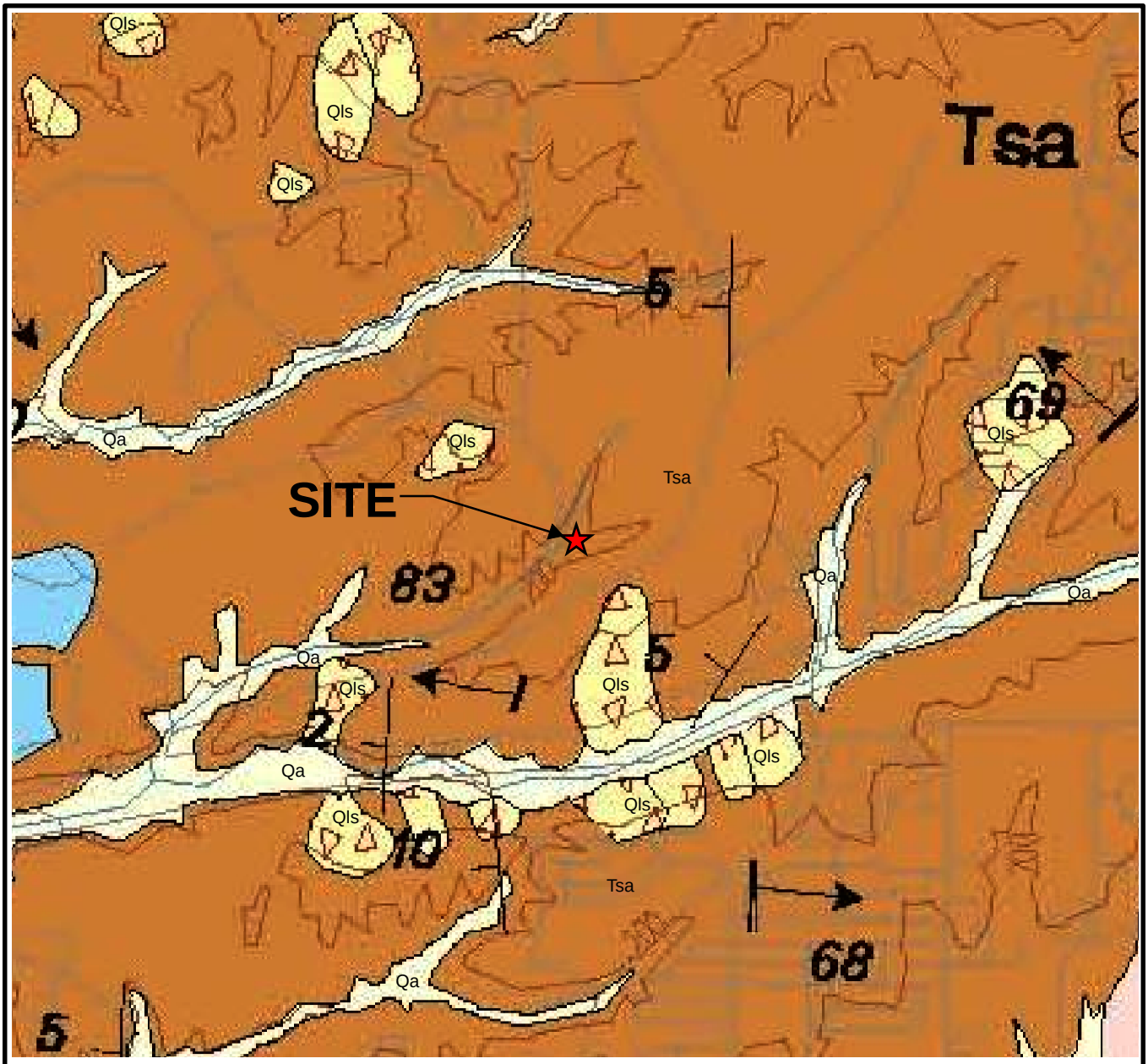
BORING LOCATION MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
2



SOURCE:
GEOLOGY OF THE OCEANSIDE 30' X 60'
QUADRANGLE, CALIFORNIA BY
M. P. KENNEDY AND S. S. TAN, 2005

0 1,000 2,000 4,000
Feet

N

LEGEND

Qa	ALLUVIAL FLOOD PLAIN DEPOSITS
Qls	LANDSLIDE DEPOSITS UNDIVIDED
Tsa	SANTIAGO FORMATION

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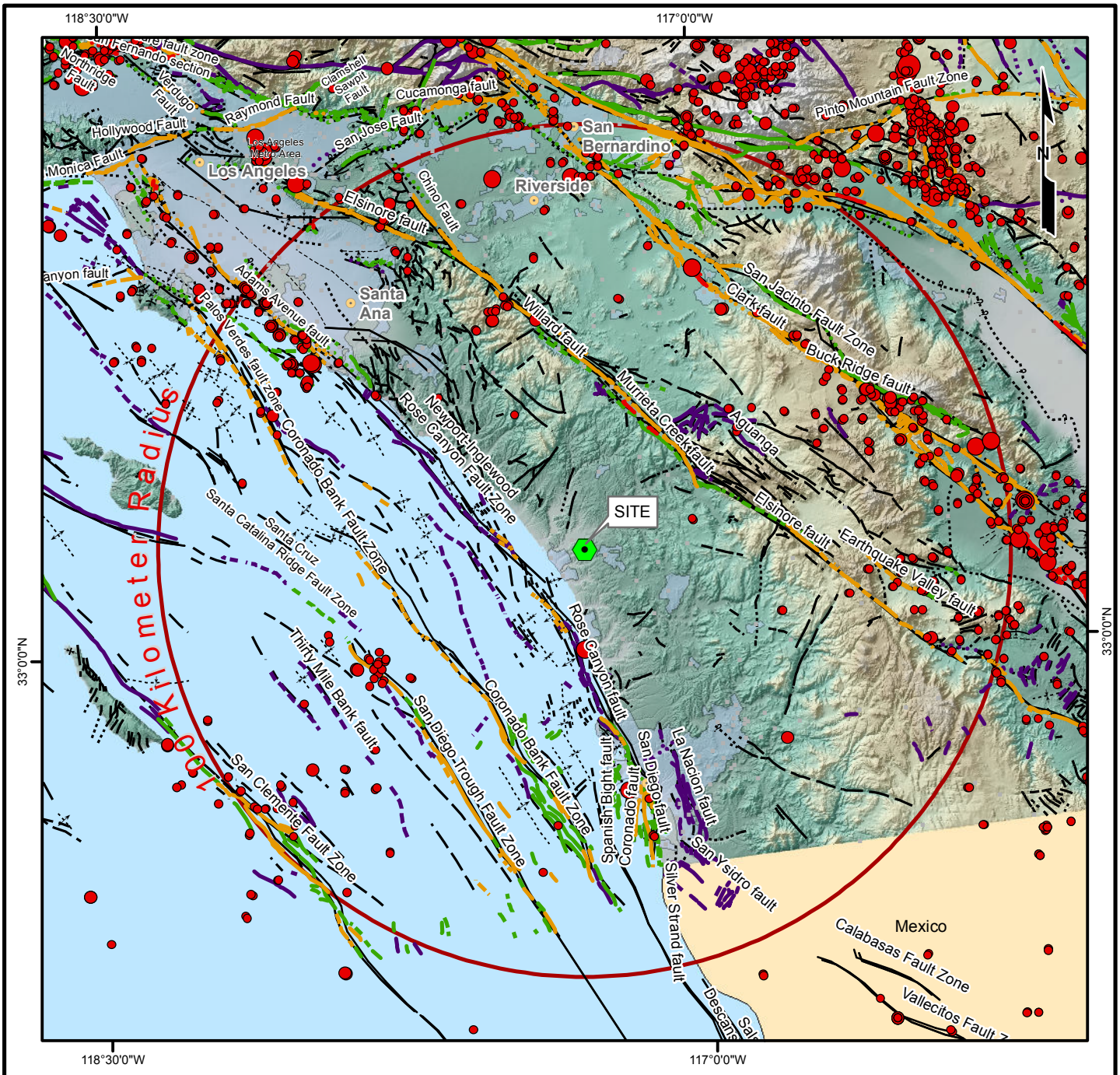
REGIONAL GEOLOGIC MAP

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
3

Date: 6/12/2015 User: jpatay Name: 20154777_oRanchGeo Path: J:_clients\SanDiegoGasAndElectric\20154777\20154777_oRanchGeo.mxd



Faulting Legend

Quaternary Faults (Bryant, 2005; USGS, 2009)

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

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

Holocene displacement (< 11,000 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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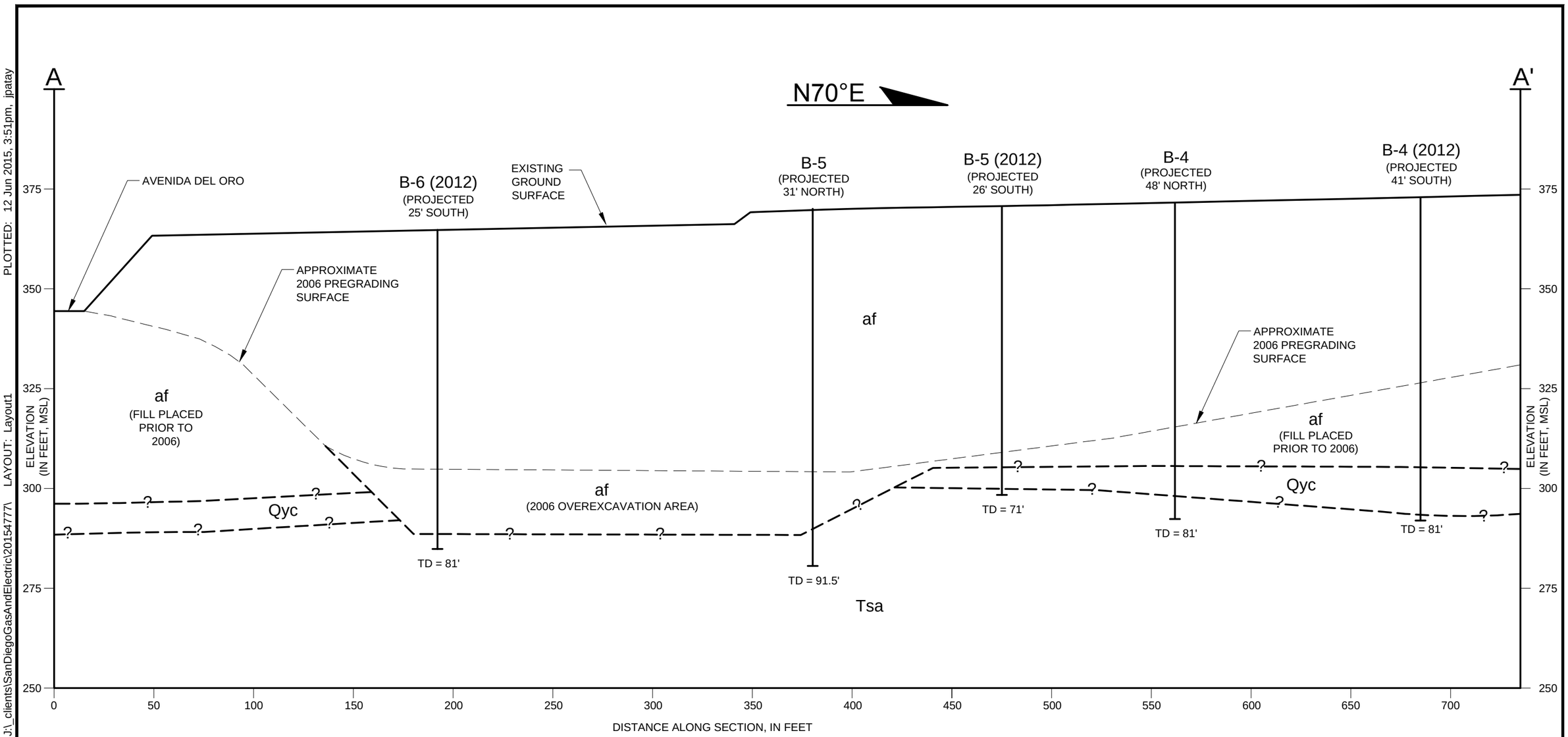
REGIONAL FAULT MAP AND EARTHQUAKE EPICENTERS (1800 - MAY 2015)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
4



LEGEND

af	ARTIFICIAL FILL
Qyc	YOUNG COLLUVIAL DEPOSITS
Tsa	SANTIAGO FORMATION

APPROXIMATE 2006 PREGRADING SURFACE

APPROXIMATE LOCATION OF GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

B-5
(PROJECTED 31' NORTH)
TD = 91.5'

APPROXIMATE LOCATION OF BORING SHOWING, PROJECTION AND TOTAL BORING DEPTH

25 0 25
APPROXIMATE VERTICAL SCALE (feet)

50 25 0 50
APPROXIMATE HORIZONTAL SCALE (feet)

