APPENDIX H-2

Preliminary Geotechnical Exploration

PRELIMINARY GEOTECHNICAL EXPLORATION

PROPOSED RESIDENTIAL DEVELOPMENT
GENERAL MILLS PROPERTY

790 DERR STREET

VALLEJO, CALIFORNIA

SUBMITTED

TO

CHEROKEE BROOKS STREET, LLC

VALLEJO, CALIFORNIA

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 7599.200.201

JUNE 27, 2008

ENGEO
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
7599.200.201

June 27, 2008

Mr. Devin Hasset
Cherokee Brooks Street, LLC
900 Walnut Avenue, #D
Vallejo, CA 94592

Subject: Proposed Residential Development
General Mills Property
790 Derr Street
Vallejo, California

PRELIMINARY GEOTECHNICAL EXPLORATION

Dear Mr. Hasset:

With your authorization, ENGEO Incorporated has completed our preliminary geotechnical exploration for the proposed 211 lot residential development located at the General Mills property at 790 Derr Street in Vallejo, California.

We find the subject property to be suitable for future development from a geotechnical standpoint, provided that supplemental field exploration to address design-level grading and foundation issues are conducted, as well as incorporating the conclusions and recommendations presented herein into the plans.

We are pleased to have been of service to you on this project and are prepared to consult further with you and your design team as the project progresses.

Very truly yours,

ENGEO Incorporated

REGISTERED PROFESSIONAL ENGINEER
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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

INTRODUCTION

Purpose and Scope

The purpose of this preliminary geotechnical exploration is to evaluate the feasibility of the proposed site development from a geotechnical and geologic perspective, and provide preliminary conclusions and recommendations for the planned development, as deemed applicable. Once details regarding the planned development have been determined, supplemental field exploration should be performed to address design-level grading and foundation issues.

The scope of this study included the following services:

1. Review of pertinent geologic maps and literature.
2. Review of previous ENGEO Incorporated geotechnical report relevant to the planned site development.
3. Review of conceptual grading and development plan prepared by project Civil Engineer (Meridian Associates).
4. Field exploration including excavation and logging of 12 test pits ranging in depth from approximately 5 to 14 feet and the collection of samples for laboratory testing.
5. Engineering and geologic analysis of the field and laboratory data.
6. Report preparation to provide our conclusions and recommendations regarding potential geologic hazards, with associated geotechnical engineering recommendations including remedial grading, site preparation and grading, foundation design, and preliminary pavement design.

We prepared this report exclusively for Cherokee Brooks Street, LLC and their design team consultants. ENGEO Inc. must review any changes made in the character, design or layout of the development to modify the conclusions and recommendations contained in this report, as necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without the express written consent of ENGEO Inc..

Proposed Development

A preliminary grading and improvement plan has been prepared by Meridian Associates, Inc., dated March 2008. The plans show a residential development with 211 high to low density residential lots, commercial lots, interior roads and proposed park space. Retaining walls are proposed in some areas along the west facing slope to provide for level building areas. It is also our understanding that several existing buildings will remain, or be relocated on-site. Preliminary mass grading concepts anticipated for the development call for cuts up to 20 feet in depth, placement of fills up to 40 feet in thickness. According to the preliminary plans, cut slopes within the project area are depicted up to 50 feet high at gradients of 2:1 (horizontal:vertical) with intermediate benches at variable intervals up to 30 vertical feet. Fill slopes are planned up to 30 feet high at gradients of 2:1.

Location and Description

The project site is located at 790 Derr Street, in Vallejo, California (Figure 1). The 45 acre site is currently occupied by warehouses, multi-story industrial structures, silos, supporting structures, and a single family residence. The remaining portion of the site is covered by pavement and seasonal vegetation. The topographic relief is relatively flat throughout the western portion of the site. A relatively steep, west facing slope that trends north to south crosses the property along the eastern side. The western portion of the site is bounded by Mare Island Strait. The elevation of the property ranges from approximately 164 feet above mean sea level (MSL) along the slope in the eastern portion of the site to approximately 10 feet (MSL) along the western limits adjacent to Mare Island Strait.

Previous Geotechnical Work

In 2006, ENGEO prepared a geotechnical feasibility report for the subject site. Previous field exploration locations are shown on Figure 4, as well as limited laboratory testing. A copy of the boring logs and lab data are included in Appendix C of this report. Additionally, ENGEO provided part-time field observations during environmental field work associated performed by Engineering/Remediation Resources Group, Inc (ERRG, Inc.) and the work was summarized in their report dated August 6, 2007. The results of previous work have been used and incorporated into this current study, as deemed appropriate.

GEOLOGIC CONDITIONS

Geologic Setting

The project site is located in the northern portion of the East Bay Hills east of San Pablo Bay and the Mare Island Strait. The East Bay Hills lie within the region of coastal California referred to by geologists as the Coast Ranges geomorphic province. The Coast Ranges have experienced a complex geological history characterized by Late Tertiary folding and faulting that has resulted in a series of northwest-trending mountain ranges and intervening valleys. The San Francisco Bay Valley and enclosing peripheral hills, in association with the two main fault structures (the San Andreas and Hayward-Rodgers Creek faults), comprise the main geological features of the local Bay Area. Diverse crustal movements within this tectonic framework are responsible for the morphology and seismicity of the area. The project area has been mapped by Graymer (2002) as underlain by Holocene Artificial Fill in the west and Late Cretaceous undivided sandstone, siltstone and shale of the Great Valley Complex in the east (Figure 2). Dibblee (1980) maps the eastern upland portion of the site as Panoche formation consiting of micaceous shale with minor thin sandstone beds (Kp) and arkosic sandstone (Kps). Dibblee shows the bedrock dipping approximately 60 degrees to the northeast.

Existing "Man-Made"Fill Deposits. These deposits have been designated as "AF" on the Preliminary Geology Map, Figure 4. Locally, deposits designated as "AF" typically consist of undocumented 'man-made" fills that may have been derived from material generated from cutting of the adjacent rock slope placed in connection with existing site improvements, and possibly from off-site sources. These existing fills generally consist of intermixed loose to dense silty and gravelly sands, silty clays, rock fragments with occasional intermixed construction rubble and debris (ie. brick, wood, metal, and concrete fragments, etc.). The rock fragments vary in size from cobbles to boulders, likely derived from excavations generated in the surrounding slopes to the east. According to a 2006 ERRG report, some debris and rubble was encountered during their excavation work at the site in connection with environmental remediation work. Existing fills range from about 3 to 19 feet thick, thickening towards the western portion of the site. From a geotechnical standpoint, if these existing fill deposits are cleared of significant deleterious matter and over-sized fragments; these may be reused as engineered fill at this site. All engineered fills should be in accordance with the Guide and Contract Specifications in Appendix D.

Alluvial Soils and Bay Mud Deposits. Based on our review of published maps, and our limited observation during the remedial excavation work conducted by ERRG in November 2006 thru May 2007, the western lower lying areas of the site appear to be underlain by natural soft, highly compressible alluvial soils and "Bay Mud" deposits. Bay Mud deposits are of particular concern since these deposits are highly compressible and may be susceptible to significant settlement when subjected to additional loading, either through the placement of additional fill and/or additional structural loads. In addition, these deposits have low strength characteristics and may be problematic when excavated due to their instability in temporary cuts and slopes. In general, these materials are not considered suitable for reuse as engineered fill and are subject to remedial measure as discussed in following sections of this report. Underlying the Bay Mud deposit are medium stiff to stiff alluvial deposit of silts and clays..

Colluvial Deposits. Colluvium is an accumulation of soil that has been deposited primarily by erosion and slope wash. Areas of thicker soil cover in swales have been mapped as Colluvium (Qc) on Figures 4 and 5. Colluvium consists of dark brown or dark gray, soft to stiff, silty clay to sandy clay with varying moisture content; these soils were encountered within swales in the eastern portion of the site. Based on the findings of our exploration, the colluvium appears to be up to 12 feet in thickness, as shown on the test pit logs in Appendix A. A bulk sample of the colluvium was collected from test pit TP-8 for laboratory testing. Laboratory testing shows that the colluvium (Appendix B) has a Plastic Index (PI) of 37, indicating this material is highly expansive.

Bedrock. Bedrock encountered at the site mainly consists of interbedded sandstone, siltstone, and claystone of the Cretaceous Great Valley Sequence. In general, the sandstone is moderately to well cemented, moderately strong to friable, thinly bedded, light yellowish brown where weathered, and gray to dark gray where fresh. Siltstone is generally light gray to dark gray, friable, and thin bedded to laminated. Claystone is generally dark gray to yellowish brown, friable, preferentially sheared and thinly bedded. As shown on figure 4, strike and dip measurements of the bedrock were taken at various locations and range from N80W dipping 65N to N79E dipping 60N. No adverse bedding attitudes were observed during our site reconnaissance. In general, depth to bedrock in the western low lying areas of the project site increases eastward towards the Mare Island Strait.

Landslides. Regional landslide mapping covering the project site by Nilsen (1975) does not indicate the presence of landslides at the subject property; however, in our previous exploration surficial landslides and/or talus debris was mapped along the eastern ridge flank portion of the site, shown on Figure 5. These talus deposits consist of unconsolidated angular bedrock material and should be removed and replaced with engineered fill.

Groundwater

We observed groundwater in all of the borings from our previous exploration and various test pits in the low lying western portion of the site at approximately 4 to 9 feet below the existing surface. No groundwater was encountered in any of the test pits excavated on the upslope eastern portion of the site. Fluctuations in groundwater levels will occur seasonally and over a period of years due to the seasonality and magnitude of precipitation, changes in drainage patterns, irrigation and other factors. Future irrigation may cause an overall rise in groundwater levels.

DISCUSSION

Potential Seismic Hazards

Faulting. The study area is not located within a State of California Earthquake Hazard Fault Zone. We did not observe geologic or geomorphic features indicative of faulting at the site. Based on these findings, the potential for ground rupture from faulting at the site appears to be low.

Ground Shaking. Quality construction can best mitigate the hazard of ground shaking within the study area. Seismic design provisions in current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead and live loads.

Liquefaction. Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength because of pore pressure build-up under the cyclic shear stresses associated with earthquakes. Based on our observation, on-site material consists of silty clay that is not likely to be susceptible to liquefaction.

Lurching and Lateral Spreading. Lurch cracking and lateral spreading can occur in weaker soils on slopes and adjacent to open channels that are subjected to strong ground shaking during earthquakes. The proposed development is situated along the Mare Island Strait. However, based on the material encountered, fine grained sediment constitute for majority of the material within the lower lying area adjacent to the Mare Island Strait. As such, the risk of lateral spreading along the free face of the shoreline is low.

Seismically-Induced Landsliding. As for all of the San Francisco Bay Area, the risk of instability is greater during major earthquakes than during other time periods. As discussed in the previous section, the areas susceptible to seismically-induced landsliding appear to be landslide and colluvial swales extending upslope of the project and the free face between Mare Island Strait and the shoreline. As discussed in later sections of this report, designed reconstruction of existing landslide deposits that exist within the areas of proposed development will require mitigation for debris movement from seismically-induced landsliding thereby reducing the associated risks to a low level.

Compressible Soils

Future fills placed over compressible colluvial, alluvium, Bay Mud, and/or landslide deposits could result in undesirable total and differential settlement if not properly mitigated. Moreover, portions of this site are underlain by highly compressible Bay Mud, in the western portion of the site (as shown on Figure 4). Bay Mud areas may be subject to significant settlements due to consolidation from new fill from raised grades and future building loads.

Our borings and test pits encountered up to 12 feet of compressible colluvial deposits in swales on the eastern portion of the site. Also, exploratory borings have encountered approximately 19 feet of undocumented fill overlying Bay Mud on the western portion of the site. Figure 4 depicts the areas underlain by highly compressible Bay Mud, as well as a rough interpolation of contour thickness. It should be noted that this report shows preliminary estimates based on limited information available at this time for Bay Mud limits, extent and thickness;, further delineation and additional exploration should be used during design level study.

Expansive Soils

The results of laboratory testing indicate that the clayey soils and bedrock at this site have Plasticity Indices (PI) ranging from 17 to 37, which indicates a moderate to high potential for shrink/swell behavior. Additional laboratory testing and foundation design recommendations should be provided in the design-level phase of this project to mitigate expansive soils at this site. It is anticipated that mitigation may include a combination of special rigid mats such as post-tensioned slabs or conventional reinforced mats, and special grading requirements such moisture conditioning and compaction within specified ranges.

Undocumented "Man Made" Fill

As previously discussed a portion of the site is covered by undocumented man-made fills of significant thickness; these are considered highly susceptible to excessive total and differential settlement. In general, the existing fills should be completely removed and replaced with properly compacted engineered fill, where it will be located beneath areas of planned structures and related improvements at this site. The thickness of the existing fill will be further studied during the design-level exploration.

Groundwater

As described previously, relatively shallow groundwater was encountered on the western portion of the site. Relatively shallow groundwater should be expected in the proposed project area. In order to perform grading using conventional equipment, dewatering may be required when excavations extend near or below the level of the groundwater surface. Pumping of the ground surface may be experienced during grading on the proposed subgrade preparation for building basement foundations because of the high water table and cohesive nature of the majority of the site soils. Waterproofing may be required for below-grade concrete parking structures. The basement walls may have to be designed to resist hydrostatic pressures. The effects of buoyancy on basements that extend to and below the groundwater level will require evaluation. The effects of buoyancy are typically resisted by the dead weight of the structure, friction on the foundation walls and the use of tie-down anchors or hold-down piers, if required. Utility trenches and other similar excavations may require temporary dewatering during construction if they extend below a depth of approximately 10 feet.

Corrosion Potential

Two representative samples of the near-surface soils were collected during our field exploration and transported to our laboratory and tested for sulfate content in accordance with Caltrans Test Method 417. The concentrations of water-soluble sulfate (SO_4) were determined in accordance with Caltrans Test Method 417. As reported in the attached analytical results, the samples tested contained 109 and 420 mg/kg (ppm) water-soluble sulfate (SO_4) concentration levels. The 2007 California Building Code refers to ACI 318, Section 4.3, Table 4.3.1 for requirements to cement type, maximum water-cement ratio, and concrete compressive strength considering various sulfate concentrations. Those requirements are summarized in the table below.

Sulfate Exposure	Water Soluble Sulfate (SO_4) in Soil		Cement Type	Maximum Water-Cement Ratio	Minimum f'_c (psi)
	mg/kg	(%)			
Negligible	0 – 1,000	0.00 – 0.10	---	---	---
Moderate	1,000 – 2,000	0.10 – 0.20	II, IP(MS), IS(MS), P(MS), I(PM)(MS), I(SM)(MS)	0.50	4,000
Severe	2,000 – 20,000	0.20 – 2.00	V	0.45	4,500
Very Severe	Over 20,000	over 2.00	V plus pozzolan	0.45	4,500

It is recommended that where critical pipelines and related site improvements are in contact with the on-site soils, a corrosion specialist be consulted concerning specific requirements for corrosion protection.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on our preliminary studies, we conclude that the proposed project is feasible from a geotechnical standpoint provided the geotechnical concerns discussed in this report and subsequent studies can be mitigated and addressed in the design stage of the project. The main geotechnical issues for the proposed development include: (1) stability of relatively steep natural and proposed graded slopes along the eastern side of the project. The planned development lies along the subject slopes and there are potentially unstable landslide, colluvial and residual soils that should be mitigated for the planned development; (2) the presence of highly compressible Bay Mud, colluvial, and artificial fill deposits mainly along the western side of the site that pose a risk of sigificnat settlement and deformation when subject to increased loads; (3) presence of moderately expansive soil and bedrock materials that are considered susceptible to shrink and swell when subject to fluctuations in moisture content. Other geotechnical matters addressed in this report include site preparation and grading, proposed mitigation of slopes and preliminary recommendations for graded cut and fill slopes, preliminary foundation design considerations, underground utilities, preliminary pavements, retaining walls, site drainage, and subdrainage.

This preliminary study provides recommendations to be used as general guidelines for the planned development; as such, the recommendations should be refined and modified, as deemed appropriate by the Geotechnical Engineer during project development and preparation of the final 40-scale grading plans.

Slopes

The eastern portion of the site is occupied by westerly facing slopes that are relatively steep with inclinations ranging from ½:1 (horizontal:vertical) to 1½:1. Based on steepness of the proposed grading and existing slope conditions, the primary geologic conditions to potentially affect slope stability include surficial landslides, unstable talus deposits and colluvial deposits mapped at the site. A review of the preliminary development plan indicates that anticipated grading will result in 2:1 (horizontal : vertical) cut slopes up to 50 feet high in the eastern portion of the site. Slopes within the development will require stabilization and restore to site grades with proper corrective grading measures as describe in recommendations section of this report is required. In addition, the conceptual plans identify areas where no civil grading is currently planned; however given the existing site conditions proper remedial grading may be necessary to enhance the stability of these areas to reduce potential impact for the planned development. Colluvium and residual soils that are clayey are susceptible to movement as a result of potential expansive soil creep. Soil creep is the slow, downslope movement of soil caused by the annual cycle of wetting and drying under the influence of gravity. Fill placed on slopes steeper than 6:1 (horizontal:vertical) should be benched into competent underlying material.

Based on our experience, engineered slopes with the above strength characteristics constructed at gradients no steeper than 2:1 with intermediate benches spaced at a minimum of 30 feet apart in vertical height appear adequate for residential development. We recommend that slope stability analysis be conducted once the 40-scale grading plan is finalized to evaluate the long-term and seismic short-term loading conditions. Other potential slope instability conditions exist where the development abuts steep slope construction that extends upslope from the proposed development and the existence of soft fill material adjacent to the free face along Mare Island, Strait. Slope stability analysis should be performed during design level study and remedial grading recommendations will be provided.

Based on bedding attitudes encountered in test pits at the site (Appendix A), there appears to be a low potential for adverse bedding to occur on cut slopes. Adverse bedding is considered to be an unstable bedrock slope condition, where beds dip out of the slope (e.g. at angles less than the designed slope angle) yet also dip at a high enough angle (generally greater than 8 degrees) to cause bedding contacts to represent unfavorable discontinuities (i.e. planes of weakness) and act as landslide slip surfaces that increase the likelihood of slope failure. Despite that test pit information indicates an overall low potential for adverse bedding, a Certified Engineering Geologist should observe exposed cut slopes on the site during excavation and that the slope be over-excavated and re-built as a buttress fill if adverse geologic structures are encountered.

Preliminary Grading Recommendations

According to the preliminary grading plan, most of the site development will consist of cutting and filling to provide drainable grades for the proposed development. Grading operations should meet the requirements of the "Guide Contract Specifications" included in the Appendix D and must be observed and tested by ENGEO's field representative. Ponding of storm water, except within engineered sediment detention basins, should not be permitted at the site, particularly during work stoppage for rainy weather. Before the grading is halted by rain, positive slopes should be provided to direct the surface runoff water in a controlled manner.

Grading should begin with the removal of existing structures, if any, including their foundations within the area of planned development. Entirely remove from the project study area underground structures, such as buried pipes, septic tanks and leach fields, if any, which will be abandoned or are expected to deteriorate. Preliminary remedial grading is depicted on Figure 5. The remedial grading is anticipated to include: Remove landslide, colluvium and artificial fill deposits within the proposed grading areas. Reconstruct cut slopes with engineered fill, and construct a buttress with intervening benched/terraces. Majority of the slopes within the development will require rebuilding at a gradient of no steeper than 2:1 with intermediate benches a minimum of 8 feet wide spaced no greater than 30 feet in vertical height is recommended. Existing slopes steeper than 2:1 should also be rebuilt based on this requirement. See Figure 5 for areas requiring slope rebuilding. It is recommended that slope stability analyses should be performed on final slope configurations once 40 scale grading plans are prepared.

