ENGEO INCORPORATED

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

GEOTECHNICAL REPORT

SILVER SPRINGS RESIDENTIAL DEVELOPMENT AND OFFSITE IMPROVEMENTS

EL DORADO COUNTY, CALIFORNIA

SUBMITTED

TO

SILVER SPRINGS LLC
2999 OAK ROAD, SUITE 400
WALNUT CREEK, CALIFORNIA 94597

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 7125.5.001.01

FEBRUARY 1, 2006

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1. INTRODUCTION

ENGEO Incorporated prepared this geotechnical report for design of the Silver Springs Residential Development and offsite improvements in El Dorado County, California.

Anderson Consulting Group (ACG) performed 38 subsurface explorations and five seismic refraction surveys at the project site, and prepared the geotechnical report for the Silver Springs Residential Development, titled "Geotechnical Report for Bass Lake Property," file No. 2011-3, dated May 26, 1989. In 2000, ACG prepared a geotechnical report update for the Silver Springs Phases I, II, III, IV, (formerly the Bass Lake Property) and the Bass Lake Road Realignment. ENGEO Incorporated acquired the assets of ACG in 2002.

At your request, we performed additional exploration to supplement the 1989 ACG subsurface information and prepared this geotechnical report to provide geotechnical recommendations for the following eight components of the Silver Springs Development project:

- Silver Springs Unit 1
- Silver Springs Unit 2
- Silver Springs Unit 3
- Green Valley Road and Deer Valley Road Widening
- Bass Lake Road Widening
- Silver Springs Force Main Extension
- Preliminary geotechnical information for the Parcel 2 Tentative Map
- Preliminary geotechnical information for the Lot 7 Tentative Map

For our use, we received the following documents prepared by Stantec Consulting Incorporated (Stantec):

1. "Silver Springs Unit 1, padded single family detached dwellings, Exhibit A;" dated November 4, 2005.
2. "Silver Springs Unit 2 & 3, non-padded single family detached dwellings, Exhibit B & C;" dated November 4, 2005.
3. "Green Valley / Deer Valley Widening, Exhibit D;" undated.
4. "Bass Lake Road Widening, Exhibit E;" undated.
5. "Silver Springs Force Main Extension, Exhibit F;" undated.
6. "Preliminary Grading and Improvement Plans for Green Valley / Deer Valley;" plot date November 7, 2005.

For our use, we received the following documents prepared by MacKay & Somps Civil Engineers Incorporated (MacKay & Somps):

1. "Preliminary Plans for the Improvement of Silver Springs, Large Lot Subdivision I-133, Silver Springs Parkway Realignment Onsight Phase – 2;" plot date April 8, 2005.

2. "Silver Springs Large Lot Tentative Map and Small Lot Tentative Map, El Dorado County, California;" prepared June 2, 1997, latest revision date November 2, 1998.

1.1 SCOPE OF SERVICES

ENGEO prepared this report as outlined in our agreement dated December 5, 2005. Silver Springs LLC authorized ENGEO to conduct the proposed scope of services, which included the following:

- Service Plan Development
- Subsurface Field Exploration
- Soil Laboratory Testing
- Data Analysis and Conclusions
- Report Preparation.

1.2 PROJECT LOCATION

Figure 1 displays the Site Vicinity Map, which shows the relative locations of the eight Silver Springs project components in El Dorado County, California, as described in Section 1 above.

Figure 2 shows project boundaries, proposed building and pavement areas, and our exploratory locations for the Silver Springs Residential Units 1 through 3. Figure 2 also shows corresponding site boundaries and our exploratory locations for the Parcel 2 and Lot 7 project areas.

Figures 3 through 5 show the project boundaries and our test pit locations for the offsite improvements including Silver Springs Force Main Sewer Extension, the Green Valley Road and Deer Valley Road Widening, and the Bass Lake Road Widening projects, respectively.

1.3 PROJECT DESCRIPTION

Based on our discussions with Stantec, and review of the information provided, we understand that the Silver Springs Development project will consist of construction of the following components:

Silver Springs Residential Units 1 through 3:

Silver Springs Unit 1 will include 53 single family detached production houses with slab-on-grade floors, and Silver Springs Units 2 and 3 will include a combined 181 lots for single family detached custom houses. These units cover an approximately 170 acre area and will include construction of cuts and fills up to approximately 9 feet, retaining walls up to approximately 7 feet high, underground utilities, asphalt concrete pavement, flatwork, and landscaping.

Green Valley Road and Deer Valley Road Widening:

We understand that Green Valley Road is to be widened to create left turn pockets for access to Deer Valley Road. The widening project extends along approximately 1,600 feet of Green Valley Road and will require both cuts and fills of up to 10 feet and 5 feet, respectively. Along a portion of the widening, the existing roadway embankment will be extended by placing fill. Underground storm drains with pipe diameters up to 24 inches will be constructed within the widening.

Bass Lake Road Widening:

We understand that approximately 2,000 feet of Bass Lake Road will be widened from approximately Green Spring Creek in the south to just before Gateway Drive in the north, with cuts and fills on the order of 3 feet.

Silver Springs Force Main Extension:

We understand that the 6-inch diameter force main extension will begin at an existing stub at Madera Parkway and follow the Bass Lake Road right-of-way at a depth below existing grade of approximately 3 feet and then proceed south overland to an existing stub at Birmingham Way.

Preliminary Geotechnical Information for Parcel 2 and Lot 7 Tentative Maps:

We understand that preliminary geotechnical information is needed for the development and approval of tentative maps for the site areas currently described as Parcel 2 and Lot 7. Approximately 20 single family residential units, and 25 multi-family residential units are proposed for Parcel 2 and Lot 7, respectively. Design level geotechnical recommendations for the Parcel 2 and Lot 7 projects are not included in this report.

2. FINDINGS

We visited the site on December 29, 2005 and January 5 and 10, 2006 to perform our site explorations. Section 2 presents descriptions of surface and subsurface conditions observed during our exploration.

2.1 SURFACE CONDITIONS

Silver Springs Residential Units 1 through 3, Parcel 2, and Lot 7

Based on our review of the information provided, the proposed residential land portions of the project consist of approximately 210 acres. The ground surface of the residential areas varies from relatively steep to gentle slopes and relatively flat areas. The 1998 Tentative Map prepared by MacKay & Somps indicates the ground surface varies from approximately Elevation 1,340 feet along the southeast boundary to approximately Elevation 1,120 feet along the northwest boundary.

We observed the following site features during our reconnaissance of the proposed residential area:

- The area has many large trees and is covered by a moderate growth of grasses and weeds up to 4 feet tall.
- Several dirt trails traverse the area.
- Several seasonal drainage swales and several creek channels cross the area. Green Creek is mapped on the site and delineates the Unit 2 and Unit 3 project areas.
- An existing cemetery measuring approximately 20 feet by 20 feet enclosed by an iron fence, and a small pond less than 50 feet in diameter exist within the Unit 1 project area.
- Four culvert crossings have been constructed along the proposed Silver Springs Parkway alignment.
- A large detention basin exists on Parcel 2, west of the Unit 2 area.
- Several manholes labeled as either Storm Drain or Sanitary Sewer are evident within the future alignment of Silver Springs Parkway. The tops of the manholes were typically flush with the ground or slightly higher than the adjacent ground.
- Survey stakes are visible at numerous locations across the area.

Bass Lake Road Widening and Silver Springs Force Main Extension

The Bass Lake Road Widening and Silver Springs Force Main Sewer Extension project areas are approximately 1000 feet apart along a portion of Bass Lake Road on the east side of Bass Lake.

In these areas, we observed:

- Several trees and short vegetation along both shoulders of Bass Lake road.
- Shallow drainage ditches along Bass Lake Road.
- A large drainage canal approximately 6 feet deep follows the east side of Bass Lake Road between Madera Parkway and Bridlewood Drive; we observed a sprinkler system along the western bank of the canal, and overhead power lines.
- Rock outcrops along Bass Lake Road between the Private Drive at the south end of Bass Lake, to Hill Road towards the future Silver Springs Parkway alignment.
- The Bass Lake Road pavement surface in the widening area appears to be in generally good condition; however, several local areas up to approximately 3 feet by 8 feet near the edge of pavement were observed to be in failed condition exhibited by severe alligator cracking and depression. We summarize our pavement surface observations, conclusions, and provide recommendations for repair and overlay in Section 2.7, Section 3.8, and Section 8, respectively.

Green Valley Road and Deer Valley Road Widening

The Green Valley Road and Deer Valley Road Widening project area is northwest of the proposed intersection of Silver Springs Parkway and Green Valley Road.

In this area, we observed:

- Green Valley Road appears to be a major arterial roadway.
- The portion of Green Valley Road, east of Deer Valley Road, was constructed on rocky fill up to approximately 15 feet high. The shoulders slope downward at approximately 2:1 (horizontal:vertical). We observed the shoulder slopes to be stable and in generally good condition, with limited surface erosion.
- The western portion of Green Valley Road was constructed over bedrock as evident by the cut slopes on both sides of the roadway. We observed cut slopes to be as steep as approximately 1:1 (horizontal:vertical) with most of the cut slopes on the order of 1½:1. We observed the condition of the slopes to have minor surface raveling with minor accumulation of rock and soil material at the toe of the slope.

- The Green Valley Road and southern side of Deer Valley Road pavement surfaces were observed to be relatively new and in good condition. The pavement surface on the north side of Deer Valley Road was in generally good condition with areas of sealed alligator cracking up to approximately 4 feet by 4 feet. We summarize our pavement surface observations, conclusions, and provide recommendations for repair and overlay in Section 2.7, Section 3.8, and Section 8, respectively.

2.2 SITE GEOLOGY

We present the underlying geology for the project areas based on our field reconnaissance, subsurface exploration, and review of the *Geologic Map of the Sacramento Quadrangle* (Wagner, Jennings, Bedrossian, and Bortugno, 1987) and the *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California* (Helley and Harwood, 1985).

Our site reconnaissance and previously referenced geologic maps indicate that the underlying geologic formations at the project areas are part of the Foothills terrane. The Foothills terrane is composed of three different bedrock types: gabbroic type rocks, metavolcanic type rocks, and ultramafic type rocks. The following summarizes each of the rock type:

Gabbroic rocks (Gb) are typically composed of gabbro and diorite rock. These rocks are typically crystalline, massive, and dark gray to a salt and pepper coloring. These rocks are similar to granite but are composed of more mafic minerals and are typically darker in color.

Metavolcanics (Mv) are composed of metamorphic volcanic rocks. These rocks are typically microcrystalline, have a slight schist appearance, and slightly foliated. Foliations are observed to be steeply dipping in the area. The foliations may result in outcrops that have a tombstone appearance.

Ultramafic rocks (Um) in the area are typically composed of igneous mafic rocks that originated from the upper portion of the earths mantle. These rocks have been metamorphosed into a greenschist (locally called greenstone). Greenstone is typically green to dark green in color, massive in structure, and may contain asbestos bearing serpentine.

We tabulate the mapped formations underlying each project area below,

TABLE 1
Mapped Geologic Formations by Project

Project	Formation
Silver Springs Units 1, 2, 3	Gb
Lot 7	Gb
Parcel 2	Gb and Mv (see Figure 2)
Force Main Sewer Extension	Um and Mv (see Figure 3)
Bass Lake Road Widening	Gb
Green Valley / Deer Valley Widening	Gb and Um (see Figure 4)

2.3 NATURALLY OCCURRING ASBESTOS MAPPING

Based on our review of the El Dorado County Map for "Asbestos Review Areas Western Slope, County of El Dorado, State of California," dated July 21, 2005, the Parcel 2 project area and the southwest corner of the Unit 3 project area are mapped as "more likely to contain [naturally occurring] asbestos." See Figure 2 for affected project areas.

2.4 SUBSURFACE CONDITIONS

We observed excavation of 22 test pits to a maximum depth of 10 feet at the locations shown on Figures 2 through 5. The former ACG explorations are also shown on Figure 2; these included 20 borings and 18 test pits performed by ACG in 1989.

In general, the explorations performed in the project areas encountered surficial residual soils consisting of mixtures of gravels, sands, silts, and clays underlain by weak to very strong Metavolcanic, Granitic (Gabbroic), and Ultramafic rock. The surficial soil varied widely in thickness, from negligible in some locations to greater than 20 feet at other locations. Rock refusal conditions were encountered at several explorations; these are summarized in Table 2 below.

Our exploration indicates that the thicker surficial soil layers were prevalent in the swales and low-lying areas; the surficial soil tends to thin out on the hills and ridges.

We observed silty and sandy clay mixtures of varying plasticity in the surficial soil encountered in our explorations. Moderately to highly plastic clays were observed in the Silver Springs Residential areas, predominately near the low-lying creek channels, shallow drainage swales, and other watershed features.

We did not encounter any noticeably weak or compressible soil in our exploratory test pits.

TABLE 2
Rock Refusal Explorations

Exploration	Depth to Refusal on Strong Rock, (ft.)
TP1	5
TP2	2
TP3	4
TP4	3
TP5	6
TP6	5
TP7	1
TP10	6
TP15	9
TP22	7
B1*	4
B3*	18
B6*	14
B8*	18½
B12*	11
B13*	6
B14*	8
B18*	8
T3*	7
T5*	5
T16*	5

*1989 ACG exploration

Consult the Site Plans and exploration logs for specific soil, rock, and groundwater conditions at each location. We include our exploration logs in Appendix A and 1989 ACG exploration logs in Appendix C. The logs contain the soil/rock type, color, consistency, and visual classification in general accordance with the Unified Soil Classification System. Appendix A also provides additional exploratory information in the general notes to the logs.

2.5 SEISMIC SETTING

The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone and no known surface expression of active faults is believed to exist within the site. Fault rupture through the site, therefore, is not anticipated.

The site does lie within a seismically active region. According to a search using the software program EQFAULT Version 3.00b (Blake, 2000) and our review of the previously referenced Sacramento Quadrangle Geologic Map, the site is mapped approximately 2 miles east of the Bear Mountains Fault Zone, which is part of the Type C Foothills Fault System. The Foothills fault segments are considered potentially active and capable of a moment magnitude earthquake of 6.5. Other active faults in the region include the Type B Genoa Fault approximately 65 miles away, capable of a moment magnitude of 6.9 and the Type B Hunting Creek - Berryessa Fault approximately 66 miles away capable of a moment magnitude of 7.1.

2.6 GROUNDWATER CONDITIONS

We did not observe groundwater in any of our subsurface explorations for the Bass Lake Road and Green Valley / Deer Valley Widening projects or the Force Main Sewer Extension project. However, we did observe perched groundwater in TP-13 and TP-18 performed in the Lot 7 and the Unit 2 project areas, respectively, at a depth of 6 to 8 feet below existing grade. At the above locations, surface water may have infiltrated the surface soil and ponded on the less permeable rock layers. The 1989 ACG study encountered perched groundwater at depths between 4 and 16 feet below the surface in borings B4, B7, B10, and B19, and in trenches T14 and T15.

Fluctuations in the level of perched groundwater may occur due to variations in rainfall and other factors not evident at the time measurements were made.

2.7 OFFSITE PAVEMENT CONDITION SURVEY

We performed a brief pavement condition survey for the offsite Bass Lake Road Widening and the Green Valley and Deer Valley Road Widening projects.

We observed Bass Lake Road to have mostly marginal with some major signs of pavement surface fatigue. Marginal signs include sporadic longitudinal and transverse cracks with crack seal, and several small patched areas. Major signs of fatigue include locally failed areas with severe alligator cracking and pavement surface depression potentially extending into the subgrade. Several of these areas were observed along the outside edge of pavement up to approximately 3 feet wide by 8 feet long.

Based on our observations, it appears that Green Valley Road, and the southern portion of Deer Valley Road were rehabilitated within the last 1 to 3 years and were generally without obvious signs of fatigue at the time of our visit. However we observed minor raveling of the surface course and several areas approximately 4 feet by 4 feet with slight to moderate alligator cracking, with crack seal, within the project area on the northern portion of Deer Valley Road.

We performed three pavement cores within the Bass Lake Road Widening project area and three cores within the Green Valley Road and Deer Valley Road Widening project area. We provide our pavement core results in the table below.

TABLE 3
Pavement Core Results

Approximate Core Location*	Asphalt Concrete (in.)	Aggregate Base (in.)
West of the Bass Lake Road centerline, 300 feet south of Gateway Drive	2½	8
East of the Bass Lake Road centerline at intersection with Woodleigh Lane	3¾	8
East of Bass Lake Road centerline, near southern project boundary	4	8
Green Valley Road Station 242+50 right of roadway centerline	3½	8
Deer Valley Road Station 10+60 left of roadway centerline	2½	6
Deer Valley Road near 9+40 right of roadway centerline	3	6

*the cores were performed near the fog line at the locations described

2.8 EXISTING GREEN VALLEY ROAD CUT SLOPES

On December 29, 2005 we observed that the existing cut slopes on both sides of Green Valley Road are composed of slightly to moderately fractured, slightly weathered, intact ultramafic rock that appears to be stable at the current slope angle of approximately 1½:1 (horizontal to vertical).

We also observed portions of the slopes to be stable at slope angles as steep as 1:1. We observed the slopes to be in generally good condition with only minor accumulation of raveled slope material at the toe of the slopes at the time of our visit.

2.9 SEISMIC REFRACTION SURVEY

ACG performed a seismic refraction survey in 1989 within the Silver Springs Residential project area (formerly known as the Bass Lake Property) to estimate the depth and hardness of the underlying bedrock. The survey within the subject project area included five traverses as shown on Figure 2. A signal enhancement seismograph was used to measure the first arrival times of the waves produced by a mechanical source. Shock waves were measured at 10 foot intervals. The maximum distance between the geophone and the point where the shock wave was induced was 120 feet. The data collected from the 1989 ACG seismic survey is summarized in Table 4 below.

TABLE 4
Summary of 1989 Seismic Refraction Survey Data by ACG

Traverse	Approximate Thickness of Material (ft.)	Approximate Subsurface Material Velocity (fps)	Estimated Material
A-A	0 to > 20 feet	5,000	Moderately to slightly weathered granite rock
C-C	0 to 9 feet	2,000	Completely to moderately weathered granitic rock
	> 9 feet	4,000	Moderately to slightly weathered granitic rock
D-D	0 to 10 feet	2,400	Completely to moderately weathered granitic rock
	>10 feet	4,300	Moderately to slightly weathered granitic rock
E-E	0 to 13 feet	1,800	Completely to moderately weathered granitic rock
	>13 feet	11,000	Slightly weathered granitic rock
F-F	0 to 14 feet	2,000	Completely to moderately weathered granitic rock
	>14 feet	7,500	Moderately to slightly weathered granitic rock

2.10 LABORATORY TESTING

We performed laboratory tests on selected soil samples to determine their engineering properties. For this project, we performed moisture content, plasticity index, expansion index, hydrometer, resistance value, and soil corrosion potential testing. We include the laboratory data in Appendix B.

3. CONCLUSIONS

From a geotechnical engineering viewpoint, in our opinion, the project areas are suitable for the proposed residential developments and offsite improvements. The primary geotechnical concerns that could affect development are the potential for shallow groundwater, expansive soil, rock excavatability, and naturally occurring asbestos. We summarize our conclusions followed by our recommendations below.

3.1 EXCAVATABILITY

We used a Case 580 M backhoe with a 2-foot wide bucket during our exploratory work. Based upon our observation and experience, we provide the following conclusions regarding excavation resistance at the site:

1. Conventional grading and backhoe equipment will likely be able to excavate the surficial soil deposits that overlie the bedrock below. The thickness of surficial soil at the locations explored ranged from negligible to over 20 feet. Consult the test pits for the thickness of surficial soil at specific locations.

2. We experienced shallow refusal when excavating into the rock formations; typically, we were unable to excavate more than 1 foot into the underlying bedrock. Grading excavations in this material will likely require moderate to high effort with a CAT D10 or larger bulldozer, equipped with a single tooth ripper. A CAT 245 or larger excavator may be necessary to facilitate trench excavations with moderate to high effort. Due to the variable and chaotic nature of the rock types encountered at the site, more resistant material will likely be encountered that will likely require heavier, more powerful excavating equipment. Heavy excavators equipped with rock teeth, hoe-rams, or blasting may be required where excavations extend more than 3 feet into the underlying rock, or where large boulders or resistant lenses are encountered.

Note that "refusal" conditions or "resistant" rock are highly dependent on the type of equipment, the effort expended, and the amount of wear and tear the contractor is willing to tolerate.

We provide the above excavatability information for general planning purposes only. This information is not intended for bidding purposes.

3.2 EXPANSIVE SOIL

We observed potentially expansive clay near the surface of the residential project areas in Test Pits TP-12, TP-15, TP-17, TP-18, TP-20, and TP-22. The potentially expansive clays were generally encountered in the low-lying areas adjacent to the creeks and natural drainage swales. Our laboratory testing indicates that these soils exhibit moderate to high shrink/swell potential with variations in moisture content. Expansive soil can cause distress to foundations, floor slabs, pavements, sidewalks, and other improvements which are sensitive to soil movements.

To reduce the potential for damage to the planned residential structures, we recommend slabs-on-grade have sufficient reinforcement and be supported on a layer of non-expansive fill and that footings extend below the zone of significant seasonal moisture fluctuation. As an alternative to reduce the complexity of site grading, and the risks associated with developing residential communities on potentially expansive soil sites, we recommend that all buildings be supported on properly designed post-tensioned mat foundations bearing on competent native soil or compacted fill.

We provide detailed recommendations for both foundation alternatives in Section 5 of this report.

We have also provided specific grading recommendations for compaction of clay soil at the site. The purpose of these recommendations is to reduce the swell potential of the clay by compacting the soil at high moisture content and controlling the amount of compaction. Expansive soil mitigation and compaction recommendations are presented in Section 4 of this report.

3.3 NATURALLY OCCURRING ASBESTOS

Based on the July 2005 El Dorado County Asbestos Review Area Map, the Parcel 2 and Unit 3 project areas will be subject to an Asbestos Dust Mitigation Plan (ADMP) during site grading, as required by the El Dorado County Environmental Management.

3.4 SOIL CORROSION POTENTIAL

We submitted five soil samples to an analytical lab for determination of pH, resistivity, sulfate, and chloride. The sulfate lab test results indicate the sulfate exposure may be categorized as "Negligible" in accordance with Table 19-A-4 of the California Building Code. For "Negligible" sulfate exposure, the CBC indicates that either Type I or Type II Portland Cement may be used for concrete mix designs for the project.

The samples tested had low to high resistivities, indicating that they are severely to marginally corrosive to buried metal.

If desired to investigate this further, we recommend a corrosion consultant be retained to determine if specific corrosion recommendations are necessary for the project. We present the analytical lab test results in Appendix B.

3.5 PERCHED GROUNDWATER

As mentioned previously, we observed perched groundwater in two of our test pits at a depth of approximately 6 to 8 feet and ACG encountered groundwater in six explorations at depths between 4 to 16 feet below the existing site grades, within the Silver Springs Residential project area. Perched groundwater can:

1. Impede underground utility construction and grading activities;
2. Cause moisture damage to sensitive floor coverings;
3. Transmit moisture vapor through slabs causing excessive mold/mildew build-up, fogging of windows, and damage to computers and other sensitive equipment;
4. Cause premature pavement failure if hydrostatic pressures build up beneath the section.

The grading contractor should be advised that perched groundwater will likely be encountered during grading and underground utility construction. We provide recommendations to reduce the effects of perched water in the sections addressing Over Optimum Soil Conditions, Site Drainage, Landscaping Considerations, Slab Moisture Vapor Reduction, and Cut-off Curbs.

3.6 2001 CBC SEISMIC DESIGN PARAMETERS

To provide California Building Code (CBC) seismic design parameters, we reviewed the 2001 CBC and the February 1998 California Divisions of Mines and Geology "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada".

Based on our review, we provide the 2001 California Building Code (CBC) seismic parameters in Table 5 below.

TABLE 5
2001 CBC Seismic Parameters

Categorization	Design Value
Soil Profile	S_C
Seismic Zone	3
Seismic Zone Factor, Z	0.3
Seismic Coefficient Ca	0.33
Seismic Coefficient Cv	0.45

3.7 LOT 7 AND PARCEL 2 PRELIMINARY CONCLUSIONS

The geotechnical conclusions provided within this report may be applied, on a preliminary basis, to Lot 7 and Parcel 2 project areas to satisfy the Tentative Map criteria for El Dorado County. We recommend that ENGEO be retained to prepare a design level geotechnical report for the Lot 7 and Parcel 2 project once the development plans have been completed.