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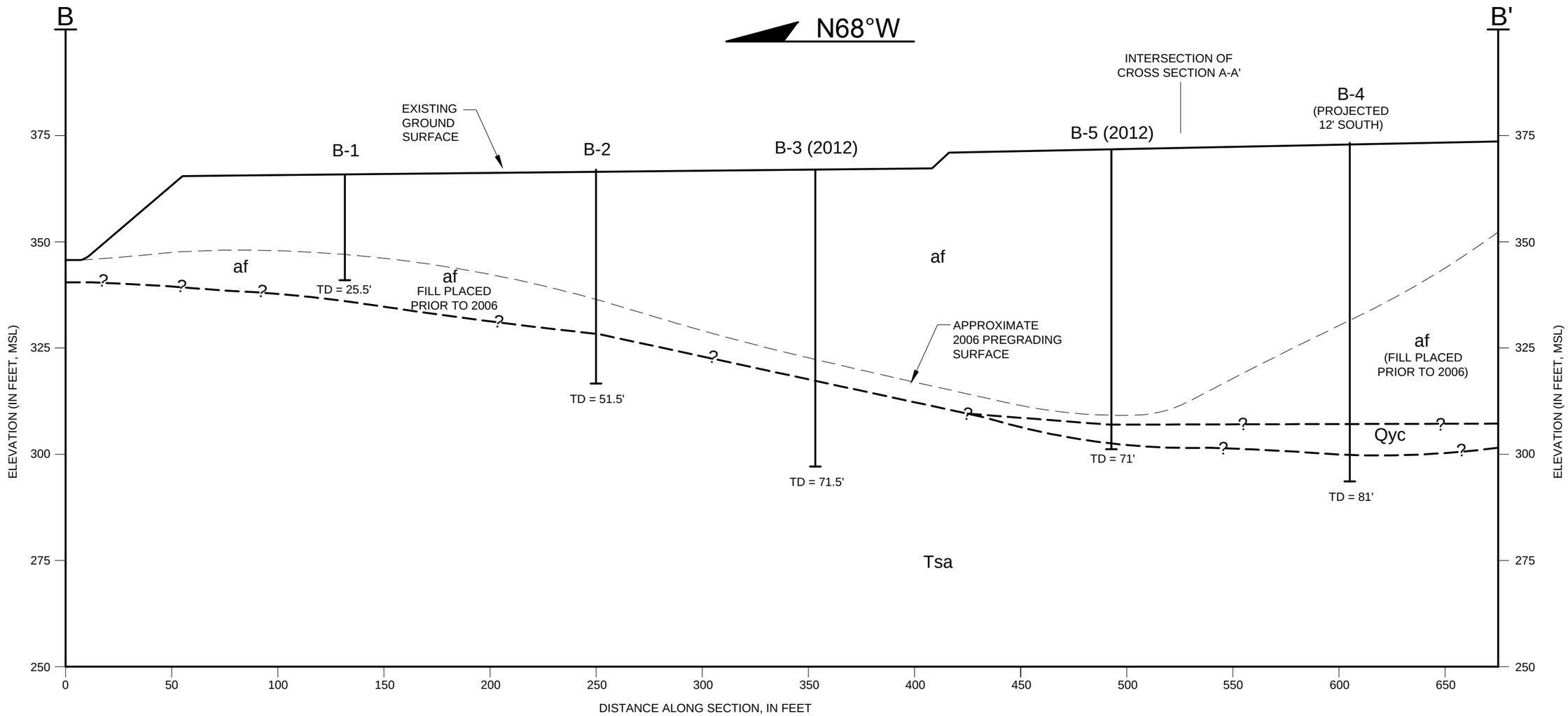
FILE NAME:	20154777_Section2.dwg

GEOLOGIC CROSS SECTION A-A'

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
5



LEGEND

af	ARTIFICIAL FILL
Qyc	YOUNG COLLUVIAL DEPOSITS
Tsa	SANTIAGO FORMATION

APPROXIMATE 2006 PREGRADING SURFACE

APPROXIMATE LOCATION OF GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN

B-4
(PROJECTED 12' SOUTH)
TD = 81'

APPROXIMATE LOCATION OF BORING SHOWING, PROJECTION AND TOTAL BORING DEPTH

25 0 25
APPROXIMATE VERTICAL SCALE (feet)

50 25 0 50
APPROXIMATE HORIZONTAL SCALE (feet)

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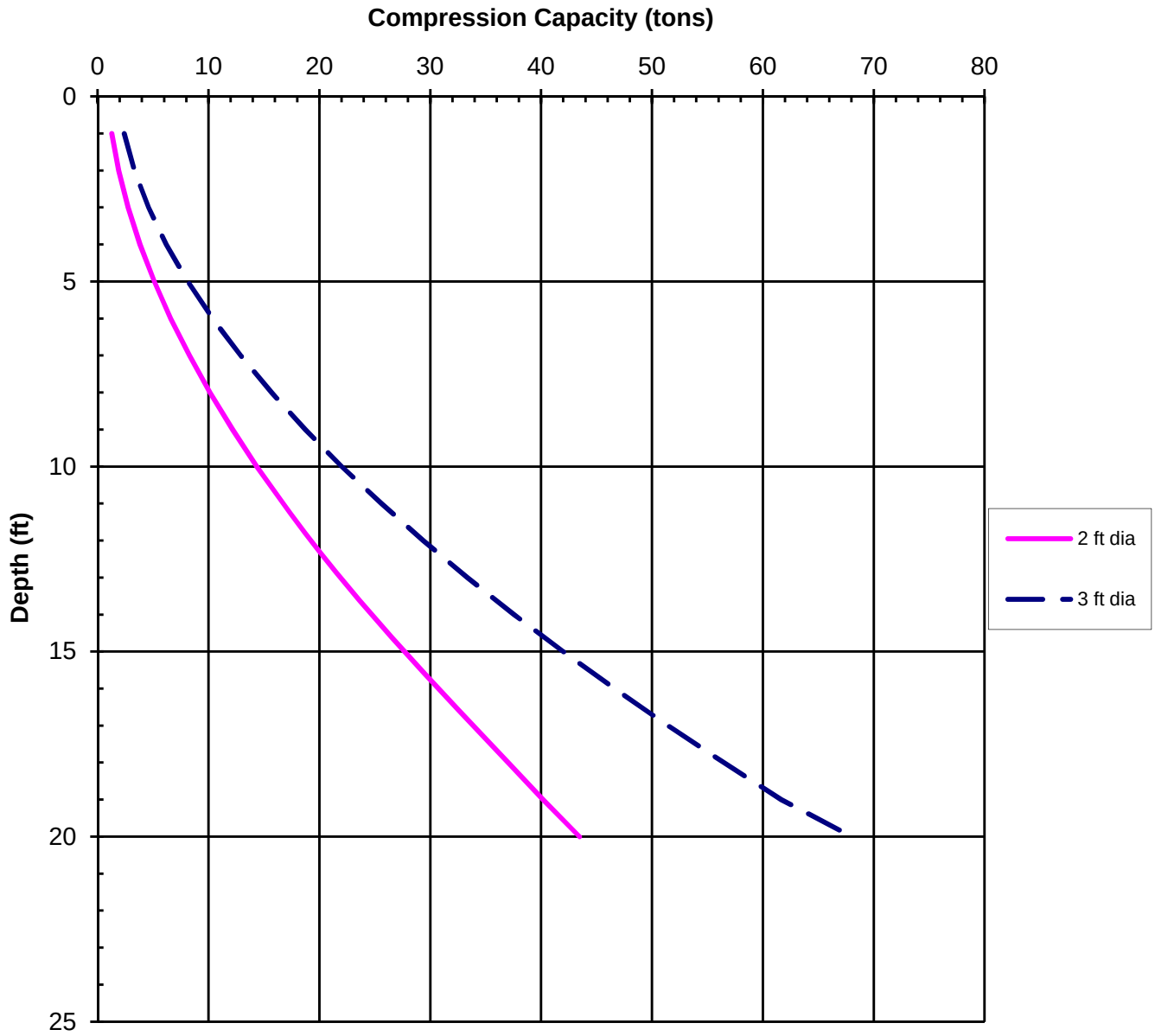
GEOLOGIC CROSS SECTION B-B'

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

FIGURE
6

Allowable Axial Capacity Curves For Drilled Piers
Southern Area of Site

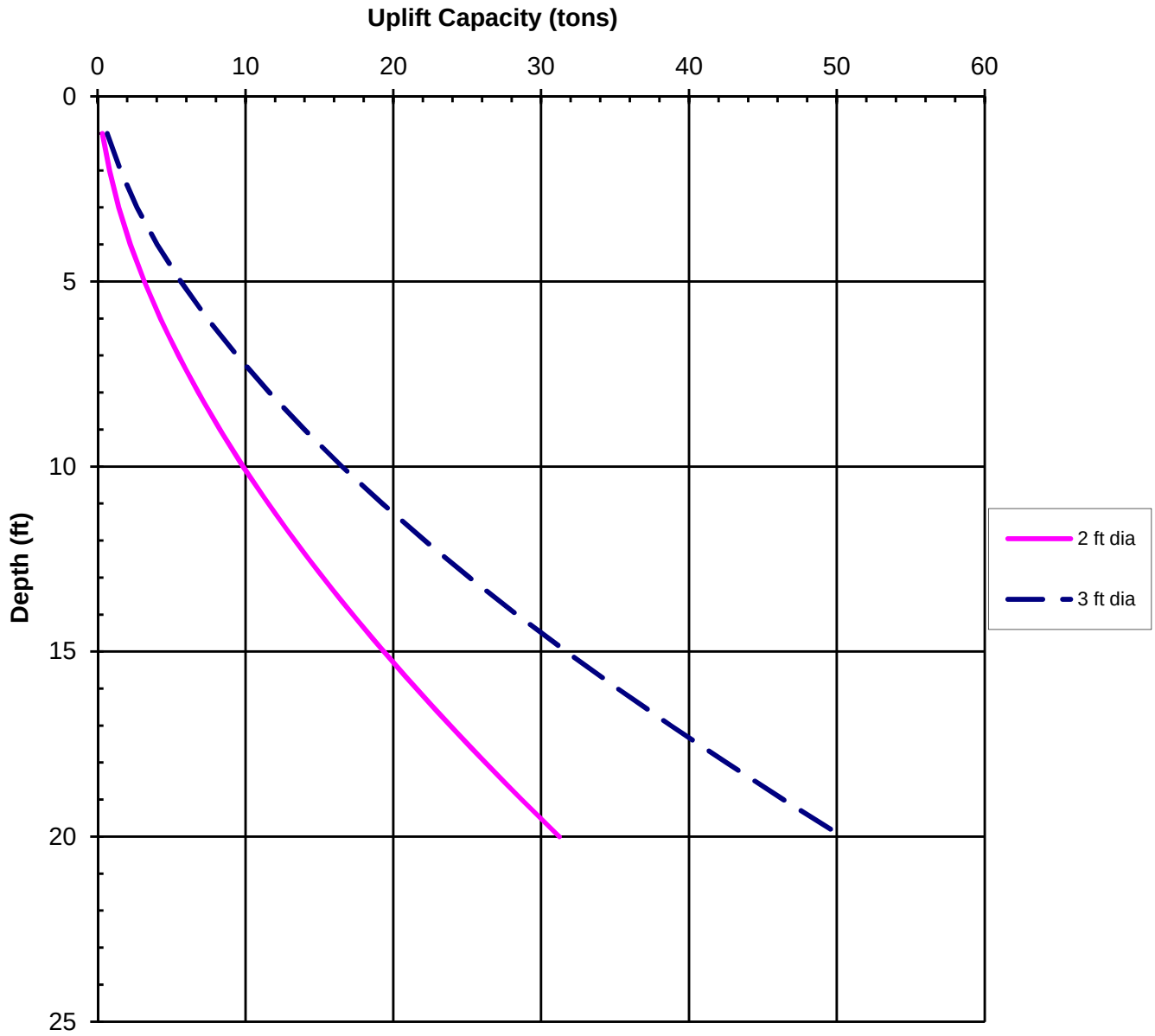


These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder.

- Soil profile is coarse grain fill from the ground surface to 25 feet, and then underalin by fine grained fill.
- Pile modulus of elasticity, E = 0.410E+07 lb/sq. in
- End bearing was utilized
- Ground water was not encountered

KLEINFELDER Bright People. Right Solutions.		**DOWNWARD AXIAL CAPACITY CURVES**	FIGURE
Checked by: KC	By: JC	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	**7**
Project No. 8 20154777	Date: 05/22/2015		

Allowable Axial Capacity Curves For Drilled Piers
Southern Area of Site



These results are based on the following assumptions and conditions. Piles with conditions different from those assumed should be re-evaluated by Kleinfelder.

- Soil profile is coarse grain fill from the ground surface to 25 feet, and then underalin by fine grained fill.
- Pile modulus of elasticity, E = 0.410E+07 lb/sq. in
- End bearing was utilized
- Ground water was not encountered

KLEINFELDER Bright People. Right Solutions.		**UPLIFT CAPACITY CURVES**	FIGURE
Checked by: KC	By: JC	SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CALIFORNIA	**8**
Project No. 20154777	Date: 05/22/2015		

APPENDIX A

FIELD INVESTIGATION AND BORING LOGS

APPENDIX A
FIELD INVESTIGATION AND BORING LOGS

GENERAL

Our field exploration program consisted of a site reconnaissance, review of previous geotechnical borings and test pits in 2012, and drilling ten geotechnical borings between April 15, 2015 and April 17, 2015. Prior to commencement of the fieldwork, geophysical techniques were used at the boring location in order to identify potential conflicts with subsurface structures. The boring locations were also cleared for buried utilities through Underground Service Alert (USA) of Southern California. In addition, Kleinfelder subcontracted a private utility locating company to sweep the proposed boring locations for underground utilities at the site.

Borings were placed within a structure, pavement or other improvement area. The borings were drilled to depths of approximately 6½ to 91½ feet below the existing ground surface (bgs) using a truck-mounted drill rig equipped with 6-inch-diameter hollow-stem augers (HSA). In addition to our current field exploration program, four borings were drilled within the project area to depths ranging between approximately 20 to 34 feet bgs and four test pits to depths ranging approximately 5 to 10 feet by Kleinfelder, Inc. in 2012 as part of our geotechnical site study for the substation. These borings are presented in Appendix A.1.

The boring logs of our current study are presented as Figures A-3 through A-19. An explanation to the boring logs are presented as Figures A-1 and A-2. The boring logs describe the earth materials encountered, samples obtained and show field and laboratory tests performed. The logs also show the location, boring number, drilling date and the name of the drilling subcontractor. The borings were logged by a Kleinfelder engineer using the Unified Soil Classification System. The boundaries between soil types shown on the log are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of selected earth materials were obtained from the borings.

A California type sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4-inch I.D. split barrel shaft that is pushed or driven a total of 18 inches into the soil at the bottom of the boring. The soil was retained in 6-inch brass sleeves 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 sampler was driven using a 140-pound hammer falling 30 inches. The total number of blows required to drive the sampler the final 12 inches is termed blow count and is recorded on the Log of Boring.

Samples were also obtained using a Standard Penetration Sampler (SPT). This sampler consists of a 2-inch O.D., 1⅜-inch I.D. split barrel shaft that is advanced into the soils at the bottom of the drill hole a total of 18 inches. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count (N), however all blow counts for each 6-inches is recorded on the boring log. The procedures we employed in the field are generally consistent with those described in ASTM Standard Test Method D1586.

