APPENDIX H:
GEOLOGIC RESOURCES SUPPLEMENT

2008 GEOTECHNICAL INVESTIGATION

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APPENDIX 4.6-A

GEOTECHNICAL INVESTIGATION FOR SALT CREEK SUBSTATION PROPONENT'S ENVIRONMENTAL ASSESSMENT (PEA)

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March 7, 2008

Attachment 8

GEOTECHNICAL INVESTIGATION
PROPOSED SDG&E OTAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

March 7, 2007

A report prepared for:

San Diego Gas & Electric
8313 Century Park Court
San Diego, California 92123

Attention: Mr. Ron Brunton

GEOTECHNICAL INVESTIGATION
PROPOSED SDG&E OTAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

Kleinfelder Project No. 67735

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EXECUTIVE SUMMARY

Based on data collected during our investigation, it is our opinion that the proposed development is feasible from a geotechnical perspective. We developed the following summary of key geotechnical and geologic items relating to development of the proposed substation facility improvements.

- There are no known faults crossing the site or known ancient deep-seated landslides lying beneath the site that would affect the proposed construction. The site is located in the seismically active southern California area. The potential for liquefaction and dynamic compaction appears to be relatively low over the majority of this site.
- Topsoil/colluvial materials were encountered to approximate depths of 2 to 4 feet across the majority of the natural slope areas with localized depths up to about 8 to 10 feet. The thicker deposits are located near the base of slopes. Remedial removals of these materials should occur in areas to receive engineered fill or other proposed improvements. These soils are generally fine grained and moderately expansive and should not be placed as engineered fill within 3 feet of finished grade.
- Excavation of the topsoil/colluvium and formational sandstone can likely be achieved with heavy-duty excavation equipment. The on-site topsoil/colluvium and formation may be used as backfill or fill material provided it is prepared and placed in accordance with the recommendations contained in this report. Given the quantity of coarse grained material from cuts into formational materials, it is preferable not to place the fine grained colluvium below structural areas.
- Fill materials underlying the proposed retaining wall along the western portion of the existing access road consist of clay which exhibits lower strength parameters and higher compressibility than the granular formational materials. Granular fill materials generated from cuts into formational materials should be used as fill within the reinforced zone of the proposed segmented retaining walls
- Groundwater at the project site is located well below the depth of the proposed construction activities.

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation for the SDG&E Otay Ranch Substation facility to be located in the Otay Ranch area of Chula Vista, California. Specifically the proposed substation is to be located just southeast of the recent extension of Hunte Parkway, and just west of the SDG&E easement. The results of our preliminary geotechnical siting study for the site were presented in our July 20, 2006 report and are included as Appendix D of this report.

The latitude and longitude coordinates of the substation are:

Latitude: 32.6189°N

Longitude: 116.9486°W

The site location is shown on the Vicinity Map, Figure 1. A site plan showing approximate site limits, proposed improvements and field exploration locations is presented as Figure 2, Site Plan/Geologic Map. Figure 2 is based on civil drawings prepared by SDG&E. An aerial photo of the site and surrounding area is presented on Figure 3.

1.1 PROJECT DESCRIPTION

We understand the proposed project will consist of the construction of a new 69/12kV distribution substation. Although we have not been provided with details of the proposed substation, we anticipate that equipment will consist of transformers, switch stands, circuit breakers, capacitor banks, switchgear, and a single story concrete masonry control building. Based on our review of the preliminary site plans and our discussions with SDG&E, the substation area would be about 250 feet by 270 feet and be accessed by a driveway from Hunte Parkway to the north. The substation pad will consist of 12 inches of compacted class II base course on top of compacted select fill subgrade in accordance with SDG&E Standard EW-6. The current site generally consists of gentle to moderately sloping hillsides which descend downward to the west, south and east to a natural drainage system below the site. Preliminary pad elevations are about 486 to 490 feet MSL. Grading for the substation pad will consist of performing cuts on the north and fills on the south, with cut and fill slope heights up to about 35 and 25 feet, respectively.

The majority of the southern side of the main access road will require construction of a geogrid-reinforced segmental block retaining wall (Keystone Wall) to accommodate road widening, with heights up to about 17 feet on the western end and decreasing to the east. The geogrid-reinforced wall is considered the most feasible and economical wall type at this location due to settlement considerations of placing new fill of variable height over existing fill of variable depth. The entire substation pad area will be secured with a perimeter masonry block wall.

1.2 PURPOSE AND SCOPE OF SERVICES

The purpose of our current geotechnical and geologic engineering services was to evaluate the soil and geologic conditions at the site and provide conclusions and recommendations for preliminary design of the proposed development. The scope of our investigation consisted of a literature review, subsurface investigation, geotechnical laboratory testing, engineering evaluation and analysis, and the preparation of this report.

The following geotechnical information and recommendations are presented in our report:

- Vicinity map and site plan showing approximate locations of soil borings and test pits;
- Logs of soil borings, test pits and laboratory test results;
- Discussion of field exploration methods and laboratory test procedures;
- Discussion of the site and subsurface conditions;
- Discussion of faulting and seismicity in the region;
- Discussion of potential geologic hazards, which may impact the site;
- A map showing faults and historical earthquakes in the region;
- Review of anticipated excavation conditions;
- Guidelines for earthwork construction, including recommendations for site preparation, fill placement, and compaction;
- Lateral earth pressures and recommendations for design of retaining walls;
- Discussion of the possible foundation types;
- Discussion of the possible retaining wall types;
- Soil parameters for design of structural mat foundations or conventional spread footings;

- Soil parameters for drilled pier design using the EPRI – MFAD computer program; and
- Preliminary screening of the soil properties affecting corrosion of concrete and steel.

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 as Appendix E. We recommend that all individuals utilizing this report read the limitations along with the attached document.

2.0 INVESTIGATIVE METHODS

2.1 GEOLOGIC EVALUATION

Our geologic evaluation consisted of reviewing aerial photographs, researching geologic reports and maps reasonably available to our office, and observation of the geotechnical conditions in the field at the time of our subsurface investigation. The site geology is shown on the Site Plan/Geologic Map, Figure 2 and the geology of the site area is shown Local Geologic Map, Figure 4.

We have reviewed the following documents in preparation of this report::

1. Grading Plan for Otay Ranch – Village 11, Phase III subdivision, prepared by Hunsaker & Associates, undated.
2. Drawings C-1 and C-2, Conceptual Grading Plan and Grading Profiles for the Otay Ranch Substation, prepared by San Diego Gas and Electric, dated January 30, 2007.
3. Stereoscopic Aerial Photographic Plates 210-32F-5 & 4, on file at the County of San Diego Cartographic Services, dated November 29, 1978.
4. Aerial Photographic Plate 78-E11, on file at the County of San Diego Cartographic Services, dated 1928.
5. Geology of National City, Imperial Beach and Otay Mesa Quadragles, Southern San Diego Metropolitan Area, California, Map Sheet 29, Michael P. Kennedy and Siang S. Tan, CDMG, 1977.
6. Geotechnical Investigation, Otay Ranch Village 11 Subdivision, Chula Vista, California, prepared by GeoCon, dated February 2000.

2.2 SUBSURFACE INVESTIGATION

The subsurface investigation included four borings and eight test pits. All activities were approved by a biologist and erosion control measures were implemented. Three small diameter borings were excavated on January 18, 2007 to depths between 36 and 40 feet. The 8-inch diameter borings were excavated with a limited access hollow stem auger by Tri-County Drilling. An additional boring was drilled to a depth of 91.5 feet on March 8, 2007 for the proposed retaining wall on the access road off of Hunte Parkway. An engineer from our office supervised the field operations and logged the borings.

Selected bulk, disturbed, and intact samples were retrieved from the borings, sealed, and transported to our laboratory for further evaluation. Our typical vertical sampling interval was five feet. We recorded the number of blows necessary to drive either a Standard Penetration Test (SPT) sampler or a California sampler at each sampling location. The borings were backfilled using bentonite chips and any remaining soil cuttings were spread out in the vicinity of the boring location. The approximate location of each boring is shown on Figure 2 and logs of borings are included in Appendix A.

Eight backhoe test pits were excavated on December 20, 2006. The depth ranged from about 4 to 12 feet. An engineering geologist from our office supervised the field operations and logged the pits. Selected bulk samples were retrieved from the borings and transported to our laboratory for further evaluation. The pits were backfilled with nominal effort.

2.3 LABORATORY TESTING

A limited laboratory testing program was conducted to substantiate field classifications and evaluate selected physical characteristics and engineering properties of the soils encountered. Moisture content, unit weight, plasticity index, sieve analyses, R-value, direct shear, expansion index and corrosion tests were performed in general accordance with the applicable ASTM or Caltrans test methods. Details of the laboratory testing program are presented in Appendix B.

3.0 SITE CONDITIONS

3.1 GEOLOGIC SETTING

The project area is situated in the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California, and varies in width from approximately 30 to 100 miles (Norris and Webb, 1990). The province is characterized by mountainous terrain on the east composed mostly of Mesozoic igneous and metamorphic rocks, and relatively low-lying coastal terraces to the west underlain by late Cretaceous, Tertiary, and Quaternary age sedimentary rocks. Most of the coastal region of the County of San Diego, including the general site area, occur within this coastal region and are underlain by sedimentary rock. Specifically, the project site in this portion of the Province is underlain at depth by Quaternary-age and Tertiary-age (Eocene) sediments.

3.2 TECTONIC SETTING

The Peninsular Ranges are traversed by several major active faults (Figure 6). The Whittier-Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located northeast of the site and the Rose Canyon, Newport-Inglewood (offshore), Coronado Bank, and San Diego Trough are active faults located to the west-southwest. Major tectonic activity associated with these and other faults within this regional tectonic framework is right-lateral strike-slip movement. These faults, as well as other faults in the region, have the potential for generating strong ground motions at the project site. Further discussion of faulting relative to the site is provided in the Faulting and Seismicity section of this report.

3.3 SITE DESCRIPTION

Site access is provided via a recently constructed access road from the south side of Hunte Parkway. This access road and the recently constructed extension of Hunte Parkway are part of a significant grading project for the Otay Ranch – Village 11 residential subdivision. This earthwork has included grading work on the north side of the proposed substation site and consisted primarily of cut depths up to about 30 feet on the east and fill depths up to about 100 feet below the access road. The earthwork resulted in the creation of a v-shaped cut made for the access road with slopes up to 30 feet in height and gradients of approximately 2:1 (horizontal to vertical).

An existing 96-inch RCP storm drain is located within the existing canyon fill below the western end of the access road and discharges into the drainage at the base of the slope. The pipe has a flow line elevation of about 490 feet at the cleanout near Hunte Parkway and slopes down at about 4 horizontal to 1 vertical to an elevation of about 421 at the energy dissipater. At the location where the pipe crosses the proposed retaining wall, the top of pipe is at about 480 feet, existing grade is about 508 feet and the proposed top of wall is 523 feet.

The south side of the site has remained relatively undisturbed and consists of gentle to moderately sloping hillsides which descend downward to the west, south and east to a natural drainage system below the site. The undeveloped portions of the site are covered with grasses which appear to have been previously used for cattle grazing.

3.4 SITE GEOLOGY AND SUBSURFACE CONDITIONS

Geologic units encountered in our borings, or mapped during our field evaluation included fill, topsoil/colluvium, and the Otay Formation. The areal extent of fill and Otay Formation is depicted on our Site Plan/Geologic Map (Figure 2). Note that the overlying topsoil/colluvium is not depicted although it generally increases in thickness downslope. Detailed descriptions of these units are provided in Appendix A (Boring Logs and Test Pits), and generalized descriptions are provided in the subsequent sections below.

Several tonal bands are apparent on aerial photography on hillslopes nearby the site that closely follow the surface topography. These bands are due to slight color variations between adjacent stratagraphic subunits and indicate that the geologic structure is generally horizontal. Regionally, the Kennedy and Tan geologic map (1977) indicate the structure has very low dips to the southwest.

3.4.1 Fill

Fill materials present along portions of the access roads are primarily associated with the construction of Hunte Parkway. Our review of previous topography indicates that the fill may be up to about 100 feet in depth. Boring B-4 in the access road near the intersection with Hunte Parkway encountered 91 feet of fill. Compaction of this fill was observed and tested by Geocon and was reported to a minimum 90 percent relative compaction (of ASTM D1557 modified proctor. The material consisted of lean clay with some fat clay. This material was not observed on the proposed site and may have been imported from some distance. Penetration resistance blow counts ranged from 32 to 74 blows per foot which indicates that the material appears adequately compacted.

3.4.2 Topsoil/Colluvium

Topsoil/Colluvium was encountered in all of our borings and test pits with the exception of Boring B4, which was performed in the existing access road. This material is related to natural soil development processes (pedogenesis) and movement downslope by precipitation and gravity. The topsoil/colluvium materials were generally encountered from the ground surface to depths of approximately 2 to 4 feet. However, colluvium depths of about 6, 8 and 10 feet were observed in Test Pits 2, 4 and 7, respectively. These locations are further downslope than the other explorations and likely represent greater accumulations of colluvium. As encountered, the topsoil/colluvium consisted of light brown to dark brown, dry to moist, soft to firm, sandy silt, sandy clay and clayey sand with some organics and pinhole porosity. It is compressible in its current conditions and will require removal and recompaction within areas of planned grading.

3.4.3 Otay Formation

The Pliocene-age Otay Formation has been mapped underlying the subject site (Kennedy and Tan, 1977), and was encountered in all of our explorations performed during our subsurface evaluation. Depending on site location and elevation, the Otay Formation typically consists of arkosic sandstone or claystone. As encountered in the borings and test pits for this site, the Otay Formation consisted of light brown and light gray, friable to weakly cemented, coarse-grained sandstone. Due to the low cementation, this material may also be considered an intermediate geomaterial that classifies as very dense sand. Recorded blow counts for the Otay Formation are considered relatively high, having a range of penetration of 2 to 5 inches for 50 blows using a 140 pound hammer dropped 30 inches with an attached modified California or split-spoon sampler.

We did not observe any significant clay beds within our explorations or on the full height of cut slope exposures. We also reviewed a geologic map of this area prepared by Geocon for the adjacent subdivision. Their map shows the site to be underlain by the coarse "gritstone" granular facies of the lower Otay Formation.

3.4.4 Groundwater

Groundwater was not encountered in any of our borings and is anticipated well below the proposed construction elevations. Perched groundwater in the filled drainage to the west of the site may be on the order of 225 to 230 feet in elevation. It should be noted that groundwater levels could fluctuate due to seasonal variations, irrigation, and other factors. Groundwater or seepage is not expected to be a constraint to the construction of the project or to be a design consideration.

4.0 DISCUSSIONS, ANALYSIS, AND RECOMMENDATIONS

4.1 POTENTIAL GEOLOGIC HAZARDS

Potential geologic hazards considered in our study include, surface rupture, seismic shaking, landslides, liquefaction, seismically induced settlement, tsunamis, seiches, flooding, and expansive soils. The following sections discuss these hazards and their potential at this site in more detail:

4.1.1 Faulting and Seismicity

The project vicinity is considered to be seismically active, as is most of southern California. Our review of the referenced geologic maps do not show any mapped fault traces extending through or nearby the site. We also reviewed stereoscopic aerial photographs and specifically looked for indications of faulting during our recent geologic reconnaissance. Based on these surface interpretive methods, we did not observe indication of faulting on or nearby the site.

The Rose Canyon fault zone is the closest active fault system to the site and is located approximately 11.3 miles (18.1 km) to the west. Studies indicate that the most recent earthquake on the Rose Canyon fault in San Diego occurred after A.D. 1523 but before the Spanish arrived in 1769. Two additional later earthquakes may have occurred, on offshore segments of the Rose Canyon fault in the 1800s.

The Rose Canyon fault zone consists of predominantly right-lateral strike-slip faults that extend south-southeast from La Jolla bisecting the San Diego metropolitan area. Various fault strands display strike-slip, normal, oblique, or reverse components of displacement which is typical of faults that have variations in strike and dip along their length. The fault zone extends offshore at La Jolla and continues north-northwest subparallel to the coastline. South of downtown San Diego, the fault zone splits into several splays that underlie San Diego Bay, Coronado, and the ocean floor south of Coronado. Portions of the fault zone in the Mount Soledad, Rose Canyon, and downtown San Diego areas have been designated by the State of California (CDMG, 1991, 2003) as being Earthquake Fault Zones.

A major strand of the potentially active La Nacion fault has been mapped approximately 3.8 miles (6.1 km) west of the site. The La Nacion fault zone is composed of several parallel to subparallel, west dipping normal faults that displace Tertiary and Quaternary deposits. Radiocarbon dates of unfaulted Holocene alluvium overlying the fault range from approximately 6,800 years to 13,400 years old (Hart, 1974). In addition, geomorphic features commonly associated with Holocene faulting, such as sag ponds and well-defined scarps, have not been observed along the La Nacion fault zone (Elliott and Hart, 1977). Furthermore, the California Geological Survey (CGS) does not consider the La Nacion fault zone to be an active or independent seismogenic source. Based on this data, we consider the seismic parameters associated with the closest known active fault, the Rose Canyon fault, more appropriate for design purposes. Based on the above information, the hazard with respects to ground rupture at the site is considered low. The locations of faults and earthquake epicenters are shown on Figure 5.

4.1.2 Surface Rupture

As previously discussed, the subject site is not underlain by a known active or potentially active fault. Therefore, the potential for ground rupture due to faulting at the site is considered low. Ground lurching is defined as movement of low density materials on a bluff, steep slope, or embankment due to earthquake shaking. Since there are slopes located on and adjacent to some of the project site, lurching or cracking of the ground surface as a result of nearby or distant seismic events is considered possible.

4.1.3 Seismic Shaking and CBC Seismic Design Parameters

The most significant seismic event likely to affect the project site would be a maximum moment magnitude 7.2 earthquake (Cao et al., 2003) resulting from the Rose Canyon fault zone (CDMG, 1998), located approximately 6.3 kilometers northeast of the project site.

This section presents our recommendations for seismic design parameters in accordance with the 2007 California Building Code (CBC) (CBSC 2007), which is based on the 2006 International Building Code (IBC). Based on our field investigation and using the 2007 CBC Table 1613.5.2, we classify the site as Site Profile C. This site is defined as very dense soil and soft rock with average shear wave velocities within the upper 100 feet between 1,200 ft/s (360 m/s) and 2,500 ft/s (760 m/s), average SPT N>50, or average su greater than or equal to 2,000 psf.

Based on the Site Class C designation and on the site location with respect to mapped spectral acceleration parameters SS and S1, Kleinfelder developed 2007 CBC seismic design parameters. The recommended seismic design parameters are summarized in Table 1 below.

Table 1
Recommended 2007 CBC Seismic Design Parameters

Design Parameter	Symbol	Recommended Value	2007 CBC / (ASCE 7) Reference(s)
Site Class	--	C	Section 1613.5.5
Mapped spectral acceleration for short periods (Site Class B)	S_s	0.94g	Section 1613.5.1
Mapped spectral acceleration for a 1-second period (Site Class B)	S_1	0.34g	Section 1613.5.1
Site Coefficient	F_a	1.026	Table 1613.5.3(1)
Site Coefficient	F_v	1.460	Table 1613.5.3(2)
MCE(1) Peak Ground Acceleration (S_M at T=0)	PGA_M	0.38g	n/a
MCE(1) spectral response acceleration for short periods	S_{MS}	0.96g	Section 1613.5.3 / (Section 11.4.3)
MCE* spectral response acceleration at 1-second period	S_{M1}	0.50g	Section 1613.5.3 / (Section 11.4.3)
Design Peak Ground Acceleration (S_D at T=0)	PGA_D	0.26g	(Section 11.4.5)
Design spectral response acceleration (5% damped) at short periods	$S_{DS} = 2/3 \cdot S_{MS}$	0.64g	Section 1613.5.4 / (Section 11.4.4)
Design spectral response acceleration (5% damped) at 1-second period	$S_{D1} = 2/3 \cdot S_{M1}$	0.33g	Section 1613.5.4 / (Section 11.4.4)

Table 1 Notes:

1. MCE: Maximum Considered Earthquake (2% probability of exceedance in 50 years).

4.1.4 Landslides

Landslides are deep-seated ground failures (several tens to hundreds of feet deep) in which a large arcuate shaped section of a slope detaches and slides downhill.

Landslides are not to be confused with minor slope failures (slumps), which are usually limited to the topsoil zone and can occur on slopes composed of almost any geologic material. Landslides can cause damage to structures both above and below the slide mass. Structures above the slide area are typically damaged by undermining of foundations. Areas below a slide mass can be damaged by being overridden and crushed by the failed slope material.

Several formations within the San Diego region are particularly prone to landsliding. These formations generally have high clay content and mobilize when they become saturated with water. Other factors, such as steeply dipping bedding that project out of the face of the slope and/or the presence of fracture planes, will also increase the potential for landsliding.

No indications of deep-seated landsliding were noted at the site during our field exploration or our review of available geologic literature, topographic maps, and stereoscopic aerial photographs. It is our professional opinion that the potential for landsliding is low.

4.1.5 Liquefaction and Seismic Settlement

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

The majority of the subject site is underlain at depth by weakly to moderately cemented sandstones or by compacted fill. Based on the dense nature of the on-site formational deposits as well as the absence of a shallow groundwater in those areas, it is our opinion that the potential for liquefaction and seismic related settlement across the majority of the site is low.

4.1.6 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance map overlay 2177F on the SANGIS database, the site is outside of a 100-year and 500-year floodplains and subject to minimal flooding. Based on review of topographic maps, the site is not located downstream of a dam or within a dam inundation area. In addition, based on our document review there are no dams or facilities upstream of the site that could cause inundation of the subject site. Based on this review and our site reconnaissance, the potential for flooding of the site is considered low.

4.1.7 Expansive Soils

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

A sample of the topsoil was tested for expansion index (UBC Standard 18-2). These test results indicated an expansion index (EI) of 46. Based on this result and our visual evaluation of topsoil and colluvial soil variability through the site, these materials may be classified in the medium expansion range (<50 EI) with the potential for high expansion in some areas. The granular materials of the Otay Formation will be present over the majority of the substation pad and will comprise the majority of cut materials to be used as compacted fill. These granular materials were not tested but are considered to have a very low to low expansion potential.

4.2 SLOPE STABILITY

The majority of existing and proposed site slopes are considered grossly stable without rigorous analyses due to their planned inclinations, strength of subsurface materials and lack of adverse bedding. However, Kleinfelder performed static and seismic slope stability analyses for the proposed retaining wall overlying the existing fill slope at the north end of the proposed access road. The proposed segmented wall reaches an exposed maximum height of about 17 feet near the intersection with Hunte Parkway. We used limit equilibrium computer program SLOPE/W (Geo-Slope, 2001) with Spencer's method of slices considering circular and block slip surfaces. Shear strength parameters were developed from the results of our field investigation, direct shear testing and engineering judgment. The results of the stability analysis for static and pseudo-static conditions are included as Figures 6 and 7, respectively.

The permanent fill slopes should be constructed no steeper than 2:1 (horizontal to vertical) and keyed and benched into approved materials. Fill materials should be placed and compacted in accordance with the Section 5.1.4 of this report. Fill keys, where required, should be a minimum of 15 feet wide and should extend a minimum of 3 feet into the competent formation material. For our analyses, we assumed the MSE wall will have geogrids every 3 feet vertically and the grids are at least 80 percent of the wall height. The grid length was increased to obtain the required minimum safety factor. The base of the wall should have a minimum horizontal distance of 7 feet from the finished slope surface and the height of the wall is measured from the base of the lowest block.

The external static and seismic factors of safety calculated in our 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 field investigation and engineering evaluations, it is our opinion that the proposed wall geometry is stable provided that the internal geogrids are of sufficient length.

4.3 SITE GRADING

4.3.1 General

Based on our understanding of the project and the results of our investigation, we anticipate that grading for the substation pad will generally consist of making cuts up to approximately 30 to 35 feet in the northern and eastern portions of the site and placing fills up to about 20 to 25 feet in the southern and western portion of the site. Preliminary plans also indicate fill up 17 feet for a segmental geogrid-reinforced wall for widening the entrance of the access road from Hunte Parkway.

All site preparation and earthwork operations should be performed in accordance with applicable codes, including Chapter 15 of the City of Chula Vista Municipal Code. All reference to maximum dry density is established in accordance with American Society for Testing and Materials (ASTM) ASTM D 1557. We recommend that site earthwork and construction be performed in accordance with the following recommendations and the guidelines presented in the Guidelines for Earthwork Construction included in

Appendix D. In case of conflict, the following specific recommendations supersede those outlined in Appendix D.

In general, these earthwork requirements should be applied to the structure foundations, including an area extending at least 5 feet beyond their foundation perimeters. Also, these earthwork recommendations should be applied to flatwork such as driveways or walkways, except that the additional area being recompacted need only extend 1 foot beyond their perimeters.

4.3.2 Pre-construction Conference

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

4.3.3 Construction Observation

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

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

4.3.4 Excavation Characteristics

The explorations completed at the site indicate the subsurface materials consist of loose to soft topsoil/colluvium, over friable to weakly cemented sandstones (or very dense soil) of the Otay Formation. Excavation into the on-site materials can likely be achieved with moderate to heavy effort with conventional heavy-duty excavation equipment. Segregation of the fine grained topsoil and colluvium from the granular formational materials should be anticipated. Depending on grading quantities, the fine grained materials should be exported or used in non-structural fills on site, including slopes.

4.3.5 Site Preparation

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

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

Based on our review of the preliminary project site plan, and anticipated remedial grading, cuts and fills up to 35 and 25 feet, respectively, in depth may be performed. To avoid potential differential settlement at cut/fill transitions under structural areas, we recommend that remedial grading be performed so that a minimum of 3 feet be undercut and replaced with properly compacted fill. As an alternative, the cut portion of the site may be sloped at about 4 horizontal to 1 vertical to transition deeper fill to cut. Details of cut / fill transitions are presented on Figure 8. Final recommendations should be provided upon review of the substation layout and evaluation of differential settlement for specific improvements. The excavated soil should be moisture conditioned, replaced and compacted, as recommended below. We recommend that foundation components of the proposed structures be founded either entirely in undisturbed Otay Formation or entirely in engineered fill materials; foundations of any given structure should not transition between native and fill support. This may be achieved by either overexciting the cut area and replacing with a similar depth of compacted fill or by deepening foundation excavations in fill to formational materials and placing a minimum 2-sack sand cement slurry back up foundation elevation.

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

4.3.6 Recommendations for Treatment of Compressible / Potentially Expansive Soils

The site is covered with a variable thickness of potentially compressible and expansive topsoil/colluvium. The thickness of the potentially compressible soil in each exploration location is estimated as follows:

Table 2
Depth of Topsoil and Colluvium

Boring / Test Pit	Approximate Depth (feet)
TP1	5.5
TP2	6
TP3	4
TP4	8
TP5	2
TP6	2
TP7	10
TP8	3
B1	2
B2	2
B3	2

We recommend that existing potentially compressible soils within the limits of site grading be removed to native formation prior to the placement of engineered fill materials. Soils with an expansion index over 50 may be blended with other granular soils and used as embankment fill. The expansive soils may also be used as deeper compacted fill in non-structural areas but not placed in the outer portion of fill slopes. The outer portion is defined as the outer 15 feet from slope faces or the height of the slope, whichever is less.

4.3.7 Engineered Fill

Fill materials generated from the on-site formational soils are generally suitable for placement as compacted fill provided they are free of oversized rock, expansive clay, organic materials, and deleterious debris. Based on the medium expansion potential (EI=46) of one laboratory test and our geologic logging, the topsoil / colluvium is potentially expansive. Additional testing may be performed to further characterize these soils. Based on the anticipated quantities from cuts in granular formation, it should be feasible to either export the fine grained colluviuim or place in non-structural areas. Rocks or cemented formation greater than 3 inches in diameter should not be placed within 2 feet of finished grade. Oversize material in excess of 6 inches in diameter should not be used in structural fill within 8 feet of finished grade. Fill soil placed within the upper 4 feet of finished grade in structural areas should consist of granular material with a very low to low expansion index (expansion index of 30 or less) as evaluated by UBC Standard 18-2 (Expansion Index Test). Selective grading may achieve the recommended 4-foot zone of very low to low expansive soils in structural areas.

Fill should be moisture conditioned to or above optimum and be compacted to 90 percent or more relative compaction in accordance with ASTM D 1557. Expansive soils with an expansion index greater than 30 should be similarly compacted, but at a moisture content over 2 to 3 percent above optimum. Although the optimum lift thickness for fill soils will be dependent on the type of compaction equipment used, fill should generally be placed in uniform lifts not exceeding approximately 8 inches in loose thickness. Although not anticipated, oversized material, rocks, or hard lumps greater than 6 inches in dimension should not be used in compacted fills within 8 feet of finished grade.

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

4.3.8 Import Materials

Although not anticipated for this project other than aggregate base, we recommend that general import material consist of granular, very low to low expansive material (expansion index of 30 or less) as evaluated by UBC Standard 18-2 (Expansion Index Test) and with low corrosivity characteristics. Low corrosivity material is defined as having a minimum resistivity of more than 2,000 ohm-cm when tested in accordance with California Test 643, unless defined otherwise by the corrosion consultant. Import material should be evaluated by the geotechnical consultant at the borrow site for its suitability as fill prior to importation to the project site.

4.3.9 Temporary Slopes

Temporary cut slopes are primarily anticipated for the area behind the retaining walls between the north side of the proposed access road and Hunte Parkway, and into the slope to accommodate potential geogrid lengths for the walls on the southern side of the access road. Care should be taken to identify the location and protect all subsurface structures including the cleanout structure for the existing storm drain. Except as discussed with regard to utility trench excavation, temporary cut slopes in topsoil/colluvium or granular fill materials should not be steeper than 1.5:1. Cut slopes in clayey fill or underlying formational materials to overall excavation depths of 20 feet can be as steep as 1:1. If steeper side slopes should be necessary due to construction restrictions, or excavations are deeper than 20 feet, shoring and bracing should be considered and a specific geotechnical analysis performed. OSHA and Cal-OSHA requirements should be observed for all excavations. If excavations deeper than 20 feet below existing site grades will be made that are not going to be shored or braced, then slopes should be cut at a gradient of 1.5H:1V.

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

4.3.10 Permanent Slopes

Preliminary plans indicate that cut and fill slopes will have maximum height of 25 to 35 feet. In general, both cut and fill slopes up to a maximum height of 50 feet can be as steep as 2H:1V. If fill slopes higher than 50 feet will be constructed, we should review each situation on a case-by-case basis. Flatter side slopes or benching may be needed for fill slopes higher than 50 feet.

New fill slopes should not be constructed above existing topsoil or colluvial soils. Where new fill slopes will be built, the existing topsoil or colluvial soil should be excavated and a keyway constructed into the underlying formational materials. The dimensions and depth of the keyway will depend on final slope configurations and heights. For fill slopes constructed at 2H:1V up to 40 feet high, a keyway having a minimum width of 15 feet and a minimum depth of 3 feet into formational material would be appropriate. Figure 8 shows a typical keyway and benching detail.

New fill placed on existing slopes that are steeper than 5H:1V should be keyed and benched into the existing hillside. Keyway recommendations are presented in the preceding paragraph. Benches should be a minimum of 10 feet in width and spaced at no more than 4-foot vertical height intervals.

Subsurface drainage of slopes is not anticipated, but may be needed depending on slope configurations, facility locations, and the conditions encountered in the field during construction. We should review project plans prior to final design and prepare recommendations for subsurface drains, if needed. If any zones of specific seepage, are encountered during construction, they should be addressed as recommended by the geotechnical engineer in the field at that time.

4.3.11 Bulking and Shrinkage Factors

Estimates of engineered fill bulking and shrinkage factors are typically based on comparing laboratory compaction tests with the in-place density of the soil material as encountered during the subsurface evaluation. Due to limited lab testing due to high resistance of the sampler, and variations in existing and compacted soil densities, the bulking and shrinkage factors are to be considered very approximate. Based on the results of our laboratory testing and experience, it is our opinion that the topsoil/colluvium materials will have an approximate shrinkage factor on the order of 7 to 12 percent when excavated from their existing state and placed as compacted fills.

A bulking factor of approximately 5 to 10 percent is anticipated for materials of the Otay Formation.

4.4 UTILITY TRENCH EXCAVATIONS

4.4.1 Temporary Trench Excavations

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

Table 3
OSHA Soil Classifications

Fill, Topsoil/Colluvium	Type C
Otay Formation	Type B

The classification of Otay Formation considers the minimal cementation in the sands. A Type A classification is unlikely but possible if more cohesive or cemented zones are encountered. Temporary excavations should be constructed in accordance with OSHA recommendations. Excavations deeper than 5 feet should be shored or laid back on a slope no steeper than 1.5H:1V (horizontal:vertical) above the Otay Formation and 1H:1V within the Otay Formation. In the case of trench excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes), or by laying back the slopes in accordance with OSHA requirements. Temporary excavations that encounter seepage may require shoring or may be stabilized by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. On-site safety of personnel is the responsibility of the contractor, and their designated "competent person" should perform regular inspections of all temporary excavations.

4.4.2 Pipe Bedding and Trench Backfill

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

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

4.5 SETTLEMENT OF DEEP FILLS

Settlement of deep fills occurs from self weight of the fill. This occurs slowly, even when subsurface and surface drainage is provided, and is a function of a number of variables including soil type, age of fill, degree of wetting and depth. Experience has shown that this consolidation may approach from 0.2 percent (for granular soils) to 0.5 percent (for clayey soils) of the fill thickness. We estimate that the long-term total fill settlement for granular fill from the Otay Formation would be on the order of 0.75 to 1.0 inches for fill depths of 30 to 40 feet, respectively. The settlement may be larger if the fine grained soil from topsoil and colluvium is incorporated into the fill thickness. This settlement is in addition to the static settlements due to loading from structures or new fill loading as discussed in Section 4.6.2. Specific settlement estimates can be provided once the locations of the proposed substation improvements are known.

Based on the approximate depth of 90 feet of existing fill below the proposed access road and a consolidation factor of about 0.4 percent, we estimate about 4 ½ inches of potential long-term settlement following completion of fill placement in about 2001. Although the actual magnitude and rate of settlement is dependent on several variables, experience has shown this can take about 10 to 20 years to occur with about half in the first 5 years. Based on these approximations, we estimate the fill may settle an additional 1 to 2 inches in the next 10 to 15 years. This settlement is in addition to the static settlements due to loading from the proposed retaining wall, as discussed in Section 4.6.2.

4.6 FOUNDATIONS AND SLABS FOR STRUCTURES

4.6.1 General

The proposed substation structures and walls may be supported on shallow spread and continuous footings and shallow and deep drilled piers founded on either engineered fill soils or undisturbed formational materials. Foundations for each individual structure should be supported on the same type of material, that is, either entirely supported by engineered fill or undisturbed Otay Formation. Foundations should not be supported on a combination of both materials such as may occur where there is a transition between fill and formational material. The fill soils below the footprint of each improvement should be prepared as stated in Section 4.3.7. All footing excavations should be observed by a representative of the geotechnical engineer prior to placing reinforcing or concrete to verify proper subgrade conditions.

Spread and continuous footings for the substation structures that will be founded on engineered fill soils can be designed using an allowable soil bearing pressure of 2,500 psf, for dead loads plus long-term live loads. Footings that are founded on undisturbed formational materials can be designed using an allowable soil bearing pressure of 5,000 psf, for dead loads plus long-term live loads. These values are based on a minimum width of 12 inches and may be increased by 500 psf for each additional foot of depth up to maximum of 4,000 psf for fill and 7,000 psf for undisturbed formational. Mat foundations that will be founded on engineered fill soils can be designed using an allowable soil bearing pressure of 4,000 psf, for dead loads plus long-term live loads and mat foundations that are founded on undisturbed formational materials can be designed using an allowable soil bearing pressure of 7,000 psf, for dead loads plus long-term live loads. These values can be increased by one-third for short term loads such as those due to wind and seismic forces.

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

Foundations should have a minimum width of 15 inches and have an embedment at least 12 inches below the lowest adjacent grade. Structural reinforcement should be provided by the project structural engineer for load carrying purposes.

4.6.2 Estimated Settlements

Estimated total settlements for the proposed improvements, constructed in accordance with the recommendations contained herein, are anticipated to be less than 1/2 inch. Estimated differential settlement between points 40 feet apart on continuous footings and/or isolated spread footings are anticipated to be less than 1/4 inch. These settlements are in addition to long-term settlement of the deep engineered fills discussed previously in Section 4.5.

4.6.3 Lateral Resistance

For passive resistance, we recommend using an equivalent fluid weight of 325 pcf for footings or grade beams poured neat against properly compacted select fill or Otay Formation. This lateral pressure assumes a horizontal surface for the soil mass extending at least 10 feet from the face of the footing, or three times the height of the surface generating passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by concrete slabs should not be included in design for passive resistance to lateral loads. The coefficient of friction between the bottom of the footings or grade beams and the prepared soil can be assumed as 0.40. Passive and frictional resistance may be combined without reduction.

4.6.4 Concrete Slabs-On-Grade

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

Slab-on-grade floors for the substation facility, if any, should be underlain by formation or engineered fill compacted as described in Section 4.2.7. To provide uniform subgrade support, a 6 inch layer of clean free-draining sand, gravel or crushed rock conforming to Section 7.1 of Appendix C should be placed between the finished subgrade and the bottom of the concrete. The aggregate base should be compacted to at least 90 percent of ASTM D 1557.

4.7 DRILLED PIER FOUNDATIONS

Drilled pier lengths should satisfy criteria for downward, uplift and lateral loading. We understand that SDG&E will utilize computer program Moment Foundation Analysis Design (MFAD) to design deep foundations such as drilled piers. We recommend utilizing the following soil parameters for compacted fill from onsite materials. These values are intended for use in computer program MFAD only, values for other design analyses may be provided upon request.

Table 4
Recommended Soil Parameters For MFAD Analysis

Soil Type	Unit Cohesion (psf)	Friction Angle (degrees)	Total Moist Unit Weight (pcf)	Moisture Content (%)	Total Saturated Unit Weight (pcf)	Deformation Modulus Ep (ksi)	Strength Reduction Factor
FILL Silty Sand (SM)	0	32	120	12	144	1.0	1.0
OTAY FORM Sand (SM)	0	38	120	10	144	4.0	1.0

The upper 1-foot of material should be ignored in design.

For downward loading, we have considered end bearing and skin friction along the shaft embedment into formational materials. We recommend neglecting downward friction in fill soils due to the potential for settlement. Skin friction along the entire shaft length is considered for uplift. The depth of fill can be estimated from grading plans and should be verified at pier locations following earthwork operations. Unanticipated deviations from estimated fill depth prior to grading could result in incorrect lengths of reinforcing cages and potential delays to adjust length during construction.

We have performed preliminary analyses for a pier diameter of 3 feet using computer program SHAFT by Ensoft, Inc. The piers should have a minimum total depth of 10 feet, or a minimum embedment depth of 2 pile diameters into formational materials, whichever is deeper. Allowable shaft capacity for downward loading were calculated with a factor of safety of 3 on end bearing and 2 on skin friction. The capacity curves are presented in Figures 10 and 11 for compression and uplift, respectively. Pile design should consider the effects of pile spacing if the spacing is less than 3 diameters.

We estimate that total post-construction settlement of the CIDH pile foundations resulting from structural loads should not exceed 1 inch.

4.8 SELECTION OF RETAINING WALL TYPE

The selection of type of retaining wall for different site conditions and applications may be based consideration of numerous factors. For discussion purposes, wall types considered are conventional gravity walls (concrete cast-in-place, masonry block, etc), segmental mechanically stabilized earth with geogrid reinforcing (MSE), soldier beam and lagging (with or without tieback anchors), soil nail, secant pile, and sheetpile walls. The issues listed below are general considerations with a discussion of site specific conditions following.

- The relative cost of a wall is a function of whether the wall is primarily located within a cut condition into an existing slope, primarily a new fill condition, or both cut and fill. This condition affects the amount of soil that is excavated, stockpile and replaced. For cut conditions, soldier beam, soil nail or sheetpile walls do not require excavation beyond the wall limits. Although it is possible to fill about the cut portion of soil nail or soldier beam walls, extending the height only practical in short elnghts or heights. MSE walls require the most excavation to accommodate the geogrid reinforcing length for internal and external stability.
- The proximity to property lines can impact wall type. Permanent tieback anchors or soil nails require a permanent easement from property owners or municipalities. Other wall types may require a temporary construction easement for excavation slopes.
- Future land use behind wall should be anticipated. Geogrids for MSE walls are required for long term support and cannot be cut to accommodate future improvements such as utility trenches or foundations. Similarly, permanent tieback anchors or soil nails restrict future excavations. Gravity walls are generally the most accommodating.

- MSE walls typically require select granular fill in the reinforced zone, whereas other wall types can be designed for a lower quality material.
- Potential for wall settlement. MSE walls can tolerate significantly more total and differential settlement and deformation than concrete gravity walls, and can be constructed on a wider spectrum of ground conditions. This flexibility can significantly reduce the extent of subgrade improvement or the need for deep foundations.
- Global stability of walls constructed on slopes. For new wall geometries that result in unstable slopes, longer geogrid reinforcing in MSE walls has the ability to improve the safety factor.
- Visual aesthetics and desire for consistency of wall type. Site location may dictate wall type or facing. The use of several wall types may be most cost effective for sites with variable conditions, however, aesthetics may limit the umber of wall types or facings. MSE walls have a wider capability for plantable units or landscape terraces.
- MSE walls have a higher resistance to seismic loading than rigid walls and have typically performed better during seismic events.
- Long-term performance. Corrosive soils can impact long-term performance of ground anchors and contaminated soil can impact synthetic geogrids.

Retaining walls for widening the existing access road at the subject site can be generalized to three areas; 1) short walls (less than about 5 to 8 feet) on the north side of the access road which are cut into the existing slope, 2) the higher walls (over about 5 to 8 feet) on the western approximate 250 feet of the downslope (south) side of the access road off of Hunte Parkway, and 3) the lower walls (less than about 5 feet) on the eastern approximate 460 feet of the downslope (south) side of the access road.

We recommend that conventional concrete gravity walls be used for the upslope (north) side of the access road. This is primarily due to the cut condition into the existing slope and low wall height. Soldier beam and lagging or soil nail walls may also be considered to avoid excavation and stockpiling of wall backfill.

We recommend that MSE walls be used for the higher walls on the western downslope side of the access road. This is primarily due to the ability of MSE walls to tolerate settlement of the underlying clay fill and ability of the geogrid reinforcing to mitigate global instability caused by the new loading on a descending fill slope. The top of the temporary backcut ascending from the lowest geogrid may impact the width of the access road (particularly at the eastern end of this section) and should be addressed in project planning and design. For example, access may be restricted or blocked until the wall height is of sufficient height. The temporary backcut may also impact the existing storm drain or other utilities. Temporary shoring or utility relocation may be utilized in this case.

For aesthetic and continuity reasons, one continuous wall type of MSE may be desired for the eastern 450 feet on the downslope side of the road. However, different wall types should be considered due to the significant length of the wall and other considerations. Global stability and settlement are acceptable for gravity walls due to the low wall height. Excavation depths for foundation setback from the slope face will be similar (8 feet) for both wall types, but the MSE wall will likely result in slightly larger excavations when foundation widths and geogrid lengths are compared. The temporary backcut of the MSE excavation will encroach further into the access road and have a higher temporary impact on construction traffic. Distribution ducts and possible future subsurface utilities within the road would need to be located north of the geogrid zone.

4.9 CAST-IN-PLACE AND MASONRY BLOCK RETAINING WALLS

Lateral pressures acting against retaining walls can be calculated assuming that the backfill soils act as a fluid. The equivalent fluid weight (efw) value would depend on allowable wall movement. Walls which are free to rotate at least 0.5 percent of the wall height can be designed for the active efw. Walls which are restrained at the top or are sensitive to movement and tilting should be designed for the at-rest efw. Specific information for segmented retaining walls is provided in Section 4.9.

Our site specific study indicates that potential fill materials generated from cuts into the Otay Formation are suitable for use as retaining wall backfill, but that fill, topsoil and colluvium may not be suitable due to their expansive and slow-draining properties. Therefore, the following values assume that non- to low-expansive sandy soils (SP, SM, SC) will be used as backfill. Values given in the table below are in terms of equivalent fluid weight and assume a triangular distribution.

Table 5
Equivalent Fluid Weights (efw)
For Calculating Lateral Earth Pressures

Condition	Slope Inclination	Equivalent Fluid Weight (pcf)
Active	Level	35
	2:1	65
At-Rest	Level	55
	2:1	90

Fifty and thirty percent of any uniform areal surcharge placed at the top of the wall may be assumed to act as a uniform horizontal pressure over the entire wall for the at-rest and active cases, respectively. As a minimum, we recommend that a traffic surcharge equivalent to 2 feet of soil backfill be assumed as a surcharge for the at-rest condition. For this condition a pressure of 120 psf may be assumed to act as a uniform horizontal pressure over the entire height of the wall, H. Seismic induced lateral loading may be neglected for the site walls but can be provided if requested. We should be contacted where other point or line loads are expected so we can provide recommendations for additional wall stresses.

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

Allowable foundation bearing pressure values described in 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 that is normally applied to static loads could be used. This factor of safety for dynamic load conditions should not be less than 1.2. Backfill for retaining walls should consist of predominately granular materials from on-site excavations or imported fill. All backfill should be placed in 8-inch loose lifts, moisture-conditions to 2 percentage points above optimum moisture content, and compacted to at least 90 percent relative compaction.

Wall backfill should be compacted by mechanical methods to at least 90 percent relative compaction in accordance with ASTM D 1557. For all retaining walls, we recommend a minimum horizontal distance from the outside base of the footing to daylight of 7 feet for slopes of less than 20 feet in height, and 10 feet for slopes of greater heights.

4.10 MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS

The following are our geotechnical recommendations for the wall designer. Wall design and construction should be performed in general accordance with the current standards "Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines," Publication No. FWHA-NHI-00-043, dated March 2001.

1. Recommended total stress and unit weight properties of the retained and foundation soils for segmented wall designs are summarized below. These values are for the existing clay fill along the access road. Other values may be provided if walls are used in other areas such as the base of fill slopes.

Soil Zone	Soil Unit Weight (pcf)	Internal Friction Angle	Cohesion (psf)
Retained	125	24°	300
Foundation	125	24°	300

2. Recommended ranges of total stress and unit weight properties of typical soil types for segmented retaining wall drainage fill and the reinforced (infill) soil zone are summarized below.

Soil Type	Soil Unit Weight (pcf)	Internal Friction Angle	Cohesion (psf)
Sand, Silty Sands (SW, SP, SM)	125	32°	0

The fill used within the reinforced zone should have a minimum friction angle of 32 degrees when tested in accordance with ASTM D-300, a maximum plasticity Index of 6, no rocks greater than 3 inches in maximum dimension, contain at least 40 percent of material smaller than ¼ inch in size, and have a maximum of 20 percent passing the #200 seive.

3. The allowable bearing capacity of the retaining wall foundation soils can be assumed as 3,000 pounds per square foot on engineered fill. This value is based on a safety factor of 2.0 for wall design.

4. A foundation leveling pad is recommended to provide a firm level surface on which to place the base course units at the design elevations. A minimum of 6 inches of compacted aggregate base is recommended. The compacted aggregate base should meet the following grading requirements:

Sieve Size	Percent Passing
1 inch	100
No. 4	35-80
No. 10	20-65
No. 40	10-35
No. 200	0-10

The top of the foundation leveling pad should be compacted by a minimum of three passes of a vibrating base plate compactor. The vibrating compactor should have a minimum weight of 200 pounds and a minimum vibration frequency of 1600 cycles per minute.

5. The minimum embedment of retaining wall foundation should be either the exposed wall height in feet multiplied by a factor of 0.20, or 1.5 feet, whichever is greater. In addition, the wall foundation should have a minimum 8-foot setback from the surface of the finished slope.

6. The dry-stack mortarless construction method for segmented retaining walls bearing on an aggregate bearing pad is generally considered a flexible structure that can tolerate total settlements on the order of 3 to 6 inches with differential settlements on the order of 1 percent of the total wall height. Anticipated settlements for the maximum foundation pressures are not expected to exceed one inch for a properly compacted fill and subgrade. This settlement is in addition to potential long term consolidation of the fill due to self weight and increase in moisture content.

7. Walls should be designed for any surcharge loading due to slopes and traffic. For walls that may be subjected to light surcharge loading only, we recommend that a surcharge loading of at least 100 pounds per square foot be incorporated into the design. The access road wall should be designed for the trucks that deliver the transformers or other large equipment for the substation. These surcharge loads should be provided when identified.

8. Critical segmented retaining walls should also be designed for seismic loading. These may be walls that support slopes below the substation or along the access road to the substation. Based on a horizontal acceleration of 0.23g, the resultant seismic force (in pounds) for each linear foot of wall can be estimated as $5H^2$ where H is the height of the wall (in feet) above its base. The resultant seismic force acts at 0.6H above the wall base.

9. The wall designer should incorporate a drainage system into all walls. A minimum of 12 inches of drainage fill should extend behind each wall to within 1 foot of final grade. Drainage fill should consist of free-draining, sound, durable particles of 1-inch minus or No. 57 crushed stone conforming to the following gradation:

Sieve size	Percent Passing
1 inch	100
3/4 inch	75-100
No. 4	0-10
No. 50	0-5

A perforated PVC pipe should be placed near the bottom of the wall and sloped a minimum of 0.5%. The drain outlets should be protected and the locations documented. In addition, a prefabricated drainage composite, such as Miradrain® 6000, should be used to collect water in the areas of the backcut with the potential for seepage, such as a fill/formation interface. This may be waived for the majority of the site with backcut located within fill but may be required in cut areas on the eastern end of the wall.

10. We recommend that the wall designer incorporate the following minimum design criteria into the segmented retaining wall design:

External Stability	Minimum Factor of Safety
Sliding	1.5
Overturning	1.5
Bearing Capacity	2.0
Local Stability	1.5
Shear Facing Units	1.5
Global Stability	1.3

11. Geogrid Reinforcement Installation

a. The geogrid should be installed at the wall height, horizontal location, and to the extent as shown on the project construction plans, or as directed by the design engineer.

b. The geogrid should be laid horizontally on compacted infill and connected to the concrete wall units. Embedment details should be consistent with details utilized in evaluation of connection strength.

c. Correct orientation (roll direction) of the geogrid should be verified by the contractor.

d. The geogrid should be pulled taut and free of wrinkles prior to placement of soil fill. The geogrid may be secured in placed with staples, pins, sandbags, or fill as required by fill properties, fill placement procedures, or weather conditions, or as directed by the design engineer.

e. The procedure for tensioning the geosynthetic geogrid should be uniform throughout the wall length and height.

f. Overlaps:

   1. Overlap of the geogrid in the design strength direction should not be permitted. The design strength direction is that length of geogrid perpendicular to the wall face and should be one continuous piece of material.

   2. If required, overlaps of adjacent rolls should be in accordance with manufacturer's recommendations. Geogrid should be continuous throughout wall length, except for curves.

12. Fill Placement Over Geogrid

a. Reinforced wall fill material should comply with the specified soil parameters in 2 above and be placed in maximum 8-inch compacted lifts on the geogrid or as directed by the design engineer. Each lift should be compacted to a minimum density of 90 percent of ASTM D 1557.

b. The geogrid should be pretensioned by hand to remove wrinkles. Tensioning is usually facilitated by the use of steel rakes. Constant tension should be applied to each section of geogrid until soil fill has been placed. Soil fill should be placed, spread, and compacted in such a manner that prevents the development of wrinkles and/or movement of the geogrid.

c. Only hand-operated compaction equipment should be allowed within three feet of the front of wall face.

d. If possible, fill should be placed from the wall face outward to ensure that the geogrid remains taut. Soil should be placed in uniform lifts.

e. Tracked construction equipment should not be operated directly on the geogrid. A minimum fill thickness of 8 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

f. If, in accordance with manufacturer's recommendations, rubber-tired equipment may pass over the geogrid at slow speeds (less than 10 mph), sudden braking and sharp turning should be avoided.

g. Surface draining during, and after, construction of the wall should be provided to minimize water infiltration in the reinforced soil zone.

13. Common soil backfill placed behind the reinforced wall fill (infill) material should be placed as engineered fill.

4.11 PAVEMENT SECTIONS

For purposes of preliminary analysis of pavements, we performed an R-value test on a soil sample considered representative of potential subgrade materials on-site. This should be considered preliminary due to the length and change in elevation of the sloping access road. Our limited test result indicates an R-value on the order of 21. In general, the topsoil and colluvial soils will have low R-values and the granular sands of the Otay Formation will have higher R-values. Based on the quantity of material generated from cuts into formation, a more economical pavement section would result from using granular material from the Otay Formation in the upper two feet. However, it may not be economical to remove the clayey fill on the access road. For preliminary design we have assumed an R-Value of 15.

Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations across the site at the completion of the grading operations.

4.11.1 Flexible Pavements

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

Table 6
Flexible Pavement Sections

Traffic Index	Asphalt Concrete (inches)	Aggregate Base (inches)
4.5	3	6.5
5.0	3	8
6.0	4	9.5

Flexible pavements should be constructed in accordance with Section 302-5 of the Standard Specifications for Public Works Construction (Greenbook), 2000 edition. Aggregate base should comply with the specifications in Section 26 of Caltrans Standard Specifications. Aggregate base should be compacted to a minimum of 95 percent relative compaction (ASTM D 1557).

4.11.2 Rigid Pavement

Portland cement concrete pavement (PCCP) may be desirable at entry points and other locations where tight-turning heavy vehicles are expected. For moderate commercial usage, we recommend a 7-inch thick rigid concrete pavement over 4 inches of aggregate base compacted to at least 95 percent relative compaction (ASTM D 1557). The subgrade beneath the aggregate base should be compacted to at least 95 percent relative compaction (ASTM D 1557). Aggregate base should comply with the specifications in Section 26 of Caltrans Standard Specifications.

According to the 2001 UBC, Section 1701.5, non-structural slabs-on-grade and site work concrete fully supported on earth and concrete are exempt from inspection by a special inspector. Therefore, pavements can be designed with a higher compressive strength and are exempt from special inspection. We recommend a 28-day compressive strength of at least 4,000 pounds per square inch for the pavement concrete mix design. The concrete mix should also be designed for a slump not exceeding 4 inches. Thickened edges should be used along outside edges of concrete pavements. Edge thickness should be at least 2 inches greater than the concrete pavement thickness and taper to the actual concrete pavement thickness 36 inches inward from the edge. Integral curbs may be used in lieu of thickened edges.

Continuous sections of concrete pavement should have construction joints spaced on an approximate 12-foot square grid system or less. All longitudinal or transverse control joints should be constructed by saw-cutting, hand forming, or placing pre-molded filler such as zip strips. Longitudinal or transverse construction joints should be keyed or doweled to mitigate differential movement. In general, longitudinal or transverse construction joints should be keyed or doweled to mitigate differential movement.

4.12 FLATWORK

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

4.13 PRELIMINARY CORROSIVE SOIL SCREENING

A preliminary corrosive soil screening for representative on-site soil materials was completed to evaluate their potential effect on concrete and ferrous metals. The corrosion potential was evaluated using the results of laboratory testing on a composite soil sample of the Otay Formation obtained during our subsurface evaluation. We do not anticipate that concrete and ferrous metals will be in contact with the more corrosive topsoil and colluvium.

Table 7
Corrosion Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Minimum Resistivity (ohm-cm)
B-3	3-10	9.4	<10	10	1,400

Concrete in contact with soil or water that contains high concentrations of soluble sulfates can be subject to chemical deterioration. Based on the UBC criteria (UBC, 2001), the potential for sulfate attack is negligible for water-soluble sulfate contents in soil ranging from 0.00 to 0.10 percent by weight (0 to 1,000 ppm), and moderate for water-soluble sulfate contents ranging from 0.10 to 0.20 percent by weight (1,000 to 2,000 ppm). The potential for sulfate attack is severe for water-soluble sulfate contents ranging from 0.20 to 2.00 percent by weight (2,000 to 20,000 ppm) and very severe for water-soluble sulfate contents over 2.00 percent by weight (greater than 20,000 ppm). Based on the corrosion test results, the sulfate content is less than 10 ppm, therefore the potential for sulfate attack is considered negligible.

Our corrosion screening tests are preliminary in nature. Additional sampling and testing may be warranted after completion of grading if improvements will be in contact with soils other than the granular Otay Formation.

4.14 SURFACE DRAINAGE

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

4.15 SLOPE PROTECTION AND MAINTENANCE

Although graded slopes on this site are anticipated to be grossly stable, the surficial soils may be somewhat erodible due to low cohesion of the sands. For this reason, the finished slopes should be planted as soon as practical after the end of construction. Cut slopes into the Otay Formation may be difficult to plant. Preferably, deep-rooted plants adapted to semi-arid climates should be used. Due to the close proximity to a natural drainageway, we anticipate that aggressive erosion control measures should be implemented. In general, runoff water should not be permitted to drain over the edges of slopes unless that water is confined to properly designed and constructed drainage facilities.

5.0 ADDITIONAL STUDIES

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

- A review of plans and specifications;
- Observation of site clearing;
- Construction observation and density testing of fill material placement, trench backfill and subgrade preparation; and
- Observation of foundation excavations and foundation construction.

6.0 LIMITATIONS

Our firm has prepared this geotechnical investigation report for the exclusive use of our client. 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 evaluations yield more information, which may help understand and manage the level of risk. Since detailed evaluation and analysis involve greater expense, our clients participate in determining levels of service, which provide adequate information for their purposes as acceptable levels of risk. SDG&E has reviewed our scope of work and determined that it does not need or want a greater level of service than that being provided for this design study phase. A brochure prepared by ASFE (Association of Firms Practicing in the Geoscience) has been included in Appendix D of this report. All individuals reading this report should also read the attached brochure.

The services provided under this contract as described in this report include professional opinions and judgments based on the data collected. These services have been performed according to our agreed scope of services at the time the report was written. No warranty is expressed or implied. This report is issued with the understanding the owner chooses the risk he wishes to bear by the expenditures involved with the construction alternatives and scheduling that is chosen.

Regulations and professional standards applicable to Kleinfelder's services are continually evolving. Techniques are, by necessity, often new and relatively untried. Different professionals may reasonably adopt different approaches to similar problems.

The conclusions and recommendations presented in this report are based on information obtained from the review of documents, nine borings, observations of our engineer and geologist, our laboratory testing program, and our experience. It is the client's responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety.

7.0 REFERENCES

American Concrete Institute, 1991a, Guidelines for Concrete Floor and Slab Construction (ACI 302.1R).

American Concrete Institute, 1991b, Guidelines for Residential Cast-in-Place Concrete Construction (ACI 332R).

American Public Works Association (APWA), 2000, "Greenbook," Standard Specifications for Public Works Construction.

Blake, Thomas F., FRISKSP, 2000.

Boore, D.M., Joyner W.B., and Fumal T.E. (1994), Estimation of Response Spectra and Peak Acceleration from Western North American Earthquakes: An Interim Report, Part 2, U.S. Geological Survey, Open-File Report 94-127.

Boore, D.M., Joyner W.B., and Fumal T.E. (1997), Equations for Estimating Horizontal Response Spectra and Peak Acceleration from Western North American Earthquakes, Seismological Research Letters, Vol. 68, No. 1, January/February.

California Division of Mines and Geology (CDMG), 1999, Seismic Shaking Hazard Maps of California: Map Sheet 48.

California Division of Mines and Geology (CDMG), 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada: International Conference of Building Officials.

California Division of Mines and Geology (CDMG), 1995, Landslide Hazards in the Southern Part of the San Diego Metropolitan Area, San Diego County, California, Landslide Hazard Identification Map No. 35, Del Mar Quadrangle, Open-File Report 95-04

City of San Diego, 1995, Seismic Safety Study, Sheet 26.

Geocon, Incorporated. 2000, Geotechnical Investigation, Otay Ranch Village 11 Subdivsion, Chula Vista, California

Jennings, C.W., 1994, Fault Activity Map of California and Adjacent Areas: California Division of Mines and Geology, California Geologic Map Series, Map No. 6.

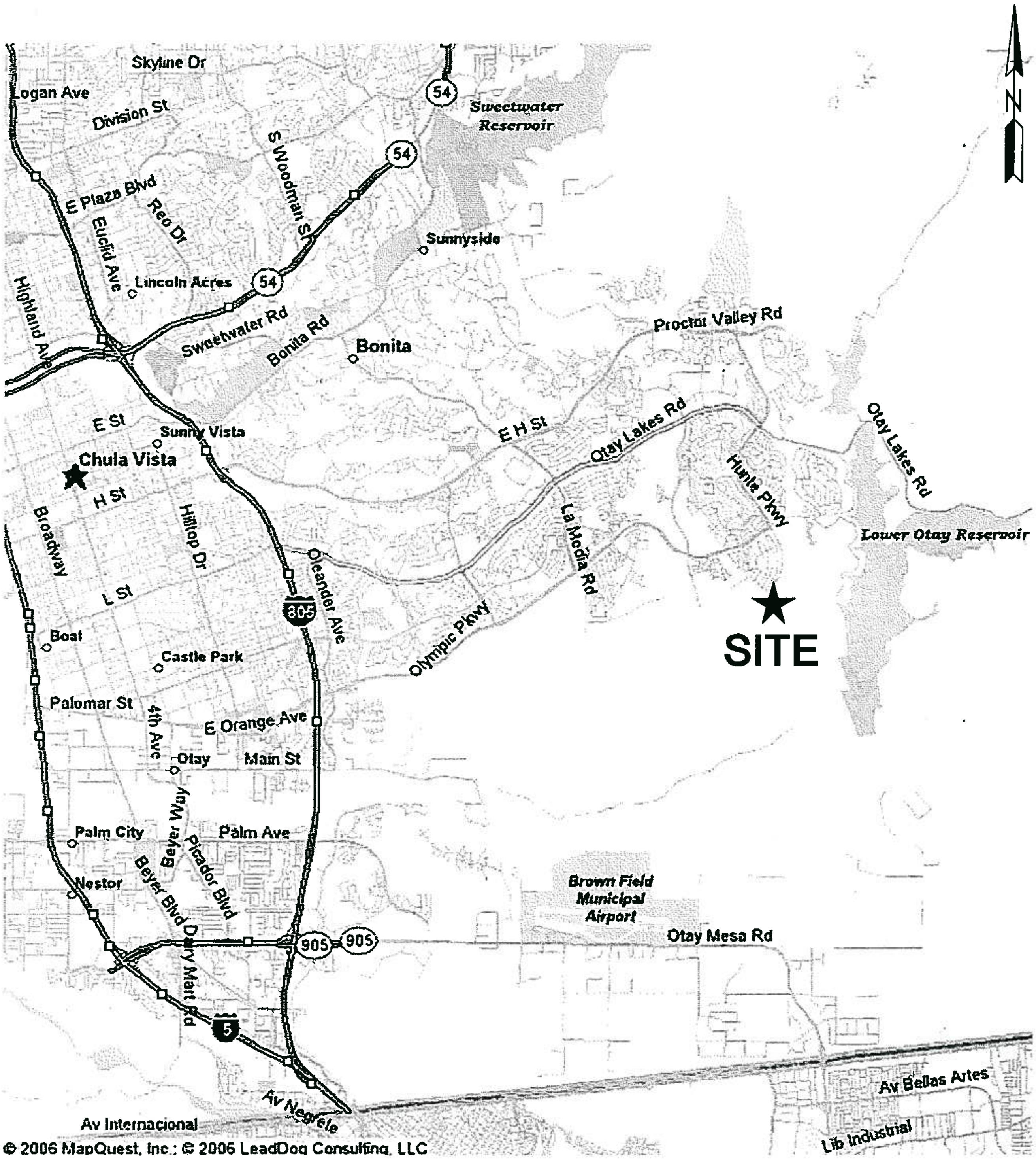
Kennedy, M.P., and Tan, S.S., 1977, Geology of National City, Imperial Beach and Otay Mesa Quadragles, Southern San Diego Metropolitan Area, California, CDMG Map Sheet 29.

Norris, R.M., and Webb, R.W., 1990, Geology of California, Second Edition: John Wiley & Sons, Inc.

Peterson, M. and others, 1996, Probabilistic Seismic Hazard Assessment for the State of California, California Division of Mines and Geology, DMG Open-File Report 96-08, http://www.consrv.ca.gov/dmg/shezp/shaking/sndiego.htm.

Treiman, J.A., 1993, The Rose Canyon Fault Zone, Southern California: California Division of Mines and Geology, Open File Report 93-02.

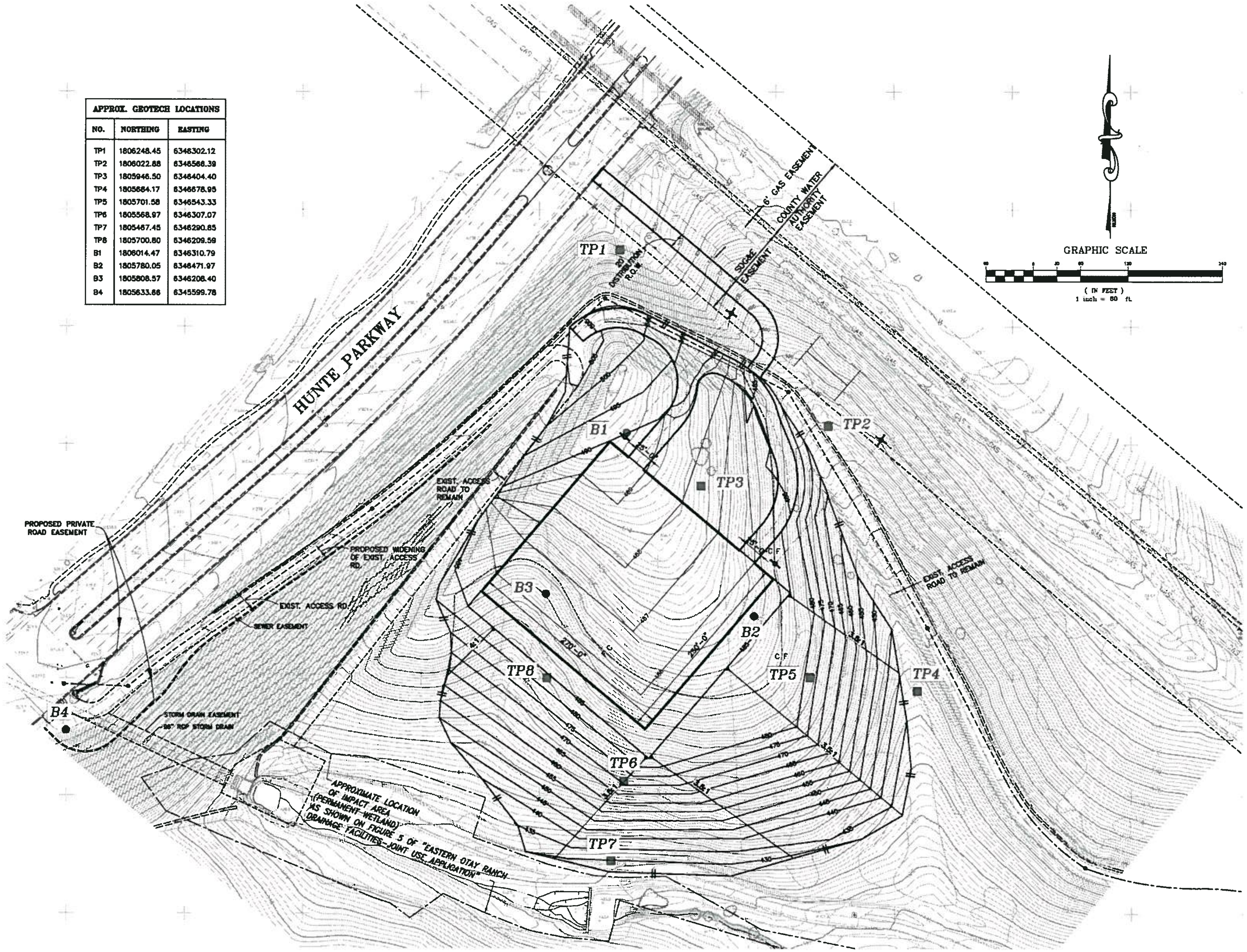
FIGURES



NOT TO SCALE

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		VICINITY MAP OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 1
CHECKED BY: SHR	FN: 67735SITE		
PROJECT NO. 67735	DATE: 04/2006		

PRELIMINARY
FOR PLANNING PURPOSES ONLY



APPROX. GEOTECH LOCATIONS		
NO.	NORTHING	EASTING
TP1	1806248.45	6346302.12
TP2	1806022.88	6346566.39
TP3	1805946.50	6346404.40
TP4	1805684.17	6346678.95
TP5	1805701.58	6346543.33
TP6	1805568.97	6346307.07
TP7	1805467.45	6346290.85
TP8	1805700.80	6346209.59
B1	1806014.47	6346310.79
B2	1805780.05	6346471.97
B3	1805808.57	6346208.40
B4	1805633.86	6345599.78

LEGEND

- RETAINING WALL
- SEWER MANHOLE
- SEWER LINE
- CUT/FILL LINE
- ELEC. TRANSMISSION LINE
- FINISHED CONTOUR LINES
- EXISTING COUNTER LINES
- GAS TRANSMISSION LINE —GAS—
- WATER —W—
- DRAINAGE SWALE
- NEW TRANSMISSION STEEL CABLE POLE
- NEW TRANSMISSION STEEL POLE
- SOIL BORING Bx
- TEST PIT TPx

PRELIMINARY

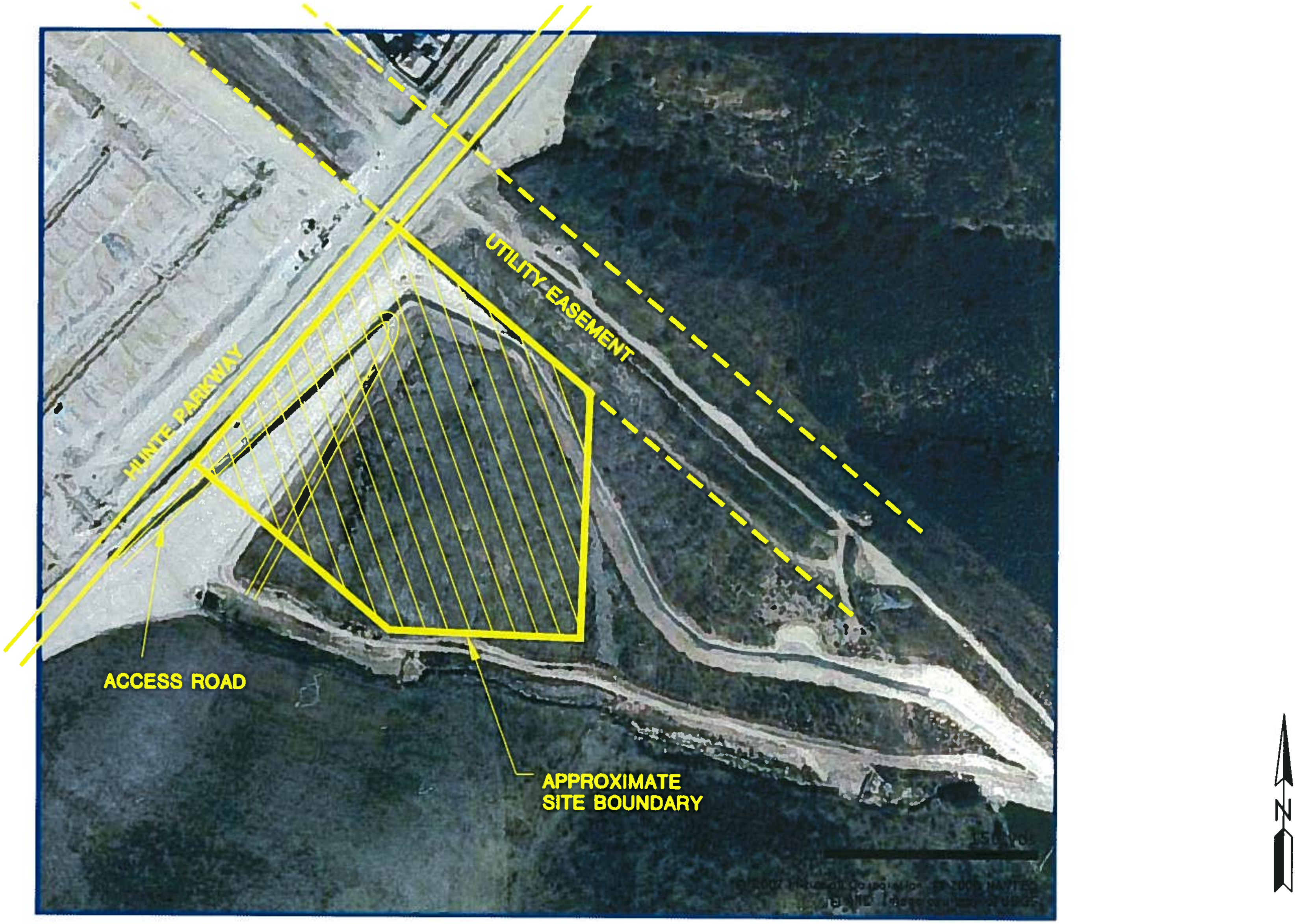
KLEINFELDER
5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

CHECKED BY: SHR	FN: 67735SITE
PROJECT NO. 67735	DATE: 10/2007

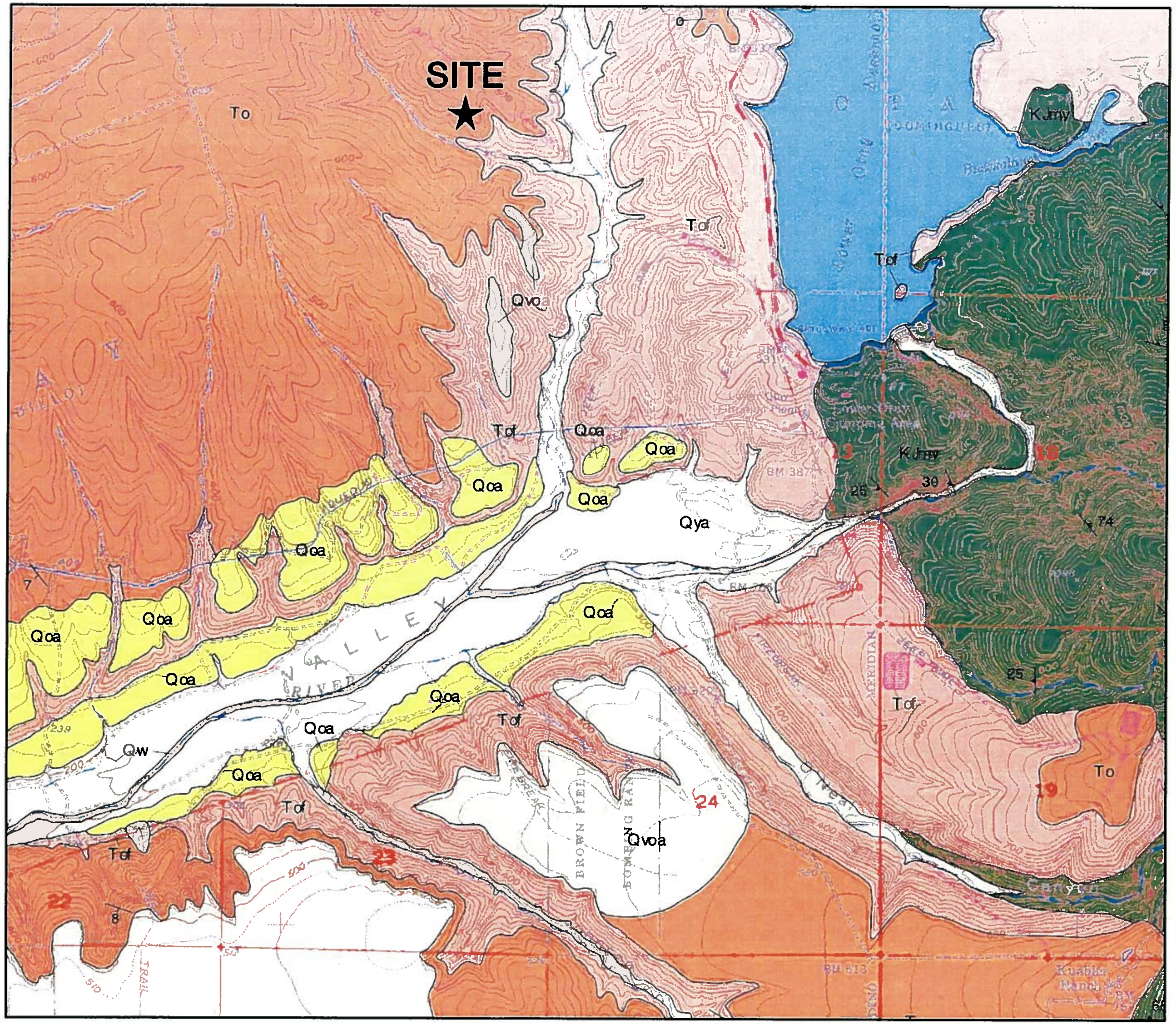
SITE PLAN

OTAY RANCH SUBSTATION SITE
OTAY, CALIFORNIA

FIGURE
2



KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		AERIAL PHOTOGRAPH OF SITE OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 3
CHECKED BY: SHR	FN: 67735SITE		
PROJECT NO. 67735	DATE: 10/2007		



DESCRIPTION OF MAP UNITS

Qw	Late Holocene active channel and wash deposits; unconsolidated sand, silt, gravel and clay. Deposits along smaller drainage channels are included in Qya.
Qya	Holocene alluvial deposits; unconsolidated to poorly consolidated silt, clay, sand and gravel. Includes modern active sediments along small drainage channels.
Qoa	Alluvial deposits (late to middle Pleistocene); moderately consolidated, poorly sorted flood plain deposits consisting of gravely sandy silt and clay.
Qvoa	Alluvial deposits (middle to early Pleistocene); well consolidated, poorly sorted flood plain deposits consisting of gravel, sand, silt and clay.
To	Otay Formation (Oligocene to Miocene); poorly indurated massive light colored sandstone, siltstone and claystone, interbedded with bentonite lenses.
Tof	Otay Formation-fanglomerate facies (Oligocene to Miocene); poorly cemented bouldery conglomerate and coarse-grained sandstone. Interfingered with overlying To.
KJmv	Metavolcanic rocks (Jurassic and Cretaceous); mildly metamorphosed volcanic, volcaniclastic and sedimentary rocks. Volcanic rocks range from basalt to rhyolite, but are predominately andesite and dacite. In general, metavolcaniclastic rocks are most abundant.