3.8 OFFSITE PAVEMENT CONDITIONS

Based on our pavement condition survey and cores performed for the offsite Bass Lake Road Widening and the Green Valley and Deer Valley Road Widening projects, we provide estimated remaining design life and estimated nominal pavement section thicknesses in Table 6 below.

TABLE 6
Estimated Existing Pavement Conditions

Roadway	Remaining Design Life, in percent	Nominal Asphalt Concrete, (in.)	Nominal Aggregate Base, (in.)
Bass Lake Road	70	3½	8
Green Valley Road	90	3½	8
Deer Valley Road, north	60	2½	6
Deer Valley Road, south	90	3	6

It is important to note that the above estimated values are based on our observations and professional opinions only. The actual remaining design life may be less than indicated above due to undeterminable factors such as the quality and methods of the original construction and the variability of future traffic loading.

3.9 GREEN VALLEY ROAD CUT SLOPES

We understand that the existing Green Valley Road cut slopes, at the current slope angle of approximately 1½:1 may have to be cut back, up to 10 feet laterally, and steepened to 1:1 to accommodate the roadway widening. Based on our observations, it is our opinion that the rock material forming these slopes would remain stable at a slope angle up to 1:1 after being cut back; however, weathering and some raveling of the new slope face will likely occur more frequently than experienced with the original slope angle. This may result in greater accumulation of material at the toe of the slope over time, which will require occasional maintenance. ENGEO should be retained to observe any slope excavation to check for stability and adverse bedding that could lead to future instability of the cut slope. If unstable conditions or adverse bedding conditions arise, reducing the slope angle or constructing a retaining wall at the base of the slope may be necessary.

4. EARTHWORK RECOMMENDATIONS

The relative compaction and optimum moisture content of soil, rock, and aggregate base referred to in this report are based on the most recent ASTM D1557 test method. Compacted soil is not acceptable if it is unstable. It should exhibit only minimal *flexing* or *pumping*, as determined by an ENGEO representative.

As used in this report, the term "moisture condition" refers to adjusting the moisture content of the soil by either drying if too wet or adding water if too dry.

We define "structural areas" in Section 4 of this report as any area sensitive to settlement of compacted soil. These areas include, but are not limited to building pads, sidewalks, pavement areas, and retaining walls.

4.1 EXPANSIVE SOIL MITIGATION

To help reduce the risk of structural damage associated with the variably expansive soil conditions, we recommend constructing the upper 18 inches of building pads and roadway subgrades with non-expansive fill.

However, as an alternative to reduce the complexity of site grading work, and associated risks with developing expansive soil sites, we provide alternative foundation design recommendations in this report that mitigate the effects of native expansive soil, and therefore will not require the additional grading work described above.

4.2 GENERAL SITE CLEARING

Clear areas to be developed of all surface and subsurface deleterious materials including existing building foundations, slabs, buried utility and irrigation lines, pavements, debris, and designated trees, shrubs, and associated roots. Clean and backfill excavations extending below the planned finished site grades with suitable material compacted to the recommendations presented in Section 4.7. ENGEO should be retained to observe and test all backfilling.

Following clearing, strip the site to remove surface organic materials. Strip organics from the ground surface to a depth of at least 2 to 3 inches below the surface. Remove strippings from the site or use them in landscape fill. It may also be feasible to mulch organics in place, depending on the amount and type of vegetation present at the time of grading as well as the proposed mulching method. If desired, ENGEO will evaluate site vegetation at the time of grading to determine the feasibility of mulching organics in place.

4.3 CUT/FILL TRANSITIONS OR CUT LOTS

Building pads constructed in cuts may encounter variably expansive subsurface conditions in the near surface soil, these pads may therefore be subject to damaging differential soil movements. Building pads that transition from cut to fill within the building pad area can also experience differential soil movements.

We recommend such building pads be reconstructed to create uniform subgrade conditions. This should be accomplished by subexcavating the soil on the building pads to a minimum depth of 18 inches below finished pad grade on all cut lots or lots constructed over cut-and-fill transitions and replacing the subexcavated material with uniformly-mixed compacted fill. The subexcavation should be performed over the entire flat pad area. Compacted fill used to replace subexcavated soil should be placed in accordance with compaction recommendations provided below. See Figure 6 for a graphical depiction.

4.4 DIFFERENTIAL FILL THICKNESS

Differential building movements may result from conditions where building pads have significant differential fill thickness. We recommend that the differential fill thickness across any lot be no greater than 10 feet. Subexcavation of soil material and replacement with compacted fill will be necessary to achieve this recommendation.

4.5 OVER-OPTIMUM SOIL MOISTURE CONDITIONS

The contractor should anticipate encountering excessively over-optimum (wet) soil moisture conditions during winter or spring grading, or during or following periods of rain. In addition, wet soil conditions may be found near the existing creeks, drainage swales, and other watershed features that traverse the project areas. Wet soil can make proper compaction difficult or impossible. Wet soil conditions can be mitigated by:

1. Frequent spreading and mixing during warm dry weather;
2. Mixing with drier materials;
3. Mixing with a lime, lime-flyash, or cement product; or
4. Stabilizing with aggregate, geotextile stabilization fabric, or both.

Options 3 and 4 should be evaluated and approved by ENGEO prior to implementation.

4.6 ACCEPTABLE FILL

On-site soil and rock material is suitable as fill material provided it is processed to remove concentrations of organic materials, and particles greater than 6 inches in maximum dimension.

Rocks larger than 6 inches may be placed in deeper portions of fills provided that:

- They are located at least 2 feet below any planned excavations limits (i.e. for utilities or foundations);
- They are placed individually and not nested together; and
- The contractor can achieve acceptable compaction adjacent to the boulders, as determined by ENGEO.

Imported fill materials should meet the above requirements and have a plasticity index less than 12. Allow ENGEO to sample and test proposed imported fill materials at least 72 hours prior to delivery to the site.

4.7 COMPACTION

We provide recommendations below for compaction of the native materials at the site. We provide separate recommendations for compaction of expansive, non-expansive and rocky material. For the purposes of this report, we define expansive soils as those with a PI greater than 12.

4.7.1 Grading in Structural Areas

Native Expansive Material

Perform subgrade compaction prior to fill placement, following cutting operations, and in areas left at grade as follows.

1. Scarify to a depth of at least 8 inches;
2. Moisture condition soil to at least 4 percentage points over the optimum moisture content; **and**
3. Compact the soil to between 87 and 92 percent relative compaction. Compact the upper 6-inches of finish pavement subgrade to at least 90 percent relative compaction prior to aggregate base placement.

After the subgrade has been compacted, place and compact acceptable fill (defined in Section 4.6) as follows:

1. Spread fill in loose lifts that do not exceed 8 inches;
2. Moisture condition lifts to at least 4 percentage points over the optimum moisture content; **and**
3. Compact fill to between 87 and 92 percent relative compaction; compact the upper 6 inches of fill in pavement areas to at least 90 percent relative compaction prior to aggregate base placement.

Native Non-Expansive Material

Perform subgrade compaction prior to fill placement, following cutting operations, and in areas left at grade as follows.

1. Scarify to a depth of at least 8 inches;
2. Moisture condition soil to at least 1 percentage point above the optimum moisture content; **and**

3. Compact the subgrade to at least 90 percent relative compaction. Compact the upper 6-inches of finish pavement subgrade to at least 95 percent relative compaction prior to aggregate base placement.

After the subgrade soil has been compacted, place and compact acceptable fill (defined in Section 4.6) as follows:

1. Spread fill in loose lifts that do not exceed 8 inches;
2. Moisture condition lifts to at least 1 percentage point above the optimum moisture content; **and**
3. Compact fill to a minimum of 90 percent relative compaction; Compact the upper 6 inches of fill in pavement areas to 95 percent relative compaction prior to aggregate base placement.

Native Rocky Material

Where fill or subgrade materials contain more than 30 percent rock retained on a ¾-inch sieve, a performance specification should be used to evaluate compaction. For this condition, we recommend a maximum loose lift thickness (or subgrade processing depth) of 12 inches. Moisture condition rocky fill such that the moisture content of the matrix soil (minus ¾-inch material) is at or slightly above the optimum moisture content determined by visual/manual methods. Compact each lift of rocky fill with at least five passes of a Caterpillar 825 compactor to achieve equivalent 90 percent relative compaction; use seven passes to achieve equivalent 95 percent relative compaction. We will develop other performance standards for different compaction equipment if necessary during construction.

Compact the pavement Caltrans Class 2 Aggregate Base section to at least 95 percent relative compaction (ASTM D1557). Moisture condition aggregate base at or slightly above the optimum moisture content prior to compaction.

4.7.2 Underground Utility Backfill

The contractor is responsible for conducting all trenching and shoring in accordance with CALOSHA requirements. Project consultants involved in utility design should specify pipe bedding materials.

Native Expansive Material

Place and compact trench backfill in structural areas as follows:

1. Trench backfill should have a maximum particle size of 6 inches;
2. Moisture condition trench backfill to at least 4 percent above the optimum moisture content. Moisture condition backfill outside the trench;
3. Place fill in loose lifts not exceeding 12 inches;
4. Compact fill to between 87 and 92 percent relative compaction (90 percent minimum relative compaction at depths of 3 feet or more below finish grades).

Native Non-Expansive Material

Place and compact trench backfill in structural areas as follows:

1. Trench backfill should have a maximum particle size of 6 inches;
2. Moisture condition trench backfill to or slightly above the optimum moisture content. Moisture condition backfill outside the trench;
3. Place fill in loose lifts not exceeding 12 inches;
4. Compact fill to a minimum of 90 percent relative compaction (ASTM D1557).

Native Rocky Material

Where fill or subgrade materials in structural areas contain more than 30 percent rock retained on a ¾-inch sieve, a performance specification should be used to evaluate compaction. For this condition, we recommend a maximum loose lift thickness of 12 inches. Moisture condition rocky fill such that the moisture content of the matrix soil (minus ¾-inch material) is at or slightly above the optimum moisture content determined by visual/manual methods. Compact each lift of rocky fill with at least six passes of a Caterpillar 235 or larger excavator with a sheepsfoot wheel attachment to achieve equivalent 90 percent relative compaction; use nine passes to achieve equivalent 95 percent relative compaction. We will develop other performance standards for different compaction equipment if necessary during construction.

Where utility trenches cross beneath buildings, we recommend that a plug be placed within the trench backfill to help prevent the normally granular bedding materials from acting as a conduit for water to enter beneath the building. The plug should be constructed using a sand cement slurry (minimum 28-day compressive strength of 500 psi) or relatively impermeable native soil for pipe bedding and backfill. We recommend that the plug extend for a distance of at least 3 feet in each direction from the point where the utility enters the building perimeter.

Jetting of backfill is not an acceptable means of compaction. We may allow thicker loose lift thicknesses based on acceptable density test results, where increased effort is applied to rocky fill, or for the first lift of fill over pipe bedding.

4.7.3 Landscape Fill

Process, place and compact fill in accordance with Sections 4.6 and 4.7, except compact to at least 85 percent relative compaction (ASTM D1557).

4.8 SLOPES

4.8.1 Slope Gradients

With the exception of the Green Valley Road cut slopes described in Section 3.9, construct final slope gradients to 2:1 (horizontal:vertical) or flatter. The contractor is responsible to construct temporary construction slopes in accordance with CALOSHA requirements.

4.8.2 Fill Placed on Existing Slopes

We recommend keying and benching where fills are placed on original grade with a gradient of 6:1 or steeper.

Construct a minimum 15-foot wide key inward from the toe of the new fill slope. Extend the key at least 2 feet below original grade into firm competent soil/rock, as determined by ENGEO. Slope the key bottom at least 5 percent downward toward the slope crest. Deeper keys may be required by ENGEO based on actual soil/rock conditions observed during construction.

Cut benches into original grade after the key has been filled and compacted in accordance with Section 4. Construct benches into original slope grade as filling proceeds every 2 feet vertically, to remove loose soil/rock. Deeper bench depths may be required by ENGEO depending on actual conditions observed during construction. Bench widths will vary depending on the original slope grade and actual bench depth.

4.9 SITE DRAINAGE

4.9.1 Surface Drainage

The project civil engineer is responsible for designing surface drainage improvements. With regard to geotechnical engineering issues, we provide the following minimum recommendation for surface drainage.

1. Slope pavement areas a minimum of 2 percent towards drop inlets or other surface drainage devices.
2. Slope finished grade away from building exteriors at a minimum of 2 percent for a distance of at least 5 feet.
3. Discharge roof down spouts into closed conduits and direct away from buildings to appropriate drainage devices.

4.9.2 Subsurface Drainage

Based on our findings, rear lot subdrains may be necessary to help mitigate seepage problems associated with water seeping down from higher lots to adjacent lower lots during periods of heavy rain or due to landscape irrigation.

On a preliminary basis, we recommend that any cut or fill slope taller than 5 feet have a subdrain installed along the toe of slope. The subdrain trench should be at least 3 feet deep and 12 inches wide. The subdrain should consist of a minimum 4-inch-diameter perforated pipe, perforations placed down, surrounded by a filter medium consisting of washed, crushed rock or gravel encapsulated in filter fabric. The top 6 inches of subdrain trench backfill should consist of native compacted soil. Where solid pipe is used as the collector to discharge to an approved outlet, the trench backfill should consist of native compacted soil. See Figure 7 for a typical subdrain detail.

We should be retained to review all subdrainage systems prior to construction and further evaluate the site conditions during site grading to assess the need for additional or modified subsurface drainage systems.

4.10 LANDSCAPING CONSIDERATION

As some of near surface soils are moderately to highly expansive, we recommend greatly restricting the amount of surface water infiltrating these soils near structures, pavements, flatwork, and slabs-on-grade. This may be accomplished by:

- Selecting landscaping that requires little or no watering, especially within 3 feet of structures, slabs-on-grade, or pavements,
- Using low precipitation sprinkler heads,
- Regulating the amount of water distributed to lawn or planter areas by installing timers on the sprinkler system,
- Providing surface grades to drain rainfall or landscape watering to appropriate collection systems and away from structures, slabs-on-grade, or pavements,

- Preventing water from draining toward or ponding near building foundations, slabs-on-grade, or pavements, and
- Avoiding open planting areas within 3 feet of the building perimeter.

We recommend that the landscape architect incorporate these items into the landscaping plans, and that we review the plans before construction.

5. FOUNDATION RECOMMENDATIONS

We developed foundation recommendations using data obtained from our field exploration, laboratory test results, and engineering analysis. As previously mentioned, the alternatives proposed for addressing the effects of the native expansive soil on building foundations include conventional footings with slabs-on-grade underlain with non-expansive fill, and post-tensioned mat foundations. The following recommendations may be used for design of the structures in Units 1 through 3. On a preliminary basis, these recommendations may be used for Parcel 2 and Lot 7; however, a design level geotechnical report should be prepared to develop design level recommendations once development plans are finalized.

5.1 CONVENTIONAL FOOTINGS WITH SLAB-ON-GRADE

To help reduce the risk of structural damage associated with variably expansive soils, we recommend at a minimum constructing residential building foundations with conventional footings that extend below the nominal depth of seasonal moisture variation, and constructing slab-on-grade floors over a minimum 18-inch layer of non-expansive fill. The typical drawback with this approach is the additional grading work, the possible need for select import fill, and the resulting higher level of geotechnical observation and testing and as-built surveying needed during construction.

5.1.1 Footing Dimensions and Allowable Bearing Capacity

Provide minimum footing dimensions as follows:

TABLE 7
Minimum Footing Dimensions

Footing Type	Minimum Depth (in.)	Minimum Width (in.)
Continuous	18	12
Isolated	18	18

Minimum footing depths shown above are taken from lowest adjacent pad grade. The cold joint between the exterior footing and slab-on-grade should be located at least 4 inches above adjacent exterior grade.

Design foundations recommended above for a maximum allowable bearing pressure of 2,500 pounds per square foot (psf) for dead plus live loads. Increase this bearing capacity by one-third for the short-term effects of wind or seismic loading

The maximum allowable bearing pressure is a net value; the weight of the footing may be neglected for design purposes. All footings located adjacent to utility trenches should have their bearing surfaces below an imaginary 1:1 horizontal to vertical plane projected upward from the bottom edge of the trench to the footing.

5.1.2 Waterstop

If a two pour system is used for footings and slab, the cold joint between the exterior footing and slab-on-grade should be located at least 4 inches above adjacent finish exterior grade. If this is not done, then we recommend the addition of a waterstop between the two pours to reduce moisture penetration through the cold joint and migration under the slab. Use of a monolithic pour would eliminate the need for the waterstop.

5.1.3 Reinforcement

The structural engineer should design footing reinforcement to support the intended structural loads without excessive settlement. Reinforce all continuous footings with top and bottom steel to provide structural continuity and to permit spanning of local irregularities. At a minimum, design continuous footings to structurally span a clear distance of 5 feet.

To help resist expansive soil movement, reinforce continuous footings with at least four No. 4 steel reinforcement bars, two top and two bottom.

5.1.4 Foundation Lateral Resistance

Lateral loads may be resisted by friction along the base and by passive pressure along the sides of foundations. The passive pressure is based on an equivalent fluid pressure in pounds per cubic foot (pcf). We recommend the following allowable values for design:

Passive Lateral Pressure: 300 pcf

Coefficient of Friction: 0.35

The above allowable values include a factor of safety of 1.5. Increase the above values by one-third for the short-term effects of wind or seismic loading

Passive lateral pressure should not be used for footings on or above slopes.

5.1.5 Settlement

Provided our report recommendations are followed, and given the proposed residential construction, we estimate total and differential foundation settlements will be less than approximately ¾ and ½ -inch, respectively.

5.2 POST-TENSIONED MAT FOUNDATIONS

We provide the following alternative foundation recommendations to mitigate the risks associated with expansive soil conditions and negate the need for non-expansive fill placed on the building pads.

PT mat foundations may be designed in accordance with the 2001 California Building Code. We recommend that PT mats be at least 10 inches thick and have a thickened edge at least 2 inches greater than the mat thickness. The thickened edge should be at least 12 inches wide.

PT mats may be designed for an average allowable bearing pressure of 1,000 pounds per square foot (psf) for dead plus live loads, with maximum localized bearing pressures of 1,500 psf at column or wall loads. Allowable bearing pressures can be increased by one-third for all loads including wind or seismic. Design PT mats using the criteria presented below.

TABLE 8
Post-Tension Design Criteria

Condition	Center Lift	Edge Lift
Edge Moisture Variation (ft.)	5	4
Differential Soil Movement (in.)	1.4	0.8

The above design criteria are based on the procedure presented by the Post-Tensioning Institute (1996, 2nd Edition).

Underlay PT mats with a moisture reduction system as recommended below. In addition, moisture condition the pad subgrade to a moisture content at least 4 percentage points above optimum prior to foundation construction. The subgrade should not be allowed to dry prior to concrete placement.

5.3 SLAB MOISTURE VAPOR REDUCTION

When buildings are constructed with conventional concrete slabs-on-grade, or post-tensioned mats, water vapor from beneath the slab will migrate through the slab and into the building. This water vapor can be reduced but not stopped. Vapor transmission can negatively affect floor coverings and lead to increased moisture within a building. When water vapor migrating through the slab would be undesirable, we recommend the following to reduce, but not stop, water vapor transmission upward through the slab-on-grade.

1. Construct a moisture retarder system directly beneath the slab on-grade that consists of the following:

   a) Impermeable vapor retarder membrane sealed at all seams and pipe penetrations and connected to all footings. Vapor retarders shall conform to Class A vapor retarder per ASTM E 1745-97 "Standard Specification for Plastic Water Vapor Retarders used in Contact with Soil or Granular Fill under Concrete Slabs." The vapor retarder should be **underlain by**
   b) 4 inches of clean crushed rock. Crushed rock should have 100 percent passing the ¾-inch sieve and less than 5 percent passing the No. 4 Sieve; **underlain by**

2. Use a concrete water-cement ratio for slabs-on-grade of no more than 0.50.
3. Provide inspection and testing during concrete placement to check that the proper concrete and water cement ratio are used.
4. Moist cure slabs for a minimum of 3 days.

The structural engineer should be consulted as to the use of a layer of clean sand or pea gravel (less than 5 percent passing the U.S. Standard No. 200 Sieve) placed on top of the vapor retarder membrane to assist in concrete curing. If post-tensioned mats are used for building foundations, the crushed rock may be eliminated.

6. CONCRETE SLABS-ON-GRADE

6.1 EXTERIOR FLATWORK

Exterior flatwork includes items such as concrete sidewalks, steps, and outdoor patios exposed to foot traffic only. Provide a minimum concrete flatwork thickness of 4 inches.

Where clay is evident at the subgrade level during grading, additional recommendations are necessary to reduce expansive soil effects. We recommend as a minimum that flatwork be underlain by at least 4 inches of Class 2 aggregate compacted to at least 90 percent relative compaction (ASTM D1557) at or slightly above the optimum moisture content. In addition, thicken flatwork edges so they extend to the subgrade soil to help control moisture variations in the subgrade.

Additional measures that can be implemented to further reduce the risk of damage from expansive soil movement include:

1. Increase flatwork thickness to 5 inches.
2. Place wire mesh or rebar within the middle third of the slab to help control the width and offset of cracks.
3. Use dowels at all joints.

Construct control and construction joints in accordance with current Portland Cement Association Guidelines.

6.2 CONVENTIONAL INTERIOR CONCRETE FLOOR SLABS

Due to the high expansion potential of some of the near surface soils, we recommend that interior concrete floor slabs be supported on non-expansive fill to reduce the likelihood of slab damage from heave or shrinkage. We recommend floor slabs be underlain with at least 18 inches of non-expansive fill, which may include the 4 inches of crushed rock and a layer of pea gravel or sand associated with the Slab moisture Vapor Reduction System recommended in Section 5.3.

To reduce the effects of expansive soil on interior slabs, we recommend the following:

1. Provide a minimum concrete thickness of 5 inches.
2. Reinforce slabs with No. 3 rebar on 18 inch centers, each way, placed within the middle third of the slab.

The structural engineer should provide final design thickness and additional reinforcement, if necessary, for the intended structural loads.

6.3 TRENCH BACKFILL

Backfill and compact all trenches below building slabs-on-grade and to 5 feet laterally beyond any edge in accordance with Section 4.7.2.

7. RETAINING WALLS

We understand that both concrete gravity walls and Keystone type walls will be constructed for this project, we provide recommendations for both types of walls.

7.1 CONCRETE GRAVITY WALLS

7.1.1 Lateral Soil Pressures

Design proposed retaining walls to resist lateral earth pressures from adjoining natural materials and/or backfill and from any surcharge loads. Provided that adequate drainage is included as recommended below, design walls unrestrained from movement at the top to resist an equivalent fluid pressure of 45 pounds per cubic foot (pcf). In addition, design restrained walls to resist an additional uniform pressure equivalent to one-third of any surcharge loads applied at the surface.

The above lateral earth pressures assume level backfill conditions and sufficient drainage behind the walls to prevent any build-up of hydrostatic pressures from surface water infiltration and/or a rise in the groundwater level. If adequate drainage is not provided, we recommend that an additional equivalent fluid pressure of 40 pcf be added to the values recommended above for both restrained and unrestrained walls. Damp-proofing of the walls should be included in areas where wall moisture would be problematic.

Construct a drainage system, as recommended below, to reduce hydrostatic forces behind the retaining wall.

7.1.2 Retaining Wall Drainage

Construct either graded rock drains or geosynthetic drainage composites behind the retaining walls to reduce hydrostatic lateral forces. For rock drain construction, we recommend two types of rock drain alternatives:

1. A minimum 12-inch-thick layer of Class 2 Permeable Filter Material (Caltrans Specification 68-1.025) placed directly behind the wall, or
2. A minimum 12-inch-thick layer of washed, crushed rock with 100 percent passing the ¾-inch sieve and less than 5 percent passing the No. 4 sieve. Envelope rock in a nonwoven geotextile filter fabric such as Mirafi 140NC, or equivalent.

For both types of rock drains:

1. Place the rock drain directly behind the walls of the structure.
2. Extend rock drains from the wall base to within 12 inches of the top of the wall.
3. Place a minimum of 4-inch-diameter perforated pipe at the base of the wall, inside the rock drain and fabric, with perforations placed down.
4. Place pipe at a gradient at least 1 percent to direct water away from the wall by gravity to a drainage facility.

ENGEO should review and approve geosynthetic composite drainage systems prior to use.