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 ≥4 and 1≤ Cc≤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 ≥4 and 1≤ Cc≤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 ≥6 and 1≤ Cc≤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 ≥6 and 1≤ Cc≤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.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

GRAPHICS KEY

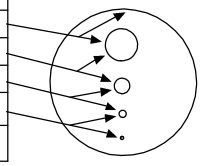
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

A-1

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 - #10	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

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.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

SOIL DESCRIPTION KEY

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

A-2

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling	**BORING LOG B-1**	
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21113° N
Longitude: -117.29459° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
365	0		**Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium-grained, light yellowish brown (2.5 Y 6/3), moist, loose, low plasticity fines	1											
			Silty SAND (SM): fine to medium-grained, pale yellow (2.5 Y 7/3), moist, medium dense, low plasticity fines	2		BC=5 6 10	18"								
	5		mottled with olive gray, dense, becomes mottled with some clayey sand	3		BC=17 15 26	18"		12.2	117.3		33			
360															
	10		**Lean CLAY (CL)**: fine-grained, pale olive (5 Y 6/3) mottled with dark gray (2.5 Y, 4/1), moist, very hard, low plasticity	4		BC=5 13 21	14"		15.6	114.2			39	20	
355															
	15		organic odor	5		BC=7 14 20	18"								
350															
	20		**Lean CLAY (CL)**: olive gray (5 Y 5/2), moist, hard, weak cementation, low plasticity	6		BC=9 11 9	18"								
345			**Poorly-graded SAND with Silt (SP-SM)**: light gray (2.5 Y 7/2) to olive yellow (2.5Y 6/6), moist, medium dense												
	25		1 foot layers of claystone and sandstone, mottled clay in sand	7		BC=7 15 19	18"								
340															
	30														
335															

The boring was terminated at approximately 26.5 ft. below ground surface. The exploration was backfilled with bentonite on April 15, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-1

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-3

PAGE: 1 of 1

Date Begin - End: 4/15/2015 **Drilling Company:** Pacific Drilling **BORING LOG B-2**

Logged By: J. Co **Drill Crew:** Gordy/Toby

Hor.-Vert. Datum: Not Available **Drilling Equipment:** Unimog **Hammer Type - Drop:** 140 lb. Auto - 30 in.

Plunge: -90 degrees **Drilling Method:** Solid Stem Auger

Weather: Sunny and Warm **Exploration Diameter:** 6 in. in. O.D.

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21099° N
Longitude: -117.29424° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
365			**Artificial Fill (af)** **Clayey SAND (SC)**: fine to coarse-grained, light yellowish brown (2.5 Y 6/3), dry to moist, loose, low plasticity fines	1											
			Silty SAND (SM): fine to coarse-grained, light yellowish brown (2.5 Y 5/3), dry to moist, medium dense, random dark gray claystone 1/2 inch chunks, low plasticity fines	2		BC=8 15 15			12.2	112.6					DS
	5		**Poorly-graded SAND with Silt (SP-SM)**: fine to medium-grained, light gray (5 Y 7/2), dry to moist, medium dense, random 1/2 inch chunks of dark gray silty sand	3		BC=10 10 21	18"								
360			**Clayey SAND (SC)**: fine to medium-grained, light yellowish brown (2.5 Y 5/3) to olive gray (5Y 5/2) with very dark gray (5Y 3/1), dry to moist, medium dense, randomly mixed with silty sand and 1/2" chunks of claystone, low plasticity fines	4		BC=9 11 15	18"		14.4	106.6		38			
	10		some mottled strong brown (7.5 YR 5/8)	5		BC=8 11 14	18"								
355															
	15		increase in coarse grain sand and fine gravel from 20-20.5 feet	6		BC=6 8 7	18"								
350															
	20		3" thick weakly cemented claystone, some mica	7		BC=8 11 8	18"		7.8	106.1					
345			**Sandy CLAY (CL)**: fine to coarse-grained, very dark gray (5 Y 3/1), moist, hard, low plasticity fine, organic odor, small roots												
	25		random sandy clay, some gray to olive yellow	8		BC=10 12 23	18"								
340															
	30														
335															

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BORING LOG B-2

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-4

BORING LOG B-2

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21099° N
Longitude: -117.29424° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)
330			**Lean CLAY with Sand (CL)**: fine to coarse-grained, very dark gray (5 Y 3/1), moist, hard, rootlets	9		BC=8 8 10	18"
			Santiago Formation (Tsa) **SANDSTONE (excavates as):** **Silty SAND (SM)**: fine to coarse-grained, olive yellow (2.5 Y 6/6) to light gray (2.5 Y 7/2), dry to moist, very dense, 1/2" chunks of claystone at shoe, non-plastic				
	40			10		BC=14 37 50/6"	18"
325							
	45		becomes light yellowish brown (2.5Y 6/3) to olive yellow (2.5 Y 6/6)	11		BC=14 19 22	18"
320							
	50			12		BC=20 36 50/4"	16"
315							
	55						
310							
	60						
305							
	65						
300							

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	13.4			81			
	10.2	111.4		23			

The boring was terminated at approximately 51.5 ft. below ground surface. The exploration was backfilled with bentonite grout on April 15, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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BORING LOG B-2

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-5

BORING LOG B-3

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21109° N
Longitude: -117.29366° W
Approximate Ground Surface Elevation (ft.): 368
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)
365	0		**Artificial Fill (af)** **Sandy CLAY (CL)**: fine to coarse grained, light olive brown (2.5 Y 5/3), moist, loose, low plasticity fines	1			
			Clayey SAND (SC): fine to coarse grained, light yellow brown (2.5 Y 6/3), moist, medium dense, low plasticity fines	2		BC=7 8 11	18"
				1			
	5		1/2" chunks of non-uniform clay	3		BC=9 11 17	18"
360							
	10		some light olive brown (2.5 Y 5/3), 1/2" claystone chunks	4		BC=7 9 12	18"
355							
	15		**Sandy CLAY (CL)**: fine to medium grained, gray (2.5 Y 5/1) to light olive brown (2.5 Y 5/3), moist, hard, low plasticity fines	5		BC=7 13 14	18"
350							
	20		mostly fine to coarse grained sandy clay with random silty sand and claystone chunks. gray to brownish yellow and dusky red	6		BC=7 6 7	16"
345							
	25		becomes very hard, random chunks of sandy clay, olive yellow mixed with gray and dark gray	7		BC=6 16 20	18"
340			**Santiago Formation (Tsa)** **CLAYSTONE: excavates as CLAY with Sand (CL)**: grayish brown (10 YR, 5/2), moist, very dense, weak cemented calcium carbonate fracture, low plasticity				
	30			8		BC=15 21 35	22"
335			**SANDSTONE: excavates as Silty SAND (SM)**: fine to medium grained, olive gray to gray (5 Y 4/2) with strong brown (7.5 YR 5/6), moist, very dense, low plasticity fines, caliche filled fractures				

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
					44	26	Corrosion
	12.8	108.9	100	26			
	15.8	103.0					
	15.2	108.9					
	13.0						

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BORING LOG B-3

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-6

BORING LOG B-3

Date Begin - End:	4/15/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21109° N
Longitude: -117.29366° W
Approximate Ground Surface Elevation (ft.): 368
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
330			**SANDSTONE: excavates as Poorly-graded SAND with Silt (SP-SM)**: fine to medium-grained, light yellowish brown (2.5 Y 6/4), moist, very dense, low plasticity fines	9		BC=17 34 50/4"	16"								
				10		BC=14 19 24	18"								
325	40		The boring was terminated at approximately 38 ft. below ground surface. The exploration was backfilled with bentonite on April 15, 2015.												
320	45														
315	50														
310	55														
305	60														
300	65														

LABORATORY RESULTS

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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BORING LOG B-3

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-7

Date Begin - End: 4/16/2015 **Drilling Company:** Pacific Drilling

BORING LOG B-4

Logged By: J. Co **Drill Crew:** Gordy/Toby

Hor.-Vert. Datum: Not Available **Drilling Equipment:** Unimog **Hammer Type - Drop:** 140 lb. Auto - 30 in.

Plunge: -90 degrees **Drilling Method:** Solid Stem Auger

Weather: Sunny and Warm **Exploration Diameter:** 6 in. in. O.D.

FIELD EXPLORATION

Latitude: 33.21067° N
Longitude: -117.29314° W
Approximate Ground Surface Elevation (ft.): 373
Surface Condition: Bare Earth and Grass

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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)	1											
			Clayey SAND (SC): fine to coarse grained, light olive gray (5 Y 6/2), moist, loose, low plasticity fines												
370			becomes white, medium dense, random 1/2" dark olive gray	2		BC=7 10 13	16"		14.0	114.2			33	16	DS, Corrosion
				1											
	5		random 1/2" dark olive gray	3		BC=4 7 10	14"								
365															
	10		**Silty SAND (SM)**: pale yellow, moist, medium dense, 1/2" dark gray claystone chunks	4		BC=8 10 15	18"		10.8	114.1	100	29 29			
360															
	15		increase in 2" claystone chunks	5		BC=7 9 11	18"								
355															
	20		**Sandy CLAY (CL)**: fine grained, pale olive (5 Y 6/3) mixed with random yellowish brown (10 YR 5/8), moist, firm, 1/4" claystone chunks, low plasticity fines	6		BC=3 6 6	14"		15.1						
350															
	25		becomes hard, 1/2 to 1" chunks of weak cemented fine grained silty sand, some white 1/2"	7		BC=6 11 12	18"								
345															
	30		**Lean CLAY (CL)**: yellowish brown (10 YR 5/4), moist, hard	8		BC=7 8 9	26"						41	23	
340															

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BORING LOG B-4

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

A-8

BORING LOG B-4

Date Begin - End:	4/16/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

Latitude: 33.21067° N
Longitude: -117.29314° W
Approximate Ground Surface Elevation (ft.): 373
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
			Sandy CLAY (CL): fine grained, pale olive (5 Y 6/3) mottled with very dark gray (5 Y 3/1) and chunks of strong brown (7.5 YR 5/6), moist, very hard, low plasticity fines	9		BC=9 13 20	18"								
335															
	40		**Silty SAND (SM)**: white, gray to strong brown, moist, dense, 1/4" piece of wood, low plasticity fines	10		BC=6 7 6	24"								
330			**CLAY (CL)**: light brownish gray (2.5 Y 6/2), moist, firm, low plasticity fines												
	45		**Sandy CLAY (CL)**: fine to medium grained, pale olive with random chunks of very dark gray and strong brown, moist, hard, low plasticity fines	11		BC=5 10 15	18"		13.3	107.6					
325															
	50		**CLAY with Sand (CL)**: fine to medium grained, very dark gray (2.5 Y 3/1), moist, firm to hard, low plasticity fines	12		BC=4 6 9	24"								
320															
	55		**Clayey SAND (SC)**: fine grained, light olive gray (5 Y 6/2), moist, hard, low plasticity fines	13		BC=3 8 11	14"		17.8	103.4		43			
315															
	60		**Sandy CLAY (CL)**: fine to medium grained, very dark gray (2.5Y 3/1) to greenish gray (5 GY 6/1), moist, hard, organic odor, unwithered dry plants, low plasticity fines	14		BC=4 8 11	24"								
310															
	65		**CLAY with Sand (CL)**: fine grained, very dark gray (2.5 Y 3/1), moist, very hard, chunk of 2-3" wood with 1" nails in sampler, organic odor and rootlets, medium plasticity fines	15		BC=13 19 27	20"		20.1	107.5			45	27	
305			**Young Colluvial Deposits (Qyc)**												

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BORING LOG B-4

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-9

BORING LOG B-4

Date Begin - End:	4/16/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21067° N
Longitude: -117.29314° W
Approximate Ground Surface Elevation (ft.): 373
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)
300			**Young Colluvial Deposits (Qyc)** **CLAY with Sand (CL)**: fine grained, greenish black (10Y 2.5/1) and flecks of strong brown (7.5 YR 5/6), moist, hard, rootlets and wood fragments, medium plasticity fines	16		BC=6 9 10	18"
295	75		**Santiago Formation (Tsa)** **SANDSTONE: excavates as Silty SAND (SM)**: fine grained, brownish yellow (10 YR 6/8) with pale yellow, light gray, and gray (5 Y, 7/3, 7/1, 5/1), moist, very dense, non-plastic	17		BC=36 50/2"	8"
290	80			18		BC=23 50/5"	11"
285	85						
280	90						
275	95						
270	100						

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks

The boring was terminated at approximately 81 ft. below ground surface. The exploration was backfilled with bentonite grout on April 16, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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BORING LOG B-4

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-10

BORING LOG B-5

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21053° N
Longitude: -117.29372° W
Approximate Ground Surface Elevation (ft.): 371
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)
370	0		**Artificial Fill (af)**	1			
			Silty SAND (SM): fine to medium grained, light olive gray (5 Y 6/2), dry to moist, loose, rootlets and roots, low plasticity fines				
			fine to coarse grained, medium dense, becomes olive gray to white with 1/2" chunks of claystone	2		BC=7 14 16	16"
				1			
365	5		becomes pale yellow (5 Y 7/3), random clayey sand and 1/2" claystone chunks,	3		BC=9 14 18	16"
360	10			4		BC=5 8 13	18"
			Clayey SAND (SC): pale yellow (5 Y 7/3), moist, medium dense, increase in clay, becomes more olive gray (5 Y 5/2) chunks of white and very dark gray	5		BC=5 5 8	18"
355	15						
			moist, olive gray mixed with pale yellow	6		BC=5 5 7	20"
350	20						
			Sandy CLAY (CL): fine to medium grained, olive (5 Y 5/3) and random dusk red, strong brown and gray, moist, hard, 1/2" chunks of claystone, low plasticity fines	7		BC=9 9 20	18"
345	25						
340	30			8		BC=8 8 7	24"

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
							Modified Proctor, Corrosion
	13.3	113.8		27			DS
	12.2	111.2					
	15.6	110.3					
	12.2	107.6					

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BORING LOG B-5

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-11

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling	**BORING LOG B-5**	
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

Latitude: 33.21053° N
Longitude: -117.29372° W
Approximate Ground Surface Elevation (ft.): 371
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
			FIELD EXPLORATION					LABORATORY RESULTS							
335			**Sandy CLAY (CL)**: fine to medium grained, olive (5 Y 5/3) and random dusk red, strong brown and gray, moist, hard, 1/2" chunks of claystone, low plasticity fines moderatley cemented dusk red, random chunks of pale yellow silty sand	9		BC=8 8 9	18"		14.4	112.4					
330	40		some strong brown	10		BC=6 7 9	24"								
325	45		random chunks of dusk red, olive gray, and strong brown	11		BC=4 9 11	18"		7.8	112.8					
320	50		**Silty SAND (SM)**: fine grained, pale yellow (2.5 Y 7/4) mixed with yellow (2.5 Y 7/8), moist, medium dense	12		BC=5 7 7	24"								
315	55		**Clayey SAND (SC)**: fine grained, pale yellow (2.5 Y, 8/2) to yellow (2.5 Y 7/8), moist, dense, 1/2" chunks of claystone	13		BC=9 19 25	18"								
310	60		becomes light yellowish brown (2.5 Y 6/4) mottled with strong brown (7.5 YR 5/8). Then at 61.5 feet becomes white and light gray, low plasticity fines	14		BC=5 6 9	24"								
305	65		becomes white to light gray (5 Y 7/1) with little strong brown	15		BC=10 14 20	18"		13.4	111.5		46			

