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Geotechnical Study Report

Truchard Family Winery P14-00330-UP & P14-00331-VAR
Planning Commission Hearing Date September 20, 2017

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GEOTECHNICAL STUDY REPORT

TRUCHARD WINERY
4062 OLD SONOMA ROAD
NAPA, CALIFORNIA

Project Number:

6838.01.04.2

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INTRODUCTION

This report presents the results of our geotechnical study for the planned Truchard Winery to be constructed at 4062 Old Sonoma Road in Napa, California. The site is located on the east side of Old Sonoma Road near the intersection with Congress Valley Road. The site location is shown on Plate 1, Appendix A.

We understand it is proposed to construct a new winery production building at the site. The main winery building will be constructed on a full basement. Foundation loads are expected to be typical of the light to moderately heavy type of construction proposed. We anticipate wall loads will range from ¾ to 2 kips per lineal foot. A new driveway from Old Sonoma Road will provide access to the new winery building and a bridge will be required to cross the seasonal creek located between the road and the planned building area. We understand site grading will be the minimum needed to construct a level building pad and paved areas with positive drainage. Such grading could include cuts and fills of about 1 to 3 feet and up to 10 feet for the basement.

SCOPE

The purpose of our study, as outlined in our Professional Service Agreement dated October 31, 2014, was to generate geotechnical information for the design and construction of the project. Our scope of services included reviewing selected published geologic data pertinent to the site; evaluating subsurface conditions with test pits and laboratory tests; analyzing the field and laboratory data; and presenting this report with the following geotechnical information:

1. A brief description of soil, bedrock and groundwater conditions observed during our study;
2. A discussion of seismic hazards that may affect the proposed improvements;
3. A discussion of the nature and impacts related to ground fractures related to faulting;
4. Possible setbacks from ground fractures; and
5. Conclusions and recommendations regarding:
    a. Primary geotechnical engineering concerns and mitigating measures, as applicable;
    b. Site preparation and grading including remedial grading of weak, porous, compressible and/or expansive, creep-prone surface soils;
    c. Foundation type(s), design criteria, and estimated settlement behavior;
    d. Lateral loads for retaining wall design;
    e. Support of concrete slabs-on-grade;
    f. Preliminary pavement thickness based on our experience with similar soils and projects and the results of an R-value test on the anticipated subgrade soils;

g. Utility trench backfill;

h. Geotechnical engineering drainage improvements; and

i. Supplemental geotechnical engineering services.

STUDY

Site Exploration

We reviewed our previous geotechnical studies in the vicinity and selected geologic references pertinent to the site. The geologic literature reviewed is listed in Appendix B.

On November 19, 2014, we performed a geologic reconnaissance of the site and explored the subsurface conditions by excavating five test pits to depths ranging from about 6 to 8½ feet. The test pits were excavated with a track-mounted excavator at the approximate locations shown on the Exploration Plan, Plate 2. The test pit locations were determined approximately by pacing their distance from features shown on the Exploration Plan and should be considered accurate only to the degree implied by the method used. Our engineering geologist located and logged the test pits and obtained samples of the materials encountered for visual examination, classification and laboratory testing. Disturbed samples were obtained at selected depths from the test pits and placed in plastic bags and buckets.

The logs of the test pits showing the materials encountered, groundwater conditions and sample depths are presented on Plates 3 through 5. The soils are described in accordance with the Unified Soil Classification System, outlined on Plate 6. Bedrock is described in accordance with Engineering Geology Rock Terms, shown on Plate 7.

The test pit logs show our interpretation of subsurface soil and bedrock conditions on the date and at the locations indicated. Subsurface conditions may vary at other locations and times. Our interpretation is based on visual inspection of soil and bedrock samples, laboratory test results and interpretation of excavation resistance. The location of the soil and bedrock boundaries should be considered approximate. The transition between soil and bedrock types may be gradual.

Laboratory Testing

The samples obtained from the test pits were transported to our office and re-examined to verify soil classifications, evaluate characteristics and assign tests pertinent to our analysis. Selected samples were laboratory tested to determine their classification (Atterberg Limits, percent of silt and clay), expansion potential (Expansion Index - EI) and R-value. Results of the laboratory tests are presented on Plates 8 and 9.

SITE CONDITIONS

General

Napa 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 units are the Jurassic-Cretaceous Franciscan Complex and Great Valley sequence sediments 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

Published geologic maps (Clahan et al., 2004) indicate the winery location is underlain by alluvium that is early to late Pleistocene in age (Qoa). The bridge area is shown to be underlain by alluvium that is latest Pleistocene to Holocene in age. Both units are described as being comprised of sand, silt, clay and gravel. During our geologic reconnaissance we observe bedrock within the creek bottom near the planned bridge that does not appear to be consistent with the geologic mapping.

Landslides

Published landslide maps (Dwyer, 1976) do not indicate large-scale slope instability at the site, and we did not observe active landslides at the site during our study.

Surface

The property extends primarily over relatively level terrain with a small grade break between the planned winery building location and Old Sonoma Road. The vegetation consists of low seasonal grasses over much of the winery building site, however, a portion of the planned structure will be within the area currently used as vineyard.

In general, the ground surface is moderately hard. However, soils in the area that appear hard and strong when dry will typically lose strength rapidly and settle under the loads of fills, foundations and slabs as their moisture content increases and approaches saturation. This typically occurs because the surface soils are weak, porous and compressible. The surface soils are disturbed by randomly arrayed shrinkage cracks generally associated with expansive soils. Locally, expansive soils shrink and swell with the weather cycle. The cyclic shrinking and swelling tends to disturb the upper portion of the expansive clay. This zone is defined hereinafter as the active layer. On sloping terrain (10:1 or steeper), the weak, expansive surface materials undergo a gradual downhill movement known as creep. 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.

Natural drainage consists of sheet flow over the ground surface that concentrates in man made surface drainage elements such as roadside ditches, canals and gutters, and natural drainage elements such as swales, ravines, and creeks.

Subsurface

Our test pits and laboratory tests indicate that the portion of the site we studied is blanketed by 1½ to 3 feet of weak, porous, compressible, clayey soils. Porous soils appear hard and strong when dry but become weak and compressible as their moisture content increases towards saturation. These soils exhibit high plasticity (LL = 51 to 66; PI = 37 to 48) and high to very high expansion potential (EI = 113 to 131). The surface soils are locally covered by 1 to 1½ feet of heterogeneous fill. Heterogeneous fill is a material with varying density, strength, compressibility and shrink-swell characteristics that often has an unknown origin and placement history. These surface materials are underlain by expansive subsoils to depths of between 3 and 5 feet.

Siltstone bedrock or soil that was derived from completely weathered bedrock was encountered below the surface materials. The bedrock is generally either sandy clay developed by completely weathering bedrock or siltstone bedrock that is firm, weak and moderately to highly weathered. A detailed description of subsurface conditions found in our test pits is given on Plates 3 through 5, Appendix A. Based on Table 20.3-1 of American Society of Civil Engineers (ASCE) Standard 7-10, titled “Minimum Design Loads for Buildings and Other Structures” (2010), we have determined a Site Class of C should be used for the site.

Corrosion Potential

Mapping by the Natural Resources Conservation Service (2015) indicates that the corrosion potential of the near surface soil is moderate to high for uncoated steel and low to moderate for concrete. Performing corrosivity tests to verify these values was not part of our requested and/or proposed scope of work. Should the need arise, we would be pleased to provide a proposal to evaluate these characteristics.

Groundwater

Free groundwater was not observed in our test pits at the time of excavation. Fluctuation in the groundwater level typically occurs because of a variation in rainfall intensity, duration and other factors such as flooding and periodic irrigation.

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. Therefore, we judge the potential for the occurrence of this phenomenon at the site to be low.

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 improvements in strict adherence with current standards for earthquake-resistant construction.