N

NOT TO SCALE

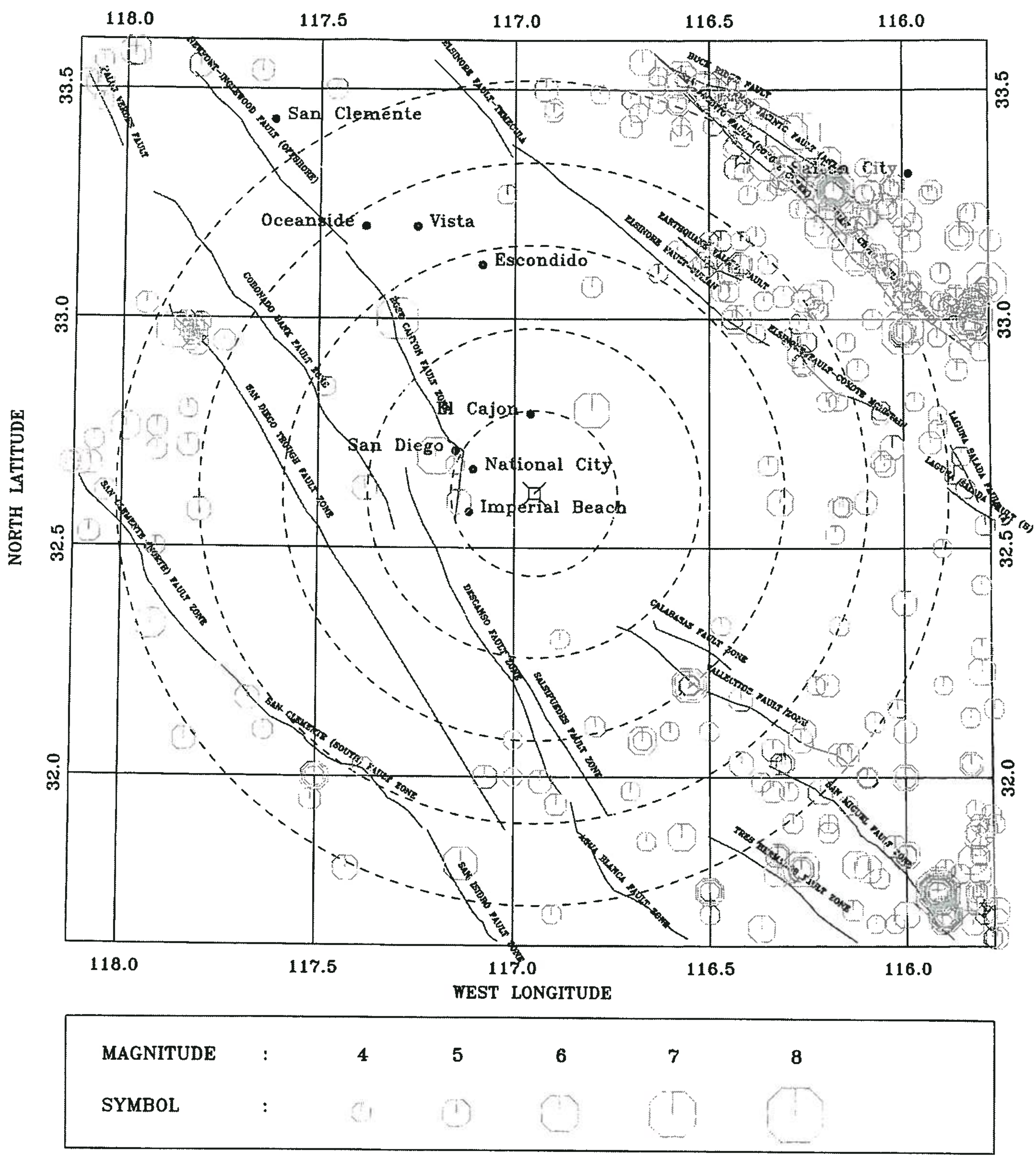
KLEINFELDER
5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

CHECKED BY: SHR | FN: 67735SITE
PROJECT NO. 67735 | DATE: 10/2007

LOCAL GEOLOGIC MAP

OTAY RANCH SUBSTATION SITE
OTAY, CALIFORNIA

FIGURE 4



FAULT MAP AND EPICENTERS OF EARTHQUAKES

OTAY RANCH SUBSTATION, SAN DIEGO, CALIFORNIA

RADIUS OF LARGEST CIRCLE IS 100 KM

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122	FAULT MAP	FIGURE
CHECKED BY: SHR / FN: 67735SITE	OTAY RANCH SUBSTATION SITE	5
PROJECT NO. 67735 / DATE: 10/2007	OTAY, CALIFORNIA	

KLEINFELDER, Inc.
SLOPE STABILITY ANALYSIS

Project No.: 67735
Project : SDG&E Otay Substation
Driveway Extension
(Static Condition)

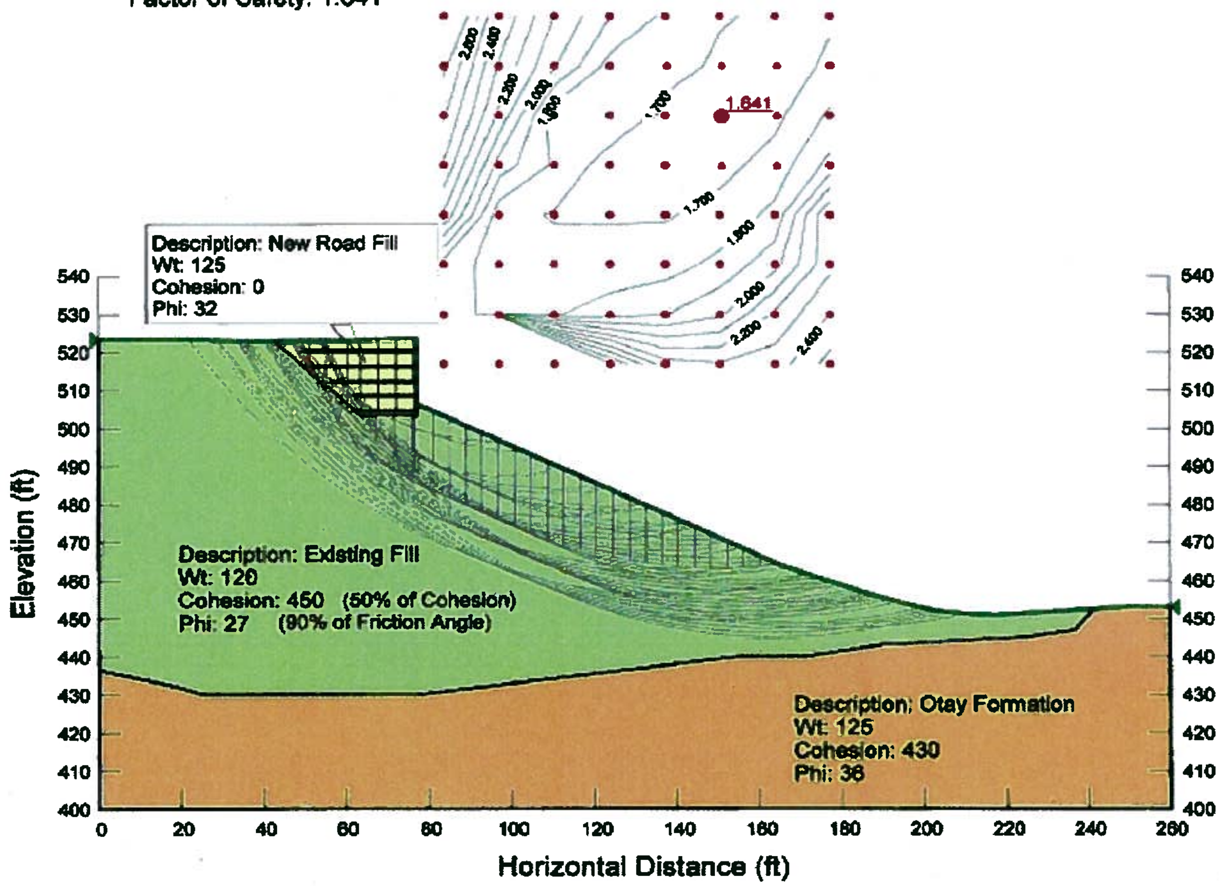
File Name: MSE Reinforce II.gsz
Date: 3/20/2007
Analysis Method: Spencer
Horz Seismic Load: 0g

Factor of Safety: 1.641

REINFORCEMENT INFORMATION

Reinf. Type: Fabric
Reinf. Capacity: 3080 lb/ft
Bar Safety Factor: 1

Contact Cohesion: 0 psf
Contact Phi: 24 degree
Interface Factor: 2



KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122	**STATIC SLOPE STABILITY ANALYSIS** OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 6
CHECKED BY: KMC / FN: 67735SLOPESTA		
PROJECT NO. 67735 / DATE: 03/2007		

KLEINFELDER, Inc.
SLOPE STABILITY ANALYSIS

Project No.: 67735
Project : SDG&E Otay Substation
Driveway Extension
(Seismic Condition)

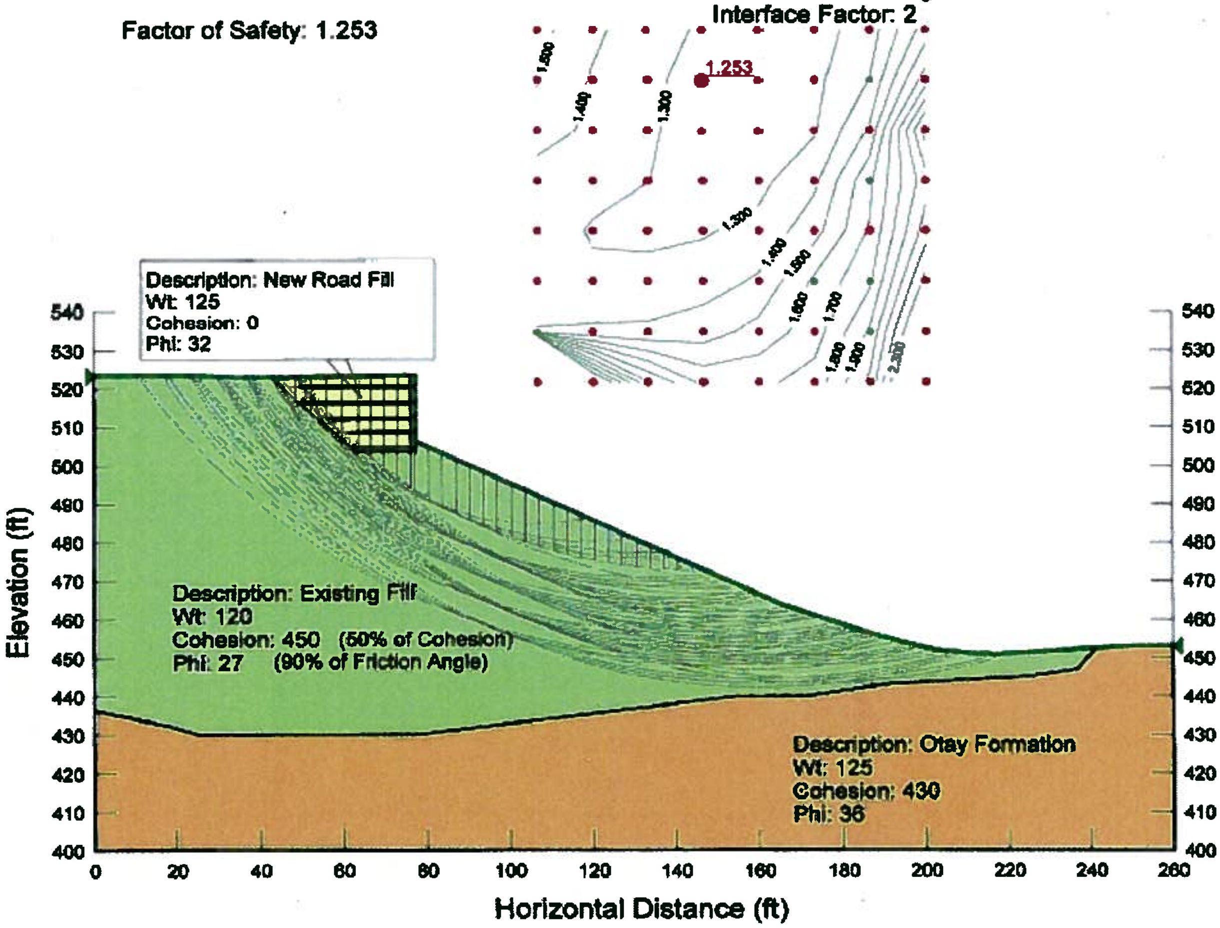
File Name: MSE Reinforce IIs.gsz
Date: 3/20/2007
Analysis Method: Spencer
Horz Seismic Load: 0.15g

Factor of Safety: 1.253

REINFORCEMENT INFORMATION

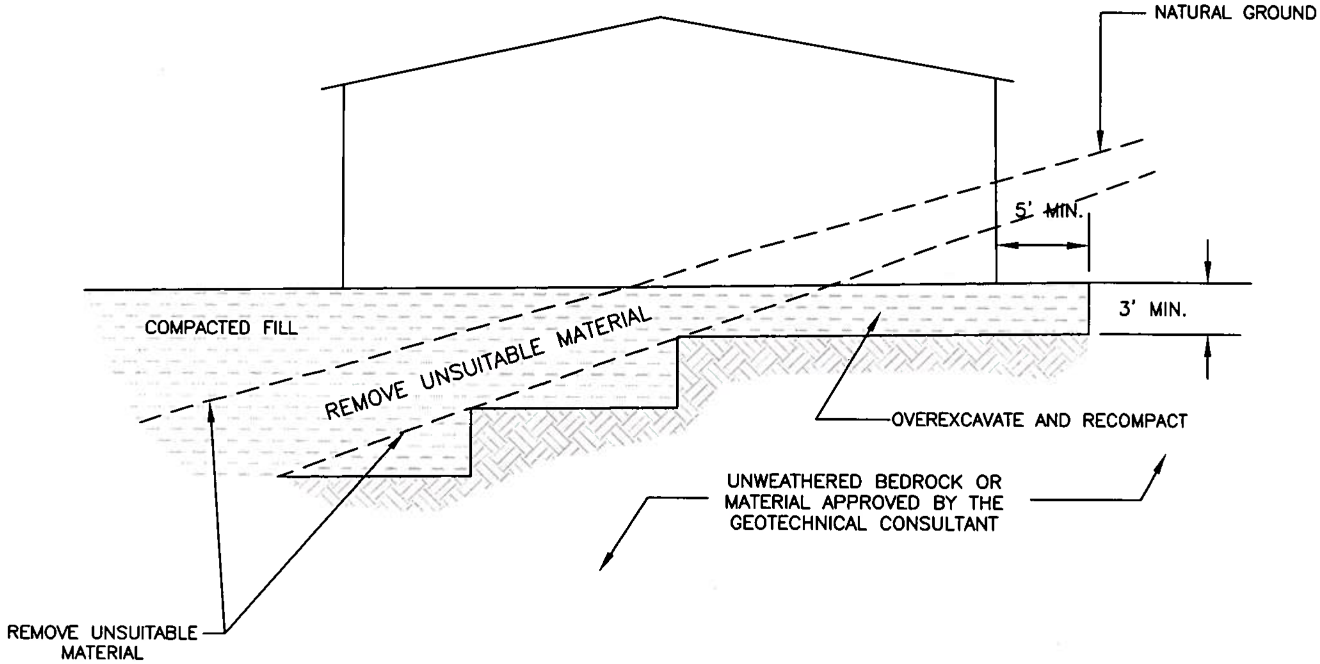
Reinf. Type: Fabric
Reinf. Capacity: 3080 lb/ft
Bar Safety Factor: 1

Contact Cohesion: 0 psf
Contact Phi: 24 degree
Interface Factor: 2



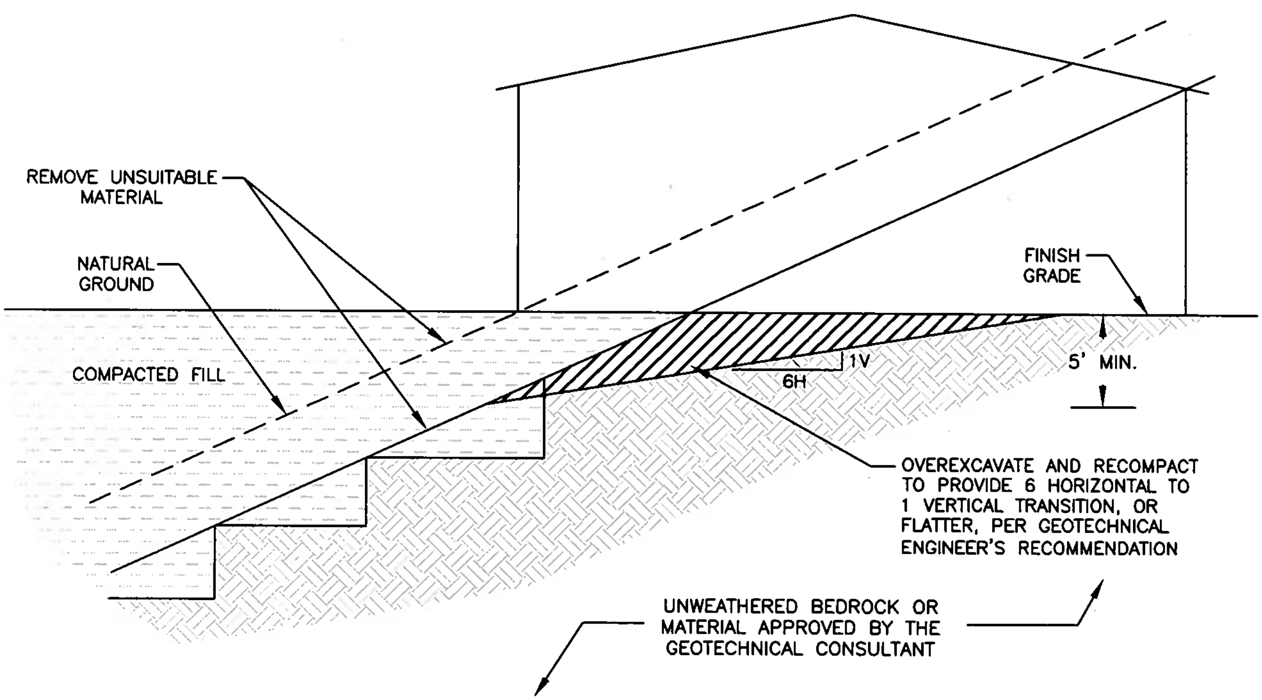
KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		SEISMIC SLOPE STABILITY ANALYSIS OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 7
CHECKED BY: KMC	FN: 67735SLOPESEIS		
PROJECT NO. 67735	DATE: 03/2007		

CUT-FILL LOT



PRIMARILY CUT LOT

(OPTION)



KLEINFELDER

5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

CHECKED BY: KC	FN: 67735_CUT
PROJECT NO. 67735	DATE: 10/2007

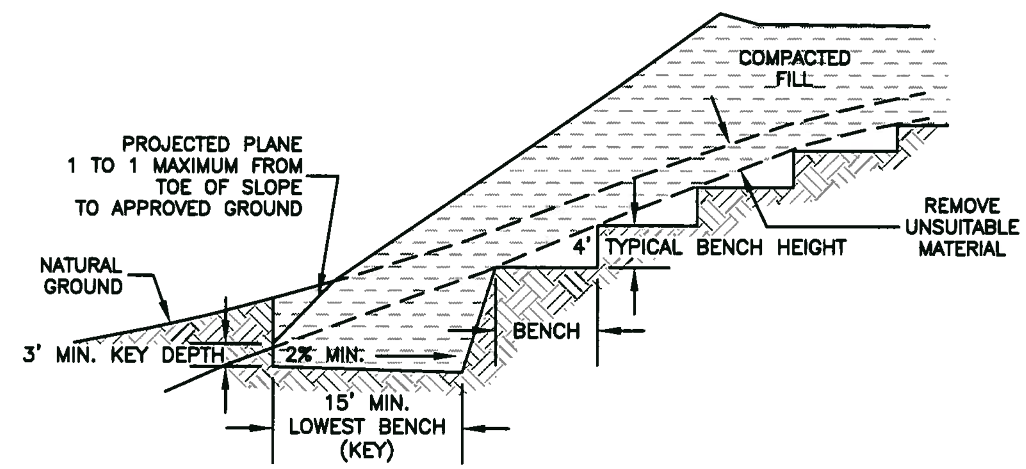
CUT-FILL TRANSITION DETAILS

OTAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

FIGURE

8

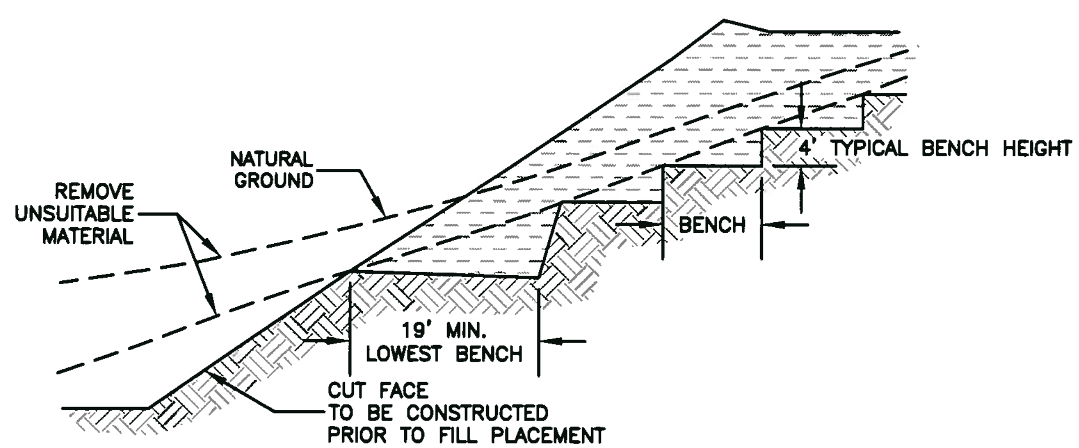
BENCHING DETAILS



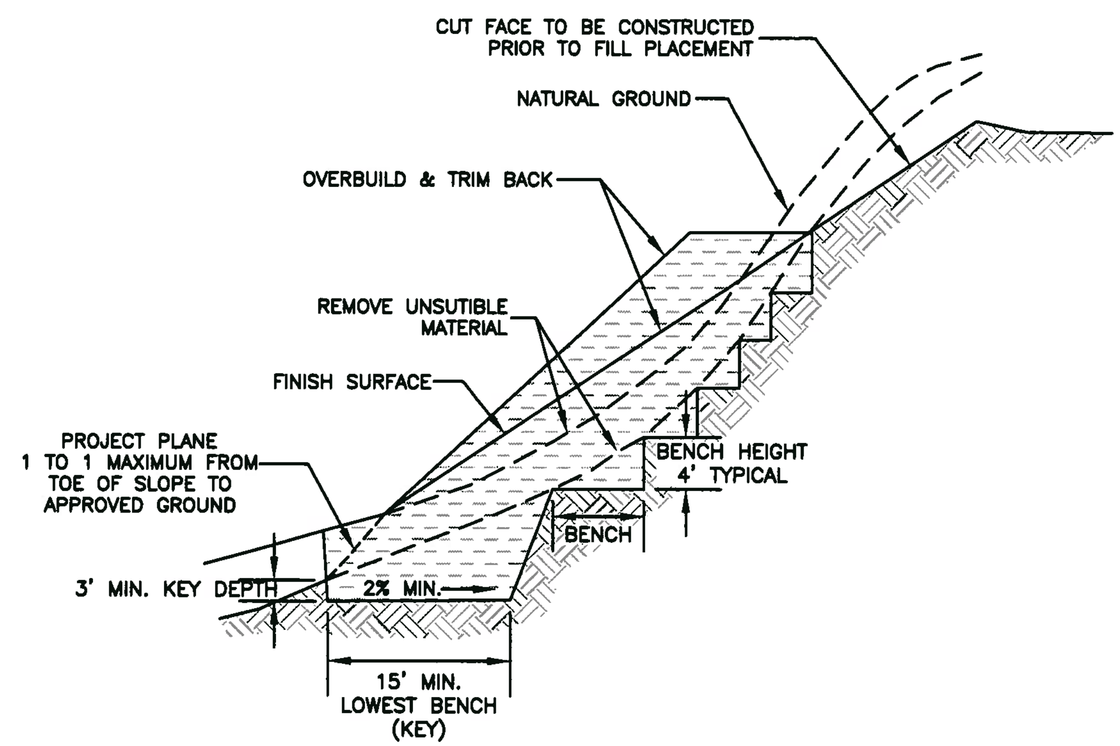
FILL SLOPE

NOTES:
LOWEST BENCH: DEPTH AND WIDTH SUBJECT TO FIELD CHANGE BASED ON CONSULTANT'S INSPECTION.

SUBDRAINAGE: BACK DRAINS MAY BE REQUIRED AT THE DISCRETION OF THE GEOTECHNICAL CONSULTANT.

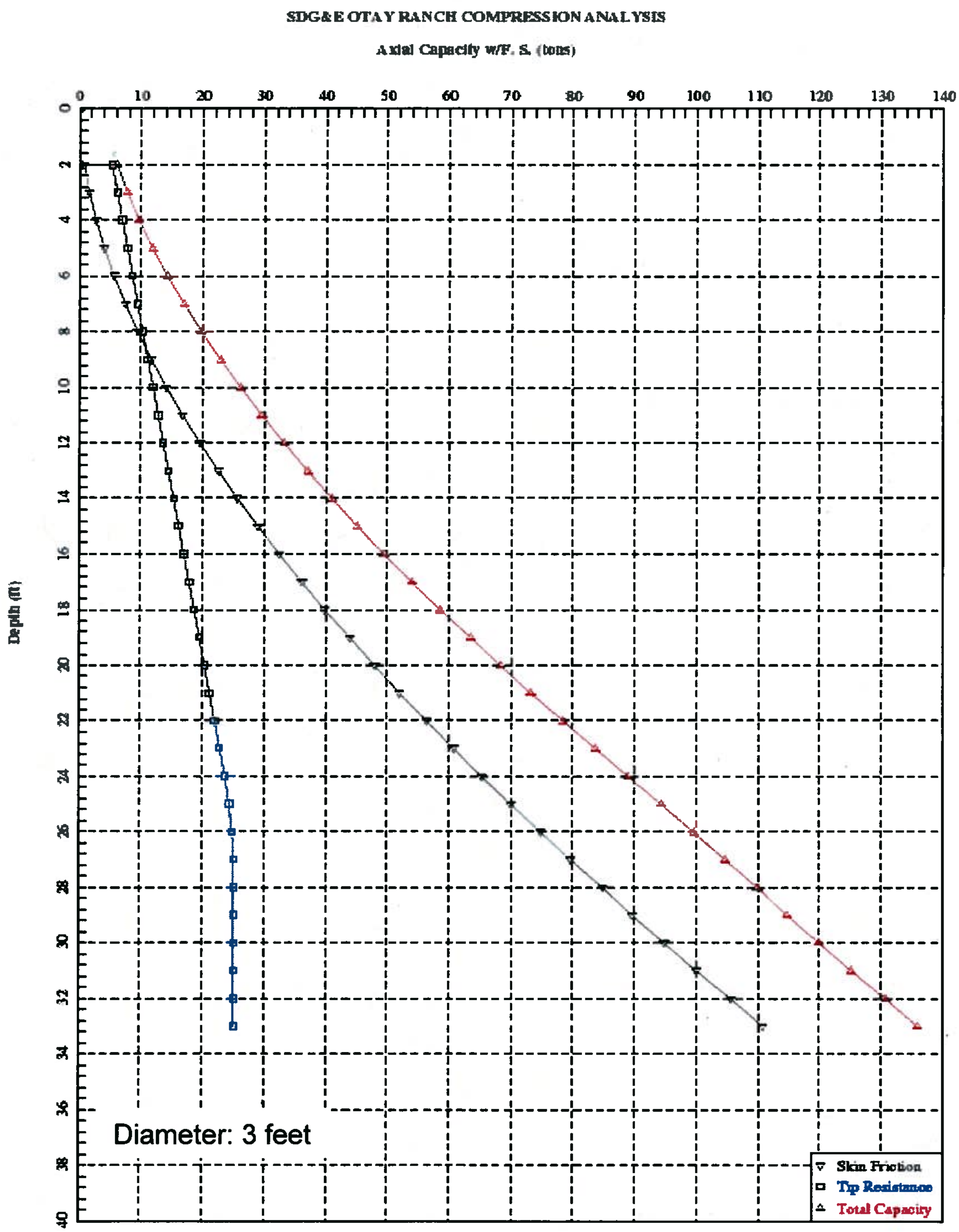


FILL-OVER-CUT SLOPE



CUT-OVER-FILL SLOPE

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		BENCHING DETAILS OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 9
CHECKED BY: SHR	FN: 67735DETAILS		
PROJECT NO. 67735	DATE: 10/2007		



KLEINFELDER

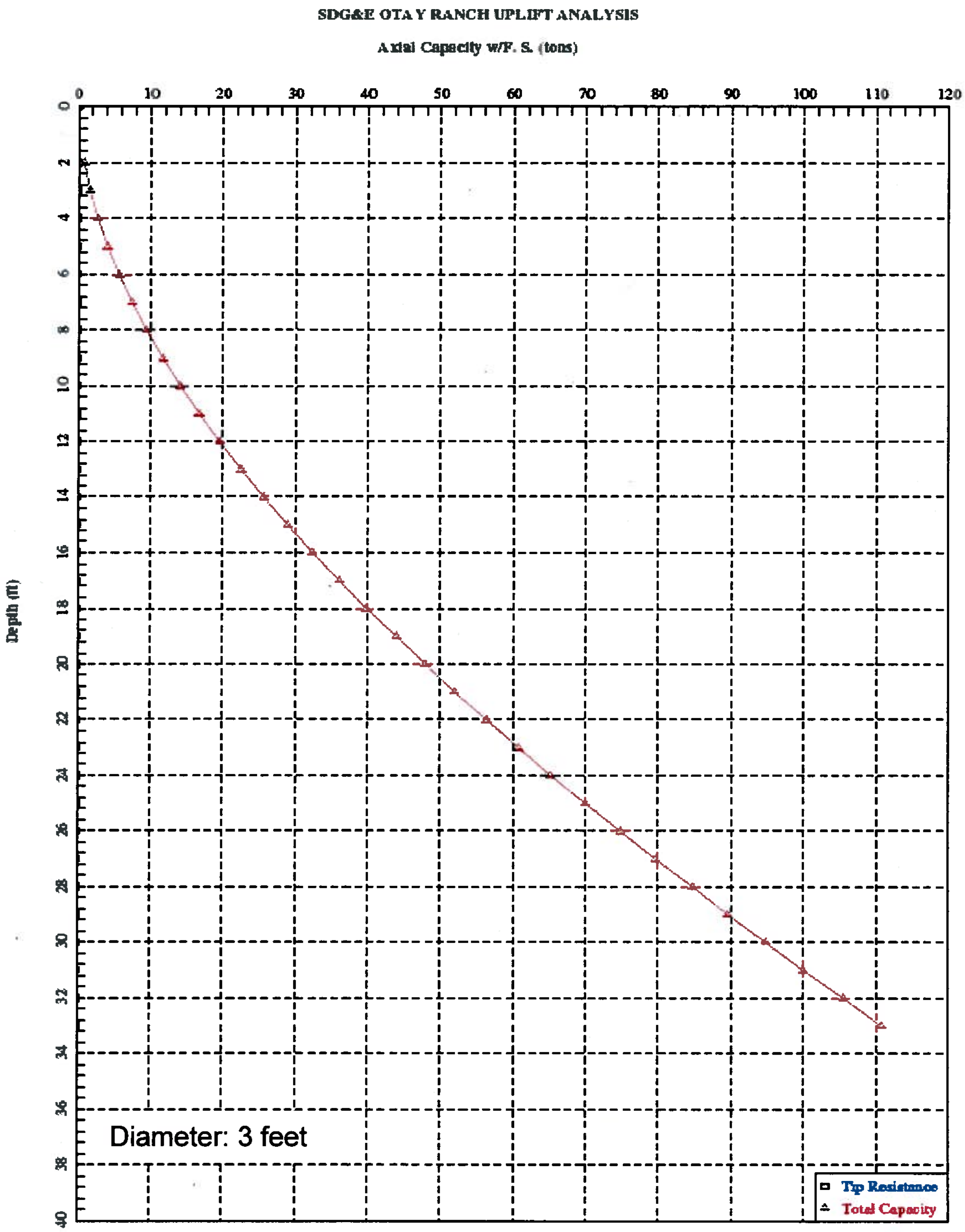
5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

CHECKED BY: KMC	FN: 67735COMPRESS
PROJECT NO. 67735	DATE: 03/2007

ALLOWABLE AXIAL CAPACITY CURVES
3 – FOOT DIAMETER DRILLED PIERS

OTAY RANCH SUBSTATION SITE
OTAY, CALIFORNIA

FIGURE
10



KLEINFELDER

5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

CHECKED BY: KMC	FN: 67735UPLIFT
PROJECT NO. 67735	DATE: 03/2007

ALLOWABLE UPLIFT CAPACITY CURVE
3 – FOOT DIAMETER DRILLED PIERS

OTAY RANCH SUBSTATION SITE
OTAY, CALIFORNIA

FIGURE
11

APPENDIX A

Boring Logs

APPENDIX A
BORING LOGS

The geotechnical test boring program for the proposed project consisted of the excavation and logging of four small diameter borings and eight test pits. The borings utilized a limited access hollow stem auger drill rig. The borings were advanced on January 18 and March 8, 2007 to depths ranging from 36 to 91 feet below existing grades. The test pits were advanced on December 20, 2006 to depths between 4 and 12 feet. Figure 2 presents the approximate locations of the borings and test pits.

The Logs of Borings are presented as Figures A3 through A12. A Unified Soil Classification System (USCS) chart and a Boring Log Legend are presented as Figures A1 and A2, respectively. The Logs of Borings describe the earth materials encountered, samples obtained, and show field and laboratory tests performed. The logs also show the general location, boring number, drilling date, and the names of the logger and drilling subcontractor. The borings were logged by an engineer/geologist using the USCS. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and intact samples of representative earth materials were obtained from the borings.

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

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122	**SOIL CLASSIFICATION CHART** **SDG&E SUBSTATION** **ORAY RANCH SUBSTATION** **CHULA VISTA, CALIFORNIA**	FIGURE **A1**
CHECKED BY: KW / FN: 67735_Keys		
PROJECT NO. 67735 / DATE: 06/2007		

LOG SYMBOLS:

BULK/BAG SAMPLE

MODIFIED CALIFORNIA SAMPLER
(2-1/2 inch outside diameter)

CALIFORNIA SAMPLER
(3 inch outside diameter)

STANDARD PENETRATION
SPLIT SPOON SAMPLER
(2 inch outside diameter)

NO SAMPLE RECOVERY

SHELBY TUBE

▼ WATER LEVEL
(level after completion)

▽ WATER LEVEL
(level where first encountered)

ABBREVIATIONS:

SA – (38%) SIEVE ANALYSIS (PERCENT PASSING #200 SIEVE)
WA – (38%) – ONE POINT GRAIN SIZE ANALYSIS (PERCENT PASSING #200 SIEVE)
PI – PLASTICITY INDEX
AL – ATTERBERG LIMITS
DS – DIRECT SHEAR TEST
'R' – R-VALUE TEST
CORR – CORROSIVITY TEST
EI – UBC EXPANSION INDEX
LC – LABORATORY COMPACTION TEST
M&D – MOISTURE & DENSITY
PP – POCKET PENETROMETER

GENERAL NOTES:

1. *Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.*
2. *No warranty is provided as to the continuity of soil conditions between individual sample locations.*
3. *Logs represent general soil conditions observed at the point of exploration on the date indicated.*
4. *In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.*

CONSISTENCY CRITERIA BASED ON FIELD TESTS

RELATIVE DENSITY	SPT* (# blows/ 300 mm)	RELATIVE DENSITY (%)
Very Loose	<4	0 – 15
Loose	4 – 10	15 – 35
Medium Dense	10 – 30	35 – 65
Dense	30 – 50	65 – 85
Very Dense	>50	85 – 100

		TORVANE	POCKET** PENETROMETER
CONSISTENCY	SPT (# blows/ 300 mm)	UNDRAINED SHEAR STRENGTH (MPa)	UNCONFINED COMPRESSIVE STRENGTH
Very Soft	<2	0.012	0.024
Soft	2 – 4	0.012 – 0.024	0.024 – 0.05
Medium Stiff	4 – 8	0.024 – 0.05	0.05 – 0.10
Stiff	8 – 15	0.05 – 0.10	0.10 – 0.20
Very Stiff	15 – 30	0.10 – 0.20	0.20 – 0.40
Hard	>30	>0.2	>0.40

NUMBER OF BLOWS OF 63 kg HAMMER FALLING 750 mm TO DRIVE A 50 mm O.D. (34 mm I.D.) SPLIT BARREL SAMPLER (ASTM-1386 STANDARD PENETRATION TEST)

** UNCONFINED COMPRESSIVE STRENGTH IN MPa READ FROM POCKET PENETROMETER

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

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

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		KEY TO LOGS SDG&E SUBSTATION ORAY RANCH SUBSTATION CHULA VISTA, CALIFORNIA	FIGURE **A2**
CHECKED BY: KW	FN: 67735_Keys		
PROJECT NO. 67735	DATE: 06/2007		

DATE DRILLED:	1/18/2007	WATER DEPTH:	None
DRILLING COMPANY:	Tri-County Drilling	DATE OBSERVED:	1/18/2007
DRILLING METHOD:	ATV Auto Hammer, 140 lb hammer, 30" drop	GROUND ELEVATION:	551' MSL
		LOGGED BY:	JL
HOLE DIAMETER:	8" Hollow Stem Auger (HSA)		

ELEVATION (ft)	DEPTH (ft)	SAMPLES: BULK	SAMPLES: DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							TOPSOIL: SANDY CLAY (CL), dark brown, dry to moist, stiff, trace of roots			
							OTAY FORMATION: CLAYEY SANDSTONE, very light grayish brown, moist, very dense, fine to coarse grained, highly weathered, weakly cemented, massive			
	5			1	50/5"					SA (42.5%) DS
				2						
	10			3	75					
							Color change to brownish gray			
							Color change to light gray			
	15			4	50/5"			121	5	
							Fine to medium subangular gravels observed from 17.5 feet			
	20			5	50/5"					
							Becomes light brown			

KLEINFELDER
5015 SHOREHAM PLACE
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PROJECT NO. 67735

SDG&E SUBSTATION
ORAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

LOG OF BORING B1

FIGURE A3

ELEVATION (feet)	DEPTH (feet)	SAMPLES BULK	SAMPLES DRIVEN	BLOW COUNTS (blows/foot)	SAMPLE NUMBER	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT pcf	MOISTURE CONTENT (%)	COMMENTS/ ADDITIONAL TESTS
							(Continued From Previous Page)			
				50/3"	6		SILTY SANDSTONE, pale brownish gray with mottled red, moist, very dense, fine to coarse grained, poorly graded, weakly cemented, highly weathered, massive			
	30			50/3"	7					
	35			50/5"	8			104	11.0	
	40			50/3"	9					
							Bottom of boring at 40.3' No groundwater observed Boring backfilled with grout			
	45									
	50									

KLEINFELDER
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SDG&E SUBSTATION
ORAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

LOG OF BORING B1

FIGURE A4

DATE DRILLED:	1/18/2007	WATER DEPTH:	None
DRILLING COMPANY:	Tri-County Drilling	DATE OBSERVED:	1/18/2007
DRILLING METHOD:	ATV Auto Hammer, 140 lb hammer, 30" drop	GROUND ELEVATION:	492' MSL
		LOGGED BY:	JL
HOLE DIAMETER:	8" Hollow Stem Auger (HSA)		

ELEVATION (ft)	DEPTH (ft)	SAMPLES: BULK	SAMPLES: DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							TOPSOIL: SANDY CLAY (CL), dark brown, dry to moist, stiff to hard, trace of roots			
			X	1	50/5"		**OTAY FORMATION:** SILTY SANDSTONE, light brown, moist, very dense, fine to coarse grained, massive, weakly cemented, trace of gravel, highly weathered	110	9	
	5		X	2	24					SA (20%)
	10		X	3	50/5"		Cobble larger at 10.5 feet CLAYEY SANDSTONE, light brown with mottled black and red, slightly moist, very dense, highly weathered, moderately cemented, massive			DS
	15		X	4	50/5"		SILTY SANDSTONE, light brown with mottled white and green, moist, very dense, fine to coarse grained, highly weathered, moderately cemented, massive, trace gravel			
	20		X	5	50/2"		Few gravels, subangular, greenish			
			X	6	50/4"		Cobble layer, dark gray rock			
							Drill action indicates cobble layer at 23 feet SILTY SANDSTONE, light brown with white, slightly moist, very dense, fine to coarse grained, highly weathered, massive			

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SAN DIEGO, CALIFORNIA 92122

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SDG&E SUBSTATION
ORAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

LOG OF BORING B2

FIGURE **A5**

ELEVATION (ft)	DEPTH (ft)	SAMPLES BULK	SAMPLES DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							(Continued From Previous Page)			
				7	67/6"		SILTY SANDSTONE, light brown with white, slightly moist, very dense, fine to coarse grained, highly weathered, massive			
	30			8	50/3"					
	35			9	50/3"					
	40			10	50/5"					
							Bottom of boring at 40' No groundwater observed Boring backfilled with grout			
	45									
	50									

KLEINFELDER
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SAN DIEGO, CALIFORNIA 92122

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SDG&E SUBSTATION
ORAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

LOG OF BORING B2

FIGURE **A6**

DATE DRILLED:	1/18/2007	WATER DEPTH:	None
DRILLING COMPANY:	Tri-County Drilling	DATE OBSERVED:	1/18/2007
DRILLING METHOD:	ATV Auto Hammer, 140 lb hammer, 30" drop	GROUND ELEVATION:	480' MSL
		LOGGED BY:	JL
HOLE DIAMETER:	8" Hollow Stem Auger (HSA)		

ELEVATION (ft)	DEPTH (ft)	SAMPLES: BULK	SAMPLES: DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							TOPSOIL:			
							SANDY CLAY (CL), dark brown, dry, stiff			
							OTAY FORMATION:			
				1 2	50/5"		SILTY SANDSTONE, light brown, dry, very dense, fine to coarse grained with silt, massive, highly weathered, trace of gravels, well graded	96	6	CORR
	5			3	50/2"		Greenish angular gravel, light brown with mottled red and black, dry, very dense, massive, highly weathered			
							Gravel and cobble layer at approximately 6 to 7 feet			
	10			4	50/5"					
	15			5	50/3"		No recovery			
				NR	50/5"		No recovery			
	20			NR 6	50/3" 50/3"		No recovery			

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SDG&E SUBSTATION
ORAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

LOG OF BORING B3

FIGURE A7

ELEVATION (ft)	DEPTH (ft)	SAMPLES BULK	SAMPLES DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							(Continued From Previous Page)			
				7	50/3"					
	30			8	50/4"		SILTY SANDSTONE, light brown, dry, very dense, fine to coarse grained, highly weathered, massive, some gravel			
	35			9	50/4"					
							Bottom of boring at 36.4' No groundwater observed Boring backfilled with grout			
	40									
	45									
	50									

KLEINFELDER
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LOG OF BORING B3

FIGURE **A8**

DATE DRILLED:	3/8/2007	WATER DEPTH:	None
DRILLING COMPANY:	Tri-County Drilling	DATE OBSERVED:	3/8/2007
DRILLING METHOD:	CME-75, 140 lb hammer, 30" drop	GROUND ELEVATION:	524' MSL
		LOGGED BY:	JL
HOLE DIAMETER:	8" Hollow Stem Auger (HSA)		

ELEVATION (ft)	DEPTH (ft)	SAMPLES: BULK	SAMPLES: DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							6 inches of asphalt pavement			
							FILL (Qaf):			
		X		1			LEAN CLAY WITH SAND (CL), grayish brown, moist, very stiff to hard, low plasticity, trace of fine sand and cemented sandstone clasts			
	5		■	2	50					
	10		■	3	63		Sand and silt content increased	91	16	
	15		■	4	46		Pocket of fat clay			
	20		■	5	39		Red color lean clay interlayer at 21.5 feet			

KLEINFELDER
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SDG&E SUBSTATION
ORAY RANCH SUBSTATION
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LOG OF BORING B4

FIGURE **A9**

ELEVATION (ft)	DEPTH (ft)	SAMPLES BULK	SAMPLES DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							(Continued From Previous Page)			
							Becomes reddish brown with greenish gray			
				6	40					DS
	30			7	58			104	20	
	35			8	55		Becomes dark gray, fine silty sand pockets			
	40			9	41			105	21	
	45						FAT CLAY (CH), very dark brown, moist, hard, trace of mottled sand and silt, buried grass and roots, strong odor			
				10	32		LEAN CLAY (CL), reddish brown, moist, hard, low plasticity			
	50			11	40			93	24	CONSOL

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LOG OF BORING B4

FIGURE A10

ELEVATION (ft)	DEPTH (ft)	SAMPLES: BULK	SAMPLES: DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							(Continued From Previous Page)			
	55			12	49		Becomes brown			
	60			13	60		Becomes hard			
	65			14	69		Clast of cemented sand at 66.5 feet			
							LEAN CLAY (CL), brown with mottled red, moist, very hard, clast of cemented sand			
	70			15	69			98	20	
	75			16	52					
	80			17	49		FAT CLAY (CH), dark brown with mottled light gray, moist, hard, high plasticity	101	22	

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SDG&E SUBSTATION
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LOG OF BORING B4

FIGURE
A11

ELEVATION (ft)	DEPTH (ft)	SAMPLES BULK	SAMPLES DRIVEN	SAMPLE NUMBER	BLOW COUNTS (blows/foot)	GRAPHIC LOG	SOIL DESCRIPTION AND CLASSIFICATION	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	NOTES
							(Continued From Previous Page)			
	85						Becomes dark brown, trace of fine gravel			
				18	39		SILTY SAND (SM), light brown, moist, very dense, fine grained	101	22	CONSOL
	90						**OTAY FORMATION (To):**			
				19	74		SILTY SANDSTONE, CLAYEY SAND, very light brown with mottled red and black, moist, very dense, fine grained, trace of fine gravel			
							Bottom of boring at 91.5 feet No groundwater observed Boring backfilled with grout			
	95									
	100									
	105									
	110									

KLEINFELDER
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PROJECT NO. 67735

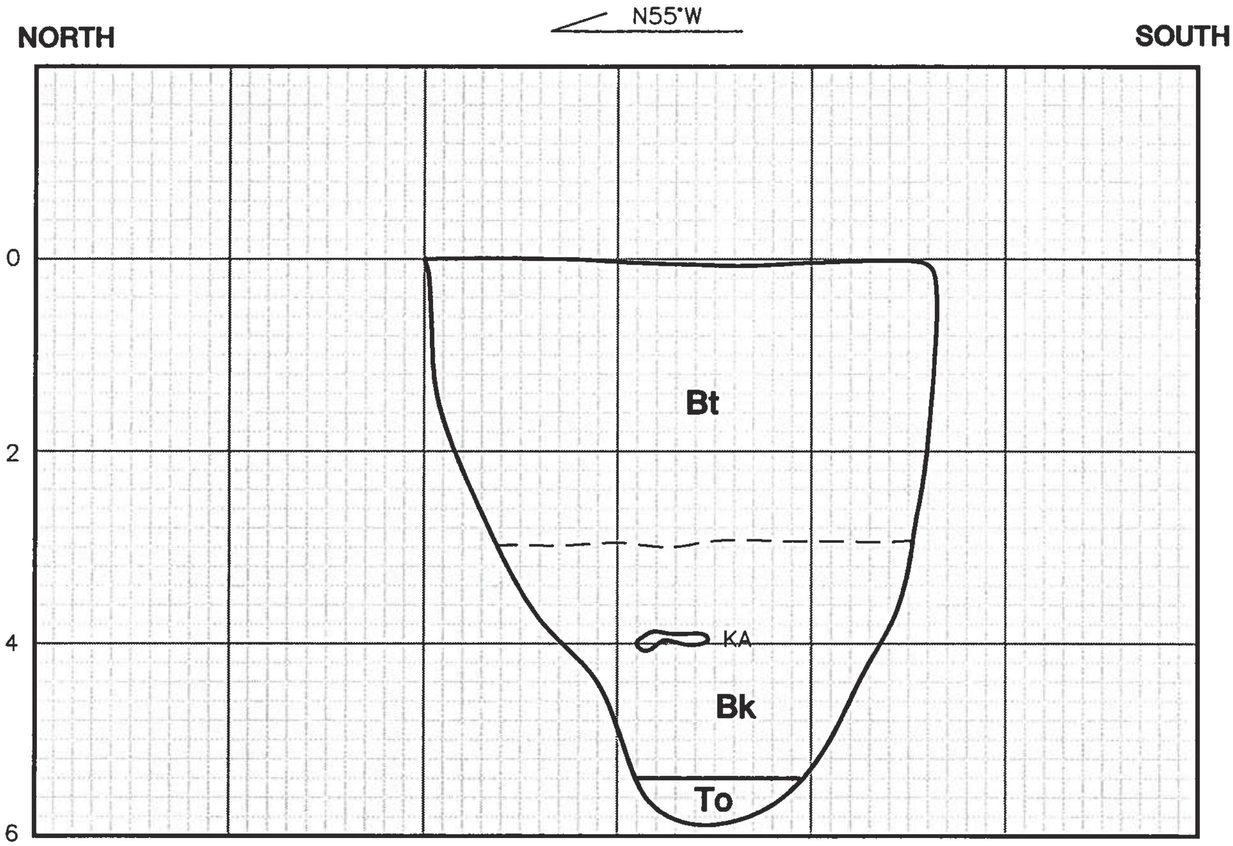
SDG&E SUBSTATION
ORAY RANCH SUBSTATION
CHULA VISTA, CALIFORNIA

LOG OF BORING B4

FIGURE
A12

PROJECT NO. 67735	LOG OF TEST PIT NO. 1		SHEET 1 OF 1
EXCAVATION EQUIPMENT BACKHOE	PROJECT NAME OTAY RANCH SUBSTATION	LOCATION	

DATE: 12/20/2006	LOGGED BY: SHR	CHECKED BY: KMC	DEPTH: 6'	ELEVATION: 530'	DIRECTION:

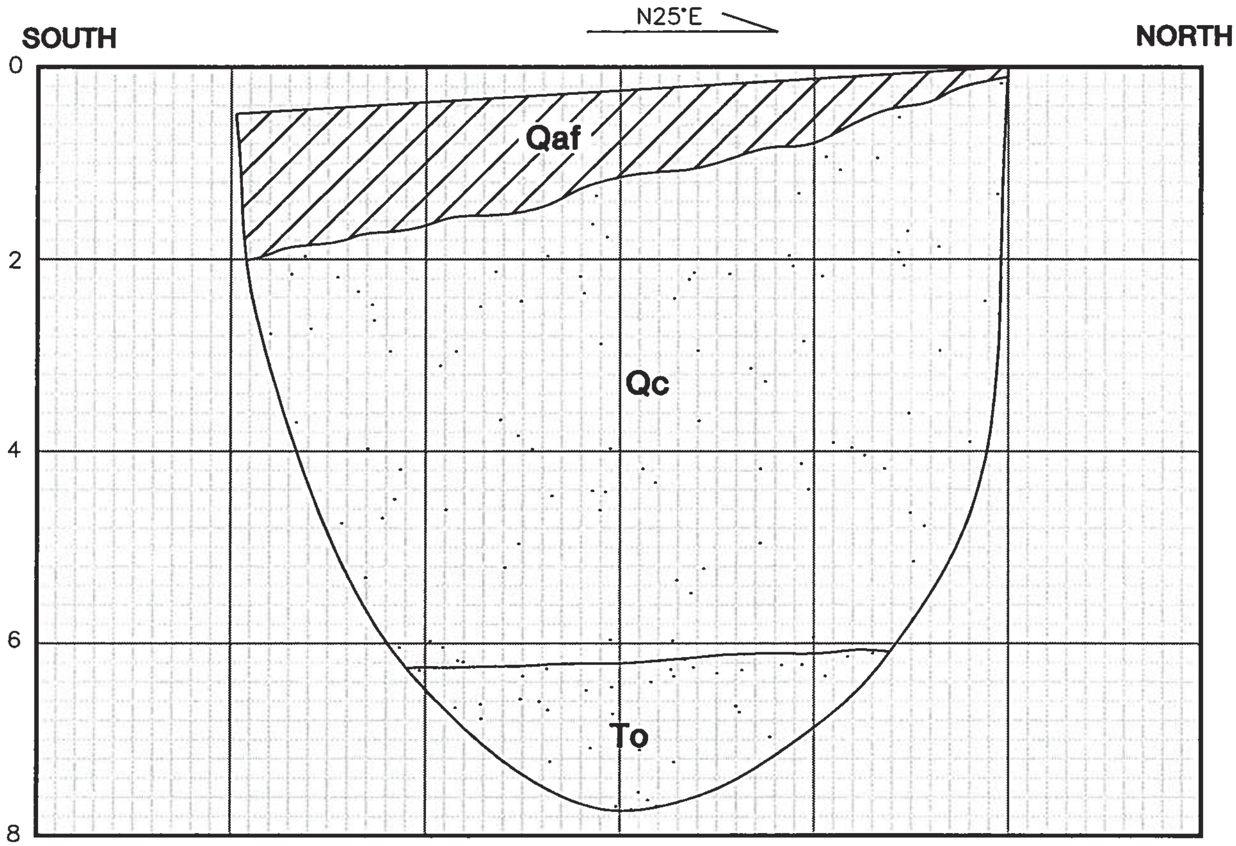


DEPTH IN FEET	MATERIAL DESCRIPTION
0 to 3'	**TOPSOIL:** **Bt** CLAYEY SILT (ML), DARK BROWN, MOIST, SOFT
3' to 5.5'	**Bk** SANDY SILT (ML), WHITE, DRY, MEDIUM STIFF, LIGHT ???
5.5' TO 6'	**OTAY FORMATION:** **To** SILTY SANDSTONE, YELLOW BROWN, MOIST, VERY DENSE, FINE TO COARSE GRAINED WITH TRACE GRAVEL

K – KROTOVINA ANIMAL BURROWS

PROJECT NO. 67735	LOG OF TEST PIT NO. 2	SHEET 1 OF 1
EXCAVATION EQUIPMENT: BACKHOE	PROJECT NAME: OTAY RANCH SUBSTATION	LOCATION:

DATE:	LOGGED BY:	CHECKED BY:	DEPTH:	ELEVATION:	DIRECTION:
12/20/2006	SHR	KMC	8'	470'	

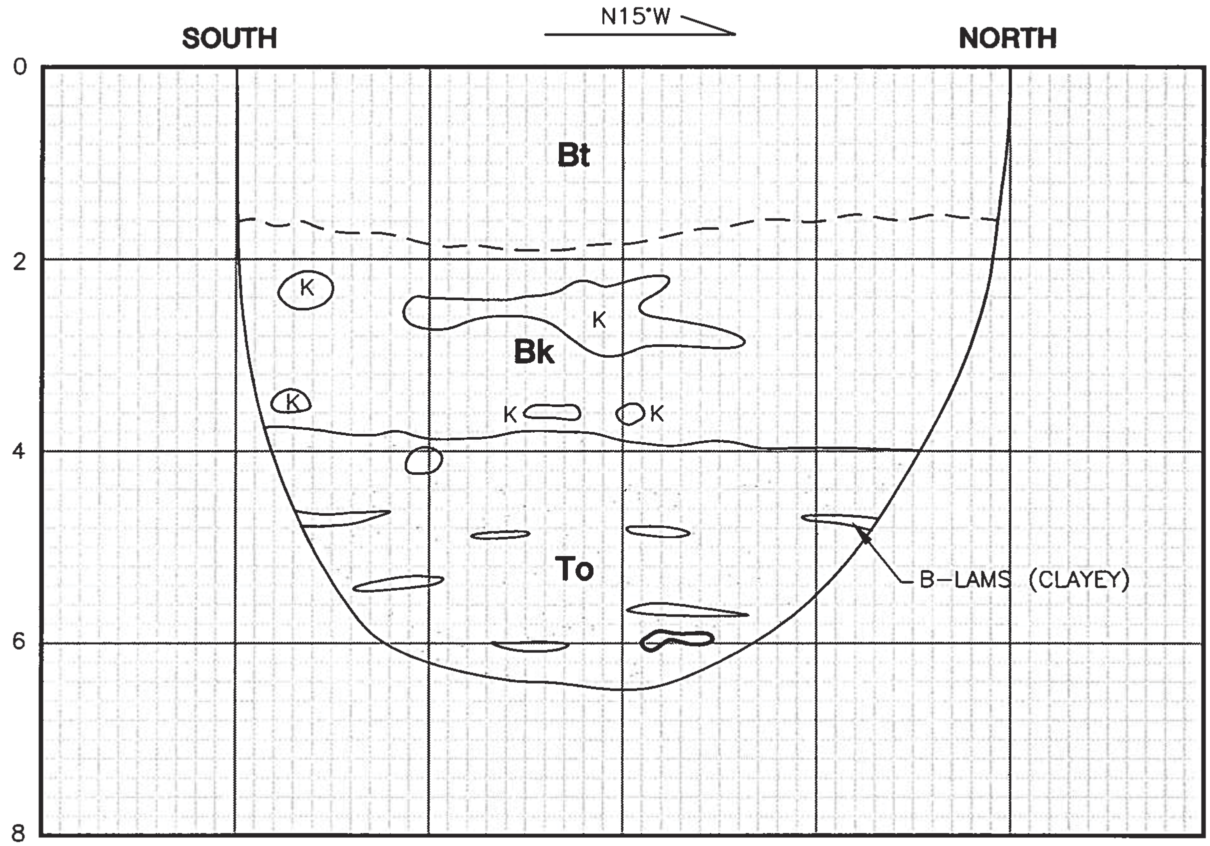


DEPTH IN FEET	MATERIAL DESCRIPTION
0 to 2'	**ARTIFICIAL FILL:** **Qaf** CLAYEY SANDY SILT (ML), DARK BROWN, MOIST, SOFT
2' to 6'	**COLLUVIUM** **Qc** CLAYEY SANDY SILT (ML), DARK BROWN, MOIST, SOFT, MINOR CARBONATE ON PEDOGENIC SURFACES
6' to 8'	**OTAY FORMATION:** **To** SILTY SANDSTONE, YELLOW BROWN, MOIST, DENSE COARSE SAND FRACTION ROUNDED UP TO 1/4", TRACE GRAVEL

FN: 67735TP KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122 FIGURE NO.: A-14

PROJECT NO. 67735	LOG OF TEST PIT NO. 3	SHEET 1 OF 1
EXCAVATION EQUIPMENT: BACKHOE	PROJECT NAME: OTAY RANCH SUBSTATION	LOCATION:

DATE:	LOGGED BY:	CHECKED BY:	DEPTH:	ELEVATION:	DIRECTION:
12/20/2006	SHR	KMC	6.5'	507'	



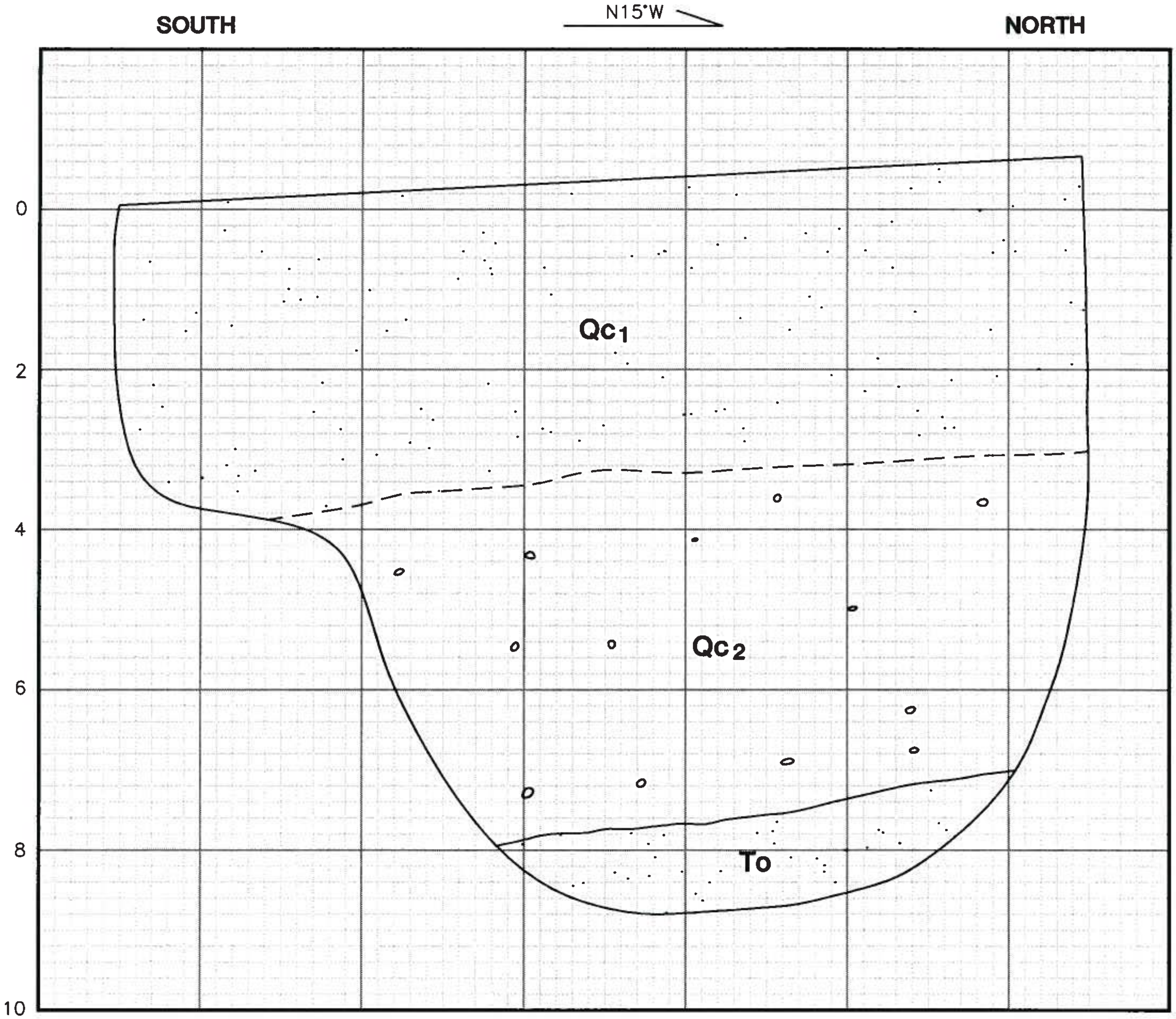
DEPTH IN FEET	MATERIAL DESCRIPTION
0 – 2'	**Bt** **TOPSOIL:** CLAYEY SILT (ML), DARK BROWN, MOIST, SOFT
2' – 4'	**Bk** SANDY SILT (ML), WHITE, DRY, MEDIUM STIFF
4' – 6.5'	**To** **OTAY FORMATION:** SILTY SANDSTONE, WHITE GRAY, MOIST, DENSE, FINE TO COARSE GRAINED, TRACE GRAVEL

K – KROTOVINA ANIMAL BURROWS

PROJECT NO. 67735	LOG OF TEST PIT NO. 4	SHEET 1 OF 1

EXCAVATION EQUIPMENT BACKHOE	PROJECT NAME OTAY RANCH SUBSTATION	LOCATION

DATE: 12/20/2006	LOGGED BY: SHR	CHECKED BY: KMC	DEPTH: 9'	ELEVATION: 438'	DIRECTION:

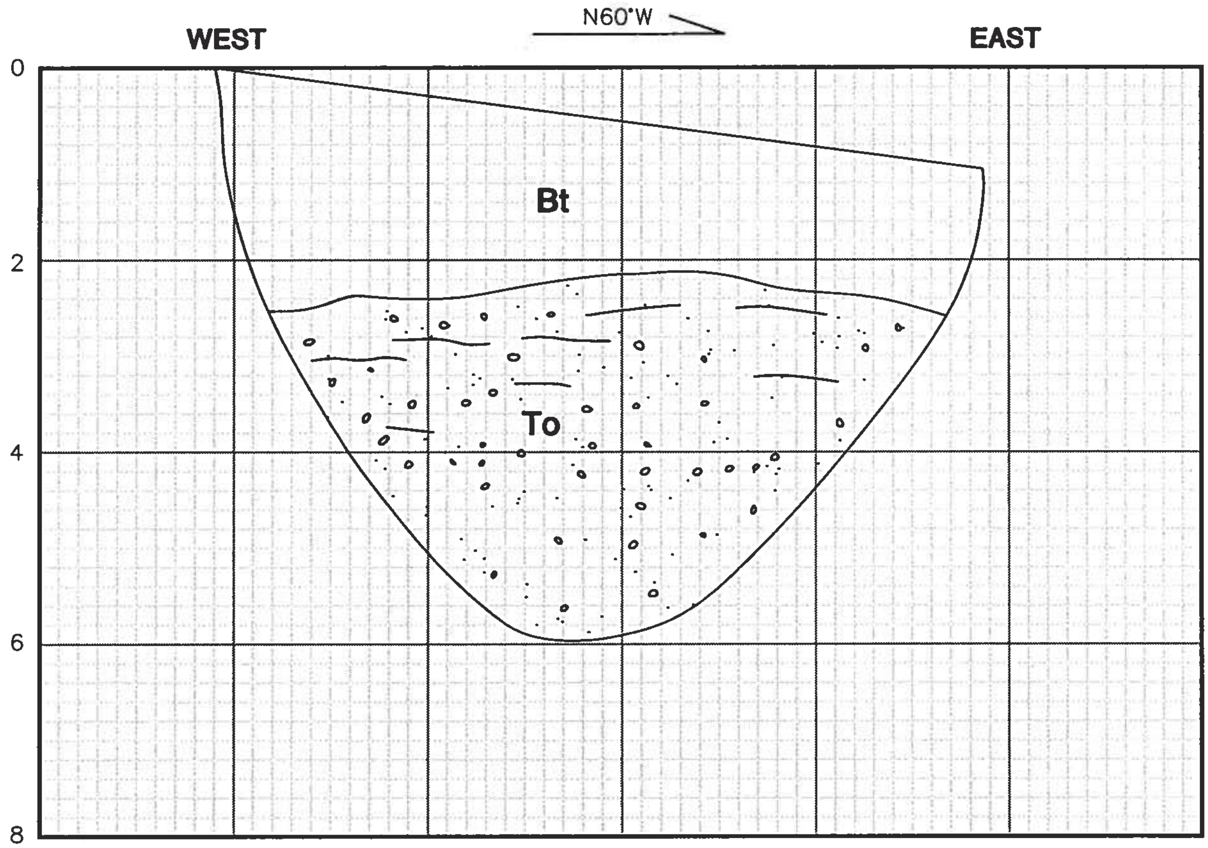


DEPTH IN FEET	MATERIAL DESCRIPTION
0 to 4'	Qc1 **COLLUVIUM:** SANDY SILT (ML) WITH CLAY, DARK BROWN, MOIST, MEDIUM STIFF
4' to 8'	Qc2 SANDY CLAY (CL), DARK BROWN, MOIST, MEDIUM STIFF, CONTAINS GRAVEL
8' to 8.4'	To **OTAY FORMATION:** SILTY SANDSTONE, YELLOW BROWN, MOIST VERY DENSE, FINE TO COARSE GRAINED, TRACE GRAVEL

PROJECT NO.	LOG OF TEST PIT NO. 5		SHEET
67735			1 OF 1

EXCAVATION EQUIPMENT	PROJECT NAME	LOCATION
BACKHOE	OTAY RANCH SUBSTATION	

DATE:	LOGGED BY:	CHECKED BY:	DEPTH:	ELEVATION:	DIRECTION:
12/20/2006	SHR	KMC	6'	471'	



DEPTH IN FEET	MATERIAL DESCRIPTION
0 to 2'	**Bt** **TOPSOIL:** SANDY SILTY CLAY (CL), DARK BROWN, MOIST, SOFT
2' to 6'	**To** **OTAY FORMATION:** SANDY SILT STONE, YELLOW BROWN MOIST, VERY DENSE, COARSE GRAINED WITH GRAVEL AND TRACE COBBLE

K – KROTOVINA ANIMAL BURROWS

FN: 67735TP

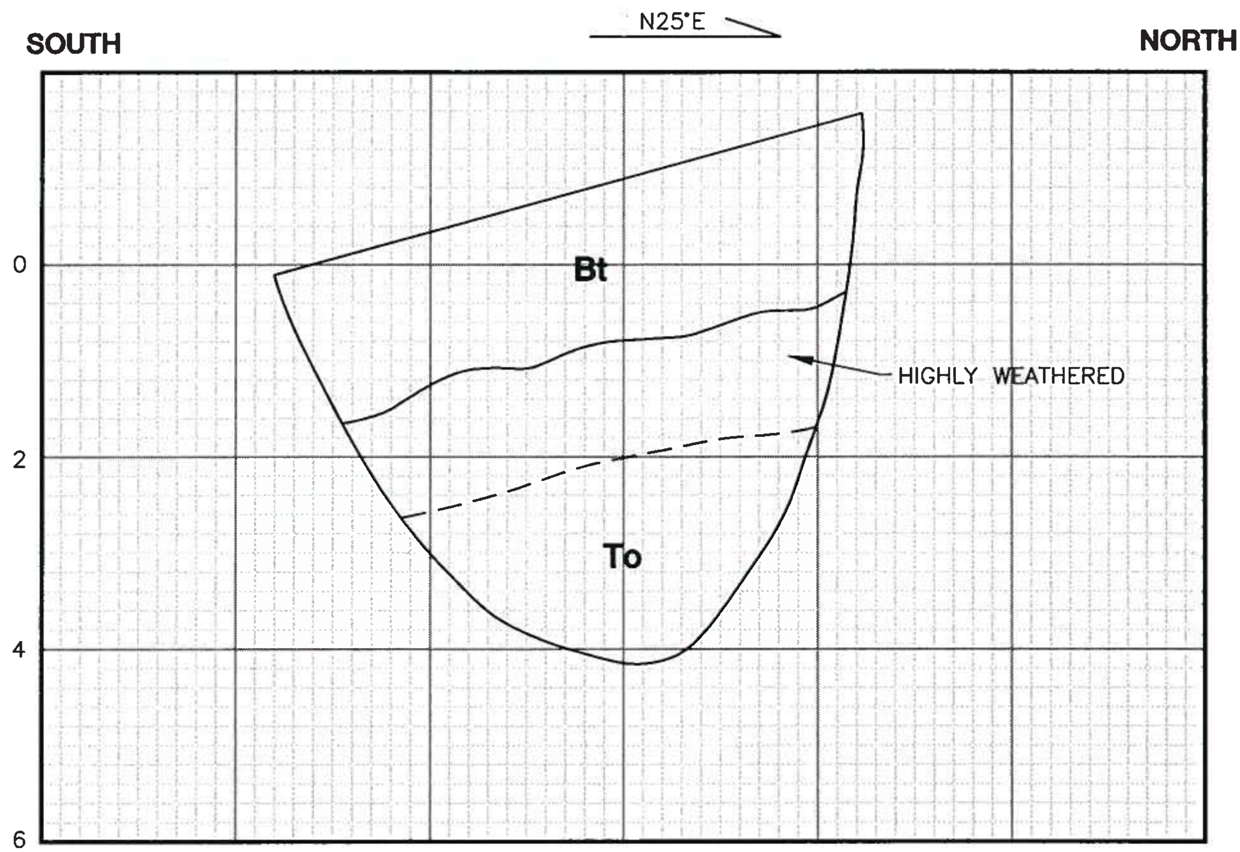
KLEINFELDER

5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

FIGURE NO.: A–17

PROJECT NO. 67735	LOG OF TEST PIT NO. 6	SHEET 1 OF 1
EXCAVATION EQUIPMENT BACKHOE	PROJECT NAME OTAY RANCH SUBSTATION	LOCATION

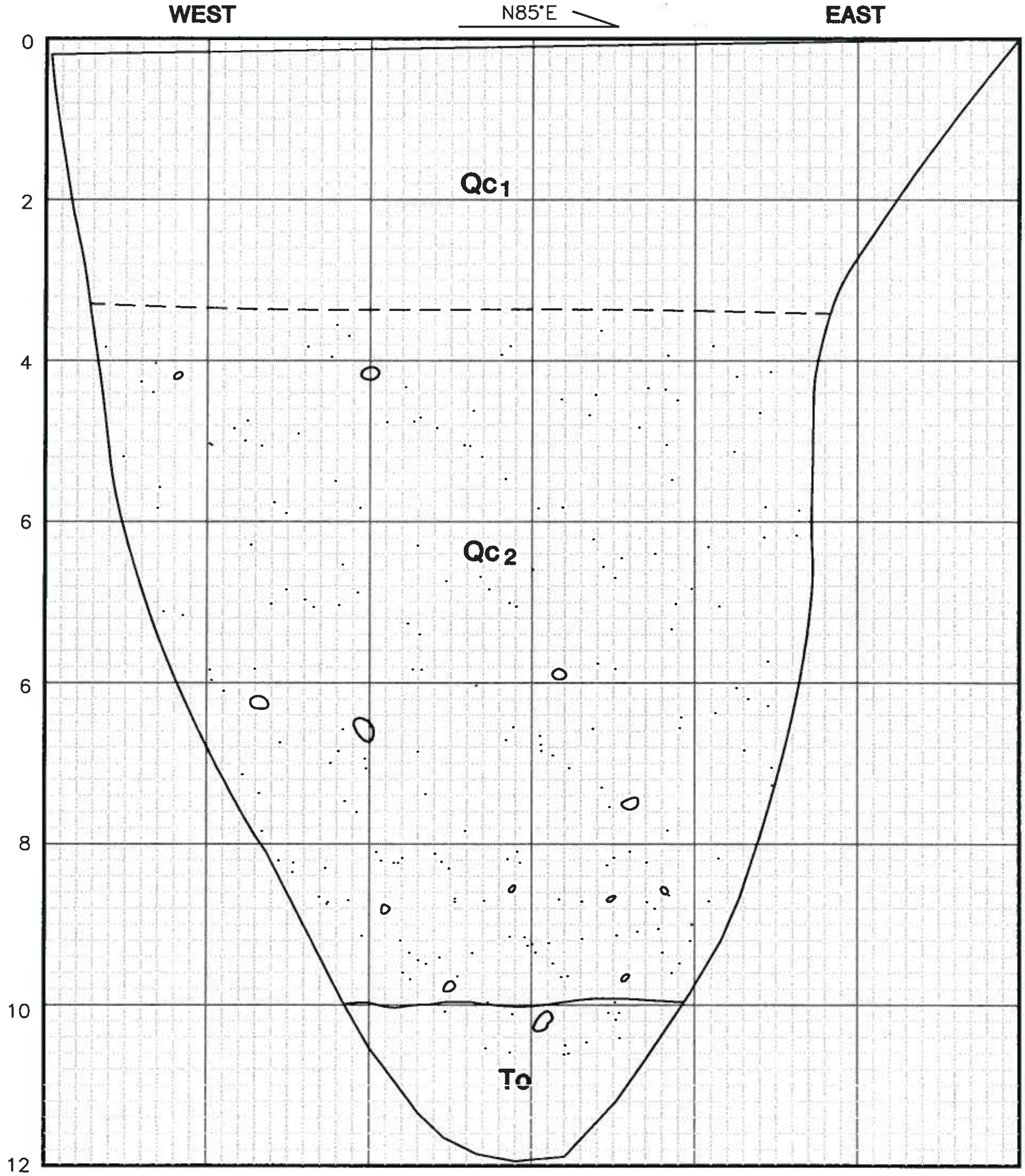
DATE: 12/20/2006	LOGGED BY: SHR	CHECKED BY: KMC	DEPTH: 4'	ELEVATION: 453'	DIRECTION:



DEPTH IN FEET	MATERIAL DESCRIPTION
0' TO 2'	**TOPSOIL:** **Bt** CLAYEY SAND (SC), DARK BROWN, MOIST, MEDIUM DENSE
2' to 4'	**OTAY FORMATION:** **To** SILTY SANDSTONE, YELLOW BROWN, MOIST, VERY DENSE, UPPER PART REDDISH BROWN, CONTAINS TRANSLOCATED CLAY

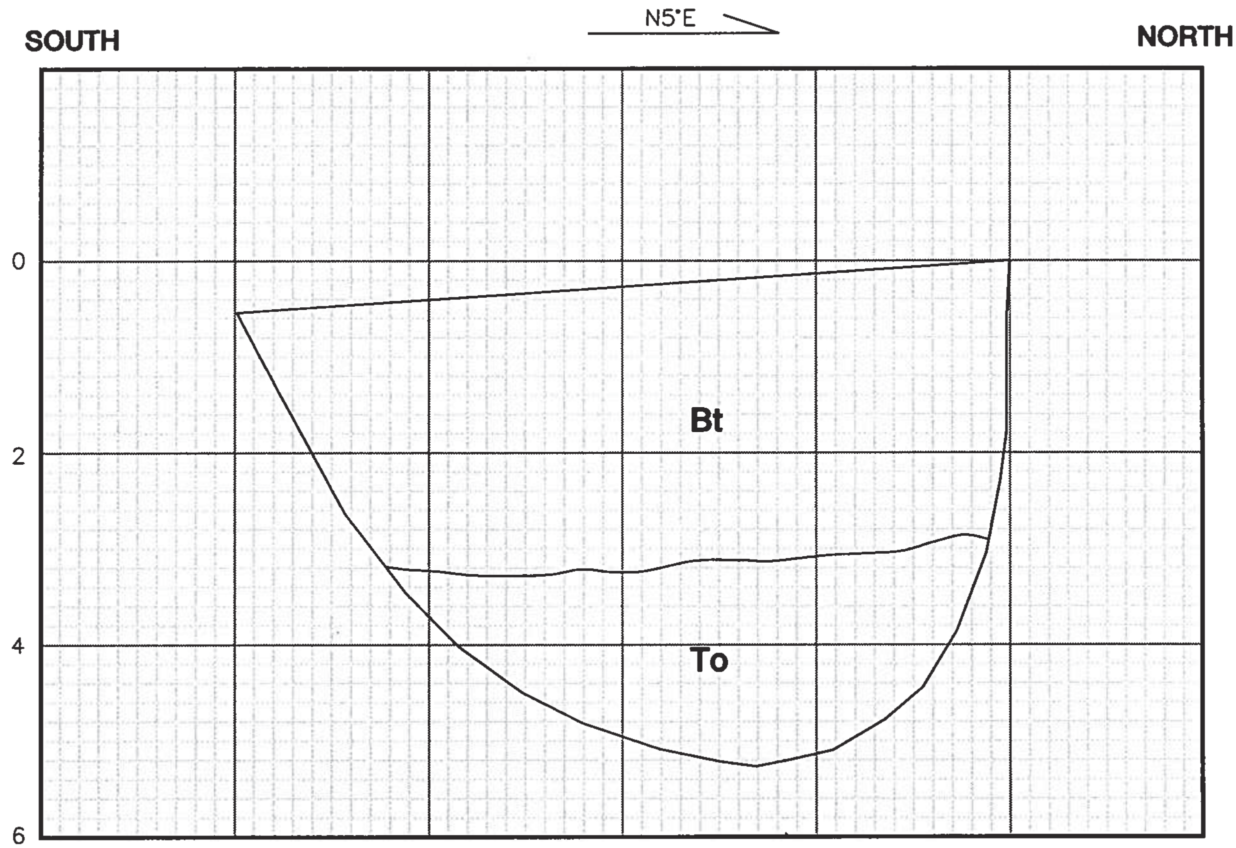
PROJECT NO. 67735	LOG OF TEST PIT NO. 7			SHEET 1 OF 1
EXCAVATION EQUIPMENT BACKHOE	PROJECT NAME OTAY RANCH SUBSTATION			LOCATION

DATE:	LOGGED BY:	CHECKED BY:	DEPTH:	ELEVATION:	DIRECTION:
12/20/2006	SHR	KMC	12'	427'	



DEPTH IN FEET		MATERIAL DESCRIPTION
0 to 3.4'	Qc1	**COLLUVIUM** CLAYEY SAND (SC), DARK BROWN, MOIST, SOFT
3.4' to 10'	Qc2	**COLLUVIUM** SANDY CLAY (CL), STIFF TO VERY STIFF, MOIST
10' to 12'	To	**OTAY FORMATION:** CLAYEY SANDSTONE (SC), YELLOW-REDDISH BROWN, MOIST, DENSE, HIGHLY WEATHERED

PROJECT NO. 67735	LOG OF TEST PIT NO. 8				SHEET 1 OF 1
EXCAVATION EQUIPMENT BACKHOE	PROJECT NAME OTAY RANCH SUBSTATION				LOCATION
DATE: 12/20/2006	LOGGED BY: SHR	CHECKED BY: KMC	DEPTH: 5'	ELEVATION: 465'	DIRECTION:



DEPTH IN FEET	MATERIAL DESCRIPTION
0 to 3'	**TOPSOIL:** **Bt** SANDY CLAY (CL), DARK BROWN, MOIST, MEDIUM STIFF
3' to 5.2'	**OTAY FORMATION:** **To** SILTY SANDSTONE, YELLOW BROWN, MOIST, VERY DENSE FINE TO COARSE GRAINED

APPENDIX B

Laboratory Test Results

APPENDIX B
LABORATORY TEST RESULTS

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

MOISTURE CONTENT AND DRY UNIT WEIGHT

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

SIEVE ANALYSIS

Three sieve analyses were performed on a representative sample of the materials encountered at the site to evaluate the gradation characteristics of the soil and to aid in classification. The tests were performed in general accordance with ASTM Test Method D 422. The result of the test is presented on Figure B-2 and B-4.

DIRECT SHEAR TEST

Four direct shear tests were performed on representative soil samples. The test procedures were in general accordance with the ASTM D 3080. The results are presented in Figures B-5 and B-8. Two of the samples were remolded to about 90 percent of the maximum dry density determined by ASTM D 1557.

COMPACTION TEST

The maximum dry density and optimum moisture content of two samples was evaluated by performing a compaction test in general conformance with ASTM test procedure D 1557. The results of these tests are shown on Figures B9 and B10.

EXPANSION INDEX TEST

One expansion index tests were performed on a representative soil sample. Test procedures were in general accordance with the Uniform Building Code (UBC) standard 18-2. The results are presented in Figure B-11.

CONSOLIDATION TEST

Consolidation tests were performed on two samples to aid in evaluating the compressibility of the fine grained soil when subjected to new loads. This test was performed in general accordance with ASTM Test Method D2435. The results of the tests are presented on Figures B4 and B5.

R-VALUE TESTS

R-value testing was performed on one sample of the potential subgrade soil. The test was performed in general accordance with Caltrans Standard Test Method 301. The test results are presented on Figure B14.

CORROSION TESTS

A series of chemical tests were performed on one representative sample of the anticipated near surface soils (after grading) to estimate pH, resistivity and sulfate and chloride contents. The test results are presented in Table B-1 and are attached.

