APPENDIX 4.1-6

Land Exchange Alternative
Preliminary Geotechnical Report

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Report No. 1312-02-B-3R2

Attention: **Ms. Liz Jackson**

Subject: ***Geotechnical Review of Tentative Map, Otay Ranch Village 14 and Planning Area 16/19 – Land Exchange EIR Alternative, County of San Diego, California***

Gentleperson:

Pursuant to your request, presented herein are the results of Advanced Geotechnical Solutions, Inc.'s, (AGS) Geotechnical Review of the proposed Tentative Map for Otay Ranch Village 14 and Planning Area 16/19 – Land Exchange Alternative, County of San Diego, California. AGS has been retained by JacksonPendo Development Company to complete the geotechnical services supporting the tentative tract approval process for this project.

As part of our services, AGS has conducted field mapping, subsurface exploration, laboratory testing, geotechnical engineering and geologic analysis related to the current Tentative Map for Otay Ranch - Proctor Valley Village 14 and Preserve.

The purpose of this geotechnical review is to evaluate the proposed Tentative Map/Preliminary Grading Plans relative to the near-site and on-site geologic and geotechnical conditions and provide conclusions and recommendations to aid in the development of the project. Tentative Map proposed grading prepared by Hunsaker & Associates was provided to AGS for preparation of this report. These maps are included in this document with appurtenant geologic and geotechnical data superimposed upon them.

Advanced Geotechnical Solutions, Inc., appreciates the opportunity to provide you with geotechnical consulting services and professional opinions. If you have any questions, please contact the undersigned at (619) 867-0487.

Respectfully Submitted,
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TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1. Background and Purpose 1
1.2. Scope of Study 1
1.3. Geotechnical Study Limitations 2
2.0 SITE LOCATION AND DESCRIPTION 3
2.1. Site Location and Description 3
2.2. Proposed Development 3
3.0 FIELD AND LABORATORY INVESTIGATION 5
3.1. Field Investigation 5
4.0 ENGINEERING GEOLOGY 6
4.1. Geologic Analysis 6
4.1.1. Literature Review 6
4.1.2. Aerial Photograph Review 6
4.1.3. Field Mapping 6
4.2. Geologic and Geomorphic Setting 6
4.3. Stratigraphy 7
4.3.1. Surficial Units 7
4.3.1.1. Artificial Fill (afu) 7
4.3.1.2. Topsoil/Colluvium (no map symbol) 8
4.3.1.3. Alluvium (Qal) 8
4.3.1.4. Older Alluvium (Qoa) 8
4.3.1.5. Landslide Debris (Qls) 8
4.3.2. Bedrock Units 8
4.3.2.1. Otay Formation – Fanglomerate (Tof) 8
4.3.2.2. Santiago Peak Volcanics (Jsp) 9
4.4. Geologic Structure and Tectonic Setting 9
4.4.1. Regional Faulting 9
4.4.2. Local Faulting 10
4.4.3. Geologic Structure 10
4.5. Groundwater 10
4.6. Non-seismic Geologic Hazards 11
4.6.1. Mass Wasting and Debris Flows 11
4.6.2. Rock Fall 11
4.6.3. Flooding 12
4.6.4. Subsidence and Ground Fissuring 12
4.7. Seismic Hazards 12
4.7.1. Surface Fault Rupture 12
4.7.2. Ground Motions 13
4.7.3. Liquefaction 13
4.7.4. Lateral Spreading 15
4.7.5. Seismically Induced Dynamic Settlement 15
4.7.6. Seismically Induced Landsliding 15
4.7.7. Earthquake Induced Flooding 15
5.0 GEOTECHNICAL ENGINEERING 16

5.1. Material Properties ... 16
5.1.1. Excavation Characteristics ... 16
5.1.2. Oversized Materials ... 17
5.1.3. Compressibility ... 18
5.1.4. Collapse Potential/Hydro-Consolidation ... 18
5.1.5. Expansion Potential ... 18
5.1.6. Shear Strength ... 18
5.1.7. Chemical and Resistivity Test Results ... 19
5.1.8. Earthwork Adjustments ... 19
5.1.9. Pavement Support Characteristics ... 20
5.2. Analytical Methods ... 21
5.2.1. Slope Stability Analysis ... 21
5.2.2. Pavement Design ... 21
5.2.3. Bearing Capacity and Lateral Pressure ... 21
6.0 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS ... 21
6.1. Site Preparation and Removals/Overexcavation ... 21
6.1.1. Site Preparation and Removals ... 22
6.1.2. Overexcavation ... 23
6.1.2.1. Cut Lot Overexcavation ... 23
6.1.2.2. Cut/Fill Transition Lot Overexcavation ... 23
6.1.2.3. Street Overexcavation ... 23
6.1.3. Removals Along Grading Limits and Property Lines ... 23
6.2. Slope Stability and Remediation ... 23
6.2.1. Cut Slopes ... 24
6.2.2. Fill Slopes ... 24
6.2.3. Skin Cut and Skin Fill Slopes ... 25
6.2.4. Fill Over Cut Slopes ... 25
6.2.5. Surficial Stability ... 25
6.2.6. Temporary Backcut Stability ... 25
6.2.7. Observation During Grading ... 26
6.3. Survey Control During Grading ... 26
6.4. Subsurface Drainage ... 26
6.5. Seepage ... 26
6.6. Earthwork Considerations ... 27
6.6.1. Compaction Standards ... 27
6.6.2. Mixing and Moisture Control ... 27
6.6.3. Haul Roads ... 27
6.6.4. Import Soils ... 27
6.6.5. Rock Excavation Considerations and Potential Grading Impacts ... 27
6.6.6. Oversize Rock ... 28
6.6.6.1. Rock Blankets ... 28
6.6.6.2. Rock Windrows ... 29
6.6.6.3. Individual Rock Burial ... 29
6.6.6.4. Rock Disposal Logistics ... 29
6.6.7. Fill Slope Construction ... 29

6.6.7.1. Overbuilding Fill Slopes ... 29
6.6.7.2. Compacting the Slope Face ... 30
6.6.8. Utility Trench Excavation and Backfill ... 30
7.0 DESIGN RECOMMENDATIONS ... 30
7.1. Structural Design Recommendations ... 31
7.1.1. Foundation Design ... 31
7.1.1.1. Deepened Footings and Setbacks ... 31
7.1.1.2. Moisture and Vapor Barrier ... 32
7.1.2. Retaining Wall Design ... 32
7.1.3. Seismic Design ... 34
7.2. Civil Design Recommendations ... 35
7.2.1. Rear and Side Yard Walls and Fences ... 35
7.2.2. Drainage ... 35
7.2.3. Water Quality Basins/ Drainage ... 35
7.2.4. Pavement Design ... 36
8.0 FUTURE STUDY NEEDS ... 36
9.0 CLOSURE ... 37
9.1. Geotechnical Review ... 37
9.2. Limitations ... 37

ATTACHMENTS:

FIGURE 1- REGIONAL LOCATION MAP
FIGURE 2- SITE LOCATION MAP
FIGURE 3- LAND EXCHANGE ALTERNATIVE PLAN
FIGURE 4- SITE UTILIZATION PLAN
FIGURE 5- REGIONAL GEOLOGY MAP
FIGURE 6- FAULT ACTIVITY MAP OF CALIFORNIA
FIGURE 7- NEAR SOURCE SHAKING ZONES
FIGURE 8- POTENTIAL LIQUEFACTION AREAS

PLATES 1 THROUGH 7- GEOLOGIC MAP AND EXPLORATION LOCATION PLANS
PLATES 8 THROUGH 10- GEOLOGIC CROSS SECTIONS
PLATE 11 – LIQUEFACTION POTENTIAL PLAN

APPENDIX A- REFERENCES
APPENDIX B- SUBSURFACE INVESTIGATION
APPENDIX C- LABORATORY TEST RESULTS
APPENDIX D- SLOPE STABILITY ANALYSES
APPENDIX E- INFILTRATION FEASIBILITY STUDY
APPENDIX F- EARTHWORK SPECIFICATIONS AND GRADING DETAILS

Geotechnical Review of Tentative Map, Otay Ranch Village 14 and Planning Areas 16/19 –Land Exchange EIR Alternative, County of San Diego, California

1.0 INTRODUCTION

1.1. Background and Purpose

The purpose of this report is to provide a "Tentative Map" (TM) level geotechnical study that may be utilized to support the EIR submittal for the proposed Tentative Map for Otay Ranch Village 14 and Planning Areas 16/19 – Land Exchange Alternative located in the County of San Diego, California. This report has been prepared to address TM conceptual design prepared by Hunsaker & Associates in a manner consistent with County of San Diego geotechnical report guidelines and current standard of practice. Geotechnical conclusions and recommendations are presented herein, and the items addressed include, without limitation: 1) unsuitable soil removals and remedial grading; 2) cut, fill and natural slope stability; 3) potential geologic hazards and general mitigation measures for these potential hazards; 4) buttress/stabilization fill criteria; 5) cut/fill pad overexcavation criteria; 6) remedial and design grading recommendations; 7) rippability of the onsite bedrock; 8) disposal of oversize hard earth materials; and 9) general foundation design recommendations based upon anticipated as-graded soil conditions.

1.2. Scope of Study

This study is aimed at providing geotechnical/geologic conclusions and recommendations for development of the TM for residential and commercial uses, attendant streets, parks, schools, community facilities, water storage distribution facilities, and open space areas.

The scope of this study included the following tasks:

- Review of pertinent published and unpublished geologic and geotechnical literature, maps, and aerial photographs readily available to this firm (Appendix A).
- Perform geologic field mapping within the proposed tentative map boundaries.
- Transfer selected geologic and geotechnical information generated from this investigation onto the 100-scale Tentative Map/Preliminary Grading Plan prepared by Hunsaker & Associates, included as Plates 1 through 7 (attached). These plans depict existing grades and proposed rough grading. AGS has added geologic and geotechnical information to the plans, including: the approximate limits of surficial geologic units; locations of soil borings and test pits (backhoe and excavator) with abbreviated logs.
- Excavate, sample, and log 17 backhoe test pits (TP-1 through TP-17) with a Cat 416F and 430F (Appendix B).
- Excavate, sample, and log 6 excavator test pits EX-1A through EX-6A with a Cat 328D (Appendix B).

- Excavate, sample, and log 23 excavator test pits EX-1 through EX-23 with a Cat 349E (Appendix B).
- Excavate, sample, and log eight (8) 30-inch diameter borings, BA-1 through BA-8 (Appendix B).
- Excavate and log eight (8) percolation test borings (P-1 through P-8), and eight (8) associated exploratory trenches (PT-1 through PT-8), with a Caterpillar 420F backhoe (Appendix E).
- Conduct preliminary percolation/infiltration testing in general conformance with the County of San Diego's Best Management Practices Design Manual.
- Thirteen (13) seismic refraction traverses (SL-1 through SL-13) and associated tomographic modeling.
- Laboratory testing of representative "undisturbed" and bulk samples obtained during this study (Appendix C).
- Prepare geologic/geotechnical cross-sections A-A' thru I-I' as shown on Plates 8 through 10.
- Conduct a geotechnical engineering and geologic hazard analysis of the site.
- Conduct a limited seismicity analysis.
- Define remedial grading requirements.
- Evaluate the stability the highest cut, fill, and natural slopes within the limits of the proposed development (Appendix D).
- Data analyses in relation to the site specific proposed improvements.
- Preliminary analysis of the excavation characteristics (i.e. rippability) of onsite bedrock materials.
- Discussion of pertinent geologic and geotechnical topics.
- Prepare general foundation design parameters which can be used for preliminary design.
- Prepare this geotechnical tentative map review report with exhibits summarizing our findings. This report is suitable for preliminary design and regulatory review.

1.3. Geotechnical Study Limitations

The conclusions and recommendations in this report are professional opinions based on the data developed during this investigation. The conclusions presented herein are based upon the current design as reflected on the included TM. Changes to the plan would necessitate further review.

The materials immediately adjacent to or beneath those observed may have different characteristics than those observed. No representations are made as to the quality or extent of materials not observed. Any evaluation regarding the presence or absence of hazardous material is beyond the scope of this firm's services.

2.0 SITE LOCATION AND DESCRIPTION

2.1. Site Location and Description

The Land Exchange Alternative is located within Township 17 South, Range 1 East, Sections 17, 18, 19, 20, and 30 on the USGS 7.5' Jamul Mountains quadrangle, generally along Proctor Valley Road between the City of Chula Vista and Jamul, California. The Land Exchange Area is more specifically located within Proctor Valley Village 14 and Planning Areas 16 and 19 as depicted in Figure 1.

The total Land Exchange Area covers approximately 2,387 acres, of which the Applicant owns 1,294 acres, the State owns approximately 1,053 acres and 39.9 acres are Offsites. Within the Land Exchange Area, there are 1,003 acres in Village 14 and 1,345 acres in Planning Areas 16 and 19. The Land Exchange Area is in a natural state and is covered with a light to dense growth of annuals and some chaparral. A network of improved and unimproved roads provides access throughout the site. The existing elevations within the proposed development ranges from a high of approximately 1,080 feet above mean sea level (MSL) in neighborhood R-15 to a low of approximately 550 feet above MSL within an active drainage near the southern limit of the proposed development. Topography on site ranges from gently sloping terraces to moderately steep existing natural slopes approaching 1:1 (horizontal to vertical) slope inclinations. Two southerly flowing active drainages transect the site ultimately converging into a broad drainage adjacent to the existing Proctor Valley Road which drains into Upper Otay Lake (Figure 2).

2.2. Proposed Development

The Land Exchange Alternative is located within Otay Ranch Village 14 and Planning Areas 16 and 19 in the Proctor Valley parcel of Otay Ranch. Village 14 and Planning Areas 16 and 19 are part of the larger Otay Ranch an approximately 23,000-acre master-planned community in southern San Diego County designed as a series of villages and planning areas (Figure 3). The Land Exchange Alternative proposes 1,530 homes within a development footprint that is limited to Proctor Valley Village 14. The majority of Planning Areas 16 and 19 would be converted to MSCP and Otay Ranch RMP Preserve and would not be developed. A Site Utilization Plan is presented as Figure 4.

The Land Exchange Alternative includes approximately 511 acres designated for 1,530 homes, 1,124 of which would be traditional single-family homes, 283 would be single family age-restricted and 123 would be multi-family homes. Eighteen (18) neighborhoods are planned with approximate densities ranging from 1.5 to 15.0 dwelling units per acre. The age-restricted neighborhoods would be gated, as would four of the single-family neighborhoods situated on the largest lots.

Village 14 in the Land Exchange Alternative is planned around a Village Core, centrally located in the heart of the village. Higher density residential uses will be adjacent to the Village Core with single family residential radiating out in decreasing density. The Village Core is comprised of the Neighborhood Center which includes an 8-acre elementary school; a 4-acre Village Green (public park); a 3-acre Mixed Use Site with up to 15,000 square feet of commercial/retail uses and 54 multi-family homes; and a 2-acre Village Square Community Facility. The Village Core also includes a 2-acre public safety site for a fire station and sheriff's storefront facility and 69 multi-family townhomes located adjacent to the public safety site.

The Land Exchange Alternative is designed around an active lifestyle and wellness recreation theme and includes an extensive park and recreation system including four public parks totaling 13 acres (Figure 4). The remaining private recreation facilities include three private swim clubs, a senior activity center, the Village Square community facility and numerous pocket parks totaling approximately 9 acres. Approximately 4.6 miles of community pathway are proposed on the Proctor Valley Road. Approximately three (3) miles of Park-to-Park Loop connect to the regional pathway.

After implementing the proposed land exchange agreement, MSCP and RMP Preserve boundary adjustment, and General Plan Amendment, the Land Exchange will include 1,749 acres of land for MSCP and Otay Ranch RMP Preserve, consisting of 404 acres in Proctor Valley Village 14, and 1,345 acres in Planning Areas 16 and 19.

Additional improvements include several water quality retention/infiltration basins; water and sewer pump stations; a water tank; and associated roadways and utilities. It is anticipated that conventional cut and fill grading techniques will be utilized to develop the Land Exchange Alternative. Current plans prepared by Hunsaker and Associates show maximum cuts and fill on the order of 60 to 70 feet, with proposed cut and fill slope ratios on the order of 1.5:1 to 2:1.

Proctor Valley Road would provide the main access to Village 14 and is planned as a two-lane road designated as a scenic corridor. The Land Exchange Alternative includes an Otay Ranch GDP/SRP amendment to the classification of Proctor Valley Road from a four lane Major to a two lane Light Collector. The northern connection of Proctor Valley Village 14 to Jamul will be in the alignment of the existing partially-improved Proctor Valley Road and will be paved to provide both public access and secondary emergency access to both communities. As part of the proposed roadway improvements, culverts and a bridge structure will likely be needed to cross existing active drainages.

The Land Exchange Alternative includes three options for internal circulation: (1) the Proctor Valley Road North Option, (2) the Preserve Trails Option and (3) the Perimeter Trail Option. The Draft EIR Land Exchange Alternative assesses each of these options and their respective impacts. Each of the options summarized below. For detailed descriptions with exhibits, see the Specific Plan Section VIII. Internal Circulation Options.

Proctor Valley Road North Option: The Proctor Valley Road North Option applies to Proctor Valley Road Street Section 10 at the northerly edge of Village 14. Street Section 10 would be replaced with Street Section 10B to provide for two dedicated bike lanes (one on each side of the road) instead of the "sharrows" proposed in the Land Exchange Alternative. Note that Street Section 10A provides a transition section at the northerly property boundary and does not change in the Option scenario. Generally, the Proctor Valley Road North Option would increase the right-of-way width from 40 feet to 48 feet.

Preserve Trails Option: The Preserve Trails Option consists of two segments of existing, disturbed trails. These segments would be located within the Otay Ranch RMP Preserve. The Preserve Trails Option includes segments “A” & “B” as identified in the Otay Ranch GDP/SRP, which are also identified as segments 52& 49 in the County of San Diego’s Community Trails Master Plan (CTMP). Segment “A”/“52” is 4,450 lineal feet, generally located at the northern terminus of Village 14 and extending northeast through the onsite Otay Ranch RMP Preserve to the eastern edge of the Echo Valley loop (CTMP Trail 53). Segment “B”/”49” is approximately 3,100 lineal feet and is located between South and Central Village 14, along an existing, historic ranch road. This trail is located within onsite Otay Ranch RMP Preserve and bisects regional wildlife corridor R1. The Preserve Trails Option would retain these portions of trails in their existing conditions, which meet the CTMP primitive trail standard. No improvements to these Preserve Trails are contemplated.

Perimeter Trail Option: The Perimeter Trail Option is an approximately 4.5-mile perimeter trail located within the Development Footprint of Village 14. The Perimeter Trail Option is situated primarily within the Otay Ranch RMP 100-foot Preserve Edge. The Perimeter Trail Option is designed to CTMP primitive trail standards, and the trail tread varies from 2-6 feet. Due to topography, trail grades range from 2% to the maximum grade allowed of 30%. The Perimeter Trail Option requires the construction of approximately 5,200 lineal feet (1.0 mile) of 5- to7-foot-high retaining walls due to steep topography and drainage constraints. The Perimeter Trail Option would be graded as part of overall project grading and does not encroach into the Otay Ranch RMP Preserve. The perimeter trail would be accessed at public parks and trailheads and would be maintained by the County of San Diego.

Advanced Geotechnical Solutions, Inc., has evaluated these options and they are not material to the information presented in this technical report.

3.0 FIELD AND LABORATORY INVESTIGATION

3.1. <u>Field Investigation</u>

For this study AGS performed geologic mapping and conducted subsurface exploration and laboratory testing. Mapping and subsurface exploration was conducted within Otay Ranch Village 14 and Planning Areas 16 and 19; however, geologic mapping and subsurface exploration within Planning Areas 16 and 19 is generally not reflected on the attached plans since development in this area is not proposed as part of the Land Exchange Alternative. Our scope of work consisted of the following:

- Seventeen (17) backhoe test pits (TP-1 through TP-17), with a Caterpillar 416F and 430F.
- Six (6) excavator test pits (EX-1A through EX-6A), with a Caterpillar 328D.
- Eight (8) 30-inch diameter bucket auger borings (BA-1 through BA-8).
- Twenty-three (23) excavator test pits (EX-1 through EX-23) with a Caterpillar 349E.

- Eight (8) percolation boreholes (P-1 through P-8), and eight (8) associated backhoe test pits (PT-1 through PT-8).
- Thirteen (13) seismic refraction traverses (SL-1 through SL-13) and associated tomographic modeling.

The data for the field investigation is presented herein in Appendix B. Selected bulk samples and ring samples obtained during our field investigation were transported to our approved laboratory for testing and analysis; results of that testing are presented in Appendix C.

As part of our services, AGS integrated appurtenant information from our field mapping and subsurface exploration on the 100-scale Tentative Map/Preliminary Grading Plan prepared by Hunsaker & Associates (Plates 1 through 7), prepared cross-sections A-A' through I-I' (Plates 8 through 10) and prepared this report with our findings and recommendations.

4.0 ENGINEERING GEOLOGY

4.1. Geologic Analysis

4.1.1. Literature Review

AGS reviewed the referenced geologic documents in preparing this study, and where appropriate, that information was included in this document. Of particular use, are the maps by Tan (1992 and 2002) and Todd (2004).

4.1.2. Aerial Photograph Review

AGS reviewed historic aerial photographs and satellite imagery during this investigation. The photographs AGS reviewed are presented in the References section. Notable features observed include possible landslides and lineaments. These features are discussed in further detail in the following sections.

4.1.3. Field Mapping

The geologic contacts mapped on the TM are based on our observations of the site and subsurface data collected from our test pits and soil borings.

4.2. Geologic and Geomorphic Setting

Otay Ranch Village 14 and Planning Areas 16/19 Land Exchange Alternative is located in the lower Peninsular Range Region of San Diego County, a subset of the greater Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges Geomorphic province is approximately bounded to the east by Elsinore Fault Zone, to the north by the Transverse Ranges, the south by Baja California, and to the west by the Pacific Ocean. This portion of the Peninsular Ranges is underlain by Jurassic and Cretaceous plutonic rocks of the Peninsular Ranges Batholith, which contains screens of variably metamorphosed Mesozoic supracrustal rocks. Late Jurassic and Early Cretaceous volcanic and volcaniclastic rocks exposed southwest of the Elsinore Fault Zone represent an older superjacent part of the Peninsular Ranges magmatic arc.

These basement rocks are non-conformably overlain by a thick sequence of relatively undisturbed sedimentary rocks ranging from upper Cretaceous to Pleistocene in age.

The project site is located near the eastern edge of the coastal plain at the contact with the metavolcanic rocks of the Jamul Mountains. Geologically, the site is underlain by two principle rock types, the Late Jurassic to early Cretaceous aged metavolcanic rocks of the Santiago Peak Volcanics and the Tertiary aged sedimentary rocks of the Otay Formation. The Otay Formation is informally subdivided into three subunits: an upper sandstone-claystone member; a middle gritstone member; and a basal angular-clast fanglomerate member. Minor exposures of upper Pleistocene older alluvium exist locally as relatively flat lying river terraces and unconsolidated alluvium of Holocene age occupies the active drainages onsite.

A regional geology map is shown on Figure 5.

4.3. Stratigraphy

A basement complex consisting of Mesozoic-aged prebatholithic volcanic and metavolcanic rocks underlies the Land Exchange area at depth and are exposed at the surface at higher elevations in the easterly and northerly portions of Village 14. The basement rocks are non-conformably overlain by Tertiary-aged sedimentary bedrock which are subsequently mantled by Quaternary-aged surficial soil units. Approximate geologic contacts are shown on Plates 1 through 7 with subsurface relationships depicted on the geologic cross-sections (Plates 8 through 10). A brief description of the earth materials encountered during our investigation is presented in the following sections. More detailed description of these materials is provided in the boring and test pit logs included in Appendix B.

4.3.1. Surficial Units

Surficial units onsite include undocumented artificial fill (afu), topsoil/colluvium (unmapped), young alluvium (map symbol Qal), older alluvium (map symbol Qoal), and landslide debris (map symbol Qls). More detailed descriptions of these units are presented below.

4.3.1.1. Artificial Fill (afu)

Although not encountered during our subsurface exploration, undocumented artificial fill soils were observed locally within the Land Exchange area. The undocumented fills are primarily located along the current alignment of Proctor Valley Road as embankment fills for the road and associated culverts. Based on limited observed exposures, these materials can generally be described as clayey to gravelly sands with abundant rock fragments in a dry to slightly moist and loose to moderately dense condition. In addition, minor undocumented fills exist locally across the site as Jeep trails. In consideration of the limited extent of the material and the plan scale, these fills are not mapped.

4.3.1.2. Topsoil/Colluvium (no map symbol)

Undifferentiated topsoil and colluvium exist throughout the Land Exchange Alternative as a thin soil veneer. Thicker accumulations commonly occur near the base of slopes and natural topographic swales. As encountered, these materials ranged from less than one foot to four feet in thickness and are generally composed of silty to clayey sand and sandy clay in a dry to slightly moist and loose to moderately dense condition. Roots and minor to moderate porosity are common.

4.3.1.3. Alluvium (Qal)

Young alluvial deposits occupy the bottoms of the primary and tributary drainages onsite. These materials can generally be described as silty to clayey sand with gravel and small rock fragments in a dry to moist and loose condition and sandy clay in a moist and soft condition.

4.3.1.4. Older Alluvium (Qoal)

Older alluvium occurs onsite as moderately dissected terraces that flank modern drainage channels/valleys. The older alluvium consists of poorly bedded, poorly to moderately well consolidated sand to boulder sized sediment in a clayey sand matrix. Clasts are generally subangular to subrounded. Matrix soils are commonly rubified and locally exhibit weak cementation.

4.3.1.5. Landslide Debris (Qls)

Localized landslide debris is mapped in the central portion of Village 14, easterly superjacent to an active intermittent drainage. Although no subsurface exploration was performed in the area due to access restrictions by the State, geomorphic evidence suggests the presence of landslide debris.

4.3.2. Bedrock Units

4.3.2.1. Otay Formation – Fanglomerate (Tof)

Regional mapping of the El Cajon 30’ x 60’ quadrangle by Todd (2004) identifies the unit as an ‘unnamed’ fanglomerate of Pliocene and Miocene age. Tan (2002) identifies the unit in the Jamul Mountains 7.5’ geologic map as Otay Formation - Fanglomerate of Oligocene and Miocene age. In consideration of the non-conformable contact with the underlying Santiago Peak Volcanics, the presence of intertongued lenses of bentonitic sandstone and claystone common to the Otay Formation, and the presence of Otay Formation overlying the fanglomerate facies west of the project site, we consider the fanglomerate unit to be roughly coeval with the Otay Formation and are following Tan’s (2002) designation.

The Otay Formation - Fanglomerate underlies much of the project site and occupies the lower flanks and valleys of the highlands to the east and north of the project area. The fanglomerate has a more subdued topography and is moderately to highly dissected. This unit is typified by thickly to massively bedded breccia intertongued with a finer grained subunit consisting of claystone and sandstone. The breccia subunit is generally in a slightly moist to moist and moderately hard to hard condition. The breccia subunit is composed of subangular to angular, gravel to cobble size clasts in a clayey sand matrix. Occasional to common boulder sized clasts were encountered in our borings and excavator test pits. Rock clasts appear to be locally derived from the Santiago Peak Volcanics. The clay matrix is commonly waxy, highly expansive, and is likely bentonitic. The finer grained subunit is generally comprised of olive gray to pale brownish yellow, sandy claystone and clayey sandstone in slightly moist to moist and soft to hard condition.

4.3.2.2. Santiago Peak Volcanics (Jsp)

The site is underlain by Jurassic-aged Santiago Peak Volcanics at depth and outcrops at the surface primarily in the eastern and northern portions of the site. The contact between the Santiago Peak Volcanics and the overlying younger geologic units represents a significant geologic hiatus. This contact is irregular and reflects a relatively high relief Mesozoic landscape. Subsequent erosion has exhumed portions of this ancient landscape, creating modern topographic highs including San Miguel Mountain to the north and the Jamul Mountains to the east.

The Santiago Peak Volcanics are generally dense and mildly metamorphosed volcanic rocks. Composition of the volcanic rocks varies from basalt to rhyolite but is predominantly dacite and andesite (Kennedy and Tan, 1977). Typically the meta-volcanics display crude to moderate bedding and foliation. Fracturing is poorly to moderately well developed. In general, outside of boulder areas, a weathered halo of only a few feet thick exists. Below this, the rock is very dense and hard.

4.4. Geologic Structure and Tectonic Setting

4.4.1. Regional Faulting

The San Andreas fault zone is the dominant and controlling tectonic stress regime of southern California (Figure 6). As the boundary between the Pacific and North American structural plates, this northwest trending right lateral, strike–slip, active fault has controlled the crustal structural regimes of southern California since Miocene time. Numerous related active fault zones with a regular spacing, including the Elsinore-Whittier-Chino, Newport-Inglewood-Rose Canyon, and San Jacinto fault zones characterize the stress regime and also trend to the northwest as do the Santa Ana Mountains and the Peninsular Ranges.

The Silver Strand section of the Newport-Inglewood-Rose Canyon fault zone is closest known active fault to the project and is located approximately 15 miles to the west.

4.4.2. Local Faulting

Alquist-Priolo County Special Studies Fault Zones and San Diego County Fault Zones are not located onsite. The most influential geologic fault potentially affecting the property is the active Silver Strand section of the Newport-Inglewood-Rose Canyon fault zone. The La Nacion Fault is located approximately 6 miles west of the project site. The La Nacion Fault is currently considered to be a potentially active fault, having evidence of displacement within the Quaternary Period. Some recent, independent reports indicate there is evidence to support classification as an active fault (movement within the last ~11,000 years).

No faults have been mapped onsite on published geologic maps and none were observed during this geologic studies. Offsite to the northwest, lineaments were observed both in the field and on aerial photos. These lineaments occur in the Santiago Peak Metavolcanics and are considered to be related to foliation in the metamorphic rock and are not related to faulting. Foliation is discussed in further detail in Section 4.4.3 below.

4.4.3. Geologic Structure

The Otay Formation rests nonconformably over metavolcanic basement rock of the Santiago Peak Volcanics. Geologic structure within the sedimentary Otay Formation is typically characterized by regional westerly to southwesterly dipping beds with inclinations on the order of 3 to 7 degrees from horizontal. However, geologic mapping by Tan (2002) shows a bedding attitude within the fanglomerate having a northeasterly strike with a 30-degree dip to northwest. Crude bedding observed within the Otay Formation as encountered during our subsurface exploration was generally flat lying to very slightly dipping to the west and east. Contacts between the between breccia (fanglomerate) and finer grained subunits are conformable and typically near horizontal to undulatory and indicative of scour and fill type successions.

Dominant foliations, fracture patterns or other structural features common to bedrocks were not mapped during this study. Geologic mapping by Tan (2002) shows foliation in the Santiago Peak Volcanics as predominantly striking northwest to north-northeast and dipping steeply to the west and east. Lineaments identified by air photo analysis are also presented on this map and strongly correlate with the local foliation.

4.5. Groundwater

Shallow groundwater was not observed during this study. Intermittent flows within the active primary and tributary drainages should be anticipated during rain events.

4.6. Non-seismic Geologic Hazards

4.6.1. Mass Wasting and Debris Flows

Tan (1992) identified the majority of the Land Exchange Alternative as being generally susceptible to landsliding, hypothesizing that due to the presence of weaker materials (fine-grained fanglomerate subunit) many slopes within the area are at or near their stability limits. Based on our site investigation, the majority of the Land Exchange Alternative area is sloping at shallow to moderate slope ratios and is underlain by bedrock that is not considered to be generally susceptible to mass wasting. In addition, bedding attitudes mapped in the field are predominantly favorable with respect to slope stability.

It is our opinion that the potential for landsliding is low to moderate in its current state. Possible exception to the predominantly stable site geology is discussed below. However, the potentially adverse effects of landsliding can be mitigated during development through the use of design avoidance or through typical remedial grading measures (construction of stabilization and buttress fills). Accordingly, it is our opinion that the susceptibility to landsliding onsite after development is considered to be less than significant.

Based on our review of aerial photographs and observations at the site, there is geomorphic evidence that suggests the presence of landslide(s) locally near the central portion of the site (Plate 4). More specifically, the current mapped extent of Landslide Debris affects a Mixed-use lots (MU-1a&b), a Community Facility lot (PP-5), a water pump station, and several acres of open space. Due to access constraints, direct investigation of the suspect area was precluded during this study. However, it is anticipated that the failure occurred within a weak claystone bed of the Otay Formation – Fanglomerate. As mentioned, mitigation of the postulated landslide would occur during development through removal of landslide debris during remedial grading and construction of a drained stabilization and buttress fills. The exact extent and geometry of the drained buttress fill would be defined in future studies and refined, as necessary, during remedial grading activities. As a result, it is our opinion that removal of landslide debris and stabilization of affected slopes through construction of a drained buttress fill would reduce the potential impact to less than significant.

Due to the presence of the steeper offsite terrain composed of highly fractured/jointed Santiago Peak Volcanics, the potential for debris flows emanating from the mouths of the up-gradient drainages is feasible but the likelihood is considered to be less than significant.

4.6.2. Rock Fall

The potential for rock fall is generally considered to be low given the limited rock outcrops and subdued topography within a majority of the proposed development. Based on our site mapping, localized areas within the steeper northerly and easterly portions of the Land Exchange Area have more rock outcrops and therefore possess moderate risk for rock fall hazard. However, development within these areas generally would not have superjacent natural or graded slopes at the conclusion of site grading. As such, rock fall is considered to be unlikely. Mapping and evaluation of hard rock slopes should be performed by an engineering geologist prior to and during site development. Rock fall hazards could become potentially significant if unforeseen conditions are encountered during site development. If rock fall hazards are encountered during grading, mitigation measures during site development may be warranted to reduce the potential risks. Potential mitigation measures could include scaling of the slope faces, construction of catchment areas or debris fences, and removal of precariously situated boulders. It is our opinion that the potential risk for rock fall hazards at the site currently is less than significant, and if any rock fall hazards are encountered during grading, these mitigation measures also would reduce the potential risk to less than significant.

4.6.3. Flooding

Detailed FEMA flood maps are not currently available for the Land Exchange Alternative. The San Diego County Hazard Mitigation plan indicates the site is located outside designated 100- and 500-year floodplain areas. The potential for flooding is considered to be low. Hydrology studies should be provided by the Civil Engineer.

4.6.4. Subsidence and Ground Fissuring

Owing to the presence of shallow bedrock and dense formational materials underlying the Land Exchange Area, subsidence and ground fissuring potential at the site is considered very low.

4.7. Seismic Hazards

The Land Exchange Area is located in the tectonically active Southern California area, and will therefore likely experience shaking effects from earthquakes. The Near Source Shaking Zones of the County of San Diego (Figure 7) shows the distance of the site from near source shaking zones. The type and severity of seismic hazards affecting the Land Exchange Alternative site are to a large degree dependent upon the distance to the causative fault, the intensity of the seismic event, the direction of propagation of the seismic wave and the underlying soil characteristics. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction, seismically induced slope failure or dynamic settlement. The following is a site-specific discussion of ground motion parameters, earthquake-induced landslide hazards, settlement, and liquefaction. The purpose of this analysis is to identify potential seismic hazards and propose mitigations, if necessary, to reduce the hazard to an acceptable level of risk. The following seismic hazards discussion is guided by the California Building Code (2016), CDMG (2008), and Martin and Lew (1998).

4.7.1. Surface Fault Rupture

Surface rupture is a break in the ground surface during or as a consequence of seismic activity. In large part, research supports the conclusion that active faults tend to rupture at or near pre-existing fault planes. No faults have been mapped within or near the project.

As such, it is appropriate to conclude that the potential for surface fault rupture is very low.

4.7.2. Ground Motions

As noted, the site is within the tectonically active southern California area, with segments of the Newport-Inglewood-Rose Canyon fault zone within 15 miles of the site. The potential exists for strong ground motion that may affect future improvements. As part of this assessment, AGS utilized the California Geologic Survey Probabilistic Seismic Hazards Seismic Hazards Ground Motion Interpolator Page. A site location with latitude of 32.6756˚N and longitude 116.9161˚W was utilized. Ground motions (10% probability of being exceeded in 50 years) are expressed as a fraction of the acceleration due to gravity (g). Three values of ground motion are shown, peak ground acceleration (Pga), spectral acceleration (Sa) at short (0.2 second) and moderately long (1.0 second) periods. Ground motion values are also modified by the local site soil conditions. Ground motion values are shown for two different site conditions: Rock (site category B, V_s30=760m/s) and Stiff Soil (site category D, V_s30=270m/s).

TABLE 4.7.2
SELECTED GROUND MOTIONS*

	Bedrock	Stiff Soil
Pga (g)	0.171g	0.224g
Sa 0.2 sec	0.396g	0.508g
Sa 1.0 sec.	0.142g	0.274g

*Ground Motion values were interpolated from a grid (0.05 degree spacing) of values calculated using the 2008 PSHA model. Interpolated ground motion may not equal values calculated for a specific site, therefore these values are not intended for design or analysis.

Currently, non-critical structures (commercial, residential, and industrial) are usually designed according to the 2016 California Building Code and that of the controlling local agency.

Characterization of earthquake induced ground motion is a key component in the seismic design of buildings, retaining walls, and other structures. Incorporating appropriate code compliant ground motions, as presented above and in Section 7.1.3 below, in the structural design is intended to reduce the effects of ground shaking on structures to an acceptable level of risk.

4.7.3. Liquefaction

Liquefaction is the phenomenon where seismic agitation of loose, saturated sands and silty sands can result in a buildup of pore pressures that, if sufficient to overcome overburden stresses, can produce a temporary quick condition. Localized, loose lenses/layers of sandy soils may be subject to liquefaction when a large, prolonged, seismic event affects the site. As the excess pore water pressure dissipates, the liquefied zones/lenses can consolidate causing settlement. Post liquefaction effects at a site can manifest in several ways and may include: 1) ground deformations; 2) loss of shear strength; 3) lateral spread; 4) dynamic settlement; and 5) flow failure.

In general, the more recently sediment has been deposited, the more likely it is to be susceptible to liquefaction. Further, liquefaction potential is greatest in loose, poorly graded sands and silty sands with mean grain size in the range of 0.1 to 0.2 mm. Other factors that must be considered are groundwater, confining stresses, relative density, intensity and duration of ground shaking. It is generally held that soils possessing clay content (particle size < 0.005mm) greater than fifteen (15) to twenty (20) percent may be considered non-liquefiable (Southern California Earthquake Center, 1999).

The State of California (California Division of Mines, 1997) has mandated that the California Geological Survey identify areas that may be susceptible to liquefaction and provide *USHMA* quadrangle maps showing these zones establish procedures for investigating same and ensure that local agencies require such studies prior to project approval. Similarly, the County of San Diego has established its study zones. The project area is not in a State liquefaction susceptibility zone; however, localized areas of the Proposed Project are situated within an area zoned by the County of San Diego as a Potential Liquefaction Area (Figure 8). The boundary of the Potential Liquefaction Area in proximity to the project area, utilizing County of San Diego GIS data, is presented on Plate 20. The area identified by the County of San Diego as being potentially susceptible to liquefaction appears to be related to young alluvial soils contained within the primary drainage north of Upper Otay Lake but, likely do to scale, the County's mapped boundary extends beyond the limits of the drainage and includes areas not susceptible to liquefaction. Based on geologic mapping, subsurface exploration, and laboratory testing specific to the project area, it is our opinion that a large portion of the area identified by County of San Diego as being susceptible to liquefaction is not liquefiable due to the soils age, density, and fines content. In an effort to better evaluate the potential for liquefiable soils to impact the Proposed Project, the area within the County's boundary has been further delineated to show the limits of areas considered not liquefiable and those that are potentially susceptible to liquefaction. The refined boundaries are presented on Plate 11. The areas identified as not susceptible to liquefaction are delineated with purple cross-hatching. The yellow cross-hatching delineates areas we consider to be potentially susceptible to liquefaction. Areas potentially susceptible to liquefaction include a portion of the proposed school site (S-1c and S-1d) in Center Village 14, Lots 4 through 11 and 18 in neighborhood R-4, and portions of proposed Proctor Valley Road south and west of South Village 14.

The potentially liquefiable soils in the area of the proposed school site and neighborhood R-4 are shallow and will be mitigated through complete removal and replacement with compacted fill during grading operations. Proposed offsite improvements located in areas susceptible to liquefaction can also be mitigated through complete removal and replacement with compacted fill. If complete removal and replacement cannot be accomplished, mitigation in the form of ground improvement (e.g. stone columns) and/or deepened foundation elements will be required to mitigate the liquefaction potential to an acceptable level of risk.

In consideration of the recommended remedial grading, and dense nature of the formational materials and proposed fills within the limits of the Proposed Project, the potential for liquefaction or seismically induced settlement is considered remote.

4.7.4. Lateral Spreading

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. Due to the anticipated removals proposed herein the potential for lateral spreading is considered to be very low.

4.7.5. Seismically Induced Dynamic Settlement

Seismically induced dynamic settlement occurs in response to seismic shaking of loose sandy earth materials. The source of settlement is volumetric strain associated with liquefaction of saturated soils strata, and/or, the rearrangement of sandy particles in dry, relatively loose layers of sandy soils (cohesionless). These two sources of settlement potential are mutually exclusive. As a result, if the groundwater rises, the liquefaction potential and its adverse effects increase, while dry sand settlement potential decreases; and, vice-versa.

Due to the anticipated removals proposed herein, the density and cementation of older alluvium to be left in-place and the hardness of the underlying bedrock, the potential for seismically induced settlement is considered very low.

4.7.6. Seismically Induced Landsliding

Pseudo-static slope stability analyses were performed using a horizontal destabilizing seismic coefficient (kh) of 0.15g for the highest design cut and fill slopes and were determined to be grossly stable. A more detailed discussion of slope stability is presented in Section 6.2.Based on these analyses, seismically induced landsliding of engineered fill slopes is considered to be very low. For cut slopes excavated in the metavolcanic bedrock and remaining shallow natural slopes, the potential for seismically induced landsliding is considered to be very low. Cut slopes excavated in the fine-grained subunit of the fanglomerate has low to moderate potential for seismically induced landsliding. However, as discussed in Section 6.2, cut slopes within this unit will likely be removed and replaced with engineered fill in the form of buttresses or stability fills. Earthquake Induced Flooding

Earthquake induced flooding can be caused by tsunamis, dam failures, or seiches. Also, earthquakes can cause landslides that dam rivers and streams, and flooding can occur upstream above the dam and also downstream when these dams are breached. A seiche is a free or standing-wave oscillation on the surface of water in an enclosed or semi-enclosed basin. The wave can be initiated by an earthquake and can vary in height from several centimeters to a few meters. Due to the lack of an up gradient freestanding body of water nearby, the potential for a seiche impacting the site is considered to be non-existent.

Considering the lack of any dams or permanent water sources upstream, earthquake induced flooding caused by a dam failure is considered to be remote.

Considering the distance of the site from the coastline, the potential for flooding due to tsunamis is non-existent.

5.0 GEOTECHNICAL ENGINEERING

Presented herein is a general discussion of the geotechnical properties of the various soil types and the analytic methods used in this report.

5.1. Material Properties

5.1.1. Excavation Characteristics

It is anticipated that excavations within the alluvium, older alluvium, colluvium/residual soil, fanglomerate and highly weathered portions of the Santiago Peak Volcanics can be accomplished with conventional grading equipment (D-9 or equivalent). It is likely that oversized "float" will be encountered in surface outcrops and will require special handling.

As part of our current study, AGS subcontracted Southwest Geophysics, Inc. (SGI) to perform 13 seismic refraction survey lines (SL-1 through SL-13) within the Land Exchange Area and provide two-dimensional tomographic models for each traverse. The report by SGI is presented in Appendix B. Approximate locations of the survey lines within Village 14 are shown on Plates 1 through 7. Generally, it has been AGS's experience that when velocities are higher than 6,500 to 7,000 feet/sec., blasting will be required for efficient excavation. Although it is possible that in certain instances seismic velocities in excess of 6,500 feet/sec. can be ripped, production rates are typically low and drilling and shooting may be preferred in order to increase production. Velocities in areas greater than 5,000 to 5,500 feet/sec. may require localized blasting for efficiency during grading and will probably contain common boulders that will require special handling. It should be anticipated that oversized materials will be generated from cuts in the bedrock. These oversized materials should be handled as discussed in Section 6.6.6. Recommended undercuts to remove hard rock from the near pad grade and within utility alignments are presented in Section 6.1.2.

In addition, 23 test pit excavations (EX-1 through EX-23) utilizing a Caterpillar 349 excavator, which is comparable in size and breakout power to a Caterpillar D9 bulldozer, were performed at accessible locations throughout the site. Refusal was encountered in several of the exploratory test pits excavated with the Caterpillar 349 excavator. Depth of refusal provides a reasonable estimation of the depth of rippable materials in the area. Logs of the excavator pits are presented in Appendix B.

In general, the ease of rock rippability depends upon factors such as the rock type, rock hardness and density, the amount of weathering, and the existence and characteristics of discontinuities such as joint spacing, foliation, or random fractures. For example, a rock mass that is weathered and exhibits well-developed discontinuities, such as joints, will be easier to excavate than a compositionally similar rock mass that lacks discontinuities and significant weathering. Weathering typically decreases cohesive rock strength, and discontinuities typically provide a mechanism that allows the rock mass to readily part upon stress (Hoek and Bray, 1981).

For the Land Exchange Alternative, the main controls on rippability are joints, fractures and foliations; the degree of weathering at depth; and the depth and size of the cut areas. Additionally, numerous other factors can affect whether to use blasting, including: 1) considerations of overburden; 2) fracture spacing and pattern; 3) the experience of the equipment operator; 4) the equipment type; 5) the size and depth of the cuts; and 6) cost/contractual issues. Based upon our preliminary evaluation, areas underlain by the breccia subunit of the fanglomerate and cemented portions of the older alluvium will generally be difficult to excavate but rippable with larger Bulldozers (Caterpillar D-9 or equivalent) to currently proposed cut depths. Excavations within the Santiago Peak Volcanics below the upper weathered surface (approximately 5 feet) will require blasting for efficient excavation in order to achieve design grade as well as the undercuts to accommodate footings, utilities and other subsurface improvements. It is likely that the blasting and excavation operations will generate oversized rock fragments requiring specialized handling and grading techniques. Recently, heavier equipment has become available including large Bull Dozers (Caterpillar D-10 and D-11) 190,000 to 230,000lb machines and Self Propelled Shovels (Caterpillar 5130) 400,000lb machines which have greater down forces resulting in the ability to excavate in fractured rock with higher velocities. As a result, this may reduce the volume of hard rock requiring blasting.

Blasting techniques may require an overburden of material to be left in place in order to control the blast debris and size of material produced. Therefore, some areas that are rippable will likely be left in place in order to provide adequate overburden for effective blasting. Techniques for potential blasting of hard-rock at the site should be evaluated by a blasting specialist during the grading plan review stage of the Land Exchange Alternative. Further, it is recommended that a grading and blasting logistics program should be developed to allow for efficient excavation and to reduce the potential for adverse effects of blasting.

5.1.2. Oversized Materials

Oversized rock greater than 24 inches will be generated in cuts and over excavations within the Santiago Peak Volcanics. Portions of the Older Alluvium and fanglomerate will locally generate oversized rock. This rock may be incorporated into the compacted fill section to within ten (10) feet of finish grade or within two (2) feet of the deepest utility (if utility is greater than ten (10) feet). Oversize rock is not to be placed within areas of proposed drainage structures and should be kept minimally five (5) feet outside and below proposed culverts, pipes, etc.

It is recommended that the maximum rock size between three (3) feet and ten (10) feet of finished grade is restricted to twenty-four (24) inches and in the upper three (3) feet from finish grade is restricted to a maximum rock size of eight (8) inches. Variances to the above rock hold-down must be approved by the owner, geotechnical consultant and governing agencies.

5.1.3. Compressibility

The onsite materials that are compressible include topsoil, alluvium, colluvium, and highly weathered bedrock. Highly compressible materials will require removal from fill areas prior to placement of fill and where exposed at grade in cut areas.

5.1.4. Collapse Potential/Hydro-Consolidation

The hydro-consolidation process is a singular response to the introduction of water into collapse-prone sandy soils. Upon initial wetting, the soil structure and apparent strength are altered and a virtually immediate settlement response occurs. Recommended measures to mitigate potential for differential settlement due to hydro-collapse include removal/recompaction and/or foundation design, such as described in Sections 6.1 and 7.1 of this report. Typical mitigation measures consist of removal and recompaction of these soils where these soils are found within structural areas.

5.1.5. Expansion Potential

Based upon the sampling and associated laboratory testing conducted by AGS the onsite soils are considered to exhibit “Very Low” to “Very High” expansion potential, with the majority of the onsite soils possessing “Low to “High” expansion potential. Typical mitigation measures for expansive soils include: structural design; pre-saturation; and overexcavation where the higher expansion characteristics are present and replacement with lower expansive soils (selective grading).

5.1.6. Shear Strength

Shear strength testing was conducted by AGS on undisturbed and remolded samples that were collected during this study (see Appendix C). Within the onsite bedrock units, the in-situ shear strength and fracture patterns are the most significant factors in cut slope and natural slope stability. Typically, the metavolcanic bedrock possesses relatively high shear strength and can stand unsupported at relatively steep slope ratios. The breccia subunit of the fanglomerate and older alluvium generally possess “good” in-situ shear strength except within the upper weathered horizon (upper five feet). The fine-grained subunit of the fanglomerate contains bentonitic claystone and clayey sandstones. This subunit possesses “poor to moderate” in situ shear strength. The alluvium generally can be characterized as possessing “poor to fair” strength characteristics. The shear strength of the fill soils created during grading generally will exhibit “moderate to good” shear strength for fill slopes and for support of structures. The shear strengths recommended by AGS for use in preliminary design are presented in Table 5.1.6.

TABLE 5.1.6
RECOMMENDED SHEAR STRENGTHS FOR DESIGN

Material	Cohesion (psf)	Friction Angle (degrees)	Density (pcf)
Artificial Fill Compacted @90% (afc_{90})	200	32	125
Artificial Fill Compacted @93% (afc_{93})	250	33	125
Alluvium	100	25	120
Fanglomerate	300	33	130
Santiago Peak Volcanics (Jsp)	500	40	140

5.1.7. Chemical and Resistivity Test Results

The initial test results from AGS's investigation in the general area indicate that the water soluble sulfate concentrations for the onsite soils tested ranged from 0.01% to 0.603% which corresponds to a "negligible" to "severe" sulfate exposure when classified in accordance with ACI 318-05 Table 4.3.1 (per 2016 CBC). Resistivity testing of the onsite soils ranged from 223 ohm-cm to 776 ohm-cm which corresponds to "low" to "very low" resistivity. Based upon these initial test results higher concrete strength, low water to cement ratios (0.5 to 0.45) and specialized cement types (Type V) could be required.

As the majority of this testing was conducted in the Fanglomerate deposits it is anticipated that further chemical and resistivity testing will indicate that the other geologic deposits found onsite (Santiago Peak Metavolcanics, alluvium, and Older alluvium) will have more favorable characteristics. Based upon our past experience in the general area these other deposits will likely have significantly lower water soluble sulfate concentrations ("negligible" to "moderate") and will likely exhibit higher resistivity.

5.1.8. Earthwork Adjustments

The following average earthwork adjustment factors are presented for use in evaluating earthwork quantities. The numbers for earthwork adjustments are considered approximate and should be refined during grading when actual conditions are better defined. Contingencies should be made during grading, to modify the earthwork adjustment factors, if necessary.

TABLE 5.1.8
EARTHWORK ADJUSTMENTS

Geologic Unit	Approximate Range
Topsoil/Colluvium & Alluvium (Qal)	10% to 12% Shrink
Older Alluvium (Qoal)	0% to 5% Bulk
Landslide Debris (Qls)	6% to 12% Shrink
Fanglomerate (Tof)	10% to 15% Bulk
Santiago Peak Volcanics (Jsp): (*Rippable*)	15% to 18% Bulk
: (*Blasting*)	18% to 25% Bulk

5.1.9. Permeability/Infiltration Potential

AGS conducted eight (8) borehole percolation tests (P-1 through P-8) at various locations throughout the overall Land Exchange Area. Approximate locations of the percolation test holes are presented on the Geologic Map and Exploration Location Plan, Plates 1 through 7, included herewith. Testing was performed in accordance with the methods described in Appendix D of the 2016 County of San Diego BMP Design Manual. Field percolation rates were converted to infiltration rates using the using the Porchet method. Based on the results of our site specific subsurface investigation and percolation testing, it is anticipated that the onsite soils and bedrock possess low infiltration rates. Preliminary infiltration rates ranged between 0.09 in/hr and 0.36 in/hr. A more detailed discussion of test methods and findings are presented in Appendix E – Infiltration Feasibility Study. Table 5.1.9 presents estimated infiltration rates for the various onsite soil and geologic units. Dependent upon proposed BMP type and location, additional infiltration may be warranted.

TABLE 5.1.9
ESTIMATED INFILTRATION RATES

Geologic Unit	Estimated Infiltration Rate (Inches per Hour)
Topsoil/Colluvium & Alluvium (Qal)	0.10 – 0.50
Older Alluvium (Qoal)	0.05 – 0.35
Fanglomerate (Tof)	0.05 – 0.20
Santiago Peak Volcanics (Jsp)	0.00 – 0.10

5.1.10. Pavement Support Characteristics

Compacted fill derived from onsite soils and cuts within the older alluvium and fanglomerate are expected to possess poor to moderate pavement support characteristics. Cuts within the Santiago Peak Volcanic rock are anticipated to exhibit good pavement support characteristics. Testing should be completed once subgrade elevations are reached for the onsite roadways. For preliminary planning purposes, AGS has used an R-Value of 20 for the preliminary design of roadway pavement sections.

5.2. Analytical Methods

5.2.1. Slope Stability Analysis

Stability analyses were performed for both static and seismic (pseudo-static) conditions using the GSTABL7 computer program. The Modified Bishop method was used to analyze circular-type failures. The critical failure surface determined in the static analysis was used in the pseudo-static analysis. A horizontal destabilizing seismic coefficient (kh) of 0.15g was selected for the site and used in the pseudo-static analyses. Peak shear strengths have been utilized in the pseudo-static analysis.

Surficial stability analyses were conducted using an infinite height slope method assuming seepage parallel to the slope surface.

5.2.2. Pavement Design

Asphalt concrete pavement sections have been designed using the recommendations and methods presented in the Caltrans Highway Design Manual. Portland cement concrete pavement for onsite roads and driveways has been designed in accordance with the recommendations presented in the "Design of Concrete Pavement for City Streets" by the American Concrete Pavement Association.

5.2.3. Bearing Capacity and Lateral Pressure

Ultimate bearing capacity values were obtained using the graphs and formula presented in NAVFAC DM-7.1. Allowable bearing was determined by applying a factor of safety of at least 3 to the ultimate bearing capacity. Static lateral earth pressures were calculated using Rankine methods for active and passive cases.

6.0 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

Based on the information presented herein and our experience in the vicinity of the Land Exchange Alternative, it is AGS's opinion that the potential development of Village 14 is feasible, from a geotechnical point of view, provided that the constraints discussed in this report are addressed in the design and construction phases. Key issues related to site development are discussed and associated geotechnical recommendations for use in planning and design are presented in the following sections of this report.

All grading shall be accomplished under the observation and testing of the project Geotechnical Consultant in accordance with the recommendations contained herein, the current codes practiced by the County of San Diego and this firm's Earthwork Specifications (Appendix F).

6.1. Site Preparation and Removals/Overexcavation

Guidelines to determine the depth of removals are presented below; however, the exact extent of the removals must be determined in the field during grading, when observation and evaluation in greater detail afforded by those exposures can be performed by the Geotechnical Consultant. In general, removed soils will be suitable for reuse as compacted fill when free of deleterious materials and after adequate moisture conditioning and mixing.

Removal of unsuitable soils typically should be established at a 1:1 projection to suitable materials outside the proposed engineered fills. Front cuts should be made no steeper than 1:1, except where constrained by other factors such as property lines and protected structures. Removals should be initiated at approximately twice the distance of the anticipated removal depth, outside the engineered fills. During grading, the bottoms of all removal areas should be observed, mapped, and approved by the Geotechnical Consultant prior to fill placement. It is recommended the bottoms of removals be surveyed and documented.

6.1.1. Site Preparation and Removals

Grading should be accomplished under the observation and testing of the project soils engineer and engineering geologist or their authorized representative in accordance with the recommendations contained herein, the current San Diego County Grading Ordinance, and AGS's Earthwork Specifications (Appendix F). Existing vegetation, trash, debris and other deleterious materials should be removed and wasted from the site prior to removal of unsuitable soils and placement of compacted fill. Artificial fill, topsoil/colluvium, alluvium, landslide debris, highly weathered older alluvium and highly weathered Otay Formation - Fanglomerate and Santiago Peak Volcanics should be removed in areas planned to receive fill or where exposed at final grade. The resulting undercuts should be replaced with engineered fill. Estimated depths of removals based upon the geologic unit are presented in Table 6.1, it should be noted that local variations can be expected requiring an increase in the depth of removal for unsuitable and weathered deposits. The extent of removals can best be determined in the field during grading when observation and evaluation can be performed by the soil engineer and/or engineering geologist. Removals should expose competent formational materials and be observed and mapped by the engineering geologist prior to fill placement. In general, soils removed during remedial grading will be suitable for reuse in compacted fills provided they are properly moisture conditioned, mixed, and do not contain deleterious materials.

Table 6.1

Estimated Depth of Removal

Geologic Unit (map symbol)	Estimated Removal Depth
Undocumented Artificial Fill (afu)	3-15 feet
Topsoil/Colluvium (No Map Symbol)	2-5 feet
Alluvium (Qal)	4-10 feet
Older Alluvium (Qoal)	1-4 feet
Landslide Debris (Qls)	20-50 feet
Otay Formation – Fanglomerate (Tof)	1-3 feet
Santiago Peak Volcanics (Jsp)	1-3 feet

6.1.2. Overexcavation

6.1.2.1. Cut Lot Overexcavation

Cut lots exposing older alluvium, fanglomerate, and Santiago Peak Volcanics should be overexcavated such that a minimum of three feet of compacted fill is placed below the building pad and deeper overexcavation may be considered for structures planned with deeper footings, swimming pools, etc. The undercut overexcavation should maintain a minimum one (1) percent gradient to the front of the lot. In addition, where steep cut/fill transitions are created, additional overexcavation and flattening of the transitions may be required.

6.1.2.2. Cut/Fill Transition Lot Overexcavation

Where design or remedial grading activities create a cut/fill transition on the "structural" lots, excavation of the cut or shallow fill portion should be performed such that at least three (3) feet of compacted fill exists over the pad. The undercut overexcavation should maintain a minimum one (1) percent gradient to the front of the lot. In addition, where steep cut/fill transitions are created, additional overexcavation and flattening of the transitions may be recommended.

6.1.2.3. Street Overexcavation

Streets that are cut into older alluvium, fanglomerate and metavolcanic bedrock could potentially pose excavation difficulties during utility and street installation. The older alluvium and fanglomerate may require heavy ripping and the metavolcanic bedrock will likely require heavy ripping and/or blasting in deeper cut areas in order to get to utility excavation depth. During mass grading, where such materials are exposed, consideration should be given to undercutting the street/utility areas during mass grading to minimize this condition. The undercut should extend at least one foot below the deepest utility. The undercut zone should be replaced with compacted fill in accordance with project standards as outlined herein.

6.1.3. Removals Along Grading Limits and Property Lines

Removals of unsuitable soils will be required prior to fill placement along the project grading limits. A 1:1 projection, from toe of slope or grading limit, outward to competent materials should be established, when possible.

6.2. Slope Stability and Remediation

Based on current geologic information, it is generally anticipated that the proposed permanent graded cut and fill slopes will be grossly and surficially stable as designed. The majority of the project site is underlain by Metavolcanic bedrock and Tertiary age Otay Formation – Fanglomerate which are locally mantled by Quaternary age surficial soil units. It should be noted that sheared zones can be found within claystone beds in the Otay Formation – Fanglomerate. If encountered during grading operations in sloped areas, these slopes may require construction of stabilization fills to provide adequate long-term slope stability.

In proposed development areas underlain by landslide debris, complete removal of compressible soils, where possible, is recommended. In the area of the postulated landslide in the central portion of Village 14 (Neighborhood R-8), typical remediation would consist of removing compressible debris/soils and constructing shear keys and buttress fills to mitigate future slope instability and settlement of unconsolidated landslide debris. Additional investigation and analysis will be required to determine depth and areal extent of removals and to define the geometry of the buttresses and shear keys. In reviewing the current design with regard to the proposed development within the Land Exchange Alternative, it is AGS's opinion that the postulated landslide can be stabilized and reduce the impact to less than significant.

6.2.1. Cut Slopes

The highest proposed cut slopes are approximately 120 feet at a slope ratio of 2:1 (horizontal: vertical) and 85 feet at a slope ratio of 1.5:1. Based upon the currently available information, we anticipate that proposed cut slopes in Older Alluvium and Otay Formation - Fanglomerate will be grossly stable at slope ratios of 2:1 (horizontal: vertical) or flatter to maximum proposed height and that proposed cut slopes in Metavolcanic bedrock will be grossly stable at slope ratios of 1.5:1 or flatter to maximum proposed heights. Calculations supporting AGS's conclusions and recommendations relative to cut slopes are represented in Appendix D (Plates D-1 thru D-6).

Cut slopes should be observed by the Geotechnical Consultant during grading. Where cut slopes expose unfavorable geology, such as, daylighted joints, sheared zones, loose or raveling weathered bedrock, or where boulders may pose a rock fall hazard, replacement of the unsuitable portions of the cut with stabilization fill will be recommended.

TABLE 6.2.1
CUT SLOPE STABILITY

Slope Height (Slope Ratio)	Geologic Unit	Static F.S	Pseudostatic F.S
120 ft. (2:1)	Tof	1.90	1.34
85 ft. (1.5:1)	Jsp	2.41	1.76

6.2.2. Fill Slopes

Fill slopes on the project are designed at 2:1 ratios (horizontal to vertical) or flatter. The highest anticipated fill slope is approximately 165 feet high with an overall slope ratio of approximately 3.2:1. The most critical slope, in regard to slope stability, is a 150 feet high with a slope ratio of 2:1. This slope was used for slope stability analysis. Fill slopes, when properly constructed with onsite materials, are expected to be grossly stable as designed. Stability calculations supporting this conclusion are presented in Appendix D

(Plates D-7 through D-9). Fill slopes will be subject to surficial erosion and should be landscaped as quickly as possible.

Keys should be constructed at the toe of all fill slopes "toeing" on existing or cut grade. Fill keys should have a minimum width equal to one-half the height of ascending slope, and not less than 15 feet. Unsuitable soil removals below the toe of proposed fill slopes should extend from the catch point of the design toe outward at a minimum 1:1 projection into approved material to establish the location of the key. Backcuts to establish that removal geometry should be cut no steeper than 1:1 or as recommended by the Geotechnical Consultant.

TABLE 6.2.1 FILL SLOPE STABILITY		
Slope Height	Static F.S	Pseudostatic F.S
150 ft. (2:1 Fill Slope)	1.65	1.17

6.2.3. Skin Cut and Skin Fill Slopes

A review of the TM indicated a few design skin fill and skin cut conditions. Additional skin cut or thin fill sections may be created during grading. Where these conditions occur, it is recommended that a backcut and keyway be established such that a minimum fill thickness equal to one-half the remaining slope height, and not less than 15 feet, is provided. Where the design cut is insufficient to remove all unsuitable materials, overexcavation and replacement with a stabilization fill will be required, as shown on Grading Detail 6 in Appendix E.

6.2.4. Fill Over Cut Slopes

Fill over cut slopes should be constructed such that the cut portion is excavated first for geologic mapping and stability determination. If deemed stable then a "tilt-back" keyway half the remaining slope height or minimally twenty (20) feet wide should be established. Drains will be required for this condition with the locations determined based upon exposed field conditions.

6.2.5. Surficial Stability

The surficial stability of proposed fill and cut slopes, constructed in accordance with the recommendations presented herein, have been analyzed, and the analyses presented in Appendix D (Plates D-3 and D-6 and D-9) indicates factors-of-safety in excess of code minimums. When fill and cut slopes are properly constructed and maintained, satisfactory performance can be anticipated although slopes will be subject to erosion, particularly before landscaping is fully established.

6.2.6. Temporary Backcut Stability

During grading operations, temporary backcuts may occur due to grading logistics and during retaining wall construction. Backcuts should be made no steeper than 1:1

(horizontal to vertical) to heights of up to 20 feet, and 1½:1 (horizontal: vertical) for heights greater than 20 feet. Flatter backcuts may be necessary where geologic conditions dictate, and where minimum width dimensions are to be maintained.

In consideration of the inherent instability created by temporary construction of backcuts, it is imperative that grading schedules be coordinated to minimize the unsupported exposure time of these excavations. Once started these excavations and subsequent fill operations should be maintained to completion without intervening delays imposed by avoidable circumstances. In cases where five-day workweeks comprise a normal schedule, grading should be planned to avoid exposing at-grade or near-grade excavations through a non-work weekend. Where improvements may be affected by temporary instability, either on or offsite, further restrictions such as slot cutting, extending work days, implementing weekend schedules, and/or other requirements considered critical to serving specific circumstances, may be imposed.

6.2.7. Observation During Grading

All temporary slope excavations, including front, side and backcuts, and all cut slopes should be mapped to verify the geologic conditions that were modeled prior to grading.

6.3. Survey Control During Grading

Removal bottoms, fill keys, stabilization fill keys, and backdrains should be surveyed prior to final observation and approval by the geotechnical engineer/engineering geologist in order to verify locations and gradients.

6.4. Subsurface Drainage

Canyon subdrains should be constructed within the major drainages which will ultimately be filled as part of the mass grading of the site. Canyon subdrains will range in diameter from 6 to 8 inches in diameter and should be constructed in accordance with Grading Details 1 and 2. Final determination as to the location and the size of these subdrain systems will be dependent upon the final design grades and length of drain sections. Accordingly, once more detailed plans become available, site specific recommendations will be prepared regarding the size, location, and extent of the subdrain system for the project. Preliminary canyon subdrain drain locations and sizes are shown on Plates 1 through 7, and actual subdrain locations will be determined in the field, after completion of remedial grading.

Backdrains, where required, should be constructed in accordance with Grading Detail 2. Drains should be installed behind all retaining walls.

6.5. Seepage

Seepage, if encountered during grading, should be evaluated by the Geotechnical Consultant. In general, seepage is not anticipated to adversely affect grading. If seepage is excessive, remedial measures such as horizontal drains or under drains may need to be installed.

6.6. Earthwork Considerations

6.6.1. Compaction Standards

All fills should be compacted at least 90 percent of the maximum dry density as determined by ASTM D1557. All loose and or deleterious soils should be removed to expose firm native soils or bedrock. Prior to the placement of fill, the upper 6 to 8 inches should be ripped, moisture conditioned to optimum moisture or slightly above optimum, and compacted to a minimum of 90 percent of the maximum dry density (ASTM D1557). Fill should be placed in thin (6 to 8-inch) lifts, moisture conditioned to optimum moisture or slightly above, and compacted to 90 percent of the maximum dry density (ASTM D1557) until the desired grade is achieved. For fills greater than 50 feet, AGS recommends a minimum compaction standard of 93% percent of the maximum dry density (ASTM D1557). For fills deeper than 75 feet, AGS recommends a minimum compaction standard of 95% percent of the maximum dry density (ASTM D1557).

Where the natural slope is steeper than 5-horizontal to 1-vertical and where determined by the Geotechnical Consultant, compacted fill material shall be keyed and benched into competent materials.

6.6.2. Mixing and Moisture Control

In order to prevent layering of different soil types and/or different moisture contents, mixing and moisture control of materials will be necessary. The preparation of the earth materials through mixing and moisture control should be accomplished prior to and as part of the compaction of each fill lift. Water trucks or other water delivery means may be necessary for moisture control. Discing may be required when either excessively dry or wet materials are encountered.

6.6.3. Haul Roads

All haul roads, ramp fills, and tailing areas shall be removed prior to engineered fill placement.

6.6.4. Import Soils

The project is proposed to balance on site. If this changes, the Geotechnical Consultant should be contacted.

6.6.5. Rock Excavation Considerations and Potential Grading Impacts

The impacts of grading and potential blasting with regard to dust control, noise, etc. is generally under the purview of others and the conditions of the regulating agency. Potential impacts to the surrounding community environment during grading, blasting and rock crushing should be evaluated by licensed, experienced, grading and blasting contractors. The grading, blasting, and rock crushing operations should be coordinated by the contractors to minimize the impact of the grading operation on the surrounding community, environment, and improvements. The grading and blasting contractors should follow the guidelines and permit conditions provided by the regulating agency. The County of San Diego has strict grading and blasting ordinances that should be followed by grading and blasting contractors.

6.6.6. Oversize Rock

Oversized rock material [i.e., rock fragments greater than eight (8) inches] will be produced during the excavation of the design cuts and undercuts. Provided that the procedure is acceptable to the developer and governing agency, this rock may be incorporated into the compacted fill section to within three (3) feet of finish grade within residential areas and to two (2) foot below the deepest utility in street and house utility connection areas. Maximum rock size in the upper portion of the hold-down zone is restricted to eight (8) inches. Disclosure of the above rock hold-down zone should be made to property owners explaining that excavations to accommodate swimming pools, spas, and other appurtenances will likely encounter oversize rock [i.e., rocks greater than eight (8) inches] below three (3) feet. Rock disposal details are presented on Detail 10, Appendix E. Rocks in excess of eight (8) inches in maximum dimension may be placed within the deeper fills, provided rock fills are handled in a manner described below. In order to separate oversized materials from the rock hold-down zones, the use of a rock rake may be necessary

6.6.6.1. Rock Blankets

Rock blankets consisting of a mixture of fines, sand, gravel, and rock to a maximum dimension of 2 feet may be constructed. The construction of rock fill shall be continuously observed by the geotechnical consultant. The rock should be placed on a prepared grade, mixed with sand and gravel, watered and worked forward with bulldozers and pneumatic compaction equipment such that the resulting fill is comprised of a mixture of the various particle sizes, is without significant voids, and forms a dense, compact fill matrix. Adequate water shall be provided continuously during these operations.

Rock blankets may be extended to the slope face provided the following additional conditions are met: 1) no rocks greater than 12 inches in diameter are allowed within 6 horizontal feet of the slope face; 2) 50 percent of the material is to be three-quarters (3/4) of an inch minus by volume; and 3) back-rolling or track walking of the slope face is conducted at 4-foot verticals to meet project compaction specifications.

6.6.6.2. Rock Windrows

Rocks up to a maximum dimension of 4 feet may be placed in windrows in deeper soil fill areas in accordance with Grading Detail 10. The construction of rock fill shall be continuously observed by the geotechnical consultant. The base of the windrow should be excavated the width of the equipment and into the compacted fill core with rocks placed in single file within the excavation. Sands and gravels should be added and thoroughly flooded and tracked until voids are filled. Windrows should be separated by at least 15 feet of compacted fill, be staggered vertically, and separated by at least 4 vertical feet of compacted fill. Windrows should not be placed within 10 feet of finish grade within structural fill areas, within 2 vertical feet of the lowest buried utility conduit in structural fills, or within 15 feet of the finish slope surface unless specifically approved by the owner, geotechnical consultant, and governing agency.

6.6.6.3. Individual Rock Burial

Rocks in excess of four (4) feet, but not greater than eight (8) feet may be buried in the compacted fill mass on an individual basis. Rocks of this size may be buried separately within the compacted fill by excavating a trench and covering the rock with sand/gravel, and compacting the fines surrounding the rock. Distances from slope face, utilities, and building pad areas (i.e., hold-down depth) should be the same as windrows.

6.6.6.4. Rock Disposal Logistics

The grading contractor should consider the volume of rock disposal afforded by the design when excavation techniques and grading logistics are formulated. Rock disposal techniques should be discussed and approved by the geotechnical consultant and developer prior to implementation.

6.6.7. Fill Slope Construction

Fill slopes may be constructed by preferably overbuilding and cutting back to the compacted core or by back-rolling and compacting the slope face. The following recommendations should be incorporated into construction of the proposed fill slopes.

Care should be taken to avoid spillage of loose materials down the face of any slopes during grading. Spill fill will require complete removal before compaction, shaping, and grid rolling.

Seeding and planting of the slopes should follow as soon as practical to inhibit erosion and deterioration of the slope surfaces. Proper moisture control will enhance the long-term stability of the finish slope surface.

6.6.7.1. Overbuilding Fill Slopes

Fill slopes should be overfilled as determined by the grading contractor, but not less than 2 feet measured perpendicular to the slope face, so that when trimmed back to the compacted core, compaction of the slope face meets the minimum project requirements for compaction.

Compaction of each lift should extend out to the temporary slope face. The slope should be back-rolled at fill intervals not exceeding 4 feet in height, unless a more extensive overfilling is undertaken.

6.6.7.2. Compacting the Slope Face

As an alternative to overbuilding the fill slopes, the slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Back-rolling at more frequent intervals may be required. Compaction of each fill lift should extend to the face of the slope. Upon completion, the slopes should be watered, shaped, and track-walked with a D-8 bulldozer or similar equipment until the compaction of the slope face meets the minimum project requirements. Multiple passes may be required.

6.6.8. Utility Trench Excavation and Backfill

All utility trenches should be shored or laid back in accordance with applicable OSHA standards. Excavations in bedrock areas should be made in consideration of underlying geologic structure, and the geotechnical consultant should be consulted on these issues during construction.

Mainline and lateral utility trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557-09. Onsite soils will not be suitable for use as bedding material but will be suitable for use in backfill, provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks, or other construction materials and equipment. Drainage above excavations should be directed away from the banks, and care should be taken to avoid saturation of the soils.

Compaction should be accomplished by mechanical means. Jetting of native soils will not be acceptable.

To reduce moisture penetration beneath the slab-on-grade areas, shallow utility trenches should be backfilled with lean concrete or concrete slurry where they intercept the foundation perimeter, or such excavations can be backfilled with native soils, moisture-conditioned to over optimum, and compacted to a minimum of 90 percent relative compaction.

7.0 DESIGN RECOMMENDATIONS

From a geotechnical perspective, the Land Exchange Alternative is feasible provided the following recommendations are incorporated into the design and construction. Preliminary design recommendations are presented herein and are based on some of the general soils conditions encountered during the recent investigation and described in the referenced geotechnical investigations. As such, recommendations provided herein are considered preliminary and subject to change based on the results of additional observation and testing that will occur during grading operations. Final design recommendations should be provided in a final rough/precise grading report.

7.1. Structural Design Recommendations

It is our understanding that the Land Exchange Alternative would be graded and at least some portion of the lots will be ultimately sold to merchant builders; thus, precise building products, loading conditions, and locations are not currently available. It is expected that for typical one to three story residential/commercial products and loading conditions (1 ksf to 6 ksf for spread and continuous footings), conventional or post-tensioned shallow slab-on-grade foundation systems will be utilized.

Upon the completion of rough grading, finish grade samples should be collected and tested to develop specific recommendations as they relate to final foundation design recommendations for individual lots. These test results and corresponding design recommendations should be presented in a Final Rough Grading Report.