Faulting

On the morning of August 24, 2014, a magnitude 6.0 earthquake occurred in Napa County. As reported, surface rupture occurred along segments of the fault in the vicinity of the site. Several ground fractures were noticed within the project site. We observed landforms within the area that would indicate the presence of an active fault. The site is not within a current Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). However, we believe the further risk of fault rupture at the site is high. Based on our subsurface exploration program we identified surface fault rupture resulting from the South Napa Earthquake, and we suggest that structures not be constructed over active traces of the fault. Additionally, 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). The shortest distances from the site to the mapped surface expression of these faults are presented in the table below.

ACTIVE FAULT PROXIMITY		
Fault	**Direction**	**Distance-Miles**
San Andreas	W	31
Healdsburg-Rodgers Creek	W	10
Concord-Green Valley	E	8
West Napa*	S	4

* Measured to the current active fault zone that terminates near the Napa Airport.

Liquefaction

Liquefaction is a rapid loss of shear strength experienced in saturated, predominantly granular soils below the groundwater level during strong earthquake ground shaking due to an increase in pore water pressure. The occurrence of this phenomenon is dependent on many complex factors including the intensity and duration of ground shaking, particle size distribution and density of the soil.

The site is mapped as having a moderate potential for liquefaction along the creek at the edge of the project area (Witter, et al., 2006). Based on our observation of bedrock outcrops within the creek and completely weathered bedrock or bedrock within our test pits, we judge that the risk of liquefaction at the site is low.

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 foundations are installed as recommended herein, we judge the potential for impact to the proposed improvements from the occurrence of this phenomenon at the site is low. However, some of these secondary earthquake effects are unpredictable as to location and extent, as evidenced by the 1989 Loma Prieta Earthquake.

Geotechnical Issues

General

Based on our study, we judge the proposed improvements can be built as planned, provided the recommendations presented in this report are incorporated into their design and construction. The primary geotechnical concerns during design and construction of the project are:

1. The presence of recent fault surface rupture;

2. The presence of 1½ to 3 feet of highly expansive, weak, porous, compressible, clayey surface soils and localized heterogeneous fill;

3. The detrimental effects of uncontrolled surface runoff and groundwater seepage; and

4. The strong ground shaking predicted to impact the site during the life of the project.

Heterogeneous Fill

Heterogeneous fills of unknown quality and unknown method of placement, such as those found at the site, can settle and/or heave erratically under the load of new fills, structures, slabs, and pavements. Footings, slabs, and pavements supported on heterogeneous fill could also crack as a result of such erratic movements. Thus, where not removed by planned grading, the heterogeneous fill must be excavated and replaced as an engineered fill if it is to be used for structural support.

Weak, Porous Surface Soils

Weak, porous surface soils, such as those found at the site, appear hard and strong when dry but will lose strength rapidly and settle under the load of fills, foundations, slabs, and pavements as their moisture content increases and approaches saturation. The moisture content of these soils can increase as the result of rainfall, periodic irrigation or when the natural upward migration of water vapor through the soils is impeded by, and condenses under fills, foundations, slabs, and pavements. The detrimental effects of such movements can be reduced by strengthening the soils during grading. This can be achieved by excavating the weak soils and replacing them as properly compacted (engineered) fill.

Expansive Soil

In addition, the surface soils are expansive. Expansive surface soils 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) and slabs and pavements. The zone of significant moisture variation (active layer) is dependent on the expansion potential of the soil and the extent of the dry season. In the Napa area, the active layer is generally considered to range in thickness up to about 3 feet. The detrimental effects of the above-described movements can be reduced by pre-swelling the expansive soils and covering them with a moisture fixing and confining blanket of properly compacted select fill, as subsequently defined. In building areas, the blanket thickness required depends on the expansion potential of the soils and the anticipated performance of the foundations and slabs. In order to effectively reduce foundation and slab heave given the expansion potential of the site's soils, a blanket thickness of 30 inches will be needed. In exterior slab and paved areas, the select fill blanket need only be 12 inches thick. The main winery building is planned to have a full basement and will be founded below the expansive surface soils and active layer, as such select fill is not required under the basement.

Foundation and Slab Support - Provided grading is performed as discussed above, satisfactory foundation support can be obtained from spread footings or concrete slabs that bottom on the select engineered fill. Shallow spread footings should be embedded at least 12 inches below pad subgrade. Bridge foundations may be either spread footings that gain support below the active layer (3 feet) or drilled piers.

Excavation Difficulty

Site excavation may encounter hard, resistant bedrock 4 or 5 feet below the surface. Site excavations, including utility trenches will require heavy ripping and jack hammering. The contractors and subcontractors bidding this job should read this report and become familiar with site conditions as they pertain to their operation and the appropriate equipment needed to perform their tasks. If more detailed information regarding excavatability of the bedrock is required, a seismic refraction study should be performed or additional test pits should be excavated using the type and size of equipment planned for construction.

Exterior Slabs and Pavements

Exterior slabs 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, but not eliminated, by covering the pre-swelled expansive soils with at least 12 inches of select fill (see "On-Site Soil Quality" section) prior to constructing the slab or pavement required to carry the anticipated traffic.

On-Site Soil Quality

All fill materials used in the upper 30 inches of the building area and the upper 12 inches of exterior slab and pavement subgrade must be select, as subsequently described in "Recommendations." We anticipate that, with the exception of organic matter and of rocks or lumps larger than 6 inches in diameter, the excavated material will be suitable for re-use as general fill, but will not be suitable for use as select fill unless stabilized with lime.

Select Fill

The select fill can consist of approved on-site soils or import materials with a low expansion potential or lime stabilized on-site clayey soils. Lime stabilized soils may prevent the growth of landscape vegetation due to the inherent elevated pH level of the soil. The geotechnical engineer must approve the use of on-site soils as select fill during grading.

Settlement

Provided remedial grading is performed as recommended herein, we estimate that post-construction differential settlements between columns and lightly loaded perimeter footings will be about ½ inch.

Surface Drainage

Because of topography and location, the site will be impacted by surface water. Surface runoff typically sheet flows over the ground surface but can be concentrated by the planned site grading, landscaping and drainage. The surface runoff can pond against structures and cause deeper than normal soil heave. Therefore, strict control of surface runoff is necessary to provide long-term satisfactory performance of the project. It will be necessary to divert surface runoff around improvements and provide positive drainage away from structures. This can be achieved by constructing the building pad several inches above the surrounding area and conveying the runoff into man made drainage elements or natural swales that lead downgradient of the site.

RECOMMENDATIONS

Surface Fault Rupture Setback

We believe the potential for future fault rupture with ground displacement in the area of the fault trace is high. We therefore recommend a building setback of 25 feet on either side of the observed fault trace. The fault trace location is shown on the Exploration Plan presented on Plate 2 and was surveyed by the project civil engineer. In addition, we recommend that if structures for human occupancy are added to the current plan or moved that we be able to review their location and we may need to perform additional subsurface exploration.

Seismic Design

Seismic design parameters presented below are based on Section 1613 titled "Earthquake Loads" of the 2013 California Building Code (CBC). Based on Table 20.3-1 of American Society of Civil Engineers (ASCE) Standard 7-10, titled "Minimum Design Loads for Buildings and Other Structures" (2010), we have determined a Site Class of C should be used for the site. Using a site latitude and longitude of 38.2817°N and 122.3235°W, respectively, and the U.S. Seismic Design Maps from the United States Geological Survey (USGS) website (http://geohazards.usgs.gov/designmaps/us/application.php), we recommend that the following seismic design criteria be used for structures at the site.

2013 CBC Seismic Criteria	
Spectral Response Parameter	**Acceleration (g)**
S_S (0.2 second period)	1.925
S_1 (1 second period)	0.697
S_{MS} (0.2 second period)	1.925
S_{M1} (1 second period)	0.906
S_{DS} (0.2 second period)	1.284
S_{D1} (1 second period)	0.604

Grading

Site Preparation

Areas to be developed should be cleared of vegetation and debris including that left by the removal of obsolete structures. Trees and shrubs that will not be part of the proposed development should be removed and their primary root systems grubbed. Cleared and grubbed material should be removed from the site and disposed of in accordance with County Health Department guidelines. We did not observe septic tanks, leach lines or underground fuel tanks during our study. Any such appurtenances found during grading should be capped and sealed and/or excavated and removed from the site, respectively, in accordance with established guidelines and requirements of the County Health Department. Voids created during clearing should be backfilled with engineered fill as recommended herein.

