PRELIMINARY GEOLOGIC STUDY REPORT

CORNELL WINERY
245 WAPPO ROAD
SANTA ROSA, CALIFORNIA
APN 028-260-041

Project Number:
2096.02.01.1

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INFORMATION ABOUT YOUR GEOFTECHNICAL REPORT
INTRODUCTION

This report updates and supersedes our Preliminary Geologic Study (PGS), dated May 31, 2006, for the proposed Cornell winery to be constructed on the lands of Cornell Farms, LLC in Sonoma County, California. The Cornell Farms land consists of 174 acres situated within rural open space and is approximately 1 mile east of the Sonoma-Napa County line. The proposed winery site is located at 245 Wappo Road (APN 028-260-041), the southwestern 40-acre parcel of the Cornell Farms property. The Cornell Farms property is accessed by Wappo Road, a partial paved/dirt and gravel road that extends generally northward off St. Helena Road. The subject parcel, or property, as referred herein, is the 40-acre parcel located at the 245 Wappo Road address unless specified otherwise. The 40-acre subject parcel relative to the Cornell Farms land is shown on the Site Vicinity Map, Plate 1, Appendix A, presented herein and in our original report.

The terrain on the subject parcel extends over variably-sloping shrubland and woodland characterized by westerly-facing spur ridges and intervening ravines off a southerly trending ridge and knoll top that borders the eastern parcel boundary. In general, the groundslopes across the site range locally between about 1.3:1 (Horizontal to Vertical) and 13H:1V. Groundslopes generally range between 3½H:1V and 7½H:1V at the proposed winery site. The U.S. Geological Survey (USGS) 7½ Minute series topographic map of the Calistoga Quadrangle (1997) indicates the topography ranges from over 1680 feet above mean sea level along the eastern parcel boundary to approximately 1360 feet within a deep ravine on the west. It should be noted that the contours shown on the USGS map do not agree with the contours shown on the site specific topographic map, presented herein as the Geologic Map and the Exploration Plan. Wappo Road traverses northeasterly through the southeastern quadrant of the subject parcel. Site improvements include a residence, a leachfield, a small vineyard and a well on the southwestern quadrant of the property. The proposed winery site is located on the western portion of the southeastern quadrant of the 40-acre parcel, and immediately northwest of Wappo Road. The vegetation at the site and immediate vicinity were grubbed during the summer of 2005 and covered with erosion

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control (straw, bales and wattles). Since our original study, more extensive grubbing and clearing has occurred and the erosion control materials have degraded over time.

BACKGROUND

We performed a Preliminary Geologic Study (PGS) for a proposed winery site and submitted the results in a report dated May 31, 2006. At the time of our study, the concept was to construct the proposed winery across two spur ridges that are separated by the head of a narrow ravine, and then step down the hillside. Building plans were still in the formative stages, thus we did not know details of the winery layout. Our study included field mapping and drilling three borings in the immediate vicinity of the proposed winery.

Following the submittal of our PGS report to the client, we received a preliminary site plan showing the proposed winery improvements. The improvements were situated immediately northwest of Wappo Road and across the spur ridges. The plan included wine cave portals to commence near Wappo Road and extend eastward into the hillside. Accordingly, we performed additional subsurface exploration for the proposed improvements. Subsequently, the winery improvements were re-designed. The revised plan shows the winery to be constructed across the hillside rather than being stepped downhill, and it is shifted approximately 65 feet north and 70 feet west of its previous location. Because of these changes, and more extensive grubbing and clearing of vegetation at the proposed winery site, we recommended and performed additional subsurface exploration for preparation of this revised PGS report.
PURPOSE

The purpose of this study, as outlined in our confirming agreement dated November 8, 2005 and revised per discussions with Mr. Guy Davis, manager of the Cornell Farms vineyard, during our subsurface exploration on December 12, 2005, was to evaluate the geologic hazards at the winery site and to comment on the geotechnical feasibility of the project rather than to complete a geotechnical study report. This was requested because the winery plans were in the formative stages and it was desired to obtain a land use permit. In addition, we were to recommend future geotechnical engineering services needed for actual development, design and construction of the winery project.

SCOPE

Our updated scope of work collectively included reviewing our previous work at the site, selected published geologic data and stereo-paired aerial photographs; performing a site reconnaissance with geologic mapping; deep subsurface exploration; supplemental subsurface exploration in accordance with then-applicable and current plans; and preparation of this updated report. Once the land use permit is obtained, and the winery layout plans, type of construction and elevations are close to final, we will assess the need for supplemental subsurface exploration and complete a site-specific Geotechnical Study report that provides geotechnical recommendations for final design.
SERVICES PROVIDED

We reviewed our work at the site and select published geologic information and stereo-paired aerial photographs pertinent to the winery site. Geologic information we reviewed included "Geology for Planning in Sonoma County," prepared by Huffman and Armstrong (1980) of the California Geological Survey (CGS), formerly the California Division of Mines and Geology, and "Reconnaissance Photo-Interpretation Map of Landslides in 24 Selected 7.5-Minute Quadrangles in Lake, Napa, Solano, and Sonoma Counties, California," prepared by Dwyer et al. (1976) for the USGS. The portions of the CGS geologic map by Huffman and Armstrong (1980) pertinent to the site is shown on Plates 2A and 2B, Appendix A, of this report. The portions of the CGS Landslides and Relative Slope Stability map and the USGS Reconnaissance Photo-Interpretation Map of Landslides pertinent to this site are shown on Plates 3A and 3B, respectively, Appendix A. We also had a personal communication with Robert McLaughlin (2006) of the USGS regarding recency of faulting in the vicinity of the site. The listing of the geologic references reviewed is presented in Appendix B. In addition to our review of the original PGS report, geologic literature and stereo-paired aerial photographs, we performed supplemental geologic mapping for the portion of the parcel including the winery site, supplemental deep subsurface exploration at the proposed winery sites and constructed additional geologic cross sections. Based on our inclusive work at the site, we were to provide the following preliminary information for the winery project:

1. A brief description of soil and geologic conditions observed during our reconnaissance and subsurface exploration;

2. Distances to nearby active faults and a discussion of geologic hazards;
3. Our opinion regarding the potential geologic hazards and geotechnical feasibility of the winery project; and

4. Recommendations for possible supplemental subsurface exploration in order to develop site-specific geotechnical recommendations for the final design and construction of this project.

Site Reconnaissance

On August 26, 2005, our geologist conducted a surficial reconnaissance of the property to observe features detected in aerial photographs, exposed topographic features, surface soils, rock outcroppings and cut banks. Outcrops mapped were located by triangulation to mapped surface features on the USGS Calistoga 7½ minute quadrangle and supplemented by a hand-held Global Positioning System (GPS) instrument. Outcrops were plotted and confirmed by GPS measurements.

During our supplemental subsurface exploration from March 11 through 13, 2008, additional information and features related to slope instability, bedrock outcrops and erosion features were mapped. These features are shown on a topographic map of the current winery plans prepared by Backen Gillam Architects, the project architect, are presented herein on the Site Geologic Map, Plate 4, Appendix A. Supplemental geologic cross sections were constructed across the winery site and through the borings and test pits using topography shown on Plate 4. The supplemental geologic cross sections are shown on Plates 5A and 5B. A generalized geologic cross section was constructed oblique to the contours to show geologic structure, and is shown on Plate 5, Appendix C.
Subsurface Exploration

On November 8 through 14, 2005, we explored subsurface conditions across the general winery site by drilling, logging and sampling one core boring (Core Boring 1) to a depth of approximately 104 feet. The core boring was drilled with a track-mounted auger-mud rotary drill rig. Due to limited and disturbed core recovery, relatively undisturbed samples were obtained at selected intervals up to a depth of 28 feet by driving a 2.43-inch inside diameter Sprague and Henwood split barrel sampler, containing 6-inch long brass liners, using a 140-pound hammer falling approximately 30 inches. The sampler was driven 12 to 18 inches. The blows required to drive each 6-inch increment were recorded and the blows required to drive the last 12 inches, or portion thereof, were converted to equivalent Standard Penetration Test (SPT) blow counts for correlation with empirical test data. Sampler penetration resistance (blow counts) provides a relative measure of soil/rock consistency and strength. Below a depth of 28 feet, the boring was advanced by continuously drilling and spot coring with core barrels using rotary wash techniques. Spot samples of rock cores were recovered using 94 mm and HQ core barrels. The core samples were visually classified and logged by our field geologist, and stored in core-boxes for transport to the office.

On December 12 and 13, 2005, we drilled two bucket auger borings to depths of 50 (Test Boring 2) and 63 feet (Test Boring 3). The borings were drilled with a Calweld 42 bucket auger drilling rig equipped with a 24-inch diameter bucket auger. Sidewalls were cleaned of smear and visually downhole logged in detail. The core and bucket auger boring logs are presented on Plate 6 through 8, Appendix C.

During the preliminary design phase of the project and following submittal of our original Preliminary geologic study report, we performed subsurface exploration at various times and using various methods in response to ongoing design modifications. The dates and methods of subsurface exploration are summarized in chronological order below.

On September 27, 2006, we explored subsurface conditions for the initial winery configuration by excavating five test pits to depths ranging from about 6 to 18 feet with a
John Deere 160C LC track-mounted excavator. Test pit sidewalls were cleaned of smear and logged in detail.

On November 15 through 18, 2006, we supplemented the test pits by drilling five test borings to depths ranging from about 30 to 48 1/2 feet. The borings were drilled with a track-mounted auger-mud rotary drill rig and advanced by coring with pitcher barrels using rotary wash techniques. Core samples of the soils and bedrock were recovered at selected intervals by using pitcher barrels. The core samples were visually classified and logged by our geologist, and stored in core boxes for transport to our laboratory. Disturbed samples were also obtained at selected depths by driving a 1.375-inch inside diameter (2-inch outside diameter) Standard Penetration Test (SPT) sampler, without liners or rings, using a 140-pound hammer dropping approximately 30 inches. The sampler was driven 12 to 18 inches, the blows to drive each 6-inch increment were recorded, and the blows required to drive the final 12 inches, or portion thereof, are provided on the test boring logs. Grab samples were collected at selected intervals from the test pits and placed in plastic bags.

On March 11 through 13, 2008, we explored subsurface conditions for a new winery configuration by excavating 12 test pits to depths ranging from about 5 to 14 feet using a Hitachi 120 track-mounted excavator. Test pit sidewalls were cleaned of smear and logged in detail.

The exploration locations were determined approximately by pacing their distance from features shown on the Exploration Plan (Plate 6) and should be considered accurate only to the degree implied by the method used. Our geologist located and logged the borings and test pits and obtained relatively undisturbed spot core and bulk samples of the materials encountered for visual examination, classification, and possible laboratory testing.