7.1.1. Foundation Design

Residential/Commercial structures can be supported on conventional shallow foundations and slab-on-grade or post-tensioned slab/foundation systems, as discussed above. The design of foundation systems should be based on as-graded conditions as determined after grading completion. The following values may be used in preliminary foundation design:

Allowable Bearing: 2000 psf.

Lateral Bearing: 250 psf. per foot of depth to a maximum of 2000 psf. for level conditions. Reduced values may be appropriate for descending slope conditions.

Sliding Coefficient: 0.35

The above values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern. Depth and reinforcement requirements and should be evaluated by a qualified engineer.

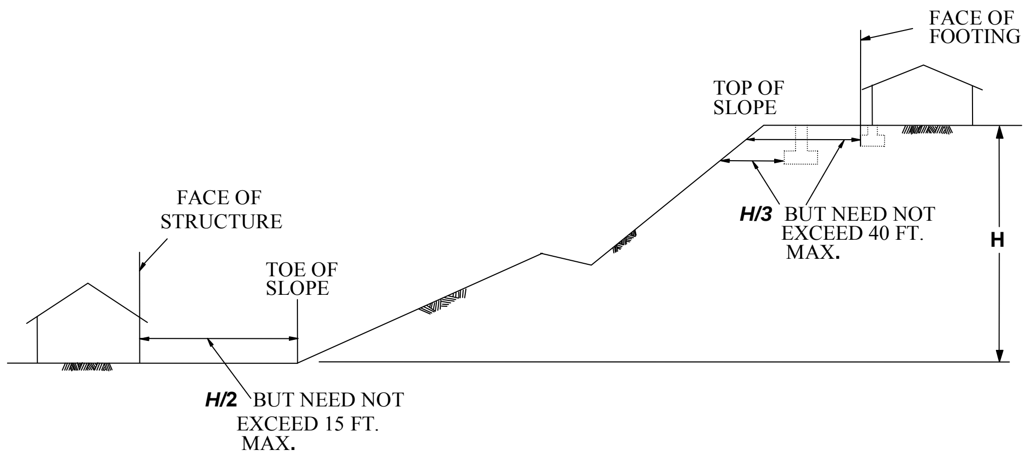
7.1.1.1. Deepened Footings and Setbacks

Improvements constructed in proximity to natural slopes or properly constructed, manufactured slopes can, over a period of time, be affected by natural processes including gravity forces, weathering of surficial soils and long-term (secondary) settlement. Most building codes, including the California Building Code, require that structures be set back or footings deepened where subject to the influence of these natural processes.

For the subject site, where foundations for residential structures are to exist in proximity to slopes, the footings should be embedded to satisfy the requirements presented in the following figure.

FIGURE 7.1.1.2

Setback Dimensions (CBC, 2016)



7.1.1.2. Moisture and Vapor Barrier

A moisture and vapor retarding system should be placed below the slabs-on-grade in portions of the structure considered to be moisture sensitive. The retarder should be of suitable composition, thickness, strength, and low permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. Historically, a 10-mil plastic membrane, such as *Visqueen*, placed between one to four inches of clean sand, has been used for this purpose. More recently Stego® Wrap or similar underlayments have been used to lower permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. The use of this system or other systems, materials, or techniques can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

7.1.2. Retaining Wall Design

The foundations for retaining walls of appurtenant structures structurally separated from the building structure may bear on properly compacted fill. The foundations may be designed in accordance with the recommendations provided in Table 7.1.2, Conventional Foundation Design Parameters. When calculating the lateral resistance, the upper 12 inches of soil cover should be ignored in areas that are not covered with hardscape. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance.

Retaining walls should be designed to resist earth pressures presented in the following table. These values assume that the retaining walls will be backfilled with select materials as shown in Detail RTW-A or native soils as shown in Detail RTW-B. The type of backfill (“select” or “native”) should be specified by the wall designer and shown on the plans. Retaining walls should be designed to resist additional loads such as construction loads, temporary loads, and other surcharges as evaluated by the structural engineer.

TABLE 7.1.2
RETAINING WALL EARTH PRESSURES

"Native"* Backfill Materials (γ=125pcf, EI$\leq$50)				
	Level Backfill		**Sloping (2:1) Backfill**	
	Rankine Coefficients	**Equivalent Fluid Pressure (psf / lineal foot)**	**Rankine Coefficients**	**Equivalent Fluid Pressure (psf / lineal foot)**
Active Pressure	K_a = 0.33	42	K_a = 0.54	67
Passive Pressure	K_p = 3.00	375	K_p = 1.12	140
At Rest Pressure	K_o = 0.50	63	K_o = 0.81	101
"Select"* Backfill Materials (γ=120pcf, EI$\leq$20, SE$\geq$20)				
	Level Backfill		**Sloping (2:1) Backfill**	
	Rankine Coefficients	**Equivalent Fluid Pressure (psf / lineal foot)**	**Rankine Coefficients**	**Equivalent Fluid Pressure (psf / lineal foot)**
Active Pressure	K_a = 0.28	34	K_a = 0.44	53
Passive Pressure	K_p = 3.54	420	K_p = 1.33	160
At Rest Pressure	K_o = 0.44	53	K_o = 0.75	90

Notes: "Select" backfill materials should be granular, structural quality backfill with a Sand Equivalent of 20 or better and an Expansion Index of 20 or less. The "select" backfill must extend at least one-half the wall height behind the wall; otherwise, the values presented in the "Native" backfill materials columns must be used for the design. "Native" backfill materials should have an Expansion Index of 50 or less. The upper one-foot of backfill should be comprised of native on-site soils.

In addition to the above static pressures, unrestrained retaining walls should be designed to resist seismic loading as required by the 2016 CBC. The seismic load can be modeled as a thrust load applied at a point 0.6H above the base of the wall, where H is equal to the height of the wall. This seismic load (in pounds per lineal foot of wall) is represented by the following equation:

$$Pe = \tfrac{3}{8} * \gamma * H^2 * k_h$$

Where:
- Pe = Seismic thrust load
- H = Height of the wall (feet)
- γ = soil density = 125 pounds per cubic foot (pcf)
- k_h = seismic pseudostatic coefficient = 0.5 * peak horizontal ground acceleration / g

The peak horizontal ground accelerations are provided in Section 5.7.2. Walls should be designed to resist the combined effects of static pressures and the above seismic thrust load.

Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces as shown in Details RTW-A and RTW-B in Appendix E. Otherwise, the retaining walls should be designed to resist hydrostatic forces. Proper drainage devices should be installed along the top of the wall backfill and should be properly sloped to prevent surface water ponding adjacent to the wall. In addition to the wall drainage system, for building perimeter walls extending below the finished grade, the wall should be waterproofed and/or damp-proofed to effectively seal the wall from moisture infiltration through the wall to the interior wall face.

The wall should be backfilled with granular soils placed in loose lifts no greater than 8-inches thick, at or near optimum moisture content, and mechanically compacted to a minimum 90 percent of the maximum dry density as determined by ASTM D1557. Flooding or jetting of backfill materials generally do not result in the required degree and uniformity of compaction and is not recommended. No backfill should be placed against concrete until minimum design strengths are achieved as verified by compression tests of cylinders. The geotechnical consultant should observe the retaining wall footings, back drain installation, and be present during placement of the backfill to confirm that the walls are properly backfilled and compacted.

7.1.3. Seismic Design

The site has been identified to have multiple site classes (Site Class B, C, and D) in accordance with CBC, 2016, Section 1613.3.2 and ASCE 7, Chapter 20. Utilizing this information, the United States Geological Survey (USGS) web tool (http://earthquake.usgs.gov/hazards/designmaps/) and ASCE 7 criterion, the mapped seismic acceleration parameters S_S, for 0.2 seconds and S_1, for 1.0 second period (CBC, 2016, 1613.3.1) for Risk-Targeted Maximum Considered Earthquake (MCE_R) can be determined. The mapped acceleration parameters are provided for Site Class “B”. Adjustments for other Site Classes are made, as needed, by utilizing Site Coefficients F_a and F_v for determination of MCE_R spectral response acceleration parameters S_{MS} for short periods and S_{M1} for 1.0 second period (CBC, 2016, 1613.3.3). Five-percent damped design spectral response acceleration parameters S_{DS} for short periods and S_{D1} for 1.0 second periods can be determined from the equations in CBC, 2016, Section 1613.3.4. Results are presented in Table 7.1.3.

TABLE 7.1.3
SEISMIC DESIGN CRITERIA

PARAMETER	SITE CLASS B (Hard rock-Jsp)	SITE CLASS C (Soft Rock-Tof/Qoa)	SITE CLASS D (Compacted Fill-afc)
Mapped Spectral Acceleration (0.2 sec Period), S_S	0.818g	0.818g	0.818g
Mapped Spectral Acceleration (1.0 sec Period), S_1	0.318g	0.318g	0.318g
Site Coefficient, F_a	1.000	1.073	1.173
Site Coefficient, F_v	1.000	1.482	1.764
MCE Spectral Response Acceleration (0.2 sec Period), SM_S	0.818g	0.878g	0.960g
MCE Spectral Response Acceleration (1.0 sec Period), SM_1	0.318g	0.471g	0.561g
Design Spectral Response Acceleration (0.2 sec Period), SD_S	0.546g	0.585g	0.640g
Design Spectral Response Acceleration (1.0 sec Period), SD_1	0.212g	0.314g	0.374g

7.2. Civil Design Recommendations

7.2.1. Rear and Side Yard Walls and Fences

Block wall footings should be founded a minimum of 24-inches below the lowest adjacent grade. To reduce the potential for uncontrolled, unsightly cracks, it is recommended that a construction joint be incorporated at regular intervals. For side yard walls situated perpendicular to the top of slopes a joint should be constructed at approximately 10 feet from the slope hinge point. Spacing of the joints should be between 10 and 20 feet.

7.2.2. Drainage

Final site grading should assure positive drainage away from structures. Planter areas should be provided with area drains to transmit irrigation and rain water away from structures. The use of gutters and down spouts to carry roof drainage well away from structures is recommended. Raised planters should be provided with a positive means to remove water through the face of the containment wall.

7.2.3. Water Quality Basins/ Drainage

AGS conducted site specific percolation testing to evaluate feasibility for storm water infiltration at the subject site and to determine preliminary infiltration rates for the proposed BMP basins. Testing was completed in general accordance with the 2016

County of San Diego BMP Design Manual. A copy of our site specific Infiltration Feasibility Study is included herewith in Appendix E.

7.2.4. Pavement Design

Final pavement design should be made based upon sampling and testing of post-grading conditions. For preliminary design and estimating purposes the pavement structural sections presented in Table 7.2.4 can be used for the range of likely traffic indices. The structural sections are based upon an assumed R - Value of 20.

TABLE 7.2.4
PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS

Traffic Index	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
5.0	3	7.5
6.0	4	8.5
7.0	4	10.5
8.0	5	14.5

Pavement subgrade soils should be at or near optimum moisture content and should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557. Aggregate base should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557 and should conform with the specifications listed in Section 26 of the *Standard Specifications for the State of California Department of Transportation* (Caltrans) or Section 200-2 of the *Standard Specifications for Public Works Construction* (Green Book). The asphalt concrete should conform to Section 26 of the Caltrans *Standard Specifications* or Section 203-6 of the Green Book.

8.0 SUMMARY OF SIGNFICANCE FOR GEOLOGIC HAZARDS

The potential for adverse effects related to soil and geologic hazards, both onsite and offsite, has been evaluated based on guidance presented in the County of San Diego Guidelines for Determining Significance – Geologic Hazards (2007). Soil and geologic hazards addressed in this report include fault rupture, ground shaking, liquefaction, landslides, rock fall, and expansive soils. It is our opinion that the risk associated with these hazards is less than significant or less than significant with mitigation. Where appropriate, mitigation measures are presented in the text of this report.

9.0 FUTURE STUDY NEEDS

This report represents an EIR level TM review of the Land Exchange Alternative. As the project design progresses, additional site specific geologic and geotechnical issues will need to be considered in the ultimate design and construction of the project. Consequently, future geotechnical reviews are necessary. These reviews may include reviews of:

- Rough grading plans.

- Precise grading plans.
- Foundation plans.
- Retaining wall plans.

These plans should be forwarded to the project geotechnical engineer/geologist for evaluation and comment, as necessary.

10.0 CLOSURE

10.1. Geotechnical Review

As is the case in any grading project, multiple working hypotheses are established utilizing the available data, and the most probable model is used for the analysis. Information collected during the grading and construction operations is intended to evaluate the hypotheses, and some of the assumptions summarized herein may need to be changed as more information becomes available. Some modification of the grading and construction recommendations may become necessary, should the conditions encountered in the field differ significantly than those hypothesized to exist.

AGS should review the pertinent plans and sections of the project specifications, to evaluate conformance with the intent of the recommendations contained in this report.

If the project description or final design varies from that described in this report, AGS must be consulted regarding the applicability of, and the necessity for, any revisions to the recommendations presented herein. AGS accepts no liability for any use of its recommendations if the project description or final design varies and AGS is not consulted regarding the changes.

10.2. Limitations

This report is based on the project as described and the information obtained from the test pits and the borings at the locations indicated on the plans. The findings are based on the review of the field and laboratory data combined with an interpolation and extrapolation of conditions between and beyond the exploratory excavations. The results reflect an interpretation of the direct evidence obtained. Services performed by AGS have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that additional exploration will be performed and an appropriate level of field review will be provided by geotechnical engineers and engineering geologists who are familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this and future reports. AGS should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations of this report are applicable to the specific design of this project as discussed in this report. They have no applicability to any other project or to any other location, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of AGS.

AGS has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the CONTRACTOR, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the final design drawings and specifications.

APPENDIX A

REFERENCES

References

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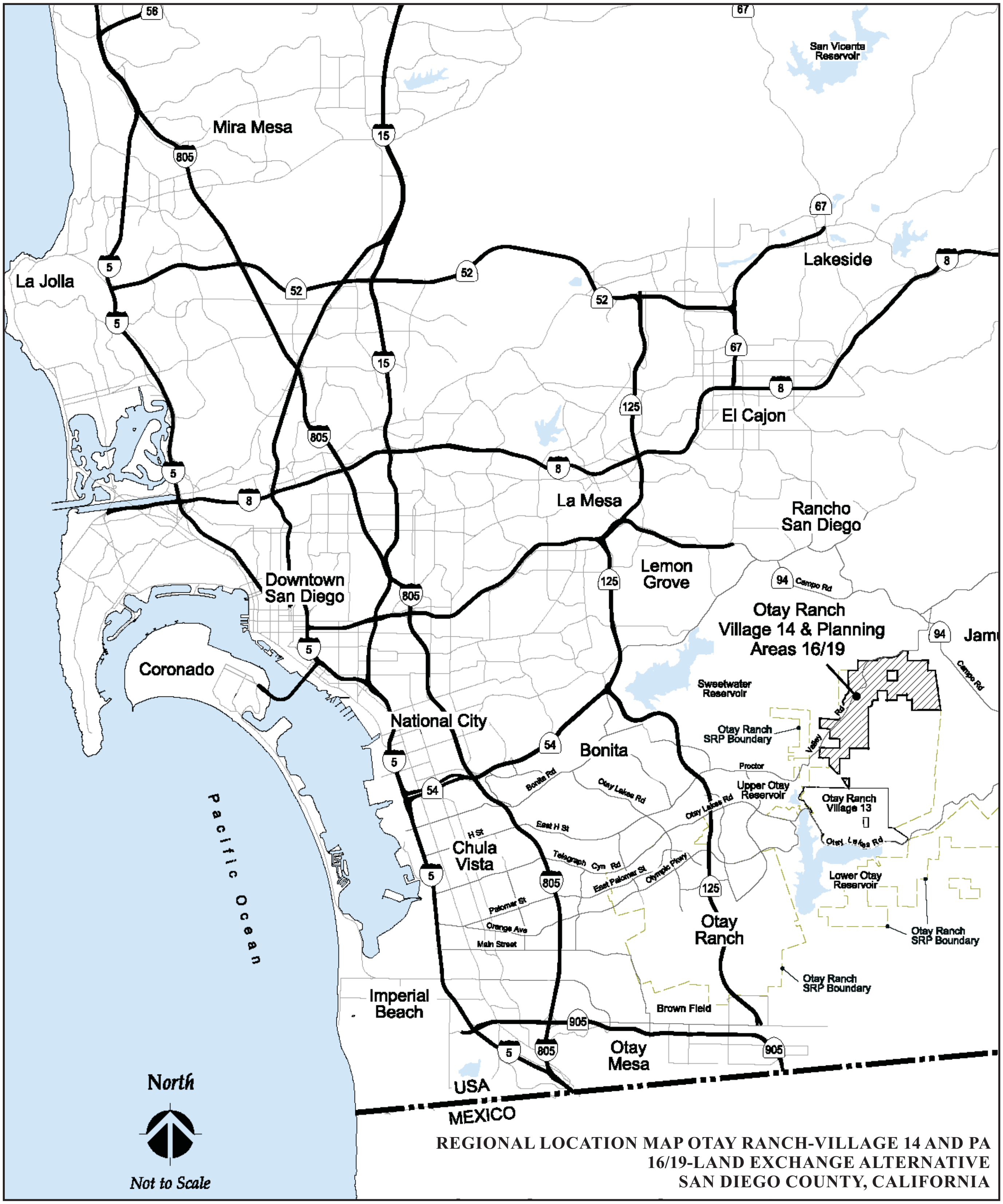
References (continued)

Aerial Photographs Reviewed for Report			
Year	**Flight ID**	**Photo ID**	**Photo Scale**
1928	SD	69B- 1, 2, 3 69C- 1, 2, 3 69D- 1, 2, 3	1” = 1000’
1960-1970	SDCT2/T11	2- 74 14- 28, 29, 30	1” = 1000’
1968	AXN	3JJ- 101, 102, 175	1” = 2800’
1970	SDC	13- 7, 8	1” = 2000’
1971	GS-VCSQ	1- 5	1” = 2600’
1973-1975	SDPD	14- 11, 12, 13 15- 14	1” = 1000’
1974	SDC ORTHOS	Jamul Mtn.	1” = 2000’
1974	SDPD	2- 3,4	1” = 2000’
1976	SAN DIEGO	235, 236, 247, 248	1” = 2000’
1978-1979	SDCO (WEST)	33- F1,F2 34- D22, D23, D24	1” = 1000’
1983	C11109 (CAS)	139, 140	1” = 2000’
1989	WAC (WEST)	18- 49, 51	1” = 2640’

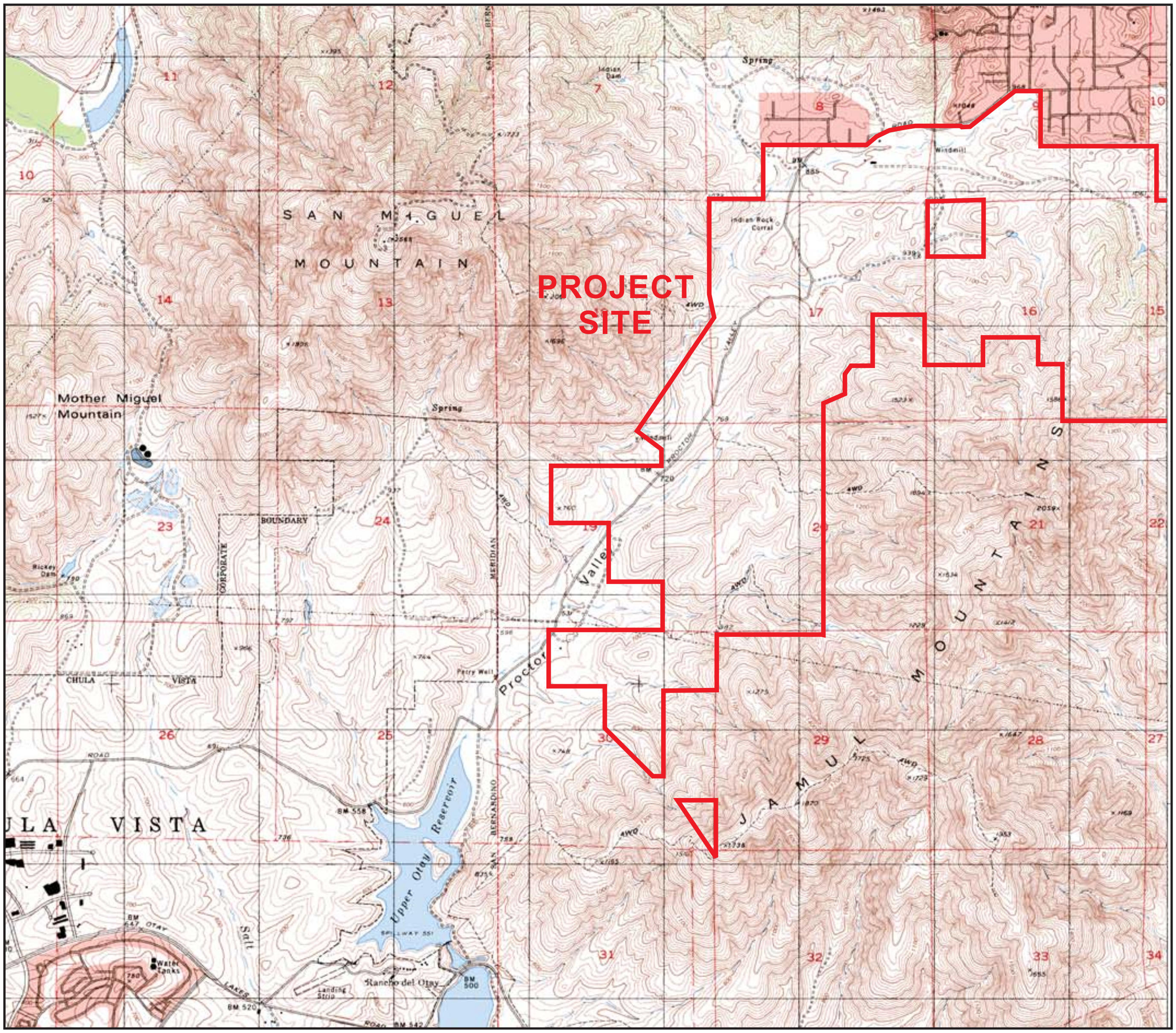


REGIONAL LOCATION MAP OTAY RANCH-VILLAGE 14 AND PA 16/19-LAND EXCHANGE ALTERNATIVE
SAN DIEGO COUNTY, CALIFORNIA

P/W 1312-02

FIGURE 1

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, CA 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287



N

1"=approx. 4000 ft.

SITE LOCATION MAP
OTAY RANCH-VILLAGE 14 AND PA 16/19-LAND EXCHANGE ALTERNATIVE SAN DIEGO COUNTY, CALIFORNIA

P/W 1312-02

FIGURE 2

SOURCE MAP - TOPOGRAPHIC MAP OF THE JAMUL MOUNTAINS 7.5 MINUTE QUADRANGLE, SAN DIEGO COUNTY, CALIFORNIA

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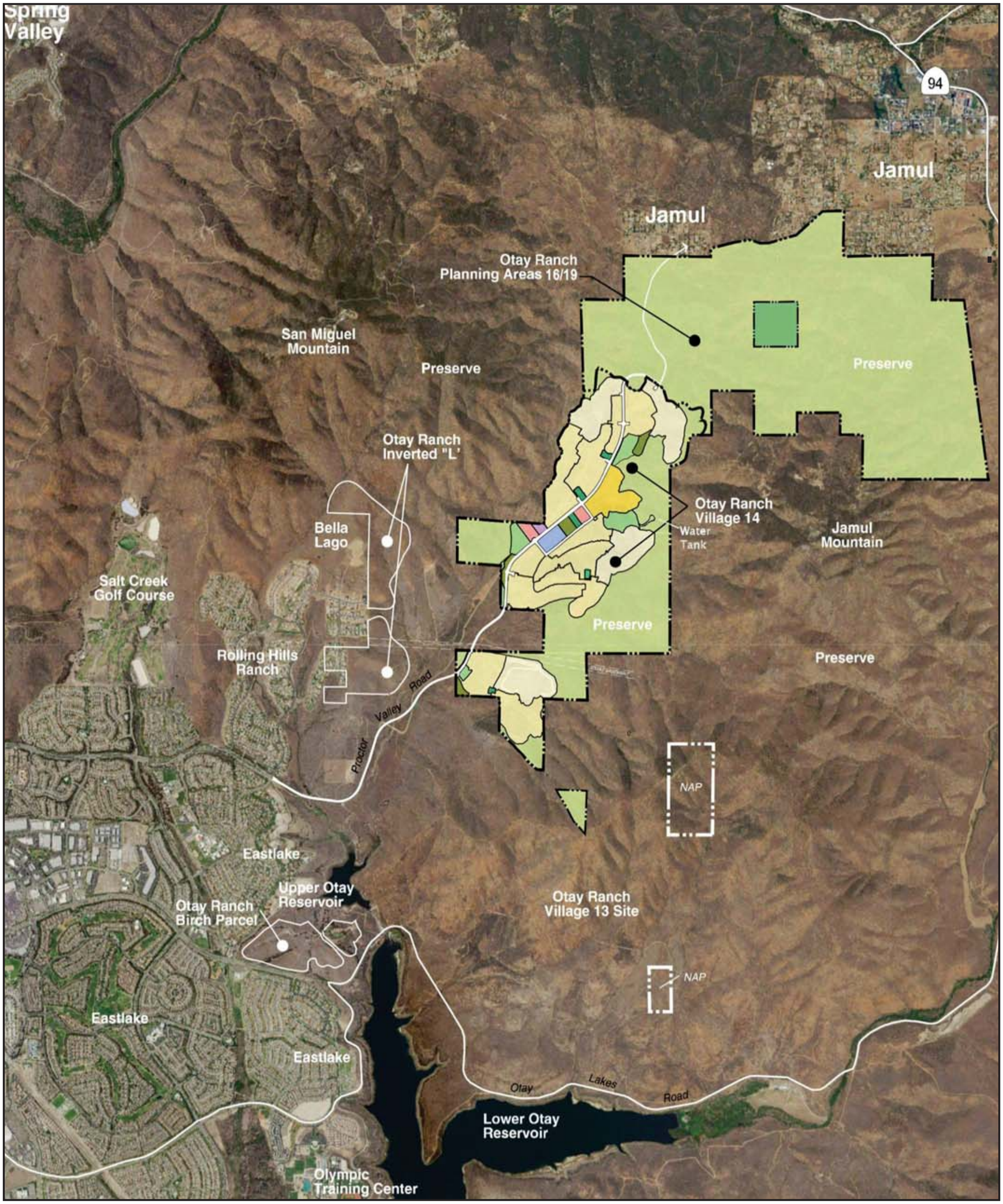

LEGEND

- V14 & PA16/19 DEVELOPMENT AREAS
- V14 & PA16/19 MSCP OPEN SPACE
- OTHER APPROVED DEVELOPMENT
- SPECIFIC PLAN BOUNDARY
- PROPOSED SPECIFIC PLAN BOUNDARY
- OTAY V14 & PA16/19 VILLAGE BOUNDARY
- MUNICIPAL BOUNDARY

P/W 1312-02

FIGURE 3

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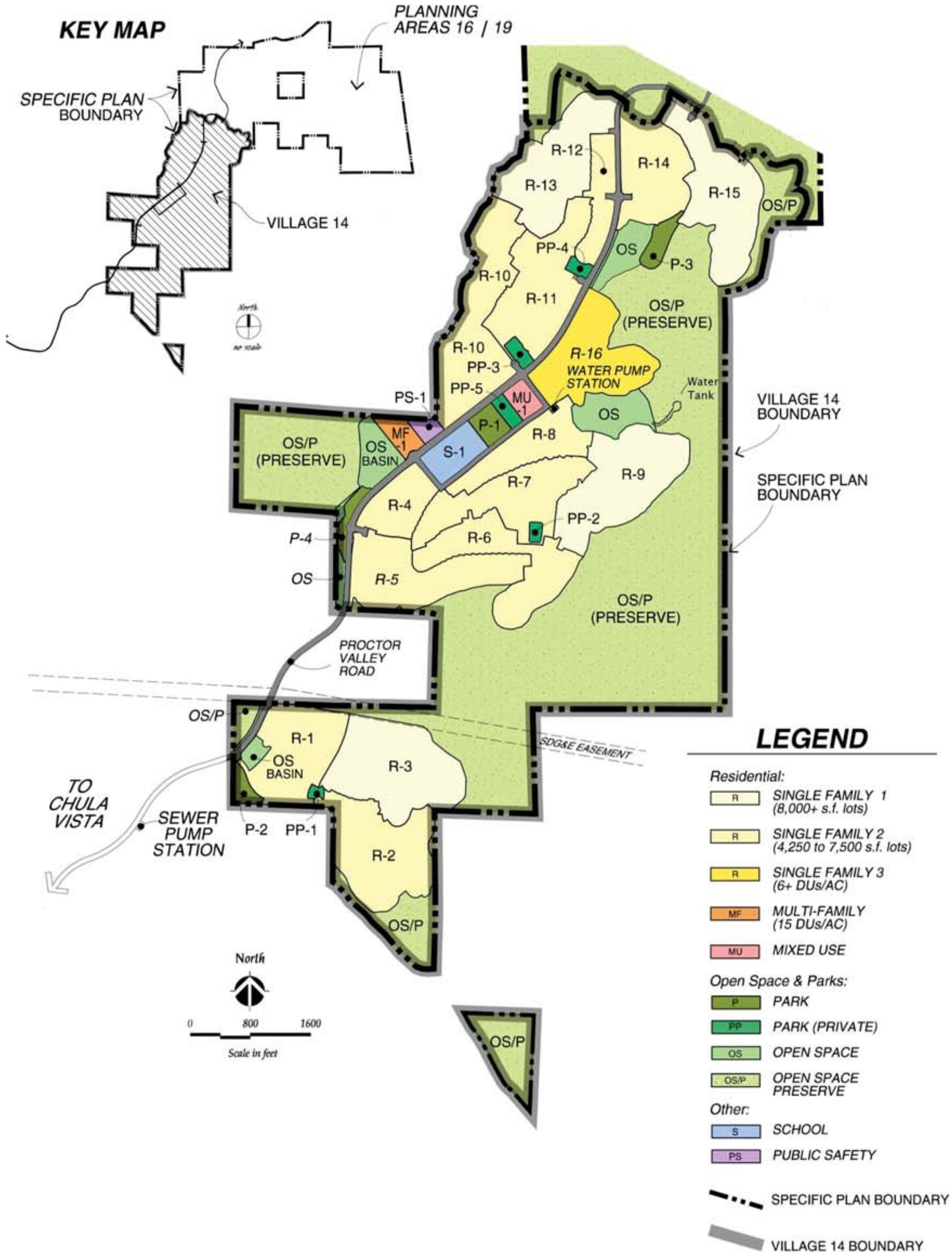

Land Exchange Alternative

SITE UTILIZATION PLAN
OTAY RANCH-VILLAGE 14 AND PA 16/19-LAND EXCHANGE
ALTERNATIVE, SAN DIEGO COUNTY, CALIFORNIA

P/W 1312-02

FIGURE 4

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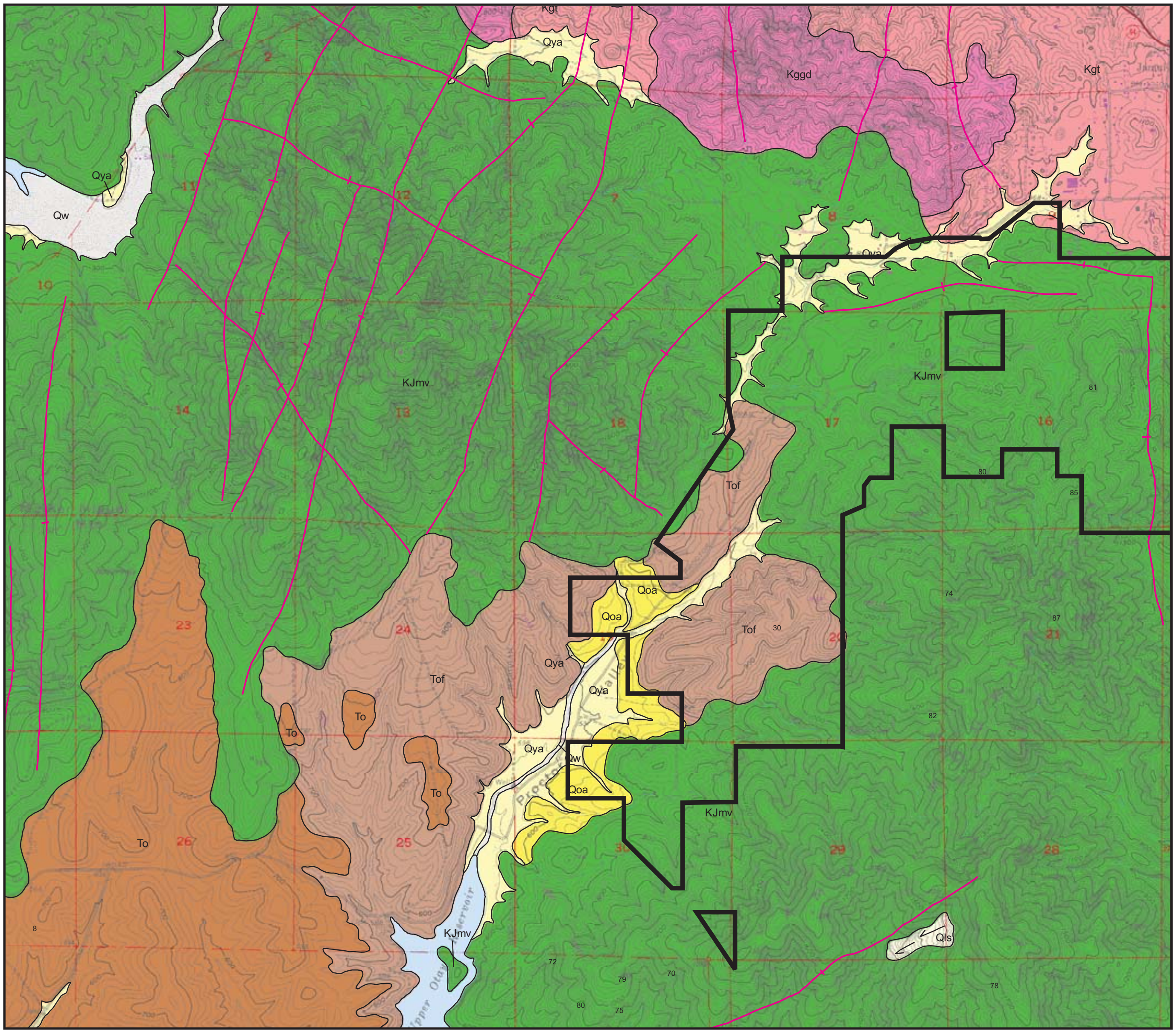

REGIONAL GEOLOGY MAP
OTAY RANCH-VILLAGE 14 AND
PA 16/19-LAND EXCHANGE ALTERNATIVE
SAN DIEGO COUNTY, CALIFORNIA

N

1”=approx. 4000 ft.

Qya	Holocene alluvial deposits unconsolidated to locally poorly consolidated silt, clay, sand and gravel. Included modern active sedmients along small drainage channels.
Qoa	Late Pleistocene alluvial deposits; moderately consolidated, poorly sorted flood plain deposits consisting of gravelly sandy silt and clay.
Tof	Otay Formation - fanglomerate facies (Oligocene to Miocene); poorly cemented bouldery conglomerate and coarse-grained sandstone. Interfingered with overlying To.
Kgt	Tonalite (Cretaceous); includes some granodiorite and quartz diorite; medium-grained; generally dark colored and severely weathered.
KJmv	Metavolcanic rocks (Jurassic and Cretaceous); mildly metamorphosed volcanic, volcaniclastic and sedimentary rocks. Volcanic rocks range from basalt to rhyolite, but are predominantly andesite and dacite.

P/W 1312-02

FIGURE 5

SOURCE MAP - GEOLOGIC MAP OF THE 7.5’ JAMUL MOUNTAINS QUADRANGLE, TAN, S.S., 2002.

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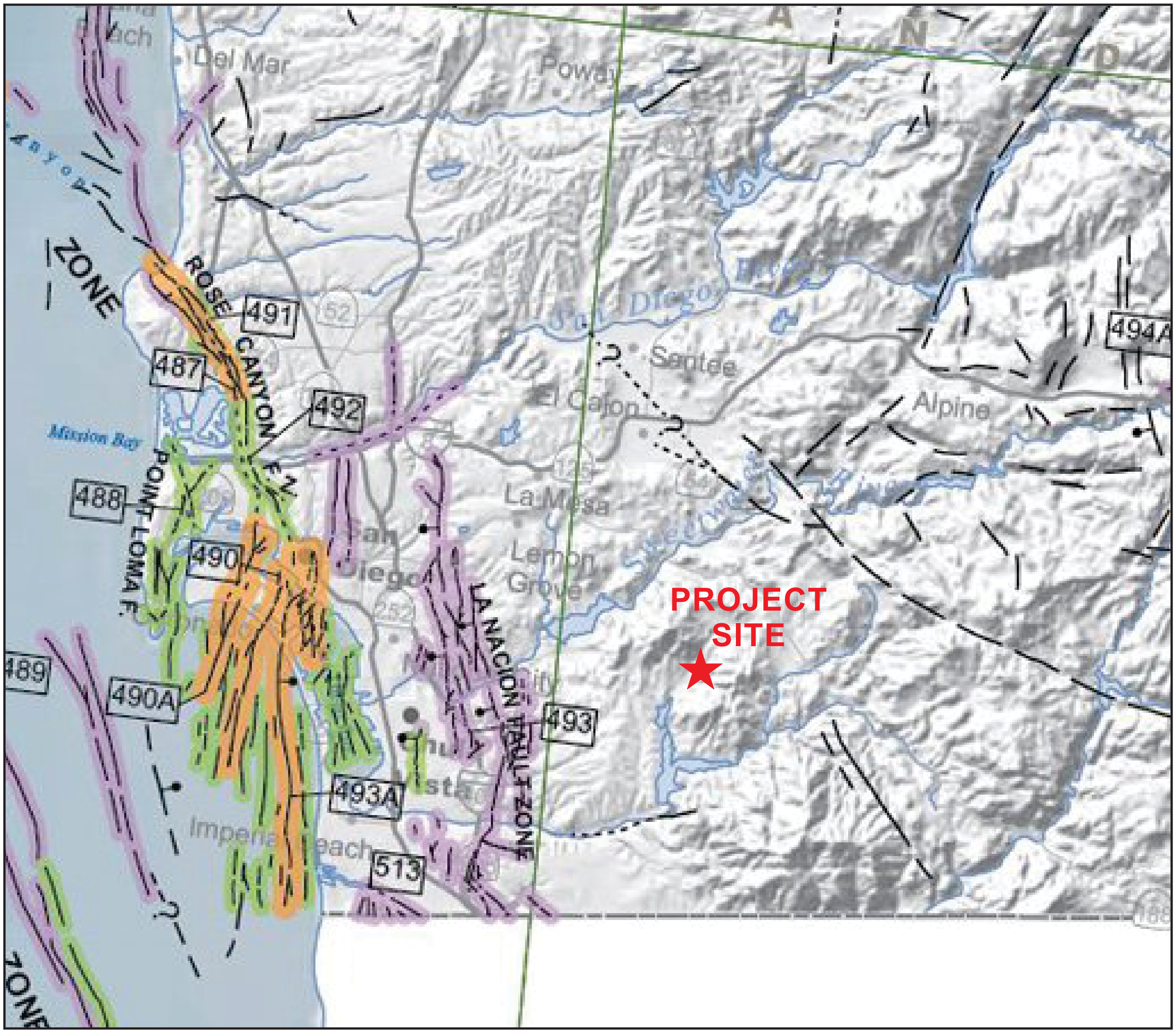

FAULT ACTIVITY MAP OF CALIFORNIA

P/W 1312-02

FIGURE 6

SOURCE MAP - 2010, CALIFORNIA GEOLOGICAL SURVEY, 150TH ANNIVERSARY FAULT ACTIVITY MAP OF CALIFORNIA

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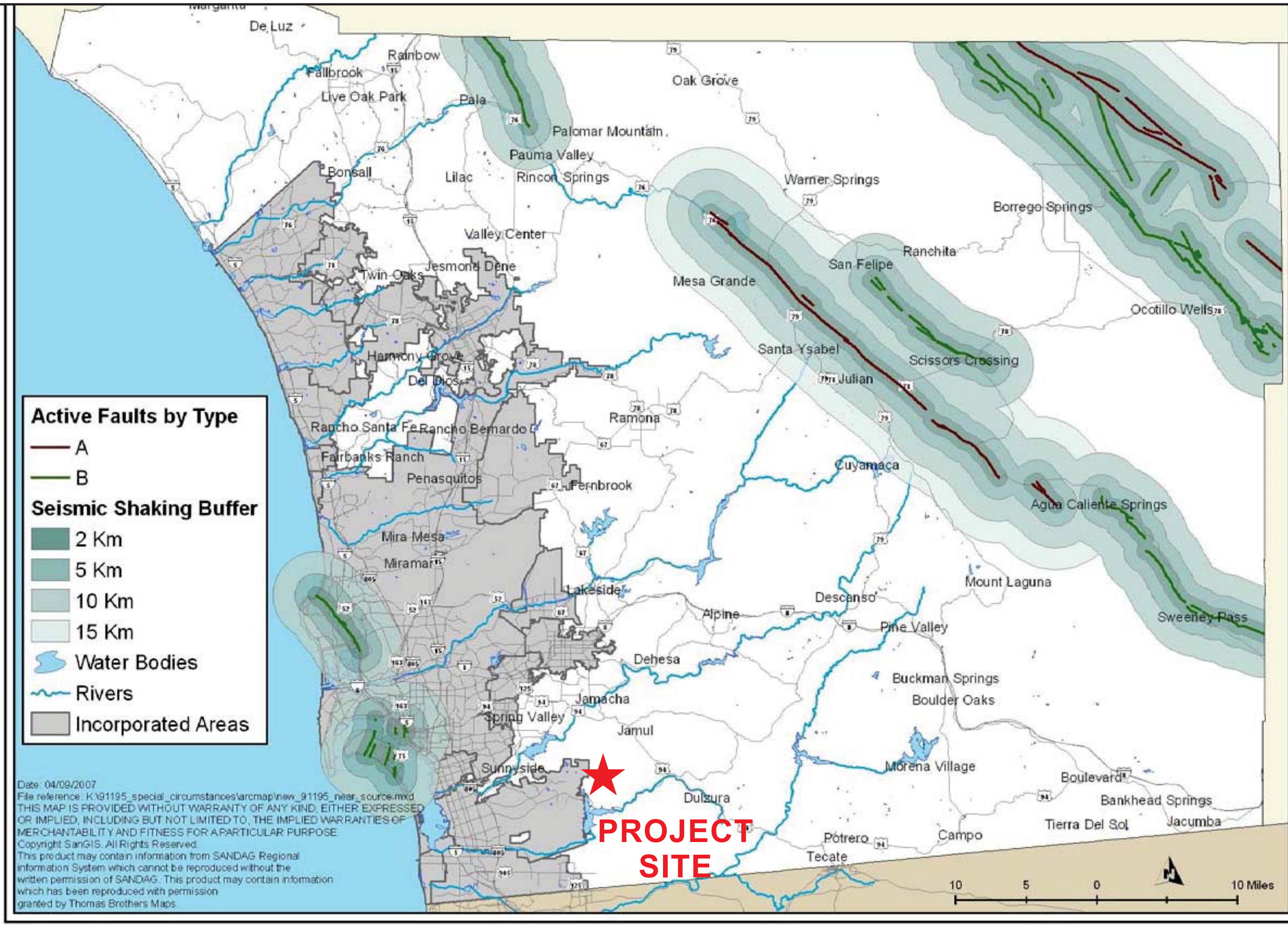

N

Guidelines for Determining Significance
Geologic Hazards

25

NEAR SOURCE SHAKING ZONES

P/W 1312-02

FIGURE 7

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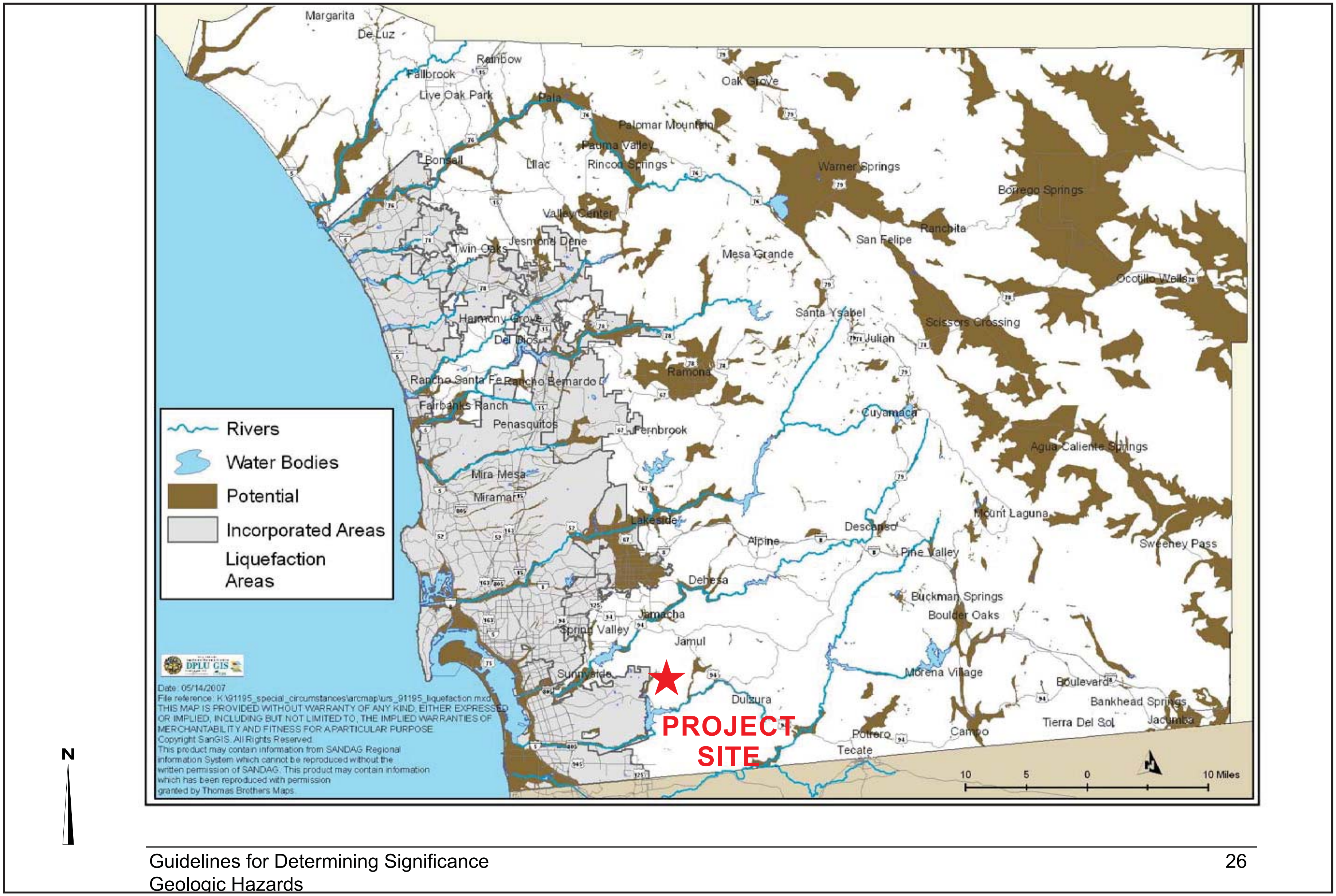
SOURCE MAP - COUNTY OF SAN DIEGO GUIDELINES FOR DETERMINING SIGNIFICANCE, GEOLOGIC HAZARDS, JULY 30, 2007



POTENTIAL LIQUEFACTION AREAS

P/W 1312-02

FIGURE 8

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SOURCE MAP - COUNTY OF SAN DIEGO GUIDELINES FOR DETERMINING SIGNIFICANCE, GEOLOGIC HAZARDS, JULY 30, 2007

APPENDIX B

SUBSURFACE INVESTIGATION

BORING AND TRENCH LOGS

BORING NUMBER BA-1

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo

PROJECT NAME Otay Village 14

PROJECT NUMBER 1312-02

PROJECT LOCATION Proctor Valley

DATE STARTED 1/29/15 **COMPLETED** 1/29/15

GROUND ELEVATION 752 ft **HOLE SIZE** 30

DRILLING CONTRACTOR Dave's Drilling

GROUND WATER LEVELS:

DRILLING METHOD Bucket Auger/Flight Auger

AT TIME OF DRILLING ---

LOGGED BY FE **CHECKED BY** PJD

AT END OF DRILLING ---

NOTES drop = 12"; 0-27ft.-4500lbs; 28-62.5ft. 3500lbs

AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
	0	SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, dry, loose; some clay.							
750			**Otay Formation - Fanglomerate (Tof):** CLAYEY SANDSTONE, brown, dry, soft, highly weathered; fractured; some secondary clay development.							
			@4 ft. fine to coarse grained, pale yellow, slightly moist to moist, moderately hard, slightly weathered.							
	5			UD	8	126	7.8	62	26	DS, PA
745				BU						
	10			UD	9	122	6.7	48	29	DS, PA
740			@11 ft. undulatory to flat-lying contact, SANDY CLAYSTONE, fine to medium grained, yellowish brown, moist, hard.							
	15		@15 ft. mottled light olive gray and light brownish yellow.	UD	9	127	10.9	89	87	PA
735										
	20			BU						MAX
730			@22 ft. grades down to BRECCIA.							
			@23 ft. CLAYEY SANDSTONE, brownish yellow, moist, hard; some subangular volcanic clasts to 10" diameter, one 12" clast.							
	25		@25 ft. BRECCIA, subangular volcanic clasts to 4" diameter in a clayey sandstone matrix; yellowish brown, moist, hard, massive.							
725										
	30		@29 ft. CLAYEY SANDSTONE, fine to coarse grained, light olive gray, moist, hard.							
720			@31 ft. abundant volcanic clasts to 6" diameter.							
	35									

(Continued Next Page)

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

BORING NUMBER BA-1

CLIENT Jackson Pendo **PROJECT NAME** Otay Village 14

PROJECT NUMBER 1312-02 **PROJECT LOCATION** Proctor Valley

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
	35			@35 ft. using flight auger to advance through Breccia with subrounded clasts to 10" diameter.							
715											
				@38 ft. some SANDY CLAYSTONE lenses to 24" thick.							
	40										
710				@41 ft. BRECCIA, metavolcanic clasts to 8" diameter in a clayey sandstone matrix; fine to coarse grained, pale yellow, moist, hard.							
				@44 ft. yellowish brown.							
	45										
					BU						CHEM
705											
				@48 ft. SANDSTONE, fine to coarse grained, light yellowish brown, moist, moderately hard, massive.							
	50										
700											
				@53 ft. CLAYEY SANDSTONE, fine to coarse grained, pale yellow, moist, hard; abundant subrounded gravel to 1" diameter.							
	55										
695											
	60										
690											

TD = 62.5 ft. No Groundwater. No Caving.

BORING NUMBER BA-2

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo
PROJECT NAME Otay Village 14
PROJECT NUMBER 1312-02
PROJECT LOCATION Proctor Valley
DATE STARTED 1/29/15 **COMPLETED** 1/29/15
GROUND ELEVATION 690 ft **HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger/Flight Auger
AT TIME OF DRILLING ---
LOGGED BY FE **CHECKED BY** PJD
AT END OF DRILLING ---
NOTES no drive samples
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
690	0		SC	**Topsoil:** CLAYEY SAND, fine to coarse grained, brown, loose; some angular volcanic clasts to 2" diameter.	BU					69	DS, PA
				Otay Formation - Fanglomerate (Tof): CLAYEY SANDSTONE, fine to coarse grained, reddish brown, moist, soft. @3 ft. light yellowish brown, moist, moderately hard, massive; abundant subangular to subrounded volcanic clasts to 4" diameter.							
685	5										
680	10										
					GB					24	PA
675	15										
				@19 ft. encountered large clast, switched to flight auger.							
				TD = 19.5 ft. (refusal) No Groundwater. No Caving.							

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

BORING NUMBER BA-3

CLIENT Jackson Pendo
PROJECT NAME Otay Village 14
PROJECT NUMBER 1312-02
PROJECT LOCATION Proctor Valley
DATE STARTED 1/29/15 **COMPLETED** 2/2/15
GROUND ELEVATION 700 ft **HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger/Flight Auger
AT TIME OF DRILLING ---
LOGGED BY FE **CHECKED BY** PJD
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
700	0		SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, slightly moist, loose; some clay.							
				Otay Formation - Fanglomerate (Tof): SANDY CLAYSTONE, reddish brown, slightly moist, soft; some subangular gravel to 2" diameter.							
				@2.5 ft. pale yellow, slightly weathered, moderately hard, massive; some subangular clasts to 8" diameter.							
695	5										
				@6 ft. CLAYEY SANDSTONE, fine to coarse grained, pale yellow, moist, moderately hard; some subangular clasts to 6" diameter.							
				@8 ft. one clast to 12" diameter, some olive siltstone clasts to 4" diameter.							
				@9 ft. pale brown to light gray; one volcanic clast to 16" diameter.							
690	10										
					UD	7	122	8.9	64	25	DS, PA
					BU						EI, MAX, R-VAL
685	15										
				@15 ft. pale yellow; some subangular gravel and cobbles to 4" diameter.	UD	10	125	8.4	64	20	DS, PA
				@15 ft. N70°E, 3°SE - faint bedding.							
680	20										
				@20 ft. hard, highly channelized.							
				@23 ft. BRECCIA; subangular to subrounded volcanic clasts to 8" diameter and abundant gravel in a dry, hard, massive, CLAYEY SANDSTONE matrix.							
675	25										
				@25 ft. one clast to 16" diameter; switched to flight auger.	BU						
670	30										
				@31 ft. very slow drilling through 12" clasts with flight auger.							
665	35										

(Continued Next Page)

CLIENT Jackson Pendo | **PROJECT NAME** Otay Village 14

PROJECT NUMBER 1312-02 | **PROJECT LOCATION** Proctor Valley

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
665	35			@35 ft. light yellowish brown.							
				@39 ft. some CLAYEY SANDSTONE lenses to 16" thick.							
660	40			@40 ft. BRECCIA, clasts to 14" diameter.							
655	45										

TD = 46 ft. (refusal on large clast) No Groundwater. No Caving.

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

BORING NUMBER BA-4

CLIENT Jackson Pendo
PROJECT NAME Otay Village 14
PROJECT NUMBER 1312-02
PROJECT LOCATION Proctor Valley
DATE STARTED 1/30/15 **COMPLETED** 1/30/15
GROUND ELEVATION 823 ft **HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger/Flight Auger
AT TIME OF DRILLING ---
LOGGED BY FE **CHECKED BY** PJD
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
	0		SM	**Topsoil:** SILTY SAND, fine to coarse grained, light brown, dry, loose; some clay; some volcanic clasts to 3" diameter.							
820				**Otay Formation - Fanglomerate (Tof):** BRECCIA, subrounded volcanic clasts to 8" diameter in a CLAYEY SANDSTONE matrix; fine to coarse grained, light yellowish brown, slightly moist, hard.							
	5				GB						
815				@6 ft. CLAYEY SANDSTONE, fine to coarse grained, pale yellow to light gray, dry to slightly moist, moderately hard to hard, massive; some gravel and subangular volcanic clasts to 6" diameter.							
	10				BU						MAX
810				@12 ft. light brownish yellow, moist, hard; abundant volcanic clasts to 6" diameter.							
	15				GB						
805				@18 ft. some SANDY CLAYSTONE lenses, fine to medium grained, light olive gray, moist, moderately hard; polished surfaces from 18 to 20 ft.	UD	8	101	14.3	57	32	PA
	20										
800				@23 ft. becomes fine grained, light olive gray, moist, moderately hard.							
	25				UD	5	99	19.8	76	89	DS, PA
					GB						EI, CHEM
795											
	30			@30 ft. BRECCIA, subangular volcanic clasts to 6" diameter in a CLAYEY SANDSTONE matrix, light yellowish brown, slightly moist, hard.							
790					GB						
				@33 ft. SANDY CLAYSTONE, fine grained, light olive gray, moist, moderately soft to moderately hard, massive.							
	35										

(Continued Next Page)

BORING NUMBER BA-4

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo | **PROJECT NAME** Otay Village 14

PROJECT NUMBER 1312-02 | **PROJECT LOCATION** Proctor Valley

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
	35										
					UD	10	105	18.5	82	77	DS, PA
785											
	40										
					GB						
780											
	45										
					GB						
775											
	50										
				@51 ft. CLAYEY SANDSTONE, fine to coarse grained, light yellowish brown, moist, hard; abundant gravel and some volcanic clasts to 8" diameter.							
770				@52 ft. SANDY CLAYSTONE, fine to coarse grained, light olive gray, moist, hard.	UD	12	110	19.6	99	80	DS, PA
	55										
765											
	60										
760				@62 ft. BRECCIA, subangular volcanic clasts to 4" diameter in a CLAYEY SANDSTONE matrix, light yellowish brown, moist, moderately hard.							
				@63 ft. light olive gray.	BU						
	65										
755											
	70										
750											

TD = 73 ft. No Groundwater. No Caving.

BORING NUMBER BA-5

AGS ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo
PROJECT NAME Otay Village 14
PROJECT NUMBER 1312-02
PROJECT LOCATION Proctor Valley
DATE STARTED 2/2/15 **COMPLETED** 2/3/15
GROUND ELEVATION 781 ft **HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger/Flight Auger
AT TIME OF DRILLING ---
LOGGED BY FE **CHECKED BY** PJD
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
780	0	SM	**Topsoil:** SILTY SAND, fine to coarse grained, light reddish brown, dry, loose.							
			Otay Formation - Fanglomerate (Tof): SANDY CLAYSTONE, fine to medium grained, reddish brown, slightly moist, soft, highly weathered. @2 ft. light olive gray, moist, slightly weathered, moderately soft; abundant iron oxide.							
775	5									
			@7 ft. CLAYEY SANDSTONE, fine to medium grained, light olive gray, moist, moderately hard; with iron oxide staining. @8 ft. fine to coarse grained; abundant subangular gravel and clasts to 6" diameter.							
770	10		@10.5 ft. GRAVELY SANDSTONE.	UD	4	115	12.4	72	43	DS, PA
			@14 ft. BRECCIA.							
765	15									
			@17 ft. some clasts to 8" diameter.							
760	20			BU						EI, MAX
			@24 ft. subrounded clasts to 4" diameter.							
755	25									
			@26 ft. CLAYEY SANDSTONE, fine grained, light olive gray, moist, hard, massive; undulatory contact with overlying breccia. @26.5 ft. N15°E, 5°NW approximate bedding.							
			@29.5 ft. BRECCIA							
750	30									
			@34 ft. light brown, very slow drilling -alternating between							
	35									

(Continued Next Page)

BORING NUMBER BA-5

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo **PROJECT NAME** Otay Village 14

PROJECT NUMBER 1312-02 **PROJECT LOCATION** Proctor Valley

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
	35			bucket auger and flight auger.							
745											
				@38 ft. pale yellow, moist.							
	40			@40 ft. some fine grained CLAYEY SANDSTONE lenses to 18" thick, pinching out, highly channelized.	GB					34	PA
740											
	45			@45 ft. matrix is moist to very moist.							
735											
	50			@50 ft. BRECCIA.							
730											
	55				GB						
725											
				@57 ft. CLAYEY SANDSTONE, light olive gray, moist, hard; undulatory contacts. Scour-fill contact with underlying clayey sandstone.							
	60										
720				@61 ft. BRECCIA lens, 6" thickness.							
				@62 ft. Grades in and out from SANDY CLAYSTONE to fine grained CLAYEY SANDSTONE, light olive gray, moist, hard, massive.							
	65				GB						
715					UD	20	108	14.1	67	80	DS, PA
				@67 ft. BRECCIA lens, 6" thickness, undulatory to flat lying contact with underlying SANDY CLAYSTONE, light olive gray, moist, hard. @67 ft. N70°W, 4°NE - approximate bedding.							
	70										
710											

TD = 74 ft. No Groundwater. No Caving.

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.

BORING NUMBER BA-6

CLIENT Jackson Pendo
PROJECT NAME Otay Village 14
PROJECT NUMBER 1312-02
PROJECT LOCATION Proctor Valley
DATE STARTED 2/3/15 **COMPLETED** 2/4/15
GROUND ELEVATION 995 ft **HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger/Flight Auger
AT TIME OF DRILLING ---
LOGGED BY FE **CHECKED BY** PJD
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
995	0		SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, dry, loose.							
				Santiago Peak Volcanics (Jsp): Metavolcanic bedrock, brown to reddish brown, slightly moist, moderately hard, highly weathered, tightly fractured, breaks into angular gravel to 3" diameter and silt. Hollow sounding with rock hammer.	UD	4	99	11.7	45		
				@3 ft. light brownish gray, slightly weathered, moderately hard.							
990	5			@3 ft. N40°E, 75°NW - foliation.							
				@8 ft. N30°E, 75°NW - joint @8 ft. N73°W, 60°NE - joint	BU						
985	10			@10 ft. highly to moderately jointed, tight to blocky fracture spacing.							
980	15			@14 ft. fewer joints.							

TD = 15 ft. (refusal) No Groundwater. No Caving.

BORING NUMBER BA-7

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo		**PROJECT NAME** Otay Village 14	
PROJECT NUMBER 1312-02		**PROJECT LOCATION** Proctor Valley	
DATE STARTED 2/4/15	**COMPLETED** 2/4/15	**GROUND ELEVATION** 890 ft	**HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling		**GROUND WATER LEVELS:**	
DRILLING METHOD Bucket Auger/Flight Auger		**AT TIME OF DRILLING** ---	
LOGGED BY FE	**CHECKED BY** PJD	**AT END OF DRILLING** ---	
NOTES		**AFTER DRILLING** ---	

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
890	0										
			SM	**<u>Artificial Fill - Undocumented (afu)</u>:** SILTY SAND, brown, moist, medium dense; abundant gravel and some subrounded cobbles to 4" diameter.							
				<u>Otay Formation - Fanglomerate (Tof)</u>: PALEOSOL, red, 2" thickness, over BRECCIA, yellowish brown, slightly moist, moderately hard.							
885	5			@5 ft. tabular, subangular clasts to 14" diameter in a SILTY SANDSTONE matrix, fine to coarse grained, dry, hard; with some clay.							

TD = 7.5 ft. (refusal) No Groundwater. No Caving.

BORING NUMBER BA-8

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

CLIENT Jackson Pendo
PROJECT NAME Otay Village 14
PROJECT NUMBER 1312-02
PROJECT LOCATION Proctor Valley
DATE STARTED 2/4/15 **COMPLETED** 2/4/15
GROUND ELEVATION 895 ft **HOLE SIZE** 30
DRILLING CONTRACTOR Dave's Drilling
GROUND WATER LEVELS:
DRILLING METHOD Bucket Auger/Flight Auger
AT TIME OF DRILLING ---
LOGGED BY FE **CHECKED BY** PJD
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	SATURATION (%)	FINES CONTENT (%)	OTHER TESTS
895	0		SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, slightly moist, loose.							
				Otay Formation - Fanglomerate (Tof): BRECCIA, subangular volcanic clasts to 12" diameter in a CLAYEY SANDSTONE matrix, fine to coarse grained, slightly moist, moderately hard.	GB						
890	5			@3.5 ft. brownish yellow, slightly weathered; abundant gravel; some gabbro (?) clasts to 4" diameter.							
885	10										
880	15			@15 ft. CLAYEY SANDSTONE, pale yellow, slightly moist, moderately hard; highly channelized.	UD	8	83	14.4	37	49	DS, PA
				@17.5 ft. grades down to BRECCIA, subangular volcanic clasts to 16" diameter in a CLAYEY SANDSTONE matrix, light olive gray to pale yellow, moist, hard, massive.							
875	20				BU						
				@22 ft. encountered large clast.							

TD = 22.5 ft. (refusal) No Groundwater. No Caving.

Project Otay Village 14
Date Excavated Jan. 26-28, 2015
Logged by FE/PJD
Equipment Cat 349E

LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
EX-1	0.0 – 2.0	SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, slightly moist, loose.
	2.0 – 12.0		**Otay Formation - Fanglomerate (Tof):** CLAYEY SANDSTONE, fine to coarse grained, reddish brown, dry, soft; some subrounded clasts to 8” diameter; highly weathered. @4 ft. light olive, moist to slightly moist; slightly weathered; some iron oxide staining; abundant subrounded clasts to 8” diameter; one 16” diameter clast.
			TOTAL DEPTH 12.0 FT. NO WATER, NO CAVING
EX-2	0.0 – 1.5	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, dry, loose.
	1.5 – 11.5		**Otay Formation - Fanglomerate (Tof):** SANDY CLAYSTONE, reddish brown, dry, soft; some subrounded clasts to 3” diameter. @3 ft. interlensed olive CLAYSTONE and yellowish brown, fine grained CLAYEY SANDSTONE; soft to moderately hard. @5 ft. some subrounded cobbles to 4” diameter. @6 ft. light olive CLAYSTONE lens, 12” thick.
			TOTAL DEPTH 11.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-3	0.0 – 1.5	SM	**Topsoil:** SILTY SAND, fine to medium grained, dark brown, dry, loose.
	1.5 – 7.5		**Otay Formation - Fanglomerate (Tof):** BRECCIA, subangular to subrounded volcanic clasts to 3" diameter in a CLAYEY SAND matrix; brown, slightly moist, highly weathered, soft to moderately hard. @2.5 ft. olive gray, hard, slightly weathered. @7 ft. very hard, cemented. @7.5 ft. encountered large clast. TOTAL DEPTH 7.5 FT. (PRACTICAL REFUSAL) NO WATER, NO CAVING
EX-4	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, brown, slightly moist, loose; some angular gravel to 0.5" diameter.
	1.0 – 13.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, angular volcanic clasts to 4" diameter in a CLAYEY SAND matrix; light gray to pale yellow, moderately soft, highly weathered, soft to moderately hard. @3 ft. hard, cemented, slightly weathered. @6 ft. clasts to 1" diameter. @7 ft. CLAYEY SANDSTONE, olive, moist, moderately hard. @13 ft. slow digging. TOTAL DEPTH 13.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-5	0.0 – 1.5	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, dry, loose.
	1.5 – 20.0		**Otay Formation - Fanglomerate (Tof):** CLAYSTONE, brownish gray, moist, soft, massive; some weathered volcanic clasts to 1” diameter. @6 ft. light olive gray, hard. @8 ft. light olive to pale yellow. @17 ft. fine SANDY CLAYSTONE, light olive, moist, hard.
			TOTAL DEPTH 20.0 FT. NO WATER, NO CAVING
EX-6	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, brown, slightly moist, loose.
	1.0 – 12.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, subangular volcanic clasts in a CLAYEY SANDSTONE matrix, light olive, moist, soft, massive. @6 ft. CLAYSTONE, some fine grained sand, light olive, moist, soft to moderately hard, massive.
			TOTAL DEPTH 12.0 FT. NO WATER, NO CAVING
EX-7	0.0 – 3.5	SM	**Topsoil/Colluvium (Qcol):** SILTY SAND, fine to coarse grained, slightly moist, loose.
		SC	@0.5 ft. CLAYEY SAND, brown, dry, medium dense; visible porosity.
	3.5 – 11.0		**Otay Formation - Fanglomerate (Tof):** Fine SANDY CLAYSTONE, olive, moist, moderately soft, massive; some subangular clasts to 1” diameter; old root fractures near vertical to a depth of 7 feet. @9 ft. SANDSTONE, fine grained, light yellow, dry, hard; cemented; massive.
			TOTAL DEPTH 11.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-8	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, dry, loose.
	1.0 – 9.0		**Otay Formation - Fanglomerate (Tof):** CLAYSTONE, brown, slightly moist, soft; highly weathered. @4 ft. BRECCIA, subangular volcanic clasts to 10” diameter in a SANDY CLAY matrix, light olive gray, moderately hard. @6.5 ft. SANDY CLAYSTONE, light olive gray, moist, hard; some gravel sized angular volcanic clasts. @8 ft. BRECCIA, subangular volcanic clasts to 8 diameter in a CLAYEY SANDSTONE matrix, light olive gray, moderately hard, massive.
			TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING
EX-9	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, slightly moist, very loose.
	1.0 – 13.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, angular volcanic clasts to 6” diameter in a SANDY CLAYSTONE matrix, grayish brown, dry, moderately hard, highly weathered; clay-lined fractures. @3 ft. slightly weathered, hard, some SANDY CLAYSTONE lenses, light olive gray, moist, moderately hard.
			TOTAL DEPTH 13.0 FT. NO WATER, NO CAVING
EX-10	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, reddish brown, slightly moist, loose.
	1.0 – 2.5		**Santiago Peak Volcanics (Jsp):** Meta-volcanic bedrock, reddish brown, moderately hard, highly weathered, fractured. @2 ft. Very hard, slightly weathered, light gray.
			TOTAL DEPTH 2.5 FT. (REFUSAL) NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-11	0.0 – 1.0	SP	**<u>Topsoil:</u>** GRAVELY SAND, brown, dry, loose; some clay.
	1.0 – 20.0		**<u>Otay Formation - Fanglomerate (Tof):</u>** SANDY CLAYSTONE, light gray and light brownish yellow, soft, highly weathered. @6 ft. slightly weathered, soft to moderately hard, some subrounded to angular gravel to 1" diameter. @16 ft. CLAYEY SANDSTONE, brownish yellow and light olive gray, moist, moderately hard; laminated. @19 ft. hard. TOTAL DEPTH 20.0 FT. NO WATER, NO CAVING
EX-12	0.0 – 0.5	SM	**<u>Topsoil:</u>** SILTY SAND, fine to coarse grained, brown, dry, loose; some clay.
	0.5 – 15.0		**<u>Otay Formation - Fanglomerate (Tof):</u>** SANDY CLAYSTONE, brown to reddish brown, highly weathered, dry, moderately hard; visible porosity. @4 ft. light yellow to light olive gray, slightly weathered, moderately hard. @11 ft. one 16" clast.
	15.0 – 16.0		**<u>Santiago Peak Volcanics (Jsp):</u>** Meta-volcanic bedrock, slightly weathered, hard, light gray; fractured. TOTAL DEPTH 16.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-13	0.0 – 0.5	SW	**Topsoil:** GRAVELY SAND, fine to coarse grained, brown, loose.
	0.5 – 20.0		**Otay Formation - Fanglomerate (Tof):** CLAYEY SANDSTONE, fine to medium grained, pale yellow to light yellow, dry, moderately hard, massive; moderately weathered. @3.5 ft. hard, moderately cemented, slightly weathered; some subrounded to subangular clasts to 2" diameter; some clay matrix. @9 ft. BRECCIA, clasts to 4" diameter. @10.5 BENTONITIC CLAYSTONE, pale red, moist, moderately hard, some manganese oxide, massive. TOTAL DEPTH 20.0 FT. (REFUSAL) NO WATER, NO CAVING
EX-14	0.0 – 1.0	SC	**Topsoil:** CLAYEY SAND, brown, dry, loose.
	1.0 – 17.5		**Otay Formation - Fanglomerate (Tof):** SANDY CLAYSTONE, brown, soft to moderately hard, moist; secondary clay development; fractured. @5 ft. light yellowish brown, slightly weathered, moderately hard. @6 ft. BENTONITIC CLAYSTONE, pale red, moist, moderately soft; some shrink-swell fractures. Flat-lying contact between breccia and bentonitic claystone. @13 ft. SANDY CLAYSTONE, yellowish brown, slightly moist, hard. @17 ft. very hard. TOTAL DEPTH 17.5 FT. (PRACTICAL REFUSAL) NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-15	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, dry, loose.
	1.0 – 13.0		**Otay Formation - Fanglomerate (Tof):** CLAYEY SANDSTONE, fine to coarse grained, reddish brown, dry, soft; some angular volcanic clasts to 1" diameter; highly weathered. @2.5 ft. pale yellow and light gray, slightly weathered, moderately hard. @7.5 ft. abundant subangular volcanic clasts to 1" diameter.
			TOTAL DEPTH 13.0 FT. NO WATER, NO CAVING
EX-16	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, slightly moist, loose.
	1.0 – 13.0		**Otay Formation - Fanglomerate (Tof):** SANDY CLAYSTONE, brown, slightly moist, soft, fractured; one 24" diameter clast. @4 ft. light olive gray and light yellow, slightly weathered. @5 ft. BRECCIA, angular volcanic clast to 8" diameter in a CLAYEY SAND matrix, pale yellow, dry to slightly moist, hard. @10 ft. slow digging.
			TOTAL DEPTH 13.0 FT. NO WATER, NO CAVING
EX-17	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, slightly moist, loose.
	1.0 – 10.0		**Otay Formation - Fanglomerate (Tof):** CLAYEY SANDSTONE to SANDY CLAYSTONE, brown, dry, highly weathered, fractured. @3.5 ft. gray to brownish gray, moist, hard, slightly weathered, massive.
			TOTAL DEPTH 10.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-18	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, slightly moist, loose.
	1.0 – 15.0		**Otay Formation - Fanglomerate (Tof):** Interlensed SANDY CLAYSTONE and CLAYEY SANDSTONE, reddish brown, moist, soft, fractured, highly weathered. @4 ft. light olive gray, hard, slightly weathered. @8 ft. SANDY CLAYSTONE, light olive gray, moist, hard, some gravel to 1” diameter. @12 ft. olive gray, moderate ripping to excavate. TOTAL DEPTH 15.0 FT. NO WATER, NO CAVING
EX-19	0.0 – 1.5	SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, slightly moist, loose; some subangular gravel to 3” diameter.
	1.5 – 17.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, angular volcanic clasts to 3” diameter in a CLAYEY SAND matrix, fine to coarse grained, brown, highly weathered, fractured; secondary clay development. @3ft. light olive gray, slightly weathered. @8 ft. some subangular clasts to 12” diameter; slow digging. @17 ft. refusal on large gray volcanic clasts >12” diameter. TOTAL DEPTH 17.0 FT. (REFUSAL) NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-20	0.0 – 0.5	SM	**Topsoil:** SILTY SAND, fine to medium grained, brown, slightly moist, loose.
	0.5 – 14.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, angular to subangular volcanic clasts to 6" diameter in a CLAYEY SAND matrix, reddish brown, soft, highly weathered, fractured. @3 ft. light olive gray, hard, slightly weathered. @10.5 ft. SANDY CLAYSTONE, olive gray, moist, moderately soft, polished surfaces. TOTAL DEPTH 14.0 FT. NO WATER, NO CAVING
EX-21	0.0 – 6.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, angular volcanic clasts to 10" diameter in a SANDY CLAY matrix. @3 ft. light olive gray, dry, slightly weathered, very hard; less matrix. @5 ft. very hard. TOTAL DEPTH 6.0 FT. (REFUSAL) NO WATER, NO CAVING
EX-22	0.0 – 3.0	CL	**Alluvium (Qal):** SANDY CLAY, brown, moist, soft; some angular clasts to 1.5" diameter.
	3.0 – 17.0		**Otay Formation - Fanglomerate (Tof):** CLAYSTONE, olive gray, very moist, soft, trace of pebbles; some fine grained sand; moderately weathered. @6 ft. CLAYEY SAND, fine to coarse grained; slightly weathered. @11.5 ft. CLAYEY SANDSTONE, light yellow, slightly moist, hard, abundant subangular clasts to 2" diameter. @14 ft. abundant subrounded pebbles. @15 ft. slow digging. @16 ft. very hard. TOTAL DEPTH 17.0 FT. (PRACTICAL REFUSAL) NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-23	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine to coarse grained, brown, slightly moist, loose.
	1.0 – 17.0		**Otay Formation - Fanglomerate (Tof):** SANDY CLAYSTONE, reddish brown, moist, moderately soft; highly weathered; fractured; secondary clay development. @3.5 ft. abundant subangular gravel. @4 ft. light olive gray, moderately hard; slightly weathered. @6.5 ft. CLAYEY SANDSTONE, pale yellow, moist, moderately hard, massive, some subrounded clasts to 8” diameter. @15 ft. more gravel, fine to coarse grained sand; some clasts to 16” diameter.
			TOTAL DEPTH 17.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-1A	0.0 – 2.0	SC/CL	**Topsoil/Colluvium (Qcol):** CLAYEY SAND to SANDY CLAY, dark brown to reddish brown, dry to slightly moist, loose/firm; with subangular to subrounded gravel and cobble.
	2.0 – 16.5		**Otay Formation - Fanglomerate (Tof):** SANDY CLAYSTONE, olive gray, slightly moist, moderately hard; with occasional small gravel; localized carbonate stringers (to 1" thick) to about 5.5 ft.; polished surfaces. @4.0 – 4.5 ft. gravelly layer, predominantly small, subrounded. @7.0 – 7.5 ft. SILTY CLAYSTONE, greenish gray to purplish brown; with occasional round to subrounded gravel/cobble; polished surfaces; manganese oxide staining.
			TOTAL DEPTH 16.5 FT. NO WATER, NO CAVING
EX-2A	0.0 – 1.0	SM/ML	**Topsoil:** SILTY SAND to SANDY SILT, reddish brown, dry, loose; with gravel and cobble.
	1.0 – 9.0		**Santiago Peak Volcanics (Jsp):** (RESIDUAL SOIL) SANDY CLAY matrix, dark reddish brown, with abundant angular to subangular gravel to boulders. @4.5 – 5.5 ft. Highly weathered, breaks into angular gravel to large cobble size fragments and occasional boulders; moderate clay development. @7.0 ft. Very hard digging; generally reducing to 8"-minus with some greater than 12".
			REFUSAL TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-3A	0.0 – 1.0	SM	**Topsoil:** SILTY SAND with clay, fine grained, dry, loose; with some gravel.
	1.0 – 9.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, SANDY CLAY, brown to dark reddish brown, slightly moist to moist, stiff; with abundant gravel to cobble size clasts. @4.0 ft. increased clast size (cobble with occasional boulder). @6.0 ft. CLAYEY SAND matrix, fine to coarse grained, pinkish brown to light brownish gray; moderately hard to hard; carbonate development on rock surfaces. @9.0 ft. Very hard digging, Jsp(?)
	9.0 – 11.5		**Santiago Peak Volcanics (Jsp):** Metavolcanic bedrock, moderately weathered, hard.
			REFUSAL TOTAL DEPTH 11.5 FT. NO WATER, NO CAVING
EX-4A	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine grained, brown, dry, loose; with clay and gravel.
	1.0 – 8.5		**Otay Formation - Fanglomerate (Tof):** BRECCIA with SANDY CLAY matrix, reddish brown, slightly moist, firm; with gravel and cobble size clasts; highly weathered; soft to moderately hard. @4.0 ft. abundant subangular to subrounded gravel and cobble with occasional boulders. @7.0 ft. hard.
			TERMINATED - LIMITED SPOIL AREA DUE TO SENSITIVE SPECIES TOTAL DEPTH 8.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-5A	0.0 – 4.0	CL	**<u>Topsoil/Colluvium (Qcol):</u>** SILTY to SANDY CLAY, dark brown, dry, loose; abundant rootlets. At 1.5 ft. becomes slightly moist to moist, firm; occasional angular to subrounded gravel. At 2.5 ft. abundant carbonate spotting.
	4.0 – 9.0		**<u>Otay Formation - Fanglomerate (Tof):</u>** SILTY CLAYSTONE, olive gray to pale yellowish brown, dry to slightly moist, highly weathered, soft; iron oxide development. @6.0 ft. becomes moderately hard, blocky fracture spacing.
	9.0 – 13.0		**<u>Santiago Peak Volcanics (Jsp):</u>** Metavolanic bedrock, highly weathered, moderately hard, tight to blocky fracture spacing, generally reduces to 8”-minus. @10.0 ft. hard to very hard. REFUSAL TOTAL DEPTH 13.0 FT. NO WATER, NO CAVING
EX-6A	0.0 – 2.5	SC/CL	**<u>Topsoil/Colluvium (Qcol):</u>** CLAYEY SAND to SANDY CLAY, brown, dry, loose; roots to 1.0 ft.
		CL	@1.0 ft. SANDY CLAY, reddish brown, slightly moist, firm to stiff; with occasional gravel; porous.
	2.5 – 8.0		**<u>Otay Formation - Fanglomerate (Tof):</u>** SILTY CLAYSTONE, dark olive green to grayish green with iron oxide development, moderately weathered, slightly moist, moderately hard; breaks into small gravel chunks with polished surfaces.
	8.0 – 16.0		**<u>Santiago Peak Volcanics (Jsp):</u>** Metavolcanic bedrock, highly to completely weathered, moderately hard, moist, clay development along fracture surfaces, abundant manganese oxide staining; generally reduces to 8”-minus. @14.0 ft. less weathered, hard. TOTAL DEPTH 16.0 FT. NO WATER, NO CAVING

Project PV Village 14 and PA 16&19
Date Excavated 10/13/16
Logged by FE
Equipment CAT 420 F

LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
PT-1	0.0 – 1.0	SM	**Topsoil:** SILTY SAND; fine to coarse grained, light brown, dry, loose; some clay and gravel.
	1.0–2.5	SC	**Older Alluvium (Qoal):** CLAYEY SAND; fine to coarse grained, reddish brown, slightly moist, dense; highly weathered, some clay, secondary clay development along partings, few rounded volcanic clasts.
	2.5 – 10.0		**Otay Formation – Fanglomerate (Tof):** CLAYEY SILTSTONE; very pale brown, slightly moist, soft; weathered, massive, some fine grained sand. @ 7.5 ft. CLAYEY SANDSTONE; brownish yellow, moist, moderately hard; breaks up to clayey sand with some silt.
			TOTAL DEPTH 10 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
PT-2	0.0 – 1.0	SC	**Topsoil:** SILTY SAND; fine to coarse grained, brown, dry, loose; some clay, trace gravel.
	1.0 – 6.5	CL	**Older Alluvium (Qoal):** SANDY CLAY; fine to coarse grained, reddish brown, slightly moist, very stiff, secondary clay development, highly weathered (Paleosol). @ 2.5 ft. CLAYEY SAND; with gravel and cobbles to 8-inch diameter, yellowish brown, moist, dense.

