PRELIMINARY
GEOLOGIC HAZARD EVALUATION

VINEYARDS AT MARSH CREEK
L630 NEW BRENTWOOD CENTER
BRENTWOOD, CALIFORNIA

Submitted to:

Mr. Ray Pile
Contra Costa Community College District
500 Court Street
Martinez, CA 94553

January 29, 2010
Project No. 3229.001.001

- Expect Excellence -
January 29, 2010

Mr. Ray Pyle  
Contra Costa Community College District  
500 Court Street  
Martinez, CA 94553

Subject: Vineyards at Marsh Creek  
L630 New Brentwood Center  
Brentwood, California

PRELIMINARY GEOLOGIC HAZARD EVALUATION

Dear Mr. Pyle:

With your authorization, we conducted a preliminary geologic hazard evaluation for the proposed L630 New Brentwood Center Community College located at the Vineyards at Marsh Creek in Brentwood, California.

The purpose of this study is to provide a preliminary geologic hazard evaluation of the soil and geologic conditions affecting the subject site for development as a school.

Based on this study, it is our opinion that the site geotechnical hazards can be mitigated. We find the site suitable from a geologic and geotechnical standpoint for the proposed Community College development provided a design level geotechnical exploration is conducted and the recommendations included in this and future geotechnical reports are incorporated into the project planning, design and construction.

We are pleased to be of service to you on this project. If you have any questions regarding the contents of this report, do not hesitate to contact us.

Very truly yours,

Zac Crawford, CEG  
zac/jjt/jf/prelim

Josef J. Tootle, GE

ENGEIO Incorporated
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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this preliminary geologic hazard evaluation report is to provide you and your design team with our preliminary geologic and geotechnical findings, including the feasibility of the site for development as a community college and associated improvements with respect to geologic hazards.

The scope of this preliminary study, as described in our proposal dated December 4, 2009, included the following:

- Reviewing available literature, geologic maps and previous geotechnical reports pertinent to the site.
- Drilling one boring within the general area of the proposed new structures.
- Laboratory testing of selected samples recovered from our boring.
- Analyzing the geologic and geotechnical data.
- Reporting our findings and providing preliminary conclusions.

It is anticipated that during future site development planning and prior to site construction, additional geotechnical exploration will be conducted to further evaluate subsurface conditions, develop site-specific grading, drainage and foundation design recommendations and verify and/or revise the conclusions provided in this report, as needed. The California Geological Survey (CGS) Note 48 checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools was used as a general guideline for this study. Because of the intended preliminary nature of the current study, not all aspects of the draft CGS report were followed in detail.

This report was prepared for the exclusive use of Contra Costa Community College District and its design team consultants. In the event that any changes are made in the character or design of the development, the conclusions and recommendations contained in this report should be reviewed by ENGEO Incorporated to determine whether modifications to the report are 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 Incorporated.

1.2 SITE LOCATION AND DESCRIPTION

The Vineyards at Marsh Creek development (Vineyards) is located west of Concord Avenue and north of Marsh Creek Road in Brentwood, California. The proposed Community College Campus is to be located north of the intersection of Marsh Creek Road and Fairview Avenue, on the east side of Miwok Avenue (Figure 1).
The proposed Community College site was previously sheet graded as part of the grading for the Vineyards development (ENGEIO 2005). Based on our understanding and review of previously published documents and the conditions encountered in our subsurface exploration, the site appears to be underlain by up to 5 feet of engineered fill. Some existing roadways have been graded and underground utilities installed; however, the surface of the site currently exists as bare dirt primarily covered in 1- to 3-foot-tall native grasses with scattered brush and mature oak trees. As a result of previous grading, the site is relatively flat with elevations ranging from 143 to 132 feet and sloping gently from west to east. An approximately 16-foot-deep detention basin exists in the eastern side of the site.

1.3 PROPOSED DEVELOPMENT

According to the Vineyards College Site Conceptual Plan prepared by Carlson, Barbee, & Gibson (CBG) dated December 8, 2009, the proposed Community College site will consist of constructing two new approximately 22,000-square-foot buildings and associated parking as shown on Figure 2. To construct the proposed new structures and associated improvements cuts and fills of approximately 3 to 5 feet deep are anticipated.