The logs of the test pits and supplemental core borings showing the materials encountered, depth to free water seepage and sample depths are presented on Plates 7 through 28, Appendix A. The soils are described in accordance with the Unified Soil Classification System, outlined on Plate 29, Appendix A. Bedrock materials are described in accordance with Engineering Geology Rock Terms shown on Plate 30, Appendix A.
SITE CONDITIONS

General

Sonoma County is located within the California Coast Range geomorphic province. This province is a geologically complex and seismically active region characterized by sub-parallel northwest-trending faults, mountain ranges and valleys. The oldest bedrock unit in the area is the lower Jurassic to upper Cretaceous Franciscan Complex, originally deposited in a marine environment. Subsequently, younger rocks such as the Tertiary-age Sonoma Volcanics group, the Plio-Pleistocene-age Clear Lake Volcanics and sedimentary rocks such as the Guinda, Domengine, Petaluma, Wilson Grove, Cache, Huichica and Glen Ellen formations were deposited throughout the province. Extensive folding and thrust faulting during late Cretaceous through early Tertiary geologic time created complex geologic conditions that underlie the highly varied topography of today. In valleys, the bedrock is covered by thick alluvial soils.

Geology and Soils

The CGS geologic maps prepared by Huffman and Armstrong (1980), shown on Plate 2A and 2B in Appendix A of this report, indicate an unnamed thrust fault extends northwesterly through the northern portion of the parcel. The thrust fault is shown to juxtapose sheared shale and sandstone (melange unit) of the Franciscan Complex northeast of the fault over the younger tuffaceous unit of the Sonoma Volcanics Group on the southwest (Huffman and Armstrong, 1980; Fox 1973). The melange unit is shown to consist of sheared shale and sandstone that contains generally resistant masses of chert, high-grade metamorphic rocks, variable shattered sandstone and greenstone,
metagreenstone and generally less resistant serpentinite. The tuffaceous rocks are reported to comprise pumicitic ash-flow tuff that is locally or partly welded, and contains bedded agglomeratic tuff, andesitic or basaltic lava flows, tuff breccia, bedded tuff and pumicitic tuff.

Based on Huffman and Armstrong (1980) and Fox (1973), the winery site is shown to be underlain by the Sonoma Volcanics; however, our findings indicate the site to be underlain by the Franciscan Complex. During our August 25, 2005 site reconnaissance, we observed outcrops of the Franciscan Complex on the knoll top on the eastern portion of the parcel, along a portion of the road cut for Wappo Road and within a cut slope east of the existing leachfield. We also observed Franciscan Complex bedrock along the road past the electronic gate on the eastern side of the subject parcel. On the western portion of the parcel, we observed local outcrops of tuff breccia of the Sonoma Volcanics. Our test pits and supplemental borings confirm the winery site is underlain by materials of the melange unit of the Franciscan Complex. During our reconnaissance of March 11 through 13, 2008, we observed Franciscan Complex outcrops at the bottoms of the southern ravines and cuts made for a siltation basin further south. These areas were previously covered with erosion control straw which has subsequently degraded. The results of our outcrop mapping are shown on Plate 4, Appendix A.

Mapping by the U.S. Soil Conservation Service (Miller, 1990) has classified soil over the portion of this property proposed for development as belonging to the Goulding (GlF) series with areas of Boomer loam, Henneke gravelly loam and Toomes rocky loam. The Goulding series is shown to consist of well-drained clay loams that are underlain by metamorphosed basic igneous and weathered andesitic basalt of old volcanic formations. These soils are said to be found on mountainous uplands with slopes of 30 to 50 percent. The series comprises two soil horizons. The topsoil is shown to be a cobbly clay loam that exhibits moderate plasticity (LL = 30-40; PI = 15-30) and moderate shrink-swell potential, and extends to a depth of 10 inches. The subsoil is shown to be a very gravelly clay loam that exhibits moderate plasticity (LL = 30-40; PI = 15-30) and low shrink-swell potential, and extends from a depth of 10 to 20 inches. Runoff over these soils is said to be
rapid. The hazard of erosion is said to be high. The risk of corrosion for uncoated steel is given as moderate in topsoil and low in subsoil.

As previously discussed, the portion of this property proposed for development is underlain by rocks of the Franciscan Complex. The Boomer series (BoF) appears to resemble the soils developed on the Franciscan rocks in the area. The Boomer series is said to consist of well-drained clay loams that have a clay loam subsoil, and are underlain by greenstone and metamorphosed rocks. These soils are said to be found on mountainous uplands with slopes of 30 to 50 percent. The series comprises two soil horizons. The topsoil is shown to be a loam that exhibits moderate plasticity (LL = 30-40; PI = 5-15) and moderate shrink-swell potential, and extends to a depth of 19 inches. The subsoil is shown to be a gravelly clay loam and clay loam that exhibits moderate plasticity (LL = 30-40; PI = 10-20) and moderate shrink-swell potential, and extends from a depth of 19 to 55 inches. Runoff over these soils is said to be rapid. The hazard of erosion is said to be high. The risk of corrosion for uncoated steel is given as low in topsoil and moderate in subsoil.

Performing corrosivity tests to verify these values was not part of our requested and/or proposed scope of work. Should the need arise, we can provide a proposal to evaluate these characteristics.

Landslides

Published CGS and USGS maps do not show the presence of landslides at the proposed winery site. However, we encountered active, dormant and ancient landslides at the site during the course of our study. Brief descriptions of active, dormant and ancient landslides are summarized herein:

Active - Active landslides, including recently active, exhibit areas of unstable ground with fresh geomorphic features. Common fresh features can include
hummocky topography, abrupt grade breaks, ground cracks, exposed soils and disrupted vegetation. Active landslides typically range in age from recent to ±50 years.

**Dormant** - Dormant landslides appear to be quasi-stable with a mature and subdued surface expression. Fresh features generally become vague or indistinct, and vegetation generally re-establishes itself but is typically different in type and/or density than original. The age of dormant landslides is estimated to range from ±50 years to several hundred years.

**Ancient** - Ancient landslides differ from dormant landslides in that the landslide features are highly eroded and subdued, and vegetation is more heavily re-established and with a similar type as the surrounding terrain.

Presented below is a summary of landsliding mapped in the vicinity by CGS and USGS. A summary of landsliding observed during our study is presented in the Landslides subheading commencing on Page 19 of this report.

The CGS “Landslide and Relative Slope Stability” maps (Plate 3A, Appendix A) by Huffman and Armstrong (1980) do not show the presence of landslides at the proposed winery site. The site is shown to be within a relative slope stability category “C” - areas of relatively unstable rock and soil units, and slopes of greater than 15 percent are said to contain abundant landslides. There are three landslides mapped by Huffman and Armstrong within the near vicinity:

1. A very large landslide is shown to the northeast of the winery site. The nearest part of the site is shown to be the knoll top approximately 250 feet east of the proposed winery site. Our site reconnaissance indicates this knoll is underlain by rocks of the Franciscan Complex. The nearest portion of the
landslide we observed is on the steep eastern flanks of Wappo Road past the
winery site and approximately 500 feet northeast of the proposed winery site;

2. A second landslide is shown approximately 500 feet away on the far western
parcel boundary that encompasses the residence and also includes the
southern and southeastern flanks of a knoll across the ravine. We confirmed
the presence of at least a portion of this landslide during our subsurface
exploration on March 11 through 13, 2008; and

3. A third, queried (?) landslide is shown 1000 feet away two ravines to the east.

The USGS “Reconnaissance Photo-Interpretation Map of Landslides” by Dwyer, et
al (1976) does not indicate the presence of landslides at the winery site (Plate 3B, Appendix
A). Further, Dwyer et al (1976) shows a much smaller landslide to the northeast. That
landslide is mapped to be at least 900 feet northeast of the proposed winery site. The Dwyer
landslide is mapped on the southern flanks of a very narrow ridgeline. The second and third
landslides mapped by Huffman and Armstrong (1980) were not confirmed by Dwyer’s
(1976) map.

It should be noted that much of the data in the Huffman and Armstrong publication
was compiled between 1971 and 1974, or before the Dwyer map was completed. In
addition, page 2 of “Geology for Planning in Sonoma County” discusses several limitations
of the published maps, including that the data was mostly obtained by aerial photograph
interpretation without field verification and the scale (1:62,500) of the base map.

Surface

The roughly square-shaped, 40-acre parcel is located within rural open space at 245
Wappo Road. The terrain extends over shrubland and woodland characterized by westerly-
facing spur ridges and intervening ravines off a southerly trending ridge and knoll top that borders the eastern parcel boundary. Plate 1 shows that the topography ranges from over 1680 feet on a prominent knoll top on the eastern part of the parcel to approximately 1360 feet on a deeply incised ravine on the west. As previously discussed, the contours shown on the USGS map do not agree with the contours shown on the Site Geologic Map (Plate 4) and Exploration Plan (Plate 6). Wappo Road initially extends northerly off St. Helena Road and traverses northeasterly through the southeastern portion of the parcel. Wappo Road is paved for the first approximately 300 feet then transitions to a dirt and gravel road. The parcel contains a residence, a leachfield, a well and a small vineyard on the southwestern quadrant of the property.

The proposed winery site is located in approximately the southeastern quadrant of the property and on the northwesterly (downhill) side of Wappo Road. The site was grubbed of natural brushwood during the summer of 2005 and was covered with erosion control (straw, bales and wattles). Subsequently, more extensive grubbing and clearing was performed after submittal of our original preliminary geologic study report of May 31, 2006, and the erosion control has degraded. The terrain is characterized by westerly to northwesterly-sloping ridges and intervening ravines. Groundslopes across the winery site generally range between 3½H:1V and 7½H:1V.

In general, the ground surface is currently wet, soft and spongy in the winter months and dry and hard in the summer months. These soil conditions are generally associated with weak, porous surface soils. On sloping terrain 5H:1V or steeper, the weak, surface materials are prone to undergo a gradual downhill movement known as creep which includes a large portion of the site. Areas of active soil creep are shown on the Site Geologic Map (Plate 4). Soil creep is inherent to hillsides in the area and its force is directly proportional to slope inclination, the soils plasticity, water content and expansion potential. Creep issues are discussed briefly in this report, and will be discussed in more detail in a future site-specific Geotechnical Study report.

Natural drainage consists of overland flow that concentrates on natural drainage elements such as swales, ravines and creeks. The natural drainages from the site trend
westerly into a deep ravine that trends southwesterly through the northwestern portion of the subject parcel. The ravine trends off the parcel and into a second south-westerly-flowing intermittent blue-line stream that empties into Mark West Creek off the property. Mark West Creek is a perennial blue-line stream that flows westerly adjacent to St. Helena Road.

**Subsurface**

Our subsurface exploration indicates the project site is underlain by both non-landslide and landslide terrain. In non-landslide terrain, the surface soils range in thickness from about 2 to 4 feet thick and consist of weak, porous and compressible clayey and gravelly topsoil. Porous topsoil generally appears hard and strong when dry but becomes weak and compressible as their moisture content increases towards saturation. Porous topsoil can be considered to be actively creeping, such as found on the steeper ravine slopes southwest of the proposed winery, or creep-prone. In general, surface materials are considered prone to creep on hillsides through most of the site sloping at 5H:1V or steeper.