Based on the nature of the bedrock present at the site we anticipate that cut slopes greater than 10 feet high may require rebuilding as engineered fill slopes, depending on the mapping by Cetrified Engineering Geologist during grading. To reduce potential for triggering significant instability that may affect the adjacent property during earthwork associated with the slope rebuilds, we recommend that excavation areas and removal of existing unstable landslide debris be perform in a staged construction (phased grading) within designated areas. Even with the recommended phased and/or staged grading approach, there remains a risk of slope movement and instability during grading and this risk of movement would need to be accepted by the client as a part of the repair scheme. In addition, it may be necessary to install special structural mitigation measures (such as closely spaced and significantly reinforced below grade pier walls, etc.) to protect the adjacent properties or existing site improvements to remain in place during grading.

Provide filled drainage courses with adequate subsurface drainage prior to any fill placement. Clean swales to a firm soil or rock base. Then, install a subdrain through the center of the subexcavation. Remove desiccated, cracked surface clays and slumping soils located along the swale areas, and bench the slopes prior to fill placement. The Geotechnical Engineer should determine in the field actual limits of subexcavation during grading. Discharge from the subdrains will generally be low but in some instances may be continuous. Provide subdrain outlets into the storm drain system or other approved outlets, and document these locations for future maintenance.

Existing “Man-Made” Fills

As described above, the western side of the site is comprised of existing “man-made” fill placed as a part of the pre-existing development. These fills are undocumented and contain some unsuitable materials. Based on observations during our exploration program, in some locations the fill material extends down to at least 19 feet. The existing fill materials range from loose to medium dense or soft to stiff, and are generally unconsolidated. These materials are considered considered susceptible to excessive total and differential settlements where these may underlie the planned structures, grading and related site improvements. One practical measure to mitigate such conditions is to remove and replace these with properly compacted engineered fill. Due to shallow groundwater at this site portions of the existing fill are below free water levels, as such construction dewatering measures may be anticipated during mitigation measures to facilitate complete removal of the fill materials and replacement with engineered fill.

Compressible Soils (Bay Mud, Alluvium and Colluvium)

As previously discussed, highly compressible clay deposits underlie the soils on the western portion of this site. These compressible soils have been observed during environmental remedial activities on the western portion of the site as overseen by ERRG and Malcom-Pirni. Compressible Bay Mud is considered susceptible to excessive total and differential settlement, if not properly mitigated. Settlement related to soil compression could adversely impact planned structures, improvements, and site grades. In general it is recommended that all areas underlain by compressible deposits be mitigated prior to the construction of houses and site improvements. A number of mitigation alternatives can be applied to reduce the effects of settlement, such as surcharging a broad area of the site, or another approach may be to support structures on deep foundations extending below compressible layers.

Without mitigation, consolidation of the compressible deposits will continue for a long duration (5 years or greater). To mitigate long-term total and differential settlements, a number of mitigation measures may be considered appropriate. One approach that has been successfully performed on many sites in the San Francisco Bay Area is "preconsolidation" of the compressible layer prior to site development to reduce the future long-term settlements. In general, preconsolidation of compressible soils can be achieved by the use of a surcharge fill loading program. A surcharge program would involve the placement of temporary fills uniformly blanketed over future building areas until the desired degree of consolidation in these areas has occurred as determined by a site-specific settlement monitoring program.

The actual surcharge duration will be determined by monitoring the actual settlements over time via a series of surveyed settlement monuments and remote sensing equipment be installed at locations selected by the Geotechnical Engineer. After the desired degree of consolidation has occurred, the surcharge fill above building pad grades is removed. Once the settlement has occurred, the use of shallow foundation systems such as post-tensioned mat foundations would be appropriate for the planned residential structures with light to moderate loads. Surcharge program for the proposed development will be provided once 40-scale grading plan are completed and additional exploration are conducted.

Fill Placement and Monitoring. Prior to fill placement, areas receiving fills should be scarified, moisture-conditioned and recompacted to provide adequate bonding with the initial fill lift. Fills should be placed in thin lifts under the observation of the Geotechnical Engineer. The Geotechnical Engineer or his/her qualified representative should be present during all phases of grading operations to observe demolition, ground preparation, grading operations, and subdrain placement. The final grading plans should be review by the Geotechnical Engineer. Relative compaction refers to in-place dry density of the fill material expressed as a percentage of the maximum dry density based on ASTM D-1557-91. Optimum moisture is the moisture content corresponding to the maximum dry density. Avoid track rolling to compact slope faces. Overfill and cut back fill slopes to design grades.

Mitigation For Cut Lots, Differential Fill Thickness Lots, and Cut-Fill Transition Lots. The proposed residential lots include the construction of cut lots, fill or traversed by a cut-fill transition lots. Significant variations in material properties may occur in cut-and-fill areas if not mitigated during grading; therefore, sufficient amount of overexcavation and scarification in place and replace with properly compacted-engineered fill to achieve reworked engineered soil zone beneath the foundation slab is required. Lots planned for fills above existing slopes could have a differential fill thickness greater than 20 feet. Differential building movements may become apparent for these large differential fill thicknesses. Accordingly, avoid differential fill thickness across a lot greater than 10 feet. Local soil and bedrock material over-excavation and replacement by engineered fill will be necessary to achieve the above recommendation.

Graded Slopes.

Because of the steep existing slope gradients in the eastern portion of the site significant cut slopes with inclinations of 2:1 have been planned. We recommend that these slopes be overexcavated and rebuilt as engineered fill slopes. Where steeper slopes are desired, supplemental slope stabilization techniques (e.g. geogrid reinforcing) may be required.

If minimizing erosion of major slopes exceeding 30 feet in vertical height is desired, the use of erosion mats or alternative intermediate benches, and concrete-lined V-ditches should be considered by the Civil Engineer. It should be noted that graded slopes will require periodic maintenance.

All cut slopes should be viewed by the Engineering Geologist for unsuspected slope conditions that might be detrimental to slope stability. Such conditions may include adverse rock and seepage conditions. If such conditions are encountered, additional recommendations for mitigation will be provided. All cut slopes should be viewed by the Engineering Geologist for adverse bedding, seepage, or bedrock conditions that may affect slope stability. In the event that adverse geologic conditions are detected during grading of the cut slopes, overexcavation and reconstruction of these slopes may be necessary.

Preliminary Foundation Design

The major considerations in foundation design for structures proposed for this project are the structure building area on steep terrain and effects of potential differential movement of on-site soils as a result their shrink-swell characteristics, settlement associated with consolidation of underlying soil, and the distance of the proposed structure from the top of the slope. The effects of potential foundation movement can be reduced by the choice of a proper foundation system. In order to reduce the effects of potential differential movement, the foundations should be sufficiently stiff to move as rigid units. This section provides recommendations for appropriate foundation types. Final foundation plans should be submitted to the project Geotechnical Engineer for review prior to submittal to the appropriate agency. For planning purposes, we have prepared the following table which identifies the appropriate foundation system for a given site condition. Specific design parameters for the recommended foundations are discussed below. Detail foundation design criteria will be provided during design level studies.

FOUNDATION SYSTEMS

Foundation type	Greater than 10 feet back from the top of the slope	Less than 10 feet back from the top of the slope	Greater than 10 feet differential fill	Less than 10 feet differential fill
Conventionally Reinforced Structural Mat Foundation	X			X
Post Tensioned Slab Foundation	X			X
Spread Footings with Raised Floor Foundation	X			X
Deep Foundations – Driven Pile or Drilled Piers	X	X	X	X

Conventionally Reinforced Structural Mat Foundations. Residences located on level building pads at least 10 feet from the top of slope with differential fill thickness less than 10 feet can be supported utilizing a mat foundation system. Conventionally reinforced structural mats should be designed for a 5-foot edge-cantilever distance and a 15-foot unsupported interior-span distance. These structural mats should have a minimum thickness of 10 inches and be thickened to 12 inches at the perimeter.

Post-Tensioned Slab Foundations. Post-tensioned slab foundations are suitable to provide; support of the proposed one- or two-story wood-frame houses that are located at least 10 feet from the top of slopes. Post-tensioned slabs should be designed according to the method recommended in the Design and Construction of Post-Tensioned Slabs-on-Ground (PTI, 2004).

Spread Footing Foundations with Raised Floors. Residences located on level building pads at least 10 feet from the top of slope can be supported utilizing spread footing foundations with raised floors. We recommend using stiffened continuous strip footings. If moderately expansive clays are encountered at the bottom of the foundation excavations, these soils should be removed and replaced with low to non-expansive material (P.I. less than 12).

The spread footings should be a minimum of 12 inches wide and should be founded in either properly compacted fill, or directly on firm natural soil deposits. Footing trenches should be cleared of loose soil prior to concrete placement. It is important that footing trenches not be allowed to desiccate prior to placing concrete.

Drilled Piers with Raised Floor Foundations. Residences, including those that are located within 10 feet of the top of slopes and/or with differential fill thickness greater than 10 feet, can be supported on drilled piers with raised floors. The piers should be interconnected by grade beams and used in conjunction with raised floors. The construction of deeper piers with a wider spacing and stiffer grade beams is preferred. We also recommend extending the piers into firm, natural materials as determined by ENGEO from the boring data and also from pier drilling during construction.

Pier hole drilling should be done under the observation of the Geotechnical Engineer or his qualified representative to confirm that the above recommendations are being complied with and so that alternative action may be implemented when subsurface conditions vary from those encountered in the borings.

Driven Piles In areas underlying by Bay mud buildings may be supported on deep pile foundations that extend through the Bay Mud and derive their support capacity by skin friction in the underlying stiff soils or by end bearing in bedrock as an alternative to site mitigation by surcharging. Design for driven piles will depend on the depths to bearing strata, building loads, and thickness of underlying Bay mud. Specfic design parameters will be provided during design level study when 40 scale grading plans is available.

Surface Drainage

Improper drainage may result in fill saturation with consequent loss of compaction and fill strength. It is very important that all lots be positively graded at all times to provide for rapid removal of surface water. Ponding of water under floors or seepage toward foundation systems at any time during or after construction must be prevented.

We recommend that a subsurface drain be provided around the perimeter of the residential structures that have raised floors and crawl spaces to help protect against subsurface seepage under the foundation.

Secondary Slab-on-Grade Construction Secondary slabs-on-grade should be designed specifically for their intended use and loading requirements. Some of the site soils have a moderate to critically high expansion potential; therefore, cracking of conventional slabs should be expected in the future. As a minimum requirement, slabs-on-grade should be reinforced for control of cracking. Frequent control joints should be provided to reduce the cracking. Reinforcement should be designed by the Structural Engineer.

Materials Selection. With the exception of organic-laden soils, we anticipate engineered fill to consist of the on-site soils and bedrock derived materials in connection with the planned grading and site improvements. Organic laden soils contain more than 3 percent organic content above typical background levels in soil and bedrock. It is our experience that organic laden soils can be blended with general fill material at a ratio not greater than 10:1.

Based on our experience in similar rock formations, equipment such as D-8 bulldozers should be able to rip the rock. The ripping operation can be slow and may generate large pieces of rock, some as large as 4 feet in size.

Import Materials. Inform the Geotechnical Engineer if any soil importation is expected. Import materials must meet the requirements contained in Section 2.02B, Part I of the Guide Contract

Specifications in Appendix D. A sample of the proposed import material should be submitted to the Geotechnical Engineer for evaluation by laboratory testing prior to study area delivery.

Retaining Walls

According to the preliminary grading plan retaining walls are proposed for various locations within up to 30 feet in vertical height. It is anticipated that the walls may consist of conventional masonry or concrete wall, keystone wall, or soil nail wall design. All retaining walls should include drainage facilities to prevent the build-up of hydrostatic pressures behind the walls. Wall drainage and wall design criteria will be provided during the design level study for the project. Design parameters for walls will be provided during design level study. Wall designs should be reviewed by the Geotechnical Engineer.

Utilities

It is recommended that all utility trench backfill be done under the observation of a Geotechnical Engineer. Pipe zone backfill (i.e. material beneath and immediately surrounding the pipe) may consist of a well-graded import or native material in accordance with Appendix D. Trench zone backfill (i.e. material placed between the pipe zone backfill and the ground surface) may consist of native soil compacted in accordance with recommendations for engineered fill.

Utility trenches should not be located upslope of any foundation area unless the placement, depth, and backfill material to be used are reviewed by the Geotechnical Engineer. Care should be exercised where utility trenches are located beside foundation areas. Utility trenches constructed parallel to foundations should be located entirely above a plane extending down from the lower edge of the footing at an angle of 45 degrees. Utility companies and Landscape Architects should be made aware of this information.

It is the responsibility of the contractor to provide a safe and stable trench side-wall condition. The contractor should follow the trench safety requirements of CAL-OSHA and the City of Vallejo.

Utility trenches in areas to be paved should be backfilled to the specifications for engineered fill and in accordance with City of Vallejo requirements; however, compaction of trench backfill by jetting shall not be allowed at this site.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is issued with the understanding that it is the responsibility of the owner to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, and designers for the project so that the necessary steps can be taken by the contractors and subcontractors to carry out such recommendations in the field. The conclusions and recommendations contained in this report are solely professional opinions.

The professional staff of ENGEO Incorporated strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. There are risks of earth movement and property damages inherent in land development. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our work.

This report is based upon field and other conditions discovered at the time of preparation of ENGEO's work. This document must not be subject to unauthorized reuse, that is, reuse without written authorization of ENGEO. Such authorization is essential because it requires ENGEO to evaluate the document's applicability given new circumstances, not the least of which is passage of time. Actual field or other conditions will necessitate clarifications, adjustments, modifications or other changes to ENGEO's work. Therefore, ENGEO must be engaged to prepare the necessary clarifications, adjustments, modifications or other changes before construction activities commence or further activity proceeds. If ENGEO's scope of services does not include on-study area construction observation, or if other persons or entities are retained to provide such services, ENGEO cannot be held responsible for any or all claims arising from or resulting from the performance of such services by other persons or entities, and from any or all claims arising from or resulting from clarifications, adjustments, modifications, discrepancies or other changes necessary to reflect changed field or other conditions.

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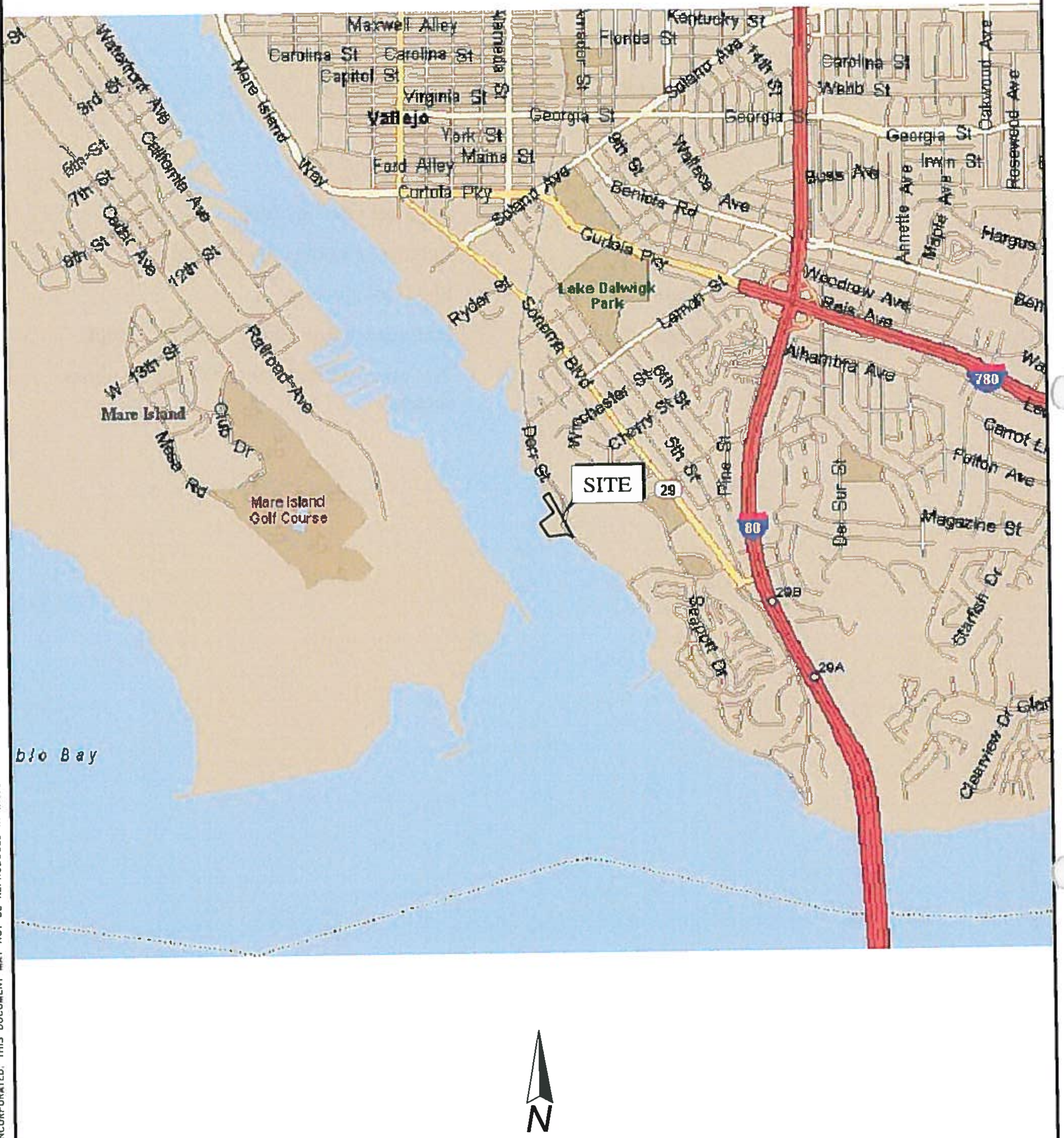
LIST OF FIGURES AND TABLE