1.4 PREVIOUS STUDIES

ENGEIO prepared a geotechnical exploration report dated March 19, 2003, for the Vineyards at Marsh Creek active adult community which included the community college site. ENGEIO also prepared a geotechnical exploration report dated March 18, 2004, for the Fairview Avenue Bridge at Marsh Creek, located approximately 800 feet southwest of the proposed community college structures. The geologic conditions, seismic hazards, exploration logs, and laboratory results presented in the referenced reports in part pertain to the Community College site and are included in this report for completeness.

2.0 GEOLOGIC CONDITIONS

2.1 SITE GEOLOGY

The site is located in the Coast Ranges geomorphic province on the eastern side of the Diablo Range. In this part of the province, bedrock is mapped as Miocene and Cretaceous age marine sedimentary rock (Graymer, et al., 1994). Bedrock in the area generally consists of interbedded sandstone, siltstone, and claystone that vary from friable to strong. Bedrock structure in the area generally strikes to the northwest and dips at an inclination of about 20 to 40 degrees to the northeast to east. The geologic setting of the site is shown on the attached Regional Geologic Map, Figure 5. More detailed local geologic conditions, including the locations of our former explorations, are presented on Figure 3. The proposed school site is located in an area mapped as Quaternary Alluvium (Qal) with minor amounts of Older Alluvium (Qoal) as shown on Figure 3; however, based on our recent and former subsurface explorations on the site, the alluvium is approximately 30 feet thick underlain by claystone of the Meganos, Upper Member (Tme).
2.2 FAULTING AND SEISMICITY

As with much of the Central Valley in Northern California, the site is situated between two seismically active regions (CDMG Open-File Report 96-08). Our review of geologic literature did not identify the presence of any known active or potentially active faults on the proposed Community College project site.

The site is not within an Alquist-Priolo earthquake hazard zone. Maps showing faulting prepared by Bortugno (1991) and Jennings (1994) show no active or potentially active faults on the site. Three fault segments are mapped on the nearby Vineyards residential site by Graymer et al. (1994). The fault mapping by Graymer et al. appears to be the same as earlier mapping by Brabb (1971). Several faults are also mapped on the Vineyards site by Crane (1988), Harding Lawson & Associates (1991), the State of California, Department of Water Resources (DWR, 1978), and Wagstaff and Associates (1994). The main north-south trending fault mapped on the Vineyards site is referred to as the Brentwood fault by DWR (1978), or the Sherman Island fault by Crane (1988). Extensive geologic studies for the Los Vaqueros Dam by DWR (1978) found that the Brentwood fault has not experienced movement for at least 50,000 to 70,000 years.

To evaluate the distance of the site from nearby active faults, we used Blake’s computer program, EQFAULT (2005) to locate potential seismic sources within 100 kilometers (62 miles) of the site. The closest known faults classified as active by the State of California Geologic Survey (CGS) are the Greenville fault, located approximately 6 miles to the southwest of the site; the Mount Diablo fault, located approximately 11 miles to the west; Segment 5 of the Great Valley fault, located approximately 13 miles to the southwest of the site; and the Concord – Green Valley fault, located approximately 15 miles to the west. Additionally, two other significant seismic sources are the Calaveras fault and the Hayward fault, located 16 and 25 miles to the west of the site, respectively.

According to the California Geological Survey’s Interactive Probabilistic Seismic Hazard Map, ground motions at the site with 10 percent probability of exceedance in 50 years (expressed as a fraction of the acceleration due to gravity) are 0.39g for peak ground acceleration, 0.95g for spectral acceleration at short 0.2-second periods, and 0.40g for spectral acceleration at moderately long 1.0-second periods (CGS, 2002).