In non-landslide terrain, Franciscan Complex bedrock extends from beneath the surface materials to the maximum depths explored (6 to 104 feet). The bedrock consists of the melange unit, and generally consists of intermixed graywacke sandstone and sheared shale. Melange is formed by tectonic processes, and by definition generally consists of fragments and blocks (some exotic) of various rock types embedded in a fragmented and generally sheared matrix. The graywacke sandstone is generally firm to hard, friable to strong and fresh to slightly weathered. The graywacke is matrix and rock supported, and exhibits extremely close to closely spaced fractures and quartz veining. Local saccharoidal (sugary) texture was observed from 27 to 35 feet in Boring 3 only, and increased in appearance below 35 feet to the maximum depth explored (63 feet). The sheared shale is generally firm to moderately hard, plastic to weak and fresh to slightly weathered. The sheared material is locally foliated and matrix supported, and exhibits
extremely closely spaced fractures and quartz veining. Few distinct and continuous fracture planes were observed within the Franciscan rocks and bedding is generally absent.

Active landslide debris was encountered in Test Pits 7 and 11 excavated at the head of a ravine and swale, respectively. The debris is about 3½ feet thick and is generally clayey with high plasticity. The active landslide at Test Pit 7 is underlain by bedrock of the Franciscan Complex, while the landslide at Test Pit 11 is underlain by ancient landslide debris.

Test Pits 9 through 16 excavated northwesterly, north and northeasterly of the winery site revealed the presence of landslide debris. Test Pits 9 through 12 excavated northwest of the winery revealed the presence of about 5 feet or more of colluvium overlying ancient landslide debris. The colluvium generally comprises clayey soils and exhibits moderate to high plasticity, locally light to moderate seepage conditions and low strengths. These test pits (9-12) bottomed into ancient landslide debris to the maximum depths explored (12 feet). Test Pits 14 through 17 excavated within the north-northeastern portion of the winery project encountered colluvium to a depth of about 6½ feet and overlies dormant landslide debris. The colluvium differs from the description above in that it exposes moderate to heavy seepage and the unit is actively creeping. Dormant landslide debris was encountered from below the creeping colluvium to the maximum depths explored (13½ feet) in Test Pits 14 through 16.

The dormant and ancient landslide debris generally consists of sheared, shattered shale that is firm to moderately hard, plastic to weak and moderately weathered. Fractures are generally very closely to extremely closely spaced. We observed features including talc streaks and stringers, root mats and local pinched clay seams within the landslide debris. Within the dormant landslide on the north-northeast, Test Pits 14 through 16 bottomed on the dormant landslide debris. Test Pit 17, excavated in the headscarp area of the dormant landslide, we encountered sheared shale of the Franciscan Complex below the creeping colluvium.
A detailed description of subsurface conditions found in our core borings and test pits is given on Plates 7 through 28, Appendix A, and Plates 6 through 8, Appendix C.

**Groundwater**

Free groundwater seeped into Test Boring 3 of our original study below a depth of approximately 27 feet at the time of drilling. The seepage occurred within fractures in the Franciscan Complex bedrock materials. We did not observe evidence of groundwater seepage in Test Boring 2 of our original study. It should be noted that Core Boring 1 of our original study and our supplemental core borings may have encountered groundwater. However, the core borings were drilled using rotary wash drilling techniques, which involves circulating drilling fluid to help clean cuttings and advance the hole. Unless bore holes drilled with this method are flushed and a piezometer constructed, groundwater levels cannot be accurately measured. Locally, free groundwater seeped into test pits excavated on March 11 through 13, 2008, at various depths. Seepage generally was observed locally within and along the contacts between the colluvium and landslide debris. On hillsides, rainwater typically percolates through the porous surface materials and migrates downslope in the form of seepage at the interfaces of the surface materials including landslide debris, the bedrock, and through fractures and discontinuities in the bedrock. Fluctuations in the seepage rates typically occur due to variations in rainfall intensity, duration and other factors.
DISCUSSION AND CONCLUSIONS

Seismic Hazards

General

We did not observe subsurface conditions within the portion of the property we studied that would suggest the presence of materials that may be susceptible to seismically induced densification or liquefaction. Therefore, we judge the potential for the occurrence of these phenomena at the winery site to be low.

Faulting

There are faults mapped in close proximity to the site. As previously discussed, CGS (Huffman and Armstrong, 1980) shows an unnamed thrust fault that extends northwesterly through the northern portion of the subject parcel, and a parallel fault mapped approximately 1.3 miles to the southwest. An easterly-westerly fault that branches off the thrust fault is mapped approximately 700 to 800 feet to the southeast of the subject parcel. The branch fault shows a dip angle of 60 degrees northerly. Two short, northeasterly-trending faults are mapped approximately 300 feet southeast and between 4500 and 5000 feet northwest of the parcel. All of these faults are said to show evidence of faulting during the Pleistocene-age (700,000 to 2 million years) in Bortugno (1982).

Recent geologic mapping of the adjacent Mark West Springs 7½ minute quadrangle by Mr. Robert McLaughlin of the USGS is published as Scientific Investigations Map (SIM) 2858 (2004). SIM 2858 indicates the formerly unnamed thrust fault is the Petrified Forest Thrust (PFT) zone. Our personal communication with Mr. McLaughlin (2006) indicates the PFT fault dip ranges from approximately 50 degrees northeasterly to near
vertical at the surface, and that the age of faulting could be younger than about 2.8 million years, but no evidence of Holocene rupture was observed. The dip of the contact was not determined during mapping.

We did not observe landforms at the winery site that would indicate the presence of active faults and the site is not within a current Alquist-Priolo (A-P) Earthquake Fault Zone (Bryant and Hart, 2007). Active faults are defined by the CGS as one which has had surface displacement within Holocene time (last 11,000 years). Since the site is not within a current (A-P) Earthquake Fault Zone, we believe the risk of surface fault rupture at the site is low. However, the site is within an area affected by strong seismic activity. Several northwest-trending Earthquake Fault Zones exist in close proximity to, and within several miles of, the site (Bortugno, 1982; Brown, 1970; Helley and Herd, 1977). The shortest distances from the site to the mapped Earthquake Fault Zones are presented below in Table 1.

**TABLE 1**

**ACTIVE FAULT PROXIMITY**

<table>
<thead>
<tr>
<th>Fault</th>
<th>Direction</th>
<th>Distance-Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Andreas</td>
<td>SW</td>
<td>28½</td>
</tr>
<tr>
<td>Healdsburg-Rodgers Creek</td>
<td>SW</td>
<td>7</td>
</tr>
<tr>
<td>Redwood Hill</td>
<td>W-NW</td>
<td>7½</td>
</tr>
<tr>
<td>Yountville Earthquake of 2000</td>
<td>SE</td>
<td>13</td>
</tr>
<tr>
<td>West Napa</td>
<td>SE</td>
<td>14</td>
</tr>
<tr>
<td>Maacama</td>
<td>NW</td>
<td>8</td>
</tr>
</tbody>
</table>

**Seismicity**

Data presented by the Working Group on California Earthquake Probabilities (2007) estimates the chance of one or more large earthquakes (Magnitude 6.7 or greater) in the San Francisco Bay region within the next 30 years to be approximately 63 percent.
Therefore, future seismic shaking should be anticipated at the site. It will be necessary to design and construct the proposed winery and related improvements in strict adherence with current standards for earthquake-resistant construction, as will be recommended in a future Geotechnical Study.

**Lurching**

Seismic slope failure or lurching is a phenomenon that occurs during earthquakes when slopes or man-made embankments yield and displace in the unsupported direction. Provided the proposed fills and foundations, as applicable, are adequately keyed into underlying bedrock material, as will be recommended in a future Geotechnical Study report, we judge the potential for impact to the proposed winery from the occurrence of these phenomena at the winery site is low to moderate. Some of these secondary earthquake effects are unpredictable as to location and extent, as evidenced by the 1989 Loma Prieta Earthquake. A site-specific Geotechnical Study report will be completed once the actual building placement, elevations and related improvements are near completion.

**Landslides**

As previously discussed, CGS and USGS maps indicate the presence of landslides in the vicinity of, but not at, the proposed winery site. The discussion below summarizes mapping by CGS and USGS, and then follows with our own discussion of landsliding observed at and around the proposed winery site.

There are three landslides mapped in the vicinity by Huffman and Armstrong (1980). The very large landslide to the northeast is shown to extend southwestward along the eastern subject parcel boundary and encompasses the knoll top uphill of the proposed winery site. Our reconnaissance indicates this knoll top is underlain by Franciscan Complex bedrock. The landslide shown by Dwyer (1976) is shown to be much smaller in size, and
based on our reconnaissance and aerial photograph review, we generally tend to agree with Dwyer’s interpretation. The nearest portion of this landslide is approximately 500 feet away and on ridge flanks facing the opposite direction (easterly) of the winery site.

The second landslide, mapped on the far western parcel boundary by Huffman and Armstrong (1980), is not shown on Dwyer’s (1976) map. Our test pits excavated in the area confirm the presence of this landslide mapped by Huffman and Armstrong (1980).

The third landslide, which is queried by Huffman and Armstrong (1980) and not confirmed by Dwyer’s mapping, is located approximately 1000 feet to the east of the proposed winery site. This landslide is located past two ravines and a prominent ridge, and due to the distance and proximity, we judge this landslide will have no impact on winery construction.

During our study, we encountered active, dormant and ancient mapped and unmapped landslides at the site (see Plate 4). The two active landslides are small, rotational landslides or earth slumps that are less than 5 feet in depth. They are found at the head of a ravine southwest of the proposed winery access road, and within a shallow swale far downhill of the proposed winery.

We also encountered dormant and ancient landslides that feature rounded and subdued geomorphic features and locally dense re-vegetation. The ancient landslide on the northwest is situated nearly 200 feet downhill of the proposed winery. We did not explore the site to confirm the lower landslide limits as this area is far outside the proposed improvements. The ancient landslide exhibits rotational, or concave upward, movement which produces a curved shear surface. We estimate the ancient landslide likely exceeds a depth of 25 feet.

The dormant landslide on the north-northeast extends onto the northern end of the new proposed winery configuration, a portion of the cave and roadway. The dormant landslide appears to be a translational feature, which is sliding along a roughly planar surface that is parallel with the ground surface. Preliminarily, we estimate the middle and lower portions of this landslide to be in the 15- to 25-foot depth range but will need to be verified during a site specific geotechnical study.
SUMMARY

Based upon the results of our geologic data review, site reconnaissance's and subsurface explorations, we judge that it is currently geologically and geotechnically feasible to construct a winery and related improvements at the planned site. Creep and creep prone soils and shallower landslides can be mitigated during the normal course of grading. Avoiding or setting structures back from landslides is also a feasible mitigation. The dormant translational landslide on the north-northeastern portion of the proposed winery will require reconstructing portions or the entire landslide, depending on the planned grading, as drained, buttressed fills bearing below the landslide plane. The primary geotechnical considerations and potential mitigating measures recommended for winery site development, including constructing buttressed fills on sloping terrain and reconstructing landslides, as appropriate, will be addressed during a detailed site-specific Geotechnical Study and geotechnical engineering evaluation, as recommended herein. Based on modifications to the current plan, supplemental exploration and laboratory testing may be required to complete the geotechnical study report.