7.1.3 Backfill

Backfill behind retaining walls should be placed and compacted in accordance with Section 4.7. Use light compaction equipment within 5 feet of the wall face. If heavy compaction equipment is used, the walls should be temporarily braced to avoid excessive wall movement.

7.1.4 Foundations

Retaining walls may be supported on continuous footings designed in accordance with recommendations presented in Section 5.1, except the minimum embedment depth should be increased to 24 inches below lowest adjacent soil grade.

7.2 KEYSTONE TYPE RETAINING WALLS

We understand Keystone walls up to 7 feet are planned. Design these walls with a minimum embedment of 1 foot below lowest adjacent ground surface. Where walls are constructed above slopes greater than 5 feet high, increase the minimum embedment to 2½ feet below the lowest adjacent ground surface. Design Keystone walls using the following parameters:

TABLE 9
Keystone Retaining Wall Design Parameters

	Cohesion (c') (pcf)	Friction Angle (ϕ') (degrees)	Unit Weight (γ) (pcf)
Reinforced Fill	0	35	125
Retained Soil	0	30	125
Foundation Fill or Native Subgrade	0	30	125

All retaining walls should be provided with proper drainage to prevent the build-up of hydrostatic pressures behind the walls.

Soil placed as reinforced fill should be a primarily granular material with a maximum particle size of 2 inches, no more than 25 percent passing the No. 200 sieve, and a plasticity index less than 12.

8. PAVEMENT DESIGN

8.1 OFFSITE ASPHALT CONCRETE PAVEMENT RECOMMENDATIONS

We understand that El Dorado County is requiring the Green Valley / Deer Valley Road intersection and Bass Lake Road to be structurally overlayed to provide estimated year 2025 Traffic Indices (TI) of 9.0 and 8.5, respectively. Based on laboratory R-value tests conducted on subgrade material from each of the proposed widening projects, and our existing pavement condition opinions, we provide recommended asphalt concrete (AC) overlay thicknesses to meet El Dorado County's expected year 2025 TI demand using Procedure 608 of the Caltrans Highway Design Manual (including the asphalt factor of safety).

TABLE 10
Minimum Required AC Overlay

Roadway	Design R-value	Minimum AC Overlay (in.)
Bass Lake Road	31	5
Green Valley Road	48	2
Deer Valley Road, north		5
Deer Valley Road, south		4

As discussed previously in this report, we observed several failed pavement areas up to approximately 3 feet by 8 feet, evident by severe alligator cracking and depression within the Bass Lake Road widening areas. These failed areas should be removed and replaced prior to overlay.

We provide minimum required pavement sections for the newly constructed widened portions of the above roadways in Table 11 below.

TABLE 11
Recommended Asphalt Concrete Pavement Sections

Roadway	Design TI	Section	
		Asphalt Concrete (in.)	Class 2 Aggregate Base (in.)
Bass Lake Road	8.5	5	12
Green Valley Road	9.0	5½	7
Deer Valley Road	9.0	5½	7

8.2 RESIDENTIAL ASPHALT CONCRETE PAVEMENT RECOMMENDATIONS

We obtained three bulk samples of the surface soil from the Silver Springs Residential pavement areas and performed R-value tests to provide data for pavement design. The results of the tests are included in Appendix B. We judge an R-value of 20 to be appropriate for design if pavements are constructed with native non-expansive subgrade. Where clay is encountered at subgrade, the clay should be excavated and blended with non-expansive material or chemically treated to obtain a minimum R-value of 20.

Using estimated traffic indices for various pavement loading requirements, we developed the following recommended pavement sections using Procedure 608 of the Caltrans Highway Design Manual (including the asphalt factor of safety), presented in Table 12 below.

TABLE 12
Recommended Asphalt Concrete Pavement Sections

Traffic Index	Section	
	Asphalt Concrete (in.)	Class 2 Aggregate Base (in.)
5	3	9
6	3	11
7	4	12
8	4	16

APPENDIX B

The civil engineer should determine the appropriate traffic indices based on the estimated traffic loads and frequencies.

8.3 SUBGRADE AND AGGREGATE BASE COMPACTION

Compact finish subgrade and aggregate base in accordance with Section 4.7. Aggregate Base should meet the requirements for ¾ -inch maximum Class 2 AB per section 26-1.02a of the latest Caltrans Standard Specifications.

8.4 CUT-OFF CURBS

Saturated pavement subgrade or aggregate base can cause premature failure or increased maintenance of asphalt concrete pavements. This condition often occurs where landscape areas directly abut pavements. If increased protection against saturated subgrade or aggregate base is desired, construct concrete cut-off curbs where pavements abut landscape areas. Extend the curbs at least 4 inches into the subgrade below the aggregate base course level.

8.5 PAVEMENT MAINTENANCE AND REHABILITATION

Due to variability in environmental conditions, thermal cracking, traffic conditions, construction quality, and pavement materials, periodic maintenance and/or rehabilitation of the pavement will likely become necessary during the pavement design life. Such periodic maintenance may include crack sealing, seal coats, and patching, as necessary. Rehabilitation may include structural overlay or reconstruction, as necessary.

8.6 RESIDENTIAL DRIVEWAYS/GARAGE SLABS

We were not retained to provide design recommendations for residential driveways or garage slabs. They should be designed to resist the anticipated traffic and structural loads, (and the effects of expansive soil movement.

9. RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risk of costly design, construction, and maintenance problems can be significantly lowered by retaining the design geotechnical engineering firm to provide construction monitoring services as outlined below:

1. Retain ENGEO to review the final grading, improvement, and foundation plans prior to construction to determine whether our recommendations have been implemented, and to provide additional or modified recommendations, if necessary.

2. Retain ENGEO to perform construction monitoring to check the validity of the assumptions we made to prepare this report. Our services would include testing and observation during site clearing, mass grading, remedial grading, subdrain installation, foundation excavation, underground utility construction, and pavement subgrade and aggregate base compaction.

3. If any changes occur in the nature, design or location of the proposed improvements, then retain ENGEO to review the changes and prepare a written response and validate the conclusions and recommendations in this report.

4. If 2 years or more lapse between the time this report was prepared and construction, or if conditions have changed because of natural causes or construction operations on or near the site, then retain ENGEO to review this report for applicability to the new conditions. This report is applicable only for the project and site studied.

If we are not retained to perform the services described above, then we are not responsible for any party's interpretation of our report (and subsequent addenda, letters, and verbal discussions).

10. LIMITATIONS

This report presents geotechnical recommendations for construction of improvements discussed in Section 1.3 for the Silver Springs Development project and associated offsite improvement projects. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied.

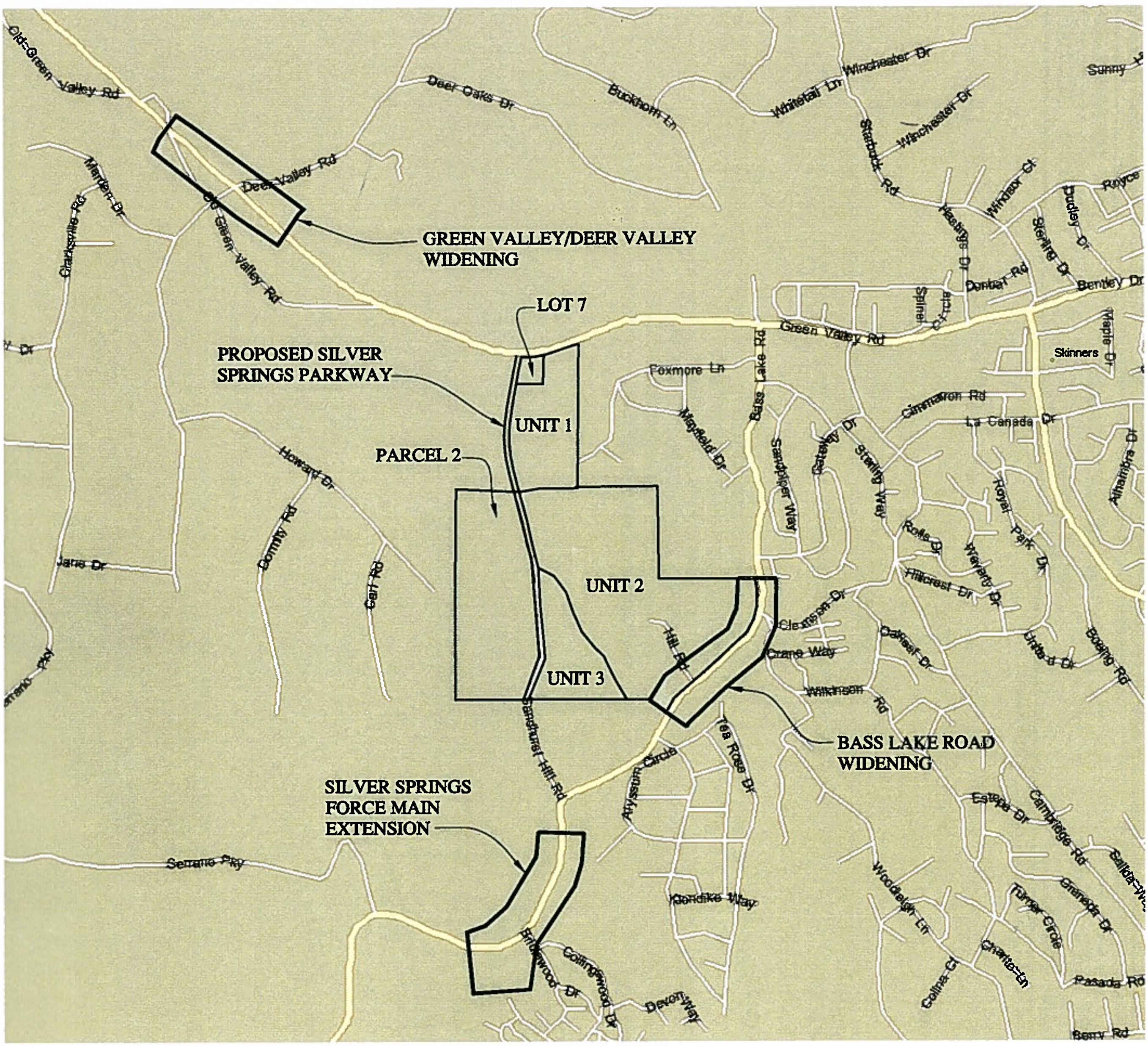
We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data is representative of soil/rock and groundwater conditions across the site. Considering possible underground variability of soil, rock, stockpiled material, and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, notify ENGEO immediately to review these conditions and provide additional and/or modified recommendations, as necessary.

The locations of our test pits are approximate and were estimated by pacing from features shown on the site plan Exhibits A through F, prepared by Stantec Consultants Incorporated, dated November 4, 2005.

Our services did not include excavation sloping or shoring, soil volume change factors, flood potential, or a geohazard exploration.

This geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, then notify the proper regulatory officials immediately.

FIGURES



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BASE MAP SOURCE: MS STREETS AND TRIPS

ENGEO INCORPORATED — EXCELLENT SERVICE SINCE 1971	VICINITY MAP SILVER SPRINGS DEVELOPMENT EL DORADO HILLS, CALIFORNIA	PROJECT NO.: 7125.5.001.01 DATE: FEBRUARY 2006 DRAWN BY: SRP — CHECKED BY: KB	FIGURE NO. 1

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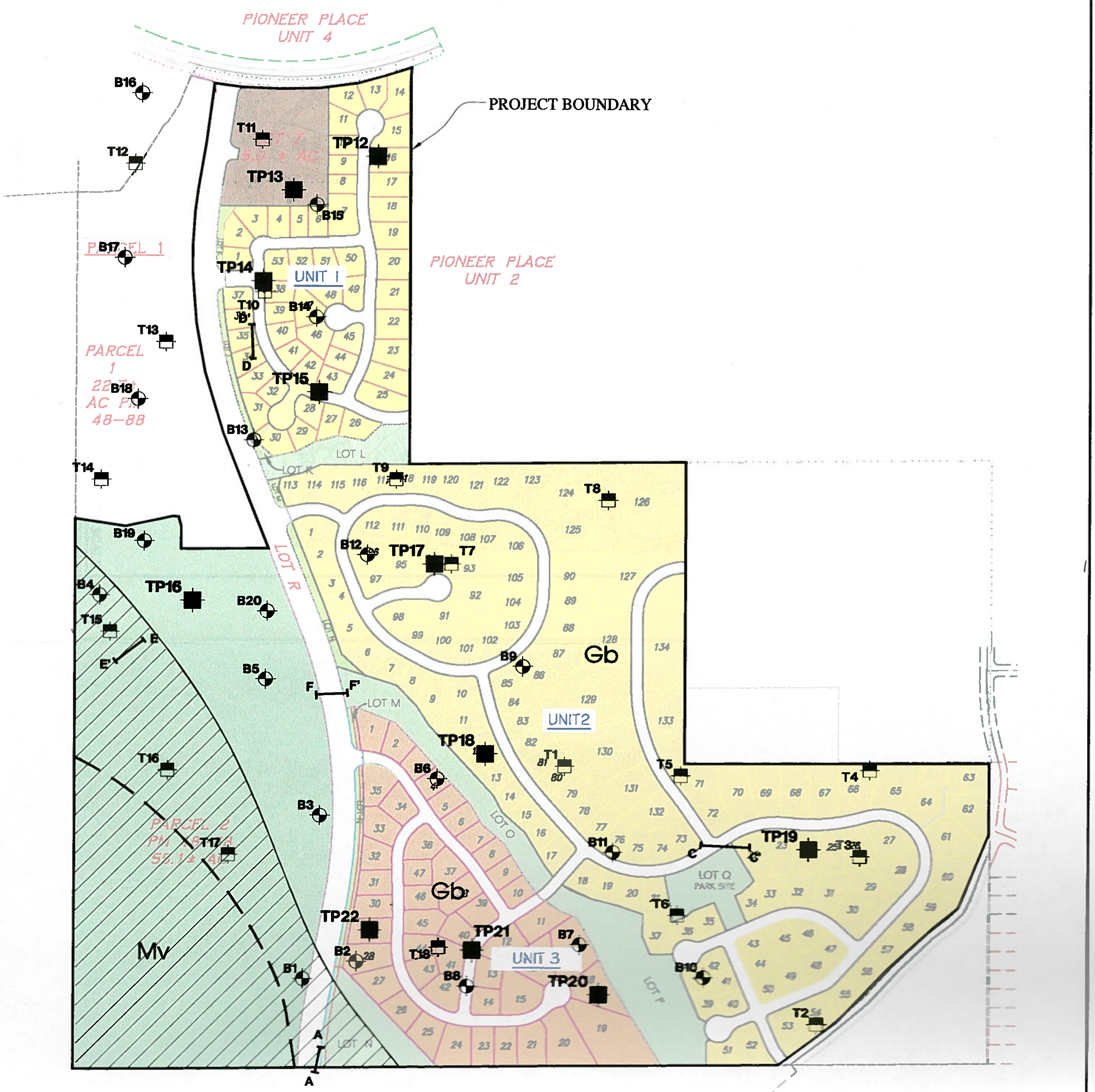


EXPLANATION

TP22	APPROXIMATE LOCATION OF TESTPIT (ENGEO, 2006)
T18	APPROXIMATE LOCATION OF TESTPIT (ACG, 1989)
B20	APPROXIMATE LOCATION OF BORING (ACG, 1989)
A—A	APPROXIMATE LOCATION OF SEISMIC REFRACTION LINES (ACG, 1989)
— — —	APPROXIMATE GEOLOGIC INTERFACE
(hatched)	PORTION OF PROJECT MAPPED AS "MORE LIKELY TO CONTAIN NATURALLY OCCURRING ASBESTOS" (EL DORADO COUNTY, ASBESTOS REVIEW AREAS WESTERN SLOPE COUNTY OF EL DORADO, CA DATED JULY 21, 2005)
Mv	METAVOLCANICS
Gb	GABBROICS

BASE MAP SOURCE: STANTEC CONSULTING

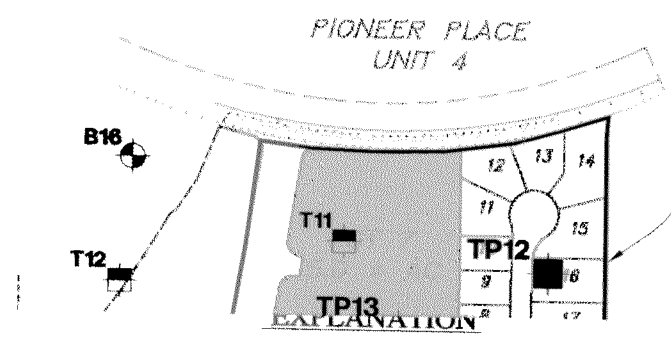
NO SCALE

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

SITE PLAN
SILVER SPRINGS DEVELOPMENT
EL DORADO COUNTY, CALIFORNIA

PROJECT NO.: 7125.5.001.01	FIGURE NO. 2
DATE: FEBRUARY 2006	
DRAWN BY: SRP	CHECKED BY: KB

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

- TP22 — APPROXIMATE LOCATION OF TESTPIT (ENGEO, 2006)
- T18 — APPROXIMATE LOCATION OF TESTPIT (ACG, 1989)
- B20 — APPROXIMATE LOCATION OF BORING (ACG, 1989)
- A —— A — APPROXIMATE LOCATION OF SEISMIC REFRACTION LINES (ACG, 1989)
- — — — APPROXIMATE GEOLOGIC INTERFACE
- (hatched box) — PORTION OF PROJECT MAPPED AS "MORE LIKELY TO CONTAIN NATURALLY OCCURRING ASBESTOS" (EL DORADO COUNTY, ASBESTOS REVIEW AREAS WESTERN SLOPE COUNTY OF EL DORADO, CA. DATED JULY 21, 2005)
- Mv — METAVOLCANICS
- Gb — GABROICS

N

BASE MAP SOURCE: STANTEC CONSULTING

NO SCALE

ENGEO INCORPORATED — EXCELLENT SERVICE SINCE 1971

SITE PLAN
SILVER SPRINGS DEVELOPMENT
EL DORADO COUNTY, CALIFORNIA

PROJECT NO.: 7125.5.001.01		FIGURE NO. 2
DATE: FEBRUARY 2006		
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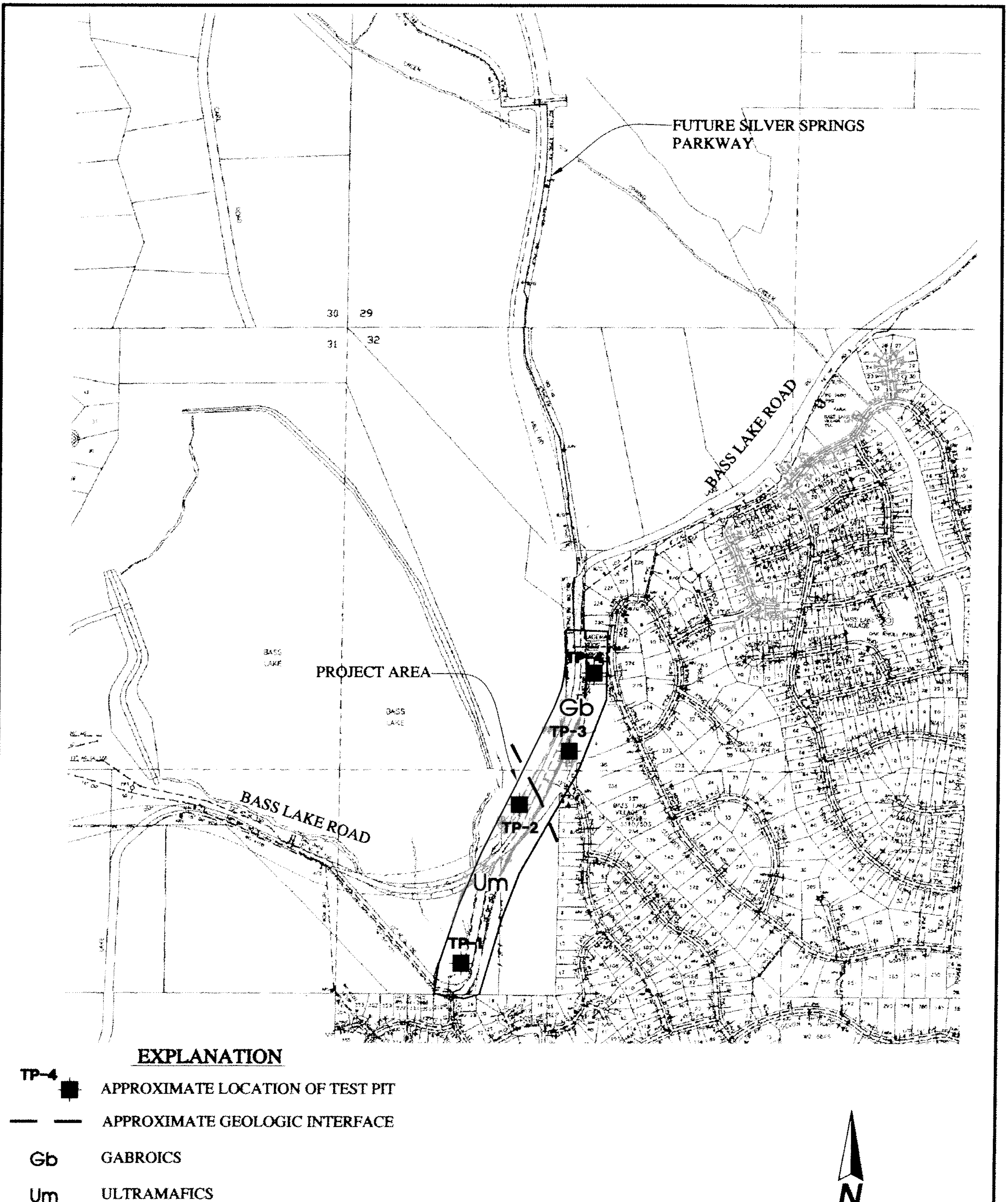

BASE MAP SOURCE: STANTEC CONSULTING INC.

NO SCALE

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	SITE PLAN SILVER SPRINGS FORCE MAIN SEWER EXTENSION EL DORADO COUNTY, CALIFORNIA	PROJECT NO.: 7125.5.001.01		FIGURE NO. 3
		DATE: FEBRUARY 2006		
		DRAWN BY: SRP	CHECKED BY: KB	

ORIGINAL FIGURE PRINTED IN COLOR

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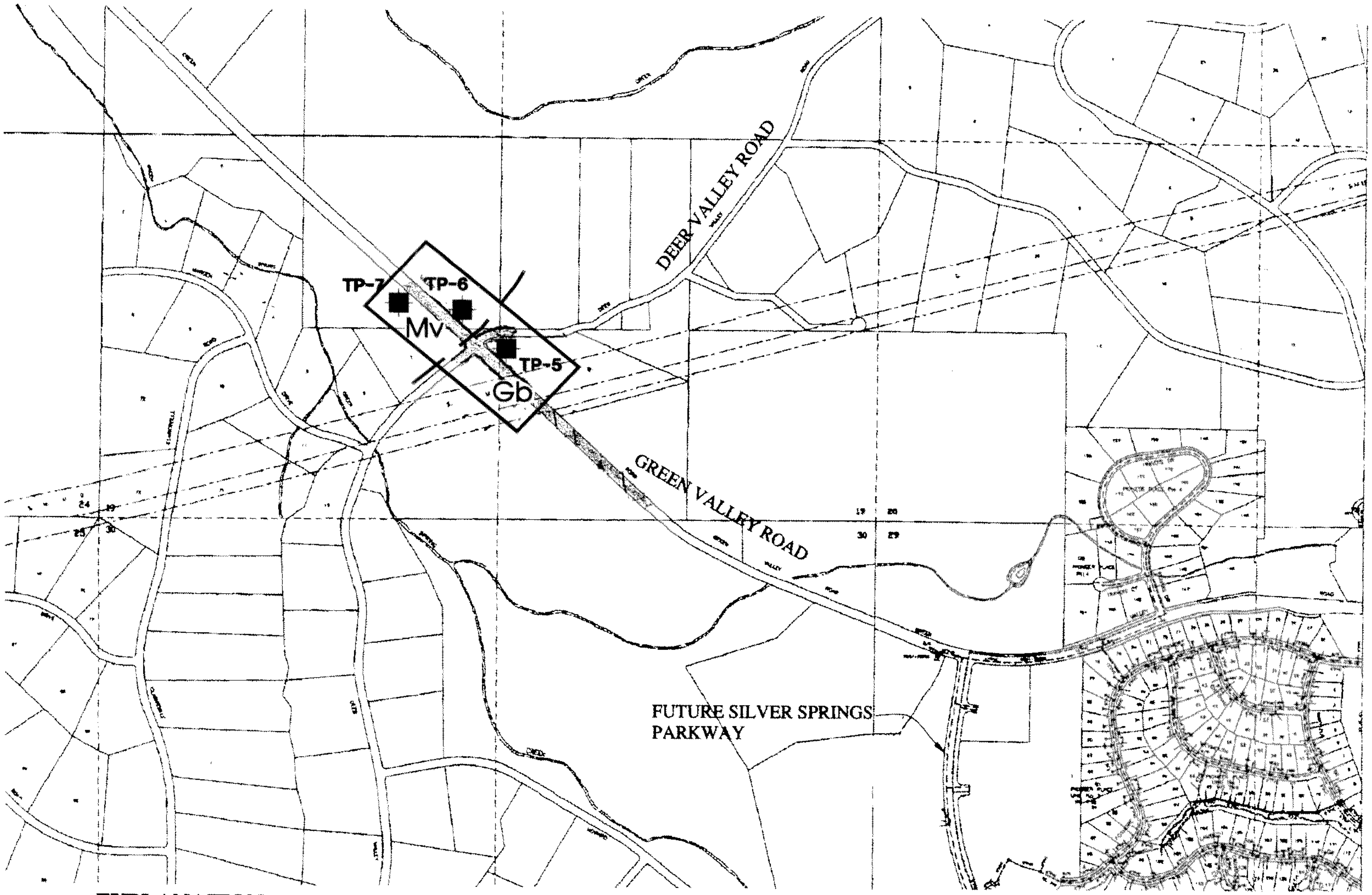

EXPLANATION

- TP-7 ■ APPROXIMATE LOCATION OF TEST PIT
- — — APPROXIMATE GEOLOGIC INTERFACE
- Mv METAVOLCANICS
- Gb GABROICS

BASE MAP SOURCE: STANTEC CONSULTING INC.