The regional seismicity of the Bay Area was recently evaluated by the Working Group on Northern California Earthquake Probabilities (WGEP, 2003). The Working Group periodically attempts to summarize seismic risk in the Bay Area by presenting probabilities of 6.7MW or greater earthquakes on active Bay Area faults for a 30-year return interval. The probability of a 6.7MW or greater earthquake on the Hayward, San Andreas, and Calaveras faults are 27, 21, and 11 percent, respectively. When each individual fault’s probability is weighted, combined, and considered with mathematical uncertainties, the Working Group’s most recent summary gives a 62 percent aggregate probability for the entire Bay Area. Empirical relationships between earthquake magnitude and surface displacement suggest that a magnitude 6.7 quake averages 1 to 2 m of offset along strike-slip faults (Wells and Coppersmith, 1994).
3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION

One exploratory boring was drilled at the site on December 29, 2009. The approximate exploration location is shown on the Site Plan, Figure 2, and the log of the exploratory boring is included in Appendix A. The exploration location was approximately located by estimating from existing features and the use of a Site Conceptual Plan, topographic map, and aerial photography.

Exploratory Boring 1-B1 was drilled with a track-mounted CME-55 drill rig equipped with 8-inch-diameter hollow stem augers. An ENGEIO representative logged the boring in the field and collected soil samples using either a 3-inch O.D. California-type split-spoon sampler fitted with 6-inch-long brass liners, or a 2-inch O.D. Standard Penetration Test (SPT) split-spoon sampler. The samplers were advanced with a 140-pound hammer with a 30-inch drop, employing an automatic hammer system. The penetration of the samplers into the native materials was field-recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. Blow count results on the boring log were recorded as the number of blows required for the last one foot of penetration, or the distance indicated if driving refusal was encountered.

The log depicts subsurface conditions within the boring at the time the exploration was conducted. Subsurface conditions at other locations may differ from conditions noted at this location. The passage of time may result in altered subsurface conditions. In addition, stratification lines represent the approximate boundaries between soil types and the transitions may be gradual.

3.2 SUBSURFACE CONDITIONS

The subsurface soil encountered during our exploration generally consisted of approximately 2 feet of clayey engineered fill underlain by 4 to 5 feet of moderately to highly expansive stiff silty clay (colluvium; Qc) with varying amounts of fine-grained sand. Beneath the clay, we encountered very stiff sandy silt and medium dense silty sand (Alluvium; Qal) to a depth of 21 feet. This was underlain by hard silty clay to a depth of 28½ feet. Approximately 22 feet of highly to moderately weathered in-place claystone bedrock underlies the alluvial and colluvial soil (weathered Tme). This bedrock condition is similar to that exposed in other explorations at the site (ENGEIO, 2002; ENGEIO, 2007). One Plasticity Index (Pl) test was performed on the near-surface native soil at the site and resulted in a Pl of 36. This is an indication that the site soils have a high shrink-swell potential and medium to high plasticity. We did not encounter any noticeably weak or compressible native soil in our exploratory boring.

It should be noted that the boring log depicts subsurface conditions within the boring at the time of drilling; however, subsurface conditions may vary with time. Consult the Site Plan and exploration log for specific subsurface conditions at the boring location. We include our exploration log in Appendix A. The log contains the soil type, color, consistency, and visual classification in general accordance with the Unified Soil Classification System. The log graphically depicts the subsurface conditions encountered at the time of the exploration.
3.3 GROUNDWATER CONDITIONS

We did not observe static or perched groundwater in our subsurface exploration; however, groundwater was encountered at the site within the boring drilled for the Vineyards development in 2002 at a depth of approximately 25 feet. Fluctuations in the level of groundwater may occur due to variations in rainfall, irrigation, and other factors not evident at the time measurements were made.

4.0 DISCUSSION AND CONCLUSIONS

It is our geological and geotechnical opinion, based on the exploration data, laboratory test results, and our analysis, that the project site is suitable for the proposed construction. Recommendations for project construction were not part of this scope. A design-level geotechnical and geologic hazards report should be conducted prior to site development.