BASE MAP SOURCE: MS STREETS AND TRIPS

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

VICINITY MAP
790 DERR STREET
VALLEJO, CALIFORNIA

PROJECT NO.: 7599.200.201
DATE: JUNE 2008
DRAWN BY: LC
CHECKED BY: TPB
FIGURE NO. 1

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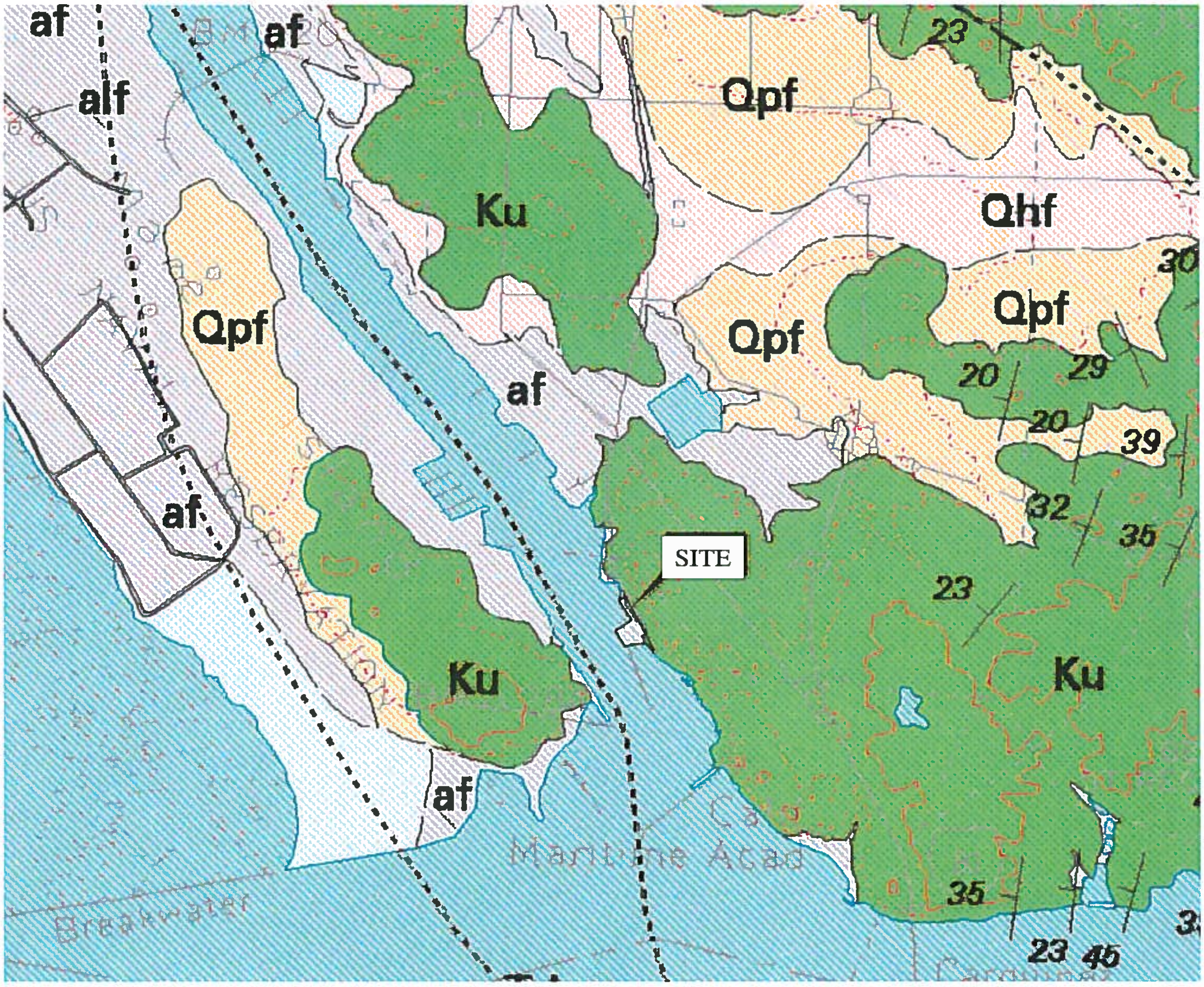
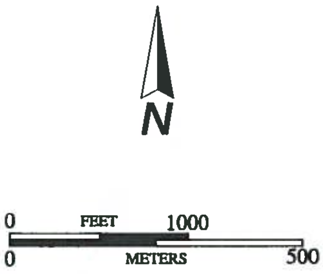


EXPLANATION

af	ARTIFICAL FILL (HOLOCENE, HISTORIC)
Qpf	ALLUVIAL FAN DEPOSITS (LATE PLEISTOCENE)
Ku	UNDIVIDED SANDSTONE, SILTSTONE AND SHALE (LATE CRETACEOUS)
- - - - - - -	FAULT (INFERRED LOCATION)
35	STRIKE AND DIP OF BEDDING



BASE MAP SOURCE: GRAYMER 2002

ENGEO
INCORPORATED
EXCELLENT SERVICE SINCE 1971

REGIONAL GEOLOGIC MAP

790 DERR STREET
VALLEJO, CALIFORNIA

PROJECT NO.: 7599.200.201	FIGURE NO. 2
DATE: JUNE 2008	
DRAWN BY: JSW	CHECKED BY: TPB

ORIGINAL FIGURE PRINTED IN COLOR

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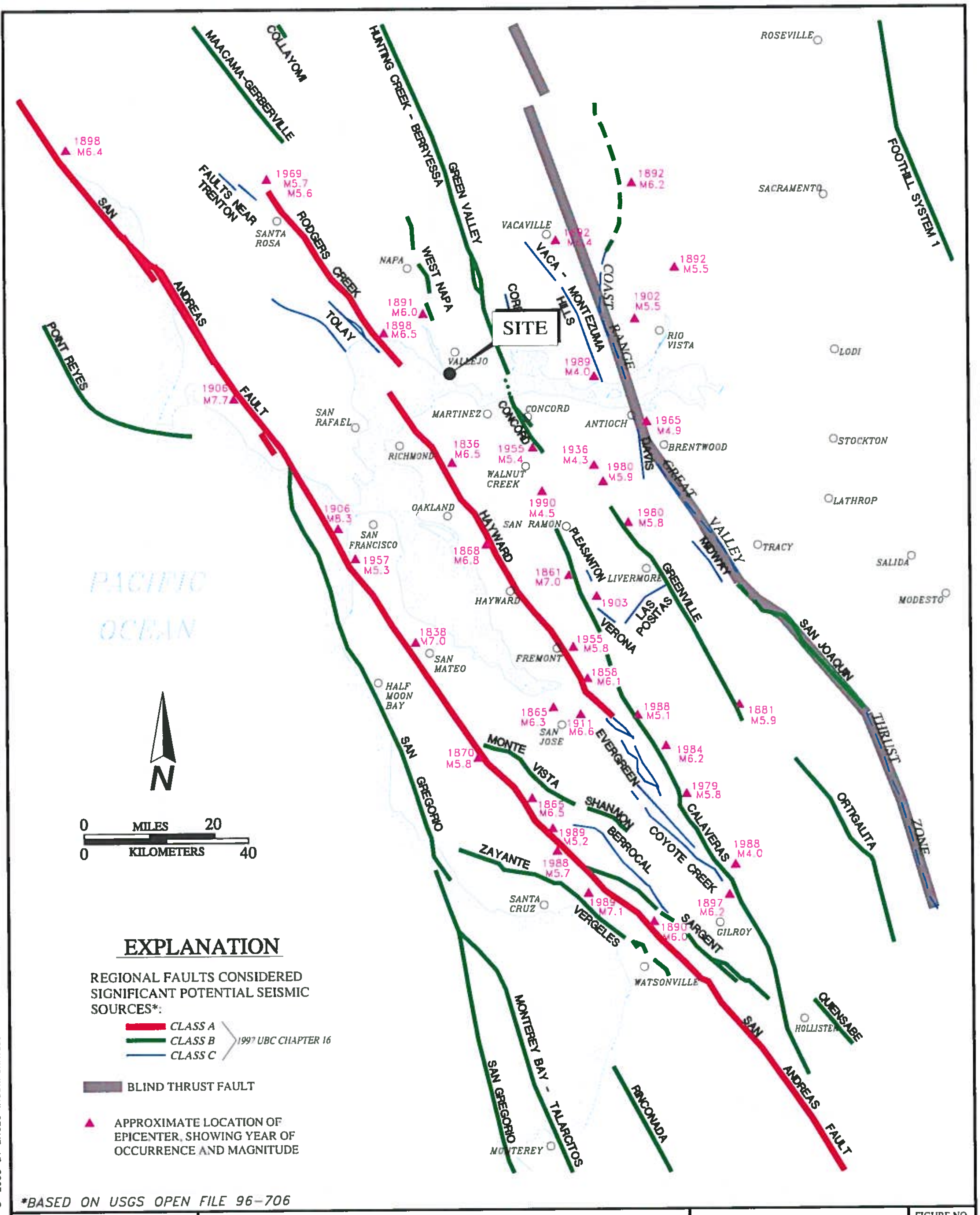

EXPLANATION

REGIONAL FAULTS CONSIDERED SIGNIFICANT POTENTIAL SEISMIC SOURCES*:

🟥	CLASS A	1997 UBC CHAPTER 16
🟩	CLASS B	
—	CLASS C	

▬ BLIND THRUST FAULT

▲ APPROXIMATE LOCATION OF EPICENTER, SHOWING YEAR OF OCCURRENCE AND MAGNITUDE

*BASED ON USGS OPEN FILE 96-706

ENGEO
INCORPORATED
EXCELLENT SERVICE SINCE 1971

REGIONAL FAULTING AND SEISMICITY

790 DERR STREET
VALLEJO, CALIFORNIA

PROJECT NO.: 7599.200.201	
DATE: JUNE 2008	
DRAWN BY: JSW	CHECKED BY: TPB

FIGURE NO.
3

ORIGINAL FIGURE PRINTED IN COLOR

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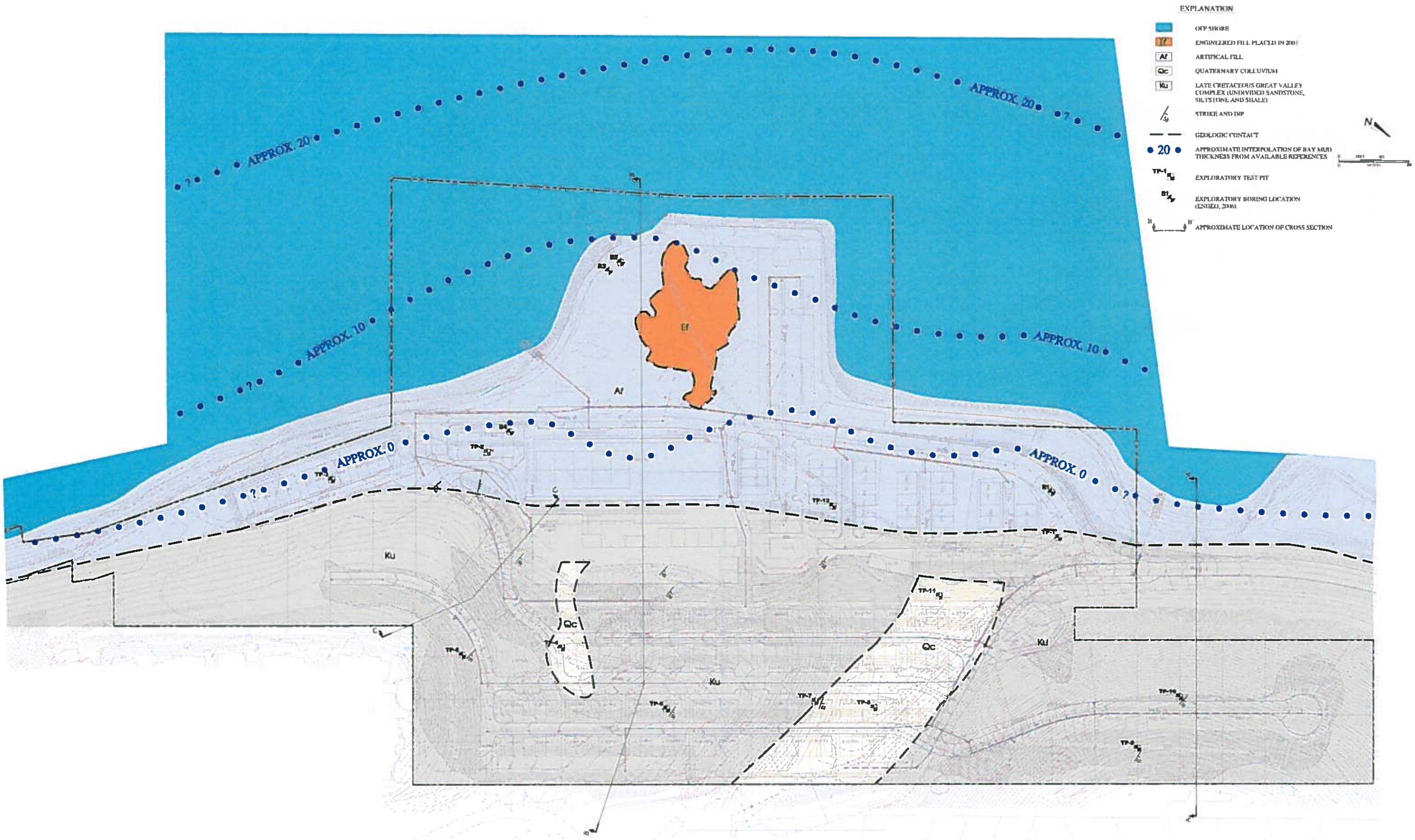


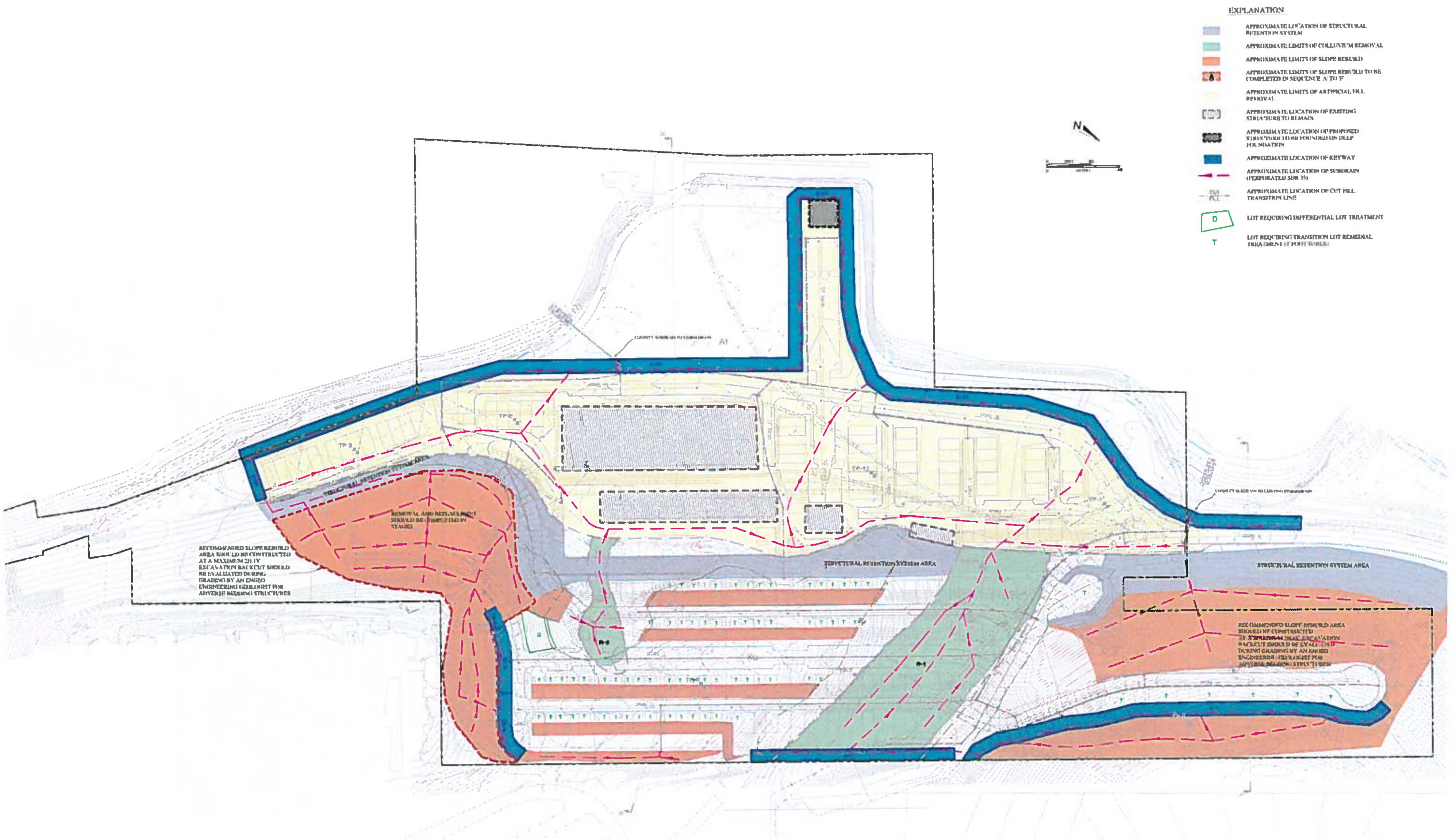
BASE MAP SOURCE: [illegible] ASSOCIATES

ENGEO INCORPORATED

PRELIMINARY GEOLOGY MAP
790 DEBB STREET
VALLEJO, CALIFORNIA

PROJECT NO.: 7999.[illegible]
DATE: JUNE 20[illegible]
DRAWN BY: JSW
CHECKED BY: TPB

FIGURE NO. 4

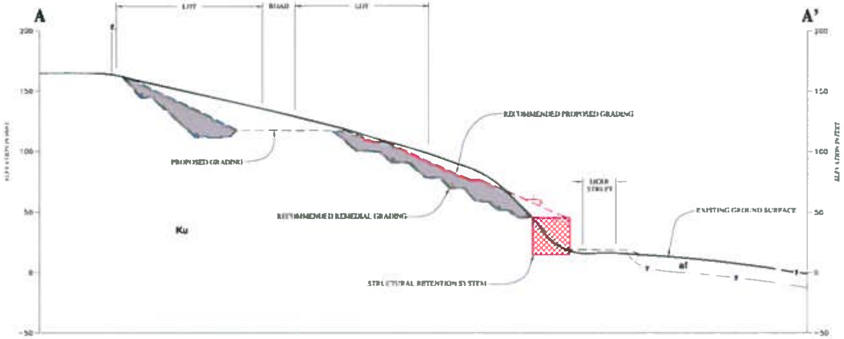


BASE MAP SOURCE: MERIDIAN ASSOCIATES 2008

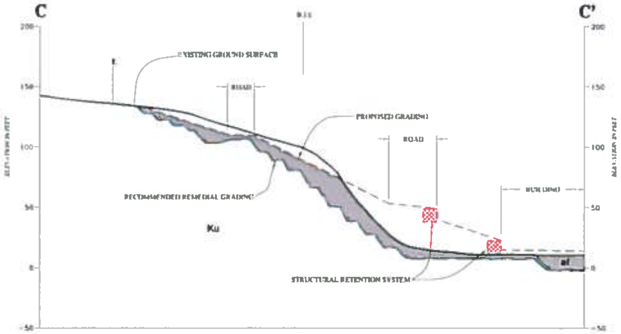
ENGEO
INCORPORATED
EXCELLENCE SINCE 1971

PRELIMINARY REMEDIAL GRADING CONCEPT
790 DERR STREET
VALLEJO, CALIFORNIA

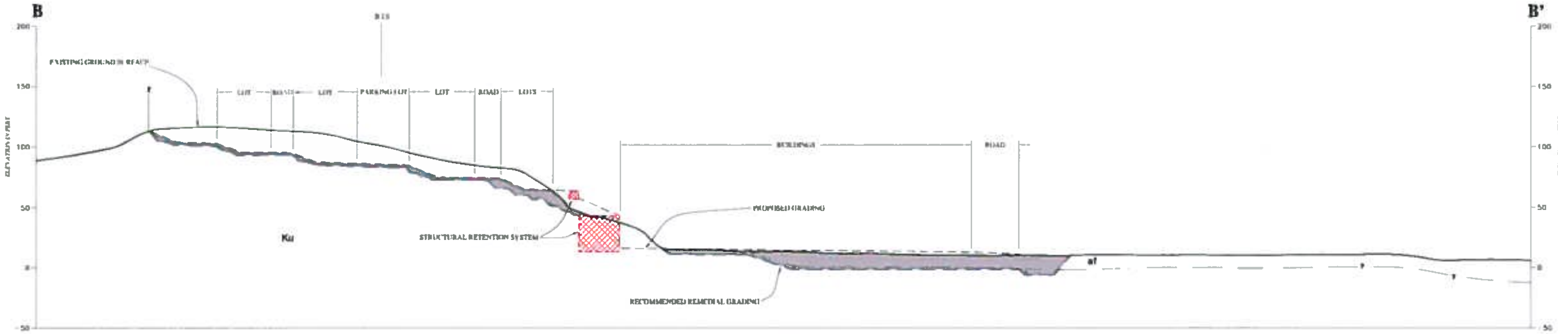
PROJECT NO.: 7599.000.201
DATE: JUNE 2008
DRAWN BY: JSW
CHECKED BY: TPB
FIGURE NO. 5