NO SCALE

ENGEO INCORPORATED — EXCELLENT SERVICE SINCE 1971

SITE PLAN
GREEN VALLEY/DEER VALLEY ROAD WIDENING
EL DORADO COUNTY, CALIFORNIA

PROJECT NO.: 7125.5.001.01	FIGURE NO. 4
DATE: FEBRUARY 2006	
DRAWN BY: SRP	CHECKED BY: KB

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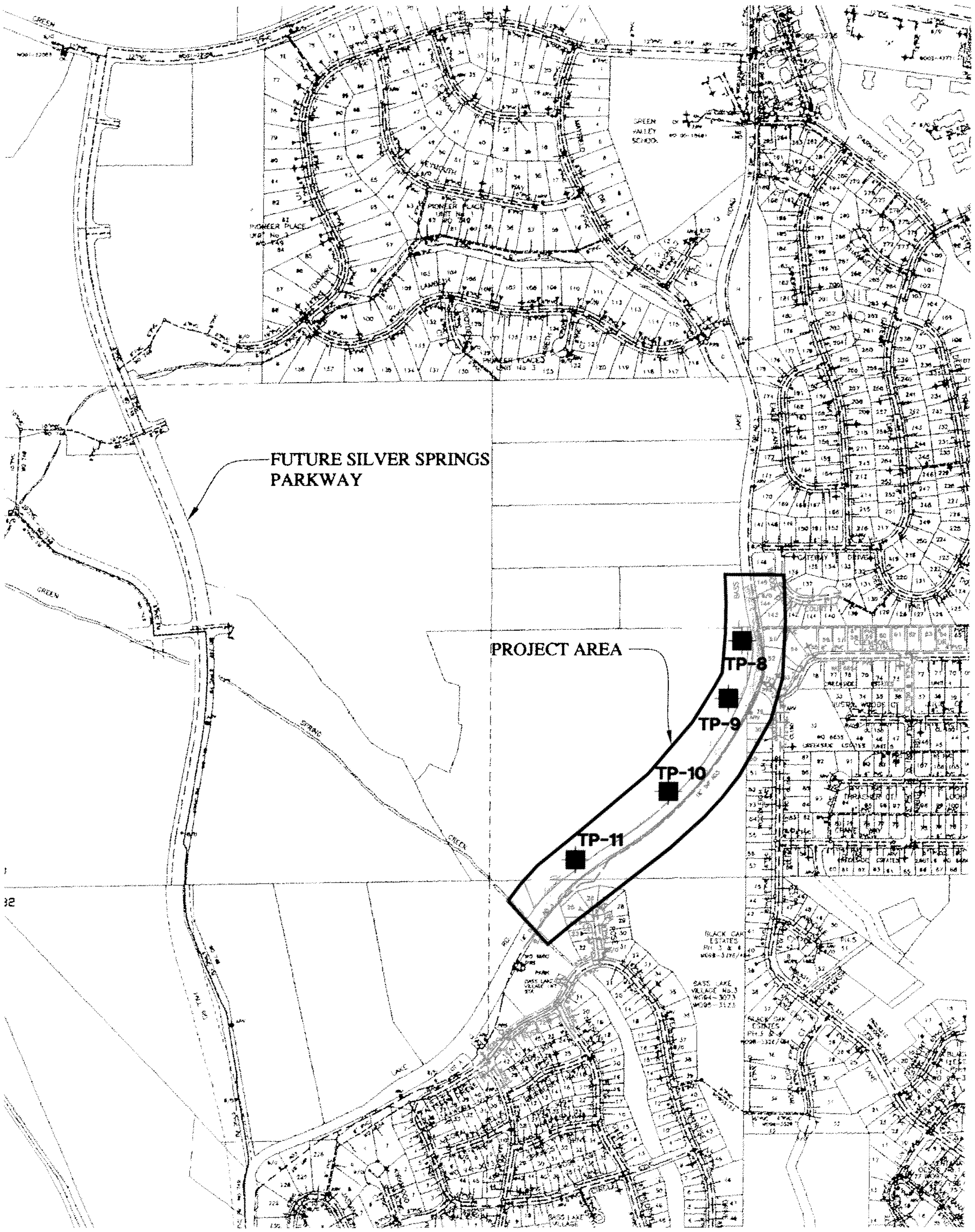

EXPLANATION

TP-11 ■ APPROXIMATE LOCATION OF TEST PIT

N

BASE MAP SOURCE: STANTEC CONSULTING INC.

NO SCALE

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	SITE PLAN BASS LAKE ROAD ROAD WIDENING EL DORADO COUNTY, CALIFORNIA	PROJECT NO.: 7125.5.001.01 DATE: FEBRUARY 2006 DRAWN BY: SRP CHECKED BY: KB	FIGURE NO. 5

ORIGINAL FIGURE PRINTED IN COLOR

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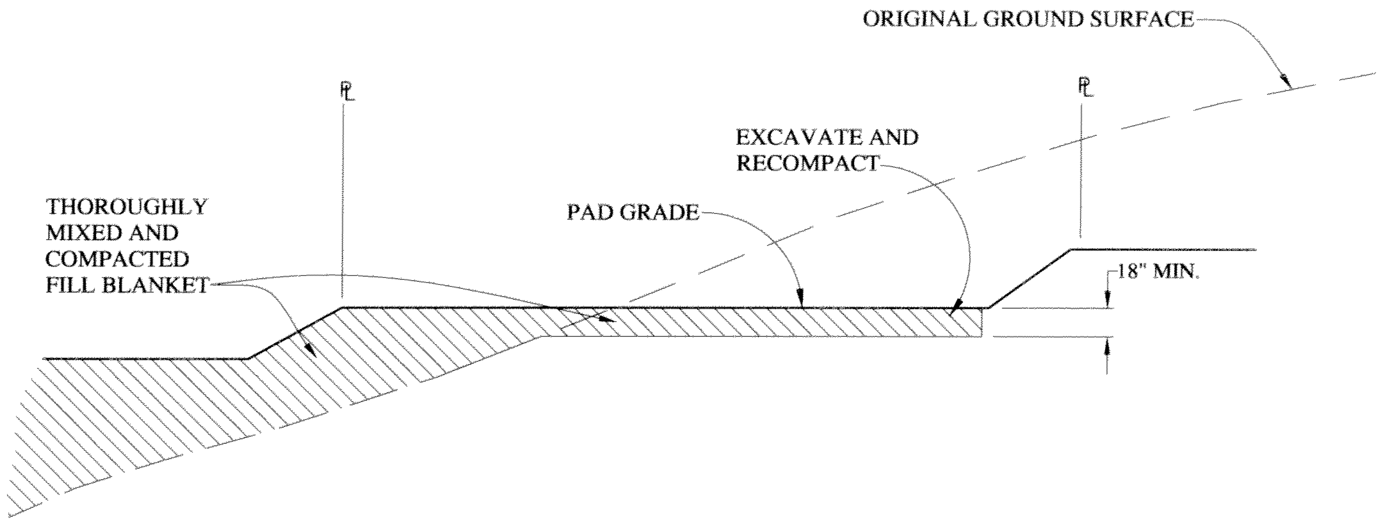

ON CUT LOTS AND CUT/FILL LOTS, THE UPPER 18" SHOULD BE EXCAVATED SCARIFIED, MIXED, AND RECOMPACTED TO CREATE A RELATIVELY HOMOGENEOUS FILL BLANKET AS SHOWN

NO SCALE

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	OVEREXCAVATION FOR CUT AND CUT/FILL LOTS SILVER SPRINGS DEVELOPMENT VALLEY SPRINGS, CALIFORNIA	PROJECT NO.: 7125.5.001.01 DATE: FEBRUARY 2006 DRAWN BY: SRP CHECKED BY: KB	FIGURE NO. 6

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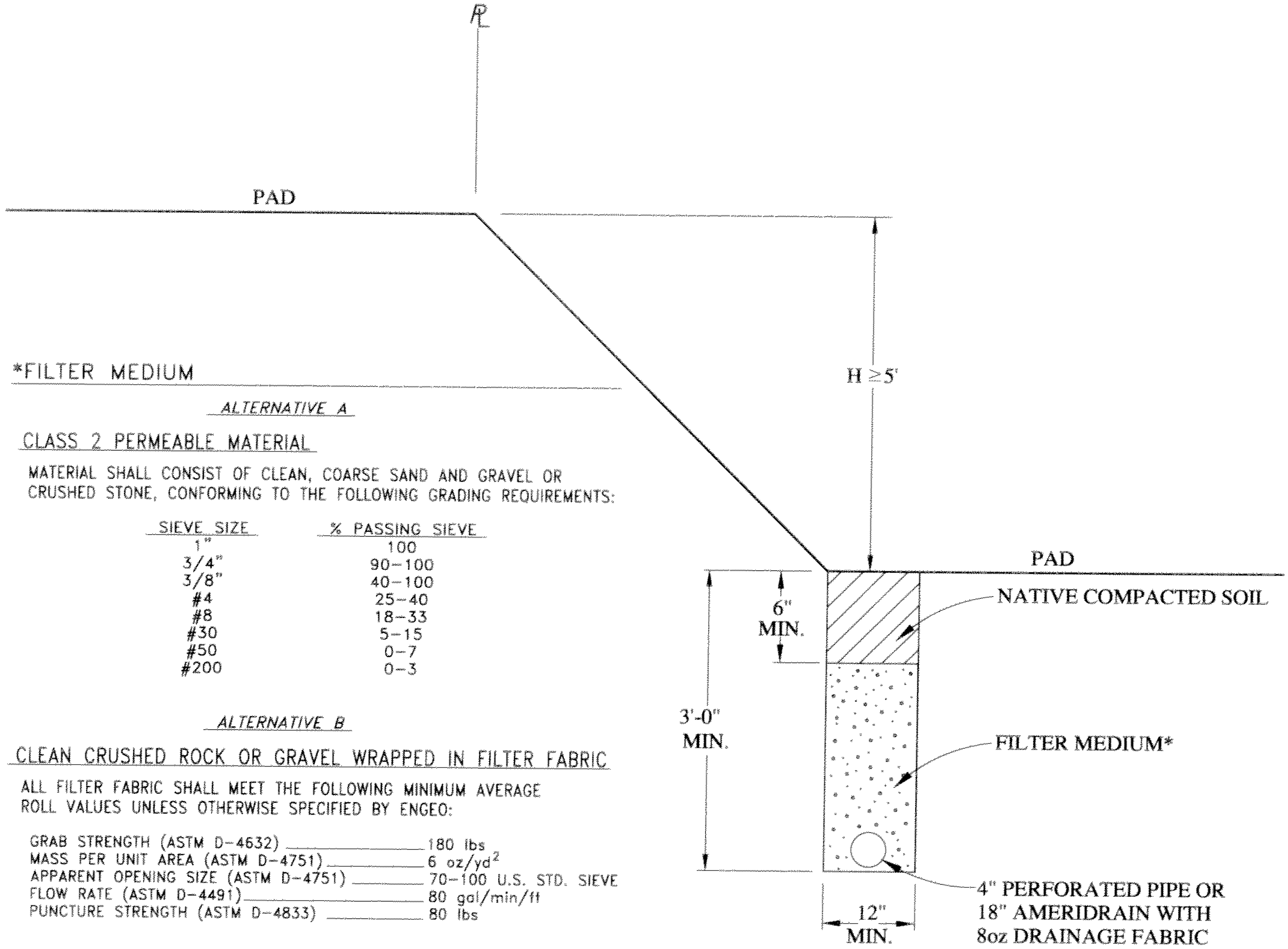

*FILTER MEDIUM

ALTERNATIVE A

CLASS 2 PERMEABLE MATERIAL

MATERIAL SHALL CONSIST OF CLEAN, COARSE SAND AND GRAVEL OR CRUSHED STONE, CONFORMING TO THE FOLLOWING GRADING REQUIREMENTS:

SIEVE SIZE	% PASSING SIEVE
1"	100
3/4"	90–100
3/8"	40–100
#4	25–40
#8	18–33
#30	5–15
#50	0–7
#200	0–3

ALTERNATIVE B

CLEAN CRUSHED ROCK OR GRAVEL WRAPPED IN FILTER FABRIC

ALL FILTER FABRIC SHALL MEET THE FOLLOWING MINIMUM AVERAGE ROLL VALUES UNLESS OTHERWISE SPECIFIED BY ENGEO:

GRAB STRENGTH (ASTM D-4632)	180 lbs
MASS PER UNIT AREA (ASTM D-4751)	6 oz/yd^2
APPARENT OPENING SIZE (ASTM D-4751)	70–100 U.S. STD. SIEVE
FLOW RATE (ASTM D-4491)	80 gal/min/ft
PUNCTURE STRENGTH (ASTM D-4833)	80 lbs

NOTES:

1. *ALL PIPE JOINTS SHALL BE GLUED*
2. *ALL PERFORATED PIPE PLACED PERFORATIONS DOWN*
3. *1% FALL (MINIMUM) ON ALL TRENCHES AND DRAIN LINES*

NO SCALE

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

TYPICAL SUBDRAIN DETAIL
SILVER SPRINGS DEVELOPMENT
EL DORADO COUNTY, CALIFORNIA

PROJECT NO.: 7125.5.001.01		FIGURE NO.
DATE: FEBRUARY 2006		7
DRAWN BY: SRP	CHECKED BY: KB	

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APPENDIX A

APPENDIX A

Field Exploration Notes
Exploratory Logs

FIELD EXPLORATION NOTES

We excavated 22 test pits on the project sites for this report. An ENGEO representative supervised the trenching, and logged the type, location, and uniformity of the underlying soil/rock. A Case 580 M backhoe was used to excavate the test pits using a 2 foot wide bucket.

The exploratory trench logs present descriptions of the subsurface soil, rock and groundwater conditions encountered. The maximum depth penetrated by the test pits was 10 feet.

We obtained bulk soil samples from the test pits using hand sampling techniques.

NOTES TO THE LOGS

We determined the lines designating the interface between soil/rock materials on the logs using visual observations. The transition between the materials may be abrupt or gradual.

The logs contain information concerning samples recovered, indications of the presence of various materials such as sand, silt, rock, existing fill, etc., and observations of groundwater encountered. The field logs also contain our interpretation of the soil/rock conditions between samples. Therefore, the logs contain both factual and interpretative information. Our recommendations are based on the contents of the final logs. The final logs represent our interpretation of the contents of the field logs.

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-1	0 – 3½	SILTY CLAY (CL), reddish brown, stiff, moist, slightly plastic. Field penetrometer = 2.0 tsf Sample taken at 2 feet.
	3½ - 5	ULTRAMAFIC ROCK, brown, very strong. Bottom of test pit at 5 feet due to refusal on very strong rock. No groundwater encountered.
TP-2	0 – 1	SILTY CLAY (CL), reddish brown, soft wet, slightly plastic. Sample taken at ½ foot.
	1 – 2	ULTRAMAFIC ROCK, dark gray, very strong. Sample taken at 1 foot. Bottom of test pit at 2 feet due to refusal on very strong rock. No groundwater encountered.
TP-3	0 – 3 ½	SILTY CLAY (CL), reddish brown, medium stiff, moist to wet, slightly plastic. Sample taken at 1 foot. Sample taken at 3 feet.
	3 ½ - 4	METAVOLCANIC ROCK, dark brown to black, very strong. Sample taken at 4 feet. Bottom of test pit at 4 feet due to refusal on very strong rock. No groundwater encountered.

Logged By: Kyle Bickler / Steve Crenshaw
7125.5.001.01
Date Logged: 12/29/05 – 01/10/06

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-4	0 – 2 ½	SILTY CLAY (CL), reddish brown, medium stiff, moist, slightly plastic.
		Sample taken at 1 foot.
	2 ½ - 3	METAVOLCANIC ROCK, dark grayish black, very strong.
		Sample taken at 3 feet.
		Bottom of test pit at 3 feet due to refusal on very strong rock. No groundwater encountered.
TP-5	0 – 5	SILTY CLAY (CL), reddish brown, medium stiff, moist to wet, slightly plastic.
		Bulk sample taken at 1 foot.
	5 – 5 ½	SILTY SAND (SW), light grayish brown, dense, moist, weathered rock.
	5 ½ - 6	GABBROIC ROCK, light yellowish brown, very strong.
		Bottom of test pit at 6 feet due to refusal on very strong rock. No groundwater encountered.
TP-6	0 – 1	SILTY CLAY (CL), reddish brown, medium stiff, moist, slightly plastic.
	1 – 4 ½	SANDY FRACTURED ROCK (GP), light brown, very dense, breaks into 2 – 3 inch cubical and angular particles.
		Sample taken at 3 feet.
	4 ½ - 5	GABBROIC ROCK, brown to dark brown, very strong.
		Bottom of test pit at 5 feet due to refusal on very strong rock. No groundwater encountered.

Logged By: Kyle Bickler / Steve Crenshaw
7125.5.001.01
Date Logged: 12/29/05 – 01/10/06

Figure A-2

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-7	0 – ½	SANDY GRAVEL (GP), gray, loose, moist.
		Sample taken at ½ foot.
	½ -1	ULTRAMAFIC ROCK, dark gray to black, very strong.
		Bottom of test pit at 1 foot due to refusal on very strong rock. No groundwater encountered.
TP-8	0 – 3	SANDY SILT (ML), reddish brown, stiff, moist, slightly plastic, with fine-grained sand and trace clay.
		Bulk sample taken at 2 feet.
	3 - 5	SILTY SAND (SM), yellowish brown, dense, moist, medium- to coarse-grained sand.
		Bulk sample taken at 4 feet.
		Bottom of test pit at 5 feet. No groundwater encountered.
TP-9	0 – 2	SANDY SILT (ML), reddish brown, stiff, moist, slightly plastic, with fine-grained sand and some clay.
		Bulk sample taken at 2 feet.
	2 - 5	SILTY SAND (SM), light brown, dense, moist, medium-grained sand.
		Bottom of test pit at 5 feet. No groundwater encountered.

Logged By: Kyle Bickler / Steve Crenshaw
7125.5.001.01
Date Logged: 12/29/05 – 01/10/06

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-10	0 – 2	SANDY SILT (ML), reddish brown, stiff, moist, slightly plastic, with fin-grained sand and some clay. Bulk Sample taken at 2 feet.
	2 – 5 ½	SILTY SAND (SM), light brown, dense, moist, medium- to coarse-grained sand.
	5 ½ - 6	GABBROIC ROCK, light brown, very strong. Bottom of test pit at 6 feet due to refusal on very strong rock. No groundwater encountered.
TP-11	0 – 4	SANDY SILT (ML), reddish brown, stiff, moist, slightly plastic, with clay. Bulk sample taken at 2 feet.
	4 – 7	SILTY SAND (SM), light brown, dense, moist, medium-grained sand.
	7 - 10	SANDY GRAVEL (GP), light brownish yellow, very dense, damp, coarse-grained sand and gravel. Bottom of test pit at 10 feet. No groundwater encountered.
TP-12	0 – 3 ½	SILTY CLAY (CL), brown, medium stiff, moist, low to moderate plasticity with trace sands and gravels. Field penetrometer = ½ tsf Sample taken at 1 ½ feet.

Logged By: Kyle Bickler / Steve Crenshaw
7125.5.001.01
Date Logged: 12/29/05 – 01/10/06

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
		At 2 feet becomes olive brown, stiff, moist. Field penetrometer = 1.5 tsf
		Sample taken at 3 feet.
	3 ½ - 10	SANDY GRAVEL (GW), with clay, reddish brown, moist, with cobbles.
		Sample taken at 7 feet.
		Bottom of test pit at 10 feet. No groundwater encountered.
TP-13	0 – 2	SILTY CLAY (CL), brown, soft, low plasticity, with trace sands and gravels.
		Sample taken at 1 foot.
	2 – 3 ½	SANDY CLAY (CL), olive brown, stiff, moderate plasticity. Field penetrometer = 1.3 tsf
		Sample taken at 3 feet.
	3 ½ - 10	CLAYEY GRAVEL (GC), reddish brown, medium dense, moist.
		Sample taken at 7 feet.
		At 6 feet, becomes wet.
		Bottom of test pit at 10 feet. Groundwater encountered at 6 feet.

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-14	0 - 10	SANDY GRAVEL (GW), olive brown, moist, traces of clay.
		Sample taken at 3 feet.
		Sample taken at 7 feet.
		Bottom of test pit at 10 feet. No groundwater encountered.
TP-15	0 – 1 ½	SILTY CLAY (CL), brown, medium stiff, moist, moderate plasticity, with trace sands and gravels. Field penetrometer = 1.0 tsf
		Sample taken at 1 foot.
	1 ½ - 3	GRAVELLY CLAY (CL), reddish brown, stiff, moist, moderate plasticity, gravel particles up to 1 inch. Field penetrometer = 1.3 tsf
		Sample taken at 3 feet.
	3 – 8 ½	GRAVELLY SAND (SW), yellowish brown, medium density, moist, gravel particles up to 3 inches.
		Sample taken at 8 feet.
	8 ½ - 9	GABBROIC ROCK, yellowish brown, very strong.
		Bottom of test pit at 9 feet due to refusal on very strong rock. No groundwater encountered.

Logged By: Kyle Bickler / Steve Crenshaw
7125.5.001.01
Date Logged: 12/29/05 – 01/10/06

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-16	0 – 1	SANDY CLAY (CL), brown, soft, moist to wet, low plasticity, traces of gravel. Sample taken at ½ foot.
	1 – 2	GRAVELLY CLAY (CL), reddish brown, stiff, moist, low plasticity. Field penetrometer = 1.3 tsf Sample taken at 1 ½ feet.
	2 - 10	GRAVELLY SAND (SW), reddish brown to yellowish brown, medium dense, moist. Sample taken at 8 feet. Bottom of test pit at 10 feet. Groundwater encountered at 10 feet.
TP-17	0 – 2	GRAVELLY CLAY (CL), brown, medium stiff, moist, low to moderate plasticity. Field penetrometer = 1.0 tsf Sample taken at 1 ½ feet.
	2 – 5 ½	CLAYEY GRAVEL (GC), black gravel, red clay, moist, rock fractures filled with moderately plastic clay. Sample taken at 4 feet.
	5 ½ - 10	GRAVELLY SAND (SW), light brown, dense, coarse-grained sand. Sample taken at 8 feet. Bottom of test pit at 10 feet. No groundwater encountered.