The main geologic concerns for the proposed site development include the presence of moderately to critically expansive soil (residual soils, colluvium, and claystone) considered susceptible to significant volume changes (swell and compression) when subjected to varying moisture contents; and the potential for earthquake induced ground shaking. These concerns and other geotechnical issues are discussed in the following sections of this report. None of the hazards listed below are considered unique to the property but are common to many sites in the region.

4.1 SEISMIC HAZARDS

4.1.1 Ground Rupture

The property is not within a State of California Earthquake Fault Hazard Zone and no indications of active faulting were found in our exploration of the site. Based on the previous study by DWR (1978) and the findings of our previous exploratory trenching, the Brentwood fault has not experienced movement for at least 50,000 to 70,000 years, and, therefore, is not considered active (ENGEO 2002). The likelihood of fault ground rupture at the site is considered low.

4.1.2 Building Code Seismic Information

An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site. The degree of shaking is dependent on the magnitude of the event, the distance to its epicenter, and local geologic conditions. To mitigate ground shaking effects, the school should be designed using sound engineering judgment and the 2007 California Building Code (CBC) requirements as a minimum. To provide California Building Code (CBC) seismic design parameters, we reviewed the 2007 CBC and the February 1998 California Divisions of Mines and Geology “Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada”.

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Based on our review, we provide the 2007 California Building Code (CBC) seismic parameters in the table below:

### SUMMARY OF 2007 CBC SEISMIC DESIGN VALUES

*Latitude = 37.895 and Longitude = -121.724*

<table>
<thead>
<tr>
<th></th>
<th>DESIGN VALUE</th>
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<tr>
<td>Site Class</td>
<td>C</td>
</tr>
<tr>
<td>0.2 second Spectral Response Acceleration, $S_s$</td>
<td>1.50</td>
</tr>
<tr>
<td>1.0 second Spectral Response Acceleration, $S_1$</td>
<td>0.53</td>
</tr>
<tr>
<td>Site Coefficient, $F_a$</td>
<td>1.0</td>
</tr>
<tr>
<td>Site Coefficient, $F_c$</td>
<td>1.3</td>
</tr>
<tr>
<td>Maximum considered earthquake spectral response accelerations for short periods, $S_{MS}$</td>
<td>1.50</td>
</tr>
<tr>
<td>Maximum considered earthquake spectral response accelerations for 1-second periods, $S_{M1}$</td>
<td>0.70</td>
</tr>
<tr>
<td>Design spectral response acceleration at short periods, $S_{DS}$</td>
<td>1.00</td>
</tr>
<tr>
<td>Design spectral response acceleration at 1-second periods, $S_{D1}$</td>
<td>0.46</td>
</tr>
<tr>
<td>Long period transition-period, TL</td>
<td>8 seconds</td>
</tr>
</tbody>
</table>

### 4.1.3 Liquefaction

Liquefaction is a phenomenon in which saturated cohesionless soils have a temporary loss of strength due to cyclic stresses and increased pore pressure as a result of strong ground shaking caused by earthquakes. The common adverse effects of liquefaction may include settlement, loss of foundation support, ground surface rupture and sand boils, lateral spreading, instability of slopes and related effects. Soils most susceptible to liquefaction are clean, loose, uniformly graded and fine-grained granular soils.

No soil or groundwater conditions exist at the proposed school site that are considered susceptible to liquefaction. Therefore, it is our opinion that the risk of liquefaction at the site is low.

### 4.1.4 Densification Due to Earthquake Shaking

Densification of loose granular soils can cause settlement of the ground surface due to earthquake-induced vibrations. Loose granular soils were not encountered within native materials in our exploratory excavations. Accordingly, it is our opinion that the potential for dynamic densification is low.
4.1.5 Lurching

Ground lurching occurs as a result of the rolling motion imparted to the ground surface during energy released by an earthquake. The deformation of the ground surface by such rolling motion can cause ground cracks to form. The potential for the formation of these cracks is considered greater at contacts between material with significantly different properties, such as deep soft soil and bedrock. Such an occurrence is possible at the proposed Community College site as in other locations in the San Francisco Bay Area, but the offset or strain is expected to be minor. During a design-level geotechnical exploration, recommendations should be provided for foundation and pavement design to reduce the potential for adverse impacts from lurch cracking as necessary.