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-5

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-12

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling	**BORING LOG B-5**	
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21053° N
Longitude: -117.29372° W
Approximate Ground Surface Elevation (ft.): 371
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)
300			**Sandy CLAY (CL)**: fine to medium grained, very dark gray (2.5 Y 3/1) with some light greenish gray at 70.5 feet, organic odor, moist, firm, organic odor, low to medium plasticity fines	16		BC=6 6 7	24"
295	75		olive gray (5 Y 5/2) mixed with very dark gray (2.5 Y 3/1), becomes very hard, organic odor	17		BC=10 17 31	18"
290	80		light olive gray (5 Y 6/2) to light gray (5 Y 7/1) mottled with strong brown and very dark gray, becomes hard	18		BC=7 7 12	24"
285	85		**Santiago Formation (Tsa)** **SANDSTONE: excavates as Silty SAND (SM)**: fine grained, pale olive (5 Y 6/3), moist, medium dense, low plasticity fines	19		BC=9 10 17	16"
280	90		becomes light gray (5 Y 7/1)	20		BC=21 39 50/4"	16"
275	95						
270	100						

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
				67			

The boring was terminated at approximately 91.5 ft. below ground surface. The exploration was backfilled with bentonite grout on April 17, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-5

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-13

BORING LOG B-6

Date Begin - End:	4/16/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21057° N
Longitude: -117.29464° W
Approximate Ground Surface Elevation (ft.): 357
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
355			**Artificial Fill (af)** **Silty SAND (SM)**: fine to medium grained, light yellowish brown (2.5 Y 6/3) to pale yellow (5 Y, 8/3), dry to moist, medium dense, random clayey sand, low plasticity fines	1											
				2		BC=6 8 12	18"								
				1											
	5		increase in clay content	3		BC=7 11 14	18"		12.9	105.1		45			
350															
	10		**Poorly-graded SAND (SP)**: medium to coarse grained, pale yellow (5 Y 7/3), moist, medium dense, non-plastic	4		BC=4 8 8	18"		16.0	109.8					
345			**Clayey SAND (SC)**: fine to coarse grained, olive gray (5 Y 5/2), moist, medium dense, non-plastic												
	15		**Sandy CLAY (CL)**: fine to medium grained, light olive brown mottled with pink, moist, hard, 1/2" chunks of claystone, low plasticity fines	5		BC=5 9 12	18"		19.5	103.9			38	18	
340															
	20		becomes light yellow brown (2.5 Y 6/3) mottled with strong brown	6		BC=3 4 8	18"								
335			**Silty SAND (SM)**: fine grained, pale yellow (2.5 Y 7/3), moist, medium dense, low plasticity fines												
	25		**Sandy CLAY (CL)**: fine grained, light yellow brown (2.5 Y 6/3) mottled with strong brown, moist, hard	7		BC=2 7 11	18"		18.0	108.4					
330															
	30		becomes light olive brown (2.5 Y 5/4), firm	8		BC=3 6 8	18"								
325															

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DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-6

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

A-14

BORING LOG B-6

Date Begin - End:	4/16/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Toby		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21057° N
Longitude: -117.29464° W
Approximate Ground Surface Elevation (ft.): 357
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
			Silty SAND (SM): fine grained, pale yellow (2.5 Y 7/3), very moist, medium dense	9		BC=8 12 16	18"		17.4	108.2					
320			**Sandy CLAY (CL)**: fine grained, olive yellow (2.5 Y 6/8), very moist, hard												
	40		**CLAY (CL)**: fine grained, dark gray (2.5 Y 4/1) with strong brown (7.5 YR 5/8), moist, hard, low plasticity fines	10		BC=5 8 10	18"								
315															
	45		**Sandy CLAY (CL)**: fine grained, light yellowish brown (2.5 Y 6/3) mottled with white and strong brown, very moist, hard, low plasticity fines	11		BC=5 10 14	18"		21.8	104.1					
310															
	50		moist	12		BC=7 9 12	18"								
305															
	55														
300															
	60														
295															
	65														
290															

The boring was terminated at approximately 51.5 ft. below ground surface. The exploration was backfilled with bentonite on April 16, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-6

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-15

BORING LOG B-7

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

Latitude: 33.21021° N
Longitude: -117.29439° W
Approximate Ground Surface Elevation (ft.): 366
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
365	0		**Artificial Fill (af)** **Silty SAND (SM)**: fine to coarse grained, pale olive (5 Y 6/3), dry to moist, medium dense, low plasticity fines	1											R-Value
360	5		becomes fine grained mottled with dark gray and 1/2" chunks of claystone	2		BC=7 9 16	18"								
355	10														
350	15														
345	20														
340	25														
335	30														

The boring was terminated at approximately 6.5 ft. below ground surface. The exploration was backfilled with soil cuttings on April 17, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-7

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-16

BORING LOG B-8

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.20979° N
Longitude: -117.29447° W
Approximate Ground Surface Elevation (ft.): 367
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)
365	0		**Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium grained, olive gray (5 Y 5/2) mottled with very dark gray to light gray, dry to moist, loose, low plasticity fines				
	5			1		BC=3 3 6	18"
360			**Sandy CLAY (CL)**: fine to medium-grained, pale olive (5 Y 6/4), moist, hard				
	10			2		BC=9 12 15	18"
355			**Santiago Formation (Tsa)** **SANDSTONE: excavates as Silty SAND (SM)**: fine to medium-grained, light yellowish brown (2.5 Y 6/4), moist, very dense, low plasticity fines becomes greenish gray (10Y 6/1) mottled with yellowish brown (10 YR 5/8)	3			
	15			4		BC=15 23 28	16"
350							
	20						
345							
	25						
340							
	30						
335							

LABORATORY RESULTS

USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	15.0	114.4		68			

The boring was terminated at approximately 16.5 ft. below ground surface. The exploration was backfilled with bentonite on April 17, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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BORING LOG B-8

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-17

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling	**BORING LOG B-9**	
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

FIELD EXPLORATION

Latitude: 33.21129° N
Longitude: -117.29375° W
Approximate Ground Surface Elevation (ft.): 368
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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
365			**Artificial Fill (af)** **Clayey SAND (SC)**: fine to medium grained, light olive gray (5 Y, 6/2), dry to moist, loose, medium plasticity fines	1											
	5		**Santiago Formation (Tsa)** **CALICHE**: pale yellow to strong brown, dry, very dense, highly cemented rock	2		BC=35 26 26	18"		13.2	112.1					
360			**SANDSTONE: excavates as Clayey SAND (SC)**: fine to medium grained, light olive gray (5 Y 6/2), dry to moist, very dense, low plasticity fines												
	10		The boring was terminated at approximately 6.5 ft. below ground surface. The exploration was backfilled with soil cuttings on April 17, 2015.												
355															
	15														
350															
	20														
345															
	25														
340															
	30														
335															

LABORATORY RESULTS

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-9

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-18

BORING LOG B-10

Date Begin - End:	4/17/2015	**Drilling Company:**	Pacific Drilling		
Logged By:	J. Co	**Drill Crew:**	Gordy/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Unimog	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Solid Stem Auger		
Weather:	Sunny and Warm	**Exploration Diameter:**	6 in. in. O.D.		

Latitude: 33.21114° N
Longitude: -117.29319° W
Approximate Ground Surface Elevation (ft.): 374
Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	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)	1											R-Value
370			**Clayey SAND (SC)**: fine to medium grained, light olive gray (5 Y, 6/2) with chunks of dark gray, dry to moist, loose, low plasticity fines												
	5		medium dense to dense, medium plasticity fines	2		BC=7 10 22	18"		9.1	112.9		19			
365	10														
360	15														
355	20														
350	25														
345	30														
340															

The boring was terminated at approximately 6.5 ft. below ground surface. The exploration was backfilled with soil cuttings on April 17, 2015.

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

GENERAL NOTES:
The exploration elevation is approximate and was estimated from the Preliminary Civil Development Plan by SDG&E dated February 27, 2015.

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PROJECT NO.:	20154777
DRAWN BY:	JC
CHECKED BY:	SR
DATE:	5/28/2015
REVISED:	6/1/2015

BORING LOG B-10

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE
A-19

PAGE: 1 of 1

APPENDIX A-1
PREVIOUS FIELD INVESTIGATION BORING LOGS AND TEST PITS (2012)

Date Begin - End:	4/26/12 - 4/27/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-3 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21081° N
Longitude: 117.29389° W
Approximate Surface Elevation (ft): 367.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
365	0													**Artificial Fill** **Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist
360	5													
355	10		1		BC=17 32 44									**Sandy CLAY (CL)**: fine to medium grained, medium plasticity fines, gray to brown, moist, very hard
350	15													
345	20		2		BC=13 27 40									Fine to coarse grained, low plasticity fines, gray, moist, very hard
340	25													
335	30		3		BC=20 30 50/5"									Fine to medium grained, medium plasticity fines, grayish brown, moist, very hard, decrease in grain size

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH/SR
DATE:	5/7/2012
REVISED:	6/2/2015

BORING LOG B-3 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-5

Date Begin - End: 4/26/12 - 4/27/12 | **Drill Company:** Scott's Drilling | **BORING LOG B-3 (2012)**

Logged By: E. Koprulu | **Drill Crew:**

Hor.-Vert. Datum: NAD83 - NAD83 | **Drill Equipment:** CME-55 | **Hammer Type - Drop:** 140 lb. Automatic - 30"

Angle from Vert.: 0 degrees | **Exploration Method:** Hollow Stem Auger

Weather: Sunny | **Auger Diameter:** 8 inches

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Latitude: 33.21081° N Longitude: 117.29389° W Approximate Surface Elevation (ft): 367.0 Surface Condition: Bare Earth and Grass												
330			**Sandy CLAY (CL)**: fine to medium grained, medium plasticity fines, gray to brown, moist, very hard *(continued)*												
	40		Fine to coarse grained, low plasticity fines, moist, very hard, intermixed color from light gray - dark brown to reddish brown, some scattered sand lenses	4		BC=13 18 24									
325															
	45														
320															
	50		Fine to medium grained, medium plasticity fines, moist, very hard, intermixed color from light gray to reddish brown, some brown lenses of sand	5		BC=21 25 35									
315			**Santiago Formation (Tsa)**												
	55														
310															
	60		**CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, gray, moist, very hard												
305															
	65														
300															

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH/SR
DATE:	5/7/2012
REVISED:	6/2/2015

BORING LOG B-3 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-6

BORING LOG B-3 (2012)

Date Begin - End:	4/26/12 - 4/27/12	**Drill Company:**	Scott's Drilling		
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21081° N, Longitude: 117.29389° W, Approximate Surface Elevation (ft): 367.0, Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
295			**Santiago Formation (Tsa)** **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, gray, moist, very hard, iron-oxide staining *(continued)*	6		BC=28 45 50/4"									
	75		The boring was terminated at approximately 71.5 feet below ground surface. The Boring was backfilled with bentonite on April 27, 2012.												
290															
	80														
285															
	85														
280															
	90														
275															
	95														
270															
	100														
265															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH/SR
DATE:	5/7/2012
REVISED:	6/2/2015

BORING LOG B-3 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-7

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-4 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	Description
370	0					**Artificial Fill**
		1				**Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense
		2		BC=9 20 28		Trace Clay Increase in Clay content
	5	3		BC=14 26 40		**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, dark gray, moist, dense
365						
	10	4		BC=12 31 42		Fine to coarse grained, low plasticity fines, dark gray, moist, very dense, some lenses of dark brown Lean Clay
360						
	15	5		BC=18 32 42		**Sandy CLAY (CL)**: fine to medium grained, low plasticity fines, moist, very hard, intermixed color from light gray to light tan, some lenses of dark brown Lean Clay
355						
	20	6		BC=18 35 50/5.5"		Fine grained, medium plasticity fines, light yellowish brown to light gray, moist, very hard, increase in clay content, decrease in sand content, lenses of Sand
350						
	25	7		BC=16 35 42		Fine to coarse grained, low plasticity fines, gray to brown, trace organic smell odor, moist, very hard, lenses of Sand throughout, dark brown to black lenses of old Top Soil
345						
	30	8		BC=12 31 48		Fine grained, medium plasticity fines, gray to dark brown, trace organic smell odor, moist, very hard, black lenses of old Top Soil
340						

LABORATORY RESULTS

USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks

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BORING LOG B-4 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE

A-8

Date Begin - End: 4/24/12 | **Drill Company:** Scott's Drilling | **BORING LOG B-4 (2012)**

Logged By: E. Koprulu | **Drill Crew:**

Hor.-Vert. Datum: NAD83 - NAD83 | **Drill Equipment:** CME-55 | **Hammer Type - Drop:** 140 lb. Automatic - 30"

Angle from Vert.: 0 degrees | **Exploration Method:** Hollow Stem Auger

Weather: Sunny | **Auger Diameter:** 8 inches

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Silty SAND (SM): fine grained, non-plastic fines, gray, moist, very dense	9		BC=20 40 50/5"									
335	40		**Clayey SAND (SC)**: fine grained, low plasticity fines, white to light brown, moist, very dense, caliche	10		BC=17 42 50									
330	45		**Sandy CLAY (CL)**: fine grained, medium plasticity fines, dark gray to black, moist, very hard	11		BC=19 38 50									
325	50		Fine grained, low plasticity fines, dark gray, moist, very hard, increase in Sand content, reddish brown and gray sand lenses	12		BC=15 29 46									
320	55		Fine to medium grained, low plasticity fines, gray, moist, hard, black colored CL-CH at shoe of sampler	13		BC=12 26 28									
315	60		**Lean to Fat CLAY (CL-CH)**: fine grained, medium plasticity fines, dark gray to black, moist, hard	14		BC=16 22 34									
310	65		Fine grained, medium plasticity fines, dark gray to black, moist, very hard, increase in sand content	15		BC=19 30 40									
305			**Young Colluvial Deposits (Qyc)**												

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BORING LOG B-4 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-9

Date Begin - End:	4/24/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-4 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21102° N
Longitude: 117.29288° W
Approximate Surface Elevation (ft): 374.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			16		BC=15 32 40									
300	75		17		BC=18 37 50									CONSOL
295	80		18		BC=39 50/4"									

Young Colluvial Deposits (Qyc)
Fat CLAY (CH): fine grained, high plasticity fines, black, moist, very hard *(continued)*

Fine grained, high plasticity fines, black, moist, very hard

Santiago Formation (Tsa)
CLAYSTONE excavates as **Sandy CLAY (CL):** fine to medium grained, low plasticity fines, gray, moist, very hard

The boring was terminated at approximately 81 feet below ground surface. Boring was backfilled with bentonite on April 24, 2012.