Table B-1
Corrosion Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Minimum Resistivity (ohm-cm)
B-3	3-10	9.4	<10	10	1,400

Boring #	Sample #	Depth (ft)	Dry Density (pcf)	Moisture Content (%)	Description
B1	4	15	121.0	4.9%	light gray silty sand
B1	8	35	104.2	10.6%	brown silty sand
B2	1	2	110.3	8.6%	brown silty sand
B3	2	2	95.7	6.1%	light gray silty sand
B4	3	10	90.7	15.5%	grayish brown sandy clay
B4	7	30	103.5	20.0%	reddish brown clay
B4	9	40	105.1	21.0%	reddish brown clay
B4	15	70	98.2	19.5%	reddish brown clay
B4	17	80	101.2	21.5%	dark brown clay

Performed in General Accordance with ASTM D2937 and D2216

KLEINFELDER
An employee owned company

CHECKED BY: Uly TECH: E.M./R.R

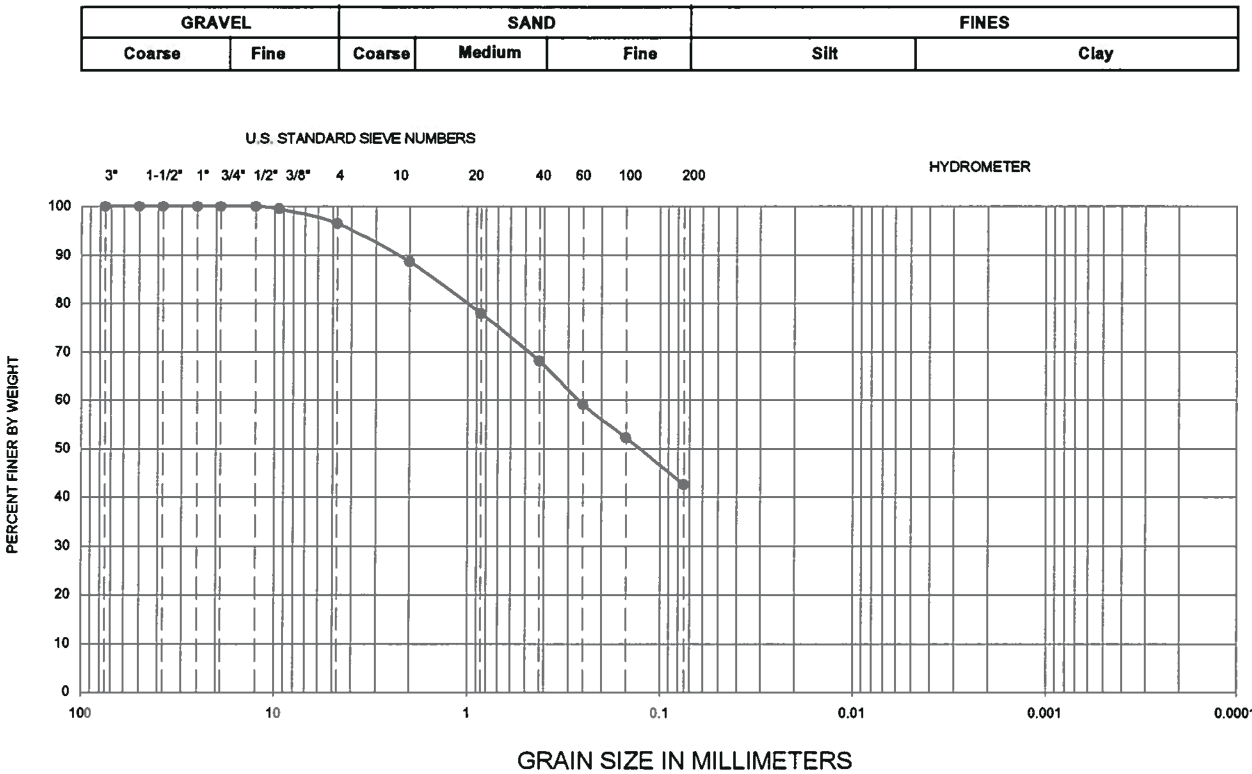
JOB NUMBER: 67735 DATE: 23-May-07

Dry Density and Unit Weight

SDG&E Otay Ranch Substation, Otay California

FIGURE

B1

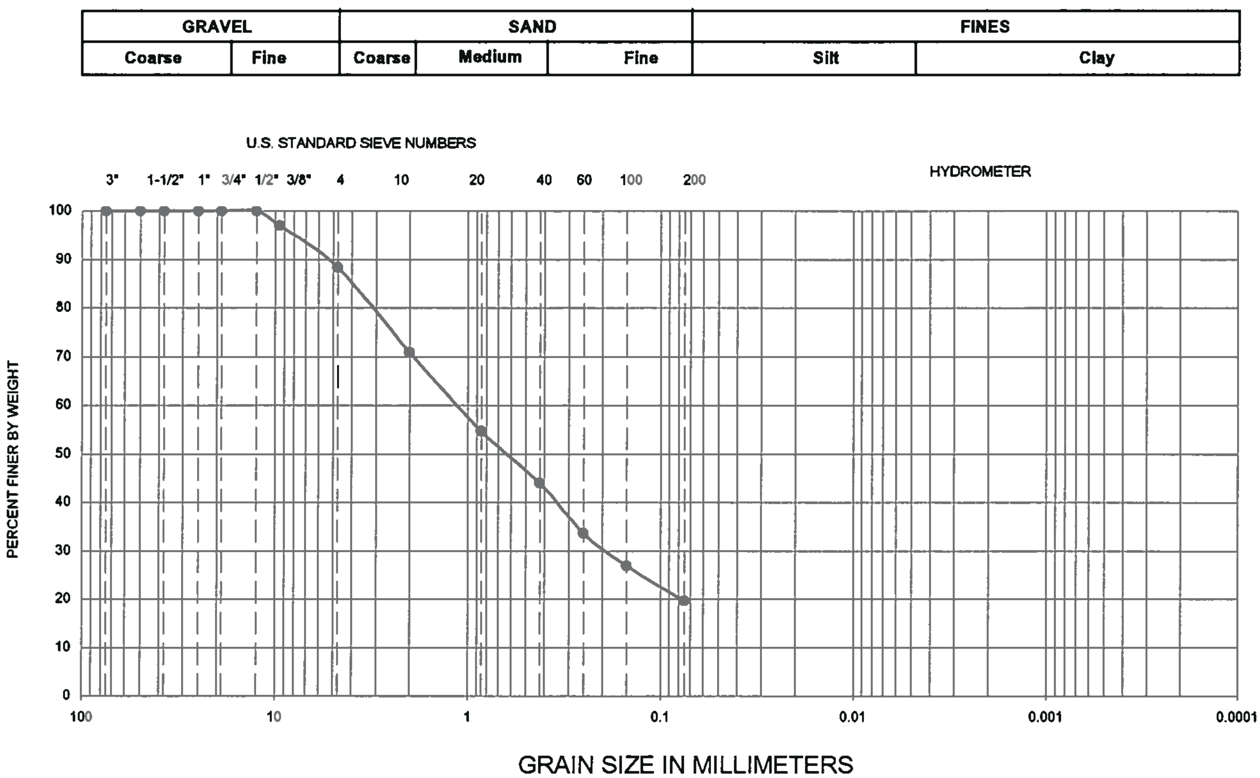


Sample Number	Location	Depth (ft)	Passing 200 (%)	USCS Classification
2	B1	5-9'	42.5	SM

Sample Description	light grayish brown clayey sand

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

KLEINFELDER An employee owned company		GRADATION TEST RESULTS SDG&E Otay Ranch Substation Otay California	FIGURE B2
CHECKED BY: Uly	TECH: E.M.		
PROJECT NO: 67735	DATE: 23-May-07		



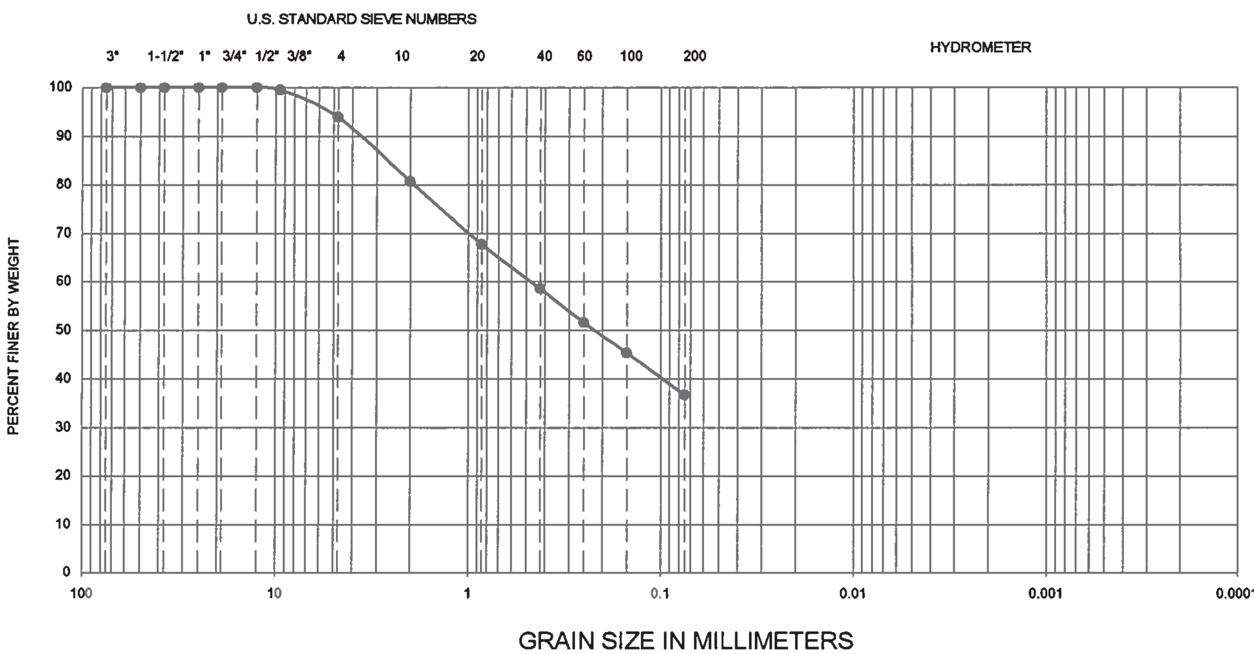
Sample Number	Location	Depth (ft)	Passing 200 (%)	USCS Classification
2	B2	5	19.6	SM

Sample Description	light brown silty sand

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

KLEINFELDER *An employee owned company*		GRADATION TEST RESULTS	FIGURE
		SDG&E Otay Ranch Substation Otay California	B3
CHECKED BY: Uly	TECH: E.M.		
PROJECT NO: 67735	DATE: 23-May-07		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Sample Number	Location	Depth (ft)	Passing 200 (%)	USCS Classification
1	TP7	1-3'	36.8	SC

Sample Description	dark brown clayey sand with trace of gravel

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

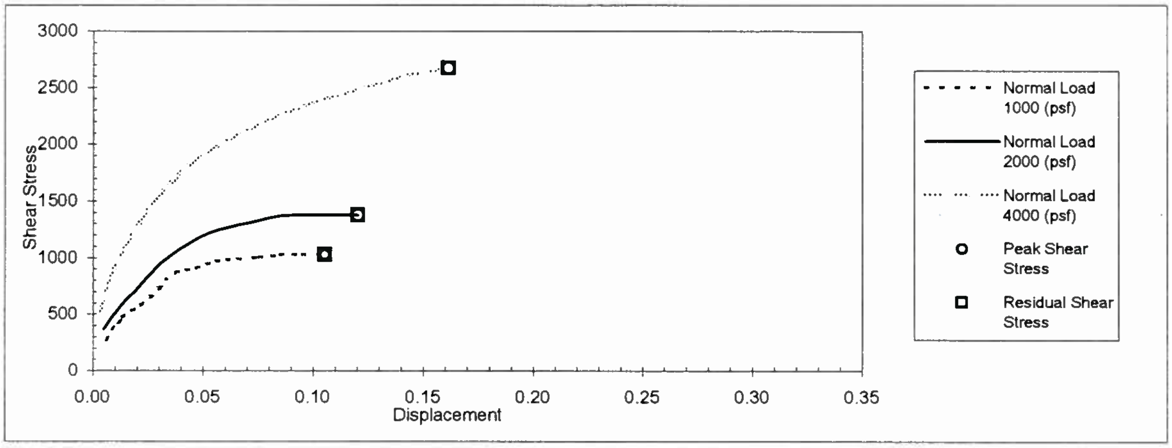
KLEINFELDER
An employee owned company

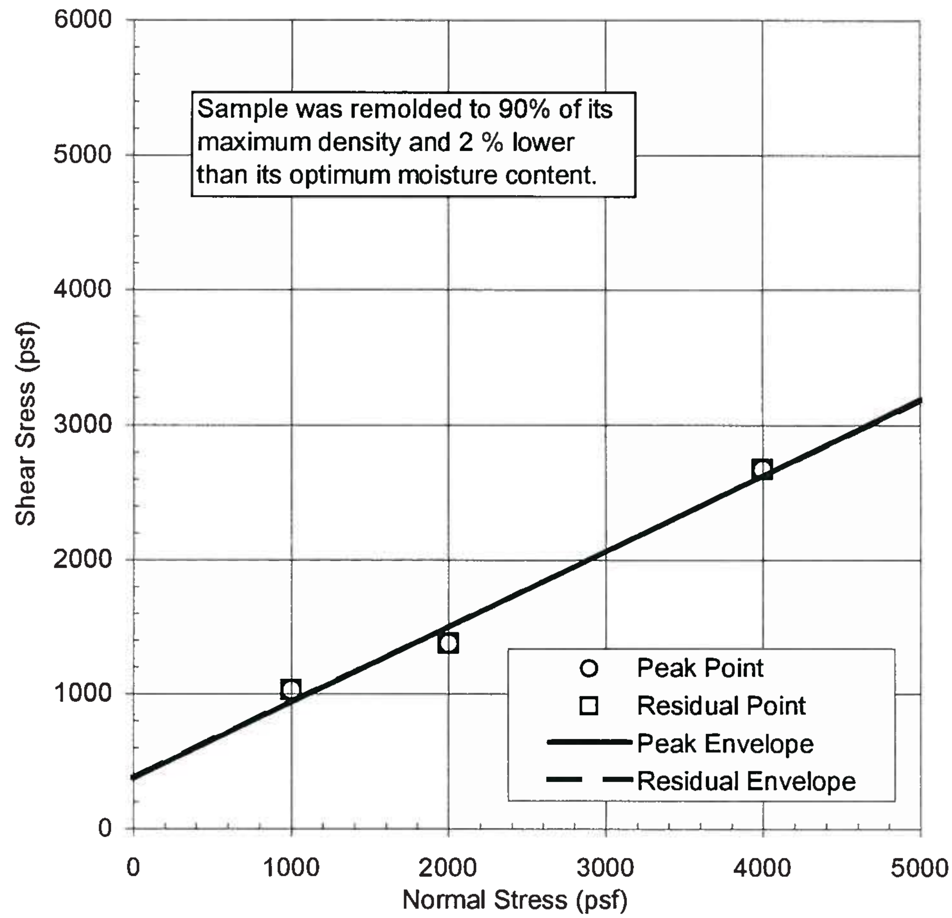
CHECKED BY: Uly	TECH: RR
PROJECT NO: 67735	DATE: 23-May-07

GRADATION TEST RESULTS

SDG&E Otay Ranch Substation
Otay, California

FIGURE
B4



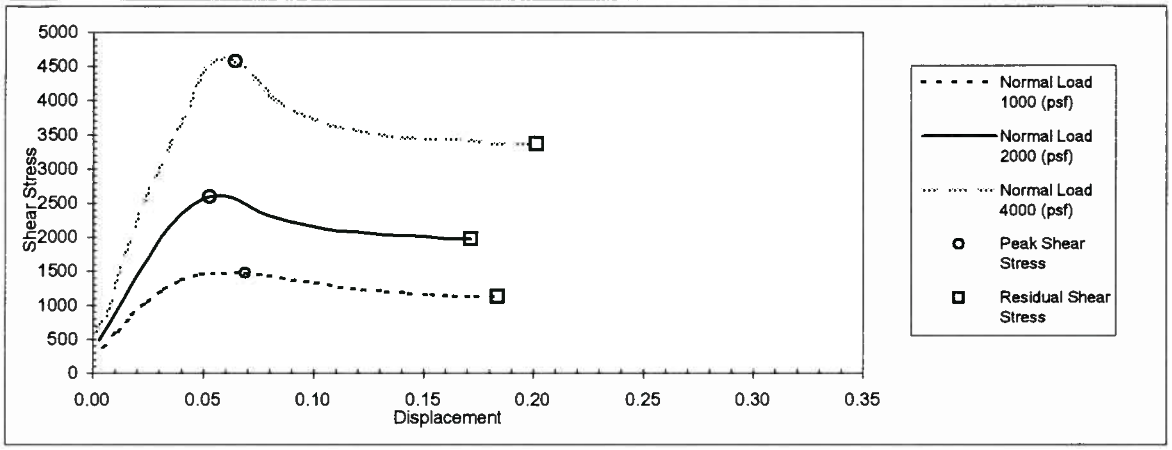


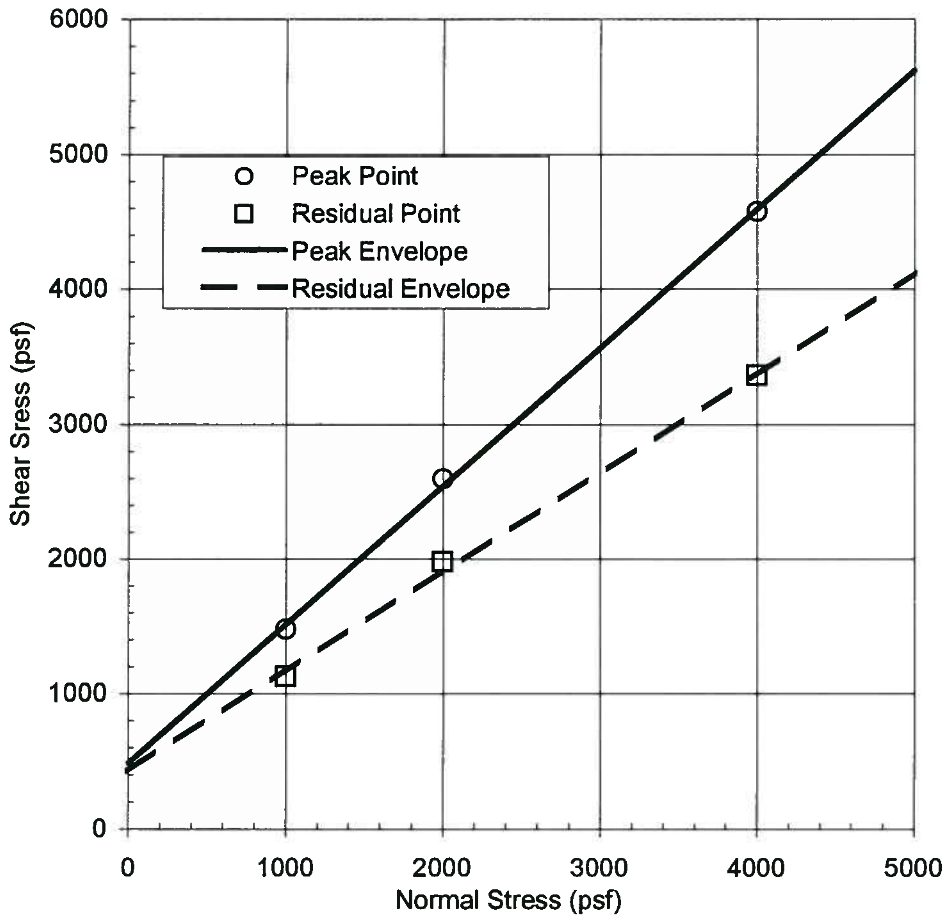
Strain Rate = 0.0158 inch/min

				Interpreted Shear Strength			
				Peak		Residual	
Description	Location	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)
See below	B1-2	5-9'	SC	378	29.4	378	29.4

Sample description: light gray clayey sand (Remolded Sample)

KLEINFELDER An employee owned company		Remolded Shear	Figure
		SDG&E Otay Ranch Substation Otay California	B5
Checked I Uly	FN: LAB		
Project # 67735	24-Feb-07		





Strain Rate = 0.0158 inch/min

Description	Location	Depth	UCSC	Interpreted Shear Strength: Peak Cohesion (psf)	Peak Friction Angle (deg)	Residual Cohesion (psf)	Residual Friction Angle (deg)
See below	B2-3b	10'	SM	486	45.8	430	36.5

Sample description: light brown silty sand with some clay and trace of gravel

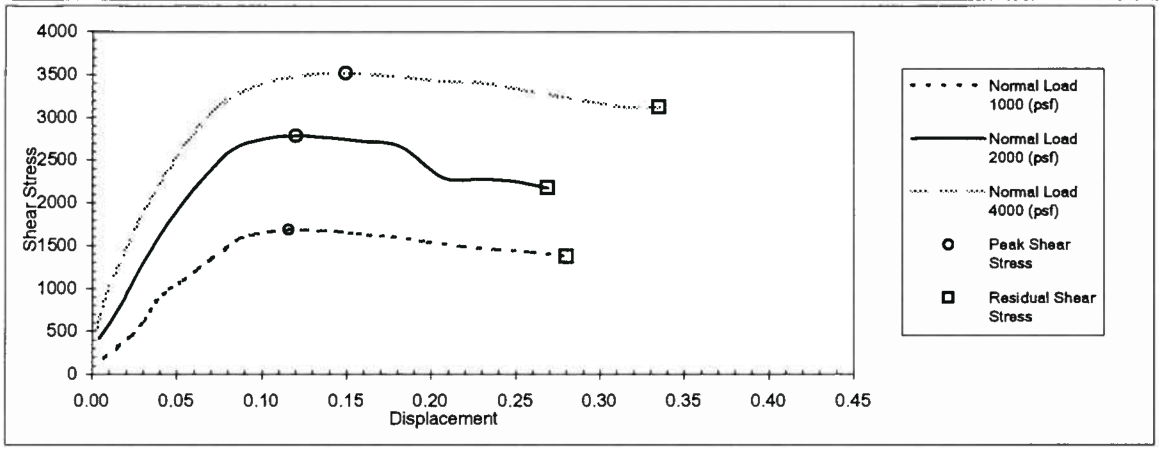
KLEINFELDER
An employee owned company

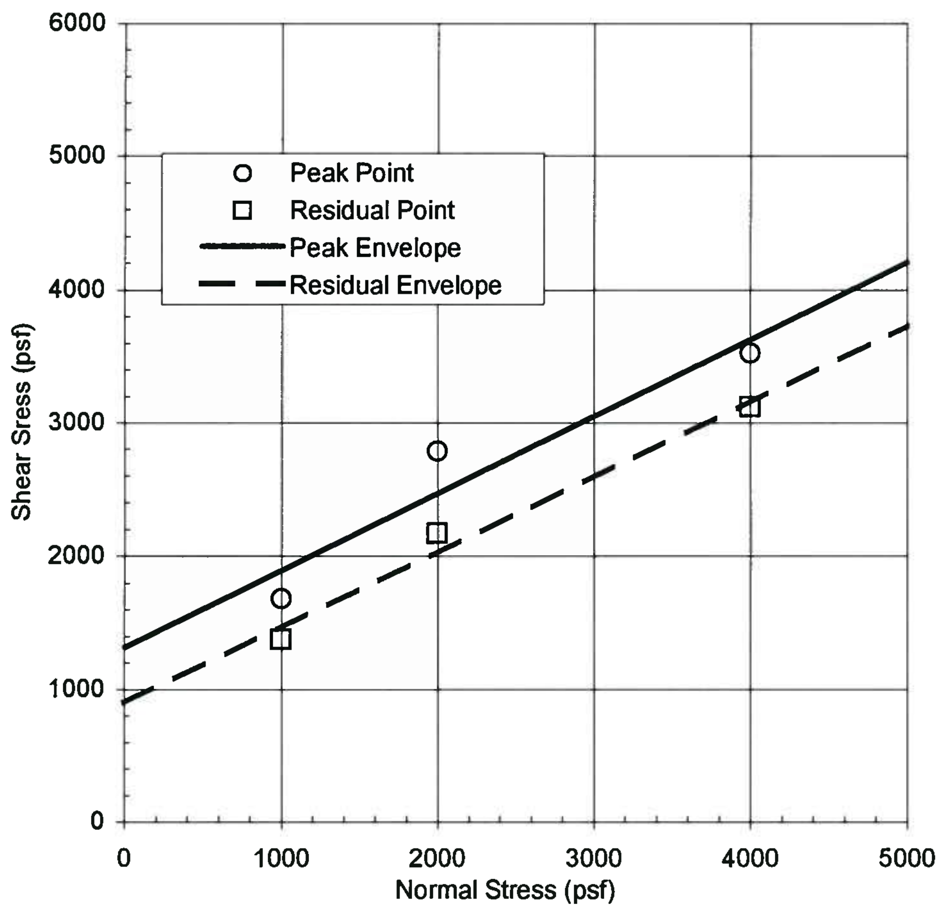
Checked I Uly	FN: LAB
Project # 67735	23-Feb-07

Direct Shear Test Results (ASTM D 3080)

SDG&E Otay Ranch Substation

Figure **B6**



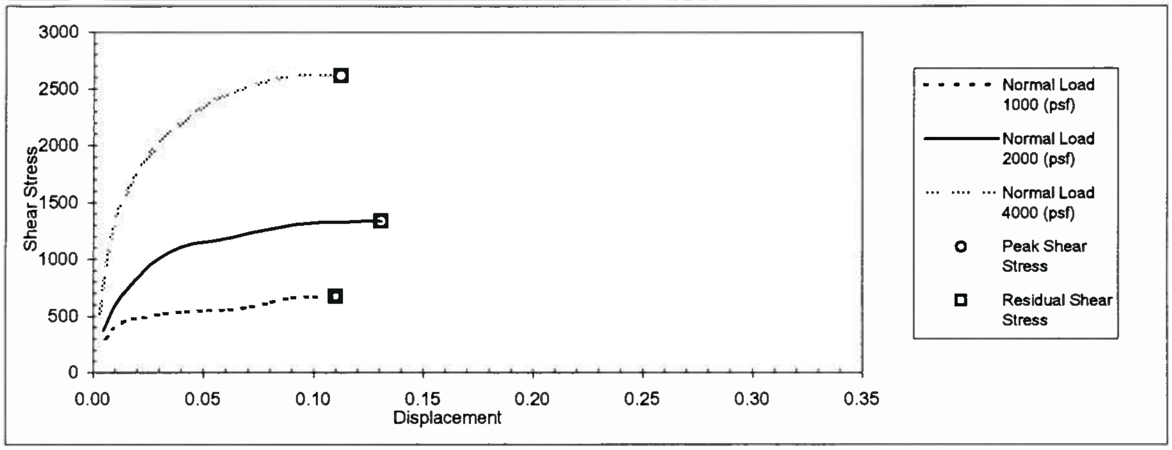


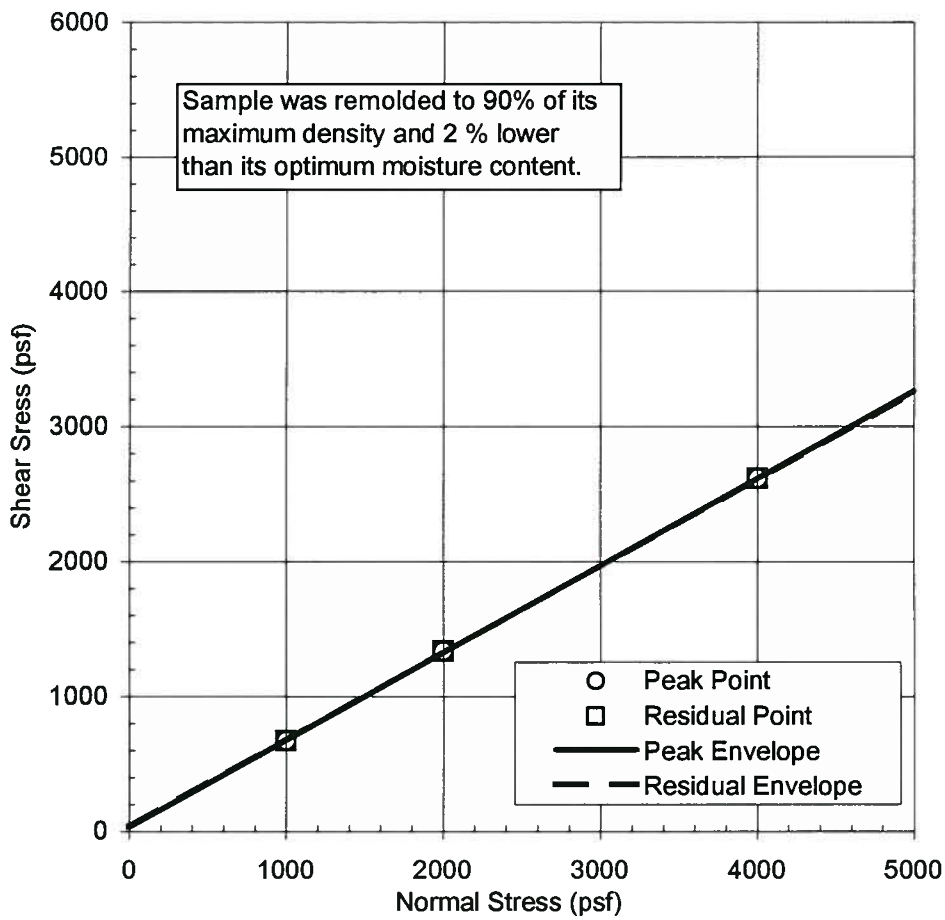
Strain Rate = 0.00315 inch/min

Description	Location	Depth	UCSC	Interpreted Shear Strength: Peak Cohesion (psf)	Peak Friction Angle (deg)	Residual Cohesion (psf)	Residual Friction Angle (deg)
See below	B4-6	25'	CL	1318	30	898	30

Sample description: Reddish brown with gray clay (fill)

KLEINFELDER An employee owned company		Direct Shear Test Results (ASTM D 3080)	Figure
Checked I JL	FN: LAB	SDG&E Otay Ranch Substation Otay California	B7
Project # 67735	20-Mar-07		





Strain Rate = 0.00315 inch/min

				Interpreted Shear Strength			
				Peak		Residual	
Description	Location	Depth	UCSC	Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)
See below	TP7-1	1-3'	SC	31	32.9	31	32.9

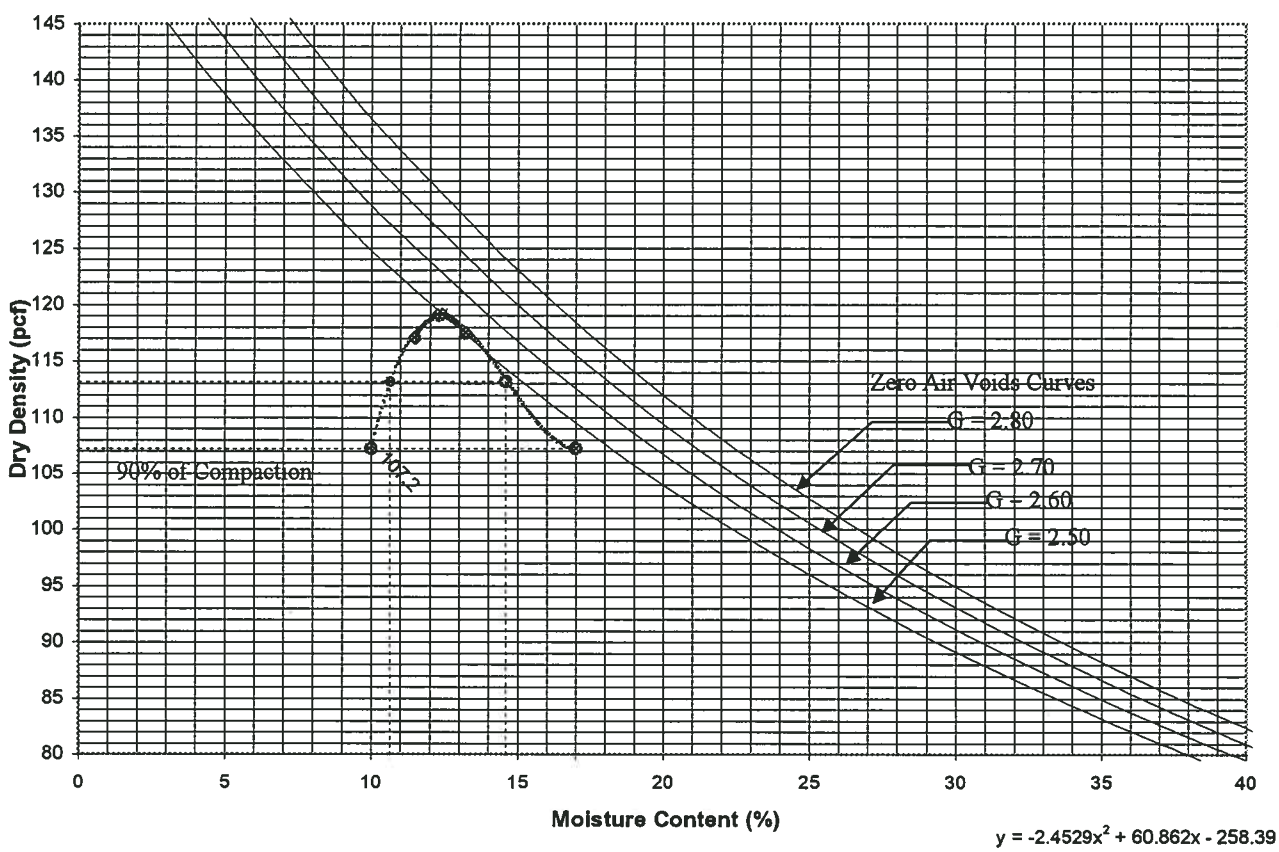
Sample description: dark brown clayey sand (Remolded Sample)

KLEINFELDER An employee owned company	**Remolded Shear Test**	Figure
Tech Uly / FN: LAB	**SDG&E Otay Ranch Substation Otay, California**	**B8**
Project # 67735 / 28-Feb-07		

Technician	S. Maletic		
Sample No.	2	Date Tested	2/13/2007
Location	B1 @ 5-9'		
Description	light grayish brown clayey sand		

Method	
D1557	X Performed in General Accordance with ASTM D1557
D698	

		4" or 6"					
		x					
Scalp Fraction	X	-No. 4	-3/4	Wet Density Determination			
Hammer Wt. (lb)	X	10	10	Soil + Mold	4008.8	3998	3961
Mold Size (c.f)	X	1/30	1/13.3	Mold Tare	1986.8	1986.8	1986.8
Drop Ht. (in.)	X	18	18	Wet Wt. Of Soil (g)	2022	2011.2	1974.2
Blows per Layer	X	25	56	Wet Density (pcf)	133.7	133.0	130.6
No. of Layer	X	5	5	Moisture Content Determination			
				Wet Wt. Of Soil (g)	170	165.2	163.9
				Dry Wt. Of Soil (g)	151.4	145.9	147
Results:				Tare (g)	0	0	0
Maximum Density (pcf) :			**119.1**	Moisture Content (%)	12.3	13.2	11.5
Optimum Moisture (%) :			**12.4**	Dry Density (pcf)	119.1	117.5	117.1



KLEINFELDER
An employee owned company

CHECKED BY:	Uly	FN.	LAB	
JOB NUMBER:	67735	DATE	23-May-07	

MAXIMUM DENSITY

SDG&E Otay Ranch Substation, Otay California

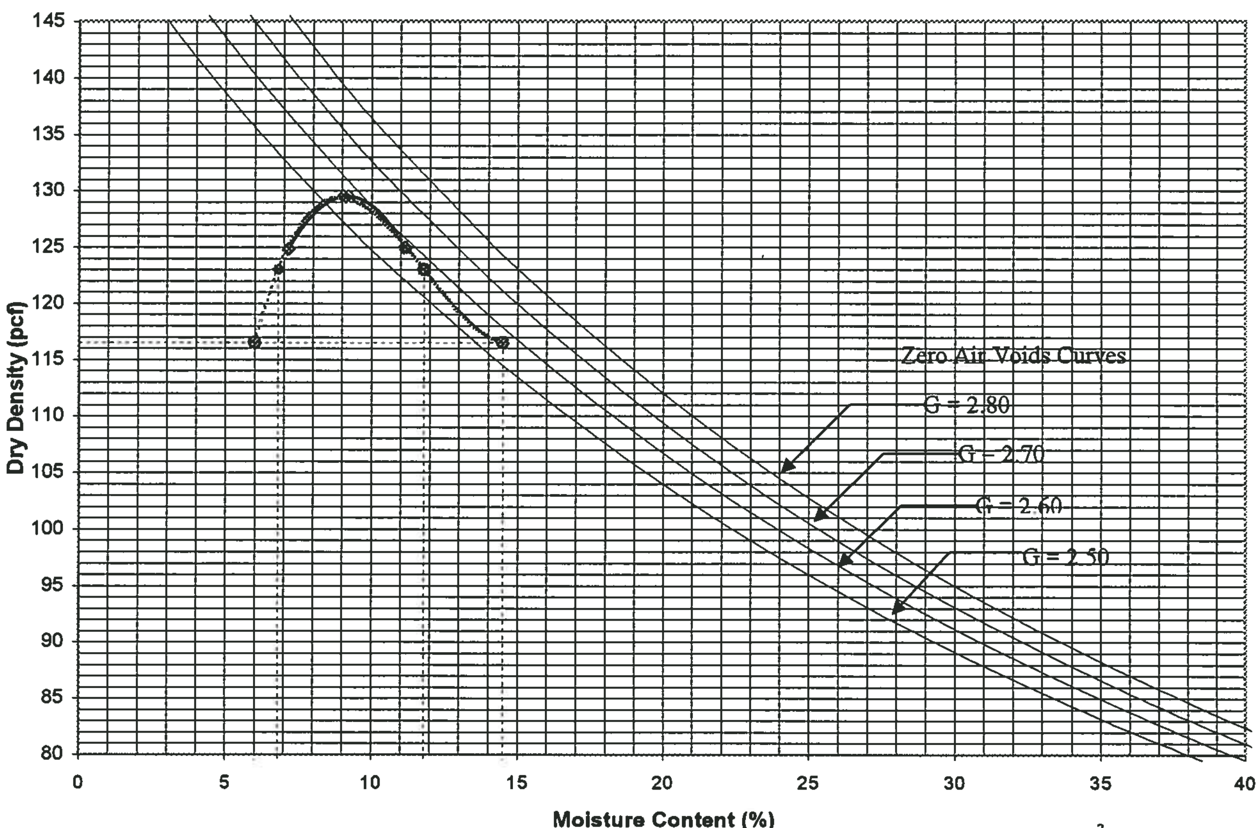
FIGURE **B9**

Kleinfelder Inc., 5015 Shoreham Place, San Diego Ca, 92122. Phone: (858)320-2000, Fax: (858)320-2001

Technician	RAR		
Sample No.	1	Date Tested	2/26/2007
Location	TP7 @ 1-3'		
Description	dark brown clayey f-c sand		

Method	
D1557	X Performed in General Accordance with ASTM D1557
D698	

		4" or 6"					
		x					
Scalp Fraction	X	-No. 4	-3/4	**Wet Density Determination**			
Hammer Wt. (lb)	X	10	10	Soil + Mold	4137.9	4103.2	4025.7
Mold Size (c.f)	X	1/30	1/13.3	Mold Tare	2003	2003	2003
Drop Ht. (in.)	X	18	18	Wet Wt. Of Soil (g)	2134.9	2100.2	2022.7
Blows per Layer	X	25	56	Wet Density (pcf)	141.2	138.9	133.8
No. of Layer	X	5	5	**Moisture Content Determination**			
				Wet Wt. Of Soil (g)	151.8	152.4	151.1
				Dry Wt. Of Soil (g)	139.2	137.1	141
Results:				Tare (g)	0	0	0
Maximum Density (pcf) :			**129.5**	Moisture Content (%)	9.1	11.2	7.2
Optimum Moisture (%) :			**9.2**	Dry Density (pcf)	129.5	125.0	124.8



$y = -1.1516x^2 + 21.131x + 32.558$

KLEINFELDER
An employee owned company

CHECKED BY:	Uly	FN.	LAB
JOB NUMBER:	67735	DATE	23-May-07

MAXIMUM DENSITY

SDG&E Otay Ranch Substation
Otay, California

FIGURE **B10**

Kleinfelder Inc., 5015 Shoreham Place, San Diego Ca, 92122. Phone: (858)320-2000, Fax: (858)320-2001

Sample Number	Location	Depth (ft)	Sample Description
1	TP3	1-3'	dark brown clayey sand

Density Determination	Trial #1	Trial #2
Weight Compacted Sample and Ring	596.0	
Weight of Ring	229.3	
Net Weight of Sample	366.7	
Wet Density, pcf	111.1	
Dry Density, pcf	96.6	

Moisture Determination		
Wet Weight of Sample, g	162.3	
Dry Weight of Sample, g	141	
Moisture Content, %	15.1%	

Expansion Index	43	
Corrected Expansion Index	**46**	**(LOW)**
% Saturation	54.7	

Expansion Readings

DATE	TIME	READING	
2/26/2007	6:26pm	0.358	
2/26/2007	6:36pm	0.3587	<< Add Water
2/27/2007	3:47pm	0.3153	<< Final

Moisture Content after Test

Wet+Ring	**631.8**
Dry	318.6
	26.3%

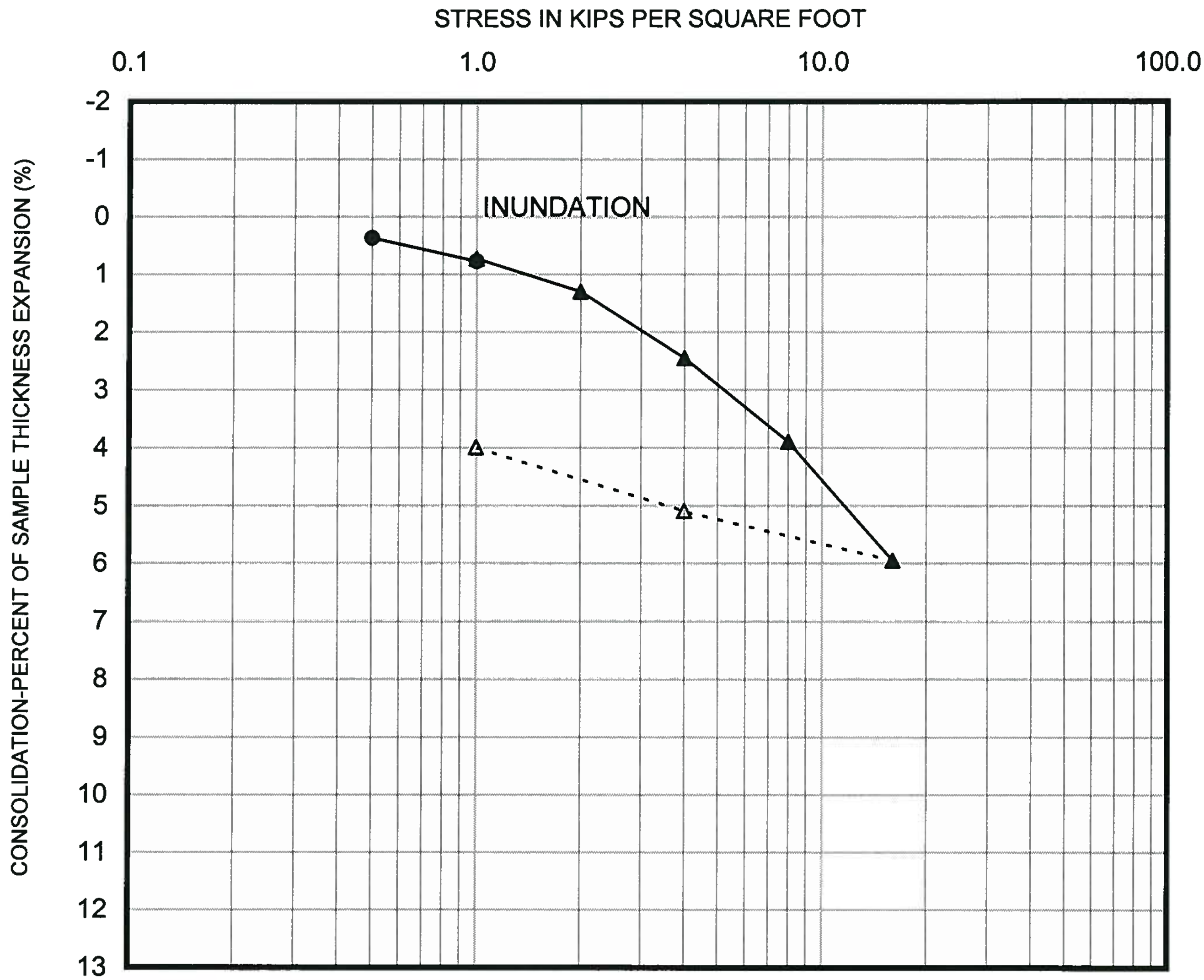
KLEINFELDER
An employee owned company

CHECKED BY: Uly	TECH: Uly
JOB NUMBER: 67735	DATE: 23-May-07

Expansion Index (ASTM D4829)

SDG&E Otay Ranch Substation
Otay, California

FIGURE **B11**

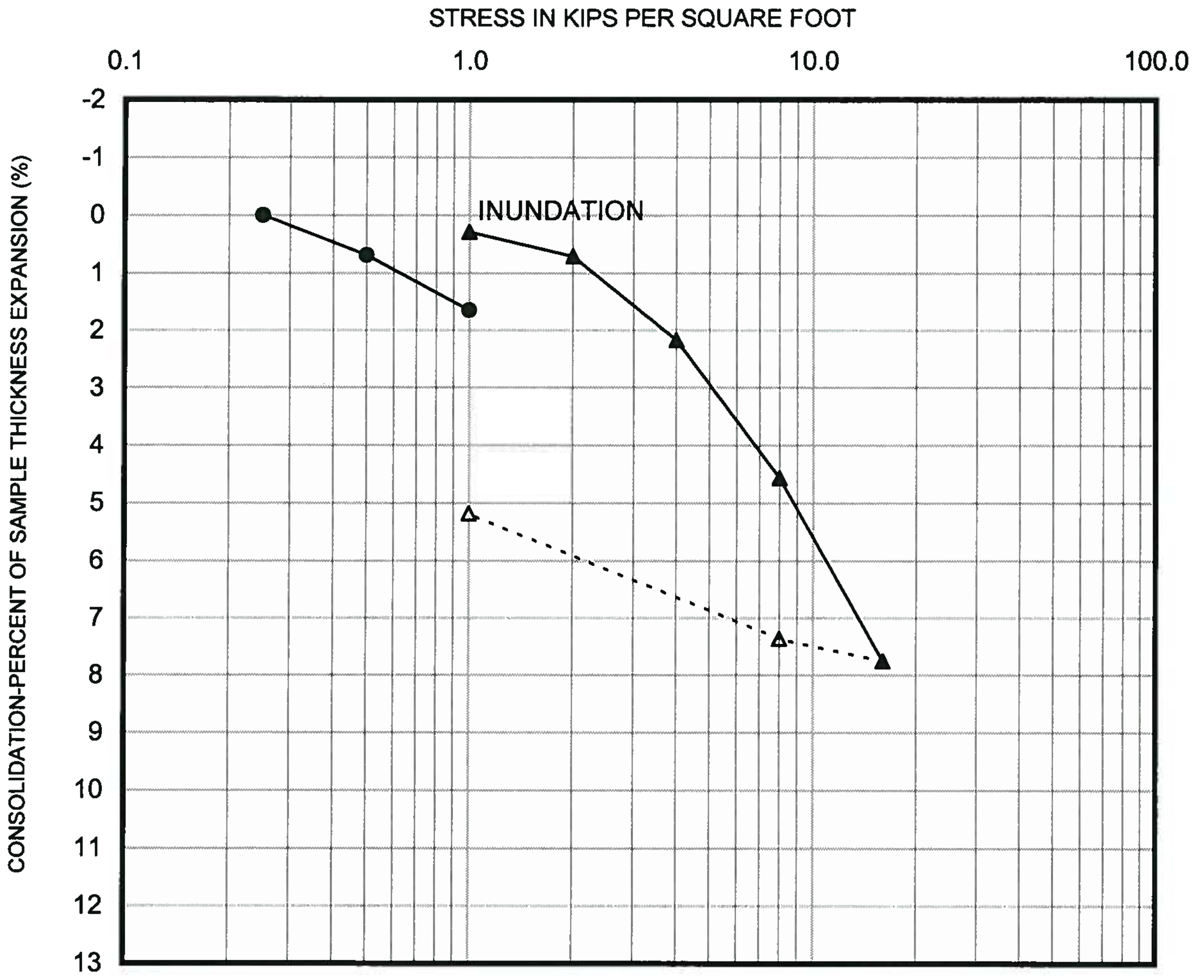


Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

Boring No. B4-11
Depth (ft) 50

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-96

KLEINFELDER *An employee owned company*		**CONSOLIDATION TEST**	**FIGURE**
		SDG&E Otay Ranch Substation Otay California	**B12**
CHECKED BY: JL	FN: LAB		
PROJECT NO.: 67735	DATE: 3/20/07		



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

Boring No. B4-18a
Depth (ft) 85

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-96

KLEINFELDER
An employee owned company

CONSOLIDATION TEST

SDG&E Otay Ranch Substation
Otay California

FIGURE
B13

CHECKED BY: JL	FN: LAB
PROJECT NO.: 67735	DATE: 3/20/07

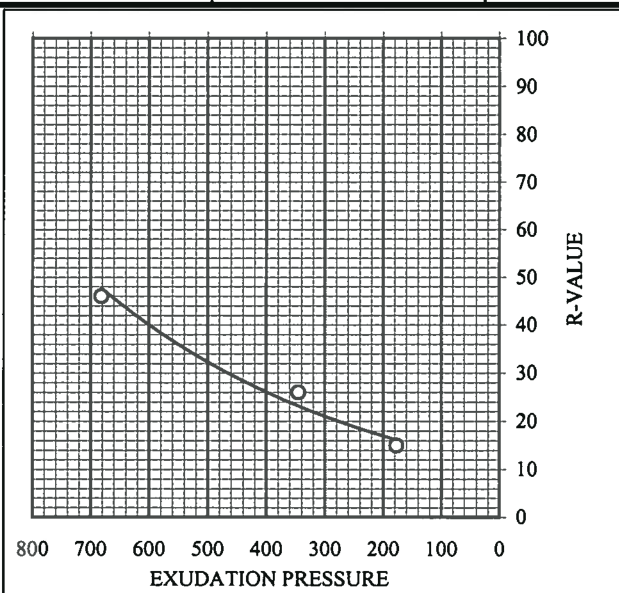
Sample No	Location	Description	Date Tested
Bulk 2	0-2'	Light yellow brown, silty f-c sand (SM) with few gravel	3/21-22/2007

TEST SPECIMEN				
MOLD NO.	#7	#3	#8	
FOOT PRESSURE, psi	**130**	**250**	**350**	
INITIAL MOISTURE, %	6.4	6.4	6.4	
"AS-IS" WEIGHT, g	1200	1200	1200	
DRY WEIGHT, g	1128.2	1128.2	1128.2	
WATER ADDED, ml	**80**	**65**	**50**	
COMPACTION MOISTURE, %	13.5	12.1	10.8	
HEIGHT OF BRIQUETTE, in.	**2.55**	**2.4**	**2.45**	
WEIGHT BRIQUETTE/MOLD, g	**3283**	**3248**	**3249**	
WEIGHT OF MOLD, g	**2106**	**2106**	**2114**	
WEIGHT OF BRIQUETTE, g	1177	1142	1135	
DRY DENSITY, pcf	123.4	128.7	126.8	
STABILOMETER, 1000 lbs	**54**	**41**	**20**	
2000lbs	**125**	**103**	**72**	
DISPLACEMENT, in	**4.01**	**3.58**	**3.44**	
EXUDATION LOAD, lbs	**2225**	**4339**	**8565**	
EXUDATION PRESSURE, psi	177.1	345.5	681.9	
R-VALUE	15	28	47	
CORRECTED R-VALUE	15	26	46	
DIAL READING, END				
DIAL READING, START				
DIFFERENCE				
EXPANSION PRESSURE, PSF				

INITIAL MOISTURE	
WET WEIGHT, g	1204.0
DRY WEIGHT, g	1132.0
WEIGHT OF WATER	
WEIGHT OF SAMPLE	
MOISTURE CONTENT %	6.4

R-VALUE: 21

REMARKS:



KLEINFELDER
An employee owned company

Checked By: Uly	TECH: Uly
Job Number: 67735	DATE: 23-May-07

R-Value (ASTM D2844)

SDG&E Otay Ranch Substation

FIGURE **B14**

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: February 22, 2007
Purchase Order Number: 67735
Sales Order Number: 87394
Account Number: KLE

To:

Kleinfelder Inc.
5015 Shoreham Drive
San Diego, CA 92122
Attention: Uly Panuncialman

Laboratory Number: SO2161 Customers Phone: 858-320-2000
Fax: 858-320-2001

Sample Designation:

One soil sample received on 02/21/07, taken on 02/21/07 taken from SDG&E Substation Otay Ranch marked as B3/1, B3/2, B3/4 @ 2'.5' '0' Respectivity

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

pH 9.4

Water Added (ml)	Resistivity (ohm-cm)
10	3,100
5	1,700
5	1,400
5	1,800
5	1,900

35 years to perforation for a 16 gauge metal culvert.
46 years to perforation for a 14 gauge metal culvert.
63 years to perforation for a 12 gauge metal culvert.
81 years to perforation for a 10 gauge metal culvert.
98 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate	Calif. Test 417	<0.001%
Water Soluble Chloride	Calif. Test 422	0.001%

Laura Torres
Laura Torres
LT/ovv

APPENDIX C
SUGGESTED GUIDELINES FOR EARTHWORK CONSTRUCTION

1.0 GENERAL

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

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

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

1.4 **Standard Specifications** - Where referred to in these specifications, "Standard Specifications" shall mean the State of California Standard

APPENDIX C

Earthwork Guidelines

Specifications for Public Works Construction, with Regional Supplement Amendments for San Diego County, 2000 Edition.

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

2.0 SITE PREPARATION

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

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

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

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

3.0 EXCAVATION

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

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

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

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

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

4.0 COMPACTED FILL

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

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

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

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

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

5.0 UTILITY TRENCH BEDDING AND BACKFILL

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

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

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

6.0 SUBSURFACE DRAINAGE

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

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

Sieve Size	Percentage Passing
3"	100
1-1/2"	90 - 100
3/4"	50 - 80
No. 4	24 - 40
No. 100	0 - 4
No. 200	0 - 2

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

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

7.0 AGGREGATE BASE BENEATH INTERIOR CONCRETE SLABS

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

Sieve Size	Percent Passing
1"	100
3/8"	30 – 100
No. 20	0 – 10

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

APPENDIX D

Preliminary Geotechnical Siting Study

KLEINFELDER
An employee owned company

July 20, 2006
Project No. 67735

Mr. Selim Tarabus
San Diego Gas & Electric
8316 Century Park Court
San Diego, California 92123

Subject: **Preliminary Siting Study Report**

Project: **SDG&E Substation**
Otay Ranch
Chula Vista, California

Dear Mr. Tarabus:

Kleinfelder is please to present this letter report concerning our preliminary siting study for a proposed SDG&E substation site located in the Otay Ranch area of Chula Vista, California. This is a revised report to our draft report dated on May 5, 2006. This report includes analysis of grading option 2A which was unavailable at the time of our draft report.

PURPOSE AND SCOPE OF SERVICES

San Diego Gas & Electric (SDG&E) is evaluating the suitability of a site in the Otay Ranch area of Chula Vista for the development of a new substation. In preparation of our study, we reviewed pertinent documents concerning the site and performed a site geologic reconnaissance. Our study was performed in accordance with the general guidelines for a preliminary siting study contained in "Technical Guidelines for Geo-Engineering Studies at Electrical Substation Sites," prepared by Woodward-Clyde, dated May 31, 1996. A subsurface exploration and laboratory testing were not included in the scope of this limited evaluation.

BACKGROUND RECORD REVIEW

We have reviewed the following documents in preparation of this report:

1. Grading Plan for the Otay Ranch – Village 11, Phase III subdivision, prepared by Hunsaker & Associates, undated.
2. Option 1 Preliminary Grading Plan for the Otay Ranch Substation, prepared San Diego Gas and Electric, dated October 19, 2005.
3. Option 2 Preliminary Grading Plan for the Otay Ranch Substation, prepared San Diego Gas and Electric, dated October 19, 2005.

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4. Option 2A Preliminary Grading Plan for the Otay Ranch Substation, prepared San Diego Gas and Electric, dated May 2, 2006.
5. Stereoscopic Aerial Photographic Plates 210-32F-5 & 4, on file at the County of San Diego Cartographic Services, dated November 29, 1978.
6. Aerial Photographic Plate 78-E11, on file at the County of San Diego Cartographic Services, dated 1928.
7. Geology of National City, Imperial Beach and Otay Mesa Quadragles, Southern San Diego Metropolitan Area, California, Map Sheet 29, Michael P. Kennedy and Siang S. Tan, CDMG, 1977.
8. Geotechnical Investigation, Otay Ranch Village 11 Subdivsion, Chula Vista California, prepared by GeoCon, dated February 2000.

SITE LOCATION AND SITE BACKGROUND

The general, the project area for the subject site is within the Otay Ranch region of Chula Vista, California (see Vicinity Map, Figure 1). This site is just southeast of the new extension of Hunte Parkway, which is currently under construction for the Otay Ranch – Village 11 Subdivision (see Site Map and aerial view, Figure 2). Review of historic aerial photography indicates that the site and surrounding area were previously used for agricultural purposes, most probably for cattle grazing. The site appears to have remained relatively unchanged between 1928 (the time of the oldest photo reviewed) and the initiation of the residential subdivision.

FIELD RECONNAISSANCE AND SITE DESCRIPTION

A certified engineering geologist and a geotechnical engineer from Kleinfelder conducted a site reconnaissance in January 2006, to assess and document current site conditions. Site access is provided via a recently constructed access road from the south side of Hunte Parkway. This access road and the newly constructed extension of Hunte Parkway are part of a significant grading project for the Otay Ranch – Village 11 residential subdivision. This earthwork has included grading work on the north side of the proposed substation site and consisted primarily of cut type grading of up to 30 feet in depth. The earthwork resulted in the creation of a v-shaped cut made for the access road with slopes up to 30 feet in height and gradients of approximately 2:1 horizontal to vertical units.

The south side of the site has remained relatively undisturbed and consists of gentle to moderately sloping hillsides which descend downward to the west, south and east to a natural drainage system below the site. The undeveloped portions of the site are covered with grasses which appear to have been previously used for cattle grazing. Based on our discussions with SDG&E, we understand that from an engineering standpoint, a suitable site for a substation would generally have approximately two acres of level space, and access roads having no more than a six to ten percent grade. Due to the present site conditions a significant amount of grading will be required to meet these conditions.

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SITE GEOLOGY

The geologic map by Kennedy and Tan (1977) indicates that the Pliocene age Otay Formation underlies the site (see local Geologic Map, Figure 3). The Otay Formation typically consists of arkosic sandstone and claystone. The claystone includes of beds of tan to gray bentonitic clay up to 1 meter in width. Our inspection of the cut slopes on the property indicate that geologic materials below the site consist of a very coarse friable silty sand. We did not observe any significant clay beds within the full height of the cut slopes. We also reviewed a geologic map prepared by GeoCon of this area for the adjacent subdivison. Their map show the site to be underlain by the coarse "gritstone" member of the Otay Formation. GeoCon's 2000 map does not show any landslides on or nearby the site.

The undisturbed natural ground surfaces are covered with a dark brown clay soil horizon to a depth of up to about 18 inches. This clay is related to natural soil development processes (pedogenesis).

Several tonal bands are apparent on aerial photography on hillslopes nearby the site that closely follow the surface topography. These bands are due to slight color variations between adjacent stratagraphic subunits and indicate that the geologic structure is generally horizontal. Regionally, the Kennedy and Tan geologic map indicate the structure has very low dips to the southwest.

POTENTIAL GEOLOGIC HAZARDS

Potential geologic hazards evaluated in our study include; fault rupture, seismic shaking, liquefaction, seismically induced settlement ground lurching and landslides. The following sections discuss these hazards and their potential at the sites in more detail.

Faulting and Ground Rupture

The project vicinity is considered to be seismically active, as is most of southern California. Our review of the referenced geologic maps do not show any mapped fault traces extending through or nearby the site. We also reviewed stereoscopic aerial photographs and specifically looked for indications of faulting during our recent geologic reconnaissance. Based on these surface interpretive methods, we did not observe indication of faulting on or nearby the site.

The Rose Canyon fault zone is the closest active fault system to the site and is located approximately 11.3 miles (18.1 km) to the west. Studies indicate that the most recent earthquake on the Rose Canyon fault in San Diego occurred after A.D. 1523 but before the Spanish arrived in 1769. Two additional later earthquakes may have occurred, on offshore segments of the Rose Canyon fault in the 1800s.

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The Rose Canyon fault zone consists of predominantly right-lateral strike-slip faults that extend south-southeast from La Jolla bisecting the San Diego metropolitan area. Various fault strands display strike-slip, normal, oblique, or reverse components of displacement which is typical of faults that have variations in strike and dip along their length. The fault zone extends offshore at La Jolla and continues north-northwest subparallel to the coastline. South of downtown San Diego, the fault zone splits into several splays that underlie San Diego Bay, Coronado, and the ocean floor south of Coronado. Portions of the fault zone in the Mount Soledad, Rose Canyon, and downtown San Diego areas have been designated by the State of California (CDMG, 1991, 2003) as being Earthquake Fault Zones.

A major strand of the potentially active La Nacion fault has been mapped approximately 3.8 miles (6.1 km) west of the site. The La Nacion fault zone is composed of several parallel to subparallel, west dipping normal faults that displace Tertiary and Quaternary deposits. Radiocarbon dates of unfaulted Holocene alluvium overlying the fault range from approximately 6,800 years to 13,400 years old (Hart, 1974). In addition, geomorphic features commonly associated with Holocene faulting, such as sag ponds and well-defined scarps, have not been observed along the La Nacion fault zone (Elliott and Hart, 1977). Furthermore, the California Geological Survey (CGS) does not consider the La Nacion fault zone to be an active or independent seismogenic source. Based on this data, we consider the seismic parameters associated with the closest known active fault, the Rose Canyon fault, more appropriate for design purposes. Based on the above information, the hazard with respects to ground rupture at the site is considered low.

Seismic Shaking

The most significant seismic event likely to affect the project sites would be strong seismic shaking from a maximum moment magnitude 6.9 earthquake resulting in the Rose Canyon fault zone. Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the United States Geological Survey the project site is located in an area where the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years will be approximately 0.23g (23 percent of the acceleration of gravity). The requirements of the governing jurisdictions and other governing standards should be considered in the design of structures.

Liquefaction and Secondary Seismic Hazards

There are several secondary hazards caused by seismic shaking from a significant earthquake event. The most notable is liquefaction. Other seismically induced hazards include lateral spread, seismic settlement and ground lurching.

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

The subject site is underlain at depth by dense sandstone. Our inspection of cut and natural slopes did not show signs of water seepage. Based on the dense nature of the on-site formational deposits and the apparent absence of a near surface groundwater, it is our opinion that the potential for liquefaction is low.

Lateral spread occurs when a clayey or weak water saturated subsurface layer undergoes a threshold reduction in of strength due to an instantaneous rise in pore water pressure during to seismic shaking. The weakened layer provides a surface of translational movement which causes the ground surface to spread laterally down an incline toward an unsupported slope face. We did not observe potential weak water layers during our site reconnaissance and we consider hazard with respects to lateral spread to be low.

Seismic settlement occurs when low density, natural or artificially placed fill soils undergo a volumetric reduction during a seismic event. Natural soils which are prone to seismic settlement are poorly consolidated coarse to medium grained alluvium and colluvium. Non-engineered poorly compacted fill soils are also prone to seismic settlement. We did not observe alluvium or colluvium at the site. Fill soils are present on slopes nearby the site which have been placed during earthwork on the residential subdivision. These fills are engineered and any fill placed during earthwork of the substation site will obviously be engineered. Based on these conditions, seismic settlement is considered be low.

Ground lurching is defined as mass movement of low-density materials on a bluff, steep slope, or embankment which yield laterally during an earthquake. Because the site is surrounded by gentle to moderately steep slopes, ground lurching is considered possible during a significant seismic event. However, the dense sandstone underlying the site is not the type of material particularly prone ground lurching and we therefore consider the hazard with respect to ground lurching to be low to moderate. Fill slopes are typically less dense and have lower strength characteristics than slopes of natural geologic material and therefore are more prone to lurching. If fill slopes are planned, it is important to maintain good quality control and proper benching during fill placement in order to achieve proper compaction, thus minimizing the potential for seismic ground lurching

Landslides

Landslides are deep-seated ground failures (several tens to hundreds of feet deep) in which a large arcuate shaped section of a slope detaches and slides downhill. Landslides can cause damage to structures both above and below the slide mass.

Structures above the slide area are typically damaged by undermining of foundations. Areas below a slide mass can be damaged by being overridden and crushed by the failed slope material. Landslides are not to be confused with minor slope failures (slumps), which are usually limited to the topsoil zone and can occur on slopes composed of almost any geologic material.

Several formations within San Diego County are particularly prone to landsliding. These formations generally have high clay content and mobilize when they become saturated with water. Other factors, such as steeply dipping bedding that project out of the face of the slope and/or the presence of fracture planes, will also increase the potential for landsliding.

Certain strata within the Otay Formation are highly susceptible to landsliding. These strata consist of layers of low strength bentonite clay and have been responsible for spectacular landslides in the border area south of the site. The geologic map covering the site does not show any landslides on or nearby the site. Additionally, our review of historical aerial photography did not show clear surface disruptions or topographic features indicative of landsliding. We did not observe clay beds within the sandstone material on any of the cuts on the north side of the site. Based on this information it is our opinion the hazard with respects to landsliding is low. Borings during geotechnical design should verify the absence of clay beds which could impact stability.

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. The geologic material underlying the sight consists of sandstone which we anticipate will have a low expansion potential. However, at the time of our site reconnaissance, we observed that the ground surface is underlain by a dark brown clayey soil horizon with dessication cracks up to about 8 inches deep. This soil horizon extends to depth of up to 18 inches and we anticipate that it will have a high expansion poteintial. Due to the shallow depth of the horizon, it can be addressed during grading by removal and either exportation or placement in non-sensitive areas.

Tsunamis and Seiches

Tsunamis are long wavelength sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. Low lying, near shore coastal areas are particularly prone to damages from tsunamis. The run-up in these areas can reach several thousands of feet inland for large wave events. Inland surges of up to a mile or more can occur up low profile valleys which are open toward the ocean.

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Due to the elevation of the site (over 500 feet above mean sea-level) and the distance from the ocean, the hazard with respects to tsunami damage is considered nil.

A seiche is an oscillation (wave) of a body of water in an enclosed or semi-enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from several inches to several feet. A seiche is caused chiefly by local changes in atmospheric pressure, aided by winds, tidal currents, and occasionally earthquakes. The closest body of the water to the site is Otay Reservoir which is located approximately near a mile (1.6 km) west of the site. Based on the distance to Otay Reservoir and the presence of an intervening valley, the potential for damage due to seiche is considered nil.

Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map 2177F (reviewed on website: www.sangis.org), the site is considered to be outside of 100-year and 500-year floodplains. Based on review of topography, the site is not located downstream from the nearby Otay reservoir and is at and elevation of over 500 feet MSL which is above the spillwater elevation of 491 feet MSL of the reservoir. Based on this review, the potential for flooding at the site is considered low.

GEOTECHNICAL CONSIDERATIONS

Based on the results of our preliminary geologic reconnaissance and review, it is our opinion that construction of the project at the proposed substation site is feasible from a geotechnical perspective. A significant amount of earthwork will be required for the site based on the required approximate 2-acre level pad and access roadway grades Specific geotechnical factors that should also be considered when evaluating Options 1 and 2 for grading development of this site are discussed below. Figures 4 and 5 present the preliminary grading plans for Options 1 and 2, respectively.

- Option 1: Creating a mostly cut pad at a notably lower elevation below Hunte Parkway will require a longer site access road and with cut into and fills over the existing graded slope. This will require detailed study and engineering analysis for the effects of grading and stability of this slope. Additionally, the sloping ground which descends essentially in three directions down the hillside nose, will result in fill placement along with several cut/fill transition lines across corner of the pad. Sensitive structures should not be positioned across these transitions or it will probably be necessary to overexcavate and recompact portions of the pad to provide a more uniform subgrade.
- Option 2: Creating a pad near the elevation of Hunte Parkway will require deep fill placement within the v-shaped cut feature for the existing access road on the north side of the site. This fill will have appreciable depth variation across the pad which may result in adverse differential settlement across the fill area. The deepest portion of the fill will be near the center of the pad and be up to about 45 feet deep.

- Option 2A: This option results in a combination cut/fill pad with a cut of up to 25 feet on the north and fill of up to 50 feet on the south. Access is provided from the east via a roadway through the SDG&E easement on the northeast. The combination of cut/fill pad and resultant varible depth fill wedge which will increase from a daylight near the center of the pad up to 50 feet will have significant differential fill settlement potential.
- All Options: A thin cover of potentially highly expansive soils covers the natural ground surface. These soils will require removal during grading so they do not remain at finish grade below sensitive structures.

RECOMMENDATIONS FOR ADDITIONAL STUDY

We recommend that a comprehensive geotechnical evaluation, including development-specific subsurface exploration and laboratory testing be conducted prior to design and construction. The purpose of the subsurface evaluation would be to further evaluate the subsurface conditions and to provide information pertaining to the engineering characteristics of earth materials at the project site. We also recommend that corrosion testing be performed on all on-site soils and imported soils used in the project. Based on the results of the geotechnical evaluation and laboratory testing, recommendations for grading/earthwork, surface and subsurface drainage, foundations, pavement structural sections, and other pertinent geotechnical design considerations may be formulated.

We appreciate this opportunity to be of continued service and look forward to future endeavors. If you have any questions about our report, please contact us at (858) 320-2000.

Very truly yours,

KLEINFELDER, INC.

Scott H. Rugg, CEG 1651
Senior Engineering Geologist

REGISTERED GEOLOGIST
SCOTT H. RUGG
NO. 1551
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

SHR:KMC:aea

Attachments: Vicinity Map
Site Map
Local Geologic Map
Option 1 Grading
Option 2 Grading
Option 2A Grading

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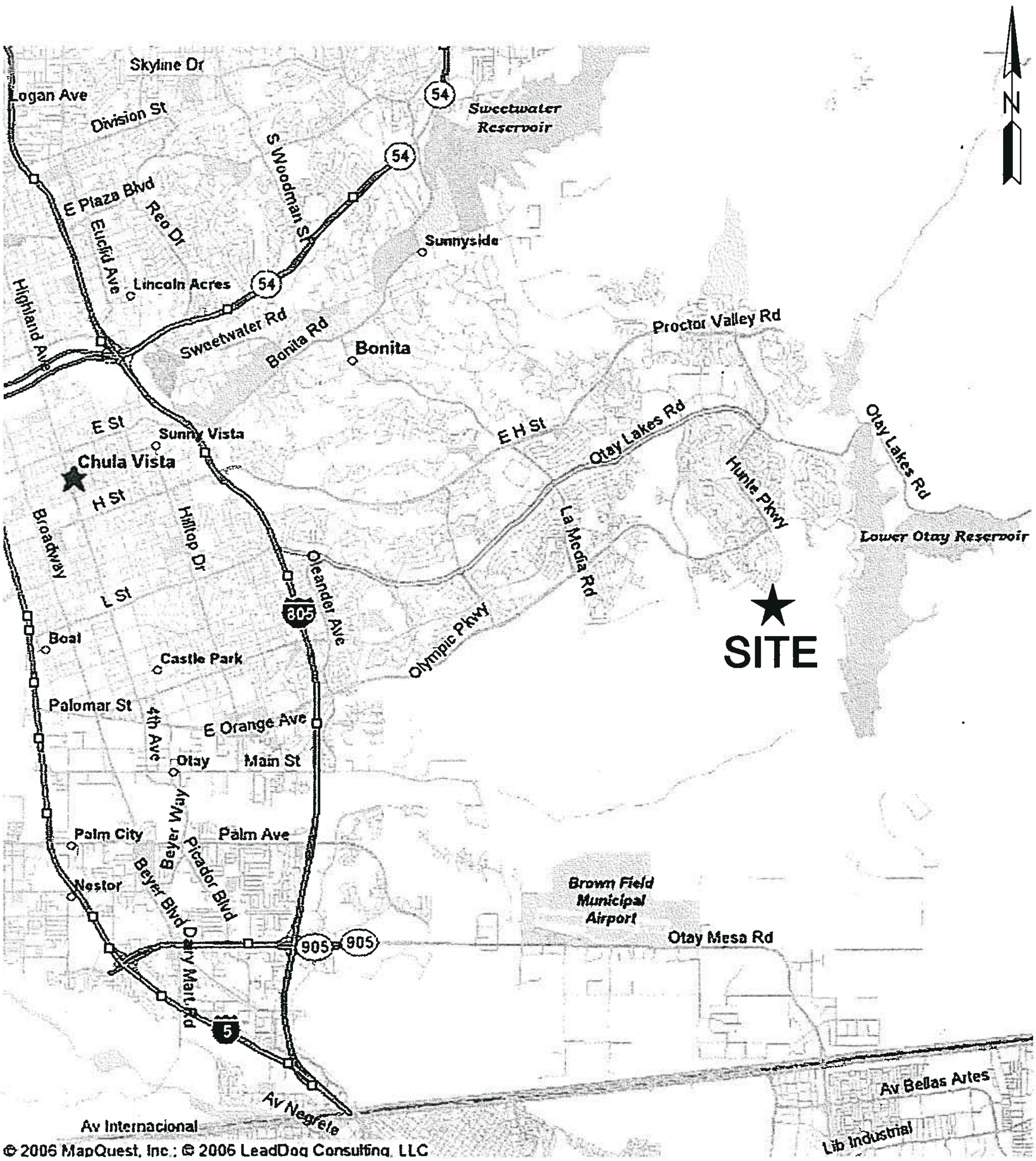
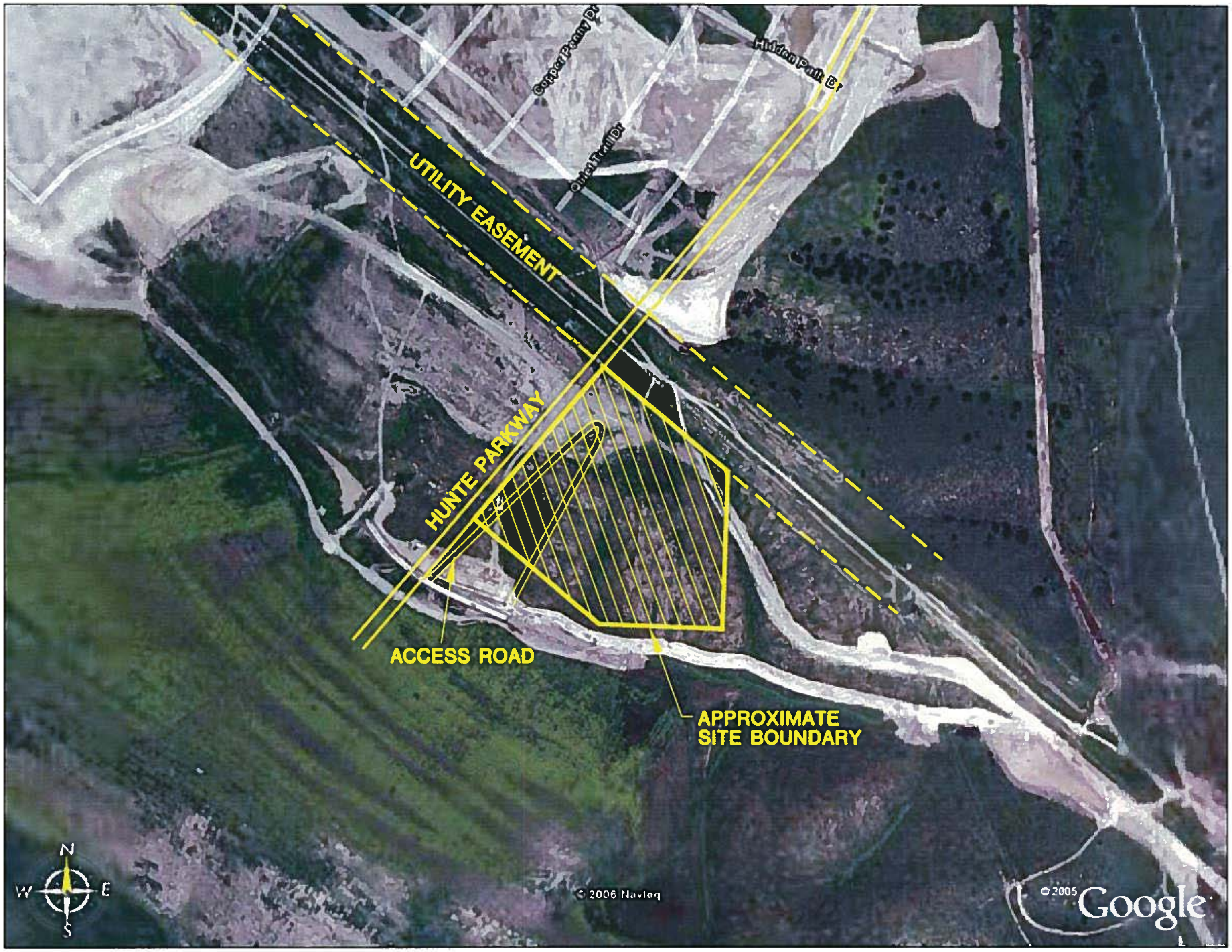


NOT TO SCALE

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		VICINITY MAP OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 1
CHECKED BY: SHR	FN: 67735SITE		
PROJECT NO. 67735	DATE: 04/2006		



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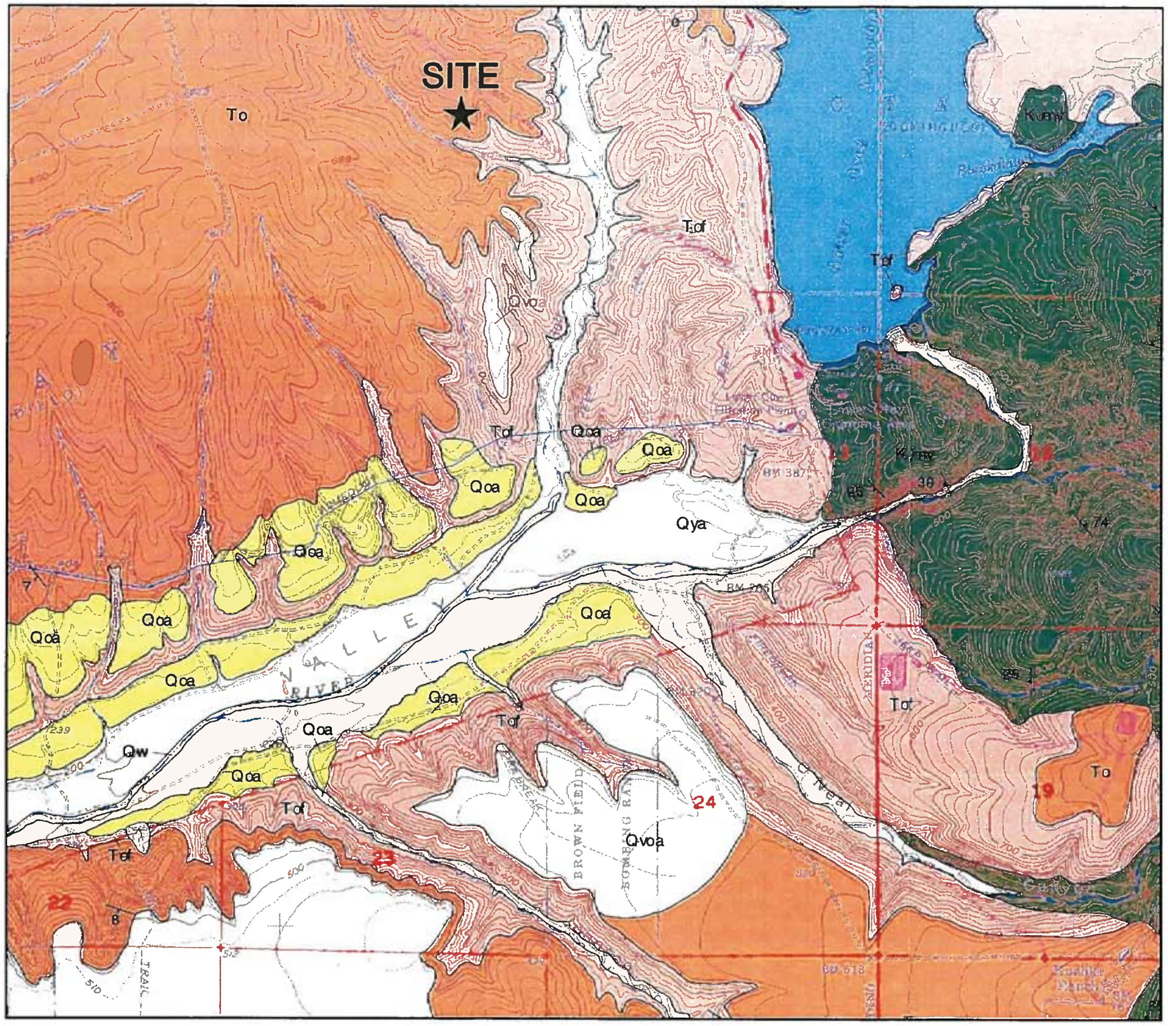
NOT TO SCALE

KLEINFELDER 5015 SHOREHAM PLACE SAN DIEGO, CALIFORNIA 92122		SITE MAP OTAY RANCH SUBSTATION SITE OTAY, CALIFORNIA	FIGURE 2
CHECKED BY: SHR	FN: 67735SITE		
PROJECT NO. 67735	DATE: 04/2006		



DESCRIPTION OF MAP UNITS

Qw	Late Holocene active channel and wash deposits; unconsolidated sand, silt, gravel and clay. Deposits along smaller drainage channels are included in Qya.
Qya	Holocene alluvial deposits; unconsolidated to poorly consolidated silt, clay, sand and gravel. Includes modern active sediments along small drainage channels.
Qoa	Alluvial deposits (late to middle Pleistocene); moderately consolidated, poorly sorted flood plain deposits consisting of gravely sandy silt and clay.
Qvoa	Alluvial deposits (middle to early Pleistocene); well consolidated, poorly sorted flood plain deposits consisting of gravel, sand, silt and clay.
To	Otay Formation (Oligocene to Miocene); poorly indurated massive light colored sandstone, siltstone and claystone, interbedded with bentonite lenses.
Tof	Otay Formation-fanglomerate facies (Oligocene to Miocene); poorly cemented bouldery conglomerate and coarse-grained sandstone. Interfingered with overlying To.
KJmv	Metavolcanic rocks (Jurassic and Cretaceous); mildly metamorphosed volcanic, volcaniclastic and sedimentary rocks. Volcanic rocks range from basalt to rhyolite, but are predominately andesite and dacite. In general, metavolcaniclastic rocks are most abundant.

N

NOT TO SCALE

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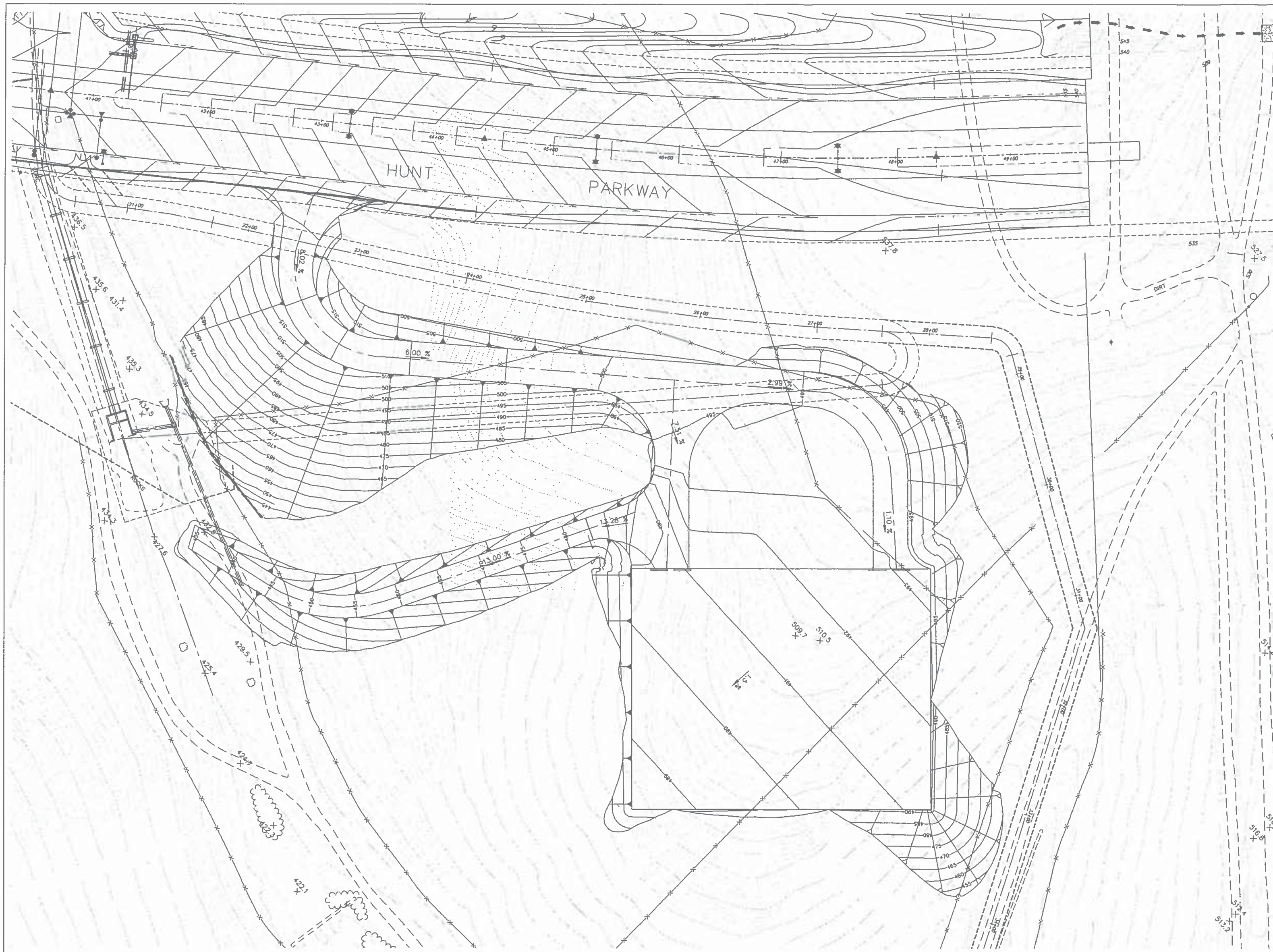
5015 SHOREHAM PLACE
SAN DIEGO, CALIFORNIA 92122

CHECKED BY: SHR	FN: 67735SITE
PROJECT NO. 67735	DATE: 04/2006

LOCAL GEOLOGIC MAP

OTAY RANCH SUBSTATION SITE
OTAY, CALIFORNIA

FIGURE 3



PRELIMINARY
FOR PLANNING PURPOSES ONLY

SCALE: 1" = 40'
FULL SIZE

EARTHWORK:
CUT: 41,000 CY
FILL: 52,000 CY
NET: 11,000 CY.
SLOPES: 2:1

RETAINING WALL
AREA: 2,200 SQ.FT
LENGTH: 160 FT
MAX HEIGHT: 15 FT (ABOVE FINISHED GRADE)
AVE. HEIGHT: 12 FT (ABOVE FINISHED GRADE)

ACCESS ROAD
ASPHALT:
LENGTH: 920 FT
AREA: 27,600 SQ.FT.

CONCRETE:
LENGTH: 420 FT
AREA: 8,400 SQ.FT.

LEGEND
CUT
FILL
RETAINING WALL

REVISIONS

NO.	WORK DONE	DATE	BY	APP'D	NO.	WORK DONE	DATE	BY	APP'D	NO.	WORK DONE	DATE	BY	APP'D	NO.	WORK DONE	DATE	BY	APP'D

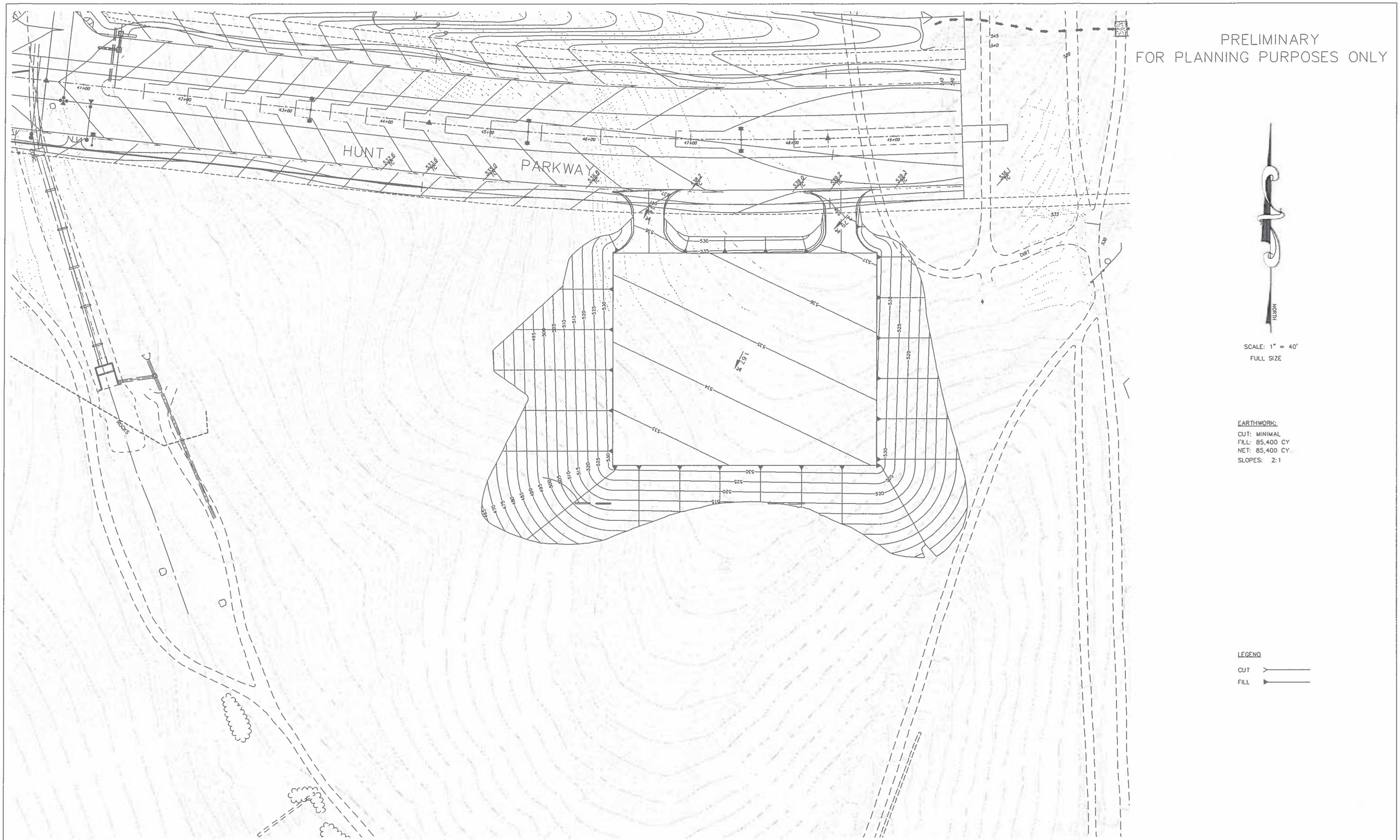
SAN DIEGO GAS & ELECTRIC COMPANY
SAN DIEGO, CALIFORNIA

OTAY RANCH SUBSTATION
OPTION 1

DRAWN BY: SA	DATE: 10/19/05	SCALE: AS NOTED	W.O.	REV. 0
CHECKED BY: MH	DATE:			1/1
APPROVED BY:	DATE:			
CAD NO. OTAY-RANCH.DWG	PLOT SCALE: 1 = 1			

11/01/2005 7:47:40 AM

Figure 4



REVISIONS

NO.	WORK DONE	DATE	BY:	APP'D:	NO.	WORK DONE	DATE	BY:	APP'D:	NO.	WORK DONE	DATE	BY:	APP'D:	NO.	WORK DONE	DATE	BY:	APP'D:

SAN DIEGO GAS & ELECTRIC COMPANY
SAN DIEGO, CALIFORNIA

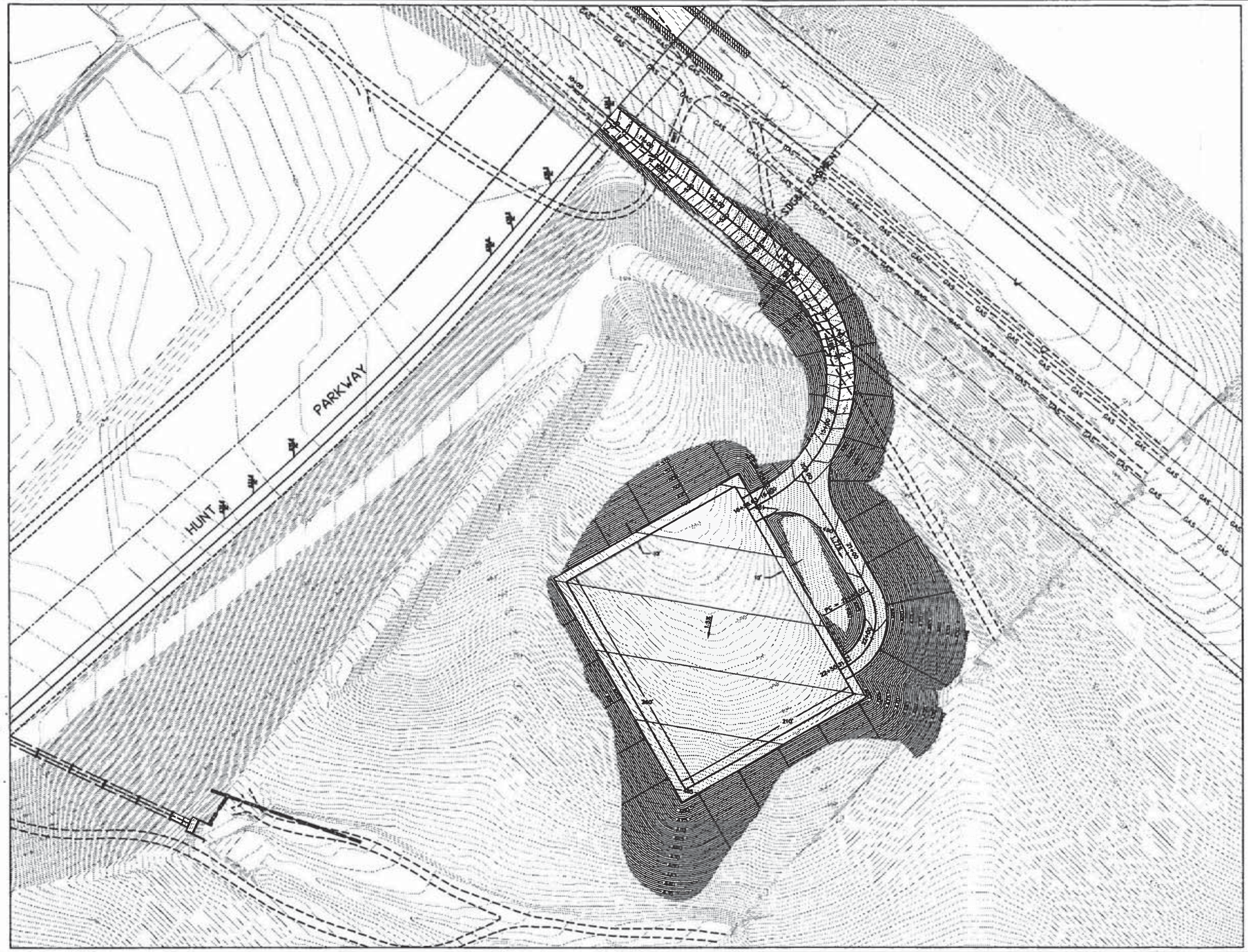
OTAY RANCH SUBSTATION
OPTION 2

DRAWN BY: SA	DATE: 10/19/05	SCALE: AS NOTED	W.O. / REV. 0
CHECKED BY: MH	DATE:		1/1
APPROVED BY:	DATE:		
CAD NO.: OTAY-RANCH.DWG	PLOT SCALE: 1 = 1		

11/01/2005 7:45:44 AM

Figure 5

PRELIMINARY
FOR PLANNING PURPOSES ONLY



NORTH

SCALE: 1" = 50'
FULL SIZE

EARTHWORK:
CUT: 23,322 CY
FILL: 30,392 CY
NET: 7,070 CY (FILL)
SLOPES: 2:1

LEGEND
CUT
FILL

REVISIONS

NO.	WORK DONE	DATE	BY:	APP'D:	NO.	WORK DONE	DATE	BY:	APP'D:	NO.	WORK DONE	DATE	BY:	APP'D:	NO.	WORK DONE	DATE	BY:	APP'D:

SAN DIEGO GAS & ELECTRIC COMPANY
SAN DIEGO, CALIFORNIA

OTAY RANCH SUBSTATION
OPTION 2A

DRAWN BY: EN | DATE: 05/02/05 | SCALE: AS NOTED | W.O. | REV. 0
CHECKED BY: | DATE:
APPROVED BY: | DATE:
CAD NO.: OTAY-RANCH.DWG | PLOT SCALE: 1 = 1

1/1

APPENDIX E

ASFE Insert

Important Information About Your

Geotechnical Engineering Report

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

The following information is provided to help you manage your risks.