SECTION A-A'
1" = 50'



SECTION D-D'
1" = 50'



SECTION C-C'
1" = 50'

ENGEO INCORPORATED	PRELIMINARY REMEDIAL AND GEOLOGIC CONCEPTS 790 DERR STREET VALLEJO, CALIFORNIA	PROJECT NO.: 7599.000.201 DATE: JUNE 2018 DRAWN BY: JSW CHECKED BY: TPB	FIGURE NO. 6

APPENDIX A

ENGEO INCORPORATED

Test Pit Logs

7599.200.201
June 27, 2008

TEST PIT LOGS

Test Pit Number	Depth (feet)	Description
TP-1	0-1	AC (4 inches)/ AB (8 inches), olive brown to brown, dense to medium dense, moist.
	1-3	SILTY CLAY (CL), olive brown, stiff, moist, trace gravel, trace rock fragments. (fill)
	3-10	Interbedded SILTSTONE and CLAYSTONE, dark yellowish brown to olive brown, moderately strong to weak, closely fractured, thinly bedded, moderately to highly weathered, Fe staining throughout, groundwater at 8 feet. (bedrock)
TP-2	0-1	AC (5 inches)/ AB (7 inches), brown to dark brown, medium dense, moist.
	1-6	SILTY CLAY (CL), olive brown to dark yellowish brown, medium stiff, moist, trace gravel. (fill)
	6-10	SILTY CLAY (CL), dark reddish brown, medium stiff, moist, trace gravel. (fill)
	10-12	SILTSONE, gray to light gray, strong to very strong, closely fractured, thickly bedded, slightly weathered, Fe stained joints. (bedrock)
TP-3	0-1	AB, brown to dark brown, medium dense, Dry.
	1-12	SILTY CLAY (ML/CL), olive brown to dark reddish brown, stiff to very stiff, dry to moist becomes wet to saturated, trace coarse gravel, trace cobbles, trace deleterious materials. Caving at 12 feet, groundwater at 9 feet. (fill)

TP-4	0-5	CLAY with SILT (CH), dark brown, soft to medium stiff, moist, trace rootlets/organics. (colluvium)
	5-13	SILTY CLAY (CL), light reddish brown to brown, medium stiff to stiff, moist, trace rounded fine gravel. (colluvium)
	13-14	Interbedded SILTSONE and SANDSTONE, yellowish brown, moderately strong, closely fractured, thinly bedded, moderately weathered. (bedrock)
TP-5	0-3	CLAY with SILT (CH/CL), dark brown, soft to medium stiff, moist, tree roots, trace organics. (colluvium)
	3-6	Interbedded SANDSTONE, SILTSTONE and CLAYSTONE, light yellowish brown to yellowish brown, strong, closely to very closely fractured, thinly bedded (N80W/ 65N), moderately weathered, Fe staining throughout. (bedrock)
TP-6	0-1	SILTY CLAY (CL), brown, medium stiff, dry, trace rootlets. (topsoil/ colluvium)
	1-4	Interbedded SANDSTONE, SILTSONE and CLAYSTONE, light yellowish brown to dark yellowish brown to dark gray, strong, closely fractured, thinly to very thinly bedded (N85E/ 58N), moderately weathered, Fe stained joints. (bedrock)
TP-7	0-2	SILTY CLAY (CL), brown to dark brown, soft to medium stiff, moist, trace fine gravel. (topsoil/ colluvium)
	2-6	Interbedded SANDSTONE, SILTSONE and CLAYSTONE, light yellowish brown to dark yellowish brown, strong, closely fractured, thinly to very thinly bedded (N70E/ 63N), moderately weathered, Fe stained joints. (bedrock)

TP-8	0-3	CLAY with SILT (CH), brown to grayish brown, soft to medium stiff, moist, trace rootlets/organics. (colluvium)
	3-8	SILTY CLAY (CL), light reddish brown to brown, medium stiff, moist, trace rounded fine gravel. (colluvium)
	8-10	Interbedded SANDSTONE, SILTSTONE and CLAYSTONE, light yellowish brown to dark yellowish brown, strong, closely fractured, thinly bedded, moderately weathered, Fe stained joints. (bedrock)
TP-9	0-2	SILTY CLAY (CL), brown to grayish brown, soft to medium stiff, moist, trace fine gravel. (topsoil/ colluvium)
	2-5	Interbedded SANDSTONE, SILSTONE and CLAYSTONE, light yellowish brown to dark yellowish brown, weak to moderately strong, closely to very closely fractured, very thinly bedded (N79E/ 60N), moderately to highly weathered, Fe stained throughout. (bedrock)
TP-10	0-2	SILTY CLAY (CL), brown to grayish brown, soft to medium stiff, moist, trace fine gravel. (topsoil/ colluvium)
	2-6	Interbedded SANDSTONE, SILTSTONE and CLAYSTONE, light yellowish brown to dark yellowish brown, weak to moderately strong, very closely fractured, thinly bedded (N85W/ 55N), moderately weathered, Fe stained throughout, cobble size concretions. (bedrock)

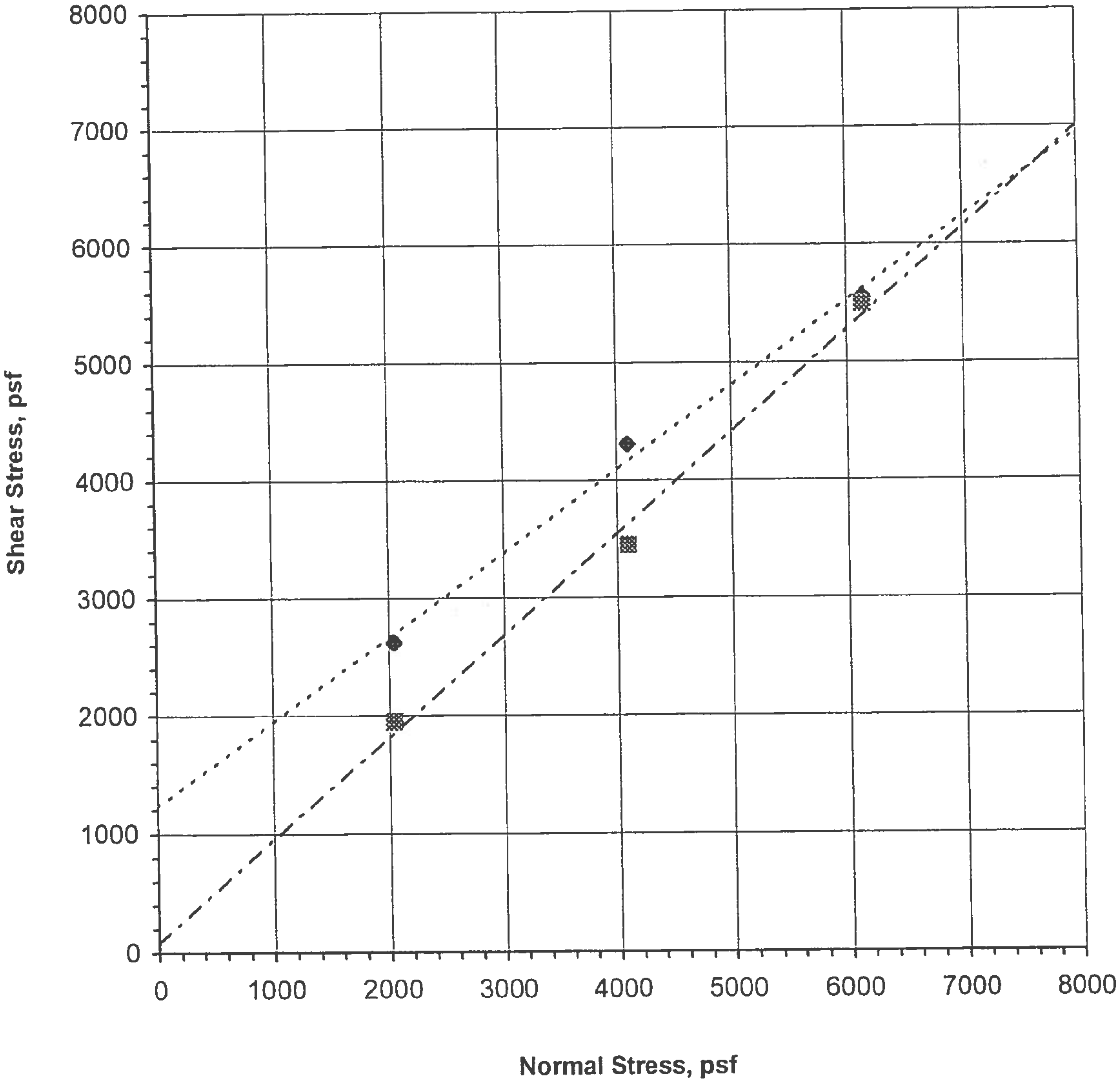
TP-11	0-5	CLAY with SILT (CH), brown to grayish brown, soft to medium stiff, moist, trace rootlets/organics. (colluvium)
	5-12	SILTY CLAY some SAND (CL), olive brown mottled with dark gray, medium stiff, moist, trace fine gravel. (colluvium)
	12-13	Interbedded SILTSTONE and CLAYSTONE, light yellowish brown to dark yellowish brown, moderately strong, very closely fractured, thinly bedded, moderately weathered. (bedrock)
TP-12	0-1	AC (6 inches)/ AB (6 inches), brown to dark brown, medium dense, dry to moist.
	1-8	SILTY CLAY some SAND (ML/ CL), light olive brown to light olive gray, medium stiff, moist becomes wet to saturated, trace coarse gravel. Caving at 8 feet, groundwater at 5 feet. (fill)

APPENDIX B

Laboratory Test Data

7599.200.201
June 27, 2008

Direct Shear Test
ASTM Test Method D3080



	FRICTION ANGLE	COHESION
Peak	36 degrees	1229 psf
Softened	41 degrees	82 psf

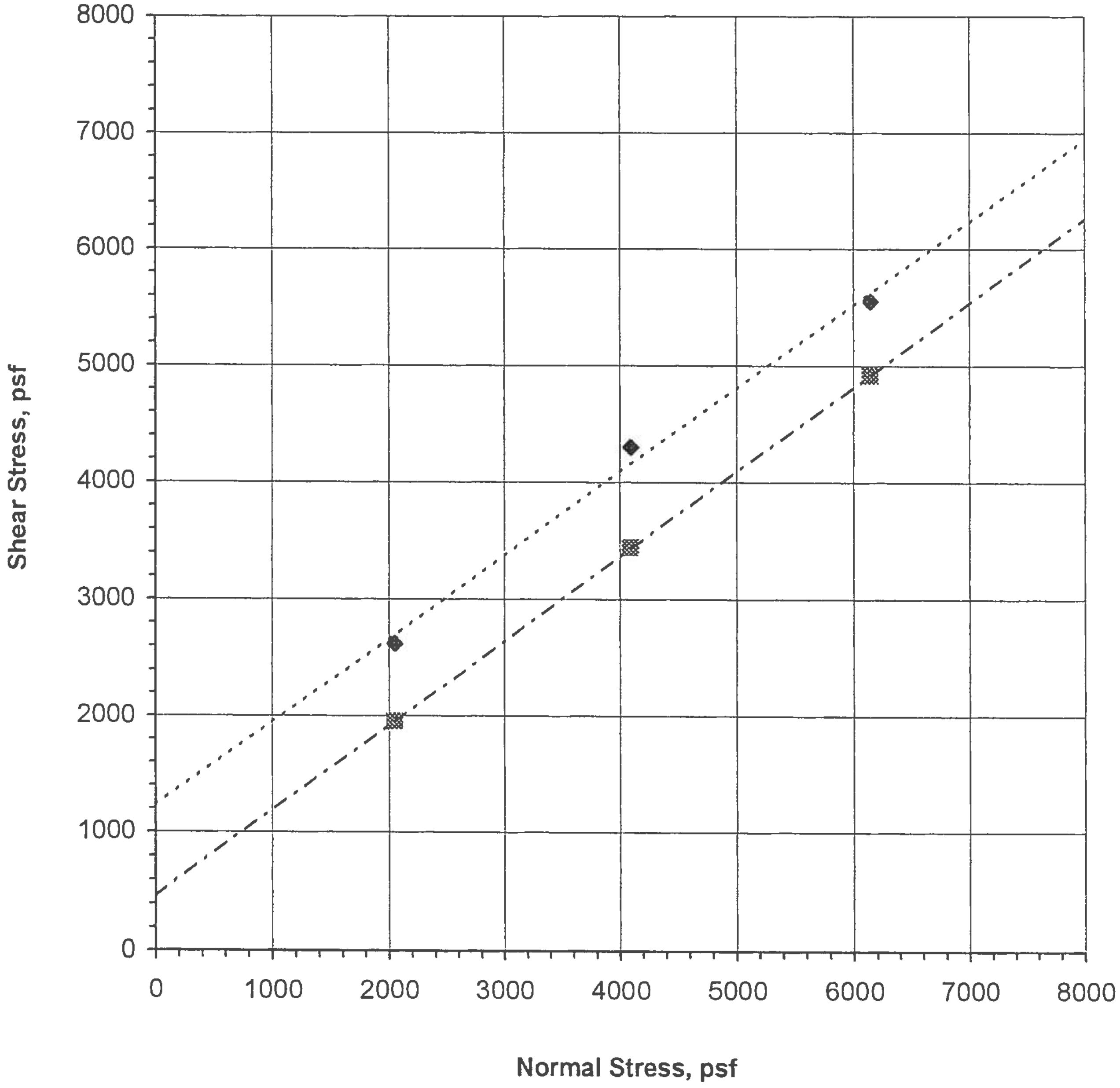
Dry Density:	115.4 pcf
Moisture Content:	15.1 %
USCS Classification:	CL
Shear Type:	CD
Shear Rate:	Slow

ENGEO
INCORPORATED

790 DERR STREET
VALLEJO, CALIFORNIA

Job No.:	**7238.2.001.01**	**Figure No.**
Sample Number:	**B4@11'**	
Date:	**5/5/2006**	

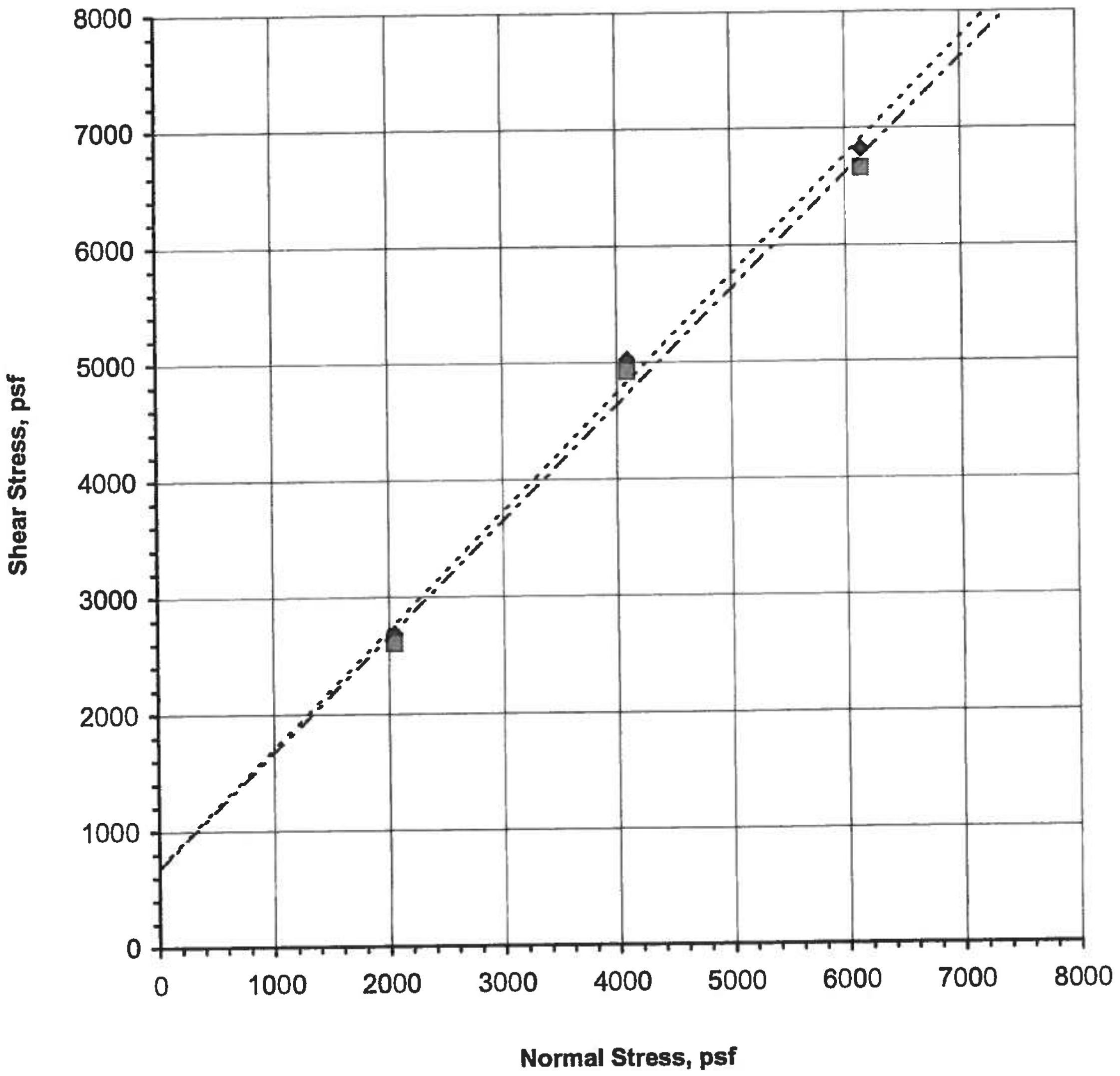
Direct Shear Test
ASTM Test Method D3080



	FRICTION ANGLE	COHESION
Peak	36 degrees	1229 psf
Softened	36 degrees	464 psf

Dry Density:	115.4 pcf
Moisture Content:	15.1 %
USCS Classification:	CL
Shear Type:	CD
Shear Rate:	Slow