Geotechnical Issues

Downslope Creep

Weak, actively creeping and creep-prone surface soils (colluvium), such as those found at the site, tend to naturally consolidate and settle on sloping terrain that is 5H:1V or steeper. Typically, winery structures built on hillside terrain require excavating the high areas and filling the low areas to create level building pads for construction of the slab floors. Fills
deriving support from the creep-prone materials will be susceptible and contribute to accelerated downslope creep and settlement unless the fills are properly embedded in bedrock and buttressed (keyed, benched, drained and compacted). The settlement causes cracks in the slabs and foundations, and structural distress in the form of cracked concrete walls and/or plaster, sticky doors and windows, and distressed paved areas. Therefore, it will be necessary to obtain fill and/or foundation support below the creeping soils. Where creeping soils are not strengthened by remedial grading, foundations will need to be designed to resist stresses imposed by the creeping soils. In proposed building areas underlain by landslide debris, said areas will need to be reconstructed and strengthened by remedial grading, as discussed in the Fill Support section of this report. A stability analysis of areas with varying fill heights will be performed during the geotechnical study phase.

Expansive Bedrock

Sheared shale bedrock at the site is judged to be locally expansive. These materials will be exposed during site grading. Expansive materials shrink and swell as they lose and gain moisture throughout the yearly weather cycle. Near the surface, the resulting movements can heave and crack lightly loaded shallow foundations (spread footings), slabs and pavements. The zone of significant moisture variation (active layer) is dependent on the expansion potential of the soil and/or bedrock and the extent of the dry season. Stable foundation support will need to be obtained below this layer. Cut slopes in these materials will need to be constructed no steeper than 3H:1V and will be further evaluated during the geotechnical study.

Fill Support

Hillside fills need to be constructed on level keyways and benches excavated entirely into bedrock. However, regardless of the care used during grading, buttressed fills of uneven
thickness such as those typically built on hillsides, will settle differentially. Satisfactory performance of structural elements constructed on hillside fills will require the use of specialized grading techniques that will be summarized during a site-specific Geotechnical Study. These include excavating all creeping soils, and replacing said materials as a buttressed fill of even thickness or constructing said improvements entirely on cut and below creep-prone materials. Fill slopes constructed with expansive materials will need to be inclined at 3H:1V or flatter.

Fill support in areas of landsliding will need to be treated similarly. Fills planned in landslide areas will need to be keyed and benched into firm bedrock materials found below the landslide plane. The fills should be constructed as engineered, drained buttresses. In areas where planned excavations do not extend below the landslide plane, the landslide debris needs to be removed in its entirety and replaced as compacted fill to planned grades, as previously discussed.

**Foundation Support**

Satisfactory foundation support for winery structures and related improvements can be obtained from deep spread footings that bottom at minimum depth on firm bedrock exposed by planned excavations or from spread footings supported on buttressed fills of equal thickness and comprised of materials with low expansion potential (select fill). Where the creeping soils are not buttressed or removed by grading the footings must be designed to resist creep forces.

As an alternative, drilled piers gaining support in bedrock and designed to resist creeping forces, as needed, can be used for foundation support either under all parts of the structure or within areas of deep soils or buttressed fill of uneven thickness.

Foundations in areas underlain by landslides will need to be supported on engineered fill buttresses or in cut areas below the landslide debris, as previously discussed.
Recommendations for foundation design will be presented in a future geotechnical study report for the project.

**Slabs and Pavement Support**

In general, slabs-on-grade and pavements will heave and crack as the expansive soils shrink and swell through the yearly weather cycle. Slab and pavement cracking and distress are typically concentrated along edges where moisture content variation is more prevalent within subgrade soils. Slab and pavement performance and the incidence of repair can be reduced by covering the pre-swelled expansive soils with select fill prior to constructing the slabs or pavements, or by constructing moisture cutoff barriers.

**Access Roads**

The proposed roadway alignment extends off Wappo Road and wraps around the downhill western portion of the project, splits into two parallel roads through the proposed winery and merges with an existing dirt road that extends back up to Wappo Road. Road elevations are not known at this time however, we anticipate local ravines will need to be filled and uphill cuts made to construct the roads. The north-northeastern portions of the roads extend across a dormant landslide. In order to construct the roads as shown, the upper portion of the dormant landslide will have to be reconstructed as an engineered fill buttress beginning at the toe of the planned fills. Final roadway design recommendations will be included in a site-specific Geotechnical Study. In general, roadways should be aligned to avoid steep slopes and areas of potential instability in order to reduce construction costs and future maintenance.
Erosion and Site Drainage

The long-term satisfactory performance of winery improvements and roadways constructed on hillsides results primarily from strict control of surface runoff and subsurface seepage. The site's surface soils have a moderate to high erosion potential depending on slope inclination. Uncontrolled erosion could induce sloughing, new landsliding or landslide reactivation. Roof downspouts from the future winery improvements should discharge into closed glued pipes that empty away from steep and/or potentially unstable areas. Discharge for downspout points, roadway culverts and ditches and storm drain outfalls will need to be protected against erosion and sloughing by installing energy dissipators and piping the collected waters downhill to planned discharge facilities, as appropriate.

Groundwater

Free groundwater seeps were observed locally within the shallow ravines bordering the dormant landslide deposit. We also observed phreatophyte grasses, generally associated with spring activity, on the far western portion of the surveyed site (Plate 4). On hillsides, rainwater typically percolates through the porous surface materials and migrates downslope in the form of seepage at the interfaces of the surface materials including landslide debris, bedrock, and through fractures and discontinuities in the bedrock. Fluctuations in the seepage rates typically occur due to variations in rainfall intensity, duration and other factors.

Supplemental Services

We should prepare a detailed, site-specific Geotechnical Study report during the final design and construction of the winery and roadways. The study may require supplemental
subsurface exploration, laboratory testing, and engineering analyses. The Geotechnical Study should address specific design of the winery improvements and access roads, and the data generated should be incorporated into the approved project plans. The plans should then be reviewed by the geotechnical engineer and/or engineering geologist prior to receiving bids for the planned work.

If more than 18 months have elapsed since the submission of this report, the conclusions and recommendations made in this report may no longer be valid or appropriate. In such case, we recommend that we be retained to review this report and verify the applicability of the conclusions and recommendations or modify the same considering the time lapsed or changed conditions. The validity of conclusions and recommendations made in this report is contingent upon such review.

These supplemental services are performed on an as-requested basis and are in addition to this preliminary geotechnical study. We cannot accept responsibility for items that we are not notified to observe or for changed conditions we are not allowed to review.

LIMITATIONS

This report has been prepared by RGH for the exclusive use of Cornell Farms, LLC and their consultants to evaluate the preliminary geologic feasibility of winery development on the subject site.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no other warranty, either expressed or implied. Our conclusions and preliminary recommendations are based on the information provided to us regarding the proposed winery development, the results of our field reconnaissance, deep subsurface exploration and data review, and our professional judgment. As such, our conclusions and recommendations discussed above should be considered preliminary and for feasibility and
planning purposes only. Following our receipt of the site plan showing the actual layout of the winery and related improvements with elevations and supplemental subsurface exploration, such as recommended herein, local conditions may be different from those inferred by our previous work. Such subsurface study may warrant a revision to our preliminary conclusions and geotechnical issues discussed above.

Site conditions and cultural features described in the text of this report are those existing at the time of our site reconnaissance on August 26, 2005, and our field explorations on November 8 through 14, 2005, December 12 through 13, 2005, September 27, 2006, November 15 through 18, 2006 and March 11 through 13, 2008, and may not necessarily be the same or comparable at other times.

It should be understood that slope failures including reactivation of landslides, new landslides, debris flows and erosion are on-going natural processes which gradually wear away the landscape. Residual soils and weathered bedrock can be susceptible to downslope movement, even on apparently stable sites. Such inherent hillside and slope risks are generally more prevalent during periods of intense and prolonged rainfall, which occasionally occur in northern California and/or during earthquakes. Therefore, it must be accepted that occasional slope failure, reactivation of landslides and erosion and deposition of the residual soils and weathered bedrock materials are irreducible risks and hazards of building upon or near the base of any hillside or steep slope throughout northern California. By accepting this report, the client and other recipients acknowledge their understanding and acceptance of these risks and hazards.

The scope of our services did not include an environmental assessment or a study of the presence (or absence) of hazardous, toxic or corrosive materials in the soil, surface water, groundwater or air on, below, or around this site, nor did it include an evaluation or study for the presence (or absence) of wetlands.
APPENDIX A - PLATES

LIST OF PLATES

Plate 1  Site Location Map
Plates 2A and 2B  CGS Geologic Map
Plates 3A and 3B  CGS and USGS Landslide Maps
Plate 4  Site Geologic Map
Plates 5A and 5B  Geologic Cross Sections
Plate 6  Exploration Plan
Plates 7 to 11  Test Pit Logs 1 through 5 (09-27-06)
Plates 12 to 16  Core Borings 1 through 5 (12-15 to 18, 2006)
Plates 17 to 28  Test Pit Logs 6 through 17 (03-11 to 13, 2008)
Plate 29  Soil Classification Chart and Key to Test Data
Plate 30  Engineering Geology Rock Terms
SYMBOLS

Contact: solid line where well located, long dash where approximately located, short dash where inferred (gradational in the Talus 15... minute quadrangle), dotted where concealed; query indicates additional uncertainty.

Fault: solid line where well located, long dash where approximately located, short dash where inferred, dotted where concealed; query indicates additional uncertainty. Arrow and number indicate direction and amount of dip in degrees. Whether or not the fault is active or poses any hazard to man is generally unknown. Only crosscutting faults are shown within KJfs, although most contacts therein probably are faults.

Strike and dip of bedding inclined

EXPLANATION

Sonoma Volcanics Group
(not necessarily in stratigraphic sequence.)

Tsa Andesitic to basaltic lava flows
Tst Pumiceous ash-flow tuff, locally welded or partly welded with intercalated bedded agglomeritic tuff, andesitic or basaltic lava flows, tuff breccia, bedded tuff, and pumiceous tuff
Tes Sedimentary deposits; unconsolidated interbedded and interlayering tuffaceous sand, silt, volcanic gravel; bedded tuff, clay, diatomite

Franciscan Assemblage
(not necessarily in correct time sequence.)

KJs Sheared shale and sandstone that contains generally resistant masses of chert, "high grade" metamorphic rock, variable shattered sandstone and greenstone, metagreenstone, and generally less resistant serpentinite; masses range in length from less than one foot to greater than 5 miles, and constitute a variable, generally unknown proportion of the unit. Potassium feldspar generally absent. Parts of unit correspond to midrange unit described by Hau (1969).