Stripping

Areas to be graded should be stripped of the upper few inches of soil containing organic matter. Soil containing more than two percent by weight of organic matter should be considered organic. Actual stripping depth should be determined by a representative of the geotechnical engineer in the field at the time of stripping. The strippings should be removed from the site, or if suitable, stockpiled for re-use as topsoil in landscaping.

Excavations

Following initial site preparation, excavation should be performed as planned or recommended herein. Excavations extending below the proposed finished grade should be backfilled with suitable materials compacted to the requirements given below.

The main winery building will be constructed on a full basement and founded on a concrete slab. Within other building areas, where spread footings bottomed at minimum depth are chosen for foundation support, and within fill and interior slab-on-grade areas, the old fill and weak, porous, compressible expansive surface soils should be excavated to a minimum depth of 30 inches below proposed pad and slab subgrade level to allow space for the installation of the select fill blanket discussed in the conclusions section of this report. The excavation of weak, compressible, expansive soils should also extend at least 12 inches below exterior slab and pavement subgrade where planned excavations do not completely remove the weak soils to allow space for the installation of the select fill blanket.

The excavation of weak, porous, compressible, expansive surface materials should extend at least 5 feet beyond the outside edge of the exterior footings of the proposed buildings. The excavation of weak, porous, compressible, expansive surface materials should extend at least 3 feet beyond the edge of exterior slabs and pavements.

At all times, temporary construction excavations should conform to the regulations of the State of California, Department of Industrial Relations, Division of Industrial Safety or other stricter governing regulations. The stability of temporary cut slopes, such as those constructed during the installation of underground utilities, should be the responsibility of the contractor. Depending on the time of year when grading is performed, and the surface conditions exposed, temporary cut slopes may need to be excavated to 1½:1, or flatter. The tops of the temporary cut slopes should be rounded back to 2:1 in weak soil zones.

Fill Quality

All fill materials should be free of perishable matter and rocks or lumps over 6 inches in diameter and must be approved by the geotechnical engineer prior to use. The upper 30 inches of fill beneath and within 5 feet of the building area and the upper 12 inches of fill beneath and within 3 feet of exterior slabs and/or pavement edges should be select fill. We judge the on-site soils are generally suitable for use as general fill but will not be suitable for use as select fill unless they are stabilized with lime. Lime stabilized soils may prevent the growth of landscape vegetation due to the inherent elevated pH level of the soil. The suitability of the on-site soils for use as select fill should be verified during grading.

Select Fill

Select fill should be free of organic matter, have a low expansion potential, and conform in general to the following requirements:

SIEVE SIZE	PERCENT PASSING (by dry weight)
6 inch	100
4 inch	90 – 100
No. 200	10 – 60

Liquid Limit – 40 Percent Maximum
Plasticity Index – 15 Percent Maximum
R-value – 20 Minimum (pavement areas only)

Expansive on-site soils may be used as select fill if they are stabilized with lime. In general, imported fill, if needed, should be select. Material not conforming to these requirements may be suitable for use as import fill; however, it shall be the contractor's responsibility to demonstrate that the proposed material will perform in an equivalent manner. The geotechnical engineer should approve imported materials prior to use as compacted fill. The grading contractor is responsible for submitting, at least 72 hours (3 days) in advance of its intended use, samples of the proposed import materials for laboratory testing and approval by the soils engineer.

Lime Stabilization

For preliminary planning purposes, we estimate that high calcium lime mixed at a minimum of 5½ percent (dry weight) will stabilize the expansive site soils. This percentage of lime needs to be verified prior to construction with engineering analysis and laboratory Atterberg Limits and/or pH testing using lime from the same source as that planned for use on the project and a sample of the soil to be treated. Laboratory test results and engineering analysis may indicate that a higher percentage of lime is required. The contractor should allow a minimum of 5 business days for the laboratory tests to be completed.

The lime stabilization should be performed in accordance with Section 24 of the Caltrans Standard Specifications except that a curing seal will not be required, provided the moisture content of the lime-stabilized material is maintained at or above optimum moisture content until it is permanently covered with subsequent construction. Lime stabilized materials are generally not suitable for reuse as general fill, select fill or backfill after compaction has taken place.

Fill Placement

The surface exposed by stripping and removal of heterogeneous fill and weak, compressible, expansive surface soils should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to at least 4 percent above optimum and compacted to at least 90 percent of the maximum dry density of the materials as determined by ASTM Test Method D-1557. In expansive soil areas, moisture conditioning should be sufficient to completely close all shrinkage cracks for their full depth within pavement, exterior slab and building areas, if present. If grading is performed during the dry season, the shrinkage cracks may extend to a few feet below the surface. Therefore, it may be necessary to excavate a portion of the cracked soils to obtain the proper moisture condition and degree of compaction. Approved fill material should then be spread in thin lifts, uniformly moisture-conditioned to near optimum and properly compacted. All structural fills, including those placed to establish site surface drainage, should be compacted to at least 90 percent relative compaction. Expansive soils used as fill should be moisture-conditioned to at least 4 percent above optimum. Only approved select materials should be used for fill within the upper 30 inches of interior slab subgrades and within the upper 12 inches of exterior slab and pavement subgrades.

SUMMARY OF COMPACTION RECOMMENDATIONS	
Area	Compaction Recommendation (ASTM D-1557)
Preparation for areas to receive fill	After preparation in accordance with this report, compact upper 6 inches to a minimum of 90 percent relative compaction.
General fill (native or import)	Compact to a minimum of 90 percent relative compaction.
Structural fill beneath buildings, extending outward to 5' beyond building perimeter	Compact to a minimum of 90 percent relative compaction. Compact to a minimum of 95 percent where building pad transitions between bedrock and fill.
Structural fill beneath building pads that transition between bedrock and fills less than 3 feet thick	Compact to a minimum of 95 percent relative compaction.
Trenches	Compact to a minimum of 90 percent relative compaction. Compact the top 6 inches below vehicle pavement subgrade to a minimum of 95 percent relative compaction.
Retaining wall backfill	Compact to a minimum of 90 percent relative compaction, but not more than 95 percent.
Pavements, extending outward to 3' beyond edge of pavement	Compact upper 6 inches of subgrade to a minimum of 95 percent relative compaction.

Concrete flatwork and exterior slabs, extending outward to 3' beyond edge of slab	Compact subgrade to a minimum of 90 percent relative compaction. Where subject to vehicle traffic, compact upper 6 inches of subgrade to at least 95 percent relative compaction.
Aggregate Base	Compact aggregate base to at least 95 percent relative compaction.

Permanent Cut and Fill Slopes

In general, cut and fill slopes should be designed and constructed at slope gradients of 2:1 (horizontal to vertical) or flatter, unless otherwise approved by the geotechnical engineer in specified areas. In expansive soil areas cut and fill slopes should be no steeper than 3:1. Where steeper slopes are required, retaining walls should be used. Fill slopes should be constructed by overfilling and cutting the slope to final grade. “Track walking” of a slope to achieve slope compaction is not an acceptable procedure for slope construction. Permanent cut slopes should be observed in the field by the geotechnical engineer to verify that the exposed soil and bedrock conditions are as anticipated. The geotechnical engineer is not responsible for measuring the angles of these slopes. Denuded slopes should be planted with fast-growing, deep-rooted groundcover to reduce sloughing or erosion.

Wet Weather Grading

Generally, grading is performed more economically during the summer months when on-site soils are usually dry of optimum moisture content. Delays should be anticipated in site grading performed during the rainy season or early spring due to excessive moisture in on-site soils. Special and relatively expensive construction procedures, including dewatering of excavations and importing granular soils, should be anticipated if grading must be completed during the winter and early spring or if localized areas of soft saturated soils are found during grading in the summer and fall.