	6.5 – 10.0		**Otay Formation – Fanglomerate (Tof):** BRECCIA; angular to subangular, tabular volcanic clasts to 2-inch diameter in a clayey silt matrix, olive with iron oxide along fine fractures, moist, moderately soft, massive, some fine grained sand. TOTAL DEPTH 10 FT. NO WATER, NO CAVING

PT-3	0.0 –1.5	SM	**Topsoil:** SILTY SAND; brown, dry, loose, blocky; visible porosity, some clay, trace angular gravel to 0.5 inch diameter.
	1.5 – 8.0		**Older Alluvium (Qoal):** SILTY SAND; brown, dry, loose, blocky to 2.5 feet; visible porosity, some clay, trace angular gravel to 0.5 inch diameter.
	8.0 – 10.0		**Otay Formation – Fanglomerate (Tof):** CLAYEY SANDSTONE; brownish yellow, moist, moderately soft, massive, some silt. TOTAL DEPTH 10 FT. NO WATER, NO CAVING

PT-4	0.0 – 1.5	SM	**Topsoil:** SILTY SAND; fine to coarse grained brown, dry, loose; some clay, trace gravel, visible porosity.
	1.5 –8.0		**Older Alluvium (Qoal):** CLAYEY SAND: brownish yellow, slightly moist to moist, moderately soft; massive, some silt. @ 3 ft. CLAYEY SILTSTONE; olive to reddish brown, mottled, slightly moist, moderately hard; massive.
	8.0 – 10.0		**Otay Formation – Fanglomerate (Tof):** CLAYEY SANDSTONE; fine to coarse grained, reddish brown, moist, moderately soft; some silt, some angular gravel to 1-inch diameter. TOTAL DEPTH 10 FT. NO WATER, NO CAVING

PT-5	0.0 –0.5	SM	**<u>Topsoil:</u>** SILTY SAND; fine to coarse grained, light brown, dry, loose; some clay and gravel.
	0.5–9.0	GP	**<u>Older Alluvium (Qoal):</u>** Subangular volcanic gravel and cobble size tabular clasts to 10-inch diameter in a sandy clay matrix; reddish brown, dry, very dense. @ 9 ft. refusal on boulder. TOTAL DEPTH 9 FT. /REFUSAL NO WATER, NO CAVING

PT-6	0.0 –1.5	SC	**<u>Topsoil:</u>** CLAYEY SAND; brown, dry, loose, fine to medium grained.
	1.5–4.0	GP	**<u>Older Alluvium (Qoal):</u>** Subangular volcanic gravel and cobble size tabular clasts to 10-inch diameter in a sandy clay matrix; reddish brown, dry, very stiff, fine to coarse grained sand. @ 4 ft. refusal on boulder. TOTAL DEPTH 4 FT. /REFUSAL NO WATER, NO CAVING

PT-7	0.0 – 1.0	SM	**<u>Topsoil:</u>** SILTY SAND; fine to medium grained, light yellowish brown, dry, loose; some clay and gravel.
	1.0 – 10.0		**<u>Otay Formation – Fanglomerate (Tof):</u>** BRECCIA; angular volcanic clasts to 2-inch diameter in a silty clay matrix; highly weathered, yellowish brown, dry, soft; massive, abundant white carbonates. @ 4 ft. CLAYSTONE; olive to reddish brown, mottled, slightly moist, moderately hard, less weathered; massive @ 6.5 ft. BRECCIA; fine to coarse grained, olive, moist, soft; some silt, some angular gravel to 1-inch diameter, TOTAL DEPTH 10 FT. NO WATER, NO CAVING

PT-8	0.0 – 1.0	SM	**Topsoil:** SILTY SAND; fine to coarse grained, light yellowish brown, dry, loose; some clay and gravel.
	1.0 – 9.5		**Otay Formation – Fanglomerate (Tof):** BRECCIA; subangular to subrounded volcanic clasts to 8-inch diameter in a clayey sand matrix; highly weathered, yellowish brown, dry, soft; massive, abundant white carbonates, one subangular tabular volcanic clasts to 14 inch diameter. @ 3 ft. angular gravel to 3-inch diameter in a sandy clay matrix; olive with red iron oxide along fine fractures, mottled, slightly moist, moderately soft, massive. @ 9 ft. large cobble size clasts. @ 9.5 ft. refusal on boulder.
			TOTAL DEPTH 9.5 FT. /REFUSAL NO WATER, NO CAVING

Work Order 1312-02
Report No. 1312-02-B-6
Date Excavated 11/22/16
Excavated by CI
Equipment Case 580 SM 4x4 Backhoe w/24" bucket

TABLE I
LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
T-1	0.0 – 1.0	ML/SM	**TOPSOIL** (No Map Symbol): SANDY SILT/SILTY SAND, medium to fine-grained, tan/ brown, dry, soft/loose.
	1.5 – 3.0		**SANTIAGO PEAK VOLCANICS** (Jsp): fine- to medium-grained, tan to light grey, dry, moderately hard to hard, highly weathered @ 2.5 ft Freshening @ 3.0 ft. hard/practical refusal. TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
T-2	0.0 – 1..5	SM/SC	**TOPSOIL** (No Map Symbol): SANDY SILT/SILTY SAND, medium to fine-grained, tan/ light brown, slightly moist, soft/moderately dense, scattered angular gravel to 1” diameter.
	1.5 – 3.5		**SANTIAGO PEAK VOLCANICS** (Jsp): fine- to medium-grained, tan to light grey, dry, moderately hard to hard, highly weathered, fractured, angular @ 2.5 ft freshening, becoming blocky, generating 6-inch diameter rock particles. @ 3.5 ft. hard/practical refusal. TOTAL DEPTH 3.5 FT. NO WATER, NO CAVING
T-3	0.0 – 1.0	SM	**TOPSOIL** (No Map Symbol): GRAVELLY SANDY SILT/SILTY SAND, medium to fine-grained, tan/ light brown, slightly moist/dry, soft/moderately dense, scattered angular gravel to 1” diameter.

TABLE I

LOG OF TEST PITS

.

	1.0 – 2.5		**SANTIAGO PEAK VOLCANICS** (Jsp): brownish red, dry, moderately hard to hard, highly weathered, fractured, generates angular rock particles to 4 -inches @ 2.5 ft. refusal. TOTAL DEPTH 2.5 FT. NO WATER, NO CAVING
T-4	0.0 – 1.5	SC	**TOPSOIL** (No Map Symbol): GRAVELLY CLAYEY SAND, medium to fine-grained, tan/ red brown, slightly moist, loose, angular gravel to 2" diameter.
	1.5 – 3.0		**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, clay in-filled fractures, generates angular rock particles to 2 to 4 -inches @ 3.0 ft. refusal. TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
T-5	0.0 – 1.5	SC	**TOPSOIL** (No Map Symbol): GRAVELLY CLAYEY SAND to SANDY CLAY, medium to fine-grained, red brown, slightly moist, loose/soft, angular gravel to 2" diameter. @ 1.5 ft. becoming dark red, medium dense to firm.
	1.5 – 5.0		**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, generates angular rock particles to 1 to 3 –inches. @ 5.0 ft. practical refusal. TOTAL DEPTH 5.0 FT. NO WATER, NO CAVING

TABLE I

LOG OF TEST PITS

T-6	0.0 – 1.0	**TOPSOIL:** (No Map Symbol): CLAYEY SAND/SANDY CLAY, medium to fine-grained, light tan/red brown, slightly moist, medium dense/firm, root hairs.
	1.0 – 2.5	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, clay rich, generates angular rock particles to 9 –inches. @ 2.5 ft. practical refusal. TOTAL DEPTH 2.5 FT. NO WATER, NO CAVING
T-7	0.0 – 1.0	**TOPSOIL** (No Map Symbol): GRAVELLEY SILTY CLAY/ CLAYEY SILT, medium to fine-grained, dark brown to red brown, slightly moist/dry, firm.
	1.0 – 2.0	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, clay rich, generates angular rock particles from 2 to 9 –inch diameter. @ 2.0 ft. practical refusal. TOTAL DEPTH 2.0 FT. NO WATER, NO CAVING
T-8	0.0 – 1.5	**TOPSOIL:** (No Map Symbol): CLAYEY SAND/SANDY SILTY, medium to fine-grained, red brown, loose to soft, occasional angular gravels to 2-inch diameter.
	1.5 – 3.0	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown to grey brown, dry, moderately hard to hard, highly weathered, clay rich, generates angular rock particles from 2 to 9 –inch diameter. @ 3.0 ft. practical refusal. TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
T-9	0.0 – 2.0	**TOPSOIL** (No Map Symbol): CLAYEY SAND/SANDY SILT, medium to fine-grained, dark brown, slightly moist, soft, occasional gravel from 3inch.
	2.0 – 4.5	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, clay rich,

		generates angular rock particles from 2 to 8–inch diameter. @ 4.5 ft. practical refusal. TOTAL DEPTH 4.5 FT. NO WATER, NO CAVING
T-10	0.0 – 2.0	**TOPSOIL** (No Map Symbol): SANDY GRAVELLY CLAY, medium to fine-grained, dark brown, soft, dry, produces gravels from 3 to 8 inch slightly porous , root hairs.
	2.0 – 4.0	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, soft, highly weathered, clay rich, generates angular rock particles from 2 to 8 –inch diameter, freshening with depth. @ 4.0 ft. practical refusal. (Note: test pit approximately 75 feet long) TOTAL DEPTH 3.0 FT (south end) to 4.0 FT (north end). NO WATER, NO CAVING
T-11	0.0 – 4.0	**TOPSOIL** (No Map Symbol): GRAVELLEY SILTY CLAY/ CLAYEY SILT, medium to coarse -grained, dark brown, dry, soft and porous. @ 1.5 ft. soft to firm.
	4.0 – 7.0	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, clay rich, generates angular rock particles from 2 to 6 –inch diameter TOTAL DEPTH 7.0 FT. NO WATER, NO CAVING
T-12	0.0 – 3.5	**TOPSOIL/COLLUVIUM** (No Map Symbol): SANDY CLAY fine-grained, dark grey/brown, dry and soft. @ 1.5 ft. slightly moist and less porosity.
	3.5 – 5.5	**SANTIAGO PEAK VOLCANICS** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, soft and dry breaks into 1.0 to 1.5 inch angular rock. @ 5 ft. Freshening. TOTAL DEPTH 5.5 FT. NO WATER, NO CAVING

T-13	0.0 – 2.5	**<u>TOPSOIL/ALLUVIUM</u>** (No Map Symbol): SANDY SILT, medium to fine-grained, dark brown, dry and soft, porous
	2.5 – 2.75	**<u>SANTIAGO PEAK VOLCANICS</u>** (Jsp): reddish brown, dry, moderately hard to hard, highly weathered, slightly moist, soft and fractured. @ 2.75 ft. practical refusal. TOTAL DEPTH 2.75 FT. NO WATER, NO CAVING

- -

T-14	0.0 – 2.0	**<u>TOPSOIL</u>** (No Map Symbol): CLAYEY SILT, medium to fine-grained, red brown, dry and soft, porous
	2.0 – 2.5	**<u>SANTIAGO PEAK VOLCANICS</u>** (Jsp): grey green, dry, moderately hard to hard, weathered, breaks into rock to 12 inches. TOTAL DEPTH 2.5 FT NO WATER, NO CAVING

- -

T-15	0.0 – 3.5	**<u>TOPSOIL</u>** (No Map Symbol): GRAVELLEY SANDY SILTY medium to fine-grained, red brown, dry and soft, porous
	3.5 – 5.5	**<u>SANTIAGO PEAK VOLCANICS</u>** (Jsp): fine grained, red brown to grey brown, dry, soft, freshening with depth, highly weathered. (Bulk @2-4 ft) TOTAL DEPTH 5.5 FT NO WATER, NO CAVING

- -

Project Otay Village 14
Date Excavated July 15-18 2014
Logged by PJD
Equipment Cat 416F, 328D, 430F

LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
TP-1	0.0 – 1.0	SC/CL	**Topsoil:** SANDY CLAY to CLAYEY SAND with gravel and angular rock fragments to 6", brown to reddish brown, dry, loose; roots.
	1.0 – 9.5		**Otay Formation – Fanglomerate (Tof):** SANDY CLAYSTONE, fine grained, reddish brown, slightly moist, stiff; with abundant angular to subrounded gravel to cobble. @4.5 ft. silty to fine grained SANDY CLAYSTONE matrix, pale greenish gray, dense. @5.5 ft. grades to sandier matrix; subrounded to subangular volcanic and siltstone/claystone clasts; generally reduces to 8"-minus. @7.5 ft. SILTY CLAYSTONE, pale olive gray with iron oxide development, moist, stiff; with occasional gravel and small cobble, polished surfaces and manganese oxide staining.
			TOTAL DEPTH 9.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-2	0.0 – 2.0	SM	**Topsoil/Colluvium (Qcol):** SILTY to CLAYEY SAND, brown to reddish brown, dry, loose; with some gravel and small cobble; roots to 1.5 ft.
	2.0 – 4.5	CL	**Older Alluvium (Qoal):** SANDY CLAY, fine grained, reddish brown, moist, firm to stiff; with silty @3.5 ft. abundant carbonate development; porous.
	4.5 – 12.0		**Otay Formation - Fanglomerate (Tof):** SANDY SILTSTONE with clay and CLAYEY fine-grained SANDSTONE, reddish brown to olive green, slightly moist, moderately hard. @7.0 ft. SILTY SANDSTONE, fine to coarse grained, greenish to purplish, slightly moist, moderately hard; occasional small angular to subrounded gravel; with clay; poorly indurated/weakly cemented. @9.0 ft. occasional cobble to small boulder. @9.5 ft. SILTY CLAYSTONE, greenish gray to purplish brown, slightly moist to moist, moderately hard; manganese oxide staining.
			TOTAL DEPTH 12.0 FT. NO WATER, NO CAVING
TP-3	0.0 – 0.5	SM	**Topsoil:** SILTY SAND, brown, dry, loose; porous.
	0.5 – 6.5	CL	**Older Alluvium (Qoal):** SANDY CLAY, dark reddish brown, slightly moist to moist, stiff; porous; roots to 1.5 ft.; occasional small subrounded gravel.
		SC	@2.5 ft. SANDY CLAY to CLAYEY SAND, brown to orange brown, moist, firm/medium dense. @3.5 ft. Abundant GRAVEL to large COBBLE size fragments, subangular to subrounded, with clayey sand matrix; hard digging.
			REFUSAL TOTAL DEPTH 6.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-4	0.0 – 2.0	SM/SC	**Topsoil/Paleosol:** SILTY to CLAYEY SAND, brown, dry, loose, fine grained sand.
		SC	@ 1 ft. CLAYEY SAND, fine-grained, dark reddish brown, slightly moist, loose to medium dense; with occasional angular to subangular gravel. @1.5 – 2.0 ft. gravelly layer.
	2.0 – 7.0		**Older Alluvium (Qoal):** SILTY to fine grained SANDY CLAY, olive gray, slightly moist to moist, stiff. @4.0 ft. grades to CLAYEY SAND, fine grained, olive brown, very dense.
			TOTAL DEPTH 7.0 FT. NO WATER, NO CAVING
TP-5	0.0 – 3.0	SM	**Topsoil/Colluvium (Qcol):** SILTY SAND, brown to reddish brown, dry, loose; with clay and occasional gravel.
		SC	@1.0 ft. CLAYEY SAND, brown to dark reddish brown, slightly moist, medium dense; with abundant angular to subrounded gravel.
	3.0 – 7.5		**Otay Formation - Fanglomerate (Tof):** BRECCIA with SANDY CLAY matrix, subrounded to subangular gravel to large cobble size clasts, subrounded to subangular, reddish brown, slightly moist, moderately hard to hard. @5.0 ft. becomes hard to very hard; difficult digging.
			PRACTICAL REFUSAL TOTAL DEPTH 7.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-6	0.0 – 1.5	SM/ML	**Topsoil/Colluvium (Qcol):** SILTY SAND to SANDY SILT, fine grained, light brown to light grayish brown, dry, loose; with gravel.
		SC/CL	@0.5 ft. SANDY CLAY to CLAYEY SAND, reddish brown, slightly moist, medium dense/stiff.
	1.5 – 6.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, gravel to large cobble size clasts in reddish brown to grayish brown clay matrix, slightly moist, moderately hard to hard; minor carbonate development. @2.5 ft. predominantly cobble to boulder size clasts, angular to subangular, in gray to olive gray, clayey sand matrix; very difficult digging.
			REFUSAL TOTAL DEPTH 6.0 FT. NO WATER, NO CAVING
TP-7	0.0 – 3.0	SM/SC	**Topsoil/Colluvium (Qcol):** SILTY to CLAYEY SAND to SANDY SILT, light brown, dry, loose.
		CL	@1.0 ft. GRAVELLY TO SANDY CLAY, reddish brown, slightly moist, loose to medium dense.
	3.0 – 8.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, gravel to cobble size clasts, angular to subrounded, highly weathered, moderately hard; with greenish gray clay to clayey sand matrix; carbonate development. @5.5 ft. hard, slightly weathered; occasional boulder size fragments, angular to subangular. @7.0 ft. primarily boulder size clasts; very hard digging.
			REFUSAL TOTAL DEPTH 8.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-8	0.0 – 0.5	SC	**Topsoil:** CLAYEY SAND, brown to reddish brown, dry, loose; with silt.
	0.5 – 4.5		**Santiago Peak Volcanics (Jsp):** (RESIDUAL SOIL) CLAYEY SAND, fine grained, reddish brown, slightly moist; with subangular gravel and small cobbles.
			REFUSAL AT 4.5 FT. NO WATER, NO CAVING
TP-9	0.0 – 2.0	SM	**Topsoil/Colluvium (Qcol):** SILTY SAND, light grayish brown to brown, dry, loose.
		SC	@0.5 ft. CLAYEY SAND, reddish brown, slightly moist, medium dense; with angular to subangular gravel and small cobble; carbonate development.
	2.0 – 8.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, large cobble to boulder size clasts, light grayish brown sandy clay matrix, slightly moist, hard. @5.0 ft. difficult digging. @7.0 ft. very hard; more large cobble and small boulders.
			PRACTICAL REFUSAL TOTAL DEPTH 8.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-10	0.0 – 3.0	SM	**Topsoil/Colluvium (Qcol):** SILTY SAND, brown, loose; weakly carbonate cemented; porous; roots to 1.5 ft.; occasional angular cobble.
		SC	@1.0 ft. CLAYEY SAND, fine to coarse grained, reddish brown, slightly moist, medium dense; with angular to subangular gravel and cobble.
	3.0 – 5.5		**Otay Formation - Fanglomerate (Tof):** BRECCIA, cobble to boulder size clasts, angular, in a clayey sand matrix, reddish brown to greenish gray. @5.0 ft. Jsp(?) or large boulder(?), moderately weathered, very hard.
			REFUSAL TOTAL DEPTH 5.5 FT. NO WATER, NO CAVING

- -

Test Pit No.	Depth (ft.)	USCS	Description
TP-11	0.0 – 3.0	CL/SC	**Topsoil/Colluvium (Qcol):** SANDY CLAY to CLAYEY SAND with gravel, fine to coarse grained, reddish brown, slightly moist to moist, medium dense.
	3.0 – 5.5		**Otay Formation - Fanglomerate (Tof):** BRECCIA, gravel and cobble, angular to subangular, in a sandy clay matrix, reddish brown to greenish gray; with angular to subangular gravel and cobble; occasional boulder; moderately hard to hard; minor carbonate development at contact. @4.0 – 5.0 ft. more large cobble and boulders.
	5.5 – 6.0		**Santiago Peak Volcanics (Jsp) (?):** Highly weathered, hard.
			REFUSAL TOTAL DEPTH 6.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-12	0.0 – 1.0	SM	**Topsoil:** SILTY SAND, fine grained, reddish brown, dry, loose; with clay.
	1.0 – 3.5		**Santiago Peak Volcanics (Jsp):** Completely weathered, soft to moderately hard, breaks into SANDY GRAVEL with clay. @2.5 ft. moderately weathered, hard; Joint: N27W 89E. @3.0 ft. very hard. REFUSAL TOTAL DEPTH 3.5 FT. NO WATER, NO CAVING
TP-13	0.0 – 2.5	SM/ML	**Topsoil/Colluvium (Qcol):** SILTY SAND to SANDY SILT, dark brown, dry, loose; with subangular to subrounded gravel and cobble. @1.0 ft. reddish brown, slightly moist to moist, stiff/medium dense; with gravel and cobble.
	2.5 – 9.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, predominantly large gravel to cobble with occasional boulders (to 18”), in a clayey sand matrix, fine to coarse grained, greenish gray with abundant iron oxide development. @4.0 ft. grades to pinkish brown/greenish gray, soft to moderately hard. @4.5 ft. hard. @5.0 ft. more boulders (to 24”). @7.0 ft. difficult digging due to rock size. TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-14	0.0 – 1.0	SM/SC	**Topsoil:** SILTY to CLAYEY SAND, brown to reddish brown; with gravel and small cobble; scattered boulders at surface.
	1.0 – 6.0		**Older Alluvium (Qoal):** (RESIDUAL SOIL) SANDY CLAY to CLAYEY fine to coarse grained SAND with gravel, dark reddish brown, slightly moist to mosit, stiff/medium dense. @3.5 ft. Hard, abundant COBBLES AND BOULDERS in greenish gray, CLAYEY SAND matrix. @4.5 ft. Very hard, difficult excavation. @5.5 ft. Large boulders. (Jsp?) REFUSAL TOTAL DEPTH 6.0 FT. NO WATER, NO CAVING
TP-15	0.0 – 1.0	SM	**TOPSOIL:** SILTY SAND, reddish brown, dry, loose; porous.
	1.0 – 6.5		**Older Alluvium (Qoal):** Abundant large COBBLE and BOULDER size clasts in reddish brown, slightly moist, medium dense, CLAYEY SAND matrix; rock to 24” common. @3.0 – 3.5 ft. hard digging with pockets of loose soil. @5.5 ft. hard to very hard. TOTAL DEPTH 6.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-16	0.0 – 4.0	SM	**Topsoil/Colluvium (Qcol):** SILTY SAND, fine grained, brown, dry, loose; with occasional gravel and cobble. @0.5 ft. SANDY CLAY, grayish brown to reddish brown, slightly moist to moist, stiff; with angular to subangular gravel; plastic; porous. @3.5 – 4.0 ft. more gravel and small cobble.
	4.0 – 17.0	SM/SC	**Older Alluvium (Qoal):** SILTY to CLAYEY SAND, fine to coarse grained, orange brown to pale yellowish brown; with subangular to subrounded gravel and small cobble; weakly cemented. @5.5 ft. BRECCIA (?) abundant gravel and cobble (to 8”); occasional small boulder (12-15”). @10.0 ft. less gravel and cobble. @14.0 ft. rocky. TOTAL DEPTH 17.0 FT. NO WATER, NO CAVING
TP-17	0.0 – 1.0	SM/SC	**Topsoil:** SILTY to CLAYEY SAND, dark brown, dry, loose; with gravel and cobbles; roots to 1.5 ft.
	1.0 – 9.0		**Otay Formation - Fanglomerate (Tof):** BRECCIA, abundant cobbles and boulders in clayey sand matrix, brown, slightly moist, loose. @5.0 ft. SILTY to SANDY CLAYSTONE, pale grayish green to pale yellowish brown, moderately hard. @6.5 ft. more sand, hard to moderately hard; iron oxide development; weakly cemented. @7.5 – 8.0 ft. more cobble.
	9.0 – 9.5		**Santiago Peak Volcanics (Jsp)?:** Hard to very hard REFUSAL TOTAL DEPTH 9.5 FT. NO WATER, NO CAVING

SEISMIC REFRACTION STUDY

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

SEISMIC REFRACTION SURVEY
PROCTOR VALLEY ROAD DEVELOPMENT
JAMUL, CALIFORNIA

PREPARED FOR:

Advanced Geotechnical Solutions, Inc.
485 Corporate Drive, Suite B
Escondido, CA 92029

PREPARED BY:

Southwest Geophysics, Inc.
8057 Raytheon Road, Suite 9
San Diego, CA 92111

November 29, 2016
Project No. 116547

SOUTHWEST GEOPHYSICS, INC.
YOUR SUBSURFACE SOLUTION

November 29, 2016
Project No. 116547

Mr. Jeff Chaney
Advanced Geotechnical Solutions, Inc.
485 Corporate Drive, Suite B
Escondido, CA 92029

Subject: Seismic Refraction Survey
Proctor Valley Road Development
Jamul, California

Dear Mr. Chaney:

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the proposed Proctor Valley Road residential development located in the Jamul area of San Diego County, California. Specifically, our survey consisted of performing 13 seismic refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed, and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

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

Sincerely,
SOUTHWEST GEOPHYSICS, INC.

Aaron Puente
Project Geophysicist

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

REGISTERED GEOPHYSICIST
Hans van de Vrugt
No 1012
Exp. 2/28/18
STATE OF CALIFORNIA

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TABLE OF CONTENTS

Page

1. INTRODUCTION 1
2. SCOPE OF SERVICES 1
3. SITE DESCRIPTION 1
4. SURVEY METHODOLOGY 1
5. ANALYSIS AND RESULTS 3
6. CONCLUSIONS AND RECOMMENDATIONS 4
7. LIMITATIONS 4
8. SELECTED REFERENCES 6

Table

Table 1 – Rippability Classification 3

Figures

Figure 1 – Site Location Map
Figure 2a – Line Location Map (SL-1 through SL-3)
Figure 2b – Line Location Map (SL-4)
Figure 2c – Line Location Map (SL-5 and SL-6)
Figure 2d – Line Location Map (SL-7)
Figure 2e – Line Location Map (SL-8 and SL-9)
Figure 2f – Line Location Map (SL-10 and SL-11)
Figure 2g – Line Location Map (SL-12 and SL-13)
Figure 3a – Site Photographs (SL-1 through SL-4)
Figure 3b – Site Photographs (SL-5 through SL-8)
Figure 3c – Site Photographs (SL-9 through SL-13)
Figure 4a – Seismic Profile, SL-1
Figure 4b – Seismic Profile, SL-2
Figure 4c – Seismic Profile, SL-3
Figure 4d – Seismic Profile, SL-4
Figure 4e – Seismic Profile, SL-5
Figure 4f – Seismic Profile, SL-6
Figure 4g – Seismic Profile, SL-7
Figure 4h – Seismic Profile, SL-8
Figure 4i – Seismic Profile, SL-9
Figure 4j – Seismic Profile, SL-10
Figure 4k – Seismic Profile, SL-11
Figure 4l – Seismic Profile, SL-12
Figure 4m – Seismic Profile, SL-13

1. INTRODUCTION

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the proposed Proctor Valley Road residential development located in the Jamul area of San Diego County, California (Figure 1). Specifically, our survey consisted of performing 13 seismic refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed, and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

2. SCOPE OF SERVICES

Our scope of services included:

- Performance of 13 seismic P-wave refraction lines at the project site.
- Compilation and analysis of the data collected.
- Preparation of this data report presenting our results, conclusions and recommendations.

3. SITE DESCRIPTION

The project site is generally located along the south side of Proctor Valley Road in or near the Jamul area of San Diego County, California (Figure 1). The study areas included several slopes and ridges in the project area. Several dirt roads and trails cross portions of the site. Vegetation in the area consists of annual grass, brush, and scattered small trees. Numerous outcrops of crystalline rock were observed on and near the property. Figures 2a through 2g and 3a through 3c depict the site conditions in the area of the seismic traverses.

Based on our discussions with you it is our understanding that the project involves the construction of single family homes and associated infrastructure. Cuts in excess of 50 feet deep may be performed.

4. SURVEY METHODOLOGY

A seismic P-wave (compression wave) refraction survey was conducted at the site to evaluate the rippability characteristics of the subsurface materials and to develop subsurface velocity profiles of the areas surveyed. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves generated at the surface, using a hammer and plate, are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component geophones and recorded with a 24-channel Geometrics Geode seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials.

Thirteen seismic lines (SL-1 through SL-13) were conducted in the project area. The general locations and lengths of the lines were selected by your office. Shot points (signal generation locations) were conducted along the lines at the ends, midpoint, and intermediate points between the ends and the midpoint for a total of seven shot points.

The seismic refraction theory requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not generally be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by fracture zones, intrusions or boulders can also result in the misinterpretation of the subsurface conditions.

In general, seismic wave velocities can be correlated to material density and/or rock hardness. The relationship between rippability and seismic velocity is empirical and assumes a homogenous mass. Localized areas of differing composition, texture, and/or structure may affect both the measured data and the actual rippability of the mass. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

The rippability values presented in Table 1 are based on our experience with similar materials and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock rippability. These characteristics may also vary with location and depth. For trenching operations, the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in a narrow trench, should be anticipated.

Table 1 – Rippability Classification

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

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook (Caterpillar, 2011). Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

5. ANALYSIS AND RESULTS

As previously indicated, 13 seismic traverses were conducted as part of our study. The collected data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008). SeisOpt Pro uses first arrival picks and elevation data to produce subsurface velocity models through a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

Figures 4a, through 4m present the velocity models generated from our study. The approximate locations of the seismic refraction traverses are shown on the Line Location Maps (Figures 2a through 2g). In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the traverse.

6. CONCLUSIONS AND RECOMMENDATIONS

The results from our seismic survey revealed distinct layers/zones in the near surface that likely represent soil overlying bedrock with varying degrees of weathering. Distinct vertical and lateral velocity variations are evident in the models. These inhomogeneities are likely related to the presence of remnant boulders, intrusions and differential weathering of the bedrock materials. It is also evident in the tomography models that the depth to bedrock is highly variable across the site.

Based on the refraction results, variability in the excavatability (including depth of rippability) of the subsurface materials should be expected across the project area. Furthermore, blasting may be required depending on the excavation depth, location, equipment used, and desired rate of production. In addition, oversized materials should be expected. A contractor with excavation experience in similar difficult conditions should be consulted for expert advice on excavation methodology, equipment and production rate.

7. LIMITATIONS

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

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

8. SELECTED REFERENCES

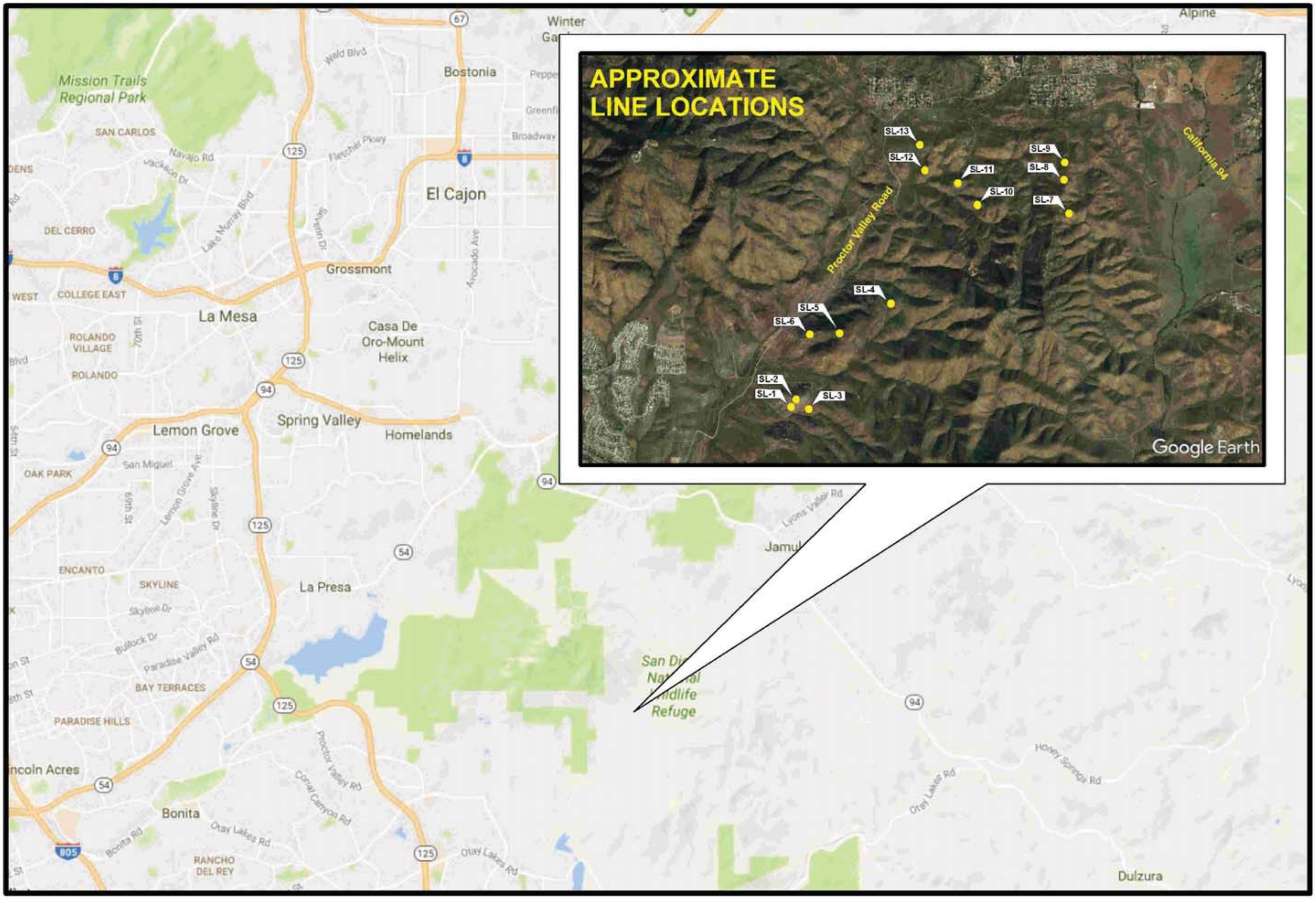
Caterpillar, Inc., 2011, Caterpillar Performance Handbook, Edition 41, Caterpillar, Inc., Peoria, Illinois.

Mooney, H.M., 1976, Handbook of Engineering Geophysics, dated February.

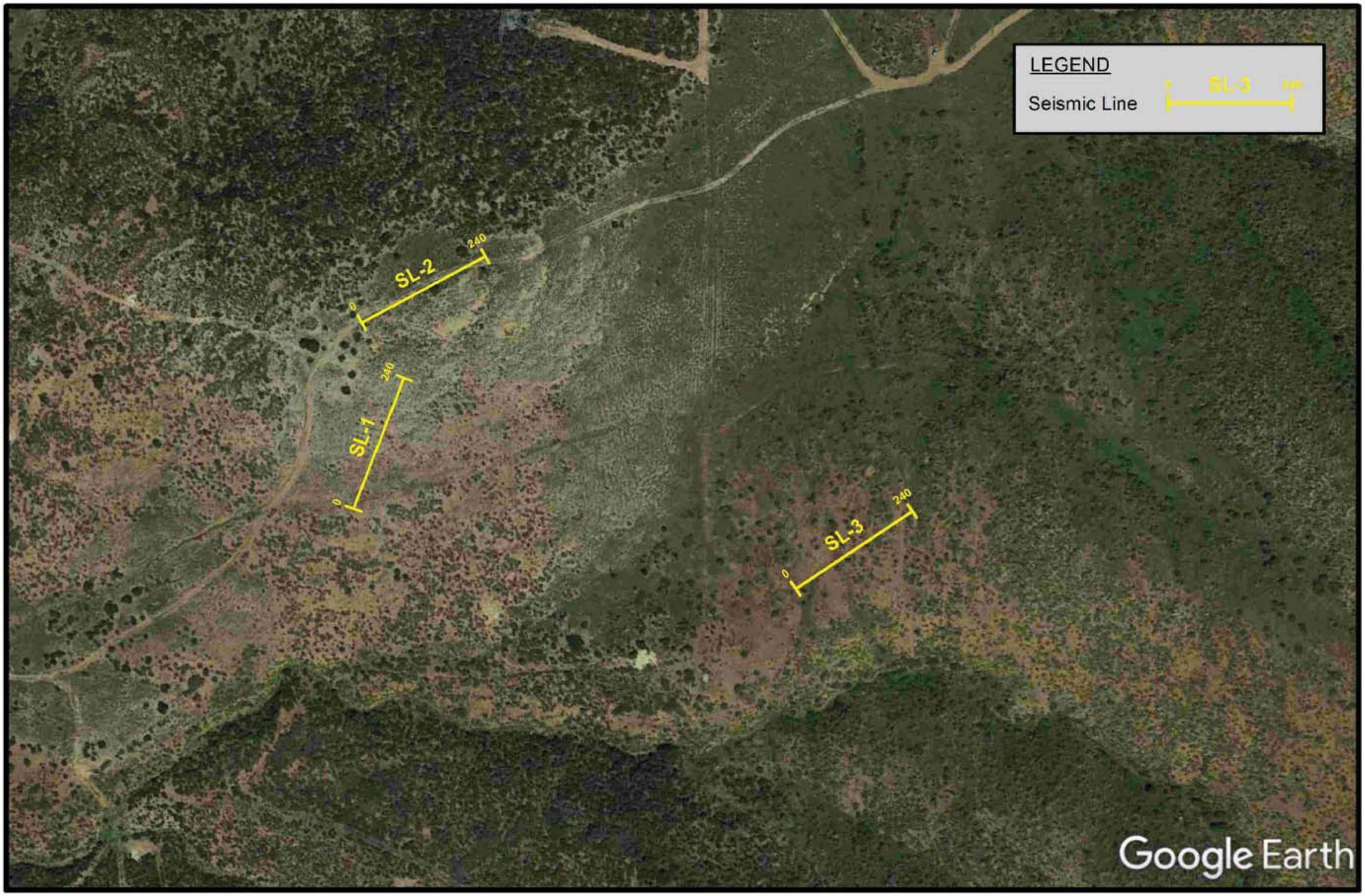
Optim, Inc., 2008, SeisOpt Pro, V-5.0.

Rimrock Geophysics, 2003, Seismic Refraction Interpretation Program (SIPwin), V-2.76.

Telford, W.M., Geldart, L.P., Sheriff, R.E., and Keys, D.A., 1976, Applied Geophysics, Cambridge University Press.



SITE LOCATION MAP	N	Proctor Valley Road Jamul, California	SOUTHWEST GEOPHYSICS INC. Figure 1
		Project No.: 116547 — Date: 11/16	



LINE LOCATION MAP
(SL-1 through SL-3)

N

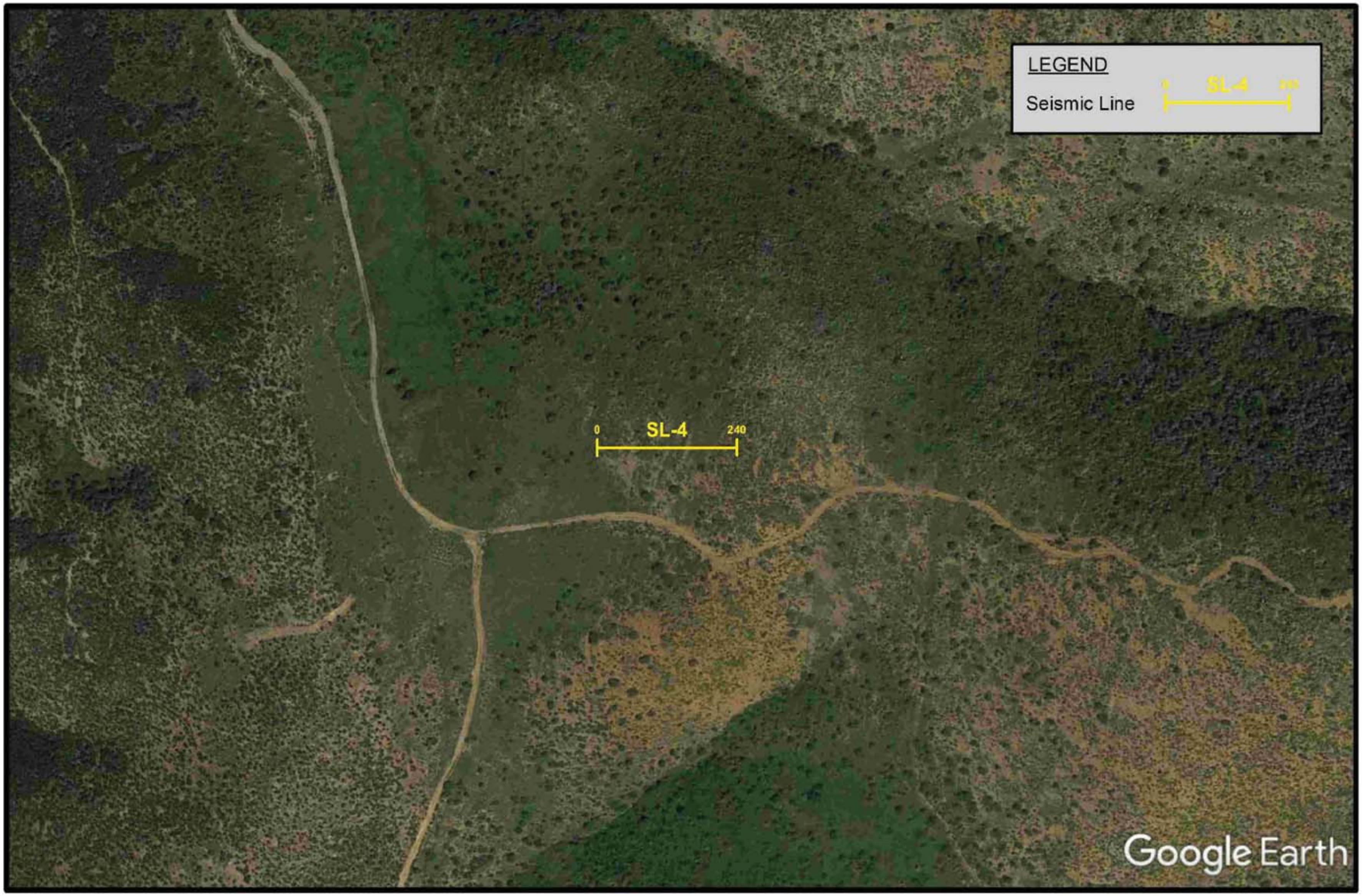
Proctor Valley Road
Jamul, California

Project No.: 116547 | Date: 11/16

SOUTHWEST GEOPHYSICS INC.

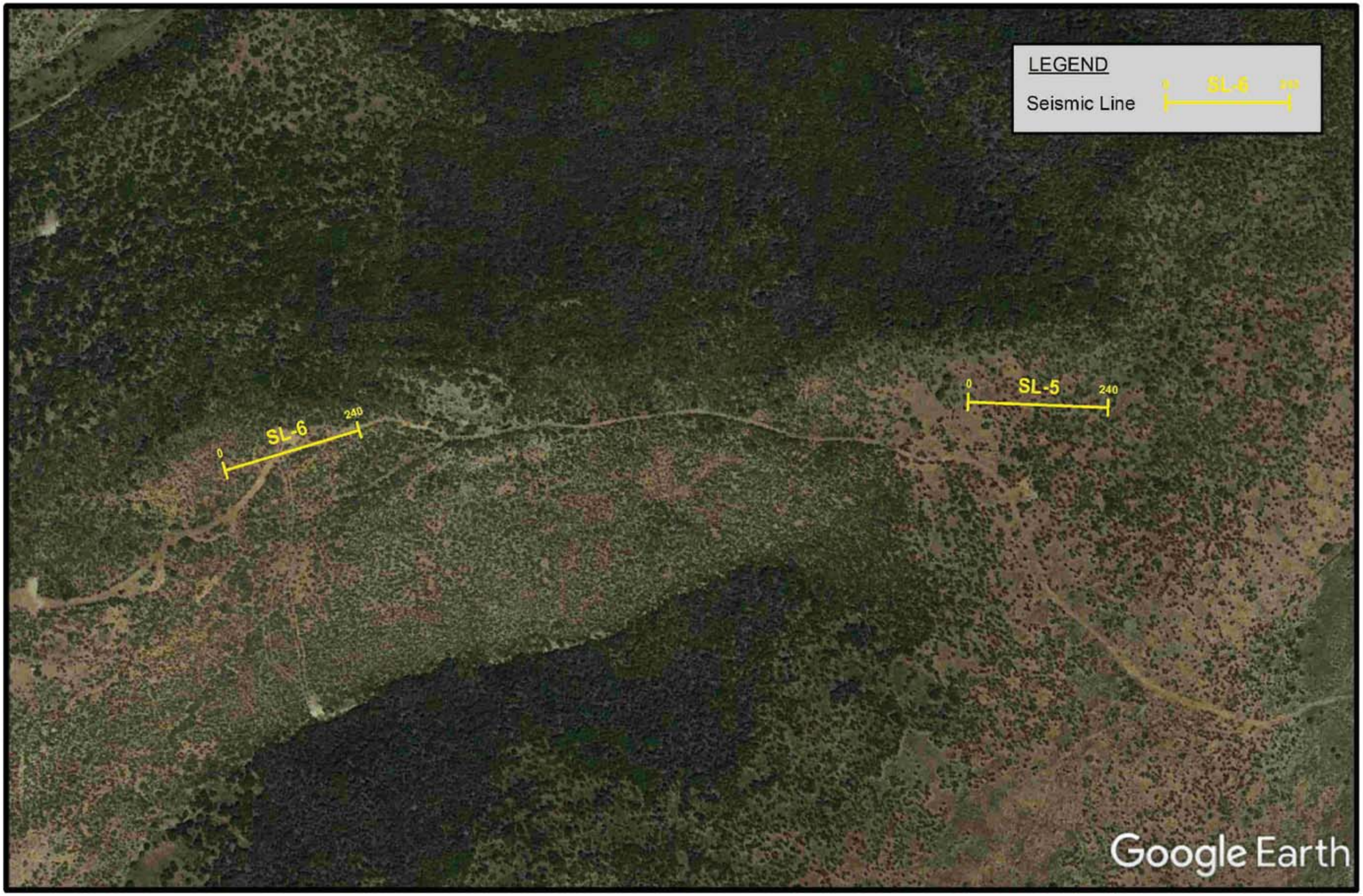
Figure 2a

0 240 480
approximate scale in feet

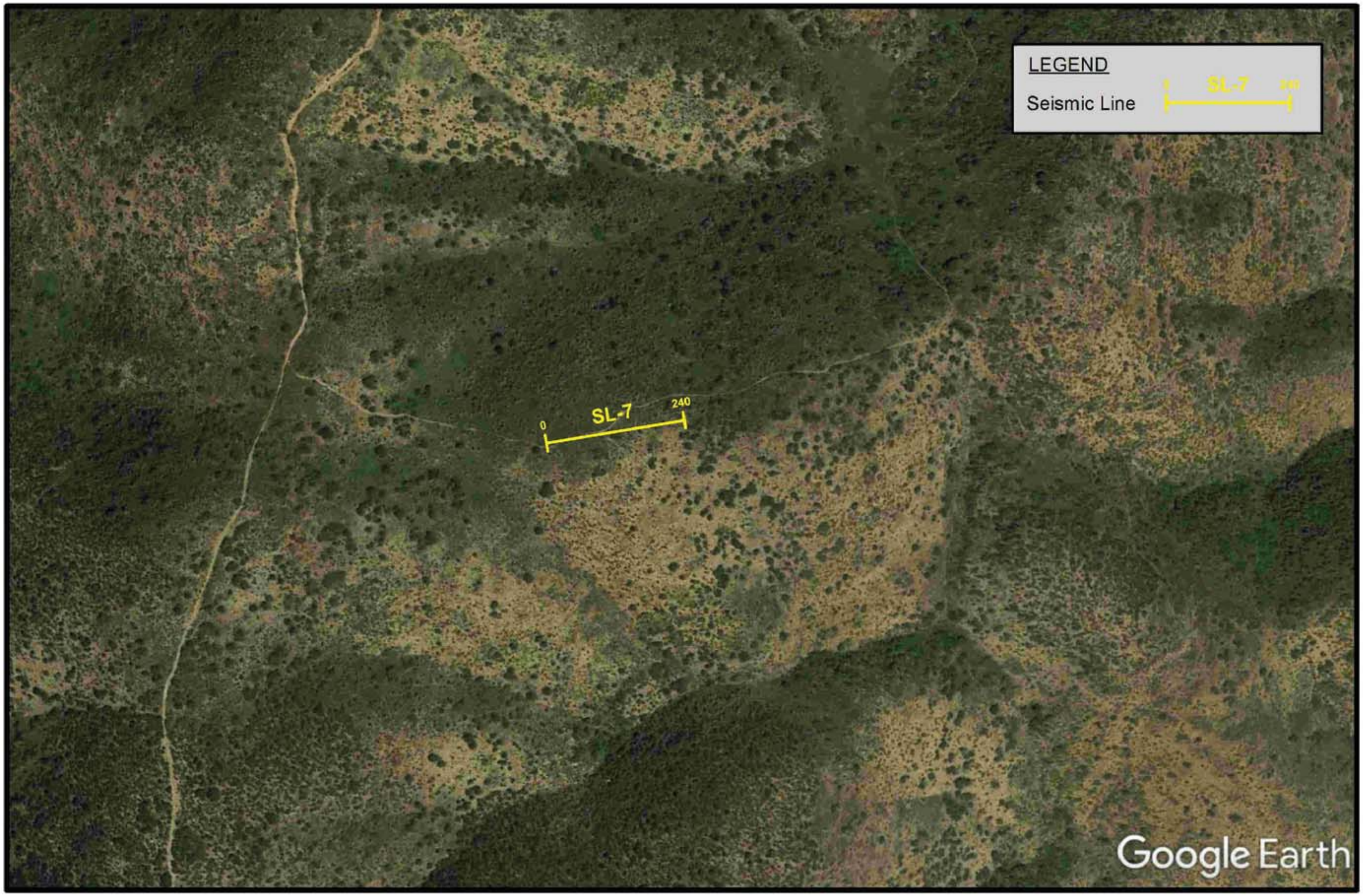


LINE LOCATION MAP (SL-4)	N	Proctor Valley Road Jamul, California	SOUTHWEST GEOPHYSICS INC. Figure 2b
		Project No.: 116547 — Date: 11/16	

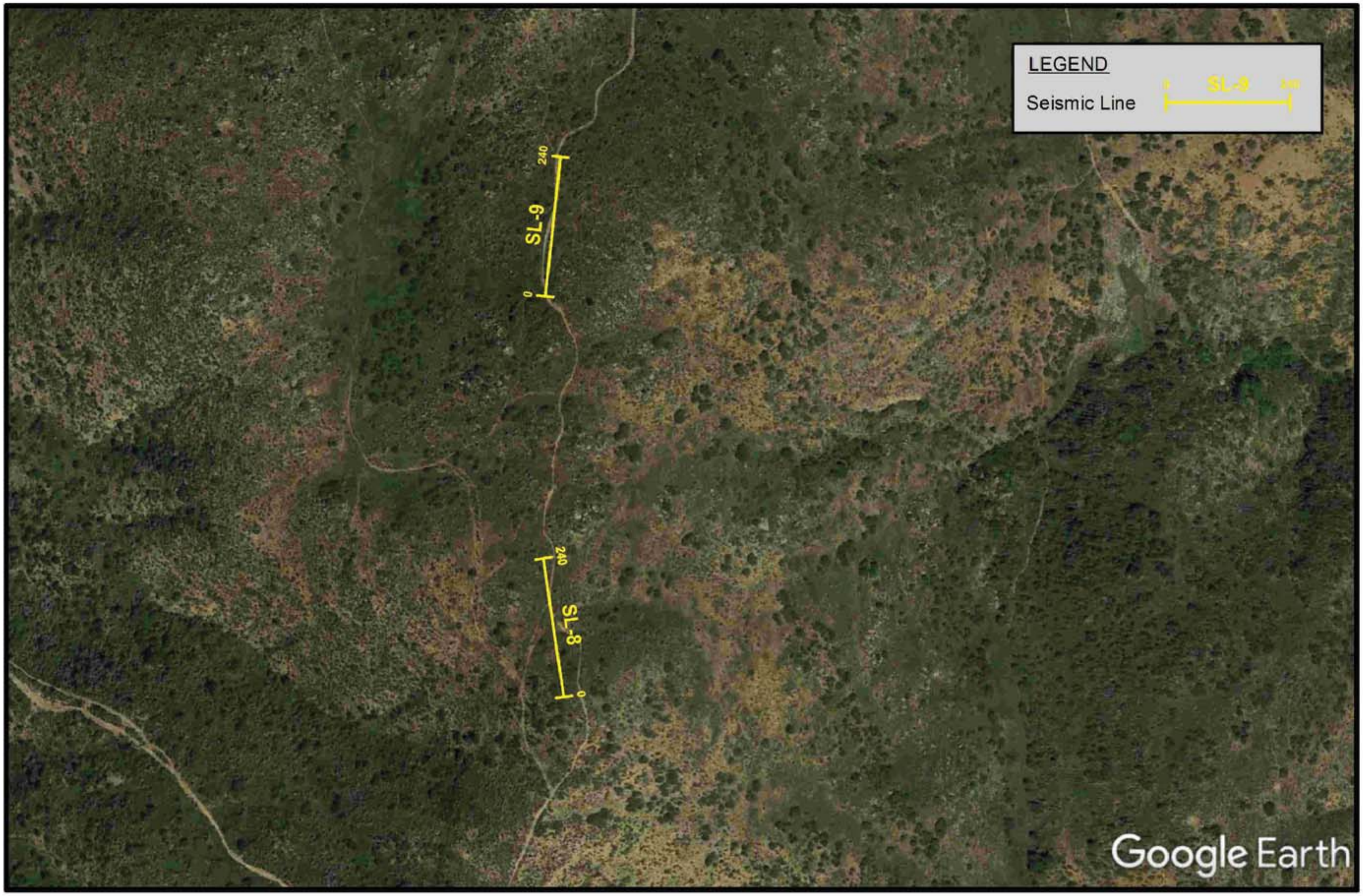
0 240 480
approximate scale in feet



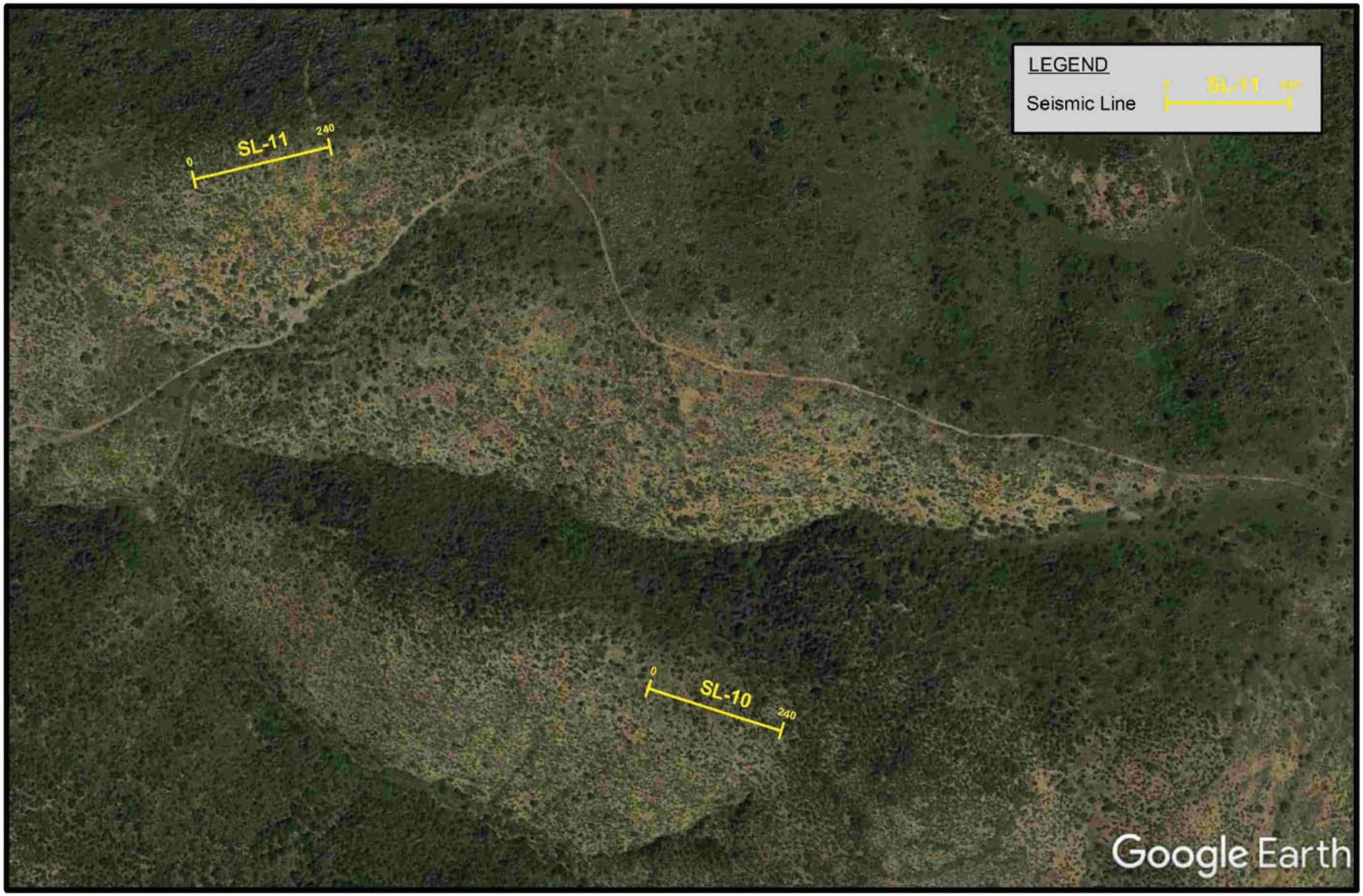
LINE LOCATION MAP **(SL-5 and SL-6)**	N	Proctor Valley Road Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 2c	0 — 240 — 480 **approximate scale in feet**



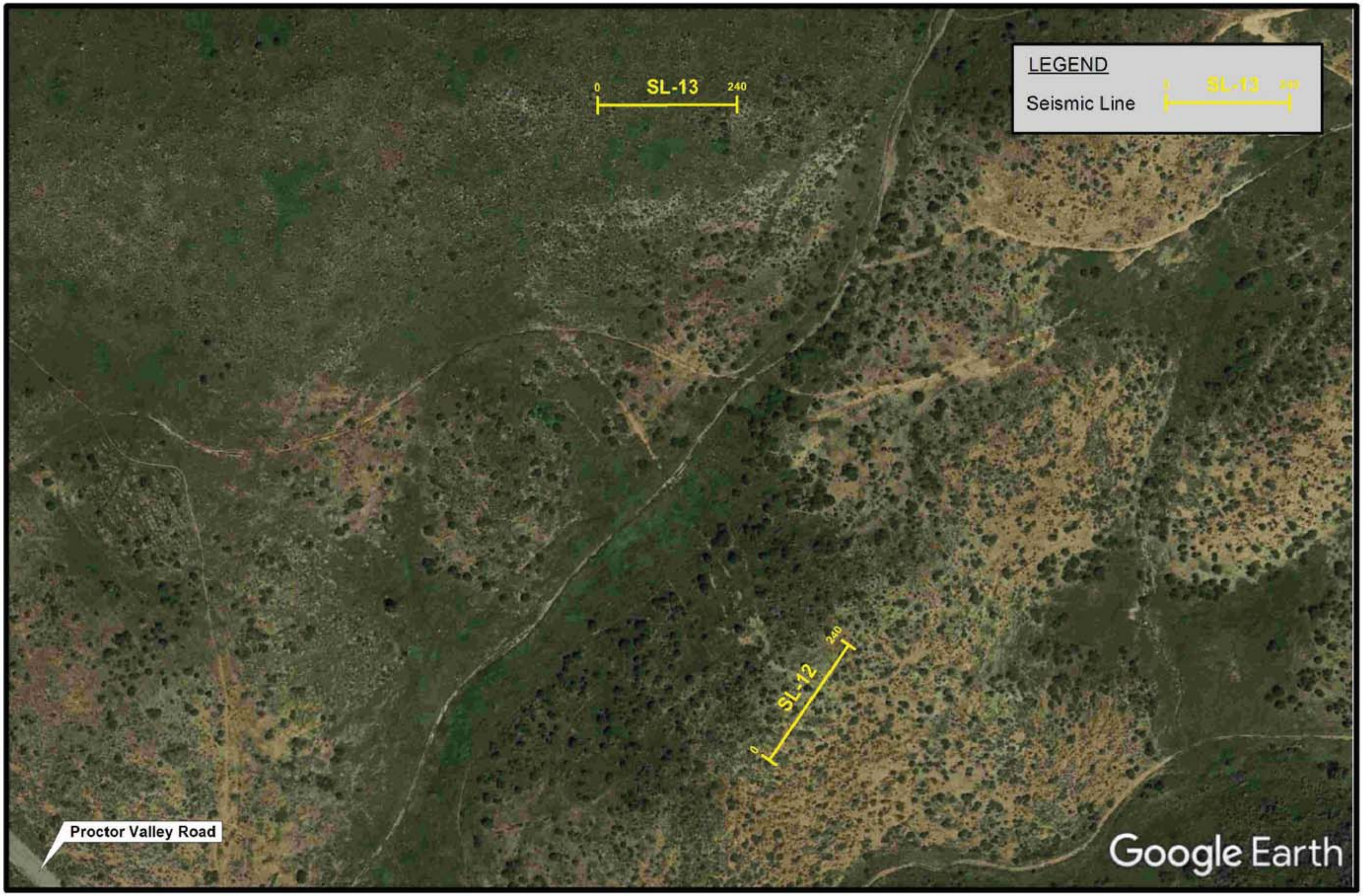
LINE LOCATION MAP (SL-7)	N	Proctor Valley Road Jamul, California Project No.: 116547 / Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 2d	0 240 480 **approximate scale in feet**

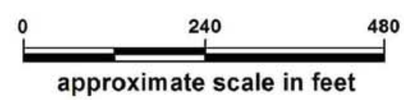


LINE LOCATION MAP **(SL-8 and SL-9)**	N	Proctor Valley Road Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 2e	0 240 480 **approximate scale in feet**

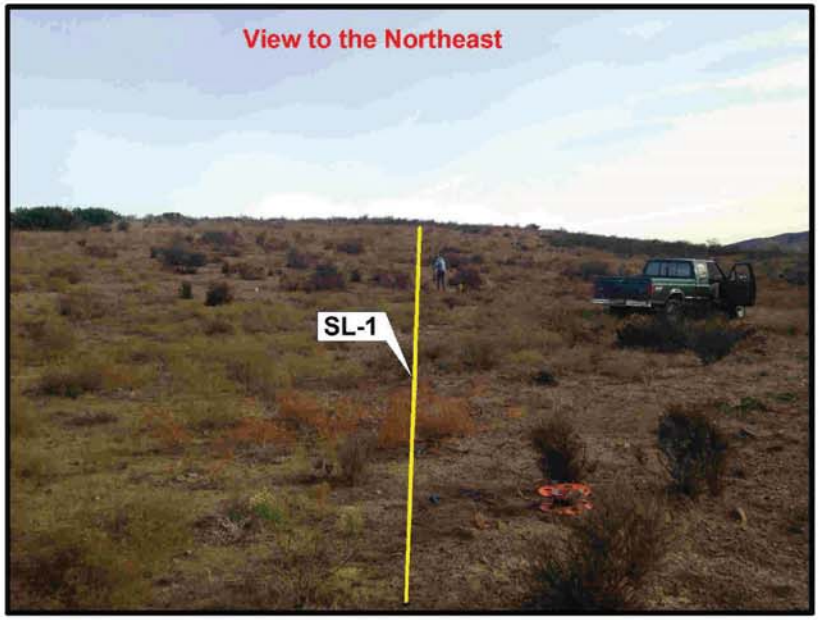


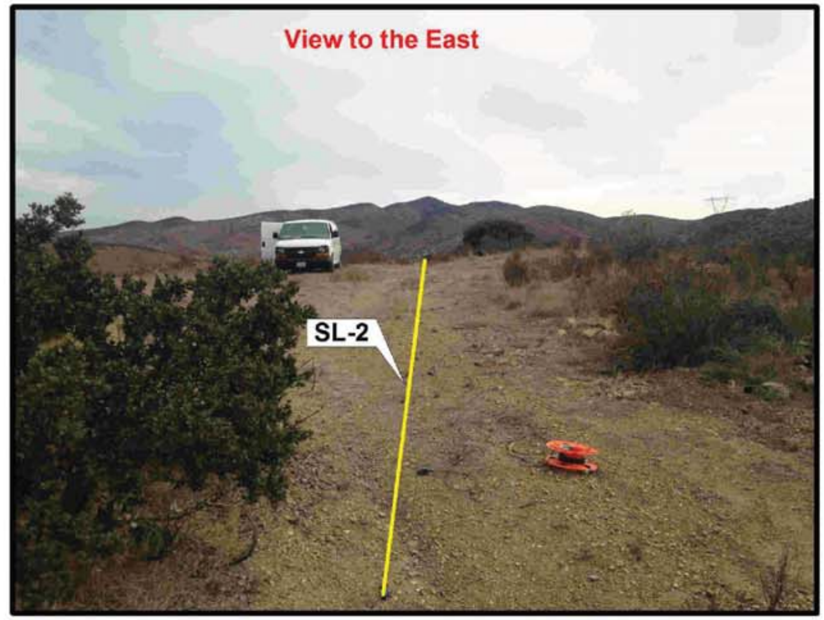
LINE LOCATION MAP (SL-10 and SL-11)	N	Proctor Valley Road Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 2f	0 — 240 — 480 approximate scale in feet

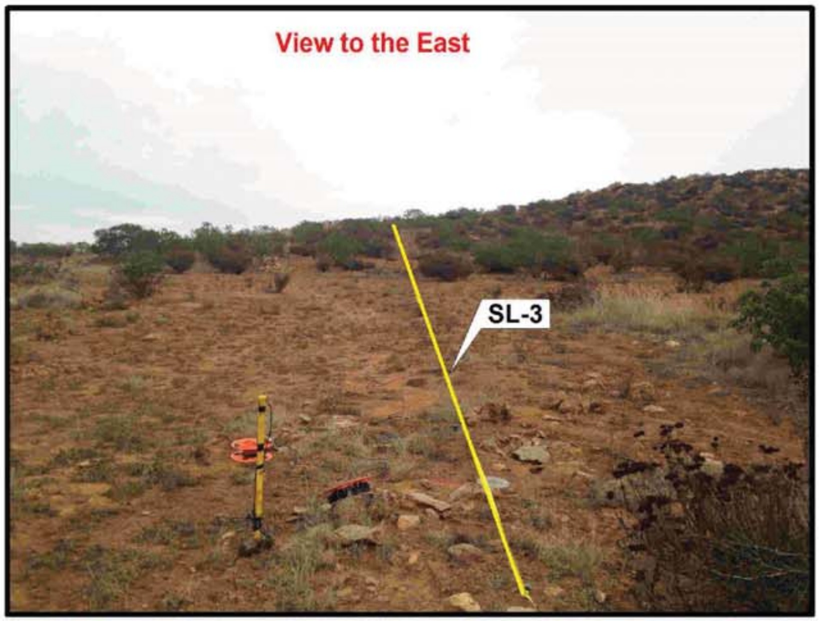


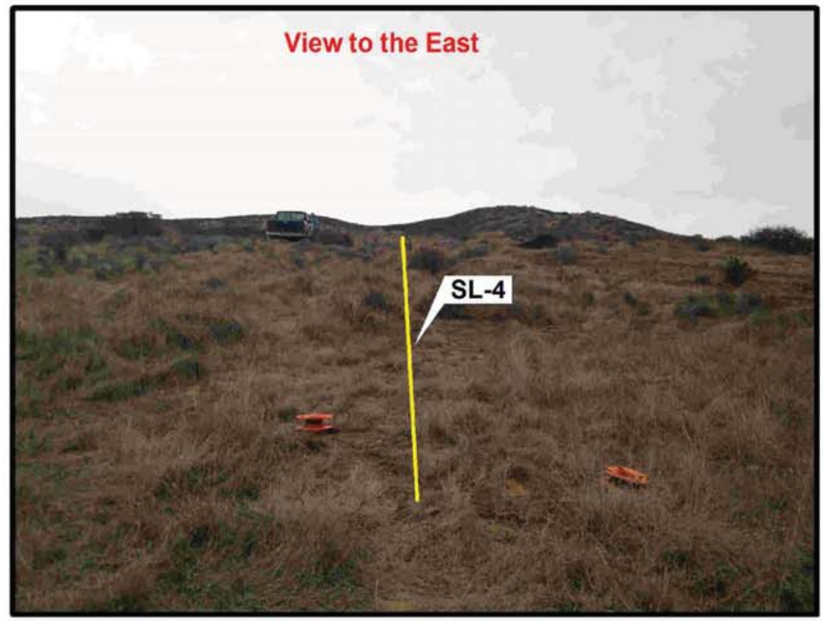


LINE LOCATION MAP **(SL-12 and SL-13)**	N	Proctor Valley Road Jamul, California Project No.: 116547 Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 2g