Rocks types that occur as discrete masses, chiefly within KJfs.

sp Serpentinite, including relatively fresh ultramafic masses. Occurs as lenses, sheets, and irregularly shaped masses, largely within and along boundaries of KJfs.

gs Greenstone, including pillow lava, tuff, minor intrusive varieties, and minor fossiliferous limestone, and metagreenstone ranging from rock containing incipient blueschist minerals to completely reconstituted blueschist. Masses range to longer than 5 miles.

Winery Site (Enlarged to show location)

Reference: Huffman and Armstrong (1980), "Geology for Planning in Sonoma County," CDMG Special Report 120, Plate 3A.

Scale: 1:62,500
SYMBOLS

Contact; solid line where well located, long dash where approximately located, short dash where inferred (gradational in the Calistoga 15 minute quadrangle), dotted where concealed; query indicates additional uncertainty.

Fault; solid line where well located, long dash where approximately located, short dash where inferred, dotted where concealed; query indicates additional uncertainty. Arrow and number indicate direction and amount of dip in degrees. Whether or not the fault is active or poses any hazard to man is generally unknown. Only crosscutting faults are shown within KJs, although most contacts therein probably are faults.

Strike and dip of bedding: Inclined

Thrust fault; dashed where approximately located, queried where doubtful. Sawteeth on upper plate.

EXPLANATION

Sonoma Volcanics Group
(not necessarily in stratigraphic sequence.)

<table>
<thead>
<tr>
<th>Tsa</th>
<th>Andesitic to basaltic lava flows.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tst</td>
<td>Pumiceous ash-flow tuff, locally welded or partly welded with intercalated bedded agglomeritic tuff, andesitic or basaltic lava flows, tuff breccia, bedded tuff, and pumiceous tuff</td>
</tr>
</tbody>
</table>

Franciscan Assemblage
(not necessarily in correct time sequence.)

<table>
<thead>
<tr>
<th>KJs</th>
<th>Sheared shale and sandstone that contains generally resistant masses of chert, &quot;high grade&quot; metamorphic rock, variable shattered sandstone and greenstone, metagreenstone, and generally less resistant serpentinite; masses range in length from less than one foot to greater than 5 miles, and constitute a variable, generally unknown proportion of the unit. Potassium feldspar generally absent. Parts of unit correspond to mélangé unit described by Hsu (1969). Rock types that occur as discrete masses; chiefly within KJs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ch</td>
<td>Serpentinite, including relatively fresh ultramafic masses. Occurs as lenses, sheets, and irregularly shaped masses, largely within and along boundaries of KJs.</td>
</tr>
<tr>
<td>sp</td>
<td>Greenstone, including pillow lava, tuff, minor intrusive varieties, and minor fossiliferous limestone, and metagreenstone ranging from rock containing incipient blueschist minerals to completely reconstituted blueschist. Masses range to longer than 5 miles.</td>
</tr>
</tbody>
</table>
EXPLANATION

Relative Slope Stability Categories

Landslides

Areas of lowest relative slope stability. Failure and downslope movement of rock and soil has occurred, or may have occurred ("possible" landslides).

Areas of relatively unstable rock and soil units, on slopes greater than 15%, containing abundant landslides.

Locally level areas within hilly terrain; may be underlain or bounded by unstable or potentially unstable rock materials.

Note: Geologic conditions in areas labeled Bf, B, C, and landslides mandate that engineering geology reports must be required prior to tentative tract approval for land use planning and land development.

Note: Categories are interpretive and apply generally to large areas. Within each area conditions may range in detail through all four stability categories. Hence, an A area may locally contain unmapped landslides, and a landslide area may contain stable slopes of slight inclination.

Landslide Symbols

Contact between landslide deposits; landslide and more stable ground; or areas of differing slope stability. Dashed line indicates an approximate location.

General direction of landslide movement

Query indicates possible landslide

Landslide or severe soil creep area too small to be outlines at the map scale. Question mark adjacent to arrow indicates landslide is uncertain, or "possible."

Reference: Huffman and Armstrong (1980), "Geology for Planning in Sonoma County," CDMG Special Report 120, Plate 2A.

Scale: 1:62,500

CGS LANDSLIDE MAP

Cornell Winery
245 Wappo Road
Santa Rosa, California

RGH Consultants, Inc.

Job No: 2096.02.01.1
Appr: D
Drwn: tI
Date: April 2008

PLATE

3A
Symbols Used

LANDSLIDE ZONE:
Slide area consisting of numerous coalesced and superposed landslides of various sizes, types of movement, and degrees of activity. Because of spatial complexity, it is generally not feasible to delineate individual slides composing these zones. Meaning of symbols: D, P, and A are the same as of LARGE LANDSLIDE DEPOSITS (see below). The following symbols are used only for the LANDSLIDE ZONES: D-DA, landslide zone consist of primarily DEFINITE TO DEFINITE and ACTIVE landslide deposits; P-?, landslide zone consists of primarily PROBABLE to QUESTIONABLE landslide deposits.

LARGE LANDSLIDE DEPOSITS:
Landslide which is 50 feet or more in maximum dimension. Arrows indicate general direction of downslope movement (omitted for lack of space on some landslides and on all questionable landslides). Single barbed arrows indicate primarily flow movement. Capital letters shown on each landslide have the following designations: D, DEFINITE landslide deposits; P, PROBABLE landslide deposits. Hachured lines show the approximate position of inferred landslide scarpas. Topographic features whose outlines are subdued by weathering and/or largely obscured by vegetation but whose overall form is suggestive of landslide origin are called questionable landslides (? On map).

SMALL LANDSLIDE DEPOSITS:
100 to 500 feet in maximum dimension. Arrows indicate general direction of downslope movement and are centered over the location of deposits. Meaning of symbols: arrows, D, P, ? are the same as for LARGE LANDSLIDE DEPOSITS (see above).

Reference: Dwyer, Noguchi, and O'Rourke (1976), "Reconnaissance Photo-Interpretation Map of Landslides in 24 Selected 7.5-Minute Quadrangles in Lake, Napa, Solano, and Sonoma Counties," USGS, OFR 76-74. Scale: 1:24,000
Explanation

Qc  Calluvium
Qals  Ancient Landslide Debris
KJls  Franciscan Complex
  sh - Sheared Shale
  ss - Sandstone

Note:
1. Winery Finished Floor Elevations To Be Determined During Design
2. Cave Floor Elevation To Be Determined During Design
3. C2-3 Projected 16°NE
   B-1 Projected 13°SW
   B-2 Projected 20°SW
   TP-9 In line of cross section
   TP-10 Projected 17°NE

Elevations determined from "Partial Site Plan, Sheet A.1.2" by Backen Gillam Architects, dated 9/4/07.
Scale: 1" = 60'

RGH Consultants, Inc.
CROSS SECTION B - B'
Cornell Winery
245 Wappo Road
Santa Rosa, California
PLATE 5A
**Explanation**

- **Qc**: Colluvium with Areas of Active Creep
- **Qdls**: Dormant Landslide Debris
- **KJs**: Franciscan Complex, Sheared Shale

**Note:**
1. TP-17 Projected 20' SW
   TP-16 in line of cross section
   TP-15 Projected 21' NE

---

Elevations determined from "Partial Site Plan, Sheet A1.2" by Backen Gillam Architects, dated 9/4/07. Scale: 1" = 60'

**CROSS SECTION C - C'**

- **RGH Consultants, Inc.**
- **Cornell Winery**
- **245 Wappo Road**
- **Santa Rosa, California**
- **PLATE 5B**
<table>
<thead>
<tr>
<th>Sample</th>
<th>Depth (Feet)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>BROWN GRAVELLY CLAY (CL), medium stiff, dry; porous, with sandstone rock fragments and abundant roots in upper 1 foot (Colluvium).</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MOTTLED BROWN SANDY CLAY (CL), medium stiff, moist (Residual Soil).</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>BROWN SANDSTONE, locally very thinly bedded, very closely spaced fractures, moderately hard to hard, moderately strong, slightly weathered; locally blue gray and orange mottle, locally moderately weathered, dark brown and black staining on fracture surfaces (Franciscan Complex).</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Excavation resistance increases below 5 feet. Bottom of test pit at 6 feet. No free groundwater seepage observed.</td>
<td></td>
</tr>
</tbody>
</table>


**LOG OF TEST PIT TP-1**

- Cornell Winery
- 245 Wappa Road
- Santa Rosa, California

**RGH Consultants, Inc.**

- Job No: 2006.02.01.1
- Appr: G
- Dwn: T
- Date: April 2006
BROWN SANDY CLAY (CL), medium stiff, dry; porous, with sandstone rock fragments and roots (Colluvium).

MOTTLED YELLOW AND ORANGE BROWN SANDY CLAY (CL), stiff, moist; contains sandstone rock fragments (Residual Soil).

BROWN SANDSTONE, very closely spaced fractures, variably firm to moderately hard, friable to moderately strong, moderately weathered; contains zones of bluish gray clay near top of unit (Franciscan Complex).

Bottom of test pit at 7 feet.
No free groundwater seepage observed.

BROWN SANDY CLAY (CL), medium stiff, dry; porous, contains small sandstone rock fragments (Topsoil).

MOTTLED DARK GRAY SANDY CLAY (CH), stiff, moist; abundant tacky and shiny polished surfaces (Residual Soil).

DARK GRAY AND BLUE GRAY SHEARED SHALE, closely to extremely closely spaced fractures, firm, plastic to friable, fresh to slightly weathered; foliated, with inclusions of moderately hard sandstone fragments, talc patches (Franciscan Complex).

Continues: DARK GRAY AND BLUE GRAY SHEARED SHALE, closely to extremely closely spaced fractures, firm, plastic to friable, fresh to slightly weathered; foliated, with inclusions of moderately hard sandstone fragments, talc patches (Franciscan Complex).

Bottom of test pit at 16 feet.
No free groundwater seepage observed.

**Other Laboratory Tests**

<table>
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<th>Depth (FEET)</th>
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<tbody>
<tr>
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<td>8</td>
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<tr>
<td>9</td>
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</tr>
</tbody>
</table>

**Equipment:** Deere 160C LC Excavator with a 36-inch bucket

**Logged By:** GDS  
**Date:** 9-27-06

**Excavator:** Mora Construction  
**Elevation:** 1922.00

---

**BROWN SANDY CLAY (CL),** medium stiff, dry, porous with small sandstone rock fragments and abundant roots (Topsoil).

---

**DARK GRAY SHEARED SHALE,** closely to extremely closely spaced fractures, firm to moderately hard, plastic to friable, fresh to slightly weathered, foliated, with inclusions of moderately strong sandstone fragments, talc stringers (Franciscan Complex).

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**RGH Consultants, Inc.**

**Job No:** 2096.02.01.1  
**Plt:** 10A

**LOG OF TEST PIT TP-4**  
Cornell Winery  
245 Wappo Road  
Santa Rosa, California  
**Date:** April 2008
Continues: DARK GRAY SHEARED SHALE, closely to extremely closely spaced fractures, firm to moderately hard, plastic to friable, fresh to slightly weathered; foliated, with inclusions of moderately strong sandstone fragments, talc stringers (Franciscan Complex).