Open excavations also tend to be more unstable during wet weather as groundwater seeps towards the exposed cut slope. Severe sloughing and occasional slope failures should be anticipated. The occurrence of these events will require extensive clean up and the installation of slope protection measures, thus delaying projects. The general contractor is responsible for the performance, maintenance and repair of temporary cut slopes.

Foundation Support

Provided the structures are founded below the active layer (about 3 feet) or the weak, expansive surface soils are strengthened and stabilized by remedial grading as recommended herein, the proposed winery structures can be supported on concrete slab foundations or continuous and isolated spread footings that bottom on select engineered fill or below the active layer (3 feet). The bridge can be supported on spread footings gaining support below the active layer (3 feet) or drilled piers.

Concrete Slab Foundations

The winery basement can be supported by a concrete slab foundation with bearing pressures presented in the spread footing section of this report or with a modulus of subgrade reaction. We recommend a modulus of subgrade reaction for highly weathered bedrock material of 85 pounds per cubic inch (pci) be used in design.

Spread Footings

Spread footings should be at least 12 inches wide and should bottom on select engineered fill, or firm native soil for the bridge only, at least 12 inches below lowest adjacent grade. Additional embedment or width may be needed to satisfy code and/or structural requirements.

The bottoms of all footing excavations should be thoroughly cleaned out or wetted and compacted using hand-operated tamping equipment prior to placing steel and concrete. This will remove the soils disturbed during footing excavations, or restore their adequate bearing capacity, and reduce post-construction settlements. Footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks appear in soils exposed in the footing excavations, the soil should be thoroughly moistened to close all cracks prior to concrete placement. The moisture condition of the foundation excavations should be checked by the geotechnical engineer no more than 24 hours prior to placing concrete.

Bearing Pressures - Footings installed in accordance with these recommendations may be designed using allowable bearing pressures of 2,000, 3,000 and 4,000 pounds per square foot (psf), for dead loads, dead plus code live loads, and total loads (including wind and seismic), respectively.

Lateral Pressures - The portion of spread footing foundations extending into select engineered fill, or firm native soil for the bridge only, may impose a passive equivalent fluid pressure and a friction factor of 350 pcf and 0.35, respectively, to resist sliding. Passive pressure should be neglected within the upper 12 inches, unless the soils are confined by concrete slabs or pavements.

Drilled Piers

Drilled, cast-in-place, reinforced concrete piers should be used for foundation support for the bridge, if desired. Drilled piers should be at least 12 inches in diameter and should extend at least 8 feet below a point at which the pier has 7 feet of horizontal confinement. Larger piers and deeper embedment may be needed to resist the lateral forces imposed by earthquakes per the 2013 California Building Code. Piers should be spaced no closer than 3 pier diameters, center to center.

Skin Friction - The portion of the piers extending below the weak surface soils may be designed using an allowable skin friction of 700 psf for dead load plus long term live loads. This value can be increased by ⅓ for total loads, including downward vertical wind or seismic forces. A skin friction value of 325 psf should be used to resist uplift forces. End bearing should be neglected because of the difficulty of cleaning out small diameter pier holes, and the uncertainty of mobilizing end bearing and skin friction simultaneously.

Lateral Forces - Lateral loads on piers will be resisted by passive pressure on the soil. An equivalent fluid pressure of 350 pcf acting on two pier diameters should be used. Confinement for passive pressure may be assumed from 2 feet below the lowest adjacent finished ground surface.

Pier Drilling - We did not encounter groundwater and/or caving-prone soils within the planned pier depth during our study. If groundwater is encountered during drilling, it may be necessary to de-water the holes and/or place the concrete by the tremie method. If caving soils are encountered, it may be necessary to case the holes. Difficult drilling may be required to achieve the required penetration. The drilling subcontractor should review this report, become familiar with site conditions as they pertain to his operation and draw his own conclusions regarding drilling difficulty, suitable drill rigs and the need for casing and dewatering prior to bidding.

Concrete - Concrete mix design and placement should be done in accordance with the current ADSC and/or ACI specifications. Concrete should not be allowed to mushroom at the top of the piers or below the bottom of grade beams.

Bridge Abutment, Basement and Retaining Walls

Abutment, basement and retaining walls constructed at the site must be designed to resist lateral earth pressures plus additional lateral pressures that may be caused by surcharge loads applied at the ground surface behind the walls. Retaining walls free to rotate (yielding greater than 0.1 percent of the wall height at the top of the backfill) should be designed for active lateral earth pressures. If walls are restrained by rigid elements to prevent rotation, they should be designed for "at rest" lateral earth pressures. In the absence of backdrains, the retaining walls should be designed to resist full hydrostatic pressure.

Retaining walls should be designed to resist the following earth equivalent fluid pressures (triangular distribution):

EARTH EQUIVALENT FLUID PRESSURES		
Loading Condition	**Pressure (pcf)**	**Additional Seismic Pressure (pcf)***
Active - Level Backfill	42	15
Active - Sloping Backfill 3:1 or Flatter	53	35
At Rest - Level Backfill	63	36
Active Full Hydrostatic	83	15
At Rest Full Hydrostatic	94	36

* If required

These pressures do not consider additional loads resulting from adjacent foundations or other loads. If these additional surcharge loadings are anticipated, we can assist in evaluating their effects. Where retaining wall backfill is subject to vehicular traffic, the walls should be designed to resist an additional surcharge pressure equivalent to two feet of additional backfill.

Retaining walls will yield slightly during backfilling. Therefore, walls should be backfilled prior to building on, or adjacent to, the walls. Backfill against retaining walls should be compacted to at least 90 and not more than 95 percent relative compaction. Over-compaction or the use of large compaction equipment should be avoided because increased compactive effort can result in lateral pressures higher than those recommended above.

Foundation Support

Retaining walls should be supported on spread footings or drilled piers, as applicable, designed in accordance with the recommendations presented in this report. Retaining wall foundations should be designed by the project civil or structural engineer to resist the lateral forces set forth in this section.

Wall Drainage and Backfill

Retaining walls should be backdrained as shown on Plate 10, Appendix A. The backdrains should consist of 4-inch diameter, rigid perforated pipe embedded in Class 2 permeable material. The pipe should be PVC Schedule 40 or ABS with SDR 35 or better, and the pipe should be sloped to drain to outlets by gravity. The top of the pipe should be at least 8 inches below lowest adjacent grade. The Class 2 permeable material should extend to within 1½ feet of the surface. The upper 1½ feet should be backfilled with compacted soil to exclude surface water. Retaining walls designed to resist full hydrostatic pressure do not need to be backdrained. Expansive soils should not be used for wall backfill. Where expansive soils are present in the excavation made to install the retaining wall, the excavation should be sloped back 1:1 from the back of the footing or grade beam. The ground surface behind retaining walls should be sloped to drain. Where migration of moisture through retaining walls would be detrimental, retaining walls should be waterproofed.

Soil Nail Walls

Because of site constraints, some areas of the basement walls may need to be constructed using soil nails and shotcrete rather than laying the basement cut back to a temporary slope condition.

We recommend that soil nail walls be designed based on an effective friction angle of 30 degrees, an effective cohesion of 200 psf, a total unit weight of 125 pcf, and an allowable bond stress of 1200 psf. The above design criteria should be confirmed by appropriate testing during construction. The allowable bond stress should be verified by pullout testing. Where the wall is subjected to vehicular traffic, a surcharge of 250 psf should be applied.

We understand that the horizontal coefficient for seismic forces is derived as a portion of the peak ground acceleration (PGA). Peak ground acceleration (PGA) was determined using the methods in the 2013 California Building Code (CBC) and the American Society of Civil Engineers (ASCE) Standard 7-10. Using the U.S. Seismic Design Maps from the USGS website (http://geohazards.usgs.gov/designmaps/us/application.php), the site's latitude and longitude and a Site Soil Class, the PGA for the site is 0.67g. The wall designer should choose the appropriate percentage of the PGA based on the design procedures used.