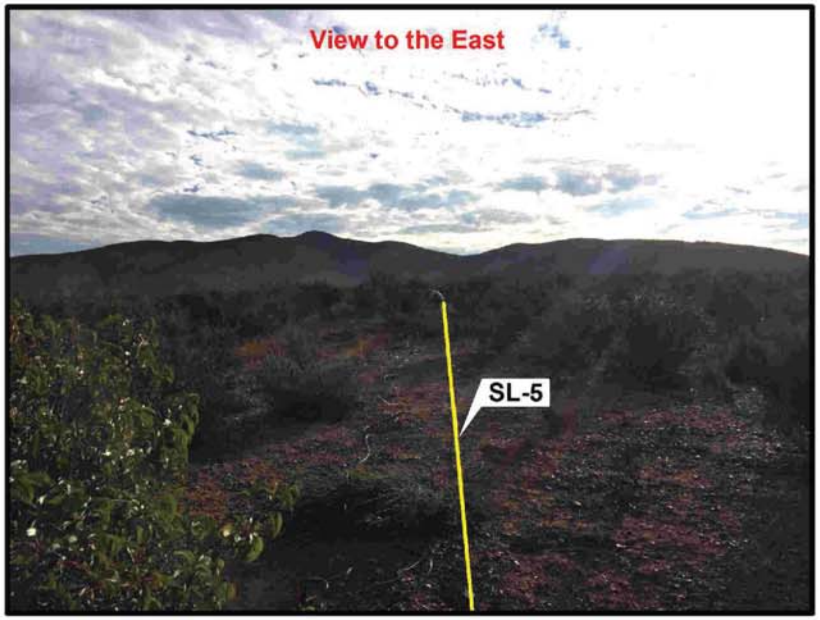


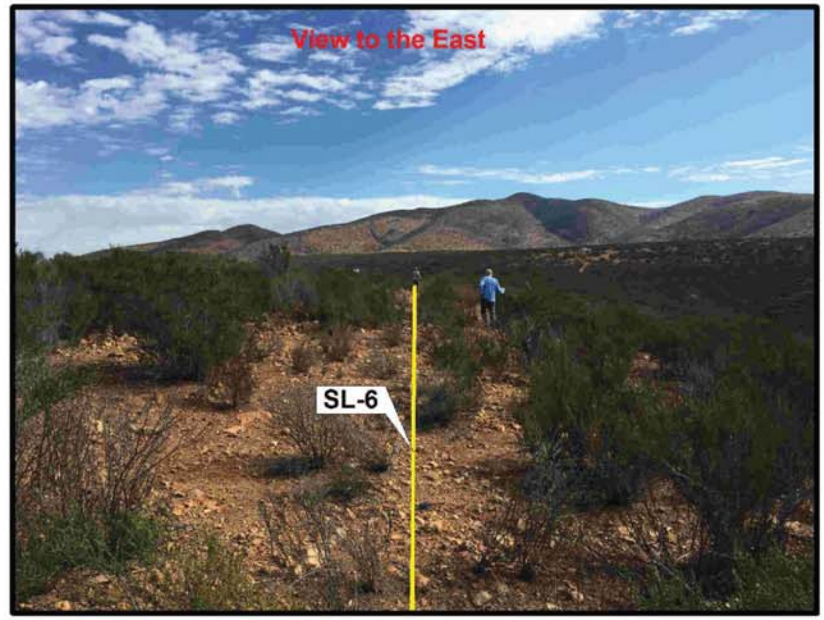


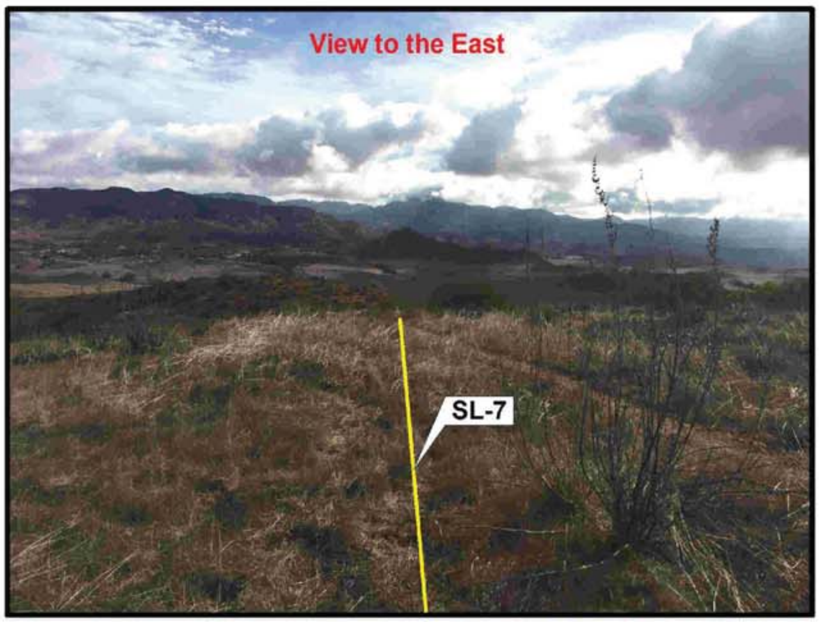


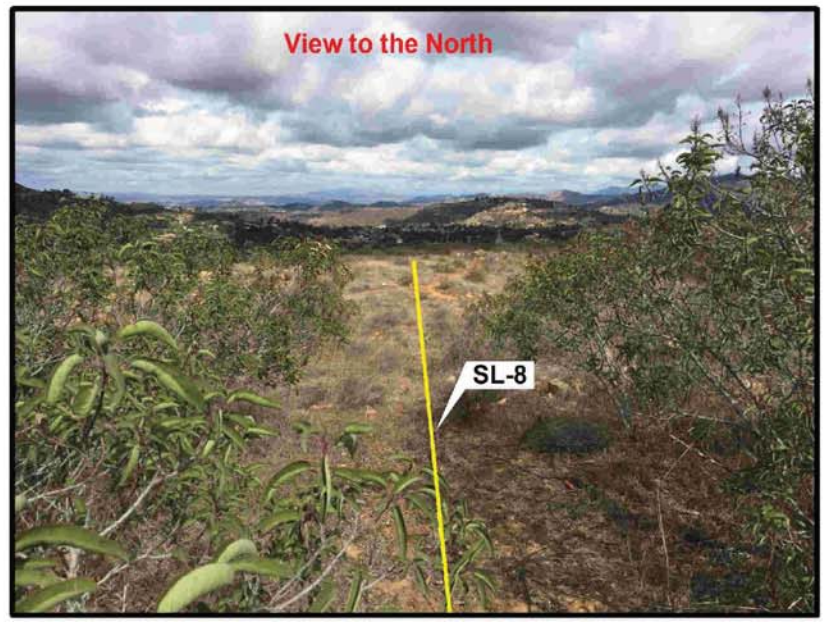


SITE PHOTOGRAPHS **(SL-1 through SL-4)**	Proctor Valley Road Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 3a

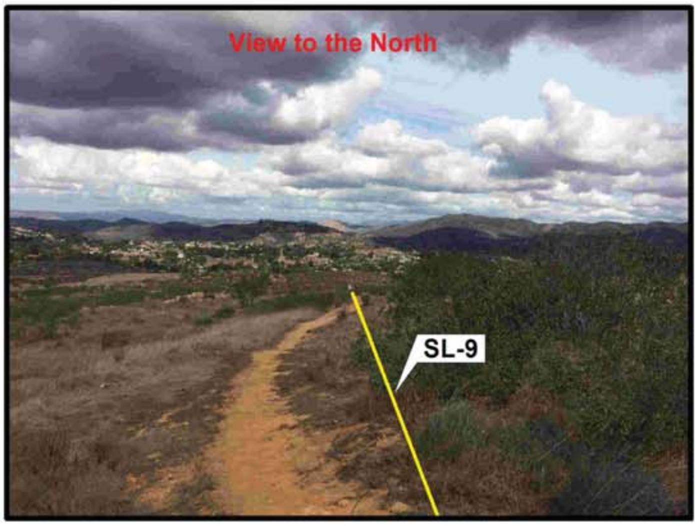


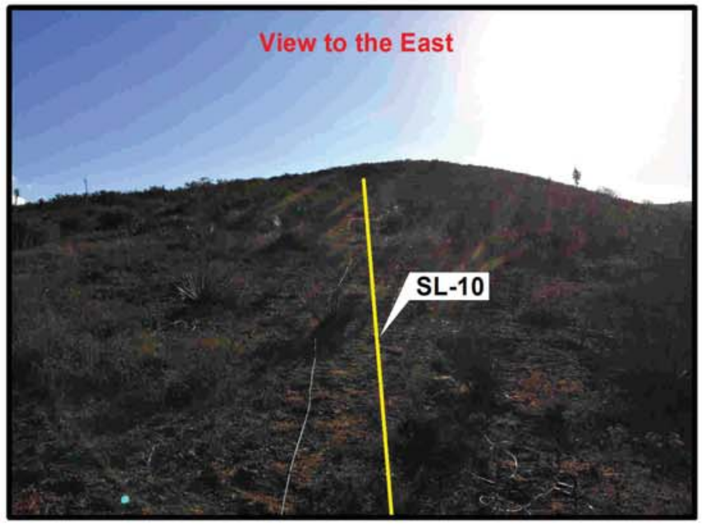


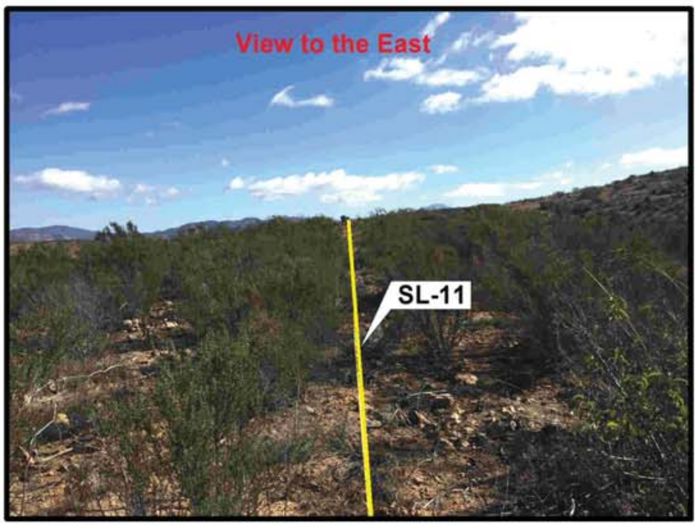


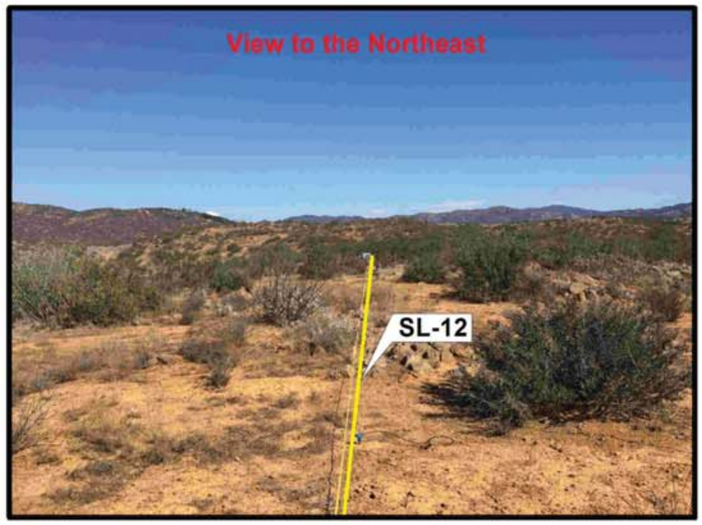


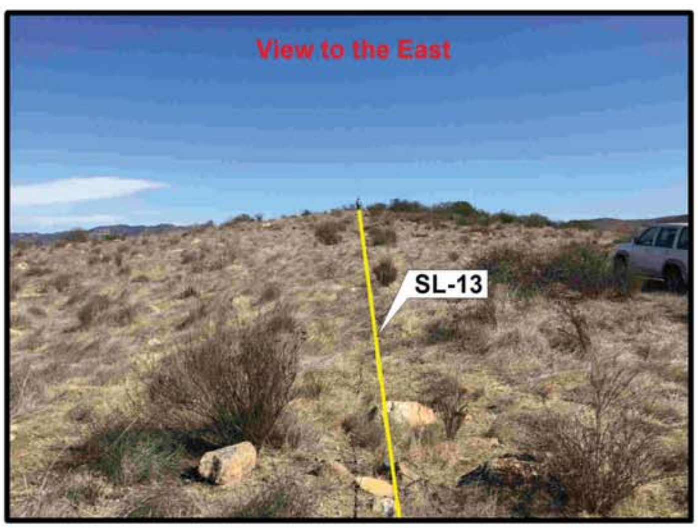
SITE PHOTOGRAPHS **(SL-5 through SL-8)**	Proctor Valley Road Jamul, California Project No.: 116547 Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 3b











SITE PHOTOGRAPHS
(SL-9 through SL-13)

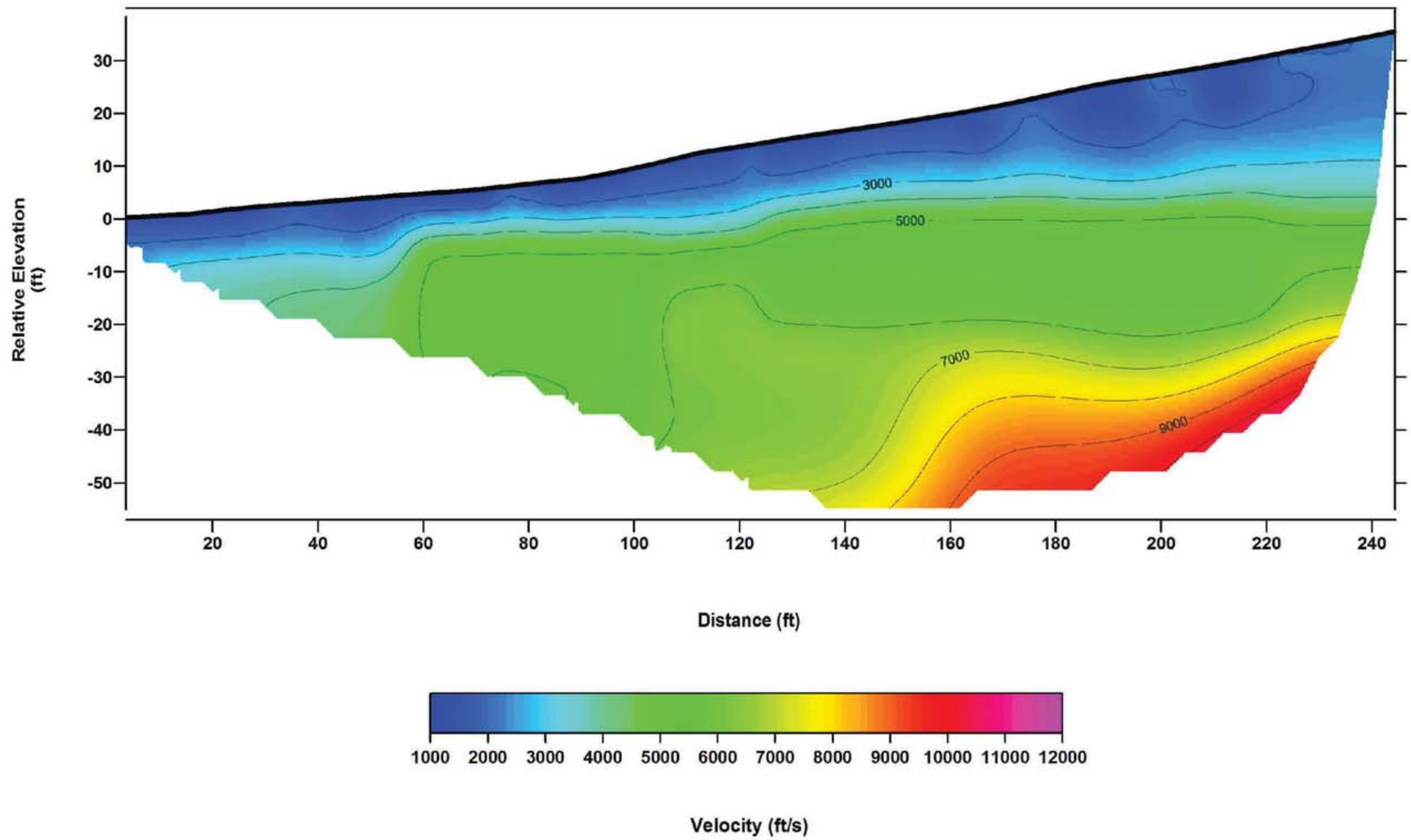
Proctor Valley Road
Jamul, California

Project No.: 116547 | Date: 11/16

SOUTHWEST GEOPHYSICS INC.

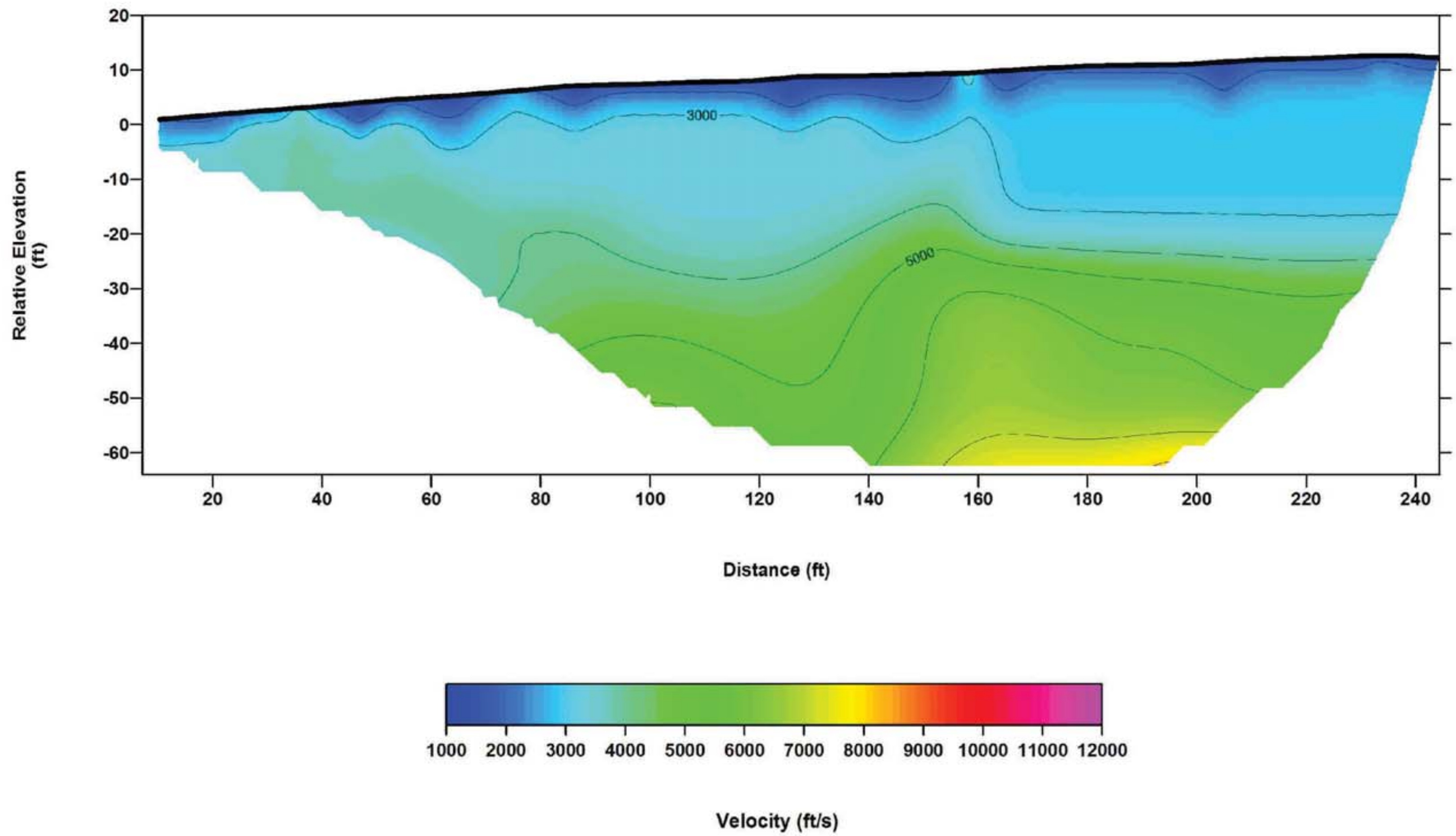
Figure 3c

TOMOGRAPHY MODEL



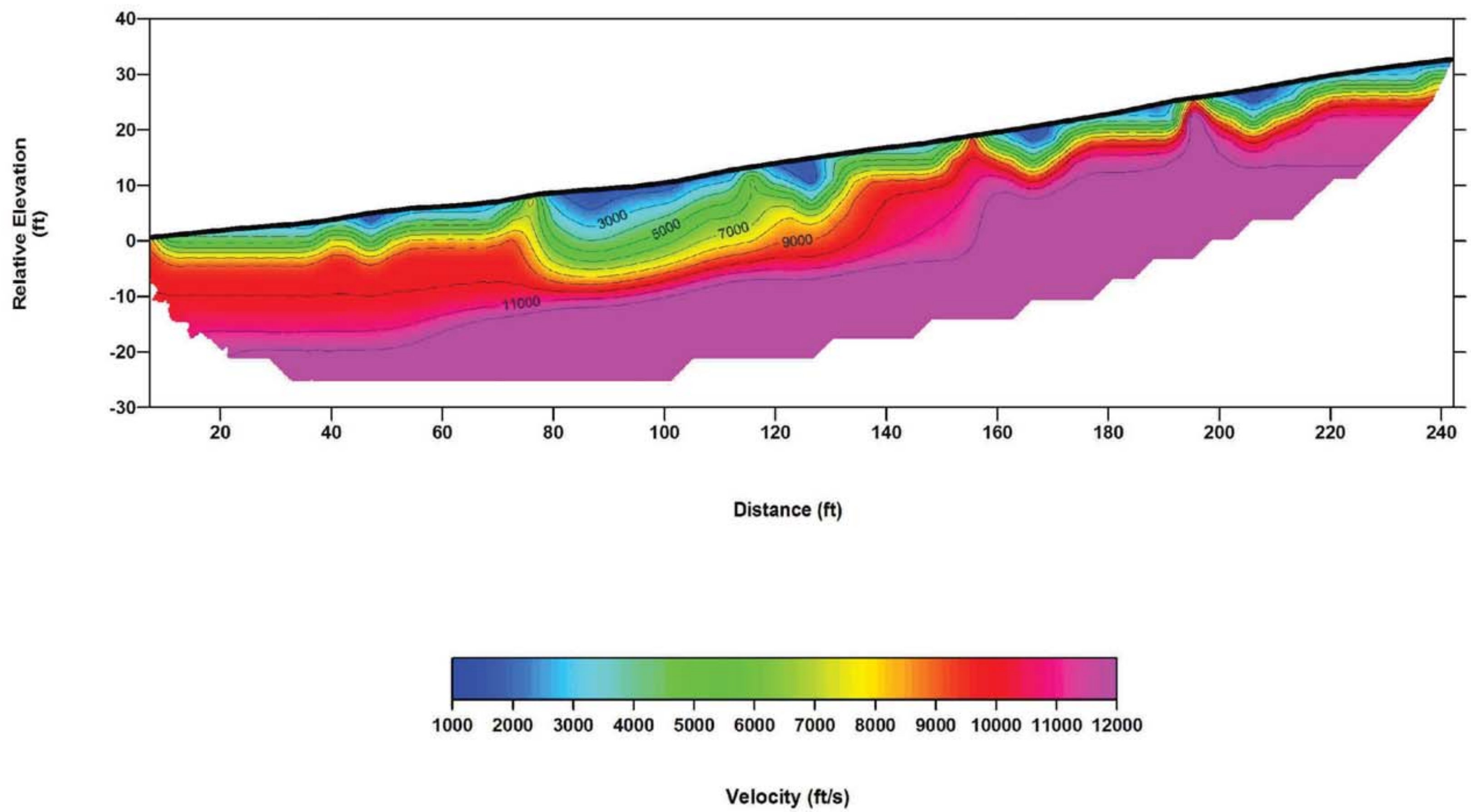
SEISMIC PROFILE SL-1	Proctor Valley Road Development Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4a	**Note: Contour Interval = 1,000 feet per second**

TOMOGRAPHY MODEL



SEISMIC PROFILE SL-2	Proctor Valley Road Development Jamul, California	SOUTHWEST GEOPHYSICS INC. Figure 4b	Note: Contour Interval = 1,000 feet per second
	Project No.: 116547 Date: 11/16		

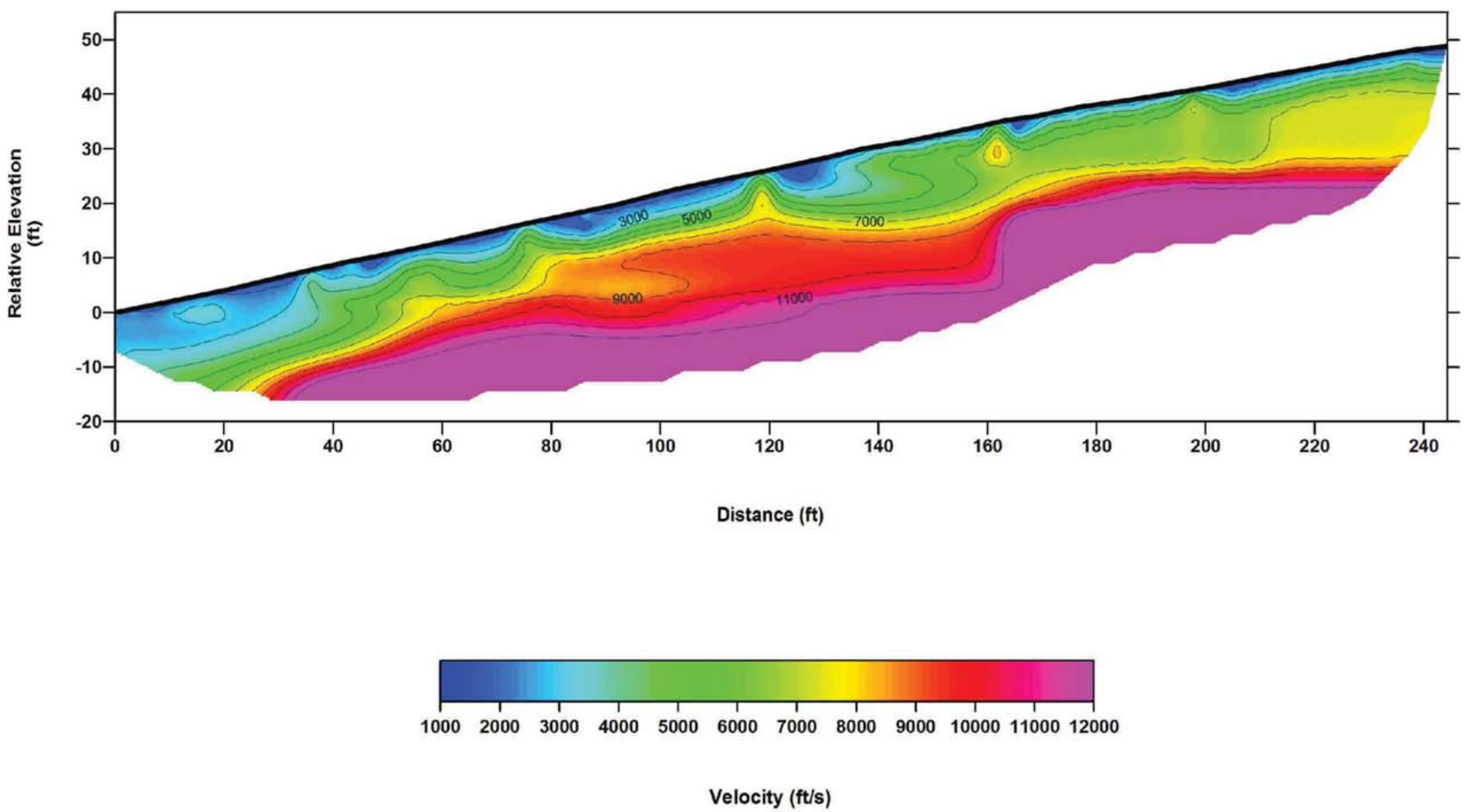
TOMOGRAPHY MODEL



SEISMIC PROFILE SL-3	Proctor Valley Road Development Jamul, California Project No.: 116547 Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4c

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL



SEISMIC PROFILE SL-4	Proctor Valley Road Development Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4d	**Note: Contour Interval = 1,000 feet per second**

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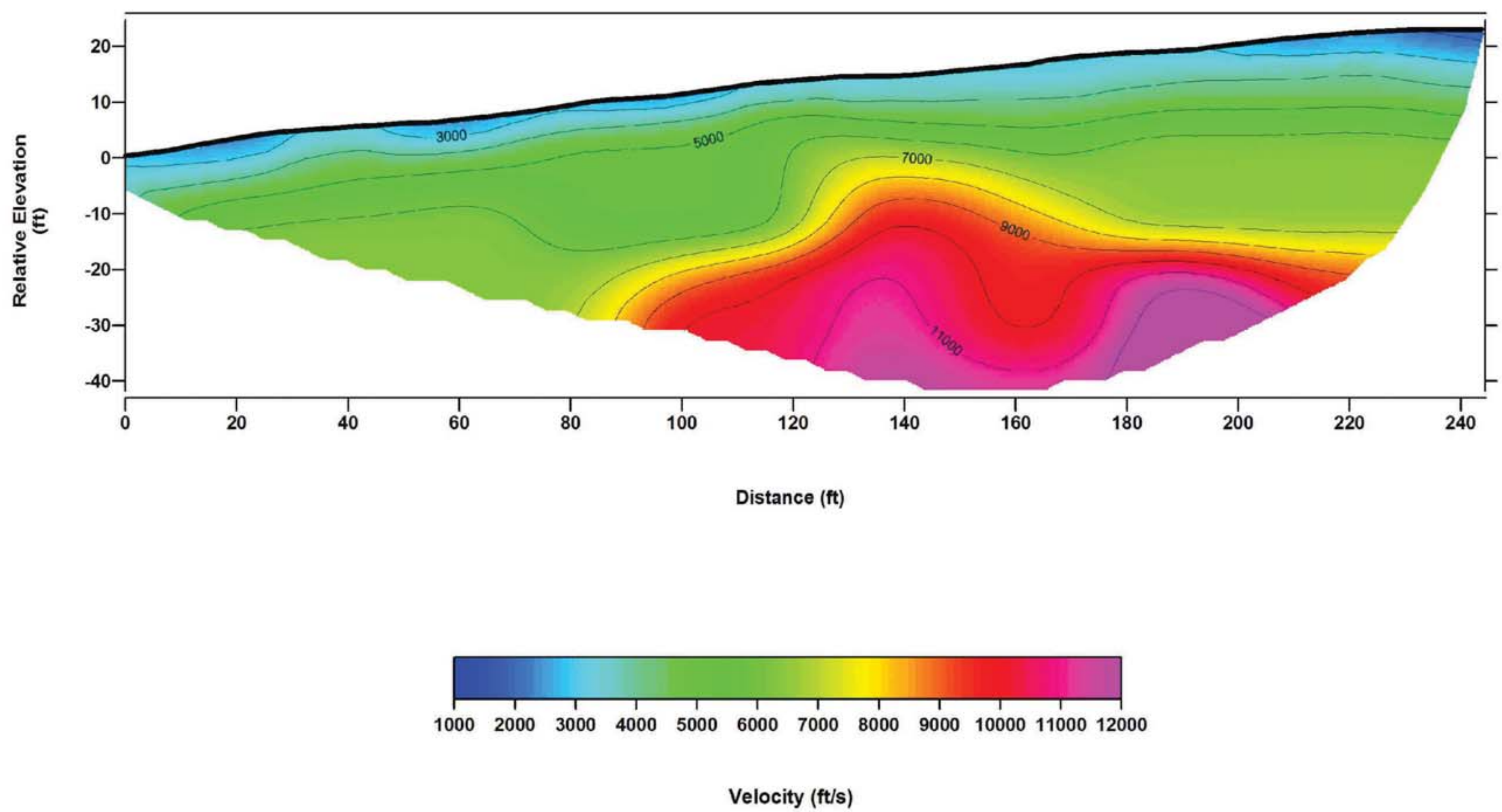

SEISMIC PROFILE SL-5	Proctor Valley Road Development Jamul, California	SOUTHWEST GEOPHYSICS INC. Figure 4e
	Project No.: 116547 / Date: 11/16	

Note: Contour Interval = 1,000 feet per second

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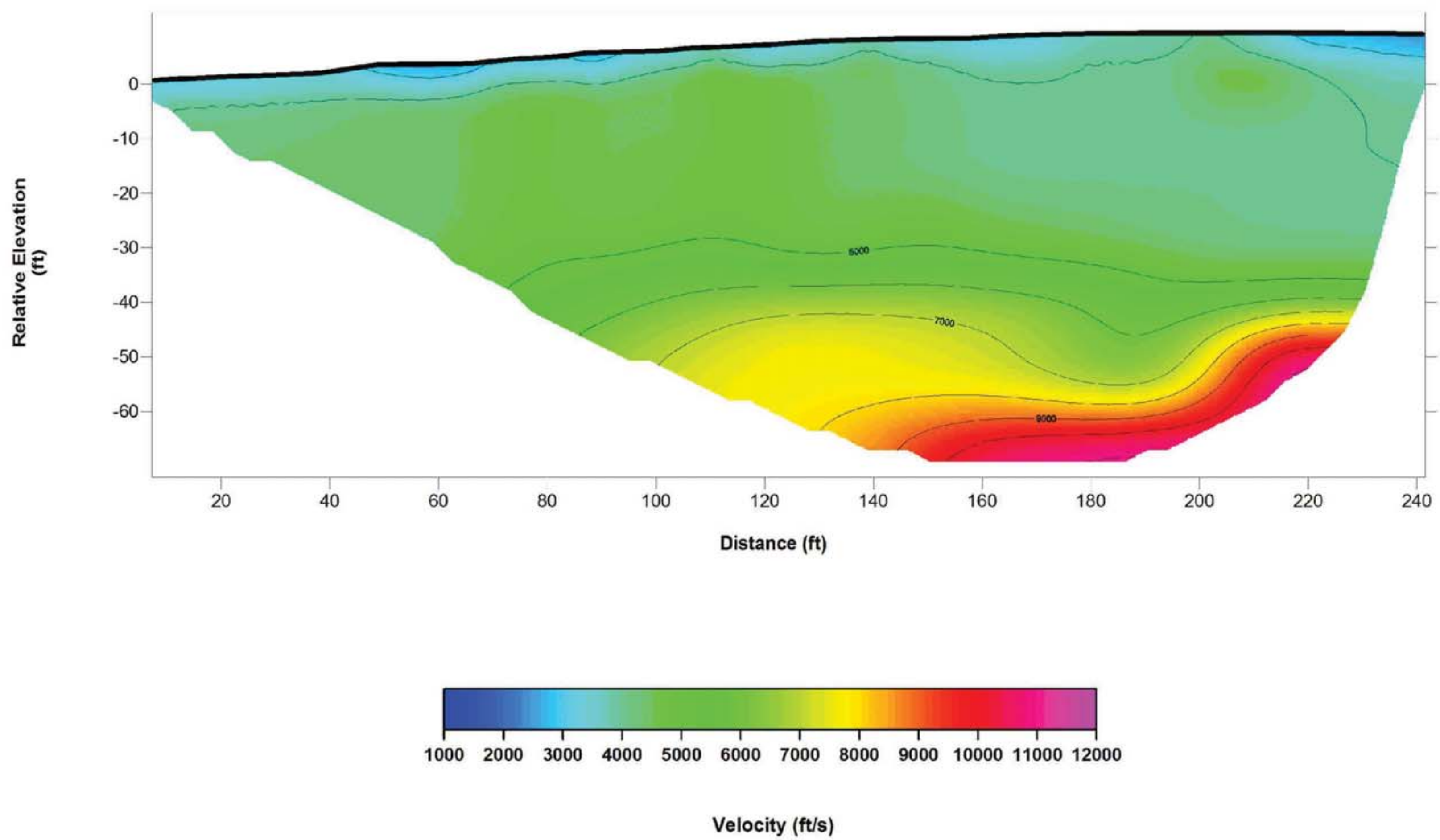
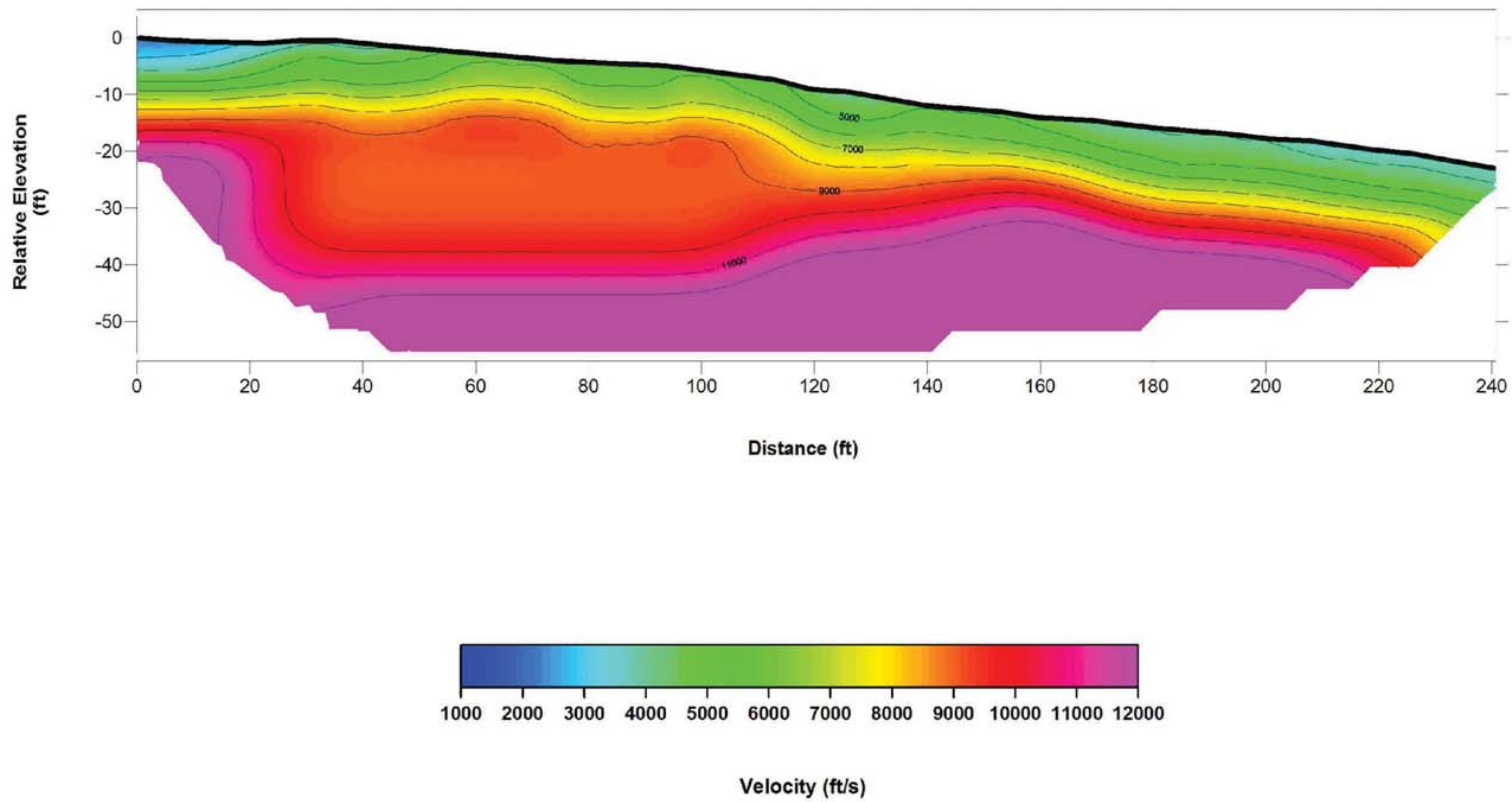


SEISMIC PROFILE SL-6	Proctor Valley Road Development Jamul, California Project No.: 116547 · Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4f	**Note: Contour Interval = 1,000 feet per second**

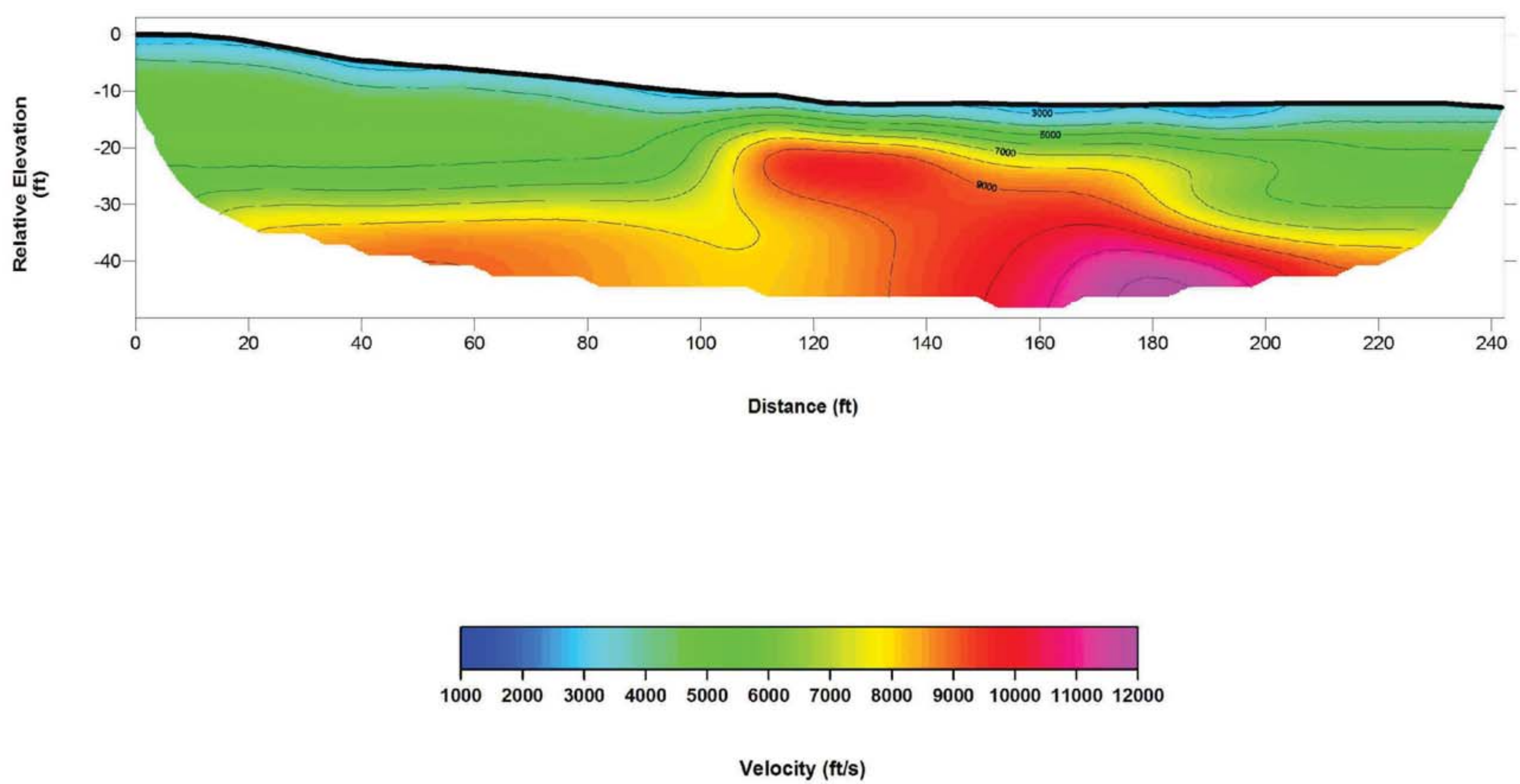
TOMOGRAPHY MODEL



SEISMIC PROFILE SL-7	Proctor Valley Road Development Jamul, California	SOUTHWEST GEOPHYSICS INC.
	Project No.: 116547 · Date: 11/16	Figure 4g

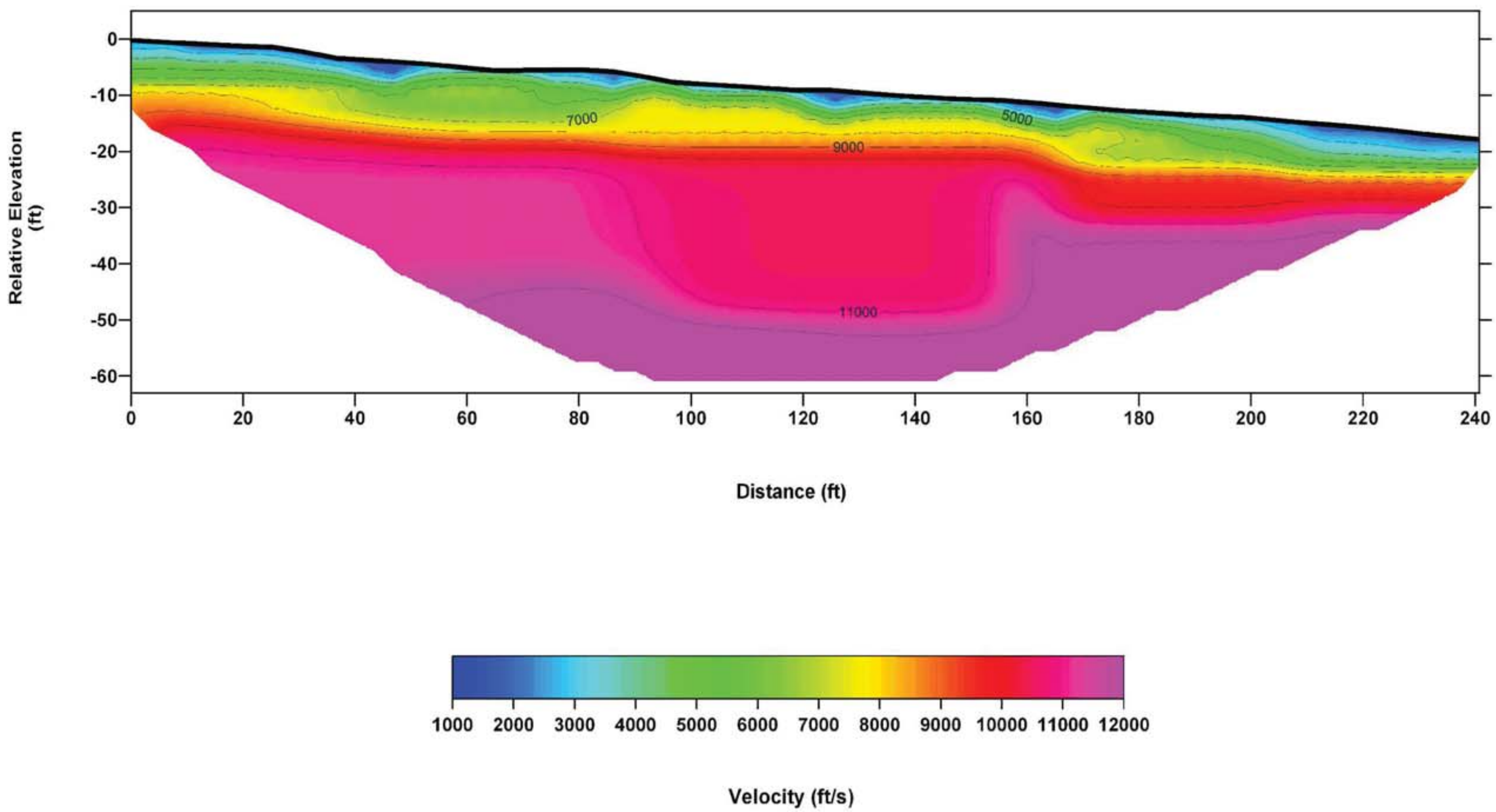
Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL



SEISMIC PROFILE SL-8	Proctor Valley Road Development Jamul, California Project No.: 116547 / Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4h	**Note: Contour Interval = 1,000 feet per second**

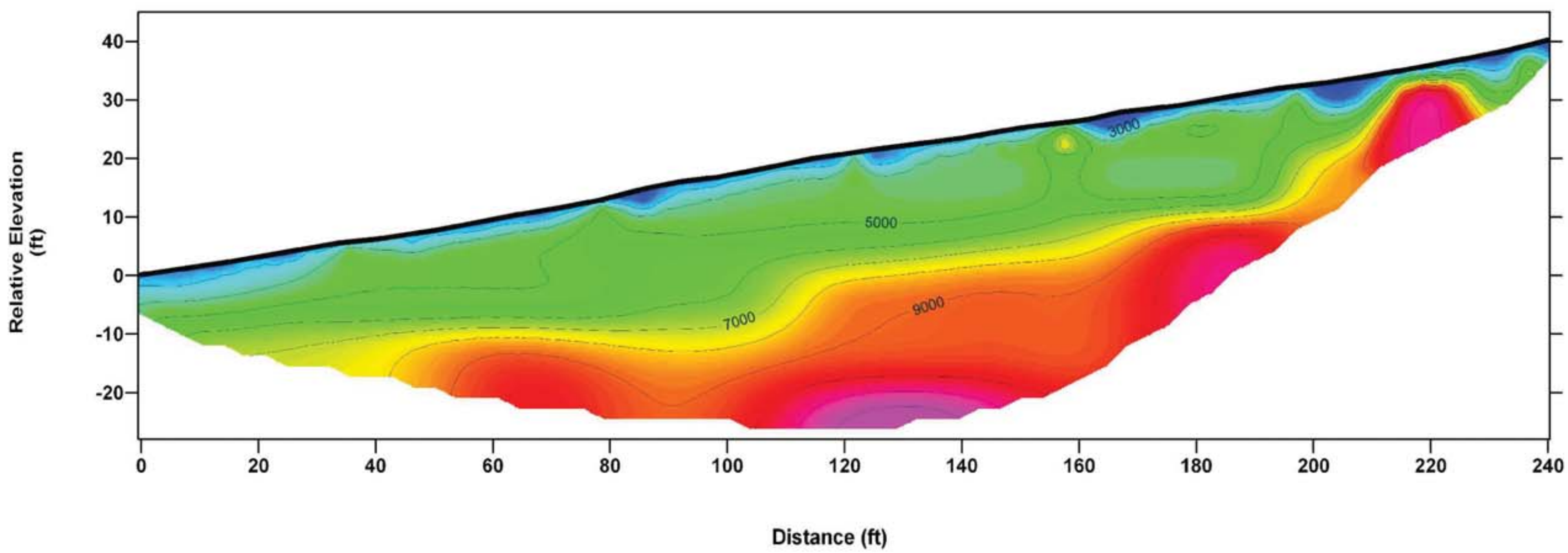
TOMOGRAPHY MODEL

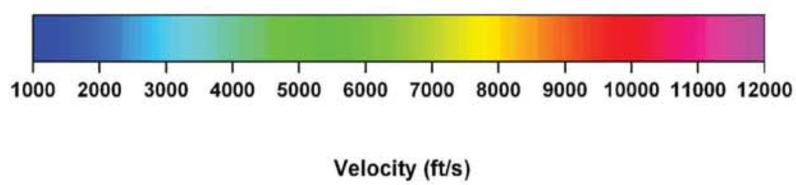


SEISMIC PROFILE SL-9	Proctor Valley Road Development Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4i

Note: Contour Interval = 1,000 feet per second

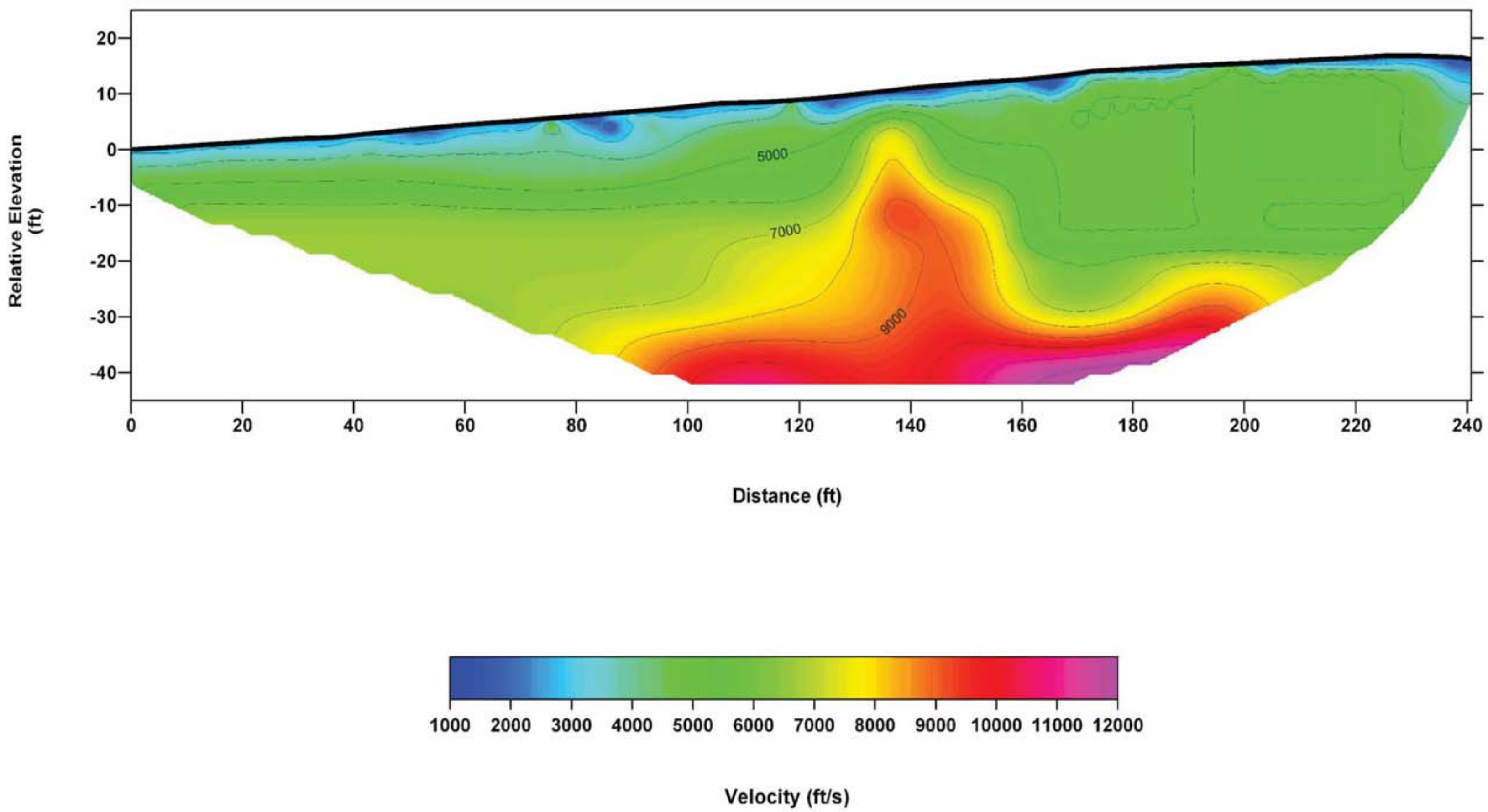
TOMOGRAPHY MODEL





SEISMIC PROFILE SL-10	Proctor Valley Road Development Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4j	**Note: Contour Interval = 1,000 feet per second**

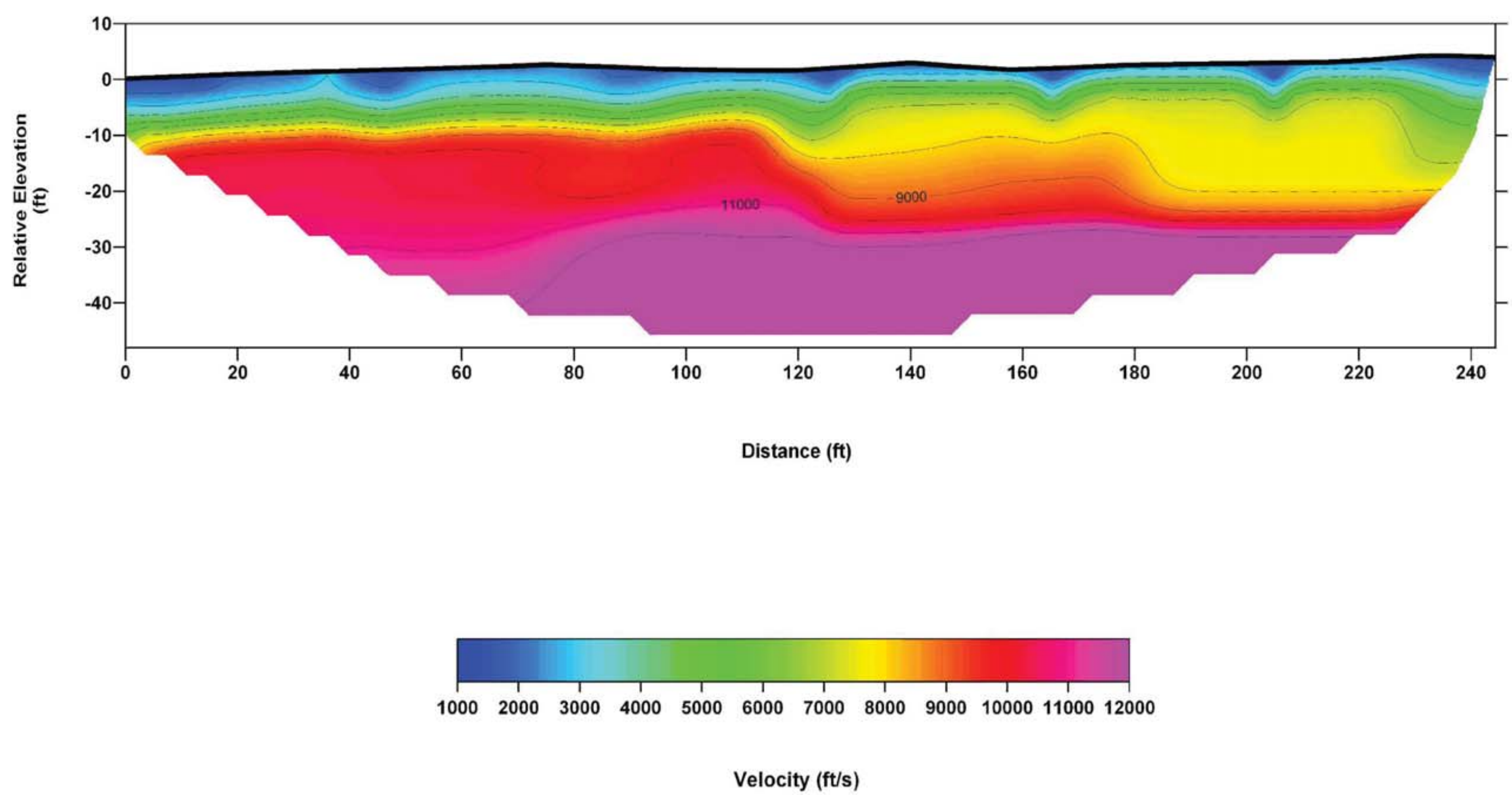
TOMOGRAPHY MODEL



SEISMIC PROFILE SL-11	Proctor Valley Road Development Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4k

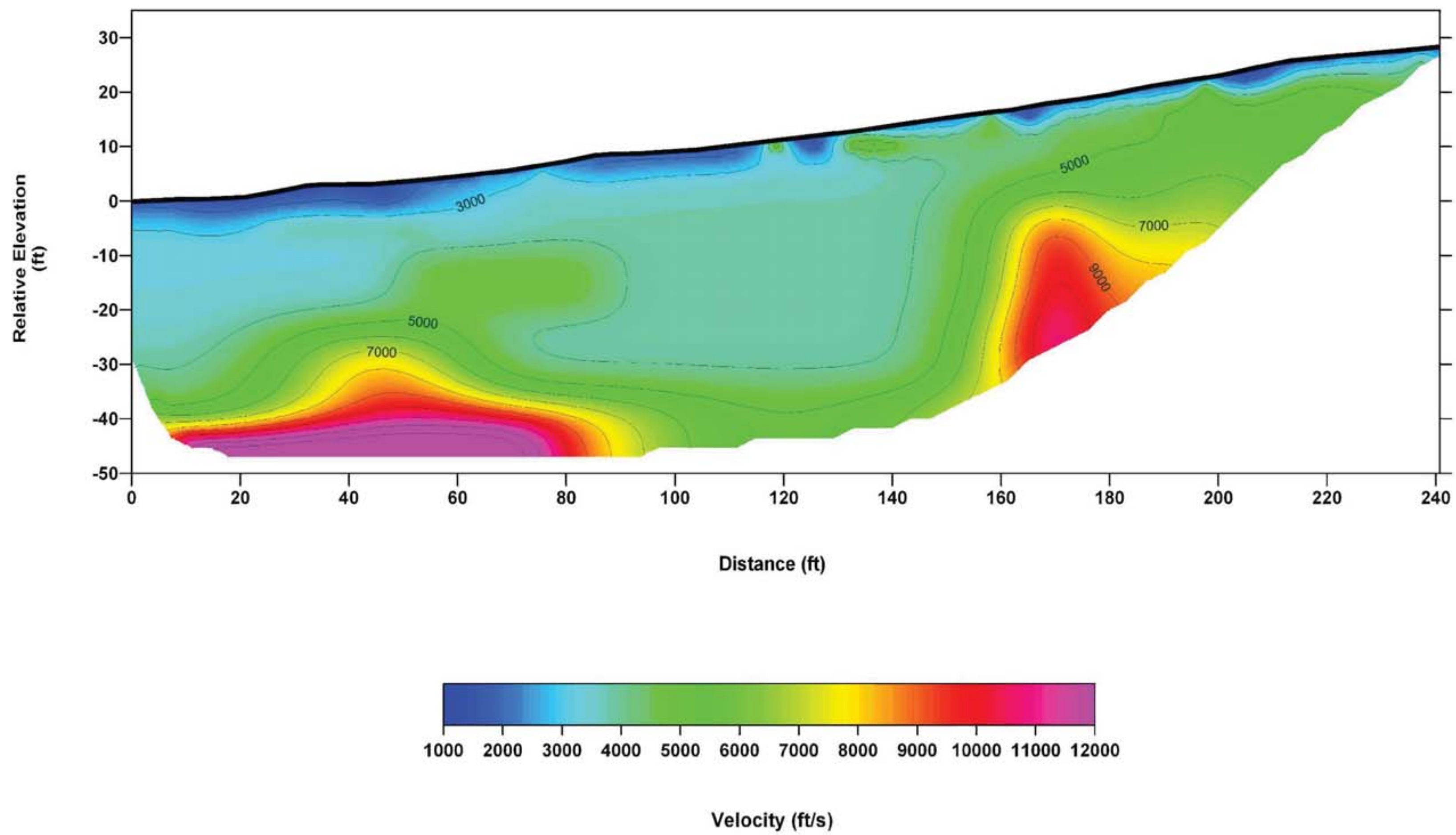
Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL



SEISMIC PROFILE SL-12	Proctor Valley Road Development Jamul, California Project No.: 116547 Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4l	**Note: Contour Interval = 1,000 feet per second**

TOMOGRAPHY MODEL



SEISMIC PROFILE SL-13	Proctor Valley Road Development Jamul, California Project No.: 116547 — Date: 11/16	SOUTHWEST GEOPHYSICS INC. Figure 4m

Note: Contour Interval = 1,000 feet per second

APPENDIX C

LABORATORY TEST RESULTS

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DRY DENSITY AND MOISTURE CONTENT - ASTM D2166

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No: 1312-02

Sample Date:	2/4/15	By:	FE
Submittal Date:	2/13/15	By:	PWM
Test Date:	2/25/15	By:	HM

Boring No.	BA-1	BA-1	BA-1	BA-3	BA-3	BA-4	BA-4	BA-4	BA-4
Depth (ft)	5-6 '	10-11 '	15-16 '	11-12 '	15-16 '	18-19 '	25-26 '	36-37 '	52-53 '
Moisture Content (%)	7.8	6.7	10.9	8.9	8.4	14.3	19.8	18.5	19.6
Dry Density (pcf)	125.7	122.4	126.7	122.3	124.6	100.8	98.7	104.9	109.7

Boring No.	BA-5	BA-5	BA-6	BA-8
Depth (ft)	10-11 '	66-77 '	1-2 '	15-16 '
Moisture Content (%)	12.4	14.1	11.7	14.4
Dry Density (pcf)	114.9	107.5	98.8	82.6

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

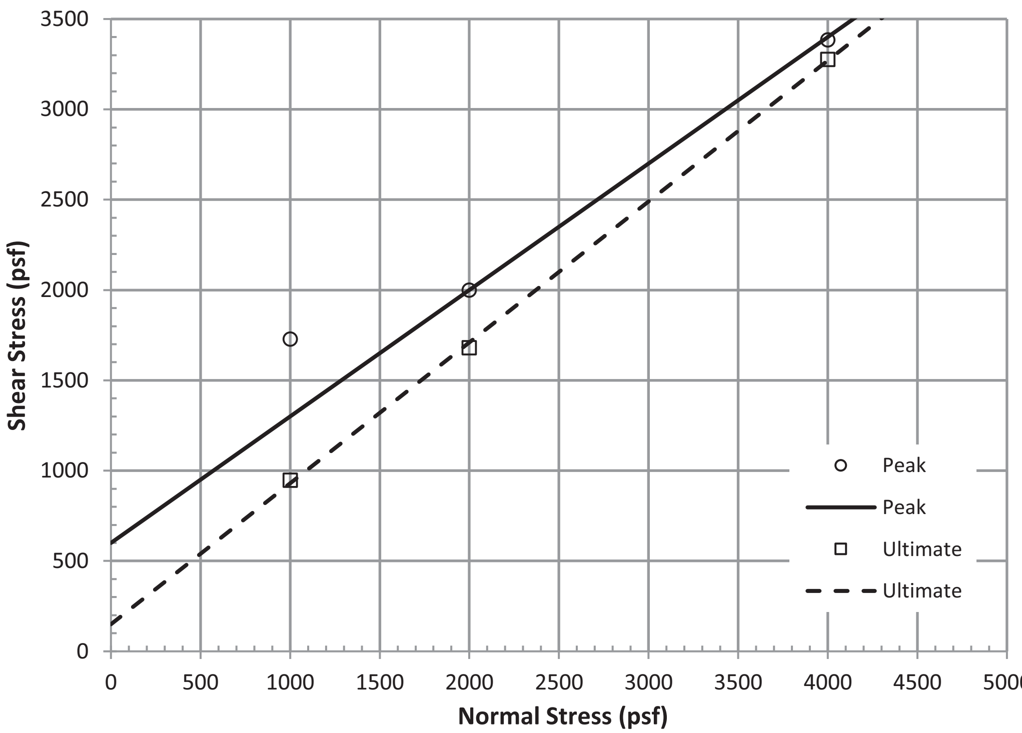
Project Name: Otay Village 14
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 3/17/15

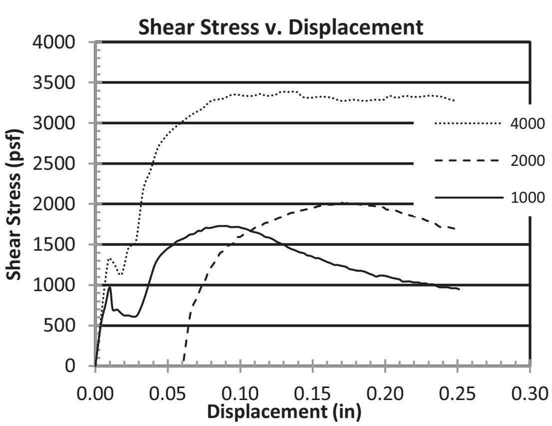
Excavation: BA-1
Depth: 5-6'
Sample Type: Undisturbed
By: HM

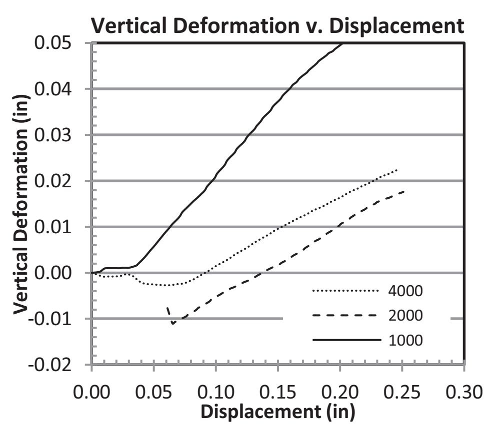
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1728	2016	3384
Ultimate Shear Stress (psf)	948	1680	3276
Initial Moisture Content (%)	13.3	13.3	13.3
Initial Dry Density (pcf)	112.7	106.7	118.2

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): .04

	Peak	Ultimate
Friction Angle, phi (deg)	35	38
Cohesion (psf)	600	150







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

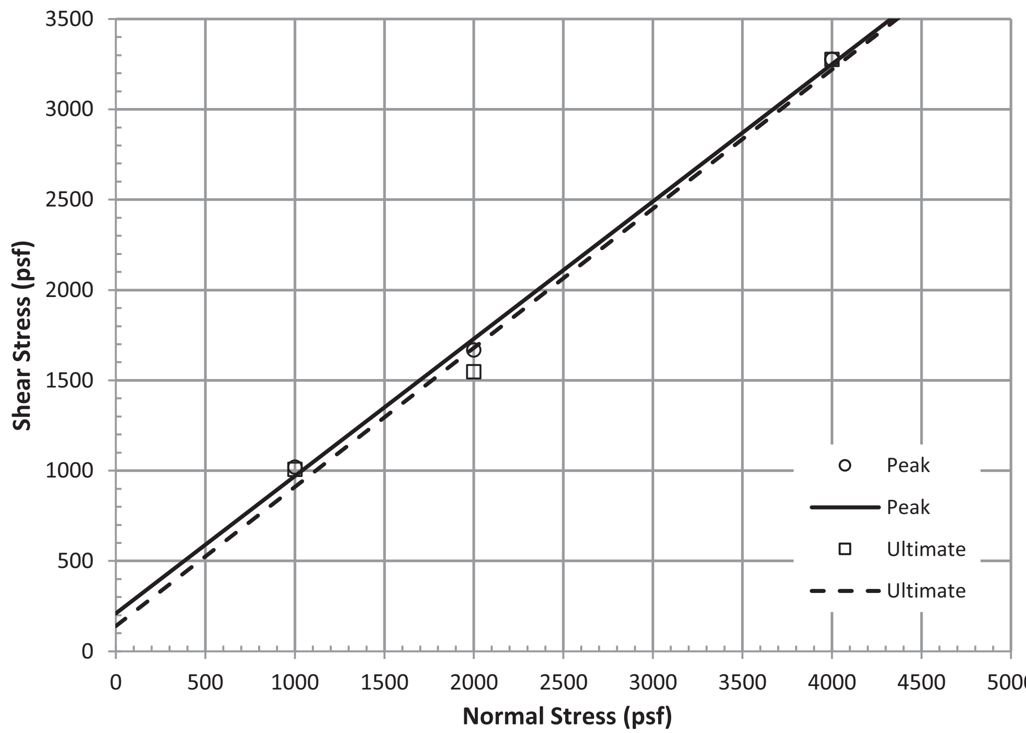
DIRECT SHEAR - ASTM D3080

Project Name:	Otay Village 14	Excavation:	BA-1
Location:	Proctor Valley Rd, SD County	Depth:	10
Project No.:	1312-02	Sample Type:	Undisturbed
Date:	3/17/15	By:	HM

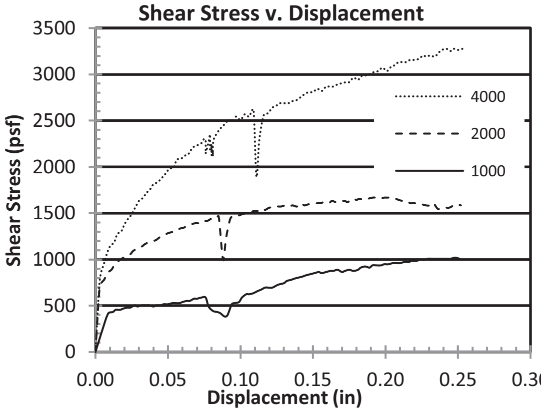
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1020	1668	3276
Ultimate Shear Stress (psf)	1008	1548	3276
Initial Moisture Content (%)	6.7	6.7	6.7
Initial Dry Density (pcf)	121.4	120.7	123.9

Method:	Drained
Consolidation:	Yes
Saturation:	Yes
Shearing Rate (in/min):	0.04

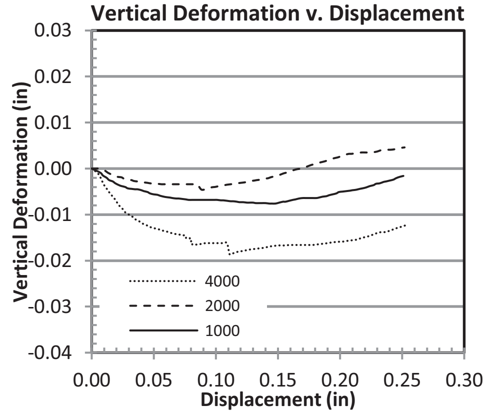
	Peak	Ultimate
Friction Angle, phi (deg)	37	38
Cohesion (psf)	210	140



Shear Stress v. Displacement



Vertical Deformation v. Displacement



ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

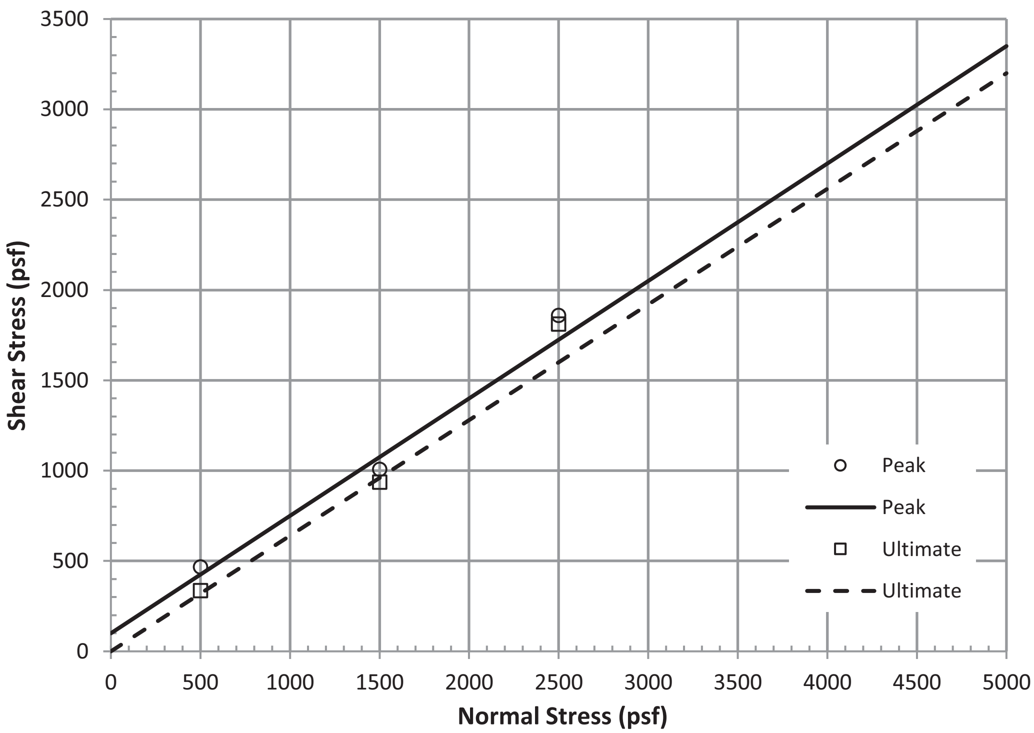
Project Name: Otay Village
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 3/30/15