Direct Shear Test
ASTM Test Method D3080



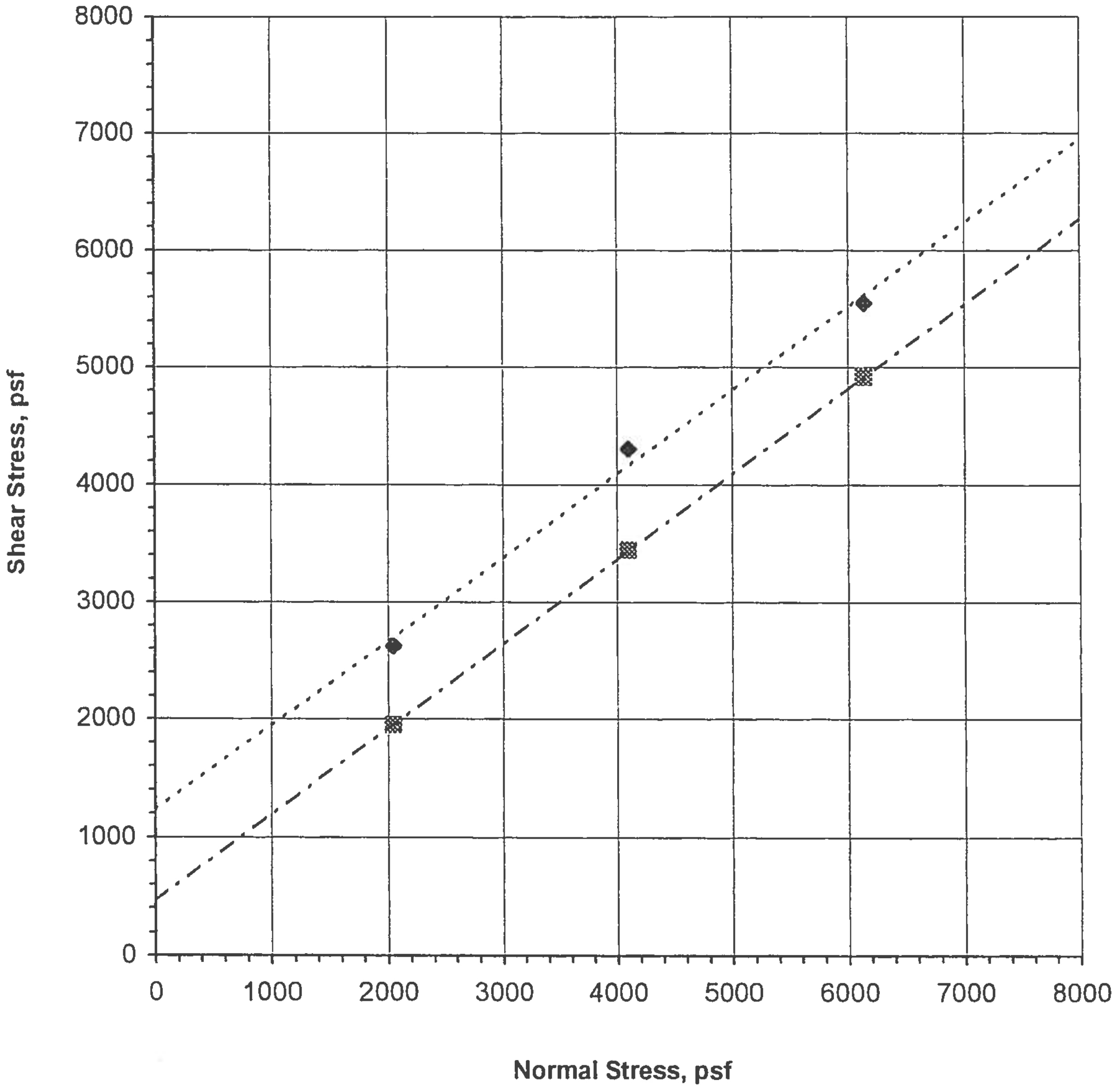
	FRICTION ANGLE	COHESION
Peak	45 degrees	703 psf
Softened	45 degrees	669 psf

SAMPLE REMOLDED TO 90%COMPACTION AT 3% OVER OPTIMUM

Dry Density:	100.5 pcf
Moisture Content:	20 %
USCS Classification:	CL
Shear Type:	CD
Shear Rate:	Slow

ENGEO INCORPORATED	**GENERAL MILLS** **Vallejo, California**	**Job No.:**	**7599.200.201**	**Figure No.**
		Sample Number:	**TP-7**	
		Date:	**4/16/2008**	

Direct Shear Test
ASTM Test Method D3080

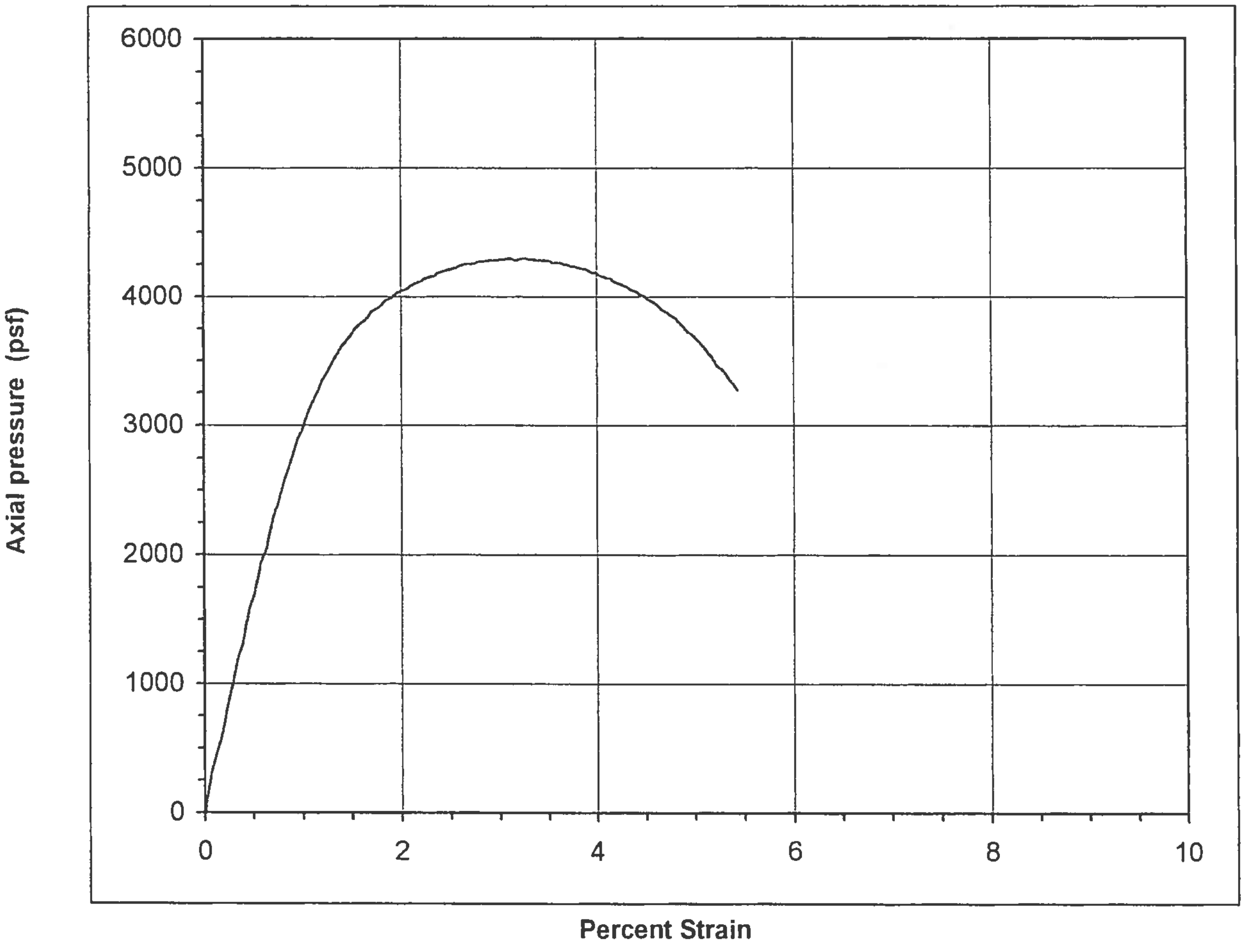


	FRICTION ANGLE	COHESION
Peak	36 degrees	1229 psf
Softened	36 degrees	464 psf

Dry Density:	115.4 pcf
Moisture Content:	15.1 %
USCS Classification:	CL
Shear Type:	CD
Shear Rate:	Slow

ENGEO INCORPORATED	790 DERR STREET VALLEJO, CALIFORNIA	Job No.: 7238.2.001.01 Sample Number: B4@11' Date: 5/5/2006	Figure No.

Unconfined Compression Test
ASTM Test Method D2166



Unconfined Compressive Strength: 4290 psf 2.1 tsf

Sample Description: Olive gray silty Clay with Claystone fragments

Initial Diameter: 2.420 in.
Initial Height: 5.00 in.
Strain Rate: 1.245 %/min
Total Strain: 5.43 %

Sample Number: B1@3.5
Dry Unit Weight: 105.7 pcf
Moisture Content: 19.2 %
Depth of Sample: 3.5 ft.

ENGEO
INCORPORATED

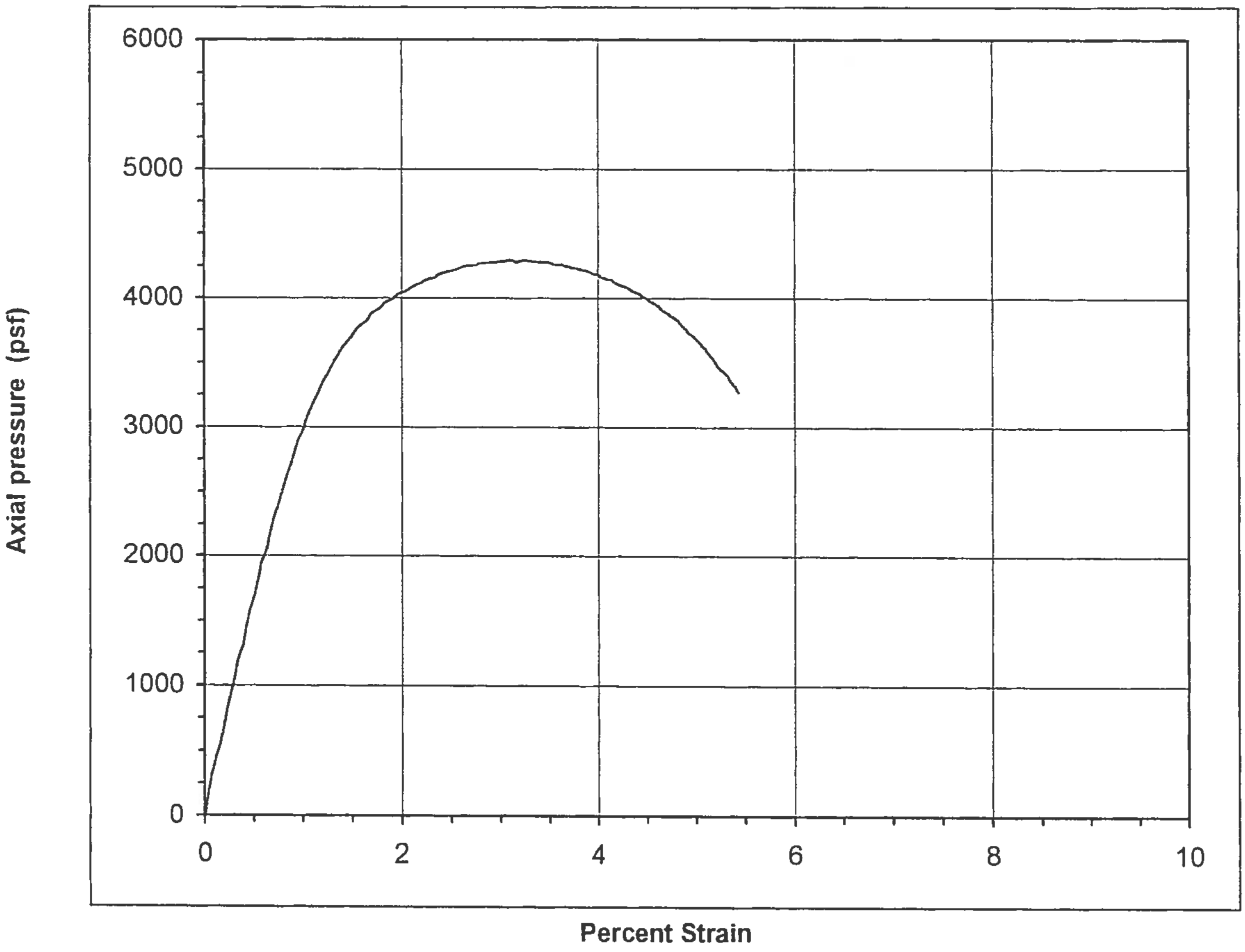
790 DERR STREET

Vallejo, California

Job No.: 7238.2.001.01
Sample Number: B1@3.5
Date: 5/8/2006

Figure No.

Unconfined Compression Test
ASTM Test Method D2166



Unconfined Compressive Strength: 4290 psf 2.1 tsf

Sample Description: Olive gray silty Clay with Claystone fragments

Initial Diameter:	2.420 in.		Sample Number:	B1@3.5	
Initial Height:	5.00	in.	Dry Unit Weight:	105.7	pcf
Strain Rate:	1.245	%/min	Moisture Content:	19.2	%
Total Strain:	5.43	%	Depth of Sample:	3.5	ft.

ENGEO
INCORPORATED

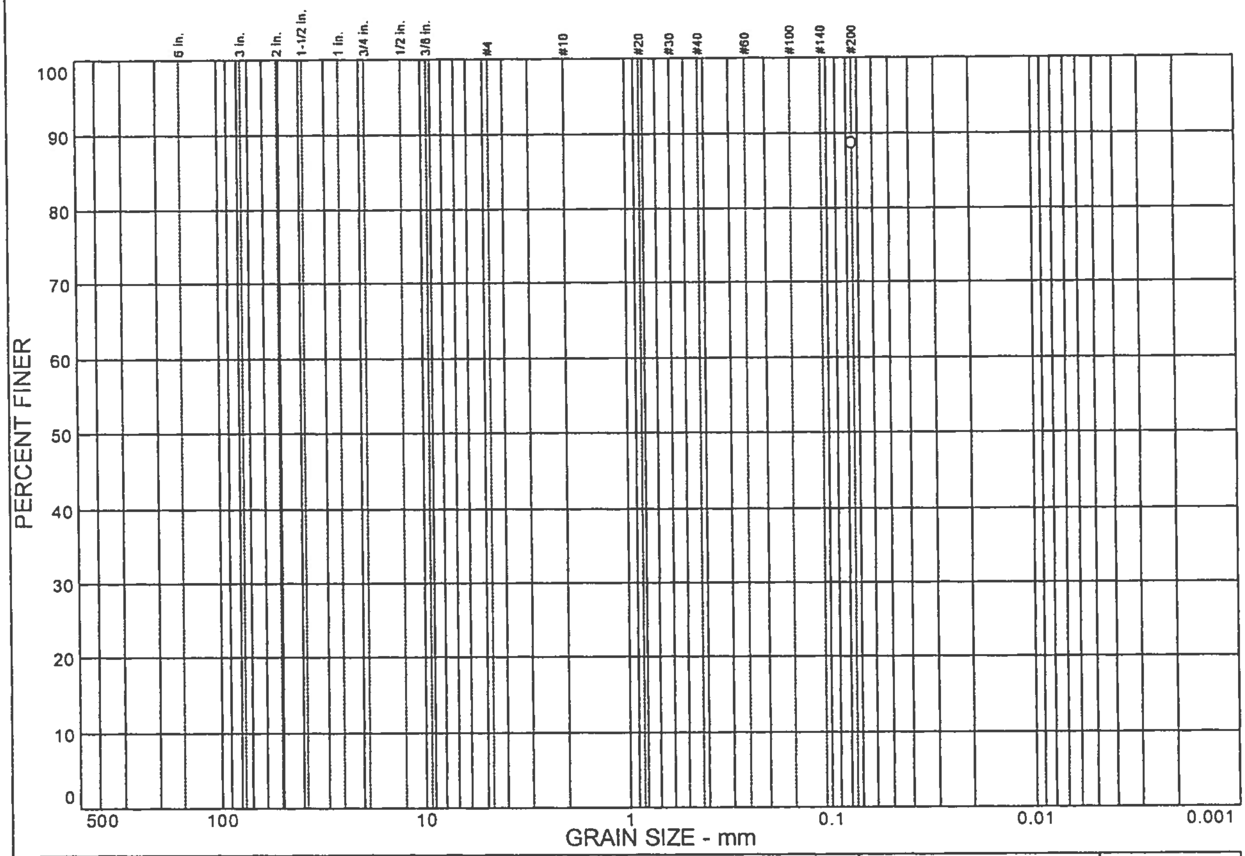
790 DERR STREET

Vallejo, California

Job No.: 7238.2.001.01
Sample Number: B1@3.5
Date: 5/8/2006

Figure No.

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
			88.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	88.6		

* (no specification provided)

Soil Description

Very dark gray silty Clay with sand and weath. claystone fragments

Atterberg Limits

PL= 18	LL= 37	PI= 19

Coefficients

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

Classification

USCS= CL
AASHTO=

Remarks

Sample No.: B3@11
Location:
Source of Sample:
Date: 5-8-09
Elev./Depth: 11 ft.

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: General Mills, 790 Derr Street
Project No: 7238.2.001.01
Plate

COMPACTION TEST REPORT

Curve No.: TP-7

Project No.: 7599.200.201

Date:

Project: General Mills, Vallejo CA

Location:

Elev./Depth:

Sample No. TP-7

Remarks: Source: Site material

MATERIAL DESCRIPTION

Description: Dark yellowish brown weathered silty CLAYSTONE

Classifications - **USCS:** **AASHTO:**

Nat. Moist. =

Sp.G. =

Liquid Limit =

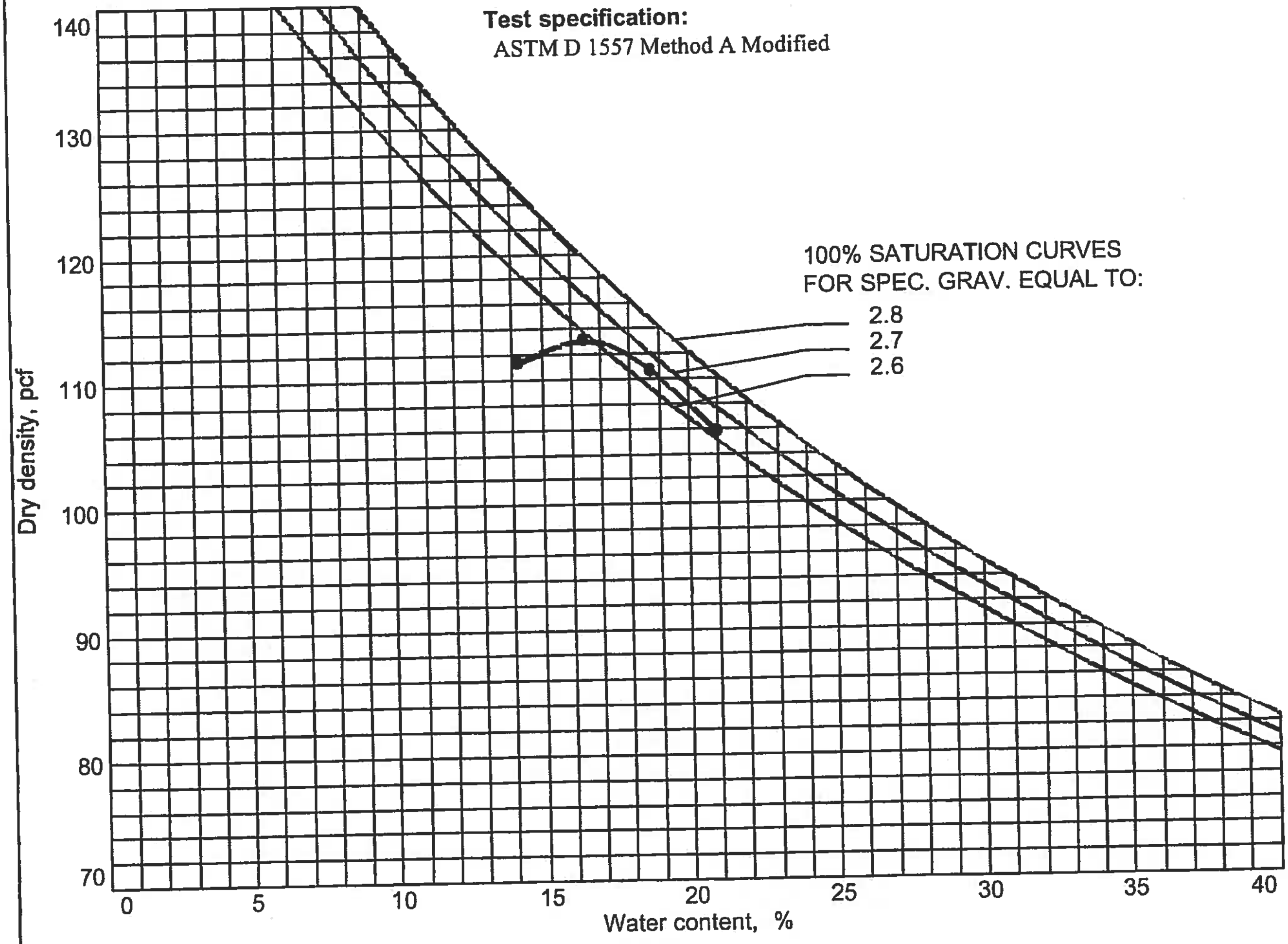
Plasticity Index =

% > No.4 = %

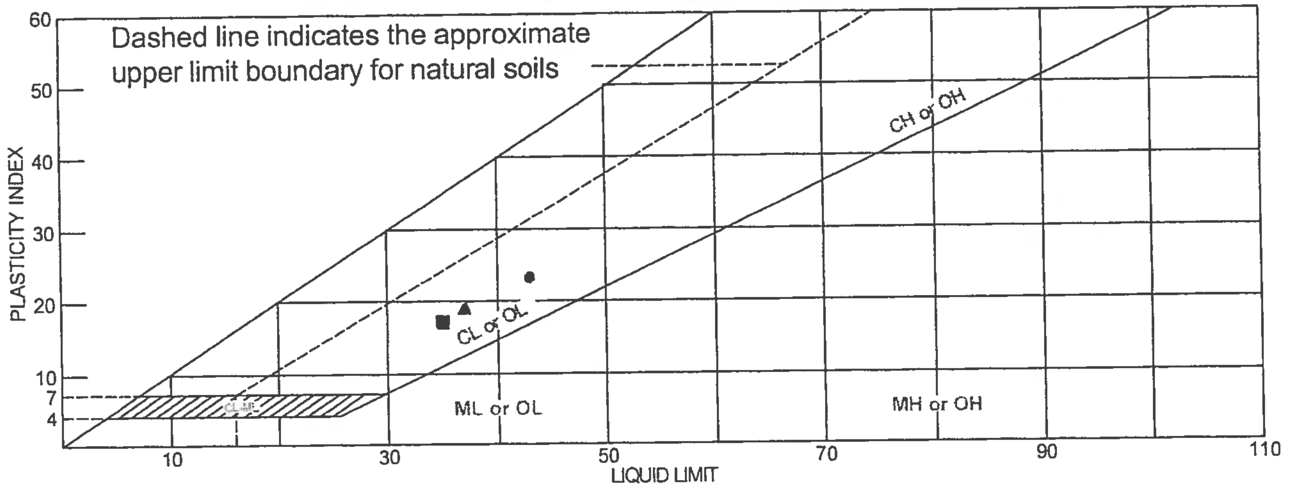
% < No.200 =

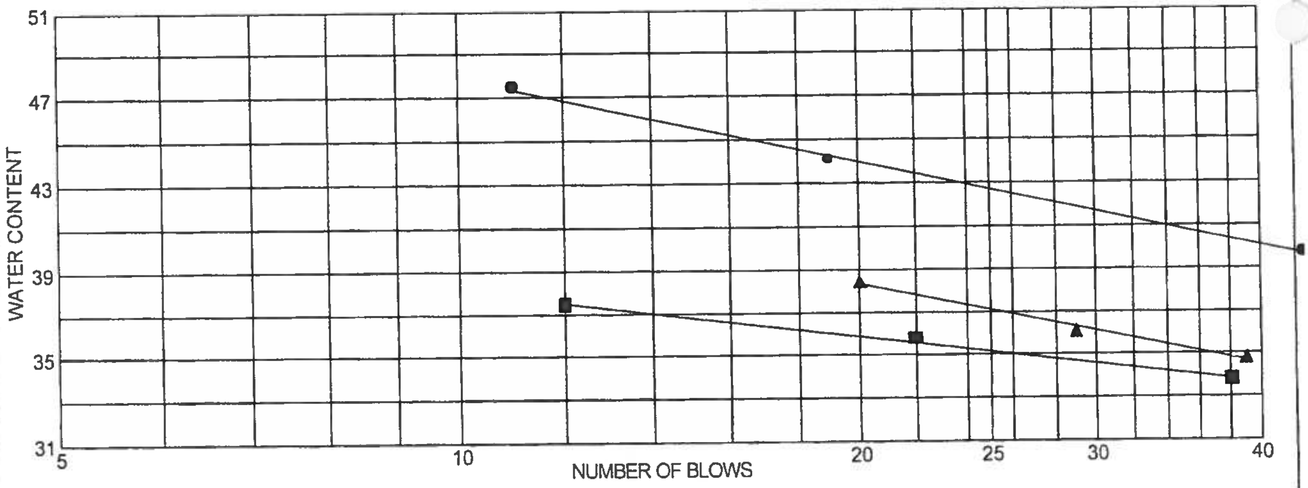
TEST RESULTS
Maximum dry density = 113.1 pcf
Optimum moisture = 16.5 %

Test specification:
ASTM D 1557 Method A Modified



LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark olive gray silty Clay with claystone fragments	43	20	23			CL
■	Very dark olive gray and olive brown silty Clay claystone fragments	35	18	17			CL
▲	Very dark gray silty Clay with sand and claystone fragments	37	18	19		88.6	CL

Project No. 7238.2.001.01 **Client:**

Project: General Mills, 790 Derr Street

● **Source:** **Sample No.:** B1@3.5

■ **Source:** **Sample No.:** B2@4

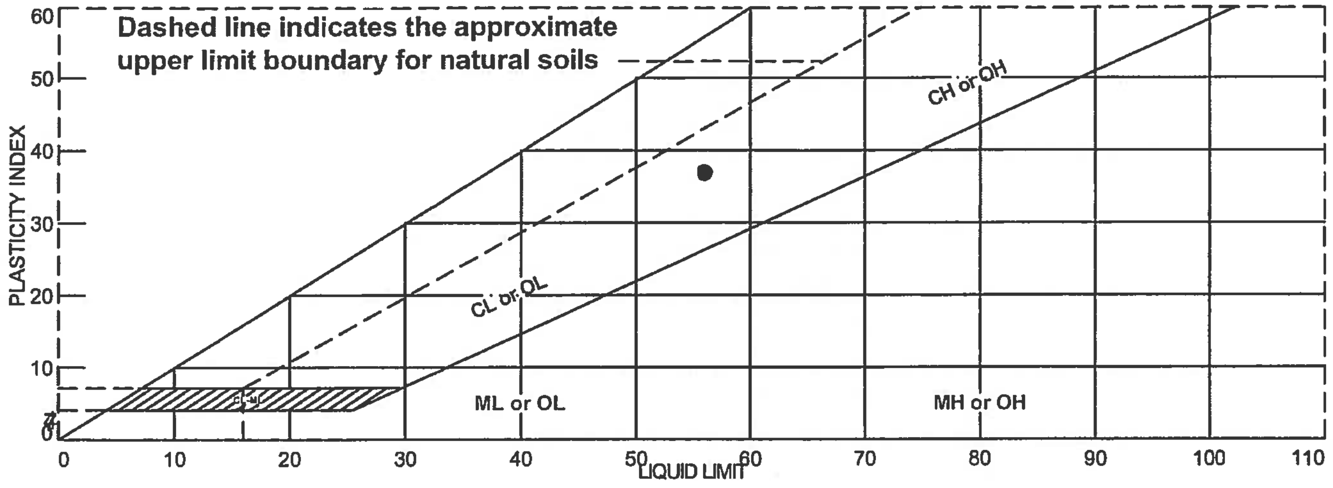
▲ **Source:** **Sample No.:** B3@11

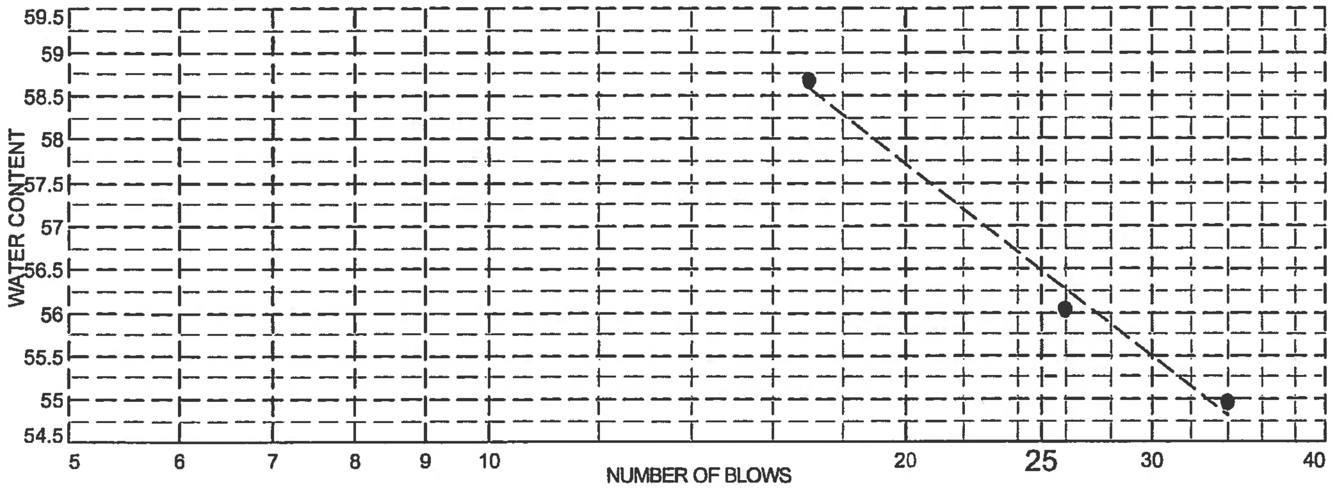
ENGEO
INCORPORATED
GEOTECHNICAL AND
ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Remarks:
- ● B1@3.5'
- ■ B2@4'
- ▲ B3@11'

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark brown CLAY	56	19	37			CH

Project No. 7599.200.201 **Client:**

Project: General Mills, Vallejo CA

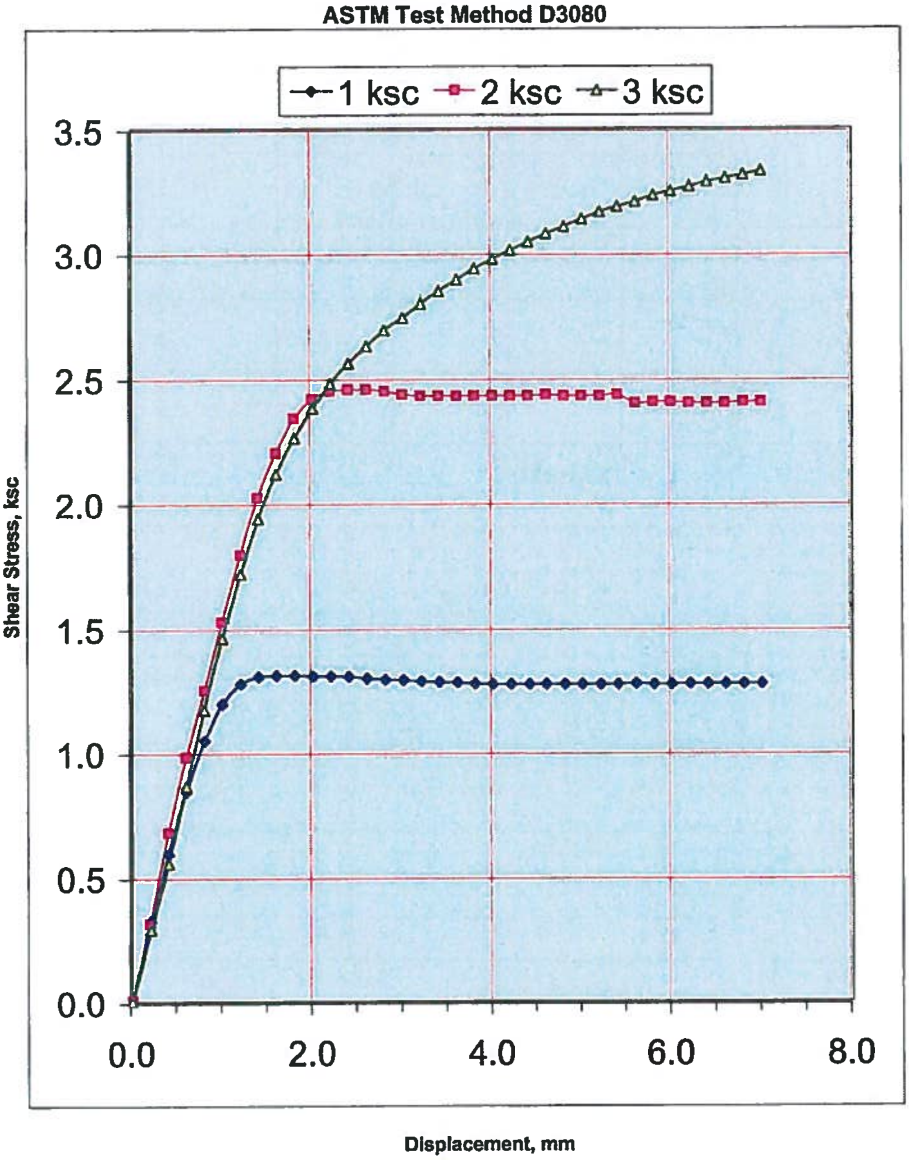
● **Sample Number:** TP-8

Remarks:

● TP-8

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Direct Shear Test
ASTM Test Method D3080



6 LOAD, (ksc)	PEAK	SOFTENED
1	1.31 ksc	1.27 ksc
2	2.45 ksc	2.40 ksc
3	3.33 ksc	3.25 ksc

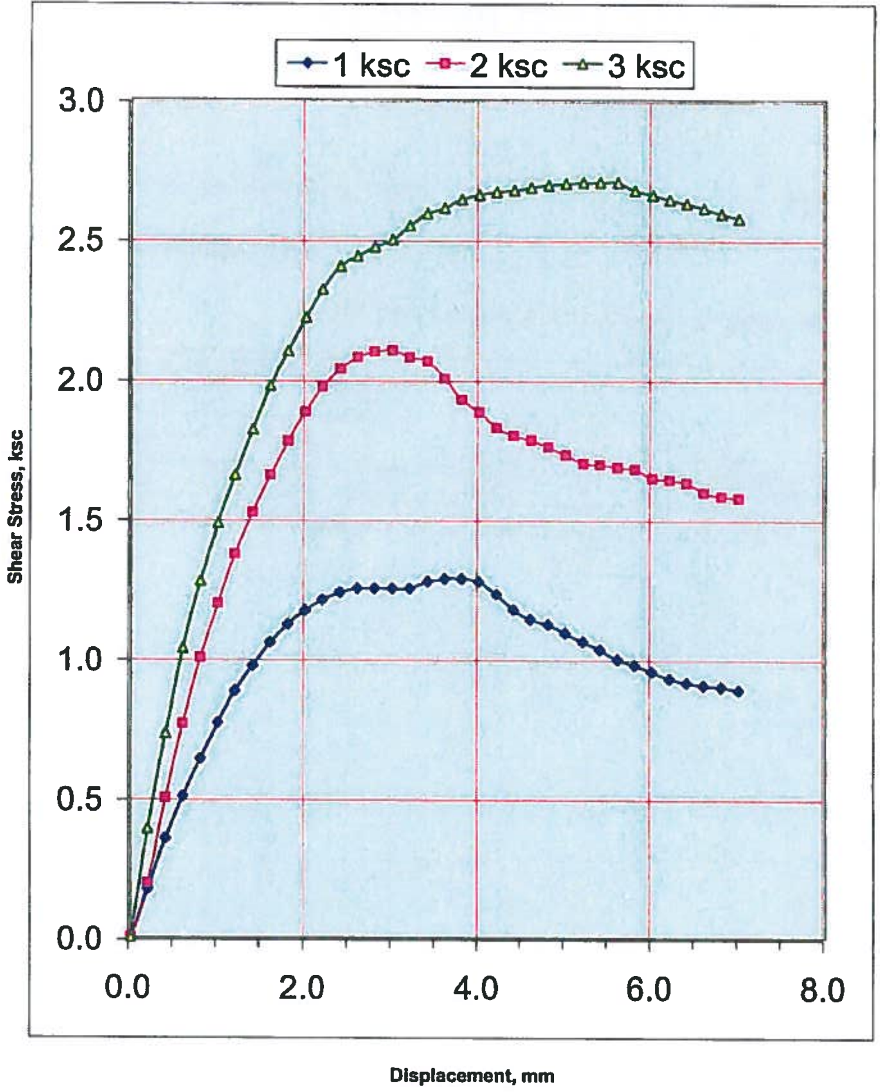
Dry Density:	100.3 pcf
Moisture Content:	20 %
USCS Classification:	CL
Shear Type:	CD
Shear Rate:	Slow

ENGEO
INCORPORATED

GENERAL MILLS
Vallejo, California

Job No.:	7599.200.201
Sample Number:	TP-7
Date:	4/16/2008

Direct Shear Test
ASTM Test Method D3080



6

LOAD, (ksc)	PEAK	SOFTENED
1	1.28 ksc	0.95 ksc
2	2.10 ksc	1.68 ksc
3	2.71 ksc	2.68 ksc

Dry Density:	115.4 pcf
Moisture Content:	15.1 %
USCS Classification:	CL
Shear Type:	CD
Shear Rate:	Slow

ENGEO
INCORPORATED

GENERAL MILLS
Vallejo, California

Job No.:	7238.2.001.01
Sample Number:	B4@11
Date:	5/5/2006

***EN*GEO Incorporated**

SULFATE TEST RESULTS

CALTRANS Test Method 417

Project Name: General Mills

Project Number: 7599.200.201

Tested By: DS

Date: April 10, 2008

Measurements less than 15 mg/kg are reported as Not Detectable (ND)

Sample Number	Sample Location	Matrix	Water Soluble Sulfate (SO_4) in Soil	
			mg/kg	% by Weight
1	TP-7	Soil	109	0.011
2	TP-2@7	Soil	420	0.042

APPENDIX C

ENGEO Incorporated

Boring Logs and Laboratory Results
From
Geotechnical Feasibility Exploration Report
August 31, 2006

7599.200.201
June 27, 2008

ENGEO INCORPORATED

LOG OF BORING B1

GENERAL MILLS
790 DERR STREET
VALLEJO, CALIFORNIA
7238.2.001.01

DATE DRILLED: 4/21/06
HOLE DEPTH (FT): 20.5 ft.
HOLE DIAMETER: 8 in.
SURF ELEV (FT-MSL): 10 ft.