290 85
285 90
280 95
275 100
270

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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BORING LOG B-4 (2012)

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PLATE
A-10

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-5 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21074° N
Longitude: 117.29347° W
Approximate Surface Elevation (ft): 372.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
370	0													**Artificial Fill** **Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense
365	5		1		BC=15 24 29									Fine to coarse grained, non-plastic fines, gray, moist, dense, increase in grain size
360	10		2		BC=18 28 38									**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray to dark gray, moist, very dense
355	15													
350	20		3		BC=10 12 13									Fine grained, low plasticity fines, gray to dark gray, moist, medium dense, increase in Clay content
345	25													
340	30		4		BC=8 11 13									**Sandy CLAY (CL)**: fine grained, low plasticity fines, light brown to light gray, moist, firm

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BORING LOG B-5 (2012)

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PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-11

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling	**BORING LOG B-5 (2012)**	
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21074° N
Longitude: 117.29347° W
Approximate Surface Elevation (ft): 372.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
335	40		5		BC=10 15 21									Fine to medium grained, low plasticity fines, light gray to reddish brown, moist, hard, trace caliche, 3-inch thick lense of Sand
330	45													
325	50		6		BC=23 19 15									**CALICHE**: dense, entire sample Caliche
320	55													
315	60		7		BC=8 13 15									Fine to coarse grained, low plasticity fines, light gray to brown, moist, hard, some rootlets
310	65													
305														**Young Colluvial Deposits (Qyc)** **Fat CLAY (CH)**: high plasticity fines, black, organic odor, moist, hard

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BORING LOG B-5 (2012)

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PLATE
A-12

BORING LOG B-5 (2012)

Date Begin - End:	4/24/12 - 4/25/12	**Drill Company:**	Scott's Drilling		
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Latitude: 33.21074° N, Longitude: 117.29347° W, Approximate Surface Elevation (ft): 372.0, Surface Condition: Bare Earth and Grass	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
300	0														
			Santiago Formation (Tsa) **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, gray, moist, very hard, strongly cemented	8		BC=15 50/3"									
	75		The boring was terminated at approximately 71 feet below ground surface. The Boring was backfilled with bentonite on April 25, 2012.												
295															
	80														
290															
	85														
285															
	90														
280															
	95														
275															
	100														
270															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.
GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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BORING LOG B-5 (2012)

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PLATE
A-13

BORING LOG B-6 (2012)

Date Begin - End:	4/26/12	**Drill Company:**	Scott's Drilling		
Logged By:	E. Koprulu	**Drill Crew:**			
Hor.-Vert. Datum:	NAD83 - NAD83	**Drill Equipment:**	CME-55	**Hammer Type - Drop:**	140 lb. Automatic - 30"
Angle from Vert.:	0 degrees	**Exploration Method:**	Hollow Stem Auger		
Weather:	Sunny	**Auger Diameter:**	8 inches		

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
365	0													**Artificial Fill** **Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, dense
360	5		1		BC=16 24 42									Fine to coarse grained, non-plastic fines, gray, moist, very dense
355	10		2		BC=16 37 45									Coarse grained, non-plastic fines, gray, moist, very dense, decrease in fines content, predominantly coarse grained sand
350	15													
345	20		3		BC=16 25 39									Coarse grained, non-plastic fines, gray, moist, very dense
340	25		4		BC=20 30 38									**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, grayish brown, moist, very hard
335	30		5		BC=23 47 50									Fine grained, low plasticity fines, light brown, moist, very hard, gray colored Sand lenses throughout

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BORING LOG B-6 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-14

Date Begin - End: 4/26/12 | **Drill Company:** Scott's Drilling | **BORING LOG B-6 (2012)**

Logged By: E. Koprulu | **Drill Crew:**

Hor.-Vert. Datum: NAD83 - NAD83 | **Drill Equipment:** CME-55 | **Hammer Type - Drop:** 140 lb. Automatic - 30"

Angle from Vert.: 0 degrees | **Exploration Method:** Hollow Stem Auger

Weather: Sunny | **Auger Diameter:** 8 inches

FIELD EXPLORATION | LABORATORY RESULTS

Latitude: 33.21047° N
Longitude: 117.29423° W
Approximate Surface Elevation (ft): 366.0

Surface Condition: Bare Earth and Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
330			**Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, grayish brown, moist, very hard *(continued)*												
	40		Fine grained, low plasticity fines, light brown to white, moist, very hard, abundant caliche	6		BC=8 15 19									
325			Pieces of debris (metal pieces) observed in soil cuttings												
	45		**Fat CLAY (CH)**: high plasticity fines, dark brown to black, trace organic odor, moist, hard, some reddish brown to gray colored Sand lenses, some rootlets	7		BC=8 11 18									
320			**Sandy CLAY (CL)**: fine grained, medium plasticity fines, grayish brown, moist, hard	8		BC=13 25 35									
	55		Soil cuttings indicate black colored Clay with strong organic smell from approximately 50 to 58 feet												
315															
	60		Fine grained, low plasticity fines, grayish brown, moist, very hard	9		BC=17 18 28									
310															
	65		Becomes firm to hard	10		BC=6 10 14									
305			**Fat CLAY (CH)**: trace fine grained, high plasticity fines, black, organic smell odor, moist, firm to hard												
300															

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BORING LOG B-6 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-15

Date Begin - End: 4/26/12 **Drill Company:** Scott's Drilling

BORING LOG B-6 (2012)

Logged By: E. Koprulu **Drill Crew:**

Hor.-Vert. Datum: NAD83 - NAD83 **Drill Equipment:** CME-55 **Hammer Type - Drop:** 140 lb. Automatic - 30"

Angle from Vert.: 0 degrees **Exploration Method:** Hollow Stem Auger

Weather: Sunny **Auger Diameter:** 8 inches

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. blows/6 in	Recovery	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Latitude: 33.21047° N Longitude: 117.29423° W Approximate Surface Elevation (ft): 366.0 Surface Condition: Bare Earth and Grass												
295			**Fat CLAY (CH)**: trace fine grained, high plasticity fines, black, organic smell odor, moist, firm to hard *(continued)*												
	75		**Santiago Formation (Tsa)** **CLAYSTONE** excavates as **Sandy CLAY (CL):** fine grained, medium plasticity fines, brown, moist, very hard	11		BC=16 24 31									CONSOL
290															
	80		Low plasticity fines, gray, moist, iron-oxide staining	12		BC=18 50/5"									
285															
	85		The boring was terminated at approximately 81 feet below ground surface. Boring was backfilled with bentonite on April 26, 2012.												
280															
	90														
275															
	95														
270															
	100														
265															

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling.

GENERAL NOTES:
The boring location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the boring with an accuracy of 5 to 10 feet.

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BORING LOG B-6 (2012)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-16

TEST PIT LOG TP-4

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Latitude: 33.21125° N Longitude: 117.29421° W Approximate Surface Elevation (ft): 368.0 Surface Condition: Bare Earth and Grass										
			Artificial Fill **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, light brown, moist, dense, chunks of clay throughout	1									
365	5		**Santiago Formation** **T(sa) SANDSTONE:** Excavates as **Clayey SAND (SC)**: fine to coarse grained, low plasticity fines, gray, moist, dense	2									
360	10												
355	15												
350	20												
345	25												
340	30												
335													

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-4

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TEST PIT LOG TP-4

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-20

Date Begin - End: 4/23/12 **Excavation Co.:** Cut N Core

Logged By: E. Koprulu **Excavation Crew:**

Hor.-Vert. Datum: NAD83 - NAD83 **Excavation Equip.:** CAT 430E Backhoe

Angle from Vert.: 0 degrees **Excav. Dimensions:** 36 inches

Weather: Sunny

TEST PIT LOG TP-5

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Latitude: 33.21126° N Longitude: 117.29373° W Approximate Surface Elevation (ft): 368.0 Surface Condition: Bare Earth and Grass										
365	0		**Artificial Fill** **Sandy CLAY (CL)**: fine to coarse grained, low plasticity fines, light brown, moist, dense, chunks of clay throughout	1									
	5		**Santiago Formation** **T(sa) SANDSTONE:** Excavates as **Silty SAND (SM)**: fine to coarse grained, low plasticity fines, gray, moist, dense, pockets of dark gray Clay, concreteion observed at approximately 5.5 feet	2									
360	10												
355	15												
350	20												
345	25												
340	30												
335													

The test pit was terminated at approximately 6 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-5

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TEST PIT LOG TP-5

SDG&E OCEAN RANCH SUBSTATION
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OCEANSIDE, CALIFORNIA

PLATE
A-21

TEST PIT LOG TP-6

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION	Sample Number	Sample Type	LABORATORY RESULTS: USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
			Latitude: 33.21125° N Longitude: 117.29333° W Approximate Surface Elevation (ft): 374.0 Surface Condition: Bare Earth and Grass										
			Artificial Fill **Clayey SAND (SC)**: trace gravel, fine to coarse grained, non-plastic fines, light brown, moist, dense	1									
370	5		**Silty SAND (SM)**: fine to coarse grained, non-plastic fines, gray, moist, dense, weakly cemented chunks mixed	2									
365	10												
360	15												
355	20												
350	25												
345	30												
340													

The test pit was terminated at approximately 9.5 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-6

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www.kleinfelder.com PH. 858-320-2000 FAX. 858-320-2001

PROJECT NO.	124202
DRAWN BY:	EK
CHECKED BY:	DH
DATE:	5/7/2012
REVISED:	

TEST PIT LOG TP-6

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-22

TEST PIT LOG TP-7

Date Begin - End:	4/23/12	**Excavation Co.:**	Cut N Core
Logged By:	E. Koprulu	**Excavation Crew:**	
Hor.-Vert. Datum:	NAD83 - NAD83	**Excavation Equip.:**	CAT 430E Backhoe
Angle from Vert.:	0 degrees	**Excav. Dimensions:**	36 inches
Weather:	Sunny		

FIELD EXPLORATION

Latitude: 32.21111° N
Longitude: 117.29319° W
Approximate Surface Elevation (ft): 373.0

Surface Condition: Bare Earth and Grass

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Sample Number	Sample Type	USCS Symbol	Moisture Content (%)	Dry Density (pcf)	Passing No.4 Sieve (%)	Passing #200 Sieve (%)	Liquid Limit (NV=No Value)	Plasticity Index (NP=No Plasticity)	Other Tests/ Remarks
370	0		1									**Artificial Fill**
			2									**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, light brownish gray, moist, dense
												Silty SAND (SM): fine to medium grained, non-plastic fines, light gray, moist, dense
			3									**Silty SAND (SM)**: coarse grained, non-plastic fines, gray, moist, dense
365	5		4									**Clayey SAND (SC)**: fine to coarse grained, non-plastic fines, gray, moist, dense
360	10											
355	15											
350	20											
345	25											
340	30											

The test pit was terminated at approximately 8 feet below ground surface. Test Pit was backfilled with excavated material on April 23, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during excavation.
GENERAL NOTES:
The test pit location and elevation are approximate and were estimated by BHA, Inc.
A Garmin etrex GPS unit was used to locate the test pit with an accuracy of 5 to 10 feet.
There was no shoring used for the test pit exploration.

TP-7

KLEINFELDER
Bright People. Right Solutions.
5015 Shoreham Place
San Diego, CA 92122
www.kleinfelder.com PH. 858-320-2000 FAX. 858-320-2001

PROJECT NO.	124202
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TEST PIT LOG TP-7

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CALIFORNIA

PLATE
A-23

APPENDIX B

LABORATORY TEST RESULTS

APPENDIX B
LABORATORY TEST RESULTS

GENERAL

Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate physical properties of the soils that may affect foundation design and construction procedures. The tests were performed in general conformance with the current ASTM or California Department of Transportation (Caltrans) standards. A description of the laboratory-testing program is presented below.

CLASSIFICATION

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the boring logs in Appendix A.

LABORATORY MOISTURE AND DENSITY DETERMINATIONS

Natural moisture content and dry density tests were performed on selected intact samples collected and moisture content was performed on selected disturbed samples. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. This data is included on the boring logs in Appendix A.

GRADATION ANALYSIS

Sieve and hydrometer analyses were performed on samples from the site to evaluate the gradation characteristics of the soil and to aid in its classification. The tests were performed in general accordance with ASTM Test Methods D6913 and ASTM D422. The results of the sieve analyses are shown in Figures B1 and B2.

WASH SIEVE

The percent passing the No. 200 sieve of selected soil samples was performed by wash sieving in accordance with ASTM Standard Test Method D1140. The results of the tests are presented on the boring logs in Appendix A.

DIRECT SHEAR TEST

Three-point direct shear tests were performed on selected soil samples to evaluate the shear strength of representative site soils encountered. The soil samples were tested in a saturated state at three different normal pressures in general accordance with ASTM Test Method D 3080. The test results are presented in Figures B3 through B5.

ATTERBERG LIMITS

Atterberg limit testing was performed on soil samples to assist in classification. Testing was performed in general accordance with ASTM D4318. Results are presented on Figure B-6.

R-VALUE TESTS

Two resistance values (R-value) test were performed on a bulk soil samples obtained within the proposed site to evaluate pavement support characteristics of the near-surface onsite soils. R-value tests were performed in accordance with ASTM Standard Test Method D4829. The test results are presented as Figures B-7and B-8.

MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT

The maximum dry density and optimum moisture content of a representative soil sample was evaluated in general accordance with ASTM Test Method D1557. The test result is summarized on Figure B-9

CORROSION TESTING

The sulfate and chloride contents, pH, and resistivity of selected samples were evaluated in general accordance with California Test 643. Our boring logs and these test results should be reviewed by a qualified corrosion engineer to evaluate the general soil stratigraphy corrosion potential with respect to construction materials to evaluate whether further testing is warranted. The results of the preliminary corrosive screening are presented on Figures B-10 through B-12 and summarized in Table B1 below.