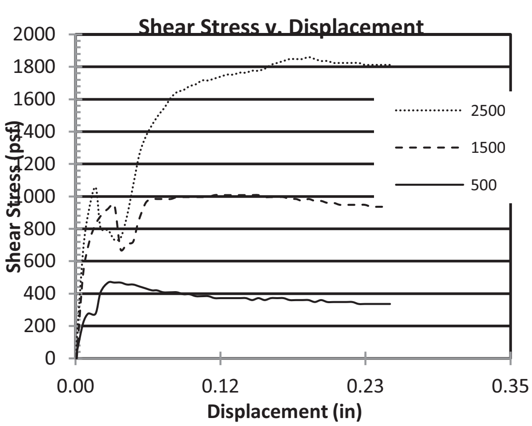
Excavation: BA-2
Depth: 1-2'
Sample Type: Remolded to 90% max
By: HM

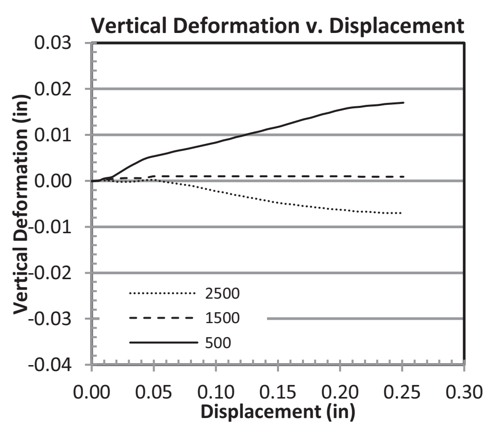
Samples Tested	1	2	3
Normal Stress (psf)	500	1500	2500
Maximum Shear Stress (psf)	468	1008	1860
Ultimate Shear Stress (psf)	336	936	1812
Initial Moisture Content (%)	13.0	13.3	109.7
Initial Dry Density (pcf)	109.8	109.8	123.9

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	33	33
Cohesion (psf)	100	0







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

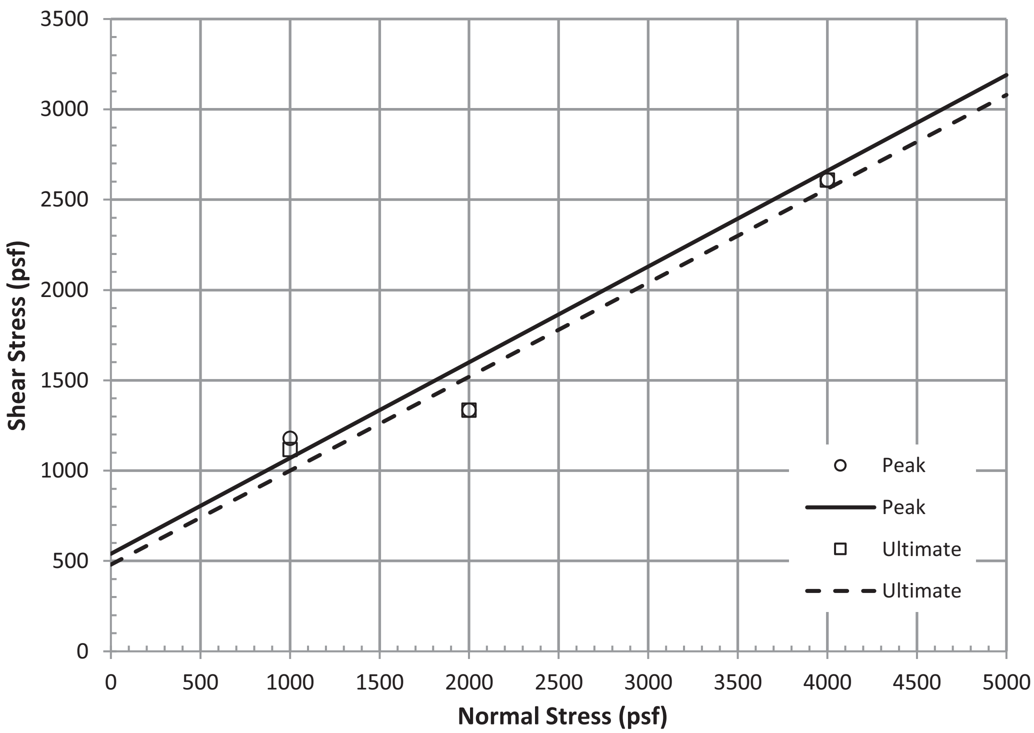
Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/18/15

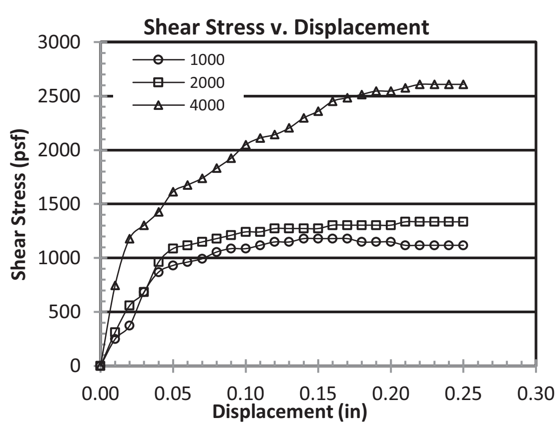
Excavation: BA-3
Depth: 11 '
Sample Type: Intact
By: H.M

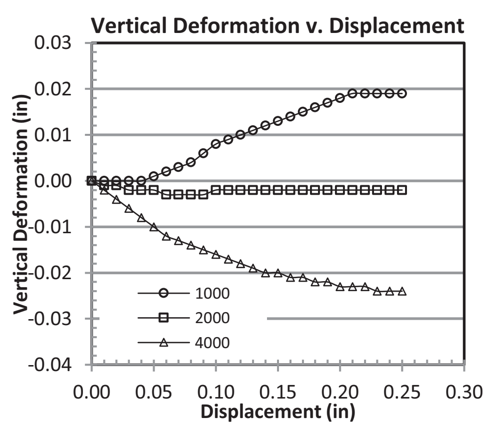
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1180	1335	2608
Ultimate Shear Stress (psf)	1118	1335	2608
Initial Moisture Content (%)	8.9	8.9	8.9
Initial Dry Density (pcf)	112.4	107.9	110.4

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.005

	Peak	Ultimate
Friction Angle, phi (deg)	28	27
Cohesion (psf)	540	480







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

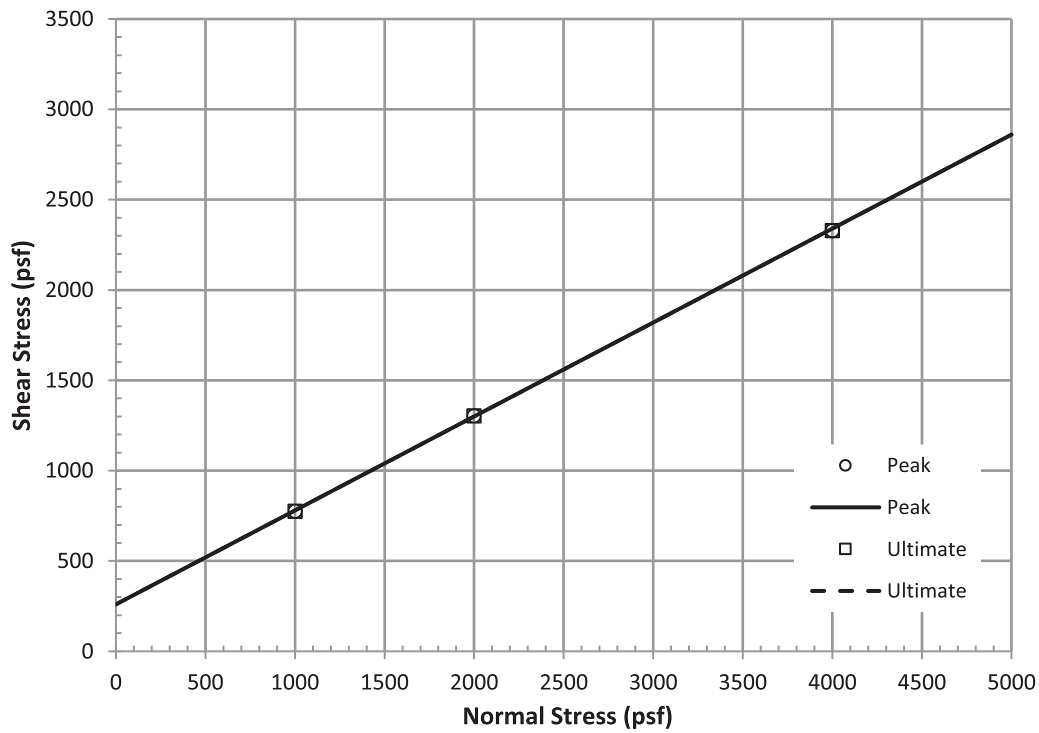
Project Name: Otay Village 14
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 3/19/15

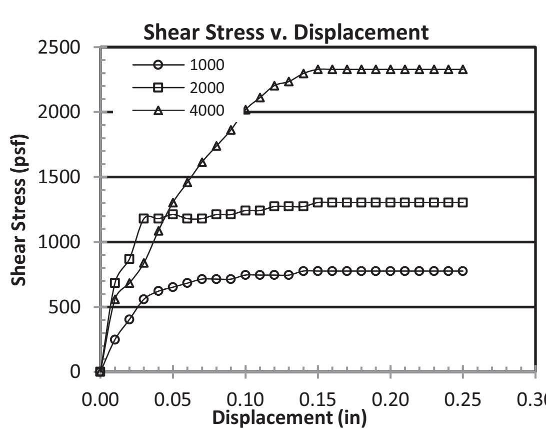
Excavation: BA-3
Depth: 15 '
Sample Type: Undisturbed
By: HM

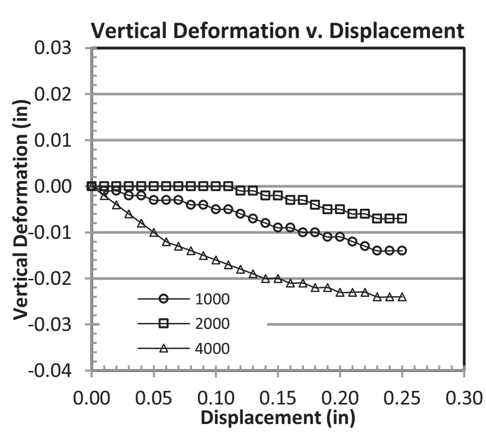
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	776	1304	2329
Ultimate Shear Stress (psf)	776	1304	2329
Initial Moisture Content (%)	8.4	8.4	8.4
Initial Dry Density (pcf)	113.6	116.6	108.8

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.005

	Peak	Ultimate
Friction Angle, phi (deg)	27	27
Cohesion (psf)	260	260







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DIRECT SHEAR - ASTM D3080

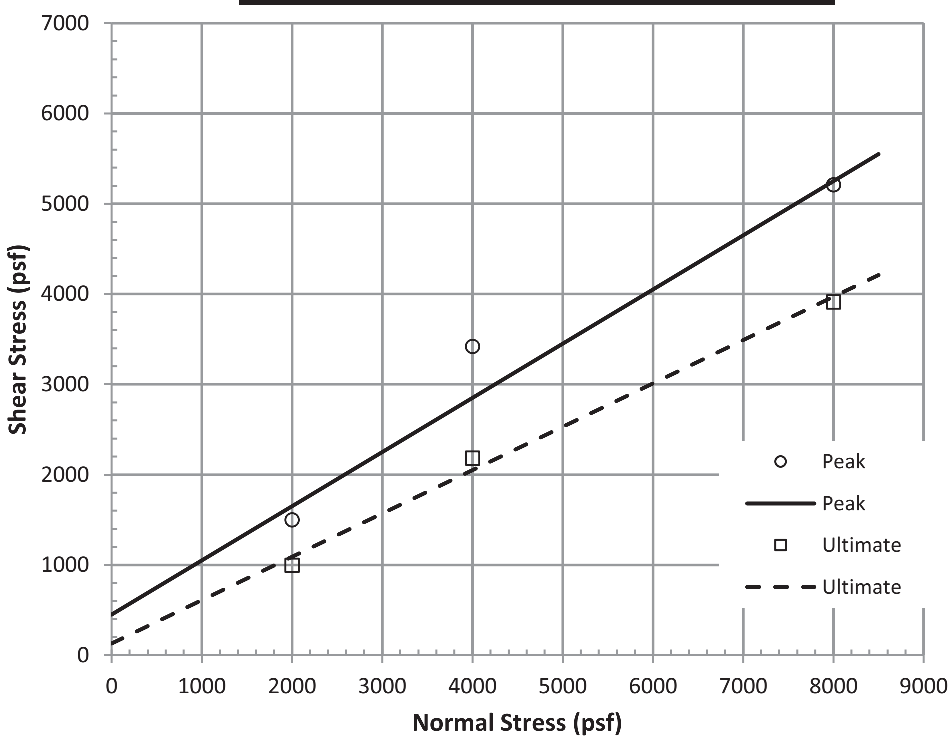
Project Name: Otay Village 14
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 3/20/15

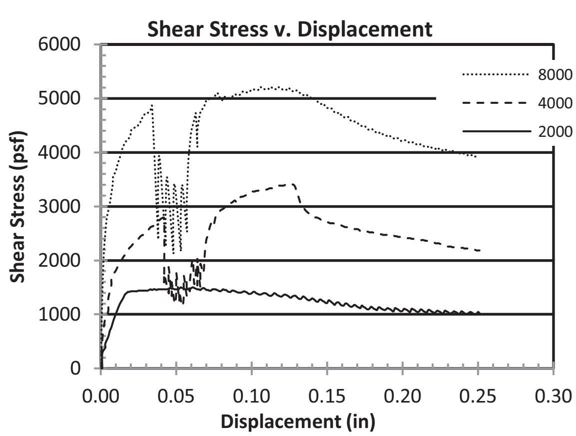
Excavation: BA-4
Depth: 25-26'
Sample Type: Undisturbed
By: HM

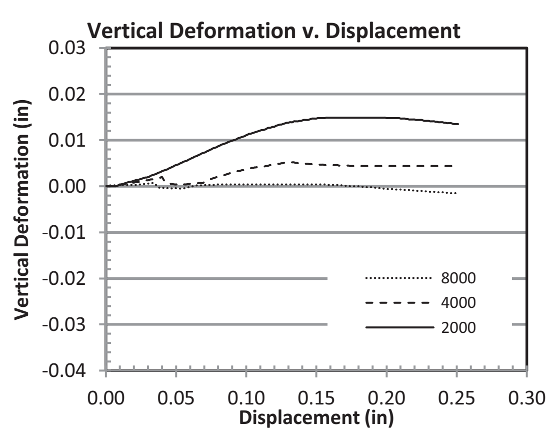
Samples Tested	1	2	3
Normal Stress (psf)	2000	4000	8000
Maximum Shear Stress (psf)	1500	3420	5208
Ultimate Shear Stress (psf)	996	2184	3912
Initial Moisture Content (%)	19.8	19.8	19.8
Initial Dry Density (pcf)	97.1	98.6	99.7

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	31	26
Cohesion (psf)	450	130







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

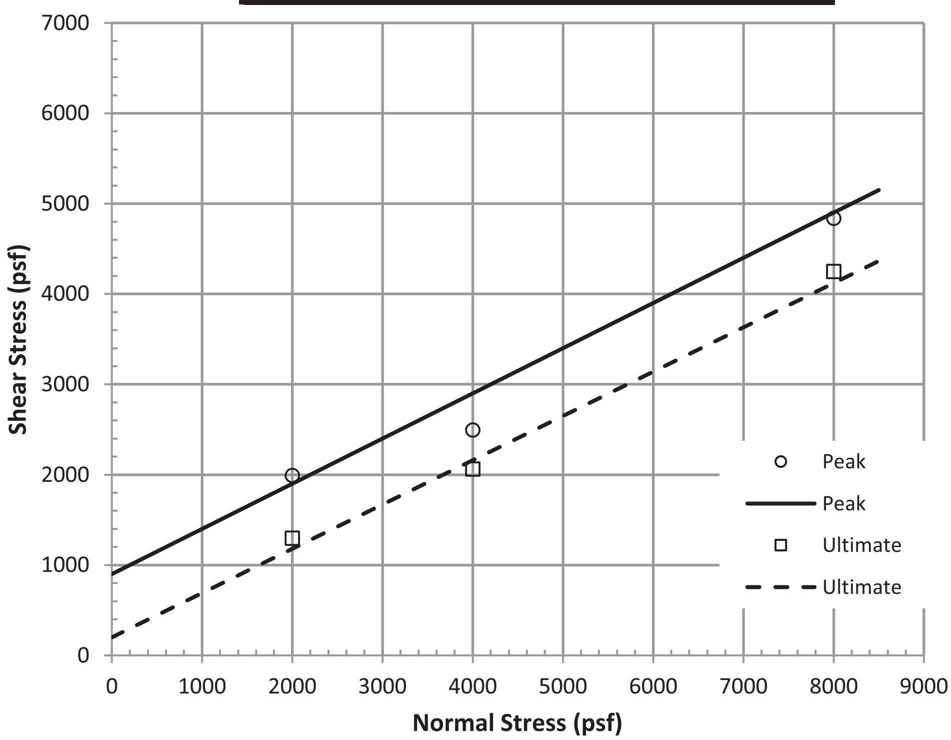
Project Name: Otay Village
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 3/23/15

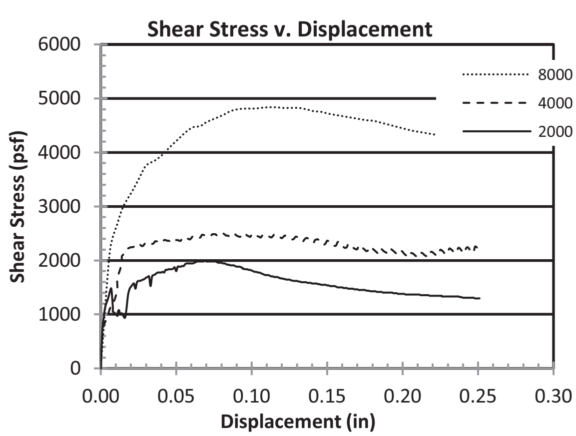
Excavation: BA-4
Depth: 36'
Sample Type: Undisturbed
By: HM

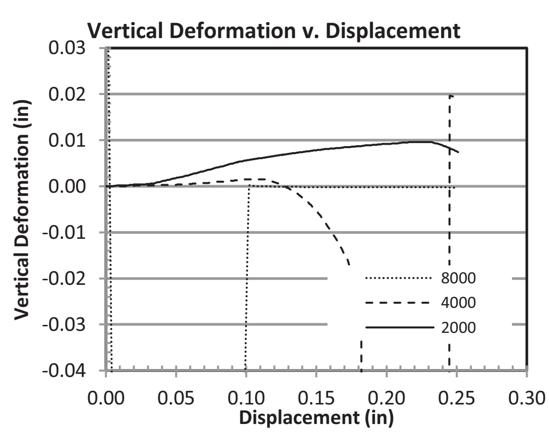
Samples Tested	1	2	3
Normal Stress (psf)	2000	4000	8000
Maximum Shear Stress (psf)	1992	2496	4836
Ultimate Shear Stress (psf)	1296	2064	4248
Initial Moisture Content (%)	18.5	18.5	18.5
Initial Dry Density (pcf)	104.1	105.3	103.2

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	27	26
Cohesion (psf)	900	200







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

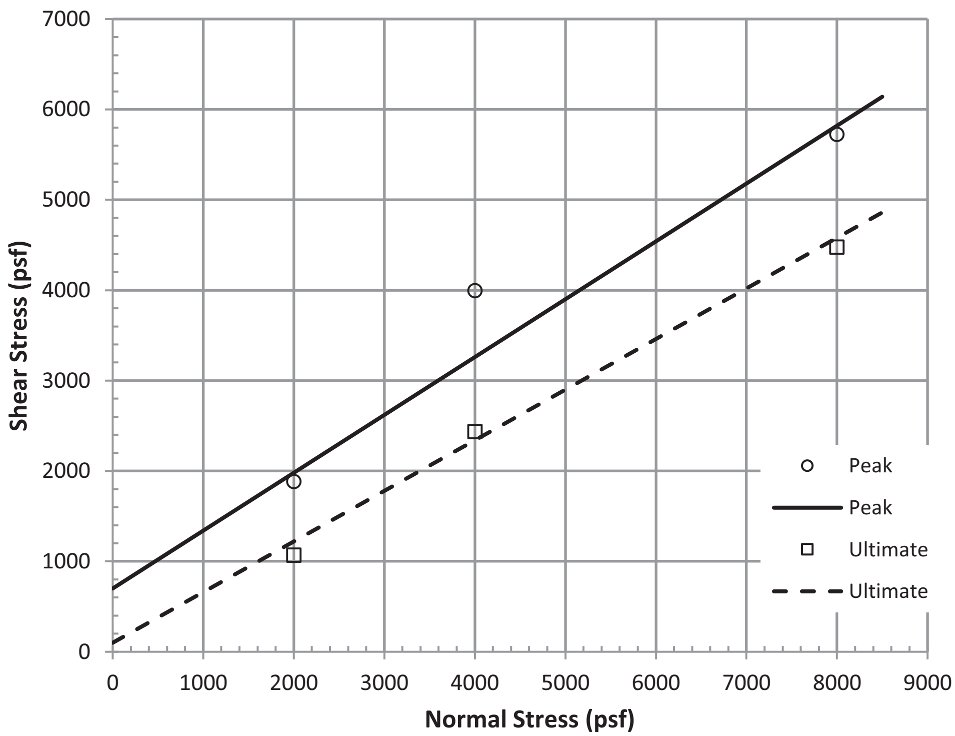
DIRECT SHEAR - ASTM D3080

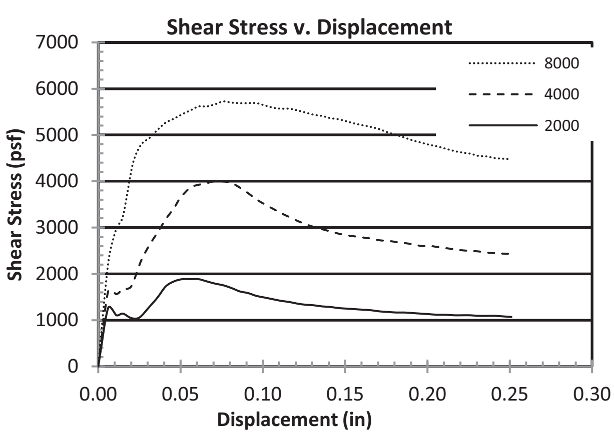
Project Name:	Otay Village	Excavation:	BA-4
Location:	Proctor Valley Rd, SD County	Depth:	52'
Project No.:	1312-02	Sample Type:	Undisturbed
Date:	3/27/15	By:	HM

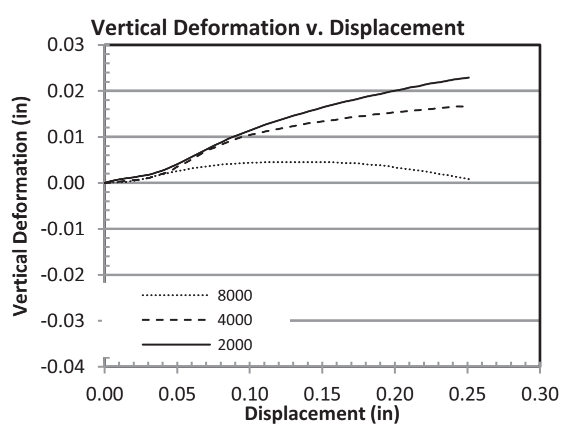
Samples Tested	1	2	3
Normal Stress (psf)	2000	4000	8000
Maximum Shear Stress (psf)	1884	3996	5724
Ultimate Shear Stress (psf)	1068	2436	4476
Initial Moisture Content (%)	19.6	19.6	19.6
Initial Dry Density (pcf)	105.4	104.3	102.2

Method:	Drained
Consolidation:	Yes
Saturation:	Yes
Shearing Rate (in/min):	0.04

	Peak	Ultimate
Friction Angle, phi (deg)	33	29
Cohesion (psf)	700	100







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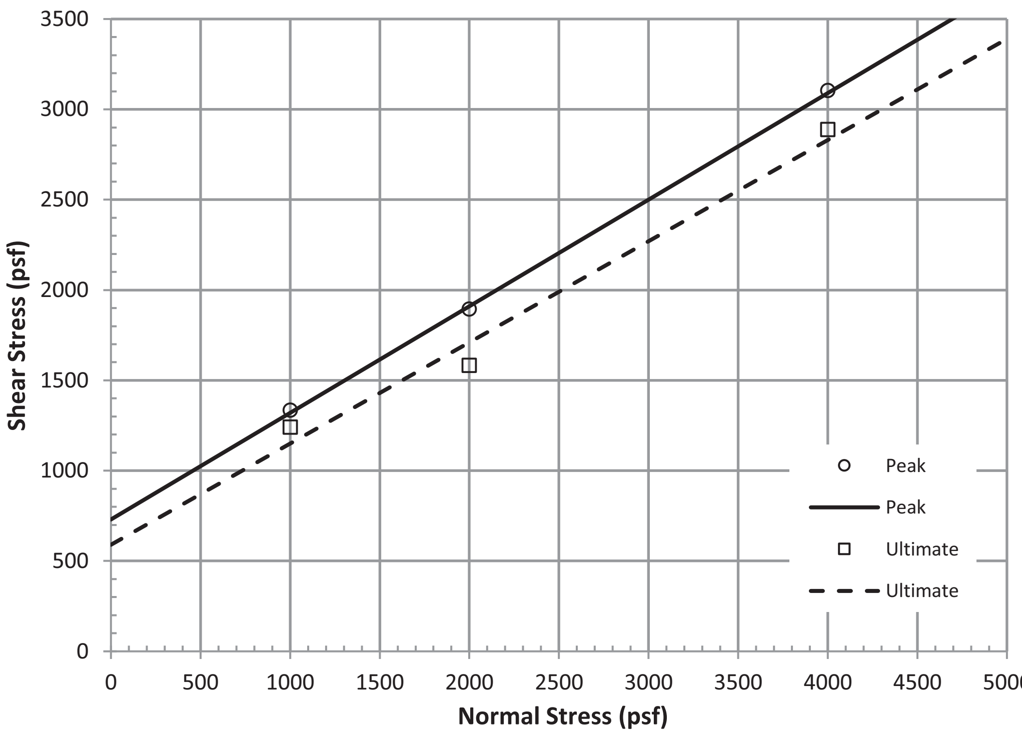
DIRECT SHEAR - ASTM D3080

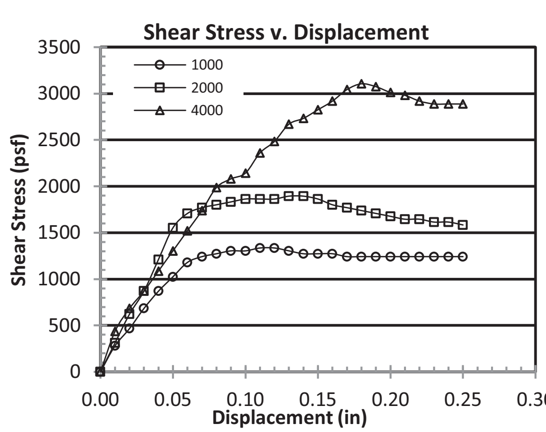
Project Name:	Otay Village 14	Excavation:	BA-5
Location:	Proctor Valley Rd, SD County	Depth:	10
Project No.:	1312-02	Sample Type:	Undisturbed
Date:	3/22/15	By:	HM

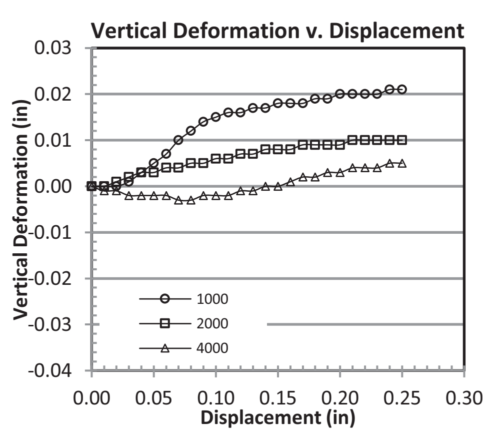
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1335	1894	3105
Ultimate Shear Stress (psf)	1242	1584	2888
Initial Moisture Content (%)	12.4	12.4	12.4
Initial Dry Density (pcf)	113.6	114.8	110.8

Method:	Drained
Consolidation:	Yes
Saturation:	Yes
Shearing Rate (in/min):	0.001

	Peak	Ultimate
Friction Angle, phi (deg)	31	29
Cohesion (psf)	730	590







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

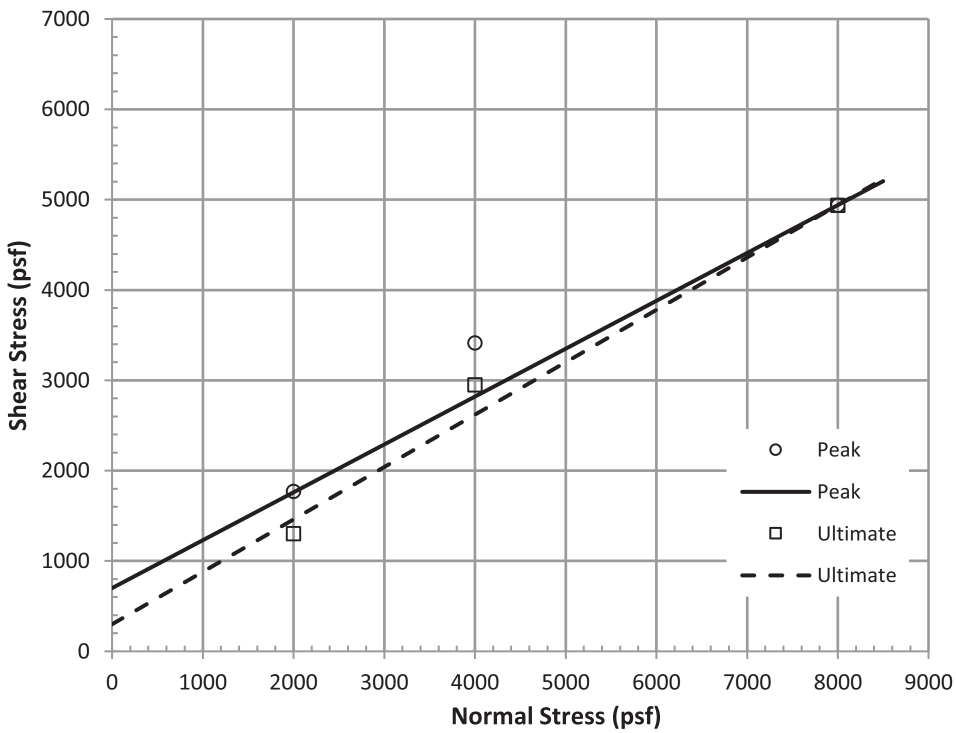
Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/25/15

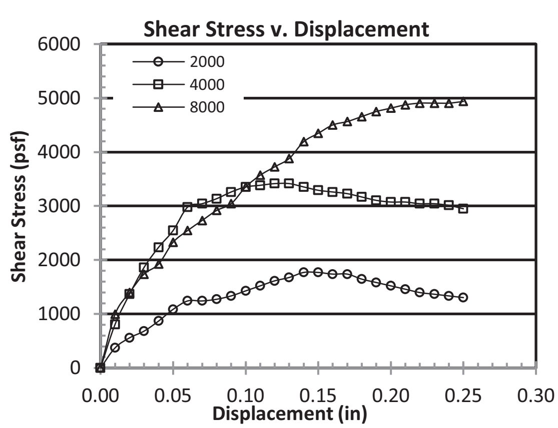
Excavation: BA-5
Depth: 66'
Sample Type: Intact
By: HM

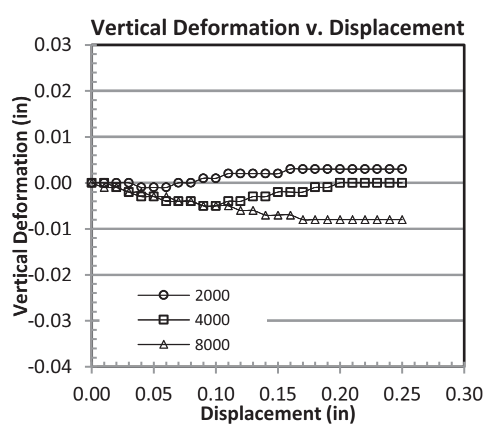
Samples Tested	1	2	3
Normal Stress (psf)	2000	4000	8000
Maximum Shear Stress (psf)	1770	3416	4937
Ultimate Shear Stress (psf)	1304	2950	4937
Initial Moisture Content (%)	14.1	14.1	14.1
Initial Dry Density (pcf)	103.5	108.3	107.1

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.001

	Peak	Ultimate
Friction Angle, phi (deg)	28	30
Cohesion (psf)	700	300







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

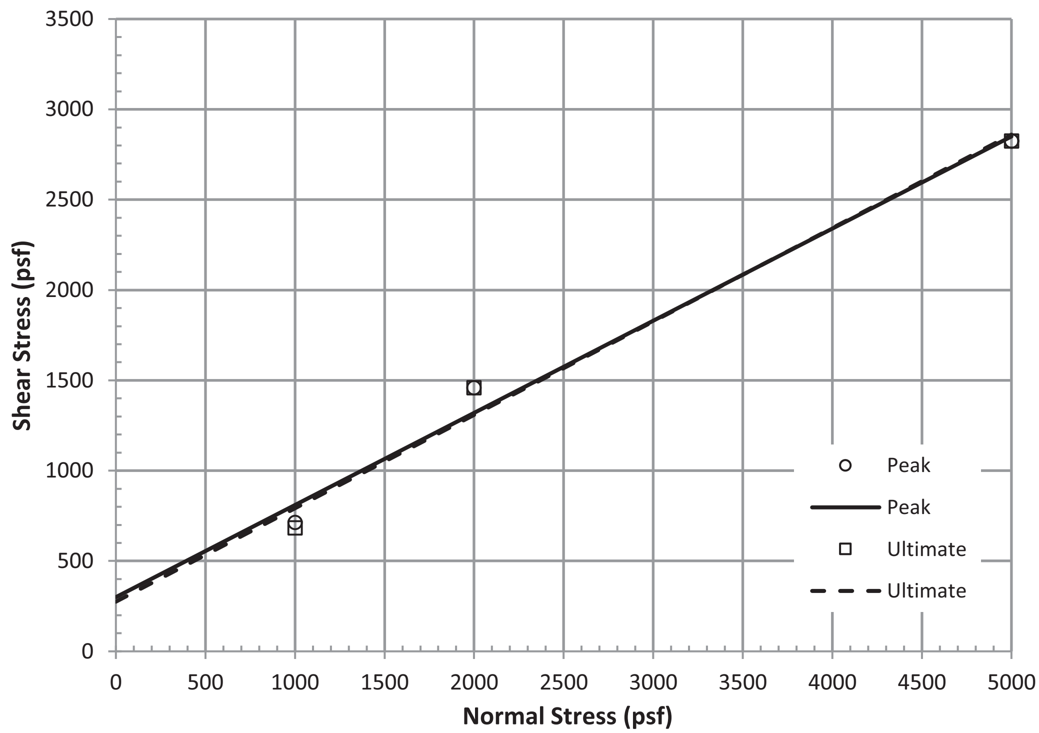
Project Name: Otay Village 14
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 3/24/15

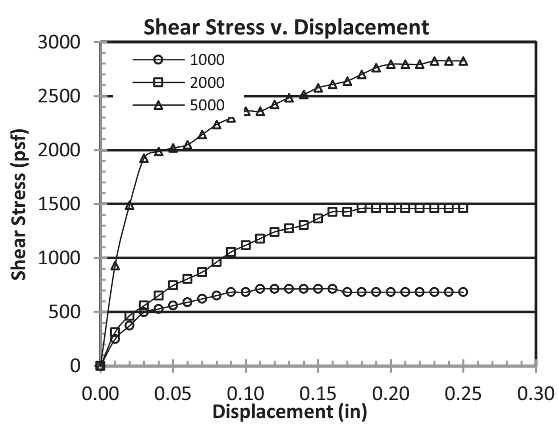
Excavation: BA-8
Depth: 15 '
Sample Type: Undisturbed
By: HM

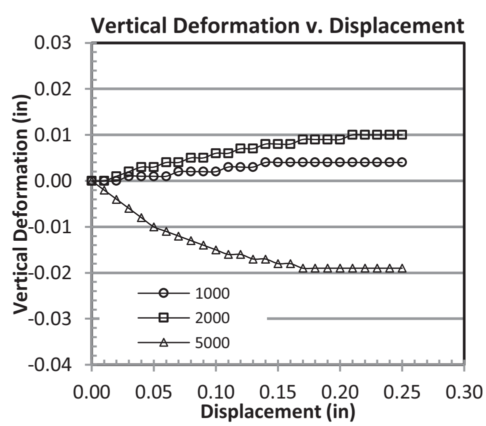
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	5000
Maximum Shear Stress (psf)	714	1459	2826
Ultimate Shear Stress (psf)	683	1459	2826
Initial Moisture Content (%)	14.4	14.4	14.4
Initial Dry Density (pcf)	99.0	100.9	108.6

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.001

	Peak	Ultimate
Friction Angle, phi (deg)	27	27
Cohesion (psf)	300	275







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

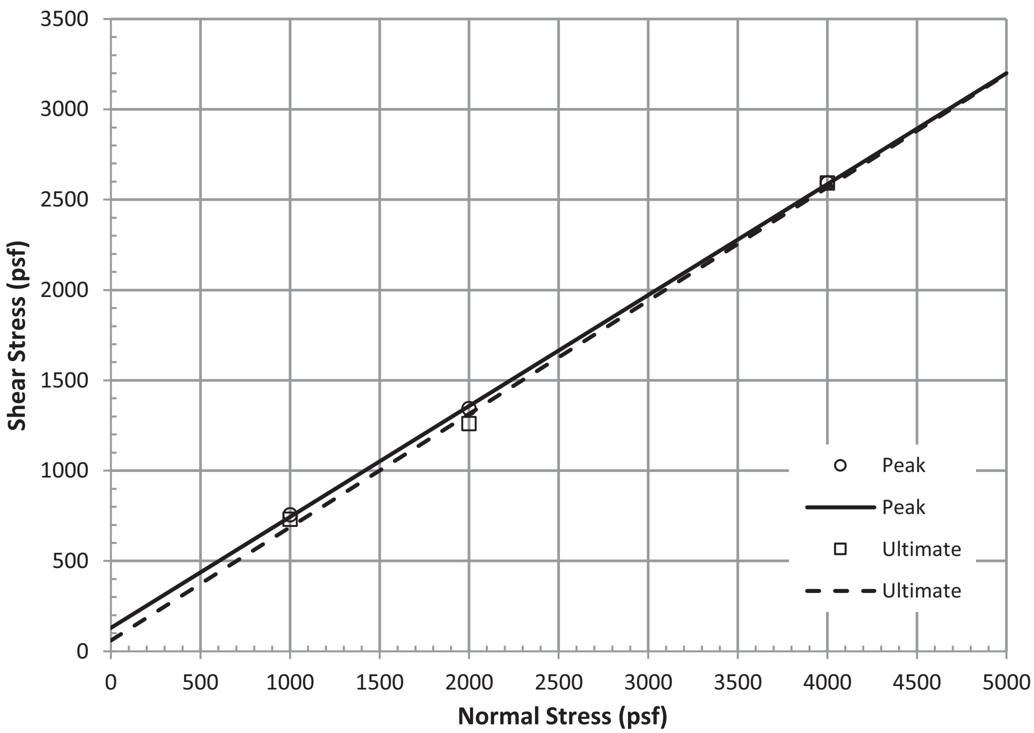
Project Name: Proctor Valley Village
Location: Chula Vista
Project No.: 1312-02
Date: 1/5/17

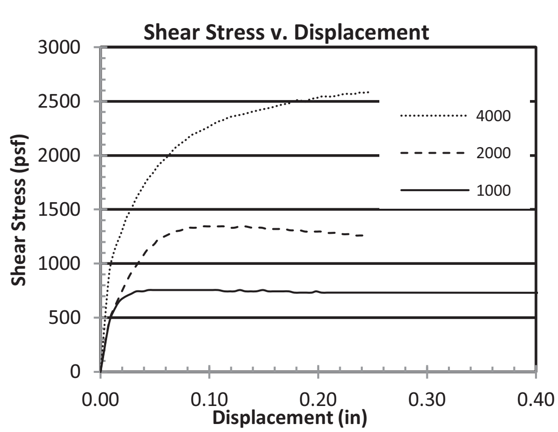
Excavation: T-7
Depth: 1-2 ft
Sample Type: Remold 90%
By: FV

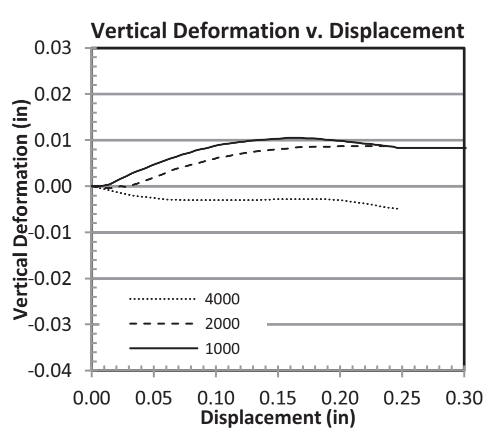
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	756	1344	2592
Ultimate Shear Stress (psf)	732	1260	2592
Initial Moisture Content (%)	11.0	11.0	11.0
Initial Dry Density (pcf)	111.1	111.1	111.1

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.05

	Peak	Ultimate
Friction Angle, phi (deg)	32	32
Cohesion (psf)	130	60







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

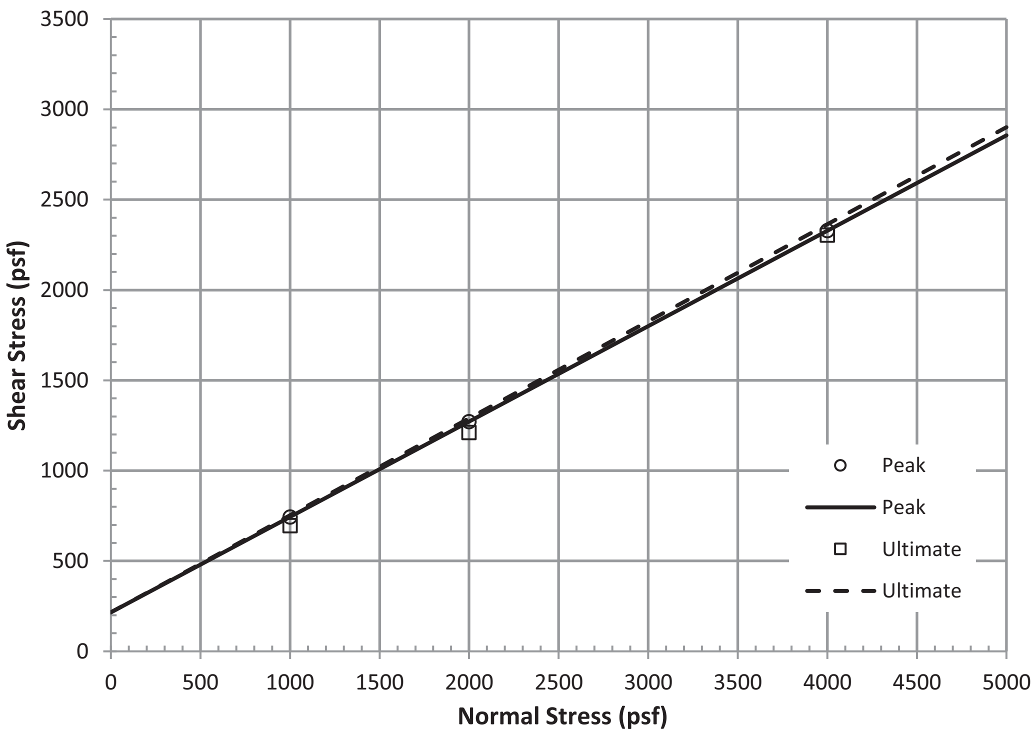
DIRECT SHEAR - ASTM D3080

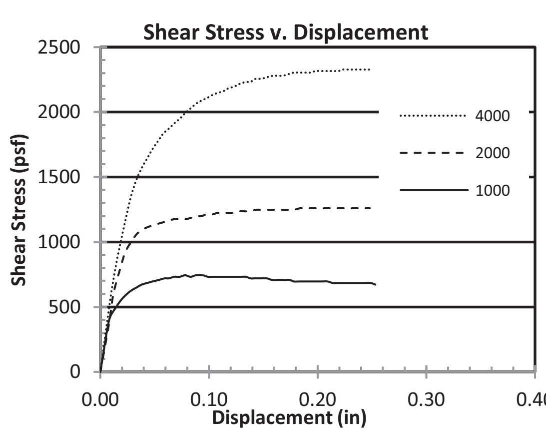
Project Name:	Proctor Valley Village	Excavation:	T-15
Location:	Chula Vista	Depth:	2-4 ft
Project No.:	1312-02	Sample Type:	Remolded 90%
Date:	1/10/17	By:	FV

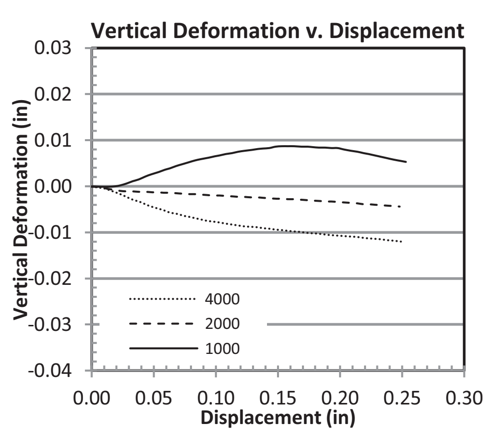
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	744	1272	2328
Ultimate Shear Stress (psf)	696	1212	2304
Initial Moisture Content (%)	11.0	11.0	11.0
Initial Dry Density (pcf)	110.2	110.2	110.2

Method:	Drained
Consolidation:	Yes
Saturation:	Yes
Shearing Rate (in/min):	0.05

	Peak	Ultimate
Friction Angle, phi (deg)	28	28
Cohesion (psf)	216	216







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

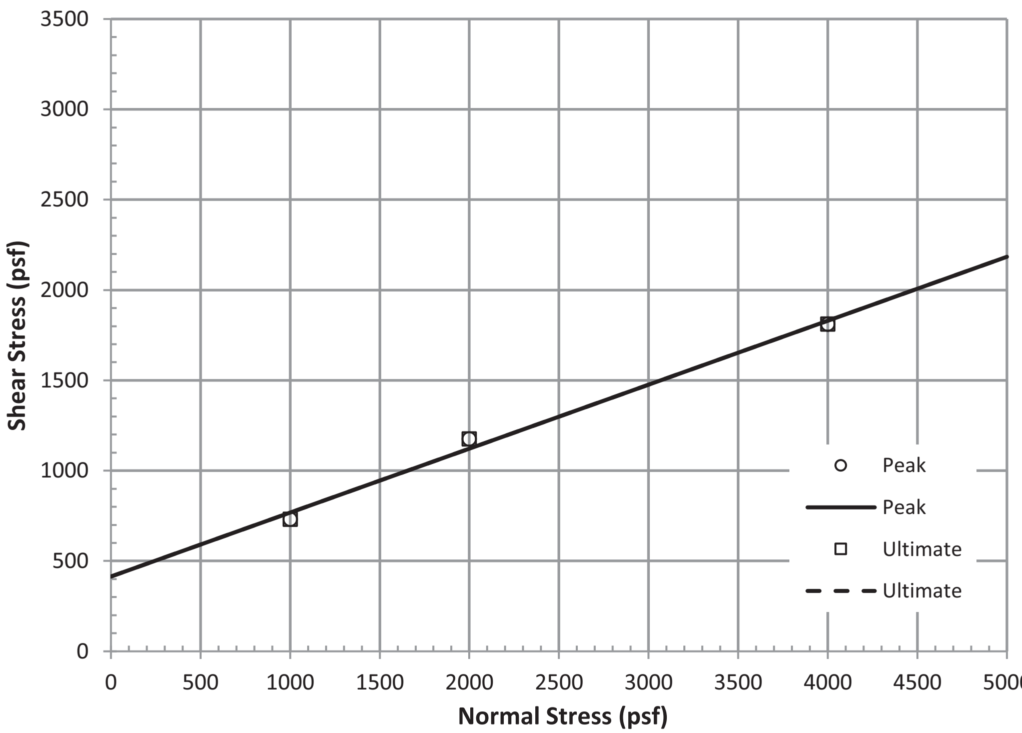
DIRECT SHEAR - ASTM D3080

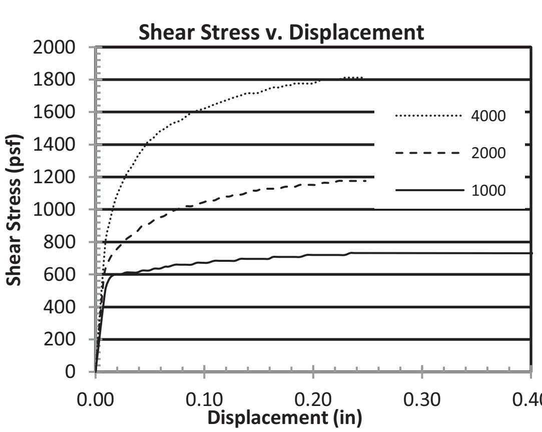
Project Name:	Proctor Valley Village	Excavation:	T-13
Location:	Chula Vista	Depth:	1-3 ft
Project No.:	1312-02	Sample Type:	Remold 90%
Date:	1/5/17	By:	FV

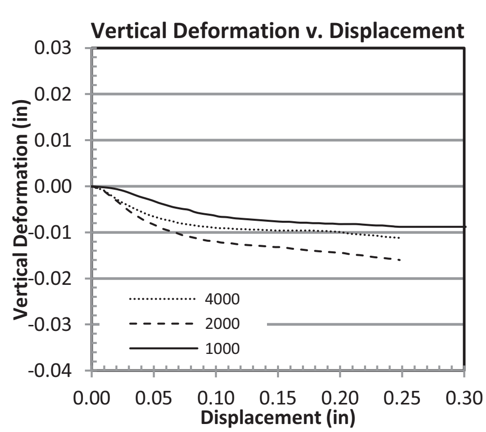
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	732	1176	1812
Ultimate Shear Stress (psf)	732	1176	1812
Initial Moisture Content (%)	11.0	11.0	11.0
Initial Dry Density (pcf)	109.4	109.4	109.4

Method:	Drained
Consolidation:	Yes
Saturation:	Yes
Shearing Rate (in/min):	0.05

	Peak	Ultimate
Friction Angle, phi (deg)	19	19
Cohesion (psf)	414	414







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

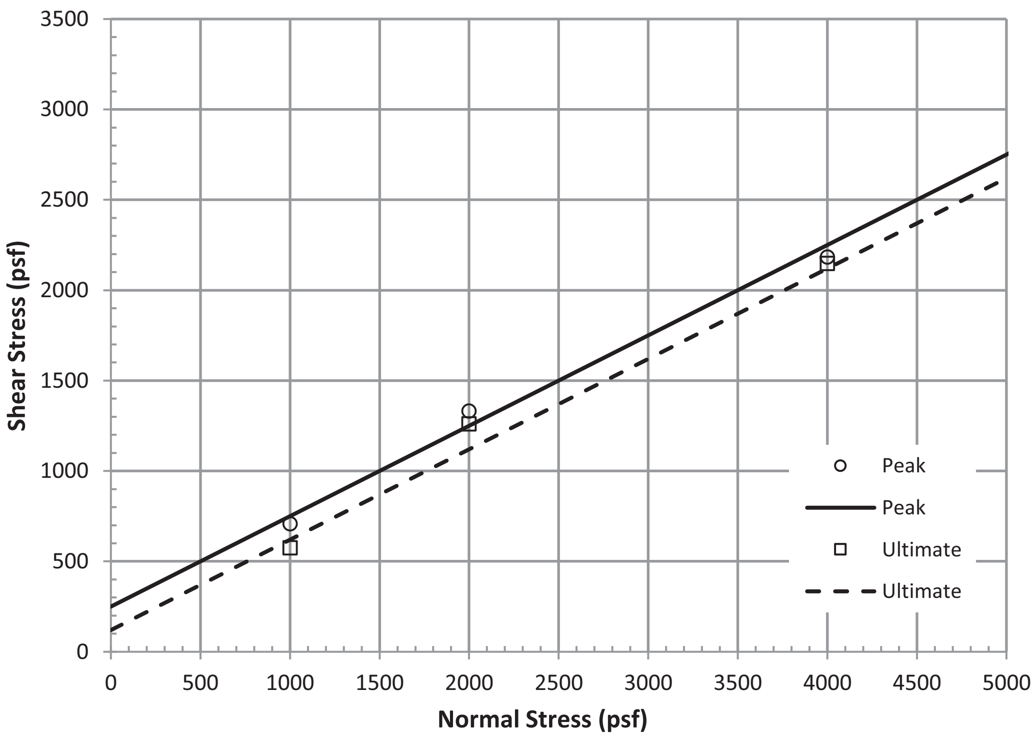
Project Name: Otay Village 14
Location: Proctor Valley Rd, SD County
Project No.: 1312-02
Date: 4/2/15

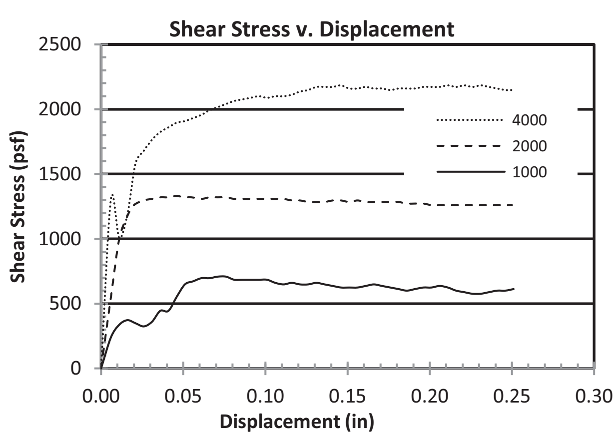
Excavation: EX-11
Depth: 9-10'
Sample Type: Remolded to 90% max
By: HM

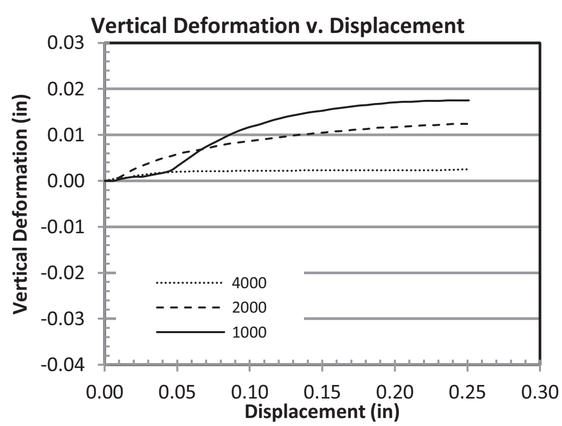
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	708	1332	2184
Ultimate Shear Stress (psf)	576	1260	2148
Initial Moisture Content (%)	12.0	12.0	12.0
Initial Dry Density (pcf)	103.5	103.5	103.5

Method: Drained
Consolidation: Yes
Saturation: Yes
Strain Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	27	27
Cohesion (psf)	250	120





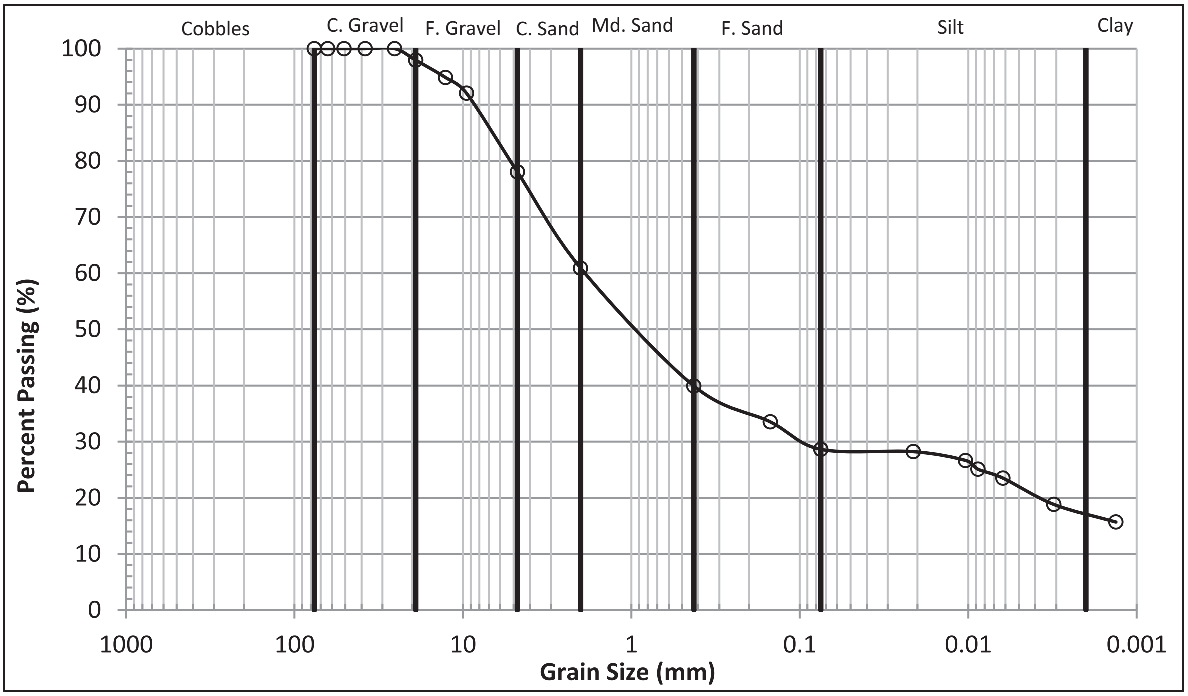


ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay- Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-1
Depth: 10-11 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	97.95
1/2 "	12.70	94.87
3/8 "	9.53	92.07
# 4	4.75	78.06
# 10	2.00	60.92
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	39.90
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	33.54
# 200	0.075	28.63
Hydro	0.0332	#N/A
Hydro	0.0212	28.22
Hydro	0.0104	26.65
Hydro	0.0087	25.08
Hydro	0.0062	23.52
Hydro	0.0031	18.81
Hydro	0.0013	15.68

Summary	
% Gravel =	21.9
% Sand =	49.4
% Fines =	28.6
Sum =	100.0

LL= ______
PL= ______
PI= ______

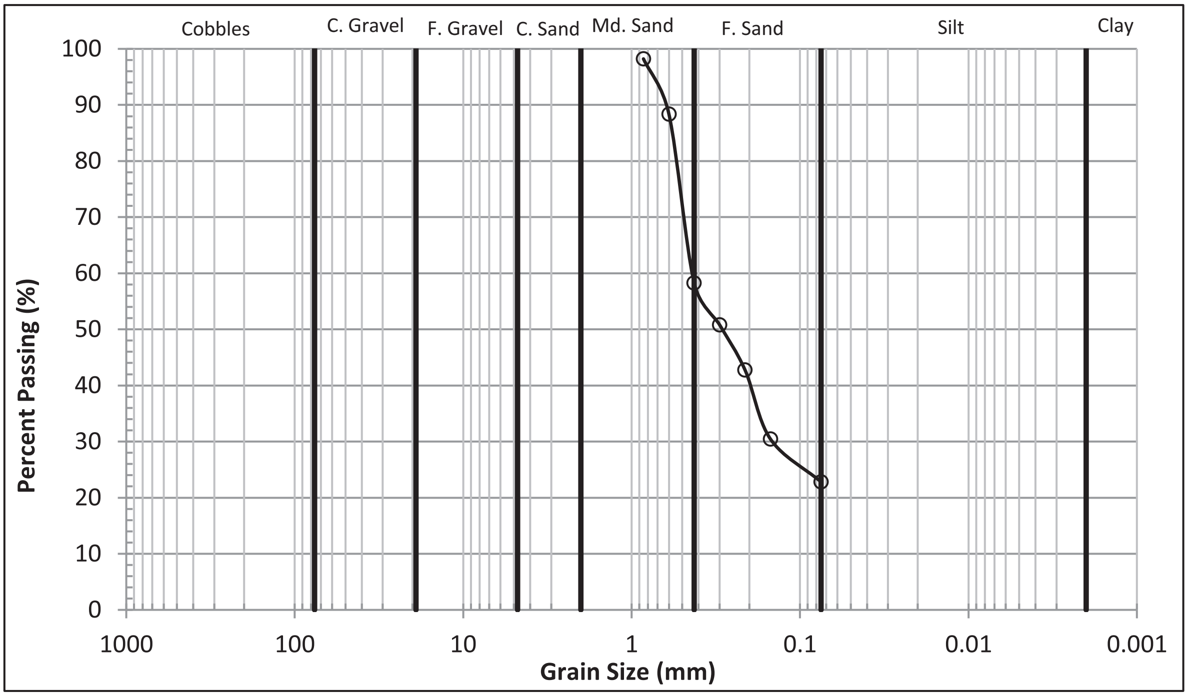
Soil Type: SC-SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Village14 Proctor Valley
Location: Chula Vista
Project No.: 1312-02
Date:

Excavation: T-1
Depth: 9 ft
By: FV



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	98.22
# 30	0.60	88.34
# 40	0.425	58.26
# 50	0.30	50.79
# 60	0.212	42.75
# 100	0.15	30.47
# 200	0.075	22.81
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!

Summary	
% Gravel =	0.0
% Sand =	77.2
% Fines =	22.8
Sum =	100.0

LL=
PL=
PI=

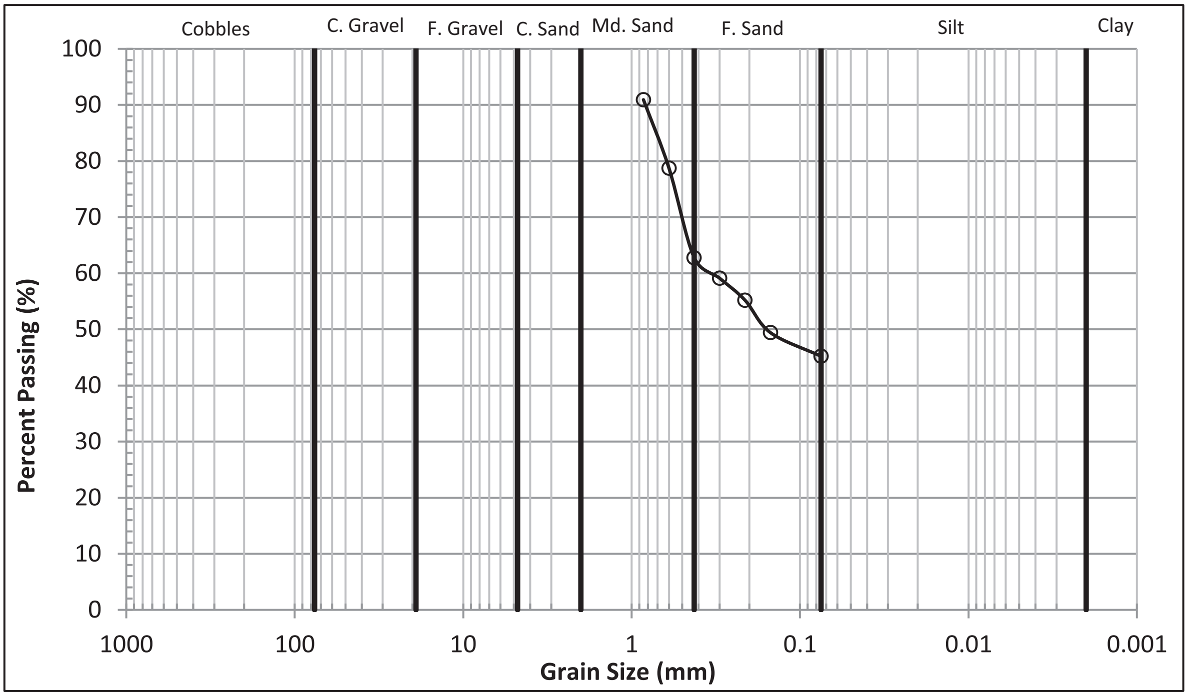
Soil Type:

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Village14 Proctor Valley
Location: Chula Vista
Project No.: 1312-02
Date:

Excavation: T-8
Depth: 2 Ft
By: FV



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	90.92
# 30	0.60	78.76
# 40	0.425	62.78
# 50	0.30	59.11
# 60	0.212	55.19
# 100	0.15	49.43
# 200	0.075	45.21
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!

Summary	
% Gravel =	0.0
% Sand =	54.8
% Fines =	45.2
Sum =	100.0

LL=
PL=
PI=

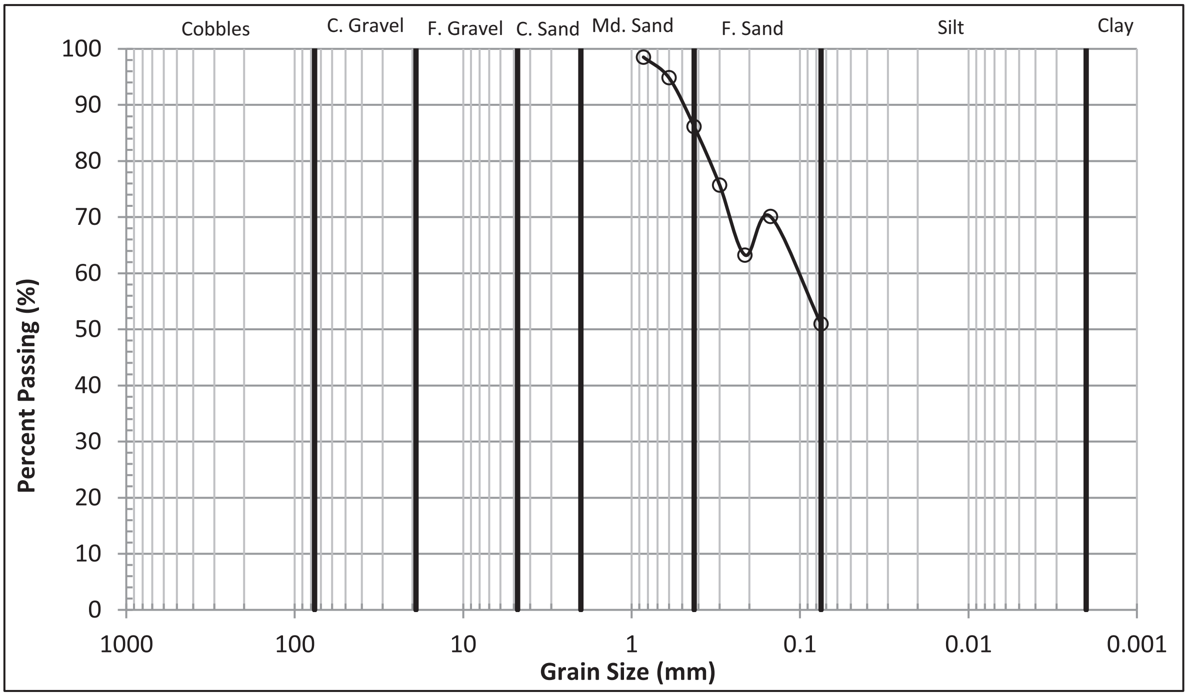
Soil Type:

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Village14 Proctor Valley
Location: Chula Vista
Project No.: 1312-02
Date:

Excavation: T-7
Depth: 2 Ft
By: FV



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	98.52
# 30	0.60	94.85
# 40	0.425	86.15
# 50	0.30	75.74
# 60	0.212	63.24
# 100	0.15	70.12
# 200	0.075	50.95
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!

Summary	
% Gravel =	0.0
% Sand =	49.0
% Fines =	51.0
Sum =	100.0

LL=

PL=

PI=

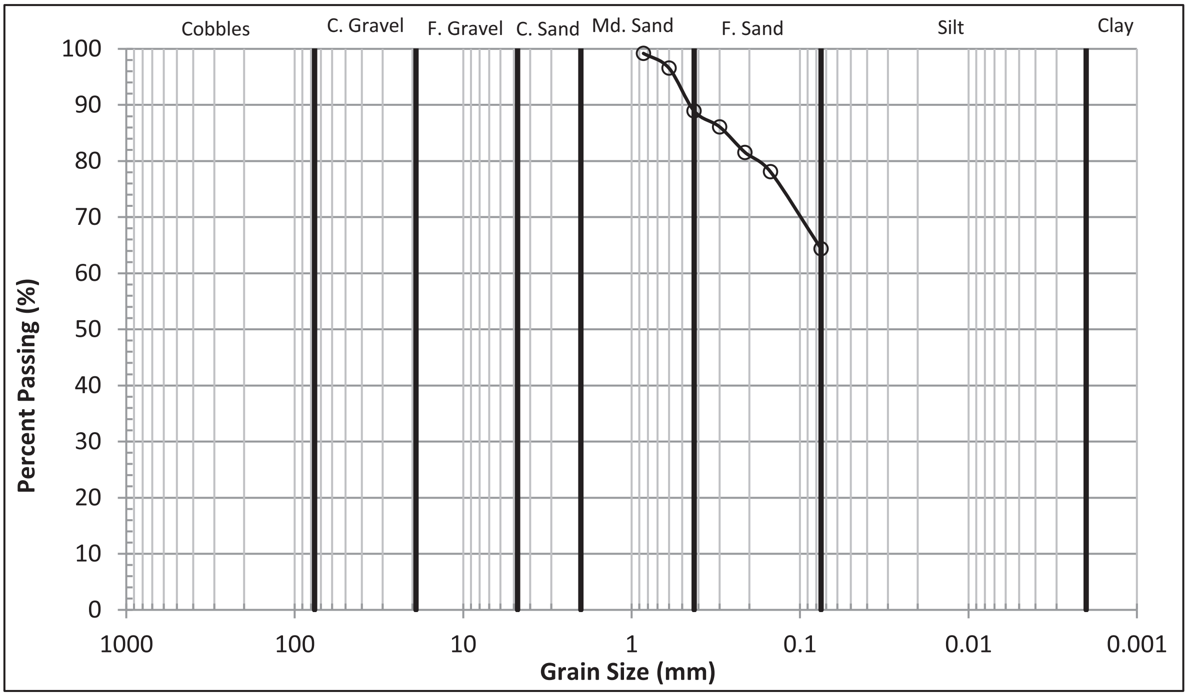
Soil Type:

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Village14 Proctor Valley
Location: Chula Vista
Project No.: 1312-02
Date:

Excavation: T-4
Depth: 5 ft
By: FV



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	99.19
# 30	0.60	96.57
# 40	0.425	88.91
# 50	0.30	86.10
# 60	0.212	81.54
# 100	0.15	78.11
# 200	0.075	64.36
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!
Hydro	#DIV/0!	#DIV/0!