4.1.6 Lateral Spreading

Lateral spreading is a failure within a nearly horizontal soil zone, which causes the overlying soil mass to move down a gentle slope or toward a free face such as a creek or open body of water. Lateral spreading is most often associated with strength loss due to liquefaction. As described above, the liquefaction potential of the subsurface soils is considered low. The potential for lateral spreading to occur at the site during seismic shaking is considered low because of a lack of liquefiable deposits.

4.1.7 Earthquake-Induced Landslides

Seismically induced landslides are triggered by earthquake ground shaking. The risk of this hazard is greatest in the late winter when groundwater levels are highest and hillside colluvium is saturated. As with all slopes in the region, this risk is also present at the site to varying degrees depending on the slope conditions and time of year. However, the hazard of seismically induced landslides to the proposed structures is considered negligible based on the distance of the structures from significant slopes. It should also be noted that previous grading on the Community College site and adjacent Vineyards development removed any mapped landslides that threatened development and engineered and graded slopes to be stable with an appropriate factor of safety (ENGEIO 2005).

4.1.8 Earthquake-Induced Flooding

Earthquake-induced failure of water retention structures can, at some locations, present a significant flooding hazard to downstream areas. The proposed Community College site is not located in a depressed area downslope or downstream from any major water retention facility. One water tank is currently present approximately 4,000 feet upslope and west of the proposed school site. Due to the distance from the site, it is expected that a catastrophic tank failure would not generate a significant amount of water at the subject site. Additionally, as previously discussed, an existing detention basin exists adjacent to the subject site north and east of the two proposed structures. This basin is located at a lower grade and drainage is to the east, away from the proposed structures. Given the distance of the existing water tank from the subject site and given that the existing basin is located below the college campus site grades, it is our opinion that the risk of earthquake-induced flooding is low.
4.2 FLOODING

Based on site elevation and distance from natural water sources, flooding is not expected at the subject site. Figure 7 is based on the FEMA Flood Insurance Rate Map (FIRM) and shows the site located in Zone X, areas to be determined to be outside the 0.2% annual chance floodplain.

4.3 INUNDATION DUE TO DAM FAILURE

The proposed Community College site is located down gradient of Marsh Creek Reservoir. According to the Association of Bay Area Governments (ABAG), the proposed school site would be subject to inundation due to a catastrophic failure of the Marsh Creek Reservoir Dam. A Dam Failure Inundation Hazards Map is presented on Figure 8. The California Division of Safety of Dams should be consulted as to the current safety rating of the Marsh Creek Reservoir Dam.

4.4 EXPANSIVE SOIL

As shown by the previous and current laboratory testing, the soil at the site displays Plasticity Indices ranging from low (non-plastic) to high (expansive soils). Expansive soils shrink and swell as a result of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Building damage due to volume changes associated with expansive soils may be reduced by a number of measures. These include replacing expansive materials below structures and improvements with a relatively thick layer of low to non-expansive material. Mitigation measures during grading may include moisture conditioning of the site soils to obtain moisture contents that reduce shrinkage and swelling. Further plasticity testing should be performed during the design-level geotechnical report and mitigation measures should be considered prior to construction.

4.5 CORROSION POTENTIAL

An evaluation of the corrosion potential of the on-site soils was not conducted as part of this study. A corrosivity analysis should be performed during the design-level geologic and geotechnical exploration.

4.6 ADDITIONAL POTENTIAL GEOLOGIC HAZARDS

Based on topographic and lithologic data, the risk from regional subsidence or uplift, tsunamis or seiches, and volcanic eruption is considered low to negligible at the project site.

4.7 CONCLUSIONS

It is our opinion that the proposed Community College project is feasible from a geological and geotechnical standpoint. It is anticipated that during future site development planning and prior to site construction, additional geologic geotechnical explorations will be conducted to further
evaluate subsurface conditions, develop site-specific grading, drainage and foundation design recommendations and verify and/or revise the conclusions provided in this report, as needed. The California Geological Survey (CGS) Note 48 checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools should be used to guide future design level studies.