Logged By: Kyle Bickler / Steve Crenshaw
7125.5.001.01
Date Logged: 12/29/05 – 01/10/06

Figure A-7

Silver Springs Development
El Dorado County, California

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
TP-18	0 – 4	SILTY CLAY (CH), brown to grayish brown, very stiff, moist, high plasticity, with trace sands. Field penetrometer = 1.5 tsf Sample taken at 2 feet.
	4 – 5 ½	GRAVELLY CLAY (CL), reddish brown, stiff, moist, moderate plasticity, with fine gravels and sand. Field penetrometer = 1.3 tsf
	5 ½ - 10	GRAVELLY SAND (SW), yellowish brown, moist, medium dense. Sample taken at 6 feet. At 7 feet, becomes wet. Sample taken at 8 feet. Bottom of test pit at 10 feet. Groundwater encountered at 8 feet.
TP-19	0 – 3	GRAVELLY CLAY (CL), brown, medium stiff, moist, low plasticity, traces of sand. Field penetrometer = ½ tsf At 1 ½ feet, becomes very stiff. Field penetrometer = 2.5 tsf Sample taken at 2 feet.
	3 – 6 ½	GRAVELLY CLAY (CL), reddish brown, stiff, moist, low plasticity. Field penetrometer = 1.5 tsf Sample taken at 6 feet.

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
	6 ½ -10	SANDY GRAVEL (GP), reddish yellow, medium dense, moist, with medium-grained sand. Sample taken at 9 feet. Bottom of test pit at 10 feet. No groundwater encountered.
TP-20	0 – 2	SANDY CLAY (CL), brown, very stiff, moist, moderate to high plasticity. Field penetrometer = 3.2 tsf Sample taken at 1 ½ feet.
	2 - 10	SANDY GRAVEL (GW), yellowish gray, medium dense, moist. Sample taken at 6 feet. Sample taken at 8 feet. Bottom of test pit at 10 feet. No groundwater encountered.
TP-21	0 – 2	SANDY CLAY (CL), brown, very stiff, moist, moderate plasticity. Field penetrometer = 2.5 tsf Sample taken at 1 ½ feet.

TEST PIT LOGS

Test Pit Number	Depth (Feet)	Description
	2 – 10	GRAVELLY SAND (SW), with clay, yellowish brown, medium dense. Sample taken at 6 feet. Sample taken at 9 feet. Bottom of test pit at 10 feet. No groundwater encountered.
TP-22	0 – 1	SANDY CLAY (CL), brown, medium stiff, moist, moderate plasticity, with medium grained sand. Field penetrometer = ½ tsf Sample taken at 1 foot.
	1 – 6	SANDY GRAVEL (GP), light brown, dense, moist, with fractured rock. Sample taken at 5 feet.
	6 – 6 ½	GABBROIC ROCK, light brown, very strong hard. Bottom of test pit at 6 ½ feet due to refusal on very strong rock. No groundwater encountered.

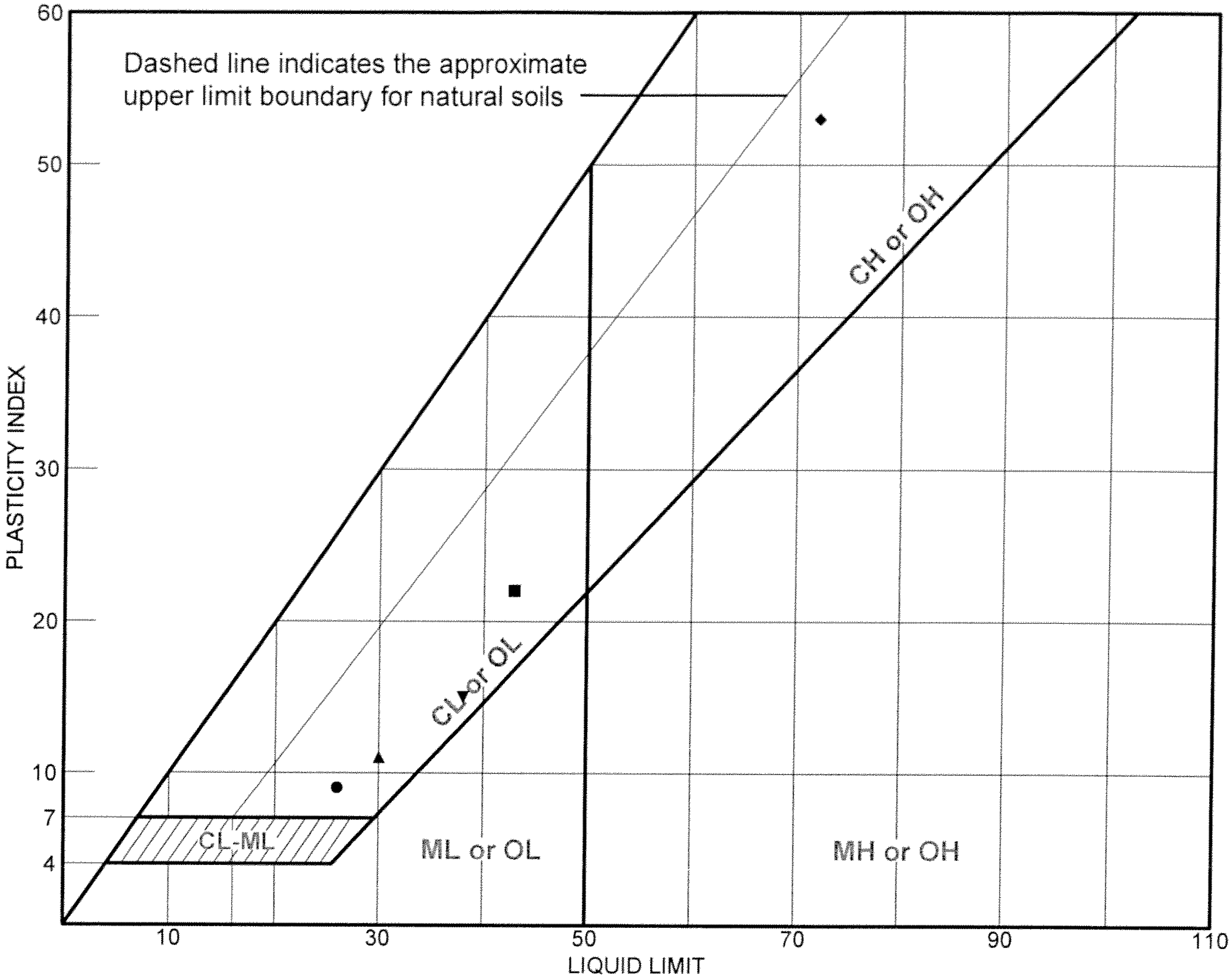
APPENDIX B
LABORATORY TEST DATA

Summary of Moisture Test Data
Liquid and Plastic Limits Test Report
Expansion Index Test Report
Particle Size Distribution Report (3 pages)
R-Value Test Reports (5 pages)
Analytical Results of Soil Corrosion (5 pages)

SUMMARY OF MOISTURE TEST DATA

Exploratory Location	Depth (feet)	Moisture Content, percent
TP-12	1½	23.7
TP-12	3	22.9
TP-12	7	17.4
TP-13	3	23.5
TP-13	7	15.8
TP-14	3	15.1
TP-14	7	10.5
TP-15	1	21.0
TP-15	3	22.5
TP-16	½	24.8
TP-16	1½	34.9
TP-16	8	26.9
TP-17	4	11.0
TP-17	8	8.9
TP-18	2	30.6
TP-18	6	20.8
TP-18	8	17.3
TP-19	6	20.2
TP-19	9	11.6
TP-20	1½	18.2
TP-20	6	10.5
TP-21	6	25.2
TP-22	9	12.8
TP-22	1	20.5

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	GEX	TP13@1.0'	1 foot		17	26	9	CL
■	GEX	TP15@1.0'	1 foot		21	43	22	CL
▲	GEX	TP16@0.5'	1/2 feet		19	30	11	CL
◆	GEX	TP18@2.0'	2 feet		19	72	53	CH
▼	GEX	TP22@1.0'	1 foot		23	38	15	CL

LIQUID AND PLASTIC LIMITS TEST REPORT **ENGEO INCORPORATED**	**Client:** **Project:** Silver Springs Development **Project No.:** 7125.5.001.01 **Figure**

EXPANSION INDEX TEST RESULTS

ASTM D 4829

DATE: **1/18/05**

JOB NO.: **7125.5.001.01**

JOB NAME: **Silver Springs Development**

SAMPLE I.D.	SOIL DESCRIPTION	INITIAL DRY DENSITY (pcf)	INITIAL MOISTURE CONTENT (%)	FINAL MOISTURE CONTENT (%)	EXPANSION INDEX
TP15@1	Brown sandy clay (CL)	107.3	9.5	23.7	**51**
TP18@2	Brown to grayish brown silty clay (CH)	95.6	12.5	36.0	**138**
TP22@1	Brown sandy clay (CL)	111.4	11.0	20.3	**28**

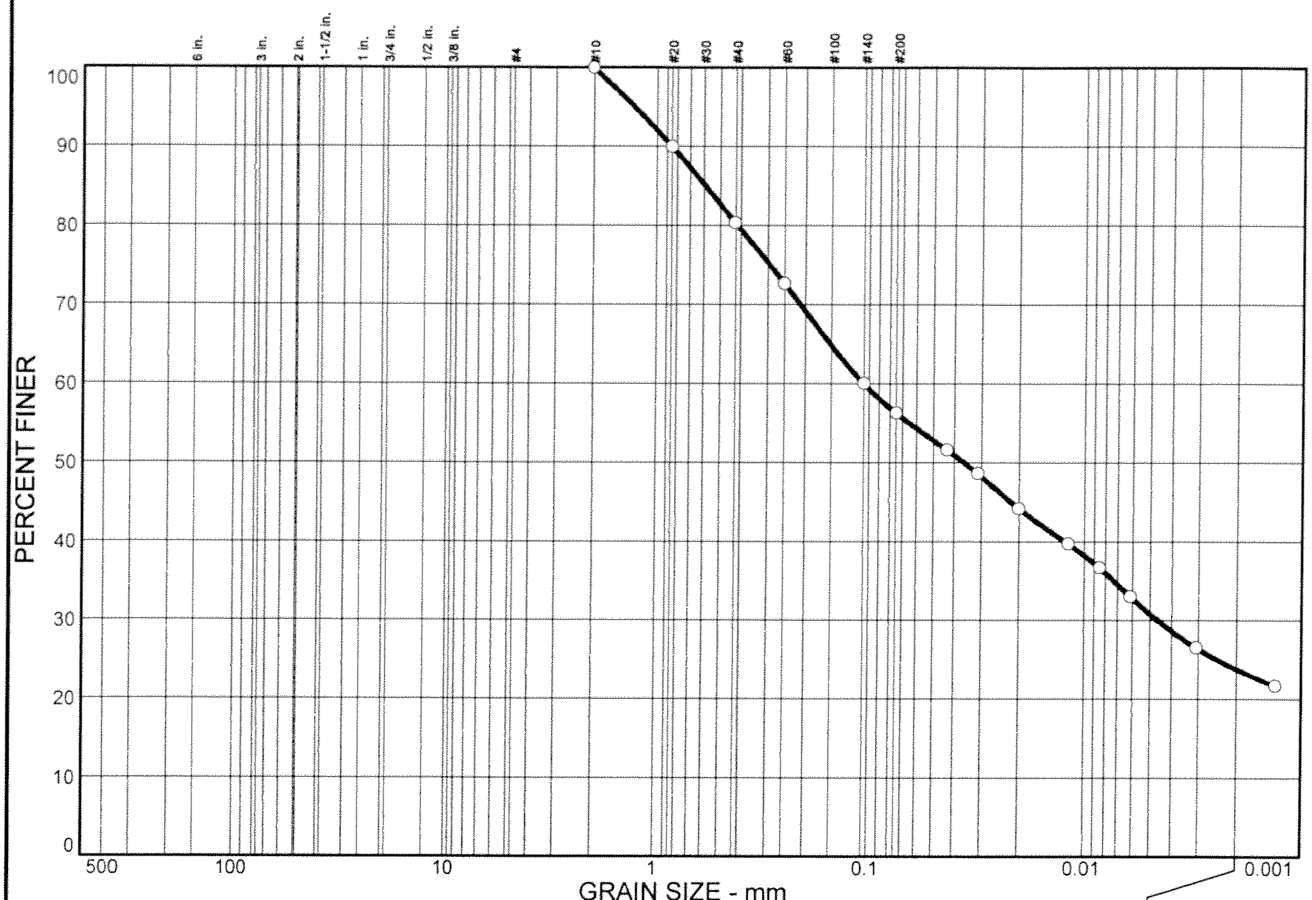
CLASSIFICATION OF EXPANSIVE SOIL

ASTM D 4829

EXPANSION INDEX	POTENTIAL EXPANSION
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

ENGEO INCORPORATED

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	43.7	32.5	23.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	90.0		
#40	80.3		
#60	72.6		
#140	60.0		
#200	56.3		

* (no specification provided)

Soil Description

Brown sandy clay

Atterberg Limits

PL= 21 LL= 43 PI= 22

Coefficients

D_{85}= 0.590 D_{60}= 0.106 D_{50}= 0.0359
D_{30}= 0.0046 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

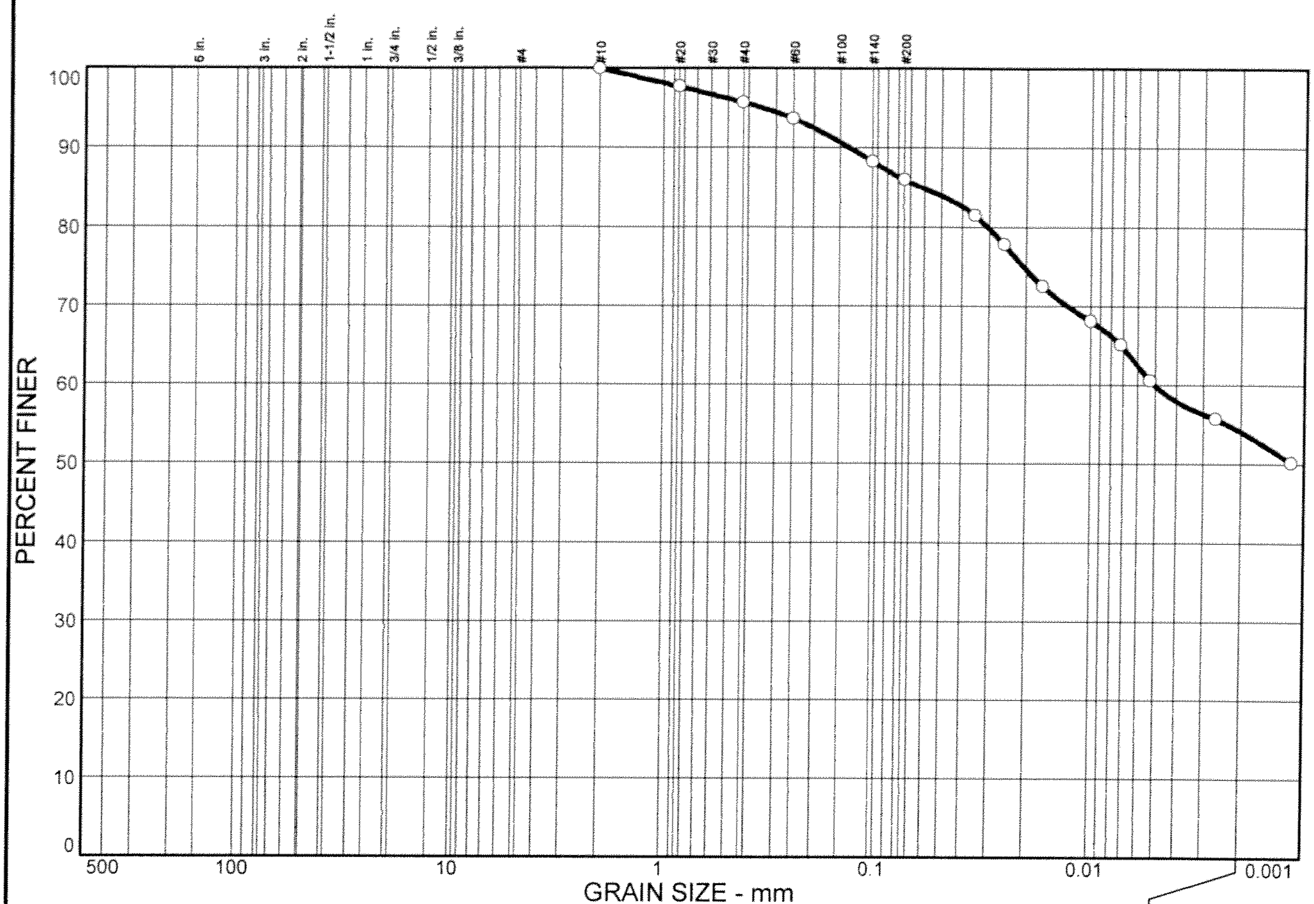
Remarks

Sample No.: TP15@1.0' **Source of Sample:** GEX **Date:** 1/18/05
Location: **Elev./Depth:** 1 foot

ENGEO INCORPORATED

Client:
Project: Silver Springs Development
Project No: 7125.5.001.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	14.0	31.9	54.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	97.7		
#40	95.7		
#60	93.7		
#140	88.3		
#200	86.0		

* (no specification provided)

Soil Description

Brown to grayish brown silty clay

Atterberg Limits

PL= 19 LL= 72 PI= 53

Coefficients

D_{85}= 0.0616 D_{60}= 0.0050 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

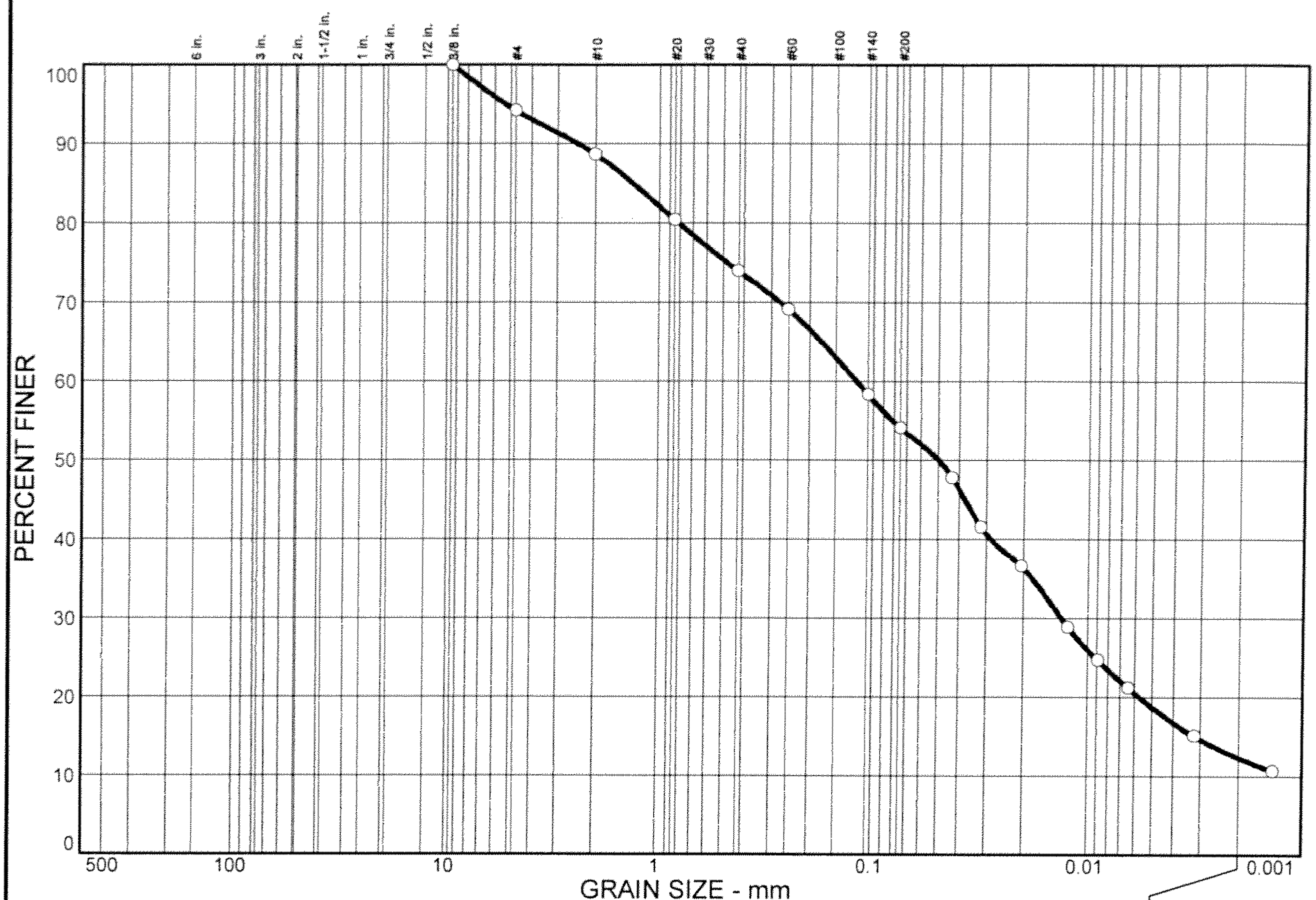
Remarks

Sample No.: TP18@2.0' **Source of Sample:** GEX **Date:** 1/18/06
Location: **Elev./Depth:** 2 feet

ENGEO INCORPORATED

Client:
Project: Silver Springs Development
Project No: 7125.5.001.01 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	5.8	40.1	41.7	12.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375 in.	100.0		
#4	94.2		
#10	88.7		
#20	80.4		
#40	73.9		
#60	69.1		
#140	58.3		
#200	54.1		

* (no specification provided)

Soil Description

Brown sandy clay

Atterberg Limits

PL= 23 LL= 38 PI= 15

Coefficients

D_{85}= 1.33 D_{60}= 0.120 D_{50}= 0.0497
D_{30}= 0.0133 D_{15}= 0.0032 D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

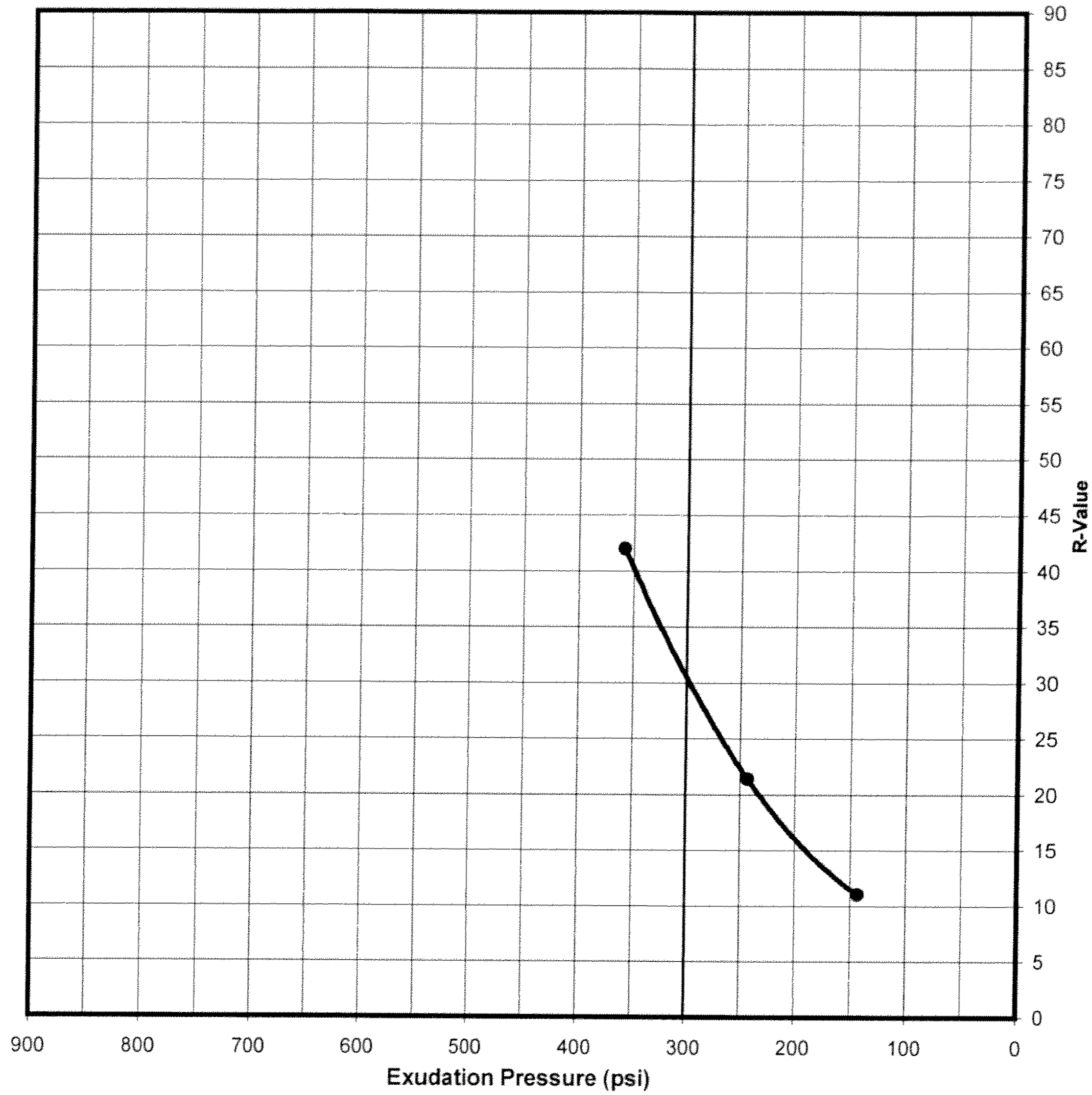
Sample No.: TP22@1.0' **Source of Sample:** GEX **Date:** 2/18/06
Location: **Elev./Depth:** 1 foot