Discontinuous, undulating, planar feature at 14 feet: N14W / 24NE.

Bottom of test pit at 18 feet.
No free groundwater seepage observed.

EQUIPMENT: Deere 160C LC Excavator with a 36-inch bucket
LOGGED BY: GDS         DATE: 9-27-06
EXCAVATOR: Mora Construction   ELEVATION: 1904.00 *

Sample

DEPTH
(FT)

0

1

2

3

4

5

6

7

BROWN CLAYEY SAND (SC), medium dense, dry; porous with roots and sandstone fragments (Topsoil).

DARK BLUE GRAY SANDSTONE, closely to extremely closely spaced fractures, firm, friable to weak, slightly to moderately weathered (Franciscan Complex).

DARK GRAY SHEARED SHALE, closely to extremely closely spaced fractures, firm, plastic to friable, fresh to slightly weathered; foliated, talc stringers (Franciscan Complex).

Bottom of test pit at 7½ feet.
No free groundwater seepage encountered.

<table>
<thead>
<tr>
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<th>Box #</th>
<th>% Rec. % Rgl</th>
<th>Sample #</th>
<th>Blows per foot*</th>
<th>Sample</th>
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<td>24*</td>
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<td>100/80</td>
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<td>5</td>
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<td>7</td>
<td>100/83</td>
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<td>8</td>
<td>100/83</td>
<td>7</td>
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<td>9</td>
<td>100/83</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


** BROWN SANDY CLAY, medium stiff, moist; porous (Colluvium).

** BROWN GRAVELLY CLAY, very stiff, moist (Residual Soil).

** BROWN SANDSTONE, closely spaced fractures, moderately hard, weak to moderately strong, slightly weathered (Franciscan Complex).

gradual color change to mottled gray brown.

gradual color change to mottled gray.

** DARK GRAY SHEARED SHALE, firm, plastic to friable, fresh to slightly weathered; with inclusions of hard graywacke sandstone fragments (Franciscan Complex).
<table>
<thead>
<tr>
<th>Box #</th>
<th>% Rec. % Rqd</th>
<th>Sample #</th>
<th>Blows per foot</th>
<th>Depth (Feet)</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>100/100</td>
<td>9</td>
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<td>30</td>
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</table>

Quartz veining in sandstone inclusion at 25.0 feet.

DARK GRAY GRAYWACKE SANDSTONE, very closely spaced fractures, moderately hard, weak to moderately strong, slightly weathered (Franciscan Complex). Shears between 70° - 75° at 29.0 feet.

Bottom of core boring at 30 feet.

EQUIPMENT: Track Mounted Mud Rotary Drill Rlg
DRILLER: Pitcher Drilling
LOGGED BY: BNP
ELEVATION: 1935 feet**
START DATE: 11-16-06
FINISH DATE: 11-16-06

BROWN SANDY CLAY, medium stiff, wet (Topsoil).

LIGHT BROWN SANDSTONE, firm, friable to weak, slightly to moderately weathered; with shale fragments (Franciscan Complex).

DARK GRAY SHEARED SHALE, extremely closely spaced fractures, firm, plastic to friable, fresh to slightly weathered (Franciscan Complex).

Quartz veining and mineralization along fractures beginning at 11½ feet.

very closely to extremely closely spaced fractures

Lenses of shale, drilling resistance increases.


R G H Consultants, Inc.

Job No: 2096.02.01.1
Appr: 
Drwn: 
Date: April 2008

LOG OF CORE BORING 2
Cornell Winery
245 Wappo Road
Santa Rosa, California
PLATE 13A
<table>
<thead>
<tr>
<th>Box #</th>
<th>% Rec. / % Red</th>
<th>Sample Level</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>3</td>
<td>100/100</td>
<td>25</td>
<td>With saccharoidal texture, light greenish gray mineralization</td>
</tr>
<tr>
<td></td>
<td>90/80</td>
<td>26</td>
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</tr>
<tr>
<td></td>
<td>93/80</td>
<td>27</td>
<td></td>
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<tr>
<td></td>
<td>100/100</td>
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<td>64/72</td>
<td>31</td>
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<tr>
<td></td>
<td>100/100</td>
<td>32</td>
<td>DARK GRAY GRAYWACKE SANDSTONE, extremely closely spaced fractures, hard, strong, slightly weathered (Franciscan Complex).</td>
</tr>
<tr>
<td></td>
<td>85/82</td>
<td>33</td>
<td>Spot core below 40 feet.</td>
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<td>34</td>
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<td></td>
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<td></td>
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</tbody>
</table>


Bottom of core boring at 48½ feet.

**Log of Core Boring 3**

Cornell Winery
245 Wappo Road
Santa Rosa, California

Job No: 2095.02.01.1
Appr: [signature]
Drwn: [signature]
Date: April 2008

**EQUIPMENT:** Track Mounted Mud Rotary Drill Rig

**DRILLER:** Pitcher Drilling

**LOGGED BY:** GDS, BNP

**ELEVATION:** 1931 feet**

**START DATE:** 11-16-06

**FINISH DATE:** 11-16-06

---

**DARK GRAY GRAYWACCHE SANDSTONE,** extremely to very closely spaced fractures, moderately strong, moderately hard, slightly weathered; with quartz veining (Franciscan Complex).

Bottom of core boring at 35½ feet.
<table>
<thead>
<tr>
<th>Remarks</th>
<th>Box#</th>
<th>% Red / % Rap</th>
<th>Sample #/ Blows per foot</th>
<th>Depth (Ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>80/30</td>
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<td>100/100</td>
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** EQUIPMENT: Track Mounted Mud Rotary Drill Rig **
** DRILLER: Pitcher Drilling **
** LOGGED BY: BNP **
** ELEVATION: 1890 feet **
** START DATE: 11-17-06 **
** FINISH DATE: 11-17-06 **

- BROWN SANDY CLAY (CL), medium stiff, moist; porous, with gravel (Colluvium).
- LIGHT BROWN SANDSTONE, firm, friable, slightly to moderately weathered (Franciscan Complex).
- MOTTLED ORANGE BROWN SANDSTONE, extremely to very closely spaced fractures, moderately hard, moderately strong, slightly weathered (Franciscan Complex).
- Sheared shale lens at 12 feet.
- Quartz veining on fracture surfaces.
- DARK GRAY GRAYWACKE SANDSTONE, very closely spaced fractures, moderately hard, moderately strong, slightly weathered; with quartz veining (Franciscan Complex).
- DARK GRAY SHEARED SHALE, extremely closely spaced fractures, firm, plastic to friable, fresh to slightly weathered (Franciscan Complex).
- With graywacke sandstone fragments.
### Log of Core Boring 4

**EQUIPMENT:** Track Mounted Mud Rotary Drill Rig  
**DRILLER:** Pitcher Drilling  
**LOGGED BY:** BNP  
**ELEVATION:** 1890 feet**  
**START DATE:** 11-17-06  
**FINISH DATE:** 11-17-06

<table>
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<tr>
<th>Box #</th>
<th>% Red./% Rp</th>
<th>Sample #</th>
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<th>Sample</th>
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<tr>
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<tr>
<td></td>
<td>67**</td>
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</table>

No recovery at 25 to 26 feet. Very hard drilling below 25 feet.

Bottom of core boring at 30¼ feet.


**BROWN SANDY CLAY (CL), medium stiff, moist; porous, with gravel (Colluvium).**

**LIGHT BROWN SANDSTONE, weak, moderately strong, slightly to moderately weathered (Franciscan Complex).**

**MOTTLED GRAY SHEARED SHALE, firm, plastic to friable, fresh to slightly weathered (Franciscan Complex).**

Lenses of sandstone, closely spaced fractures, hard, strong.

**DARK GRAY GRAYWACKE SANDSTONE, closely to extremely closely spaced fractures, hard, moderately strong, slightly weathered (Franciscan Complex).**

Spot core from below 14½ feet to 25 feet.

---

**LOG OF CORE BORING 5**

Cornell Winery
245 Wappo Road
Santa Rosa, California

Job No: 2096.02.01.1

Appl: [Signature]

Drwn: [Signature]

Date: April 2008

R.G.H. Consultants, Inc.

R G H Consultants, Inc.

Log No. 2096.02.01.1

LOG OF CORE BORING 5
Cornell Winery
245 Wappo Road
Santa Rosa, California

Plat 16B
A. DARK BROWN CLAYEY SAND (SC), loose, moist; porous, with rock fragments (Colluvium).

B. REDDISH BROWN AND LIGHT GRAY SANDY CLAY (CL), stiff, moist; with sandstone rock fragments (Residual Soil).

GRAY BROWN SANDSTONE, closely to extremely closely spaced fractures, moderately hard, weak to moderately strong, moderately weathered; with yellow and orange mottling, black staining on fracture surfaces. Fractures: N32E/8SE; N21W/25SW (Franciscan Complex)

No free groundwater seepage observed

Elevation: 1897 feet, from "Partial Site Plan, Sheet A1.2" by Backen Gillam Architects, dated 9/4/07.

Scale: 1" = 5'

RGH Consultants, Inc.

Log of Test Pit TP-6
Cornell Winery
245 Wappo Road
Santa Rosa, California
DARK BROWN SANDY CLAY (CL), soft moist; porous, with rock fragments and grass roots (Colluvium, disturbed by grubbing).

MOTTLED BROWN SANDY CLAY (CL), medium stiff, moist; porous, with small sandstone fragments and small roots (Colluvium).

DARK GRAY SANDY CLAY (CH), medium stiff, wet; with small roots, grading mottled yellow brown and moist to southwest, shearing at 30° on northeast (Active Landslide Debris).

BROWN SANDSTONE, closely to extremely closely spaced fractures, moderately hard to hard, weak to moderately strong, moderately weathered; with yellow and orange mottling, dark brown and black staining on fracture surfaces, dark gray clayey bands that are firm and friable to plastic (Franciscan Complex)
MOTTLED YELLOW BROWN CLAYEY GRAVEL (GC), loose, moist; porous, with sandstone rock fragments and grass roots (Colluvium, disturbed by grubbing).

MOTTLED YELLOW AND ORANGE BROWN SANDY CLAYEY GRAVEL (GC), medium dense, moist; with plastic clayey pockets (Colluvium).

GRAY BROWN SANDSTONE, closely to extremely closely spaced fractures, moderately hard to hard, weak to moderately strong, moderately weathered; with light gray veining, firm and friable pockets in upper portion, dark brown and black staining on fracture surfaces (Franciscan Complex).

No free groundwater seepage observed.
DARK GRAY AND BROWN SHEARED SHALE LANDSLIDE DEBRIS, closely to very closely spaced fractures.

MOTTLED GRAY AND BROWN GRAVELLY CLAY (CL-GH), stiff, moist; free water seepage observed on southeast lower.

GRAY BROWN SANDY CLAY (CL), soil in medium stiff, moist; with roots in upper root (topsoil).