5.0 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 preliminary recommendations of this report to developers, contractors, 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 contained in this report are preliminary and are solely professional opinions.

The professional staff of ENGEIO 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 services.

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Figure 5  Regional Geologic Map
Figure 6  Regional Faulting and Seismicity
Figure 7  Flood Data Map
Figure 8  Dam Failure Inundation Areas

FIGURES
EXPLANATION

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AL, AH, A1, A2, AL, AR, AO, VE, and V1. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A
No Base Flood Elevations determined.

ZONE AE
Base Flood Elevations determined.

ZONE AH
Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO
Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of shallow fan flooding, velocities also determined.

ZONE AR
Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently abandoned. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE AO9
Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V
Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

ZONE VE
Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X
Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X
Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D
Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)
APPENDIX A

Key to Boring Logs
Boring Log 1-B1 (ENGEO 2009)
Boring Log B-3 (ENGEO 2002)
### KEY TO SOIL LOGS

<table>
<thead>
<tr>
<th>MAJOR TYPES</th>
<th>DESCRIPTION</th>
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<tr>
<td>GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE</td>
<td>CLEAN GRAVELS WITH LESS THAN 5% FINES</td>
</tr>
<tr>
<td>GRAVELS WITH OVER 12% FINES</td>
<td>GW - Well graded gravels or gravel-sand mixtures</td>
</tr>
<tr>
<td></td>
<td>GP - Poorly graded gravels or gravel-sand mixtures</td>
</tr>
<tr>
<td>SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE</td>
<td>CLEAN SANDS WITH LESS THAN 5% FINES</td>
</tr>
<tr>
<td>SANDS WITH OVER 12% FINES</td>
<td>SW - Well graded sands, or gravelly sand mixtures</td>
</tr>
<tr>
<td></td>
<td>SP - Poorly graded sands or gravelly sand mixtures</td>
</tr>
<tr>
<td>SILTS AND CLAYS LIQUID LIMIT 50% OR LESS</td>
<td>ML - Inorganic silt with low to medium plasticity</td>
</tr>
<tr>
<td></td>
<td>CL - Inorganic clay with low to medium plasticity</td>
</tr>
<tr>
<td>SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%</td>
<td>OL - Low plasticity organic silts and clays</td>
</tr>
<tr>
<td>HIGHLY ORGANIC SOILS</td>
<td>MH - Elastic silt with high plasticity</td>
</tr>
<tr>
<td></td>
<td>CH - Fat clay with high plasticity</td>
</tr>
<tr>
<td></td>
<td>OH - Highly plastic organic silts and clays</td>
</tr>
<tr>
<td></td>
<td>PT - Peat and other highly organic soils</td>
</tr>
</tbody>
</table>

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravely" (whichever is predominant) are added to the group name.

### GRAIN SIZES

<table>
<thead>
<tr>
<th>U.S. STANDARD SERIES SIEVE SIZE</th>
<th>CLEAN SQUARE SIEVE OPENINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>40</td>
<td>3&quot;</td>
</tr>
<tr>
<td>10</td>
<td>12&quot;</td>
</tr>
<tr>
<td>FINE</td>
<td>Coarse</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Gravel</td>
</tr>
<tr>
<td>COARSE</td>
<td></td>
</tr>
<tr>
<td>SAND</td>
<td></td>
</tr>
</tbody>
</table>

### RELATIVE DENSITY

<table>
<thead>
<tr>
<th>SANDS AND GRAVELS</th>
<th>BLOWS/FOOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY LOOSE</td>
<td>0-4</td>
</tr>
<tr>
<td>LOOSE</td>
<td>4-10</td>
</tr>
<tr>
<td>MEDIUM DENSE</td>
<td>10-30</td>
</tr>
<tr>
<td>DENSE</td>
<td>30-50</td>
</tr>
<tr>
<td>VERY DENSE</td>
<td>OVER 50</td>
</tr>
</tbody>
</table>