ENGEO INCORPORATED

Client:
Project: Silver Springs Development
Project No: 7125.5.001.01 **Figure**

ENGEO INCORPORATED

R VALUE TEST REPORT
CAL-301

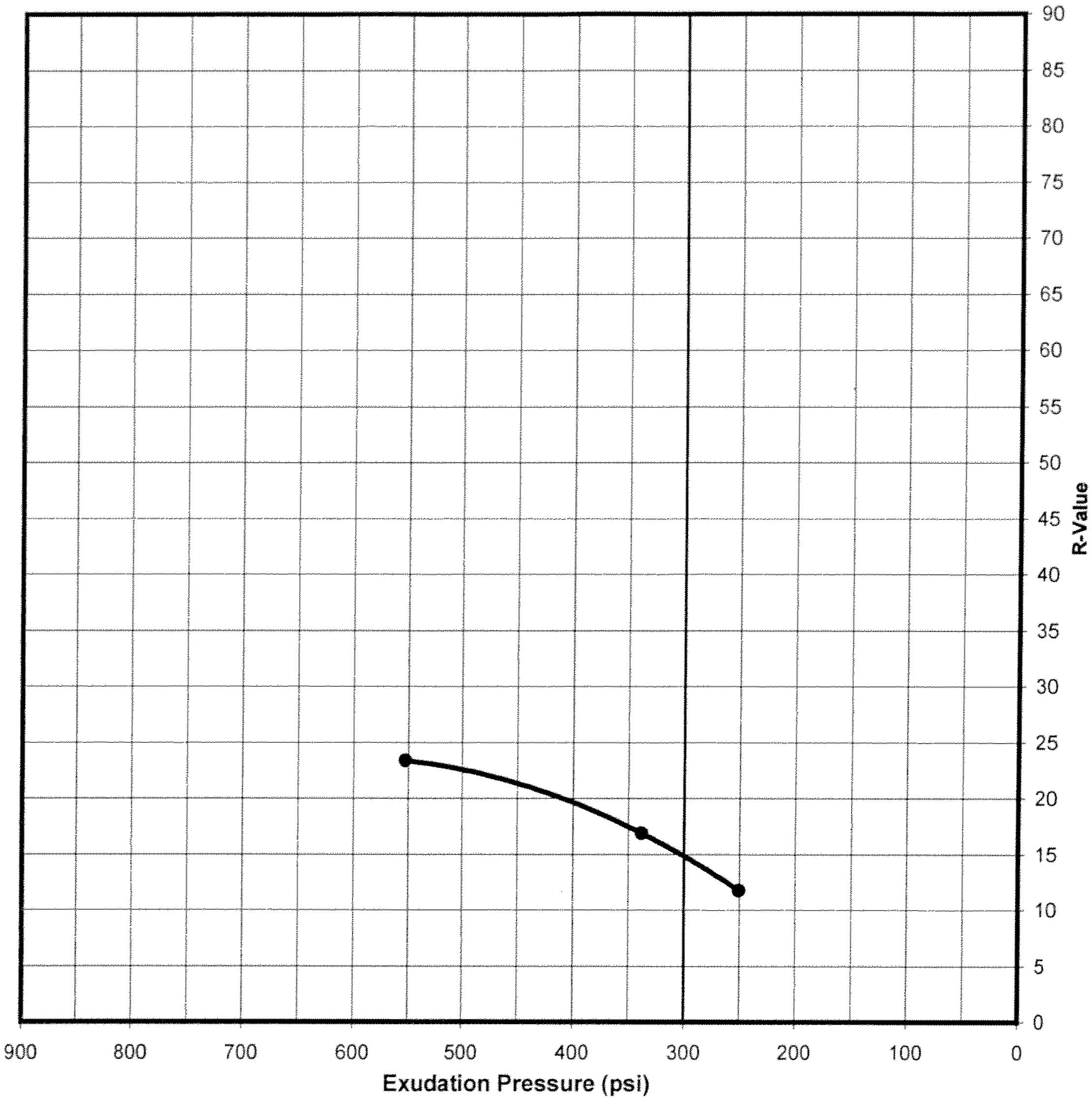


Date: 1/6/2006
Project Name: Silver Springs Development
Project Number: 7125.5.001.01
Sample: TP10-2
Description: Brown Silty Sand (SM)

Specimen	A	B	C
Exudation Pressure, p.s.i.	358	243	143
Expansion dial (.0001")	4	0	0
Expansion Pressure, p.s.f.	17	0	0
Resistance Value, "R"	42	21	11
% Moisture at Test	12.7	13.6	14.5
Dry Density at Test, p.c.f.	124.0	121.5	119.7
"R" Value at 300 p.s.i., Exudation Pressure	31		

ENGEO INCORPORATED

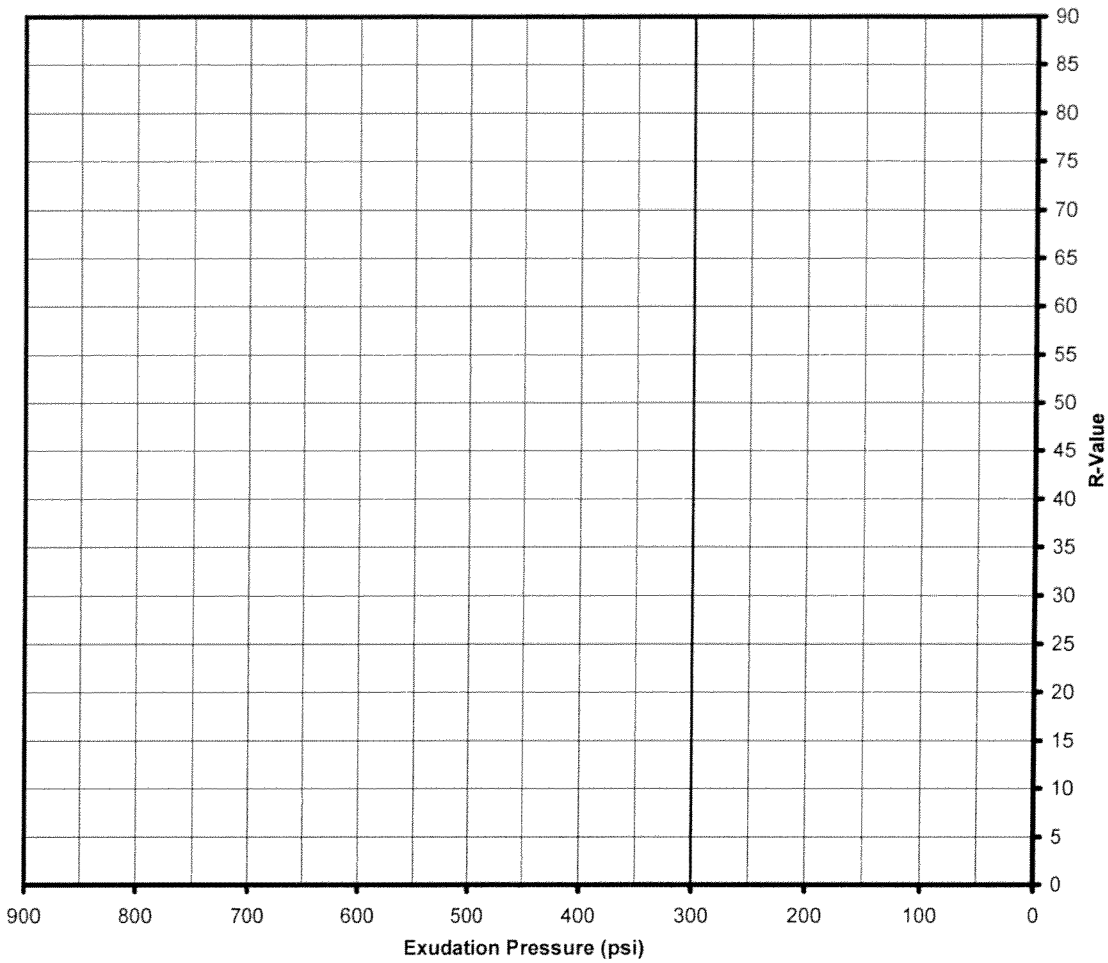
R VALUE TEST REPORT
CAL-301



Date: 1/18/2005
Project Name: Silver Springs Development
Project Number: 7125.5.001.01
Sample: TP15@1
Description: Brown sandy clay (CL)

Specimen	A	B	C
Exudation Pressure, p.s.i.	553	338	251
Expansion dial (.0001")	15	9	0
Expansion Pressure, p.s.f.	65	39	0
Resistance Value, "R"	23	17	12
% Moisture at Test	17.1	18.0	18.9
Dry Density at Test, p.c.f.	117.5	117.0	115.0
"R" Value at 300 p.s.i., Exudation Pressure	15		

R VALUE TEST REPORT
CAL-301



Date: 1/18/2006
Project Name: Silver Springs Development
Project Number: 7125.5.001.01
Sample: TP18@2
Description: Brown to grayish brown silty clay (CH)

Specimen	A	B	C
Exudation Pressure, p.s.i.			
Expansion dial (.0001")			
Expansion Pressure, p.s.f.			
Resistance Value, "R"			
% Moisture at Test			
Dry Density at Test, p.c.f.			
"R" Value at 300 p.s.i., Exudation Pressure	**<5**		

Material Extruded from under mold; R-Value was determined per CAL 301, Part III, Section F

ENGEO INCORPORATED

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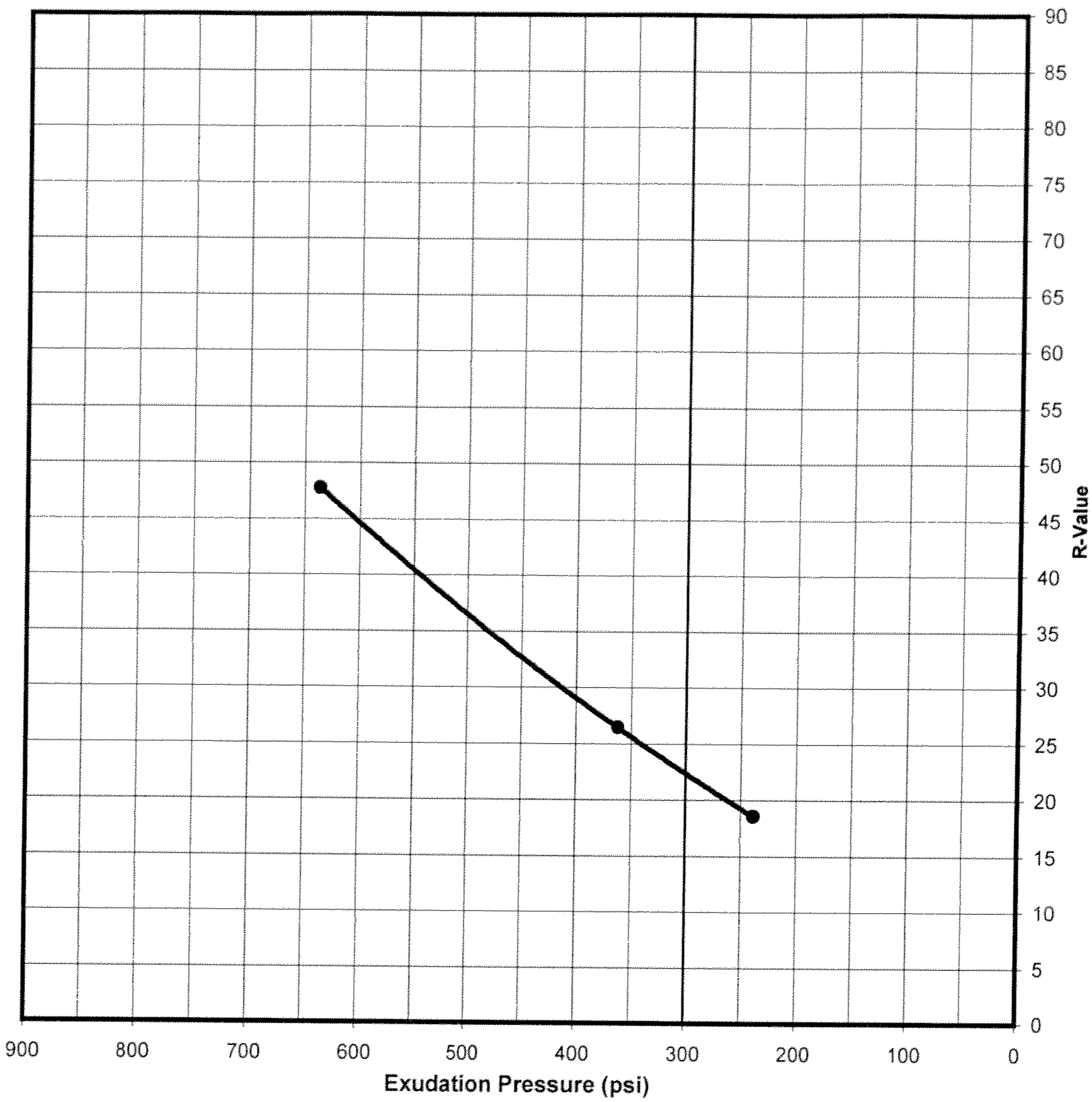
R VALUE TEST REPORT
CAL-301

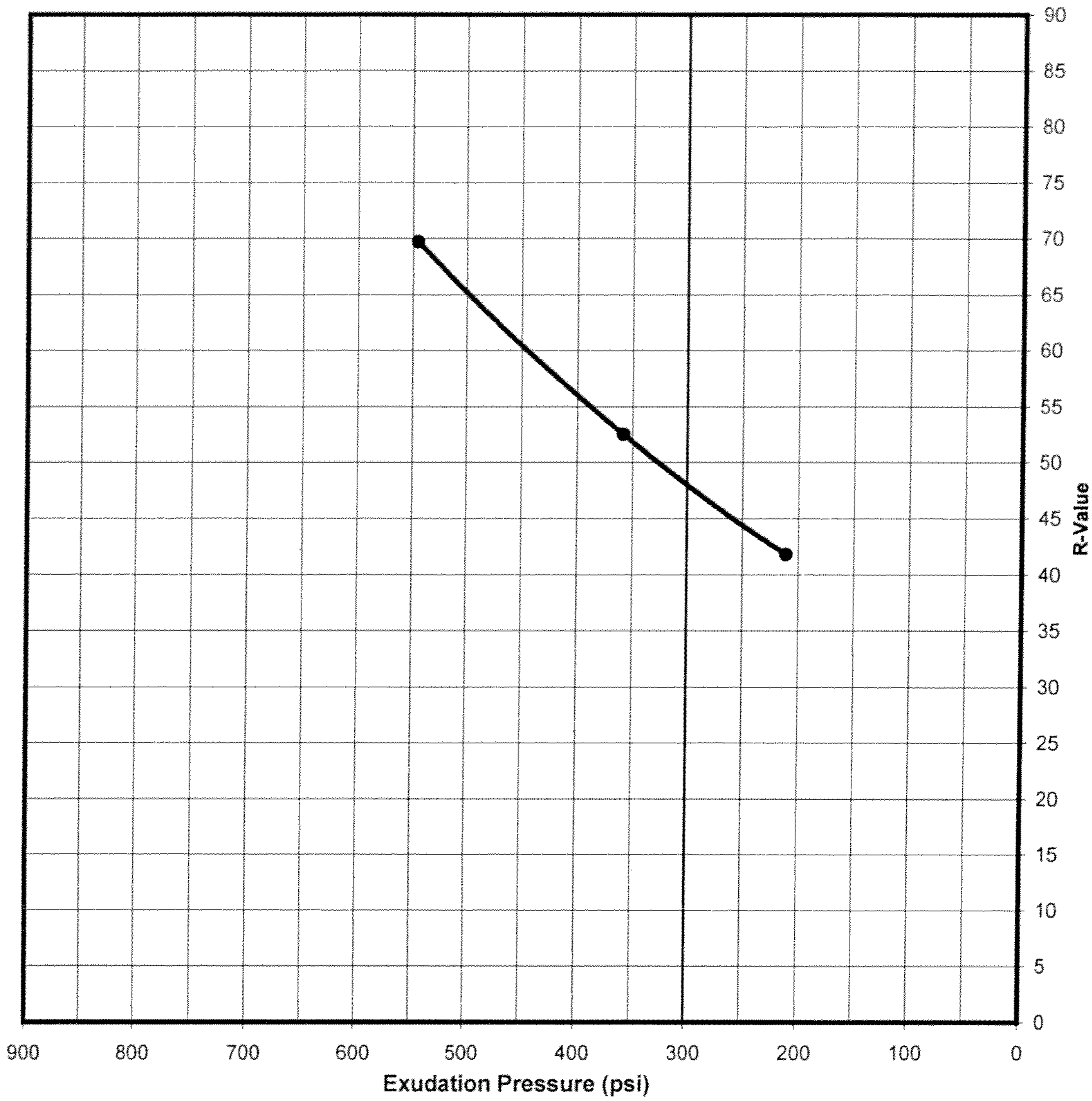


Date: 1/18/2006
Project Name: Silver Springs Development
Project Number: 7125.5.001.01
Sample: TP22@1
Description: Brown sandy clay (CL)

Specimen	A	B	C
Exudation Pressure, p.s.i.	636	362	239
Expansion dial (.0001")	42	28	18
Expansion Pressure, p.s.f.	182	121	78
Resistance Value, "R"	48	26	19
% Moisture at Test	14.7	16.5	17.4
Dry Density at Test, p.c.f.	122.5	117.0	113.8
"R" Value at 300 p.s.i., Exudation Pressure	22		

ENGEO INCORPORATED

R VALUE TEST REPORT
CAL-301



Date: 1/6/2006
Project Name: Silver Springs Development
Project Number: 7125.5.001.01
Sample: TP6-3
Description: Sandy Gravel with Silt with Trace Clay (GP)

Specimen	A	B	C
Exudation Pressure, p.s.i.	545	358	211
Expansion dial (.0001")	0	0	0
Expansion Pressure, p.s.f.	0	0	0
Resistance Value, "R"	70	53	42
% Moisture at Test	18.8	19.3	20.2
Dry Density at Test, p.c.f.	112.4	110.1	108.2
"R" Value at 300 p.s.i., Exudation Pressure	48		

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 01/18/2006
Date Submitted 01/13/2006

To: Kyle Bickler
Engeo Inc.
631 Commerce Drive Suite 100
Roseville, CA 95678

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 7125.5.001.01 Site ID : TP13 @ 1.
Thank you for your business.

* For future reference to this analysis please use SUN # 46685-92475.

EVALUATION FOR SOIL CORROSION

Soil pH	5.75		
Minimum Resistivity	7.24	ohm-cm (x1000)	
Chloride	2.7 ppm	00.00027	%
Sulfate	1.1 ppm	00.00011	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 01/18/2006
Date Submitted 01/13/2006

To: Kyle Bickler
Engeo Inc.
631 Commerce Drive Suite 100
Roseville, CA 95678

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 7125.5.001.01 Site ID : TP15 @ 1.
Thank you for your business.

* For future reference to this analysis please use SUN # 46685-92476.

EVALUATION FOR SOIL CORROSION

Soil pH	5.79	
Minimum Resistivity	3.22 ohm-cm (x1000)	
Chloride	10.0 ppm	00.00100 %
Sulfate	1.9 ppm	00.00019 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 01/18/2006
Date Submitted 01/13/2006

To: Kyle Bickler
Engeo Inc.
631 Commerce Drive Suite 100
Roseville, CA 95678

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 7125.5.001.01 Site ID : TP16 @ .5.
Thank you for your business.

* For future reference to this analysis please use SUN # 46685-92477.

EVALUATION FOR SOIL CORROSION

Soil pH	5.64	
Minimum Resistivity	4.29 ohm-cm (x1000)	
Chloride	6.0 ppm	00.00060 %
Sulfate	2.1 ppm	00.00021 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 01/18/2006
Date Submitted 01/13/2006

To: Kyle Bickler
Engeo Inc.
631 Commerce Drive Suite 100
Roseville, CA 95678

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 7125.5.001.01 Site ID : TP18 @ 2.
Thank you for your business.

* For future reference to this analysis please use SUN # 46685-92478.

EVALUATION FOR SOIL CORROSION

Soil pH	7.59	
Minimum Resistivity	1.05 ohm-cm (x1000)	
Chloride	14.8 ppm	00.00148 %
Sulfate	1.6 ppm	00.00016 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 01/18/2006
Date Submitted 01/13/2006

To: Kyle Bickler
Engeo Inc.
631 Commerce Drive Suite 100
Roseville, CA 95678

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 7125.5.001.01 Site ID : TP22 @ 1.
Thank you for your business.

* For future reference to this analysis please use SUN # 46685-92479.

EVALUATION FOR SOIL CORROSION

Soil pH	5.89		
Minimum Resistivity	3.22	ohm-cm (x1000)	
Chloride	6.9 ppm	00.00069	%
Sulfate	1.3 ppm	00.00013	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

APPENDIX C

APPENDIX C

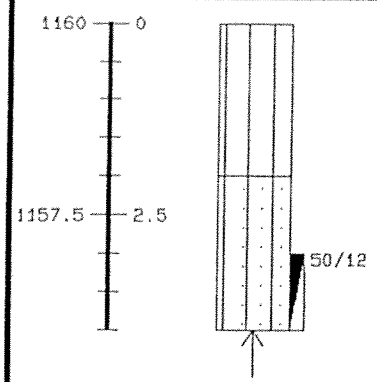
1989 Anderson Consulting Group (ACG) Exploration Logs

LOG OF BORING

Boring: 1 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1160

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		ML	Medium redbrown, wet, soft to medium dense, clayey silt with sand. (Colluvium)	Completely weathered granite rock.			
		SM	Olive brown, wet-moist, dense, silty sand.				
				Refusal in slightly to moderately weathered rock. Rock fabric clearly evident	1-1		

Bottom at 4 feet.

Figure Number 2

LOG OF BORING

Boring: 2 Project: 2011-3

Date: 17 March 1989 Elevation: 1174

Water depth at completion: n/a Depth to caving: n/a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
1175							
0		ML	Medium to redbrown wet, clayey Silt with sand (Colluvium)				
1172.5							
2.5		SW-SM	Olive brown, wet to moist, dense, (fine to medium) sand with silt.	Moderately to completely weathered granite rock.			
1170							
5				Drilling difficulty varies. Zones of hard and softer material.			
1167.5							
7.5							
1165							

Bottom at 9.5 feet.

Figure Number 3

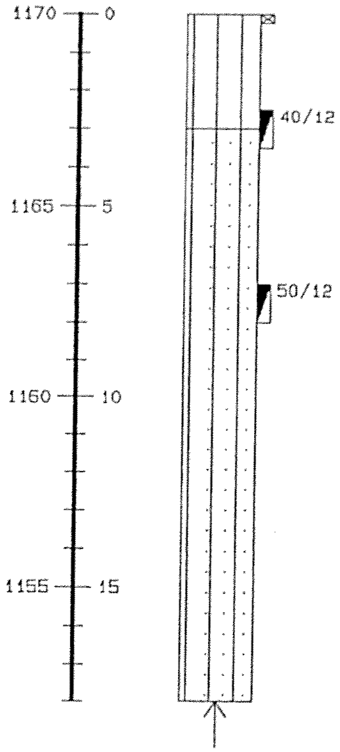
LOG OF BORING

Boring: 3 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1170

Water depth at completion: n/a | Depth to caving: n/a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		ML-MC	Med. to redbrown, wet to moist, mod. dense, clayey silt w/sand to sandy silt with clay.	Colluvium	CB-3		
		SM	Light brown, moist, dense, silty (fine to medium) sand.	Interval 3-1 includes two samples. Numbers 3-1-1 and 3-1-2. Rock fabric clearly evident Completely weathered granite rock.	3-1	110.7	16.3
				Same moderate to completely weathered granite rock.	3-2		



Boring terminated at refusal. Bottom at 18 feet.