Summary	
% Gravel =	0.0
% Sand =	35.6
% Fines =	64.4
Sum =	100.0

LL=
PL=
PI=

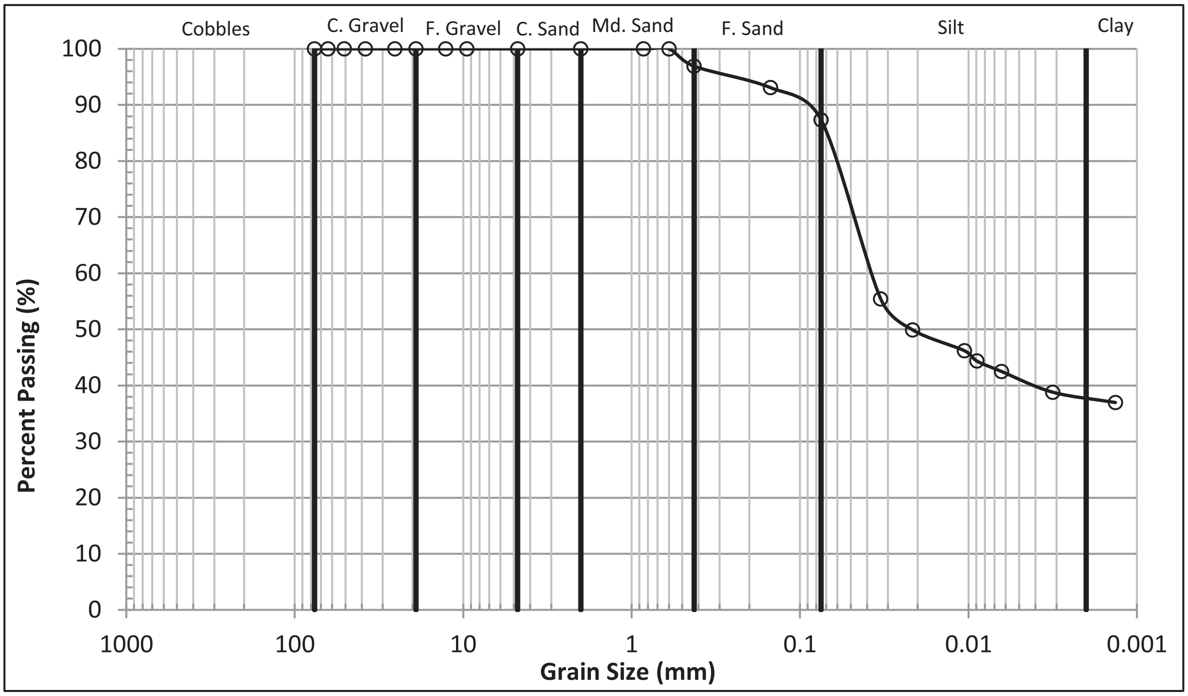
Soil Type:

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay- Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-1
Depth: 15-16 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	100.00
# 30	0.60	100.00
# 40	0.425	96.90
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	93.09
# 200	0.075	87.36
Hydro	0.0332	55.44
Hydro	0.0214	49.90
Hydro	0.0106	46.20
Hydro	0.0089	44.35
Hydro	0.0064	42.51
Hydro	0.0032	38.81
Hydro	0.0013	36.96

Summary	
% Gravel =	0.0
% Sand =	12.6
% Fines =	87.4
Sum =	100.0

LL= ______
PL= ______
PI= ______

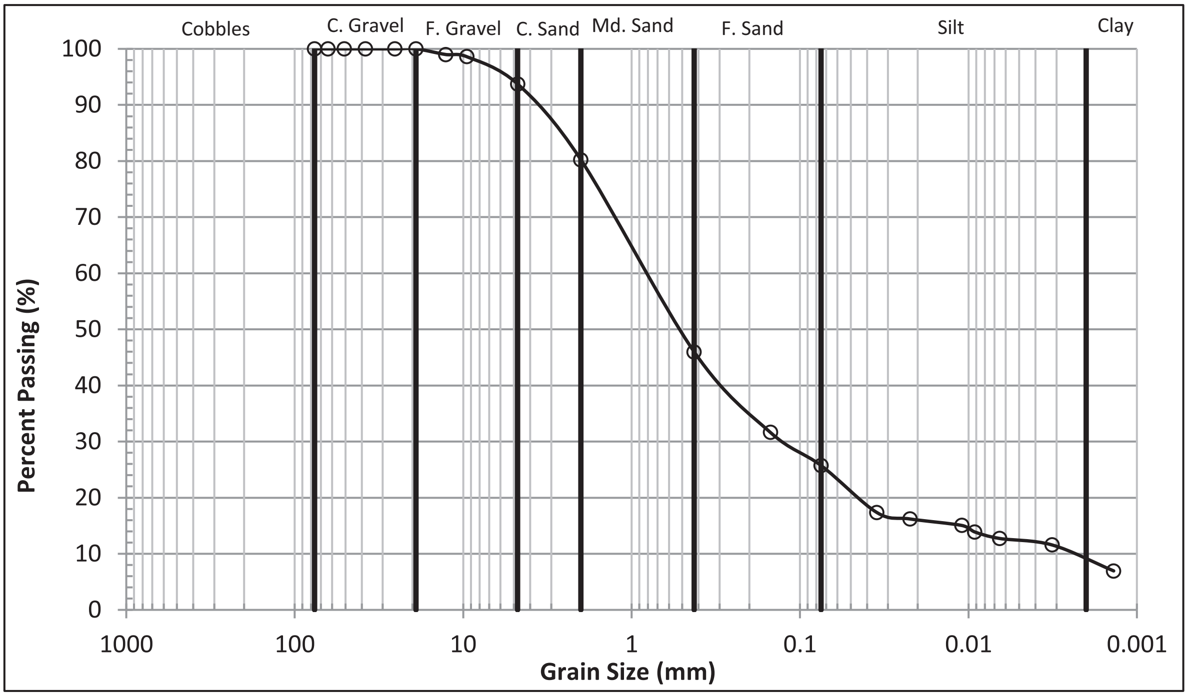
Soil Type: CL-ML

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay- Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-1
Depth: 5-6 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	98.99
3/8 "	9.53	98.61
# 4	4.75	93.74
# 10	2.00	80.24
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	45.99
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	31.63
# 200	0.075	25.73
Hydro	0.0350	17.36
Hydro	0.0222	16.20
Hydro	0.0109	15.04
Hydro	0.0092	13.89
Hydro	0.0065	12.73
Hydro	0.0032	11.57
Hydro	0.0014	6.94

Summary	
% Gravel =	6.3
% Sand =	68.0
% Fines =	25.7
Sum =	100.0

LL=
PL=
PI=

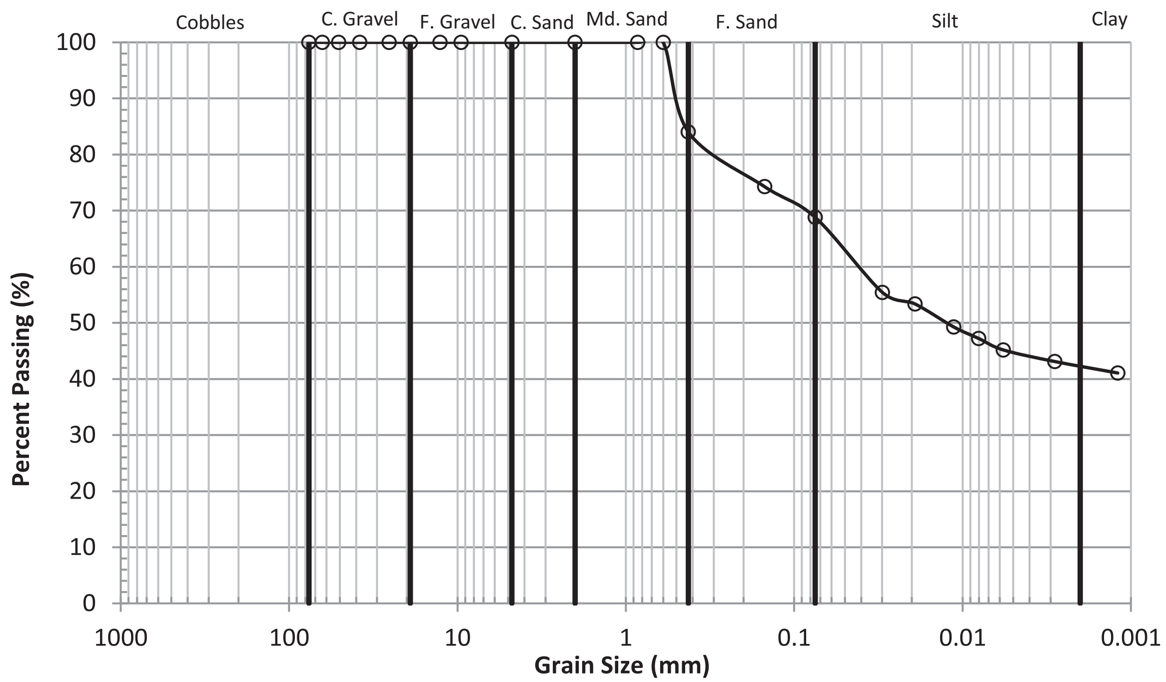
Soil Type: SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-2
Depth: 1-2 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	100.00
# 30	0.60	100.00
# 40	0.425	84.01
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	74.28
# 200	0.075	68.81
Hydro	0.0299	55.43
Hydro	0.0192	53.38
Hydro	0.0113	49.27
Hydro	0.0080	47.22
Hydro	0.0057	45.17
Hydro	0.0028	43.11
Hydro	0.0012	41.06

Summary	
% Gravel =	0.0
% Sand =	31.2
% Fines =	68.8
Sum =	100.0

LL= ________
PL= ________
PI= ________

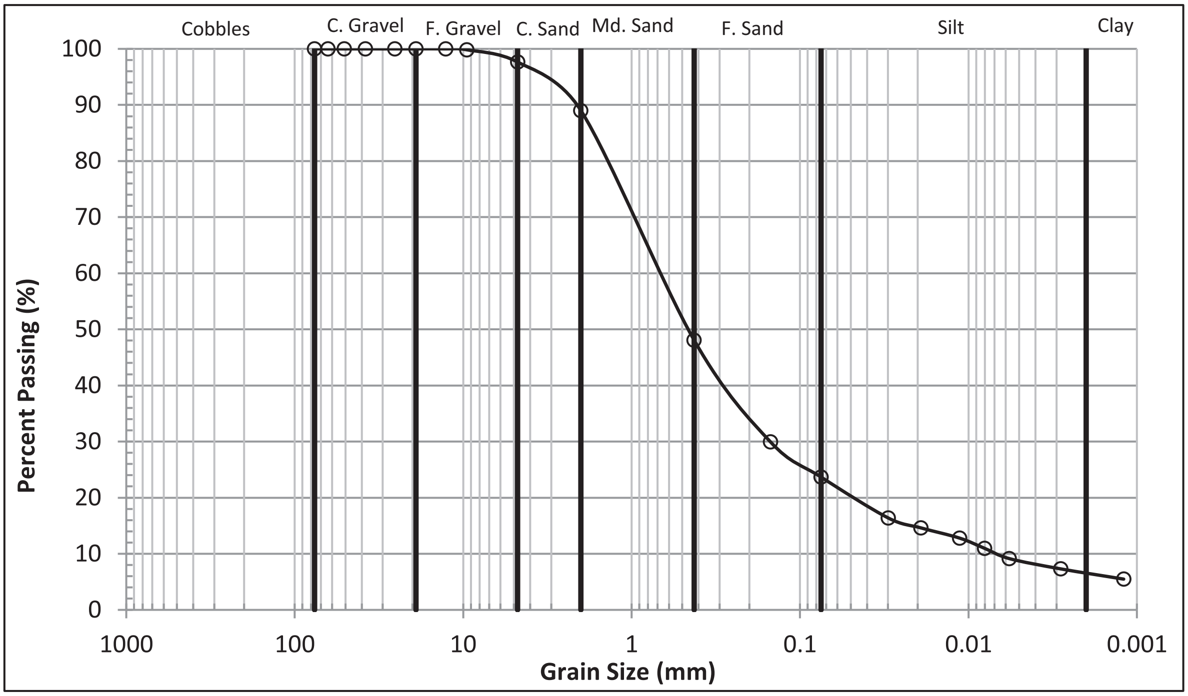
Soil Type: ________

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-2
Depth: 13-14 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	99.84
# 4	4.75	97.65
# 10	2.00	89.02
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	48.06
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	29.96
# 200	0.075	23.67
Hydro	0.0299	16.38
Hydro	0.0192	14.62
Hydro	0.0113	12.79
Hydro	0.0080	10.97
Hydro	0.0057	9.14
Hydro	0.0028	7.31
Hydro	0.0012	5.48

Summary	
% Gravel =	2.4
% Sand =	74.0
% Fines =	23.7
Sum =	100.0

LL= ______
PL= ______
PI= ______

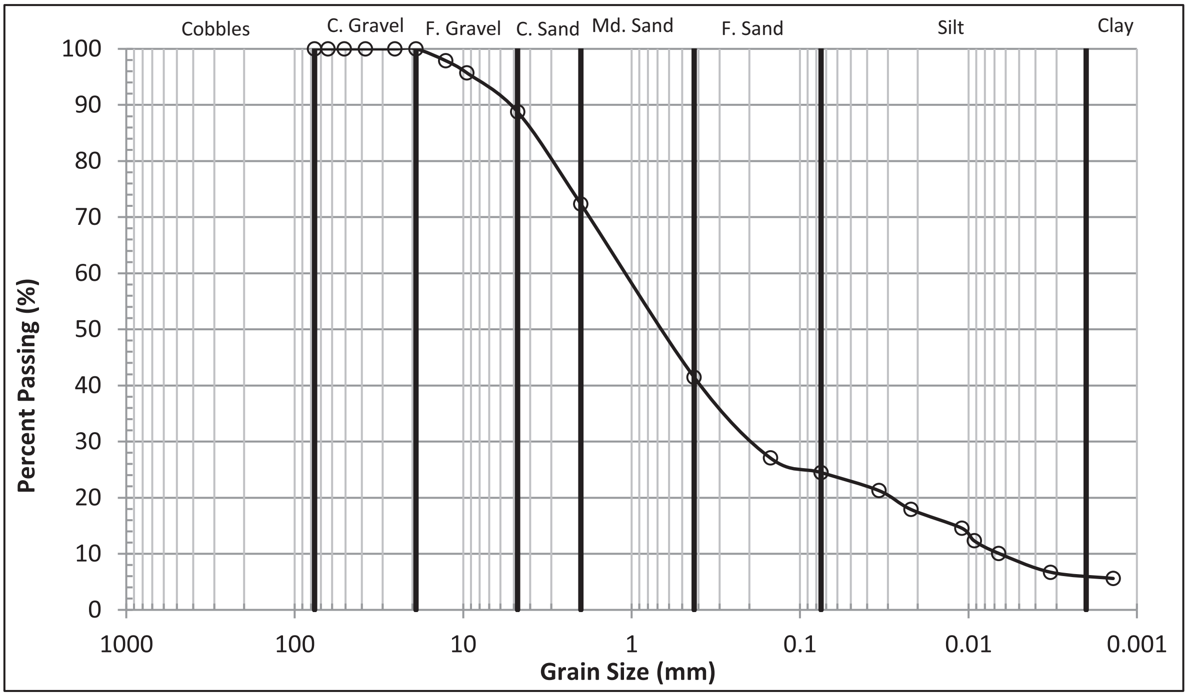
Soil Type: SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-3
Depth: 11-12'
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	97.89
3/8 "	9.53	95.74
# 4	4.75	88.76
# 10	2.00	72.35
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	41.47
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	27.07
# 200	0.075	24.47
Hydro	0.0340	21.26
Hydro	0.0220	17.90
Hydro	0.0109	14.55
Hydro	0.0092	12.31
Hydro	0.0066	10.07
Hydro	0.0033	6.71
Hydro	0.0014	5.60

Summary	
% Gravel =	11.2
% Sand =	64.3
% Fines =	24.5
Sum =	100.0

LL= ____
PL= ____
PI= ____

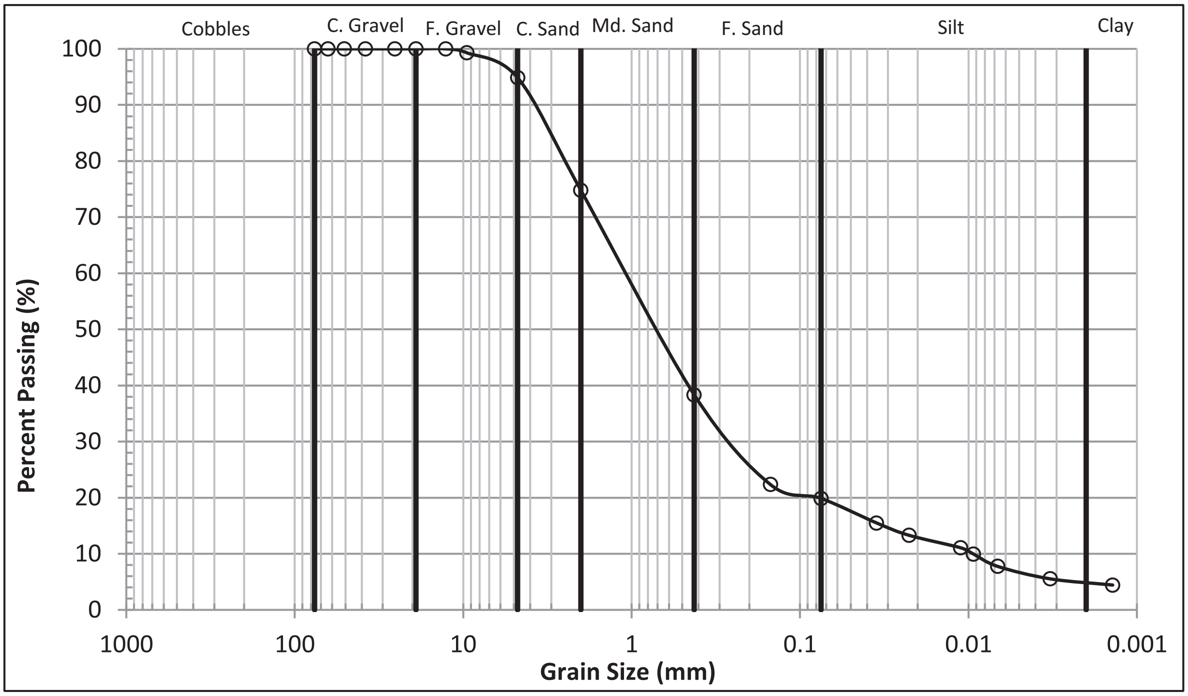
Soil Type: SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-3
Depth: 15-16 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	99.31
# 4	4.75	94.86
# 10	2.00	74.79
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	38.35
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	22.35
# 200	0.075	19.87
Hydro	0.0351	15.50
Hydro	0.0225	13.28
Hydro	0.0111	11.07
Hydro	0.0093	9.96
Hydro	0.0067	7.75
Hydro	0.0033	5.53
Hydro	0.0014	4.43

Summary	
% Gravel =	5.1
% Sand =	75.0
% Fines =	19.9
Sum =	100.0

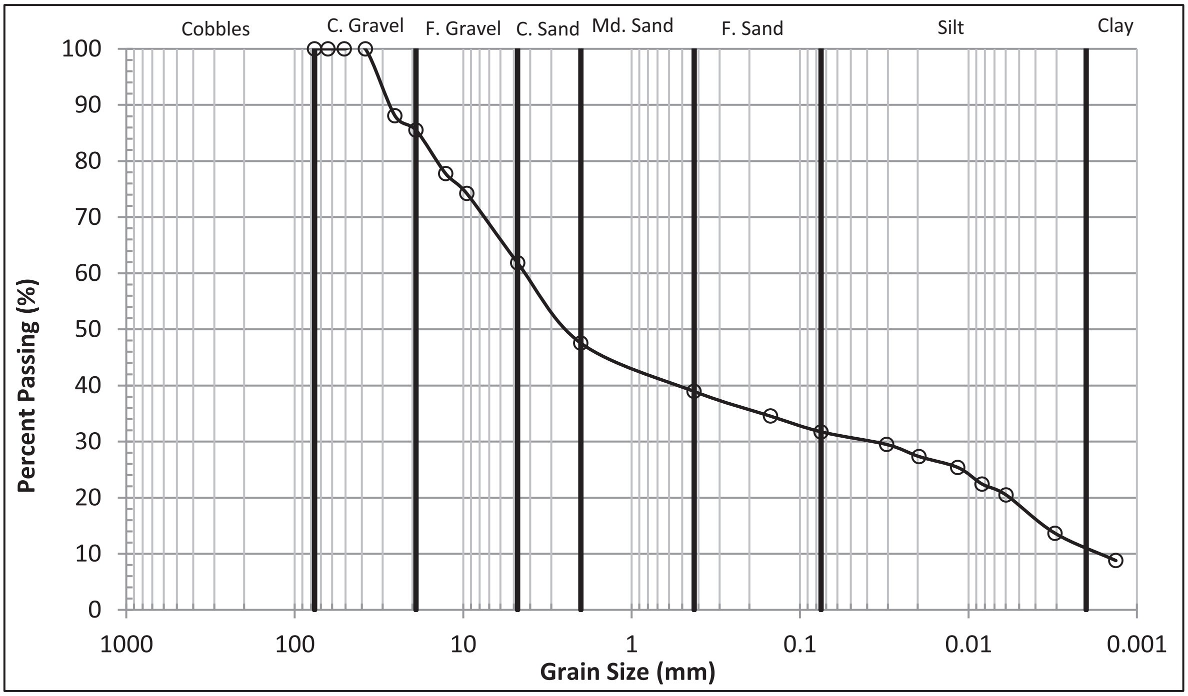
LL=
PL=
PI=

Soil Type: SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name:	Otay Village 14	Excavation:	BA-4
Location:	Proctor Valley Road, SD County	Depth:	18-19 '
Project No.:	1312-02	By:	HM
Date:	3/10/15		



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	88.07
3/4 "	19.05	85.52
1/2 "	12.70	77.76
3/8 "	9.53	74.24
# 4	4.75	61.86
# 10	2.00	47.54
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	38.93
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	34.54
# 200	0.075	31.74
Hydro	0.0306	29.48
Hydro	0.0197	27.33
Hydro	0.0116	25.38
Hydro	0.0083	22.45
Hydro	0.0060	20.50
Hydro	0.0031	13.66
Hydro	0.0013	8.78

Summary	
% Gravel =	38.1
% Sand =	30.1
% Fines =	31.7
Sum =	100.0

LL= ________

PL= ________

PI= ________

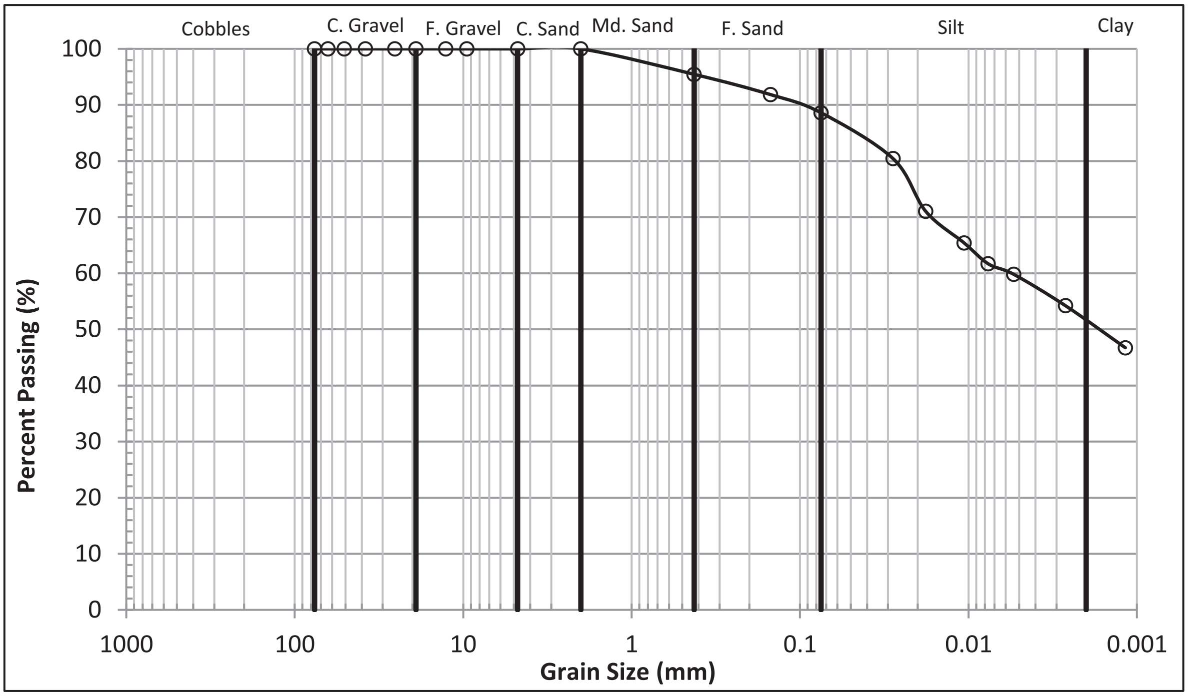
Soil Type: ________

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-4
Depth: 25-26 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	100.00
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	95.46
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	91.86
# 200	0.075	88.61
Hydro	0.0280	80.43
Hydro	0.0179	71.02
Hydro	0.0106	65.42
Hydro	0.0076	61.68
Hydro	0.0054	59.81
Hydro	0.0027	54.20
Hydro	0.0012	46.73

Summary	
% Gravel =	0.0
% Sand =	11.4
% Fines =	88.6
Sum =	100.0

LL= __________
PL= __________
PI= __________

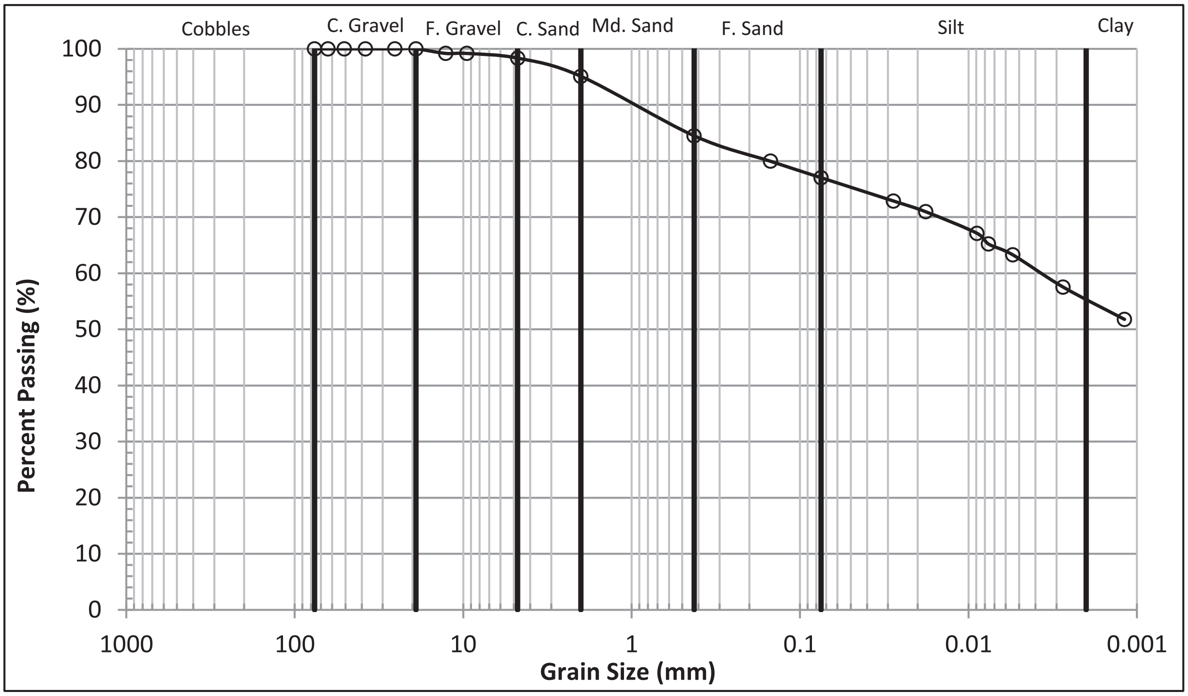
Soil Type: __________

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-4
Depth: 36-37 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	99.19
3/8 "	9.53	99.19
# 4	4.75	98.36
# 10	2.00	95.11
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	84.49
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	79.97
# 200	0.075	77.03
Hydro	0.0279	72.88
Hydro	0.0179	70.96
Hydro	0.0089	67.13
Hydro	0.0076	65.21
Hydro	0.0055	63.29
Hydro	0.0027	57.54
Hydro	0.0012	51.78

Summary	
% Gravel =	1.6
% Sand =	21.3
% Fines =	77.0
Sum =	100.0

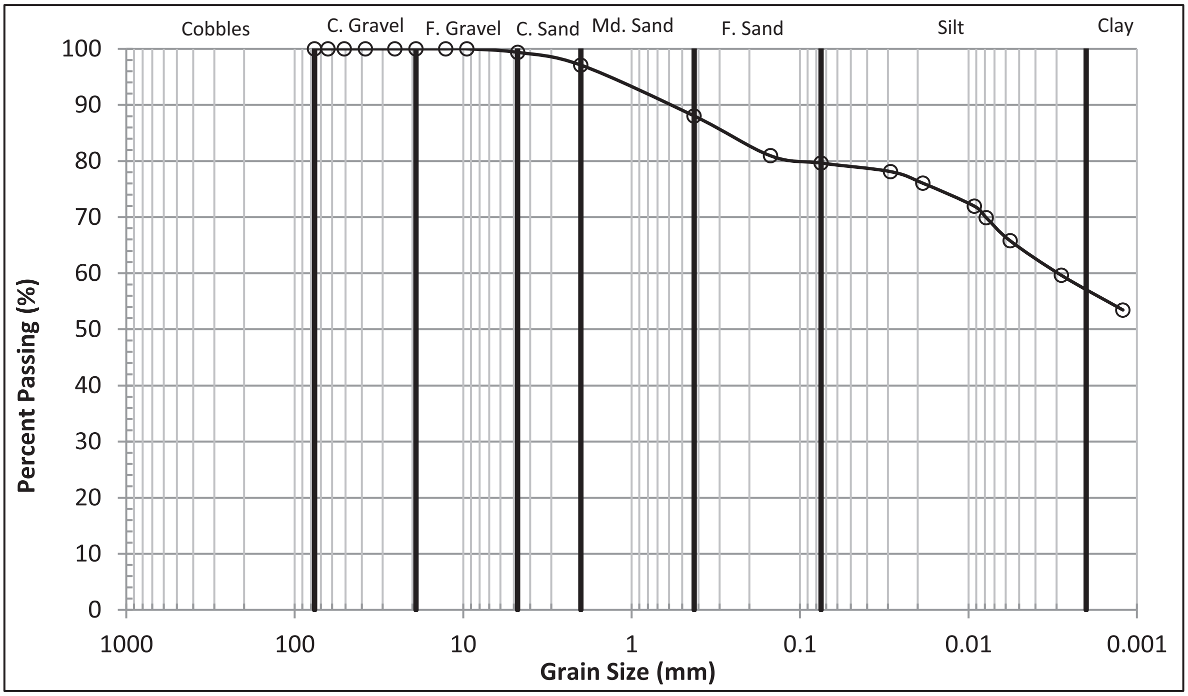
LL= ____________
PL= ____________
PI= ____________

Soil Type: ____________

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name:	Otay Village 14	Excavation:	BA-4
Location:	Proctor Valley Road, SD County	Depth:	52-53 '
Project No.:	1312-02	By:	H M
Date:	3/10/15		



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	99.38
# 10	2.00	97.10
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	88.04
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	80.95
# 200	0.075	79.63
Hydro	0.0291	78.12
Hydro	0.0187	76.07
Hydro	0.0092	71.95
Hydro	0.0078	69.90
Hydro	0.0057	65.79
Hydro	0.0028	59.62
Hydro	0.0012	53.45

Summary	
% Gravel =	0.6
% Sand =	19.7
% Fines =	79.6
Sum =	100.0

LL= ____________

PL= ____________

PI= ____________

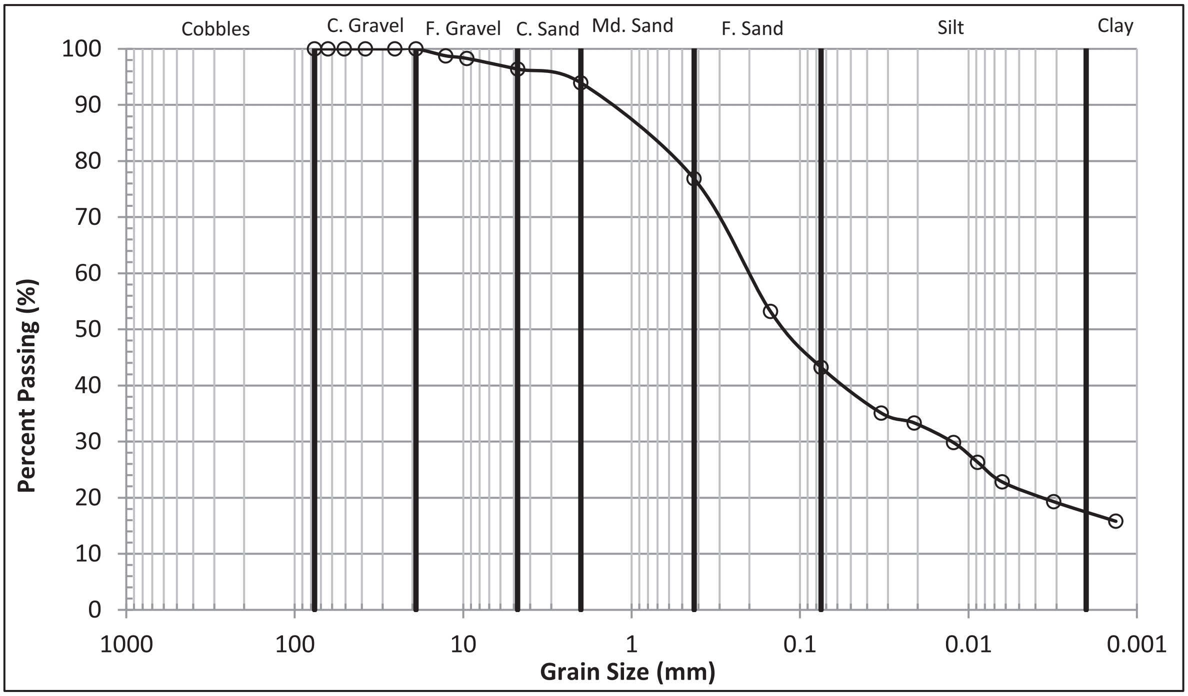
Soil Type: ____________

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-5
Depth: 10-11 '
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	98.77
3/8 "	9.53	98.30
# 4	4.75	96.39
# 10	2.00	93.94
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	76.84
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	53.22
# 200	0.075	43.23
Hydro	0.0329	35.08
Hydro	0.0210	33.33
Hydro	0.0123	29.82
Hydro	0.0088	26.31
Hydro	0.0063	22.80
Hydro	0.0031	19.30
Hydro	0.0013	15.79

Summary	
% Gravel =	3.6
% Sand =	53.2
% Fines =	43.2
Sum =	100.0

LL= ________
PL= ________
PI= ________

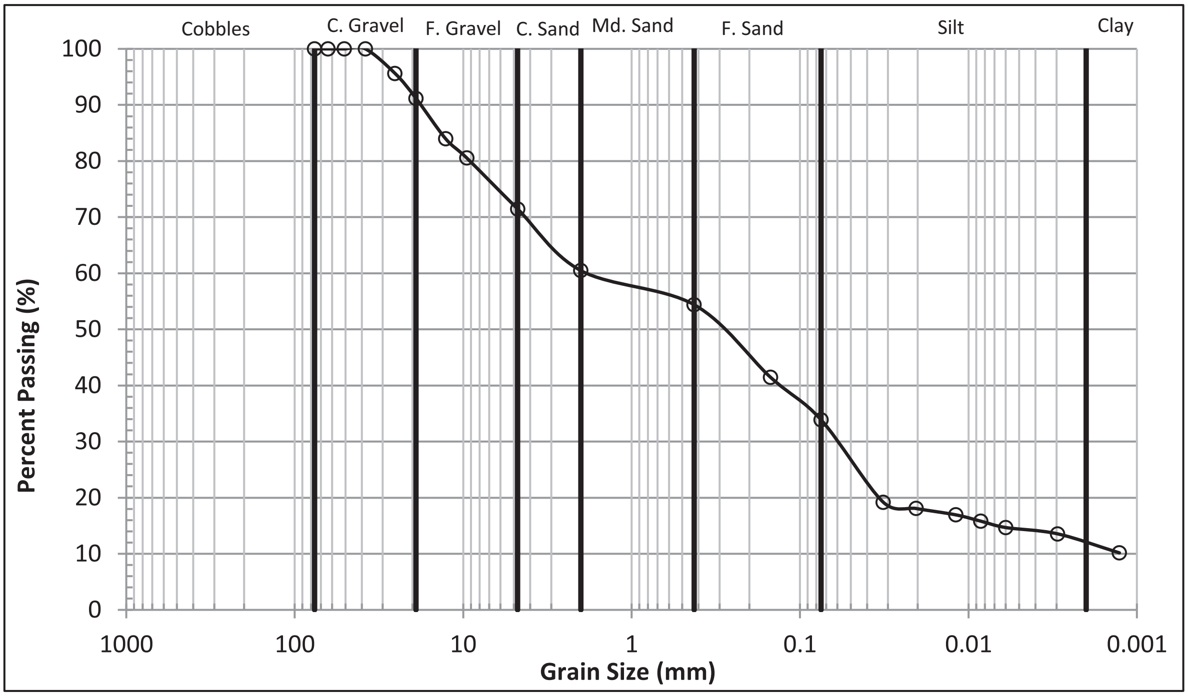
Soil Type: SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-5
Depth: 40'
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	95.64
3/4 "	19.05	91.19
1/2 "	12.70	83.97
3/8 "	9.53	80.56
# 4	4.75	71.47
# 10	2.00	60.47
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	54.39
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	41.48
# 200	0.075	33.89
Hydro	0.0321	19.20
Hydro	0.0204	18.07
Hydro	0.0119	16.94
Hydro	0.0084	15.81
Hydro	0.0060	14.68
Hydro	0.0030	13.55
Hydro	0.0013	10.16

Summary	
% Gravel =	28.5
% Sand =	37.6
% Fines =	33.9
Sum =	100.0

LL= ______
PL= ______
PI= ______

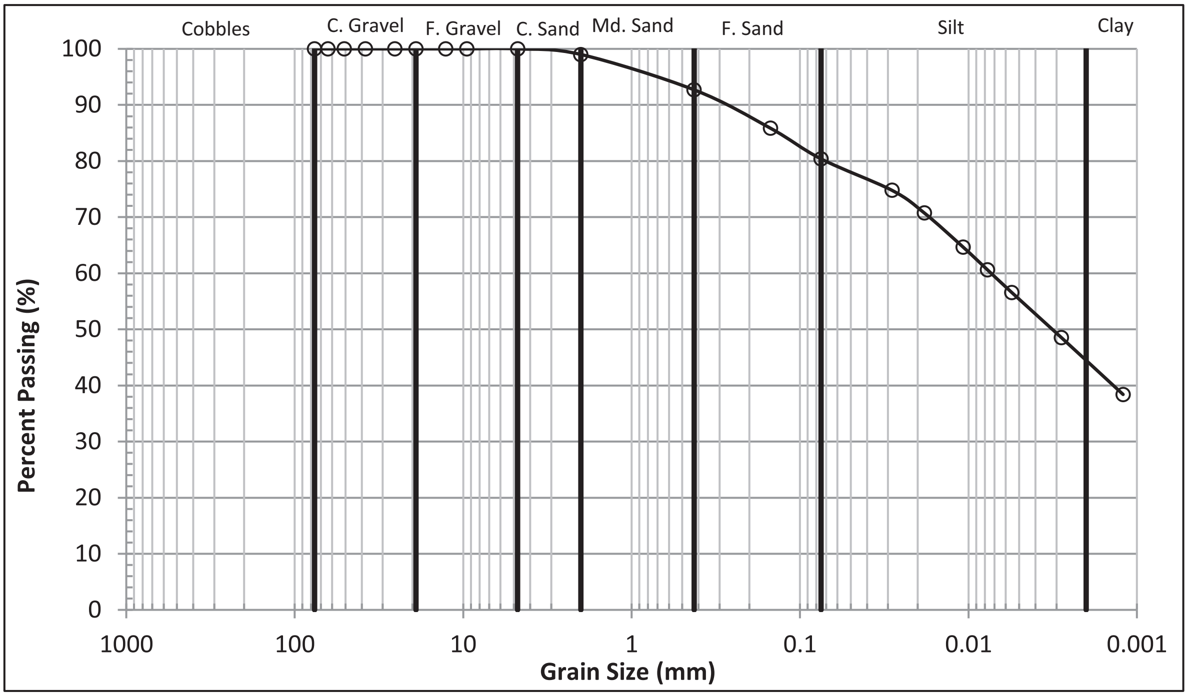
Soil Type: SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-5
Depth: 66-67
By: HM



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	100.00
3/8 "	9.53	100.00
# 4	4.75	100.00
# 10	2.00	99.00
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	92.69
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	85.86
# 200	0.075	80.38
Hydro	0.0284	74.78
Hydro	0.0183	70.74
Hydro	0.0108	64.67
Hydro	0.0077	60.63
Hydro	0.0055	56.59
Hydro	0.0028	48.51
Hydro	0.0012	38.40

Summary	
% Gravel =	0.0
% Sand =	19.6
% Fines =	80.4
Sum =	100.0

LL= ____________
PL= ____________
PI= ____________

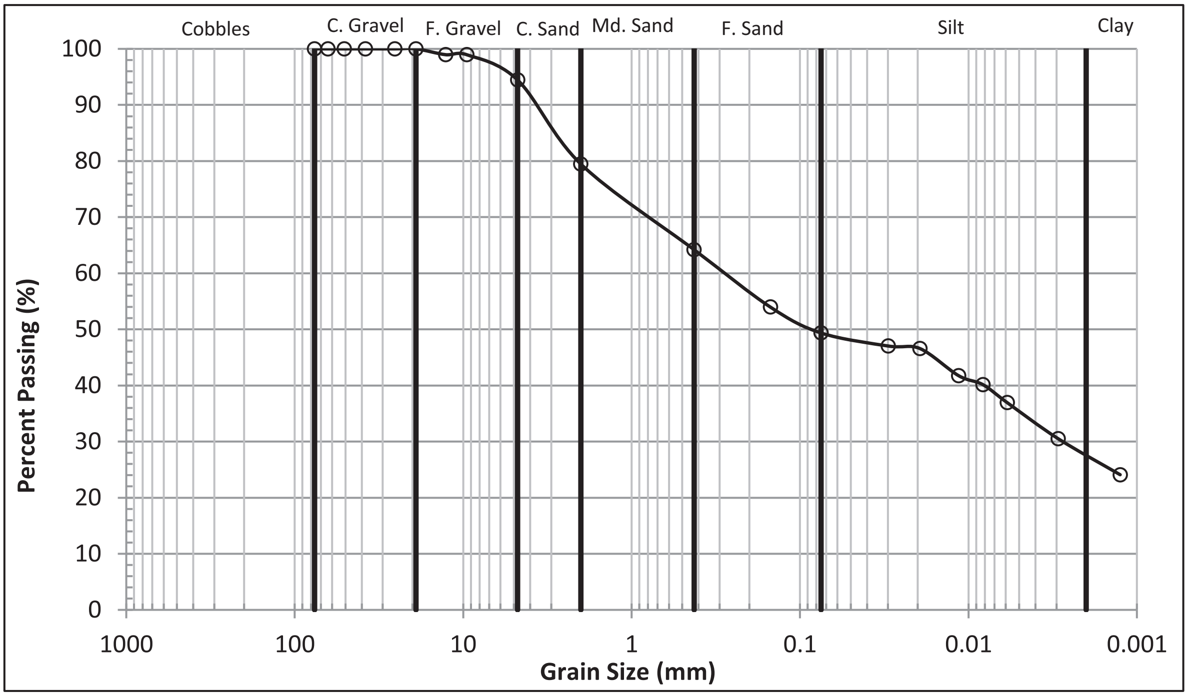
Soil Type: ____________

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

PARTICLE SIZE ANALYSIS - ASTM D422

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
Project No.: 1312-02
Date: 3/10/15

Excavation: BA-8
Depth: 15-16'
By: H M



Grain Size (in/#)	Grain Size (mm)	Amount Passing (%)
3 "	76.20	100.00
2 1/2 "	63.50	100.00
2 "	50.80	100.00
1 1/2 "	38.10	100.00
1 "	25.40	100.00
3/4 "	19.05	100.00
1/2 "	12.70	98.96
3/8 "	9.53	98.96
# 4	4.75	94.45
# 10	2.00	79.46
# 20	0.85	#N/A
# 30	0.60	#N/A
# 40	0.425	64.19
# 50	0.30	#N/A
# 60	0.212	#N/A
# 100	0.15	53.97
# 200	0.075	49.36
Hydro	0.0299	47.03
Hydro	0.0194	46.57
Hydro	0.0115	41.75
Hydro	0.0082	40.15
Hydro	0.0059	36.94
Hydro	0.0029	30.51
Hydro	0.0013	24.09

Summary	
% Gravel =	5.5
% Sand =	45.1
% Fines =	49.4
Sum =	100.0

LL= ________
PL= ________
PI= ________

Soil Type: SC-SM

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

EXPANSION INDEX - ASTM D4829

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
File No: 1312-02
Date:

Excavation: BA-3
Depth: 12 '
Description: Very Light Brown Clayey Sand
By: HM

Sample Date:	1/29/15	By:	FE
Submittal Date:	2/14/15	By:	PWM
Test Date:		By:	HM

Expansion Index - ASTM D4829	
Initial Dry Density (pcf):	112.5
Initial Moisture Content (%):	9.0
Initial Saturation (%):	48.8
Final Dry Density (pcf):	107.5
Final Moisture Content (%):	18.4
Final Saturation (%):	99.6
Expansion Index:	36
Potential Expansion:	Low

ASTM D4829 - Table 5.3	
Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

EXPANSION INDEX - ASTM D4829

Project Name: Otay Village 14
Location: Proctor Valley Road, SD County
File No: 1312-02
Date:

Excavation: BA-4
Depth: 26 '
Description: Olive Brown Sandy Clay
By: H-M

Sample Date:	1/30/15	By:	FE
Submittal Date:	2/14/15	By:	PWM
Test Date:		By:	HM

Expansion Index - ASTM D4829

Initial Dry Density (pcf):	93.7
Initial Moisture Content (%):	15.0
Initial Saturation (%):	50.7
Final Dry Density (pcf):	94.5
Final Moisture Content (%):	28.6
Final Saturation (%):	96.7
Expansion Index:	113
Potential Expansion:	High

ASTM D4829 - Table 5.3	
Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

EXPANSION INDEX - ASTM D4829

Project Name:	Proctor Valley Villages	Excavation/Tract:	T-7/16-19
Location:	Chula Vista	Depth/Lot:	1-2 ft
P/W:	1312-02	Description:	Brown SC-SM
Date:	1/5/17	By:	FV

Expansion Index - ASTM D4829	
Initial Dry Density (pcf):	111.3
Initial Moisture Content (%):	9.7
Initial Saturation (%):	51.0
Final Dry Density (pcf):	111.3
Final Moisture Content (%):	18.3
Final Saturation (%):	96.3
Expansion Index:	0
Potential Expansion:	Very Low

ASTM D4829 - Table 5.3	
Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

EXPANSION INDEX - ASTM D4829

Project Name:	Proctor Valley Villages	Excavation/Tract:	T-15/16-19
Location:	Chula Vista	Depth/Lot:	4-10 ft
P/W:	1312-02	Description:	Brown SC-SM
Date:	1/5/17	By:	FV

Expansion Index - ASTM D4829	
Initial Dry Density (pcf):	112.3
Initial Moisture Content (%):	9.5
Initial Saturation (%):	51.3
Final Dry Density (pcf):	109.9
Final Moisture Content (%):	19.2
Final Saturation (%):	97.2
Expansion Index:	22
Potential Expansion:	Low

ASTM D4829 - Table 5.3	
Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

EXPANSION INDEX - ASTM D4829

Project Name:	Otay Village 14	Excavation:	BA-5
Location:	Proctor Valley Road, SD County	Depth:	20 '
File No:	1312-02	Description:	Very Lt Brown to White Silty/Clayey Sand w/ Gravel & Sandstone
Date:		By:	H-M

Sample Date:	1/30/15	By:	FE
Submittal Date:	2/14/15	By:	PWM
Test Date:		By:	HM

Expansion Index - ASTM D4829

Initial Dry Density (pcf):	109.5
Initial Moisture Content (%):	10.0
Initial Saturation (%):	50.2
Final Dry Density (pcf):	103.1
Final Moisture Content (%):	19.9
Final Saturation (%):	99.7
Expansion Index:	25
Potential Expansion:	Low

ASTM D4829 - Table 5.3

Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

DATE: 4/7/15

AGS
2842 Walnut Avenue, Suite C-1
Tustin, CA 92780

P.O. NO.: Verbal

LAB NO.: B-8193

SPECIFICATION: CA-417/422/643

Attn: Sean Donovan

MATERIAL: Soil

J.N.: 1312-02
Project: Otay Village 14
Date sampled: 02/24/15

ANALYTICAL REPORT

CORROSION SERIES
SUMMARY OF DATA

	PH	SOLUBLE SULFATES per CA. 417 ppm	SOLUBLE CHLORIDES per CA. 422 ppm	MIN. RESISTIVITY per CA. 643 ohm-cm
BA-1@45-46’	7.1	975	1,472	430
BA-4@26-27’	6.8	593	1,472	340
EX-13@7-8’	7.1	1,078	1,702	360

RESPECTFULLY SUBMITTED

WES BRIDGER CHEMIST

ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

TO:
AGS
2842 Walnut Avenue, Suite C-1
Tustin, CA 92780

DATE: 3/30/15

P.O. NO.: Chain of Custody

LAB NO.: B-8151

SPECIFICATION: CA 301

MATERIAL: Soil

Project #: 1312-02
Otay Vil.4

ANALYTICAL REPORT

"R" VALUE

	BY EXUDATION	BY EXPANSION
1) BA-3 @ 13' Brown, F.M. Sandy Clay	32	23
2) EX-13 @ 18' Brown, Clay	15	6

RESPECTFULLY SUBMITTED

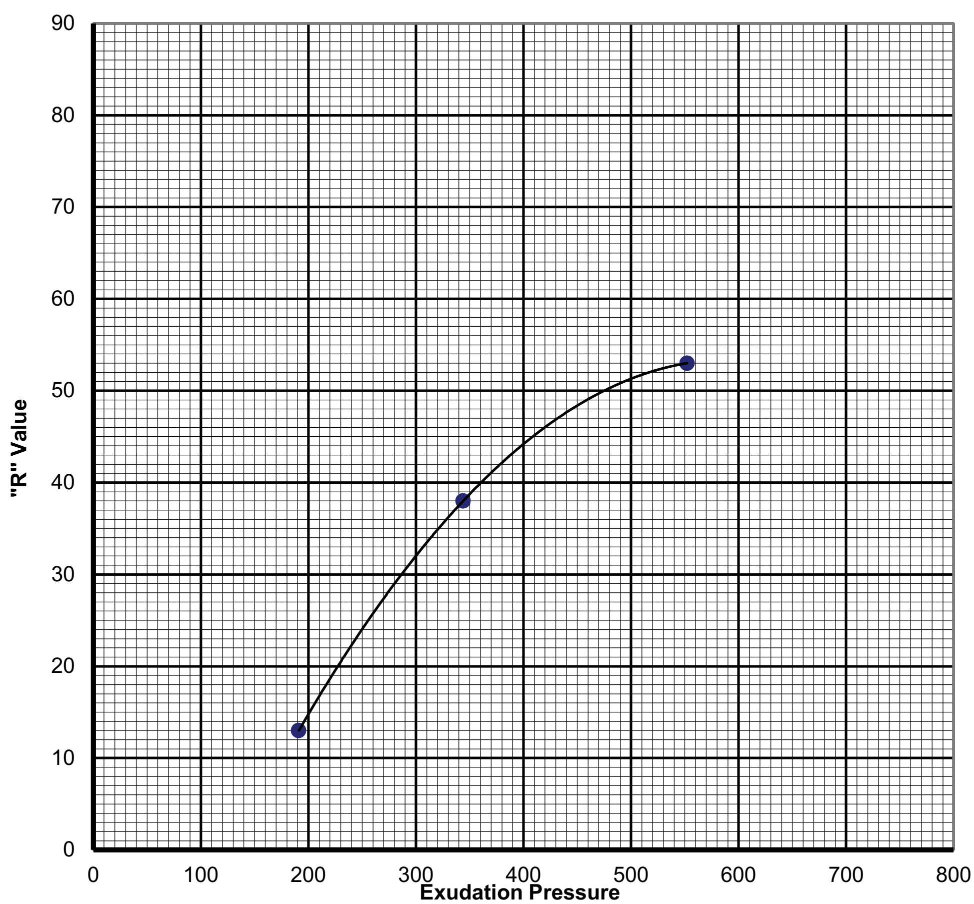
WES BRIDGER CHEMIST

"R" VALUE CA 301

Client: AGS **ATL No.:** B 8151-1 **Date:** 3/30/2015
Client Reference No.: 1312-02
Sample: BA-3 @ 13' **Soil Type:** Brown, F.M. Sandy Clay

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	60	150	100	
Initial Moisture Content	%	3.4	3.4	3.4	
Moisture at Compaction	%	14.6	12.9	13.7	
Briquette Height	in.	2.52	2.49	2.47	
Dry Density	pcf	113.7	117.7	114.9	
EXUDATION PRESSURE	psi	191	552	344	
EXPANSION dial	(x .0001)	15	63	44	
Ph at 1000 pounds	psi	55	28	38	
Ph at 2000 pounds	psi	125	58	79	
Displacement	turns	4.6	3.84	4.21	
"R" Value		13	53	38	
CORRECTED "R" VALUE		13	53	38	

Final "R" Value	
BY EXUDATION: @ 300 psi	**32**
BY EXPANSION: TI = 5.0	**23**

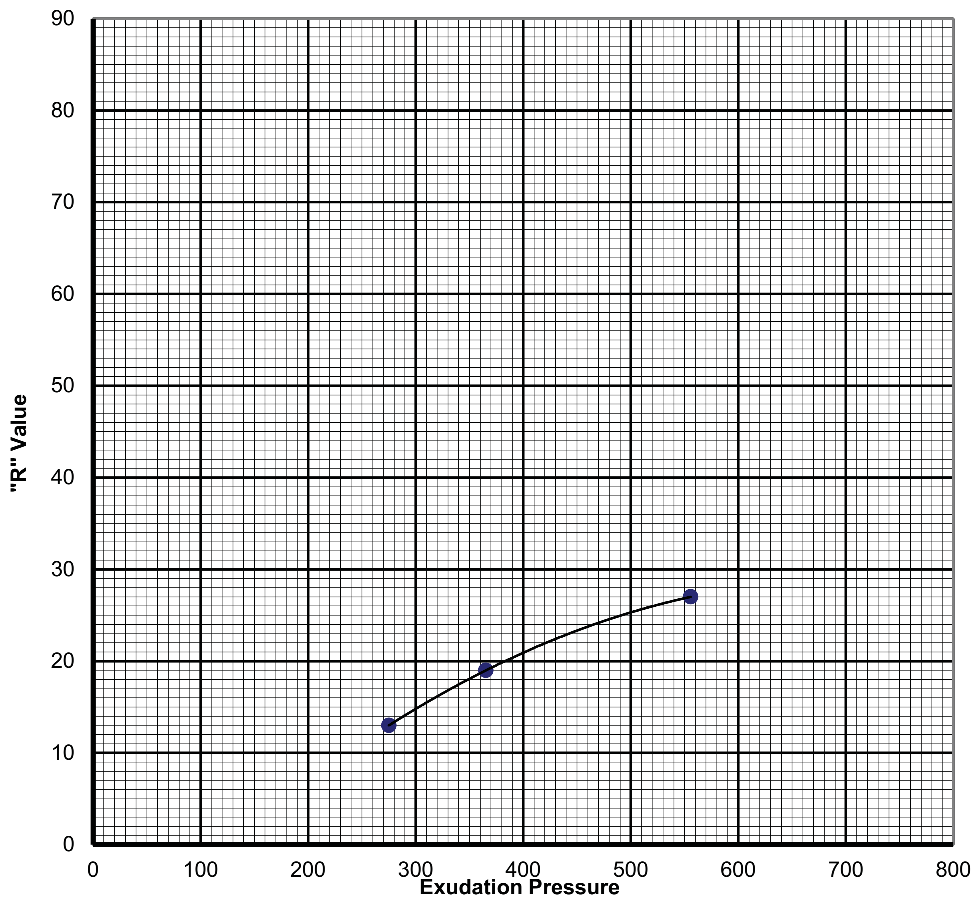


"R" VALUE CA 301

Client: AGS **ATL No.:** B 8151-2 **Date:** 3/30/2015
Client Reference No.: 1312-02
Sample: EX-13 @ 18' **Soil Type:** Brown, Clay

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	100	60	150	
Initial Moisture Content	%	25.5	25.5	25.5	
Moisture at Compaction	%	32.8	34.9	30.8	
Briquette Height	in.	2.45	2.50	2.50	
Dry Density	pcf	85.0	82.8	88.3	
EXUDATION PRESSURE	psi	365	275	556	
EXPANSION dial	(x .0001)	53	42	68	
Ph at 1000 pounds	psi	43	62	31	
Ph at 2000 pounds	psi	120	130	107	
Displacement	turns	3.65	3.9	3.39	
"R" Value		19	13	27	
CORRECTED "R" VALUE		19	13	27	

Final "R" Value	
BY EXUDATION: @ 300 psi	**15**
BY EXPANSION: TI = 5.0	**6**



Preparation
2.43" Ring

Remolding Soil Sample

Equation		
Maximum Dry Density		115
Moisture %		12
Dry Density	90 % Of Max D.D.	103.5
Ring Volume	Cubic Meters	1.2178
(1.2866)(D.D) (100+Moist)		141.17

Wt. Wet Soil + Tere	g	125
Wt. Wet Dry + Tere	g	117.2
Wt of Tere	g	47.6
Moisture Lost	g	7.8
Dry Soil	g	69.6
Moisture	%	11.21

Equation		
Maximum Dry Density		115
Moisture %		11.2
Dry Density	90 % Of Max D.D.	103.5
Ring Volume		1.2178
(1.2685)(D.D) (100+Moist)		140.16

Total Soil For 4 Rings	g	560.6
Bowl	g	370.2
Total Mix Before Water Added	g	930.8
Total Mix For 4 Rings+ Bowl	g	934.9
Total Water added	g	**4.0**
Total Mix	g	**934.9**

ADVANCED GEOTECHNICAL SOLUTION, INC.

Excavation:	EX 11	Project Name:	Otay Village
Depth:	9-10 '		
Date:	3/28/2015		

Preparation
2.43" Ring

Remolding Soil Sample

Equation		
Maximum Dry Density		122
Moisture %		13
Dry Density	90 % Of Max D.D.	109.8
Ring Volume	Cubic Meters	1.2178
(1.2866)(D.D) (100+Moist)		151.10

Wt. Wet Soil + Tere	g	125
Wt. Wet Dry + Tere	g	117.2
Wt of Tere	g	47.6
Moisture Lost	g	7.8
Dry Soil	g	69.6
Moisture	%	11.21

Equation		
Maximum Dry Density		115
Moisture %		11.2
Dry Density	90 % Of Max D.D.	103.5
Ring Volume		1.2866
(1.2685)(D.D) (100+Moist)		148.08

Total Soil For 4 Rings	g	592.3
Bowl	g	370.2
Total Mix Before Water Added	g	962.5
Total Mix For 4 Rings+ Bowl	g	974.6
Total Water added	g	**12.1**
Total Mix	g	**974.6**

Excavation:	BA-2	Project:	Otay Village
Depth:	1-2 '		
Date:	3/28/2015		

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

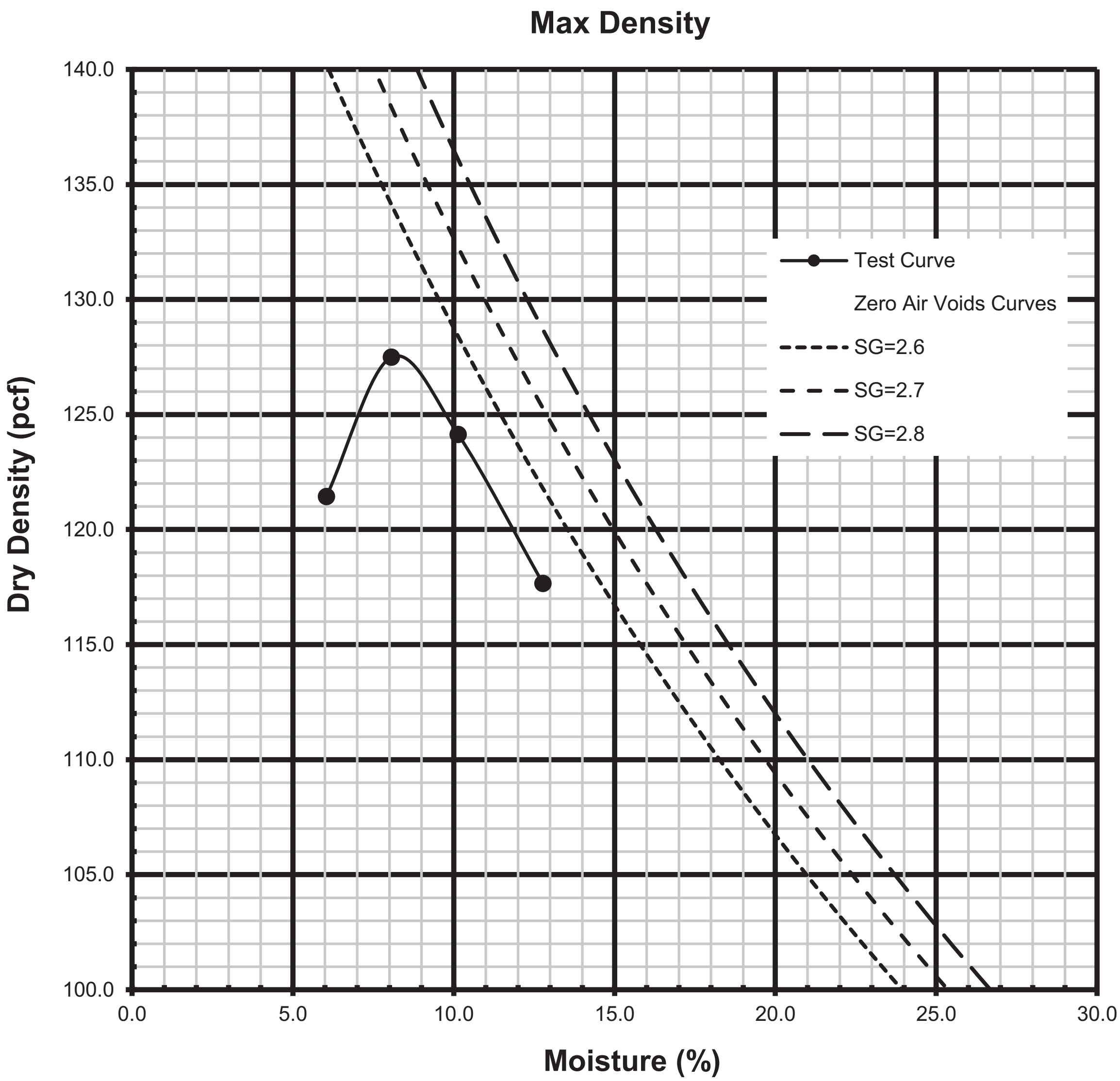
Project Name: Proctor Valley 16-19
Location: Chula Vista
Project No.: 1312-02
Date: 1/4/17

Excavation: T-10
Depth: 0-4 ft
Description: Brown SC-SM
Project Manager JC
By: FV

Method: C

Rock Coreection 3.5530342

Test Number	1	2	3	4
Dry Density (pcf)	121.4	127.5	124.1	117.7
Moisture Content (%)	6.0	8.1	10.1	12.8



Maximum Density **127.5** pcf

Optimum Moisture **8.5** %

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

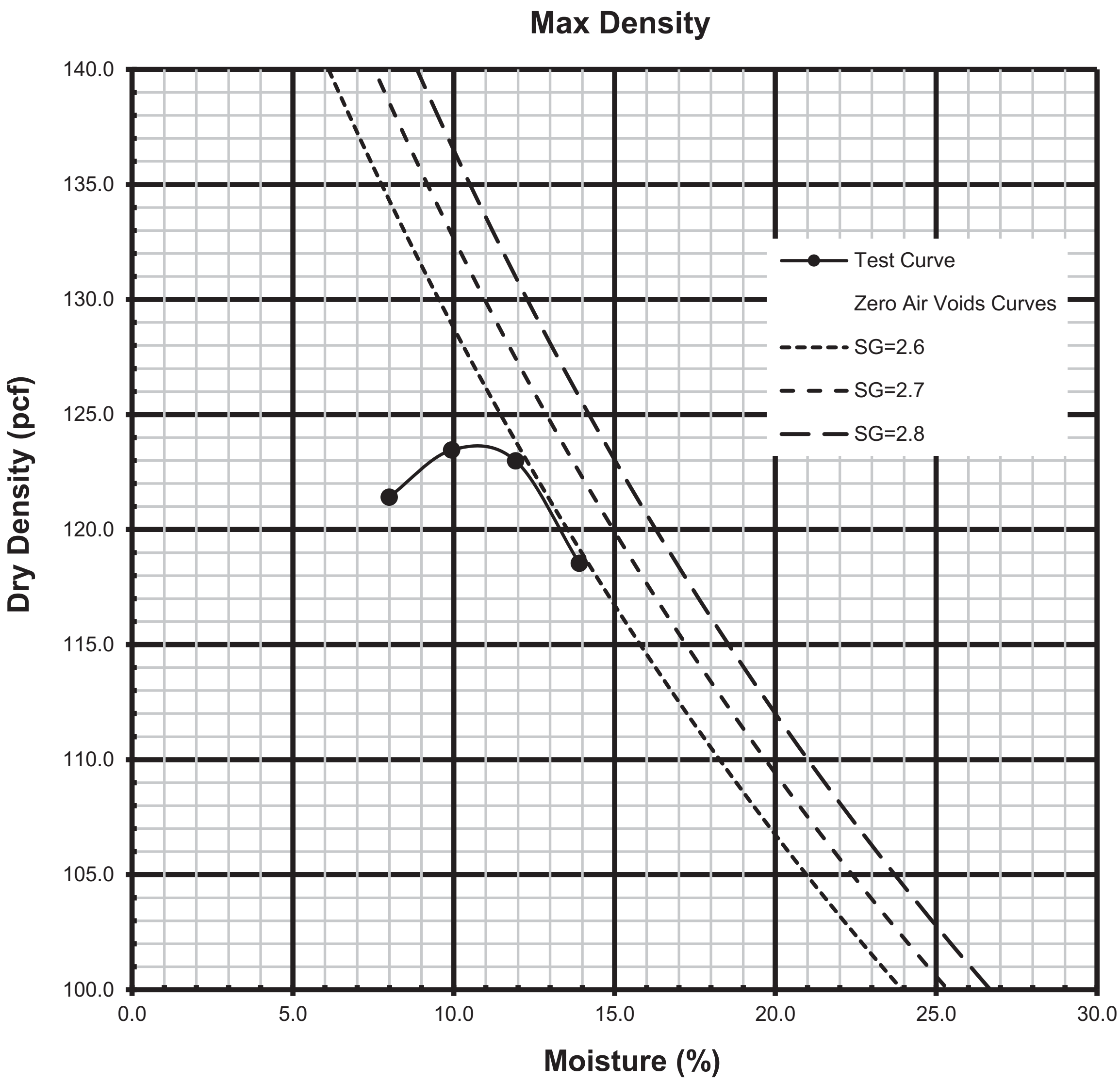
Project Name: Proctor Valley 16-19
Location: Chula Vista
Project No.: 1312-02
Date: 1/4/17

Excavation: T-7
Depth: 1-2 ft
Description: Reddish Brn. SC-SM
Project Manager JC
By: FV

Method: A

Rock Coreection 36.7

Test Number	1	2	3	4
Dry Density (pcf)	121.4	123.5	123.0	118.5
Moisture Content (%)	8.0	9.9	11.9	13.9



Maximum Density **123.5** pcf

Optimum Moisture **11.0** %

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

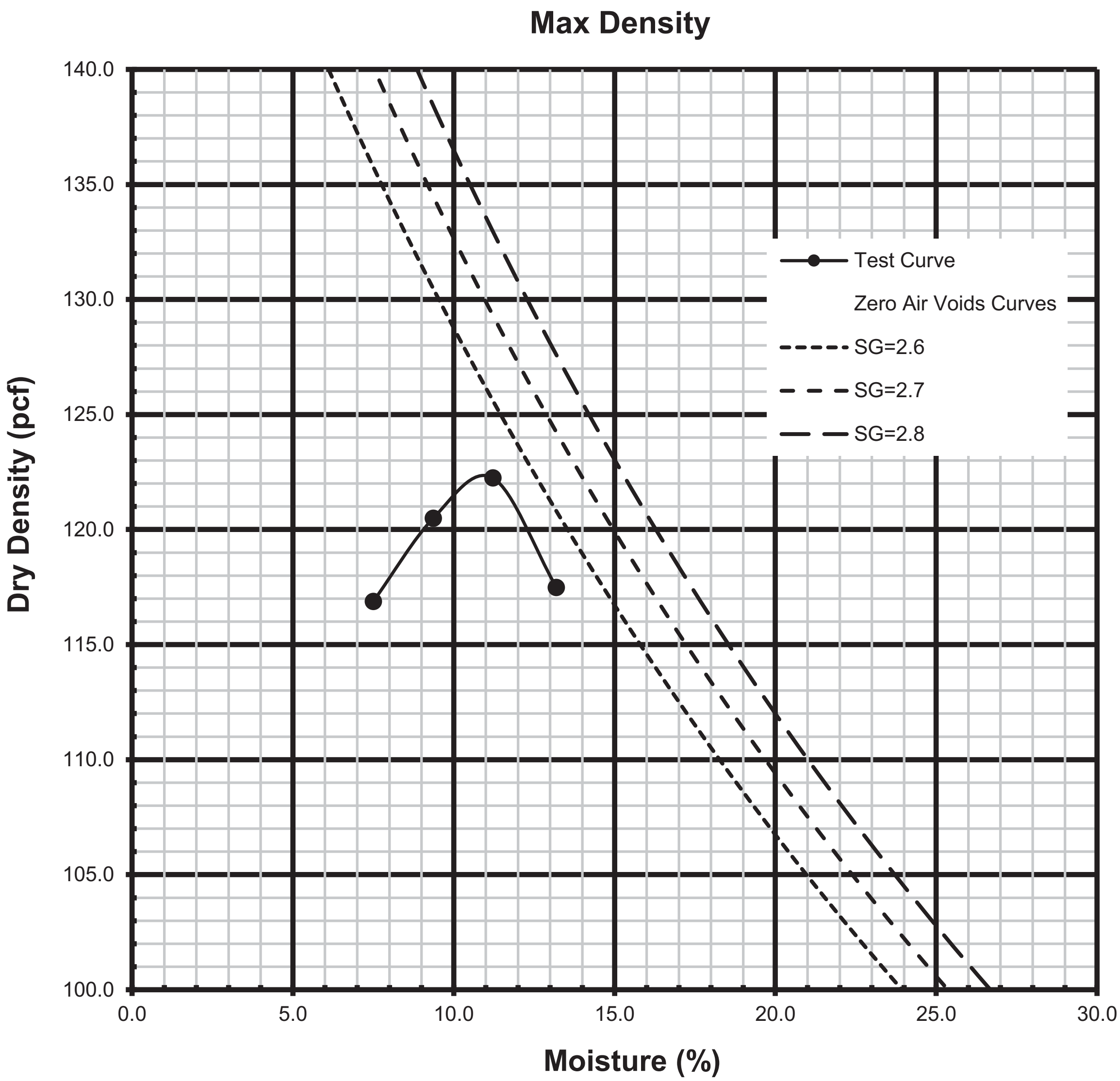
Project Name: Proctor Valley 16-19
Location: Chula Vista
Project No.: 1312-02
Date: 1/4/17

Excavation: T-15
Depth: 2-4 ft
Description: Reddish Brn. SC-SM
Project Manager JC
By: FV

Method: C

Rock Coreection 9.4

Test Number	1	2	3	4
Dry Density (pcf)	116.9	120.5	122.2	117.5
Moisture Content (%)	7.5	9.4	11.2	13.2



Maximum Density **122.5** pcf

Optimum Moisture **11.0** %

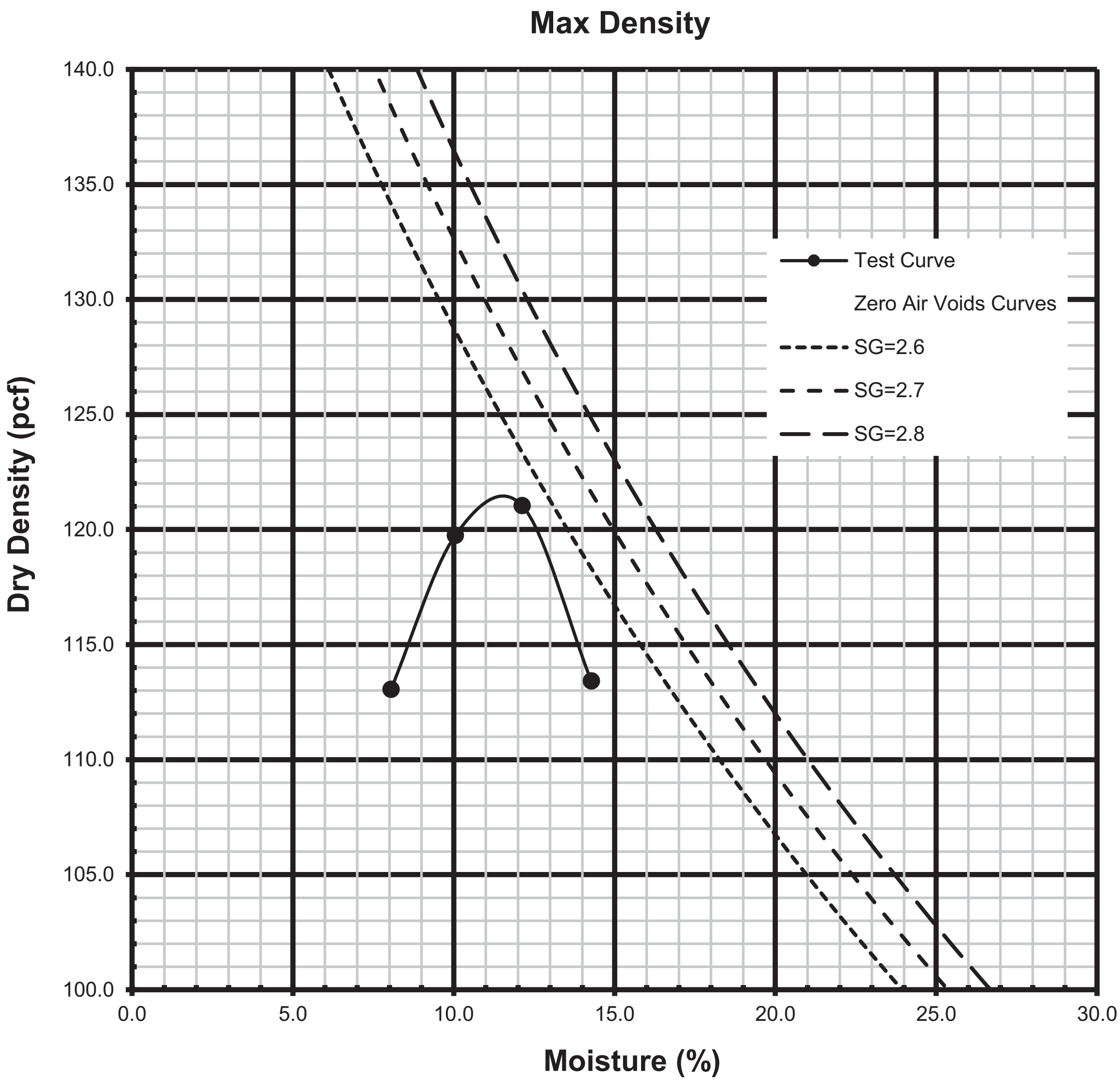
ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

Project Name:	Proctor Valley 16-19	Excavation:	T-13
Location:	Chula Vista	Depth:	1-3 ft
Project No.:	1312-02	Description:	Brown SC
Date:	42725	Project Manager	SD
		By:	JW

Method: C   Rock Coreection 0.491635

Test Number	1	2	3	4
Dry Density (pcf)	113.1	119.7	121.0	113.4
Moisture Content (%)	8.0	10.1	12.1	14.3



Maximum Density **121.5** pcf   Optimum Moisture **11.5** %

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

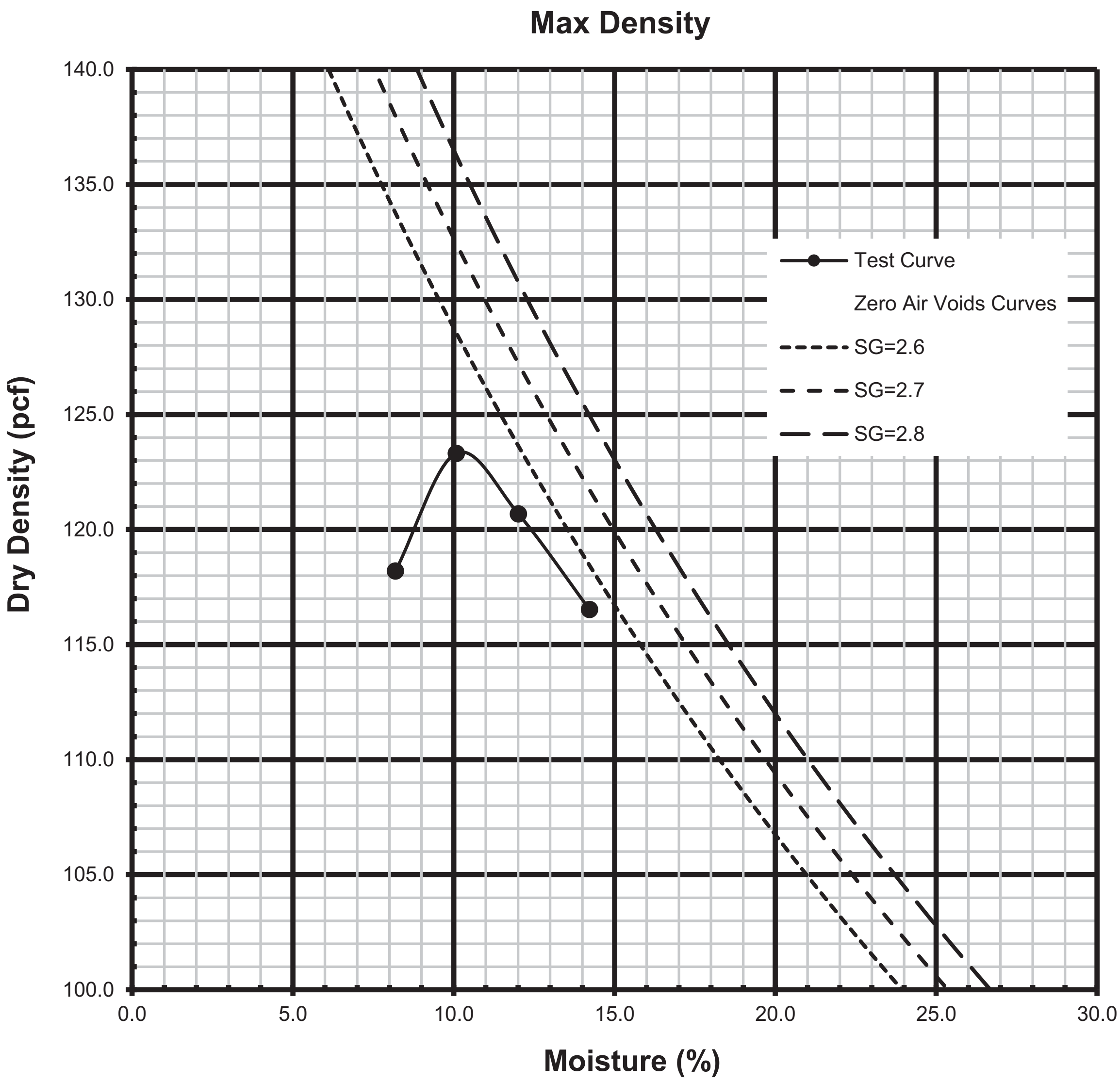
Project Name: Proctor Valley 16-19
Location: Chula Vista
Project No.: 1312-02
Date: 42724

Excavation: T-2
Depth: 1-2 ft
Description: Light Brn. CL-ML
Project Manager JC
By: JW/FV

Method: A

Rock Coreection 2.8548644

Test Number	1	2	3	4
Dry Density (pcf)	118.2	123.3	120.7	116.5
Moisture Content (%)	8.2	10.1	12.0	14.2



Maximum Density **123.0** pcf

Optimum Moisture **10.5** %

Advanced Geotechnical Solutions, Inc.