Proof Testing - Soil nails should be load tested as outlined in the Manual for Design and Construction Monitoring of Soil Nail Walls (FHWA, 1996). Sacrificial nails should be installed and proof tested to confirm the design bond stresses as discussed previously. The number of sacrificial tests should be at least 5 percent of the production nails. Where proof testing and/or creep testing indicate bond stresses lower than the design allowable bond stress, the wall design should be modified accordingly.

Wall Drainage - The wall should be provided with a drainage media such as Miradrain 6000, or equivalent, with a horizontal spacing of no more than 5 feet between strips. The drainage material should extend from 1 foot below the top of the wall to the bottom of the wall. Water from the backdrain should be outletted using either a rigid perforated PVC or ABS pipe (Schedule 40, SDR of 35 or better), 4 inches in diameter, at the base of the wall. The drainpipe should be surrounded by Class 2 permeable material.

Slab-On-Grade

Because of expansive soils slab-on-grade floors should not be used in interior areas that are not underlain by at least 30 inches of select fill. Slabs-on-grade can be used in exterior flatwork areas provided the slabs are underlain by at least 12 inches of select fill not counting the slab rock.

Slab-on-grade subgrade should be rolled to produce a dense, uniform surface. The future expansion potential of the subgrade soils should be reduced by thoroughly presoaking the slab subgrade prior to concrete placement. The moisture condition of the subgrade soils should be checked by the geotechnical engineer no more than 24 hours prior to placing the capillary moisture break. The slabs should be underlain with a capillary moisture break consisting of at least 4 inches of clean, free-draining crushed rock or gravel (excluding pea gravel) at least ¼-inch and no larger than ¾-inch in size. Interior slabs subject to vehicular traffic may be underlain by Class 2 aggregate base. The use of Class 2 aggregate base should be reviewed on a case by case basis. Class 2 aggregate base can be used for slab rock under exterior slabs. Interior area slabs should be provided with an underdrain system. The installation of this subdrain system is discussed in the "Geotechnical Drainage" section.

Slabs should be designed by the project civil or structural engineer to support the anticipated loads, reduce cracking and provide protection against the infiltration of moisture vapor. Slabs subjected to heavy concentrated wheel loads, such as forklift or trailer-trucks, should be designed to carry the anticipated wheel loads.

A vapor barrier should be placed under all slabs-on-grade that are likely to receive an impermeable floor finish or be used for any purpose where the passage of water vapor through the floor is undesirable. RGH does not practice in the field of moisture vapor transmission evaluation or mitigation. Therefore, we recommend that a qualified person be consulted to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. This person should provide recommendations for mitigation of the potential adverse impact of moisture vapor transmission on various components of the structure as deemed appropriate.

Utility Trenches

The shoring and safety of trench excavations is solely the responsibility of the contractor. Attention is drawn to the State of California Safety Orders dealing with "Excavations and Trenches."

Unless otherwise specified by the County of Napa, on-site, inorganic soil may be used as general utility trench backfill. Where utility trenches support pavements, slabs and foundations, trench backfill should consist of aggregate baserock. The baserock should comply with the minimum requirements in Caltrans Standard Specifications, Section 26 for Class 2 Aggregate Base. Trench backfill should be moisture-conditioned as necessary, and placed in horizontal layers not exceeding 8 inches in thickness, before compaction. Each layer should be compacted to at least 90 percent relative compaction as determined by ASTM Test Method D-1557. The top 6 inches of trench backfill below vehicle pavement subgrades should be moisture-conditioned as necessary and compacted to at least 95 percent relative compaction. Jetting or ponding of trench backfill to aid in achieving the recommended degree of compaction should not be attempted.

Pavements

Provided the site grading is performed to remediate expansive soil heave, as recommended herein, the uppermost 12-inches of pavement subgrade soils will be either imported select fill with a minimum R-value of 20 or lime stabilized site soils that generally have an R-value of at least 50. Based on those R-values we recommend the pavement sections listed in the tables below be used.

PAVEMENT SECTIONS WITH IMPORTED SELECT FILL SUBGRADE			
TI	ASPHALT CONCRETE (feet)	CLASS 2 AGGREGATE BASE (feet)	IMPORTED SELECT FILL* (feet)
7.0	0.30	1.15	1.0
6.0	0.25	1.05	1.0
5.0	0.20	0.90	1.0

* R-value ≥ 20

PAVEMENT SECTIONS WITH LIME STABILIZED SELECT FILL SUBGRADE			
TI	ASPHALT CONCRETE (feet)	CLASS 2 AGGREGATE BASE (feet)	LIME STABILIZED SELECT FILL* (feet)
7.0	0.35	0.50	1.0
6.0	0.30	0.50	1.0
5.0	0.20	0.50	1.0

* R-value ≥ 50

Pavement thicknesses were computed using Caltrans CalFP v1.1 design software and are based on a pavement life of 20 years. These recommendations are intended to provide support for traffic represented by the indicated Traffic Indices. They are not intended to provide pavement sections for heavy concentrated construction storage or wheel loads such as forklifts, parked truck-trailers and concrete trucks or for post-construction concentrated wheel loads such as self-loading dumpster trucks.

In areas where heavy construction storage and wheel loads are anticipated, the pavements should be designed to support these loads. Support could be provided by increasing pavement sections or by providing reinforced concrete slabs. Alternatively, paving can be deferred until heavy construction storage and wheel loads are no longer present. Loading areas subjected to heavy wheel loads and repetitive stopping and starting should be provided with reinforced concrete slabs. Alternatively, the asphalt concrete section should be increased to at least 8 inches in these areas

Prior to placement of aggregate base, the upper 6 inches of the pavement subgrade soils (excluding lime stabilized soils) should be scarified, uniformly moisture-conditioned to near optimum, and compacted to at least 95 percent relative compaction to form a firm, non-yielding surface. Lime stabilized select fill subgrade soils should be compacted as specified in Section 24 of the Caltrans Standard Specifications.

Aggregate base materials should be spread in thin layers, uniformly moisture-conditioned, and compacted to at least 95 percent relative compaction to form a firm, non-yielding surface. The materials and methods used should conform to the requirements of the County of Napa and the current edition of the Caltrans Standard Specifications, except that compaction requirements should be based on ASTM Test Method D-1557. Aggregate used for the base course should comply with the minimum requirements specified in Caltrans Standard Specifications, Section 26 for Class 2 Aggregate Base.

Wet Weather Paving

In general, the pavements should be constructed during the dry season to avoid the saturation of the subgrade and base materials, which often occurs during the wet winter months. If pavements are constructed during the winter, a cost increase relative to drier weather construction should be anticipated. Unstable areas may have to be overexcavated to remove soft soils. The excavations will probably require backfilling with imported crushed (ballast) rock. The geotechnical engineer should be consulted for recommendations at the time of construction.

Geotechnical Drainage

Surface

Surface water should be diverted away from slopes, foundations and edges of pavements. Surface drainage gradients should slope away from building foundations in accordance with the requirements of the CBC or local governing agency. Where a gradient flatter than 2 percent for paved areas and 4 percent for unpaved areas is required to satisfy design constraints, area drains should be installed with a spacing no greater than about 20 feet. Roofs should be provided with gutters and the downspouts should be connected to closed (glued Schedule 40 PVC or ABS with SDR of 35 or better) conduits discharging into the site's surface drainage system. Roof downspouts and surface drains must be maintained entirely separate from the slab underdrains recommended hereinafter.

Water seepage or the spread of extensive root systems into the soil subgrade of footings, slabs or pavements could cause differential movements and consequent distress in these structural elements. Landscaping should be planned with consideration for these potential problems.