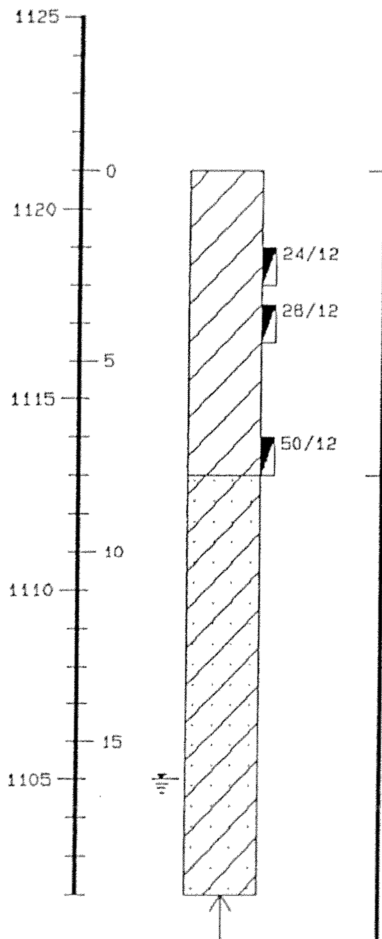
Figure Number 4

LOG OF BORING

Boring: 4   Project: 2011-3

Date: 17 March 1989   Elevation: 1121

Water depth at completion: 16 feet   Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		CL-ML	Dark brown, moist to wet, moderately stiff, silty clay with sand. (Colluvium)				
	24/12				4-1		
	28/12			Sample collected in plastic bag.	4-2		
	50/12			Interval 4-3 includes two samples. Numbers 4-3-1 and 4-3-1.	4-3		
		SC-CL (DG)	Mottled grey-red-brown-tan, sandy clay w/silt-clayey sand w/silt & minor rock fragments.	Completely to severely weathered granite rock (Colluvium).			
				Cuttings "silty clay (micacous) with fine sand."			
				Cutting, moderate, medium brown, silty fine sand.			

Bottom at 19 feet. Easy drilling.

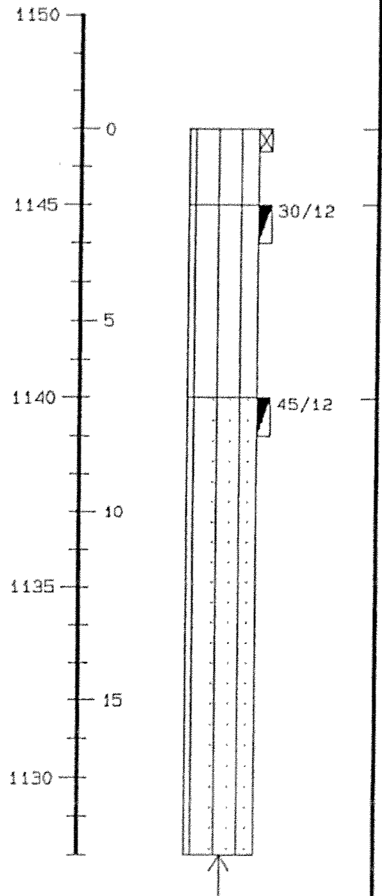
Figure Number 5

LOG OF BORING

Boring: 5 Project: 2011-3

Date: 17 March 1989 Elevation: 1147

Water depth at completion: n/a Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		ML-CL	Med.to redbrown, wet to moist, mod. stiff, clayey silt w/sand to silty clay with sand.	(Colluvium)	CB-5		
	30/12	ML-CL	Med.to dk. brown, wet, med. stiff, silty clay w/sand.	Completely weathered in-place residual granite soil.	5-1		
	45/12	SM	Lt. brown, moist-wet, mod. dense, silty (fine to coarse) sand with clay.	Completely to moderately weathered granite rock. Rock fabric evident.	5-2	91	28.2
				Difficult drilling 15 to 16 feet.			

Boring terminated at 19 feet.

Figure Number 6

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

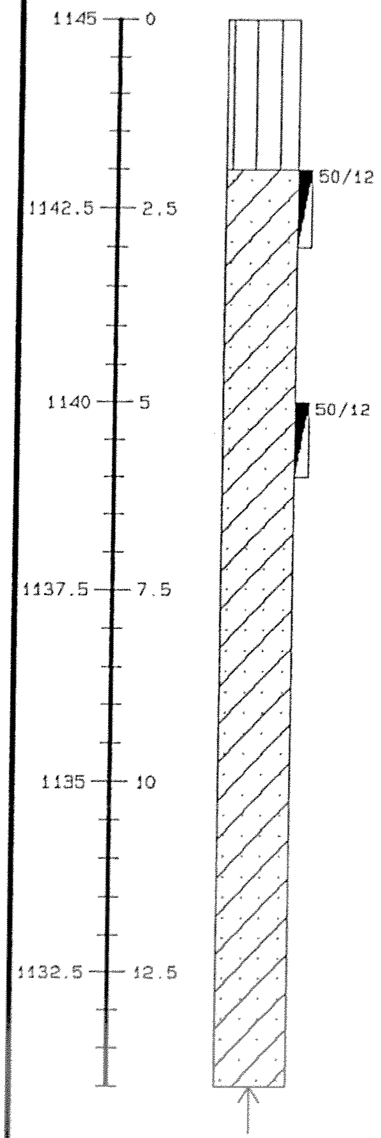
LOG OF BORING

Boring: 6 — Project: 2011-3

Date: 17 March 1989 — Elevation: 1145

Water depth at completion: n/a — Depth to caving: n/a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
1145 / 0		ML	Med. to red brown, wet-moist, clayey silt with sand. (Colluvium)				
	50/12	SC	Med.-light brown, moist, dense, clayey sand with silt.	Completely weathered granite rock.	6-1		
1140 / 5	50/12			Denser at 5 feet.	6-2	131.2	11.3
				Occasional harder rock zones generally less than 1 foot thick.			
				Becoming gradually less weathered with depth, harder drilling.			



Refusal at 14 feet. Bottom.

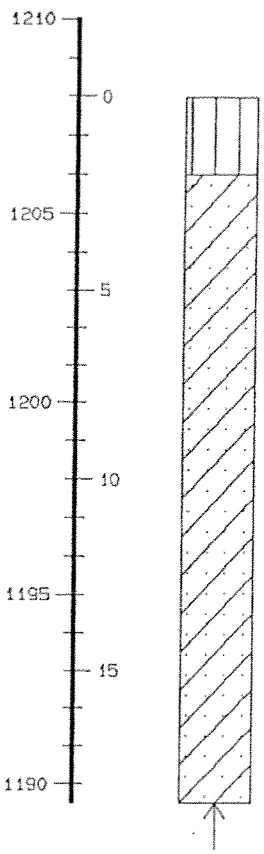
Figure Number 7

LOG OF BORING

Boring: 8 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1208

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		ML	Red brown, wet to moist, clayey silt with sand. (Colluvium)				
		SC-SM	Medium brown, moist, dense, clayey (f-m) sand w/silt to silty (f-m) sand w/clay.	Completely weathered granite rock. Rock fabric evident.			

Bottom at 18.5 feet. Refusal.

Figure Number 9

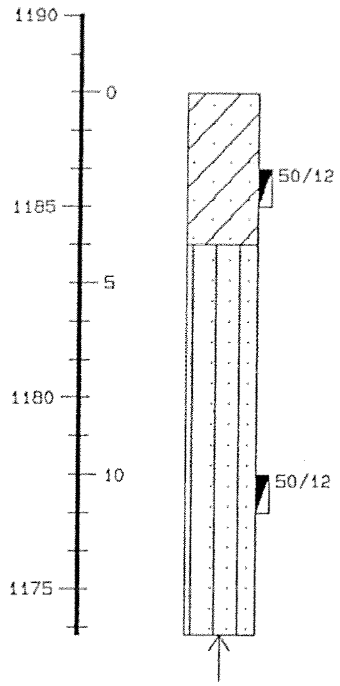
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

LOG OF BORING

Boring: 9 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1188

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		SC-SM	Red brown, wet-moist, dense, clayey (f-m) sand w/silt, & hard fresh rock fragments.	Colluvium.			
	50/12				9-1		
4		SM	Med. brown, wet to moist silty (fine to medium) sand with clay.	Completely weathered granite rock.			
	50/12				9-2		
			Tip: Orange brown, moist, very dense, (fine to coarse) sand with silt and clay.	Tip: Completely weathered in-place granite rock. Rock fabric clearly evident.			

Bottom at 11 feet.

Figure Number 10

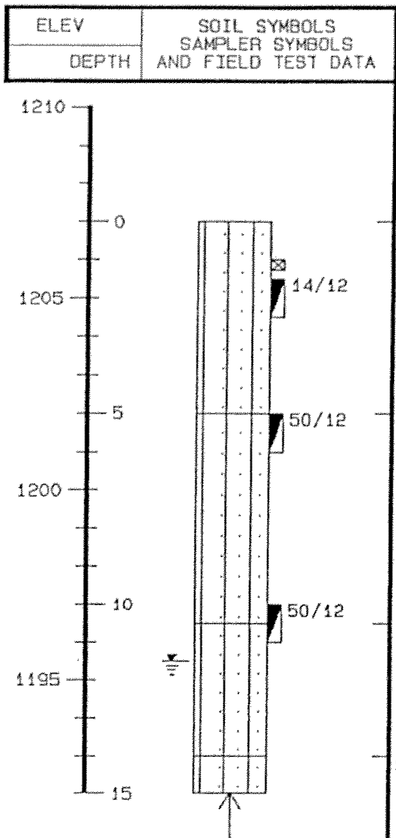
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

LOG OF BORING

Boring: 10 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1207

Water depth at completion: 11.5 feet | Depth to caving: n/a



USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
SM	Dark red-brown, moist, moderately dense, silty sand with a little clay.		B-10 10-1	105.7	22.3
	% clay increases.	Clayier.			
SM	Reddish-brown, moist, dense, silty sand with clay.	Severely weathered granite rock.	10-2	110.0	16.6
SM	Brown, moist, very dense, silty sand with clay.		10-3	121.0	12.2
SM	Olive brown, moist to wet, very dense, silty sand with clay.	Moderately weathered granite rock. Difficult drilling.			

Bottom at 15 feet. No caving.

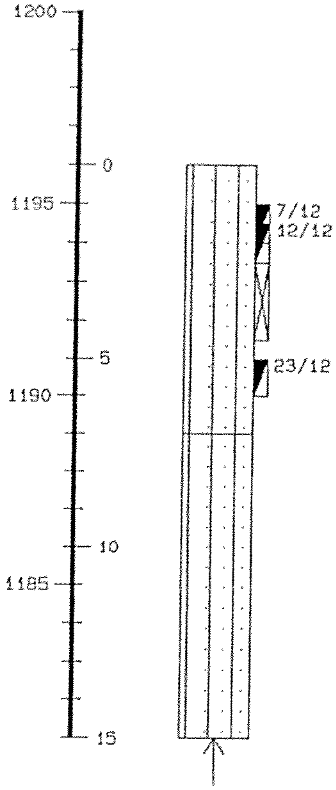
Figure Number 11

LOG OF BORING

Boring: 11 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1196

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		SM	Dark red-brown, moist, loose moderately dense silty sand with a little clay.				
	7/12				11-1		
	12/12				11-2		
					CB-11		
				Clayier with depth; some scattered pebbles.			
5	23/12				11-3		
		SM	Olive brown, moist, dense, silty sand with clay.				
				Moderately weathered granite rock. Drilling more difficult.			
10			Color grades to grey-brown.				
				Difficult drilling.			
				Near refusal			
15							

Total Depth 15 feet. No GW. No caving.

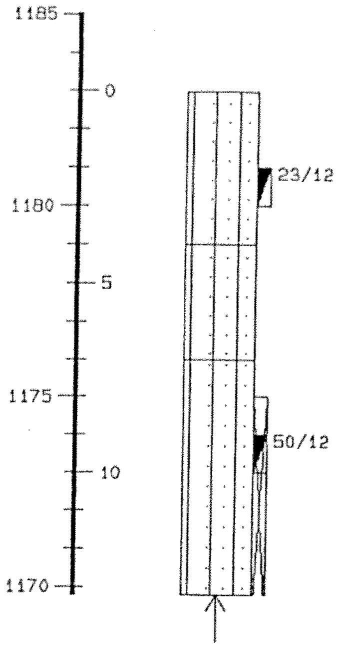
Figure Number 12

LOG OF BORING

Boring: 12 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1183

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		SM	Dark red-brown, moist, moderately dense, silty sand with some clay.				
	23/12				12-1	96.1	11.2
		SM	Brown, moist, dense, silty sand with clay.	Severely to moderately weathered granite rock.			
		SM	Light olive brown, moist, very dense, silty sand with clay.	Moderately weathered granite rock. Difficult drilling.	CB-12		
	50/12				12-2		
				Refusal			

No GW. No caving. Refusal to auger.
Bottom at 11 feet.

Figure Number 13

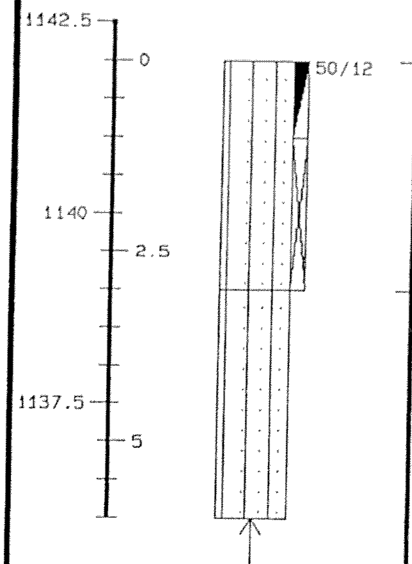
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

LOG OF BORING

Boring: 13 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1142

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0	50/12	SM-ML	Dark red-brown, moist, mod. dense, silty sand to sandy silt.		13-1		
					CB-13		
		SM	Brown, moist, very dense, slightly weathered granite rock.				
				Difficult drilling			

Bottom at 6 feet. Refusal

Figure Number 14

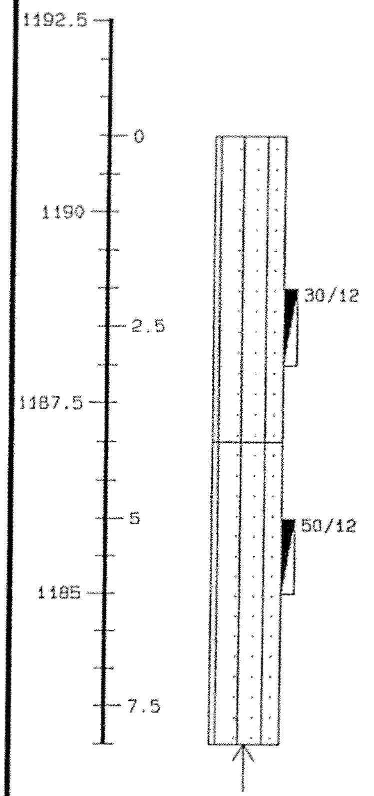
LOG OF BORING

Boring: 14 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1191

Water depth at completion: n/a | Depth to caving: n/a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		SM	Brown, moist, moderately dense, silty sand with scattered pebbles.				
	30/12				14-1	113.8	14.2
				Some clay lenses.			
		SM	Brown to gray-brown, moist, dense, silty sand.	Moderately weathered granite rock.			
	50/12				14-2	116.9	10.2
				Difficult drilling.			



Bottom at 8 feet. No GW. No caving.
Refusal

Figure Number 15

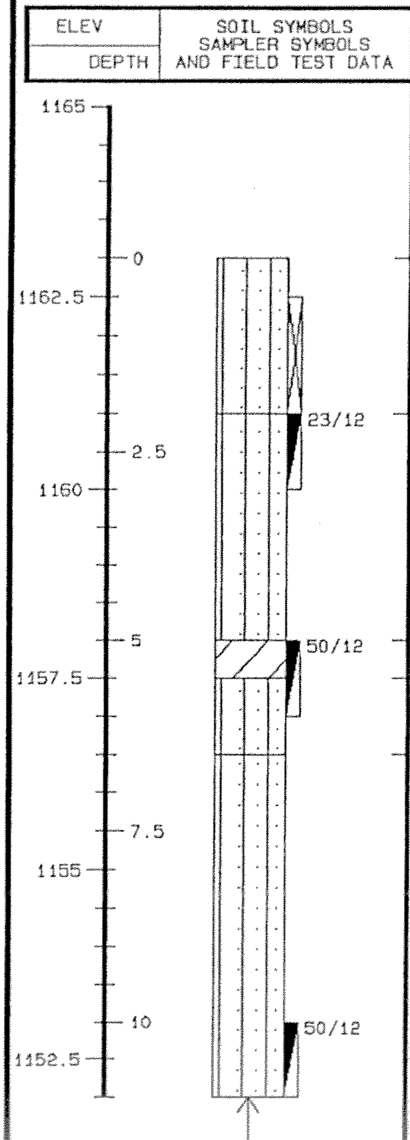
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

LOG OF BORING

Boring: 15 — Project: 2011-3

Date: 17 March 1989 — Elevation: 1163

Water depth at completion: n/a — Depth to caving: n/a



USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
SM	Dark red-brown, moist, moderately dense, silty sand.		CB-15		
SM	Reddish brown, moist moderately dense, silty sand.	Severely weathered granite rock.	15-1	106.7	16.3
CL	Grey brown clay layer.		15-2	118.6	16.0
SM	Reddish brown, moist moderately dense, silty sand.	Severely weathered granite rock.			
SM(DG)	Brown to olive brown, moist, dense, silty sand.				
		Moderately weathered granite rock. Difficult drilling.			
			15-3	134.1	9.9

Bottom at 11 feet. No GW. No caving.

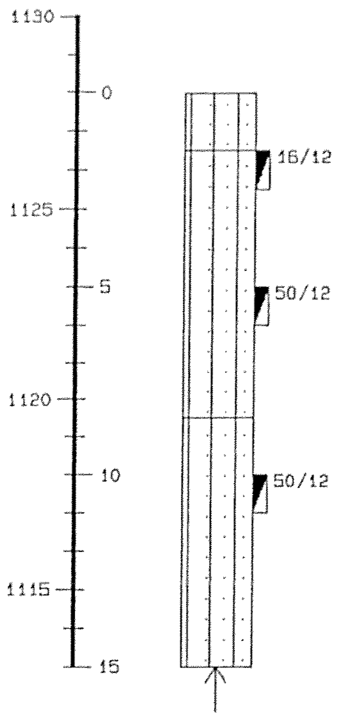
Figure Number 16

LOG OF BORING

Boring: 16 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1128

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		SM	Red-brown, moist, moderately dense silty (fine) grained sand with clay.				
	16/12	SM	Red-brown, moist, moderately dense silty sand.	Severely weathered granite rock.	16-1		
5	50/12			Becoming less weathered.	16-2	122.4	13.4
				Difficult drilling.			
		SM	Light reddish brown, moist, very dense silty sand.				
10	50/12			Moderately weathered granite rock.	16-3	118.1	15.4
				Difficult drilling.			
15							

Bottom at 15 feet. No GW. No caving.

Figure Number 17

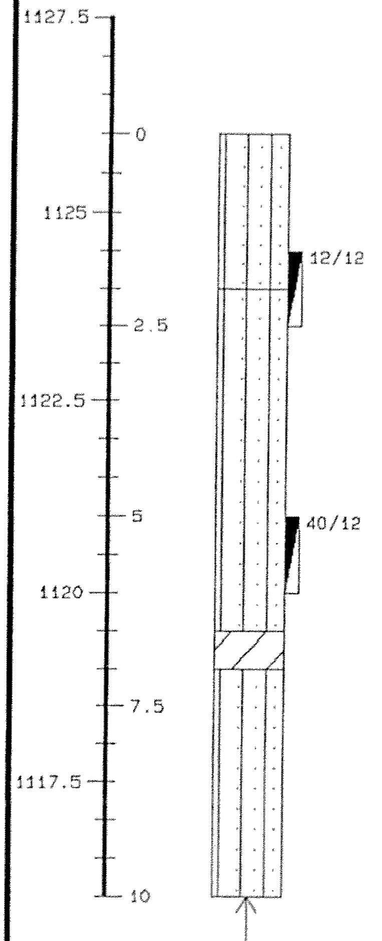
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

LOG OF BORING

Boring: 17 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1126

Water depth at completion: n/a | Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
		SM	Red-brown, moist, moderately dense, silty sand with some clay.				
	12/12				17-1	107.0	19.7
		SM	Light reddish brown, moist, dense, silty/clayey sand with scattered pebbles.	Severely weathered granite rock.			
	40/12				17-2		
		CL	Clay layer.				
		SM	Brown, moist, dense, silty sand.	Moderately weathered granite rock.			

Bottom at 10 feet.
No GW. No Caving.

Figure Number 18

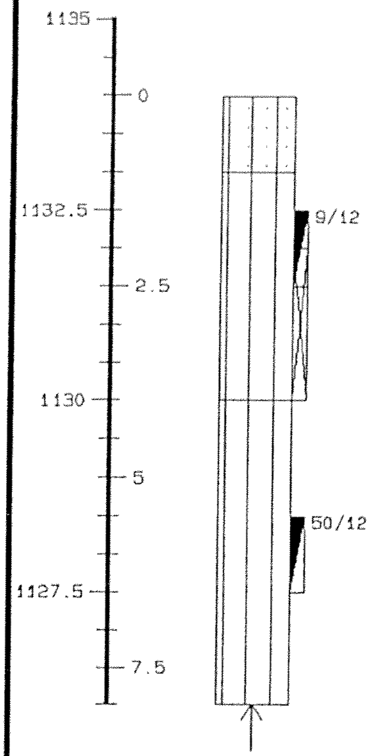
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

LOG OF BORING

Boring: 18 Project: 2011-3

Date: 17 March 1989 Elevation: 1134

Water depth at completion: n/a Depth to caving: n/a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		SM	Dark red-brown, moist moderately dense, silty sand with some clay.				
		ML	Red brown, moist, mod. stiff, sandy silt with clay.				
	9/12				18-1	100.4	21.3
			Becoming clayier.		CB-18		
				Moderately weathered granite rock.			
1130		ML	Light gray-brown, moist, dense silty sand.				
	50/12				18-2	102.7	14.5
				Becoming less weathered.			

Bottom at 8 feet. Refusal.

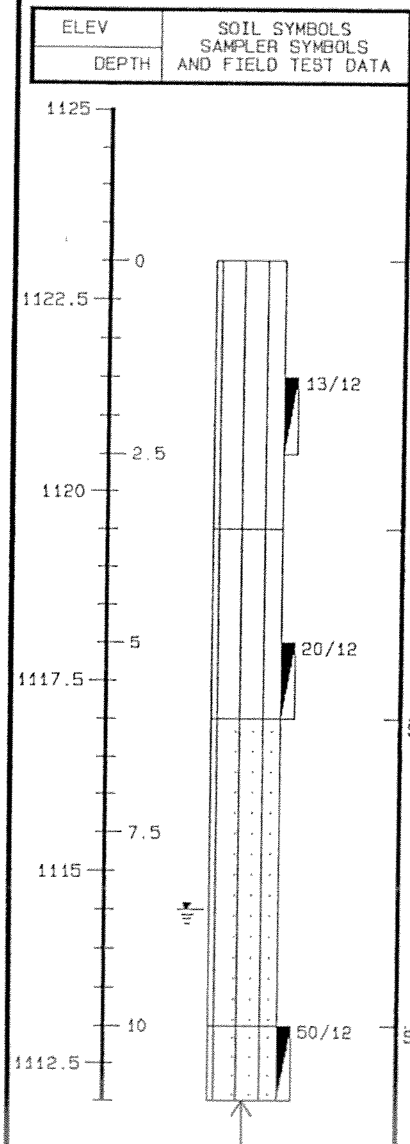
Figure Number 19

LOG OF BORING

Boring: 19 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1123

Water depth at completion: 8.5 | Depth to caving: n/a



USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
ML	Dark brown to black, wet, medium stiff, clayey silt with sand.				
			19-1	76.8	33.8
		Drills very easy.			
ML	Olive gray, wet, stiff clayey silt with sand				
			19-2	93.0	31.5
SM	Grades to an olive brown, moist, dense, silty sand.	Harder drilling. Moderately weathered granite rock.			
SM	Light reddish brown, moist very dense, silty sand.	Slightly weathered granite rock.	19-3	116.2	19.5

Bottom at 11 feet. Standing water at surface.