MAXIMUM DENSITY

ASTM D-1557

Project Name: **Otay Village 14**
Location:
File No: **1312-02**
Date: 3/3/2015

Excavation: EX-11
Depth: 9-10 '
Description: Yellowish, White, Mixtur of Sand Clay, and Sand Stone

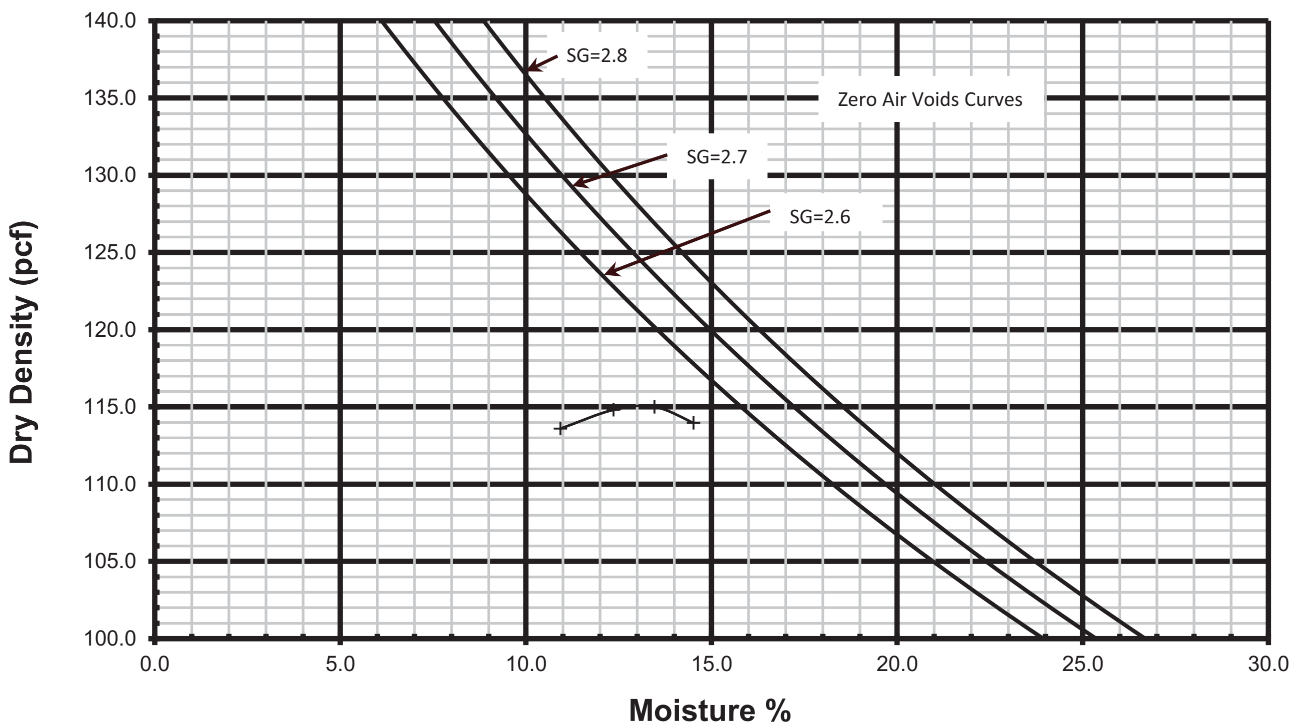
Sieve Size: 4
Mold Size: 4 "
No. of Layers: 5

% Retained: None
Method: A

By: H-M

Test point number		1	2	3	4		
Wt. wet soil + mold	g						
Wt. wet soil + mold	lbs	8.30	8.40	8.45	8.45		
Wt. of mold	lbs	4.10	4.10	4.10	4.10		
Wt. wet of soil	lbs	4.20	4.30	4.35	4.35		
Wet density	pcf	126.00	129.00	130.50	130.50		
Dry density	pcf	113.59	114.81	115.02	113.96		
Moisture Determination (Oven)							
Container number		5	12	41	52		
Wt. wet of soil+tare	g	257.6	244.3	264.9	248.8		
Dry wt. soil+tare	g	233.1	218.4	234.5	218.4		
Tare wt.	g	8.8	8.8	8.7	8.9		
Wt. of moisture	g	24.50	25.90	30.40	30.40		
Dry wt. of soil	g	224.30	209.60	225.80	209.50		
Moisture Content	g	10.92	12.36	13.46	14.51		

Max Density



Maximum Density **115.0** pcf   Optimum Moisture **13.0** %

Advanced Geotechnical Solutions, Inc.

MAXIMUM DENSITY

ASTM D-1557

Project Name: **Otay Village 14**
Location:
File No: **1312-02**
Date: 2/27/2015

Excavation: BA-5
Depth: 20 "
Description: Light Brown Mixtur of Sand, Gravel, Rock Clay, and Sand Stone

Sieve Size 3/4 "
Mold Size 6 "
No. of Layers 5

% Retained 15
Method A

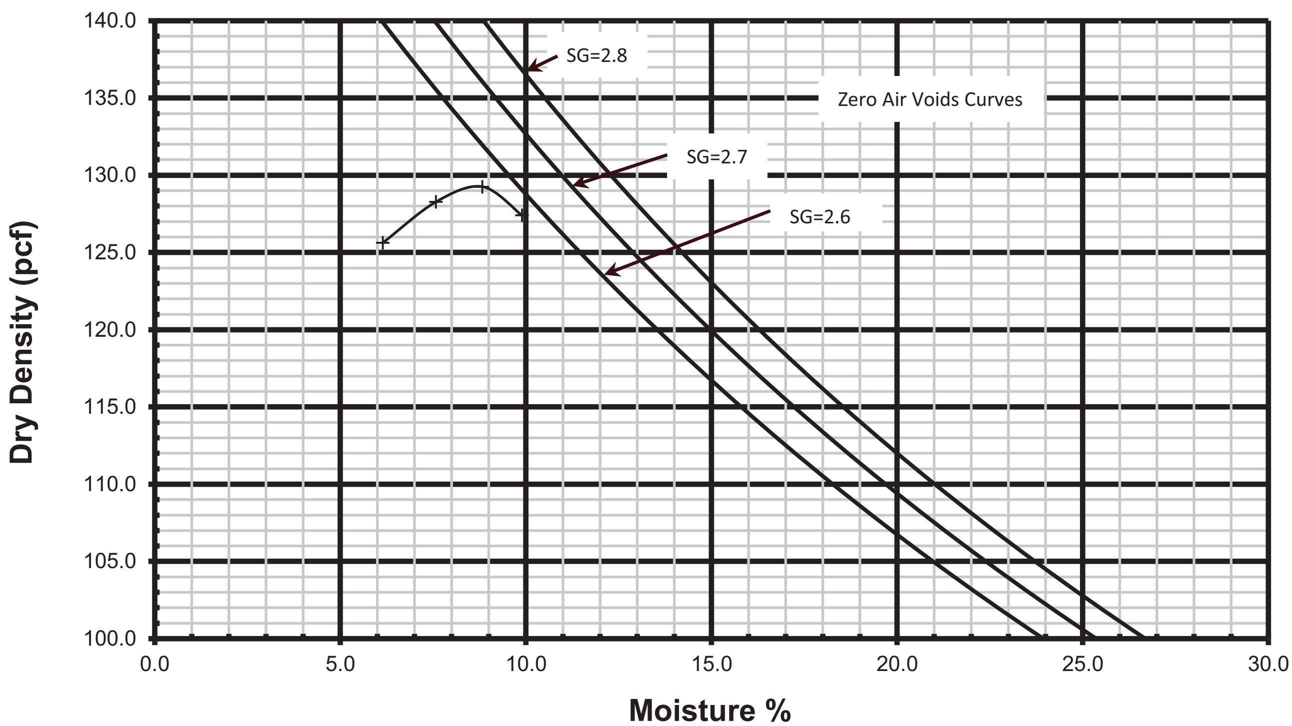
By: H-M

Test point number		1	2	3	4		
Wt. wet soil + mold	g						
Wt. wet soil + mold	lbs	16.00	16.35	16.55	16.50		
Wt. of mold	lbs	6.00	6.00	6.00	6.00		
Wt. wet of soil	lbs	10.00	10.35	10.55	10.50		
Wet density	pcf	133.33	138.00	140.67	140.00		
Dry density	pcf	125.62	128.28	129.26	127.40		

Moisture Determination (Oven)

Container number		55	74	28	11		
Wt. wet of soil+tare	g	745.2	752.6	689.4	704.5		
Dry wt. soil+tare	g	702.6	700.2	634.2	641.9		
Tare wt.	g	8.8	8.6	8.7	8.9		
Wt. of moisture	g	42.60	52.40	55.20	62.60		
Dry wt. of soil	g	693.80	691.60	625.50	633.00		
Moisture Content	g	6.14	7.58	8.82	9.89		

Max Density



Maximum Density **129.0** pcf Optimum Moisture **8.5** %

Advanced Geotechnical Solutions, Inc.

MAXIMUM DENSITY

ASTM D-1557

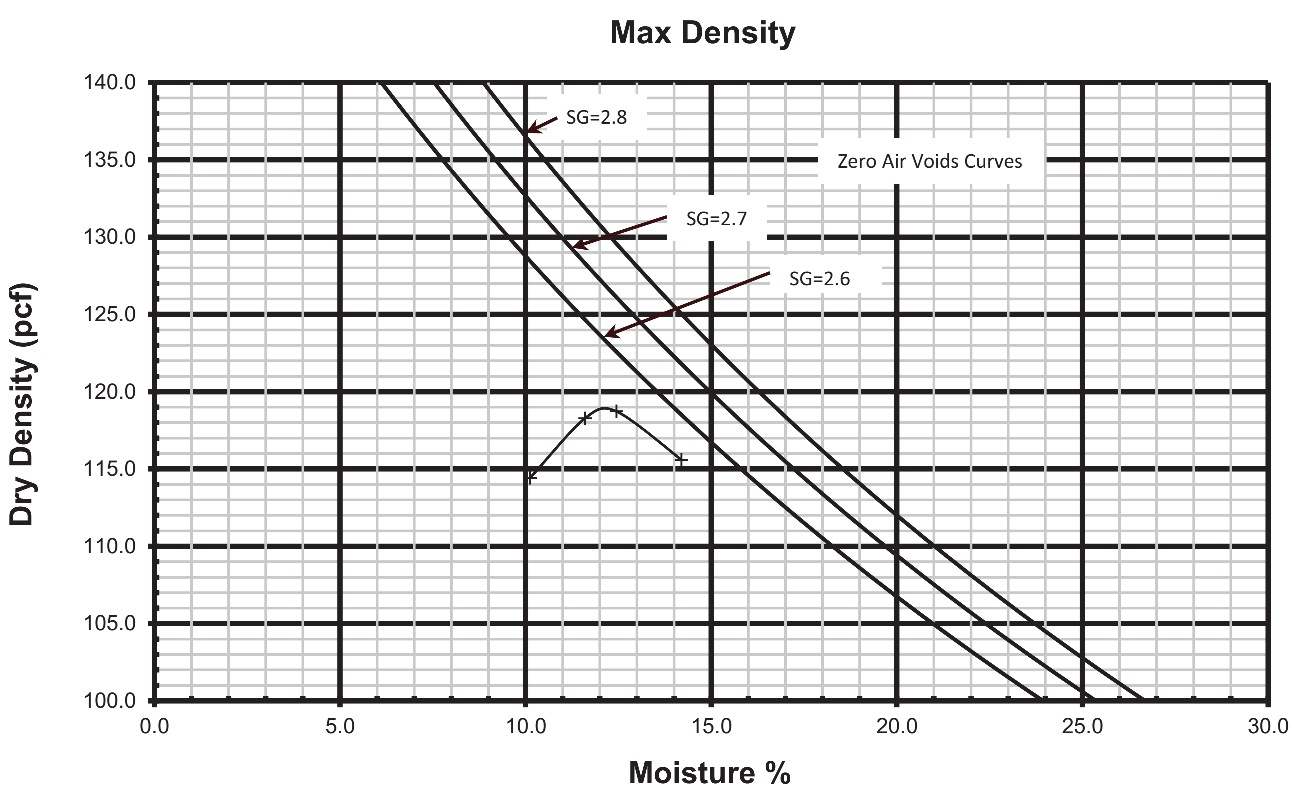
Project Name:	**Otay Village 14**	Excavation:	BA-4
Location:		Depth:	11 '
File No:	**1312-02**	Description:	Light Brown, White, Mixtur of Sand, Silt, Gravle and Sand Stone
Date:	2/27/2015		

Sieve Size	3/8 "				
Mold Size	4 "	% Retained	10		
No. of Layers	5	Method	A	By:	H-M

Test point number		1	2	3	4		
Wt. wet soil + mold	g						
Wt. wet soil + mold	lbs	8.30	8.50	8.55	8.50		
Wt. of mold	lbs	4.10	4.10	4.10	4.10		
Wt. wet of soil	lbs	4.20	4.40	4.45	4.40		
Wet density	pcf	126.00	132.00	133.50	132.00		
Dry density	pcf	114.42	118.28	118.73	115.59		

Moisture Determination (Oven)

Container number		21	25	12	18		
Wt. wet of soil+tare	g	235.2	245.3	281.6	265.5		
Dry wt. soil+tare	g	214.4	220.7	251.4	233.6		
Tare wt.	g	8.8	8.6	8.7	8.9		
Wt. of moisture	g	20.80	24.60	30.20	31.90		
Dry wt. of soil	g	205.60	212.10	242.70	224.70		
Moisture Content	g	10.12	11.60	12.44	14.20		



Maximum Density **119.0** pcf

Optimum Moisture **12.0** %

Advanced Geotechnical Solutions, Inc.

MAXIMUM DENSITY

ASTM D-1557

Project Name: **Otay Village 14**
Location:
File No: **1312-02**
Date: 2/25/2015

Excavation: BA-3
Depth: 13 '
Description: Very Light Olive Brown Clayey Sand With Bentonite

Sieve Size: 4
Mold Size: 4"
No. of Layers: 5

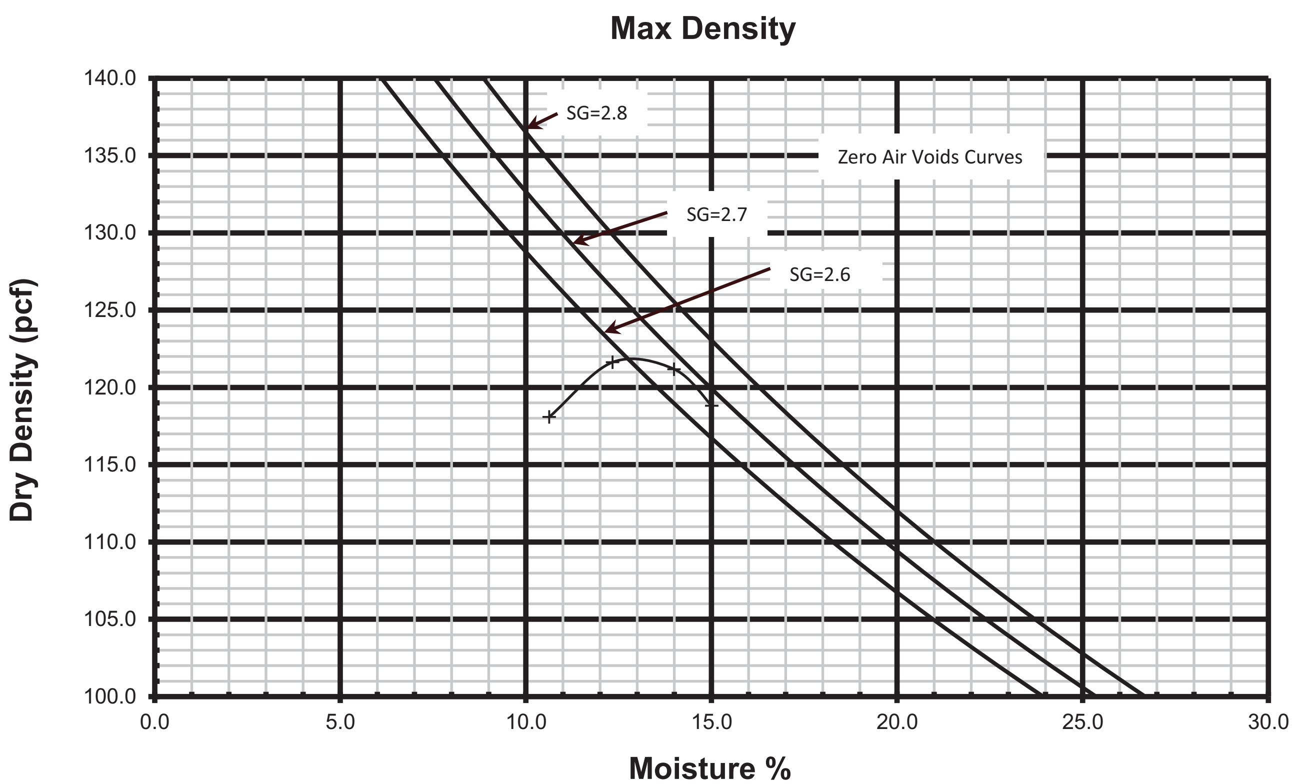
% Retained: 1
Method: A

By: H-M

Test point number		1	2	3	4		
Wt. wet soil + mold	g						
Wt. wet soil + mold	lbs	8.45	8.65	8.70	8.65		
Wt. of mold	lbs	4.10	4.10	4.10	4.10		
Wt. wet of soil	lbs	4.35	4.55	4.60	4.55		
Wet density	pcf	130.63	136.64	138.14	136.64		
Dry density	pcf	118.09	121.63	121.18	118.81		

Moisture Determination (Oven)

Container number		18	25	36	44		
Wt. wet of soil+tare	g	278	271.6	257.3	297.2		
Dry wt. soil+tare	g	252.1	242.7	226.8	259.5		
Tare wt.	g	8.3	8.4	8.8	8.2		
Wt. of moisture	g	25.90	28.90	30.50	37.70		
Dry wt. of soil	g	243.80	234.30	218.00	251.30		
Moisture Content	g	10.62	12.33	13.99	15.00		



Maximum Density **122.0** pcf

Optimum Moisture **13.0** %

Advanced Geotechnical Solutions, Inc.

MAXIMUM DENSITY

ASTM D-1557

Project Name: **Otay Village 14**
Location:
File No: **1312-02**
Date: 2/27/2015

Excavation: **BA-1**
Depth: **20-22 '**
Description: Light Brown Silt, Sand Slightly Clay

Sieve Size: 4
Mold Size: 4"
No. of Layers: 5

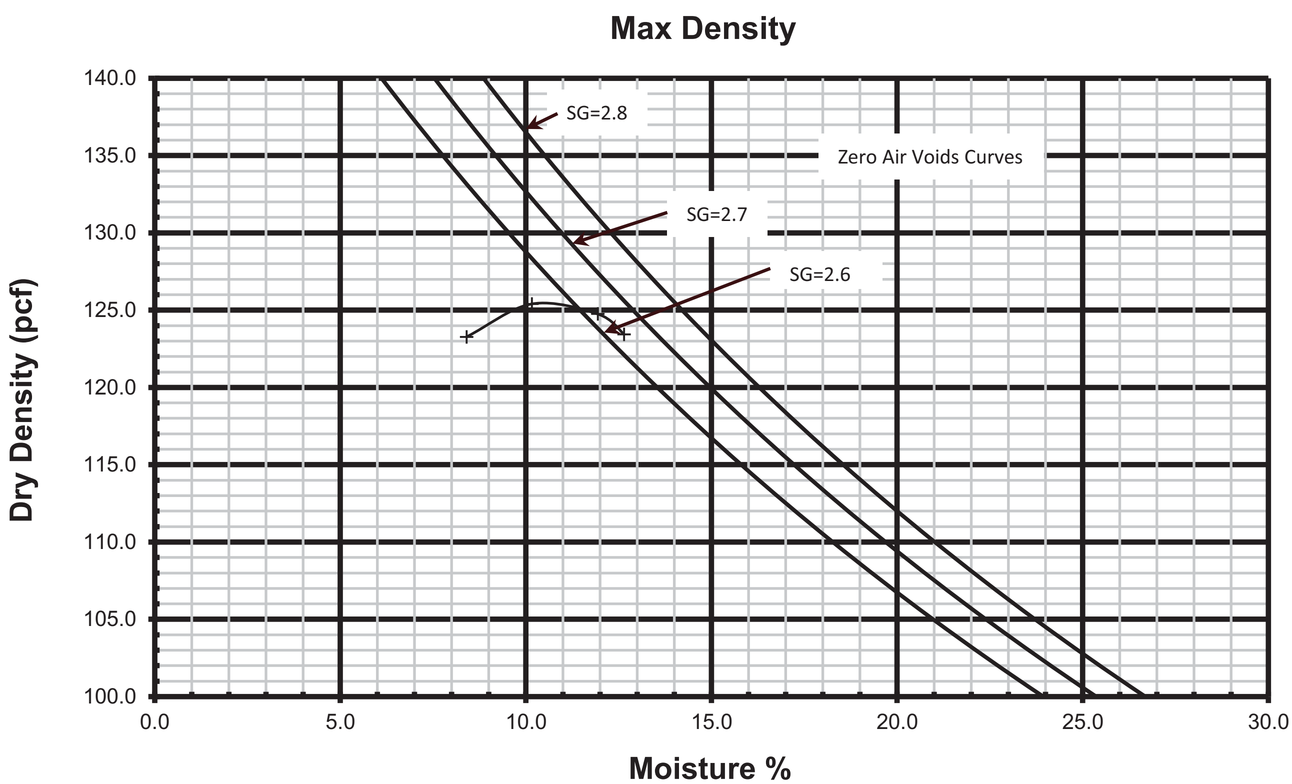
% Retained: 5
Method: A

By: H-M

Test point number		1	2	3	4		
Wt. wet soil + mold	g						
Wt. wet soil + mold	lbs	8.55	8.70	8.75	8.73		
Wt. of mold	lbs	4.10	4.10	4.10	4.10		
Wt. wet of soil	lbs	4.45	4.60	4.65	4.63		
Wet density	pcf	133.63	138.14	139.64	139.04		
Dry density	pcf	123.28	125.40	124.75	123.43		

Moisture Determination (Oven)

Container number		27	44	36	81		
Wt. wet of soil+tare	g	271.5	291.5	288.3	276.4		
Dry wt. soil+tare	g	251.1	265.4	258.5	246.3		
Tare wt.	g	8.3	8.4	8.8	8.2		
Wt. of moisture	g	20.40	26.10	29.80	30.10		
Dry wt. of soil	g	242.80	257.00	249.70	238.10		
Moisture Content	g	8.40	10.16	11.93	12.64		



Maximum Density **125.0** pcf   Optimum Moisture **11.0** %

AGS Inc.
Otay Village 14
AGS Inc. Project No: 1312-02

August 6, 2014
GF13797

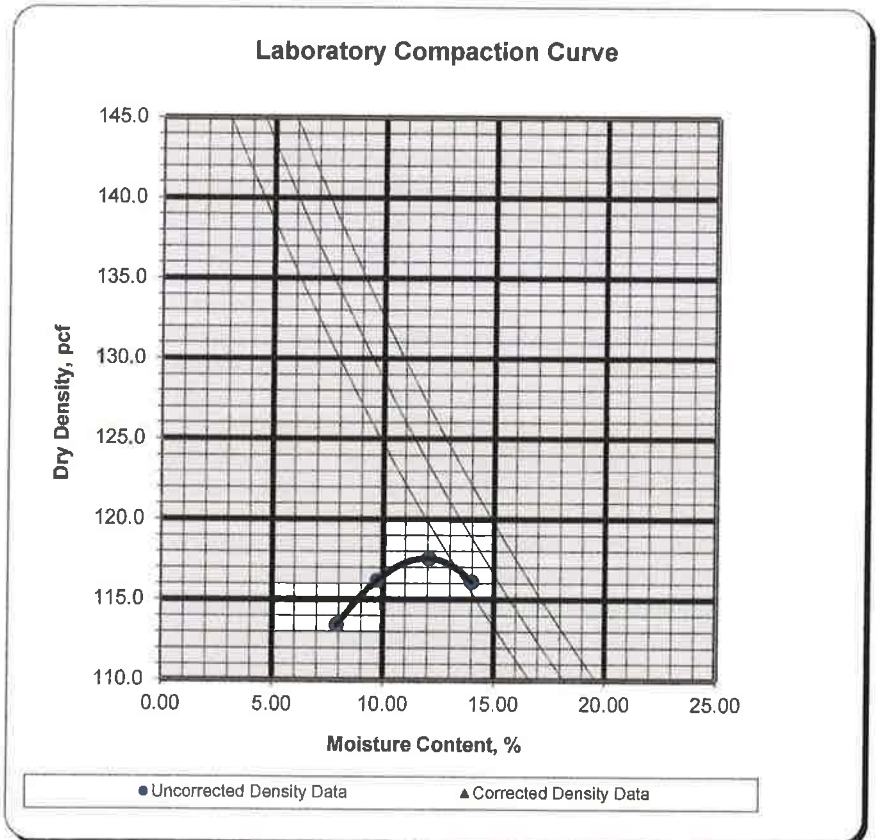
LABORATORY COMPACTION CURVE

G Force Lab No.: **10074**
Sample Location: **TP-17**
Soil Description: **Lt. Brown Tanish Clayey Siltstone (ML/MH)**
Source of Soil: **On Site**

Depth, ft.: **4-5'**
Sampled By: **PJD**
Date Sampled: **7-15-18-2014**

Test Designation: **ASTM_D1557**   Method **B**
% +3/4" **1.3**   % +3/8" **4.0**   % +#4 **12.8**
Oversize Correction Applied? **No**
Method of Sample Preparation: **Dry**
Type of Hammer Used: **Manual**

M/D Curve No. TP-17



Test Results

Maximum Density, pcf	117.6
Optimum Moisture, %	11.8

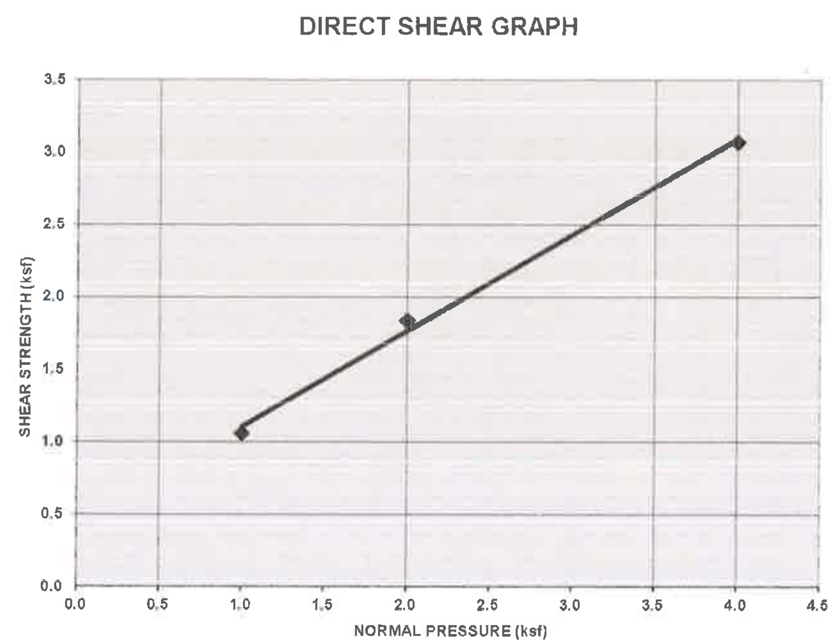
Oversize Corrected Results

Maximum Density, pcf	N/A
Optimum Moisture, %	N/A

Reviewed by: Joseph Bouknight, P.E., C81517

DIRECT SHEAR TEST REPORT

G-FORCE LAB NO.:	10077
SAMPLE LOCATION:	TP-21 @ 1-3'
SOIL TYPE:	Brownish Gray Sandy Clay (CL/SC)
SAMPLE TYPE:	Remolded at 114.8 @ 15.2% M.C. @ 90% RC



CALCULATED DATA

INITIAL					
	WET DENSITY	pcf	118.7	118.9	119.5
	DRY DENSITY	pcf	103.0	103.2	103.7
	MOISTURE	%	15.2	15.2	15.2
FINAL, at failure					
	MOISTURE	%	27.9	27.2	25.4

NORMAL PRESSURE, ksf	1.00	2.00	4.00
SHEAR STRENGTH, ksf	1.06	1.84	3.07
FRICTION ANGLE, degrees	33.5		
COHESION, ksf	0.44		

Reviewed by: Joseph Bouknight, P.E., C81517

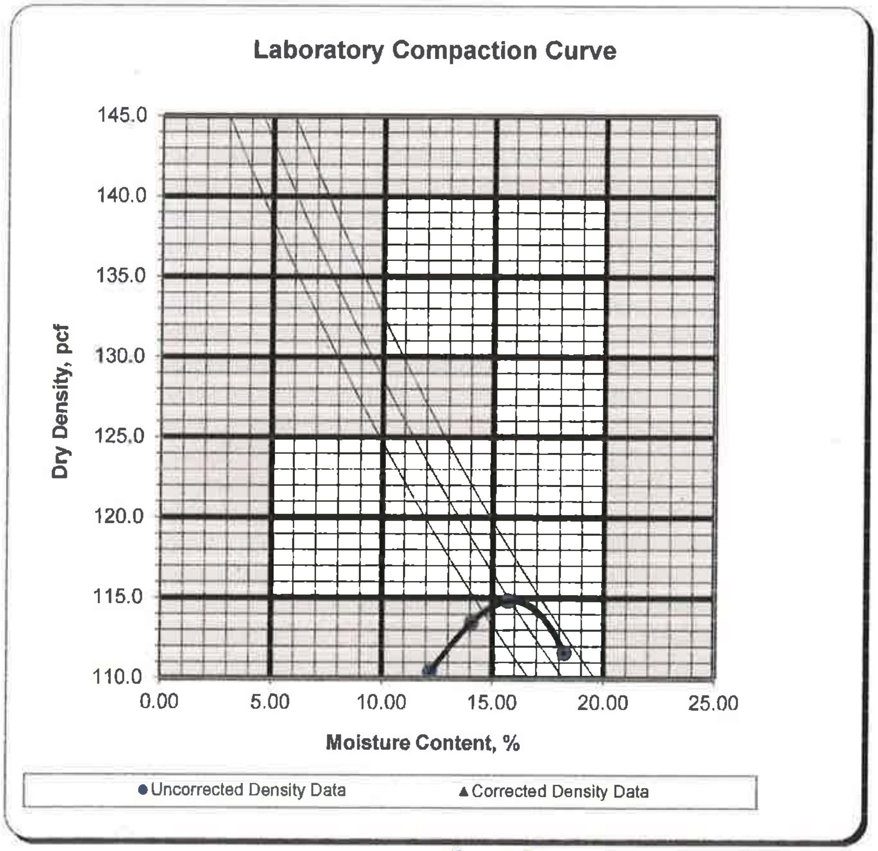
LABORATORY COMPACTION CURVE

G Force Lab No.: **10077**
Sample Location: **TP-21**
Soil Description: **Brownish Gray Sandy Clay (CL/SC)**
Source of Soil: **On Site**

Depth, ft.: **1-3'**
Sampled By: **PJD**
Date Sampled: **7-15-18-2014**

Test Designation: **ASTM_D1557** Method **B**
% +3/4" **2.2** % +3/8" **5.6** % +#4 **11.6**
Oversize Correction Applied? **No**
Method of Sample Preparation: **Dry**
Type of Hammer Used: **Manual**

M/D Curve No. TP-21



Test Results

Maximum Density, pcf	114.8
Optimum Moisture, %	15.8

Oversize Corrected Results

Maximum Density, pcf	N/A
Optimum Moisture, %	N/A

Reviewed by: Joseph Bouknight, P.E., C81517

Expansion Index
(ASTM D4829)

G Force Lab No.	10076	Sample No:	TP-21
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits		
Sample Depth:	1-3'		
Sample Description:	Dk. Brown Silty Clay (CL/CH)		

Initial Water Content, %	13.3%
Dry Density, pcf	98.0
Saturation, %	49.7%
Initial Dial Reading, in.	0.0000
Final Dial Reading, in.	0.1246
Final Water Content, %	30.1%
Expansion Index	**124**
Potential Expansion	**High**

Reviewed by: Joe Bouknight

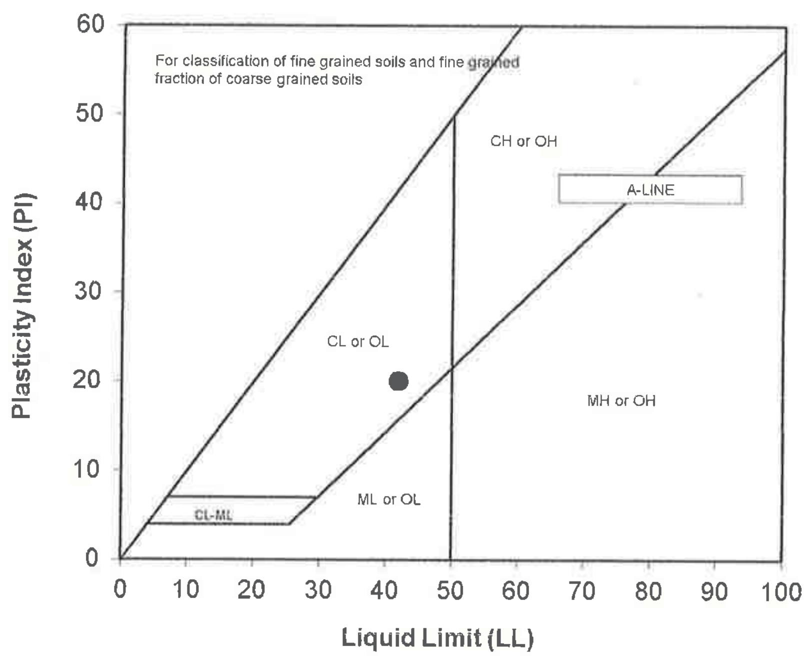
Joseph Bouknight, P.E., C81517

Atterberg Limits

(ASTM D4318)

G Force Lab No.	10075	Boring Number:	TP-17
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits	Depth:	14-15'
Boring Number:	TP-17		
Sample Description:	LT Tanish White Silty Clay (CL)		
Special Specimen Selection Process:	0		
Sample Drying Method:	Air		
Estimated Retained on No. 40 Sieve (%):	25		
Liquid Limit Procedure Used:	Method A: Multipoint		

Liquid Limit	42
Plastic Limit	22
Plasticity Index	**20**
Classification	**CL**



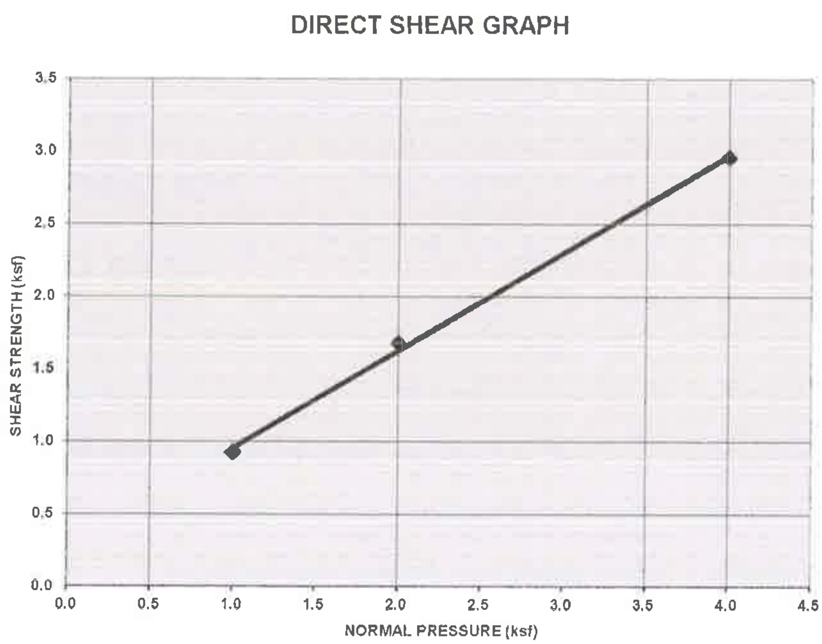
Reviewed by: Joseph Bouknight, P.E., C81517

AGS Inc.
Otay Village 14
AGS Inc. Project No: 1312-02

August 6, 2014
Project No. GF13797

DIRECT SHEAR TEST REPORT

G-FORCE LAB NO.:	10074
SAMPLE LOCATION:	TP-17 @ 4-5'
SOIL TYPE:	Lt. Brown Tanish Clayey Siltstone (ML/MH)
SAMPLE TYPE:	Remolded at 117.6 @ 13.9% M.C. @ 90% RC



CALCULATED DATA

INITIAL					
	WET DENSITY	pcf	118.6	118.9	118.8
	DRY DENSITY	pcf	105.6	105.8	105.7
	MOISTURE	%	12.4	12.4	12.4
FINAL, at failure					
	MOISTURE	%	25.4	23.5	22.1

NORMAL PRESSURE, ksf	1.00	2.00	4.00
SHEAR STRENGTH, ksf	0.92	1.68	2.96
FRICTION ANGLE, degrees	33.9		
COHESION, ksf	0.28		

Reviewed by: Joe Bauknight
Joseph Bouknight, P.E., C81517

G FORCE ®
DVBE SDVOSB SBE

Expansion Index
(ASTM D4829)

G Force Lab No.	10073	Sample No:	TP-16
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits		
Sample Depth:	1-2.5'		
Sample Description:	Pale Brown Silty Clay (CL/CH)		

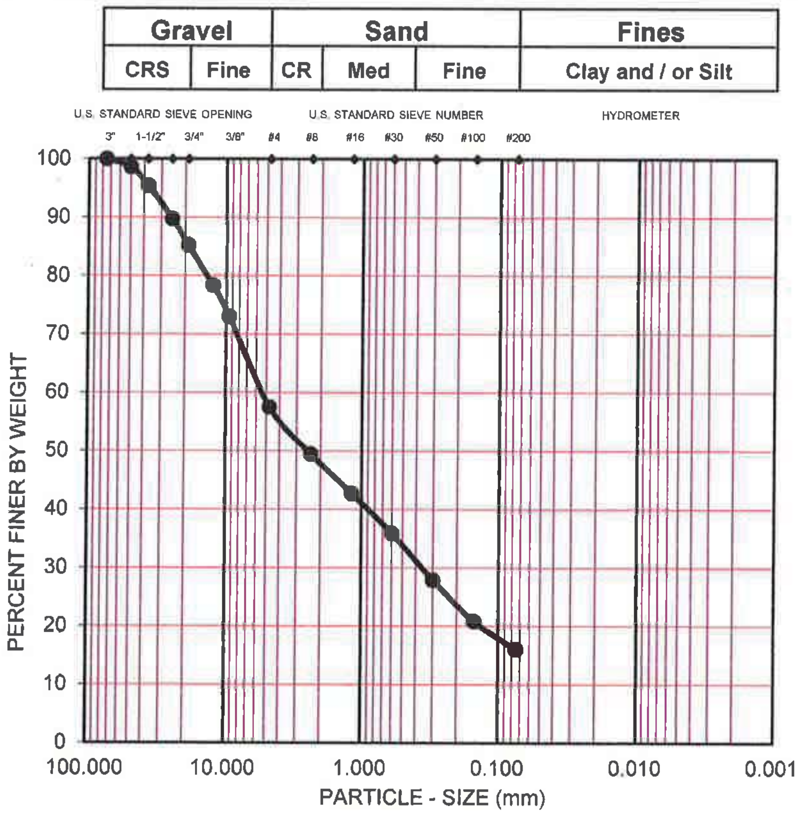
Initial Water Content, %	12.7%
Dry Density, pcf	99.7
Saturation, %	49.9%
Initial Dial Reading, in.	0.0000
Final Dial Reading, in.	0.2145
Final Water Content, %	36.7%
Expansion Index	**214**
Potential Expansion	**Very High**

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

Sieve Analysis

(ASTM C136)

G Force Lab No.	10072	Sample No:	TP-9 @ 4-5'
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits		
Sample Description:	Lt. Brown Sandy Clay (SC)		



Sieve Size	% Passing
3"	100
2"	99
1-1/2"	95
1"	90
3/4"	85
1/2"	78
3/8"	73
#4	58
#8	49
#16	43
#30	36
#50	28
#100	21
#200	16

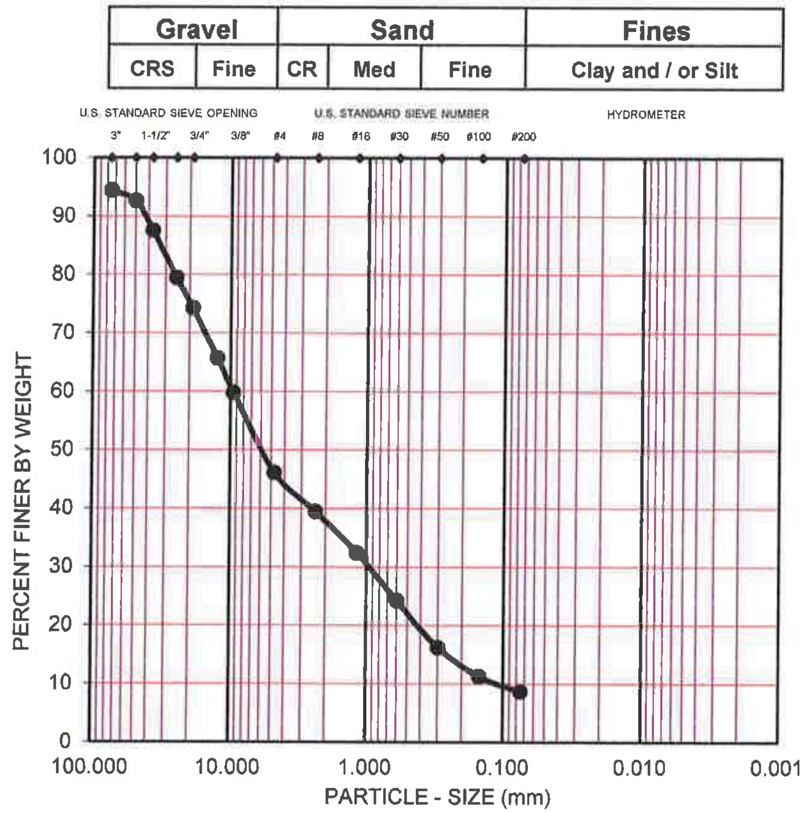
Reviewed by: ______________________

Joseph C. Bouknight, P.E., C81517

Sieve Analysis

(ASTM C136)

G Force Lab No.	10071	Sample No:	TP-6 @ 4-5'
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits		
Sample Description:	Lt. Gray Silty Sand (SM)		



Sieve Size	% Passing
3"	94
2"	93
1-1/2"	88
1"	79
3/4"	74
1/2"	66
3/8"	60
#4	46
#8	39
#16	32
#30	24
#50	16
#100	11
#200	9

Reviewed by: Joe Bouknight

Joseph C. Bouknight, P.E., C81517

Soil Corrosivity

(CTM 643,CTM 417 & CTM 422)

Lab Number	Boring No.	Depth	Sulfate %	Chloride %	PH	Resistivity (OHM-cm)
10070	TP-2	3.5-4'	0.603	0.116	6.80	223

Lab Number	Boring No.	Depth	Sulfate %	Chloride %	PH	Resistivity (OHM-cm)
10076	TP-21	1-3'	0.012	0.019	6.2	776

Lab Number	Boring No.	Depth	Sulfate %	Chloride %	PH	Resistivity (OHM-cm)
10077	TP-21	6-7'	0.01	0.064	7.92	392

Sulfate and Chloride content test were performed by Southern California Soils & Testing Inc..

Date Sampled: 7-15-18-2014
Sampled By: PJ
Date Submitted: 7/25/2014
Submitted By: PJ

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

4035 Pacific Highway, San Diego, CA 92110 (619)583-6633
www.gforceca.com

Expansion Index
(ASTM D4829)

G Force Lab No.	10069	Sample No:	TP-2-1
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits		
Sample Depth:	2-3'		
Sample Description:	Brown Silty Clay (CL/CH)		

Initial Water Content, %	10.5%
Dry Density, pcf	107.9
Saturation, %	50.5%
Initial Dial Reading, in.	0.0000
Final Dial Reading, in.	0.1371
Final Water Content, %	24.9%
Expansion Index	**138**
Potential Expansion	**Very High**

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

Expansion Index
(ASTM D4829)

G Force Lab No.	10068	Sample No:	TP-1
Date Sampled:	7-15-18-2014	By:	PJD
Date Submitted:	7-15-18-2014	By:	PJD
Sample Location:	On Site Test Pits		
Sample Depth:	8-9'		
Sample Description:	Pale Olive Gray Clayey Silt (CL/SC)		

Initial Water Content, %	12.2%
Dry Density, pcf	102.6
Saturation, %	51.5%
Initial Dial Reading, in.	0.0000
Final Dial Reading, in.	0.1161
Final Water Content, %	26.9%
Expansion Index	**118**
Potential Expansion	**High**

Reviewed by: Joe Bouknight
Joseph Bouknight, P.E., C81517

APPENDIX D

SLOPE STABILITY ANALYSIS

1312-02 Village 14 (120' 2:1 Cut Slope) Static

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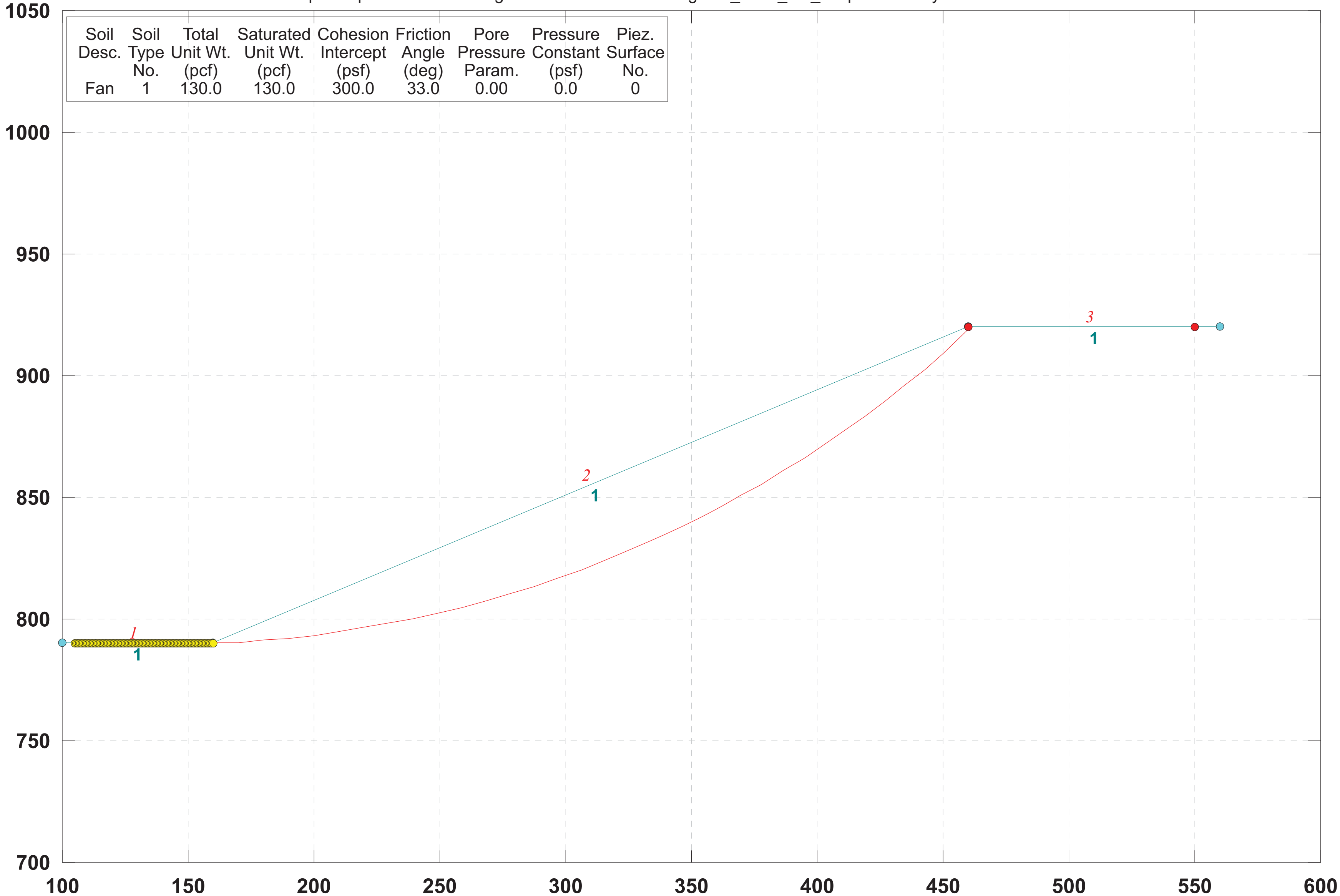


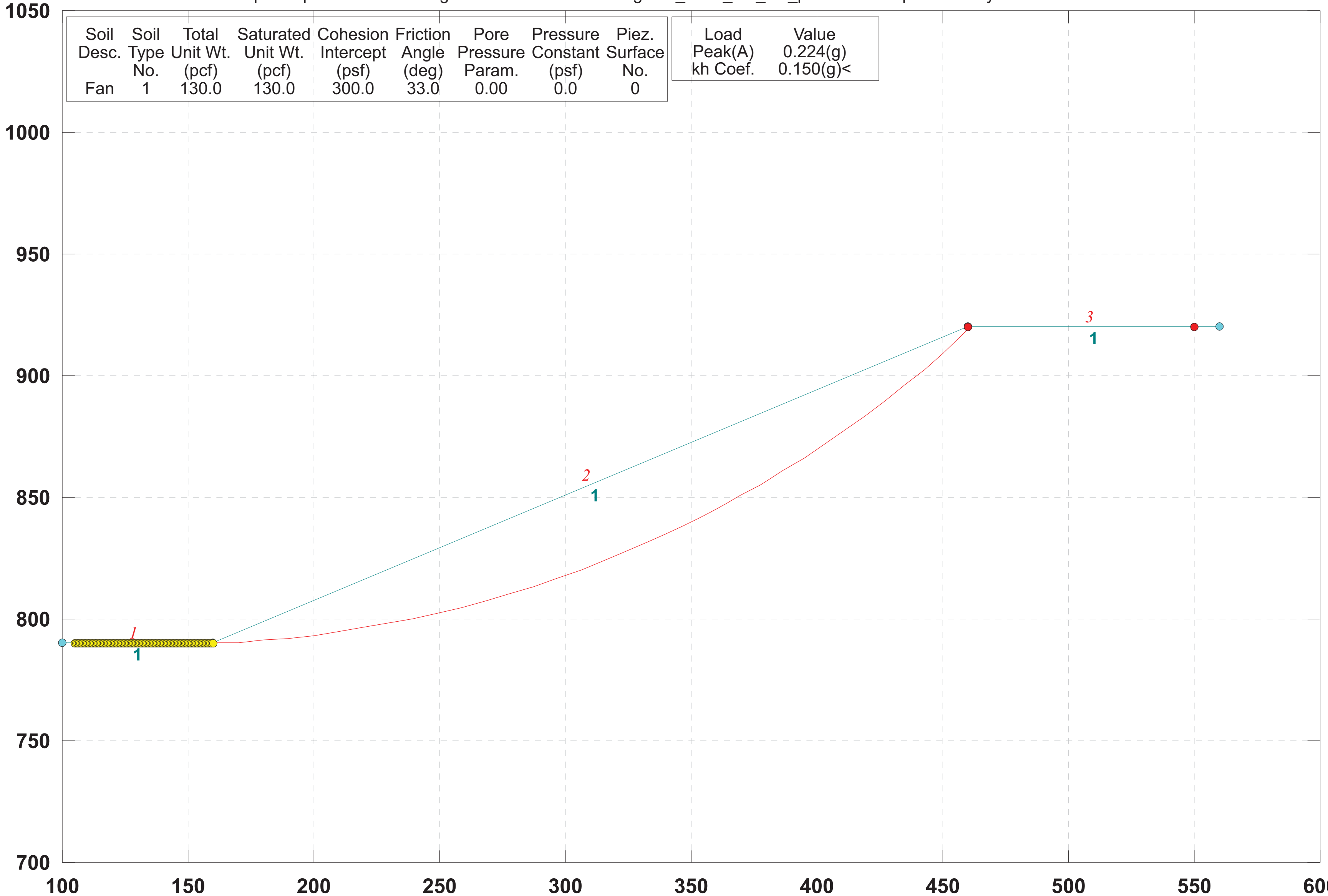
GSTABL7 v.2 FSmin=1.90
Safety Factors Are Calculated By The Modified Bishop Method

1312-02 Village 14 (120' 2:1 Cut Slope) Pseudo Static

c:\users\public\public documents\gstabl7 data\1312-02 village 14_120ft_2.1_cut_pseudo static.pl2 Run By: ss 3/24/2017 01:37PM

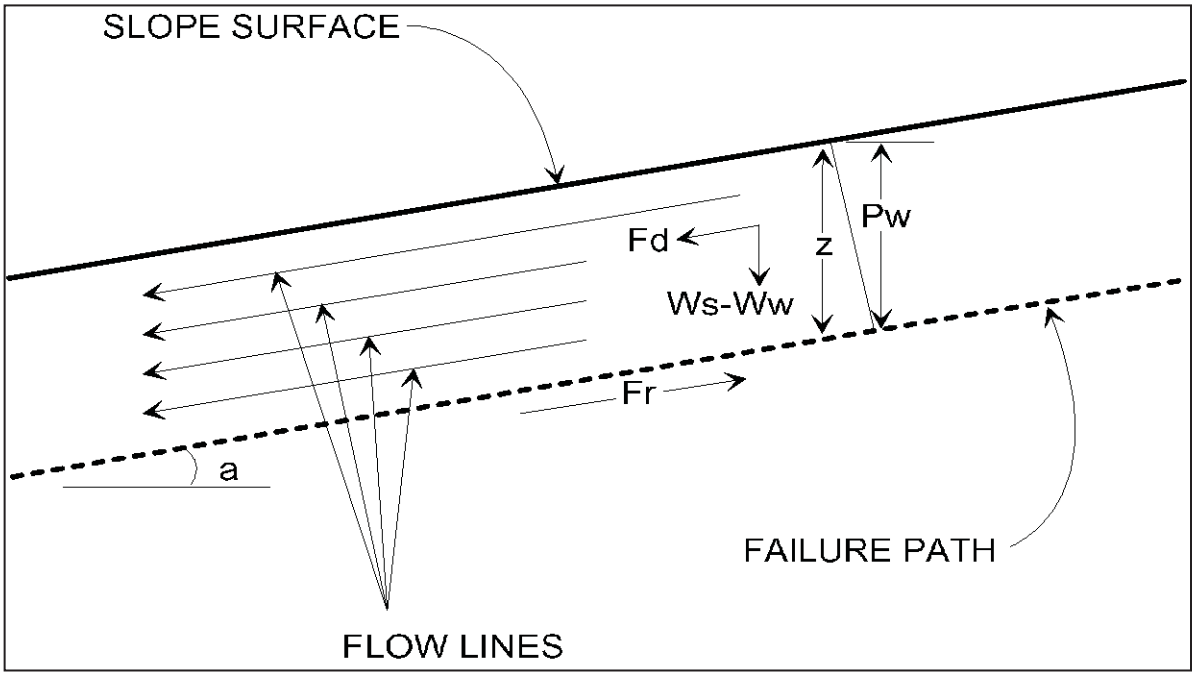
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Fan	1	130.0	130.0	300.0	33.0	0.00	0.0	0

Load	Value
Peak(A)	0.224(g)
kh Coef.	0.150(g)<



GSTABL7 v.2 FSmin=1.34
Safety Factors Are Calculated By The Modified Bishop Method

SURFICIAL SLOPE STABILITY



Assume: (1) Saturation To Slope Surface
(2) Sufficient Permeability To Establish Water Flow

Pw = Water Pressure Head=(z)(cos^2(a))
Ws = Saturated Soil Unit Weight
Ww = Unit Weight of Water (62.4 lb/cu.ft.)
u = Pore Water Pressure=(Ww)(z)(cos^2(a))
z = Layer Thickness
a = Angle of Slope
phi = Angle of Friction
c = Cohesion
Fd = (0.5)(z)(Ws)(sin(2a))
Fr = (z)(Ws-Ww)(cos^2(a))(tan(phi)) + c
Factor of Safety (FS) = Fr/Fd

2:1 CUT SLOPE

Given:

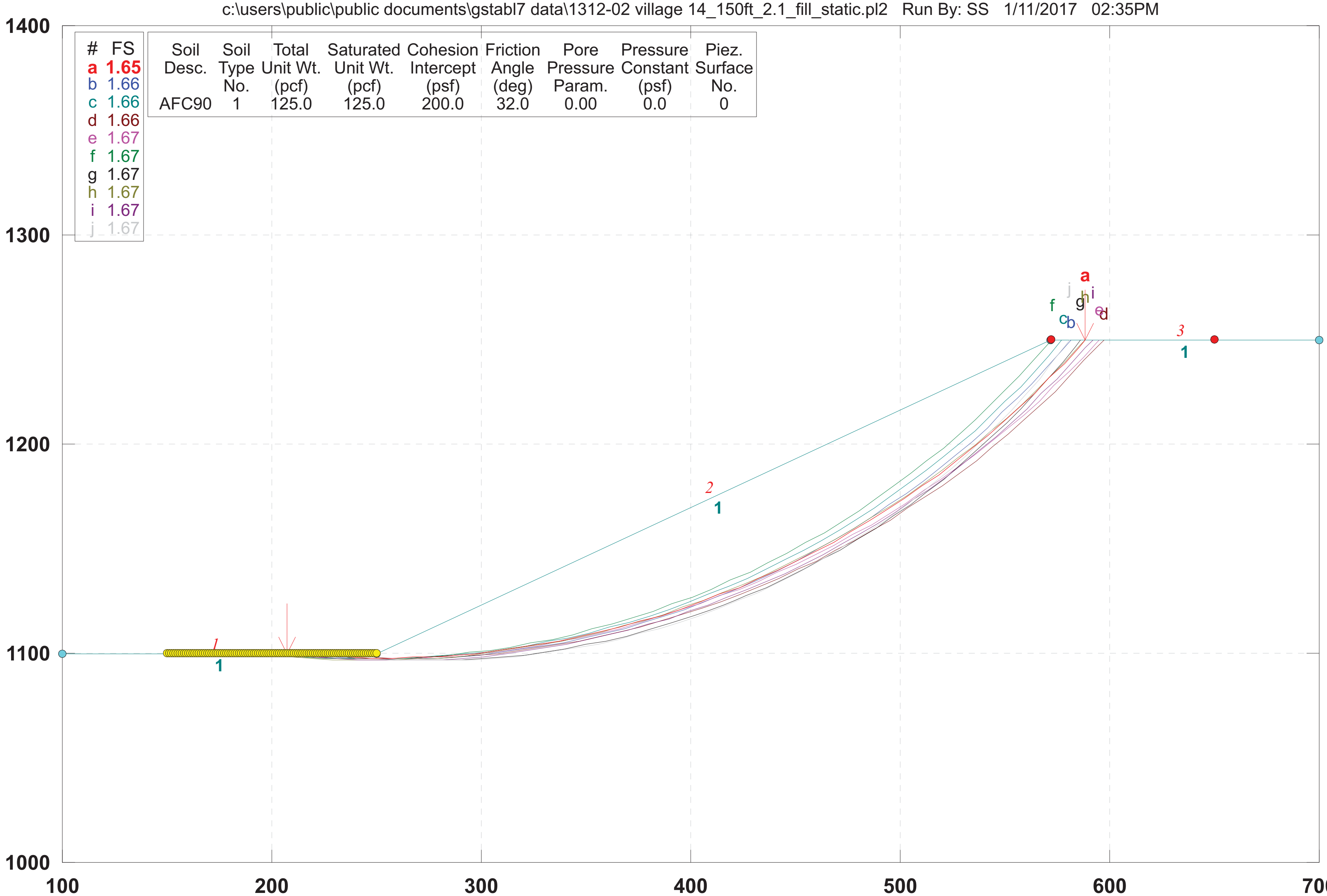
Ws	z	a		phi		c
(pcf)	(ft)	(degrees)	(radians)	(degrees)	(radians)	(psf)
130	4	26.5	0.4625123	33	0.5759587	300

Calculations:

Pw	u	Fd	Fr	**FS**
3.20	199.91	207.65	440.64	**2.12**

1312-02 Village 14 (150' 2:1 Fill Slope)Static

c:\users\public\public documents\gstabl7 data\1312-02 village 14_150ft_2.1_fill_static.pl2 Run By: SS 1/11/2017 02:35PM



GSTABL7 v.2 FSmin=1.65

Safety Factors Are Calculated By The Modified Bishop Method

PLATE D-4

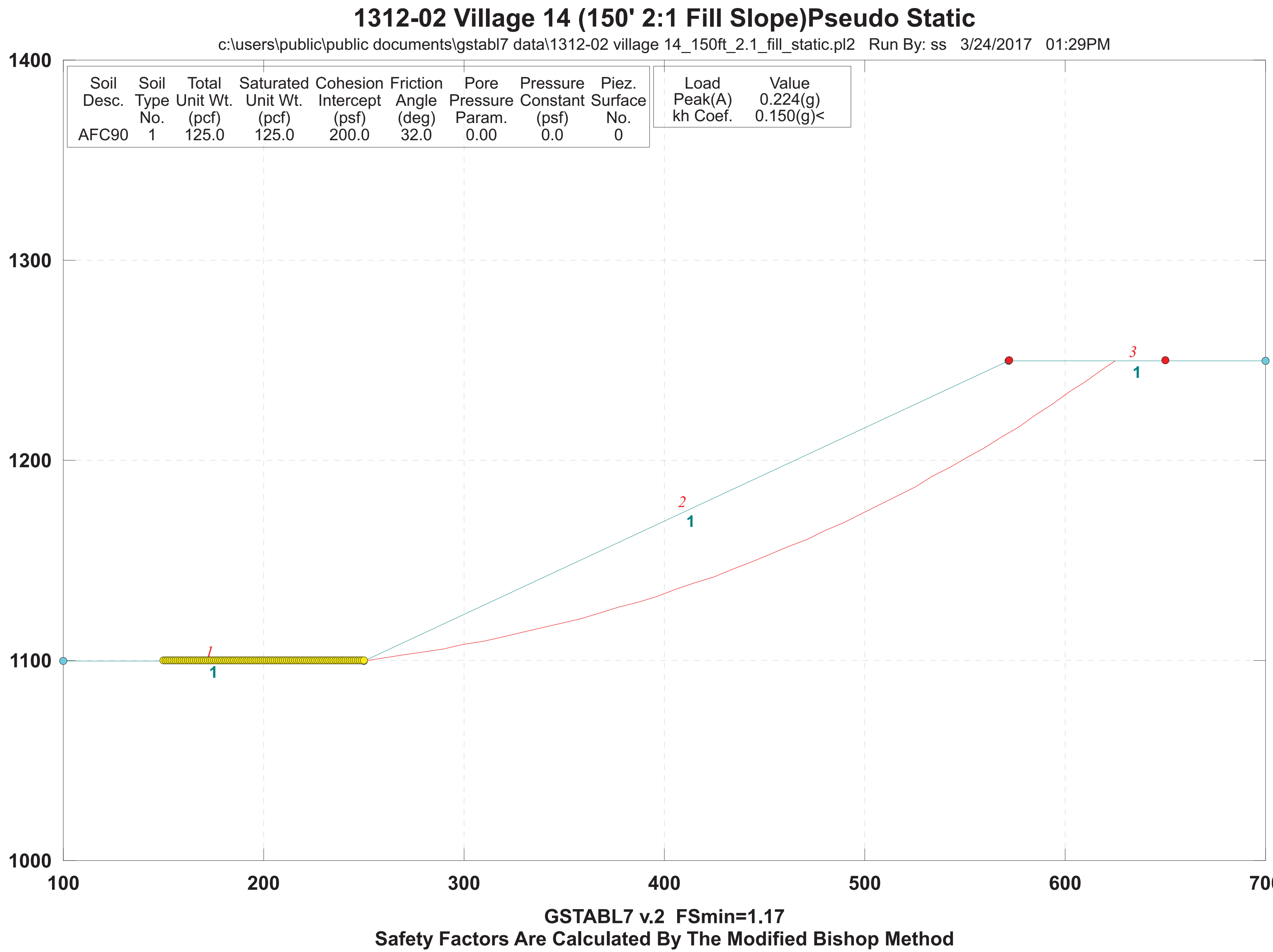
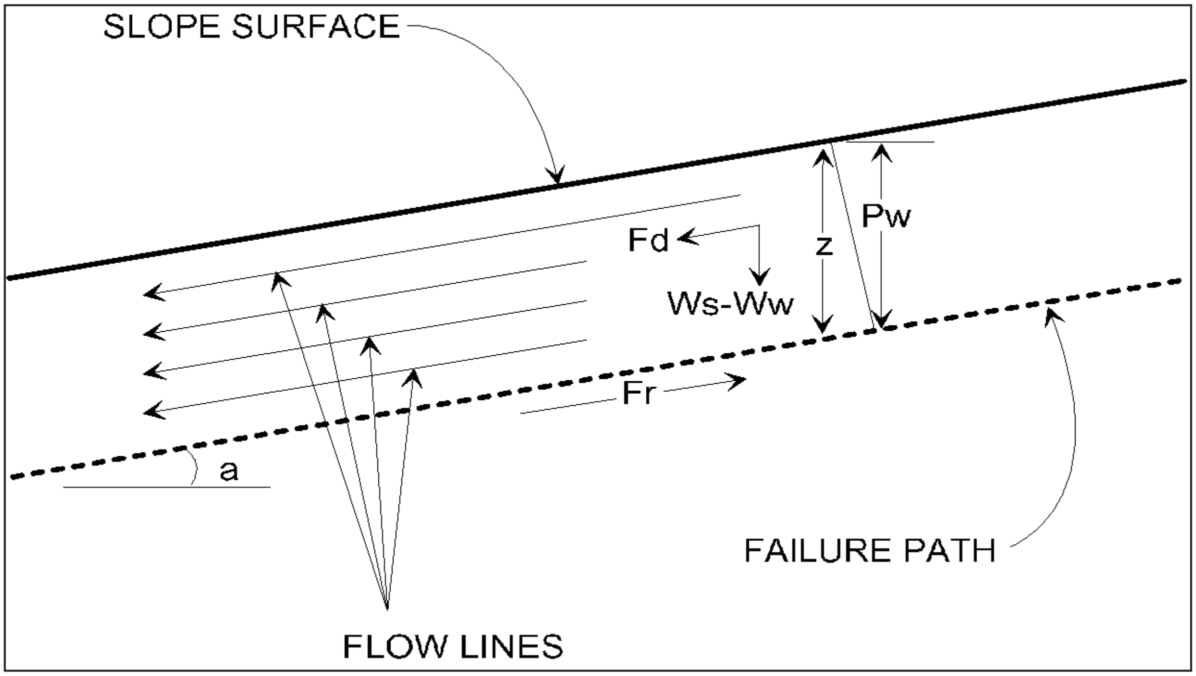

1312-02 Village 14 (150' 2:1 Fill Slope)Pseudo Static
c:\users\public\public documents\gstabl7 data\1312-02 village 14_150ft_2.1_fill_static.pl2 Run By: ss 3/24/2017 01:29PM
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No.
AFC90 | 1 | 125.0 | 125.0 | 200.0 | 32.0 | 0.00 | 0.0 | 0
Load | Value
Peak(A) | 0.224(g)
kh Coef. | 0.150(g)<
1400
1300
1200
1100
1000
100
200
300
400
500
600
700
GSTABL7 v.2 FSmin=1.17
Safety Factors Are Calculated By The Modified Bishop Method

PLATE D-5

SURFICIAL SLOPE STABILITY



Assume: (1) Saturation To Slope Surface
(2) Sufficient Permeability To Establish Water Flow

Pw = Water Pressure Head=(z)(cos^2(a))
Ws = Saturated Soil Unit Weight
Ww = Unit Weight of Water (62.4 lb/cu.ft.)
u = Pore Water Pressure=(Ww)(z)(cos^2(a))
z = Layer Thickness
a = Angle of Slope
phi = Angle of Friction
c = Cohesion
Fd = (0.5)(z)(Ws)(sin(2a))
Fr = (z)(Ws-Ww)(cos^2(a))(tan(phi)) + c
Factor of Safety (FS) = Fr/Fd

2:1 FILL SLOPE

Given:

Ws	z	a		phi		c
(pcf)	(ft)	(degrees)	(radians)	(degrees)	(radians)	(psf)
125	4	26.5	0.4625123	32	0.5585054	200

Calculations:

Pw	u	Fd	Fr	**FS**
3.20	199.91	199.66	325.32	**1.63**

APPENDIX E

INFILTRATION FEASIBILITY STUDY

JacksonPendo Development Company
2245 San Diego Avenue, Suite 223
San Diego CA 92110

February 21, 2017
P/W 1312-02
Report No. 1312-02-B-7

Attention: **Ms. Liz Jackson**

Subject: ***Infiltration Feasibility Study, Otay Ranch – Village 14 and Planning Areas 16 and 19, County of San Diego, California***

References: See Appendix A

Gentleperson:

In accordance with your request, Advanced Geotechnical Solutions, Inc. (AGS) has prepared this preliminary infiltration feasibility study for proposed BMP basins at the subject site (Figure 1). This report is intended to evaluate the feasibility for storm water infiltration and provide preliminary infiltration rates in general accordance with the current Storm Water Standards – BMP Design Manual. A discussion of our field testing and findings are presented below. Worksheet Form C.4-1 and associated supporting worksheets and data are presented in Appendix A.

1. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The Proposed Project is located within Township 17 South, Range 1 East, Sections 8, 16, 17, 18, 19, 20, and 30 on the USGS 7.5' Jamul Mountains quadrangle, generally along Proctor Valley Road between the City of Chula Vista and Jamul, California. The project area is more specifically located within Proctor Valley Village 14 and Planning Areas 16 and 19 as depicted in Figure 1.

The total Project Area covers approximately 1,370 acres, of which approximately 724 acres are within Otay Ranch Village 14, 560 acres are within Planning Areas 16 and 19, and 86 acres are for offsite circulation. The Proposed Project area is in a natural state and is covered with a light to dense growth of annuals and some chaparral. A network of improved and unimproved roads provides access throughout the site. The existing elevations within the proposed development ranges from a high of approximately 1,345 feet above mean sea level (AMSL) in the northeastern portion of the site (R-16) to a low of approximately 550 feet AMSL within an active drainage near the southern limit of proposed development. Topography on site ranges from gently sloping terraces to moderately steep existing natural slopes approaching 1:1 (horizontal to vertical) slope inclinations. Two southerly flowing active drainages transect the site ultimately converging into a broad drainage adjacent to the existing Proctor Valley Road which drains into Upper Otay Lake.

Several BMP basins are proposed throughout the site, ranging in size from approximately 2,877 to 113,501 square feet.

2. FIELD INVESTIGATION

To evaluate the feasibility of storm water infiltration on the site, and to provide preliminary design infiltration rates, eight (8) borehole percolation tests (P-1 through P-8) were performed in general conformance with Appendix D, Section D.3.3.2 of the recently adopted BMP Design Manual. Testing was performed in areas of proposed and possible water quality basins (Plates 1 through 3).

A rubber tire backhoe equipped with a hydraulic 6-inch diameter auger attachment was used to advance the infiltration test borings to depths of approximately three (3) feet below existing grades. In addition, test pits were excavated to depths of up to ten feet below the surface using the rubber tire backhoe at each of the eight (8) percolation test localities, for a total of eight (8) test pits (PT-1 through PT-8). As part of the fieldwork our Geologist provided continuous soil/geology logging of the test pits. Test pit logs are presented in the Appendix B. Locations of the infiltration test borings and test pits are shown on Figure 2.