LOGGED / REVIEWED BY: L.CHAN/ T. BAYHAM
DRILLING CONTRACTOR: BRITTON EXPLRATION
DRILLING METHOD: HSA
HAMMER TYPE: Autotrip

Depth in Feet	Depth in Meters	DESCRIPTION	Water Level	Blow Count / Foot	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
0	0	ASPHALT 4" of Asphalt Conrete					
		AGGREGATE 12" of Aggregate Base					
	1	SILTY CLAY (CL), olive gray, very stiff, moist, trace fine subrounded gravel with friable claystone fragments (FILL).	▼	22	19.2	105.7	2.1
5	2	With fine subangular gravel, trace coarse subangular gravel, becomes wet.		18			
10	3	CLAYEY GRAVEL (GW), olive brown, wet, soft, with subangular claystone fragments (FILL).		4	21.3	99.1	
	4	Stiffer Drilling.					
15	5	CLAYSTONE, yellow brown, deeply weathered, friable, crushed		86	17.2	113.8	2.4
20	6			50			

Bottom of boring at 21 feet.
Water encountered at 5 feet at the time of drilling.

ENGEO
INCORPORATED

LOG OF BORING B2

GENERAL MILLS
790 DERR STREET
VALLEJO, CALIFORNIA
7238.2.001.01

DATE DRILLED: 4/21/06
HOLE DEPTH (FT): 25.5 ft.
HOLE DIAMETER: 8 in.
SURF ELEV (FT-MSL): 9 ft.

LOGGED / REVIEWED BY: L.CHAN/T. BAYHAM
DRILLING CONTRACTOR: BRITTON EXPLRATION
DRILLING METHOD: HSA
HAMMER TYPE: Autotrip

Depth In Feet	Depth In Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count / Foot	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
0	0								
	1		SILTY CLAY (CL), olive brown, medium stiff, wet, with friable clay fragments (FILL).		▼	8	14.0		
5	2		Rock fragments becomes moderately strong.			7			
10	3		SANDY CLAY (CL), light gray, loose, wet, fine grained sand, with angular claystone fragments.			9			
15	4 5		SILTY CLAY (CH), olive gray, medium stiff, wet, trace fine sand, trace roots (FILL).			12	25.8		
20	6		CLAY (CH), dark olive grey, soft, wet.			50/5"			
	7		CLAYSTONE, dark gray, friable, moderately weathered.						
25			Becomes closely fractured.			50/1"			
	8		Bottom of boring at 25.5 feet. Water encountered at 5 feet at the time of drilling.						
30	9								

ENGEO
INCORPORATED

LOG OF BORING B3

GENERAL MILLS
790 DERR STREET
VALLEJO, CALIFORNIA
7238.2.001.01

DATE DRILLED: 4/21/06
HOLE DEPTH (FT): 11.5 ft.
HOLE DIAMETER: 8 in.
SURF ELEV (FT-MSL): 9 ft.

LOGGED / REVIEWED BY: L.CHAN/T. BAYHAM
DRILLING CONTRACTOR: BRITTON EXPLRATION
DRILLING METHOD: HSA
HAMMER TYPE: Autotrip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count / Foot	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
0	0			▨					
	1			▨	▼				
5				▨					
	2			▨					
10	3	◣	SILTY CLAY (CL), light gray, soft, wet, trace coarse sand, trace fine subrounded gravel	▨		4	22.1		
			Bottom of boring at 11.5 feet Water encountered at 5 feet at the time of drilling.						
	4								
15									
	5								
20	6								
	7								
25									
	8								
	9								
30									

ENGEO
INCORPORATED

LOG OF BORING B4

GENERAL MILLS
790 DERR STREET
VALLEJO, CALIFORNIA
7238.2.001.01

DATE DRILLED: 4/21/06
HOLE DEPTH (FT): 14.5 ft.
HOLE DIAMETER: 8 in.
SURF ELEV (FT-MSL): 11.5 ft.

LOGGED / REVIEWED BY: L.CHAN/T. BAYHAM
DRILLING CONTRACTOR: BRITTON EXPLRATION
DRILLING METHOD: HSA
HAMMER TYPE: Autotrip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count / Foot	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
0	0		ASPHALT 4" of Asphalt Conrete						
			AGGREGATE 12" of Aggregate Base						
	1		SILTY CLAY (CL), olive brown, medium stuff, moist, with friable claystone fragments (FILL).			10	20.8	98	
5					▼				
	2					6			
10	3					45			
			CLAYSTONE, dark gray, friable, moderately strong, very closely fractured.						
	4								
			Becomes deeply weathered.			50/4"	15.5	115.4	
15			Bottom of boring at 14.5 feet. Water encountered at 6 feet at the time of drilling.						
	5								
20	6								
	7								
25	8								
	9								
30									

APPENDIX D

Guide Contract Specifications

7599.200.201
June 27, 2008

GUIDE CONTRACT SPECIFICATIONS

PART I - EARTHWORK

PREFACE

These specifications are intended as a guide for the earthwork performed at the subject development project. If there is a conflict between these specifications (including the recommendations of the geotechnical report) and agency or code requirements, it should be brought to the attention of ENGEO and Owner prior to contract bidding.

PART 1 - GENERAL

1.01 WORK COVERED

A. Grading, excavating, filling and backfilling, including trenching and backfilling for utilities as necessary to complete the Project as indicated on the Drawings.

B. Subsurface drainage as indicated on the Drawings.

1.02 CODES AND STANDARDS

A. Excavating, trenching, filling, backfilling, and grading work shall meet the applicable requirements of the Uniform Building Code and the standards and ordinances of state and local governing authorities.

1.03 SUBSURFACE SOIL CONDITIONS

A. The Owners' Geotechnical Exploration report is available for inspection by bidder or Contractor. The Contractor shall refer to the findings and recommendations of the Geotechnical Exploration report in planning and executing his work.

1.04 DEFINITIONS

A. Fill: All soil, rock, or soil-rock materials placed to raise the grades of the site or to backfill excavations.

B. Backfill: All soil, rock or soil-rock material used to fill excavations and trenches.

C. On-Site Material: Soil and/or rock material which is obtained from the site.

D. Imported Material: Soil and/or rock material which is brought to the site from off-site areas.

E. Select Material: On-site and/or imported material which is approved by ENGEO as a specific-purpose fill.

F. Engineered Fill: Fill upon which ENGEO has made sufficient observations and tests to confirm that the fill has been placed and compacted in accordance with specifications and requirements.

G. Degree of Compaction or Relative Compaction: The ratio, expressed as a percentage, of the in-place dry density of the fill and backfill material as compacted in the field to the maximum dry density of the same material as determined by ASTM D-1557 or California 216 compaction test method.

H. Optimum Moisture: Water content, percentage by dry weight, corresponding to the maximum dry density as determined by ASTM D-1557.

I. ENGEO: The project geotechnical engineering consulting firm, its employees or its designated representatives.

J. Drawings: All documents, approved for construction, which describe the Work.

1.05 OBSERVATION AND TESTING

A. All site preparation, cutting and shaping, excavating, filling, and backfilling shall be carried out under the observation of ENGEO, employed and paid for by the Owners. ENGEO will perform appropriate field and laboratory tests to evaluate the suitability of fill material, the proper moisture content for compaction, and the degree of compaction achieved. Any fill that does not meet the specification requirements shall be removed and/or reworked until the requirements are satisfied.

B. Cutting and shaping, excavating, conditioning, filling, and compacting procedures require approval of ENGEO as they are performed. Any work found unsatisfactory or any work disturbed by subsequent operations before approval is granted shall be corrected in an approved manner as recommended by ENGEO.

C. Tests for compaction will be made in accordance with test procedures outlined in ASTM D-1557, as applicable. Field testing of soils or compacted fill shall conform with the applicable requirements of ASTM D-2922.

D. All authorized observation and testing will be paid for by the Owners.

1.06 SITE CONDITIONS

A. Excavating, filling, backfilling, and grading work shall not be performed during unfavorable weather conditions. When the work is interrupted by rain, excavating, filling, backfilling, and grading work shall not be resumed until the site and soil conditions are suitable.

B. Contractor shall take the necessary measures to prevent erosion of freshly filled, backfilled, and graded areas until such time as permanent drainage and erosion control measures have been installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. Contractor shall furnish all materials, tools, equipment, facilities, and services as required for performing the required excavating, filling, backfilling, and grading work, and trenching and backfilling for utilities.

2.02 SOIL MATERIALS

A. Fill

1. Material to be used for engineered fill and backfill shall be free from organic matter and other deleterious substances, and of such quality that it will compact thoroughly without excessive voids when watered and rolled. Excavated on-site material will be considered suitable for engineered fill and backfill if it contains no more than 3 percent organic matter, is free of debris and other deleterious substances and conforms to the requirements specified above. Rocks of maximum dimension in excess of two-thirds of the lift thickness shall be removed from any fill material to the satisfaction of ENGEO.

2. Excavated earth material which is suitable for engineered fill or backfill, as determined by ENGEO, shall be conditioned for reuse and properly stockpiled as required for later filling and backfilling operations. Conditioning shall consist of spreading material in layers not to exceed 8 inches and raking free of debris and rubble. Rocks and aggregate exceeding the allowed largest dimension, and deleterious material shall be removed from the site and disposed off site in a legal manner.

3. ENGEO shall be immediately notified if potential hazardous materials or suspect soils exhibiting staining or odor are encountered. Work activities shall be discontinued within the area of potentially hazardous materials. ENGEO environmental personnel will conduct an assessment of the suspect hazardous material to determine the appropriate response and mitigation. Regulatory

agencies may also be contacted to request concurrence and oversight. *ENGEO will rely on the Owner, or a designated Owner's representative, to make necessary notices to the appropriate regulatory agencies. The Owner may request ENGEO's assistance in notifying regulatory agencies, provided ENGEO receives Owner's written authorization to expand its scope of services.*

4. ENGEO shall be notified at least 48 hours prior to the start of filling and backfilling operations so that it may evaluate samples of the material intended for use as fill and backfill. All materials to be used for filling and backfilling require the approval of ENGEO.

B. Import Material: Where conditions require the importation of fill material, the material shall be an inert, nonexpansive soil or soil-rock material free of organic matter and meeting the following requirements unless otherwise approved by ENGEO.

Gradation (ASTM D-421):	Sieve Size	Percent Passing
	2-inch	100
	#200	15 - 70
Plasticity (ASTM D-4318):	Liquid Limit	Plasticity Index
	< 30	< 12
Swell Potential (ASTM D-4546B): (at optimum moisture)	Percent Heave	Swell Pressure
	< 2 percent	< 300 psf
Resistance Value (ASTM D-2844):	Minimum 25	
Organic Content (ASTM D-2974):	Less than 2 percent	

A sample of the proposed import material should be submitted to ENGEO for evaluation prior to delivery at the site.

2.03 SAND

A. Sand for sand cushion under slabs and for bedding of pipe in utility trenches shall be a clean and graded, washed sand, free from clay or organic material, suitable for the intended purpose with 90 to 100 percent passing a No. 4 U.S. Standard Sieve, not more than 5 percent passing a No. 200 U.S. Standard Sieve, and generally conforming to ASTM C33 for fine aggregate.

2.04 AGGREGATE DRAINAGE FILL

A. Aggregate drainage fill under concrete slabs and paving shall consist of broken stone, crushed or uncrushed gravel, clean quarry waste, or a combination thereof. The aggregate shall be free from fines, vegetable matter, loam, volcanic tuff, and other deleterious substances. It shall be of such quality that the absorption of water in a saturated surface dry condition does not exceed 3 percent of the oven dry weight of the samples.

B. Aggregate drainage fill shall be of such size that the percentage composition by dry weight as determined by laboratory sieves (U. S. Series) will conform to the following grading:

Sieve Size	Percentage Passing Sieve
1½-inches	100
1-inch	90 - 100
#4	0 - 5

2.05 SUBDRAINS

A. Perforated subdrain pipe of the required diameter shall be installed as shown on the drawings. The pipe(s) shall also conform to these specifications unless otherwise specified by ENGEO in the field.

Subdrain pipe shall be manufactured in accordance with one of the following requirements:

Design depths less than 30 feet

- Perforated ABS Solid Wall SDR 35 (ASTM D-2751)
- Perforated PVC Solid Wall SDR 35 (ASTM D-3034)
- Perforated PVC A-2000 (ASTM F949)
- Perforated Corrugated HDPE double-wall (AASHTO M-252 or M-294, Caltrans Type S, 50 psi minimum stiffness)

Design depths less than 50 feet

- Perforated PVC SDR 23.5 Solid Wall (ASTM D-3034)
- Perforated Sch. 40 PVC Solid Wall (ASTM-1785)
- Perforated ABS SDR 23.5 Solid Wall (ASTM D-2751)
- Perforated ABS DWV/Sch. 40 (ASTM D-2661 and D-1527)
- Perforated Corrugated HDPE double-wall (AASHTO M-252 or M-294, Caltrans Type S, 70 psi minimum stiffness)

Design depths less than 70 feet

- Perforated ABS Solid Wall SDR 15.3 (ASTM D-2751)
- Perforated Sch. 80 PVC (ASTM D-1785)
- Perforated Corrugated Aluminum (ASTM B-745)

B. Permeable Material (Class 2): Class 2 permeable material for filling trenches under, around, and over subdrains, behind building and retaining walls, and for pervious blankets shall consist of clean, coarse sand and gravel or crushed stone, conforming to the following grading requirements:

Sieve Size	Percentage Passing Sieve
1-inch	100
¾-inch	90 - 100
3/8-inch	40 - 100
#4	25 - 40
#8	18 - 33
#30	5 - 15
#50	0 - 7
#200	0 - 3

C. 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^2
Puncture Strength (ASTM D-4833)	80 lbs

D. Vapor Retarder: Vapor Retarders shall consist of PVC, LDPE or HDPE impermeable sheeting at least 10 mils thick..

2.06 PERMEABLE MATERIAL (Class 1; Type A)

A. Class 1 permeable material to be used in conjunction with filter fabric for backfilling of subdrain excavations shall conform to the following grading requirements:

Sieve Size	Percentage Passing Sieve
¾-inch	100
½-inch	95 - 100
3/8-inch	70 - 100
#4	0 - 55

#8	0 - 10
#200	0 - 3

PART 3 - EXECUTION

3.01 STAKING AND GRADES

A. Contractor shall lay out all his work, establish all necessary markers, bench marks, grading stakes, and other stakes as required to achieve design grades.

3.02 EXISTING UTILITIES

A. Contractor shall verify the location and depth (elevation) of all existing utilities and services before performing any excavation work.

3.03 EXCAVATION

A. Contractor shall perform excavating as indicated and required for concrete footings, drilled piers, foundations, floor slabs, concrete walks, and site leveling and grading, and provide shoring, bracing, underpinning, cribbing, pumping, and planking as required. The bottoms of excavations shall be firm undisturbed earth, clean and free from loose material, debris, and foreign matter.

B. Excavations shall be kept free from water at all times. Adequate dewatering equipment shall be maintained at the site to handle emergency situations until concrete or backfill is placed.

C. Unauthorized excavations for footings shall be filled with concrete to required elevations, unless other methods of filling are authorized by ENGEO.

D. Excavated earth material which is suitable for engineered fill or backfill, as determined by ENGEO, shall be conditioned for reuse and properly stockpiled for later filling and backfilling operations as specified under Section 2.02, "Soil Materials."

E. Abandoned sewers, piping, and other utilities encountered during excavating shall be removed and the resulting excavations shall be backfilled with engineered fill as required by ENGEO.

F. Any active utility lines encountered shall be reported immediately to the Owner's Representative and authorities involved. The Owner and proper authorities shall be permitted free access to take the measures deemed necessary to repair, relocate, or remove the obstruction as determined by the responsible authority or Owner's Representative.

3.04 SUBGRADE PREPARATION

A. All brush and other rubbish, as well as trees and root systems not marked for saving, shall be removed from the site and legally disposed of.

B. Any existing structures, foundations, underground storage tanks, or debris must be removed from the site prior to any building, grading, or fill operations. Septic tanks, including all drain fields and other lines, if encountered, must be totally removed. The resulting depressions shall be properly prepared and filled to the satisfaction of ENGEO.

C. Vegetation and organic topsoil shall be removed from the surface upon which the fill is to be placed and either removed and legally disposed of or stockpiled for later use in approved landscape areas. The surface shall then be scarified to a depth of at least eight inches until the surface is free from ruts, hummocks, or other uneven features which would tend to prevent uniform compaction by the equipment to be used.

D. After the foundation for the fill has been cleared and scarified, it shall be made uniform and free from large clods. The proper moisture content must be obtained by adding water or aerating. The foundation for the fill shall be compacted at the proper moisture content to a relative compaction as specified herein.

3.05 ENGINEERED FILL

A. Select Material: Fill material shall be "Select" or "Imported Material" as previously specified.

B. Placing and Compacting: Engineered fill shall be constructed by approved and accepted methods. Fill material shall be spread in uniform lifts not exceeding 8 inches in uncompacted thickness. Each layer shall be spread evenly, and thoroughly blade-mixed to obtain uniformity of material. Fill material which does not contain sufficient moisture as specified by ENGEO shall be sprinkled with water; if it contains excess moisture it shall be aerated or blended with drier material to achieve the proper water content. Select material and water shall then be thoroughly mixed before being compacted.

C. Unless otherwise specified in the Geotechnical Exploration report, each layer of spread select material shall be compacted to at least 90 percent relative compaction at a moisture content of at least three percent above the optimum moisture content. Minimum compaction in all keyways shall be a minimum of 95 percent with a minimum moisture content of at least 1 percentage point above optimum.

D. Unless otherwise specified in the Geotechnical Exploration report or otherwise required by the local authorities, the upper 6 inches of engineered fill in areas to receive pavement shall be compacted to at least 95 percent relative compaction with a minimum moisture content of at least 3 percentage points above optimum.

E. Testing and Observation of Fill: The work shall consist of field observation and testing to determine that each layer has been compacted to the required density and that the required moisture is being obtained. Any layer or portion of a layer that does not attain the compaction required shall be reworked until the required density is obtained.

F. Compaction: Compaction shall be by sheepsfoot rollers, multiple-wheel steel or pneumatic-tired rollers or other types of acceptable compaction equipment. Rollers shall be of such design that they will be able to compact the fill to the specified compaction. Rolling shall be accomplished while the fill material is within the specified moisture content range. Rolling of each layer must be continuous so that the required compaction may be obtained uniformly throughout each layer.

G. Fill slopes shall be constructed by overfilling the design slopes and later cutting back the slopes to the design grades. No loose soil will be permitted on the faces of the finished slopes.

H. Strippings and topsoil shall be stockpiled as approved by Owner, then placed in accordance with ENGEO's recommendations to a minimum thickness of 6 inches and a maximum thickness of 12 inches over exposed open space cut slopes which are 3:1 or flatter, and track walked to the satisfaction of ENGEO.

I. Final Prepared Subgrade: Finish blading and smoothing shall be performed as necessary to produce the required density, with a uniform surface, smooth and true to grade.

3.06 BACKFILLING

A. Backfill shall not be placed against footings, building walls, or other structures until approved by ENGEO.

B. Backfill material shall be Select Material as specified for engineered fill.

C. Backfill shall be placed in 6-inch layers, leveled, rammed, and tamped in place. Each layer shall be compacted with suitable compaction equipment to 90 percent relative compaction at a moisture content of at least 3 percent above optimum.

3.07 TRENCHING AND BACKFILLING FOR UTILITIES

A. Trenching:

1. Trenching shall include the removal of material and obstructions, the installation and removal of sheeting and bracing and the control of water as necessary to provide the required utilities and services.

2. Trenches shall be excavated to the lines, grades, and dimensions indicated on the Drawings. Maximum allowable trench width shall be the outside diameter of the pipe plus 24 inches, inclusive of any trench bracing.

3. When the trench bottom is a soft or unstable material as determined by ENGEO, it shall be made firm and solid by removing said unstable material to a sufficient depth and replacing it with on-site material compacted to 90 percent minimum relative compaction.

4. Where water is encountered in the trench, the contractor must provide materials necessary to drain the water and stabilize the bed.