### CONSISTENCY

<table>
<thead>
<tr>
<th>SILTS AND CLAYS</th>
<th>STRENGTH*</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY SOFT</td>
<td>0-1/4</td>
</tr>
<tr>
<td>SOFT</td>
<td>1/4-1/2</td>
</tr>
<tr>
<td>MEDIUM STIFF</td>
<td>1/2-1</td>
</tr>
<tr>
<td>STIFF</td>
<td>1-2</td>
</tr>
<tr>
<td>VERY STIFF</td>
<td>2-4</td>
</tr>
<tr>
<td>HARD</td>
<td>OVER 4</td>
</tr>
</tbody>
</table>

### MOISTURE CONDITION

<table>
<thead>
<tr>
<th>DRY</th>
<th>MOIST</th>
<th>WET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dusty, dry to touch</td>
<td>Damp but no visible water</td>
<td>Visible freewater</td>
</tr>
</tbody>
</table>

### LINE TYPES

- Solid - Layer Break
- Dashed - Gradational or approximate layer break

### GROUND-WATER SYMBOLS

- Groundwater level during drilling
- Stabilized groundwater level

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer
<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Depth in Meters</th>
<th>Sample Type</th>
<th>DESCRIPTION</th>
<th>Log Symbol</th>
<th>Water Level</th>
<th>Blow Count/foot</th>
<th>Liquid Limit</th>
<th>Plastic Limit</th>
<th>Plasticity Index</th>
<th>Atterberg Limits</th>
<th>Unconfined Strength (psi)</th>
<th>Field approx</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>3.33</td>
<td>CLAYEY SAND (SC/CL), olive brown, moist, medium plasticity, approximately 50% fines, fine-grained sand, [FILL]</td>
<td>22</td>
<td>22</td>
<td>-</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+4.5*</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>3.33</td>
<td>SANDY CLAY (CL), olive brown mottled with reddish brown, hard, moist, medium plasticity, approximately 30% fine-grained sand, [FILL]</td>
<td>31</td>
<td>31</td>
<td>-</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+4.5*</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>4.57</td>
<td>SILT WITH SAND (ML), brown, hard, moist, approximately 20% fine-grained sand</td>
<td>30</td>
<td>30</td>
<td>-</td>
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<td>+4.5*</td>
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</tr>
<tr>
<td>15</td>
<td>4.57</td>
<td>SILTY CLAY (CL-CH), brown, hard, moist, high plasticity, approximately 20% fine-grained sand</td>
<td>18</td>
<td>18</td>
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<td>4.5*</td>
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<tr>
<td>20</td>
<td>6.09</td>
<td>LEAN CLAY (CL), brown, hard, moist, medium plasticity, approximately 5% fine-grained sand</td>
<td>15</td>
<td>15</td>
<td>-</td>
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<tr>
<td>25</td>
<td>7.62</td>
<td>SILT WITH SAND (ML), brown, hard, moist, low plasticity, approximately 25% fine-grained sand</td>
<td>72</td>
<td>72</td>
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<td>+4.5*</td>
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<tr>
<td>25</td>
<td>7.62</td>
<td>SILTY SAND (SM), reddish brown, medium dense, moist, fine-to medium-grained sand, approximately 30% fines</td>
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<td>+4.5*</td>
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<tr>
<td>30</td>
<td>9.14</td>
<td>At 20 feet, grading with approximately 5% fine subrounded gravel</td>
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<td>30</td>
<td>9.14</td>
<td>SANDY LEAN CLAY (CL), olive brown, stiff, moist, medium plasticity, approximately 30% fine-grained sand, approximately 5% fine subrounded gravel</td>
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<td>30</td>
<td>9.14</td>
<td>SILTY CLAY (CL), olive brown, hard, moist, low plasticity, trace fine-grained sand</td>
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<td>+4.5*</td>
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<tr>
<td>30</td>
<td>9.14</td>
<td>CLAYSTONE, dark gray, very weak (R1), laminated, moderately weathered (WM), damp, bedding appears to dip approximately 40 degrees</td>
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<td>Depth in Feet</td>
<td>Depth in Meters</td>
<td>Sample Type</td>
<td>DESCRIPTION</td>
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</tr>
</tbody>
</table>