Table B1

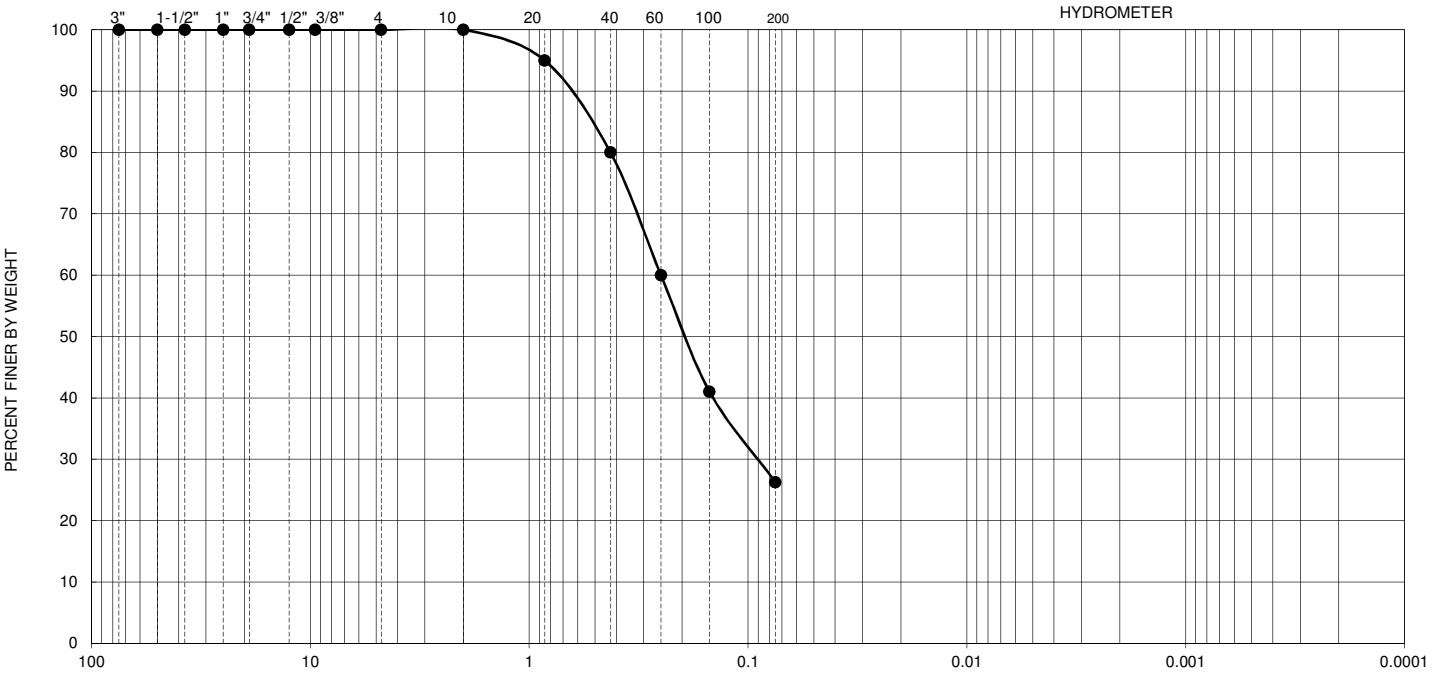
Preliminary Corrosion Test Results

BORING / SAMPLE NO.	DEPTH (FEET)	MINIMUM RESISTIVITY (OHM-CM)	PH	SULFATE CONTENT (PPM)	CHLORIDE CONTENT (PPM)
B-3 / 1	0.5 to 5	480	8.7	210	160
B-4 / 1	0.5 to 5	870	8.9	50	50
B-5 / 1	0.5 to 5	550	8.3	70	160

Date Tested: **5/4/2015**

USCS	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

U.S. STANDARD SIEVE NUMBERS



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
B3	2	2.5-4	26.3	SC

Sample Description	Light Yellow Brown Clayey SAND

Sieve Analysis	Sieve Size		% Passing
	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	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	95
	No. 40	0.425 mm	80
	No. 60	0.25 mm	60
	No 100	0.15 mm	41
	No 200	.075 mm	26.3

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

Tested by:	Uly P.	Ck by:	TG
Project No.	20154777	Date:	12-Jun-15

GRADATION TEST RESULTS

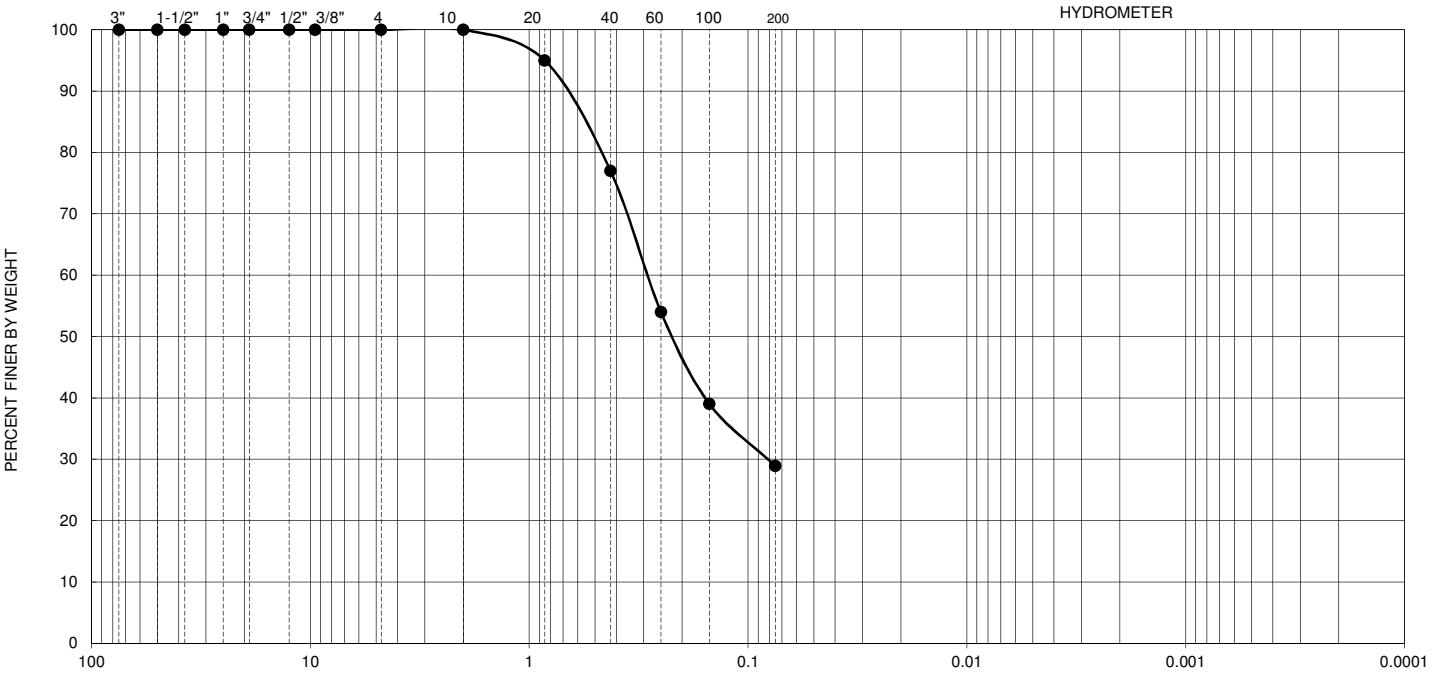
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-1

Date Tested: **5/4/2015**

USCS	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Boring No.	Sample No.	Depth (ft)	Passing 200 (%)	USCS Classification
B4	4	10-11.5	28.9	SM

Sample Description	Pale Yellow Silty SAND

Sieve Analysis	Sieve Size		% Passing
	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	100
	No. 10	2.0 mm	100
	No. 20	0.85 mm	95
	No. 40	0.425 mm	77
	No. 60	0.25 mm	54
	No 100	0.15 mm	39
	No 200	.075 mm	28.9

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 6913

KLEINFELDER
Bright People. Right Solutions.

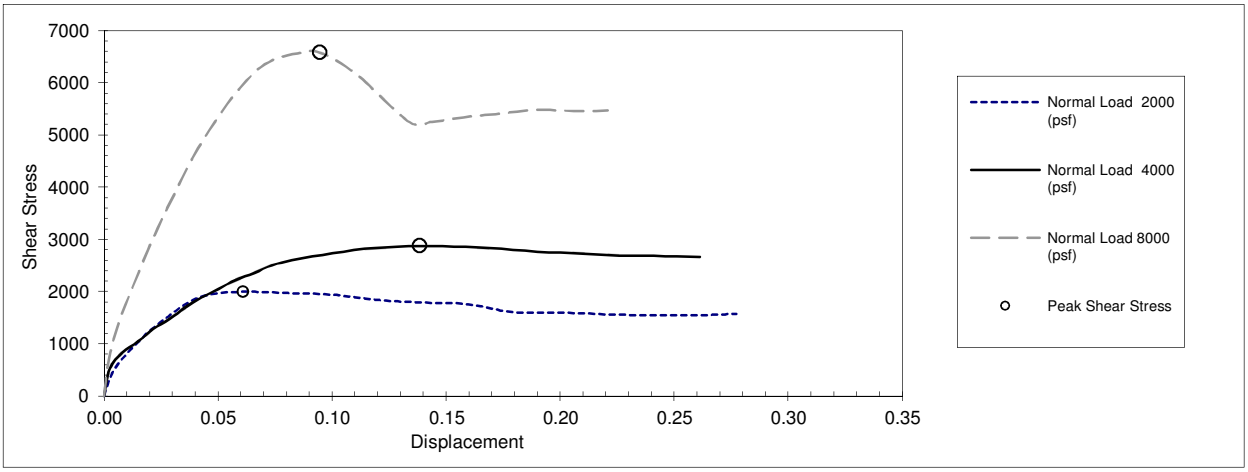
Tested by:	Uly P.	Ck by:	TG
Project No.	20154777	Date:	12-Jun-15