B. Backfilling:

1. Trenches must be backfilled within 2 days of excavation to minimize desiccation.

2. Bedding material shall be sand and shall not extend more than 6 inches above any utility lines.

3. Backfill material shall be select material.

4. Trenches shall be backfilled as indicated or required and compacted with suitable equipment to 90 percent minimum relative compaction at the required moisture content.

3.08 SUBDRAINS

A. Trenches for subdrain pipe shall be excavated to a minimum width equal to the outside diameter of the pipe plus at least 12 inches and to a depth of approximately 2 inches below the grade established for the invert of the pipe, or as indicated on the Drawings.

B. The space below the pipe invert shall be filled with a layer of Class 2 permeable material, upon which the pipe shall be laid with perforations down. Sections shall be joined as recommended by the pipe manufacturer.

C. Rocks, bricks, broken concrete, or other hard material shall not be used to give intermediate support to pipes. Large stones or other hard objects shall not be left in contact with the pipes.

D. Excavations for subdrains shall be filled as required to fill voids and prevent settlement without damaging the subdrain pipe. Alternatively, excavations for subdrains may be filled with Class 1 permeable material (as defined in Section 2.06) wrapped in Filter Fabric (as defined in Section 2.05).

3.09 AGGREGATE DRAINAGE FILL

A. ENGEO shall approve finished subgrades before aggregate drainage fill is installed.

B. Pipes, drains, conduits, and any other mechanical or electrical installations shall be in place before any aggregate drainage fill is placed. Backfill at walls to elevation of drainage fill shall be in place and compacted.

C. Aggregate drainage fill under slabs and concrete paving shall be the minimum uniform thickness after compaction of dimensions indicated on Drawings. Where not indicated, minimum thickness after compaction shall be 4 inches.

D. Aggregate drainage fill shall be rolled to form a well-compacted bed.

E. The finished aggregate drainage fill must be observed and approved by ENGEO before proceeding with any subsequent construction over the compacted base or fill.

3.10 SAND CUSHION

A. A sand cushion shall be placed over the vapor retarder membrane under concrete slabs on grade. Sand cushion shall be placed in uniform thickness as indicated on the Drawings. Where not indicated, the thickness shall be 2 inches.

3.11 FINISH GRADING

A. All areas must be finish graded to elevations and grades indicated on the Drawings. In areas to receive topsoil and landscape planting, finish grading shall be performed to a uniform 6 inches below the grades and elevations indicated on the Drawings, and brought to final grade with topsoil.

3.12 DISPOSAL OF WASTE MATERIALS

A. Excess earth materials and debris shall be removed from the site and disposed of in a legal manner. Location of dump site and length of haul are the Contractor's responsibility.

PART II - GEOGRID SOIL REINFORCEMENT

1. DESCRIPTION:

Work shall consist of furnishing geogrid soil reinforcement for use in construction of reinforced soil slopes and retention systems.

2. GEOGRID MATERIAL:

2.1 The specific geogrid material shall be preapproved by ENGEO.

2.2 The geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil or rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under construction stresses and shall have high resistance to damage during construction, to ultraviolet degradation, and to all forms of chemical and biological degradation encountered in the soil being reinforced.

2.3 The geogrids shall have an Allowable Strength (T_a) and Pullout Resistance, for the soil type(s) indicated, as listed in Table I.

2.4 Certifications: The Contractor shall submit a manufacturer's certification that the geogrids supplied meet the respective index criteria set when geogrid was approved by ENGEO, measured in full accordance with all test methods and standards specified. In case of dispute over validity of values, the Contractor will supply test data from an ENGEO-approved laboratory to support the certified values submitted.

3. CONSTRUCTION:

3.1 Delivery, Storage, and Handling: Contractor shall check the geogrid upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the geogrid shall be protected from temperatures greater than 140 °F, mud, dirt, dust, and debris. Manufacturer's recommendations in regard to protection from direct sunlight must also be followed. At the time of installation, the geogrid will be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be repaired by placing a patch over the damaged area. Any geogrid damaged during storage or installation shall be replaced by the Contractor at no additional cost to the owner.

3.2 On-Site Representative: Geogrid material suppliers shall provide a qualified and experienced representative on site at the initiation of the project, for a minimum of three days, to assist the Contractor and ENGEO personnel at the start of construction. If there is more than one slope on a project, this criterion will apply to construction of the initial slope only. The representative shall also be available on an as-needed basis, as requested by ENGEO, during construction of the remaining slope(s).

3.3 Geogrid reinforcement may be joined with mechanical connections or overlaps as recommended and approved by the Manufacturer. Joints shall not be placed within 6 feet of the slope face, within 4 feet below top of slope, nor horizontally or vertically adjacent to another joint.

3.4 Geogrid Placement: The geogrid reinforcement shall be installed in accordance with the manufacturer's recommendations. The geogrid reinforcement shall be placed within the layers of the compacted soil as shown on the plans or as directed.

The geogrid reinforcement shall be placed in continuous longitudinal strips in the direction of main reinforcement. However, if the Contractor is unable to complete a required length with a single continuous length of geogrid, a joint may be made with the Manufacturer's approval. Only one joint per length of geogrid shall be allowed. This joint shall be made for the full width of the strip by using a similar material with similar strength. Joints in geogrid reinforcement shall be pulled and held taut during fill placement.

Adjacent strips, in the case of 100 percent coverage in plan view, need not be overlapped. The minimum horizontal coverage is 50 percent, with horizontal spacings between reinforcement no greater than 40 inches. Horizontal coverage of less than 100 percent shall not be allowed unless specifically detailed in the construction drawings.

Adjacent rolls of geogrid reinforcement shall be overlapped or mechanically connected where exposed in a wrap around face system, as applicable.

The Contractor may place only that amount of geogrid reinforcement required for immediately pending work to prevent undue damage. After a layer of geogrid reinforcement has been placed, the next succeeding layer of soil shall be placed and compacted as appropriate. After the specified soil layer has been placed, the next geogrid reinforcement layer shall be installed. The process shall be repeated for each subsequent layer of geogrid reinforcement and soil.

Geogrid reinforcement shall be placed to lay flat and pulled tight prior to backfilling. After a layer of geogrid reinforcement has been placed, suitable means, such as pins or small piles of soil, shall be used to hold the geogrid reinforcement in position until the subsequent soil layer can be placed.

Under no circumstances shall a track-type vehicle be allowed on the geogrid reinforcement before at least six inches of soil have been placed. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and the geogrid reinforcement. If approved by the Manufacturer, rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds, less than 10 mph. Sudden braking and sharp turning shall be avoided.

During construction, the surface of the fill should be kept approximately horizontal. Geogrid reinforcement shall be placed directly on the compacted horizontal fill surface. Geogrid reinforcements are to be placed within three inches of the design elevations and extend the length as shown on the elevation view unless otherwise directed by ENGEO. Correct orientation of the geogrid reinforcement shall be verified by ENGEO.

Table I
Allowable Geogrid Strength
With Various Soil Types
For Geosynthetic Reinforcement In
Mechanically Stabilized Earth Slopes

(Geogrid Pullout Resistance and Allowable Strengths vary with reinforced backfill used due to soil anchorage and site damage factors. Guidelines are provided below.)

SOIL TYPE	MINIMUM ALLOWABLE STRENGTH, T_a (lb/ft)*		
	GEOGRID Type I	GEOGRID Type II	GEOGRID Type III
A. Gravels, sandy gravels, and gravel-sand-silt mixtures (GW, GP, GC, GM & SP)**	2400	4800	7200
B. Well graded sands, gravelly sands, and sand-silt mixtures (SW & SM)**	2000	4000	6000
C. Silts, very fine sands, clayey sands and clayey silts (SC & ML)**	1000	2000	3000
D. Gravelly clays, sandy clays, silty clays, and lean clays (CL)**	1600	3200	4800

* All partial Factors of Safety for reduction of design strength are included in listed values. Additional factors of safety may be required to further reduce these design strengths based on site conditions.

** Unified Soil Classifications.

PART III - GEOTEXTILE SOIL REINFORCEMENT

1. DESCRIPTION:

Work shall consist of furnishing geotextile soil reinforcement for use in construction of reinforced soil slopes.

2. GEOTEXTILE MATERIAL:

2.1 The specific geotextile material and supplier shall be preapproved by ENGEO.

2.2 The geotextile shall have a high tensile modulus and shall have high resistance to damage during construction, to ultraviolet degradation, and to all forms of chemical and biological degradation encountered in the soil being reinforced.

2.3 The geotextiles shall have an Allowable Strength (T_a) and Pullout Resistance, for the soil type(s) indicated as listed in Table II.

2.4 Certification: The Contractor shall submit a manufacturer's certification that the geotextiles supplied meet the respective index criteria set when geotextile was approved by ENGEO, measured in full accordance with all test methods and standards specified. In case of dispute over validity of values, the Contractor will supply the data from an ENGEO-approved laboratory to support the certified values submitted.

3. CONSTRUCTION:

3.1 Delivery, Storage and Handling: Contractor shall check the geotextile upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the geotextile shall be protected from temperatures greater than 140 °F, mud, dirt, dust, and debris. Manufacturer's recommendations in regard to protection from direct sunlight must also be followed. At the time of installation, the geotextile will be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be repaired by placing a patch over the damaged area. Any geotextile damaged during storage or installation shall be replaced by the Contractor at no additional cost to the owner.

3.2 On-Site Representative: Geotextile material suppliers shall provide a qualified and experienced representative on site at the initiation of the project, for a minimum of three days, to assist the Contractor and ENGEO personnel at the start of construction. If there is more than one slope on a project, this criterion will apply to construction of the initial slope only. The representative shall also be available on an as-needed basis, as requested by ENGEO, during construction of the remaining slope(s).

3.3 Geotextile Placement: The geotextile reinforcement shall be installed in accordance with the manufacturer's recommendations. The geotextile reinforcement shall be placed within the layers of the compacted soil as shown on the plans or as directed.

The geotextile reinforcement shall be placed in continuous longitudinal strips in the direction of main reinforcement. Joints shall not be used with geotextiles.

Adjacent strips, in the case of 100 percent coverage in plan view, need not be overlapped. The minimum horizontal coverage is 50 percent, with horizontal spacings between reinforcement no greater than 40 inches. Horizontal coverage of less than 100 percent shall not be allowed unless specifically detailed in the construction drawings.

Adjacent rolls of geotextile reinforcement shall be overlapped or mechanically connected where exposed in a wrap around face system, as applicable.

The Contractor may place only that amount of geotextile reinforcement required for immediately pending work to prevent undue damage. After a layer of geotextile reinforcement has been placed, the succeeding layer of soil shall be placed and compacted as appropriate. After the specified soil layer has been placed, the next geotextile reinforcement layer shall be installed. The process shall be repeated for each subsequent layer of geotextile reinforcement and soil.

Geosynthetic reinforcement shall be placed to lay flat and be pulled tight prior to backfilling. After a layer of geotextile reinforcement has been placed, suitable means, such as pins or small piles of soil, shall be used to hold the geotextile reinforcement in position until the subsequent soil layer can be placed.

Under no circumstances shall a track-type vehicle be allowed on the geotextile reinforcement before at least six inches of soil has been placed. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and the geotextile reinforcement. If approved by the Manufacturer, rubber-tired equipment may pass over the geotextile reinforcement as slow speeds, less than 10 mph. Sudden braking and sharp turning shall be avoided.

During construction, the surface of the fill should be kept approximately horizontal. Geotextile reinforcement shall be placed directly on the compacted horizontal fill surface. Geotextile reinforcements are to be placed within three inches of the design elevations and extend the length as shown on the elevation view unless otherwise directed by

ENGEO. Correct orientation of the geotextile reinforcement shall be verified by ENGEO.

Table II
Allowable Geotextile Strength With Various Soil Types For Geosynthetic Reinforcement In Mechanically Stabilized Earth Slopes

(Geotextile Pullout Resistance and Allowable Strengths vary with reinforced backfill used due to soil anchorage and site damage factors. Guidelines are provided below.)

SOIL TYPE	MINIMUM ALLOWABLE STRENGTH, T_a (lb/ft)*		
	GEOTEXTILE Type I	GEOTEXTILE Type II	GEOTEXTILE Type III
A. Gravels, sandy gravels, and gravel-sand-silt mixtures (GW, GP, GC, GM & SP)**	2400	4800	7200
B. Well graded sands, gravelly sands, and sand-silt mixtures (SW & SM)**	2000	4000	6000
C. Silts, very fine sands, clayey sands and clayey silts (SC & ML)**	1000	2000	3000
D. Gravelly clays, sandy clays, silty clays, and lean clays (CL)**	1600	3200	4800

* All partial Factors of Safety for reduction of design strength are included in listed values. Additional factors of safety may be required to further reduce these design strengths based on site conditions.

** Unified Soil Classifications.

PART IV - EROSION CONTROL MAT OR BLANKET

1. DESCRIPTION:

Work shall consist of furnishing and placing a synthetic erosion control mat and/or degradable erosion control blanket for slope face protection and lining of runoff channels.

2. EROSION CONTROL MATERIALS:

2.1 The specific erosion control material and supplier shall be pre-approved by ENGEO.

2.2 Certification: The Contractor shall submit a manufacturer's certification that the erosion mat/blanket supplied meets the criteria specified when the material was approved by ENGEO. The manufacturer's certification shall include a submittal package of documented test results that confirm the property values. In case of a dispute over validity of values, the Contractor will supply property test data from an ENGEO-approved laboratory, to support the certified values submitted. Minimum average roll values, per ASTM D 4759, shall be used for conformance determinations.

3. CONSTRUCTION:

3.1 Delivery, Storage, and Handling: Contractor shall check the erosion control material upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the erosion mat shall be protected from temperatures greater than 140 °F, mud, dirt, and debris. Manufacturer's recommendations in regard to protection from direct sunlight must also be followed. At the time of installation, the erosion mat/blanket shall be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be removed by cutting OUT a section of the mat. The remaining ends should be overlapped and secured with ground anchors. Any erosion mat/blanket damaged during storage or installation shall be replaced by the Contractor at no additional cost to the Owner.

3.2 On-Site Representative: Erosion control material suppliers shall provide a qualified and experienced representative on site, for a minimum of one day, to assist the Contractor and ENGEO personnel at the start of construction. If there is more than one slope on a project, this criteria will apply to construction of the initial slope only. The representative shall be available on an as-needed basis, as requested by ENGEO, during construction of the remaining slope(s).

3.3 Placement: The erosion control material shall be placed and anchored on a smooth graded, firm surface approved by the Engineer. Anchoring terminal ends of the erosion control material shall be accomplished through use of key trenches. The material in the trenches shall be anchored to the soil on maximum 1½ foot centers. Topsoil, if required by construction drawings, placed over final grade prior to installation of the erosion control material shall be limited to a depth not exceeding 3 inches.

3.4 Erosion control material shall be anchored, overlapped, and otherwise constructed to ensure performance until vegetation is well established. Anchors shall be as designated on the construction drawings, with a minimum of 12 inches length, and shall be spaced as designated on the construction drawings, with a maximum spacing of 4 feet.

3.5 Soil Filling: If noted on the construction drawings, the erosion control mat shall be filled with a fine grained topsoil, as recommended by the manufacturer. Soil shall be lightly raked or brushed on/into the mat to fill the mat voids or to a maximum depth of 1 inch.

PART V - GEOSYNTHETIC DRAINAGE COMPOSITE

1. DESCRIPTION:

Work shall consist of furnishing and placing a geosynthetic drainage system as a subsurface drainage medium for reinforced soil slopes.

2. DRAINAGE COMPOSITE MATERIALS:

2.1 The specific drainage composite material and supplier shall be preapproved by ENGEO.

2.2 The drain shall be of composite construction consisting of a supporting structure or drainage core material surrounded by a geotextile. The geotextile shall encapsulate the drainage core and prevent random soil intrusion into the drainage structure. The drainage core material shall consist of a three dimensional polymeric material with a structure that permits flow along the core laterally. The core structure shall also be constructed to permit flow regardless of the water inlet surface. The drainage core shall provide support to the geotextile. The fabric shall meet the minimum property requirements for filter fabric listed in Section 2.05C of the Guide Earthwork Specifications.

2.3 A geotextile flap shall be provided along all drainage core edges. This flap shall be of sufficient width for sealing the geotextile to the adjacent drainage structure edge to prevent soil intrusion into the structure during and after installation. The geotextile shall cover the full length of the core.

2.4 The geocomposite core shall be furnished with an approved method of constructing and connecting with outlet pipes or weepholes as shown on the plans. Any fittings shall allow entry of water from the core but prevent intrusion of backfill material into the core material.

2.5 Certification and Acceptance: The Contractor shall submit a manufacturer's certification that the geosynthetic drainage composite meets the design properties and respective index criteria measured in full accordance with all test methods and standards specified. The manufacturer's certification shall include a submittal package of documented test results that confirm the design values. In case of dispute over validity of design values, the Contractor will supply design property test data from an ENGEO-approved laboratory, to support the certified values submitted. Minimum average roll values, per ASTM D 4759, shall be used for determining conformance.

3. CONSTRUCTION:

3.1 Delivery, Storage, and Handling: Contractor shall check the geosynthetic drainage composite upon delivery to ensure that the proper material has been received. During all periods of shipment and storage, the geosynthetic drainage composite shall be protected from temperatures greater than 140 °F, mud, dirt, and debris. Manufacturer's recommendations in regards to protection from direct sunlight must also be followed. At the time of installation, the geosynthetic drainage composite shall be rejected if it has defects, tears, punctures, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. If approved by ENGEO, torn or punctured sections may be removed or repaired. Any geosynthetic drainage composite damaged during storage or installation shall be replaced by the Contractor at no additional cost to the Owner.

3.2 On-Site Representative: Geosynthetic drainage composite material suppliers shall provide a qualified and experienced representative on site, for a minimum of one half day, to assist the Contractor and ENGEO personnel at the start of construction with directions on the use of drainage composite. If there is more than one application on a project, this criterion will apply to construction of the initial application only. The representative shall also be available on an as-needed basis, as requested by ENGEO, during construction of the remaining applications.

3.3 Placement: The soil surface against which the geosynthetic drainage composite is to be placed shall be free of debris and inordinate irregularities that will prevent intimate contact between the soil surface and the drain.

3.4 Seams: Edge seams shall be formed by utilizing the flap of the geotextile extending from the geocomposite's edge and lapping over the top of the fabric of the adjacent course. The fabric flap shall be securely fastened to the adjacent fabric by means of plastic tape or non-water-soluble construction adhesive, as recommended by the supplier. Where vertical splices are necessary at the end of a geocomposite roll or panel, an 8-inch-wide continuous strip of geotextile may be placed, centering over the seam and continuously fastened on both sides with plastic tape or non-water-soluble construction adhesive. As an alternative, rolls of geocomposite drain material may be joined together by turning back the fabric at the roll edges and interlocking the cuspidations approximately 2 inches. For overlapping in this manner, the fabric shall be lapped and tightly taped beyond the seam with tape or adhesive. Interlocking of the core shall always be made with the upstream edge on top in the direction of water flow. To prevent soil intrusion, all exposed edges of the geocomposite drainage core edge must be covered. Alternatively, a 12-inch-wide strip of fabric may be utilized in the same manner, fastening it to the exposed fabric 8 inches in from the edge and folding the remaining flap over the core edge.

3.5 Soil Fill Placement: Structural backfill shall be placed immediately over the geocomposite drain. Care shall be taken during the backfill operation not to damage the geotextile surface of the drain. Care shall also be taken to avoid excessive settlement of the backfill material. The geocomposite drain, once installed, shall not be exposed for more than seven days prior to backfilling.