Boring terminated at approximately 51 feet. No Groundwater encountered.
DATE OF BORING: October 23, 2002

SURFACE ELEVATION: Approx. 135 feet (41 meters)

**DESCRIPTION**

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>SAMPLE NUMBER</th>
<th>LOG LOCATION AND TYPE OF SAMPLE</th>
<th>BLOWS/FT</th>
<th>qu</th>
<th>UNCON STRENGTH (TSF)</th>
<th>IN PLACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>3-1-1</td>
<td>SANDY SILT (ML), reddish brown, hard, dry, with clay and gravel.</td>
<td>78</td>
<td>4.5*</td>
<td></td>
<td>99</td>
</tr>
<tr>
<td>-2</td>
<td>3-2</td>
<td>SILTY SAND (SM), reddish yellow brown, dry to damp, very dense, cemented. Gravel. Grades with fine gravel.</td>
<td>54/5*</td>
<td></td>
<td></td>
<td>7.2</td>
</tr>
<tr>
<td>-3</td>
<td>3-3-1</td>
<td>CLAYEY SILT (ML), yellowish brown, damp, hard, with sand and gravel, fine coarse.</td>
<td>92</td>
<td>4.5*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td>3-4-1</td>
<td>Interbedded with sand, with silt. SANDY SILT/SILTY SAND (ML-SM), reddish brown, very dense, damp, hard.</td>
<td>79</td>
<td>4.25*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td>3-5-1</td>
<td>Transition from SANDY SILT to SAND. SAND (SP), yellow brown to reddish brown, very dense, damp.</td>
<td>60/5*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-8</td>
<td>3-6-1</td>
<td>Poorly-graded SAND (SP), redish brown, very dense, damp to wet. Becoming light gray brown.</td>
<td>60/4*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td>3-7-1</td>
<td>Poorly graded SAND (SP), yellow brown with red, very dense, strikes, saturated. Bottom of boring at approximately 30 1/2 feet. Groundwater encountered at 27 feet during drilling. Groundwater level at 25 feet after drilling.</td>
<td>50/3.5*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BORING NO.: B-3
LOGGED BY: S. Papadopoulos
PROJ. NO.: 3229.1.052.01
FIGURE NO. A-3
APPENDIX B

Laboratory Testing Results
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils.

SOIL DATA

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SOURCE</th>
<th>SAMPLE NO.</th>
<th>DEPTH</th>
<th>NATURAL WATER CONTENT (%)</th>
<th>PLASTIC LIMIT (%)</th>
<th>LIQUID LIMIT (%)</th>
<th>PLASTICITY INDEX (%)</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>B1-1</td>
<td>4'</td>
<td>13</td>
<td>49</td>
<td>36</td>
<td>CL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ENGEO, Inc.

Client: Contra Costa Community College District
Project: Vineyards Community College
Project No.: 3229.001.001

Rocklin, CA
### Particle Size Distribution Report

#### GRAIN SIZE - mm

<table>
<thead>
<tr>
<th>% COBBLES</th>
<th>% GRAVEL</th>
<th>% SAND</th>
<th>% FINES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRS.</td>
<td>FINE</td>
<td>CRS.</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>PERCENT FINER</th>
<th>SPEC.*</th>
<th>PASS? (X=NO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#200</td>
<td>41.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(no specification provided)*

### Soil Description

Light yellowish brown silty clayey fine Sand

### Atterberg Limits

- **PL**
- **LL**
- **Pl**

### Coefficients

- **D_85**
- **D_60**
- **D_30**
- **D_15**
- **D_10**
- **Cu**
- **C_u**

### Classification

- AASHTO = A-4(0)

### Remarks

---

**Sample No.:** 3-5  
**Source of Sample:** %200  
**Date:** 12/27/02  
**Location:**  
**Client:** Blackhawk Nunn Partnership  
**Project:** Vineyards at Marsh Creek, Brentwood CA.  
**Project No.:** 3229.1.052.01