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 a number of 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, 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, a number of 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 ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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2012 GEOTECHNICAL INVESTIGATION

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APPENDIX 4.6-B

GEOTECHNICAL INVESTIGATION FOR SALT CREEK SUBSTATION PROPONENT'S ENVIRONMENTAL ASSESSMENT (PEA)

Prepared by
Geosyntec Consultants
10875 Rancho Bernardo Road, Suite 200
San Diego, CA 92127

August 22, 2012

Prepared for:

San Diego Gas & Electric Company
8316 Century Park Court, CP52G
San Diego, California 92123

GEOTECHNICAL INVESTIGATION
69KV TRANSMISSION LINE TL6965
SALT CREEK SUBSTATION TO
MIGUEL SUBSTATION
CHULA VISTA, CALIFORNIA

Prepared by:

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22 August 2012

Mr. Tyler Lonsdale
San Diego Gas & Electric Company
8316 Century Park Court, CP-52G
San Diego, California 92123

Subject: Geotechnical Investigation
69KV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Dear Mr. Lonsdale:

Geosyntec Consultants (Geosyntec) is pleased to provide the San Diego Gas & Electric Company (SDG&E) the accompanying geotechnical investigation report for the proposed 69 kilovolt (kV) Transmission Line TL6965 between the proposed Salt Creek Substation and the existing Miguel Substation in Chula Vista, California. This report presents our conclusions and recommendations pertaining to the project and the results of the field exploration program and laboratory testing.

We appreciate the opportunity to provide geotechnical consulting services to SDG&E on this important project. If you have any questions or require additional information, please contact the undersigned at (858) 674-6559.

Sincerely,

Jennifer L. Nevius

Jennifer L. Nevius, G.E. 2825
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
JENNIFER L. NEVIUS
NO. G 2825
EXP. 6/30/13
GEOTECHNICAL
STATE OF CALIFORNIA

Alexander J. Greene, C.E.G. 2249
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Cover.doc

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1. INTRODUCTION

This report presents the results of the geotechnical investigation for the San Diego Gas & Electric Company (SDG&E) proposed 69kV Transmission Line TL6965 in Chula Vista, California (Site). The subject improvements will be located between the proposed Salt Creek Substation and the existing Miguel Substation. This report was prepared by Mr. Jared Warner and Ms. Jennifer Nevius, G.E. and has been reviewed by Mr. Steven Fitzwilliam, G.E., and Mr. Alexander Greene, C.E.G of Geosyntec Consultants (Geosyntec), in accordance with the peer review policies of the firm.

1.1 Project Description

We understand that SDG&E is proposing to construct new poles along Transmission Line TL6965, located in the vicinity of State Route 125 (SR125) and approximately from Hunte Parkway to San Miguel Road (Figure 1). The subject portion of the transmission line alignment is shown on Figure 2. We understand that fourteen of the new pole structures require geotechnical investigation. A summary of information for these proposed pole locations is presented in Table 1.

1.2 Purpose and Scope of Services

The purpose of our geotechnical investigation was to provide geotechnical engineering recommendations for the referenced pole foundations. The scope of the investigation was outlined in our proposal dated 25 April 2012. Geosyntec performed a geotechnical investigation consisting of a site reconnaissance, review of existing geotechnical and geologic information, field explorations, laboratory testing, engineering analyses and evaluations, and the preparation of this geotechnical investigation report. In addition, we reviewed existing geotechnical reports provided by SDG&E for the design and construction of other transmission lines, transmission line improvements, and substation facilities in the area to supplement the current investigation.

This report presents our findings, conclusions, and geotechnical engineering recommendations for the proposed project. Specifically, this report provides discussions, conclusions, and recommendations for the project regarding:

- Geologic and seismic setting;
- Surface conditions;
- Anticipated geologic units;
- Potential geologic hazards;

- Earthwork and grading;
- Parameters for deep foundation design;
- Foundation excavation characteristics; and
- Construction observation recommendations.

Tables, figures, and appendices follow the text of this report.

2. GEOTECHNICAL INVESTIGATION

2.1 Previous Investigations

Several geotechnical investigations have been performed in the vicinity of the proposed pole structures for previous substation and transmission line projects. Summaries of the most pertinent previous investigations are provided below, and references for the available investigation reports are provided in Section 7. Copies of the pertinent boring logs, and/or laboratory test data from the previous investigations are provided in Appendix A. The locations of the applicable subsurface explorations are presented on Figures 2a through 2c.

2.1.1 GEOCON, 2011

Geosyntec was provided with a 2011 report of geotechnical investigation prepared by GEOCON Incorporated (GEOCON) for proposed wood to steel improvements to Transmission Line TL6910 [GEOCON, 2011]. This geotechnical investigation included exploratory borings, seismic refraction surveys, and laboratory testing. Nine of these previous borings and one previous seismic refraction survey are applicable to the current project. This geotechnical report also provided recommendations for foundation design and construction considerations for a wood to steel project.

2.1.2 URS, 2011

Geosyntec was provided with a 2011 report of geotechnical investigation prepared by URS Corporation (URS) for proposed wood to steel improvements to Transmission Line TL6910 [URS, 2011]. This geotechnical investigation included review of previous exploratory borings and previous seismic refraction surveys performed by URS [2005], additional exploratory borings, and laboratory testing. Three of these previous exploratory borings and two of these previous seismic refraction surveys are applicable to the current project. This geotechnical report also provided recommendations for foundation design and construction considerations for a wood to steel project.

2.1.3 Woodward-Clyde Consultants, 1981

Geosyntec was provided with a 1981 report of geotechnical investigation prepared by Woodward-Clyde Consultants (WCC) for a 230kV transmission line from the Miguel Substation to Mexico. This geotechnical investigation included site reconnaissance, exploratory borings, seismic refraction traverses, and laboratory testing. Several of these previous exploration locations are in close proximity to the current improvements, with additional explorations in the general vicinity of the project. This geotechnical report also provided recommendations for foundation design and construction considerations for this transmission line project.

2.2 Pre-Field Activities

Prior to conducting field explorations, a site-specific health and safety plan was prepared to protect Geosyntec personnel in accordance with Geosyntec and Occupational Safety and Health Administration (OSHA) requirements. Underground Service Alert (USA) was contacted to identify subsurface utilities at each of the boring locations. Boring permits were obtained from the County of San Diego Department of Environmental Health.

2.3 Site Reconnaissance

Site reconnaissance was performed at the proposed pole locations by a geologist from our firm. The reconnaissance consisted of evaluating site access for the field exploration program and a preliminary evaluation of geologic conditions in the vicinity of the proposed pole locations.

2.4 Exploratory Borings

Exploratory borings were performed at nine of the proposed pole locations between 25 June and 3 July 2012 and were designated Borings B-1 through B-9. The borings were advanced by Pacific Drilling of San Diego, California. Borings B-2 and B-4 were advanced using a track-mounted limited-access “Mole” drill rig due to the proximity of the boring to overhead utility lines. The remaining borings advanced for this investigation were advanced using a truck-mounted Unimog drill rig. Both drill rigs were equipped with 7-inch diameter hollow-stem augers. The borings were advanced to depths ranging between 17.0 and 41.5 feet below the existing ground surface (ft bgs). The approximate locations of the borings are shown on Figure 2a and 2b.

Soil samples from the borings were collected using a Standard Penetration Test (SPT) sampler or a 3-inch diameter, split-spoon California sampler driven with an automatic hammer (140-pound hammer falling approximately 30 inches). Bulk samples of the soil cuttings were also collected from exploratory borings. The soil samples from the borings were sealed and transported to the geotechnical laboratory for testing.

Descriptions and visual classifications of the subsurface materials were logged by a geologist from our firm and subsurface descriptions were based on the recovered soil samples and soil cuttings. The subsurface descriptions were developed in general accordance with American Society for Testing and Materials (ASTM) standard D2488.

A key to logs and the individual exploratory boring logs are presented in Appendix B. Sampling information, and other pertinent field data and observations are included on the boring logs.

Due to the developed nature of the site, the soil cuttings from Boring B-6 at Location 24 were drummed and temporarily stored on site. After characterization, the drums were removed from the site by SDG&E for disposal. The soil cuttings from the remainder of the borings were thinly spread in the vicinity of those borings.

2.5 Geotechnical Laboratory Testing

Soil samples from the test borings were tested to verify field classifications and evaluate the physical and engineering properties of the subsurface materials. The geotechnical laboratory testing of soil samples was performed by Excel Geotechnical Testing Inc. of Roswell, Georgia. The laboratory tests were performed in general accordance with the testing procedures of ASTM or other generally accepted test methods.

The laboratory testing performed for this project included:

Laboratory Tests	ASTM Designation
Moisture Content/Dry Density	D2216 / D2937
Grain Size Analysis	D422
Atterberg Limits	D4318

A summary table and individual results of the geotechnical laboratory testing program are presented in Appendix C.

3. SITE AND GEOLOGIC CONDITIONS

Our knowledge of the site conditions has been developed from a review of available geologic literature, previous geologic and geotechnical investigations by others, professional experience, site reconnaissance, and field and laboratory investigations performed for this study. A regional topographic map is presented in Figure 3, and a regional geologic map is presented in Figure 4.

3.1 Geologic and Seismic Setting

The site lies within the coastal margin along the western flanks of the Peninsular Ranges Geomorphic Province of southern California. The general site area extends across a relict terraced surface dissected by numerous incised drainages extending to the west off the topographic highlands east of the alignment down toward the Pacific Ocean. To the east and southeast of the alignment respectively, crystalline granitic rock associated with the Peninsular Range batholith and metavolcanic rock associated with the Santiago Peak Volcanics form the moderately steep slopes of the Peninsular Range foothills. To the northwest of the alignment, the general site area is bounded by the Otay Valley floodplain and to the west by the marine Nestor terrace. The site is situated approximately 11 miles east of the Pacific Ocean at the Silver Strand. The site area is underlain by shallow fills, topsoil, and alluvial, colluvial, and slopewash deposits), the Tertiary-age Otay Formation, and Jurassic to Cretaceous-age Santiago Peak Volcanics at depth. The surficial regional geology is shown on Figure 4.

The Rose Canyon fault zone (RCFZ) is the closest major active fault to the project area, located approximately 9.3 miles to the northwest, and dominates the seismic exposure of San Diego [Lindvall and Rockwell, 1995]. The primary faults comprising the RCFZ extend on land from La Jolla and continue south along the east margin of Mission Bay to the Old Town area; the RCFZ then continues south toward downtown San Diego, through San Diego Bay and south of the border roughly parallel to the coastline. Together with the Newport Inglewood fault zone, the RCFZ is considered a continuous zone comprised of 5 fault segments with a total length of approximately 110 miles (175 kilometers [km]). Studies in the San Diego area indicate an estimated slip rate of 1.5 millimeters/year along the RCFZ [Rockwell, 1991]. The maximum earthquake for this fault zone consists of a three segment rupture and an estimated 7.25 moment magnitude (M_w) event. Other active faults in the vicinity include the Palos Verde fault zone offshore to the west and the Elsinore and San Jacinto fault zones to the northeast. These fault zones and their respective distance from the site and maximum moment magnitudes are presented in the following table.

Fault Name	Distance and Direction from Site [a]	Maximum Moment Magnitude [b]
Rose Canyon	9.3 miles (15 km) to northwest	7.2
Palos Verdes	17.4 miles (28 km) to west	7.1
Elsinore (Julian Segment)	45.9 miles (74 km) to northeast	7.1
San Jacinto (Coyote Creek Segment)	47.8 miles (77 km) to northeast	6.8

Notes:

a. Distances from site noted are the closest distance to the surface trace or inferred projection of the fault as measured from California Division of Mines and Geology [1998].

b. Maximum moment magnitude values reported by California Geological Survey OFR 96-08 Appendix A, revised 2002 [CGS, 2003].

3.2 Surface Conditions

The proposed poles are located within the existing SDG&E easement between the proposed Salt Creek Substation adjacent to Hunte Parkway and the existing Miguel Substation off of San Miguel Road. From south to north, the alignment extends up the margin of terrace and fanglomerate deposits out of Salt Creek (Sites 1, 2, 43 and 44), crests the Otay Valley floodplain (Sites 22 through 29), and extends northward along rolling hills with intervening ridge tops (Sites 38 and 42). The general site areas include residential and commercial development beyond the easement.

The surface conditions along the alignment in the subject pole locations are characterized by sloping terrain varying from relatively flat to gentle slopes. The natural hillsides along the alignment are covered by moderate growth of scrub brush and low grasses. Each of the proposed pole locations are sited in open space adjacent to existing residential development with the exception of Site 24, which is situated within the asphalt parking lot of an existing commercial development. Site 24 is also situated adjacent to a descending slope with an inclination of approximately (2H:1V). Elevations along the alignment range from 487 to 630 feet above Mean Sea Level, and generally drain to the west or southwest toward San Diego Bay, except for Site 1, which drains to the southeast toward Salt Creek and Lower Otay Lake.

3.3 Geologic Units

Our knowledge of the subsurface conditions at the proposed pole locations is based on a review of available published geologic information, site reconnaissance, previous borings and seismic refraction surveys performed by others for previous projects, and exploratory borings performed for the project by Geosyntec. A regional geologic map is presented in Figure 4. Generalized subsurface profiles at each of the proposed structure locations are provided in Table 2.

3.3.1 Surficial Deposits

Surficial deposits, including topsoil, alluvium, colluvium, slopewash, and residual soils are present in portions of the study area within the natural drainages and mantling the slope areas. The composition and strength of these materials are variable depending on the age, parent sources, and mode of deposition.

3.3.2 Otay Formation

The Tertiary-age Otay Formation underlies the majority of the proposed pole locations along the alignment and outcrops within the pronounced ridges of the western foothills of the Peninsular Range. The Otay Formation is described as predominantly grayish brown, silty fine sandstone to a reddish brown sandy, silty lean claystone (URS, 2011). Additionally, Kennedy and Tan (1977) describe the Otay Formation as light gray and light brown massive sandstone and claystone that is moderately well sorted and poorly indurated.

3.3.3 Santiago Peak Volcanics

The Jurassic- to Cretaceous-age, pre-batholithic metamorphosed volcaniclastic and meta-sedimentary rocks which underlie the Otay Formation at depth are known as the Santiago Peak Volcanics. These volcanic rocks, forming the bulk of the Peninsular Ranges to the east of the alignment, are slightly to intensely weathered forming the local deposits in the Otay Valley floodplain.

3.4 Groundwater

Groundwater was observed within the alluvium in Boring B-5 at a depth of approximately 11 ft bgs. This depth to groundwater represents conditions observed at the time of drilling and may not be indicative of stabilized water levels at this location.

With the exception of Boring B-5 as noted above, regional groundwater was not encountered in the current or previous explorations performed within the project alignment. Based on our review of available information, regional groundwater is expected to be greater than 40 ft bgs. Perched groundwater or localized zones of wet materials were observed in the borings, and based on our experience in the current field investigation and similar sedimentary bedrock terrain, zones of perched groundwater are anticipated during foundation excavation.

4. GEOLOGIC HAZARDS

4.1 Fault Ground Rupture

The project area, like most of southern California, is considered to be situated in a seismically active area. Based on a review of previous geotechnical reports and available geologic maps, the project alignment is not underlain by known active faults that exhibit evidence of ground displacement during the last 11,000 years, therefore, fault rupture is not considered to be a constraint to the project. The potential for fault surface rupture is generally considered to be significant along "active" faults (defined as exhibiting surface rupture within the past 11,000 years) and to a lesser degree along "potentially active" faults (surface rupture within the past 1.6 million years). A review of published geologic maps did not identify the presence of any active or potentially active faults crossing on or projecting near the project site. The nearest mapped active fault traces are approximately 9.3 miles (15 km) to the northwest of the project area within the Rose Canyon fault zone, and 17.4 miles (28 km) to the west within the Palos Verdes fault zone [Jennings, 1994]. The closest potentially active fault to the site area is the La Nacion fault situated approximately 2.5 miles (4 km) to the west. Therefore it is our opinion that the potential for fault related surface rupture along the proposed project alignment is low.

4.2 Strong Ground Shaking

The RCFZ is the dominant source of potential ground motion at the site. Earthquakes on the Rose Canyon Fault have a maximum magnitude of 7.2 and are considered to be representative of the potential for seismic ground shaking within the property. The "maximum magnitude" is defined as the maximum probable earthquake that appears capable of occurring under the presently known tectonic framework (California Division of Mines and Geology Notes, Number 43). Based on the proximity of the site to the RCFZ and other potential seismic sources on more distant active faults, the project site will likely experience moderate ground shaking in response to a local or regional large magnitude earthquake occurring during the expected life span for the proposed project. The location of regional faults and historic earthquake epicenters are shown on Figure 5.

4.3 Soil Liquefaction

Seismically induced soil liquefaction can be described as a significant loss of strength and stiffness due to cyclic pore water pressure generation from seismic shaking or other large cyclic loading. The material types considered most susceptible to liquefaction are granular soils and low-plasticity fine grained soils which are saturated and loose to medium dense. Manifestations of soil liquefaction can include the loss of bearing capacity below foundations, surface settlements and tilting in level ground, and instabilities in areas of sloping ground.

For the proposed pole locations, due to the anticipated level of ground shaking for the expected life span for the proposed project, relatively dense nature of the formational soil, and weathered bedrock underlying the proposed pole locations below groundwater and/or the lack of permanent groundwater, the probability of soil liquefaction affecting the project is low. Correspondingly, the potential for damage due to liquefaction-induced seismic settlement and lateral spreading is also considered low.

4.4 Secondary Effects of Seismic Activity

The secondary effects of seismic activity resulting from ground shaking include lateral spreading, tsunamis and seiches. The probability of occurrence of each depends on the severity of earthquake, distance from the epicenter, faulting mechanism, topography, soil and groundwater conditions, and other factors.

Tsunamis are seismically-induced waves generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. Seiches are similarly generated, but are waves in lakes or reservoirs. Based on the inland location, site elevation, and the location and direction of the downstream topography below the nearest large lake (Lower Otay Lake at approximately 1.0 miles southeast of the project, and the Sweetwater Reservoir at approximately 2.2 miles northwest of the project), the potential for damage due to a tsunami or seiche is considered very low and does not constitute a significant developmental hazard for the project.

4.5 Landslides and Slope Stability

The sedimentary deposits associated with the Otay Formation that are mapped within the site area are considered to be landslide prone. In addition, portions of the Miguel Substation have previously been identified as being underlain by landslide deposits or possible landslides (URS, 2011). Other nearby landslides have been previously mapped to the west of the proposed alignment (Figure 4), but based on our review of the available geologic maps and aerial photographs, there are no landslides that have been identified beneath the proposed sites. Given this review and our understanding of the proposed construction, the risk of slope movement associated with landslides at the proposed pole locations is considered to be low.

4.5.1 Expansive and Collapsible Soil

Our previous experience in the site area and the soil index testing performed for previous investigations and the current investigation indicates that the majority of the near-surface clayey materials are considered to be expansive and subject to desiccation cracking during cycles of wetting and drying.

Collapsible soils are not anticipated to be present in significant quantities along the proposed alignment and do not constitute a significant hazard during project construction.

4.5.2 Other Geologic Hazards

Other geologic hazards, including volcanic activity, are not considered to be a significant hazard given the geologic setting of the site.

5. DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

The discussions, conclusions, and recommendations presented in this report are intended for the proposed new structures for Transmission Line TL6956 and are based on our understanding of the proposed project and this investigation.

5.1 Earthwork

We anticipate that the earthwork for the proposed project will include site preparation, cuts on the order of 5 feet, placement of engineered fill to achieve final grades, and fine grading for site drainage control. A majority of the material from cut areas will likely be used as fill.

We recommend that a pre-grading conference be held at the site with SDG&E, the contractor, and the geotechnical engineer. We also recommend that the earthwork be performed in accordance with Section 300 of the most recent edition of the "Standard Specifications for Public Works Constriction" (also known as the Greenbook) and "Regional Supplement Amendments" and the recommendations presented below.

5.1.1 Removal of Unsuitable Areas

Prior to grading, any abandoned utilities and improvements, vegetation, or other debris should be removed and properly disposed off-site. Removal of unsuitable topsoil and residual soils to competent material shall be required in areas of fill placement (graded pad areas). Removal depths are expected to range from 1 to 3 feet. Removals should extend beyond the toe of fill slopes a minimum distance equal to a 1:1 projection outward and down to an approved removal bottom. A representative of the geotechnical engineer should determine the actual lateral removal limits in the field during grading.

5.1.2 Fill and Backfill

Except for surficial organic materials (topsoil), the onsite soils are considered suitable for use as engineered fill. It is recommended that any import materials used for the project (if any) be composed of select material. "Select material" may be defined as having at least 40 percent of the material less than ¼ inch in size, an expansion index less than 30, and no perishable, spongy, deleterious, impacted, or otherwise unsuitable material.

All fill and backfill should be compacted to a minimum relative compaction of 90 percent. Relative compaction is defined as the ratio of the in-place dry density to the maximum dry density as determined by ASTM D1557. Fill and backfill materials should be compacted above the optimum moisture content, as determined by ASTM D1557. Fill soils should be placed in loose lifts no thicker than 8 inches. We recommend that a representative of the geotechnical engineer observe and test the compacted fills.

5.1.3 Fill Slopes

Fill slopes should be formed on an equipment width keyway (10-foot minimum) excavated at least 2 feet into competent material and tilted back at least 2 percent into the slope or as recommended in the field by the geotechnical engineer. Benching will be required after the removal of unsuitable material. Benches should be excavated within competent material as the fill slope formation progresses up slope. Benching shall be in accordance with Section 300-4.4 of the Greenbook unless otherwise directed by the geotechnical engineer.

Fill slopes should be constructed at a maximum inclination of 2H:1V (horizontal:vertical). The face of the slope should be compacted by back rolling with a sheepsfoot roller after each four-foot increase in slope height. When the pad grade is achieved, the slope face should be track walked with a dozer or rolled with a cable-lowered sheepsfoot, and finally grid-rolled.

5.2 Surface Drainage

It is recommended that positive measures be taken to properly finish grade the area of the proposed poles and pad areas so that drainage water from the project area does not pond and is directed away from foundations.

5.3 Foundation Design

We understand that the deep foundations to support the proposed poles will be designed using the Electric Power Research Institute (EPRI) computer program Moment Foundation Analysis and Design (MFAD). The design parameters for use with the MFAD program include:

- Subsurface material layer depths;
- Groundwater depth;
- Total unit weight;
- Internal friction angle;
- Cohesion;
- Elastic pressuremeter modulus; and
- Strength reduction factor.

Estimates of the required parameters were developed based on the results of our site reconnaissance, field exploration program, geotechnical laboratory testing, engineering evaluation and analyses, empirical correlations, literature research, and professional judgment. The design parameters recommended for foundation design using the MFAD computer program are presented in Table 2. These design parameters are intended for use in the MFAD computer program and may not reflect actual strengths. Pressuremeter testing was not performed as part of this project; the elastic pressuremeter modulus values were estimated from published correlations [EPRI, 1990].

Other conditions that influence the design of pole foundations include the presence of groundwater, inclination of adjacent slopes, thickness of residual, disturbed, or otherwise weak soil deposits. The observed groundwater depths, where applicable, are presented in Table 2. It is recommended that a depth of surface material be discounted in the design of the pole foundations. This recommendation is based on the assumption that the loose, weathered, and near surface materials inherently have lower strengths with an associated higher uncertainty. In addition, foundations in sloping terrain have the potential for erosion. The recommended surficial discount depth based on the potential for erosion, surfacing, and depth of weaker surficial deposits at the proposed pole locations is presented in Table 2. We assume that SDG&E will incorporate any additional discount depth or other method for the effects of sloping ground on foundation design, such as at Site 24.

5.4 Foundation Excavation Characteristics

Our evaluation of excavation characteristics is based on drilling characteristics during our exploratory borings, the logs of borings from explorations performed by others during previous investigations, and our local experience.

Based on the observed and reported drilling conditions observed during this and previous investigations, we anticipate that the drilled shaft foundations will be relatively easy to excavate within surficial deposits. However, caving of the drilled holes should be expected in surficial deposits, and will likely be exacerbated by the presence of perched groundwater. We anticipate that the formational materials may be excavated with moderate effort to high effort using conventional heavy-duty foundation drilling equipment. The borings were advanced with a small diameter hollow-stem auger to between 17 and 41.5 ft bgs. Auger and/or sampler refusal was encountered in multiple boring locations, as exhibited where borings were terminated at depths less than 40 feet. Although not encountered in our borings to the depths investigated, concretions may be present in the Otay Formation which may provide localized zones of difficult drilling.

5.5 Construction Observation

Variations in subsurface conditions may be encountered during construction. To permit correlation between the investigation data and the conditions encountered during construction, we recommend that the geotechnical engineer be retained to observe site preparation, grading, and foundation excavation. We further recommend that the geotechnical engineer be retained to test any compacted fills. Additional laboratory testing will be required during construction to evaluate the moisture and density relationships of fill soils at locations where a graded pad is planned.

6. LIMITATIONS

The geotechnical investigation for this project provided for the observation of only a portion of the pertinent subsurface conditions. The information provided herein is based on specific explorations performed under the supervision of Geosyntec personnel and based on the logs of borings performed by others and is of the assumption that soil conditions do not deviate appreciably from those encountered during the current and previous field investigations. This geotechnical investigation report has been performed in accordance with current practices and the standard of care exercised by scientists, geologists, and engineers performing similar tasks in this area. The conclusions contained in this report are based solely on the analysis of the conditions observed by Geosyntec personnel and as reported in the referenced geotechnical investigations for the project site. We cannot make any assurances concerning the accuracy or completeness of the data presented to us.

No warranty, express or implied, is made regarding the professional opinions expressed in this report. Site grading and earthwork, utility trench backfill, and foundation excavations should be observed by a qualified engineer or geologist to verify that the site conditions are as anticipated. If actual conditions are found to differ from those described in the report, or if new information regarding the site is obtained, Geosyntec should be notified and additional recommendations, if required, will be provided. Geosyntec is not liable for any use of the information contained in this report by persons other than SDG&E or their subconsultants, or the use of information in this report for any purposes other than referenced in this report without the expressed, written consent of Geosyntec.

7. REFERENCES

Abbott, P.L., 1999. "The Rise and Fall of San Diego, 150 Million Years of History Recorded in Sedimentary Rocks", Sunbelt Publications, 231 p.

American Society for Testing and Materials (ASTM), 2012. "Annual Book of ASTM Standards", Section 4 Construction. Volume 04.08 Soil and Rock.

California Divisions of Mines and Geology, 1998. "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada", prepared for International Conference of Building Officials to be used with 1997 UBC, February.

California Geological Survey (CGS), 2003. "The Revised 2002 California Probabilistic Seismic Hazard Maps", prepared by T. Cao, W.A. Bryant, B. Rowshandel, D. Branum, and C.J. Wills, updating Open File Report 96-08.

Electric Power Research Institute, 1990. "Manual on Estimating Soil Properties for Foundation Design," August.

GEOCON, 2011. "Geotechnical Investigation, TL 6910 Wood to Steel Improvements, M.S.A. 6160015454, San Diego County, California," dated 15 July 2011 (GEOCON Project No. G1115-52-29).

Kennedy, M.P., and Tan, S.S, 1977. "Geology of National City, Imperial Beach and Otay Mesa Quadrangles, Southern San Diego Metropolitan Area, California," California Division of Mine & Geology, Map Sheet 29, map scale 1:24,000.

Jennings, C.W., 1994. "Fault Activity Map of California and Adjacent Areas, with Locations and Ages of Recent Volcanic Eruptions", California Department of Conservation, Division of Mines and Geology, Geologic Data Map Series, Map No. 6- Faults, Locations of recent Volcanic Eruptions, map scale 1:750,000.

Todd, V.R., 2004. "Preliminary Geologic Map of the El Cajon 30'x 60' Quadrangle, Southern California", California Geological Survey Open-File Report 2004-1361, Southern California Areal Mapping Project (SCAMP), version 1.0, map scale 1:100,000.

Lindvall, S.C., Rockwell, T.K., 1995. "Holocene Activity of the Rose Canyon fault zone in San Diego, California," Journal of Geophysical research, Volume 100, No. B12, pp 24, 121-124, 132, 10 December.

Rockwell, T.K., et. al., 1991. "Minimum Holocene Slip Rate for the Rose Canyon Fault in San Diego, California," Environmental Perils in the San Diego Region, P.L. Abbott and W.J. Elliott, eds., San Diego Association of Geologists, pp. 37-46.

United States Geological Survey, 2008. "National Seismic Hazards Mapping Program" http://earthquake.usgs.gov/research/hazmaps/design.

URS, 2011. "Geotechnical Investigation, New Steel Poles – TL-13826 Miguel to Proctor Valley, San Diego, California," dated 17 March (URS Project No. 27661044.10000).

Woodward-Clyde Consultants, 1981. "Geotechnical Investigation for the Miguel to Mexico 230 kV Transmission Line (Tower Sites 4 through 48) for San Diego Gas and Electric Company, P.O. Box 1831, San Diego, California 92112," dated 21 October (WWC Project No. 51157S-SI01).

TABLES

Table 1. Summary of Site Information
69kV Transmission Line TL6965 – Miguel Substation to Salt Creek Substation

PLS Structure #	Structure Longitude [a]	Structure Latitude [a]	Pole Base Elevation [a] (feet)	Proximate Explorations	Reference	Exploration Date
42	116°59’3.994”W	32° 40'42.186"N	312.2	*B-1* *B-19* *SL-00* *B-1*	URS, 2011 URS, 2005 URS, 2005 GEOCON, 2011	01/14/11 12/20/04 10 to 11/04 05/24/11
38	116°58'36.268"W	32° 40'29.275"N	493.0	*B-2* *SL-10* *SL-1* *B-6* *B-2* *B-3* *B-4* *4* *5*	URS, 2011 URS, 2005 GEOCON, 2011 GEOCON, 2011 GEOCON, 2011 GEOCON, 2011 GEOCON, 2011 WCC, 1981 WCC, 1981	01/14/11 10 to 11/04 NA 05/24/11 06/02/11 05/24/11 05/24/11 NA NA
29	116° 58'27.872"W	32° 39'42.261"N	584.8	B-1	Geosyntec, 2012	06/27/12
28	116° 58'26.332"W	32° 39'32.417"N	619.5	B-2	Geosyntec, 2012	06/29/12
27	116° 58'23.581"W	32° 39'14.835"N	630.3	B-3	Geosyntec, 2012	07/03/12
26	116° 58'21.527"W	32° 39'01.700"N	558.7	B-4	Geosyntec, 2012	06/29/12
25	116° 58'19.385"W	32° 38'48.007"N	503.4	B-5 *13*	Geosyntec, 2012 WCC, 1981	06/25/12 NA
24	116° 58'17.514"W	32° 38'36.049"N	544.1	B-6 14	Geosyntec, 2012 WCC, 1981	06/27/12 NA
23	116° 58'15.781"W	32° 38'24.786"N	551.6	B-7	Geosyntec, 2012	06/25/12

Table 1. Summary of Site Information (Continued)
69kV Transmission Line TL6965 – Miguel Substation to Salt Creek Substation

PLS Structure #	Structure Longitude [a]	Structure Latitude [a]	Pole Base Elevation [a] (feet)	Proximate Explorations	Reference	Exploration Date
22	116^{o} 58'12.466"W	32^{o} 38'21.456"N	563.5	B-8 *15*	Geosyntec, 2012 WCC, 1981	07/03/12 NA
2	116^{o} 56'59.058"W	32^{o} 37'16.031"N	540.5	*B-8*	GEOCON, 2011	05/25/11
1	116^{o} 56'46.648"W	32^{o} 37'7.219"N	487.6	*B-9*	GEOCON, 2011	05/25/11
43	116^{o} 56'55.562"W	32^{o} 37'12.316"N	486.0	B-9	Geosyntec, 2012	06/27/12
44	116^{o} 56'55.256"W	32^{o} 37'12.091"N	483.0	B-9	Geosyntec, 2012	06/27/12

Notes:

a. The longitude, latitude, and pole base elevation from the Structure Record Table provided by SDG&E dated 18 April 2012.
b. NA = Not Available.

Table 2. Recommended Foundation Design Parameters
69kV Transmission Line TL6965 – Miguel Substation to Salt Creek Substation

PLS Structure #	Layer Depth [a] (feet)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	E_{pmt} (ksi)	Shear Strength Reduction Factor, α	Surficial Discount Depth (feet)	Reginal Groundwater Depth (feet)
42	0 to 10	115	30	50	1.5	0.8	3	Not Encountered
	10 to 25	120	30	200	5.0	0.8		
	>25	125	30	400	5.0	0.8		
38	0 to 5	115	30	50	1.5	0.8	3	Not Encountered
	5 to 15	120	30	200	2.0	0.8		
	>15	125	30	400	5.0	0.8		
29	0 to 5	115	30	50	1.5	1.0	3	Not Encountered
	5 to 20	120	35	200	3.0	1.0		
	20 to 25	125	30	200	1.5	0.8		
	>25	130	37	500	5.0	1.0		
28	0 to 5	115	30	50	1.5	1.0	3	Not Encountered
	5 to 15	120	35	200	3.0	1.0		
	>15	125	37	500	5.0	1.0		
27	0 to 5	115	30	50	1.5	0.8	3	Not Encountered
	5 to 7	120	32	200	3.0	0.9		
	>7	125	37	500	5.0	1.0		

Table 2. Recommended Foundation Design Parameters (Continued)
69kV Transmission Line TL6965 – Miguel Substation to Salt Creek Substation

PLS Structure #	Layer Depth [a] (feet)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	E_{pmt} (ksi)	Shear Strength Reduction Factor, α	Surficial Discount Depth (feet)	Regional Groundwater Depth (feet)
26	0 to 6	115	30	50	1.5	0.8	3	Not Encountered
	6 to 11	120	30	200	1.5	1.0		
	>11	125	37	500	5.0	1.0		
25	0 to 9	115	30	50	1.5	1.0	3	11
	9 to 20	125	30	200	1.5	0.8		
	20 to 25	125	35	200	2.0	1.0		
	>25	130	37	500	5.0	1.0		
24	0 to 5	115	30	50	1.5	0.8	1	Not Encountered
	5 to 15	125	30	200	1.5	0.8		
	>15	130	37	500	5.0	1.0		
23	0 to 5	115	30	50	1.5	1.0	3	Not Encountered
	5 to 10	125	30	200	1.5	0.8		
	10 to 25	130	37	500	5.0	1.0		
	>25	130	33	500	5.0	0.8		
22	0 to 5	115	30	50	1.5	1.0	3	Not Encountered
	5 to 10	125	30	200	1.5	0.8		
	10 to 25	130	37	500	5.0	1.0		
	>25	130	33	500	5.0	0.8		

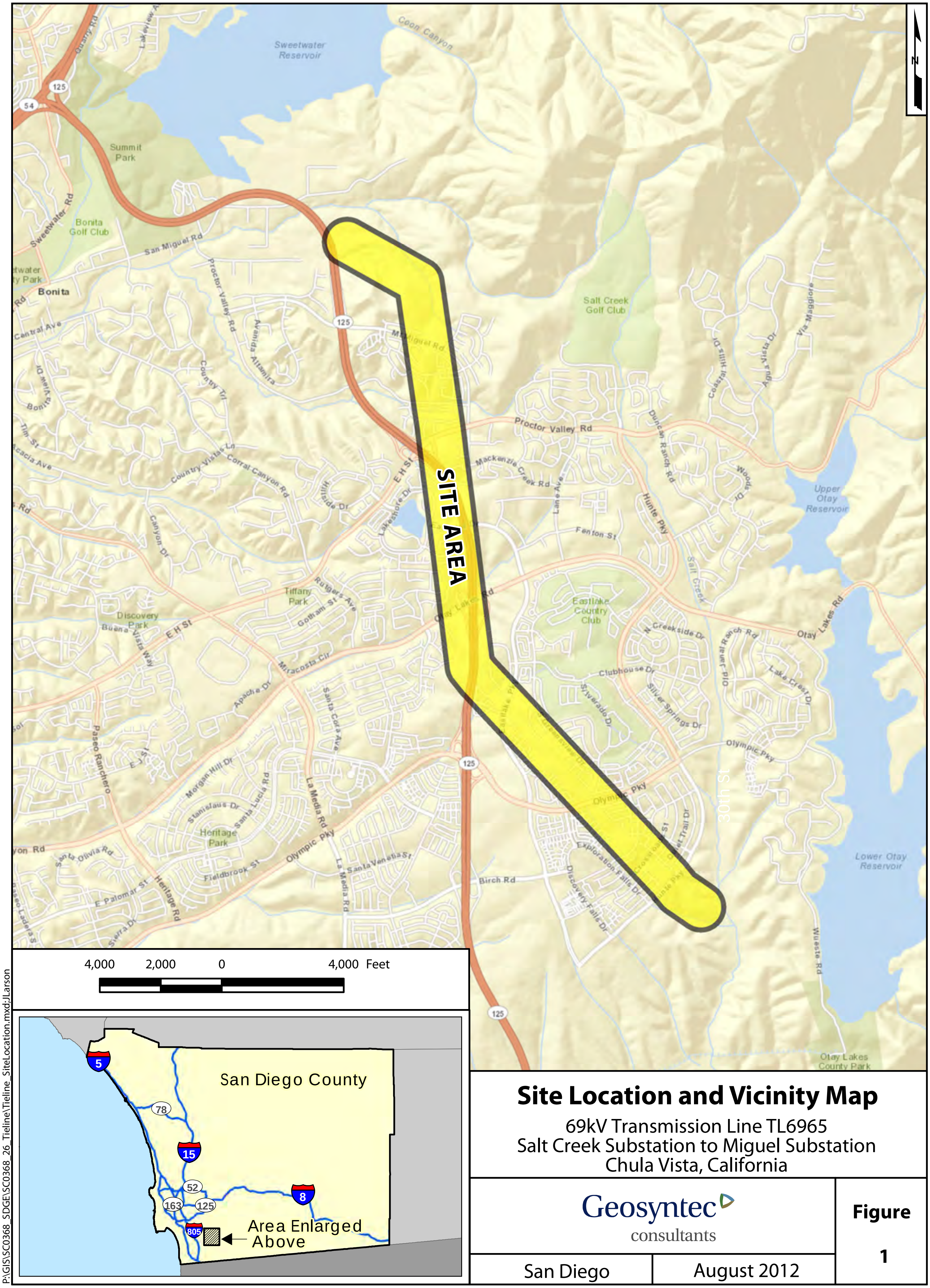
Table 2. Recommended Foundation Design Parameters (Continued)
69kV Transmission Line TL6965 – Miguel Substation to Salt Creek Substation

PLS Structure #	Layer Depth [b] (feet)	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)	E_{pmt} (ksi)	Shear Strength Reduction Factor, α	Surficial Discount Depth (feet)	Regional Groundwater Depth (feet)
2	0 to 3	115	30	50	1.5	0.8	3	Not Encountered
	3 to 10	120	35	200	3.0	0.9		
	>10	125	37	500	5.0	1.0		
1	0 to 4	115	30	50	1.5	0.8	3	Not Encountered
	>4	120	37	500	5.0	1.0		
43	0 to 5	115	30	50	1.5	0.8	3	Not Encountered
	5 to 10	120	32	200	1.5	1.0		
	>10	130	37	500	5.0	1.0		
44	0 to 5	115	30	50	1.5	0.8	3	Not Encountered
	5 to 10	120	32	200	1.5	1.0		
	>10	130	37	500	5.0	1.0		

Notes:

a. Depth below existing grade.
b. pcf = pounds per cubic foot, psf = pounds per square foot, ksi = kips per square inch.

FIGURES



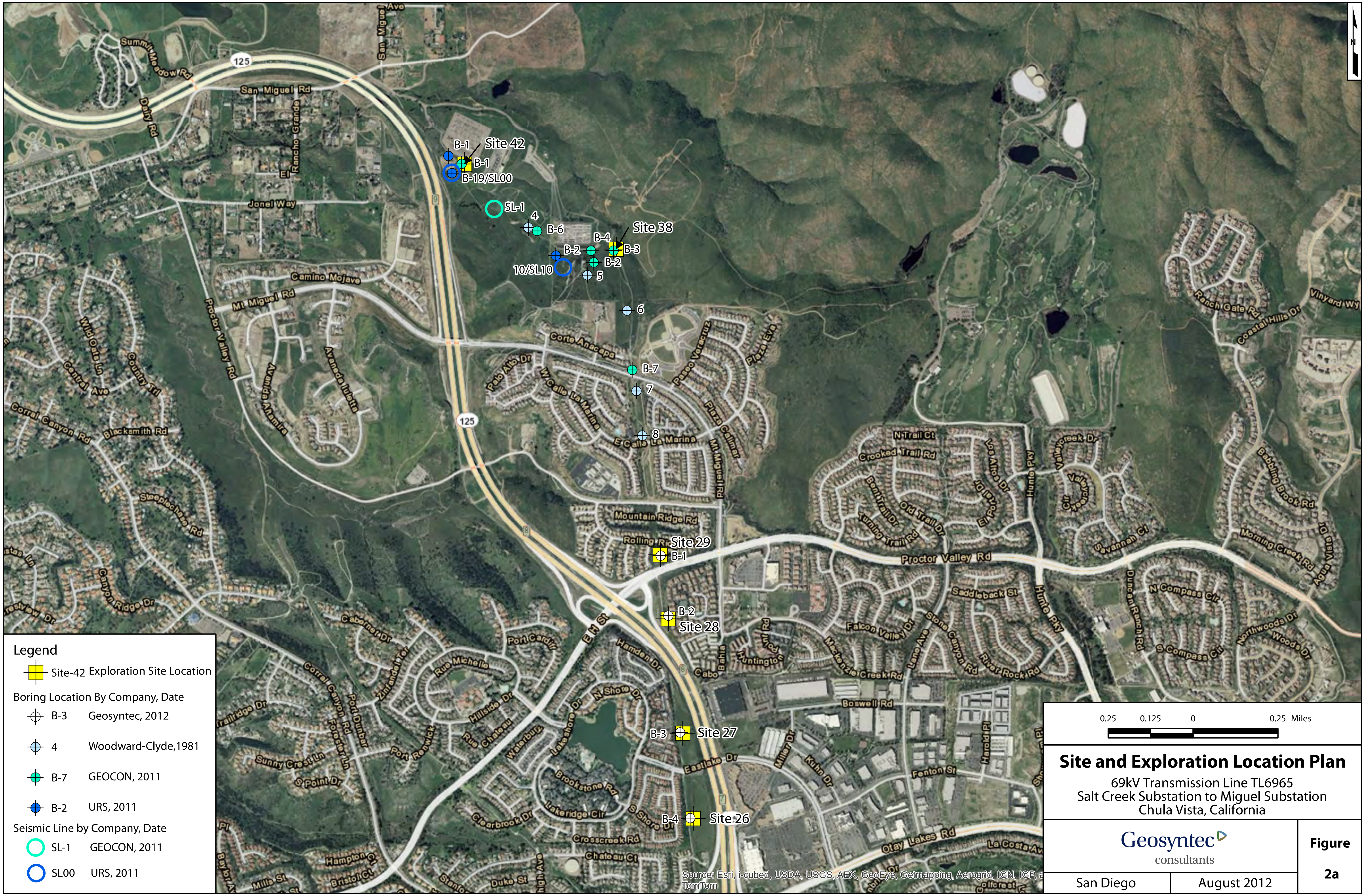
Site Location and Vicinity Map

69kV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Geosyntec consultants

Figure 1

San Diego | August 2012



Legend

Site-42		Exploration Site Location

Boring Location By Company, Date

B-3	Geosyntec, 2012
4	Woodward-Clyde, 1981
B-7	GEOCON, 2011
B-2	URS, 2011

Seismic Line by Company, Date

SL-1	GEOCON, 2011
SL00	URS, 2011

0.25 0.125 0 0.25 Miles

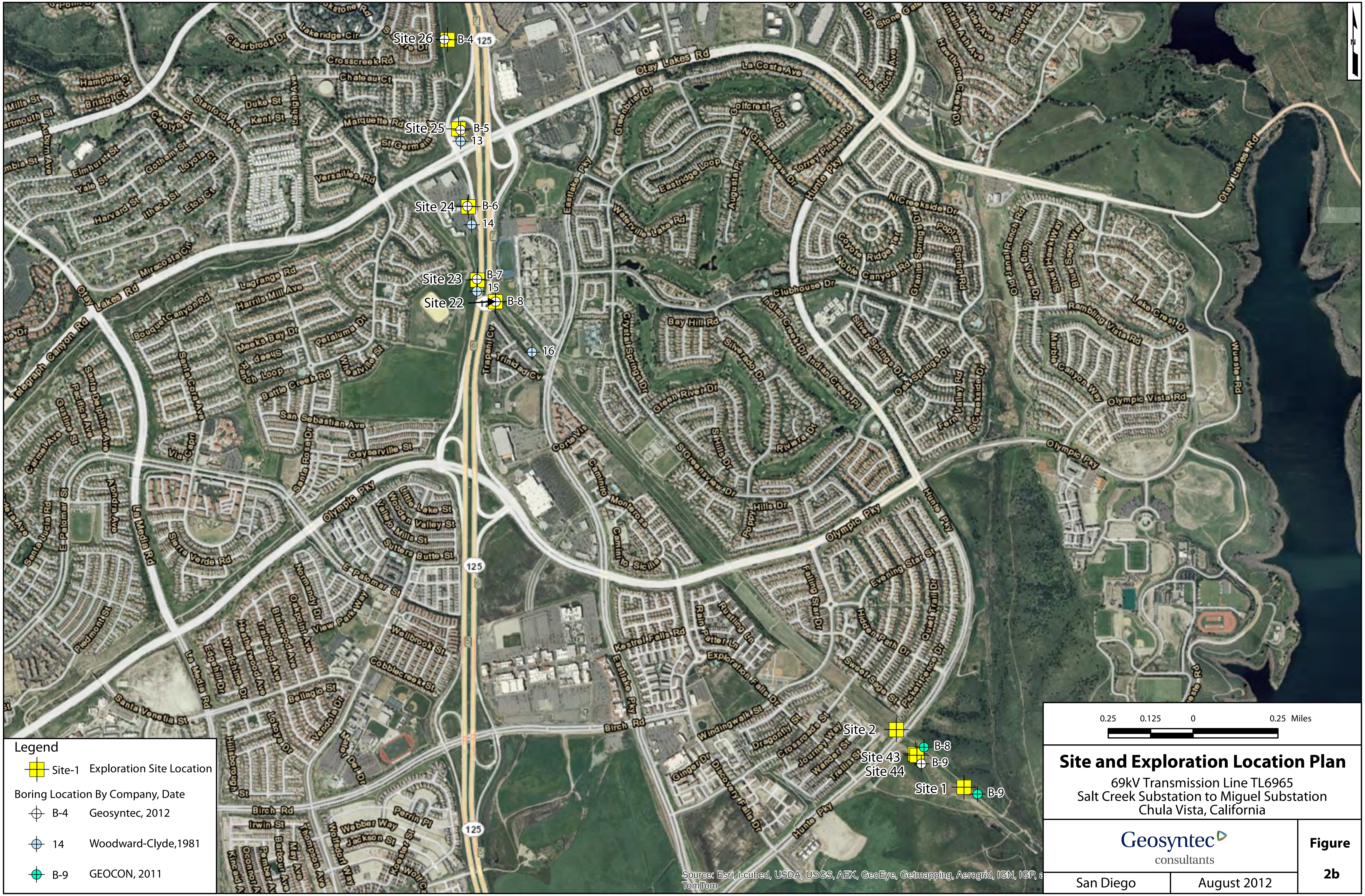
Site and Exploration Location Plan

69kV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Geosyntec consultants

San Diego | August 2012

Figure 2a



Legend

	Site-1	Exploration Site Location

Boring Location By Company, Date

	B-4	Geosyntec, 2012
	14	Woodward-Clyde, 1981
	B-9	GEOCON, 2011

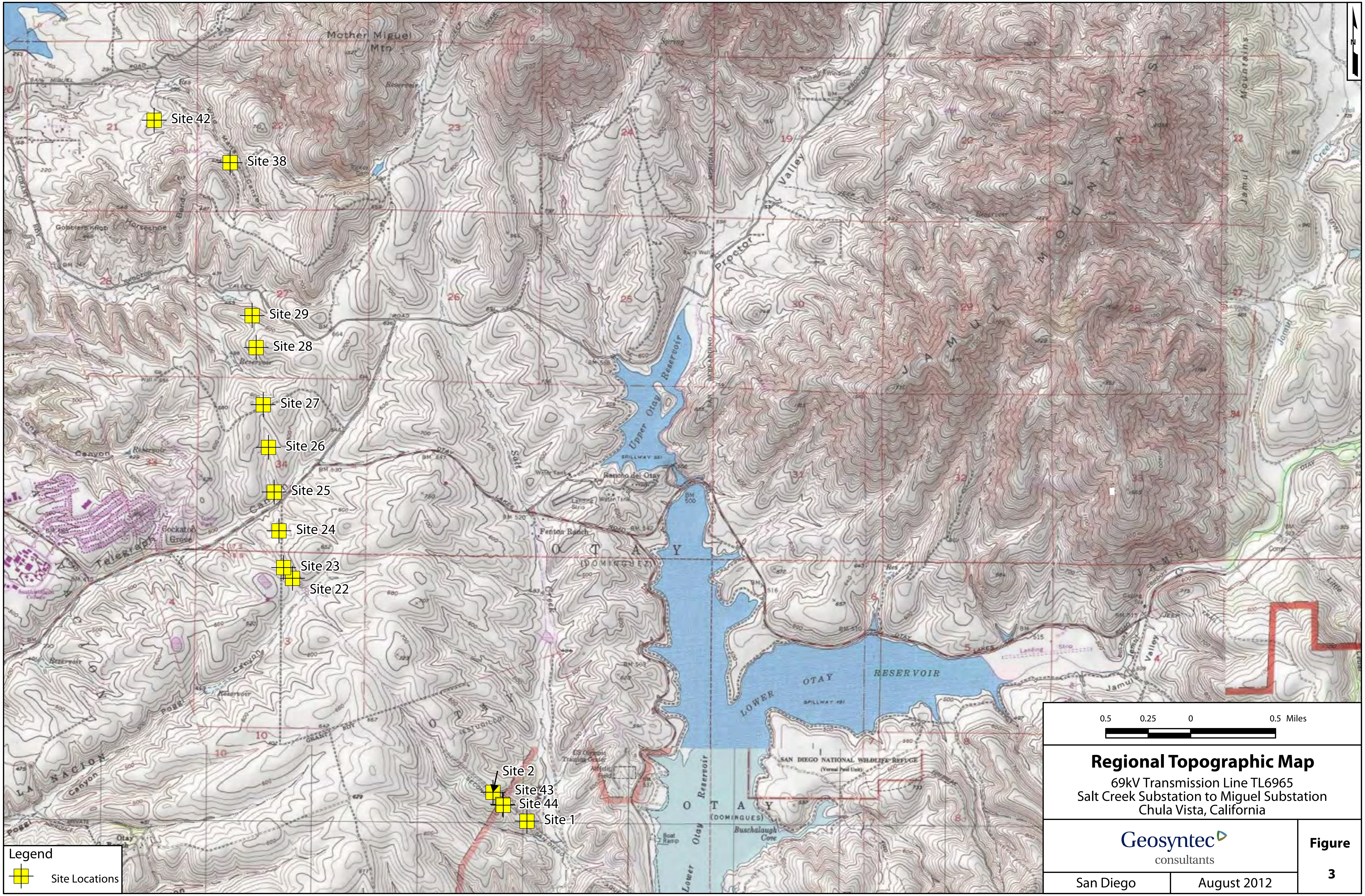
Site and Exploration Location Plan

69kV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Geosyntec consultants

San Diego | August 2012

Figure 2b

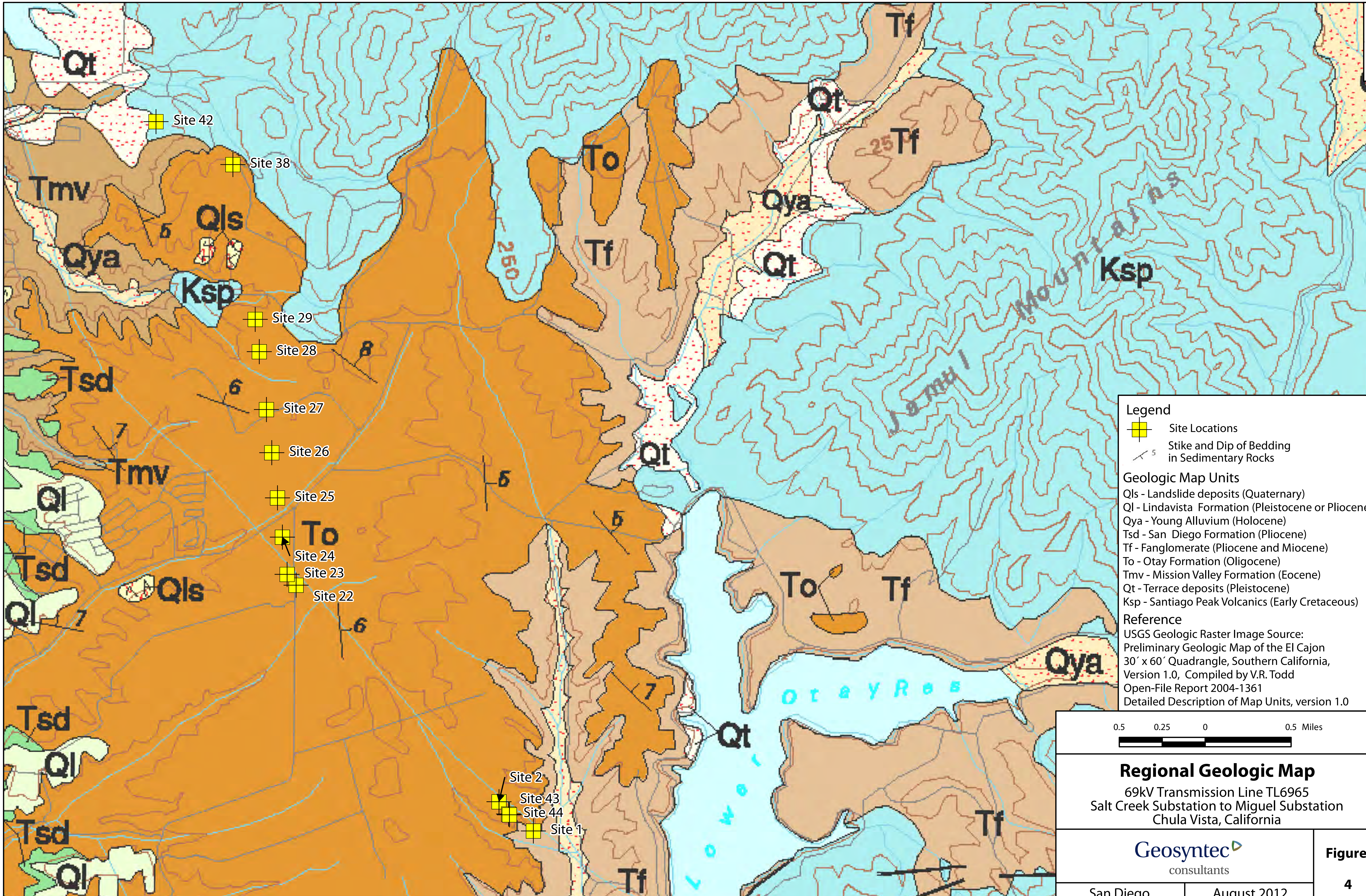


Regional Topographic Map

69kV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Geosyntec consultants

San Diego	August 2012	Figure 3



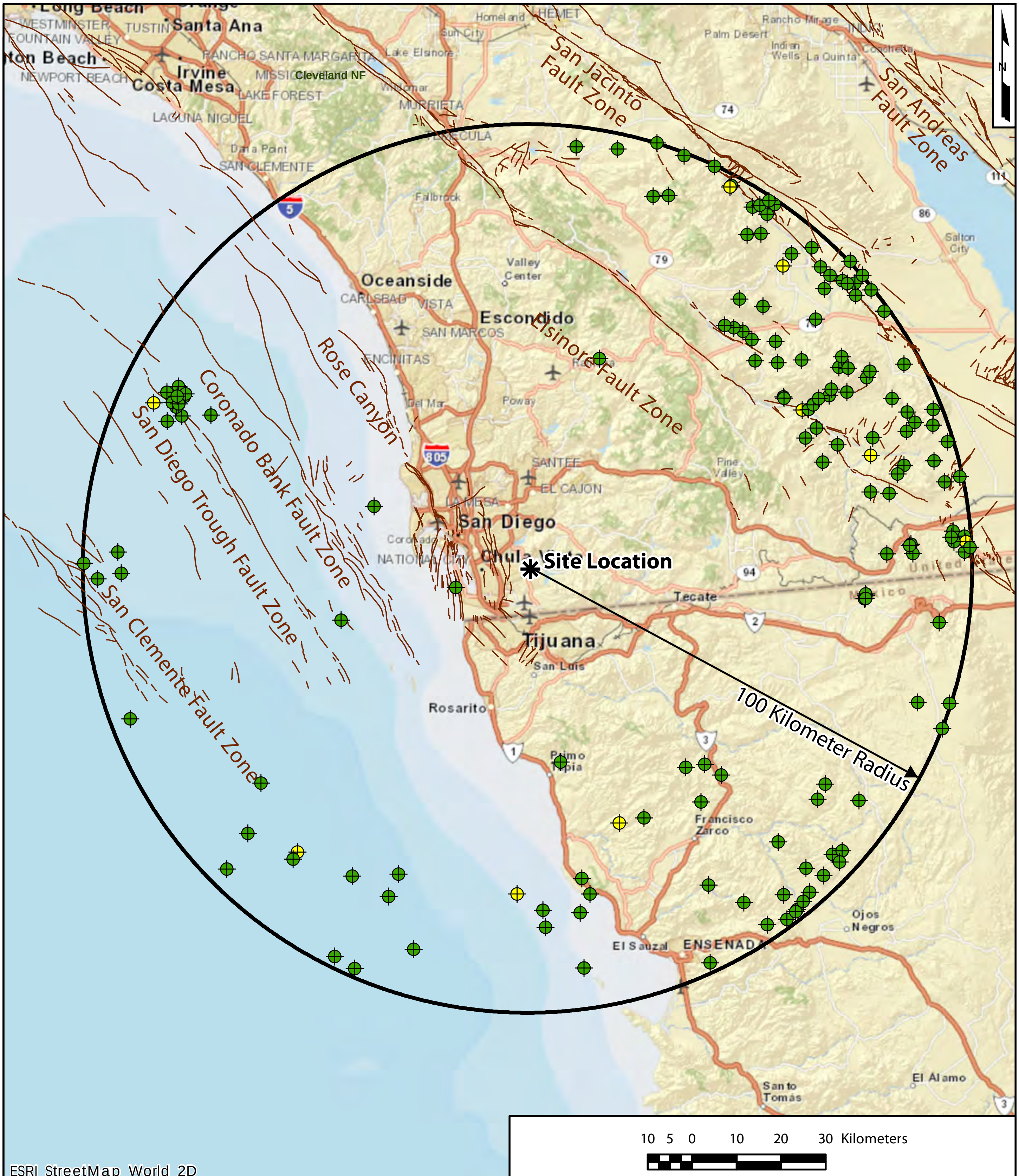
Regional Geologic Map

69kV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Geosyntec consultants

San Diego | August 2012

Figure 4



Legend

Reported Earthquake Magnitudes 1932 - 2012

- 4.0 - 4.99
- 5.0 - 5.99
- 6.0 - 6.6
- Fault

Data Source: Southern California Earthquake Data Center

Image Source: ArcOnline NGS_Topo_US_2D

Regional Fault and Epicenter Map

69kV Transmission Line TL6965
Salt Creek Substation to Miguel Substation
Chula Vista, California

Geosyntec consultants

San Diego | August 2012

Figure 5

APPENDIX A

PREVIOUS INVESTIGATIONS

GEOCON, 2011

PROJECT NO. G1115-52-29

BORING B 1

ELEV. (MSL.) 309' DATE COMPLETED 05-24-2011

EQUIPMENT CME 75 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**COLLUVIUM (Qcol)** Medium dense, moist, grayish brown, Clayey SAND; some gravel			
2								
4								
	B1-1			CL	Hard, moist, gray to brown, Sandy CLAY	23	99.8	23.0
6								
	B1-2			SM	**MISSION VALLEY FORMATION (Tmv)** Dense, moist, yellowish to gray brown, Silty, fine- to coarse-grained SANDSTONE	43		
8								
10	B1-3			CL	Hard, gray mottled yellowish brown, Silty CLAYSTONE; some fine subrounded gravels	86/9"	120.3	11.8
	B1-4							
12								
14								
	B1-5				-Some black carbon staining within matrix	72		
16								
18					-Highly weathered			
	B1-6					50/5"	115.9	16.2
					BORING TERMINATED AT 19.5 FEET Groundwater not encountered			

Figure A-1,
Log of Boring B 1, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 2

ELEV. (MSL.) 511' DATE COMPLETED 06-02-2011

EQUIPMENT MARL 5 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B2-1			SM	**OTAY FORMATION (To)** Medium dense, moist, grayish brown, Silty, fine- to medium-grained SANDSTONE			
5	B2-2			ML	Hard, moist, grayish brown, Sandy SILTSTONE	43	93.5	25.3
10	B2-3			SC	Medium dense, moist, brown, Clayey SANDSTONE; some gravels	14		
15	B2-4			SM	Dense, moist, yellowish brown, Silty, medium- to coarse-grained SANDSTONE	48	111.1	10.4
18	B2-5					23		
					BORING TERMINATED AT 19.5 FEET Groundwater not encountered			

Figure A-2,
Log of Boring B 2, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 3

ELEV. (MSL.) 491' DATE COMPLETED 05-24-2011

EQUIPMENT CME 75 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B3-1			SC	**COLLUVIUM (Qcol)** Medium dense, moist, grayish brown, Clayey, fine to medium SAND; some gravel to about 4 feet			
2								
4					-Becomes reddish brown			
	B3-2			CL	**OTAY FORMATION (To)** Very stiff, moist, light reddish brown mottled gray, Sandy CLAYSTONE; some gravel and laminations of sand	42	112.0	12.5
6								
8	B3-3					45		
10	B3-4			SC	Very dense, moist, reddish brown, Clayey, fine-grained SANDSTONE; moderately cemented	53		
12								
14								
	B3-5			CL	Hard, moist, gray mottled reddish brown, Sandy CLAYSTONE	41		
16								
18								
	B3-6				-Becomes very hard and highly weathered	50/5"	108.7	16.5
					BORING TERMINATED AT 19.5 FEET Groundwater not encountered			

Figure A-3,
Log of Boring B 3, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 4

ELEV. (MSL.) 502' DATE COMPLETED 05-24-2011

EQUIPMENT CME 75 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**UNDOCUMENTED FILL (Qudf)** Soft, moist, brown, Sandy CLAY; some gravel			
2								
4								
	B4-1			ML	**OTAY FORMATION (To)** Hard, moist, brown, Sandy SILTSTONE	59	99.7	19.9
6	B4-2							
8								
10	B4-3			CL	Very stiff, moist, reddish brown, Sandy CLAYSTONE	22		
12								
14								
	B4-4				-Becomes hard and highly weathered	72	107.2	21.2
16								
18	B4-5				-Some sand and black staining	50/5"		
					BORING TERMINATED AT 19.5 FEET Groundwater not encountered			

Figure A-4,
Log of Boring B 4, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 6

ELEV. (MSL.) 447' DATE COMPLETED 05-24-2011

EQUIPMENT CME 75 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**COLLUVIUM (Qcol)** Stiff, moist, dark brown, Sandy CLAY			
2								
4								
	B6-1			SM	**OTAY FORMATION (To)** Very dense, moist, grayish brown, Silty, fine-grained SANDSTONE; moderately cemented	80/9"	117.9	14.7
6	B6-2							
8								
10	B6-3			CL	Hard, moist, gray brown, Sandy CLAYSTONE	79		
12								
14								
	B6-4					50/5"		
16								
18	B6-5					62		
					BORING TERMINATED AT 19.5 FEET Groundwater not encountered			

Figure A-6,
Log of Boring B 6, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 7

ELEV. (MSL.) 378' DATE COMPLETED 05-25-2011

EQUIPMENT CME 75 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GP	**UNDOCUMENTED (Qudf)** Dense, dry, light brown, Sandy GRAVEL			
2								
4								
	B7-1			CL	**OTAY FORMATION (To)** Very stiff, moist, light grayish brown, Sandy CLAY; trace fine gravel, highly weathered	42	101.7	22.0
6								
	B7-2				-Becomes hard, reddish brown, moist, light gray to reddish brown, Silty to Sandy CLAYSTONE; some small subrounded gravel	54		
8								
	B7-3							
10	B7-4				-Large gravel in sampler, Poor Recovery, erroneous blow counts	50/3"		
12								
14					-Excavates to a Sandy CLAY with rounded gravel to about 14 feet			
	B7-5					90/9"		
16				SM	Very dense, damp, Silty, fine- to medium SANDSTONE; some gravels			
18	B7-6					50/3"		
					BORING TERMINATED AT 18.3 FEET Groundwater not encountered			

Figure A-7,
Log of Boring B 7, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 8

ELEV. (MSL.) **528'** DATE COMPLETED **05-25-2011**

EQUIPMENT **CME 75** BY: **M. ERTWINE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL / COLLUVIUM (Qcol)** Stiff, moist, brown, Sandy CLAY			
2								
	B8-1			SM	**OTAY FORMATION (To)** Dense to hard, dry, whitish gray, Silty, medium- to coarse-grained SANDSTONE with interlayers of fine Sandy SILTSTONE	73	95.9	6.7
4								
	B8-2			ML	Hard, dry, whitish gray Sandy SILTSTONE; some angular gravel	38		
6								
	B8-3							
8								
10	B8-4			SM	Very dense, moist, dark gray, Silty, fine-grained SANDSTONE	75/10"	106.6	17.6
12								
14								
	B8-5					78		
16								
18	B8-6				-Poor recovery	50/3"		
					BORING TERMINATED AT 18.3 FEET Groundwater not encountered			

Figure A-8,
Log of Boring B 8, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1115-52-29

BORING B 9

ELEV. (MSL.) 472' DATE COMPLETED 05-25-2011

EQUIPMENT CME 75 BY: M. ERTWINE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**OTAY FORMATION FANGLOMERATE (Tof)** Dense, dry, olive to reddish brown, Silty, fine-coarse SANDSTONE; some gravel			
2	B9-1					50/6"		
4								
	B9-2				-Becomes very dense, moist, reddish to whitish brown	73		
6	B9-3							
8								
10					-Poor recovery			
12					-Becomes whitish gray			
	B9-5					56		
14								
16								
18	B9-6				-Becomes gravelly SAND	80/6"		

BORING TERMINATED AT 19.0 FEET
Groundwater not encountered

Figure A-9,
Log of Boring B 9, Page 1 of 1

G1115-52-29.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with the generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected bulk, chunk, and ring samples were tested for their dry density moisture content and shear strength, The results of our laboratory tests are presented in tabular forms hereinafter The results of in-place density and moisture content tests are depicted on the boring logs in Appendix A.

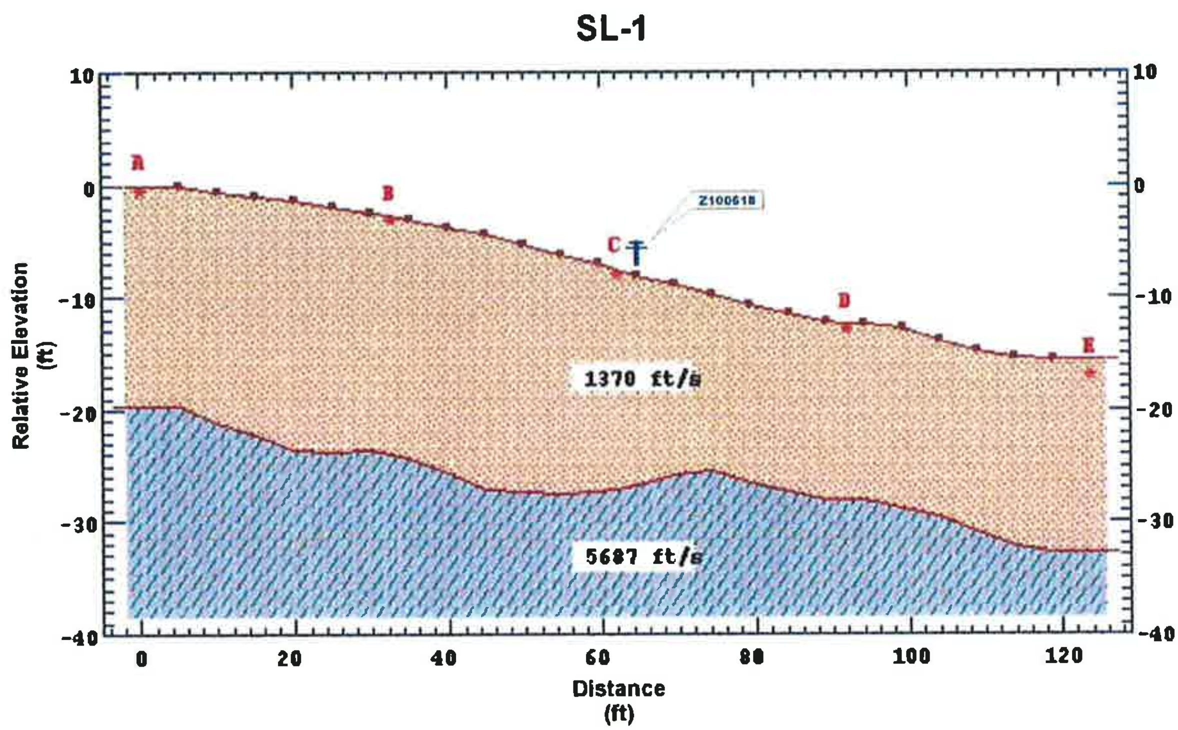
TABLE B-I
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080-03

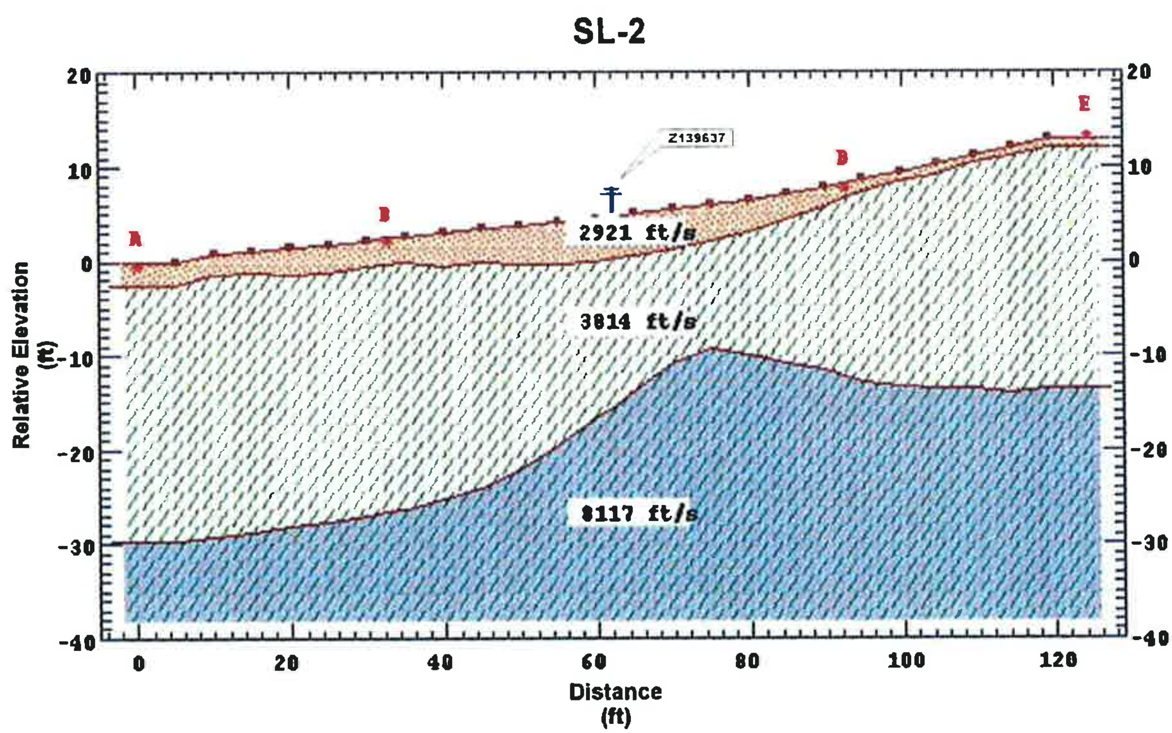
Sample No.	Dry Density (pcf)	Moisture Content %)		Ultimate Unit Cohesion (psf)	Ultimate Angle of Shear Resistance (degrees)
		Before Test	After Test		
B1-1	99.8	23	33.5	340	10
B1-3	120.3	11.8	18.8	420	30
B2-2	93.5	25.3	36.9	600	25
B2-4	111.1	10.4	16.9	290	36
B3-2	112.0	12.5	19.1	780	36
B3-6	108.7	16.5	21.8	1080	35
B4-1	99.7	19.9	29.9	230	31
B4-4	107.2	21.2	27.8	610	29
B6-1	117.9	14.7	21.6	190	41
B7-1	101.7	22.0	26.6	770	21
B8-1	95.9	6.7	25.2	450	40
B8-4	106.6	17.6	23.5	570	34
B11-1	118.3	8.1	13.3	600	38
B11-4	114.9	16.8	22.5	740	26
B15-1	111.1	7.2	17.6	780	35
B15-4	105.3	9.7	18.9	60	37

SEISMIC LINE LOCATION MAP	N	SDG&E TL-6910 San Diego County, California Project No.: 111204 Date: 06/11	SOUTHWEST GEOPHYSICS INC. Figure 2a

0 100 200
approximate scale in feet

SITE PHOTOGRAPHS	SDG&E TL-6910 San Diego County, California Project No.: 111204 — Date: 06/11	SOUTHWEST GEOPHYSICS INC. Figure 3





SEISMIC PROFILES SL-1 AND SL-2

SDG&E TL-6910
San Diego County, California

Project No.: 111204 | Date: 06/11

SOUTHWEST GEOPHYSICS INC.

Figure 4a

URS, 2011

Project: TL 13826 Miguel to Proctor Valley Project Location: San Diego, CA Project Number: 27661044.10000	**Key to Logs** Sheet 1 of 1

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1 **Elevation:** Elevation in feet referenced to mean sea level (MSL) or site datum.

2 **Depth:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

4 **Sample Number:** Sample identification number. Unnumbered sample indicates no sample recovery.

5 **Blows per foot:** Number of blows required to advance driven sampler 12 inches beyond first 6-inch interval, or distance noted, using a 140-lb hammer with a 30-inch drop.

6 **Graphic Log:** Graphic depiction of subsurface material encountered; typical symbols are explained below.

7 **Material Description:** Description of material encountered; may include relative density/consistency, moisture, color, particle size; texture, weathering, and strength of formation material.

8 **Water Content:** Water content of soil sample measured in laboratory, expressed as percentage of dry weight of specimen.

9 **Dry Unit Weight:** Dry density of soil sample measured in laboratory, expressed in pounds per cubic feer (pcf).

10 **Remarks and Other Tests:** Comments and observations regarding drilling or sampling made by driller or field personnel.