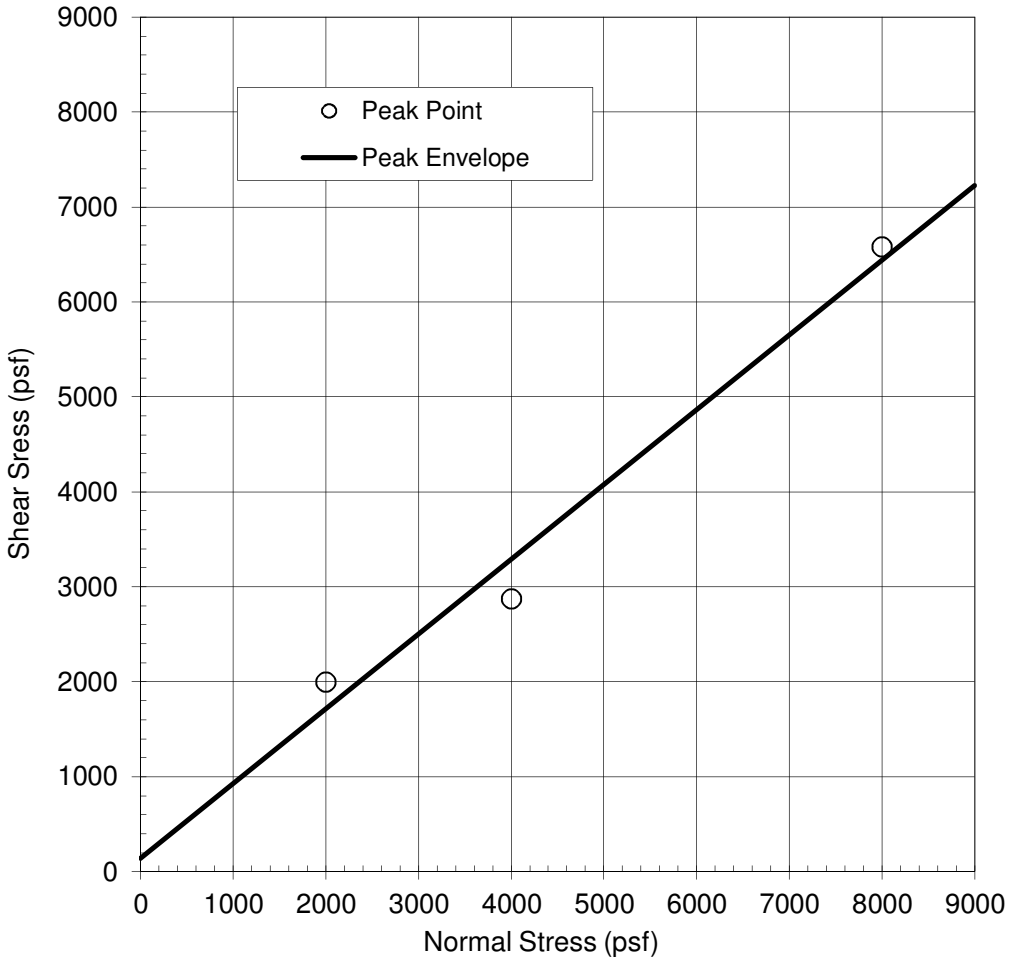
GRADATION TEST RESULTS

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-2





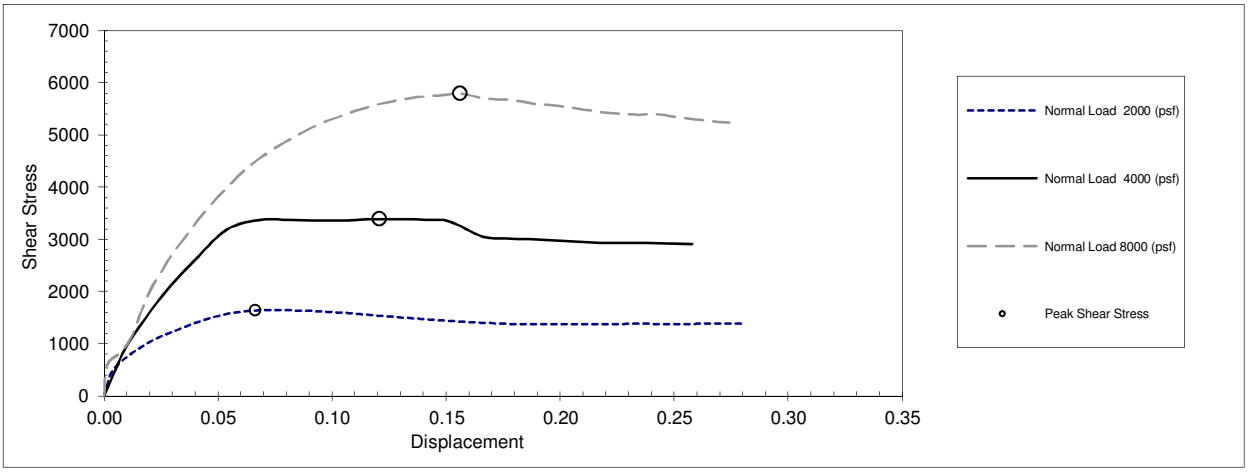
Strain Rate = 0.0118 inch/min

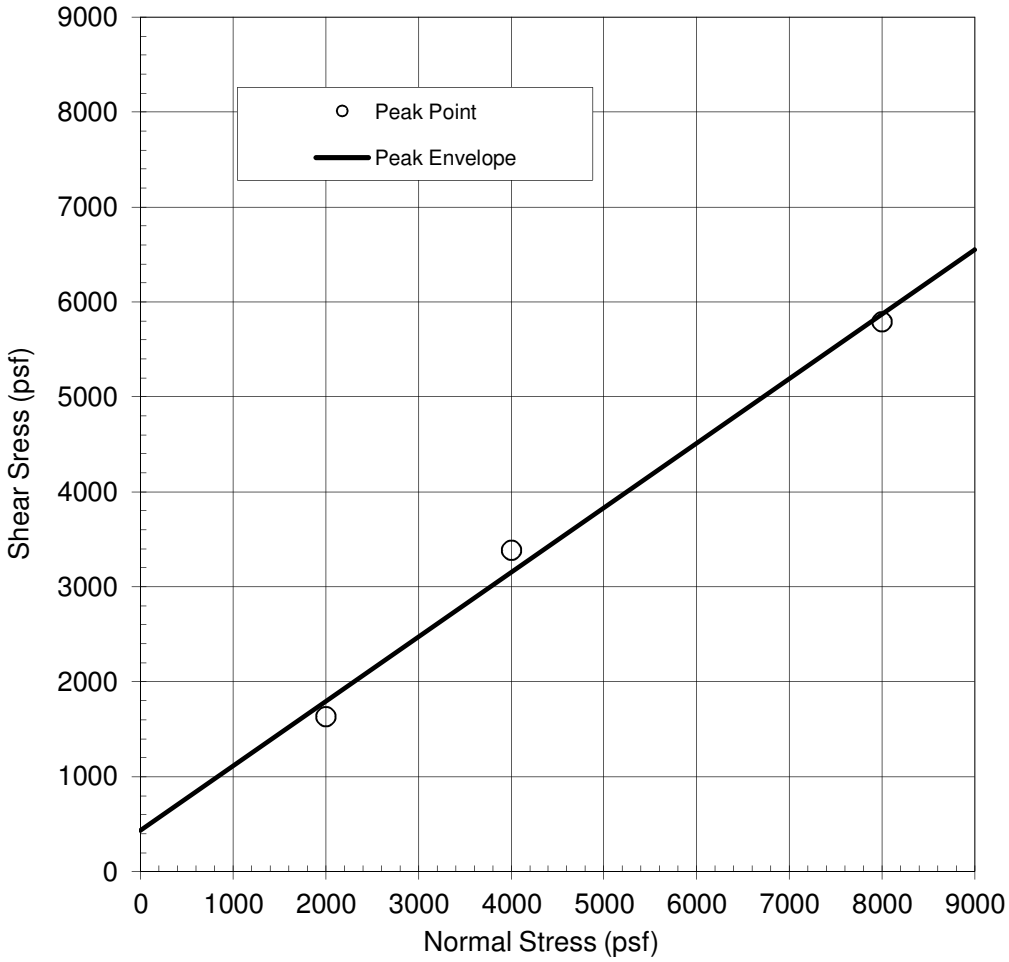
Date Tested: 4/29/2015

				Interpreted Shear Strength			
				Peak			
Boring No.	Sample No.	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)		
B-2	2	2.5'-4'	SM	140	38.2		

Sample description: Light Yellowish Brown Silty SAND

KLEINFELDER Bright People. Right Solutions.			**Direct Shear Test Results (ASTM D 3080)**	FIGURE
Tested by:	Uly P.	Ck by: TG	**SDG&E OCEAN RANCH SUBSTATION PACIFIC COAST BUSINESS PARK OCEANSIDE, CA**	**B-3**
Project #	20154777	12-Jun-15		





Strain Rate = 0.0118 inch/min

Date Tested: 4/30/2015

				Interpreted Shear Strength			
				Peak			
Boring No.	Sample No.	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)		
B-4	2	2.5'-5'	SC	435	34.2		

Sample description: Olive Gray Clayey SAND

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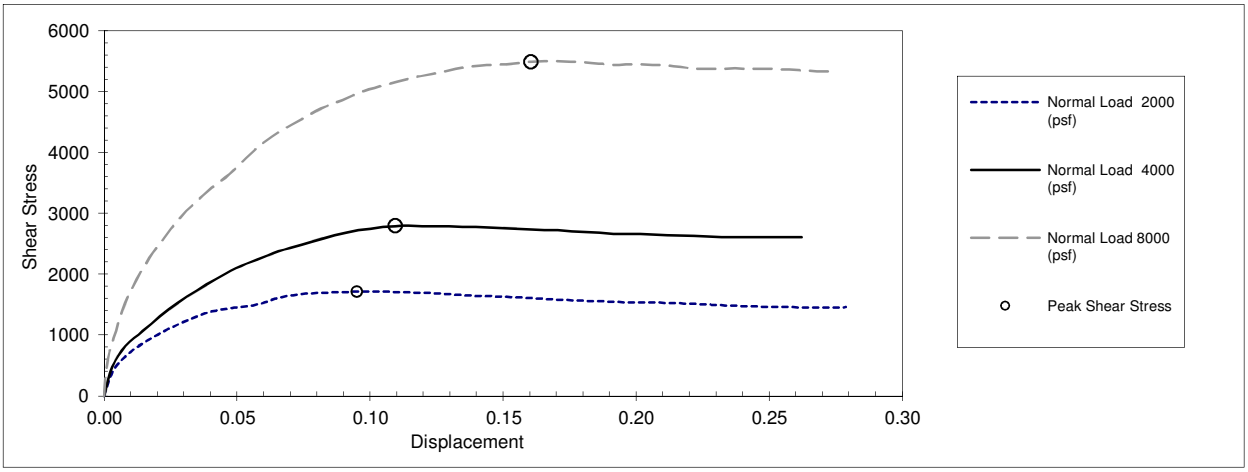
Tested by:	Uly P.	Ck by: TG
Project #	20154777	12-Jun-15

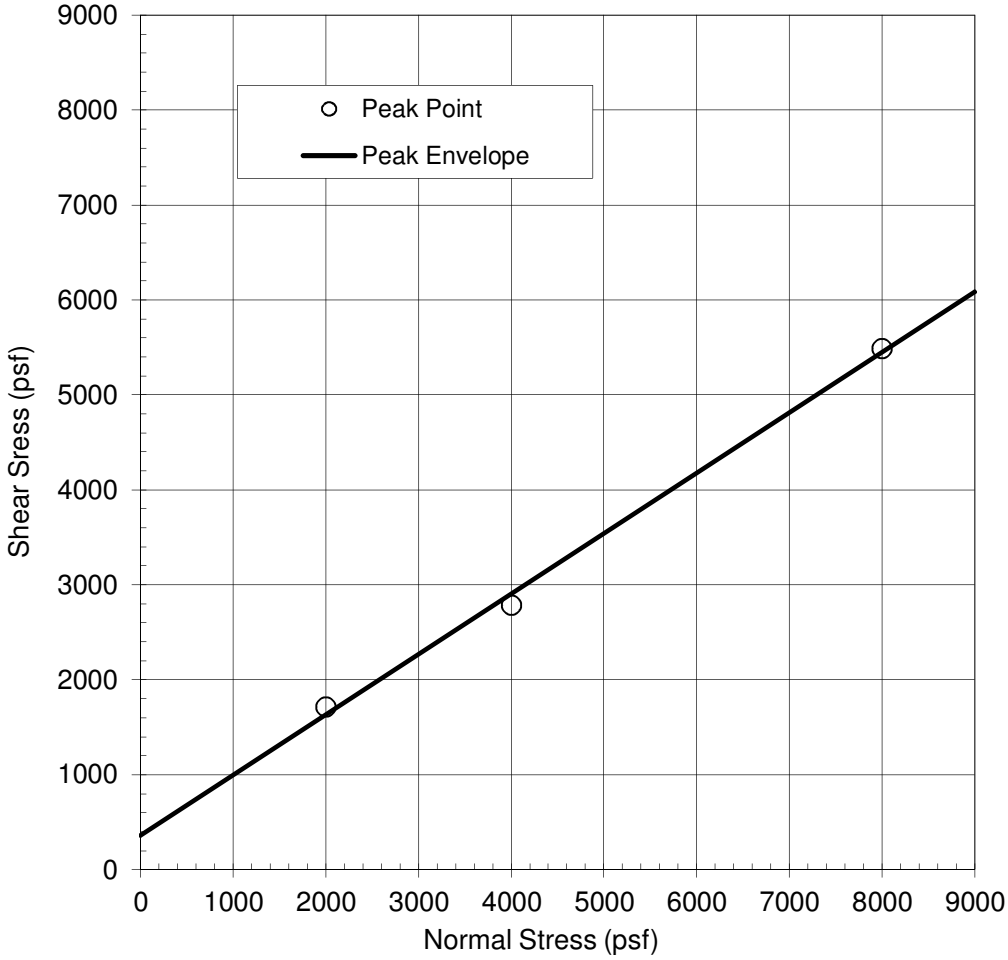
Direct Shear Test Results (ASTM D 3080)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-4





Strain Rate = 0.0118 inch/min

Date Tested: 5/4/2015

				Interpreted Shear Strength			
				Peak			
Boring No.	Sample No.	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)		
B-5	2	2.5'-4'	SM	362	32.4		

Sample description: Light Olive Gray Silty SAND

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Tested by:	Uly P.	Ck by: TG
Project #	20154777	12-Jun-15

Direct Shear Test Results (ASTM D 3080)

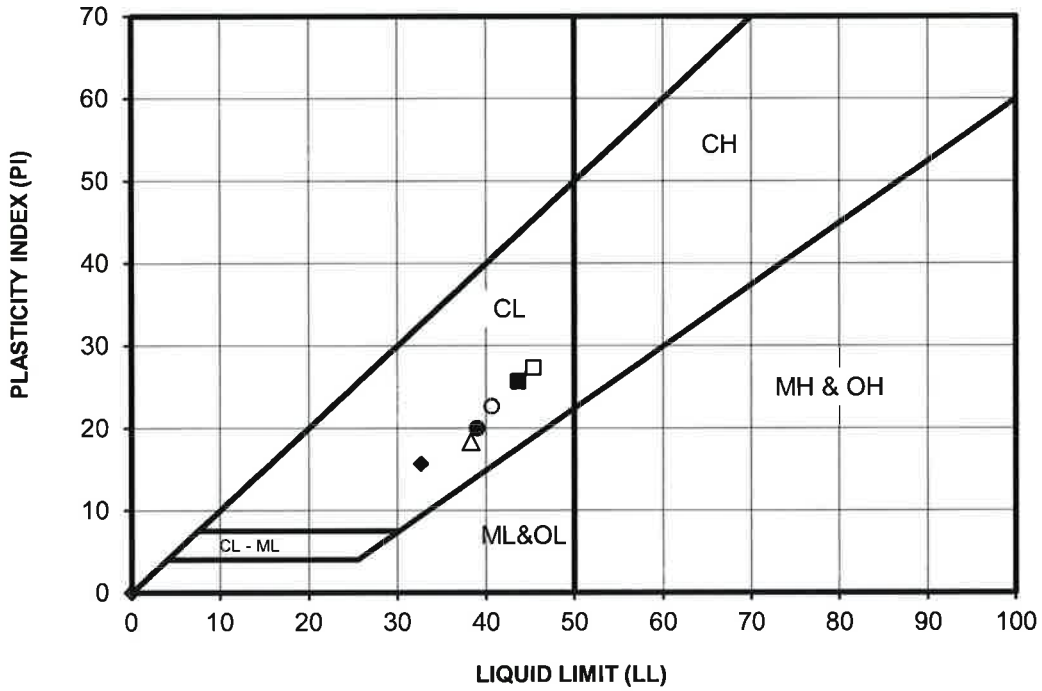
SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-5

Date Tested : 5/4/2015 & 5/13/2015

SYMBOL	SAMPLE NAME	DEPTH (ft)	LL	PL	PI	USCS CLASSIFICATION (Minus No. 40 Sieve Fraction)	USCS (Entire Sample)
●	B-1-4	10-11.5'	39	19	20	CL	CL
■	B-3-1	0.5-5'	44	18	26	CL	SC
◆	B-4-2	2.5-4'	33	17	16	CL	SC
○	B-4-8	30-31.5'	41	18	23	CL	CL
□	B-4-15	65-66.5'	45	18	27	CL	CL
△	B-6-5	15-16.5'	38	20	18	CL	CL
+							
◇							



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

KLEINFELDER
Bright People. Right Solutions.