Infiltration test borings P-1, P-2, and P-5 extended into Quaternary aged Older Alluvium, the remaining infiltration test borings extended into Tertiarty aged Otay Formation - Fanglomerate. The Older Alluvium encountered within the test borings and adjacent backhoe test pits generally consisted of reddish brown, clayey sand to sandy clay with abundant gravel and cobbles in a dry to moist and dense to very dense condition. The Otay Formation – Fanglomerate encountered generally consisted of two subunits, a fine grained unit consisting of siltstone to claystone and a coarse grained unit consisting of an angular breccia with a silty clay to clayey sand matrix.

The resulting test holes were cleaned of loose debris then successively filled with more than 5 gallons of clean, potable water and allowed to pre-soak. The following day the test holes were cleaned of sediment and the bottom was lined with approximately 2-inches of washed gravel prior to infiltration testing. A series of falling head infiltration tests were performed. The test holes were filled with clean, potable water to approximately 24 inches above the infiltration surface and allowed to infiltrate. The water level was allowed to drop for a 30-minute period, the water level was then measured and the drop rate calculated in inches per hour. The test hole was then refilled with water as necessary and the test procedure was repeated over the course of 6 hours, and until a stabilized percolation rate was recorded. The stabilized percolation rate was then converted to an infiltration rate based on the "Porchet Method" utilizing the following equation:

$$I_t = \frac{\Delta H \, \pi r^2 \, 60}{\Delta t(\pi r^2 + 2\pi r H_{avg})} = \frac{\Delta H \, 60 \, r}{\Delta t(r + 2H_{avg})}$$

Where:

I_t = tested infiltration rate, inches/hour
ΔH = change in head over the time interval, inches
Δt = time interval, minutes
$^*r$ = effective radius of test hole
H_{avg} = average head over the time interval, inches

Logs of the field testing and graphical representations of the test data presented as infiltration versus time interval are included in Appendix A as supporting documents for Form C.4-1.

3. TEST RESULTS AND PRELIMINARY DESIGN VALUES

The results of our testing are summarized in Table 1 below.

TABLE 1
SUMMARY OF INFILTRATION TEST RESULTS

Test Hole No.	Depth of Test Hole	Approximate Test Elevation	Geologic Unit	Description	Tested Infiltration Rate (inches/hour)
P-1	36 inches	602 msl	Qoal	Clayey Sand	0.28
P-2	36 inches	591 msl	Qoal	Sandy Clay	0.18
P-3	36 inches	588 msl	Tof	Clayey Sandstone	0.64
P-4	36 inches	597 msl	Tof	Clayey Siltstone	0.22
P-5	36 inches	660 msl	Qoal	Gravelly sandy clay with Cobble	0.64
P-6	36 inches	671 msl	Tof	Gravelly sandy clay with Cobble	0.72
P-7	36 inches	760 msl	Tof	Breccia	0.20
P-8	36 inches	750 msl	Tof	Breccia	0.21

In accordance with Appendix D, Section D.5. of the BMP Design Manual, a 'Factor of Safety' should be applied to the tested infiltration rates to determine the design infiltration rates. The factor of safety is determined by Worksheet D-5.1 and possesses a numerical value between 2 and 9. For the proposed project site, the factor of safety worksheet yielded a Combined Factor of Safety (S_{total}) of 5.5. However, for the purposes of feasibility screening, the Factor of Safety is restricted to a maximum value of 2.0. Table 2 below summarizes the design infiltration rates for the subject test holes utilizing a factor of safety of 2.0.

TABLE 2
SUMMARY OF PRELIMINARY DESIGN INFILTRATION RATES

Test Hole No.	Tested Infiltration Rate (in./hr.)	Factor of Safety	Design Infiltration Rate (in./hr.)
P-1	0.28	2.0	0.14
P-2	0.18	2.0	0.09
P-3	0.64	2.0	0.32
P-4	0.22	2.0	0.11
P-5	0.64	2.0	0.32
P-6	0.72	2.0	0.36
P-7	0.20	2.0	0.10
P-8	0.21	2.0	0.10

4. DESIGN CONSIDERATIONS

4.1 Groundwater

Shallow groundwater (less than 2 feet below ground surface) was encountered during recent subsurface exploration in a broad drainage located in the northeasterly portion of Planning Area 16. One structural BMP (Biofiltration Basin BF-1-6) is proposed in this area. The shallow groundwater encountered is considered to be a transient condition related to recent prolonged rain events and the presence of an undocumented fill dam located at the confluence of this drainage and another tributary drainage approximately 500 feet south of the proposed BMP. In consideration of the potential for shallow groundwater to develop in the area of Basin BF-1-6, infiltration is not recommended.

No other groundwater was encountered or evidence of high groundwater observed within borings/excavations onsite. It is our opinion that the seasonal high groundwater elevation in the remaining proposed BMP locations is deeper than ten (10) feet below the bottom of the proposed infiltration surfaces.

4.2 Geotechnical Hazards

An offsite landslide has been postulated based on geomorphic evidence. There are no proposed BMP basins located superjacent or in close proximity to the potential landslide area. There are no significant geotechnical hazards known to exist on or adjacent to the project site that would preclude construction of the proposed BMPs.

4.3 Soil Contamination

During our recent site investigation, no evidence of soil contamination was observed, nor is any contamination known to exist onsite. Groundwater was not encountered during our subsurface investigations, and is not anticipated to be contaminated.

According to the State Water Resources Control Board Geotracker website, the closest contaminated site is located at 13330 Proctor Valley Road, approximately 500 feet north/northwest of the northerly boundary of the site and in excess of 1,500 feet from the nearest proposed BMP basin. This site had a leaking underground storage tank for diesel fuel. The cleanup case was opened on July 27, 2004 and is reported as Completed - Case Closed on October 10, 2006.

4.4 Soil Characteristics and Anticipated Flow Paths

The infiltration surfaces for the proposed BMP basins are anticipated to be located within the native material at the site (Older Alluvium, Otay Formation – Fanglomerate, or Santiago Peak Volcanics).

4.4.1 Older Alluvium

As encountered, the Older Alluvium generally consists of clayey fine to coarse-grained sand and sandy clay with variable amounts of gravel to cobble size clasts in a dense to very dense condition. Refusal to excavation occurred within trenches PT-5 and PT-6 at depths of 9 feet and 4 feet below ground surface, respectively. Tested infiltration rates within the Older Alluvium ranged from 0.18 to 0.64 inches/hour and are expected to vary from location to location due to variations in density and percentage of coarse-grained material (sand and gravel) versus fine-grained material (silt and clay). It is estimated that infiltration rates within the Older Alluvium will predominantly range between 0.10 and 0.35 inches/hour. For preliminary design purposes, it is recommended that the lower bound value of 0.10 inches/hour be used.

4.4.2 Otay Formation – Fanglomerate

This unit is typified by thickly to massively bedded breccia intertongued with a finer grained subunit consisting of claystone and sandstone. The breccia subunit is composed of subangular to angular, gravel to cobble size clasts in a clayey sand matrix. Occasional to common boulder sized clasts were encountered in our borings and excavator test pits. Rock clasts appear to be locally derived from the Santiago Peak Volcanics. The clay matrix is commonly waxy, highly expansive, and is likely bentonitic. The finer grained subunit is generally comprised of olive gray to pale brownish yellow, sandy claystone and clayey sandstone in slightly moist to moist and soft to hard condition. Tested infiltration rates within the Fanglomerate ranged from 0.20 to 0.72 inches/hour and are expected to vary from location to location due to variations in density and percentage of coarse-grained material (sand and gravel) versus fine-grained material (silt and clay). It is estimated that infiltration rates within the Fanglomerate will predominantly range between 0.05 and 0.20 inches/hour. For preliminary design purposes, it is recommended that the lower bound value of 0.05 be used. It should be noted that discrete bentonitic claystone lenses are common within the Otay Formation. These lenses are highly expansive and impermeable. Infiltration in areas where bentonitic claystone is present should be avoided.

4.4.3 Santiago Peak Volcanics

Santiago Peak Volcanics were not encountered during subsurface exploration for this study. However, subsurface excavations for previous geotechnical studies on the project site indicate the Santiago peak Volcanics are generally dense and mildly metamorphosed volcanic rocks. Composition of the volcanic rocks varies from basalt to rhyolite but is predominantly dacite and andesite. Typically the meta-volcanics display crude to moderate bedding and foliation. Fracturing is poorly to moderately well developed. In general, outside of boulder areas, a weathered halo of only a few feet thick exists. Below this, the rock is very dense and hard. The bedrock of the Santiago Peak Volcanics is impermeable. Flow of water through the Santiago Peak Volcanics occurs through fractures in the bedrock. Fracture networks within the bedrock are highly variable and accurate prediction of flow path is rarely possible. It is estimated that infiltration rates within the Santiago Peak Volcanics will predominantly range between 0.00 and 0.10 inches/hour. For preliminary design purposes, it is recommended that no infiltration be used.

4.5 <u>Proximity to Water Supply Wells</u>

No water supply wells are known to exist within 100 feet of the proposed basins.

5. CONCLUSIONS AND RECOMMENDATIONS

Several BMP basins are proposed throughout the project site and will be situated in varying soil/geologic units. Eight (8) borehole infiltration tests were performed at the locations depicted on the attached plans (Plates 1 through 3). Based on our site specific testing, partial infiltration in the areas tested is considered feasible. A lower bound preliminary design infiltration rate of 0.09 inches/hour was determined using a factor of safety of 2. However, it is recommended that a rate of 0.05 inches/hour be utilized in preliminary design of BMP basins sited within areas underlain by Otay Formation – Fanglomerate and a rate of 0.10 inches/hour be utilized in areas underlain by Older Alluvium. It is further recommended that no infiltration be utilized in preliminary design of BMP based sited in areas underlain by Santiago Peak Volcanics. Dependent upon the final location, size, and depth of the BMP basins, verification of the specific soil/geologic conditions and additional testing may be warranted.

6. FUTURE STUDY NEEDS

The overall project site encompasses approximately 1,370 acres and is underlain by varying geologic/soil conditions. Access to all proposed BMP locations with large excavation equipment was not possible at the time this report was prepared. The intent of this study was to evaluate the feasibility of infiltration type BMPs within the predominant geologic/soil units identified onsite. The infiltration rates presented herein are intended to be guidelines to aid in determining the size, location, and type of BMP during the preliminary design phase and are not suitable for final design purposes. When vehicle and equipment access to all proposed BMP locations becomes available, additional exploration and testing will be necessary to verify geologic/soil conditions and determine location specific infiltration rates.

Advanced Geotechnical Solutions, Inc. appreciates the opportunity to provide you with geotechnical consulting services and professional opinions. If you have any questions, please contact the undersigned at (619) 867-0487.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

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Distribution: (6) Addressee

Attachments: References
Plates 1 through 3 – Geologic Map and Exploration Location Plan
Appendix A- Storm Water Standards BMP Design Manual - Worksheet Form C.4-1, Support Documents and Field Data

REFERENCES

Advanced Geotechnical Solutions, Inc., 2017, Geotechnical Review of Preliminary Tentative Map and Grading Plan, Otay Ranch Village 14 and Planning Areas 16 and 19, County of San Diego, California, dated February 17, 2017 (Report No. 1312-02-B-6).

California Building Code (2013), California Code of Regulations, Title 24, Part 2, based on the 2012 International Building Code, prepared by California Building Standards Commission, Dated July 2013.

California Geologic Survey (CGS), 2002, Geologic Map of the Jamul Mountains 7.5' Quadrangle, San Diego County, California: A Digital Database, Scale 1:24,000.

California Geologic Survey (CGS), 2010, 150th Anniversary Fault Activity Map of California.

County of San Diego, Guidelines for Determining Significance, Geologic Hazards – Near Source Shaking Zones and Potential Liquefaction Areas, July 30, 2007.

Jennings, C.W., 1994, Fault Activity Map of California and Adjacent Areas, California Geologic Data Map Series, Map No. 6.

State of California Water Boards, February 7, 2017, *http://geotracker.waterboards.ca.gov/*

Tan, S.S., Landslide Hazards in the Jamul Mountains, OFR 92-12, Map No. 29.

Todd, V.R., Preliminary Geologic Map of the El Cajon 30'x60' Quadrangle, 2004, USGS OFR 2004-1361

URS, 2004, San Diego County Multi-Jurisdictional Hazard Mitigation Plan, San Diego County, California, dated March 15, 2004, (URS Project No. 27653042.00500)

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Walsh, Steven L. and Demere, Thomas A., 1991, Age and Stratigraphy of the Sweetwater and Otay Formations, San Diego County California, in Abbot P.L. and May, J.A., eds., 1991, Eocene Geologic History San Diego Region, Pacific Section SEPM, Vol. 68, pp. 131-148.

APPENDIX F

EARTHWORK SPECIFICATIONS

AND

GRADING DETAILS

GENERAL EARTHWORK SPECIFICATIONS

I. General

A. General procedures and requirements for earthwork and grading are presented herein. The earthwork and grading recommendations provided in the geotechnical report are considered part of these specifications, and where the general specifications provided herein conflict with those provided in the geotechnical report, the recommendations in the geotechnical report shall govern. Recommendations provided herein and in the geotechnical report may need to be modified depending on the conditions encountered during grading.

B. The contractor is responsible for the satisfactory completion of all earthwork in accordance with the project plans, specifications, applicable building codes, and local governing agency requirements. Where these requirements conflict, the stricter requirements shall govern.

C. It is the contractor's responsibility to read and understand the guidelines presented herein and in the geotechnical report as well as the project plans and specifications. Information presented in the geotechnical report is subject to verification during grading. The information presented on the exploration logs depict conditions at the particular time of excavation and at the location of the excavation. Subsurface conditions present at other locations may differ, and the passage of time may result in different subsurface conditions being encountered at the locations of the exploratory excavations. The contractor shall perform an independent investigation and evaluate the nature of the surface and subsurface conditions to be encountered and the procedures and equipment to be used in performing his work.

D. The contractor shall have the responsibility to provide adequate equipment and procedures to accomplish the earthwork in accordance with applicable requirements. When the quality of work is less than that required, the Geotechnical Consultant may reject the work and may recommend that the operations be suspended until the conditions are corrected.

E. Prior to the start of grading, a qualified Geotechnical Consultant should be employed to observe grading procedures and provide testing of the fills for conformance with the project specifications, approved grading plan, and guidelines presented herein. All remedial removals, clean-outs, removal bottoms, keyways, and subdrain installations should be observed and documented by the Geotechnical Consultant prior to placing fill. It is the contractor's responsibility to appraise the Geotechnical Consultant of their schedules and notify the Geotechnical Consultant when those areas are ready for observation.

F. The contractor is responsible for providing a safe environment for the Geotechnical Consultant to observe grading and conduct tests.

II. Site Preparation

A. Clearing and Grubbing: Excessive vegetation and other deleterious material shall be sufficiently removed as required by the Geotechnical Consultant, and such materials shall be properly disposed of offsite in a method acceptable to the owner and governing agencies. Where applicable, the contractor may obtain permission from the Geotechnical Consultant, owner, and governing agencies to dispose of vegetation and other deleterious materials in designated areas onsite.

B. Unsuitable Soils Removals: Earth materials that are deemed unsuitable for the support of fill shall be removed as necessary to the satisfaction of the Geotechnical Consultant.

C. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, other utilities, or other structures located within the limits of grading shall be removed and/or abandoned in accordance with the requirements of the governing agency and to the satisfaction of the Geotechnical Consultant.

D. Preparation of Areas to Receive Fill: After removals are completed, the exposed surfaces shall be scarified to a depth of approximately 8 inches, watered or dried, as needed, to achieve a generally uniform moisture content that is at or near optimum moisture content. The scarified materials shall then be compacted to the project requirements and tested as specified.

E. All areas receiving fill shall be observed and approved by the Geotechnical Consultant prior to the placement of fill. A licensed surveyor shall provide survey control for determining elevations of processed areas and keyways.

III. Placement of Fill

A. Suitability of fill materials: Any materials, derived onsite or imported, may be utilized as fill provided that the materials have been determined to be suitable by the Geotechnical Consultant. Such materials shall be essentially free of organic matter and other deleterious materials, and be of a gradation, expansion potential, and/or strength that is acceptable to the Geotechnical Consultant. Fill materials shall be tested in a laboratory approved by the Geotechnical Consultant, and import materials shall be tested and approved prior to being imported.

B. Generally, different fill materials shall be thoroughly mixed to provide a relatively uniform blend of materials and prevent abrupt changes in material type. Fill materials derived from benching should be dispersed throughout the fill area instead of placing the materials within only an equipment-width from the cut/fill contact.

C. Oversize Materials: Rocks greater than 8 inches in largest dimension shall be disposed of offsite or be placed in accordance with the recommendations by the Geotechnical Consultant in the areas that are designated as suitable for oversize rock placement. Rocks that are smaller than 8 inches in largest dimension may be utilized in the fill provided that they are not nested and are their quantity and distribution are acceptable to the Geotechnical Consultant.

D. The fill materials shall be placed in thin, horizontal layers such that, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and shall be thoroughly mixed to obtain a near uniform moisture content and uniform blend of materials.

E. Moisture Content: Fill materials shall be placed at or above the optimum moisture content or as recommended by the geotechnical report. Where the moisture content of the engineered fill is less than recommended, water shall be added, and the fill materials shall be blended so that a near uniform moisture content is achieved. If the moisture content is above the limits specified by the Geotechnical Consultant, the fill materials shall be aerated by discing, blading, or other methods until the moisture content is acceptable.

F. Each layer of fill shall be compacted to the project standards in accordance to the project specifications and recommendations of the Geotechnical Consultant. Unless otherwise specified by the Geotechnical

Consultant, the fill shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method: D1557-09.

G. Benching: Where placing fill on a slope exceeding a ratio of 5 to 1 (horizontal to vertical), the ground should be keyed or benched. The keyways and benches shall extend through all unsuitable materials into suitable materials such as firm materials or sound bedrock or as recommended by the Geotechnical Consultant. The minimum keyway width shall be 15 feet and extend into suitable materials, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. The minimum keyway width for fill over cut slopes is also 15 feet, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. As a general rule, unless otherwise recommended by the Geotechnical Consultant, the minimum width of the keyway shall be equal to 1/2 the height of the fill slope.

H. Slope Face: The specified minimum relative compaction shall be maintained out to the finish face of fill and stabilization fill slopes. Generally, this may be achieved by overbuilding the slope and cutting back to the compacted core. The actual amount of overbuilding may vary as field conditions dictate. Alternately, this may be achieved by backrolling the slope face with suitable equipment or other methods that produce the designated result. Loose soil should not be allowed to build up on the slope face. If present, loose soils shall be trimmed to expose the compacted slope face.

I. Slope Ratio: Unless otherwise approved by the Geotechnical Consultant and governing agencies, permanent fill slopes shall be designed and constructed no steeper than 2 to 1 (horizontal to vertical).

J. Natural Ground and Cut Areas: Design grades that are in natural ground or in cuts should be evaluated by the Geotechnical Consultant to determine whether scarification and processing of the ground and/or overexcavation is needed.

K. Fill materials shall not be placed, spread, or compacted during unfavorable weather conditions. When grading is interrupted by rain, filing operations shall not resume until the Geotechnical Consultant approves the moisture and density of the previously placed compacted fill.

IV. Cut Slopes

A. The Geotechnical Consultant shall inspect all cut slopes, including fill over cut slopes, and shall be notified by the contractor when cut slopes are started.

B. If adverse or potentially adverse conditions are encountered during grading, the Geotechnical Consultant shall investigate, evaluate, and make recommendations to mitigate the adverse conditions.

C. Unless otherwise stated in the geotechnical report, cut slopes shall not be excavated higher or steeper than the requirements of the local governing agencies. Short-term stability of the cut slopes and other excavations is the contractor's responsibility.

V. Drainage

A. Backdrains and Subdrains: Backdrains and subdrains shall be provided in fill as recommended by the Geotechnical Consultant and shall be constructed in accordance with the governing agency and/or recommendations of the Geotechnical Consultant. The location of subdrains, especially outlets, shall be surveyed and recorded by the Civil Engineer.

B. Top-of-slope Drainage: Positive drainage shall be established away from the top of slope. Site drainage shall not be permitted to flow over the tops of slopes.

C. Drainage terraces shall be constructed in compliance with the governing agency requirements and/or in accordance with the recommendations of the Geotechnical Consultant.

D. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the prevailing drainage.

VI. Erosion Control

A. All finish cut and fill slopes shall be protected from erosion and/or planted in accordance with the project specifications and/or landscape architect's recommendations. Such measures to protect the slope face shall be undertaken as soon as practical after completion of grading.

B. During construction, the contractor shall maintain proper drainage and prevent the ponding of water. The contractor shall take remedial measures to prevent the erosion of graded areas until permanent drainage and erosion control measures have been installed.

VII. Trench Excavation and Backfill

A. Safety: The contractor shall follow all OSHA requirements for safety of trench excavations. Knowing and following these requirements is the contractor's responsibility. All trench excavations or open cuts in excess of 5 feet in depth shall be shored or laid back. Trench excavations and open cuts exposing adverse geologic conditions may require further evaluation by the Geotechnical Consultant. If a contractor fails to provide safe access for compaction testing, backfill not tested due to safety concerns may be subject to removal.

B. Bedding: Bedding materials shall be non-expansive and have a Sand Equivalent greater than 30. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting.

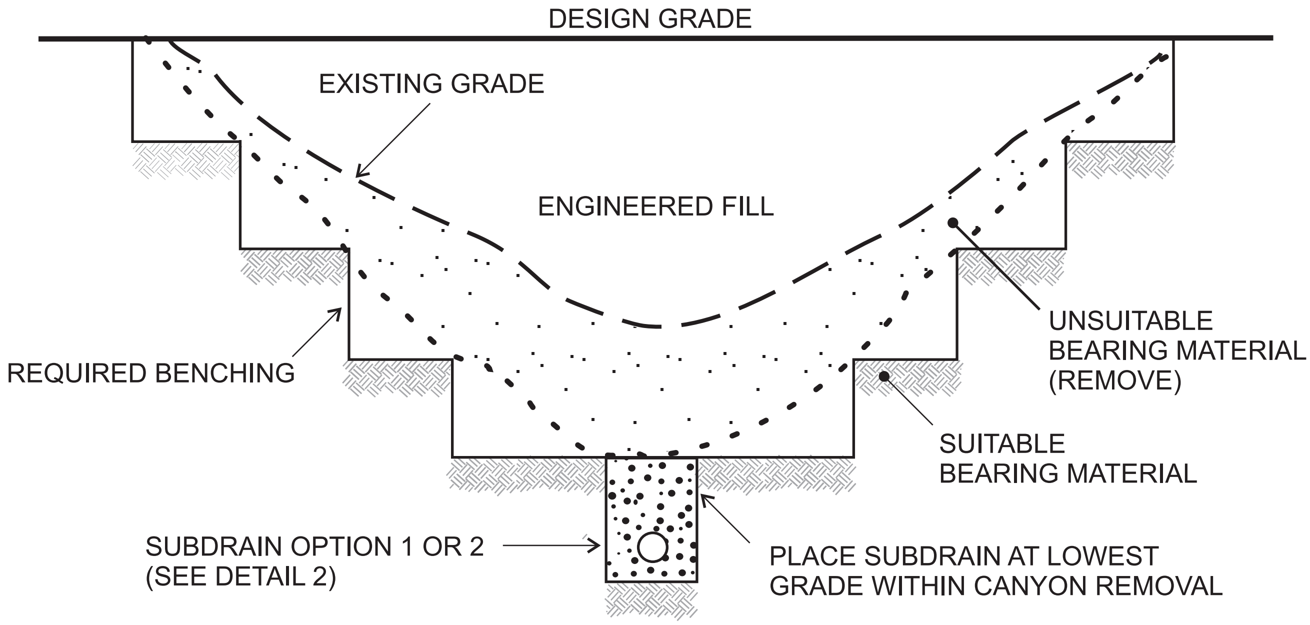
C. Backfill: Jetting of backfill materials is generally not acceptable. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting provided the backfill materials are granular, free-draining and have a Sand Equivalent greater than 30.

VIII. Geotechnical Observation and Testing During Grading

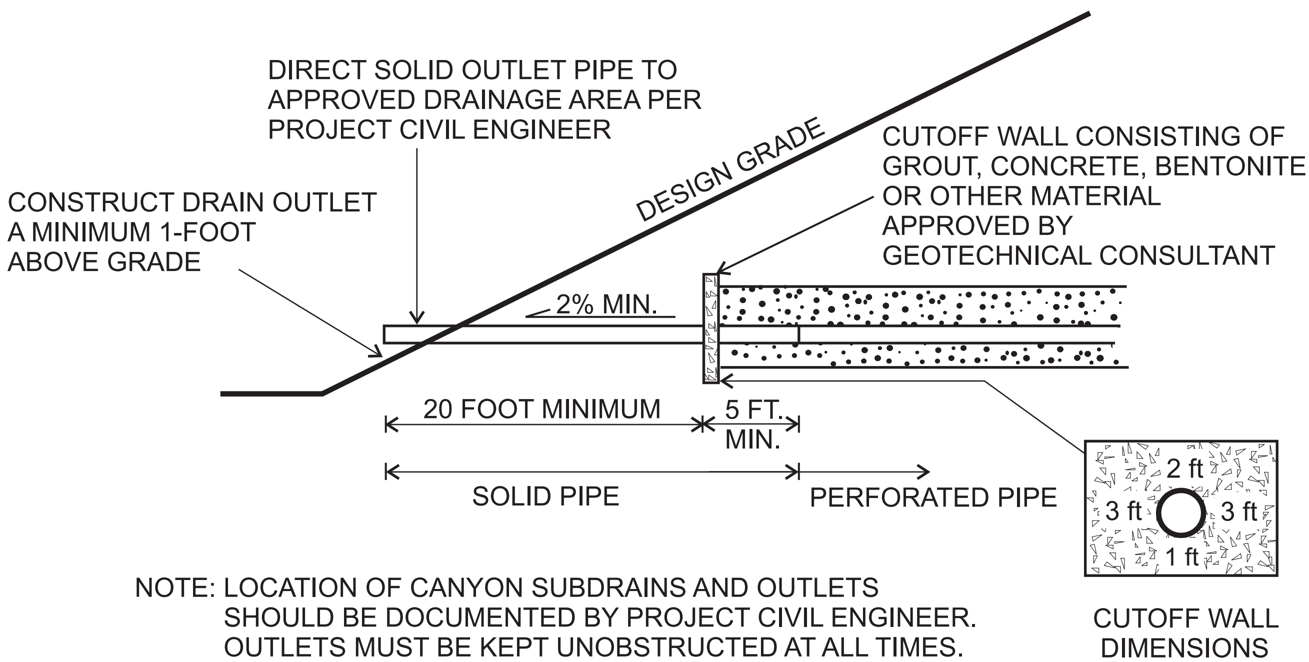
A. Compaction Testing: Fill shall be tested by the Geotechnical Consultant for evaluation of general compliance with the recommended compaction and moisture conditions. The tests shall be taken in the compacted soils beneath the surface if the surficial materials are disturbed. The contractor shall assist the Geotechnical Consultant by excavating suitable test pits for testing of compacted fill.

B. Where tests indicate that the density of a layer of fill is less than required, or the moisture content not within specifications, the Geotechnical Consultant shall notify the contractor of the unsatisfactory conditions of the fill. The portions of the fill that are not within specifications shall be reworked until the required density and/or moisture content has been attained. No additional fill shall be placed until the last lift of fill is tested and found to meet the project specifications and approved by the Geotechnical Consultant.

C. If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as adverse weather, excessive rock or deleterious materials being placed in the fill, insufficient equipment, excessive rate of fill placement, results in a quality of work that is unacceptable, the consultant shall notify the contractor, and the contractor shall rectify the conditions, and if necessary, stop work until conditions are satisfactory.



CANYON SUBDRAIN PROFILE



NOTE: LOCATION OF CANYON SUBDRAINS AND OUTLETS SHOULD BE DOCUMENTED BY PROJECT CIVIL ENGINEER. OUTLETS MUST BE KEPT UNOBSTRUCTED AT ALL TIMES.

CANYON SUBDRAIN TERMINUS

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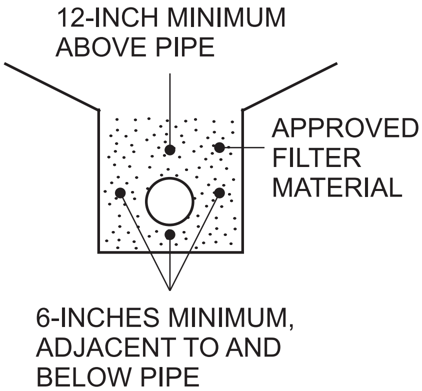
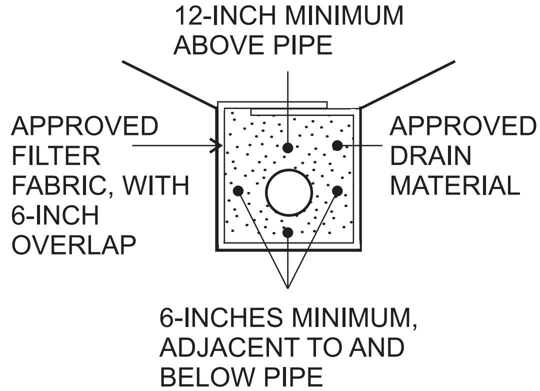
AGS ADVANCED GEOTECHNICAL SOLUTIONS	CANYON SUBDRAIN	DETAIL 1



OPTION 1

FILTER MATERIAL: MINIMUM VOLUME OF 9 CUBIC FEET PER LINEAL FOOT OF CALTRANS CLASS 2 PERMEABLE MATERIAL



OPTION 2

DRAIN MATERIAL: MINIMUM VOLUME OF 9 CUBIC FEET PER LINEAL FOOT OF 3/4-INCH MAX ROCK OR APPROVED EQUIVALENT SUBSTITUTE

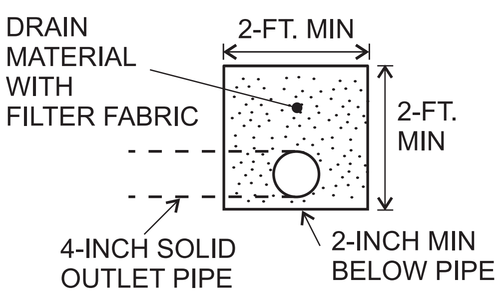
FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE

PIPE: 6 OR 8-INCH ABS OR PVC PIPE OR APPROVED SUBSTITUTE WITH A MINIMUM OF 8 PERFORATIONS (1/4-INCH DIAMETER) PER LINEAL FOOT IN BOTTOM HALF OF PIPE

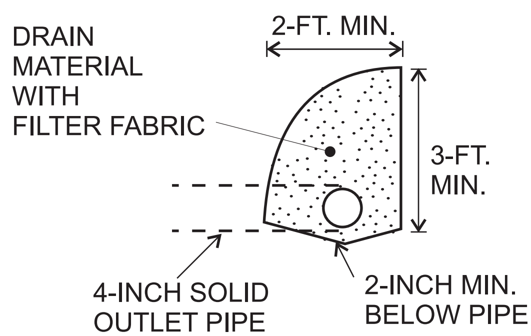
(ASTM D2751, SDR-35 OR ASTM D3034, SDR-35
ASTM D1527, SCHD. 40 OR ASTM D1785, SCHD. 40)

NOTE: CONTINUOUS RUN IN EXCESS OF 5OO FEET REQUIRES 8-INCH DIAMETER PIPE (ASTM D3034, SDR-35, OR ASTM D1785, SCHD. 40)

CANYON SUBDRAIN



OPTION 1



OPTION 2

DRAIN MATERIAL: GRAVEL TRENCH TO BE FILLED WITH 3/4-INCH MAX ROCK OR APPROVED EQUIVALENT SUBSTITUTE

FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR EQUIVALENT SUBSTITUTE WITH A MINIMUM 6-INCH OVERLAP

PIPE: 4-INCH ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE WITH A MINIMUM OF 8 PERFORATIONS (1/4-INCH DIAMETER) PER LINEAL FOOT IN BOTTOM HALF OF PIPE

(ASTM D2751, SDR-35 OR ASTM D3034, SDR-35
ASTM D1527, SCHD. 40 OR ASTM D1785, SCHD. 40)

BUTTRESS/STABILIZATION DRAIN

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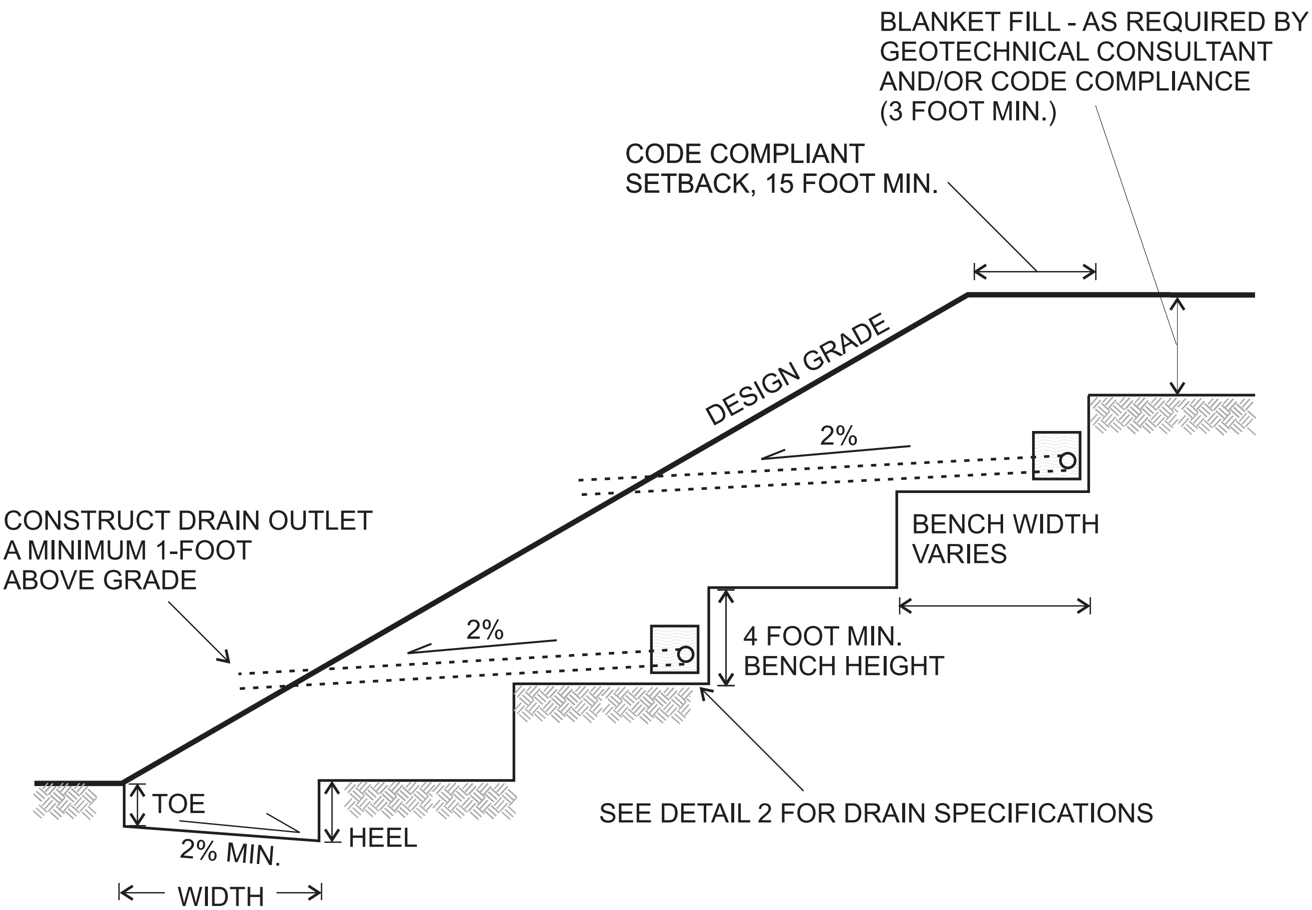
AGS ADVANCED GEOTECHNICAL SOLUTIONS	DRAIN SPECIFICATIONS	DETAIL 2



CODE COMPLIANT KEYWAY WITH MINIMUM DIMENSIONS:

TOE	2 FOOT MIN.
HEEL	3 FOOT MIN.
WIDTH	15 FOOT MIN.

NOTES:

1. DRAIN OUTLETS TO BE PROVIDED EVERY 100 FEET CONNECT TO PERFORATED DRAIN PIPE BY “L” OR “T” AT A MINIMUM 2% GRADIENT.

2. THE NECESSITY AND LOCATION OF ADDITIONAL DRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT. UPPER STAGE OUTLETS SHOULD BE EMPTIED ONTO CONCRETE TERRACE DRAINS.

3. DRAIN PIPE TO EXTEND FULL LENGTH OF STABILIZATION/BUTTRESS WITH A MINIMUM GRADIENT OF 2% TO SOLID OUTLET PIPES.

4. LOCATION OF DRAINS AND OUTLETS SHOULD BE DOCUMENTED BY PROJECT CIVIL ENGINEER. OUTLETS MUST BE KEPT UNOBSTRUCTED AT ALL TIMES.

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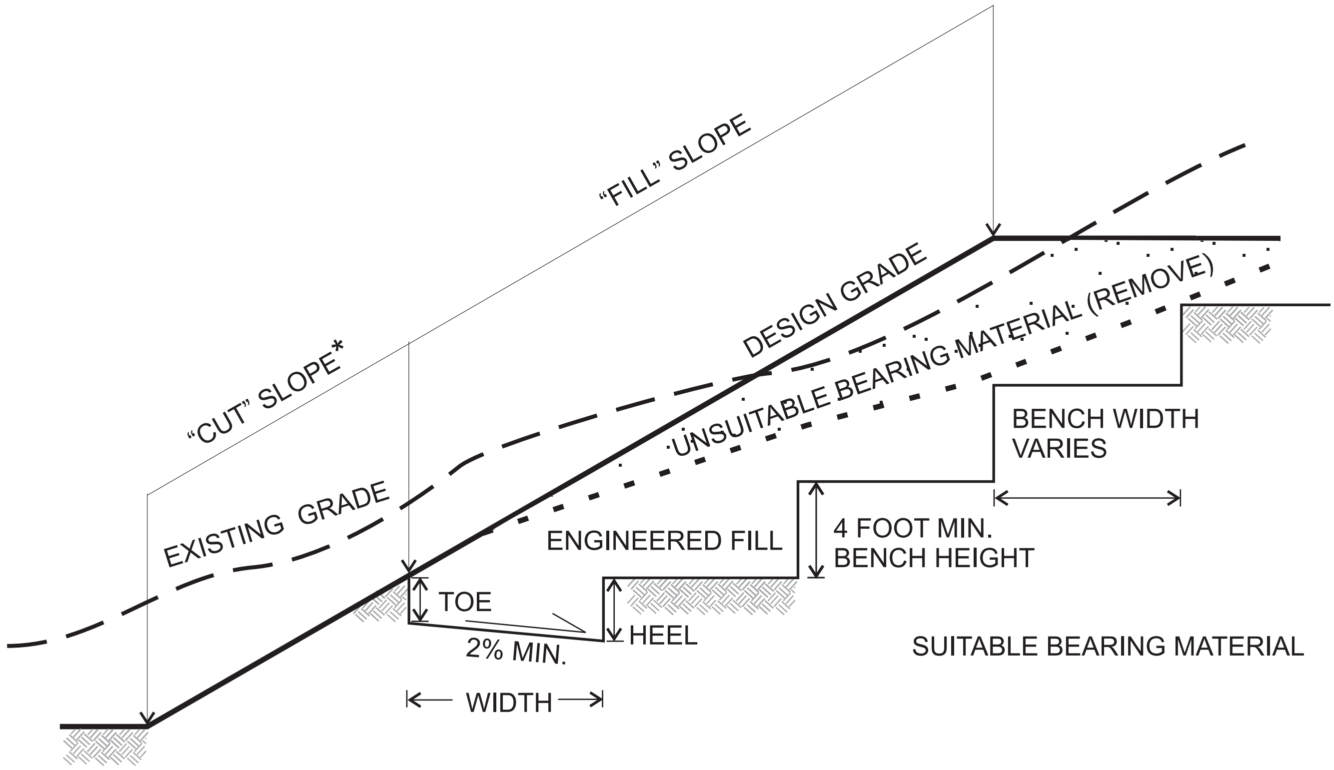
ADVANCED GEOTECHNICAL SOLUTIONS

STABILIZATION/BUTTRESS FILL

DETAIL 3

* THE “CUT” PORTION OF THE SLOPE SHALL BE EXCAVATED AND EVALUATED BY THE GEOTECHNICAL CONSULTANT PRIOR TO CONSTRUCTING THE “FILL” PORTION



SUITABLE
BEARING MATERIAL

CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.
HEEL: 3 FOOT MIN.
WIDTH: 15 FOOT MIN.

NOTES:

1. THE NECESSITY AND LOCATION OF DRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT

2. SEE DETAIL 2 FOR DRAIN SPECIFICATIONS

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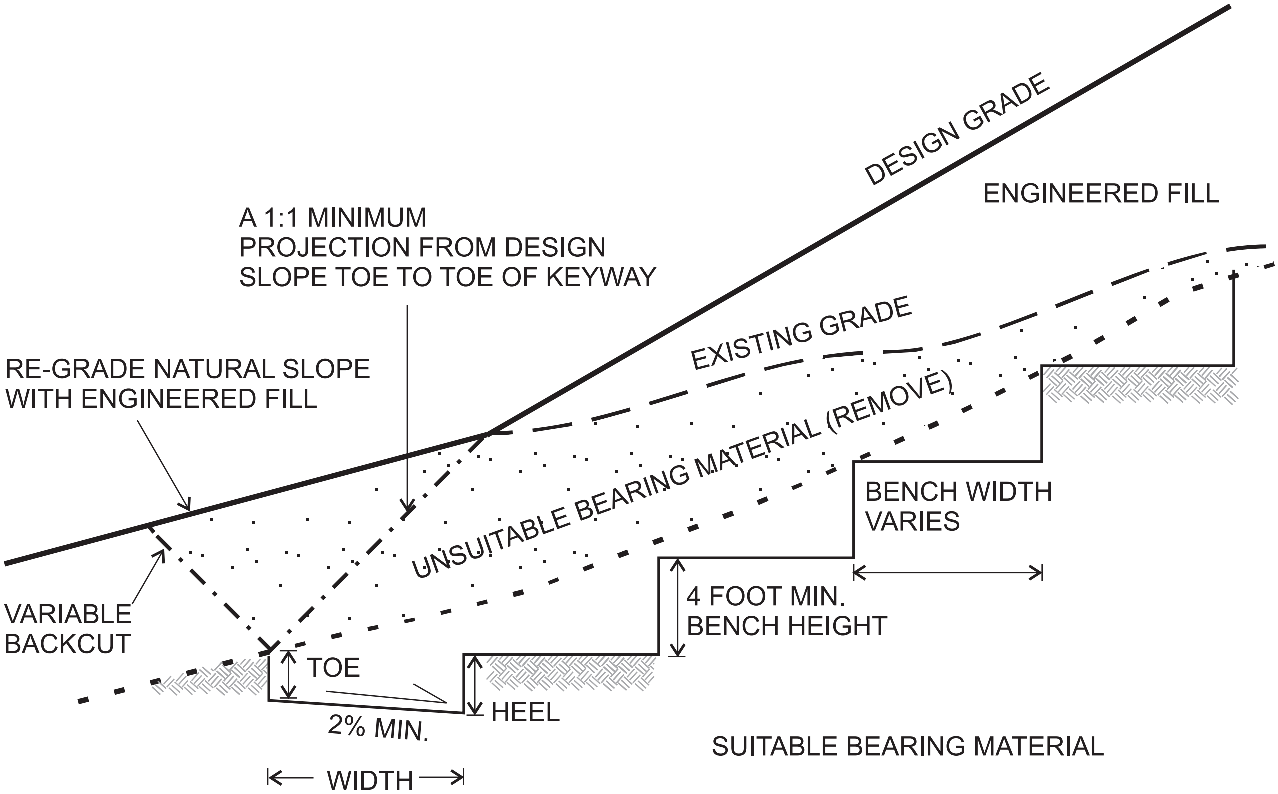
ADVANCED GEOTECHNICAL SOLUTIONS

FILL OVER CUT SLOPE

DETAIL 4



CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.
HEEL: 3 FOOT MIN.
WIDTH: 15 FOOT MIN.

NOTES:

1. WHEN THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN GRADE SLOPE RATIO, SPECIAL RECOMMENDATIONS ARE NECESSARY BY THE GEOTECHNICAL CONSULTANT

2. THE GEOTECHNICAL CONSULTANT WILL DETERMINE THE REQUIREMENT FOR AND LOCATION OF SUBSURFACE DRAINAGE SYSTEMS.

3. MAINTAIN MINIMUM 15 FOOT HORIZONTAL WIDTH FROM FACE OF SLOPE TO BENCH/BACKCUT

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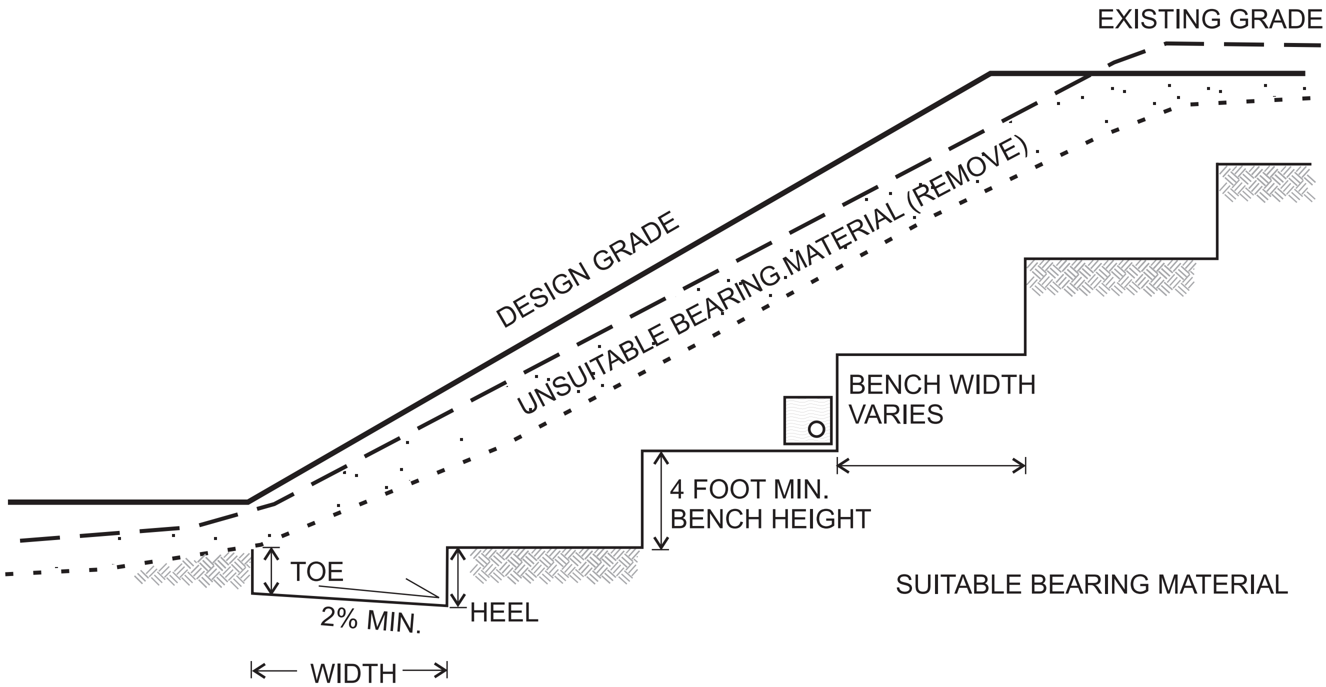
ADVANCED GEOTECHNICAL SOLUTIONS

FILL OVER NATURAL SLOPE

DETAIL 5

L



CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.
HEEL: 3 FOOT MIN.
WIDTH: 15 FOOT MIN.

NOTES:

1. MAINTAIN MINIMUM 15 FOOT HORIZONTAL WIDTH FROM FACE OF SLOPE TO BENCH/BACKCUT
2. SEE DETAIL 2 FOR DRAIN SPECIFICATIONS

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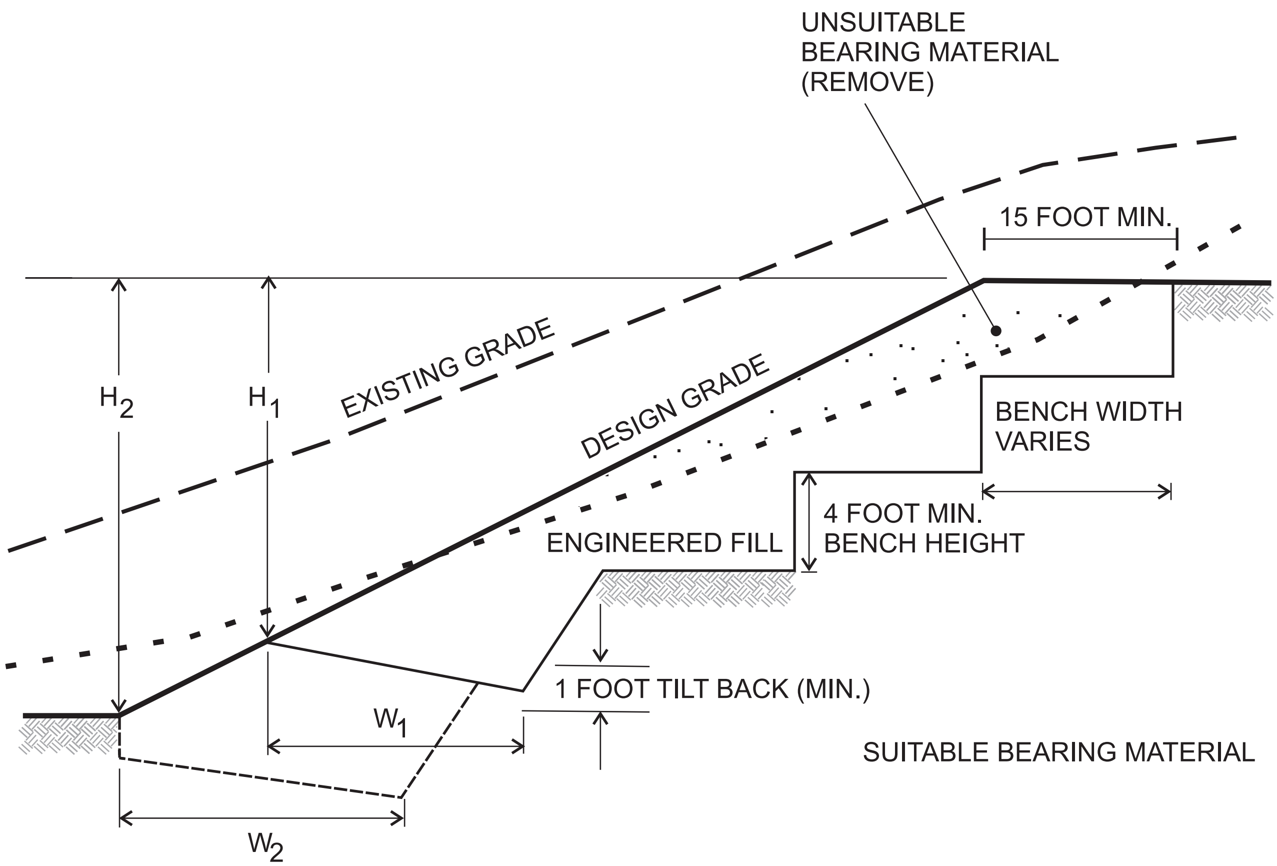
ADVANCED GEOTECHNICAL SOLUTIONS

SKIN FILL CONDITION

DETAIL 6



NOTES:

1. IF RECOMMENDED BY THE GEOTECHNICAL CONSULTANT, THE REMAINING CUT PORTION OF THE SLOPE MAY REQUIRE REMOVAL AND REPLACEMENT WITH AN ENGINEERED FILL

2. “W” SHALL BE EQUIPMENT WIDTH (15 FEET) FOR SLOPE HEIGHT LESS THAN 25 FEET. FOR SLOPES GREATER THAN 25 FEET, “W” SHALL BE DETERMINED BY THE GEOTECHNICAL CONSULTANT. AT NO TIME SHALL “W” BE LESS THAN H/2

3. DRAINS WILL BE REQUIRED (SEE DETAIL 2)

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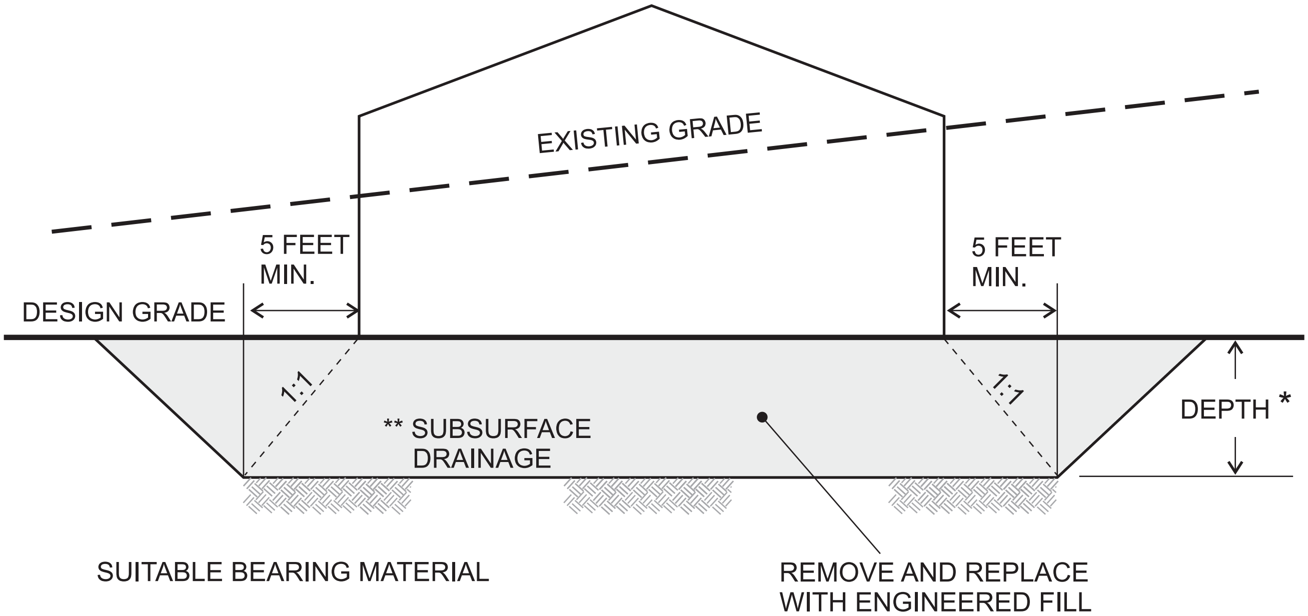
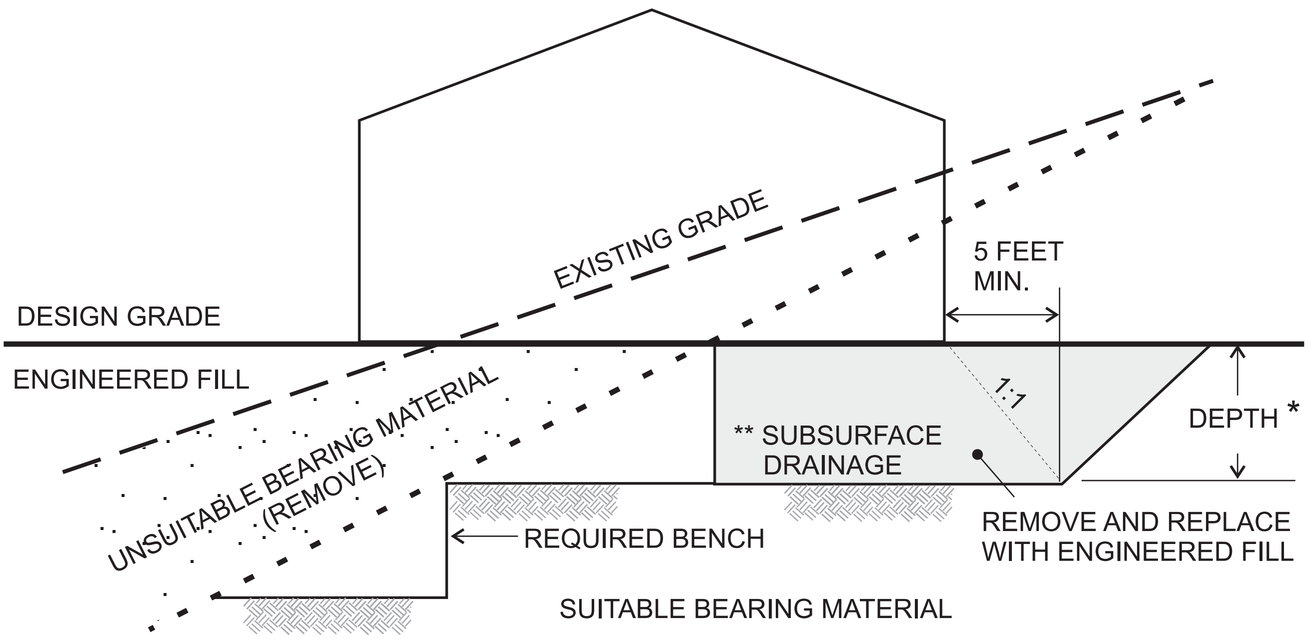
AGS ADVANCED GEOTECHNICAL SOLUTIONS	PARTIAL CUT SLOPE STABILIZATION	DETAIL 7



CUT LOT OVEREXCAVATION



CUT-FILL LOT OVEREXCAVATION

NOTES:

* SEE REPORT FOR RECOMMENDED DEPTHS, DEEPER OVEREXCAVATION MAY BE REQUIRED BY THE GEOTECHNICAL CONSULTANT BASED ON EXPOSED FIELD CONDITIONS

** CONSTRUCT EXCAVATION TO PROVIDE FOR POSITIVE DRAINAGE TOWARDS STREETS, DEEPER FILL AREAS OR APPROVED DRAINAGE DEVICES BASED ON FIELD CONDITIONS

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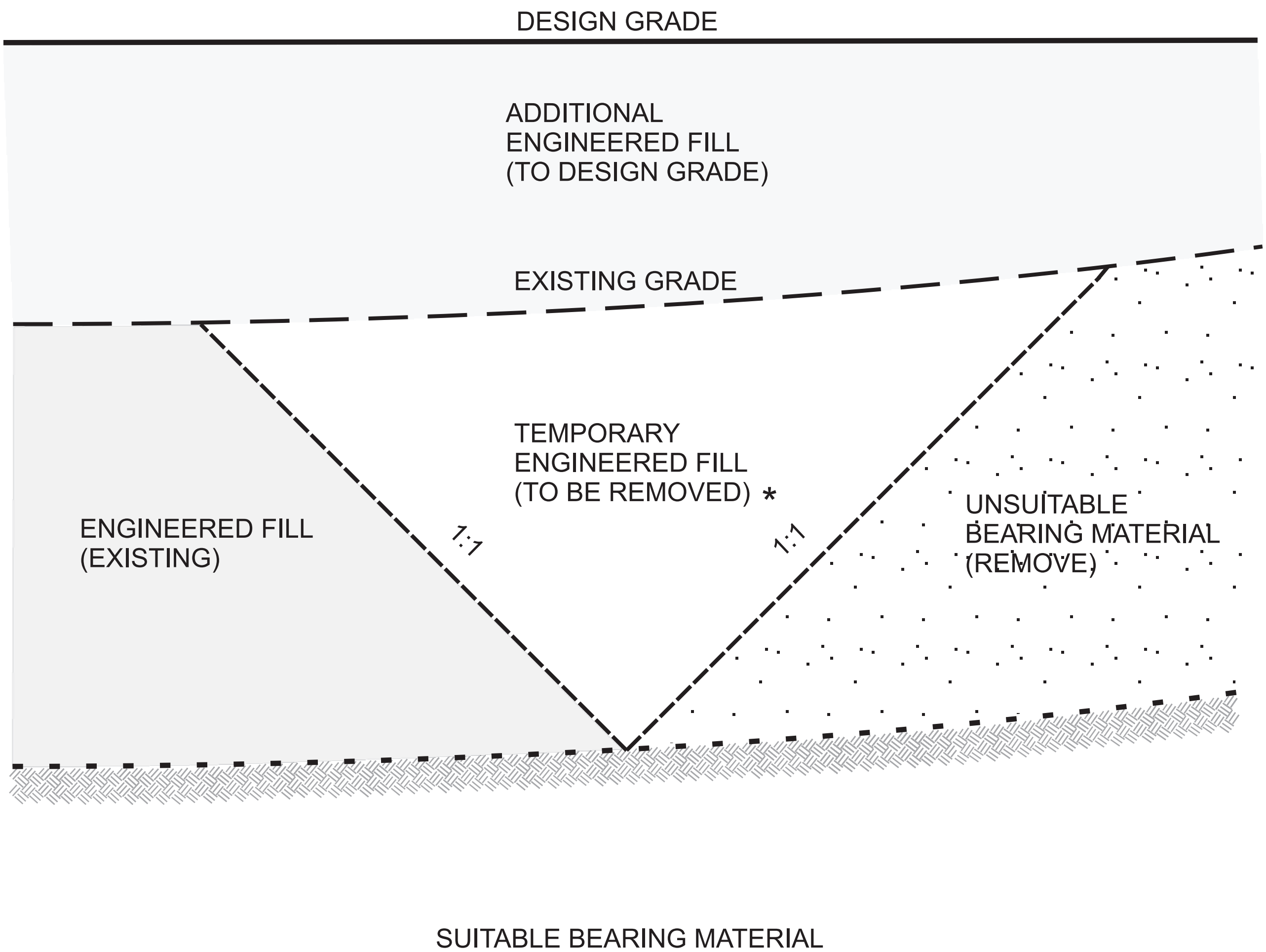
AGS ADVANCED GEOTECHNICAL SOLUTIONS	CUT & CUT-FILL LOT OVEREXCAVATION	DETAIL 8



* REMOVE BEFORE PLACING ADDITIONAL ENGINEERED FILL

TYPICAL UP-CANYON PROFILE

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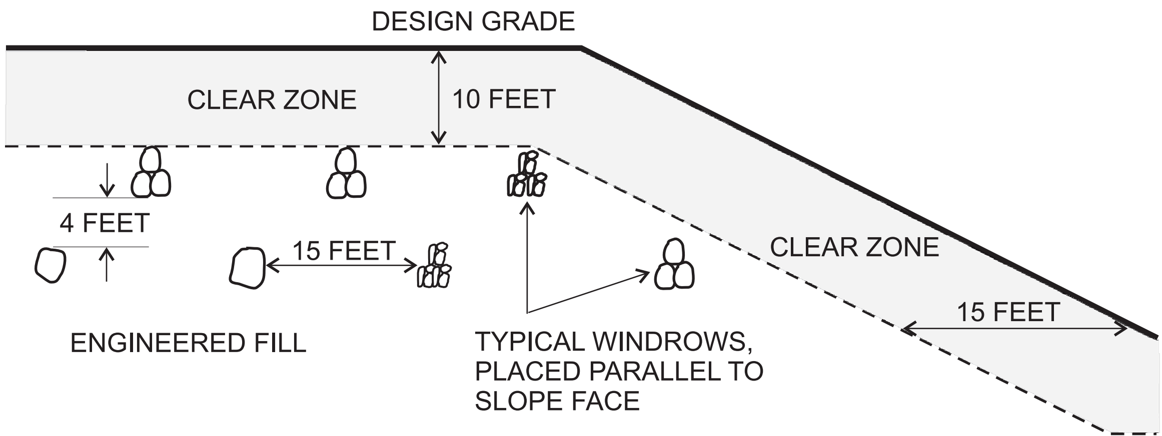
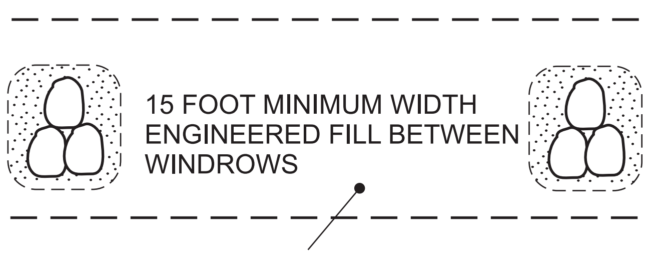
AGS ADVANCED GEOTECHNICAL SOLUTIONS	REMOVAL ADJACENT TO EXISTING FILL	DETAIL 9



CLEAR ZONE DIMENSIONS FOR REFERENCE ONLY, ACTUAL DEPTH, WIDTH, WINDROW LENGTH, ETC. TO BE BASED ON ELEVATIONS OF FOUNDATIONS, UTILITIES OR OTHER STRUCTURES PER THE GEOTECHNICAL CONSULTANT OR GOVERNING AGENCY APPROVAL

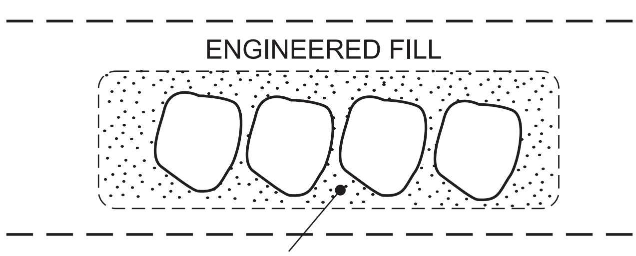
OVERSIZED MATERIAL DISPOSAL PROFILE



HORIZONTALLY PLACED ENGINEERED FILL, FREE OF OVERSIZED MATERIALS AND COMPACTED TO MINIMUM PROJECT STANDARDS

COMPACT ENGINEERED FILL ABOVE OVERSIZED MATERIALS TO FACILITATE "TRENCH" CONDITION PRIOR TO FLOODING GRANULAR MATERIALS

WINDROW CROSS-SECTION



GRANULAR MATERIAL APPROVED BY THE GEOTECHNICAL CONSULTANT AND CONSOLIDATED IN-PLACE BY FLOODING

WINDROW PROFILE

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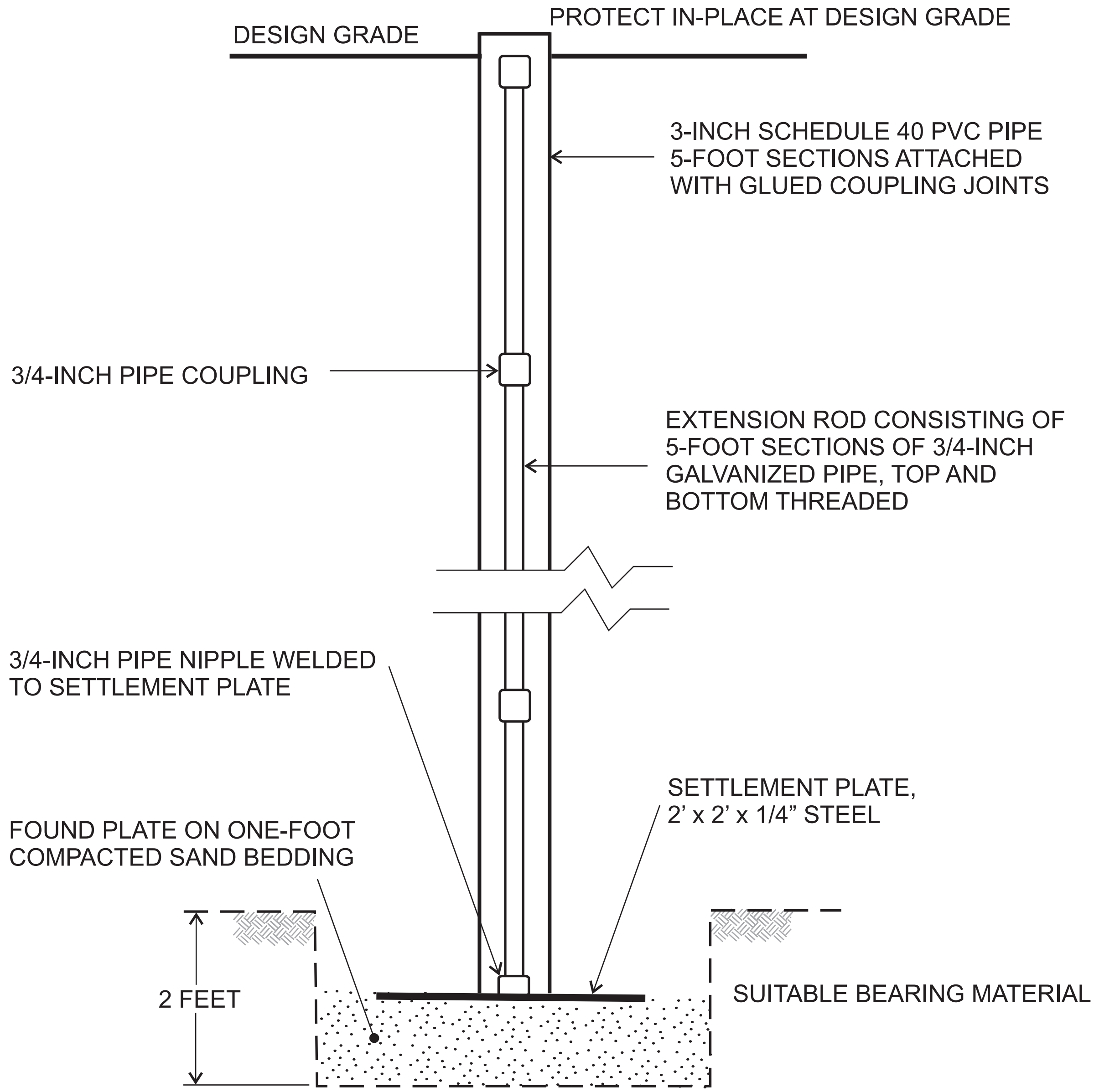
AGS ADVANCED GEOTECHNICAL SOLUTIONS	OVERSIZED MATERIAL DISPOSAL CRITERIA	DETAIL 10



NOTES:

1. SETTLEMENT PLATE LOCATIONS SHALL BE SUFFICIENTLY IDENTIFIED BY THE CONTRACTOR AND BE READILY VISIBLE TO EQUIPMENT OPERATORS.

2. CONTRACTOR SHALL MAINTAIN ADEQUATE HORIZONTAL CLEARANCE FOR EQUIPMENT OPERATION AND SHALL BE RESPONSIBLE FOR REPAIRING ANY DAMAGE TO SETTLEMENT PLATE DURING SITE CONSTRUCTION.

3. A MINIMUM 5-FOOT ZONE ADJACENT TO SETTLEMENT PLATE/EXTENSION RODS SHALL BE ESTABLISHED FOR HAND-HELD MECHANICAL COMPACTION OF ENGINEERED FILL. ENGINEERED FILL SHALL BE COMPACTED TO MINIMUM PROJECT STANDARD.

4. ELEVATIONS OF SETTLEMENT PLATE AND ALL EXTENSION ROD PLACEMENT SHALL BE DOCUMENTED BY PROJECT CIVIL ENGINEER OR SURVEYOR.

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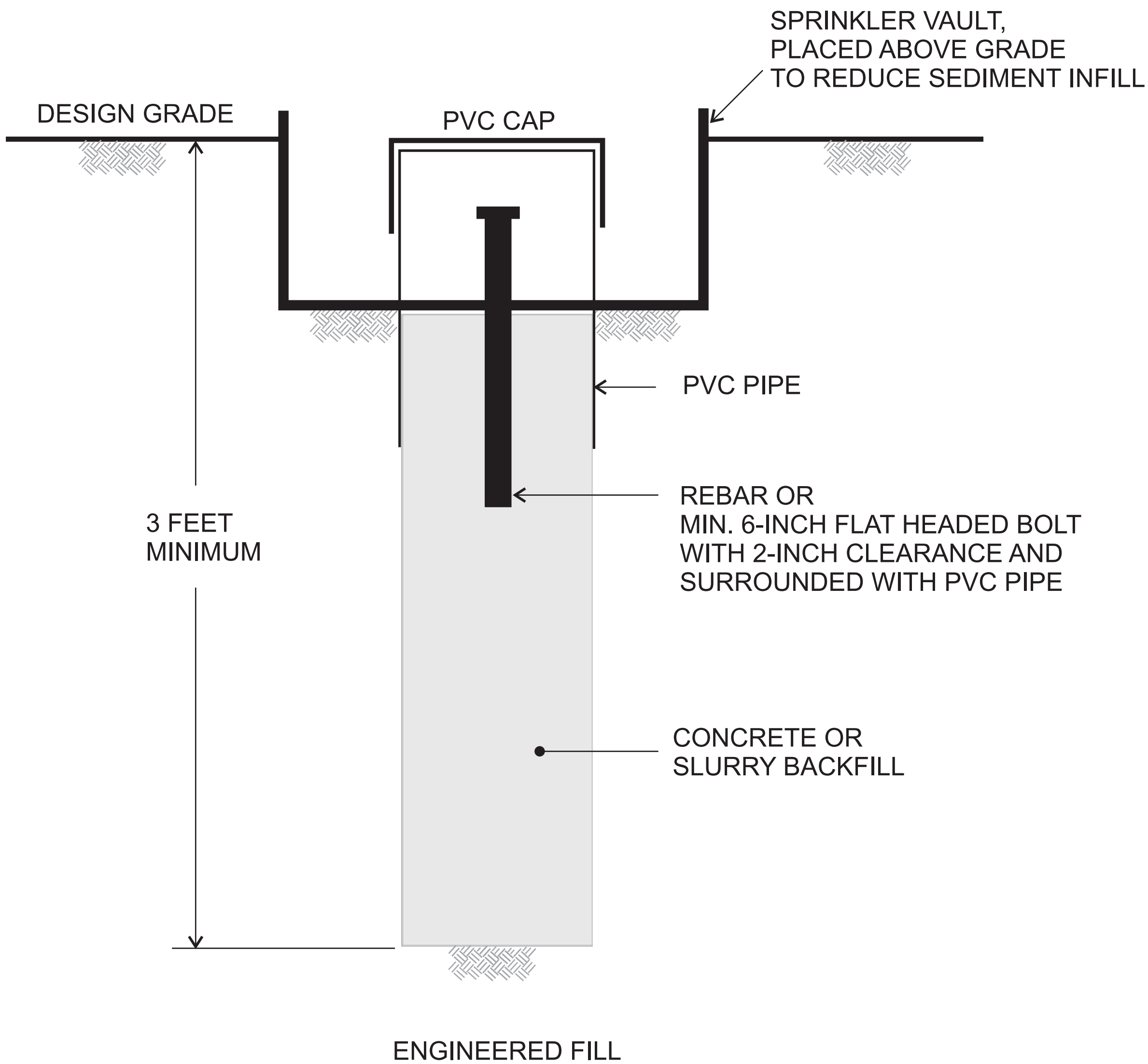
AGS ADVANCED GEOTECHNICAL SOLUTIONS	SETTLEMENT PLATE	DETAIL 11



NOTES:

1. SETTLEMENT MONUMENT LOCATIONS SHALL BE SUFFICIENTLY IDENTIFIED AND BE READILY VISIBLE TO EQUIPMENT OPERATORS.

2. ELEVATIONS OF SURFACE MONUMENTS SHALL BE DOCUMENTED BY PROJECT CIVIL ENGINEER OR SURVEYOR.

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ADVANCED GEOTECHNICAL SOLUTIONS	SETTLEMENT MONUMENT	DETAIL 12