Slab Underdrains

Where interior slab subgrades are less than 6 inches above adjacent exterior grade and where migration of moisture through the slab would be detrimental, slab underdrains should be installed to dispose of surface and/or groundwater that may seep and collect in the slab rock. Slab underdrains should consist of 6-inch wide trenches that extend at least 6 inches below the bottom of the slab rock and slope to drain by gravity. The slab underdrain trenches should be spaced no further than 15 feet, both ways. Additional drain trenches should be installed, as necessary, to drain all isolated under slab areas. Four-inch diameter perforated pipe (SDR 35 or better) sloped to drain to outlets by gravity should be placed in the bottom of the trenches. Slab underdrain trenches should be backfilled to subgrade level with clean, free draining slab rock. An illustration of this system is shown on Plate 11. If slab underdrains are not used, it should be anticipated that water will enter the slab rock, permeate through the concrete slab and ruin floor coverings.

Maintenance

Periodic land maintenance will be required. Surface and subsurface drainage facilities should be checked frequently, and cleaned and maintained as necessary or at least annually. A dense growth of deep-rooted ground cover must be maintained on all slopes to reduce sloughing and erosion. Sloughing and erosion that occurs must be repaired promptly before it can enlarge.

Supplemental Services

Pre-Bid Meeting

It has been our experience that contractors bidding on the project often contact us to discuss the geotechnical aspects. Informal contacts between RGH and an individual contractor could result in incomplete or misinterpreted information being provided to the contractor. Therefore, we recommend a pre-bid meeting be held to answer any questions about the report prior to submittal of bids. If this is not possible, questions or clarifications regarding this report should be directed to the project owner or their designated representative. After consultation with RGH, the project owner or their representative should provide clarifications or additional information to all contractors bidding the job.

Plan and Specifications Review

Coordination between the design team and the geotechnical engineer is recommended to assure that the design is compatible with the soil, geologic and groundwater conditions encountered during our study. RGH Consultants (RGH) recommends that we be retained to review the project plans and specifications to determine if they are consistent with our recommendations. In the event we are not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

Construction Observation and Testing

Prior to construction, a meeting should be held at the site that includes, but is not limited to, the owner or owner's representative, the general contractor, the grading contractor, the foundation contractor, the underground contractor, any specialty contractors, the project civil engineer, other members of the project design team and RGH. This meeting should serve as a time to discuss and answer questions regarding the recommendations presented herein and to establish the coordination procedure between the contractors and RGH.

In addition, we should be retained to monitor all soils related work during construction, including:

- Site stripping, over-excavation, grading, and compaction of near surface soils;
- Placement of all engineered fill and trench backfill with verification field and laboratory testing;
- Observation of all foundation excavations; and
- Observation of foundation and subdrain installations.

If, during construction, we observe subsurface conditions different from those encountered during the explorations, we should be allowed to amend our recommendations accordingly. If different conditions are observed by others, or appear to be present beneath excavations, RGH should be advised at once so that these conditions may be evaluated and our recommendations reviewed and updated, if warranted. The validity of recommendations made in this report is contingent upon our being notified and retained to review the changed conditions.

If more than 18 months have elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at, or adjacent to, the site, the 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 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 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 Truchard Vineyards and their consultants as an aid in the design and construction of the proposed winery described in this report.

The validity of the recommendations contained in this report depends upon an adequate testing and monitoring program during the construction phase. Unless the construction monitoring and testing program is provided by our firm, we will not be held responsible for compliance with design recommendations presented in this report and other addendum submitted as part of this report.

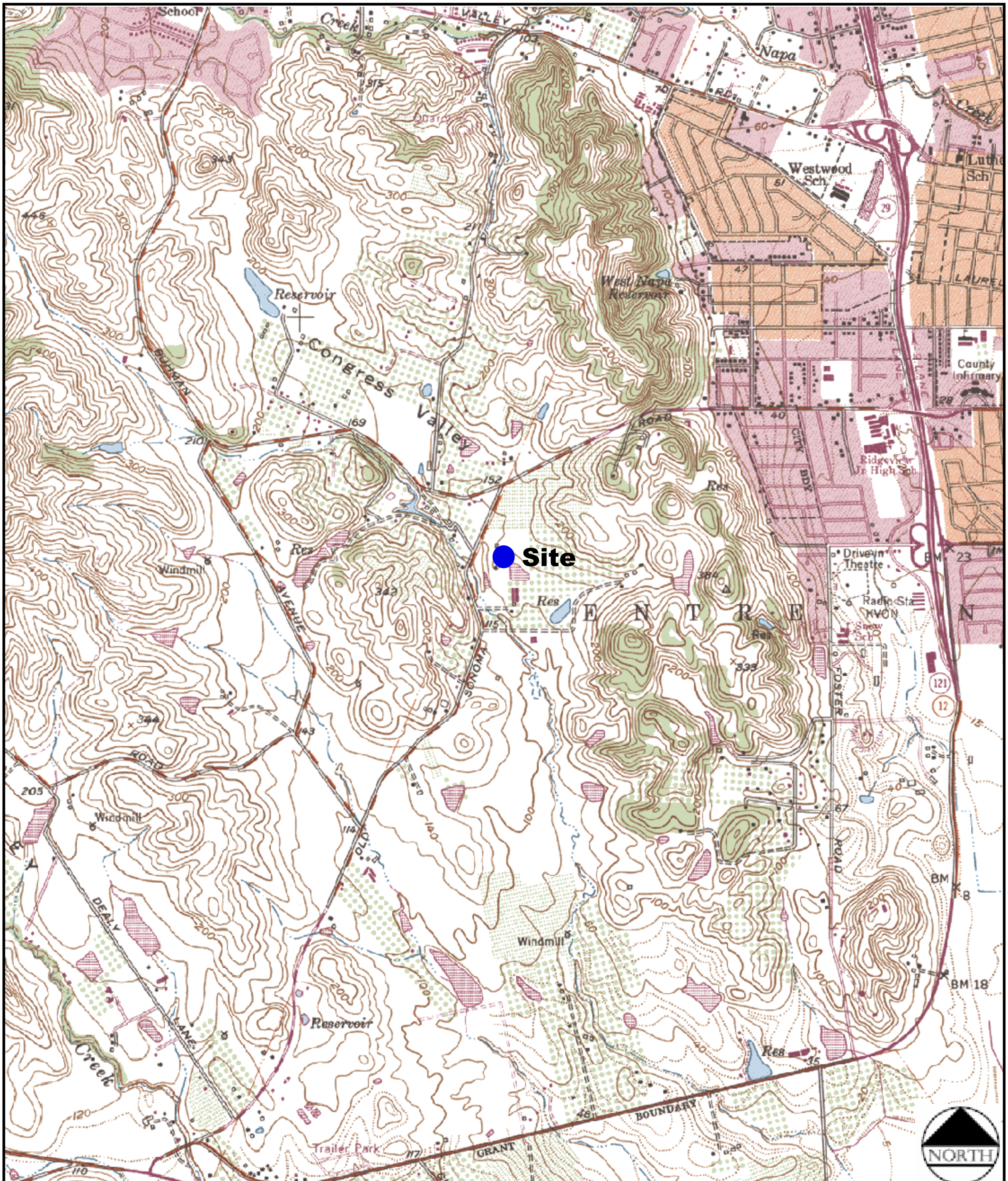
Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided to us regarding the proposed construction, the results of our field exploration, laboratory testing program, and professional judgment. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observation of construction.

The test pits represent subsurface conditions at the locations and on the date indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration on November 19, 2014, and may not necessarily be the same or comparable at other times.

The scope of our services did not include an environmental assessment or a study of the presence or absence of toxic mold and/or 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. These studies should be conducted under separate cover, scope and fee and should be provided by a qualified expert in those fields.