SA	Sieve Analysis, %<#200 sieve
WA	Wash Analysis, %<#200 sieve
LL	Liquid Limit, from Atterberg limits test, %
PI	Plasticity Index (LL-PL), %
UC	Unconfined Compression test
CORR	Corrosivity test

TYPICAL MATERIAL GRAPHIC SYMBOLS

Clayey SAND to sandy CLAY (SC/CL)

Silty, clayey SAND (SC-SM)

Lean CLAY (CL)

Fat CLAY (CH)

Sandy silty CLAY (CH-CL)

CLAYSTONE

TYPICAL SAMPLER GRAPHIC SYMBOLS

2.5" ID sampler

Standard Penetration sample

OTHER GRAPHIC SYMBOLS

First water encountered at time of drilling and sampling (ATD)

Static water level measured in boring or well at specified time after drilling

Change in material properties within a lithologic stratum

Inferred contact between strata or gradational change in lithology

GENERAL NOTES

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

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

Project: TL 13826 Miguel to Proctor Valley
Project Location: San Diego, CA
Project Number: 27661044.10000

Log of Boring B-1

Date(s) Drilled	**01/14/11**	Logged By	**K. Shaner**	Checked By	**M. Hatch**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**7 inches**	Total Depth of Borehole	**41.5 feet**
Drill Rig Type	**ATC**	Drilling Contractor	**Tri-County Drilling, Inc.**	Approximate Surface Elevation	**277 feet**
Water Level Depth (Feet)	**Not encountered**	Sampling Method(s)	**SPT/2.5" ID**	Hammer Data	**140 lbs/30-inch drop**
Borehole Backfill	**Soil cuttings**	Location	**See Site Plan**		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0					ALLUVIUM Medium stiff to stiff, moist, dark yellowish brown, sandy lean CLAY (CL)			
			1-1	9					
	5		1-2	21		RESIDUAL SOIL Medium stiff, moist, yellowish brown, silty fat CLAY (CH), low plasticity, trace caliche, blocky structure	30		WA(83), LL(64), PI(41)
270									
	10		1-3	40		SWEETWATER FORMATION Dense, moist, yellowish brown, sandy CLAY (CL) with oxidized staining, cemented seams, some gypsum lenses	16		SA(67)
	15		1-4	80		Becomes very dense, sandy cemented claystone, yellowish brown with gray seams, manganese staining	17		
260									
	20		1-5	49					
	25		1-6	65			20		
250									
	30		1-7	48		Very dense, yellowish brown, cemented CLAYSTONE with manganese staining, blocky structure			SA(84)
	35		1-8	85		Increase silt content	17		
240									
	40		1-9	71					
						Bottom of boring at 41.5 feet			
	45								

URS

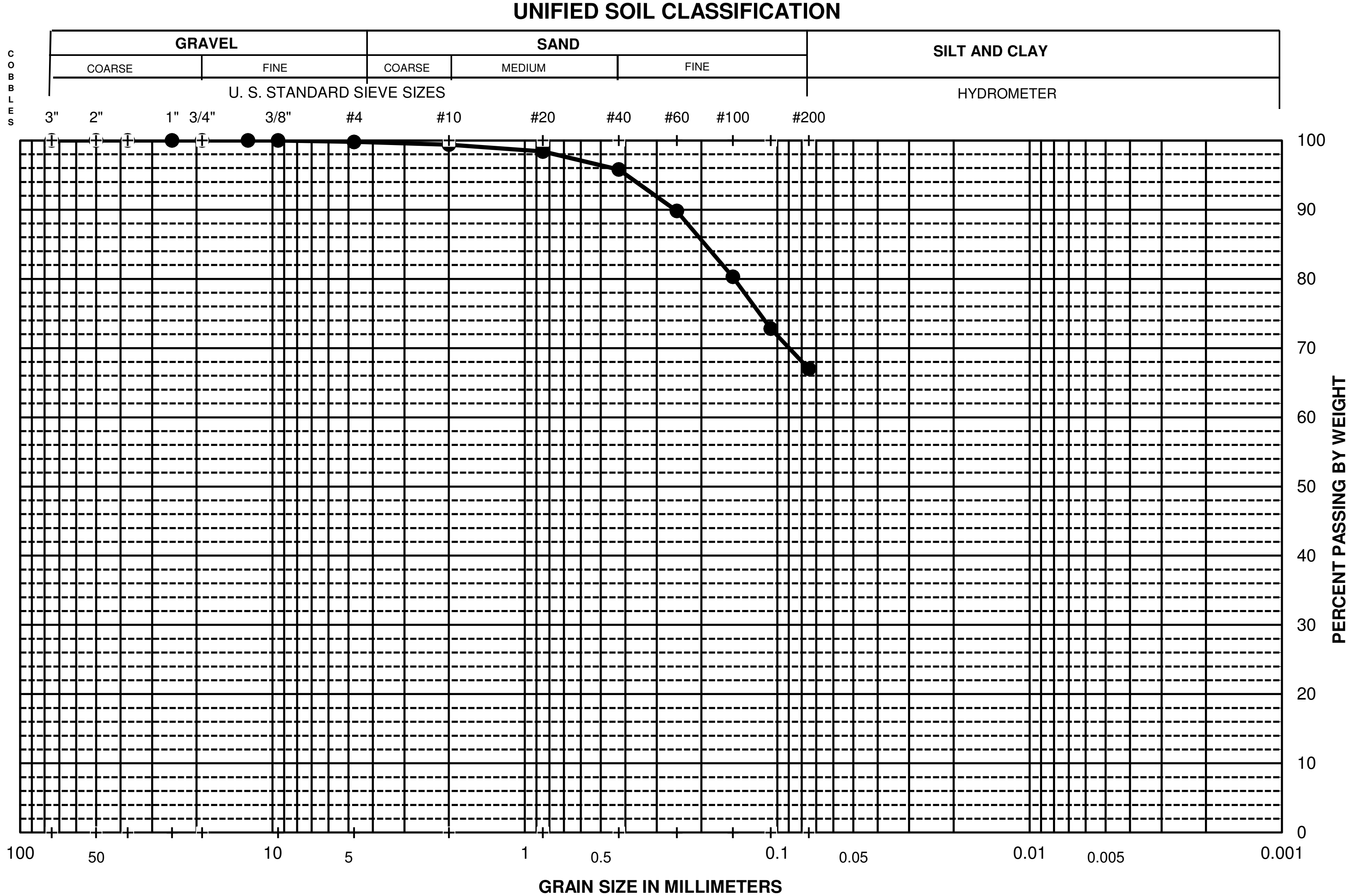
Figure B-2

Project: TL 13826 Miguel to Proctor Valley **Project Location: San Diego, CA** **Project Number: 27661044.10000**	# Log of Boring B-2 Sheet 1 of 1

Date(s) Drilled	**01/14/11**	Logged By	**K. Shaner**	Checked By	**M. Hatch**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**7 inches**	Total Depth of Borehole	**31.5 feet**
Drill Rig Type	**ATC**	Drilling Contractor	**Tri-County Drilling, Inc.**	Approximate Surface Elevation	**481 feet**
Water Level Depth (Feet)	**Not encountered**	Sampling Method(s)	**SPT/2.5" ID**	Hammer Data	**140 lbs/30-inch drop**
Borehole Backfill	**Soil cuttings**	Location	**See Site Plan**		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
480	0					TOPSOIL Dense, moist, dark brown, clayey SAND to sandy CLAY (SC/CL), trace sand			
			2-1	15		COLLUVIUM Medium dense, moist, yellowish to reddish brown, silty, clayey SAND (SM-SC), some caliche	19		
	5		2-2	27		Stiff, moist, reddish brown, sandy, silty CLAY (CH-CL)			SA(76), CORR
470	10		1-3	25			20		WA(63)
						SWEETWATER FORMATION Hard, moist, grayish brown, sandy, silty CLAYSTONE with manganese staining			
	15		1-4	27					LL(46), PI(23)
460	20		1-5	57		Becomes very hard			UC
	25		1-6	13		Becomes very stoff, increased silt and sand content	30		
450	30		1-7	50/6"		Becomes very hard			
						Bottom of boring at 31.5 feet			
	35								
440	40								
	45								

URS



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	99.8
#10	2.00	99.4
#20	0.850	98.4
#40	0.425	95.8
#60	0.250	89.8
#100	0.150	80.3
#140	0.106	72.8
#200	0.075	67.0
Hydrometer Analysis		

% Cobbles	XX
% Gravel	0.2
% Sand	32.8
% Fines	67.0
D_{85}	0.193
D_{60}	#N/A
D_{50}	#N/A
D_{30}	#N/A
D_{15}	#N/A
D_{10}	#N/A
C_u	XXX
C_c	XXX

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 µm	Description and Classification
B1	3	10.0	●	16.1	NA	NA	NA	**Very pale brown sandy Clay (CL)**

PROJECT NAME: **TL 13826 Miguel to Proctor Valley**

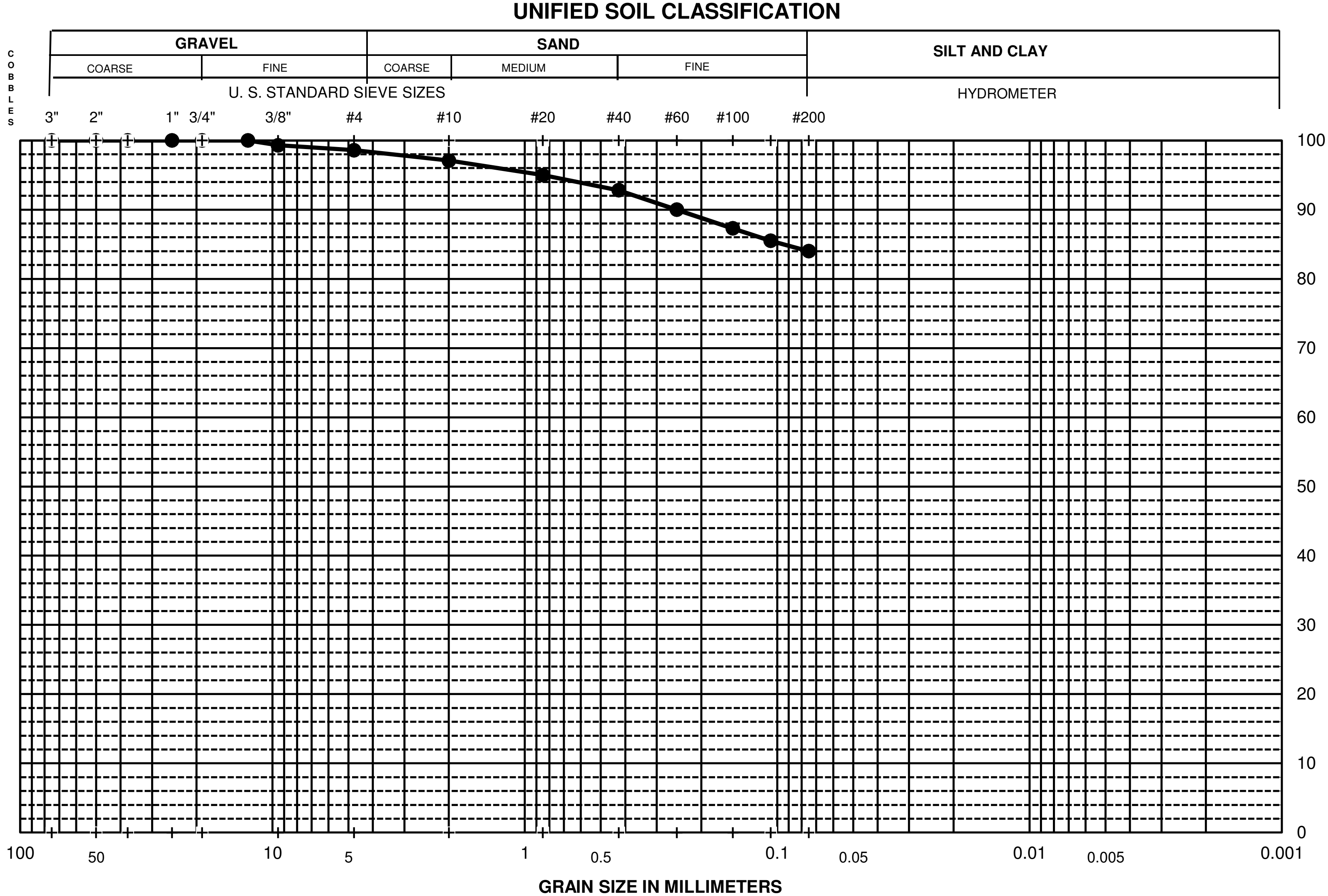
PROJECT NUMBER: **27661044.10000**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-1

Sieve Miguel B01 010

URS



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.3
#4	4.75	98.6
#10	2.00	97.1
#20	0.850	95.0
#40	0.425	92.8
#60	0.250	90.0
#100	0.150	87.3
#140	0.106	85.5
#200	0.075	84.0
Hydrometer Analysis		

% Cobbles	XX
% Gravel	1.4
% Sand	14.6
% Fines	84.0
D_{85}	0.094
D_{60}	#N/A
D_{50}	#N/A
D_{30}	#N/A
D_{15}	#N/A
D_{10}	#N/A
C_u	XXX
C_c	XXX

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 µm	Description and Classification
B1	7	30.0	●	NA	NA	NA	NA	**Light yellowish brown Clay with sand (CH)**

PROJECT NAME: **TL 13826 Miguel to Proctor Valley**

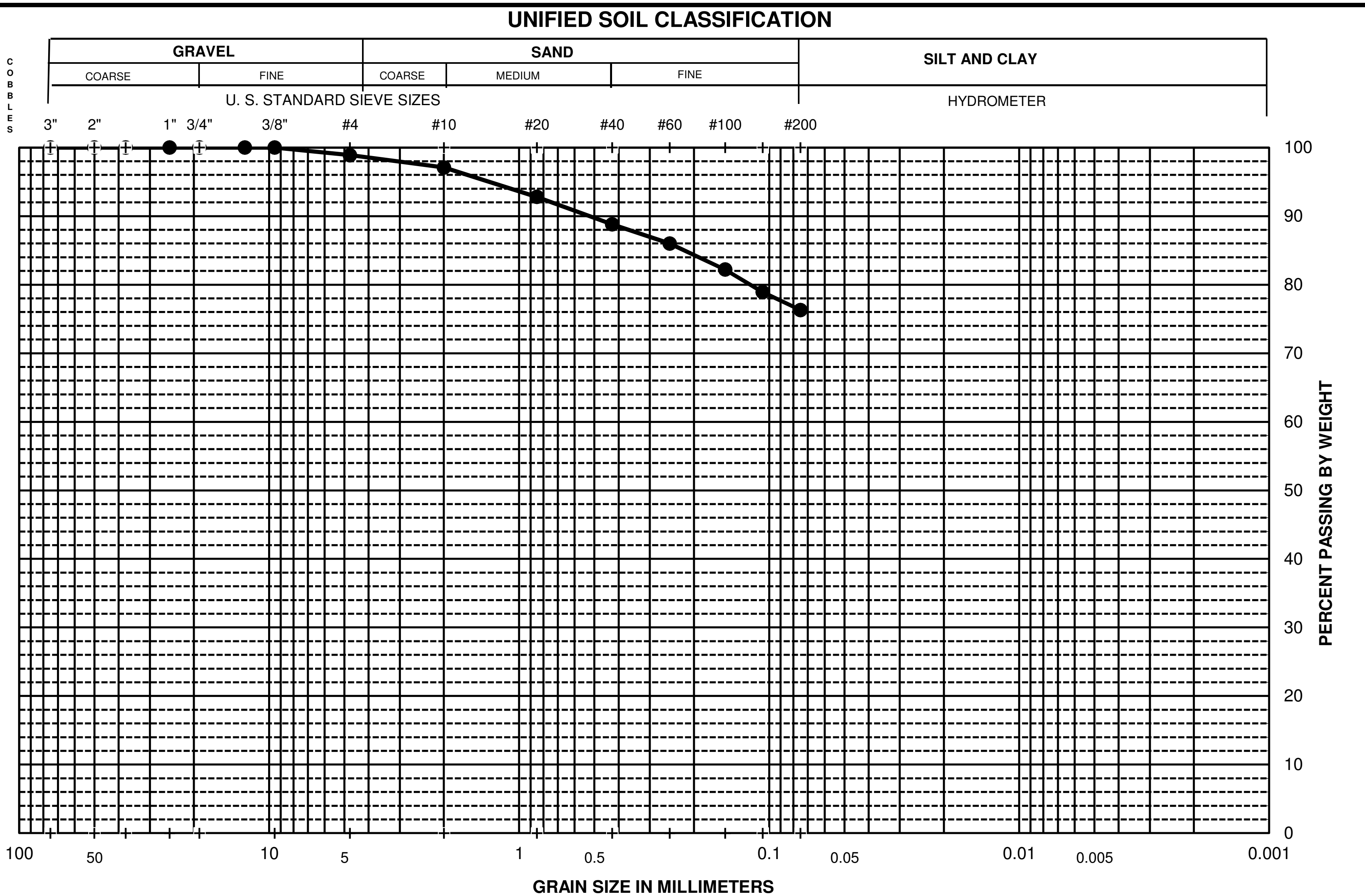
PROJECT NUMBER: **27661044.10000**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-2

Sieve Miguel B01 030

URS



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	98.9
#10	2.00	97.1
#20	0.850	92.8
#40	0.425	88.8
#60	0.250	86.0
#100	0.150	82.2
#140	0.106	78.9
#200	0.075	76.3
Hydrometer Analysis		

% Cobbles	XX
% Gravel	1.1
% Sand	22.6
% Fines	76.3
D_{85}	0.219
D_{60}	#N/A
D_{50}	#N/A
D_{30}	#N/A
D_{15}	#N/A
D_{10}	#N/A
C_u	XXX
C_c	XXX

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 µm	Description and Classification
B2	2	5.0	•	NA	NA	NA	NA	**Pale brown Clay with sand (CH)**

PROJECT NAME: **TL 13826 Miguel to Proctor Valley**

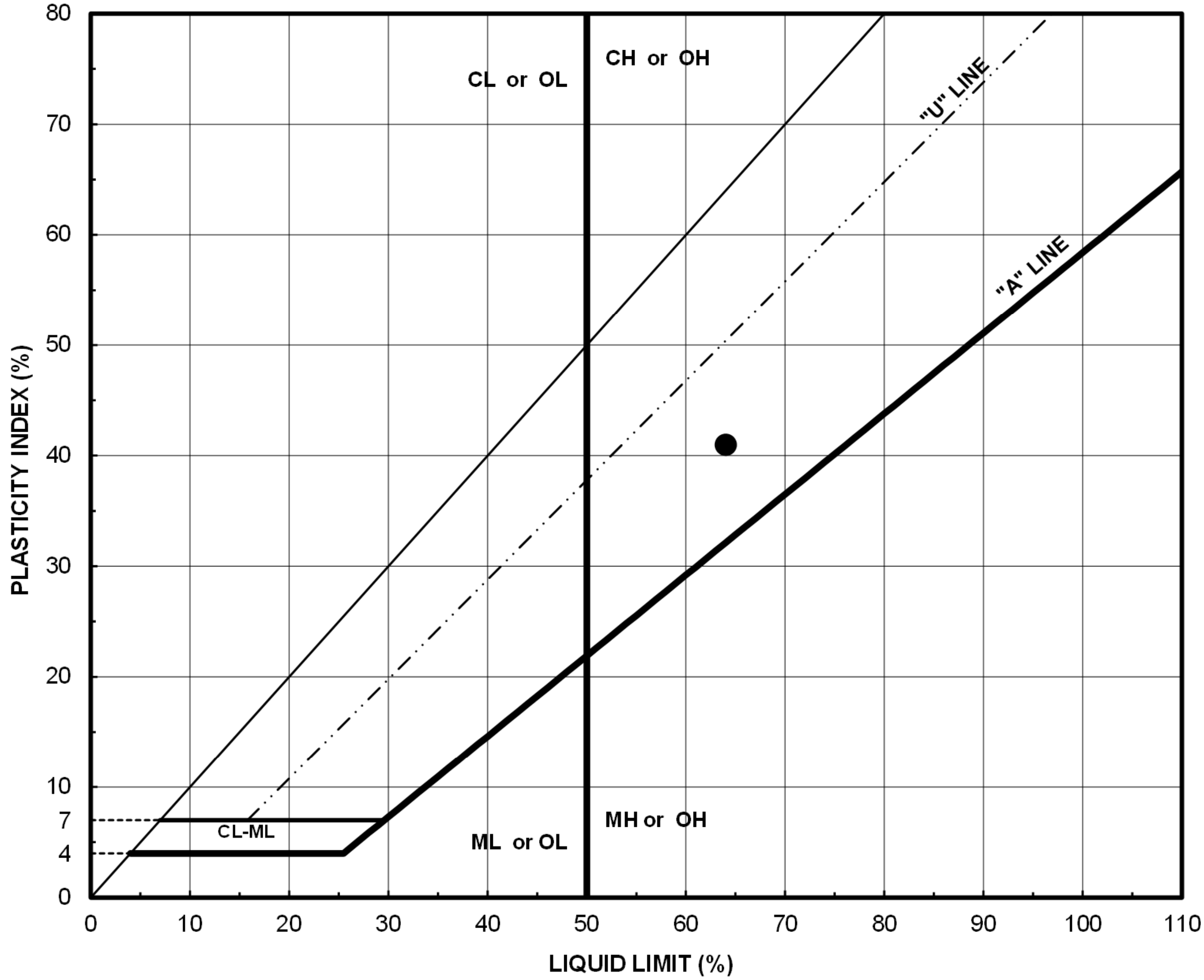
PROJECT NUMBER: **27661044.10000**

PARTICLE-SIZE DISTRIBUTION CURVES

Figure C-3

Sieve Miguel B02 005

URS



BORING No.	SAMPLE No.	DEPTH (ft.)	WATER CONTENT (%)	LL	PI	DESCRIPTION / CLASSIFICATION
B1	2	5.0	29.6	64	41	Yellowish brown Clay with sand (CH)

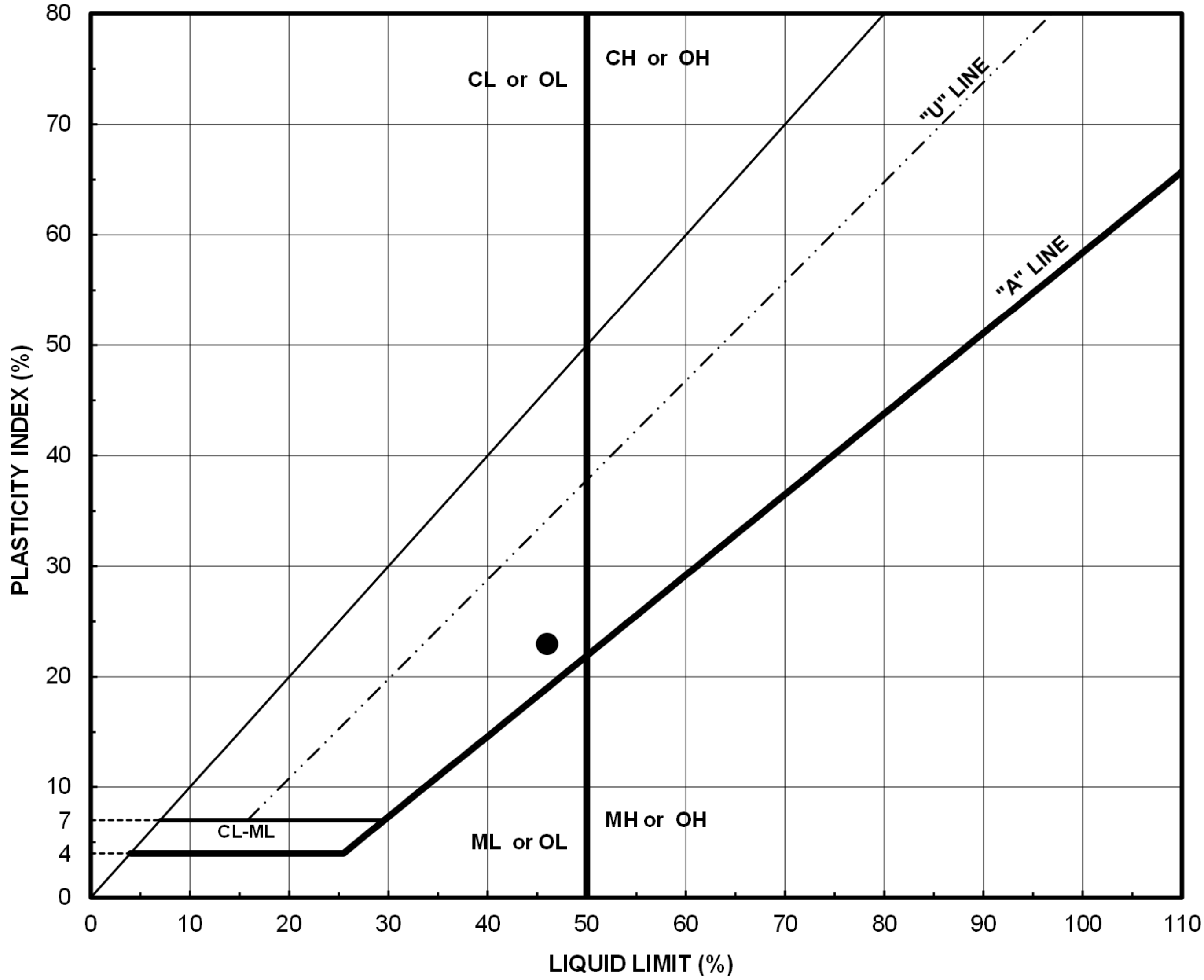
Project Name: **TL 13826 Miguel to Proctor Valley**

Project Number: **27661044.10000**

PLASTICITY CHART

Figure C-4

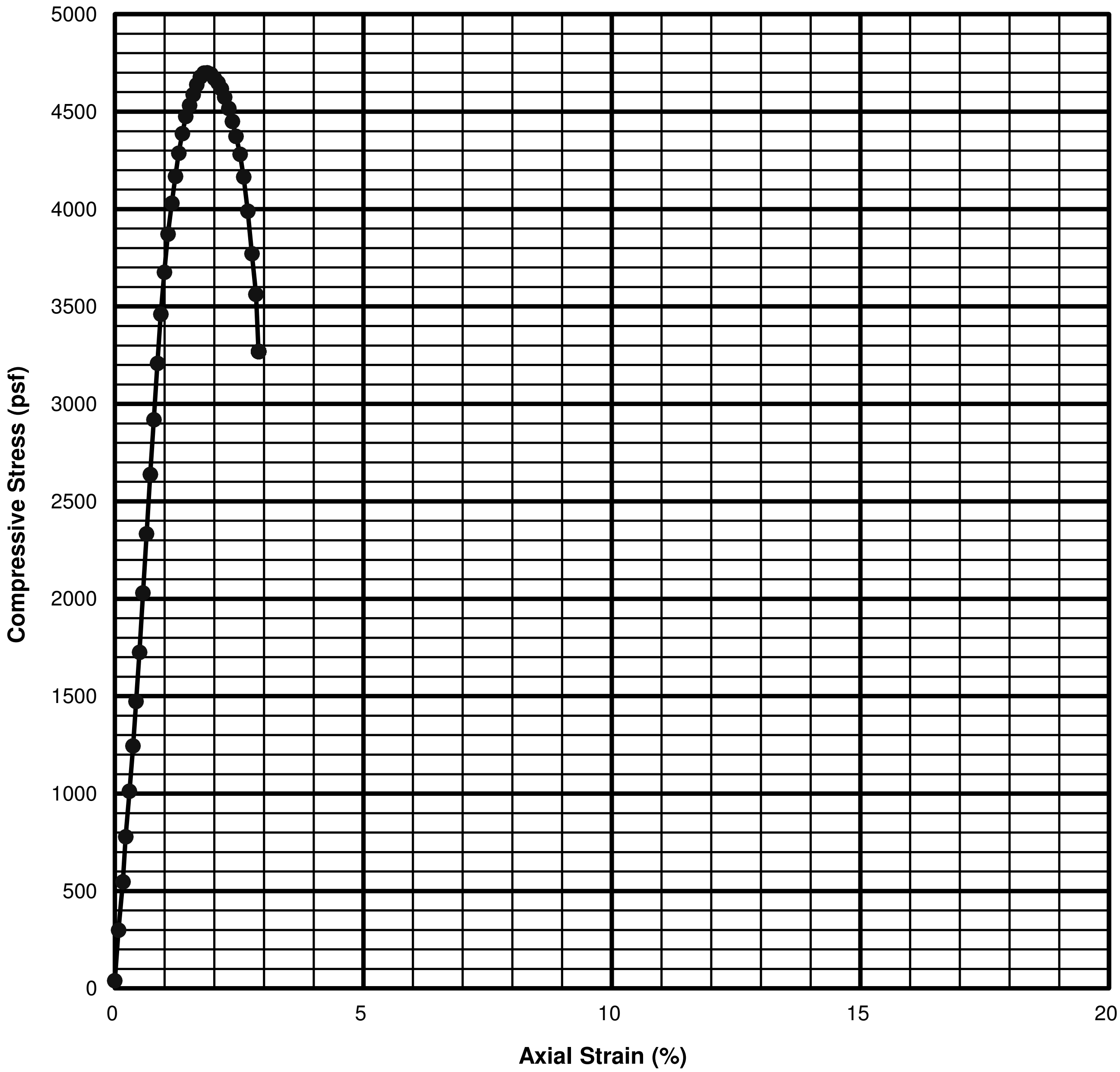
URS



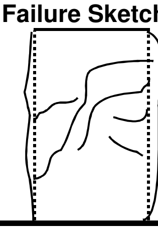
BORING No.	SAMPLE No.	DEPTH (ft.)	WATER CONTENT (%)	LL (%)	PI (%)	DESCRIPTION / CLASSIFICATION
B2	4	15.0	NA	46	23	Yellowish red Clay (CL)

Project Name: **TL 13826 Miguel to Proctor Valley** **PLASTICITY CHART**

Project Number: **27661044.10000** **Figure C-5**



Failure Sketch



Water Content (%)	Length (in)	Diameter (in)	Wet Density (pcf)	Degree of Saturation (%)	Peak Stress (psf)
21.5	6.018	2.403	121.8	80.0	4699.6

Project Name: TL 13826 Miguel to Proctor Valley

Project Number: 27661044.10000

Boring Number: B2 **Sample No.:** 5 **Depth (ft):** 20

Description and/or Classification: Reddish brown Clay (CH)

UNCONFINED COMPRESSION TEST
ASTM D2166

Figure C-6

CORROSIVITY TEST ANALYSIS

Project Number: 27661044
Project Name: TL 13826 Miguel to Proctor
Project Engineer: KAS

Boring No.: B2
Sample No.: 2
Depth (ft): 5.0

Initial Visual Classification Symbol: CH

State of Specimen before Processing

- X Passing soil through #8 sieve
- X Moist State
- [ ] Air Dried
- [ ] Oven Dried at 60 C

Set-Up Water Content	Minus No. 8 or ( )
Container No.	s25
Mass Container + Wet Soil (g), M1	117.74
Mass Container + Dry Soil (g), M2	114.49
Mass Container (g), M3	99
Water Content, w (%)	20.98

Resistivity Test: California Test Method 643

Mininum Resistence value: 360 ohm-cm

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Weight of Soil in bowl (g):	318.93	318.15	325.32	331.25	
Weight of mixing bowl (g):	151.04	151.04	151.04	151.04	
Wet weight of Soil (g):	167.89	167.11	174.28	180.21	
Amount of water added (ml):	0	10	10	10	
Soil Box + Wet Soil (g), M5	239.99	262.47	270.64	272.56	
Weight of Soil Box (g), M6	130.40	130.40	130.40	130.40	
Wt. of Wet Soil for test (g), M7	109.59	132.07	140.24	142.16	
Volume of Soil Box (cm^3)	79.2	79.2	79.2	79.2	79.2
Est. Saturation (%)	41.8	70.2	86.7	94.6	
Resistivity Reading (ohm)	1,200	480	370	360	
Resistence (ohm-cm)	1,200	480	370	360	

Resistence = Soil Box Constant x Reading

pH Test :

50g wet weight of soil mixed with 50 mL of de-ionized water.

pH of slurry: 8.10
Temperature : 21.8 Celsius

Sulfate Content:

100g of soil mixed with 300 mL of de-ionized water.

SO_4 (ppm) : 42

recorded mg of SO_4 in sample, x, = 14 mg

soil / water ratio, r, = 3

number of dilutions to obtain above value, d, = ______ = ______ mg/ L = ppm

Dilution Equation, d > 0; $SO_4 = ((x / 80)^* (r\ 80 * 2^{d} - r\ 80 * 2^{(d-1)})) + r\ 80 * 2^{(d-1)}$

Chloride Content:

100g of soil mixed with 300 mL of de-ionized water.

Cl^- (ppm) : 345

mg/L of Cl^- = ((A-B) x N x 35453) x 3

A = mL of $AgNO_3$ A= 23

B = 23 mL of the blank

N = 0.0493 N, normality of the titrant

Cl^- (mg/L) = A * 5 * 3

Tested By: TJO Date: 1/28/2011 Checked By: TJO

SNA (2007) corrosivity Miguel B02 005

Figure C-7

URS, 2005

Table A-1
Summary of Seismic Refraction and Augerability
Otay Mesa Power Purchasing Agreement

Structure No.	Apparent Compression Wave Velocity (feet/second)	Apparent Depth (feet)	Corresponding Boring	Geologic Unit [a]	Augerability [a,b]
00	1200	0 to 10		RS/Qsw	e-m
	4550	10 to 25		Wx Tsw	e-m
	6300+	25+		Tsw	r
01	1175	0 to 8		RS/Qsw	e-m
	4600	8 to 19		Wx Tsw	e-m
	6000+	19+		Tsw	r
02	1200	0 to 9		RS/Qsw	e-m
	4050	9 to 24		Wx Tsw	e-m
	6000	24+		Tsw	r
10	1200	0 to 12.5		Wx To	e-m
	2700	12.5 to 26		To	e-m
	3650	26+		Tsw	e-m
20	1250	0 to 3.5	B-14	RS	e-m
	2400	3.5 to 10		Wx To	e-m
	3150	10+		To	e-m
40	1600	0 to 3		RS	e-m
	2800	3 to 20		Wx To	e-m
	4000	20+		To	e-m
60	1200	0 to 10	B-13	RS/Hwx Tsw	e-m
	5100	10+		Wx Tsw	d
80	1500	0 to 5		RS	e-m
	2400	5 to 17		Wx To	e-m
	3500	17+		To	e-m
100	1200	0 to 12		RS/Hwx To	e-m
	3500	12 to 25		Wx To	e-m
	5400	25+		To	d
120	1500	0 to 5.5		RS	e-m
	3400	5.5 to 15		Wx To	e-m
	4700	15+		To	e-m
150	1350	0 to 17		RS/HwxTsd	e-m
	3000	17+		Tsd	e-m

Table A-1 (continued)
Summary of Seismic Refraction and Augerability
Otay Mesa Power Purchasing Agreement

Structure No.	Apparent Compression Wave Velocity (feet/second)	Apparent Depth (feet)	Corresponding Boring	Geologic Unit	Augerability [a,b]
170	1500	0 to 4	B-12	RS	e-m
	3300	4 to 14		Wx Ql	e-m
	4600	14+		Ql	e-m
180	1200	0 to 7		RS	e-m
	1700	7 to 20		Wx Tsd	e-m
	3300	20+		Tsd	e-m
210	2500	0 to 4		RS	e-m
	4650	4 to 18		Wx Ql	e-m
	7100	18+		Ql	d
230	1600	0 to 4		Qsw	e-m
	3300	4 to 15		Wx Tsd	e-m
	5350	15+		Tsd	d
250	1200	0 to 3		Fill	e-m
	3200	3 to 23		Wx Ql	e-m
	6300	23+		Ql	d
260	2200	0 to 5	B-11	Fill	e-m
	4800	5+		Ql	e-m
270	1850	0 to 4	B-10	RS	e-m
	3450	4 to 15		Wx Ql	e-m
	4700	15+		Ql	e-m
300	1200	0 to 3	B-9	Qsw	e-m
	2050	3 to 10		Wx Tsd	e-m
	3100	10+		Tsd	e-m
310	1300	0 to 5	B-8	Qsw	e-m
	3000	5 to 16		Wx Tsd	e-m
	6000	16+		Tsd	d
340	1400	0 to 3		Fill	e-m
	3600	3 to 24		Wx Qbp	e-m
	7400	24+		Qbp	d

Table A-1 (continued)
Summary of Seismic Refraction and Augerability
Otay Mesa Power Purchasing Agreement

Structure No.	Apparent Compression Wave Velocity (feet/second)	Apparent Depth (feet)	Corresponding Boring	Geologic Unit	Augerability [a,b]
360	1300	0 to 6	B-6	RS	e-m
	2700	6 to 31		Wx Qbp	e-m
	5400	31+		Qbp	d
370	1200	0 to 6	B-5	RS/Wx Qbp	e-m
	2300	6 to 14		Wx Qbp	e-m
	3800	14+		Qbp	e-m
390	1650	0 to 8	B-7	Qal / Qbp	e-m
	4950	8+		Qbp	e-m
410	1150	0 to 15		RS/Qbp	e-m
	2600	15 to 23		Wx Qbp	e-m
	3900	23+		Qbp	e-m
430	1300	0 to 30	B-3	Fill/Qbp	e-m
	3600	30+		Qbp	e-m
440	1800	0 to 22		Qal / Qbp	e-m
	3750	22+		Qbp	e-m
450	1125	0 to 4	B-15	Qal	e-m
	1650	4 to 30		Qbp	e-m
	3400	30+		Qbp	e-m
460	1175	0 to 19		Qal / Qbp	e-m
	2600	19 to 29		Qbp	e-m
	4600	29+		Qbp	e-m
470	1200	0 to 9	B-1	Fill / Wx Qbp	e-m
	2050	9 to 20		Wx Qbp	e-m
	4300	20+		Qbp	e-m
480	1450	0 to 7	B-2	RS/Qbp	e-m
	2500	7+		Qbp	e-m

Note:

a. RS = residual soil; Hwx = highly weathered; To = Otay Formation; Qbp = Bay Point Formation; Qsw = Slopewash; Wx = weathered; Tsw = Sweetwater Formation; Tsd = San Diego Formation; Qal = Alluvium; Ql = Lindavista Formation

b. Augerability Classifications:
- e-m: Easy to moderate
- d: Difficult
- r: Refusal

c. See Section 5.2 for further discussion on augerability.

Project: OMPPA **Project Location: San Diego County, CA** **Project Number: 27664035.00010**	# Log of Boring B-19 Sheet 1 of 1

Date(s) Drilled	**12-20-04**	Logged By	**A. Greene**	Checked By	**J. Nevius**
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**8"**	Total Depth of Borehole	**19.5 feet**
Drill Rig Type	**Mobile B-61**	Drilling Contractor	**F&C Drilling**	Approximate Surface Elevation	**308' MSL**
Water Level Depth (Feet)	**None encountered**	Sampling Method(s)	**ModCal/SPT**	Hammer Data	**140 lbs/30" drop**
Borehole Backfill	**Soil cuttings**	Location	**STR 00**		

Elevation, feet	Depth, feet	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Density, pcf	REMARKS AND OTHER TESTS
	0					RESIDUAL SOIL/SLOPEWASH Very stiff to hard, moist, grayish brown, fat CLAY with trace fine sand and gravel (CH)			
305			19-1	30			22		LL(73), PI(45)
	5		19-2	25		Becomes light brown with localized carbonate concretion. Scattered gravels 5'-7'			
300			19-3	37			19		LL(66), PI(40)
	10		19-4	59		SWEETWATER FORMATION Hard, moist, light brown to pale brown mottled, lean CLAY with trace fine sand (CL), slight fractured texture	22	101	
295									
	15		19-5	49					CORR
290			19-6	55					
	20					Bottom of boring at 19.5 feet			
285									
	25								
280									
	30								

Figure A-5

URS

WCC, 1981

TABLE 2.3

SUMMARY OF LABORATORY TESTING RESULTS

Sample No.	Tower Site	Depth (ft.)	Moisture Content(%)	Dry Density (lb/ft³)	Liquid Limit(%)	Plasticity Index(%)	% Passing #200 Sieve	USCS Symbol	Geologic* Formation	Direct Shear Test Results $\phi°$	Direct Shear Test Results c(psf)	Blow Count/ft
6-1-4	6	4.0- 4.5	22	100	64	46	60	CH	Tsw	5	1,080	34
6-2-3	6	8.5- 9.0	16	101				CH	Tsw	22	670	26
6-2-4	6	9.0- 9.5	14	109	35	18	45	GC-SC	Tsw			26
6-3-3	6	15.5-16.0	19	104				CH	Tsw	17	620	63
6-3-4	6	16.0-16.5	14	112	52	34	65	CH	Tsw			63
15-1-4	15	3.0- 3.5	22	103	62	46	75	CH	Residual clay/Tot			23
15-2-4	15	9.0- 9.5	16	107				CH	Residual clay/Tot			41
15-3-3	15	14.0-14.5	12	102	non-plastic		25	SM	Tot			50/4"
15-3-4	15	14.5-15.0	10	106				SM	Tot	51	0	50/4"
22-1-3	22	5.5- 6.0	16	85	47	18	58	ML-CL	Tot			72
22-1-4	22	6.0- 6.5	24	94				ML-CL	Tot	36	1,280	72
22-2-3	22	10.0-10.5	13	97			28	SM	Tot			50/4"
22-2-4	22	10.5-11.0	14	107	non-plastic			SM	Tot	45	500	50/4"
25-1	25	11.0-15.0	6				11	SC	Tsw			
31-1	31	8.0-10.0	3				5	SM-SP	Qal			
32-1	32	4.0- 7.0	5				27	GC-SC	Qt			
33-2	33	13.0-15.0	16		54	38	83	CH	Tsw/Qls			
33-3	33	38.0-40.0	37		96	66	92	CH	Tsw			
37-1	37	3.0- 6.0	8				37	GC-SC	Tsw_c			
48-2	48	12.0-15.0	13				45	GC-SC	Tsw_c			

* See Section 3.1

TABLE 3.1

SUMMARY OF TOWER SITE
SOIL AND ROCK MATERIAL
AND ANTICIPATED FOUNDATION TYPE

Tower Site No.	Subsurface Material Category	Expected Foundation Type	Notes
4	Tsw	DP	(a) (b) (h) (i)
5	Tot	DP	
6(A)	Tsw	DP	(a) (b) (h)
7	Tsw	DP	(a)
8	Tsw	DP	(a)
9	Tot	DP	(a)
10	Tot	DP	(a) (b)
11	Tot	DP	(a)
12	Tot	DP	(a)
13	Tot	DP	(a) (b) (d)
14	Tot	DP	(a) (b)
15(A)	Tot	DP	(a) (b)
16	Tot	DP	(b)
17	Tot	DP	
18	Tot	DP	(a)
19	Tot	DP	
20	Tot	DP	(a)
21	Tot	DP	(a)
22(A)	Tot	DP	(a) (b)
23	Tot	DP	(a) (h)

TABLE 3.1 (cont'd)

SUMMARY OF TOWER SITE
SOIL AND ROCK MATERIAL
AND ANTICIPATED FOUNDATION TYPE

Tower Site No.	Subsurface Material Category	Expected Foundation Type	Notes
24	Tot	DP	(a)
25(A)	Tsw	DP	(b) (h)
26	Tsw	DP	(a) (b) (h) (i)
27	Tsw	DP	(a) (b) (h) (i)
28	Tsw	DP	(a) (b)
29	Tsw	DP	(b) (h) (i)
30(A)	Qt	DP	(b) (e)
31	Qal	DP	(a) (b) (c) (d) (e)
32	Qt	DP	(b) (d) (e)
33	Tsw/Qls	DP	(b) (g) (h) (i)
34	Tsw_c	DP	(a) (b) (e)
35	Tsw_c	DP	(b) (e)
36	Tsw_c	DP	(b) (e) (i)
37	Tsw_c	DP	(e)
38	Tsw_c	DP	(a) (b) (e)
39	Tsw_c	DP	(a) (b) (e)
40(A)	Jsp	RA	(a) (b) (h) (i)
41	Jsp	RA	(a) (b) (f)
42	Jsp	RA	(a) (b) (h)
43	Jsp	RA	(a) (b) (h)

TABLE 3.1 (cont'd)

SUMMARY OF TOWER SITE
SOIL AND ROCK MATERIAL
AND ANTICIPATED FOUNDATION TYPE

Tower Site No.	Subsurface Material Category	Expected Foundation Type	Notes
44	Jsp	RA	(a) (b) (h) (i)
45	Jsp	RA	(a) (b) (h) (i)
46	Jsp	RA	(a) (b) (f)
47	Tsw_c	DP	(a) (b) (e)
48	Tsw_c	DP	(a) (b) (e)

NOTES FOR TABLE 3.1

(a) Colluvium, topsoils, loose plowed soils or loose boulders, generally less than 3 feet thick, present over formation soil/rock.

(b) Potential for erosion.

(c) In alluvial fan or valley, next to a drainage channel; potential for flooding.

(d) Potential for seasonal perched or high water tables.

(e) Subsurface soils contain cobbles and/or boulder-size material.

(f) Some drilling may be possible; if so, use Jsp (soil) parameters.

(g) Site located on landslide.

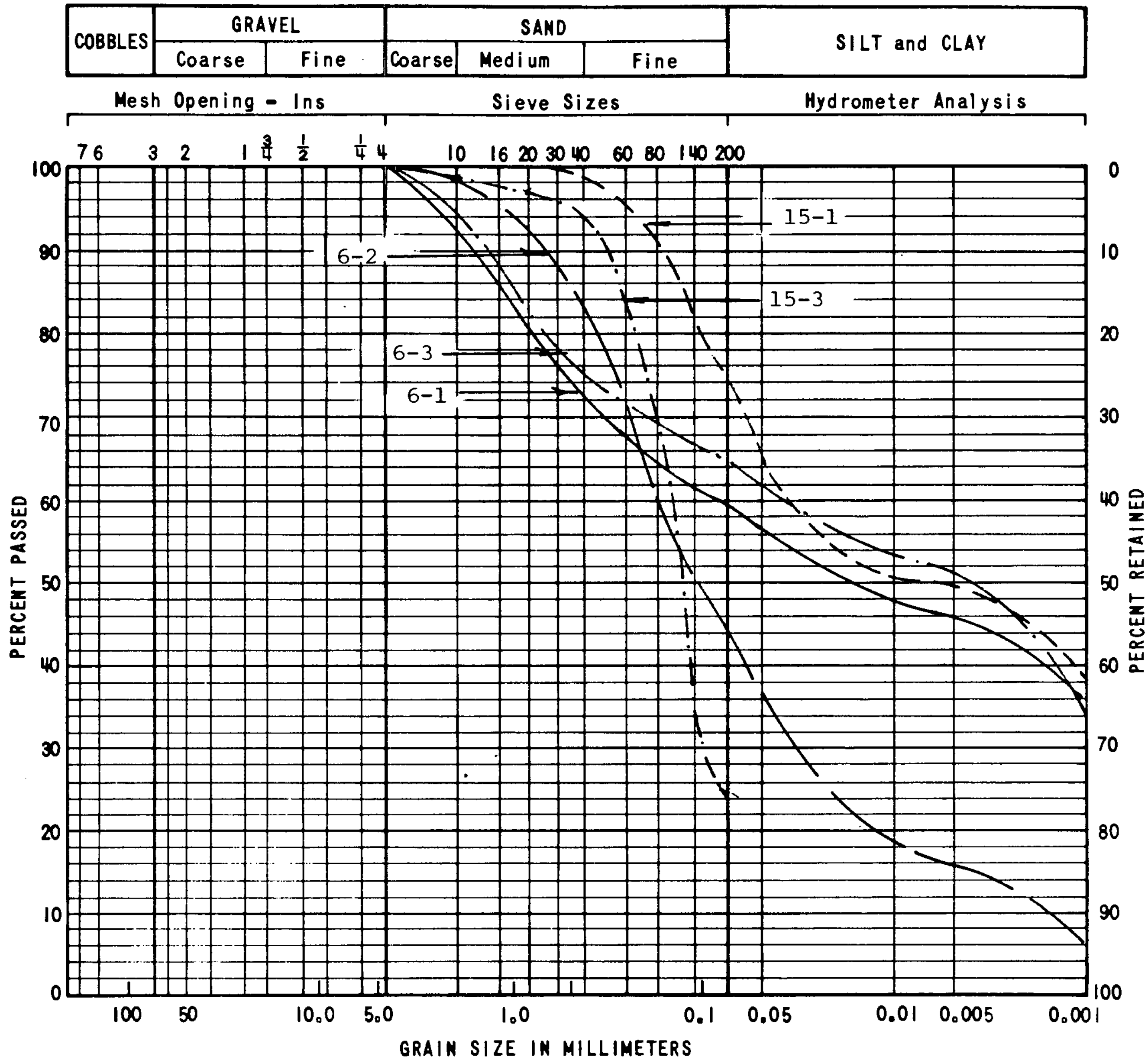
(h) Steep slopes (generally in excess of 15 degrees).

(i) Poor access.

(A) Angle Tower.

DP Drilled Pier.

RA Rock Anchor.



SAMPLE	CLASSIFICATION AND SYMBOL	*LL	*PI
6-1	Sandy clay (CH)	64	46
6-2	Clayey fine to coarse sand (SC)	35	18
6-3	Sandy clay (CH)	52	34
15-1	Sandy clay (CH)	62	46
15-3	Silty fine to medium sand (SM)	non	plastic

*LL - Liquid Limit
*PI - Plasticity Index

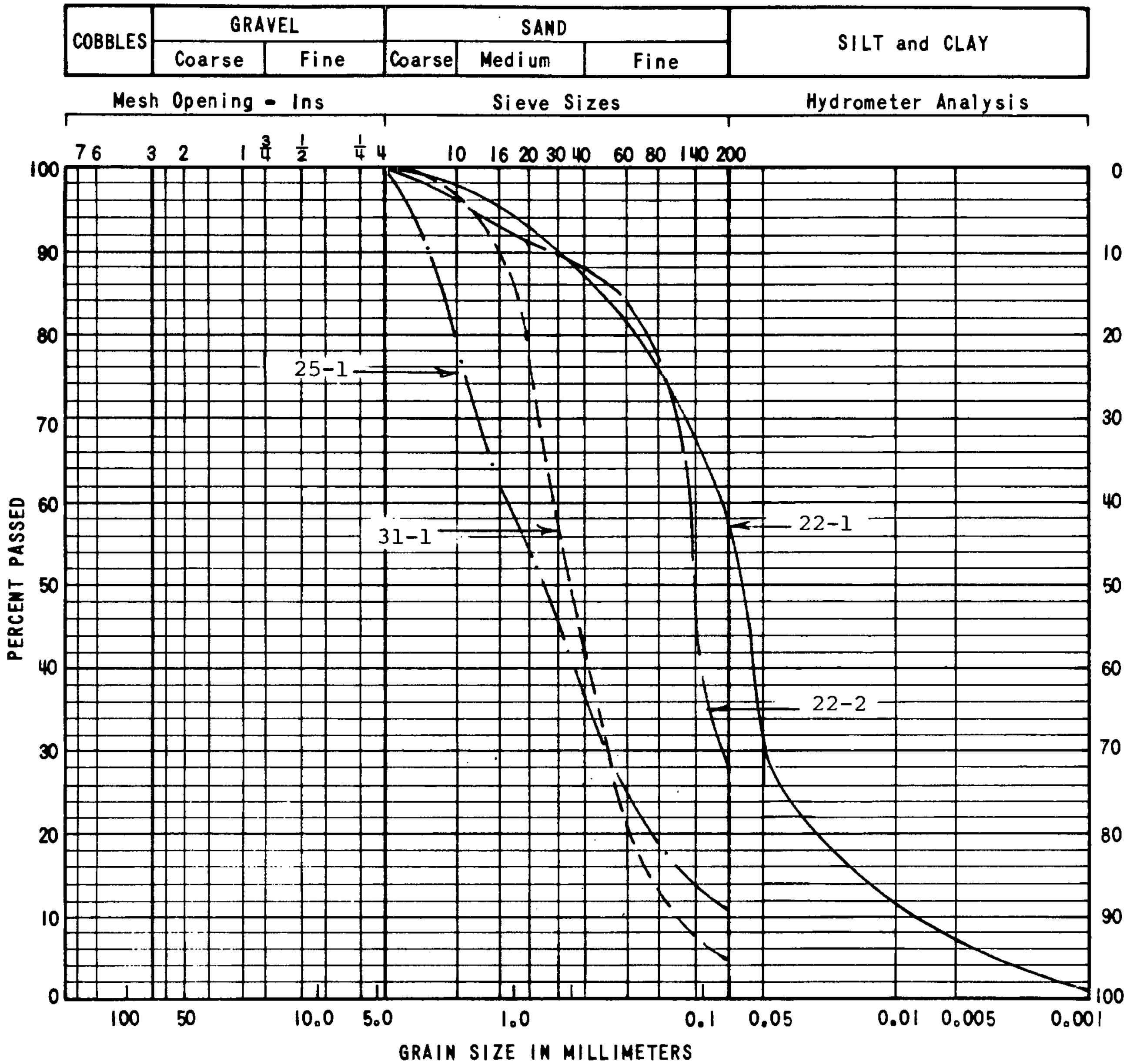
GRAIN SIZE DISTRIBUTION CURVES

MIGUEL - MEXICO 230 KV TRANSMISSION LINE

DRAWN BY: ch	CHECKED BY:	PROJECT NO: 51157S-SI03	DATE: 10-16-81	FIGURE NO: A-1

WOODWARD-CLYDE CONSULTANTS

WCC-GS-76



SAMPLE	CLASSIFICATION AND SYMBOL	*LL	*PI
22-1	Sandy silt to sandy clay (ML-CL)	47	18
22-2	Silty sand (SM)	non	plastic
25-1	Clayey sand (SC)	-	-
31-1	Silty fine to medium sand (SM-SP)	-	-

*LL - Liquid Limit
*PI - Plasticity Index

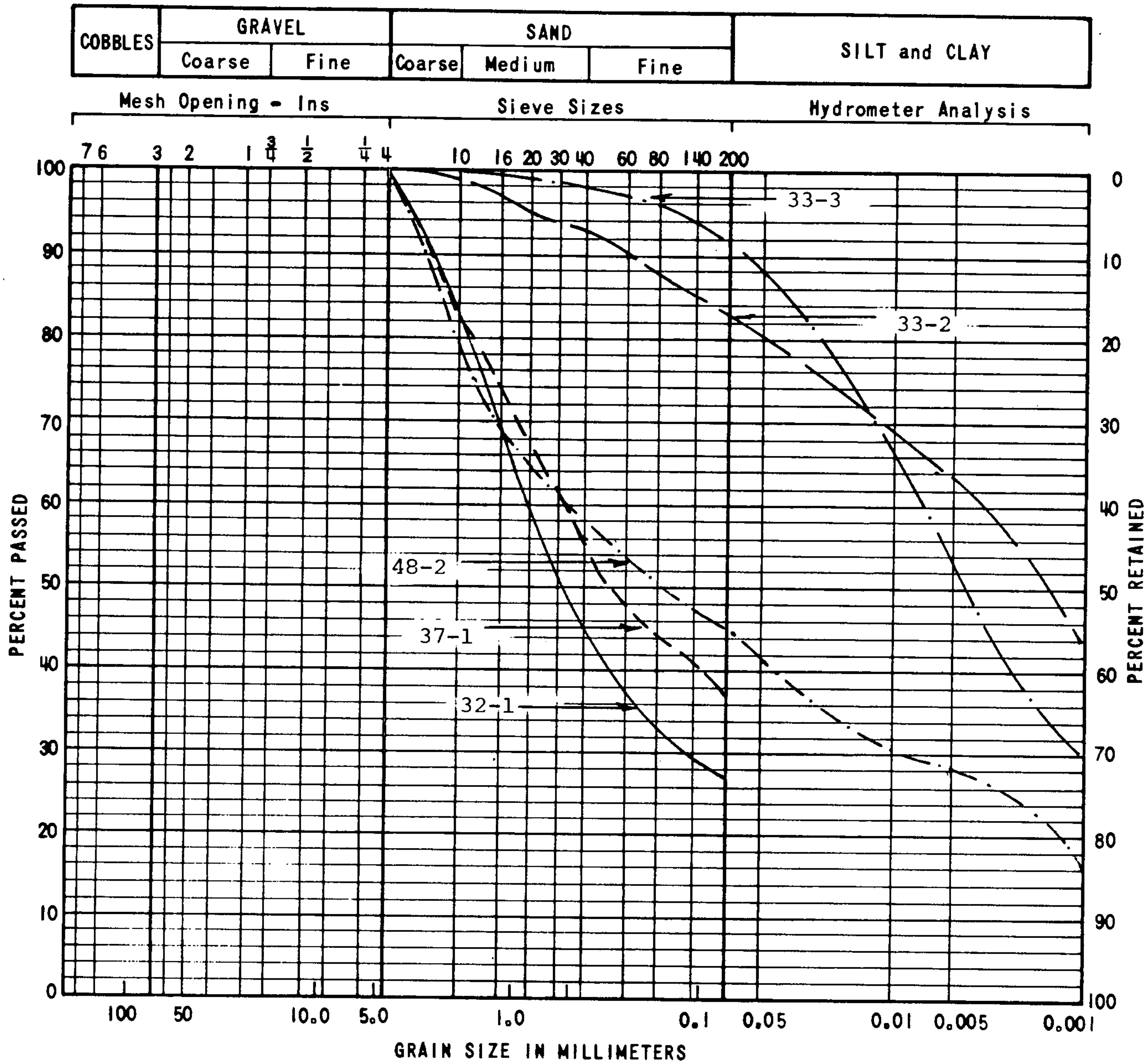
GRAIN SIZE DISTRIBUTION CURVES

MIGUEL - MEXICO 230 KV TRANSMISSION LINE

DRAWN BY: ch	CHECKED BY:	PROJECT NO: 51157S-SI03	DATE: 10-16-81	FIGURE NO: A-2

WOODWARD-CLYDE CONSULTANTS

WCC-GS-76



SAMPLE	CLASSIFICATION AND SYMBOL	*LL	*PI
32-1	Clayey fine to coarse sand (SC)	-	-
33-2	Silty clay (CH)	54	38
33-3	Silty clay (CH) - Slip plane	96	66
37-1	Clayey fine to coarse sand (SC)	-	-
48-2	Clayey fine to coarse sand (SC)	-	-

*LL - Liquid Limit
*PI - Plasticity Index

GRAIN SIZE DISTRIBUTION CURVES

MIGUEL - MEXICO 230 KV TRANSMISSION LINE

DRAWN BY: ch	CHECKED BY:	PROJECT NO: 51157S-SI03	DATE: 10-16-81	FIGURE NO: A-3

WOODWARD-CLYDE CONSULTANTS

WCC-GS-76

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 4 Station: 34 + 10.00

Tower Type: CPT Geophysical Survey: Yes ✓ No ____

Soil Description of Surface and Anticipated Subsurface Conditions:

2-3' silty clay (CH) topsoil developed on Sweetwater Fm. (claystone part of section). Dessication cracks -

Anticipated Groundwater Conditions: none within several hundred feet from surface

Site Slope Conditions:

steep hillside, 30% northerly slope

Erosion Potential and Possible Erosion Control Techniques: low potential for gullying across site

Geologic Hazards: none

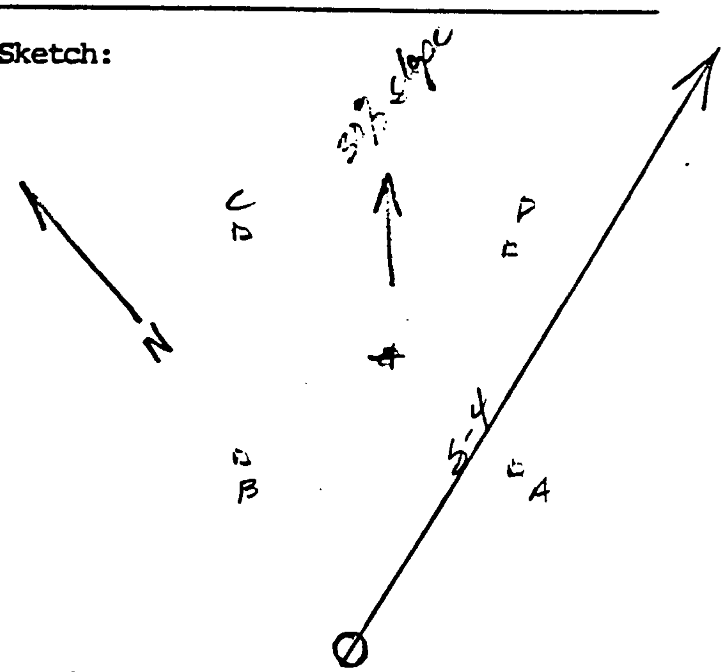
Boring Recommendation: none - site too steep

Access: walk from substation access road

Pictures:

Notes:

Sketch:



Inspection Team: DLS, BB

Date: 7/15/81

SUBSURFACE INVESTIGATION SUMMARY

Tower Site 4

Depth (ft)	Subsurface Materials			Seismic P-Wave Velocity (ft/sec)		Borings		
Boring →				T-4	T-4r			
				1300	1300			
				2900	3000			

LEGEND:

Bag Sample; Mod. CA Blowcount (5 6 7) } Auger Boring Sample

WCC,
51157S

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 5 Station: 46 + 34.90

Tower Type: CTA Geophysical Survey: Yes ✓ No ____

Soil Description of Surface and Anticipated Subsurface Conditions:

silty to sandy clay (CL-SC) developed on Otay Fm.

Anticipated Groundwater Conditions: none within several hundred feet

Site Slope Conditions: flat site area on top of knoll above substation

Erosion Potential and Possible Erosion Control Techniques: none

Geologic Hazards: none

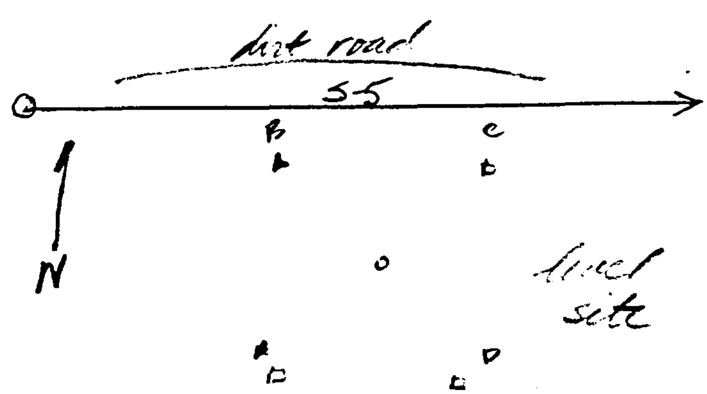
Boring Recommendation: could use WCC rig

Access: dirt road from substation, good access and level site.

Pictures:

Notes: nearby overhead high tension lines

Sketch:



Inspection Team: DLS, BE

Date: 7/15/81

SUBSURFACE INVESTIGATION SUMMARY

Tower Site 5

Depth (ft)	Subsurface Materials			Seismic P-Wave Velocity (ft/sec)		Borings		
Boring →				T-5	T-5r			
				1400	1250			
5								
10				1750	2000			
15								
20								
25								

LEGEND:

Bag Sample, Mod. CA Blowcount (5 6 7): Auger Boring Sample

WCC,
511575

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 6 Station: 54 + 84.90

Tower Type: CRS (PI) Geophysical Survey: Yes ____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions:
gravelly clay developed on Sweetwater Fm, claystone part, possibly 3-5' colluvial deposits.

Anticipated Groundwater Conditions: none within 100 feet

Site Slope Conditions: moderately steep, uneven hillside slope, 15% easterly slope

Erosion Potential and Possible Erosion Control Techniques: potential for gulleying and undercutting leg C

Geologic Hazards: none

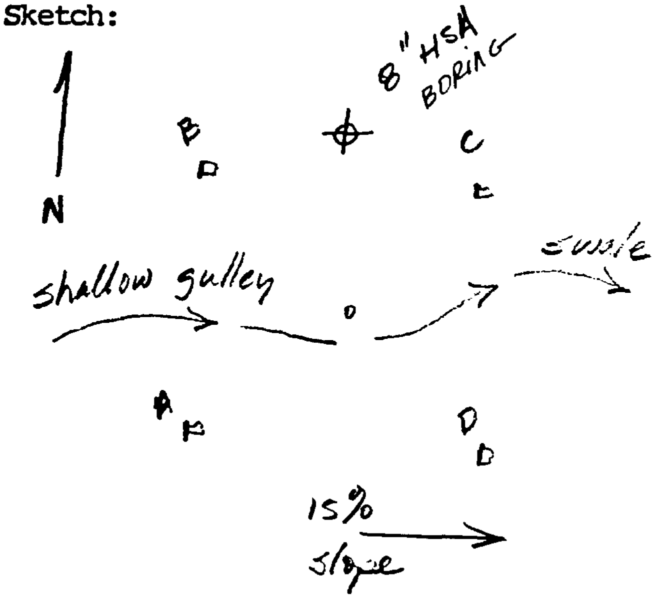
Boring Recommendation: levelling difficult - auger rig?

Access: dirt road from substation, steep hillside trail

Pictures:

Notes:

Sketch:

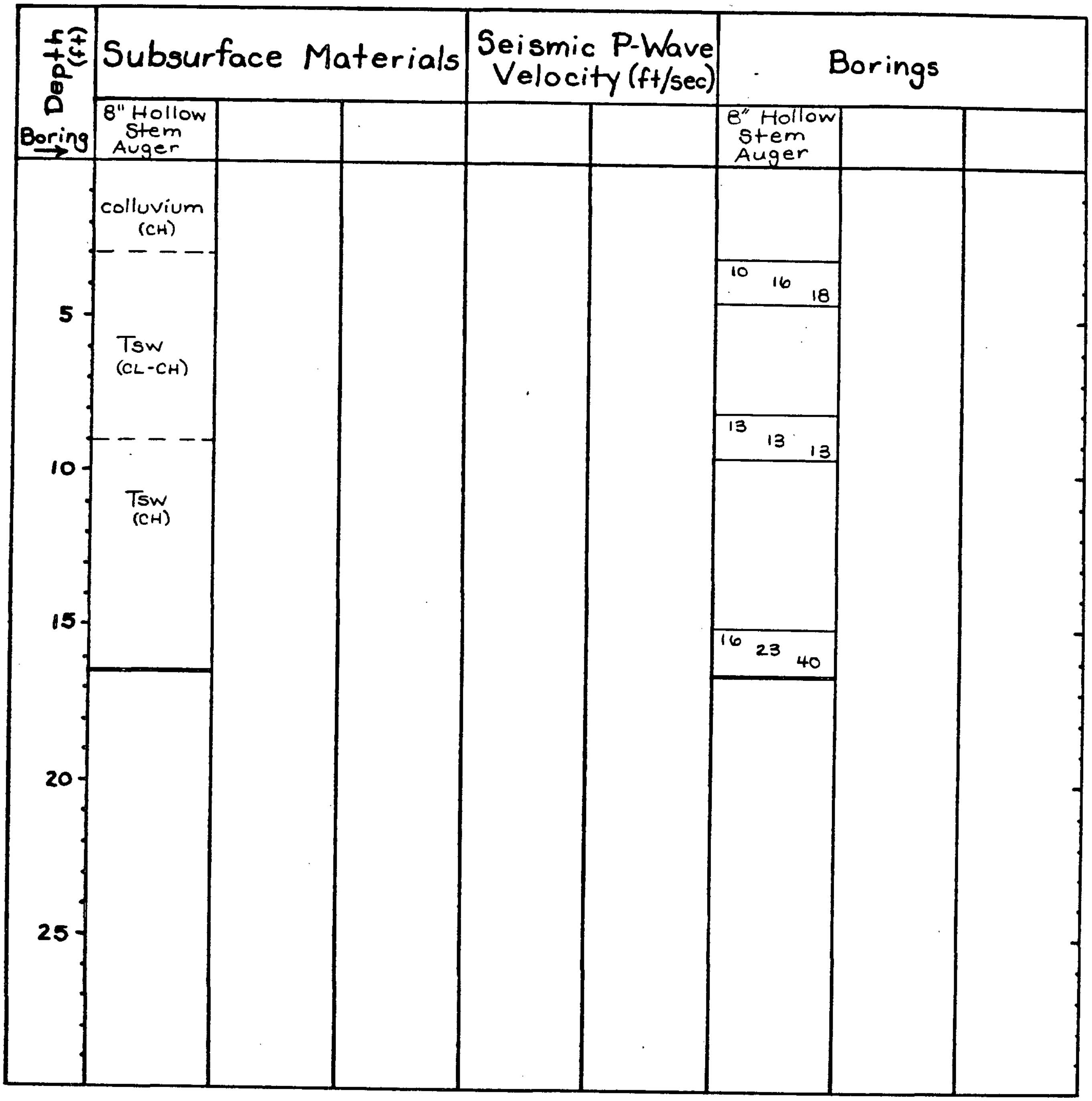


Inspection Team: DLS, BB

Date: 7/15/81

SUBSURFACE INVESTIGATION SUMMARY

Tower Site 6



LEGEND:

Bag Sample } Auger Boring Sample

5 6 7 Mod. CA Blowcount

WCC,
511575

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 7 Station: 66+90.00

Tower Type: CPT Geophysical Survey: Yes ✓ No ____

Soil Description of Surface and Anticipated Subsurface Conditions:

1-2 ft. soil cover consists of silty clay to clayey sand (CL-SC) overlies Sweetwater Fm.

Anticipated Groundwater Conditions: water table deeper than several hundred feet.

Site Slope Conditions:

top of mesa, near flat surface, less than 1% slope

Erosion Potential and Possible Erosion Control Techniques: none

Geologic Hazards: none

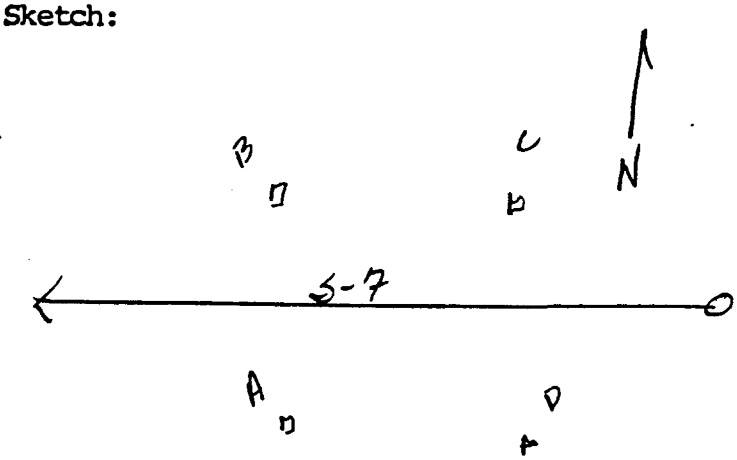
Boring Recommendation:

Access: good road, level site

Pictures:

Notes: good drill site in TSW conglomerate if Tower 6 is impossible to drill.

Sketch:

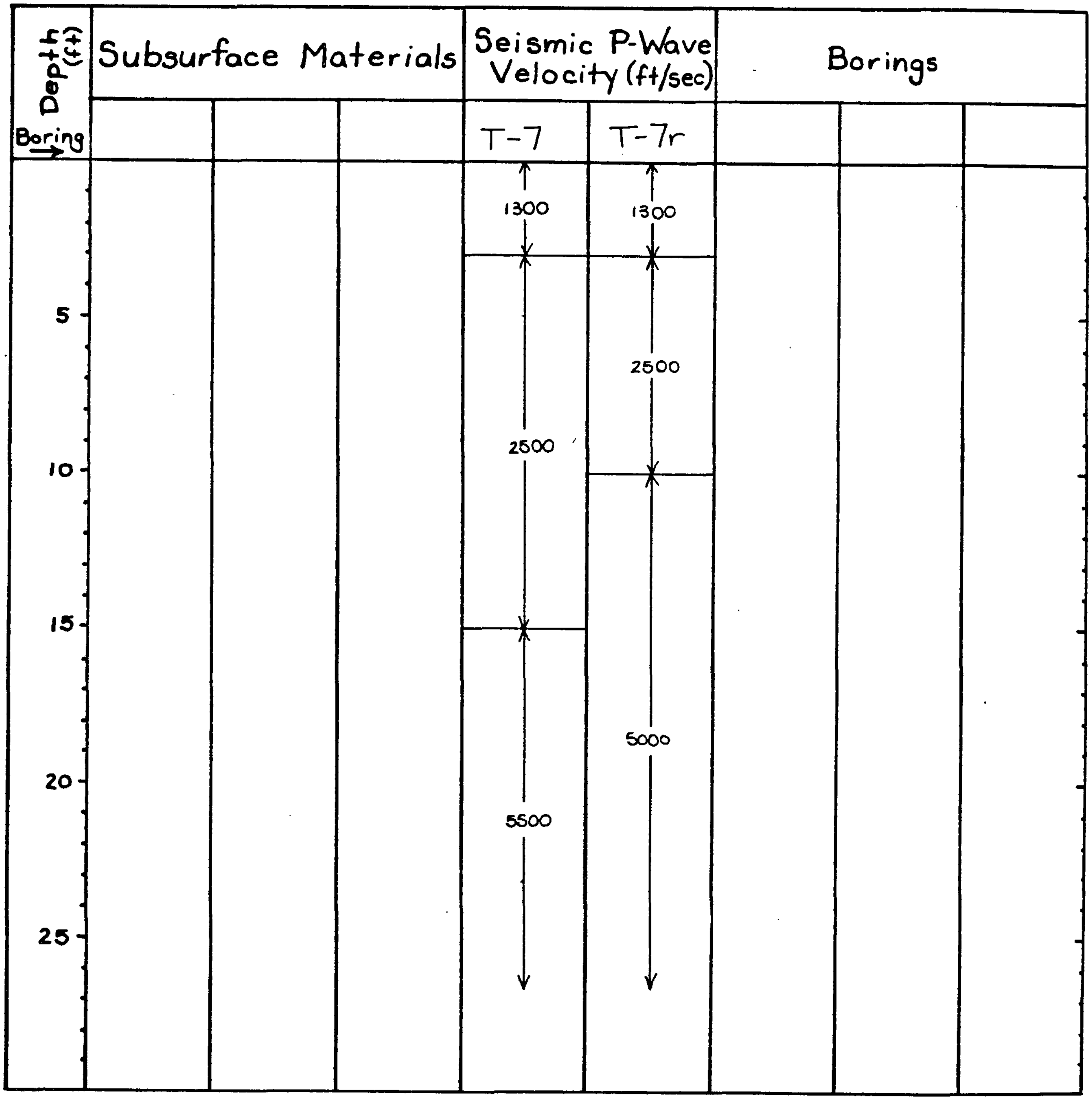


Inspection Team: DLS, BB

Date: 7/15/81

SUBSURFACE INVESTIGATION SUMMARY

Tower Site 7



LEGEND:

Bag Sample } Auger Boring Sample

5 6 7 Mod. CA Blowcount

WCC, 511575

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 8 Station: 73 + 87.00

Tower Type: CPT Geophysical Survey: Yes ____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions:

coarse sandy cover, scattered boulder sized metavolcanic float, thin soil cover (<2') on Tsw claystone part.

Anticipated Groundwater Conditions: none within several hundred feet

Site Slope Conditions: edge of mesa surface, even 10% slope

Erosion Potential and Possible Erosion Control Techniques: none

Geologic Hazards: none

Boring Recommendation: none – auger if necessary

Access:

Pictures:

Notes: Sketch:

Inspection Team: OLS, BB

Date: 7/15/81

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 9 Station: 94+20.00

Tower Type: CPT Geophysical Survey: Yes ____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions:

silty clay (CH), 2-3' thick, developed on Otay Fm. dessication cracks

Anticipated Groundwater Conditions: none within several hundred feet.

Site Slope Conditions: near edge of broad ridge, 5% northerly slope

Erosion Potential and Possible Erosion Control Techniques: none

Geologic Hazards: none

Boring Recommendation: none

Access: locked gate on Proctor Valley Rd, several fences

Pictures:

Notes:

Sketch:

Inspection Team: RLS, BB

Date: 7/15/81

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 10 Station: 104 + 11.00

Tower Type: CPT Geophysical Survey: Yes ____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions:
2-3' of silty clay (CH) topsoil developed on fine-grained sandstone of Otay Fm.

Anticipated Groundwater Conditions: none within several hundred feet

Site Slope Conditions: even hillside slope below edge of mesa, 10% westerly slope

Erosion Potential and Possible Erosion Control Techniques: very low

Geologic Hazards: none

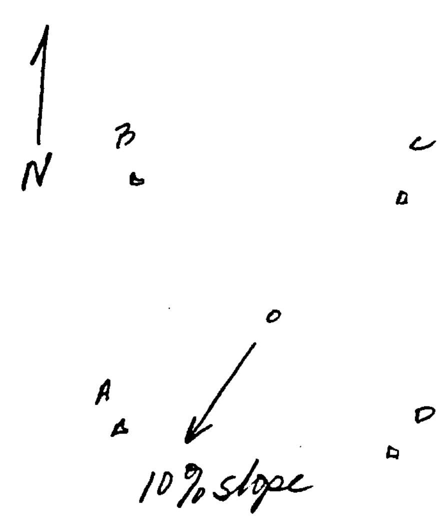
Boring Recommendation: none

Access: walk from Tower 11, fences to cross

Pictures:

Notes:

Sketch:



Inspection Team: DLS, BB

Date: 7/15/81

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 11 Station: 122.+ 50.00

Tower Type: CTA Geophysical Survey: Yes ✓ No ____

Soil Description of Surface and Anticipated Subsurface Conditions:
plowed field, 2-3 feet of silty clay (CH) on Otay Fm. sandstone

Anticipated Groundwater Conditions: none within 100 feet

Site Slope Conditions:
edge of broad ridge, even 5-7% slope

Erosion Potential and Possible Erosion Control Techniques: none

Geologic Hazards: none

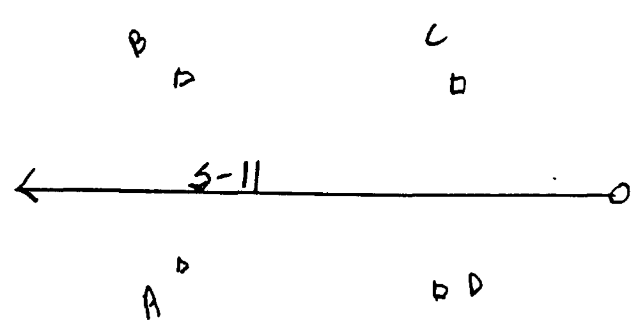
Boring Recommendation: Can use WCC rig

Access: easy access from Rancho Janal Rd. good leveling

Pictures:

Notes: estimated site location from orthophoto, all stakes and center pole are missing

Sketch:

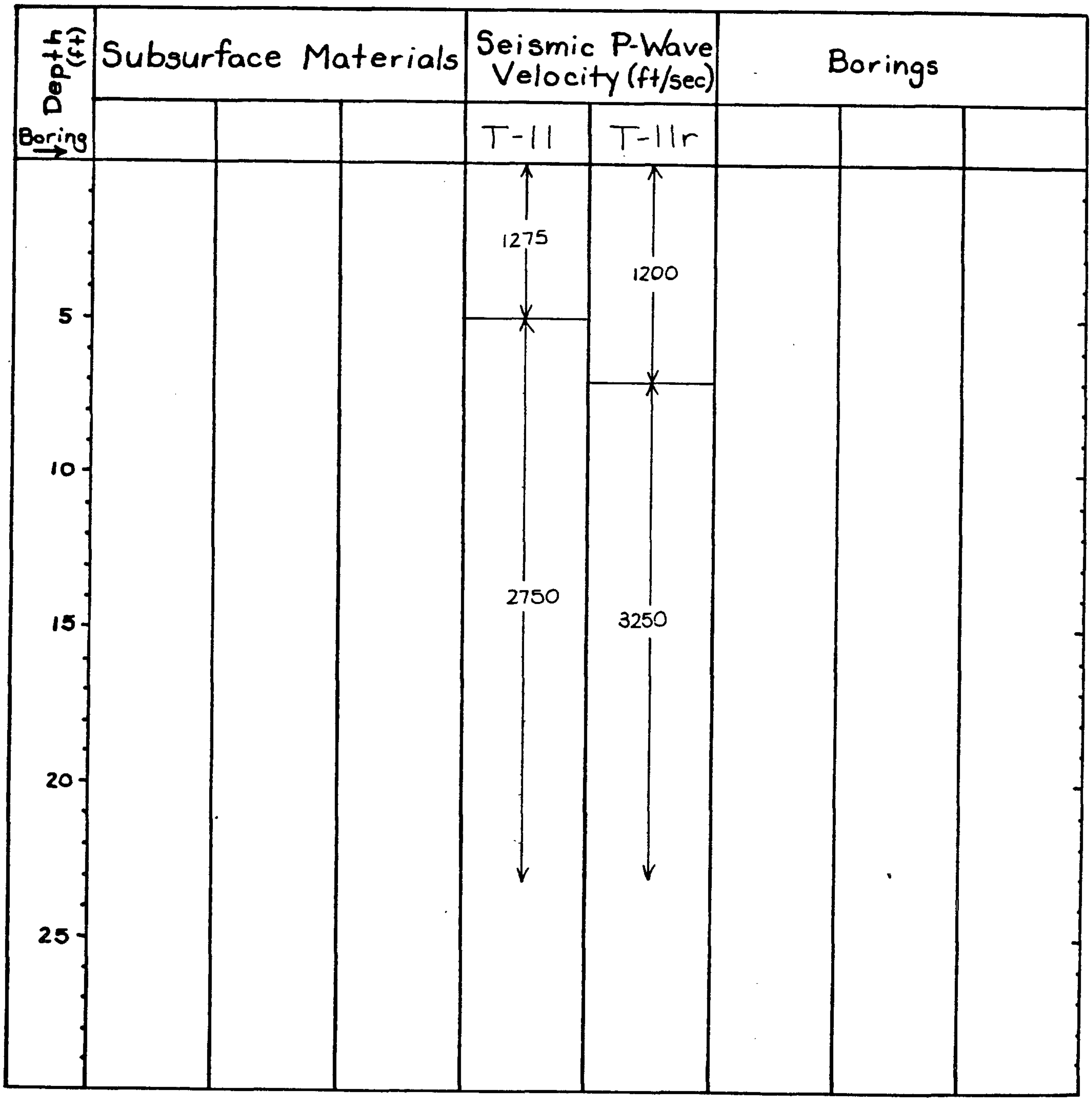


Inspection Team: DLS, BB

Date: 7/15/81

SUBSURFACE INVESTIGATION SUMMARY

Tower Site 11



LEGEND:

Bag Sample
5 6 7 Mod. CA Blowcount
} Auger Boring Sample

WCC

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 12 Station: 136 + 00.00

Tower Type: CPT Geophysical Survey: Yes ____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions: plowed field, silty clay (CH), 2-3' thick, developed on Otay Fm. sandstone

Anticipated Groundwater Conditions: none within 50 feet

Site Slope Conditions: lower slope of broad, even hillside, 10% easterly slope

Erosion Potential and Possible Erosion Control Techniques:

Geologic Hazards: none

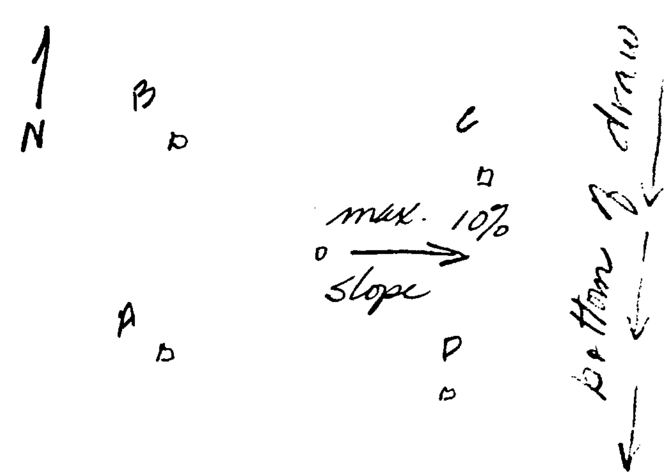
Boring Recommendation: none

Access: dirt road from Otay Lakes Rd, must cross plowed field

Pictures:

Notes: all leg stakes down

Sketch:



Inspection Team: DLS, BB

Date: 7/15/81

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 13 Station: 149 + 71.60

Tower Type: CPT Geophysical Survey: Yes ____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions: silty clay (CH), as much as 3-5 feet of topsoil and colluvium overlying Otay Fm. sandstone

Anticipated Groundwater Conditions: shallow seasonal w.t., 10-15' below surfa

Site Slope Conditions: near flat base of hillside, slightly higher than base of shallow draw. 1-3% easterly slope

Erosion Potential and Possible Erosion Control Techniques: low potential for gulleying during heavy rains

Geologic Hazards: none

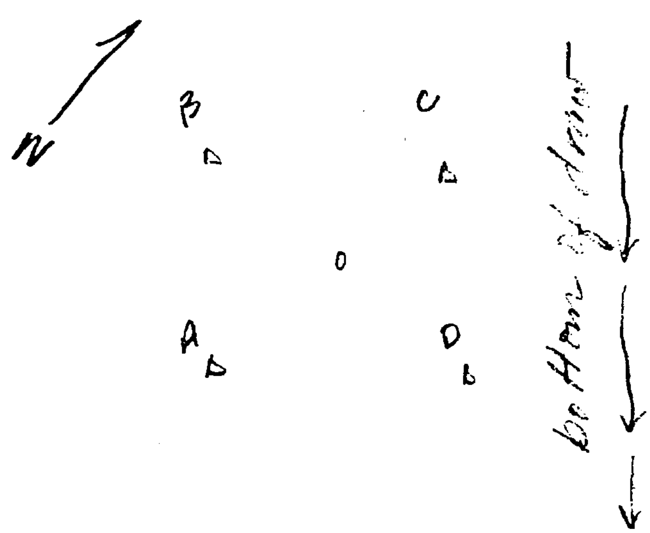
Boring Recommendation: use WCC rig

Access: fences, no gate off Otay Lakes Rd. on United Enterprises property

Pictures:

Notes: need to define colluvial thickness. possibly compressible organic rich soils.

Sketch:



Inspection Team: DLS, BB

Date: 7/16/81

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 14 Station: 162 + 15.00

Tower Type: CPT Geophysical Survey: Yes____ No ✓

Soil Description of Surface and Anticipated Subsurface Conditions:

plowed field, silty clay topsoil (CH), 2-3' thick developed on Otay Fm sandstone

Anticipated Groundwater Conditions: none within 50 feet

Site Slope Conditions: gentle, even slope at broad hillside, slope less than 5%

Erosion Potential and Possible Erosion Control Techniques: very low

Geologic Hazards: none

Boring Recommendation: none

Access: fences - U.E. property

Pictures:

Notes: Sketch:

Inspection Team: DLS, BB

Date: 7/15/81

TABLE I

TOWER SITE INSPECTION SUMMARY

Tower No: 15 Station: 172 + 83.17

Tower Type: CRS (PI) Geophysical Survey: Yes ✓ No ____

Soil Description of Surface and Anticipated Subsurface Conditions: plowed field, silty clay (CH), 2-3' thick developed on Otay Fm. sandstone

Anticipated Groundwater Conditions: none within 100 ft

Site Slope Conditions: near level site, bottom of broad draw

Erosion Potential and Possible Erosion Control Techniques: low potential for gullying during heavy rains

Geologic Hazards: none

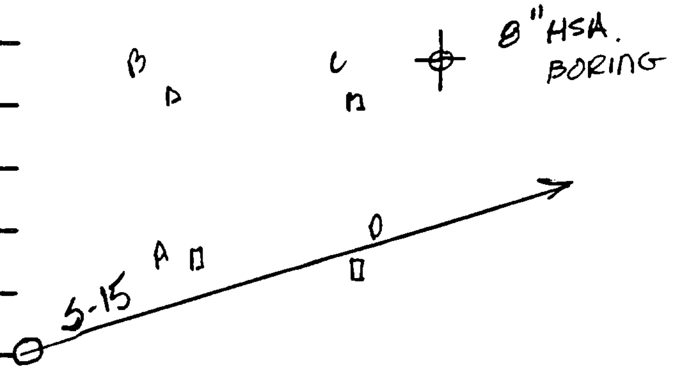
Boring Recommendation: use well rig

Access: Otay Water district aqueduct road

Pictures: ____

Notes: good drill site

Sketch:

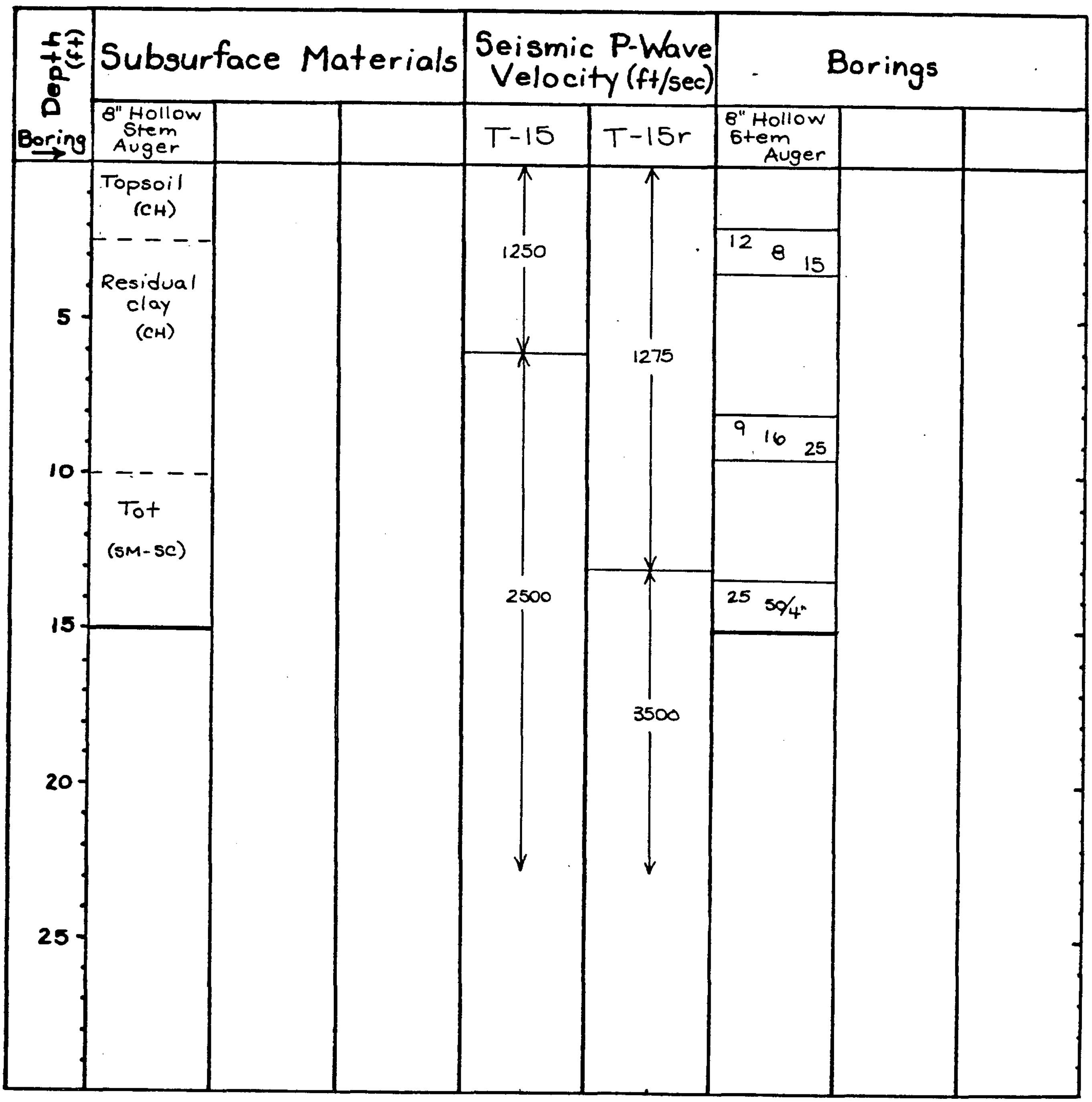


Inspection Team: DLS, BB

Date: 7/15/81

SUBSURFACE INVESTIGATION SUMMARY

Tower Site 15



LEGEND:

Bag Sample } Auger Boring Sample

5 6 7 Mod. CA Blowcount } Auger Boring Sample

WCC,
51157S

APPENDIX B

LOGS OF FIELD EXPLORATIONS

Geosyntec consultants
10875 Rancho Bernardo Rd, Suite 200
San Diego, CA 92127
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Fax: (858) 674-6586

PROJECT Miguel to Salt Creek
PROJECT LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

KEY SHEET - CLASSIFICATIONS AND SYMBOLS

GS FORM: KEY 09/99

EMPIRICAL CORRELATIONS WITH STANDARD PENETRATION RESISTANCE N VALUES *

FINE GRAINED SOILS

N VALUE * (BLOWS/FT)	CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TONS/SQ FT)
0 - 2	VERY SOFT	<0.25
3 - 4	SOFT	0.25 - 0.50
5 - 8	FIRM	0.50 - 1.00
9 - 15	STIFF	1.00 - 2.00
16 - 30	VERY STIFF	2.00 - 4.00
31 - 50	HARD	>4.00
>50	VERY HARD	

COARSE GRAINED SOILS

N VALUE * (BLOWS/FT)	RELATIVE DENSITY
0 - 4	VERY LOOSE
5 - 10	LOOSE
11 - 30	MEDIUM DENSE
31 - 50	DENSE
>50	VERY DENSE

* ASTM D 1586; NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 IN. O.D., 1.4 IN. I.D. SAMPLER ONE FOOT.

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

MAJOR DIVISIONS			SYMBOLS	DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL COARSER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO.4 SIEVE	CLEAN GRAVELS LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES APPRECIABLE AMOUNT OF FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL -SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO.4 SIEVE	CLEAN SANDS LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES APPRECIABLE AMOUNT OF FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL FINER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS

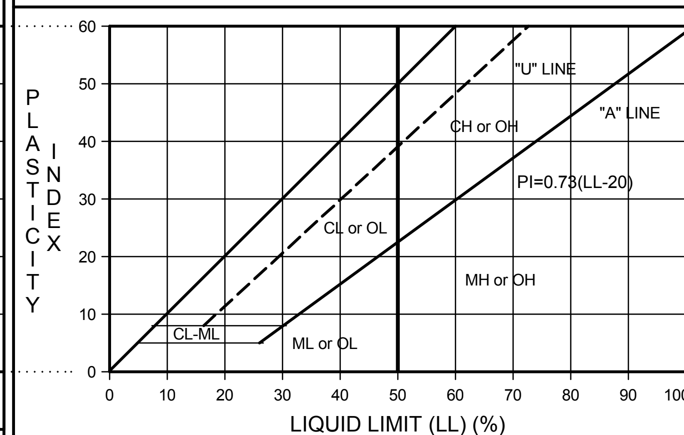
PARTICLE SIZE IDENTIFICATION

BOULDERS	>300 mm
COBBLES	75 - 300 mm
GRAVEL: COARSE	19.0 - 75 mm
GRAVEL: FINE	4.75 - 19 mm
SAND: COARSE	2.00 - 4.75 mm
SAND: MEDIUM	0.425 - 2.00 mm
SAND: FINE	0.075 - 0.425 mm
SILT	0.075 - 0.002 mm
CLAY	<0.002 mm

WELL GRADED - HAVING WIDE RANGE OF GRAIN SIZES AND APPRECIABLE AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES

POORLY GRADED - PREDOMINANTLY ONE GRAIN SIZE, OR HAVING A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING

PLASTICITY CHART



OTHER MATERIAL SYMBOLS

Siltstone	Sand
Sandstone	Silt
Siltstone/Claystone	Silty Sand
Claystone	Alluvium
Shale	Artificial Fill
Siltstone/Sandstone	Debris Fill
Conglomerate	Asphalt
Granitic	Cement

WELL SYMBOLS

- HYDRATED GRANULAR BENTONITE
- BENTONITE CEMENT GROUT
- FILTER PACK
- CONCRETE
- NATIVE/ SLOUGH
- CENTRAL- IZER

SAMPLER AND OTHER SYMBOLS

- GRAB SAMPLE
- SPLIT SPOON
- STANDARD PENETRATION TEST (SPT)
- SHELBY TUBE
- CALIFORNIA SAMPLER

- ▽ Water Level at Time Drilling, or as Shown
- ▼ Static Water Level
- MSL: Mean Sea Level
- MC: Moisture Content
- DD: Dry Density
- SA: Sieve Analysis
- PI: Plasticity Index
- LL: Liquid Limit
- c: Cohesion
- K: Hydraulic Conductivity
- Phi: Friction Angle

KEY-GEOTECH SC0368-26.GPJ GEOSNTEC.GDT 8/7/12

Geosyntec consultants

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GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-1 SHEET 1 OF 2
START DATE 6/27/2012 ELEVATION 584.0 FT MSL
FINISH DATE 6/27/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	TYPE	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
	Otay Formation: Moist, very pale brown [10YR 7/3], clayey fine to very fine sand (SC)									Hand auger to 5 feet
				B-1-1						
5	At 5 ft, contains trace angular gravels		579	B-1-2		14/17/29		56		MC, DD
10	Moist, very pale brown [10YR 7/3], sandy lean clay (CL)		574	B-1-3		13/20/24		44		MC, SA, LL, PI
15	Moist, very pale brown [10YR 8/3], very dense, poorly graded, fine sand with interbedded clay lenses (SP/SC)		569	B-1-4		15/31/50		81		MC, DD
20	Moist, very pale brown [10YR 7/4], medium dense silty fine sand (SM)		564	B-1-5		10/10/14		24		MC, SA
	Moist, pale brown [10YR 6/3], hard, fine sandy silt (ML)									MC, DD
25			559	B-1-6		24/37/50		87		
	Moist, pale brown [10YR 6/3], fine to very fine silty sand (SM)									
30			554							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5 Rig
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER N.Godinez REVIEWER A.Greene
LATITUDE 32.6617060
LONGITUDE 116.9743900
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 29.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-1 **SHEET** 2 **OF** 2
START DATE 6/27/2012 **ELEVATION** 584.0 FT MSL
FINISH DATE 6/27/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOW COUNTS	SAMPLES % RECOVERY	SAMPLES N-VALUE	TIME	COMMENTS
				B-1-7		20/23/24		47		
35	Moist, brownish yellow to pink [10YR 8/3], hard clayey silt with bentonite lenses with sand and trace fine angular gravel (ML)		549	B-1-8		14/29/50 for 5"				MC, DD
	At 40 ft, decrease in gravel and increase in sand									
40	Bottom of boring at 41.5 feet. Boring backfilled with approximately 7.4 cubic feet of bentonite grout.		544	B-1-9		27/39/44		83		
			539							
			534							
			529							
			524							

CONTRACTOR Pacific Drilling **LATITUDE** 32.6617060
EQUIPMENT Unimog MARL M5 Rig **LONGITUDE** 116.9743900
DRILL MTHD HSA **ANGLE** Vertical
DIAMETER 7 inches **BEARING** ------
LOGGER N.Godinez **REVIEWER** A.Greene **PRINTED** August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 29.