Figure Number 20

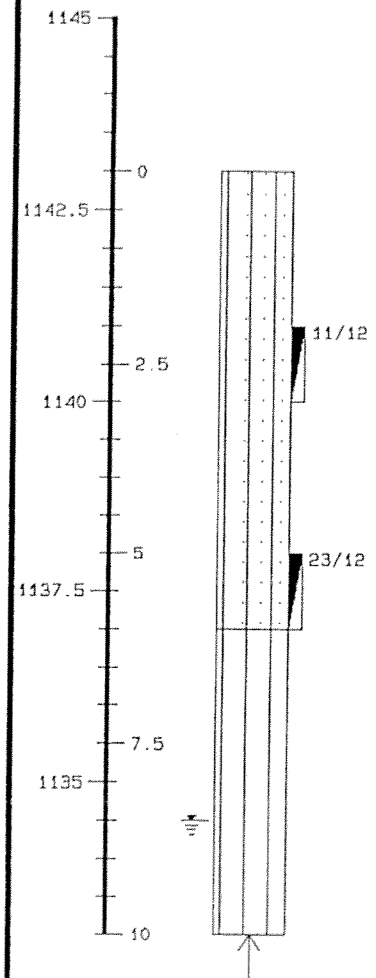
LOG OF BORING

Boring: 20 | Project: 2011-3

Date: 17 March 1989 | Elevation: 1143

Water depth at completion: 8.5 | Depth to caving: n/a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number	Density p.c.f.	Moisture %
0		SM	Dark red-brown, moist, loose to moderately dense, silty sand with trace clay.				
2.5	11/12				20-1	104.6	22.5
				Clayier			
5	23/12				20-2		
		ML	Brown to olive brown, moist stiff, clayey silt with sand.				
				Harder drilling.			



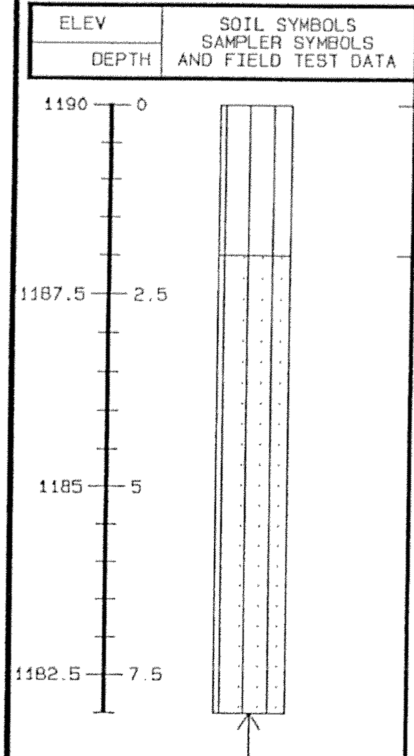
Bottom at 10 feet. No GW. No caving.

Figure Number 21

TRENCH LOG

Trench: 1
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1190
Depth to caving: n\a



USCS	Soil Description	Remarks	Sample Number
ML	Dark redbrown, moist, clayey silt with sand.	Completely weathered granite rock (Colluvium).	
SM-SW	Light redbrown to light brown, moist, moderately dense, silty sand.	Moderately to severely weathered granite rock. Rock fabric evident.	
		Becoming very dense.	

Bottom at 8 feet.

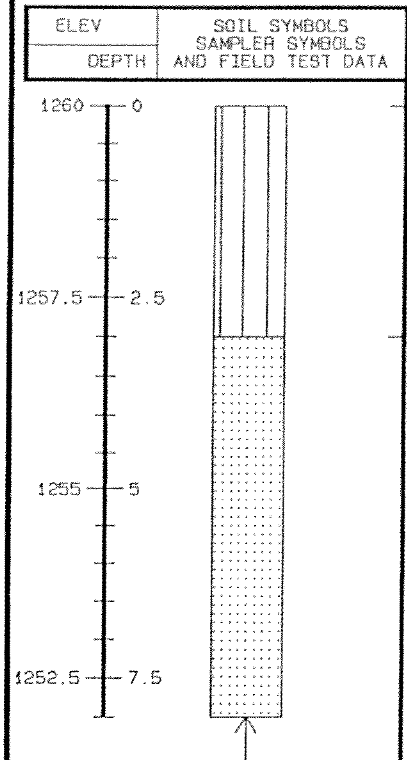
Figure 22

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

TRENCH LOG

Trench: 2
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1260
Depth to caving: n\a



USCS	Soil Description	Remarks	Sample Number
ML	Dark redbrown, moist, sandy silt with clay & occasional large hard angular rock frag.	Completely weathered rock (Colluvium).	
SW-SP	Light redbrown to light brown, moist, dense, silty sand.	Moderately to severely weathered granite rock. Rock fabric evident.	
		Becoming denser, less weathered.	

Bottom at 8 feet.

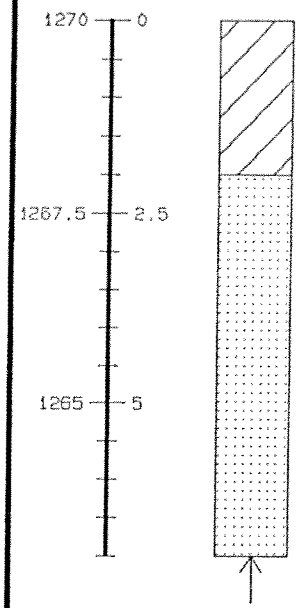
Figure 23

TRENCH LOG

Trench: 3
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1270
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1270 — 0		MC-CL	Dark redbrown, moist, clayey silt with sand & occasional large hard angular rock frag.	Completely weathered rock (Colluvium).	
		SW	Grades to lighter redbrown, silty sand.	Completely weathered rock. Rock fabric evident.	
				Becoming very dense, less weathered	
				Very hard at 7 feet, fresh rock at base.	



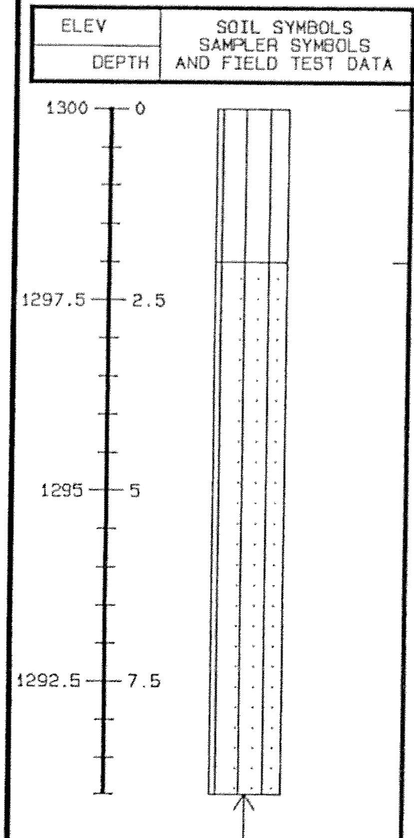
Bottom at 7 feet.

Figure 24

TRENCH LOG

Trench: 4
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1300
Depth to caving: n\a



USCS	Soil Description	Remarks	Sample Number
ML-CL	Dark redbrown, moist, clayey silt with sand.	Completely weathered granite rock (Colluvium).	
SM	Light redbrown to light brown, moist, silty sand.	Rock fabric evident. Consistency of silty sand. Completely to mod. weathered granite rock. Rock fabric evident.	
		Becoming denser, less silt.	
		Moderate to severely weathered, very friable.	

Bottom at 9 feet.

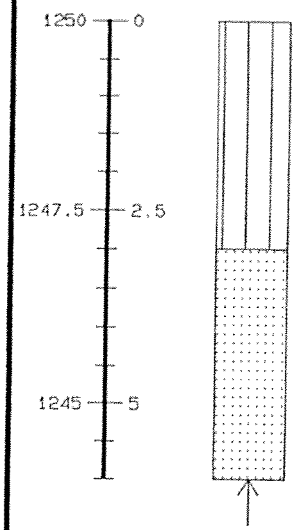
Figure 25

TRENCH LOG

Trench: 5
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1250
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1250 — 0		ML-CL	Orange to redbrown, moist, clayey silt with sand and angular rock fragments.	Completely weathered rock (Colluvium).	
1247.5 — 2.5		SW	Light to medium brown, moist, silty sand.	Severely to moderately weathered granite rock. Rock fabric evident.	
1245 — 5				Very hard, moderate to slightly weathered, near refusal.	



Bottom at 6 feet.

Figure 26

TRENCH LOG

Trench: 6
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1210
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1210 / 0		ML	Dark redbrown, moist, clayey silt to sandy silt with angular rock fragments.	Completely weathered rock (Colluvium).	
1207.5 / 2.5					
1205 / 5		SW	Orangebrown to light brown, moist, silty sand.	Severely weathered granite rock. Rock fabric evident, friable.	
1202.5 / 7.5					
1200 / 10					

Bottom at 10 feet.

Figure 27

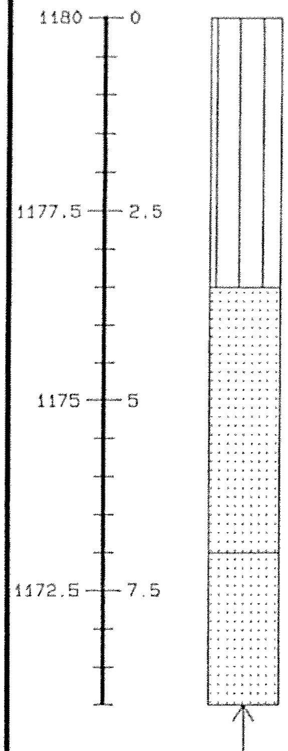
TRENCH LOG

Trench: 7 | Project: 2011-3

Date: 1 April 1989 | Elevation: 1180

Water depth at completion: n\a | Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1180 — 0		ML	Dark redbrown, moist to wet, sandy-clayey silt.	Completely weathered granite rock (Colluvium).	
1177.5 — 2.5					
		SW-SM	Dark redbrown to orange brown, moderately dense silty sand.		
1175 — 5				Moderately to serverely weathered granite rock. Fresh rock west end of trench. Rock fragments difficult to break in hand.	
		SW	Light brown, very dense, sand with silt.	Moderately weathered granite rock. Hard digging.	
1172.5 — 7.5					



Bottom at 9 feet.

Figure 28

TRENCH LOG

Trench: 8
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1260
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1260 / 0		ML	Dark redbrown, moist, clayey, sandy silt with occasional small, hard, rock fragments.	Completely weathered rock (Colluvium).	
1257.5 / 2.5		SW	Light red brown to orange brown, moist, silty sand to sand with silt.	Severe to moderately weathered granite rock.	
1255 / 5					
1252.5 / 7.5				Becoming denser.	
1250 / 10					

Bottom at 11 feet.

Figure 29

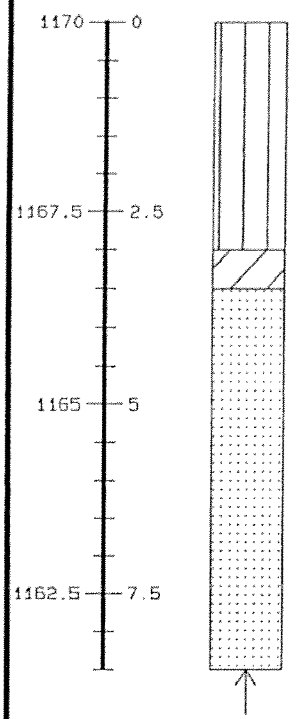
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

TRENCH LOG

Trench: 9
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1170
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1170 / 0		ML	Dark redbrown, moist, wet clayey, sandy silt.	Completely weathered granite rock (colluvium).	
		CL	Increase in clay % Consistency of silty clay with sand.		
		SW	Olive brown, moist, dense, sand with silt matrix. Hard fresh angular granite rock fragments mixed in.	Moderately weathered to fresh granite rock. Rock frabric evident	
1162.5 / 7.5				Very hard digging.	



Bottom at 8.5 feet.

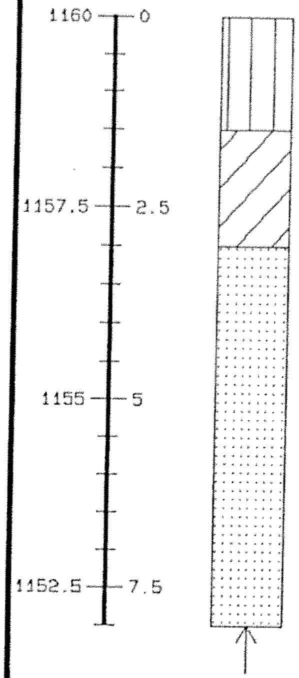
Figure 30

ANDERSON GEOTECHNICAL CONSULTANTS, INC.

TRENCH LOG

Trench: 10
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1160
Depth to caving: n\a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1160 / 0		ML	Dark redbrown, moist, sandy, clayey silt.	Completely weathered granite rock (Colluvium).	
		CL	Olive brown, moist silty Clay with sand.		
		RX	Hard quartz layer.		
		SW	Olive brown, moist, dense, sand with silt.	Moderate to severely weathered granite rock. Rock fabric evident. Friable to difficult to bre	
				Very dense, difficult digging, fresh rock fragments. Near refusal	

Bottom at 8 feet - near refusal.

Figure 31

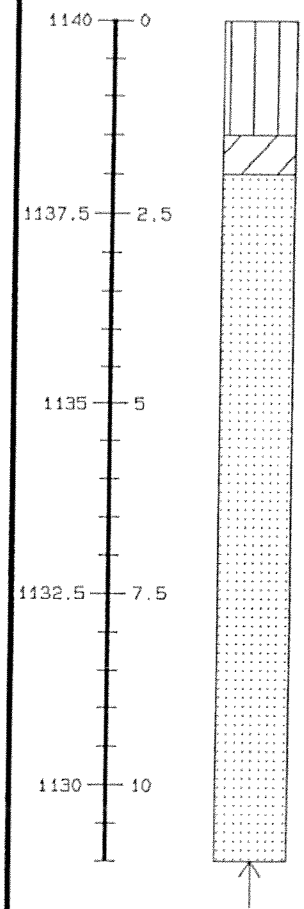
ANDERSON GEOTECHNICAL CONSULTANTS, INC.

TRENCH LOG

Trench: 11
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1140
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1140 — 0		ML	Dark redbrown, moist to wet sandy, clayey clayey silt.	Completely weathered rock (Colluvium).	
		CL	Medium brown, moist to wet, silty clay with trace sand.		
1137.5 — 2.5		SW	Tan to very light brown, moist fine sand with silt.	Very severely weathered granite rock. Rock fabric evident. Very friable.	
1135 — 5					
1132.5 — 7.5				Same very light colored tan to white.	
1130 — 10				Becoming denser, still friable.	



Bottom at 11 feet.

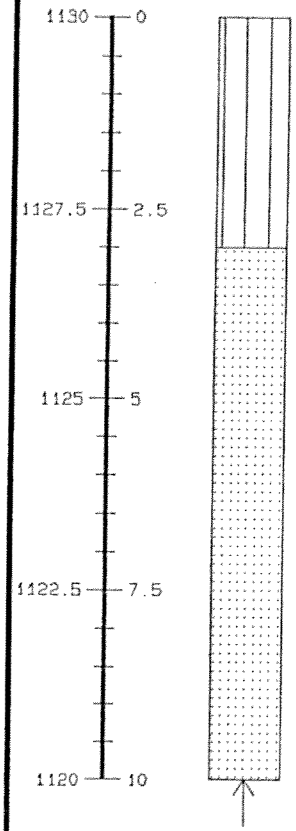
Figure 32

TRENCH LOG

Trench: 12
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1130
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1130 — 0		ML	Dark redbrown, moist to wet sandy, clayey silt with occasional hard rock fragment.		
1127.5 — 2.5				Minor clay build-up above weathered rock.	
		SW	Light olive brown, moist, silty sand with clay.		
				Severely weathered granite rock. Rcok fabric evident. Friable.	
1125 — 5				Increasing % of sand.	
1122.5 — 7.5				Becoming dense to very dense.	
				Very dense. Tough digging.	
1120 — 10					



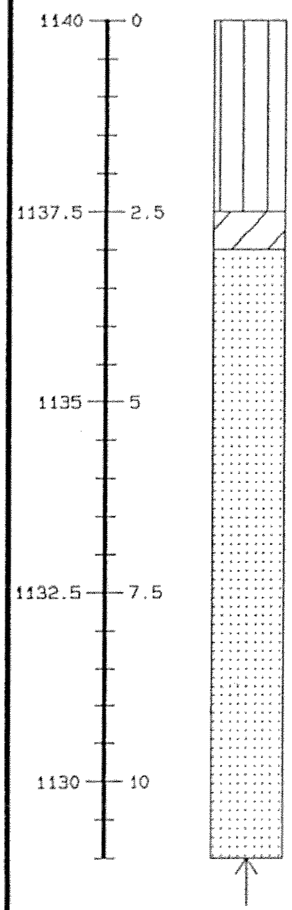
Bottom at 10 feet.

TRENCH LOG

Trench: 13
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1140
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1140 — 0		ML	Dark redbrown, moist, sandy, clayey silt.	Completely weathered rock (Colluvium).	
1137.5 — 2.5		CL	Very minor clay build up above severely weathered rock.		
		SW	Orange to brown, moist, silty sand.	Severely weathered granite rock. Rock fabric evident. Friable.	
1135 — 5					
1132.5 — 7.5					
1130 — 10				Easy digging.	



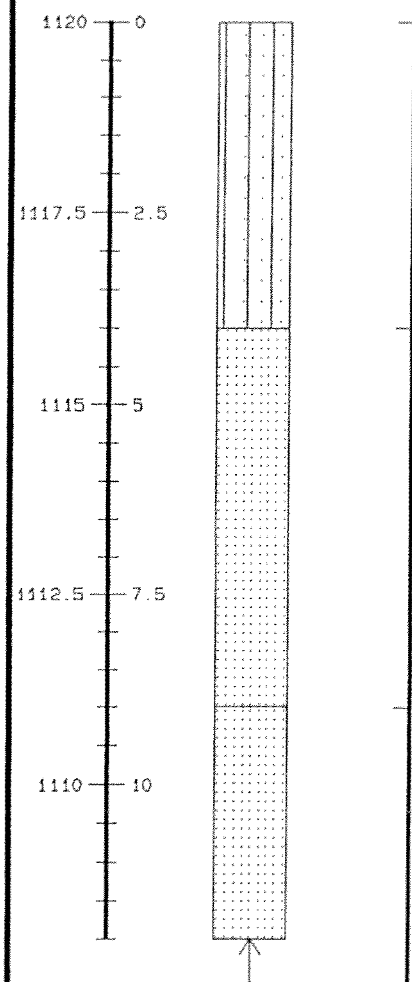
Bottom at 11 feet.

Figure 34

TRENCH LOG

Trench: 14
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1120
Depth to caving: n\a



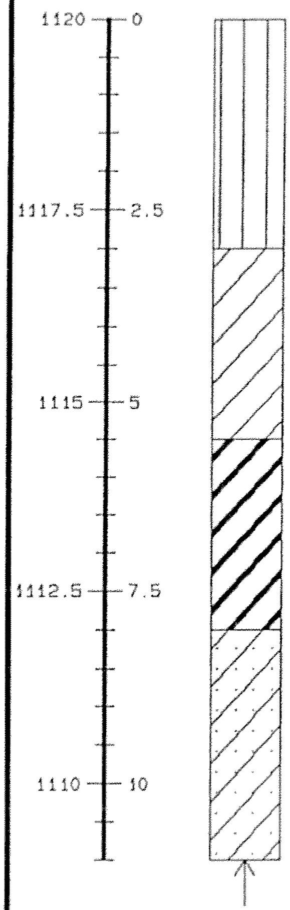
USCS	Soil Description	Remarks	Sample Number
SM	Dark brown to dark redbrown, wet to saturated, silty, clayey fine to medium sand.	Completely weathered rock (Colluvium).	
SW	Medium to dark brown, saturated, medium dense, gravely (rounded, >3"), sand w/silt & clay.	Water running into trench this layer.	
SW	Olive brown, moist to wet, sand with silt and clay.	Severely weathered granite rock. Rock fabric evident. Friable.	

Bottom at 12 feet.

Figure 35

TRENCH LOG

Trench: 15 | Project: 2011-3
Date: 1 April 1989 | Elevation: 1120
Water depth at completion: n\a | Depth to caving: n\a



ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1120 / 0		ML	Dark brown, moist to wet, mod. stiff sandy silt with clay and occasional gravel to clayey silty with sand.		
		CL-CH	Dark brown to black, moist to wet, stiff sandy clay with silt.		
		CH	Grades to grey-brown, very stiff clay with silt.		
		SC-SW	Olive brown, wet, dense, clayey sand with gravel (rounded).	Colluvium. Sometimes highly Micocous.	

Bottom at 11 feet.

Figure 36

TRENCH LOG

Trench: 16 | Project: 2011-3
Date: 1 April 1989 | Elevation: 1240
Water depth at completion: n\a | Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1240 / 0		ML	Dark redbrown, moist, sandy, clayey silt.		
		RX	Olive brown, moist, severely weathered to fresh, fine granite rock.	Completely weathered granite rock (Colluvium).	
				Difficult digging, large % fresh rock.	
1237.5 / 2.5					
1235 / 5					

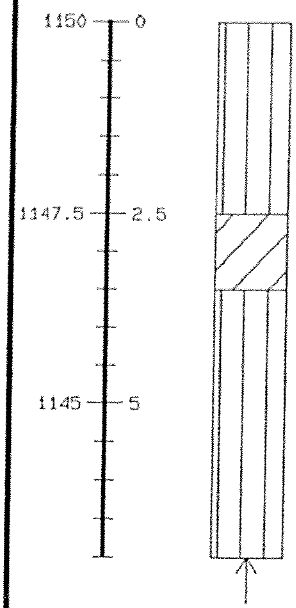
Bottom at 5 feet. Near refusal.

Figure 37

TRENCH LOG

Trench: 17
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1150
Depth to caving: n\a



ELEV / DEPTH	USCS	Soil Description	Remarks	Sample Number
1150 / 0	ML	Dark redbrown, moist to wet, clayey, sandy silt.	Completely weathered granite rock (Colluvium).	
1147.5 / 2.5	CL	Medium brown, moist, medium stiff sandy clay with silt.		
	ML	Dark redbrown, moist to wet, clayey, sandy silt.		
1145 / 5	RX	Olive brown, moist, sand to sand with clay.	Fresh to severely weathered granite rock. Hard digging.	

Bottom at 7 feet.

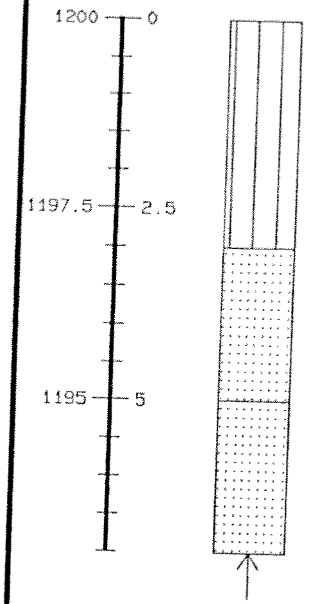
Figure 38

TRENCH LOG

Trench: 18
Date: 1 April 1989
Water depth at completion: n\a

Project: 2011-3
Elevation: 1200
Depth to caving: n\a

ELEV / DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	Remarks	Sample Number
1200 / 0		ML	Dark redbrown, moist, clayey, sandy silt.	Completely weathered granite rock (Colluvium).	
1197.5 / 2.5		SW	Olive brown, sand with clay and silt. Occasional fresh rock fragments.	Severely to moderately weathered granite rock. Rock fabric evident.	
1195 / 5		SW	Olive brown, sand with silt and clay. Approximately 40% fresh rock fragments.	Fresh to moderately weathered granite rock. Difficult digging.	



Bottom at 7 feet.