Elevation: 1668 feet, from 'Partial Site Plan, Sheet A 1', by Backen Gillam Architects, dated 9/4/07.
DARK BROWN SANDY CLAY (CL), soft moist; porous, with rock fragments and grass roots (Topsoil).

MOTTLED YELLOW BROWN SANDY CLAY (CL), stiff, moist; with sandstone rock fragments, light gray patches, grading plastic with increasing depth to base of horizon, free water seepage at base of horizon on southeast (Colluvium).

MOTTLED YELLOW BROWN SHATTERED SANDSTONE LANDSLIDE DEBRIS, very closely to extremely closely spaced fractures, firm to moderately hard, friable to weak, moderately weathered; with dark gray and light gray patches (Ancient Landslide Debris).
MOTTLED BROWN SANDY CLAY (CL), soft, moist; with mixed organics (Topsoil, disturbed by grubbing).

MOTTLED YELLOW AND ORANGE BROWN SANDY CLAY (CH), medium stiff, wet; with rock fragments and roots (Active Landslide Debris).

MOTTLED DARK GRAY AND BROWN CLAYEY GRAVEL (GC), medium dense, moist; with local roots (Active Landslide Debris).

DARK GRAY SHEARED SHATTERED SHALE LANDSLIDE DEBRIS, closely to very closely spaced fractures, moderately hard, weak to moderately strong, moderately weathered; foliated, with firm and friable pockets (Ancient Landslide Debris).

No free groundwater seepage observed.
A  BROWN SANDY CLAY (CL), soft, moist; porous, with abundant roots (Topsoil).

B  YELLOW BROWN SANDY CLAY (CL-CH), stiff, moist; with sandstone rock fragments and roots (Colluvium).

MOTTLED YELLOW BROWN SHEARED SHATTERED SHALE LANDSLIDE DEBRIS, extremely closely spaced fractures, moderately hard, moderately strong, moderately weathered; foliated, with clayey pockets and root filled veins (Ancient Landslide Debris).

No free groundwater seepage observed.
**A** DARK BROWN SANDY CLAY (CL), medium stiff, moist; porous with abundant roots (Colluvium).

**B** MOTTLED GRAY AND YELLOW BROWN SANDY CLAY (CH), medium stiff, wet; with sandstone rock fragments, shear plane N56W/50NW at base of horizon (Colluvium).

**C** DARK GRAY SHEARED SHALE LANDSLIDE DEBRIS, extremely closely spaced fractures, firm to weak, friable, moderately weathered; with moderately hard blocks of graywacke sandstone, local talc stringers, free water seepage observed throughout (Dormant Landslide Debris).

**D** MOTTLED GRAY AND YELLOW BROWN SHEARED SHALE, closely to extremely closely spaced fractures, hard, strong, slightly weathered (Franciscan Complex).
A MOTTLED BROWN SANDY CLAY (CL), medium stiff, moist; porous, with sandstone rock fragments and roots (Colluvium).

MOTTLED YELLOW BROWN AND DARK GRAY GRAVELLY CLAY (CL-CH), stiff, moist; with cobble and boulder sized sandstone fragments, tree roots, shear plane N75E/26NW @ 3½ feet on opposite pit wall (Colluvium).

DARK GRAY TO BLACK SHEARED SHATTERED SHALE LANDSLIDE DEBRIS, very closely to extremely closely spaced fractures, firm to moderately hard, friable to weak, moderately weathered; foliated, with local shattered sandstone blocks and talc streaks, root mats (Dormant Landslide Debris).

No free groundwater seepage observed.
**A** BROWN SANDY CLAY (CL), medium stiff, moist; porous, with rock fragments and abundant roots (Colluvium).

**B** MOTTLED BROWN-GRAY BROWN GRAVELLY CLAY (CH), medium stiff, moist (Colluvium).

**C** MOTTLED YELLOW BROWN AND GRAY GRAVELLY CLAY (CH), medium stiff, wet; roots along base of horizon, free water seepage throughout (Colluvium).

**D** DARK GRAY SHEARED SHATTERED SHALE LANDSLIDE DEBRIS, very closely to extremely closely spaced fractures, firm to moderately hard, plastic to weak, moderately weathered; foliated, with local talc stringers and root mats (Dormant Landslide Debris).
A BROWN SANDY CLAY (CL), medium stiff, moist; porous, with rock fragments and roots (Colluvium).

B MOTTLED BROWN GRAVELLY CLAY (CL-CH), medium stiff, moist; with some roots (Colluvium).

MOTTLED YELLOW BROWN AND GRAY GRAVELLY CLAY (CH), stiff, wet; with sandstone rock fragments and local roots, free water seepage throughout, shear plane N18W/20SW; N35W/18SW (Colluvium).

DARK GRAY SHEARED SHATTERED SHALE LANDSLIDE DEBRIS, very closely to extremely closely spaced fractures, firm, plastic, moderately weathered; foliated, with moderately hard inclusions, abundant talc patches and root mats, pinched clay seams (Dormant Landslide Debris).
DARK BROWN SANDY CLAY (CL), medium stiff, moist; porous, with rock fragments and roots (Colluvium).

BROWN GRAVELLY CLAY (CL), stiff, moist; with some roots (Colluvium).

MOTTLED YELLOW BROWN AND GRAY GRAVELLY CLAY (CH), stiff, moist (Colluvium).

DARK GRAY SHEARED SHALE, closely to extremely closely spaced fractures, firm, friable, moderately weathered; foliated, with moderately hard to hard and friable to weak inclusions, talc seams (Franciscan Complex).

No free groundwater seepage observed.
## Unified Soil Classification System

### Major Divisions

<table>
<thead>
<tr>
<th>Coarse Grained Soils</th>
<th>Fine Grained Soils</th>
<th>Highly Organic Soils</th>
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</thead>
<tbody>
<tr>
<td>Gravel and Gravelly Soils</td>
<td>Silts and Clays</td>
<td>Peat, Humus, Swamp Soils and Other Soils with High Organic-Contents</td>
</tr>
<tr>
<td>More than 50% of material is larger than No. 200 sieve size</td>
<td>Liquid limit less than 50</td>
<td>Liquid limit greater than 50</td>
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<tr>
<td>Clean Gravel (Little or Fines)</td>
<td>Clean Sands (Little or Fines)</td>
<td>Clean Sands (Little or Fines)</td>
</tr>
<tr>
<td>Gravel with Fines (Over 12% of Fines)</td>
<td>Gravel with Fines (Over 12% of Fines)</td>
<td>Gravel with Fines (Over 12% of Fines)</td>
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<tr>
<td>Clayey Gravel, Poorly Graded Gravel-Sand-Clay Mixtures</td>
<td>Clayey Sands, Poorly Graded Sand-Silt Mixtures</td>
<td>Clayey Sands, Poorly Graded Sand-Clay Mixtures</td>
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<tr>
<td>Clayey Gravel, Poorly Graded Gravel-Sand-Clay Mixtures</td>
<td>Silty Sands, Poorly Graded Sand-Silt Mixtures</td>
<td>Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands, or Clayey Silts with Slight Plasticity</td>
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<tr>
<td>Well-Graded Sand, Gravelly Sand, Little or No Fines</td>
<td>Silty Sands, Poorly Graded Sand-Silt Mixtures</td>
<td>Organic Clays and Organic Silty Clays of Low Plasticity</td>
</tr>
<tr>
<td>Poorly-Graded Sand, Gravelly Sand, Little or No Fines</td>
<td>Organic Clays and Organic Silty Clays of Low Plasticity</td>
<td>Inorganic Clays of High Plasticity, Fat Clays</td>
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<tr>
<td>Organic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils, Elastic Silts</td>
<td>Organic Clays of Medium to High Plasticity, Organic Silts</td>
<td>Organic Clays of Medium to High Plasticity, Organic Silts</td>
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</table>

### Key to Test Data

- **Consol** - Consolidation
- **LL** - Liquid Limit (in %)
- **PL** - Plastic Limit (in %)
- **Gs** - Specific Gravity
- **SA** - Sieve Analysis
- **Pitcher Barrel Sample**
- **Bulk or Disturbed Sample**
- **Standard Penetration Test**
- **Sample Attempt With No Recovery**

<table>
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<th>Value</th>
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<td>Confining Pressure, psf</td>
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<td>Consolidated Drained Direct Shear</td>
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<td>Laboratory Vane Shear</td>
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<td>Shrink Swell</td>
<td>Expansion</td>
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<td>Permeability</td>
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Note: All strength tests on 2.8-in. or 2.4-in. diameter sample, unless otherwise indicated.
**ROCK SYMBOLS**

<table>
<thead>
<tr>
<th>SHALE OR CLAYSTONE</th>
<th>CHERT</th>
<th>SERPENTINITE</th>
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<td>ALTERED ROCKS</td>
</tr>
<tr>
<td>CONGLOMERATE</td>
<td>PLUTONIC</td>
<td>SHEARED ROCKS</td>
</tr>
</tbody>
</table>

**LAYERING**

<table>
<thead>
<tr>
<th>MASSIVE</th>
<th>Greater than 6 feet</th>
<th>VERY WIDELY SPACED</th>
<th>Greater than 6 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKLY BEDDED</td>
<td>2 to 6 feet</td>
<td>WIDELY SPACED</td>
<td>2 to 6 feet</td>
</tr>
<tr>
<td>MEDIUM BEDDED</td>
<td>8 to 24 inches</td>
<td>MODERATELY SPACED</td>
<td>8 to 24 inches</td>
</tr>
<tr>
<td>THINLY BEDDED</td>
<td>2½ to 8 inches</td>
<td>CLOSELY SPACED</td>
<td>2½ to 8 inches</td>
</tr>
<tr>
<td>VERY THINLY BEDDED</td>
<td>¼ to ½ inches</td>
<td>VERY CLOSELY SPACED</td>
<td>¾ to 2¾ inches</td>
</tr>
<tr>
<td>CLOSELY LAMINATED</td>
<td>¼ to ½ inches</td>
<td>EXTREMELY CLOSELY SPACED</td>
<td>Less than ¼ inch</td>
</tr>
</tbody>
</table>

**HARDNESS**

- **Soft** - pliable; can be dug by hand
- **Firm** - can be gouged deeply or carved with a pocket knife
- **Moderately Hard** - can be readily scratched by a knife blade; scratch leaves heavy trace of dust and is readily visible after the powder has been blown away
- **Hard** - can be scratched with difficulty; scratch produces little powder and is often faintly visible
- **Very Hard** - cannot be scratched with pocket knife, leaves a metallic streak

**STRENGTH**

- **Plastic** - capable of being molded by hand
- **Friable** - crumbles by rubbing with fingers
- **Weak** - an unfractured specimen of such material will crumble under light hammer blows
- **Moderately Strong** - specimen will withstand a few heavy hammer blows before breaking
- **Strong** - specimen will withstand a few heavy ringing hammer blows and usually yields large fragments
- **Very Strong** - rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

**DEGREE OF WEATHERING**

- **Highly Weathered** - abundant fractures coated with oxides, carbonates, sulphates, mud, etc., thorough discoloration, rock disintegration, mineral decomposition
- **Moderately Weathered** - some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition
- **Slightly Weathered** - a few stained fractures, slight discoloration, little or no effect on cementation, no mineral composition
- **Fresh** - unaffected by weathering agents; no appreciable change with depth
APPENDIX B - REFERENCES

Bortugno, E.J., 1982, Map Showing Recency of Faulting, Santa Rosa Quadrangle in Wagner and Bortugno, Geologic Map of the Santa Rosa Quadrangle: California Division of Mines and Geology, Regional Geologic Map Series, Map No. 2A, Santa Rosa Quadrangle, Scale 1:250,000.