COORDINATE SYSTEM:

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GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-2 **SHEET** 1 **OF** 1
START DATE 6/27/2012 **ELEVATION** 620.0 FT MSL
FINISH DATE 6/27/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES: NUMBER	TYPE	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
0	Otay Formation: Moist, white [10YR 8/1], very dense, fine silty sand (SM) At 4 feet, increase in very fine sands		620							Hand auger to 5 feet
				B-2-1						
				B-2-2		50 for 5"				MC, DD, SA
5			615							
7	Moist, light gray [10YR 7/2], very dense, poorly graded, fine grained sand with silt (SP/SM)									
				B-2-3		40/50 for 5"				
10			610							
11	Moist, light gray [10YR 7/2], very dense fine silty sand (SM)									
				B-2-4		50 for 5"				MC, DD, SA
15			605							
				B-2-5		50 for 1"				
17	Encountered auger refusal at 17 feet. Boring backfilled with approximately 4.5 cubic feet of bentonite grout.									
20			600							
25			595							
30			590							

CONTRACTOR Pacific Drilling **LATITUDE** 32.6591420
EQUIPMENT Limited Access Rig **LONGITUDE** 116.9739800
DRILL MTHD HSA **ANGLE** Vertical
DIAMETER 7 inches **BEARING** ------
LOGGER N.Godinez **REVIEWER** A.Greene **PRINTED** August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 28.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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San Diego, CA 92127
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Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-3 — **SHEET** 1 OF 2
START DATE 7/3/2012 — **ELEVATION** 630.0 FT MSL
FINISH DATE 7/3/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	TYPE	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
0	Fill: Moist, very pale brown [10YR 8/2], silty sand with trace clay and trace angular to sub rounded gravels									Hand auger to 5 feet
				B-3-1						
5	Otay Formation: Moist, very pale brown [10YR 7/2], very dense, clayey silt (ML)		625	B-3-2		18/50 for 3"		50		MC, DD
	Moist, pale brown [10YR 6/3], very dense, fine silty sand (SM)									
10			620	B-3-3		10/21/34		55		
15	At 15 ft, trace clay		615	B-3-4		24/50 for 3.5"				MC, DD, SA
20			610	B-3-5		26/50 for 5.5"				
	At 24 ft, becomes very pale brown [10YR 8/2], increase in moisture noted above clayey silt Lense of brown [10YR 4/3], hard, clayey silt									
25			605	B-3-6		50 for 5"				MC, DD Perched water observed
	Moist, light gray [10YR 7/1], very dense, fine to medium, poorly graded sand (SP)									
30			600							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER J.Warner **REVIEWER** A.Greene
LATITUDE 32.6541160
LONGITUDE 116.9732000
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 27.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants

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Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING **B-3** SHEET **2 OF 2**
START DATE **7/3/2012** ELEVATION **630.0 FT MSL**
FINISH DATE **7/3/2012**
PROJECT **Miguel to Salt Creek**
LOCATION **Chula Vista, California**
PROJECT NUMBER **SC0368-26**

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	TYPE	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
				B-3-7		50 for 6"				
35			595	B-3-8		50 for 5.5"				MC, DD
	Moist, brown [10YR 4/3], very dense, fine to medium grained silty sand, with interbedded claystone lenses (SM)									
40	Moist, light gray [10YR 7/1], very dense, fine to medium grained, poorly graded silty sand, sand-silt (SM/SP)		590	B-3-9		23/50 for 6"				
	Bottom of boring at 41.0 feet. Boring backfilled with approximately 9.4 cubic feet of bentonite grout topped with soil cuttings.									
			585							
			580							
			575							
			570							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER J.Warner **REVIEWER** A.Greene
LATITUDE 32.6541160
LONGITUDE 116.9732000
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 27.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-4 **SHEET** 1 OF 1
START DATE 6/29/2012 **ELEVATION** 567.0 FT MSL
FINISH DATE 6/29/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOW COUNTS	SAMPLES: % RECOVERY	SAMPLES: N-VALUE	TIME	COMMENTS
	Otay Formation: Moist, light brown [7.5YR 6/3], low plasticity sandy clay (CL)									Hand auger to 5 feet
				B-4-1						
	Moist, very pale brown [10YR 8/2], very dense, fine to medium clayey to silty sand (SC/SM)			B-4-2		50 for 5"				
5			562							
				B-4-3		10/40/50 for 5"				MC, SA
	Moist, white [7.5YR 8/1], very dense, very fine silty sand (SM)									
10			557							
	Interbedded clay lenses			B-4-4		50 for 5"				MC, DD
15			552							
	Moist, pale brown [10YR 6/3], very hard, lean clayey sand (SC)			B-4-5		50 for 6"				MC, LL, PI
20	Moist, very pale brown [10YR 7/3], very dense, silty fine sand (SM)		547	B-4-6		50 for 2"				MC, DD
	Moist, very pale brown [10YR 7/4], very dense, poorly graded fine sand with trace coarse sand (SP)			B-4-7		50 for 5"				
25			542							
	At 27 ft, becomes fine to very fine sand with trace gravel									
	Encountered auger refusal at 27.2 feet. Boring backfilled with approximately 6.1 cubic feet of bentonite grout.			B-4-8		50 for 2"				MC, DD
			537							

CONTRACTOR Pacific Drilling
EQUIPMENT Limited Access Rig
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER N.Godinez **REVIEWER** A.Greene
LATITUDE 32.6504910
LONGITUDE 116.9728070
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 26.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING **B-5** SHEET **1 OF 2**
START DATE **6/25/2012** ELEVATION **504.0 FT MSL**
FINISH DATE **6/25/2012**
PROJECT **Miguel to Salt Creek**
LOCATION **Chula Vista, California**
PROJECT NUMBER **SC0368-26**

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	TYPE	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
	Alluvium (Qal): Moist, dark brown [10YR 2/3], clayey fine sand with some plant debris (SC)			B-5-1						Hand auger to 5 feet
5	Moist, brown [10YR 4/3], medium dense clayey, fine to coarse sand to fine sand with trace clay (SC)		499	B-5-2		8/12/17		29		MC, DD
	Moist, pale brown [10YR 6/3], stiff sandy lean clay with some sub rounded gravels (CL)									
10			494	B-5-3		5/5/6		11		∇
15	At 15 feet, becomes moist, pale yellow [2.5Y 8/2], to light gray [10YR 7/2], sandy lean clay with angular gravels (CL)		489	B-5-4		9/10/11		21		MC, DD, SA
20	Moist, grayish brown [10YR 4/2], medium dense fine to medium clayey sand with sub-rounded to angular gravels (SC)		484	B-5-5		9/14/15		29		
25	Otay Formation: Moist, brown [7.5YR 3/4], to very pale brown [10YR 8/5], very dense, interbedded well sorted siltstone and sandy claystone with sub rounded to angular breccia (SC)		479	B-5-6		23 for 5"				MC, DD
30			474							

CONTRACTOR	**Pacific Drilling**	**LATITUDE**	**32.6466660**
EQUIPMENT	**Unimog MARL M5**	**LONGITUDE**	**116.9205000**
DRILL MTHD	**HSA**	**ANGLE**	**Vertical**
DIAMETER	**7 inches**	**BEARING**	**------**
LOGGER J.Warner	**REVIEWER A.Greene**	**PRINTED**	**August 7, 2012**

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 25.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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GS FORM: BORE 1/99

BOREHOLE RECORD

BORING **B-5** SHEET **2 OF 2**
START DATE **6/25/2012** ELEVATION **504.0 FT MSL**
FINISH DATE **6/25/2012**
PROJECT **Miguel to Salt Creek**
LOCATION **Chula Vista, California**
PROJECT NUMBER **SC0368-26**

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOW COUNTS	SAMPLES: % RECOVERY	SAMPLES: N-VALUE	TIME	COMMENTS
				B-5-7		36 for 4"				
35			469	B-5-8		50 for 6"				MC, DD
	Moist, yellowish brown [10YR 5/4], to light yellowish brown [2.5YR 6/3], very dense, poorly graded, fine to medium sand (SP) and clayey sand (SC)									
40			464	B-5-9		19/21/35		56		
	Bottom of boring at 41.5 feet. Boring backfilled with approximately 8.7 cubic feet of bentonite grout topped with soil cuttings.									
			459							
			454							
			449							
			444							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER J.Warner **REVIEWER** A.Greene

LATITUDE 32.6466660
LONGITUDE 116.9205000
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 25.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants

10875 Rancho Bernardo Rd, Suite 200
San Diego, CA 92127
Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-6 **SHEET** 1 **OF** 2
START DATE 6/27/2012 **ELEVATION** 544.0 FT MSL
FINISH DATE 6/27/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLES NUMBER	TYPE	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
	Fill: 3" asphalt over 2" aggregate base over moist, grayish brown [10YR 5/2], clayey silt with trace fine to medium gravel		B-6-1						Hand auger to 5 feet
	Otay Formation: Moist, very pale brown [10YR 7/4], very dense fine sandy silt (ML)								
5		539	B-6-2		50 for 5"				MC, DD
10		534	B-6-3		15/25/36		61		MC, SA
15	Moist, white [10YR 8/1], very dense poorly graded fine sand (SP)	529	B-6-4		50 for 5"				MC, DD
20	Moist, pale brown [10YR 6/3], very dense, very fine to fine clayey sand (SC)	524	B-6-5		12/23/29		52		MC, LL, PI
25	At 25 ft, slight decrease in fines	519	B-6-6		27/50 for 2"				MC, DD
30		514							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER N.Godinez **REVIEWER** A.Greene
LATITUDE 32.6433630
LONGITUDE 116.9715860
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
10875 Rancho Bernardo Rd, Suite 200
San Diego, CA 92127
Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-6 | SHEET 2 OF 2
START DATE 6/27/2012 | ELEVATION 544.0 FT MSL
FINISH DATE 6/27/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOW COUNTS	SAMPLES % RECOVERY	SAMPLES N-VALUE	TIME	COMMENTS
	Moist, reddish brown [10YR 7/2], hard lean clay with trace sand (CL)			B-6-7		15/23/50 for 6"				
35			509	B-6-8		19/50 for 4"				MC, DD, LL, PI
	Moist, pale brown [10YR 6/3], to light brownish gray [10YR 6/2], very dense, very fine to fine clayey sand (SC)									
40			504	B-6-9		50 for 6"				
	Bottom of boring at 40.5 feet. Boring backfilled with approximately 7.4 cubic feet of bentonite gravel and 0.8 cubic feet of concrete.									
			499							
			494							
			489							
			484							

CONTRACTOR Pacific Drilling | LATITUDE 32.6433630
EQUIPMENT Unimog MARL M5 | LONGITUDE 116.9715860
DRILL MTHD HSA | ANGLE Vertical
DIAMETER 7 inches | BEARING ------
LOGGER N.Godinez REVIEWER A.Greene | PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
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San Diego, CA 92127
Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-7 | SHEET 1 OF 2
START DATE 6/25/2012 | ELEVATION 552.0 FT MSL
FINISH DATE 6/25/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE NUMBER	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
0	Fill: Moist, dark grayish brown [10YR 4/2], fine to medium clayey sand, with sub-rounded gravels							Hand auger to 5 feet
			B-7-1					
5	Colluvium: Moist, very dark brown [10YR 2/2], to grayish brown [10YR 5/2], very stiff sandy lean clay, with sub-rounded gravels and some plant debris (CL)	547	B-7-2	7/10/15		25		MC, DD, SA
	Otay Formation: Moist, very pale brown [10YR 7/4], medium dense, poorly graded fine to medium sand with silt (SP/SM)							
10		542	B-7-3	8/8/7		15		
15	At 15 ft, becomes light gray [2.5YR 7/2], and very dense	537	B-7-4	15/36 for 3"				MC, DD
	Moist, pale brown [10YR 6/3], medium dense, fine to medium sand with trace clay (SP/SC)							
20		532	B-7-5	10/13/17		30		
25	Moist, light gray [2.5 YR 7/2], hard sandy lean clay (CL)	527	B-7-6	29 for 3"				MC, DD, SA
	Moist, yellowish brown [10YR 5/4], medium dense, fine to medium silty sand (SM)							
30		522						

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER J.Warner REVIEWER A Greene

LATITUDE 32.6403000
LONGITUDE 116.9711170
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 23.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
10875 Rancho Bernardo Rd, Suite 200
San Diego, CA 92127
Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-7 **SHEET** 2 OF 2
START DATE 6/25/2012 **ELEVATION** 552.0 FT MSL
FINISH DATE 6/25/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOW COUNTS	SAMPLES % RECOVERY	SAMPLES N-VALUE	TIME	COMMENTS
				B-7-7		9/12/14		26		
	Moist, pale yellow [2.5YR 8/2], to light gray [2.5YR 7/2], very dense, poorly graded, fine to medium sand (SP)									MC, DD
35			517	B-7-8		26 for 4"				
40			512	B-7-9		28/38/40		78		
	Bottom of boring at 41.5 feet. Boring backfilled with approximately 10.0 cubic feet of bentonite grout/chips.									
			507							
			502							
			497							
			492							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER J.Warner **REVIEWER** A Greene

LATITUDE 32.6403000
LONGITUDE 116.9711170
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 23.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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Tel: (858) 674-6559
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GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-8 **SHEET** 1 **OF** 2
START DATE 7/3/2012 **ELEVATION** 564.0 FT MSL
FINISH DATE 7/3/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE NUMBER	BLOW COUNTS	% RECOVERY	N-VALUE	TIME	COMMENTS
0	Fill: Moist, dark yellowish brown [10YR 3/4] to dark grayish brown [10YR 4/2], silty sand with trace clay							Hand auger to 5 feet
			B-8-1					
	Colluvium: Moist, very dark brown [10YR 2/2], hard fat clay (CH)							
5		559	B-8-2	9/13/18		31		MC, DD, LL, PI
	Otay Formation: Moist, white [10YR 8/1] to yellowish brown [10YR 5/4], medium dense, clayey sand with carbonate nodules (SC)							
10		554	B-8-3	5/9/11		20		
	Moist, light brownish gray [10YR 6/2] very dense, fine clayey sand (SC)							
15		549	B-8-4	22/50 for 5.5"				MC, DD, SA
20	Moist, pale brown [10YR 6/3], fine sand with silt (SP/SM) At 20.3 feet, light gray 2" to 3" sandstone layer	544	B-8-5	21/21/24		45		
25		539	B-8-6	50 for 5"				MC, DD
	At 26 ft, becomes brown [10YR 5/3], and increase in fine to medium sand							
30		534						

CONTRACTOR Pacific Drilling **LATITUDE** 32.6392980
EQUIPMENT Unimog MARL M5 **LONGITUDE** 116.9701210
DRILL MTHD HSA **ANGLE** Vertical
DIAMETER 7 inches **BEARING** ------
LOGGER J.Warner **REVIEWER** A.Greene **PRINTED** August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 22.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
10875 Rancho Bernardo Rd, Suite 200
San Diego, CA 92127
Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-8 **SHEET** 2 OF 2
START DATE 7/3/2012 **ELEVATION** 564.0 FT MSL
FINISH DATE 7/3/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	ELEVATION (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOW COUNTS	SAMPLES % RECOVERY	SAMPLES N-VALUE	TIME	COMMENTS
	Becomes pale brown [10YR 6/3]			B-8-7		19/28/41		69		
35	Moist, yellowish brown [10YR 3/4], very dense clayey fine sand with trace silt (SC/SM) At 35.5 ft, becomes pale brown [10YR 6/3], very dense, poorly graded fine sand with trace silt		529	B-8-8		37/50 for 2"				MC, DD
40	Moist, light gray [10YR 7/2], very dense, fine to medium poorly graded sand with silt (SP-SM)		524	B-8-9		30/50 for 3"				
	Bottom of boring at 40.8 feet. Boring backfilled with approximately 7.9 cubic feet of bentonite grout topped with soil cuttings.		519							
			514							
			509							
			504							

CONTRACTOR Pacific Drilling
EQUIPMENT Unimog MARL M5
DRILL MTHD HSA
DIAMETER 7 inches
LOGGER J.Warner **REVIEWER** A.Greene

LATITUDE 32.6392980
LONGITUDE 116.9701210
ANGLE Vertical
BEARING ------
PRINTED August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site No. 22.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

Geosyntec consultants
10875 Rancho Bernardo Rd, Suite 200
San Diego, CA 92127
Tel: (858) 674-6559
Fax: (858) 674-6586

GS FORM: BORE 1/99

BOREHOLE RECORD

BORING B-9 **SHEET** 1 OF 1
START DATE 6/27/2012 **ELEVATION** 480.0 FT MSL
FINISH DATE 6/27/2012
PROJECT Miguel to Salt Creek
LOCATION Chula Vista, California
PROJECT NUMBER SC0368-26

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE NUMBER	BLOW COUNTS	N-VALUE	COMMENTS
0	Colluvium: Moist, very dark brown [10YR 2/2], medium dense, lean clay with trace fine sand and fine gravel (CL)	480				Hand auger to 5 feet
			B-9-1			
5	Moist, brown [7.5YR 5/2], medium dense, clayey fine to medium sand with coarse sand and gravels (SC)	475	B-9-2	8/8/17	25	
10	Otay Formation: Moist, light yellowish brown 2.5YR 6/4], very dense, fine to medium sand with angular coarse sand (SC) gritstone	470	B-9-3	21/50 for 5"		MC, DD, SA
	Trace fine gravel, becomes cemented		B-9-4	25/50 for 3"		Difficult drilling, added approx. 5 gallons of water to assist drilling
15	Auger refusal encountered at 15.2 feet. Boring backfilled with approximately 2.0 cubic feet of bentonite grout.	465	B-9-5	50 for 2"		
		460				
		455				
		450				

CONTRACTOR Pacific Drilling **LATITUDE** 32.6201590
EQUIPMENT Unimog MARL M5 **LONGITUDE** 116.9490720
DRILL MTHD HSA **ANGLE** Vertical
DIAMETER 7 inches **BEARING** ------
LOGGER N.Godinez **REVIEWER** A.Greene **PRINTED** August 7, 2012

REMARKS: Approximate lat/long estimated from Google Earth. Approximate elevation estimated from Google Earth/Pole Survey Data. Site Nos. 43 and 44.

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG GEOTECH (KEATON) SC0368-26.GPJ GEOSNTEC.GDT 8/7/12

APPENDIX C

GEOTECHNICAL LABORATORY TESTING

Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Test Results Summary

Project Name: Miguel To Salt Creek TL6956

Project No.: 558

Sample Information		Test Information										
Site ID	Lab No.	Moisture Content ASTM D 2216	Grain Size Analysis ASTM D 422			Atterberg Limits ASTM D 4318			Dry Unit Weight(1) Modified ASTM D 2937		Engineering Classification ASTM D 2487	Remarks
			Gravel Content	Sand Content	Fines Content	LL	PL	PI	Dry Unit Weight	Moisture Content		
(-)	(-)	(%)	(%)	(%)	(%)	(-)	(-)	(-)	(pcf)	(%)	(-)	
B-1-2	12G014								112.6	15.3		
B-1-3	12G015	13.0	2.8	45.7	51.5	46	20	26				
B-1-4	12G016								111.6	15.2		
B-1-5	12G017	4.0	0.8	68.9	30.3							
B-1-6	12G018								118.8	13.0		
B-1-8	12G019								87.8	33.7		
B-2-2	12G020		0.0	68.4	31.6				105.0	13.0		
B-2-4	12G021		0.1	84.7	15.2				101.3	8.7		
B-3-2	12G022								94.5	20.7		
B-3-4	12G023		0.8	67.3	31.9				116.2	12.2		
B-3-6	12G024								110.6	11.0		
B-3-8	12G025								111.6	10.3		
B-4-3	12G026	16.4	2.4	60.5	37.1							
B-4-4	12G027								105.0	16.0		
B-4-5	12G028	14.8				47	24	23				
B-4-6	12G029								104.3	13.3		
B-4-8	12G030								101.0	11.1		
B-5-2	12G031								112.7	9.5		
B-5-4	12G032		2.4	43.2	54.4				95.3	23.7		
B-5-6	12G033								114.8	15.9		
B-5-8	12G034								111.2	11.9		
B-6-2	12G035								111.4	12.8		
B-6-3	12G036	15.5	0.0	45.5	54.5							
B-6-4	12G037								104.7	7.2		
B-6-5	12G038	16.2				48	25	23				
B-6-6	12G039								114.2	10.8		
B-6-8	12G040	17.5				56	23	33	107.7	17.5		
B-7-2	12G041		1.2	38.8	60.0				106.7	19.9		
B-7-4	12G042								111.2	18.2		
B-7-6	12G043		0.1	28.5	71.4				105.1	14.0		
B-7-8	12G044								106.5	15.2		
B-8-2	12G045					65	26	39	102.6	22.5		
B-8-4	12G046		0.0	73.4	26.6				105.0	21.4		

Notes:
1 - Some of the samples may be disturbed and thus the values obtained may not be accurate.

7-30-12
SRS

Excel Geotechnical Testing, Inc.
"Excellence in Testing"

953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Test Results Summary

Project Name: Miguel To Salt Creek TL6956

Project No.: 558

Sample Information		Test Information										Remarks
Site ID	Lab No.	Moisture Content ASTM D 2216	Grain Size Analysis ASTM D 422			Atterberg Limits ASTM D 4318			Dry Unit Weight[1] Modified ASTM D 2937		Engineering Classification ASTM D 2487	
			Gravel Content	Sand Content	Fines Content	LL	PL	PI	Dry Unit Weight	Moisture Content		
(-)	(-)	(%)	(%)	(%)	(%)	(-)	(-)	(-)	(pcf)	(%)	(-)	
B-8-6	12G047								96.2	18.8		
B-8-8	12G048								100.6	23.4		
B-9-3	12G049		6.7	66.1	27.2				118.0	10.3		

Notes:
1 - Some of the samples may be disturbed and thus the values obtained may not be accurate.

7-30-12
SRS

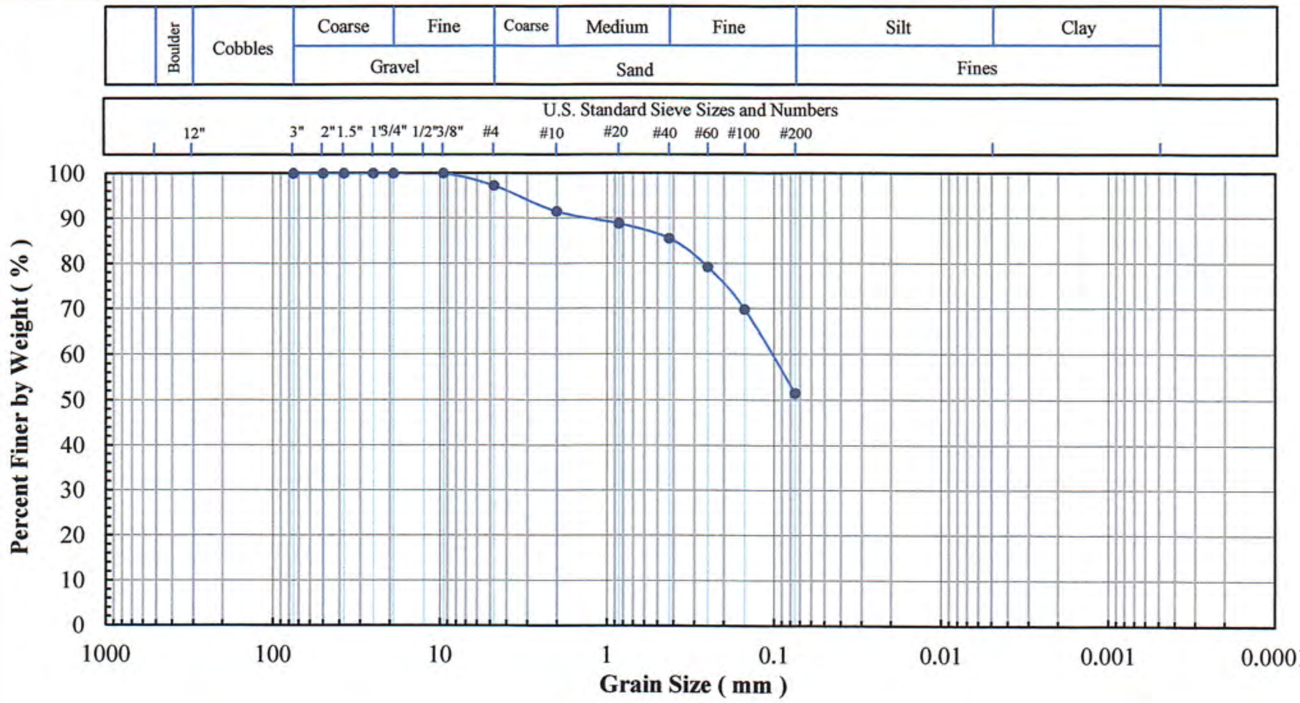
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-1-3
Lab Sample No:	12G015

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



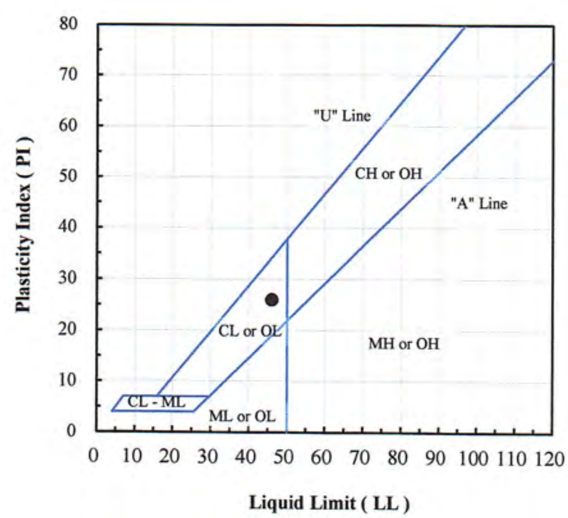
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	97.2
#10	2.00	91.5
#20	0.850	88.8
#40	0.425	85.5
#60	0.250	79.2
#100	0.150	69.8
#200	0.075	51.5

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	2.8
Sand (%):	45.7
Fines (%):	51.5
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-1-3	12G015	13.0	51.5	46	20	26	

Note(s):

7-30-12
SPS

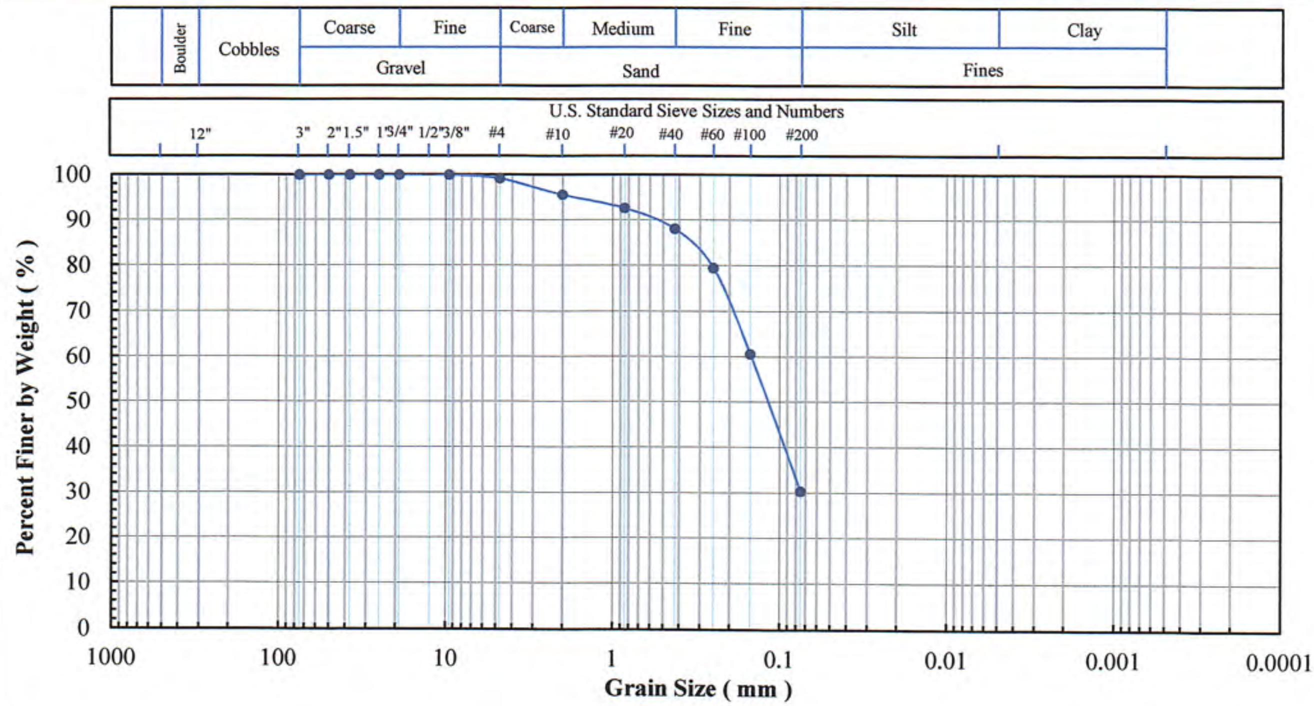
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-1-5
Lab Sample No:	12G017

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



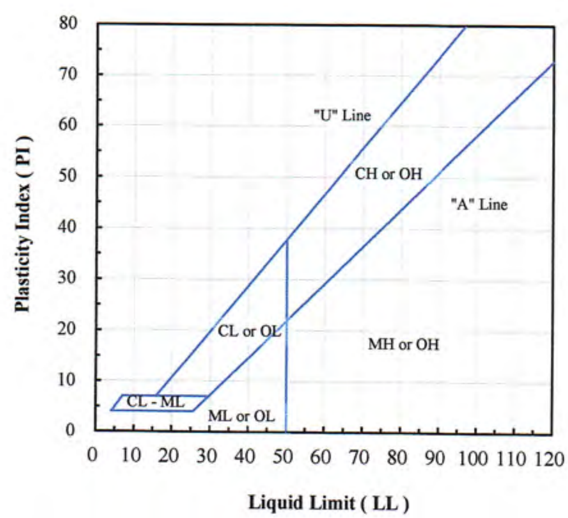
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	99.2
#10	2.00	95.6
#20	0.850	92.6
#40	0.425	88.0
#60	0.250	79.4
#100	0.150	60.6
#200	0.075	30.3

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	0.8
Sand (%):	68.9
Fines (%):	30.3
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-1-5	12G017	11.0	30.3				

Note(s):

7-30-12
JRS

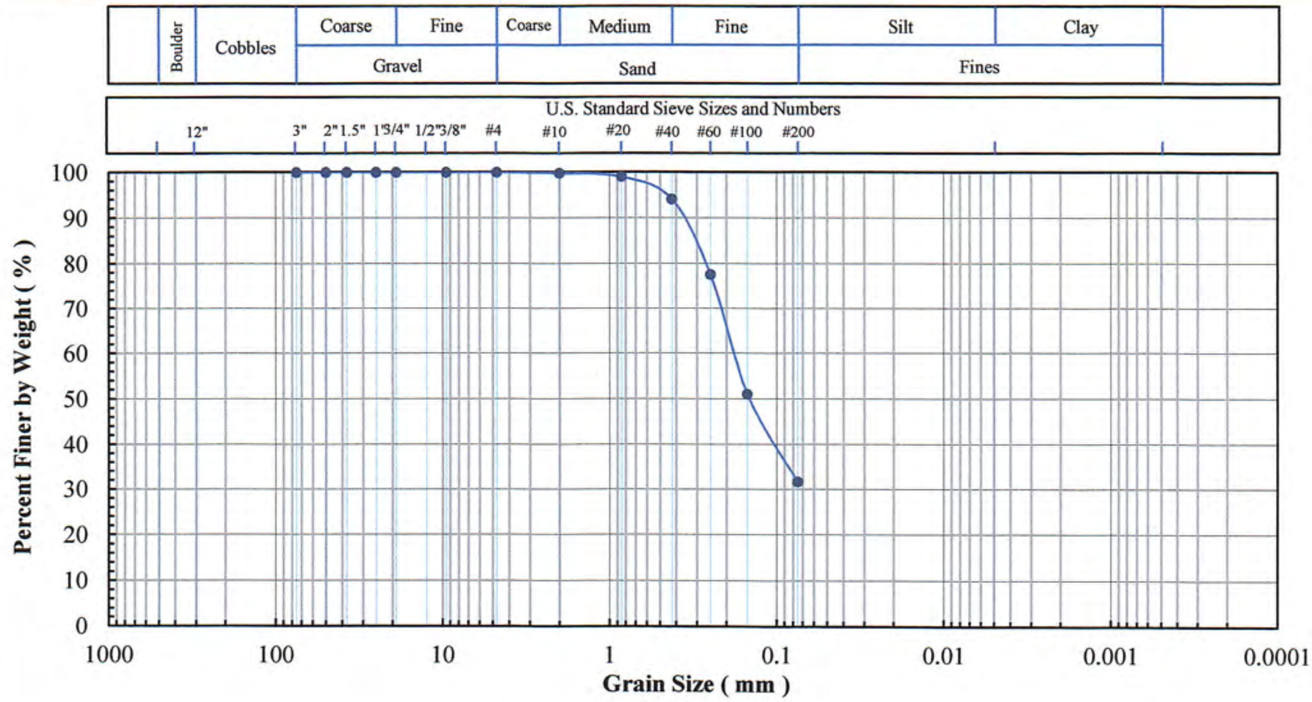
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-2-2
Lab Sample No:	12G020

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



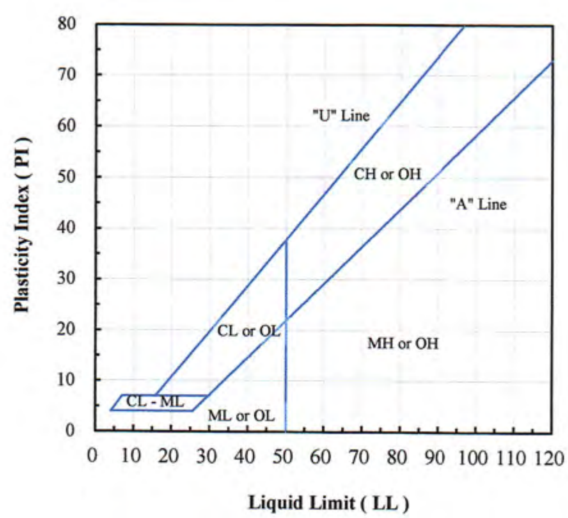
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	99.8
#20	0.850	99.0
#40	0.425	94.1
#60	0.250	77.6
#100	0.150	51.0
#200	0.075	31.6

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	
Sand (%):	68.4
Fines (%):	31.6
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-2-2	12G020	13.0	31.6				

Note(s):

7-30-12
SRS

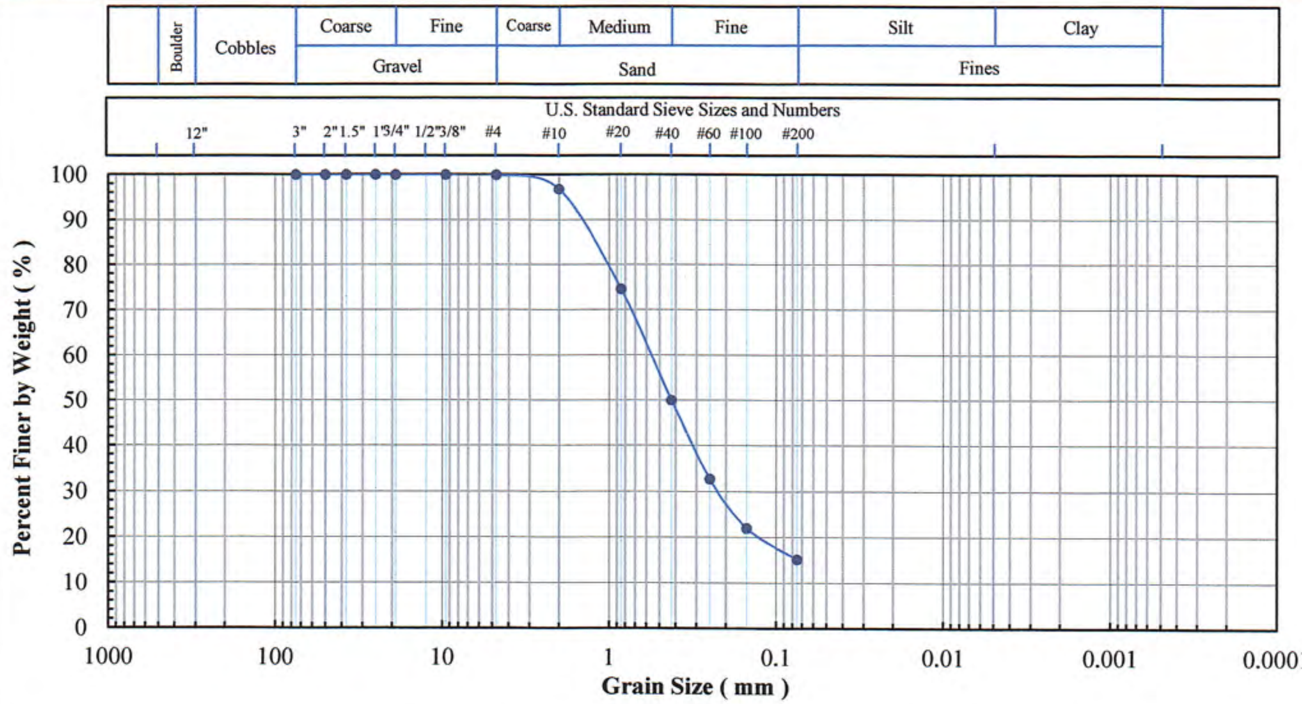
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-2-4
Lab Sample No:	12G021

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



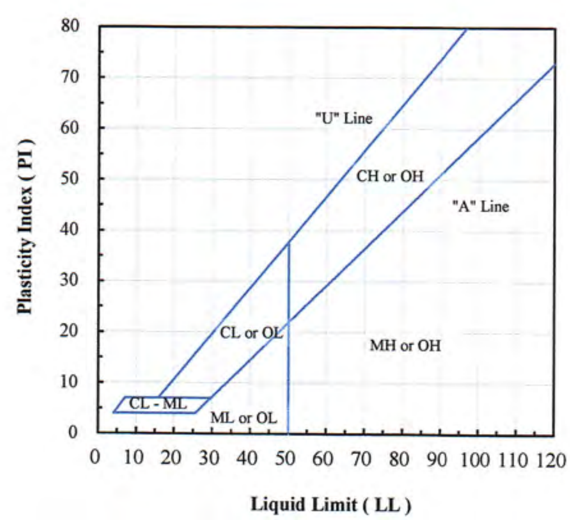
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	99.9
#10	2.00	96.8
#20	0.850	74.6
#40	0.425	50.0
#60	0.250	32.7
#100	0.150	22.0
#200	0.075	15.2

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	0.1
Sand (%):	84.7
Fines (%):	15.2
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-2-4	12G021	8.7	15.2				

Note(s):

7-31-12
SAS

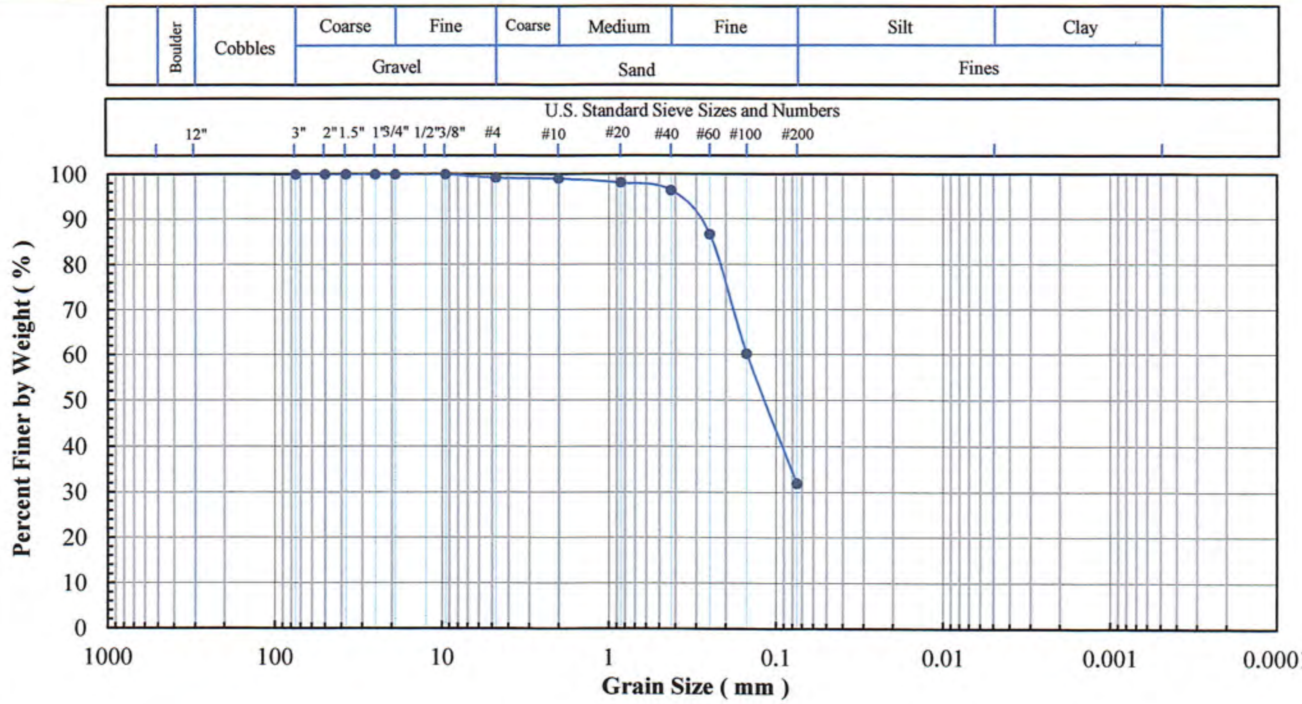
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-3-4
Lab Sample No:	12G023

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



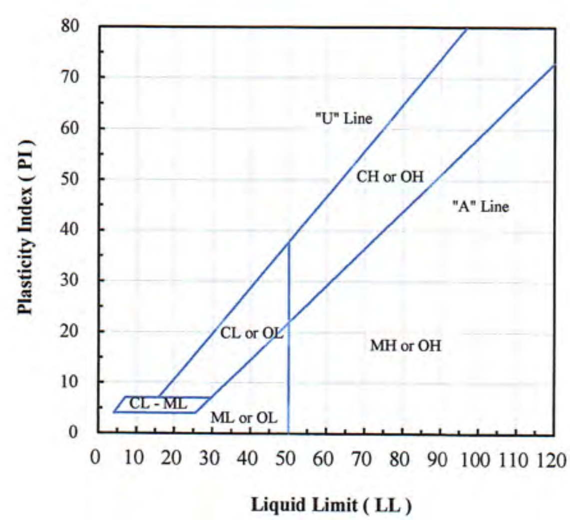
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	99.2
#10	2.00	99.0
#20	0.850	98.1
#40	0.425	96.4
#60	0.250	86.6
#100	0.150	60.2
#200	0.075	31.9

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	0.8
Sand (%):	67.3
Fines (%):	31.9
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-3-4	12G023	12.2	31.9				

Note(s):

7-30-12
GBS

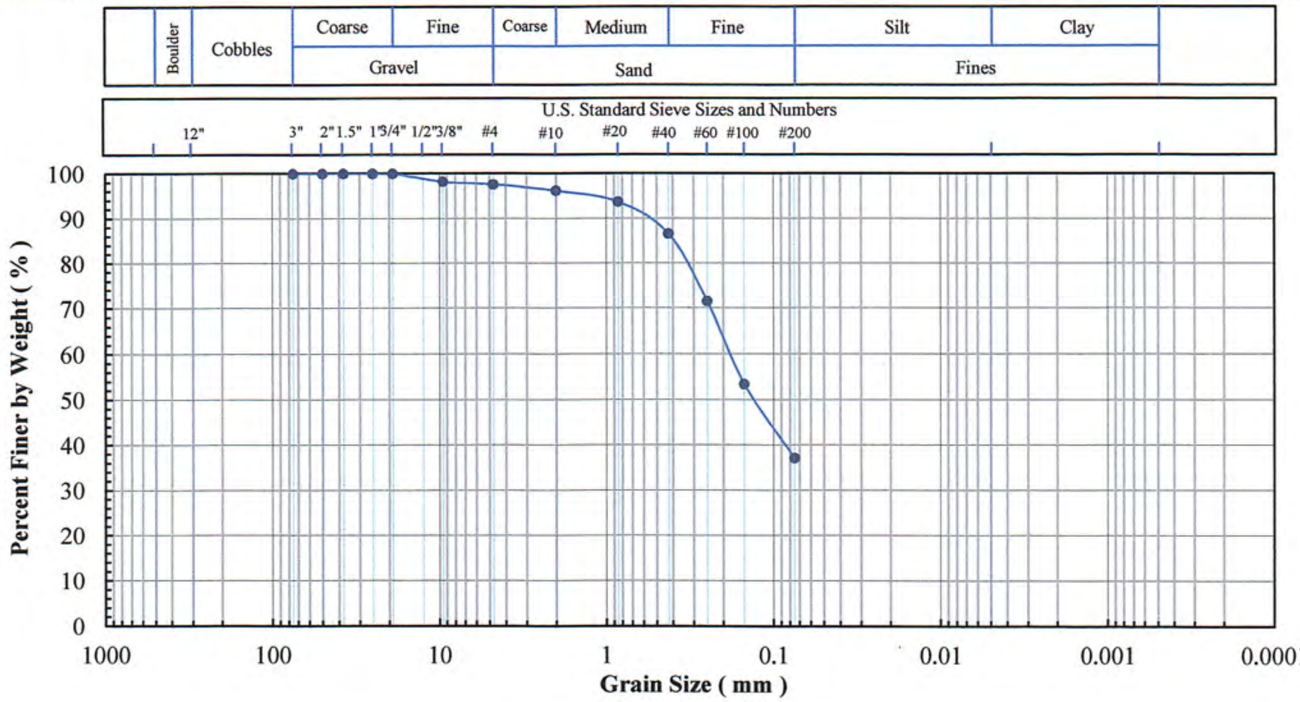
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-4-3
Lab Sample No:	12G026

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



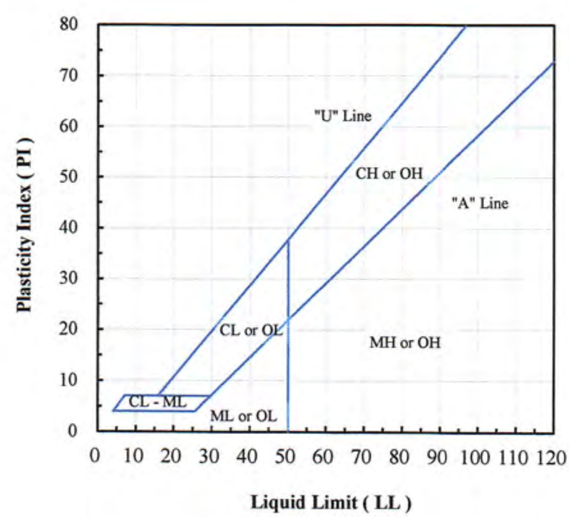
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	98.2
#4	4.75	97.6
#10	2.00	96.2
#20	0.850	93.7
#40	0.425	86.6
#60	0.250	71.5
#100	0.150	53.4
#200	0.075	37.1

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	2.4
Sand (%):	60.5
Fines (%):	37.1
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-4-3	12G026	16.4	37.1				

Note(s):

7-30-12
SRS

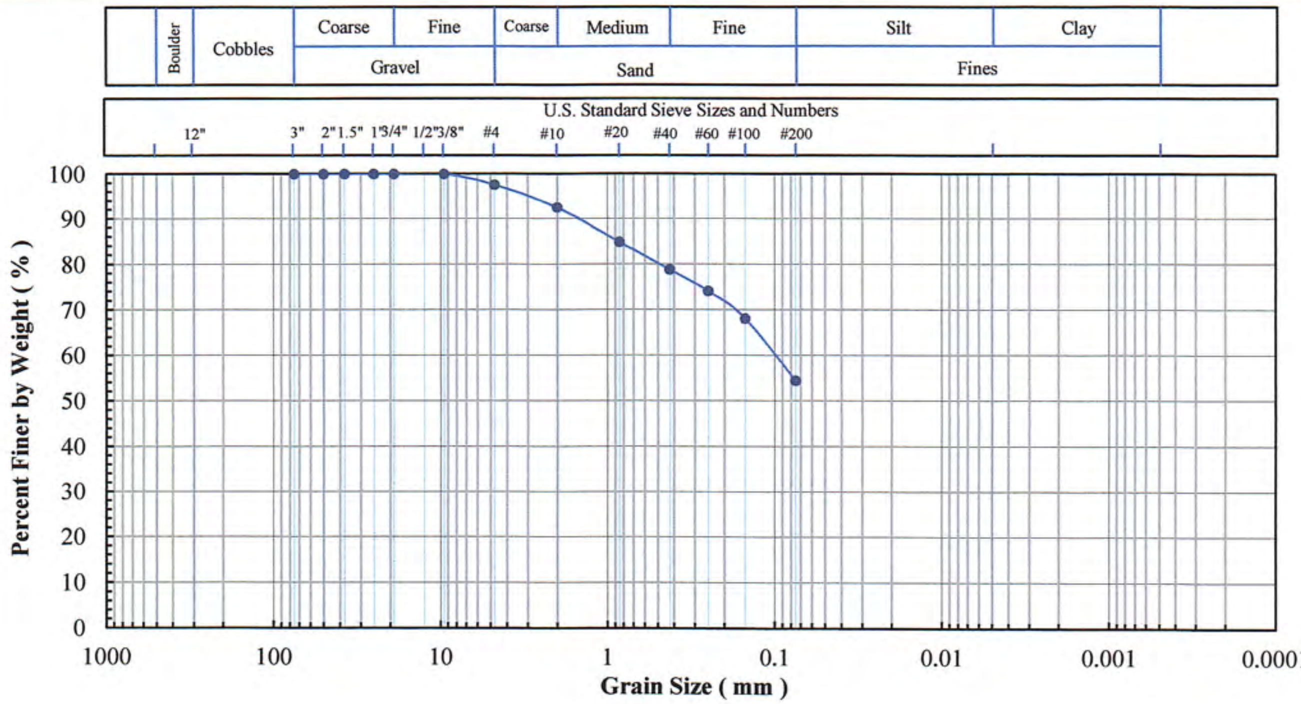
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-5-4
Lab Sample No:	12G032

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



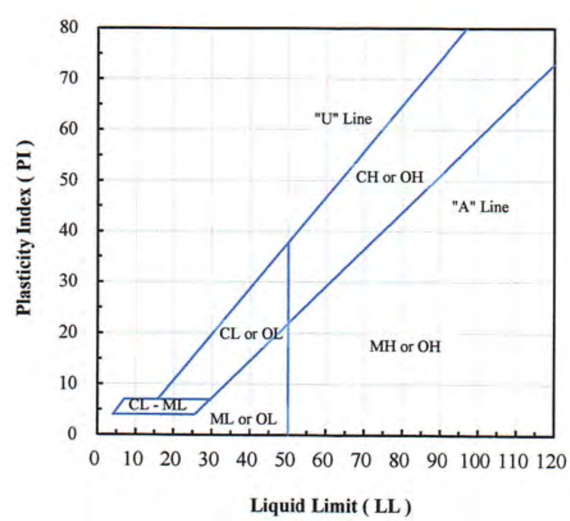
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	97.6
#10	2.00	92.5
#20	0.850	84.8
#40	0.425	78.8
#60	0.250	74.1
#100	0.150	68.1
#200	0.075	54.4

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	2.4
Sand (%):	43.2
Fines (%):	54.4
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-5-4	12G032	23.7	54.4				

Note(s):

7-31-12
SRS

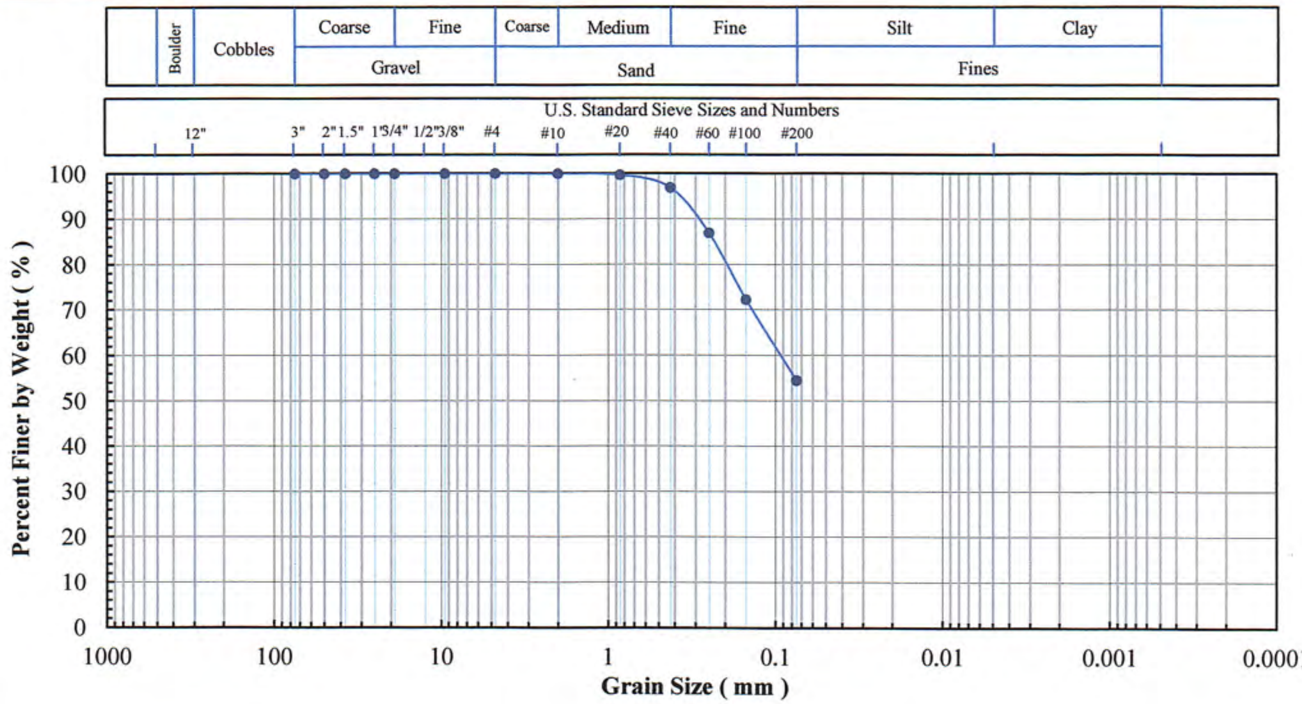
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-6-3
Lab Sample No:	12G036

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



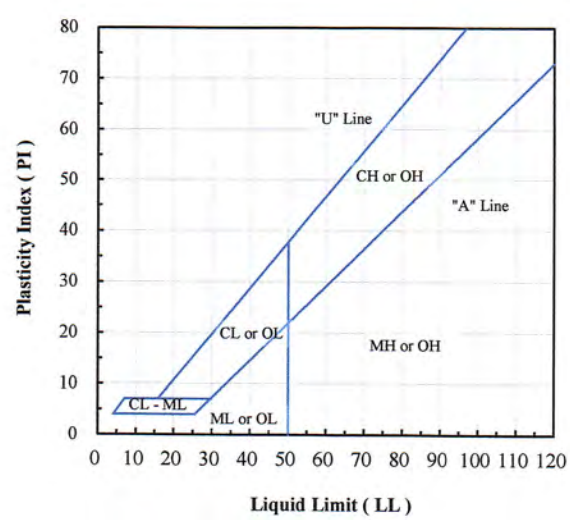
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	100.0
#20	0.850	99.7
#40	0.425	96.9
#60	0.250	86.9
#100	0.150	72.2
#200	0.075	54.5

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	
Sand (%):	45.5
Fines (%):	54.5
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-6-3	12G036	15.5	54.5				

Note(s):

7-30-12
SRS

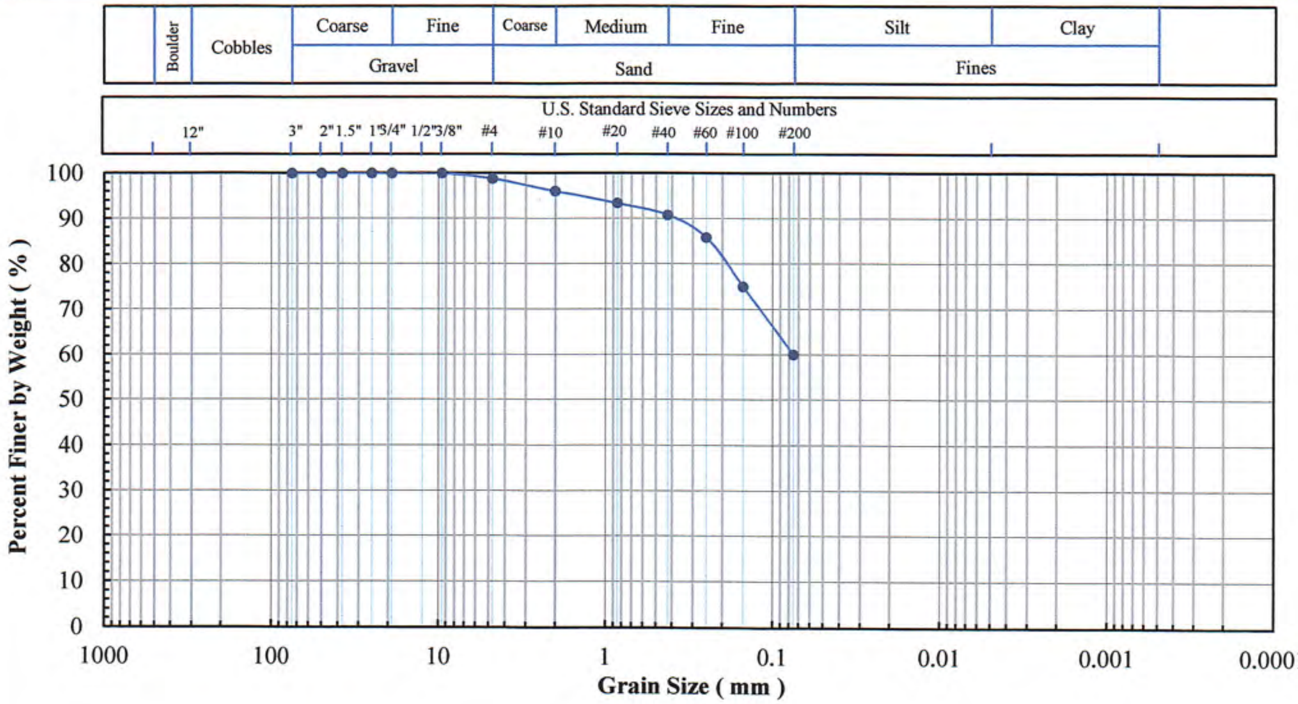
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-7-2
Lab Sample No:	12G041

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



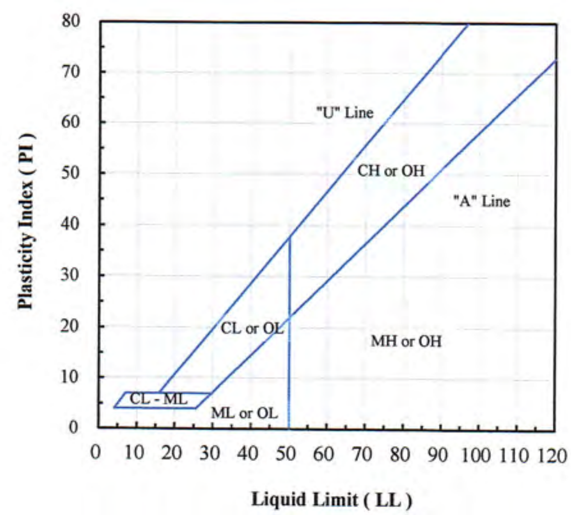
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	98.8
#10	2.00	96.1
#20	0.850	93.4
#40	0.425	90.8
#60	0.250	85.8
#100	0.150	75.0
#200	0.075	60.0

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	1.2
Sand (%):	38.8
Fines (%):	60.0
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-7-2	12G041		60.0				

Note(s):

7-30-12
STS

Excel Geotechnical Testing, Inc.
"Excellence in Testing"

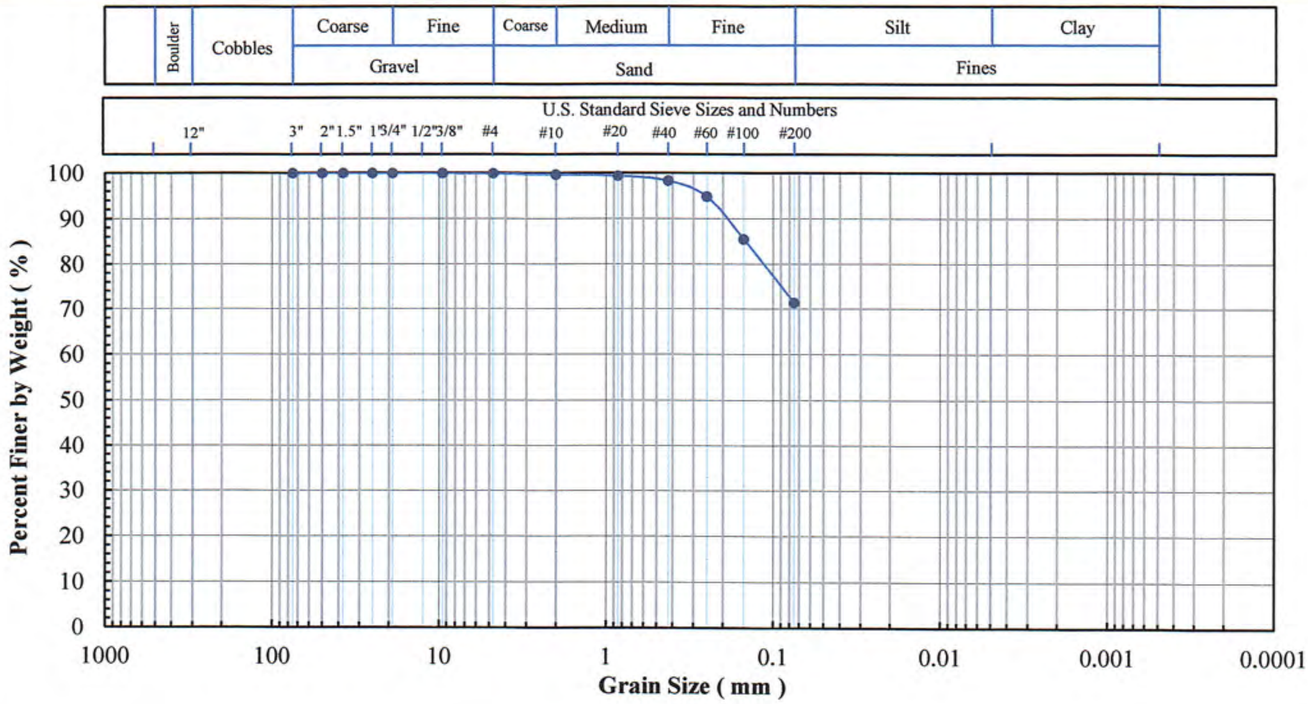
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-7-6
Lab Sample No:	12G043

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



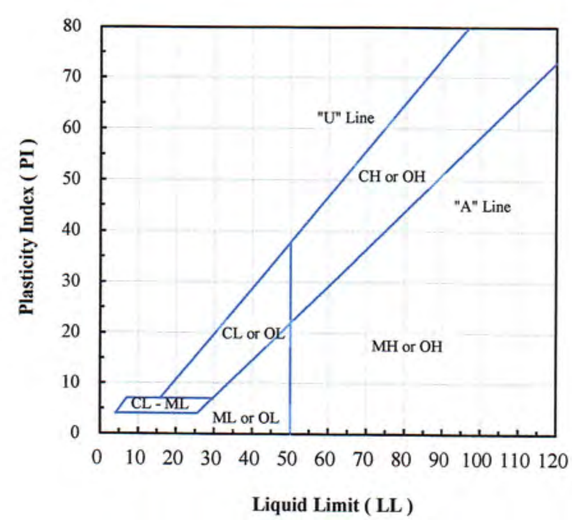
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	99.9
#10	2.00	99.7
#20	0.850	99.4
#40	0.425	98.3
#60	0.250	94.8
#100	0.150	85.5
#200	0.075	71.4

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	0.1
Sand (%):	28.5
Fines (%):	71.4
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-7-6	12G043		71.4				

Note(s):

7-30-12
SRS

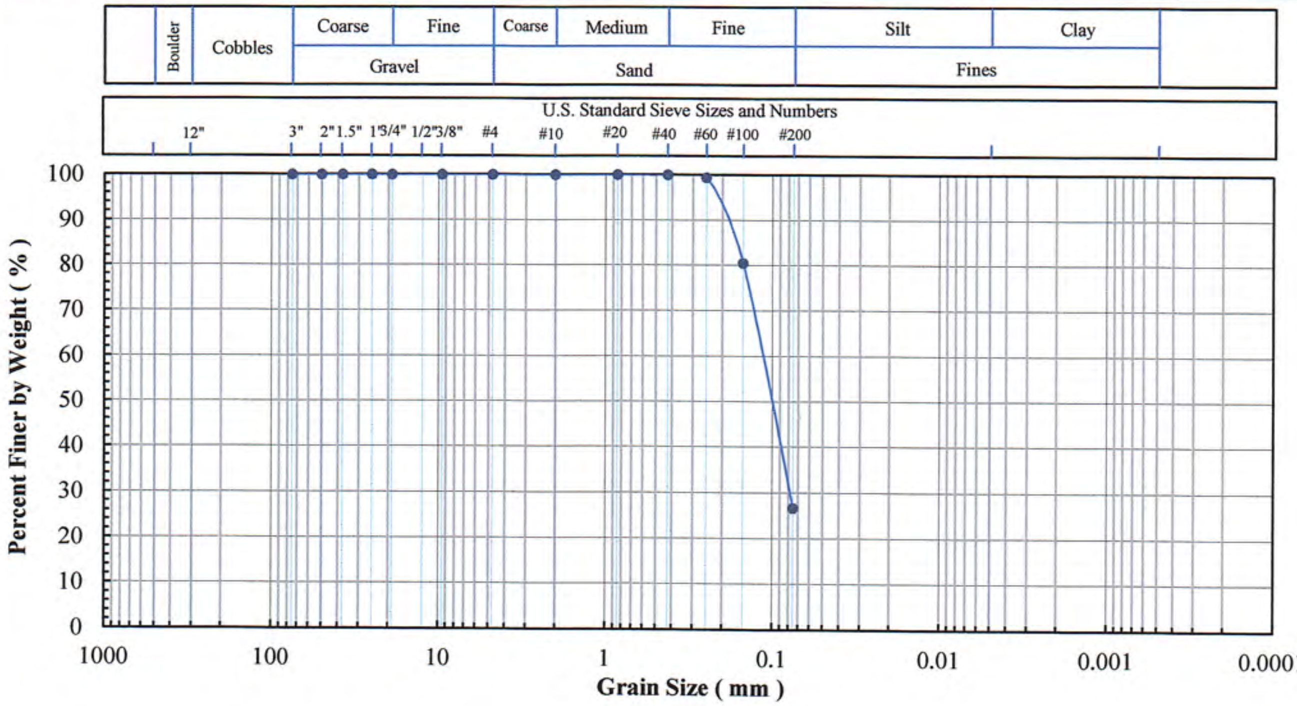
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-8-4
Lab Sample No:	12G046

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



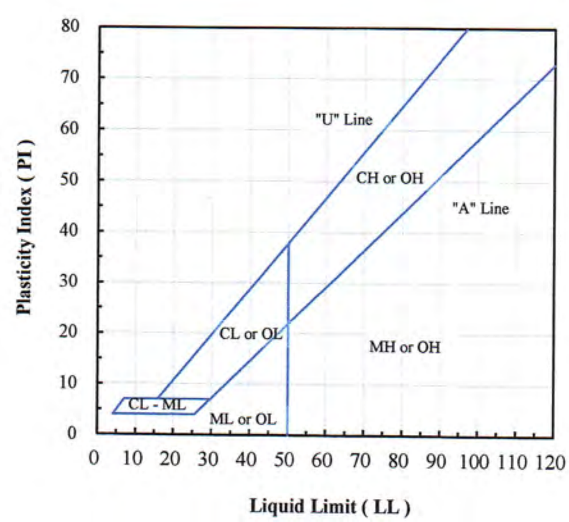
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	100.0
#10	2.00	100.0
#20	0.850	100.0
#40	0.425	100.0
#60	0.250	99.4
#100	0.150	80.4
#200	0.075	26.6

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	
Sand (%):	73.4
Fines (%):	26.6
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-8-4	12G046		26.6				

Note(s):

7-30-12
SRS

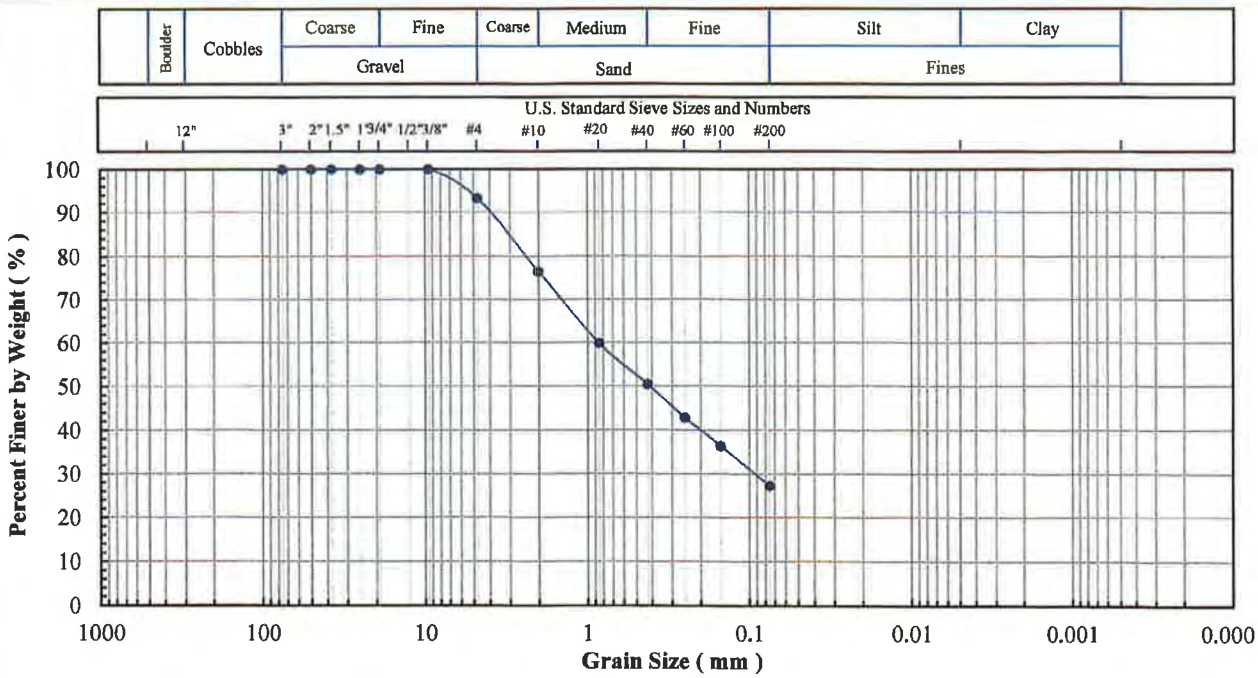
Excel Geotechnical Testing, Inc.
"Excellence in Testing"
953 Forrest Street, Roswell, Georgia 30075
Tel: (770) 910 7537 Fax: (770) 910 7538

Project Name:	Miguel To Salt Creek TL6956
Project No:	558
Client Sample ID:	B-9-3
Lab Sample No:	12G049

ASTM C 136, D 422, D 854, D 1140, D2216, D 2487, D4318

SOIL INDEX PROPERTIES

Grain Size, Spec. Gravity, Moist. Content, Eng. Classification, Atterberg Limits



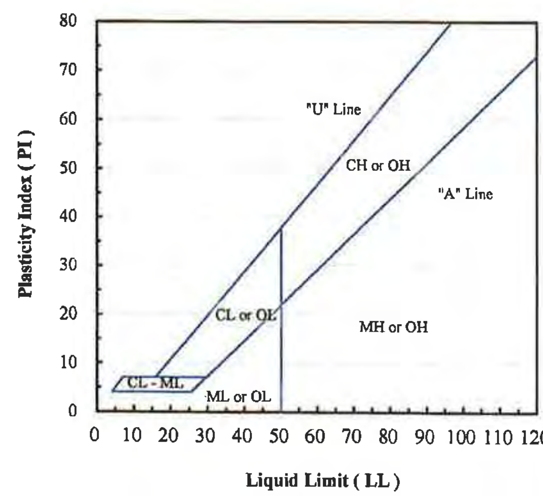
Sieve No.	Size (mm)	% Finer
3"	75	100.0
2"	50	100.0
1.5"	37.5	100.0
1"	25	100.0
3/4"	19	100.0
3/8"	9.5	100.0
#4	4.75	93.3
#10	2.00	76.5
#20	0.850	59.9
#40	0.425	50.4
#60	0.250	42.8
#100	0.150	36.4
#200	0.075	27.2

Specific Gravity (-):	

Hydrometer Particle Diameter (mm)	% Finer

Gravel (%):	6.7
Sand (%):	66.1
Fines (%):	27.2
Silt (%):	
Clay (%):	

Coeff. Unif. (Cu):	
Coeff. Curv. (Cc):	



Client Sample ID.	Lab Sample No:	Moisture Content (%)	Fines Content < No. 200 (%)	Atterberg Limits LL (-)	PL (-)	PI (-)	Engineering Classification
B-9-3	12G049		27.2				

Note(s):

7-30-12
SRS

SDG&E BEST MANAGEMENT PRACTICES MANUAL

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MANUAL

BEST MANAGEMENT PRACTICES MANUAL FOR WATER QUALITY CONSTRUCTION

Geosyntec Project No. SW0186

December 2010, Rev 2- Geosyntec Consultants
Revised July 2011, San Diego Gas & Electric Environmental Services Department

Table of Contents

Why Is There A Need for This Manual?

Sempra Energy's Environmental Policy states in part, "Sempra Energy believes in treating the Earth's resources with respect. We are committed to protecting and conserving the environment and the health and the safety of our employees, our customers, and the diverse communities in which we operate and provide service." Therefore, Sempra Energy companies will:

- Meet applicable environmental laws, regulations, and permit requirements.
- Join customers, civic leaders and other community leaders in providing sound and responsible stewardship of our environment.
- Incorporate appropriate environmental management and compliance in strategic planning and operational decisions."

Municipalities (Cities, Counties, and Special Districts) have passed storm water ordinances intended to protect storm sewer systems and receiving water bodies from sediment, chemical, and biological pollutants. These ordinances require storm water Best Management Practices (BMPs) for construction projects and construction activities that disturb soil. Due to the numerous municipalities in the San Diego Gas & Electric (SDG&E) service territory, there is a need to consolidate the various municipal BMP requirements for consistent and cost effective construction practices. This manual has been written to supplement the operational procedures of SDG&E to meet the municipal storm water ordinance requirements within SDG&E's service territory. Municipal storm water ordinances include prohibitions regarding erosion, sedimentation and discharge of other pollutants without reference to soil disturbance area and include construction "like" activities that include construction or operation and maintenance activities that can impact the municipal storm water conveyance systems. These activities include saw cutting, potholing, trenching, excavation (including trench and excavation dewatering) and stockpiling. Therefore, this BMP manual is applicable to the above construction and construction "like" activities, including field operations and maintenance activities, regardless of soil disturbance area or its location. This manual is also applicable to construction "like" activities at SDG&E facilities, such as Construction & Operations (C&O) facilities, supplementing the Facility Storm Water Management Plan (SWMP) or Storm Water Pollution Prevention Plan (SWPPP) BMPs.

Construction or demolition activities that include any land disturbance of one (1) acre or more are subject to storm water control regulations in the California Construction General Storm Water Discharge Permit (CGP) established by the California State Water Resources Control Board (SWRCB) Order No. 2009-009-DWQ. This CGP has many new requirements compared to the previous permit (Order No. 99-08-DWQ) and requires electronic submittal of the Notice of Intent (NOI), risk assessment, site map, project specific SWPPP, and annual report requirements. Projects subject to the CGP must establish a project-specific construction site risk level based on the site-specific sediment discharge risk and the site's receiving water risk. These two factors are used to determine the project risk, which is assigned as Risk Level 1, 2, or 3 for traditional (non-linear) projects or Type 1, 2, or 3 for linear underground/overhead (LUP) projects. CGP requirements are more stringent for higher Risk Levels or Types. The CGP established numeric discharge limits for turbidity and pH for Risk Level/Type 2 and 3 sites. All projects risk levels/types must implement minimum BMPs and perform visual monitoring in accordance with the CGP. In addition, the CGP has specific certification requirements for those that prepare SWPPPs (i.e., "Qualified SWPPP Developers") and those that implement requirements in the field (i.e., "Qualified SWPPP Practitioners").

The purpose is to update the manual and BMP details to reflect requirements of the new California Construction General Storm Water Discharge Permit (CGP) (California State Water Resources Control Board (SWRCB) Order No. 2009-009-DWQ), which became effective on July 1, 2010 as well as to update information related to SDG&E operations and activities.

Many of the construction activities of SDG&E are linear in nature, unique to utility work, and do not correspond to typical large development project BMPs. There is a continuing need to tailor typical BMPs to utility type work and utility work crews. This manual incorporates the above mandates of Sempra Energy's Environmental Policy. The manual is the result of surveying the available governmental, association, and industry sources of construction BMPs, and the selection and editing of BMPs appropriate to SDG&E construction activities and personnel.

A Note Regarding Impacts to Construction Cost and Scheduling

It is important for a project's or activity's budget and schedule to include BMP selection, implementation and maintenance costs and time horizons into the design and construction of a project. It is also important that there is a mechanism to hand-off the BMP portion of a project to the appropriate SDG&E Operations and Maintenance Department for final stabilization and post-project permanent BMP maintenance (including final and post-construction costs). A project's field Environmental Representative will be able to assist in estimating and incorporating these costs and scheduling considerations into the project or construction activity.

BMP PROGRAM OVERVIEW

Water Quality Construction BMP Manual

The purpose of this Water Quality Construction BMP Manual (Manual) is to provide standardized BMPs to reduce or eliminate pollutants in runoff from SDG&E construction projects and construction activities for water quality protection. This Manual applies to SDG&E's construction projects and activities that disturb soil. This manual also applies to SDG&E's contractors performing such work as part of their contractual obligations. SDG&E's service area encompasses approximately 4,000 square miles of diverse terrain from Southern Orange County to the Mexican border. Many of SDG&E's projects and work activities throughout the service area are subject to coverage under the National Pollutant Discharge Elimination System (NPDES) CGP and its conditions, and/or local municipal storm water ordinance requirements. Because of the breadth of jurisdictions and requirements that apply to SDG&E's utility construction projects and activities, this Manual has been developed to provide a consistent approach to water quality management to be applied by SDG&E and their contractors throughout the SDG&E service area.

Most construction projects performed by SDG&E are linear projects which are often short term, and are low impact on narrow corridors of land. Many of the BMPs presented in this Manual have used the best and most practical pollution prevention features from several sources, such as the SWRCB, the California Stormwater Quality Association (CASQA), local municipalities, and California Department of Transportation (Caltrans) BMP Manuals, that have been modified to integrate into our utility construction activities but are also compliant with the applicable regulations and ordinances.

This Manual is organized into three main sections:

- BMP Program Overview.
- BMP Selection and Implementation.
- BMP Details.

The BMP Details section is divided into four functional BMP categories:

- Sediment Controls.
- Waste and Materials Management Controls.
- Non-Storm Water Discharge Controls.
- Erosion Control.

Within each of these categories, specific information, including "What," "When," "Where" and "How" to implement the BMP, plus maintenance and inspection information, are provided for each BMP. Pictures and diagrams are also provided for many of the BMPs for easy reference. Photographs provided in this Manual have been primarily obtained from URS Corporation, Geosyntec Consultants, California Department of Transportation (Caltrans), CASQA, and SDG&E.

The Manual is a tool designed to assist with the identification of BMPs appropriate for use on a construction or activity site. The Manual provides guidance to SDG&E for meeting regulatory water quality requirements for utility construction and maintenance activities that involve disturbance of soil. The BMP selection process provides users with guidance for the selection of typical BMPs that may apply to standard SDG&E construction activities. During BMP selection, the users of this Manual should take into account the benefits and limitations of each of the BMPs considered in the context of the site conditions. Finally, BMP success is contingent not only on appropriate selection and implementation, but also on the coordination and communication between project management, Field Environmental Representatives, and the field construction teams.

BMP PROGRAM OVERVIEW

Utility Type Projects

Most SDG&E projects are very different from commercial or residential developments, building sites, and Caltrans projects. Many SDG&E projects are smaller, short term, and impact narrow corridors of land. SDG&E projects are constantly progressing along the route. Often, SDG&E projects are in the right-of-ways of streets or along SDG&E utility corridors that must be maintained to ensure safe access to gas and electric lines and where temporary BMPs are initially installed for a short period of time during construction, followed by soil stabilization BMPs as necessary.

Training Program

Training for construction storm water pollution prevention and control is part of SDG&E's overall Water Quality Pollution Prevention Program. All applicable company employees and contractors hired by the company have the responsibility to comply with environmental laws, regulations, and permit requirements. Training for the prevention of environmental-related incidents is conducted for applicable SDG&E employees who perform any operation or activity that has the potential to cause a pollutant to be released into the environment, including construction activity. Records are maintained as to when employees have received this training and instruction.

Contractor responsibilities, including environmental training of their employees, are specified in the terms and conditions of the contract between SDG&E and the contractor.

Applicable employees should know and contact their local Field Environmental Representatives for support and guidance on any aspects of the training program.

BMP SELECTION AND IMPLEMENTATION

General Protocol BMP

To select BMPs that are appropriate for a given project, the following steps should be followed:

Step 1 – In the project's design phase, identify "Permanent" or "Structural" BMPs required by the local municipality or the CGP. These BMPs are often stated in the requirements as "Post-Construction" or "Permanent" BMPs.
Step 2 – Identify construction activities and the associated pollutants and issues of concern
Step 3 – Evaluate site conditions and select applicable BMPs
Step 4 – Implement, monitor, and maintain the BMPs

Step 1 – Identify "Permanent" or" Structural" BMPs required by Local Municipalities and/or the SWRCB General Construction Storm Water Permit.

Municipalities may have a Standard Urban Stormwater Mitigation Plan (SUSMP) or equivalent, and other requirements such as a requirement for conformance with the California Green Building Standards Code (CalGreen Code). These Plans and Codes may require:

- Permanent stabilization of exposed soil surfaces and slopes to minimize erosion and sedimentation. Stabilization structures and/or the planting of vegetation may be required.
- Matching post-construction runoff to pre-construction runoff, utilizing the 85th percentile storm event to reduce the risk of impact to the receiving water's channel morphology and provide some protection of water quality.
- Use of Low Impact Development (LID) practices. LID practices are environmentally sustainable practices that benefit water supply and contributes to water quality protection. Unlike traditional storm water management, which collects and conveys storm water runoff through storm drains, pipes, or other conveyances to a centralized storm water facility or outfall, LID takes a different approach by using site design and storm water management to maintain the site's pre-development runoff rates and volumes. LID practices include; Impervious surface reduction & disconnection; bio-retention facilities or rain gardens, grass swales and channels, vegetated rooftops, rain barrels, cisterns, vegetated filter strips, and permeable pavements.

Step 2 – Identify Activities, Pollutants, and Issues of Concern

The second step in BMP selection is to identify the construction activities, the associated potential pollutants, and the local issues of concern. Construction activities may include saw cutting, potholing, trenching, excavation, stockpiling of soil, grading and grubbing, new access road construction, paving, or other activities with the potential to impact storm water and non- storm water discharges. Pollutants of concern may include: sediment; petroleum products such as fuel, oil, and grease from vehicle and equipment operation; paving materials such as concrete and asphalt components; other materials used or stored on site, such as pesticides, herbicides, fertilizer, detergents, paint, adhesives, and solvents; and project wastes such as litter, debris, hazardous wastes, and liquid wastes. The local issues of concern may include:

- Proximity to sensitive receiving waters (environmentally sensitive areas or Clean Water Act Section 303(d) listed water bodies, particularly those meeting the criteria for "sediment sensitive" receiving waters identified in the CGP, example: Upper Newport Bay
- Local regulatory requirements influencing BMP selection, or timing of BMP implementation.