APPENDIX A - PLATES

LIST OF PLATES



Reference: Maptech Topoquad, Napa, California Quadrangle

Scale: 1" = 2000'

RGH CONSULTANTS

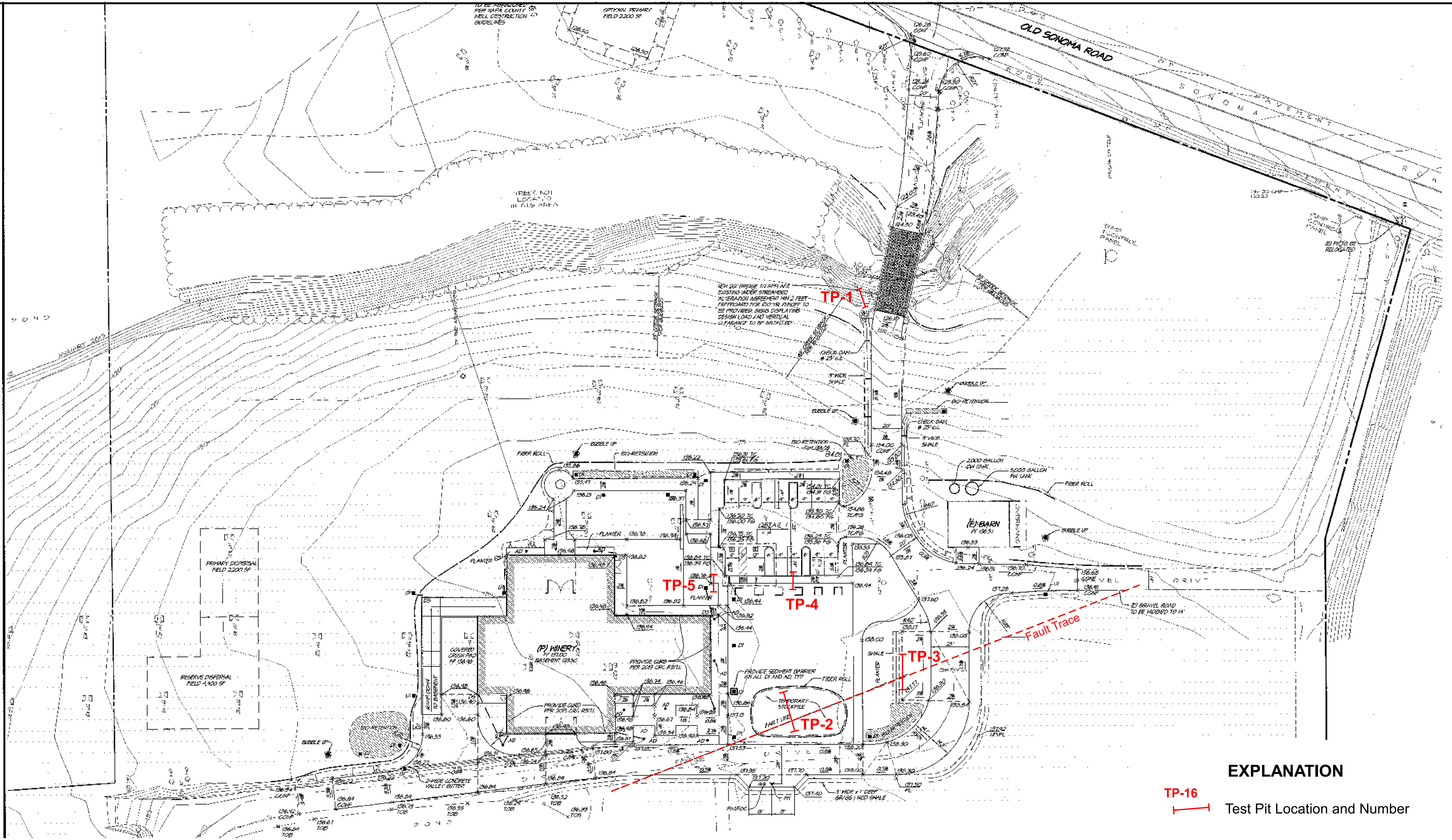
Job No: 6838.01.04.2 | Date: NOV 2015

SITE LOCATION MAP

Truchard Winery
4062 Old Sonoma Road
Napa, California

PLATE

1



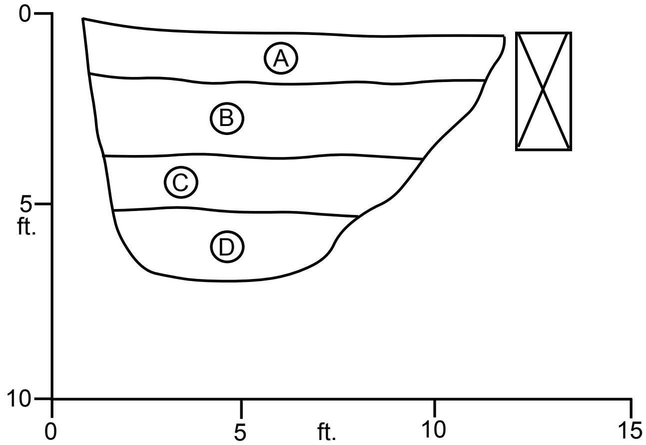
Reference: Grading and Erosion Control Plan, RSA+, Oct. 7, 2015, sheet 2 of 4

Scale: 1" = 60'

60 0 60 120 feet

RGH CONSULTANTS	EXPLORATION PLAN Truchard Winery 4062 Old Sonoma Road Napa, California	PLATE 2
Job No: 6838.01.04.2 Date: NOV 2015		

TP-1
077° ➤



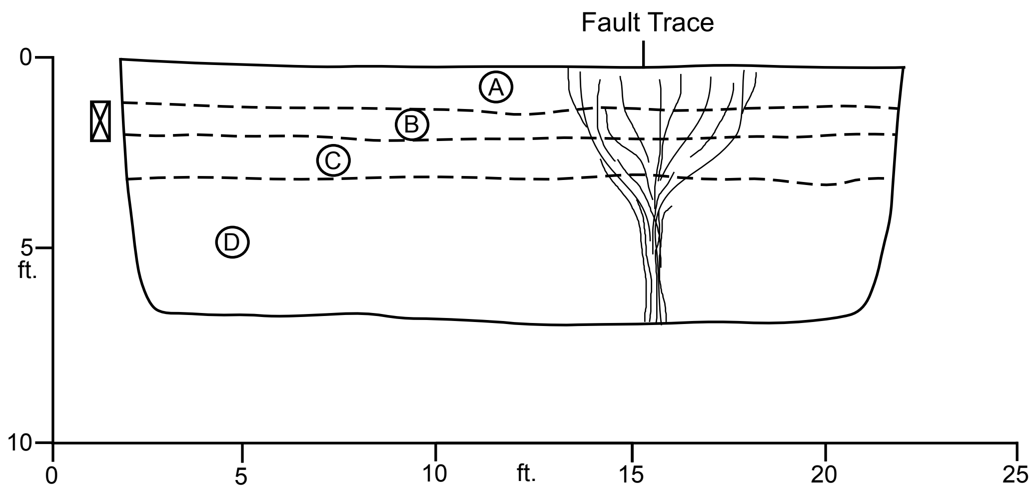
Ⓐ DARK BROWN CLAY (CH), stiff, dry, porous.

Ⓑ DARK BROWN CLAY (CH), very stiff, moist.

Ⓒ OLIVE-GRAY CLAY (CH), hard, moist.

Ⓓ YELLOW-BROWN SANDY CLAY (CL), hard, moist, completely weathered bedrock.

TP-2
067° ➤



Ⓐ RED-BROWN SANDY CLAY (CH), very stiff, moist, contains minor amounts of aggregate base (fill).