ATTERBERG LIMITS TEST RESULTS

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-6

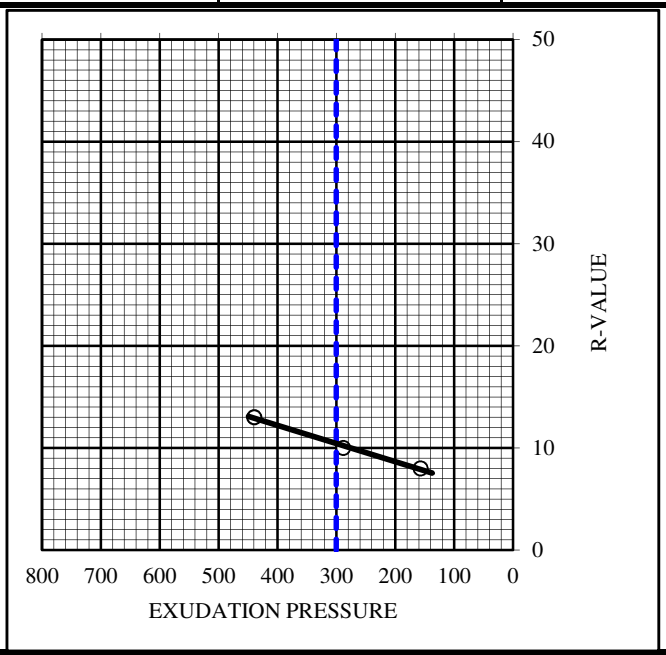
Tested by	Uly P.	Ck by:	TG
PROJECT NO: 20154777		12-Jun-15	

Boring No.	Sample No.	Depth	Description	Date Tested
B7	1	0.5-5'	Pale Olive Clayey SAND	5/6/2015

TEST SPECIMEN				
MOLD NO.	2	1	9	
FOOT PRESSURE, psi	**80**	**60**	**50**	
INITIAL MOISTURE, %	13.1	13.1	13.1	
"AS-IS" WEIGHT, g	1200	1200	1200	
DRY WEIGHT, g	1060.9	1060.9	1060.9	
WATER ADDED, ml	**40**	**52**	**64**	
COMPACTION MOISTURE, %	16.9	18.0	19.1	
HEIGHT OF BRIQUETTE, in.	**2.58**	**2.6**	**2.62**	
WEIGHT BRIQUETTE/MOLD,	**3213**	**3203.4**	**3216.4**	
WEIGHT OF MOLD, g	**2109.2**	**2103.4**	**2114.5**	
WEIGHT OF BRIQUETTE, g	1103.8	1100	1101.9	
DRY DENSITY, pcf	111.0	108.7	107.1	
STABILOMETER, 1000 lbs	**55**	**61**	**64**	
2000lbs	**134**	**139**	**144**	
DISPLACEMENT, in	**3.59**	**3.66**	**3.84**	
EXUDATION LOAD, lbs	**5515**	**3621**	**1972**	
EXUDATION PRESSURE, psi	439.1	288.3	157.0	
R-VALUE	12	9	7	
CORRECTED R-VALUE	13	10	8	
DIAL READING, END	0.0311	0.0302	0.0404	
DIAL READING, START	0.0300	0.0300	0.0400	
DIFFERENCE	0.0011	0.0002	0.0004	
EXPANSION PRESSURE, PSF	48.0	8.7	17.5	

INITIAL MOISTURE	
WET WEIGHT, g	433.8
DRY WEIGHT, g	383.5
WEIGHT OF WATER	
WEIGHT OF SAMPLE	
MOISTURE CONTENT %	13.1

R-VALUE:	**11**
Location:	



KLEINFELDER
Bright People. Right Solutions.

Tested By:	Uly P.	Ck by:	TG
Job Number:	20154777	DATE:	12-Jun-15

R-Value (ASTM D2844)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

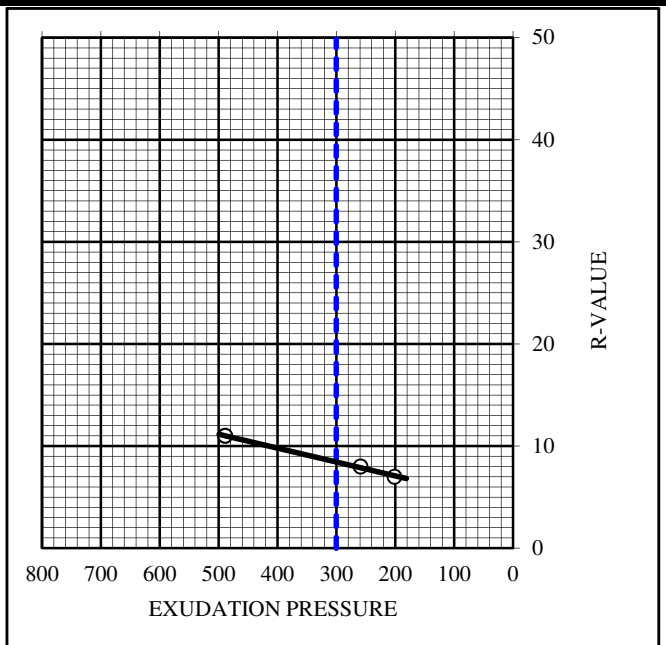
B-7

Boring No.	Sample No.	Depth	Description	Date Tested
B10	1	0.5-5'	Light Olive Gray Clayey SAND	5/6/2015

TEST SPECIMEN				
MOLD NO.	6	3	8	
FOOT PRESSURE, psi	**80**	**60**	**50**	
INITIAL MOISTURE, %	14.5	14.5	14.5	
"AS-IS" WEIGHT, g	1200	1200	1200	
DRY WEIGHT, g	1048.0	1048.0	1048.0	
WATER ADDED, ml	**30**	**45**	**58**	
COMPACTION MOISTURE, %	17.4	18.8	20.0	
HEIGHT OF BRIQUETTE, in.	**2.5**	**2.55**	**2.6**	
WEIGHT BRIQUETTE/MOLD,	**3170.7**	**3176.5**	**3174.6**	
WEIGHT OF MOLD, g	**2101**	**2105.4**	**2112.6**	
WEIGHT OF BRIQUETTE, g	1069.7	1071.1	1062	
DRY DENSITY, pcf	110.6	107.2	103.2	
STABILOMETER, 1000 lbs	**57**	**61**	**66**	
2000lbs	**136**	**142**	**145**	
DISPLACEMENT, in	**3.5**	**3.74**	**3.92**	
EXUDATION LOAD, lbs	**6142**	**3253**	**2529**	
EXUDATION PRESSURE, psi	489.0	259.0	201.4	
R-VALUE	11	8	6	
CORRECTED R-VALUE	11	8	7	
DIAL READING, END	0.0478	0.0285	0.0476	
DIAL READING, START	0.0475	0.0285	0.0482	
DIFFERENCE	0.0003	0.0000	-0.0006	
EXPANSION PRESSURE, PSF	13.1	0.0	0.0	

INITIAL MOISTURE	
WET WEIGHT, g	506.0
DRY WEIGHT, g	441.9
WEIGHT OF WATER	
WEIGHT OF SAMPLE	
MOISTURE CONTENT %	14.5

R-VALUE:	**9**
Location:	



KLEINFELDER
Bright People. Right Solutions.

Tested By:	Uly P.	Ck by:	TG
Job Number:	20154777	DATE:	12-Jun-15

R-Value (ASTM D2844)

SDG&E OCEAN RANCH SUBSTATION
PACIFIC COAST BUSINESS PARK
OCEANSIDE, CA

FIGURE

B-8

KLEINFELDER
Bright People. Right Solutions.

5761 Copley Drive, Suite 100
San Diego, CA 92111
Phone: (858) 223-8500 Fax: (858) 277-1035

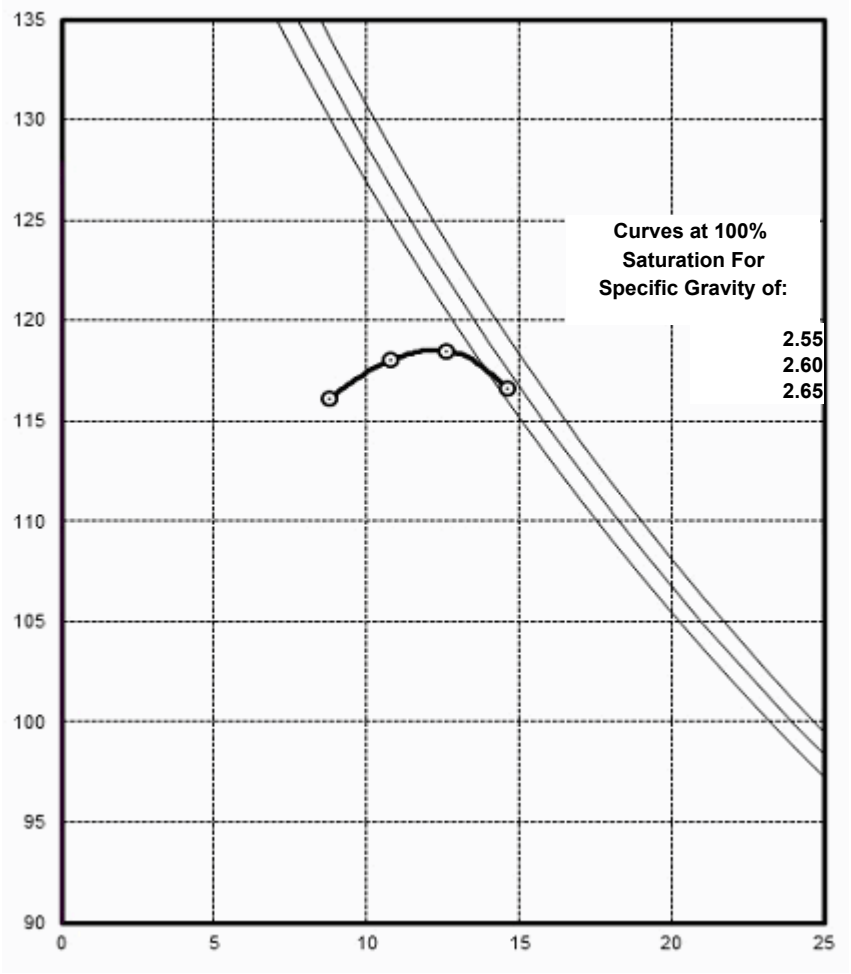
Laboratory Compaction Characteristics of Soil Using Modified Effort ASTM D 1557

Report To:

Richard Brady & Associates, Inc.
Osborn, Linda
3710 Ruffin Road
San Diego, CA 92123

Report Date: 5/14/2015
Project No.: 20154777.003A
Project: SDG&E - San Mateo Sub 12kV Breaker Proj
Task: 03-000L Lab Testing

TEST RESULTS



Sample No.: SD_20154777.B5.1
Date Sampled: 4/16/2015
Sample Location:
B-5 Sample 1 at 0.5'-5'

Material Description:
light olive brown clayey sand

Compaction Test Method:
ASTM D 1557 Method A
Maximum Dry Unit Weight (pcf): 118.5
Optimum Water Content (%): 12.3

Remarks:

Reviewed on 5/14/2015 by:

Ulysses Panuncialman
Laboratory Manager

FIGURE B-9

L A B O R A T O R Y R E P O R T

Telephone (619) 425-1993 Fax 425-7917 Established 1928

C L A R K S O N L A B O R A T O R Y A N D S U P P L Y I N C.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L A N D C O N S U L T I N G C H E M I S T S

Date: May 12, 2015
Purchase Order Number: PROJ#20154777
Sales Order Number: 26878
Account Number: KLE
To:
--
Kleinfelder Inc.
550 West C Street Ste 1200
San Diego, CA 92101
Attention: Uly Panuncialman

Laboratory Number: SO5666-1 Customers Phone: 831-4600
Fax: 831-4619
Sample Designation:
--
One soil sample received on 05/04/15 at 3:42pm
marked as:
Project: SDG&E Ocean Ranch Substation
Project #: 20154777
Boring #: B3
Sample #: 1
Depth: 0.5-5'
Date Sampled: 04/15/15.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.7

Water Added (ml)	Resistivity (ohm-cm)
10	1800
5	990
5	550
5	480
5	480
5	520
5	550

24 years to perforation for a 16 gauge metal culvert.
29 years to perforation for a 14 gauge metal culvert.
41 years to perforation for a 12 gauge metal culvert.
52 years to perforation for a 10 gauge metal culvert.
63 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.021%

Water Soluble Chloride Calif. Test 422 0.016%

Laura Torres
LT/ram

FIGURE B-10

L A B O R A T O R Y R E P O R T

Telephone (619) 425-1993 Fax 425-7917 Established 1928

C L A R K S O N L A B O R A T O R Y A N D S U P P L Y I N C.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L A N D C O N S U L T I N G C H E M I S T S

Date: May 12, 2015
Purchase Order Number: PROJ#20154777
Sales Order Number: 26878
Account Number: KLE
To:
--
Kleinfelder Inc.
550 West C Street Ste 1200
San Diego, CA 92101
Attention: Uly Panuncialman

Laboratory Number: SO5666-2 Customers Phone: 831-4600
Fax: 831-4619
Sample Designation:
--
One soil sample received on 05/04/15 at 3:42pm
marked as:
Project: SDG&E Ocean Ranch Substation
Project #: 20154777
Boring #: B4
Sample #: 1
Depth: 0.5-5'
Date Sampled: 04/15/15.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.9

Water Added (ml)	Resistivity (ohm-cm)
10	2200
5	1400
5	870
5	880
5	910
5	920

29 years to perforation for a 16 gauge metal culvert.
38 years to perforation for a 14 gauge metal culvert.
52 years to perforation for a 12 gauge metal culvert.
66 years to perforation for a 10 gauge metal culvert.
81 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.005%

Water Soluble Chloride Calif. Test 422 0.005%

Laura Torres
LT/ram

FIGURE B-11

L A B O R A T O R Y R E P O R T

Telephone (619) 425-1993 Fax 425-7917 Established 1928

C L A R K S O N L A B O R A T O R Y A N D S U P P L Y I N C.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L A N D C O N S U L T I N G C H E M I S T S

Date: May 12, 2015
Purchase Order Number: PROJ#20154777
Sales Order Number: 26878
Account Number: KLE
To:
--
Kleinfelder Inc.
550 West C Street Ste 1200
San Diego, CA 92101
Attention: Uly Panuncialman

Laboratory Number: SO5666-3 Customers Phone: 831-4600
Fax: 831-4619
Sample Designation:
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One soil sample received on 05/04/15 at 3:42pm
marked as:
Project: SDG&E Ocean Ranch Substation
Project #: 20154777
Boring #: B5
Sample #: 1
Depth: 0.5-5'
Date Sampled: 04/15/15.

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 8.3

Water Added (ml)	Resistivity (ohm-cm)
10	2000
5	1100
5	720
5	580
5	550
5	570
5	590

24 years to perforation for a 16 gauge metal culvert.
31 years to perforation for a 14 gauge metal culvert.
43 years to perforation for a 12 gauge metal culvert.
55 years to perforation for a 10 gauge metal culvert.
67 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417 0.007%

Water Soluble Chloride Calif. Test 422 0.016%

Laura Torres
LT/ram

FIGURE B-12

APPENDIX C

SUGGESTED GUIDELINES FOR EARTHWORK CONSTRUCTION

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GENERAL

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

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.

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.

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.

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.

SITE PREPARATION

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.

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 6 to 12 inches within the landscaped areas. 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.

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.

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.

EXCAVATION

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.

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 shall be removed from the site by the Contractor.

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.

COMPACTED FILL

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.

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.

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.

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.

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.

UTILITY TRENCH BEDDING AND BACKFILL

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.

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.

SUBSURFACE DRAINAGE

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

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

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.

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.

AGGREGATE BASE BENEATH CONCRETE SLABS

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

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 D

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.

GBA GEOPROFESSIONAL BUSINESS ASSOCIATION

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