BMP SELECTION AND IMPLEMENTATION

Step 3 – Evaluate Site Conditions and Select BMPs

To assist in BMP selection, this Manual presents BMPs that are anticipated to be most applicable to utility construction projects and construction activities. Most SDG&E utility projects are unique in that they are typically very short-term, low impact on narrow corridors of land, and have minimal exposure of soil or transportable materials at any one time to storm water. The selector should consider any project-specific requirements or factors such as BMP effectiveness, cost, availability, feasibility, and suitability for the site. For example, important site conditions to consider include the amount of soil disturbance, anticipated weather conditions, soil type and erodibility, flow path length, and slope of exposed soil. Selected BMPs can and should be modified to suit the scope of the project and site conditions.

Table 1 presents guidelines for BMP selection and implementation at a construction site. Table 2 presents a BMP selection worksheet for utility activities. These implementation guidelines and selection worksheet can be used to select BMPs for a specific project or construction activity. Finally, a selector may discover a better BMP for their situation not listed in Tables 1 or 2. The Environmental Services Department encourages creative and practical pollution prevention techniques. These new techniques can be shared with others to support the water quality goals of the region.

Step 4 – Implement, Monitor, and Maintain the BMP System

It is important that selected BMPs be implemented in a sequence that maximizes protection of water quality, be monitored regularly for effectiveness and be maintained as necessary throughout the project. Appropriate BMPs must be implemented year round. Additional BMPs will be implemented when needed, and/or when a storm event is forecasted or occurs. Table 1 presents a suggested schedule for BMP implementation and sequencing. Steps in this schedule should be reviewed for each project as applicable. All BMPs should be monitored and inspected regularly and particularly before and after rain events, or in compliance with the frequency specified in the CGP, if applicable. BMPs should be maintained during a project in accordance with the procedures outlined in the BMP Details Section.

BMP Installation Contractors and BMP Material Suppliers

Construction crews will implement most BMPs. This Manual identifies some SDG&E utility activities and operations that may require outside contractors to install the applicable BMPs. As needed, please consult with the Environmental Services Department, Water Quality for the most current contractor listings and contractual arrangements.

BMP SELECTION AND IMPLEMENTATION

Table 1
BMP SELECTION AND SEQUENCING GUIDE

Step No.	Description	What to Do	BMP Options (see Table 2 for BMP activities)
1.	Design Stage and Before Construction	Contact the Field Environmental Representative early, at the beginning of a project, and provide him/her with the project information on the current environmental project information form. This information will allow the Environmental Department to identify environmental concerns such as, but not limited to, permitting requirements, potentially required structural BMPs, and the identification of endangered species and/or impaired water bodies that must be avoided or mitigated. As another example, before construction, it may be necessary to evaluate, mark, and protect important trees and associated rooting zones, unique areas (e.g., wetlands), and other areas to be preserved.	Local SUSMP, CalGreen Code, or General Construction Storm Water Permit requirements 4-01, other user-defined BMPs
2.	Site Access Areas (construction entrances, roadways, equipment parking areas)	Stabilize site entrances and access roads if applicable prior to earthwork.	1-07, other user-defined BMPs
3.	Storm Drain/Drainage Inlet Protection	Install inlet protection at down-gradient inlets that project runoff/tracking might impact.	1-06, other user-defined BMPs
4.	Perimeter Sediment Control	Install perimeter sediment controls (silt fence, fiber rolls, etc.) as applicable prior to soil disturbing activities. Install additional runoff control measures during construction as needed.	1-02, 1-03, 1-04, 1-05, other user-defined BMPs
5.	Material and Waste Storage Areas	Prepare staging areas and material storage and disposal areas, as applicable, to reduce run-on and runoff. Install perimeter control, obtain clean-up materials, plastic covers for stockpiles, etc. prior to storing materials on site.	2-01 through 2-08, 1-08, other user-defined BMPs
6	Drainage Control and Run-on Diversion	Install run-on controls to direct run-on around or through the site to minimize erosion in addition to sediment control measures.	4-01 through 4-13, other user-defined BMPs
7.	Earthwork (trenching, excavation, grading, surface roughening, grubbing)	Begin excavation, trenching, or grading after installing applicable sediment and runoff control measures. Install additional control measures as work progresses as needed.	1-01 through 1-08, other user-defined BMPs
8.	Surface Stabilization (temporary and permanent seeding, mulching)	Apply temporary or permanent soil stabilization measures as applicable on all disturbed areas where work is delayed or completed.	4-01 through 4-08, other user-defined BMPs

Table 1 (continued)
BMP SELECTION AND SEQUENCING GUIDE

Step No.	Description	What to Do	BMP Options (see Table 2 for BMP activities)
9.	Construction and Paving (install utilities, buildings, paving)	Implement applicable control practices as work takes place.	3-01 through 3-9, other user-defined BMPs
10.	Final Stabilization and Landscaping	Stabilize open areas as applicable. Remove temporary control measures and install final stabilization controls appropriately (topsoil, trees and shrubs, permanent seeding, mulching, sod, riprap)	3-07, 4-03, 4-04, other user-defined BMPs

Table 2
BMP SELECTION WORKSHEET FOR UTILITY ACTIVITIES

Utility BMP No.	BMP Options	Construction						Maint. and Repair				
		Overhead Electric	Underground Electric	Potholing	Underground Gas	Boring/Directional Drilling	Pipe Spans	Gen. Maint. and Repair	Inspect and Repair	Tree Trimming	Veg. Control	Other
Section 1 Sediment Controls												
Choose from one or more of the following BMP options when applicable:												
BMP 1-01	Scheduling											
BMP 1-02	Silt Fence											
BMP 1-03	Fiber Rolls											
BMP 1-04	Gravel Bag Berm											
BMP 1-05	Sand Bag Barrier											
BMP 1-06	Storm Drain/Drainage Inlet Protection											
BMP 1-07	Tracking Controls											
BMP 1-08	Stockpile Management											
BMP 1-09	Sediment Basin											
BMP 1-10	Sediment Trap											
BMP 1-11	Check Dam											
BMP 1-12	Active Treatment Systems (ATS)											
Other-User Defined	BMP Description:											
Section 2 Waste Management and Material Controls												
Choose from one or more of the following BMP options when applicable:												
BMP 2-01	Material Delivery and Storage											
BMP 2-02	Material Use											
BMP 2-03	Spill Control											
BMP 2-04	Solid Waste Management											
BMP 2-05	Hazardous Materials/Waste Management											
BMP 2-06	Contaminated Soil Management											
BMP 2-07	Sanitary/Septic Waste Management											
BMP 2-08	Liquid Waste/Drilling Fluid Management											
Other-User Defined	BMP Description:											

Table 2 (continued)
BMP SELECTION WORKSHEET FOR UTILITY ACTIVITIES

Utility BMP No.	BMP Options	Construction: Overhead Electric	Construction: Underground Electric	Construction: Potholing	Construction: Underground Gas	Construction: Boring/Directional Drilling	Construction: Pipe Spans	Maint. and Repair: Gen. Maint. and Repair	Maint. and Repair: Inspect and Repair	Maint. and Repair: Tree Trimming	Maint. and Repair: Veg. Control	Maint. and Repair: Other
Section 3 Non-Storm Water Discharge Controls												
Choose from one or more of the following BMP options when applicable:												
BMP 3-01	Dewatering Operations											
BMP 3-02	Paving Operations											
BMP 3-03	Vehicle and Equipment Washing											
BMP 3-04	Vehicle and Equipment Fueling											
BMP 3-05	Concrete/Coring/Saw cutting and Drilling Waste Management											
BMP 3-06	Dewatering Utility Vaults											
BMP 3-07	Over-Water Protection											
BMP 3-08	Paint Removal Control											
BMP 3-09	Temporary Stream Crossing											
BMP 3-10	Clear Water Diversion											
Other-User Defined	BMP Description:											
Section 4 Erosion Control and Soil Stabilization												
Choose from one or more of the following BMP options when applicable:												
BMP 4-01	Preservation of Existing Vegetation											
BMP 4-02	Temporary Soil Stabilization (General)											
BMP 4-03	Hydraulic Mulch											
BMP 4-04	Hydroseeding											
BMP 4-05	Soil Binders											
BMP 4-06	Straw Mulch											
BMP 4-07	Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats											
BMP 4-08	Dust (Wind Erosion) Control											
BMP 4-09	Diversion Berms and Drainage Swales											
BMP 4-10	Velocity Dissipation Devices											
BMP 4-11	Slope Drains											

Table 2 (continued)
BMP SELECTION WORKSHEET FOR UTILITY ACTIVITIES

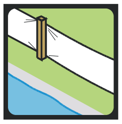
Utility BMP No.	BMP Options	Construction						Maint. and Repair				
		Overhead Electric	Underground Electric	Potholing	Underground Gas	Boring/Directional Drilling	Pipe Spans	Gen. Maint. and Repair	Inspect and Repair	Tree Trimming	Veg. Control	Other
BMP 4-12	Streambank Stabilization											
BMP 4-13	Soil Preparation											
Other-User Defined	BMP Description:											

BMP DETAILS

The previous section provides details for the selection and implementation of BMPs for the most common utility construction activities. Once the BMP objectives are defined, it is necessary to identify the category or categories of BMPs that are best suited to meet each objective.

A category is a grouping of BMPs related in how they prevent pollution. The four categories are:

- **Section 1 – Sediment Controls**
- **Section 2 – Waste Management and Material Controls**
- **Section 3 – Non-Storm Water Discharge Controls**
- **Section 4 – Erosion Control and Soil Stabilization**



Section 1 – Sediment Controls

Why Are Sediment Controls Needed?

Sediment controls are needed to provide a secondary or back-up mechanism to erosion control techniques to prevent sediment discharges from a site. Erosion controls are designed to prevent erosion (the detachment of soil particles from the surface by rain, flowing water or wind), whereas sediment controls are designed to trap soil particles once dislodged by rain, flowing water, or wind. Sediment particles (soil/dust) from construction, operations, and maintenance (construction like) activities can be transported to a different location by wind or water flow. Once these particles have become detached, they can be transported by wind or runoff to water bodies where they can cause damage to aquatic life by burying the animals or plants or reducing oxygen and/or sunlight that is necessary for their survival. Soil particles can also carry other damaging pollutants with them. Displaced sediment from these activities is therefore considered a pollutant by water quality regulatory agencies.

What are Sediment Controls?

Sediment controls include any method that aids in trapping soil particles after they have been detached and moved by wind or water. Sediment controls are usually passive systems that rely on filtering or settling the particles out of the water or wind that is transporting them. The sediment that has accumulated by the BMPs can be redistributed as excess soil on the construction site. Sediment controls are most effective in retaining sediment on site when used in combination with erosion control BMPs. Sediment Controls presented in this Manual include the following:

- BMP 1-01 Scheduling
- BMP 1-02 Silt Fence
- BMP 1-03 Fiber Rolls
- BMP 1-04 Gravel Bag Berm
- BMP 1-05 Sand Bag Barrier
- BMP 1-06 Storm Drain/Drainage Inlet Protection
- BMP 1-07 Tracking Controls
- BMP 1-08 Stockpile Management
- BMP 1-09 Sediment Basin
- BMP 1-10 Sediment Trap
- BMP 1-11 Check Dams
- BMP 1-12 Active Treatment Systems (ATS)

What Scheduling consists of the planning of soil disturbance activities to avoid periods of rain whenever practical.

When Scheduling of soil disturbance activities must be considered year-round.

Where All construction and "construction like" operations and maintenance sites where soil disturbance activities take place.

How Use the following measures as applicable:

- Consider scheduling major soil disturbing activities or activities near environmentally sensitive areas (e.g., adjacent to water bodies) during prolonged periods when no rain is forecast.
- Monitor the weather forecast for seasonable and unseasonable rain events. Obtain weather information from the National Weather Service at
  - www.srh.noaa.gov/
- Print and maintain copies of forecasts to document decisions related to inspections and BMP implementation for projects subject to the CGP.
- Appropriate sediment controls are required year round. Always be prepared to deploy additional erosion and sediment control and soil stabilization BMPs as needed. Off site sediment discharges can occur because of unseasonable rain, vehicle tracking, unanticipated wind, and non-storm water discharges.
- Sequence work to minimize soil-disturbing activities during forecasted rain events.
- Limit disturbed soil area to the amount of acreage that can be protected prior to a forecasted rain event.
- Stabilize disturbed soil areas as soon as practical, and always prior to a forecasted rain event (See Section 4, Soil Erosion BMPs for soil stabilization methods).
- Protect environmentally sensitive areas, such as drainage channels, streams, and natural watercourses.
- When rain is forecast, adjust the construction schedule to implement soil stabilization and sediment controls on all disturbed areas prior to the onset of rain.

Maintenance and Inspection

- Review applicable scheduling and sequencing of construction activities throughout the project or activity to minimize the total area of exposed soil and the exposed soil exposure time.
- Inspect erosion and sediment controls prior to and after each storm event, and routinely throughout the construction and/or clean-up activity. If inspections warrant construction BMP changes, amend the schedule accordingly.

Pictures

Corresponding CASQA Fact Sheet

Fact Sheet EC-1

What

Silt fences are temporary linear sediment barriers made of permeable fabric that lets water through but prevents the majority of sediment from passing through. Silt fences also act by intercepting and slowing the flow of sediment-laden runoff and allowing sediment to settle from the runoff before water leaves the construction site.

When

- Silt fences are designed to intercept sheet flows to moderately concentrated flows.
- Generally, silt fences shall be used in conjunction with soil stabilization source controls up slope (see Section 4) to provide effective control, particularly for steep slopes, and slopes adjacent to water bodies or Environmentally Sensitive Areas (ESAs).
- Consider BMP 1-03 "Fiber Rolls" for minor slopes or perimeter sediment control on flat or slightly sloped areas.

Where

Silt fences are placed:

- Below the toe of exposed and erodible slopes.
- Down-slope of exposed soil areas.
- Around temporary stockpiles.
- Along streams and channels.
- Along the perimeter of a project.
- Consider BMP 1-03 "Fiber Rolls" for small stockpiles and perimeters of areas with shallow slopes.

How

- Construct silt fences with a setback of at least 3 feet from the toe of a slope in areas suitable for temporary ponding or deposition of sediment. Where a 3-foot setback is not practical, construct as far from the toe of the slope as practical.
- Construct the length of each reach (length of fence) so that the change in base elevation along the reach does not exceed one-third of the barrier height; each reach should not exceed 500 feet. The last 6 feet of the reach should be turned up slope.
- The maximum length of slope draining to the silt fence should be 200 feet or less.
- Excavate a trench approximately 6 inches wide and 6 inches deep to place the bottom of the silt fence into, ensuring that is not wider or deeper than necessary.
- Key-in, or bury the bottom of silt fence fabric in the trench and tamp into place. If it is not feasible to trench along the slope contour, use sand bags or backfilling to key in the bottom of the fabric.
- Install fence posts at least 12 inches below grade on the down slope side of trench.

IMPORTANT POINT

- **Silt fences should not be used to divert water. Silt fences should not be considered for installation below slopes steeper than 1:1 (vertical: horizontal) or that contain a high number of rocks or loose dirt clods unless the rocks are removed and erosion and soil stabilization controls (Section 4) are used up slope.**

Maintenance and Inspection

- Repair or replace split, torn, slumping, undercut or weathered fabric. Note that fabric may need to be replaced when installation is required for more than 5 to 8 months due to limited durability.

Maintenance and Inspection (cont.)

- Inspect silt fences prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Remove accumulated sediment when it reaches one third of the barrier height. Removed sediment shall be incorporated in the project at appropriate locations or disposed of in accordance with federal, state and local requirements.
- Silt fences that are damaged and become unsuitable for the intended purpose shall be removed and disposed of and replaced with new silt fence barriers or other applicable control.
- Remove silt fence when no longer needed and after up-gradient areas are permanently stabilized. Fill and compact post-holes and the anchor trench, remove sediment accumulation, and work the surface of the fence alignment to blend with adjacent ground.

Pictures

Silt fence installed with at least a 3 foot setback from the toe of an erodible slope. Note that use is combined with fiber rolls and serves as perimeter control.

Corresponding CASQA Fact Sheet

Fact Sheet SE-1

What

A fiber roll (straw waddle) consists of straw, flax or other similar materials that are rolled and bound into a roll. The fiber roll lets water through but prevents the majority of sediment from passing through. Fiber rolls also act by intercepting and slowing the flow of sediment-laden runoff and allowing sediment to settle from the runoff before water leaves the construction site. In sensitive vegetation areas, only certified weed-free rice straw is to be used.

When

Fiber rolls are used for sheet flow or where flows are slightly to moderately concentrated.

Where

Fiber rolls are generally placed on the face of slopes at regular slope intervals to intercept runoff, reduce flow velocity, release the runoff as sheet flow and provide sediment removal.

- May be used along the top, face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- Fiber rolls are appropriate for perimeter site control or along streams, channels, storm drain inlets, or around stockpiles to intercept sediment-laden storm water and non-storm water runoff.

How

Installation

- Locate fiber rolls on level contours spaced in accordance with the CGP requirements for LUP Type 2 & 3 and Risk Level 2 & 3 sites as follows:

Slope Grade	Spacing (sheet flow length not to exceed)
0-25%	20 feet
25-50%	15 feet
Over 50%	10 feet

- In non-paved areas, stake fiber rolls into a trench that is the width of the roll and one-third the depth of the roll (2- to 4-inch deep trench).
- Drive stakes into fiber rolls at a minimum of 4-foot intervals.
- If more than one fiber roll is placed in a row, fiber rolls should be overlapped and not abutted together.

Removal

- When used in a permanent application, fiber rolls can be left in place.
    - Permanent fiber rolls are typically encased with a biodegradable material.
    - Note that removal can result in greater soil disturbance.
- When used for a temporary application as storm drain inlet protection or stockpile control for example, the fiber rolls should be removed at the completion of the construction cleanup activity in that area.
    - Temporary fiber rolls are typically encased with plastic netting that does not biodegrade.
    - Remove fiber rolls only when up gradient areas are stabilized and/or pollutant sources are no longer a hazard.

How (cont.)

- Remove fiber rolls before vegetation becomes too mature to avoid unnecessary soil and vegetation disturbance.
    - If fiber rolls are removed, collect and dispose of fiber roll and sediment accumulation as appropriate in accordance with federal, state and local requirements. Trapped sediment may be incorporated into the construction site. Fill and compact holes, trenches, depressions, or any other ground disturbance to blend with adjacent ground.
- Note that the cost of disposal of wet fiber rolls may be more expensive than dry fiber rolls.

Maintenance and Inspection

- Repair or replace spilt, torn, unraveling, or slumping fiber rolls.
- Inspect fiber rolls if rain is forecasted and perform maintenance as needed.
- Inspect fiber rolls prior to and after each rain event, and daily during extended rain events throughout the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Do not use fiber rolls containing polyacrylamindade or other flocculants. Use is considered "active treatment" and is subject to ATS requirements of the CGP (see BMP Detail 1-12).

Pictures

Fiber rolls as perimeter control.

Pictures (cont.)

Fiber roll installation on the face of a slope.

Corresponding CASQA Fact Sheet

Fact Sheet SE-5

What

A gravel bag berm consists of at least a single row of gravel bags that are installed end-to-end to form a barrier across a slope to intercept runoff.

When

Use gravel bag berms:

- When needed to reduce storm water flow velocity, release the runoff as sheet flow, and provide some sediment removal.
- Gravel bag berms can also be used when flows are moderately concentrated and when it is desirable to filter sediment in runoff. Gravel bag berms are generally more permeable than sand bags.

Where

- Ditches, swales, and storm drain inlets
- Gravel bag berms are also appropriate for perimeter site control or along streams, channels, storm drain inlets, or around stockpiles to intercept sediment laden storm water and non-storm water runoff.
- Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.
- Gravel bags may be implemented with other BMPs to maximize sediment containment.
- Sand bag barriers should be used in cases where it is desirable to block and pond flows (BMP 1-05 "Sand Bag Barrier").

How

- When used as a linear control for sediment removal:
  - Install along a level contour.
  - Turn ends of gravel bag row up slope to prevent flow around the ends.
  - Generally, gravel bag barriers are used in conjunction with temporary soil stabilization controls up slope to provide effective control.
- When used for concentrated flows:
  - Stack gravel bags to required height. When the height requires 3 rows or more, use a pyramid approach.
  - Upper rows of gravel bags shall overlap joints in lower rows.
- Construct gravel bag barriers with a setback of at least 3 feet from the toe of a slope. Where a 3-foot setback is not practical, construct as far from the toe of the slope as practical.

Maintenance and Inspection

- Perform routine inspections of gravel bag berms prior to and after each storm event, and daily during extended rain events throughout the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Reshape or replace gravel bags as needed.
- Repair washouts or other damage as needed. Note that bags may need to be replaced when installation is required for more than 6 months due to limited durability.
- Inspect gravel bag berms for sediment accumulations and remove sediment when accumulation reaches one-third of the berm height. Removed sediment shall be incorporated in the project at appropriate locations or disposed of in accordance with federal, state and local requirements.

Maintenance and Inspection (cont.)

- Remove gravel bag berms when no longer needed and when feasible, recycle gravel fill. Remove sediment accumulation, and clean, re-shape, and stabilize the area. Removed sediment shall be incorporated in the project at appropriate locations or disposed of in accordance with federal, state and local requirements.

Pictures

Gravel bags and fiber rolls used as perimeter sediment controls.

Gravel bags used as perimeter control.

Corresponding CASQA Fact Sheet

Fact Sheet SE-6

What

A sand bag barrier is a temporary linear sediment barrier consisting of at least one row high of sand bags placed end-to-end, designed to intercept and slow sediment-laden storm water and non-storm water runoff. Sand bag barriers allow sediment to settle from runoff before water leaves the construction site. Sand bag barriers tend to block and pond storm water flows.

When

- During construction or operation and maintenance activities in streambeds when the contributing drainage area is small.
- To capture and detain non-storm water flows.
- When site conditions or activity sequencing require adjustments or relocation of the barrier to meet changing field conditions and needs during construction.
- To temporarily close or continue broken, damaged or incomplete curbs.

Where

Sand bag barriers are used:

- To divert or direct flow away from disturbed slopes or create a temporary sediment basin.
- Where flows are moderately concentrated, such as ditches, swales, and storm drain inlets to divert and/or detain flows.
- Along the perimeter of a site, vehicle and equipment fueling and maintenance areas, chemical storage areas, or stockpiles.
- Below the toe or down slope of exposed and erodible slopes.
- Parallel to streams, channels, and roadways.
- Across channels to serve as a barrier for utility trenches or provide a temporary channel crossing for construction equipment, or to reduce stream impacts.
- Caution – do not use sand bag barriers in traffic areas or other areas where potential flooding is possible. Consider use of BMP 1-03 "Fiber Rolls" or BMP 1-04" Gravel Bag Berms."

How

- When used as a linear control for sediment removal:
  - Install along a level contour.
  - Turn ends of sand bag row up slope to prevent flow around the ends.
  - Generally, sand bag barriers shall be used in conjunction with temporary soil stabilization controls up slope to provide effective control.
- When used for concentrated flows:
  - Stack sand bags to required height. When the required height is three rows or more, use a pyramid approach. Upper rows of sand bags shall overlap joints in lower rows.
  - Construct sand bag barriers with a setback of at least 3 feet from the toe of a slope. Where a 3-foot setback is not practical, construct as far from the toe of the slope as practical.

Maintenance and Inspection

- Perform routine inspections of sand bag barriers prior to and after each storm event, and daily during extended rain events throughout the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP. Repair washouts or other damages as needed.
- Note that bags may need to be replaced when installation is required for more than 6 months due to limited durability.
- Inspect sand bag barriers for sediment accumulations and remove sediments when accumulation reaches one-third the barrier height.
- Remove sand bags when no longer needed and when feasible, recycle fill. Remove sediment accumulation, and clean, re-grade, and stabilize the area. Incorporate removed sediment at appropriate project locations or disposed of in accordance with federal, state and local requirements.

Pictures

Sand bags used as perimeter control.

Corresponding CASQA Fact Sheet

Fact Sheet SE-8

What

A BMP or a combination of BMPs used at storm drains or other drainage inlets to protect against the discharge of sediment-laden storm water and non-storm water runoff from construction or operational and maintenance activities. The BMP slows or ponds the storm water flow, giving the sediment time to settle out before discharge to the storm drain.

When

This BMP is required on all construction projects and operation and maintenance sites when sediment laden surface runoff may enter a storm drain inlet and/or drainage to watercourses. Do not construct when runoff will result in ponding into road traffic or onto erodible surfaces or slopes, or overflow onto the sidewalk.

Where

At downstream storm drain and/or drainage inlets that have the potential to be impacted by construction or "construction like" operation and maintenance activity, site storm water run-off, or non-storm water discharges.

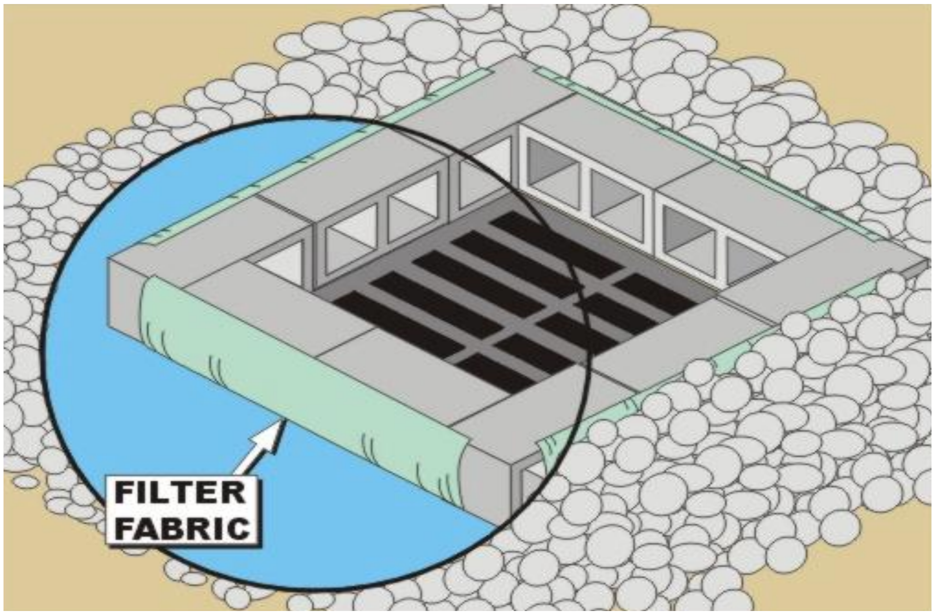
How

- Identify all downstream storm drain inlets or drainages that have the potential to receive runoff or non-storm water discharges from construction activities.
- Where a storm drain or drainage inlet is on or at the bottom of a slope, a series of small check dams (i.e., gravel bag berms) constructed at intervals along the slope may be required to slow the runoff. See BMP 1-11.
- Select appropriate protection and construct inlet protection based on the configuration of inlets at the site.
- Some municipalities require removal of BMPs from storm drains within 72 hours of a rain event (e.g., City of San Diego requires removal of inlet protection in the case that 0.25 inch or greater of rain is predicted). Consult with your project Field Environmental Representative for local requirements.
- Remove inlet protection devices at the end of the construction period, or when the inlet can no longer be impacted by the project or activity.

Maintenance and Inspection

- Perform routine inspections of BMPs prior to and after storm event, and daily during extended rain events throughout the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- During inspections:
    - Inspect bags, silt fence, or filter fabric for holes, gashes, and snags.
    - Check gravel bags for proper arrangement and displacement.
    - Remove the sediment behind the barrier when it reaches one-third of the barrier height. Removed sediment should be incorporated in the project or disposed of in accordance with federal, state and local requirements.

Pictures



Block and gravel-type inlet protection.

Inlet protection that blocks flow, preventing non-storm water discharges from entering drain.

Pictures (cont.)

Gravel bag inlet protection.

Inlet protection using fiber rolls and filter fabric.

Corresponding CASQA Fact Sheet

Fact Sheet SE-10

What

Tracking controls consist of constructed/manufactured steel plates (rumble plates) or gravel. Tracking controls reduce offsite tracking of sediment and other pollutants by providing a stabilized entrance at defined soil disturbance activity site entrances and exits with materials that aid in removing sediment from vehicles, especially their tires or tracks. Controls can also consist of providing methods to clean-up sediment or other materials to prevent them from entering a storm drain, such as sweeping or vacuuming. Tracking controls can also include implementing tire washing.

When

- Stabilized entrances/exits should be implemented on each soil disturbance site having a defined entrance/exit consisting of soil which terminates into a paved roadway or substantial paved surface. Stabilized entrances/exits are in addition to other applicable BMPs.
- Daily sweeping or vacuuming should be implemented when sediment is tracked from the site onto public or private paved roads, typically at points of site exit.
- Install and implement tire washing when the above methods are not adequately controlling track-out.

Where

Use stabilized entrances and/or sweeping (and tire washing, if needed) at construction and "construction like" operations and maintenance activity sites:

- where dirt or mud is tracked onto public roads;
- adjacent to water bodies;
- where poor soils are encountered, such as soils containing clay; and
- where dust is a problem during dry weather conditions.

How

Stabilized Entrances

- Limit the points of entrance/exit to the construction or operations and maintenance site by designating combination or single purpose entrances and exits. Require all employees, subcontractors and others to use them. Limit speed of vehicles to control dust.
- Where feasible, grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment-trapping device before discharge (see BMP 1-10).
- Design stabilized entrance/exit to support heaviest vehicles and equipment.
- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions.
- Use of constructed or constructed/manufactured steel plates with ribs for entrance/exit access is allowed.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 inches deep, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 inches but smaller than 6 inches shall be used.

Street Sweeping and Vacuuming

- Inspect potential sediment tracking locations routinely.
- Visible sediment tracking should be swept or vacuumed as needed. Manual sweeping is appropriate for small jobs.

How

(cont.)

- For larger projects, it is preferred to use mechanical sweeping methods that collect removed sediment and material.
- If not mixed with debris or trash, incorporate the removed sediment back into the project or dispose of in accordance with federal, state and local requirements.

Tire Washing

- Design wash rack to support the heaviest traffic loads.
- Provide a turnout or doublewide exit to avoid traffic from entering through the tire washing area.
- Design a drainage ditch to route all rinse or wash waters from the tire washing area to a sediment trapping device (see BMP 1-10) to prevent any wash runoff from leaving the site.
- Hoses should be equipped with automatic shutoff nozzles.

Maintenance and Inspection

Stabilized Entrances

- Inspect routinely for damage and assess effectiveness. Remove sediment and repair if the stabilized entrance/exit is clogged with sediment.
- Perform routine inspections of BMPs, prior to and after storm events, and daily during extended rain events throughout the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the CGP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Where tracking has occurred on roadways, sweeping should be conducted the same day. Water should not be used to wash sediment off the streets, unless necessary. If water is used, it must be captured, preventing sediment-laden water from running off the street or site.
- Keep all temporary roadway ditches clear.

Street Sweeping and Vacuuming

- Inspect silt fences prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect all site paved access roads daily and remove any sediment or other materials on the roads by vacuuming or sweeping daily, as needed, and prior to any rain event in accordance with the CGP Risk Levels 2 & 3 requirements.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- After sweeping is finished, properly dispose of sweeper wastes.

Tire Washing

- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect rack and/or sediment trap system routinely for damage and assess effectiveness. Remove accumulated sediment to maintain system

performance.

Pictures

Manufactured metal plates knock dirt off vehicle tires before exiting a site.

Drive through wheel wash before exiting a site.

Corresponding CASQA Fact Sheet

Fact Sheets TC-1, TC-2, TC-3, and SE-7

What Stockpile management consists of placing temporary BMPs, such as secured covers, over the piles, and/or placing berms, silt fences, fiber rolls, sand/gravel bags or straw bale barriers around the perimeter of stockpiles. Soil stabilizers/binders may also be used to augment stockpile management (BMP 4-05).

When Use this BMP when construction projects or operation and maintenance activities require stockpiled soil, waste materials, and/or paving materials. Protection of stockpiles must be implemented whenever there is a potential for transport of materials by a water source or by wind.

- Construction and waste material stockpiles require protection from rain and wind at all times unless actively being used (protect during non-activity). Projects with SWPPPs require protection at the end of each day.

Where Stockpiles at construction and "construction like" operation and maintenance activity sites, protecting against both run-on and run-off.

How One or more of the following options may be used to manage stockpiles and prevent stockpile erosion and sediment discharges for storm water and non-storm water runoff/run-on.

  - Stockpile may be returned to the excavation if precipitation is forecast.
  - Sufficient BMP materials for temporary stockpile protection should be available onsite. Select cover materials or methods based on anticipated duration.
  - Protect stockpiles from storm water run-on and sediment runoff from the stockpiles using a temporary perimeter sediment barrier such as berms, silt fences, fiber rolls, sand/gravel bags, or straw bale barriers, as appropriate.
  - Cover stockpiles to prevent erosion. Note that the CGP requires that inactive stockpiles be covered. Where feasible, cover/protect stockpiles using a soil binder, according to BMP 4-05. Alternately, secure stockpiles with covers such as Visqueen weighted down with gravel bags, or sand bags. Plastic should be properly re-used or disposed of properly. Note the CGP discourages the use of plastic materials for cover when more sustainable alternatives can be used.
  - Stockpiles may be hauled off or temporarily stored in a protected location off site.

- Keep stockpiles organized and surrounding areas clean.
- Protect storm drain inlets, watercourses, and water bodies from stockpiles, as appropriate.
- Implement dust control practices as appropriate on all stockpiled material.

- **Stockpiles should be covered, stabilized, or protected prior to the onset of precipitation.**

Maintenance and Inspection

- Repair and/or replace covers, and perimeter containment structures as needed.
- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.

Pictures

Stockpile covered with plastic and secured with large rocks.


Silt fence used for stockpile perimeter control.

Corresponding CASQA Fact Sheet

Fact Sheet WM-3

What

Sediment basins are temporary basins formed by excavation or by constructing an embankment to temporarily detain sediment-laden runoff, allowing sediment to settle out before water leaves the site. The CGP specifies that sediment basins be designed per the CASQA fact sheet SE-2, therefore, this BMP provides general guidance and the CASQA handbook reference.

When

Sediment basins are appropriate:

- If sediment-laden water may enter a drainage system or watercourse.
- If areas are disturbed during the rainy season, in association with dikes, temporary channels, and pipes to convey runoff from disturbed areas.
- To construct before land disturbance, when feasible.
- In conjunction with erosion controls.

Where

Sediment basins are suitable on larger projects with sufficient space for the basin, and should be considered:

- Where maintenance is possible year-round.
- Within property limits, and where failure will not result in loss of life, building damage, or interruption of public roads or utilities.
- At the outlet of disturbed areas draining generally between 5 and 75 acres, evaluated on a site-specific basis.
- Where post-construction detention basins are required.

How

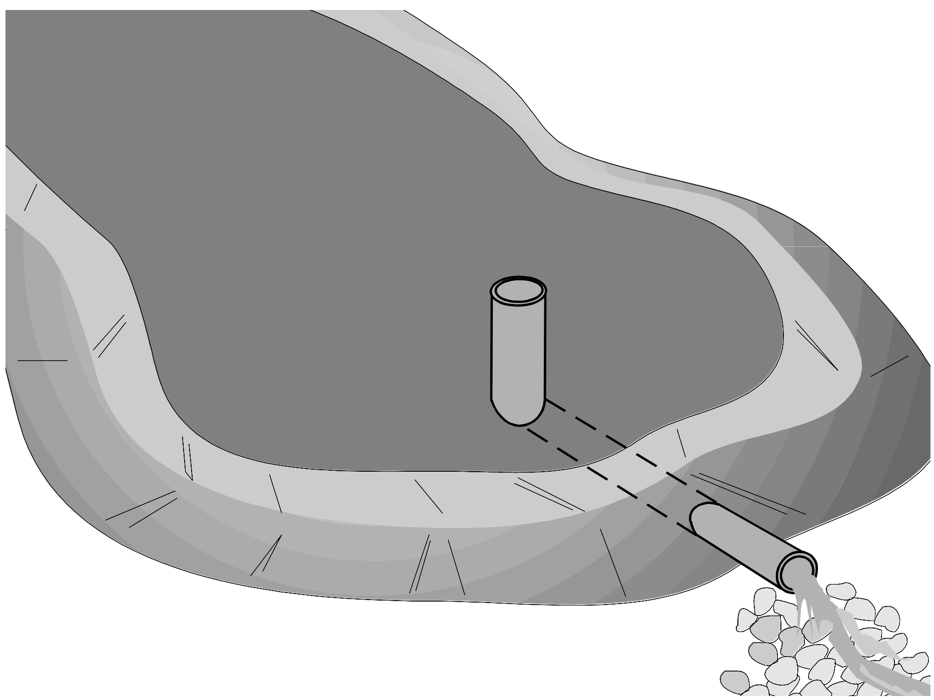
Design the sedimentation basin in accordance with CASQA fact sheet SE-2.

- In general, the basin depth must be no less than 3 feet, not including freeboard, which includes a sediment storage zone and a settling zone of at least 1 and 2 feet deep, respectively.
- Include features to accommodate overflow or bypass flows that exceed the design storm event.
- Utilize rock, vegetation, or other erosion control measures to protect the basin inlet, outlet, and slopes against erosion.
- Continuous fencing should be provided around the sedimentation basin to prevent unauthorized entry.

Maintenance and Inspection

- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect basin banks for seepage and structural soundness.
- Check inlet and outlet structures, spillway, and fencing for damage or obstructions. Repair damage and remove obstructions as needed.
- Remove accumulated sediment when it reaches 1/2 of the basin height or in accordance with the SWPPP requirements. Removed sediment shall be incorporated into the project appropriately or disposed of in accordance with federal, state and local requirements.
- Remove accumulation of any vegetation during every inspection.
- Remove standing water from the basin within 72 hours after accumulation to prevent the production of mosquitoes.
- Completely remove basin when no longer needed. Remove sediment accumulation. Fill and compact excavation, any fencing post-holes and anchor trench, and blend the surface with the adjacent ground.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet SE-2

What

Sediment traps are small, temporary containment areas where sediment-laden runoff is detained, allowing sediment to settle from the runoff before water leaves the site. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area, and usually have a gravel outlet. Sediment traps only remove large and medium-sized soil particles and require upstream erosion control.

When

Sediment traps are appropriate:

- If the drainage area is less than 5 acres.
- If sediment-laden water may enter a drainage system or watercourse.
- Construction or operation and maintenance activity occurs in small drainage areas with no unusual drainage features, and short-duration construction activities.
- To construct before land disturbance, when feasible.
- In conjunction with upstream erosion controls.

Where

Sediment traps are suitable on sites with sufficient space to allow for infiltration and sediment settling, and should be considered:

- Outside the area being graded, but as near as practical to sediment producing areas, with access for maintenance.
- At the perimeter of a site, at one or more locations where sediment-laden runoff is discharged offsite, to a storm drain or watercourse.
- Around or upslope from storm drain inlet protection measures.
- Within property limits and where failure will not result in loss of life, building damage, or interruption of public roads or utilities.

IMPORTANT POINT

- **Should not be located in streams unless properly permitted with regulatory agencies. Consult with the Field Environmental Representative.**

How

- Design the sediment trap per referenced engineering standards or local grading ordinance.
- Trap side slopes should be 1:3 (vertical: horizontal) or flatter.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 yd^3/acre and 33 yd^3/acre of contributing drainage area, respectively, based on 0.5 inch of runoff volume over 24 hours. Larger or multiple traps may be required to accommodate specific rainfall, soil, or site conditions.
- Traps with an impounding levee greater than 4.5 feet tall, measured from the lowest point of the impounding to the highest point of the levee, and traps capable of impounding more than 35,000 ft^3, should be designed by a California Registered Civil Engineer.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 foot below the top of embankment.
- When a crushed stone outlet is used, the crushed stone or gravel should meet AASHTO M43, size No. 2 or 24, or its equivalent.

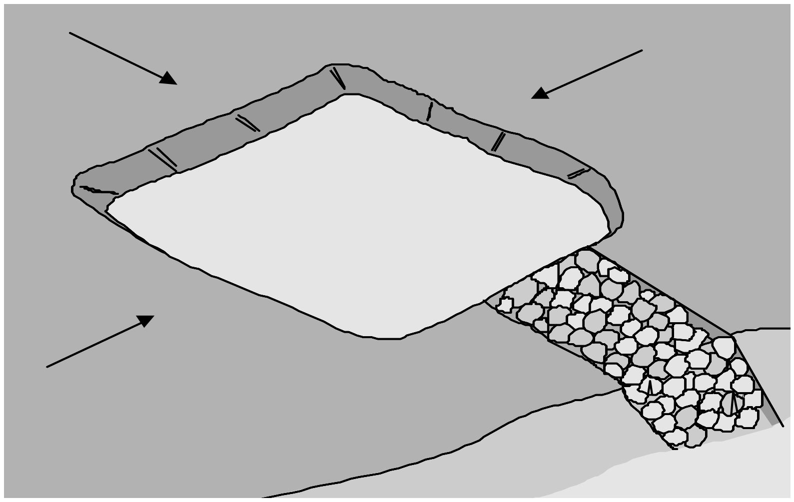
How (cont.)

- Clear any vegetation under the embankment and pool area.
- The compacted embankment fill material must be free of roots, vegetation, oversize, or other objectionable material.
- When a riser is used, all pipe joints must be watertight, and at least the top 2/3 of the riser should be perforated with 0.5-inch diameter holes spaced 8 inches vertically and 10 to 12 inches horizontally.
- Utilize rock, vegetation, or other erosion control measures to protect the trap outlets against erosion.
- Fencing should be provided around the trap to prevent unauthorized entry.

Maintenance and Inspection

- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect trap banks for seepage and structural soundness.
- Inspect outlet structures, spillway, and fencing for any erosion, damage, or obstructions. Repair damage and remove obstructions as needed.
- Remove accumulated sediment when it reaches one third of the trap capacity. Removed sediment shall be incorporated in the project appropriately or disposed of in accordance with federal, state and local requirements.
- Remove accumulation of any vegetation during every inspection.
- Water suitable for mosquito production may stand in the sediment trap, particularly if subjected to daily non-storm water flows. Remove standing water from the trap 72 hours after accumulation.
- Remove trap when no longer needed. Remove sediment accumulation, fill and compact excavation, any fencing post-holes, and blend the surface with adjacent ground.
- BMPs that require dewatering shall be continuously attended during dewatering. Dewatering BMPs shall be implemented at all times during such activities.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet SE-3

What Check dams are small barriers constructed of rock, logs, gravel bags, sandbags, fiber rolls, or other suitable materials, placed across a swale or drainage ditch. Check dams create small pools and reduce the effective slope of the channel, reducing scour and erosion by reducing flow velocity and increasing residence time within the channel. Check dams promote sediment trapping.

When Check dams are appropriate:

- If sedimentation should be promoted behind the dam.
- If erosion protection is desired in small intermittent channels and temporary swales.
- During the establishment of grass linings in drainage ditches or channels.
- If grade control is desired or required.

Where Check dams should be considered:

- In small open channels that drain 10 acres or less.
- In channels to reduce slope and storm water runoff velocities.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant lining.

IMPORTANT POINT

Check dams should not be used:

- **In streams or in channels with flow between storm events.**
- In channels that are already grass-lined, unless erosion potential or sediment-laden flow is expected. Installation of check dams may damage vegetation.

How

- Do not construct check dams with straw bales or silt fence, since concentrated flows quickly wash out these materials.
- Check dams reduce the capacity of the ditch or swale. Alternative BMPs or an increased swale or ditch size may be necessary or the size of the ditch or swale may need to be increased to prevent overtopping.
- Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center section of the dam should be lower than the edge sections (at least 6 inches), acting as a spillway, so that the check dam will direct flows to the center of the ditch or swale.
- The check dam should be installed along a level contour and should completely span the ditch or swale to prevent washout.
- Install the first check dam approximately 16 feet from the outfall device and at regular intervals based on slope gradient and type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- For multiple check dam installation, backwater from a downstream check dam should reach the toe of the upstream check dam.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.

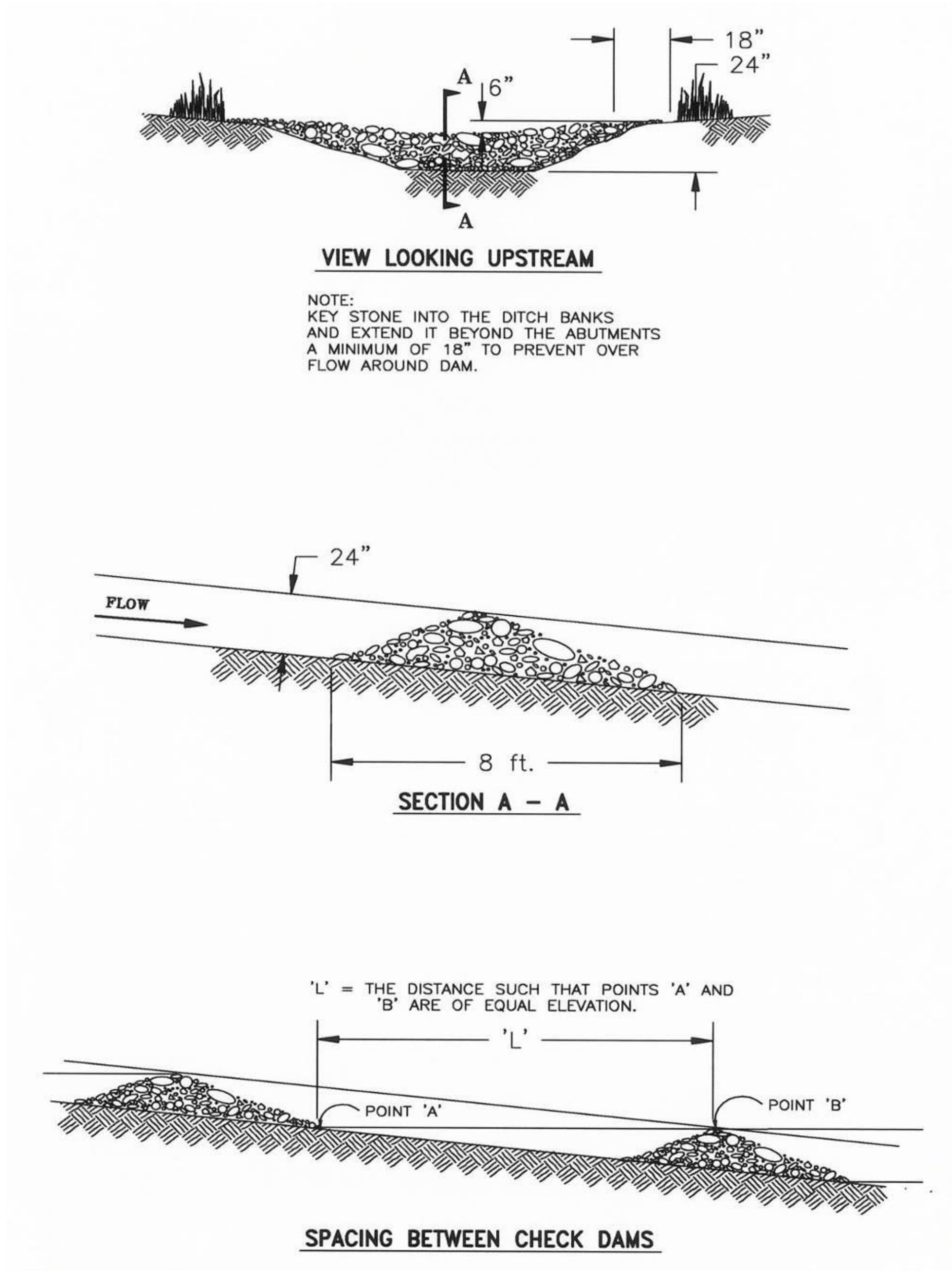
How (cont.)

- Rock check dams are usually constructed of 8 to 12 inch rock placed individually by hand or mechanically, but never dumped. The rock used should be large enough to stay in place given the expected channel flow. Abutments should be extended 18 inches into the channel bank. Rock can be graded such that smaller diameter rock (2 to 4 inches) is located on the upstream side of larger rock, increasing residence time.
- Log check dams are usually constructed of 4 to 6 inch diameter logs installed vertically, and embedded at least 18 inches into the soil, and can be bolted or wired.
- See BMP 1-03 for installation of fiber roll check dams. Fiber rolls should be trenched in, backfilled, and firmly staked.
- Gravel bag and sand bag check dams are constructed by stacking bags across the ditch or swale. Gravel bags and sand bags used to construct check dams should conform to the requirements of BMP 1-04 and 1-05, respectively. Tightly abut bags and stack in a pyramid fashion no higher than 3 feet. Upper rows shall overlap joints in lower rows.
- Manufactured products used to construct check dams should be installed in accordance with the manufacturer's instructions, and typically requires trenching or anchoring.
- If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured, unless the slope of the swale is greater than 4 percent.

Maintenance and Inspection

- Check dams require extensive maintenance following high-velocity flows.
- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Replace missing, damaged, or degraded rock, bags, rolls, etc.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Sediment can be re-suspended during subsequent storms or removal of the check dam. Remove accumulated sediment when it reaches 1/3 of the barrier height, and prior to permanent seeding or soil stabilization. Removed sediment shall be incorporated in the project at appropriate locations or disposed of in accordance with federal, state and local requirements.
- Water suitable for mosquito production may stand behind check dams, particularly if subjected to daily non-storm water flows. Remove standing water from the dam 72 hours after accumulation.
- Remove check dam and accumulated sediment when no longer needed.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet SE-4

What

Active Treatment Systems (ATS) reduce turbidity of runoff by introducing chemicals to storm water through direct dosing or an electrical current to enhance flocculation, coagulation, and sediment settling. Coagulants and flocculants include inorganic salts and polymers which enhance sediment settling and removal and reduce turbidity. The CGP has specific requirements for ATS. Only general guidance for ATS is provided in this BMP; additional details are provided in the CASQA Handbook.

Limitations:

IMPORTANT POINT

- **Specific permit requirements or mitigation measures such as RWQCB 401 Certification, U.S. Army Corps of Engineers 404 permit, and approval by the California Department of Fish and Game supersede the guidance in this BMP.**
- If numerical water quality standards are mentioned in any permits, testing and sampling may be required. Streams listed as 303(d) impaired for sediment, silt, or turbidity, are required to conduct sampling to verify that there is no net increase in sediment load due to construction activities.

When

ATS should be used when a rigorous combination of drainage control, erosion control, and sediment control BMPs are not effective or are not anticipated to be effective based on site soil types (e.g., fine grained or highly erosive soils), proximity to sediment-sensitive receiving waters, and/or other site constraints. Phasing and limiting active areas of disturbance should be considered prior to use of an ATS.

Where

ATS should be considered where turbid discharges to sediment and turbidity sensitive waters cannot be avoided using traditional BMPs.

How

IMPORTANT POINT

- **ATS should be implemented in accordance with the guidance provided in the CASQA Handbook.**
- **Dischargers choosing to utilize chemical treatment in ATS must also follow all guidelines of the CGP Attachment F – Active Treatment System Requirements.**

Maintenance and Inspection

- ATS must be operated and maintained by experienced personnel meeting CGP training requirements at all times during treatment operations. Visual monitoring for proper performance shall be performed daily and recorded in a data log. The project data log shall include the name, phone number, and training documentation of the person responsible for operating and monitoring ATS.
- Requirements for ATS shall include but are not limited to operational and compliance monitoring, toxicity monitoring for batch and flow-through treatments, numeric effluent limit compliance, operator training, implementation of standard BMPs, and proper sediment removal and disposal.

Pictures

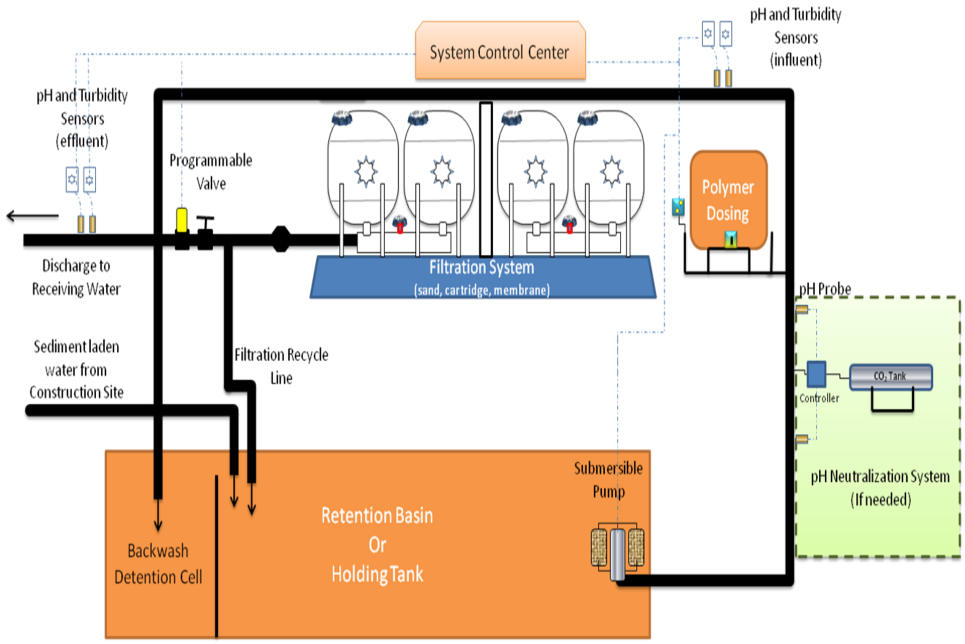
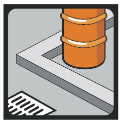


Figure has been adapted from Port of Seattle response to Washington Dept. of Ecology Action Order 2948

Corresponding CASQA Fact Sheet

Fact Sheet SE-11



Section 2 – Waste Management and Material Controls

Why Are Waste Management and Material Controls Required?

Federal, state and local laws, regulations, ordinances and permits prohibit the discharge of contaminated storm water to storm drains, drainages, and surface waters. Pollutants such as litter, paint, solvents, fuel, lubricants and demolition wastes, can be transported by runoff from a construction site. These BMPs address pollutants associated with material use and waste management to ensure that all pollutants are properly managed and are not discharged to storm drains, drainages, and surface waters.

What are Waste Management and Material Controls?

Waste Management and Materials Controls are source control BMPs that reduce or prevent contact between wastes and/or materials and storm water. Waste Management and Materials Controls presented in this Manual include the following:

- BMP 2-01 Material Delivery and Storage
- BMP 2-02 Material Use
- BMP 2-03 Spill Control
- BMP 2-04 Solid Waste Management
- BMP 2-05 Hazardous Materials/Waste Management
- BMP 2-06 Contaminated Soil Management
- BMP 2-07 Sanitary/Septic Waste Management
- BMP 2-08 Liquid Waste/Drilling Fluid Management

What Material Delivery and Storage Controls are procedural BMPs controlling the delivery and storage of construction materials, supplies and wastes so that storm water run-on and run-off and non-storm water discharges do not contact the material or wastes.

When This BMP is applicable when it is necessary to store materials at a construction or operations and maintenance site, and does not apply to materials and supplies stored on trucks that are driven on site and off site daily.

Where All construction or operations and maintenance activity sites where construction material is delivered or stored and has the potential to be contacted by storm water.

How Use the following BMP measures as appropriate:

- Only store the minimum amount of material that is needed for the job.
- Locate storage areas away from storm drain inlets, drainage systems, and watercourses to prevent storm water run-on from reaching the materials.
- If practical, store materials in enclosed storage containers such as cargo containers.
- Store materials on impervious surfaces or use plastic groundcovers and berms on bare soil to prevent spills or leakage from contaminating the ground.
- For known hazardous materials, keep materials covered using plastic or other waterproof materials.
- Store chemicals in water tight containers with appropriate secondary containment systems or in a storage shed to prevent contaminated run-off/run-on from leaving storage areas.
- Keep an adequate supply of spill kit materials nearby.
- Ensure that qualified personnel are available when hazardous materials are delivered to ensure proper delivery and storage in a designated area.
- Material Safety Data Sheets (MSDS) should be made available on-site for all materials stored that have the potential to come in contact with storm water.
- When a storage area is no longer needed, return it to original condition.
- Bagged materials such as cold patch, concrete mix, and other materials with the potential to pollute runoff should be placed on pallets and covered during non-working days and prior to and during rain events.

Maintenance and Inspection

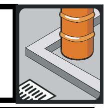
- Repair or replace covers, containment structures, or perimeter controls as needed to ensure proper function.
- Perform Routine BMP inspections of labels on containers and designated delivery and storage areas.
- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.

Pictures

Materials are covered and neatly stored within a curbed area.

Corresponding CASQA Fact Sheet

Fact Sheet WM-1



What Material Use is a procedural BMP that controls the amount or use of materials, chemicals and/or hazardous substances stored onsite and minimizes their potential for contact with storm water run-on or runoff or by non-storm water discharges.

When Apply the Material Use BMP when the following materials are used or prepared on site:

- Pesticides (herbicides, insecticides, and biocides).
- Fertilizers and soil amendments.
- Detergents.
- Petroleum products such as fuel, oil, and grease.
- Asphalt and other concrete components.
- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds.
- Mastic, pipe wrap, primers, and paint.
- Concrete compounds.
- Welding material.
- Other materials that may be detrimental if released to the environment.

Where All construction and operations and maintenance activity sites that utilize the above materials.

How

- Only use products or materials onsite that have been approved through the SDG&E Product Approval process.
- Reduce or eliminate use of hazardous materials on site when practical. Contact your Field Environmental Representative for additional information.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Thoroughly dry empty latex paint cans, used brushes, paint rags, absorbent materials, and drop cloths. These dry wastes may be disposed of with other construction debris.
- When possible, mix paint indoors, otherwise use secondary containment structures. Do not clean paintbrushes or rinse paint containers into a street, gutter, storm drain, sanitary sewer or watercourse.
- Dispose of any paint thinners, residue, and sludge that cannot be recycled as hazardous waste (see BMP 2-05). For water-based paint, clean brushes to the extent practical, and rinse into a concrete washout pit or temporary sediment trap. Do not allow liquid to discharge to a storm water conveyance system. For oil-based paints, clean brushes to the extent practical and filter and reuse thinners and solvents.
- If possible, recycle residual paints, solvents, non-treated lumber, and other materials.

IMPORTANT POINT

- **Do not over-apply fertilizers, pesticides, and soil amendments. Prepare only the amount needed. Strictly follow the recommended usage instructions.**

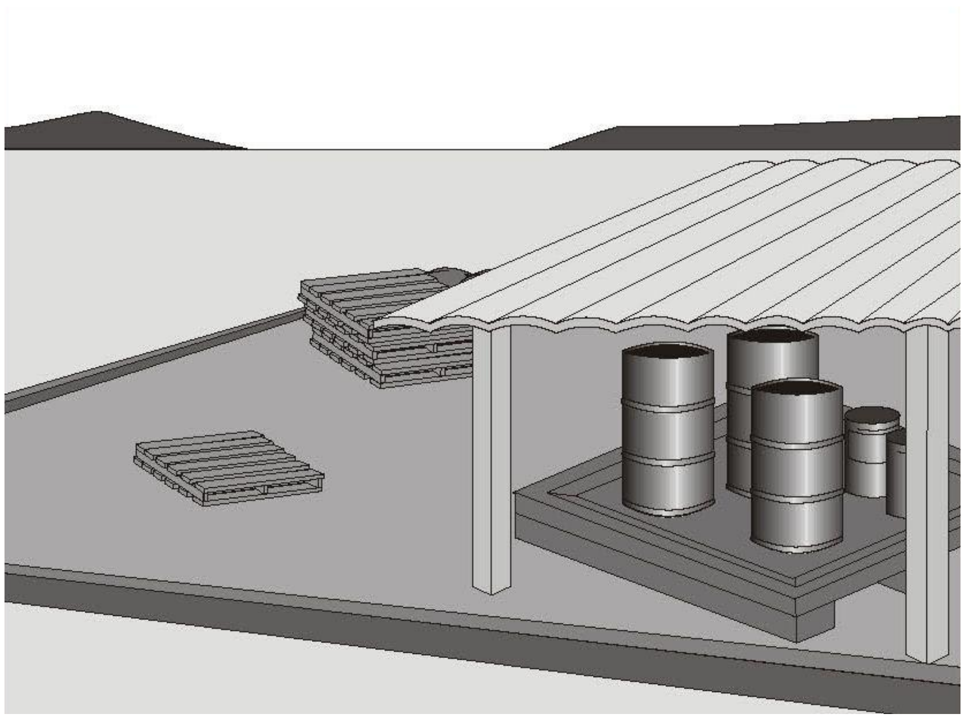
How (cont.)

- For termiticide applications (termite control pesticide) refer to CASQA Fact Sheet WM-2 "Material Use." Note that termiticide can only be applied when it is done in accordance with all applicable federal, state and local labeling requirements and in no case shall it be applied in a manner that would result in either a direct or indirect (e.g., drift) discharge to waters of the US or state.
- Keep an ample supply of spill cleanup material near use areas. Instruct employees in spill cleanup procedures.

Maintenance and Inspection

- Spot-check employees and contractors regularly throughout the job's duration to ensure appropriate practices are being employed.
- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable).

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet WM-2

What

Spill Control is a procedural BMP used to control, contain, and clean-up spills on site so that storm water run-on and runoff and non-storm water discharges do not become contaminated.

When

This BMP applies to all personnel present at construction and operations and maintenance activity sites at all times. Spill control procedures are implemented anytime chemicals (liquid or solid form) and/or hazardous materials and/or wastes are handled, used or stored. A single handling, use, or storage of a hazardous material or waste is sufficient to trigger this requirement. Such substances may include, but are not limited to fuels, lubricants, solvents, fertilizers, pesticides, herbicides, soil binders, coolants, paints, and sewage.

To the extent that work can be accomplished safely, spills of materials or chemicals shall be contained and cleaned up immediately.

Where

All construction and operations and maintenance activity sites where chemicals and/or hazardous materials and/or wastes are handled, used, or stored.

How

- Install and maintain spill control and cleanup kits in areas where any chemicals and/or hazardous materials and/or waste are handled, used and/or stored.
- Construction Supervisor, Crew Foreman, or Facility Supervisor and sufficient onsite personnel should be trained in spill control to address potential spills on the site.
- Only staff trained on spill response procedure should be used to control spill.
- If the spill is a threat to life or the environment, or other emergency situation where emergency medical support, fire department response, or outside assistance is needed, ***immediately*** call the **911** Operator and the local emergency response agency (usually the local fire department). Then, promptly call **Service Dispatch (Trouble) @ (619) 725-5100** and your supervisor.
- For all spills ***immediately*** notify the acivity and site supervisor ***and***/or the Field Environmental Representative and describe the spill and current situation. The Field Environmental Representative will make any required regulatory agency notifications per Environmental Standard (ES) G7841 and the Company's Release Reporting Scenario Guidance available on the Environmental Services Department website.
- If possible, and if you have proper training and personal protective equipment, stop the flow of the spill. If it can be done safely, contain the spill to a confined area. Containment may be able to be accomplished with:
    - Earthen berms
    - Sand bags
    - Absorbent booms
    - Absorbent socks

  Containment material on site as part of the Spill Kit should reflect site characteristics. For guidance, request assistance from the Field Environmental Representative.
- To the extent that it doesn't compromise cleanup activities, spills shall be covered and protected from storm water run-on/-off during rain events.

How (cont.)

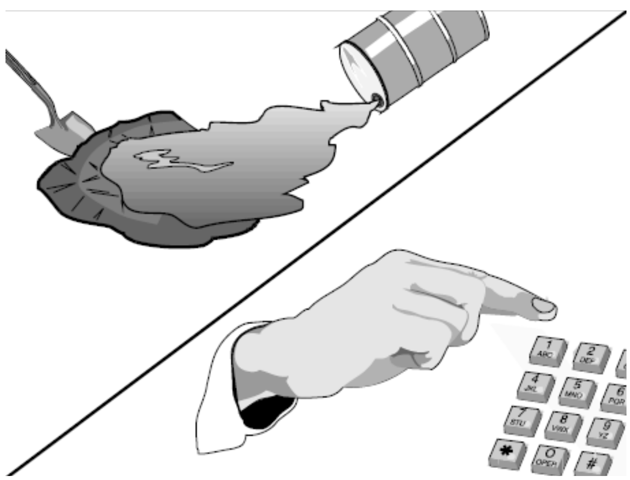
- Immediately clean the impacted area, and properly dispose of any impacted materials.
  - Spills shall not be buried, except as necessary for immediate interim containment purposes. Spilled material and impacted burial material must be removed as soon as possible after proper control and containment and properly disposed of.
  - Use absorbent materials on spills to thoroughly clean up the material to the maximum extent possible. Spills shall not be diluted with water or other liquid for purposes of mitigating the spill (the solution to pollution is not dilution). When it is necessary to use water or other liquid for final cleaning and decontamination of a spill, the water or other liquid shall not be allowed to enter storm drain inlets, drainages, or watercourses, and shall be collected and disposed of properly. Coordinate disposal of these wastes with the Field Environmental Representative.

    Used clean up materials, contaminated materials, and recovered spill material shall be stored and disposed of in accordance with federal, state and local regulations and BMP 2-05 "Hazardous Materials/Waste Management."

Maintenance and Inspection

- Perform routine inspections to verify that spill control clean-up materials are located near material storage, unloading, and use areas prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable).

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet WM-4

What

Solid Waste Management is a procedural BMP used to minimize site non-hazardous solid waste generation, and control the contact of site non-hazardous solid waste with storm water or non-storm water runoff.

Examples of potential solid wastes requiring management control BMPs include, but are not limited to:

- Concrete, cement, asphalt rubble, masonry brick/block.
- Vegetation debris, general trash, and materials used to transport and package construction materials.
- Steel and scrap metals, pipe, electrical cuttings and equipment parts.
- Hazardous Materials/Waste Management is covered in BMP 2-05.

When

During all phases of construction or operations and maintenance activities

Where

These BMPs should be used on all construction projects and operations and maintenance activities that generate solid waste.

How

- Practice good housekeeping and keep site clean.
- Use dry methods for site cleanup such as sweeping, vacuuming and hand pick-up.
- Designate a waste storage area on site. If a designated waste storage area is not feasible, remove wastes from the site regularly.
- Prohibit littering by employees, contractors and visitors.
- Trash receptacles with lids or weatherproof covers should be available on site and/or on construction vehicles.
- Cover or close lids of all waste containers at the end of each day and prior to rain.
- Protect wastes from being washed away by rain, storm water run-on, or other waters (irrigation, water line breaks, etc.).
- To prevent storm water run-on from contacting stored solid waste (stockpiled materials) use berms, secondary containment, covered dumpsters/roll-offs or other temporary diversion structure or measures (BMP 1-08 "Stockpile Management").
- For materials with the potential for spills or leaks, stockpile the material on impervious surfaces or on plastic groundcovers to prevent spills or leaks infiltrating the ground.
- Do not hose out or clean out dumpsters or containers at the construction site.
- Prevent solid waste and trash from entering and clogging storm drain inlets.
- As practical, incorporate any removed clean sediment and soil back into the project.

Maintenance and Inspection

- Collect site trash regularly, especially before rainy or windy conditions. Perform routine inspections of site, including storage areas, dumpsters, stockpiles and other areas where trash and debris are collected prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable).Close trash can lids and dumpster covers at the end of each day and before rainy or windy conditions.

Corresponding CASQA Fact Sheet

Fact Sheet WM-5

What

Hazardous Materials/Waste Management is a procedural BMP for the use, control, containment, and disposal of hazardous materials and waste. This BMP is to be used in conjunction with SDG&E Environmental Standard (ES) G 8724 Hazardous Materials/Waste Management.

Examples of potential hazardous materials and waste requiring management control BMPs may include, but are not limited to:

- Petroleum products such as oil, fuel, grease, cold mix, and tar.
- Glues, adhesives, and solvents.
- Herbicides, pesticides, and fertilizers.
- Paints, stains, and curing compounds.
- Other hazardous or toxic substances.

When

Use this BMP during all phases of construction or operations and maintenance activity when the activity involves the storage and use of hazardous materials, or the generation of hazardous waste byproducts.

Where

All applicable construction and operations and maintenance activity sites where hazardous materials are used and/or hazardous waste is generated. A single instance of handling, use, or storage of a hazardous material or waste is sufficient to trigger this requirement.

How

Hazardous materials and hazardous wastes shall be managed in accordance with the following procedures:

- Only use products or materials onsite that have been approved through the SDG&E Product Approval process.
- Minimize the amount of hazardous materials stored at the site and the production and generation of hazardous waste at the site.
- Cover or containerize and protect from vandalism and exposure any hazardous materials and hazardous wastes.
- Clearly mark all hazardous materials and hazardous waste containers per the ES. Place hazardous waste containers in watertight storage sheds for hazardous waste containers. Alternately, use secondary containment systems, but watertight storage sheds are preferred when hazardous waste containers are stored at the construction site.
- Hazardous materials and hazardous waste containers must meet DOT type and specifications per the ES. The containers must be closed (hand tightened) during activity hours and securely tightened during non-activity hours.
- Stockpiled cold mix should be placed on and covered with plastic.
- Mixing of waste materials is strictly prohibited.
- Storm water that collects within secondary containment structures must be inspected prior to being discharged to ensure no pollutants, oil sheens or non-stormwater discharges are present.
- Spills cannot be discharged to the environment from secondary containment (see BMP 2-03 "Spill Control").

How (cont.)

- All secondary containment systems for hazardous materials or hazardous wastes must be able to hold the volume of the largest container in the storage area and, if uncovered, sufficient additional capacity for storm events. A general rule of thumb for Southern California is that the additional containment volume for an anticipated rain event can be approximated by adding at least an additional four inches (a 4-inch rain) to the height of the containment sized for the entire waste volume of the largest container (Based on the Los Angeles Area 10 year, 24 hour precipitation frequency and a 24-hour manned facility). However, even within Southern California, this varies by the geographic region precipitation frequency and the hours of operation of the facility (containment inspection frequency). Consult with your Field Environmental Representative for determining the minimum volume required for the specific situation and geographical location.

IMPORTANT POINT

- Hazardous waste must be segregated from other solid waste and stored and disposed of properly according to the ES. **Only company approved vendors with current contracts in place will be used to manage or dispose of hazardous wastes.**
- In addition to following this BMP and ES G8724, employees or contractors are responsible for compliance with federal, state, and local laws and regulations regarding storage, handling, transportation, and disposal of hazardous waste.

Maintenance and Inspection

- Routinely inspect the covers on hazardous material storage areas for tears or flaws and repair as necessary. Drums and drum storage areas are to be inspected at least weekly and the results recorded on an inspection log.
- All secondary containment systems for hazardous materials or hazardous wastes must be able to hold the volume of the largest container in the storage area and, if uncovered, sufficient additional capacity for storm events. A general rule of thumb for Southern California is that the additional containment volume for an anticipated rain event can be approximated by adding at least an additional four inches (a 4-inch rain) to the height of the containment sized for the entire waste volume of the largest container. Check with your Field Environmental Representative in the event you are unsure whether sufficient secondary containment exists for any facility.
- Inspect BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable) to ensure that no hazardous materials or waste are improperly left exposed to storm water. Immediately initiate repairs related to a storm event and no later than within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event.

Corresponding CASQA Fact Sheet

Fact Sheet WM-6

What

Contaminated Soil Management is a procedural BMP for the control of contaminated soils, or soils suspected of being contaminated, that are encountered during site activities. Importation of fill shall also be managed in accordance with G8755 Import Fill Materials for Large Projects (>100 Cubic Yards), Projects within Coastal Zone, and Environmentally Sensitive Areas.

When

This contaminated soil management BMP should be used whenever soil is imported for fill, soil contamination is suspected, or when contaminated soil is encountered during construction or operation and maintenance "construction like" activities. Construction crews should be vigilant when projects are located in highly urbanized or industrial areas or in highway or roadway right-of-ways.

Where

All construction or "construction like" activity sites, but especially construction and operation and maintenance sites in urbanized or industrial areas where soil contamination may have occurred because of spills, illicit discharges, and leaks from underground storage tanks. Contaminated soils may also be encountered during digging and trenching activities on highway and roadway right-of-ways.

How

Contaminated soil (including soil import that may be contaminated) should be managed in accordance with the following procedures:

- Identify contaminated soil by looking for the following:
    - Soil that is discolored, black, gray, white; or
    - Soil that has an unusual odor, such as, petroleum, acid, alkaline, sewage, solvent, or any other chemical smell.
- If any potentially contaminated soil is detected, immediately discontinue the activity and contact the project's Field Environmental Representative.
- The CGP requires that the discharger sample and test contaminated soils to ensure proper handling and notify the appropriate local, State and federal agencies, as well as the appropriate Regional Water Board if there is a reportable release event. A reportable release is a discharge or release of oil, hazardous materials or wastes, hazardous substances or chemicals in quantities that may be harmful to the public health. This includes non-stormwater discharges of any kind into the stormwater conveyance system.
- Contaminated soils must also be managed properly per SDG&E Environmental Standards (ES). See ES G8729; G8724; and G8755.

Maintenance and Inspection

- Inspect all imported fill for contamination per Environmental Standard G8755.
- Perform routine inspections of digging and trenching operations during construction and operation and maintenance activities looking for contaminated soils in addition to normal BMP inspections prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Immediately initiate repairs related to a storm event no later than within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- All contaminated soils must be managed properly in accordance with applicable federal, state, and local laws and regulations.

Corresponding CASQA Fact Sheet Fact Sheet WM-7

What

Sanitary/Septic Waste Management is a procedural BMP for the control of sanitary/septic wastes. Sanitary/Septic waste is domestic (human) waste.

When

When construction or operation and maintenance site location requires onsite sanitary/septic waste portable toilets, or hand wash/rinse stations, or shower units.

Where

All applicable construction and field operations and maintenance sites.

How

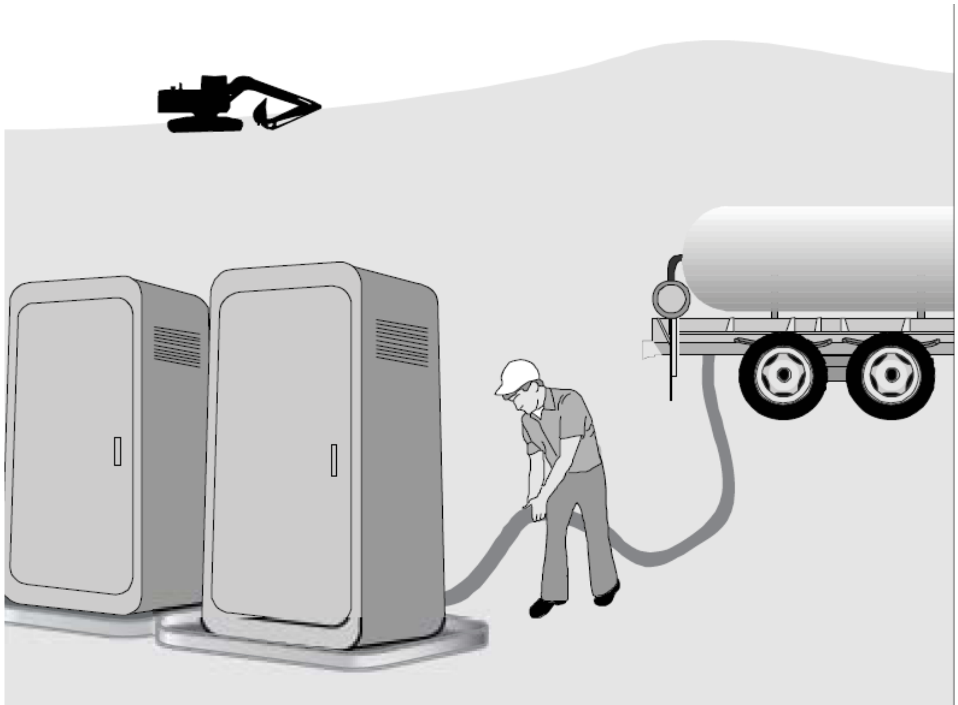
Sanitary/septic wastes shall be managed in accordance with the following procedures:

- Incorporate into regular safety meetings the education of employees, contractors, and suppliers on:
  - Potential dangers to humans and the environment from contact with sanitary/septic wastes due to bacteria, viruses, and parasites.
  - Approved sanitary/septic waste storage and disposal procedures.
- Use only reputable, licensed sanitary/septic waste facility providers and haulers for sanitary facilities (portable toilets, hand wash stations, shower units) and their transportation to and from the construction site.
- Ensure that sanitary facilities are equipped with secondary containment to prevent discharge of pollutants to the storm water drainage system or receiving water.
- Sanitary facilities should be located away from drainage systems and watercourses, minimizing the likelihood of leaks or spills contaminating waterways.
- Sanitary facilities should be located away from highways and roadways to avoid vehicles colliding with the sanitary units.
- When subjected to high winds, risk of high winds, or risk of vandalism, sanitary facilities shall be secured to prevent overturning.
- Sanitary wastewater should not be buried or discharged, except to a properly permitted sanitary sewer discharge facility. A permit may be required from the local Sanitation District.
- Temporary sanitary facility's holding tanks shall be emptied by a licensed waste hauler prior to transport.

Maintenance and Inspection

- Perform inspections of sanitary facilities and BMPs routinely prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Ensure that sanitary/septic facilities are maintained in good working order and routinely serviced by a licensed service.
- When servicing of portable sanitary facilities is conducted, wash/rinse water shall, not be allowed to runoff and shall be collected and disposed of properly in accordance with federal, state, and local requirements.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet WM-9

What

Non-hazardous Liquid Waste/Drilling Fluid Management is a procedural BMP for managing non-hazardous liquid wastes on a construction or operation/maintenance activity site.

Hazardous liquid wastes, including water with an oily sheen, should be managed using BMP 2-05 "Hazardous Materials/Waste Management."

Dewatering operations, and concrete slurry residue should be managed according to BMP 3-01, and BMP 3-05, respectively.

Non-hazardous Liquid wastes include, but are not limited to:

- Drilling slurries/muds and fluids, and waste water and rinse water without an oil sheen (including pressure washing).
- Dredging spoil, and non-storm water liquid discharges that do not have discharge permits.

When

Liquid waste management is applicable when construction projects and operations and maintenance activities generate any non-hazardous liquid byproducts, residuals,, or wastes.

Where

All applicable construction and operations and maintenance sites where non-hazardous liquid waste is present.

How

- Vehicle and equipment cleaning using water is discouraged on site. If washing is required for safety or for the work, utilize BMP 3-03 "Vehicle and Equipment Washing."
- Drilling residue and drilling fluids should be disposed of in accordance with federal, state and local requirements. Coordinate the disposal of these wastes with your Field Environmental Representative.
- Wastes generated as part of a construction, operation, or maintenance procedure, such as water laden with dredged material and drilling mud should be contained and not allowed to flow into drainage channels, storm drains, or receiving waters.
- Contain non-hazardous liquid wastes in a controlled area and manner, such as a lined pit, lined roll-off bin with a sealed bottom, or a portable tank.
- Storage tanks used for collecting and settling non-hazardous water shall be routinely checked for leaks and to ensure they are not overfilled.
- Piping used to connect storage tanks shall be routinely checked to ensure connections are secure and not leaking.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated and, if uncovered, any additional volume needed for anticipated precipitation. A general rule of thumb for Southern California is that the additional containment volume for an anticipated rain event can be approximated by adding at least an additional four inches (a 4 inch rain) to the height of the containment sized for the entire waste volume. Contained material must be routinely removed and properly disposed of in accordance with federal, state and local requirements.

IMPORTANT POINT

- **Do not locate containment areas or devices where accidental release of the contained liquid can threaten health or safety, or discharge to watercourses, storm drain system, or to a water body.**
- Capture all liquid wastes running off a surface including wash water and rinse water from cleaning walls or pavement, including pressure washing.

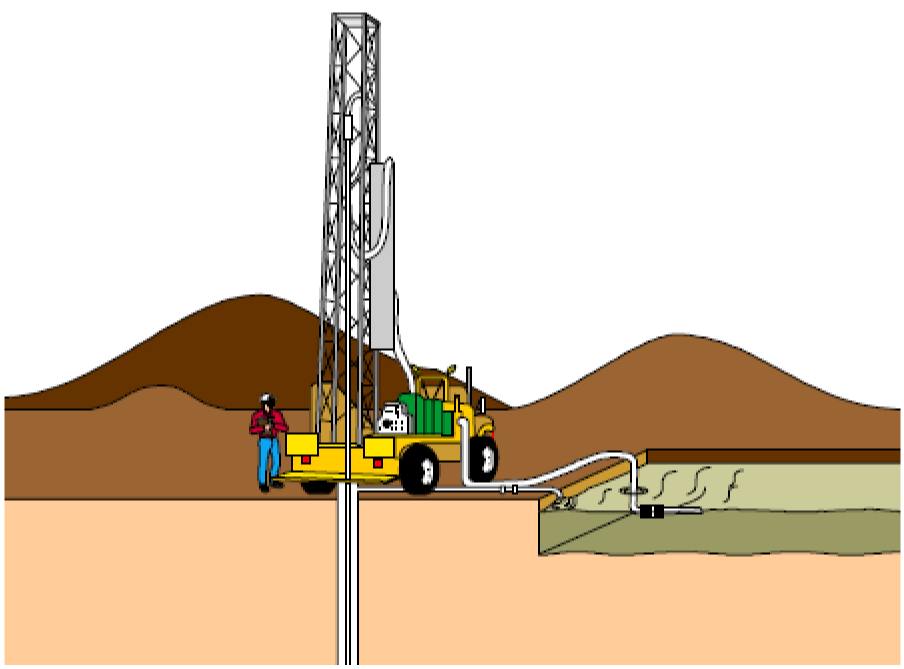
How (cont.)

- If the liquid waste is sediment laden, use a sediment trap (see BMP 1-10) or capture in a containment device and allow sediment to settle.
- Disposal of liquid wastes are subject to specific laws and regulations, or to requirements of other permits secured for the construction project. Contact your Field Environmental Representative for further information.

Maintenance and Inspection

- Remove deposited solids from containment areas and containment systems as needed, and at the completion of the project. Soil, dredged material and drilling mud to be transported offsite for reuse or disposal must first be profiled using chemical analysis. Liquid waste disposal may also need to be profiled prior to transportation and disposal. Contact the Field Environmental Representative as far in advance of the anticipated transportation need as possible.
- Inspect containment systems routinely for damage, and repair as needed.
- BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet WM-10

Section 3 – Non-Storm Water Discharge Controls

What Is Non-Storm Water?

Non-storm water is any water that does not originate as rain or snowmelt, or is rain or snowmelt that has come into contact with pollutants caused by human activities at construction and industrial sites, and commercial and residential sites.

Why Are Non-Storm Water Discharge Controls Required?

Storm water conveyance systems (natural or manmade, wet or dry) are, by regulation, for conveying storm water or exempt or permitted non-storm water discharges only. Storm water conveyance systems eventually discharge to natural water bodies. Non-storm water, which may reach these storm water conveyance systems, may contain pollutants, such as sediment, that are harmful to the natural water bodies. Also, sediment from construction sites can clog storm water systems or reduce the volume of storm water that can be handled by the storm water system.

What Are Non-Storm Water Discharge Controls?

Non-Storm Water Discharge Controls include general site and operations BMP measures that minimize pollution of water. Non-Storm Water Discharge Controls presented in this Manual include the following:

- BMP 3-01 Dewatering Operations
- BMP 3-02 Paving Operations
- BMP 3-03 Vehicle and Equipment Washing
- BMP 3-04 Vehicle and Equipment Fueling
- BMP 3-05 Concrete/Coring/Saw Cutting and Drilling Waste Management
- BMP 3-06 Dewatering Utility Vaults
- BMP 3-08 Over-Water Protection
- BMP 3-09 Paint Removal Control
- BMP 3-10 Stream Crossings
- BMP 3-11 Clear Water Diversion

What

Dewatering Operations is a procedural BMP for controlling construction or operations and maintenance dewatering to assure regulatory compliance.

When

- This BMP is applicable when groundwater from an excavation, trench, or non-storm water from a pipeline hydrostatic test must be removed.
- When excavation/trench dewatering, also see Environmental Standard (ES) 104.0226.
- When dewatering hydrostatic test water, also see ES 104.0220.

IMPORTANT POINT

- **This BMP is not Applicable to drilling mud or similar products used in drilling foundations (see BMP 2-08 "Non-hazardous Liquid Waste/Drilling Fluid Management")**
- **This BMP is not applicable to utility vault or sub-structure dewatering. For these applications, refer to the BMP 3-06 "Dewatering Utility Substructures and Vaults."**
- **This BMP is not applicable when the water is known, or suspected to be, contaminated. Under these conditions, contact your Field Environmental Representative.**
- **Water from dewatering operations cannot be discharged to the sanitary sewer, storm drain systems, drainages, creek beds (even if dry), or to water bodies without a permit. This prohibition includes groundwater dewatering to these conveyance systems or water bodies (groundwater may contain pollutants not easily detected except by analytical laboratory tests).**
- **Groundwater from excavation or trench dewatering or hydrostatic test water cannot be discharged to land without a permit or permit waiver. Groundwater and hydrostatic test water may contain pollutants not easily detected except by analytical laboratory tests.**
- Non-contaminated discharges of water from hydrostatic tests of new pipe utilizing potable water as a water source, reused for soil compaction and dust control, or reused for agricultural irrigation may be allowed to be discharged to land without a permit or under a permit waiver, depending on the local and regional regulatory requirements. Consult with your project Field Environmental Representative for permitting applicability prior to planning a discharge.

Where

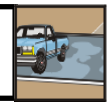
All construction sites and operations and maintenance activity sites that require excavation or trench dewatering, or pipe hydrostatic test discharges.

How

Water generated by dewatering activities should be managed in accordance with the following procedures:

- If allowed by regulations, permit, or the regulating agencies, use the water for construction activities such as onsite soil compaction and dust control. If used for these applications, ensure that the water does not run-off to storm drain systems, drainages, creek beds (even if dry), or to water bodies.
  - The water may contain uncontaminated sediments, but the water must not be contaminated with other pollutants.

  Note: Discharge to land for site compaction, dust control or for infiltration (to groundwater) may require a permit or permit waiver to discharge from the Regional Water Quality Control Board (RWQCBs) and/or local jurisdictions (such as Flood Control District). Consult with your Field Environmental Representative.



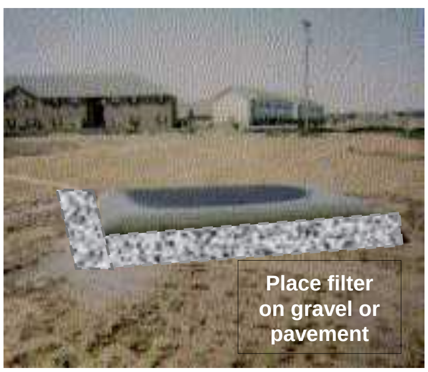
How (cont.)