International Conference of Building Officials, 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, California Department of Conservation, Division of Mines and Geology, Scale 1:156,000.


McLaughlin, R.J., 2006, personal communication.


Pacific Aerial Surveys, Sonoma County, 1980, Black and White Aerial Photographs, Roll BW-SON, Frames 20-12&13, and 21-03&04, Approximate Scale 1” = 2000’.

WAC Corporation, Sonoma County, 1996, Black and White Aerial Photographs, Roll WAC-96CA , Frames 17-99&100, Approximate Scale 1” = 2000’.

APPENDIX C - PLATES

LIST OF SELECTED PREVIOUS PLATES

Plate 5  Generalized Geologic Cross Section
Plates 6 through 8  Borings Logs
REDDISH BROWN SANDY CLAY (CL), soft, wet; porous (Colluvium).

LIGHT GRAY AND DARK GRAY SHEARED SHALE, extremely closely spaced fractures, firm, plastic to friable, fresh to slightly weathered; foliated, predominantly matrix supported (Franciscan Complex).

DARK GRAY GRAYWACKE SANDSTONE, extremely closely spaced fractures, moderately hard, moderately strong, fresh to slightly weathered, rock supported (Franciscan Complex).

DARK GRAY SHEARED SHALE, firm, plastic to friable, fresh to slightly weathered, with inclusions of hard graywacke sandstone fragments, matrix supported (Franciscan Complex).

DARK GRAY GRAYWACKE SANDSTONE, extremely closely spaced fractures, moderately hard, moderately strong, slightly weathered, rock supported (Franciscan Complex).

<table>
<thead>
<tr>
<th>Depth (Feet)</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>30</td>
<td><strong>Topographic Survey by Howard W. Brunner, dated October 2005.</strong></td>
</tr>
<tr>
<td>31</td>
<td><strong>Complex.</strong></td>
</tr>
<tr>
<td>32</td>
<td>DARK GRAY SHEARED SHALE, firm, plastic to friable, fresh to slightly weathered, with inclusions of hard graywacke sandstone fragments, matrix supported (Franciscan Complex).</td>
</tr>
<tr>
<td>33</td>
<td>DARK BLUE GRAY GRAYWACKE SANDSTONE, extremely to very closely spaced fractures, moderately hard, moderately strong to strong, slightly weathered with zone of sheared shale, firm, friable and slightly weathered, predominantly rock supported (Franciscan Complex).</td>
</tr>
<tr>
<td>34</td>
<td><strong>Complex.</strong></td>
</tr>
<tr>
<td>35</td>
<td>DARK BLUE GRAY SHEARED SHALE, extremely closely spaced fractures, firm, friable, fresh to slightly weathered, with zones of hard, strong graywacke sandstone, matrix supported (Franciscan Complex).</td>
</tr>
<tr>
<td>36</td>
<td><strong>Complex.</strong></td>
</tr>
<tr>
<td>37</td>
<td>very closely spaced fractures, matrix supported</td>
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</tbody>
</table>
DARK BLUE GRAY GRAYWACKE SANDSTONE, very closely to closely spaced fractures, moderately hard, weak to moderately strong, slightly weathered, with quartz veining, rock supported (Franciscan Complex).

DARK BLUE GRAY SHEARED SHALE, extremely closely spaced fractures, firm, friable, fresh to slightly weathered, with quartz veining and lenses and zones of black clay, matrix supported (Franciscan Complex).

<table>
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<tr>
<th>Remarks</th>
<th>Box #</th>
<th>% Rec'd Rq'd</th>
<th>Sample #/Run #</th>
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**Bottom of Core Boring at 104 feet.**

DARK BLUE GRAY SHEARED SHALE, extremely closely spaced fractures, firm, friable, fresh to slightly weathered, with quartz veining and lenses and zones of black clay, matrix supported (Franciscan Complex).

**Topographic Survey by Howard W. Brunner, dated October 2005.**
MOTTLED ORANGE BROWN CLAYEY GRAVEL, dense, moist to wet; porous, with roots up to 1-inch diameter (Colluvium).

MOTTLED ORANGE BROWN SANDSTONE, extremely closely spaced fractures, moderately hard, moderately strong, slightly weathered (Franciscan Complex).

MOTTLED BLUE GRAY SHEARED SHALE, firm, plastic to friable, fresh to slightly weathered, slightly foliated, with local small roots, matrix supported (Franciscan Complex).

with white streaks and local quartz veining

Fracture orientation: N88°W 47°SW

BROWN SANDSTONE, extremely to closely spaced fractures, hard, strong, slightly weathered, with clay patches, local quartz veining, rock supported (Franciscan Complex).

DARK BLUE GRAY GRAYWACKE SANDSTONE, extremely to closely spaced fractures, hard, strong, slightly weathered, with clay patches, local quartz veining, rock supported (Franciscan Complex).
Fracture orientation: N48°E 65°SE

Fracture orientation: N46°W 53°SW, tight, disc-shaped fracture with pockets of friable rock

N58°W 41°SW - thin blue extremely fractured rock seam, with local black staining, undulating contact and poorly defined.

DARK BLUE GRAY SHEARED SHALE, extremely closely spaced fractures, firm to moderately hard, friable to weak, fresh to slightly weathered, with brown and white streaks, with zones of friable rock and quartz veining, matrix-supported (Franciscan Complex).

Bottom of boring at 50 feet.
No free groundwater observed.

<table>
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<th>DEPTH (FEET)</th>
<th>DENSITY (pcf)</th>
<th>MOISTURE CONTENT (%)</th>
<th>% PASSING #200 SIEVE</th>
<th>BLOWS/FOOT Sample</th>
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</table>

**EQUIPMENT:** Calweld 42 Drill Rig: 24-inch Bucket  
**LOGGED BY:** GS  
**DATE:** 12-13-05  
**DRILLER:** Tri Valley Drilling  
**ELEVATION:** 1914 feet *

MOTTLED ORANGE BROWN CLAYEY GRAVEL, porous, dense, moist to wet (Colluvium).

MOTTLED ORANGE BROWN SANDSTONE, very closely spaced fractures, hard, strong, slightly weathered, with black (Mn?) staining on fracture surfaces, minor quartz veining to 15 feet, local small roots, rock supported (Franciscan Complex).

with local dark brown clayey seams

MOTTLED ORANGE BROWN SANDSTONE, very closely spaced fractures, hard, strong, slightly weathered, rock supported (Franciscan Complex).

MOTTLED ORANGE BROWN SHEARED SHALE, extremely to closely spaced fractures, firm, friable, fresh to slightly weathered, matrix supported (Franciscan Complex).  
small charcoal fragments at 18 feet


**RGH** Consultants, Inc.

**Job No:** 2086.02.04.1  
**Appr:**  
**Dwn:** jj  
**Date:** Apr 2006

**LOG OF BORING 3**  
Cornell Winery  
245 Wappo Road  
Santa Rosa, California

**PLATE** 8A
<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>EQUIPMENT: Calweld 42 Drill Rig: 24-inch Bucket</th>
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</thead>
<tbody>
<tr>
<td>20</td>
<td>LOGGED BY: GS</td>
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<td></td>
<td>DATE: 12-13-05</td>
</tr>
<tr>
<td></td>
<td>DRILLER: Tri Valley Drilling</td>
</tr>
<tr>
<td></td>
<td>ELEVATION: 1914 feet *</td>
</tr>
</tbody>
</table>

Slight seepage observed at 22 feet.

**MOTTLED ORANGE BROWN AND DARK BLUE GRAY GRAYWACKE SANDSTONE**, extremely closely spaced fractures, firm, friable, fresh to slightly weathered, with dark brown black oxide staining, rock supported with zones of matrix support (Franciscan Complex). Lenticular brown and gray sandy clay seams at 23 feet, locally 3-5 inches long, ½-inch thick.

**BLUE GRAY GRAYWACKE SANDSTONE**, extremely closely to closely spaced fractures, hard, strong, slightly weathered, with local saccharoidal texture, quartz veining; with zones of firm, friable clayey matrix, predominantly rock supported (Franciscan Complex). Fracture orientation: N75°E 49ºNW at 27 feet. Locally heavy seepage observed at 29½ feet on southern and eastern sides of boring. Fracture orientation: N23°E 35ºSE

Heavy seepage observed from 33 to 43 feet.

**MOTTLED BLUE GRAY SHEARED SHALE**, firm, plastic to friable, fresh to slightly weathered, contains locally foliated clayey seams and lenses and pockets of shattered graywacke exhibiting extremely closely spaced fractures and saccharoidal texture, predominantly matrix supported (Franciscan Complex).

f firm, plastic sheared clay zones below 43 feet lenses of black, foliated clay, randomly oriented, with shattered sandstone and saccharoidal texture to bottom of boring

<table>
<thead>
<tr>
<th>DEPTH (FEET)</th>
<th>Blows/foot</th>
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<tr>
<td>60</td>
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<tr>
<td>61</td>
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</tbody>
</table>

MOTTLED BLUE GRAY SHEARED SHALE, firm, plastic to friable, fresh to slightly weathered, contains locally foliated clayey seams and lenses and pockets of shattered graywacke exhibiting extremely closely spaced fractures and saccharoidal texture, predominantly matrix supported (Franciscan Complex).

Bottom of boring at 63 feet.
APPENDIX D - DISTRIBUTION

Cornell Farms, LLC
% Guy Davis
2555 Laguna Road
Santa Rosa, CA  95401

(3,1)

Atterbury & Associates
Attn: Tom Atterbury
16109 Healdsburg Avenue, Suite D
Healdsburg, CA  95448

(4,1)

GDS:JJP:GWR:EGC:lw

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Important Information About Your
Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.
The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one—not even you—should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

• not prepared for you,
• not prepared for your project,
• not prepared for the specific site explored, or
• completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

• the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
• elevation, configuration, location, orientation, or weight of the proposed structure,
• composition of the design team, or
• project ownership.

As a general rule, always inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not over rely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual
subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report’s recommendations if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject to Misinterpretation
Other design team members’ misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team’s plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer’s Logs
Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but prepare it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report’s accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely
Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.

Obtain Professional Assistance To Deal with Mold
Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infections, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; none of the services performed in connection with the geotechnical engineer’s study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.

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

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/565-2733
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