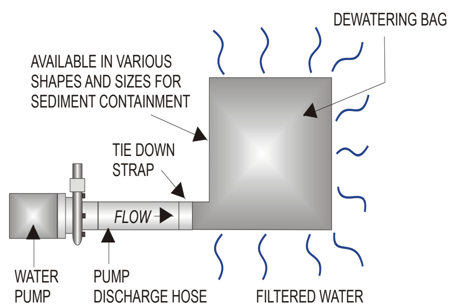
- If allowed by regulations, permit, or the regulating agencies, water from dewatering, that contains only uncontaminated sediment, may be discharged to one of the following:
    - To land for infiltration (also see soil compaction and dust control above). In some locations, a permit may be required from the RWQCB and/or a local jurisdiction (such as a Flood Control District). Consult with your Field Environmental Representative. The permit may allow sediment without settling or filtration. The permit may specify limits on other pollutants, requiring sampling and analysis, and submittal of analysis results prior to discharge approval. If allowed by regulations, permit, or the regulating agencies, infiltrate to an appropriate landscaped, vegetated, or soil area. If used for these applications, ensure that the water will infiltrate and not run-off to storm drain systems, drainages, creek beds (even if dry), or to water bodies. Land owner permission to discharge to land for infiltration is required.
    - To the Sanitation or Wastewater District Sanitary/Industrial Sewer - Requires a permit or approval of the above wastewater authority. District may require sampling and analysis and a Batch Discharge application (application for a short-term discharge of a stated volume) prior to approval. District may set a numeric limit on the amount of acceptable sediment discharged. District may require a fee, dependent on discharge volume and pollutant load.
    - To Surface Water (including storm drains) - A RWQCB discharge permit is required and a local jurisdiction permit (such a Flood Control District permit) may be required. Consult with your Field Environmental Representative. The permit may specify limits on sediment and other pollutants, require sampling and analysis, and the submittal of analysis results prior to discharge approval. These permits take advanced planning.
        - A surface water (including storm drains) discharge permit may have a numerical limit on the concentration of Total Suspended Solids (sediment) that can be discharged and a restriction limiting an increase in turbidity of the receiving water. Other pollutants, such as Oil and Grease (O&G) and Total Petroleum Hydrocarbons (TPH) may also have stringent numerical limits. As a minimum, contaminant-free temporary storage (Baker tanks) may need to be provided until permit coverage is obtained and sampling and analysis can be completed. A properly sized sediment clarifier and petroleum hydrocarbon treatment may be required. The cost of this potential treatment for discharge to surface waters should be compared to the treatment cost of discharging to the sanitary sewer (if logistically feasible) before deciding on this discharge option.
- Transport for Disposal in a Vacuum Truck for Proper Disposal. This option is usually the most expensive option and only utilized when the discharge options above cannot be permitted or is otherwise infeasible.
- If a permit is obtained for discharge to a storm water or sanitary sewer system, conduct all dewatering discharge activities in accordance with permit requirements, including installation of appropriate BMPs.
- Dewatering records should be maintained in accordance with permit requirements.

Maintenance and Inspection

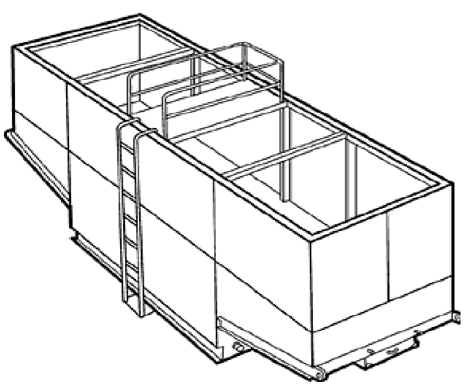
- Inspect pumps, hoses and all equipment before use to ensure they are in proper operating condition and free of contamination. Monitor dewatering operations to ensure it does not cause offsite discharge or erosion.
- Monitor the discharge for any change in characteristics (amount of sediment, oil sheen, color, etc.) that is not permitted. Stop the discharge immediately if there is a visual indication that the permit conditions are being exceeded.
- BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Sample dewatering discharges in accordance with permit requirements, if applicable.
- These operations and equipment should be made secure.

Pictures





Gravity Bag Filter



Weir Tank

Corresponding CASQA Fact Sheet

Fact Sheet NS-2

What

Paving Operations is a procedural BMP for controlling non-storm water discharges associated with pavement surfacing or resurfacing, patching, or pavement removal.

Paving Operations activities may typically utilize the following materials:

- Cold mix,
- Asphalt,
- Chip Seal, Seal Coat, Tack Coat, Slurry Seal, Fog Seal, and
- Portland Cement Concrete.

For pavement grinding, saw cutting, coring or drilling, refer to BMP 3-05 "Concrete/Coring/Saw cutting and Drilling Waste Management."

When

Use this BMP whenever paving operations are being conducted.

Where

All construction or operations and maintenance work sites that have paving activities.

How

Use the following methods as applicable:

- Protect storm drain inlets near work and down gradient of the area to be paved (see BMP 1-06 "Storm Drain Inlet Protection").
- If onsite mixing is planned, an area must be designated for conducting the mixing. This area should already be paved or made impervious (e.g., plastic or wood sheeting) and be located away from storm drain inlets, drainages, or watercourses.
- Minimize overspray of tackifying emulsions or placement of other paving materials beyond the limits of the area to be paved. Schedule the application of tackifying agents according to manufacturer's instructions regarding rain events.
- Use dry methods to clean equipment and conduct cleaning in accordance with BMP 3-03 "Vehicle and Equipment Washing."
- Material use and stockpiles are to be managed in accordance with BMP 2-02 "Material Use" and BMP 1-08, "Stockpile Management."
- Collect and remove all broken asphalt and concrete, recycle when feasible, and dispose of materials in accordance with local, state, and federal requirements.

IMPORTANT POINT

- **Do not apply asphalt, concrete paving, seal coat, tack coat, slurry seal or fog seal if rain is expected during the application or curing period.**
- **Avoid if possible, the transferring, loading, or unloading of paving materials near storm drain inlets, drainages, or watercourses. If not possible, use BMP 1-06 "Storm Drain Inlet Protection."**
- **CGP Risk Level 2 & 3 projects, that construct concrete structures onsite or store concrete mixing materials onsite, are subject to pH Numeric Action Levels (Risk 2) or pH Numeric Effluent Limits (Risk 3) for those drainage areas of the project where the concrete construction or storage of concrete mixing or waste materials take place.**
- **CGP Type 2 & 3 projects are subject to pH Numeric Action Levels (Type 2) or pH Numeric Effluent Limits (Type 3) for active areas.**

Maintenance and Inspection

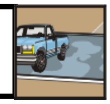
- Inspect and maintain equipment and machinery routinely to minimize leaks.

Maintenance and Inspection (cont.)

- Inlet protection BMPs prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.

Corresponding CASQA Fact Sheet

Fact Sheet NS-3



What

Vehicle and Equipment Washing is a procedural BMP for controlling vehicle and equipment washing on construction or operation and maintenance activity sites.

When

Onsite washing of vehicles and equipment on sites shall only be conducted when prior authorization has been received from the field Environmental Representative. Use this BMP on all sites when vehicle and equipment cleaning is being performed. Note that construction site vehicle and equipment washing is not typically performed on utility type construction sites unless required by safety considerations, or is necessary for work completion.

Where

Applicable to all construction and operation and maintenance sites where equipment or vehicles are washed.

How

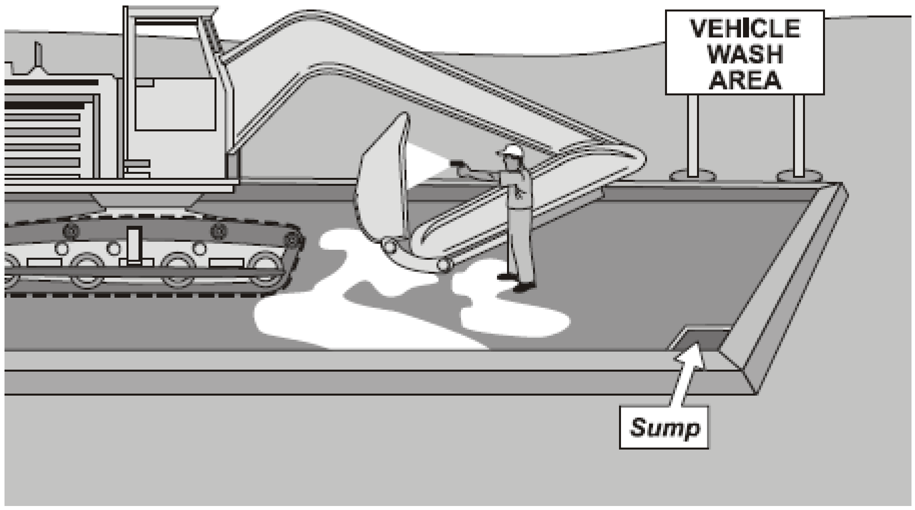
Use the following methods as applicable:

- Use dry cleaning methods such as wiping down, rather than water washing vehicles or equipment.
- If onsite vehicle washing is authorized by the Field Environmental Representative, use the following general methods:
  - Vehicle and equipment washing must be located away from storm drain inlets, drainage systems, or watercourses.
  - Place secured impermeable liners, sand bags or another type of berm around storm drain inlets and drainage systems to prevent wash water from entering a storm inlet, drainage system or watercourse. Secured, impermeable liners are preferable to sand bags. Sand bags are preferable to gravel bags. Sand bags are preferable to gravel bags because they are less porous, and are much better at preventing water and pollutants from passing through the barrier.
  - Never discharge wash water to the storm drain system, drainages, watercourses, or water bodies.
  - Use as little water as possible. High-pressure sprayers may use less water than a hose.
  - Use a positive shutoff valve to minimize water usage.
  - Collect all wash and rinse water for proper disposal.

Maintenance and Inspection

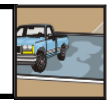
Monitor employees and contractors through the duration of the construction project to ensure appropriate practices are being implemented.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet NS-8



What

Vehicle and Equipment Fueling is a procedural BMP for controlling vehicle and equipment fueling at construction and operation and maintenance activity sites.

When

Use this BMP for construction and operation and maintenance activity sites when onsite fueling of vehicles and equipment, including handheld equipment, is planned or conducted.

Vehicle and equipment fueling, except for handheld equipment, is typically not done on a construction site. Onsite fueling of vehicles and equipment may be planned if it is impractical to send vehicles and equipment off site for fueling.

Handheld equipment is treated separately from other equipment. Handheld equipment includes those smaller, manually operated pieces of equipment such as trenchers, mowers, chainsaws, generators, and other equipment that need fueling during regular daily operation.

Where

All construction and operation and maintenance activity sites where vehicle and equipment fueling occurs.

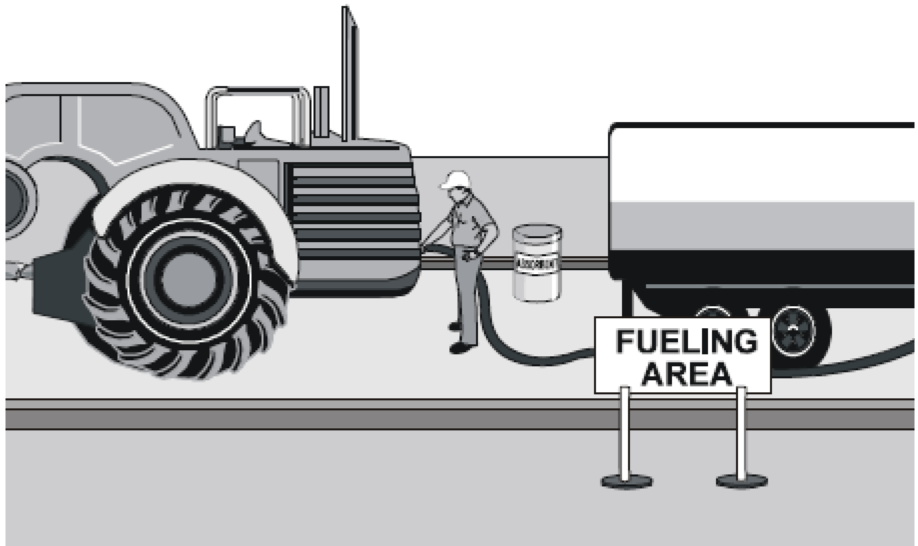
How

- If practical, fuel vehicles and equipment off site.
- Mobile fueling equipment is the preferred equipment used for construction site fueling.
- Fuel storage and fueling areas should be located away from storm drain inlets, drainage systems, watercourses, and water bodies.
- All fueling will be conducted with the fueling operator in attendance at all times regardless if fuel nozzles are equipped with automatic shutoff features.
- Fuel tanks should not be "topped off."
- All fueling operators should have readily available spill containment and cleanup equipment and materials.
- Clean up spills immediately and properly dispose of contaminated materials.
- Properly store and dispose of rags and absorbent material used to clean up spilled fuel.
- Mobile fueling trucks and operators must have all necessary permits, licenses and training.

Maintenance and Inspection

- Check to ensure that there is an adequate supply of spill cleanup materials available.
- Perform routine inspections of designated fueling areas and inspect vehicles and equipment for leaks.
- Report all spills immediately to the project Supervisor *and*/or the Field Environmental Representative.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet NS-9

What

Concrete/Coring/Saw Cutting and Drilling Waste Controls are procedural BMPs for the proper management of liquid and solid wastes from concrete/coring/saw cutting and drilling activities.

For managing any concrete curing compounds, also use BMP 2-05 "Hazardous Materials/Hazardous Waste Management." For managing paving operations, use BMP 3-02.

When

Use this BMP at construction and operation and maintenance activity sites when the activity utilizes concrete and asphalt or when slurry or pavement/concrete wastes are generated by the activities, including:

- Saw cutting.
- Coring/drilling.
- Grinding, re-paving or patching.
- Encasing conduit in concrete.
- Tower footings.

Where

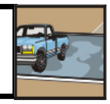
All construction and operation and maintenance activity sites where the above activities are conducted.

How

- Install storm drain protection at any down-gradient inlets that may be impacted by the activity per BMP 1-06 "Storm Drain Inlet Protection."
- Minimize the amount of water used during coring/drilling or saw cutting. During wet coring or saw cutting, use a wet vacuum to lift the slurry from the pavement as the coring or saw cutting progresses. Additionally, sand bag barriers or other containment should be used at nearby down gradient storm drain or drainage inlets per BMP 1-06 "Storm Drain Inlet Protection."
- If concrete residue remains after drying, the area should be swept in a timely manner and residue removed to avoid contact with storm water or entering a storm drain or water body via the wind. If concrete residue still remains, pressure wash the surface, with in-progress vacuum recovery of wash water to remove residual material.

IMPORTANT POINT

- Do not wash residue or particulate matter into a storm drain or drainage inlet or a watercourse or water body.
- The following options should be used for concrete truck chute and/or pump and hose washout:
    - If available, arrange to use an existing concrete washout station. Upon entering the site, concrete truck drivers should be instructed about proper site practices.
    - **Concrete Washouts:** Washout stations can be: self contained concrete trucks; commercial portable washout stations (rent-a-washout); plastic lined temporary pits, or a bermed and lined area designed with sufficient volume to completely contain all liquid and waste concrete materials plus enough capacity for rainwater. The lining must be impervious (such as Visqueen with no holes or tears). The designated area must be located away from storm drain inlets, drainages, watercourses, or water bodies.
    - **Washout in Trench:** Manually rinse the concrete truck chute into the lined trench itself. Note that this practice is not allowed on CGP projects, where minimum BMPs in the permit require containment of concrete washout areas and prohibits discharge into the underlying soil or surrounding areas. Check with the Field Environmental Representative regarding site-specific applicability.



How (cont.)

- ○ **Bucket Washout:** Manually rinse the chute into a wheelbarrow, plastic bucket or pail, and then empty the bucket into the concrete truck barrel or on top of the placed concrete within a trench or excavation. Prevent or protect against spillage, and clean up any spillage promptly.

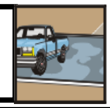
- **CGP Risk Level/Type 2 & 3 projects, that construct concrete structures onsite or store concrete mixing materials onsite, are subject to pH Numeric Action Levels (Risk/Type 2) or pH Numeric Effluent Limits (Risk/Type 3) for those drainage areas of the project where the concrete construction or storage of concrete mixing or waste materials take place.**

Maintenance and Inspection

- Responsible personnel should ensure that all drivers of concrete trucks arriving onsite are instructed about proper project practices.
- Clean out designated washout areas as needed or at a minimum when the washout is 75 percent full to maintain sufficient capacity throughout the project duration. Add additional designated areas as necessary and available to maintain capacity.
- Any designated onsite washout areas must be cleaned out and all debris removed upon project completion. Dispose of concrete waste according to BMP 2-04 "Solid Waste Management."
- Inspect routinely, when washout activities are underway to ensure the integrity of the concrete washout lining and that the concrete washout does not overflow.

Corresponding CASQA Fact Sheet

Fact Sheet WM-10



What Dewatering Utility Vaults is a procedural BMP for controlling water from dewatering utility vaults and underground structures. This BMP does not apply to trench, excavation or other general dewatering associated with construction activities, which is covered by BMP 3-01.

When This BMP is applicable whenever water must be removed from SDG&E utility vaults and underground structures.

Where All SDG&E utility vault locations.

How The discharge of clean water from dewatering of vaults and underground structures to the storm drain, drainages, or water bodies is allowed under the statewide General NPDES Permit for Discharges from Utility Vaults and Underground Structures to Surface Waters (Order No. 2006-0008-DWQ and NPDES No, CAG990002).

Discharges to land (e.g., vegetation, bare soil area) are not covered by this permit. A Waste Discharge Requirements (WDR) permit or waiver may be required by the local Regional Water Quality Control Board (RWQCB) for discharges to land. If a RWQCB does not have a general WDR or waiver for discharges to land, then the State Water Resources Control Board (SWRCB) General Permit for dewatering to land may apply. Consult with your Field Environmental Representative. Discharges to land also require the prior approval from the landowner.

General requirements for discharge under Order 2006-0008-DWQ/Permit Number CAG990002) are listed below:

- All vault dewatering discharges conducted by utility crews, including contractors, shall follow the latest version of SDG&E's Environmental Standards (ES) on Vault and Underground Structure Dewatering. For dewatering utility gas/electric vaults & underground structures follow ES http:/techdocs.sempra.com/doclib.nsf/docframe?openform&docno=G8718.
- Prior to discharge, the water in the vault shall be assessed in accordance with the requirements in the ES.
- A SDG&E-approved filter system with hydrocarbon removal capability is required to be used on the pump discharge for compliance assurance when dewatering to a surface water (drainage, gutter, storm drain inlet, or a water body).

IMPORTANT POINT

- **If the water to be discharged is Clear Water as described in the ES, then the discharge to storm drains, drainages, or water bodies is acceptable as long as the discharge does not cause nuisance or harm to the environment.**
- Water discharged to the street, gutter, drainages, watercourses, or water bodies must be clean and clear, with no evidence of oil sheen and no chemical or sewage smell.
- The dewatering discharge must be monitored at all times during the discharge to ensure the discharge is "clean and clear" with no chemical or sewage odor. If the characteristics of the discharge change (i.e., color, smell, sheen), the discharge must be stopped immediately. In such an event call the Field Environmental Representative.
- Whenever possible, discharge the clean, clear water directly to the storm drain, drainage, or water body to avoid pre-existing pollutants in the discharge path. Pre-existing soil or contaminants in the path of the discharge (i.e., gutter) that can discolor/contaminate the discharge need to be cleaned up before discharging vault water.

IMPORTANT POINT

How (cont.)

- **The discharge from the filter system must be clean and clear at all times, and if not, the discharge must be stopped.**
- As a last resort, when the water, because of sediment or pollutant contamination, cannot be discharged to the environment, contact the project Field Environmental Representative for transport of the water in an approved manner (see the linked SDG&E ES from the previous page).

Maintenance and Inspection

- Implement applicable provisions of the ES.
- Inspect pumps, hoses, filter system and equipment before use and routinely when applicable activities are underway.
- Observe dewatering activities to ensure they do not cause erosion or discharge of potential pollutants.

Corresponding CASQA Fact Sheet

Not applicable. See also Fact Sheet NS-2, Dewatering Operations

What

Over-Water Protection is a procedural and containment system BMP for protecting watercourses from overhead construction and maintenance and repair activities.

- Over-water construction and maintenance activities include, but are not limited to, chipping, grinding, scraping, welding/burning, painting, wrapping and coating of pipes and conduits.
- Watercourses (dry or wet) include drainages, creeks, streams, rivers, lakes and wetlands, bays, estuaries and oceans.

When

This BMP applies to projects when:

- Construction, maintenance or repair activities will be conducted above watercourses (dry or wet).

Prior to conducting over-water activities, check with the Field Environmental Representative for the possible need for permits with the appropriate local and state agencies. As an example, the design or installation of a containment system may itself impact the watercourse and require a permit, or the timing of the activity may impact wildlife breeding seasons, requiring a permit or preventing the activity during certain portions of the year.

Where

All construction or operation and maintenance activity above any portion of a watercourse.

How

Use the following measures as applicable:

- Containment systems must be properly designed and installed prior to the beginning of any operation that may impact a water body to prevent discharge of pollutants to surface waters, taking into account the construction or maintenance activity and factors such as wind, rain, etc.
- The work area should be kept clean of all trash and potential pollutants.
- Containment booms should be placed around the area of work as necessary to contain the discharge of potential contaminants such as oil and hydraulic fluid.
- Special attention should be given to existing and forecasted wind and weather conditions to prevent pollutant discharges to surface waters.
- Shrouds of appropriate material should be used to prevent paint overspray, welding slag, and other pollutants from entering surface waters. Shrouding may not be effective during periods of high wind.
- Shrouds should be large enough to adequately enclose or segregate the working area from surface waters. This may include a plywood barrier, Visqueen, and scaffolding to help prevent fugitive material from entering surface waters.
- Support structures such as scaffolding shall be used in conjunction with shrouding to withstand potential wind stress.
- Contaminated shrouding material and equipment shall be thoroughly cleaned or disposed of properly.

Maintenance and Inspection

- Inspect the containment systems, shrouds, and support structures prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable) to ensure their integrity and safety. Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event.

Pictures

Corresponding CASQA Fact Sheet

Fact Sheet NS-14

What

Paint Removal Control is a procedural BMP for protecting storm water and water courses from mark-out paint or graffiti paint removal activities.

When

Use this BMP when utility activities have used mark-out paint on surfaces and the paint is required to be removed by local jurisdictions or another authority, or when graffiti on company property is discovered and must be removed.

Where

Mark-out paint is usually used on road, sidewalk, and land surfaces to show the location of underground utility services. Graffiti on company property may have been painted on company fences or walls, buildings, walkways, curbs or other surface.

How

Use the following options to remove mark-out paint or graffiti:

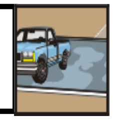
- Use non-toxic, light degradable mark-out paint when possible.
- Avoid the use of chemical paint removers whenever possible. When chemical paint removers are required, only use products that have been approved through the product review process and utilize containment and wet vacuuming of material during the removal process.
- Hydro pressure wash.
- Dry abrasive blast/grinding.
- Wet abrasive blast/grinding.

Use one or more of the following methods to promptly and effectively contain and remove paint and residues in order to protect storm water sewers, drainages and watercourses:

- Dry sweep.
- Install storm drain inlet protection at down gradient inlets during hydro pressure washing, wet abrasive blasting, grinding, and chemical removal. Discharge of any wet or dry residuals or wash water to the drainage system is prohibited.
- Minimize the amount of water used during hydro pressure washing.
- Wet or dry vacuum.
- Use wet vacuum to lift the paint slurry from the pavement or surface as hydro pressure washing progresses or as soon as possible, and before the material has a chance to migrate from the work area.
- If wet vacuuming is not adequate to capture all wastewater from these activities, use additional containment (sand bags, booms, or other containment devices) methods as near the work area as possible to prevent the discharge to a street, gutter, storm drain/drainage inlet, or watercourse.
- If paint residue remains after drying, the area should be swept up and residue removed in a timely manner to avoid contact with storm water.
- If paint residue remains after sweeping, the area can be water washed, as long as the water containing the paint residue is contained near the work and wet vacuumed and not allowed to enter storm drain inlets or watercourses.
- All waste should be disposed of using the BMP 2-08 "Non-Hazardous Liquid Waste Management."

Maintenance and Inspection

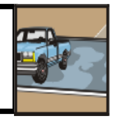
- Inspect all containment systems to ensure proper placement prior to starting utility paint removal operations.
- Inspect equipment frequently and adjust as necessary to maximize efficiency and minimize water or other material use of the paint removal



operations.

Corresponding CASQA Fact Sheet

NA



What

A stream crossing is a culvert, ford, or bridge placed across a waterway to provide access for construction or operations and maintenance activities. Utility stream crossings are not intended to maintain public traffic and project-specific permits may be required for use (see "Limitations"). The crossing design and construction allows safe access and reduces erosion and downstream sediment from vehicles.

The project Field Environmental Representative should be consulted for any permit requirements and for the stream crossing location.

The following types of stream crossing should be considered:

- **Culverts:** Appropriate to control erosion, but may cause erosion during installation/removal without appropriate BMP measures. Easily constructed and allows for heavy equipment loads.
- **Fords:** A ford is a streambed crossing alternative that involves crossing a waterbody at grade, on a hard surface maintained at the streambed bottom. Appropriate during dry weather and in arid areas in dry washes, ephemeral streams, and low-flow perennial streams. Ford crossings generally involve the placement of gravel or other non-erodible material to facilitate crossing and are appropriate for streams that would benefit from additional clean native or compatible gravel; for example, salmonid streams or rivers below reservoirs, and urban, channelized streams. Fords provide minimum sediment and erosion control in a stream channel and are most appropriate when the potential for stream channel erosion and dislodgement of sediment due to the addition of the material and traffic is low. A ford is the least expensive stream crossing, allows for maximum load limits, and offers very low maintenance. Fords may degrade water quality due to vehicle and equipment contact. Direct placement of gravel may be appropriate for short-term use. In addition, soil-confinement systems can also be used in low-flow intermittent stream crossings for ease with implantation and removal. Examples include:
  - Cellular Confinement Systems (CCS) crossings consist of three-dimensional cellular-type material placed on the streambed bottom and filled with rock or soil. CCSs are an effective option when used in conjunction with ford crossings because it is sufficient to support most construction equipment and is readily removable.
  - Articulated concrete mats (e.g., concrete blocks held together by steel cable or interlocking concrete blocks) can also be used for fording a stream. Articulated concrete mats can be used to harden the streambed for crossing. Gravel should be placed on the mats to fill in the voids between concrete blocks.
  - Gabion mattresses consisting of rock contained in rectangular, wire-mesh can also be used for constructing a hard driving surface. Gabion mattresses are strong and durable, flexible structures, and are easily constructed.
- **Bridges:** Appropriate for streams with high flow velocities, steep gradients, and where temporary restrictions in the channel are not allowed. Bridges are more expensive to design and construct, but provide the least streambed disturbance and waterway flow constriction.

What

(cont.)

IMPORTANT POINT

Limitations:

- Installation may cause a waterway constriction, which can obstruct flood flow and cause flow backups, washouts, and/or scouring.
- **Installation may require RWQCB 401 Certification, USACOE 404 permit and approval by the California Department of Fish and Game. If numerical water quality standards are mentioned in any permits, sampling and testing may be required.**
- Installation and removal will usually disturb the waterway, and may require dewatering or temporary stream diversion.
- Soil confinement systems used for stream crossings must be constructed in accordance with the manufacturer's specifications, and inspected and maintained for structural integrity.
- Gravel use in the stream for soil-confinement system crossings will require agency approval.
- Requires other BMPs to minimize soil disturbance during installation and removal.

When

Stream crossings are installed at sites when:

- Appropriate permits have been secured for activities and for the stream crossing.
- Construction or operation and maintenance equipment or vehicles need to frequently cross a waterway.
- Alternate access routes impose significant constraints.
- Crossing perennial streams or waterways without a stream crossing causes significant erosion.

Where

Stream crossings should be installed at all designated crossings of perennial and intermittent streams and in dry channels that may be significantly eroded by construction or operation and maintenance traffic at locations where:

- Erosion potential from the installation is low.
- Site runoff is not directed towards the crossing in a manner that promotes erosion of the crossing.

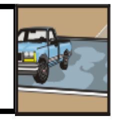
How

IMPORTANT POINT

Minimum standards and specifications for the design, construction, maintenance, and removal of the structure should be established by a California Registered Civil Engineer, and for bridges, a California Registered Structural Engineer. The design flow and stability safety factor should be based on risk evaluation of overtopping, flow backups, or washout.

Construction and Use:

- Install sediment traps immediately downstream of the crossings to capture sediment. Sediment traps may also be required to be part of the crossing permit. For CCS ford crossings, the gravel depth should be 6 to 12-inches to support construction vehicular traffic. Clean, washed, angular or rounded gravel should be used with cellular-block confinement systems.



- Avoid oil or other potentially hazardous materials for surface treatment.

How (cont.)

- Stabilize construction roadways, work area, and streambed bottom against erosion. Stream bed and bank stabilization, if necessary, may also be required to be part of the crossing permit.
- Construct during dry periods to minimize stream disturbance and reduce costs.
- Construct at or near the streambed elevation to prevent potential upstream flooding.
- Install erosion control BMPs to minimize erosion of embankment into flow lines.
- Any artificial obstruction placed within flowing water should only be built from material that will not introduce sediment or silt into the watercourse.
- Vehicles and equipment should not be driven, operated, fueled, cleaned, maintained, or stored in the wet or dry portions of a water body. Wetland vegetation, riparian vegetation, or aquatic organisms could be destroyed.
- The exterior of vehicles and equipment that will encroach on the water body should be maintained free of grease, oil, fuel, and residues.
- Drip pans should be placed under all vehicles and equipment placed over water bodies (e.g., bridges) when the equipment is planned to be idle for more than one hour.
- Disturbance or removal of vegetation should not exceed the minimum necessary to complete operations. Disturbed vegetation should be replaced with the appropriate soil stabilization measures.
- Riparian vegetation, when removed pursuant to the work provisions, should be cut off no lower than the ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble must be removed upon completion of project activities.

Maintenance and Inspection

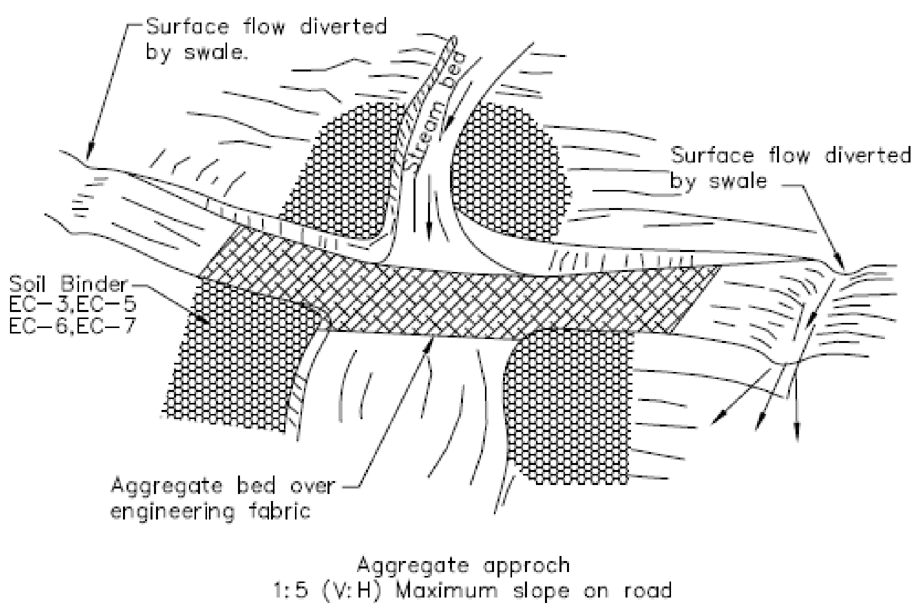
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect prior to and after each storm event, daily during extended rain events during the construction and/or clean-up activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Check for blockage in the channel, sediment buildup or trapped debris in culverts, blockage behind fords or under bridges.
- Check for erosion of abutments, channel scour, riprap displacement, or other signs of erosion.

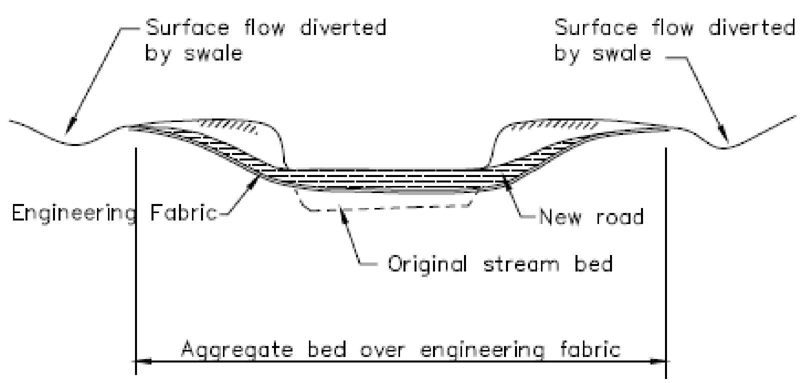
- Check for structural weakening of the crossings, such as cracks, and undermining of foundations and abutments.

Maintenance and Inspection (cont.)

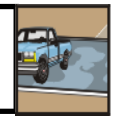
- Remove sediment that collects behind fords, in culverts, and soil confinement systems. Removal of undesirable sediment may be required to be part of the crossing permit.
- Replace lost or displaced support aggregate from inlets and outlets of culverts and soil confinement systems.
- With proper BMPs, remove temporary stream crossings promptly when it is no longer needed.

Pictures





TYPICAL FORD CROSSING
NOT TO SCALE



Corresponding CASQA Fact Sheet

Fact Sheet NS-4

What

Clear water diversion is a system of structures and measures that intercept clear surface water runoff upstream of a construction project or operation and maintenance activity, transport it around the work area, and discharge it downstream with minimal water quality degradation. It encloses a construction area in a waterway and reduces sediment pollution from construction in, or adjacent to water. Structures commonly used as part of this system include diversion ditches, berms, dikes, slope drains, rock, gravel bags, wood, aqua barriers, cofferdams, filter fabric, or turbidity curtains, drainage or interceptor swales, pipes, or flumes.

Limitations:

- Diversion activities will usually disturb the waterway during installation/removal.
- Installation may require RWQCB 401 Certification, USACOE 404 permit and approval by California Department of Fish and Game. If numerical water quality standards are mentioned in any permits, sampling and testing may be required.
- Diversion activities may constrict the waterway, obstruct flood flows, and cause flooding or washouts. Diversion structures should not be installed without identifying potential impacts to the stream channel.
- Diversion or isolation activities are not appropriate in channels where there is insufficient stream flow to support aquatic species in the dewatered area or if they will disturb sensitive aquatic species.
- Diversion or isolation activities are inappropriate in deep water unless designed and reviewed by a California Registered Civil Engineer.
- Diversion or isolation activities should not completely dam stream flow.
- Dewatering and removal may require additional sediment control or water treatment.

When

Clear water diversions should be implemented when:

- Isolating construction or operations and maintenance activities is necessary within or near a water body to protect the water body from the activity. Applicable activities may include but are not limited to: stream bank stabilization, culvert, bridge, pier, or abutment installation. They may also be used in combination with other methods, such as clear water bypasses and/or pumps.

Where

- A clear water diversion is typically implemented where appropriate permits have been secured and work must be performed in a flowing stream or water body.
- Pumped diversions are suitable for intermittent and low flow streams.
- Excavation of a temporary bypass channel, or passing the flow through a flume with a trench excavated under it, is appropriate for the diversion of streams less than 20 feet wide, with flow rates less than 100 cubic feet per second.
- Clear water diversions incorporating clean washed gravel may be appropriate for use in fish spawning streams.

How

In general:

- Where working areas encroach on flowing streams, barriers adequate to prevent the flow of muddy water into streams should be constructed and maintained. During construction of the barriers, stream muddying should be minimized.
- Diversion structures must be adequately designed to accommodate fluctuations in water depth or flow volume due to tides, storms, floods, etc.
- Equipment driven in a water body should be clean of petroleum residue, and water levels should be below the fuel tanks, gearboxes, and axles, unless lubricants and fuels are sealed such that water inundation will not result in pollutant discharges.
- Only excavation equipment buckets may reach out into the water body to remove or place fill. The main equipment body should not enter the water except as necessary to cross the stream to access the work site.
- Stationary equipment, such as motors or pumps located within or adjacent to a water body, should be positioned over drip pans.
- When any artificial obstruction is being constructed or maintained, sufficient water should at all times pass downstream to maintain aquatic life.
- Equipment should not park below high water marks unless allowed by permit.
- Disturbance or removal of vegetation should be minimized. Disturbed vegetation should be replaced with appropriate erosion control measures.
- Riparian vegetation, when removed pursuant to the work provisions, should be cut off no lower than the ground level to promote rapid re-growth. Access roads and work areas built over riparian vegetation should be covered by a sufficient layer of clean river run cobble to prevent damage to the underlying soil and root structure. The cobble must be removed upon completion of project activities.
- Drip pans should be placed under all vehicles and equipment placed structures over water bodies when the equipment is planned to be idle for more than one hour.
- Where possible, minimize diversion and encroachment impacts by scheduling construction during periods of low flow. Scheduling should also consider seasonal releases of water from dams, fish migration, and spawning seasons, and water demands due to irrigation.
- Construct diversion structures with materials free of potential pollutants such as soil, grease, or oil.

Several types of clear water diversions are detailed in the CASQA Handbook, each with different applications, design considerations, limitations, and inspection and maintenance requirements. These types of diversions include:

- Temporary Diversions and Encroachments
- Temporary Dry Construction Areas

How (cont')

- Filter Fabric Isolation
- Turbidity Curtain Isolation
- K-Rail River Isolation
- Stream Diversions

The CASQA Handbook should be consulted for additional information for these clear water diversions.

Maintenance and Inspection

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two week intervals in the non-rainy season to verify continued BMP implementation (e.g., or in compliance with the frequency specified in the CGP, if applicable).

Pictures

Corresponding CASQA Fact Sheet

Fact Sheet NS-5

Section 4 – Soil Erosion Control

What is Erosion?

Erosion is the detachment of soil particles by water or wind. Erosion is a natural process that can be accelerated by construction activities such as grading and trenching. For example, when a site is cleared and grubbed, protective vegetation is removed and the disturbed soil is directly exposed to wind, rain, and flowing water.

Why is Erosion Control Required?

Water or wind can transport soil particles to water bodies where they can cause damage to, or destruction of, aquatic animals and plants by burying them or reducing oxygen and/or sunlight that is necessary for their survival. Erosion control is required by regulatory agencies to minimize the potential additional erosion and damage to the environment from construction activities.

What is Erosion Control?

Erosion Controls are methods used to protect the soil surface and prevent the soil particles from being detached and transported by rain, flowing water or wind. Erosion controls include limiting soil or vegetation disturbance to reduce erosion. Preservation of Existing Vegetation is an example of an Erosion Control BMP.

Soil Stabilization is the most widely used and most effective method of erosion control. Preventing or reducing erosion potential by directing or controlling drainage runoff, as well as preparing and stabilizing disturbed soil areas protects the exposed soil surface from rain and wind thereby preventing erosion. Diversion Berms and Drainage Swales is an example of an erosion control BMP that intercepts and conveys run-on around or through the project reducing erosion potential. Hydroseeding is also an example of an erosion control BMP that stabilizes the soil. Erosion control BMPs used in this Manual to direct or control runoff and/or stabilize soil include:

- BMP 4-01 Preservation of Existing Vegetation
- BMP 4-02 Temporary Soil Stabilization (General)
- BMP 4-03 Hydraulic Mulch
- BMP 4-04 Hydroseeding
- BMP 4-05 Soil Binders
- BMP 4-06 Straw Mulch
- BMP 4-07 Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats
- BMP 4-08 Dust (Wind Erosion) Control
- BMP 4-09 Diversion Berms and Drainage Swales
- BMP 4-10 Velocity Dissipation Devices
- BMP 4-11 Slope Drains
- BMP 4-12 Streambank Stabilization
- BMP 4-13 Soil Preparation

What

Preservation of Existing Vegetation is a procedural BMP that maximizes the preservation of existing trees, shrubs, bushes, and grasses on a construction or operations and maintenance activity site.

When

This BMP is applicable to utility activities when there is existing vegetation.

Where

All construction and operations and maintenance activity sites where:

- There are areas on site where no activity is planned or will occur later.
- There are areas with vegetation that can be preserved to protect against soil erosion, such as on steep slopes, watercourses, and building sites in wooded areas.
- There are areas designated as ESAs, or where federal, state, or local government regulations require preservation, such as wetlands, vernal pools, marshes, etc.

How

Use the following measures as applicable:

- Preserve existing vegetation whenever possible.
- Identify areas to be preserved in the immediate vicinity of the construction or activity site, and mark as appropriate before clearing and grubbing or other soil disturbance activities.
- If necessary, contact the project Field Environmental Representative for any clarification regarding areas to be preserved.
- Whenever possible, minimize disturbed areas by locating temporary roadways to avoid stands of trees and shrubs and follow existing contours to reduce cutting and filling.
- Construction materials, equipment storage and parking areas should be located outside the drip line of any tree to be retained.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Remove any markings, barriers, or fencing after project is completed.

Maintenance and Inspection

- Maintain the clearly marked limits of disturbance during construction to preserve vegetation.
- Inspect barriers regularly during construction.

Pictures

Vegetation to be preserved is marked and outside the work area.

Corresponding CASQA Fact Sheet

Fact Sheet EC-2

What

Temporary Soil Stabilization is a procedural BMP utilizing protective materials to cover exposed soil, where the soil exposure is caused by construction or operation and maintenance activities. Materials may include hydraulic mulch and seeding, soil binders, straw, geotextiles, plastic covers and erosion control blankets.

Temporary soil stabilization BMPs and their associated materials include:

- BMP 4-03 - Hydraulic Mulch
- BMP 4-04 - Hydroseeding
- BMP 4-05 - Soil Binders
- BMP 4-06 - Straw Mulch
- BMP 4-07 - Geotextiles, Plastic Covers and Erosion Control Blankets/Mats

When

This BMP, and the situation appropriate BMPs listed above, is applicable when slopes are constructed or disturbed and/or where there are inactive soil disturbance areas that will not be worked for 14 days or more. The procedures are to be implemented after slope construction activity is complete and then prior to the onset of precipitation.

Where

- Slopes, soil stockpiles, and inactive disturbed soil areas.
- Soil binders (BMP 4-05) may be applicable to areas where there is light traffic that would minimize the effectiveness of other temporary soil stabilization BMPs.

How

- Sediment control BMPs used to break up the slope lengths, such as fiber rolls (BMP 1-03) or gravel bag berms (BMP 1-04) should be spaced in accordance with the CGP requirements (see installation for BMP 1-03 "Fiber Rolls")
- Permanent erosion control shall be applied to areas deemed substantially complete during the project's defined seeding season window.
- Refer to individual temporary soil stabilization BMPs for specific instructions for use (see BMP 4-03 through BMP 4-07).

Maintenance and Inspection

- Refer to individual temporary soil stabilization BMPs listed above for maintenance and inspection requirements.

Pictures

Applying a tackifier using a trailer mounted pump and hose.

Applying soil stabilization manually in harder to reach areas.

Corresponding CASQA Fact Sheet

Fact Sheet EC-2

What

Hydraulic Mulch is a procedural BMP for applying mulch to protect the soil surface from wind and rain erosion.

Mulch consists of a mixture of shredded wood fiber or other fiber in water and a stabilizing emulsion, or tackifier. The mulch is applied with hydro-mulching equipment (water mixture spraying equipment).

When

Hydraulic mulch is typically applied when a temporary soil cover is required for protection until permanent vegetation is established, or to disturbed areas that must be re-disturbed following a period of inactivity of 14 or more days.

Where

- To disturbed areas requiring temporary protection.
- Do not apply to active work areas where the mulch would interfere with or be destroyed by immediate earthwork activities or construction traffic. Consider using soil binders instead (BMP 4-05).

How

- Prior to application, roughen embankment and fill areas with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical and slope angle allows safe equipment operation. Track walking must be performed upslope so that equipment tracks traverse the slope horizontally along the slope.
- Avoid mulch over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.
- Avoid use of mulch without a tackifier component, especially on slopes.
- Hydraulic Mulches:
    - Apply as liquid slurry using a hydraulic application machine (i.e., hydroseeder) at rates of mulch and stabilizing emulsion recommended by the manufacturer. Wood fiber hydraulic mulches are generally short-lived (only last a part of a growing season) and must be applied no less than 24 hours before rain events to dry and become effective.
        - Hydraulic Mulch with Binder (Matrix):
    - Apply a combination of wood fiber and/or paper fiber mixed with acrylic polymers as binders. Apply the mulch matrix as liquid slurry using a hydraulic application machine (i.e., hydroseeder) at rates recommended by the manufacturer. Hydraulic matrices must be applied no less than 24 hours before a rain event to dry and become effective.
        - Bonded Fiber Matrix (BFM):
    - Apply BFM using a hydraulic application machine (mulch and tackifier are pre-mixed in a single bag) in accordance with manufacturer's instructions. Do not apply immediately before, during, or after a rain event.
    - Note that cellulose fiber mulches alone may not perform well on steep slopes or in coarse soils.

Maintenance and Inspection

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked. Inspect before expected rain and repair any damaged ground cover and re-mulch areas of exposed soil (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable).
- After any rain event, maintain all slopes to prevent erosion.

Pictures

Applying hydraulic mulch.

Close-up of bonded fiber matrix

Corresponding CASQA Fact Sheet

Fact Sheet EC-3

What

Hydroseeding is a procedural BMP for the application of vegetation seed in a protective mixture for both soil and seed. The seed then sprouts, providing vegetation that provides additional soil erosion control (holds the soil in place and shields the soil from erosion). Hydroseeding material typically consists of a mixture of fiber, seed, fertilizer, and stabilizing emulsion.

When

- When temporary protection is needed until permanent vegetation protection can be established. Temporary vegetation should not be used for more than 3 to 6 months.
- Avoid using hydroseeding during dry weather periods, unless supplemental irrigation is used.

Where

- Use on disturbed soil areas that must be re-disturbed following construction inactivity of 14 or more days.
- Avoid use of hydroseeding in areas where the BMP would be incompatible with site conditions. These conditions include:
  - Slopes steeper than 1:3 vertical: horizontal. Steep slopes are difficult to protect with temporary seeding.
  - Traffic areas, where construction or other traffic would prevent seed sprouting or vegetation growth. Consider using soil binders instead (see BMP 4-05).

How

- Hydroseeding can be accomplished using a multiple-step (with straw mulch) or a one-step process (mixed with hydraulic mulch, hydraulic matrix, or bonded fiber matrix). When the one-step process is used to apply the mixture of fiber, seed, etc., the seed rate shall be increased to compensate for all seed not having direct contact with the soil. Confirm with your project Field Environmental Representative the appropriate seed mix to be used.
- Prior to application roughen the slope, fill area, or area to be seeded with the furrows trending along the contours.
- Apply straw mulch as necessary to keep seeds in place and to moderate soil moisture and temperature until the seeds germinate and grow.
- Follow-up applications shall be made as needed to cover weak spots, and to maintain adequate soil protection.
- Avoid over-spray onto the travel way, sidewalks, drainage channels and existing vegetation.

Maintenance and Inspection

- All seeded areas shall be inspected for failures and re-seeded, fertilized, and mulched within the planting season, using not less than half the original application rates. Any temporary re-vegetation effort that does not provide adequate cover must be re-vegetated.
- After any rainfall event, maintain all slopes to prevent erosion.

Pictures

Applying hydroseed.

Corresponding CASQA Fact Sheet

Fact Sheet EC-4

What

Soil Binders is a procedural BMP for applying soil binder material to the soil surface to temporarily prevent water-induced erosion of exposed soils on construction or applicable operations and maintenance sites. Soil binders bind with the soil, creating a crust that sheds water and prevents the water erosion. Soil binders also provide temporary dust, wind, and soil stabilization benefits.

When

Soil binders are typically applied to disturbed soil areas that require short-term temporary protection.

Soil binders have the following application timing limitations:

- May not cure when low temperatures occur within 24 hours of application.
- Soil binders generally experience spot failures during heavy rain and may need reapplication after a storm.
- Some soil binders may not perform well during periods of low relative humidity.

Where

Soil binders can be used for any disturbed soil area. Soil binders can often be incorporated into the work so they may be a good choice for areas where grading activities will soon resume or that experience light construction traffic.

Soil binders have the following limitations for particular areas of application:

- Soil binders may not penetrate areas where soil surfaces are made up primarily of silt and clay, particularly when compacted.
- Soil binders may not hold up well in areas of heavy pedestrian or medium to heavy vehicular traffic.

How

Selection of soil binders should be approved by the project Field Environmental Representative after an evaluation of site-specific factors. Chemical soil binders must be on the SDG&E List of Approved Products. These approved soil binder products have low or no toxicity to aquatic organisms and wildlife and may not trigger the construction site sampling requirements of the CGP. Follow manufacturer's recommendations for application procedures and cleaning of equipment after use. Any onsite cleaning must use appropriate BMPs (BMP 2-02 "Material Use", 2-03 "Spill Control", 2-04 "Solid Waste Management", 2-08 "Liquid Waste/Drilling Fluid Management", and 3-03 "Vehicle and Equipment Washing").

- Prior to application, roughen embankment and fill areas. Track walking shall only be used where rolling is impractical.
- Soil binders should not be applied during or immediately before rain events. Soil binders must be applied no less than 24 hours before rain to cure and dry and become fully effective.
- Avoid over-spray onto paths, sidewalks, lined drainage channels, sound walls, and existing vegetation.

IMPORTANT POINT

- **Do not apply soil binders to frozen soil, areas with standing water, under freezing conditions, or when the temperature is below 40ºF during the curing period.**
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- For liquid agents:
    - Crown or slope ground to avoid ponding.
    - Uniformly pre-wet ground according to manufacturer's recommendations.
    - Apply solution under pressure. Overlap solution 6 to 12 inches.

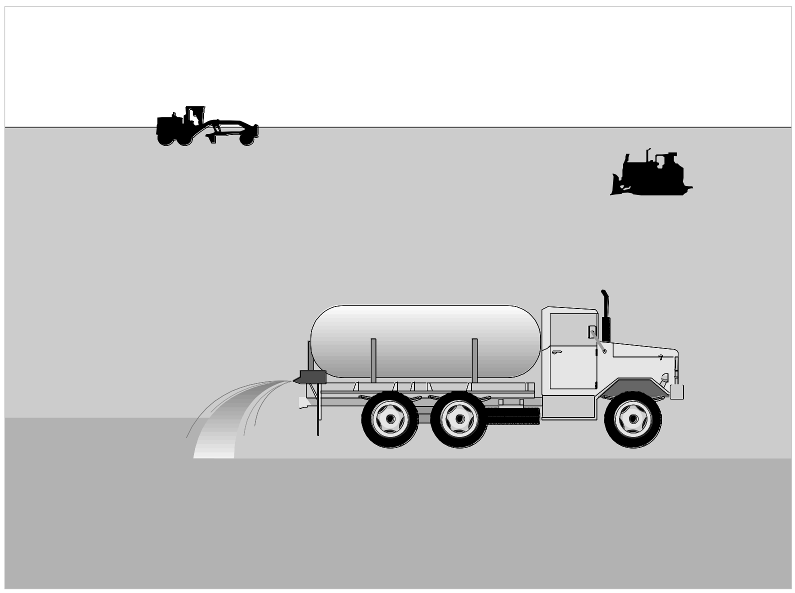
How (cont')

- Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
- Apply second treatment before first treatment becomes ineffective, using 50 percent application rate.
- In low humidity, reactivate chemicals by re-wetting according to manufacturer's recommendations.

Maintenance and Inspection

- Reapplying the selected soil binder may be needed for proper maintenance. Traffic areas should be inspected routinely.
- After any rainfall event, maintain all slopes to prevent erosion.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet EC-5

What

Straw Mulch is a procedural BMP for the application of a uniform layer of straw to exposed soil surfaces to protect exposed soil from rain and wind erosion. Straw mulch consists of straw, and may incorporate a tackifier emulsion for stabilization of the mulch when used for protecting sloped areas of exposed soil.

When

Straw mulch is used when:

- Temporary soil stabilization surface cover is needed on disturbed areas until soils can be prepared for re-vegetation and permanent vegetation is established.
- In combination with temporary and/or permanent seeding strategies to enhance plant establishment. Straw mulch typically lasts less than six months.

Limitation: There is a potential for introduction of weed-seed and unwanted plant material with straw. Certified Weed free rice straw must be used when it is important not to introduce unwanted plants.

Where

Application of straw mulch is applicable to flat areas of exposed soil and areas of exposed soil with gradual slopes.

How

Use tackifier to anchor straw mulch to the soil on slopes. Tackifiers act to glue the straw fibers together and to the soil surface, and the tackifier shall be selected based on longevity and ability to hold the fibers in place. Soil binders (tackifier) will generally experience spot failures during heavy rain events. A tackifier is typically applied at a rate of 125 pounds per acre. In windy conditions, the rates are typically 150 pounds per acre.

- Crimping, punch roller-type rollers, or track-walking may also be used to incorporate straw mulch into the soil on slopes. Track walking shall only be used where other methods are impractical.
- Avoid placing straw onto construction traffic ways, sidewalks, lined drainage channels, and existing vegetation.
- Straw mulch with tackifier shall not be applied during or immediately before rain events.
- Apply loose straw at a rate between 3,000 and 4,000 pounds per acre (lb/acre), either by machine using a straw blower or by hand distribution and provide 100 percent ground cover. Use a lighter application on flat surfaces and a heavier application on slopes.
- The straw mulch must be evenly distributed on the soil surface.
- Anchor mulch in place by "punching" it into the soil mechanically in lieu of using a tackifier. "Punching" of straw does not work in sandy soils.
- Methods for holding the straw mulch in place depend on the slope steepness, accessibility, soil conditions and longevity. If the selected method is incorporation of straw mulch into the soil, then proceed as follows:
    - A tackifier acts to glue the straw fibers together and to the soil surface. Selection of a tackifier should be based on longevity and ability to hold the fibers in place. Application of a tackifier is typically at a rate of 125 lb/acre and 180 lb/acre in windy conditions.
    - On very small areas, a spade or shovel can be used.
    - On soil slopes which are stable enough, and gradually sloped to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife-blade roller or a straight bladed coulter, known commercially as a "crimper."

How (cont')

- On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes (BMP 4-07), "
- On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes (BMP 4-07, "Geotextiles, Plastic Covers, and Erosion Control Blankets/Mats").

- Remove straw as necessary prior to permanent seeding or soil stabilization.

Maintenance and Inspection

- The key consideration in maintenance and inspection is that the straw needs to last long enough to achieve erosion control objectives.
- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.
- After any rain event, inspect and maintain all slopes and straw mulch cover to prevent erosion.

Pictures

Straw mulch.

Corresponding CASQA Fact Sheet

Fact Sheet EC-6

What

This Erosion Control and Soil Stabilization BMP is a procedural BMP for the installation of specific erosion control soil stabilization materials to control erosion from wind and water. These materials consist of:

- Geotextile blankets/mats,
- Plastic covers, and
- Natural/man-made material erosion control blankets.

Geotextiles are permeable fabrics typically made from polypropylene (plastic) or polyester that have the ability to protect the soil from erosion but are able to allow some water to reach and to drain the soil. Geotextile fabrics come in three basic forms: woven, needle punched, or heat bonded. Geotextiles also allow controlled rate and filtered drainage from a slope for slope moisture control, while providing slope reinforcement and protection.

Plastic Covers, such as Visqueen, are essentially impermeable and are used for immediate, temporary protection.

Erosion control blankets/mats are meant to protect exposed soil from wind and rain impact and reduce the speed at which water moves across the soil surface. These blankets can be made out of straw, coconut fiber, aspen fiber, jute, and polypropylene. Permeability varies according to material and material weave.

When

- Use blankets/mats when disturbed soils, especially on moderate to steep slopes, are difficult to stabilize or access. Due to wildlife concerns, consult with your project Field Environmental Representative for any restrictions on using these products on your project.
- Geotextile blanket/mats should be used when slope reinforcement may be required.
- Geotextile blankets/mats and natural fiber blankets/mats (depending on their permeability) are used when it is important to allow some water to reach the soil for seed germination or allow slope drainage for moisture control.

Where

- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (because staples and netting can catch in mowers).
- Plastic results in 100 percent runoff, therefore, their use is limited to:
    - Covering small stockpiles.
    - Covering small graded areas for short periods, such as through an imminent storm event, until alternative measures may be installed.
    - Note the CGP discourages the use of plastic materials for cover when more sustainable alternatives can be used.

Blankets/mats should be used where there are:

- Steep slopes, generally steeper than 1:3 (vertical: horizontal).
- Slopes where the erosion hazard is high.
- Slopes and disturbed soils where mulches would need to be anchored.
- Disturbed areas where plants are slow to develop adequate protective cover.
- Channels with high flows.
- Channels intended to be vegetated.
- Slopes adjacent to water bodies or ESAs).

How

For blankets or mat materials, proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.

How (cont.)

- Grade and shape the area of installation.
- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.
- Prepare seedbed by loosening of topsoil.
- Seed the area before blanket installation for erosion control and vegetation. Seeding after mat installation is often specified for turf reinforcement. When seeding prior to blanket installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.
- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples and metal stakes should be driven flush to the soil surface.
- All anchors should be 6 inches to 18 inches long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.
- Installation on slopes – Consult the manufacturer's recommendations for installation. In general, these will be as follows:
  - Begin at the top of the slope and anchor the blanket in a 6 inch deep by 6 inch wide trench. Backfill trench and tamp earth firmly.
  - Unroll blanket down slope in the direction of water flow.
  - Overlap the edges of adjacent parallel rolls 2 inches to 3 inches and staple every 3 feet.
  - When blankets must be spliced, place blankets end over end (shingle style) with a 6 inch overlap. Staple through overlapped area, approximately 12 inches apart.
  - Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
  - Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples shall be placed down the center and staggered with the staples placed along the edges.
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- For plastic sheeting, it is important for the entire stockpile or exposed soil area to be covered completely, and the plastic firmly anchored with anchor objects spaced evenly along the entire perimeter so that wind, or storm water run-on, does not uncover the stockpile. Suitable anchors are gravel bags, sand bags, hay bales, or other non-polluting objects that can be safely handled.

Maintenance and Inspection

- Areas covered with temporary soil stabilization should be inspected routinely and before and after significant forecasted storm events. Any failures should be repaired immediately. Areas covered with temporary soil stabilization should be maintained to provide adequate erosion control. Temporary soil stabilization should be reapplied or replaced on exposed soils when greater than 10 percent of the previously covered area becomes exposed or exhibits visible erosion.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.

Pictures

Several types of erosion control blankets.

Corresponding CASQA Fact Sheet

Fact Sheet EC-7

What

Dust (Wind Erosion) control is a procedural BMP that consists of applying water or other dust suppressant to prevent or alleviate dust nuisance generated by construction and operations and maintenance activities.

When

- Dust control must be used whenever wind speed picks up dust and creates visual dust emissions. Dust control should be used at least initially on any project when exposed soil is subject to vehicle traffic and soil disturbance activities (e.g., dirt construction site, dirt access road traffic, grading, excavating, and soil stockpile generation, or soil removal from soil stockpiles).
- Dust control must be implemented in accordance with local air quality requirements.

Where

All construction and operations and maintenance activity sites where exposed soil is susceptible to wind erosion.

How

Use the following measures as applicable:

- Appropriate methods of applying dust control (water, chemical dust suppressant, or soil covers and the means to apply it) should be available for construction or operation and maintenance activity sites with the potential to create dust.
- Water applied for dust control should be applied evenly and in a manner that does not generate runoff.
- Dust control methods should be approved by the project Field Environmental Representative. A construction permit or an agency rule may require specific control procedures.
- Obtain prior approval to use any chemical dust suppressant from the project Field Environmental Representative. Dust suppressant chemicals must be on SDG&E's approved product list
- Non-potable water should not be conveyed in tanks or drainpipes that will be used to convey potable water, and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes and other conveyances should be marked **"NON-POTABLE WATER – DO NOT DRINK."** Approval for use of all non-potable sources of water must be obtained from the project Field Environmental Representative.

IMPORTANT POINT

- If reclaimed wastewater is used for dust control, the sources and discharge must meet California Department of Health Services water reclamation criteria and RWQCB requirements. Approval for use of reclaimed wastewater must be obtained from the project Field Environmental Representative.

Maintenance and Inspection

- Check areas protected to ensure coverage.
- Reapply water, chemical dust suppressants, or maintain soil covers as necessary to maintain their effectiveness.

Pictures

Water being applied for dust control.

Corresponding CASQA Fact Sheet

Fact Sheet WE-1

What

A diversion berm is a temporary berm of compacted soil used to direct runoff water to a desired location. A drainage swale is a shaped and sloped soil depression used to convey runoff to a desired location. Diversion berms and drainage swales divert off site runoff around the construction or operation and maintenance site, divert runoff from flowing onto stabilized areas and disturbed areas, and direct runoff into sediment basins or traps. A diversion berm or swale itself does not control erosion or remove or trap sediment from runoff.

Limitations:

- Diversion berms may create disturbed areas and become construction equipment barriers.
- Diversion berms must be stabilized immediately, adding cost and maintenance.
- Diverted storm water may cause downstream flood damage.
- Berms should not be constructed of easily eroded soils.
- Regrading the site to remove the berm may add cost.
- Other soil stabilization and sediment controls such as check dams, plastics, and blankets may be needed to prevent erosion in newly graded berms and swales.
- Sediment accumulation, scour depression, and/or persistent non-storm water discharges can result in standing water suitable for mosquito production.

When

Diversion berms and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area to another. These BMPs may be used:

- To direct runoff away from disturbed areas or at the top of slopes.
- To convey surface runoff down sloping land.
- To divert runoff towards a stabilized watercourse, drainage pipe, or channel.
- To intercept runoff from paved surfaces.
- To divert sediment laden runoff into sediment basins or traps.

Where

Diversion berms and drainage swales should be considered:

- At the top of slopes to divert run-on from adjacent or undisturbed slopes.
- At bottom and mid-slopes to intercept sheet flow and convey concentrated flows.
- Below steep grades where runoff begins to concentrate.
- Along roadways and facility improvements subject to flood drainage.
- Berms should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger drainage areas, more permanent drainage structures should be built in accordance with local requirements.
- Drainage areas more than 5 acres should not drain to a temporary drainage swale. For larger drainage areas, use berms, or more permanent drainage structures should be built in accordance with local requirements.

How

Berms and swales should not adversely affect adjacent properties and must conform to local floodplain management regulations. Obtain written

How (cont.)

authorization from property owner to divert runoff onto another property.

- Care must be applied to correctly size and locate berms and drainage swales.
- Conveyances and outlets should be stabilized.
- Size to control flow velocity based on evaluation of the erosion risk, soil types, overtopping, flow backups, washout, and site drainage flow patterns.
- Install permanent berms and swales early in the construction process.

Diversion Berms:

- Compact all berms and provide positive drainage to an outlet.
- All berms should have 1:2 (vertical: horizontal) or flatter side slopes, and minimum 18-inch height, and minimum 24-inch top width. Wide top widths and flat slopes are usually needed for construction traffic crossings.
- Runoff should be conveyed to a sediment trapping device when the berm channel or the drainage area above the berm are not adequately stabilized.
- Temporary stabilization may be achieved using seed and mulching for slopes less than 5 percent and either riprap or sod for slopes greater than 5 percent. Stabilization should be completed immediately after installation/placement.
- If riprap is used to stabilize the channel formed along the toe of the berm, the following typical specifications apply:

Channel Grade	Riprap Stabilization
0.5 - 1%	4 inch Rock
1.1 - 2.0%	6 inch Rock
2.1 - 4.0%	8 inch Rock
4.1 - 5.0%	8 to 12 inch Riprap

- The riprap, recycled concrete, etc. should be pressed into the soil with construction equipment.
- Filter fabric may be used to cover berms in use for long periods.
- Construction activity on the earthen berms should be kept to a minimum.

Drainage Swales:

Standard engineering design criteria for small open channel and closed conveyance systems should be used. Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 feet, and the depth of the swale should be at least 18 inches. The swale side slopes should be 1:2 (vertical: horizontal) or flatter.
- Drainage swales should be at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria above.

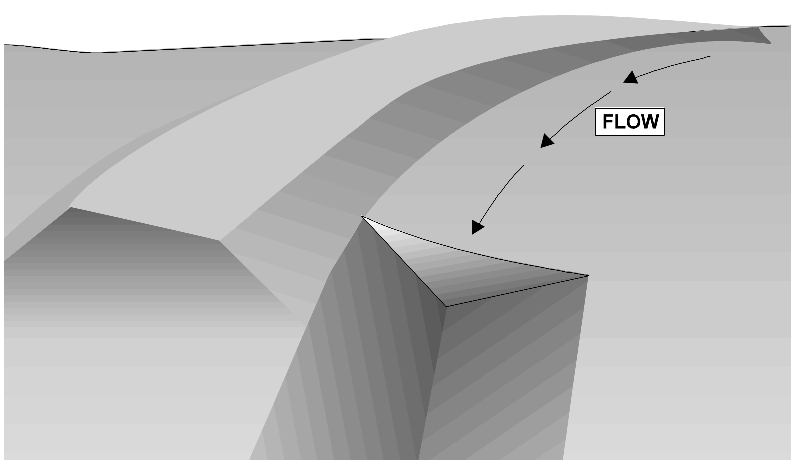
How (cont.)

- Remove all vegetation and other objectionable materials and compact the fill material along the swale path.
- Stabilize all swales immediately after installation/placement. Seed and mulch swales with slopes of less than 5 percent and use riprap or sod for swales with slopes between 5 and 15 percent. For temporary swales, geotextiles and mats may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a California Registered Civil Engineer.
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach erosive velocity.

Maintenance and Inspection

- Inspect berms and drainage swales dams prior to, daily during, and after each storm event, and routinely throughout the construction activity (e.g., weekly, or in compliance with the frequency specified in the CGP, if applicable).
- Inspect BMPs subject to non-storm water discharges daily while the discharges occur.
- Inspect ditches and berms for washouts and erosion. Repair riprap, damaged linings, or soil stabilizers, and linings as needed.
- Inspect channel linings, embankments, and beds of swales and berms for erosion and accumulation of debris and sediment. Remove accumulated debris and sediment as needed. Removed sediment shall be incorporated in the project at appropriate locations or disposed of in accordance with federal, state and local requirements.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has stabilized or at the completion of construction.

Pictures



Corresponding CASQA Fact Sheet	Fact Sheet EC-9

What

Velocity dissipation devices are composed of rock, riprap, grouted riprap or concrete rubble, placed at the outlet of a pipe, channel, or waterbar to prevent scour and erosion caused by concentrated high velocity flows. There are many types of dissipation devices.

Limitations:

- Large storms or high flows can wash away the outlet protection and leave the area susceptible to erosion.
- Sediment captured by the outlet protection may be difficult to remove without removing the protection.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- With inadequate drainage, water may build up behind and break grouted riprap.
- Sediment accumulation, scour depression, and/or persistent non-storm water discharges can result in standing water suitable for mosquito production.

When

Velocity dissipation devices are suitable when discharge velocities and energies at the outlets of culverts, conduits, waterbars, or channels are sufficient to erode the next downstream reach.

Where

Velocity dissipation devices should be considered:

- At outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, channels, waterbars, etc.
- At outlets located at the bottom of mild to steep slopes.
- At discharge outlets that carry continuous water flow.
- At outlets subject to short, intense water flows, such as flash floods.
- At points where lined conveyances discharge to unlined conveyances.

How

Depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should be considered, particularly while working in environmentally sensitive streambeds.

- Determine the apron length and rock size gradation using the discharge pipe diameter and estimated discharge rate table below. Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Recommendations for rock size and length of outlet protection mat should be considered minimums. Use sound, durable, and angular rock.
- Where flows are conveyed in open channels such as ditches or swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be the same as the culvert or channel design flow but never less than the pear 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.
- Install filter fabric, riprap, grouted riprap, or concrete apron at selected outlet. Install filter fabric or well-graded filter layer beneath the riprap apron. Riprap aprons are best suited for temporary use during construction. Grouted or wired riprap can minimize maintenance.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters, and serves to trap sediment and reduce flow velocities.

How (cont.)

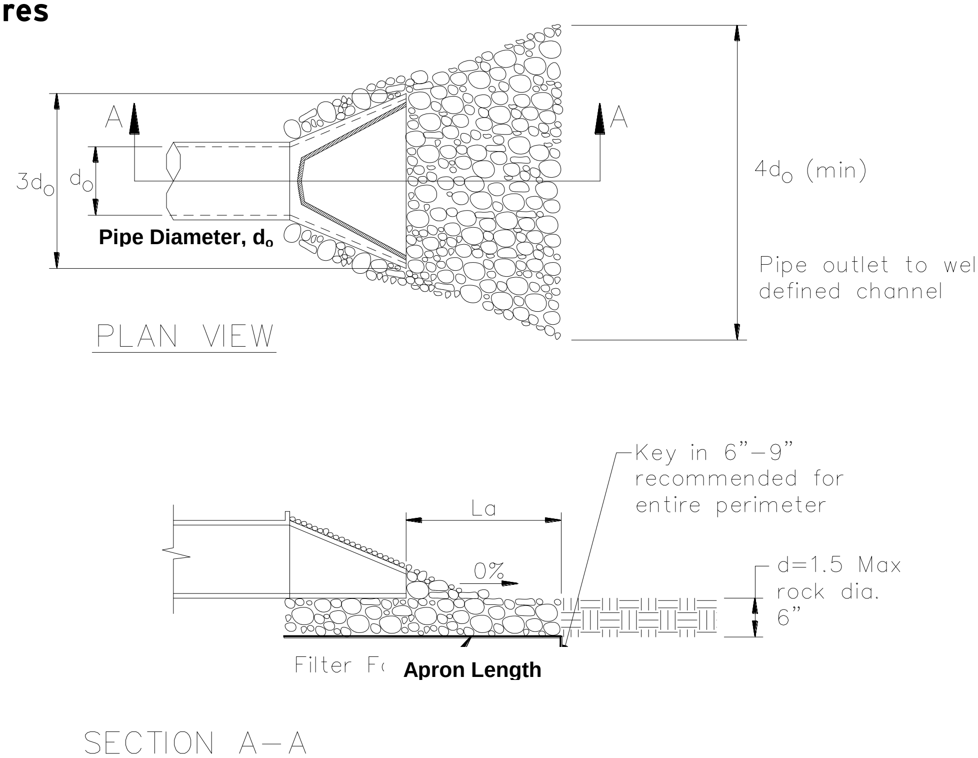
- Carefully place riprap to avoid damaging the underlying filter fabric.
    - Rock 4 to 6-inches may be carefully dumped onto the filter fabric from a maximum height of 12 inches.
    - 8- to 12-inch rock must be hand placed onto filter fabric, or the filter fabric may be covered with 4 inches of gravel, and the rock may be dumped from a maximum height of 16 inches.
    - Rock greater than 12 inches shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one-half the D_{50} rock size, with the dump height limited to twice the gravel protection layer thickness.
- Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of the apron.
- Outlets on slopes steeper than 10 percent should have additional protection.

Pipe Diameter (in)	Discharge (ft^3/s)	Apron Length (ft)	Min. Riprap D_{50} Diameter (in)
12	5	10	4
	10	13	6
18	10	10	8
	20	16	12
	30	23	16
	40	26	8
24	30	16	8
	40	26	12
	50	26	16
	60	30	8

Maintenance and Inspection

- Inspect velocity dissipation devices prior to and after each rain event, and daily during extended rain events throughout the construction activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect BMPs subject to non-storm water discharges daily while the discharges occur. Minimize standing water by removing sediment blockages and filling depressions.
- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.
- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.
- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet EC-10

What

A slope drain is a pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains are typically used with diversion berms and drainage ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes. Slope drains prevent storm water from flowing directly down the slope by confining the runoff into an enclosed pipe or channel. The slope drain may be installed as a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with a top of a slope inlet and a bottom of a slope outlet.

Limitations:

- Slope drain sizing, installation, and maintenance is critical to minimize the potential for failure. Severe erosion may result when slope drains fail by overtopping, pipe separation, or other signs of erosion.
- Dissipation of high flow velocities at the pipe outlet is required to avoid erosion.
- Sediment accumulation, scour depression, and/or persistent non-storm water discharges can result in standing water suitable for mosquito production.

When

Slope drains are suitable when:

- Concentrated runoff flow must be conveyed down a slope.
- Drainage is needed for top of slope diversion dikes or swales.
- Drainage is needed for top of cut and fill slopes where water can accumulate.
- Emergency spillway is required for a sediment basin.

Where

Slope drains should be considered where:

- The drainage area is less than 10 acres per slope drain. For larger areas, use a rock-lined channel, or subdivide into areas of 10 acres or less, with each area is treated as a separate drainage.
- Drainage areas exceeding 10 acres must be designed by a California Registered Civil Engineer and approved by the agency that issued the grading permit.

How

- Permanent structures included in the project plans can often serve as construction BMPs if implemented early. However, the permanent structure must meet or exceed the criteria for the temporary structure.
- Slope drains and inlets must be securely attached to the slope and must be adequately sized to carry the capacity of the design storm and associated forces.
- Outlets must be stabilized with riprap, concrete, or other type of energy dissipater, or directed into a stable sediment trap or basin.
- Debris racks are recommended at the inlet. Debris racks are barriers used to collect debris that is too large to pass through the inlet. Debris racks located several feet upstream of the inlet can usually be larger than racks at the inlet, and thus provide enhanced debris protection and less plugging.

How (cont.)

- Safety racks are also recommended at the inlet and outlet of pipes to prevent a human body or animal from washing into the pipe and/or becoming trapped.
- Size to convey at least the peak flow of a 10-year storm. The design storm is conservative due to the potential impact of system failures. The pipe size may be computed using the Rational Method or a method established by a local municipality. Higher flows must be safely stored or routed to prevent any offsite concentration of flow or erosion.Maximum slope generally limited to 1:2 (vertical: horizontal) as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. Top of interceptor dikes should be 12 inches higher than the top of the slope drain.
- Slope drains can be placed on or buried beneath the slope surface.
- As a guide, temporary slope drains should not be sized smaller than shown in the following table:

Minimum Pipe Diameter (inches)	Maximum Drainage Area (Acres)
12	1.0
18	3.0
21	5.0
24	7.0
30	10.0

- Recommended materials include metal, plastic, or concrete pipe, either corrugated or smooth wall. The following types of slope drains are common:
  - Rigid Pipe: Also known as a pipe drop, the pipe usually consists of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured to the slope surface or buried in a trench. Concrete thrust blocks must be used when warranted by the calculated thrust forces. Collars should be properly installed and secured with straps or watertight collars.
  - Flexible Pipe: The pipe consists of a flexible tube of heavy duty plastic, rubber, or composite material. The tube material is securely anchored to the slope surface. The tube should be securely fastened to the metal inlet and outlet conduit sections with metal straps or watertight collars.
  - Section Downdrains: The section downdrain consists of a pre-fabricated, section conduit of half round or third round material, and performs similar to a flume or chute. The pipe must be placed on undisturbed or compacted soil and secured into the slope.
  - Concrete-Lined Terrace Drain: This concrete channel drains water from a slope terrace to the next level. These drains are typically specified as permanent structures and should be designed according to local criteria. If installed early, they can be construction slope drains.

How

(cont.)

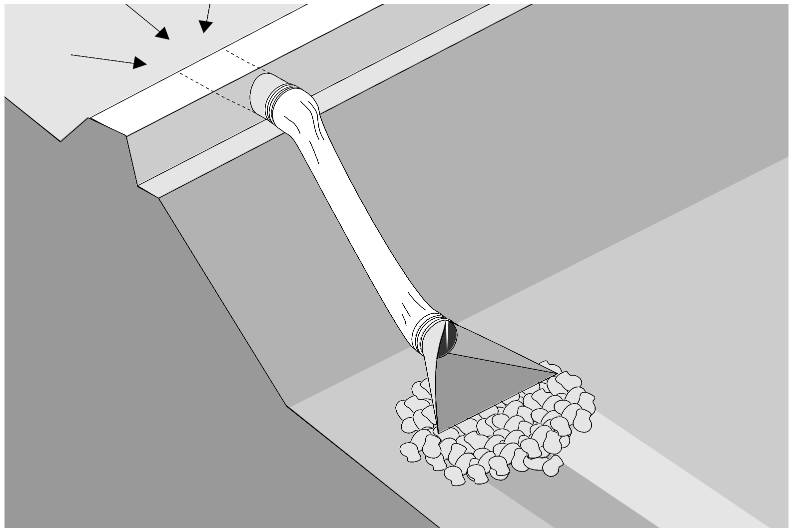
When installing slope drains:

- Install perpendicular to slope contours.
- Compact soil around and under entrance, outlet, and along length of pipe.
- Securely anchor and stabilize pipe appurtenances into soil.
- Check to ensure that pipe connections are watertight.
- Protect areas around inlet with filter fabric. A flared end section installed at the inlet will improve flow into the slope drain and prevent erosion at the pipe entrance. Use a flared section with a 6-inch minimum toe plate to help prevent undercutting. The flared section should slope towards the pipe inlet.
- Protect outlet with riprap or other energy dissipation device. Protect outlet of slope drains using a flared end section when outlet discharges to a flexible energy dissipation device.

Maintenance and Inspection

- Inspect slope drains prior to and after each storm event, and daily during extended rain events throughout the construction activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect BMPs subject to non-storm water discharges daily while the discharges occur. Minimize standing water by removing sediment blockages and filling depressions.
- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.
- Insert inlet for clogging or undercutting. Remove debris from inlet to maintain flows. Repair undercutting at inlet, and if needed, install flared section or riprap around the inlet to prevent further undercutting.
- Inspect pipes for leakage. Repair leaks and restore damaged slopes.
- Inspect slope drainage for accumulations of debris and sediment. Remove sediment from entrances and outlets as required. Flush drains as necessary; capture and settle out sediment from discharge.
- Ensure water is not ponding onto inappropriate areas (e.g. active traffic lanes, material storage areas, etc.).
- Pipe anchors must be checked to ensure that the pipe remains anchored to the slope. Install additional anchors if pipe movement is detected.

Pictures



Corresponding CASQA Fact Sheet

Fact Sheet EC-11

What

Streambank stabilization includes measures to reduce the discharge of sediment from streambanks with exposed or disturbed soil, or unstable banks. Streambank stabilization measures include preservation of existing vegetation, hydraulic mulch, hydroseeding, soil binders, straw mulch, geotextiles and mats, berms, and drainage swales, velocity dissipation devices, and slope drains. Streambank sediment controls include silt fences, fiber rolls, gravel bag berms, rock filters, and K-rail barriers, and padding. Each of these measures have different applications, limitations, and maintenance requirements for use as streambank stabilization.

Stream channels, streambanks, and associated riparian areas are dynamic and sensitive ecosystems that respond to changes in land use. Streams on the 303(d) list and listed for sediment may require numerous measures to prevent any increases in sediment load to the stream.

General streambank stabilization limitations:

IMPORTANT POINT

- **Specific permit requirements or mitigation measures such as RWQCB 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by the California Department of Fish and Game supersede the guidance in this BMP.**
- If numerical water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. Soil disturbance activities in watersheds having streams listed as 303(d) impaired for sediment, silt, or turbidity, may require sampling to verify that there is no net increase in sediment load.

When

When construction or operations and maintenance activities occur within stream channels and associated riparian areas.

Where

Streambank stabilization procedures apply to all construction projects and operations and maintenance activities that disturb or occur within stream channels and their associated riparian areas.

How

Planning should account for: scheduling; avoidance of wet in-stream construction; minimizing disturbance and construction time period; selecting crossing location; and selecting equipment.

IMPORTANT POINT

- **Construction and operation and maintenance activities should be scheduled according to the relative sensitivity of the environmental concerns and will be different when working near perennial streams vs. ephemeral streams.**
- Minimize disturbance by using pre-disturbed areas, selecting the narrowest crossing location, limiting vehicle crossing trips, and minimizing the number and size of work areas. Plan work areas at least 50 feet from the stream channel.
- Avoid steep and unstable banks, highly erodible or saturated soils, or highly fractured rock.
- Select a project or work site that minimizes disturbance to aquatic species or habitat.
- Select equipment that reduces the amount of pressure exerted on the ground surface (less than 5 or 6 pounds per square inch where possible.

Maintenance and Inspection

- Inspect streambank stabilization BMPS prior to and after each storm event, and daily during extended rain events throughout the construction activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Inspect BMPs subject to non-storm water discharges daily while the discharges occur.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets, etc.).

Pictures

Cobble or gravel armor used for streambank stabilization.

Corresponding CASQA Fact Sheet

Fact Sheet EC-12

What

Soil preparation/roughening involves assessment and preparation of surface soils for BMP installation. This includes soil testing (for seed base, soil characteristics, or nutrients), or roughening surface soils by mechanical methods (including sheepsfoot rolling, track walking, scarifying, stair stepping, and imprinting) to prepare soils for additional BMPs or to break up sheet flow. Soil preparation can also involve tilling topsoil to prepare a seed bed and/or incorporation of soil amendments to enhance vegetative establishment. Various roughening techniques on slopes can result in a significant erosion reduction as compared to smooth slopes.

Limitations:

- Preparation and roughening must take place prior to installing other erosion controls (such as hydraulically applied stabilizers) or sediment controls (such as fiber rolls) on slope faces.
- In cases where slope preparation is minimal, erosion control/revegetation BMPs that do not require extensive soil preparation (such as hydraulic mulching and seeding applications) should be employed.
- Consideration should be given to the type of erosion control BMP that follows surface preparation, as some BMPs are not designed to be installed over various types of tillage/roughening.

When

- Soil preparation is most effective when used in combination with erosion controls. Soil preparation (i.e. tilling, raking, and amendment) is essential to proper vegetative establishment, and suitable in combination with any soil stabilization method, including rolled erosion control products (RECPs) or sod.
- Soil roughening is suitable for use as a complementary process to soil preparation for controlling erosion, and is not intended to be used as a stand-alone BMP. Soil roughening should be used with perimeter controls, additional erosion control measures, grade breaks, and vegetative establishment for maximum effectiveness. Soil roughening is referred to as track walking (sometimes called imprinting) a slope, where treads from heavy equipment run parallel to the slope contours and create terraces. Roughening is intended to only affect surface soils and should not compromise slope stability or overall compaction.

Where

Soil preparation should be considered:

- Where vegetation is desired.

Soil roughening should be considered:

- Along any disturbed slopes, including temporary stockpiles, sediment basins, or compacted soil diversion berms and swales.
- Roughening should be used in combination with hydraulically applied stabilization methods, compost blankets, or straw mulch; but should not be used in combination with RECPs or sod because roughening is intended to leave terraces on the slope.

How

Minimal materials are required unless amendments and/or seed are added to the soil. Most soil roughening/preparation can be done with standard construction equipment.

How (cont.)

Soil Preparation

- Where appropriate, soil should be prepared to receive the seed by disking or scarifying the surface to eliminate crust, improve air and water infiltration and create a more favorable environment for germination and growth.
- Based on soil testing, apply additional soil amendments (e.g. fertilizers, additional seed) to the soil to help with germination.

Cut Slope Roughening

- Stair-step grade or groove the cut slopes steeper than 1:3 (vertical: horizontal).
- Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are well suited to stair-step grading.
- Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" in toward the vertical wall.
- Do not make individual vertical cuts more than 2 feet or 3 feet high in soft or rock materials, respectively.
- Groove the slope using machinery to create a series of ridges and depressions that run across the slope on the contour.

Fill Slope Roughening

- Place on fill slopes with inclinations steeper than 1:3 (vertical: horizontal) in lifts not to exceed 8 inches, and ensure that each lift is properly compacted.
- Ensure that the slope face consists of loose, uncompacted fill 4 to 6 inches deep.
- Use grooving or tracking to roughen the face of slopes, if necessary.
- Do not blade or scrape the final slope face.

Roughening for Slopes to be Mowed

- Slopes which require mowing should be flatter than 1:3 (vertical: horizontal).
- Roughen these areas to shallow grooves by track walking, scarifying, sheepsfoot rolling, or imprinting. Excessive roughness is undesirable when mowing is planned.
- Space grooves less than 10 inches apart, and not less than 1 inch deep, and perpendicular to the direction of runoff (parallel to the slope contours).

Roughening with Tracked Machinery

- Limit roughening with tracked machinery to soils with a sandy textural component to avoid undue compaction of the soil surface.
- Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.

How (cont.)

- Seed and mulch roughened areas as soon as possible to obtain optimum seed germination and growth.

Maintenance and Inspection

- Inspect BMPs prior to and after each storm event, and daily during extended rain events throughout the construction activity (e.g., weekly, or in compliance with the frequency specified in the project specific SWPPP, if applicable). Initiate repairs related to a storm event within 72 hours of identifying the problem or as soon as possible but prior to the next predicted storm event, per the CGP.
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above original grade, then reseed and mulch as soon as possible.

Pictures

Sheepsfoot used for soil preparation

Corresponding CASQA Fact Sheet

Fact Sheet EC-15

REFERENCES

CASQA, 2009. California Stormwater Quality Association Stormwater Best Management Practice Handbook Portal: Construction, November 2009. https://www.casqa.org.

Sempra Energy, December 2002. Water Quality Construction Best Management Practices Manual.

ATS	Active Treatment Systems
Base	Construction and Operations Center
BFM	Bonded Fiber Matrix
BMP	Best Management Practices
Caltrans	California Department of Transportation
CASQA	California Stormwater Quality Association
CGP	California Construction General Permit
ES	Environmental Standard
ESA	Environmentally Sensitive Area
gpm	Gallons per minute
lb/acre	Pounds per acre
LID	Low Impact Development
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board – there are nine Water Boards located throughout California that are responsible for enforcing water quality standards within their individual boundaries.
SDG&E	San Diego Gas & Electric
SUSMP	Standard Urban Storm Water Mitigation Plan
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board – The State Board is responsible for protecting and preserving water quality and water rights in California.
Watershed	The total land area that contributes water to a river, stream, lake, or other body of water. Synonymous with drainage basin.
WDR	Waste Discharge Requirements

NOTES

NOTES

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