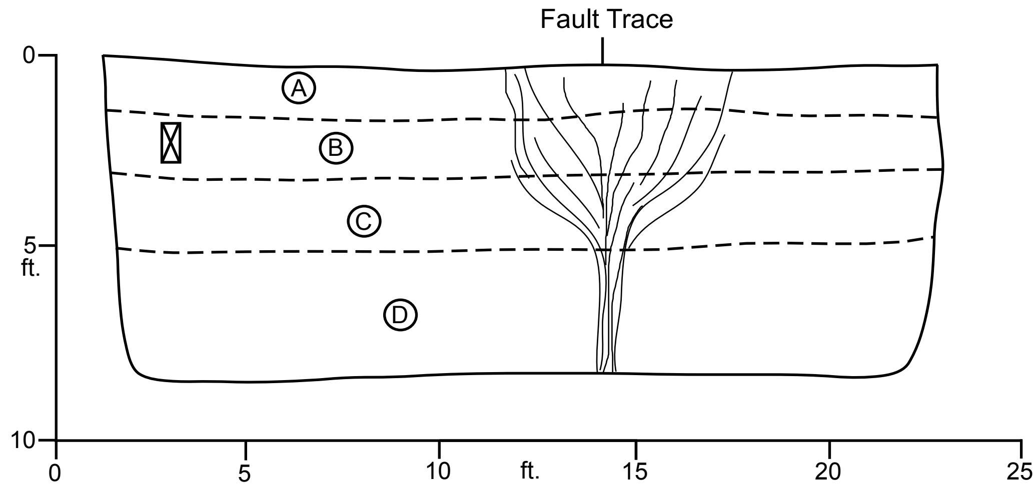
Ⓑ DARK BROWN CLAY (CH), stiff, dry, porous.

Ⓒ RED-BROWN SANDY CLAY (CH), very stiff, moist

Ⓓ MOTTLED OLIVE AND BROWN SILTSTONE, very closely spaced fractures, firm, weak, moderately to highly weathered.

RGH CONSULTANTS Job No: 6838.01.04.2 | Date: NOV 2015	**LOG OF TEST PITS TP-1 THROUGH TP-2** Truchard Winery 4062 Old Sonoma Road Napa, California	PLATE **3**

TP-3
095° ➤



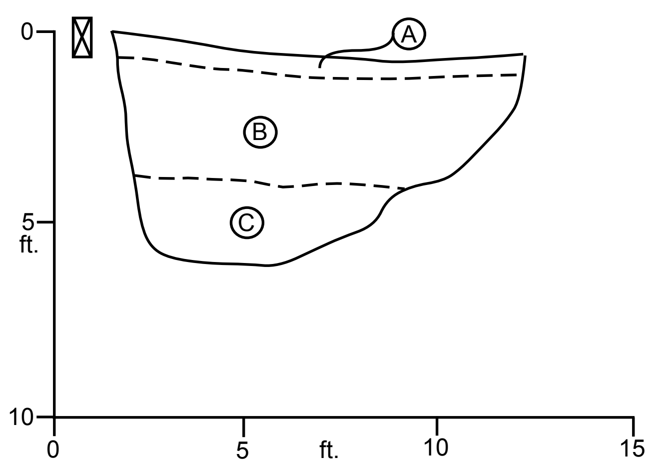
Ⓐ RED-BROWN SANDY CLAY (CH), very stiff, moist, contains minor amounts of aggregate base (fill).

Ⓑ DARK BROWN CLAY (CH), stiff, dry, porous.

Ⓒ RED-BROWN SANDY CLAY (CH), very stiff, moist

Ⓓ MOTTLED OLIVE AND BROWN SILTSTONE, very closely spaced fractures, firm, weak, moderately to highly weathered.

TP-4
095° ➤



Ⓐ DARK BROWN CLAY (CH), very stiff, moist.

Ⓑ OLIVE-GRAY CLAY (CH), hard, moist.

Ⓒ YELLOW-BROWN SANDY CLAY (CL), hard, moist, completely weathered bedrock.

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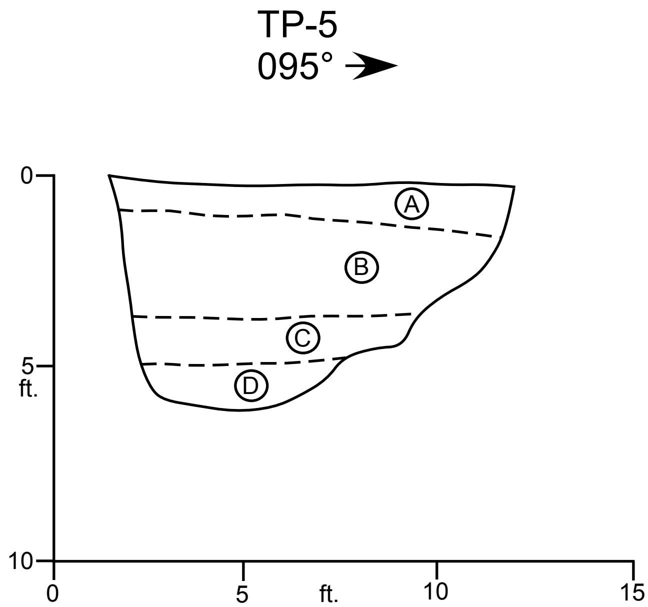
Job No: 6838.01.04.2 | Date: NOV 2015

LOG OF TEST POTS TP-3 THROUGH TP-4
Truchard Winery
4062 Old Sonoma Road
Napa, California

PLATE
4



Ⓐ DARK BROWN CLAY (CH), very stiff, moist.

Ⓑ OLIVE-GRAY CLAY (CH), hard, moist.

Ⓒ RED-BROWN SANDY CLAY (CL), hard, moist, completely weathered bedrock.

Ⓓ YELLOW-BROWN SANDY CLAY (CL), hard, moist, completely weathered bedrock.

RGH CONSULTANTS	**LOG OF TEST PIT TP-5** Truchard Winery 4062 Old Sonoma Road Napa, California	PLATE **5**
Job No: 6838.01.04.2 — Date: NOV 2015		

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	**GRAVEL AND GRAVELLY SOILS** MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	**CLEAN GRAVEL** (LITTLE OR FINES)		**GW**	WELL-GRADED GRAVEL, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVEL, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVEL WITH FINES (OVER 12% OF FINES)		**GM**	WELL-GRADED GRAVEL, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GC	CLAYEY GRAVEL, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	**CLEAN SANDS** (LITTLE OR NO FINES)		**SW**	WELL-GRADED SAND, GRAVELLY SAND, LITTLE OR NO FINES
				SP	POORLY-GRADED SAND, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (OVER 12% OF FINES)		**SM**	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
				SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50			**ML**	INORGANICS SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			**MH**	ORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				**PT**	PEAT, HUMUS, SWAMP SOILS AND OTHER SOILS WITH HIGH ORGANIC-CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

KEY TO TEST DATA

Consol - Consolidation
Gs - Specific Gravity
SA - Sieve Analysis
■ - "Undisturbed" Sample
☒ - Bulk or Disturbed Sample
◥ - Standard Penetration Test
⧄ - Sample Attempt With No Recovery
▯ - Sample Recovered But Not Retained

	Shear Strength, psf	Confining Pressure, psf	
Tx	320	(2600)	- Unconsolidated Undrained Traixial
TxCU	320	(2600)	- Consolidated Undrained Triaxial
DS	2750	(2600)	- Consolidated Drained Direct Shear
UC	2000		- Unconfined Compression
FVS	470		- Field Vane Shear
LVS	700		- Laboratory Vane Shear
SS			- Shrink Swell
EXP			- Expansion
P			- Permeability

Note: All strength tests on 2.8-in. or 2.4-in. diameter sample, unless otherwise indicated.

RGH CONSULTANTS

Job No: 6838.01.04.2 | Date: NOV 2015

SOIL CLASSIFICATION AND KEY TO TEST DATA
Truchard Winery
4062 Old Sonoma Road
Napa, California

PLATE
6

LAYERING	
MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINLY BEDDED	2½ to 8 inches
VERY THINLY BEDDED	¾ to 2½ inches
CLOSELY LAMINATED	¼ to ¾ inches
VERY CLOSELY LAMINATED	Less than ¼ inch

JOINT, FRACTURE, OR SHEAR SPACING	
VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY SPACED	8 to 24 inches
CLOSELY SPACED	2½ to 8 inches
VERY CLOSELY SPACED	¾ to 2½ inches
EXTREMELY CLOSELY SPACED	Less than ¼ inch

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

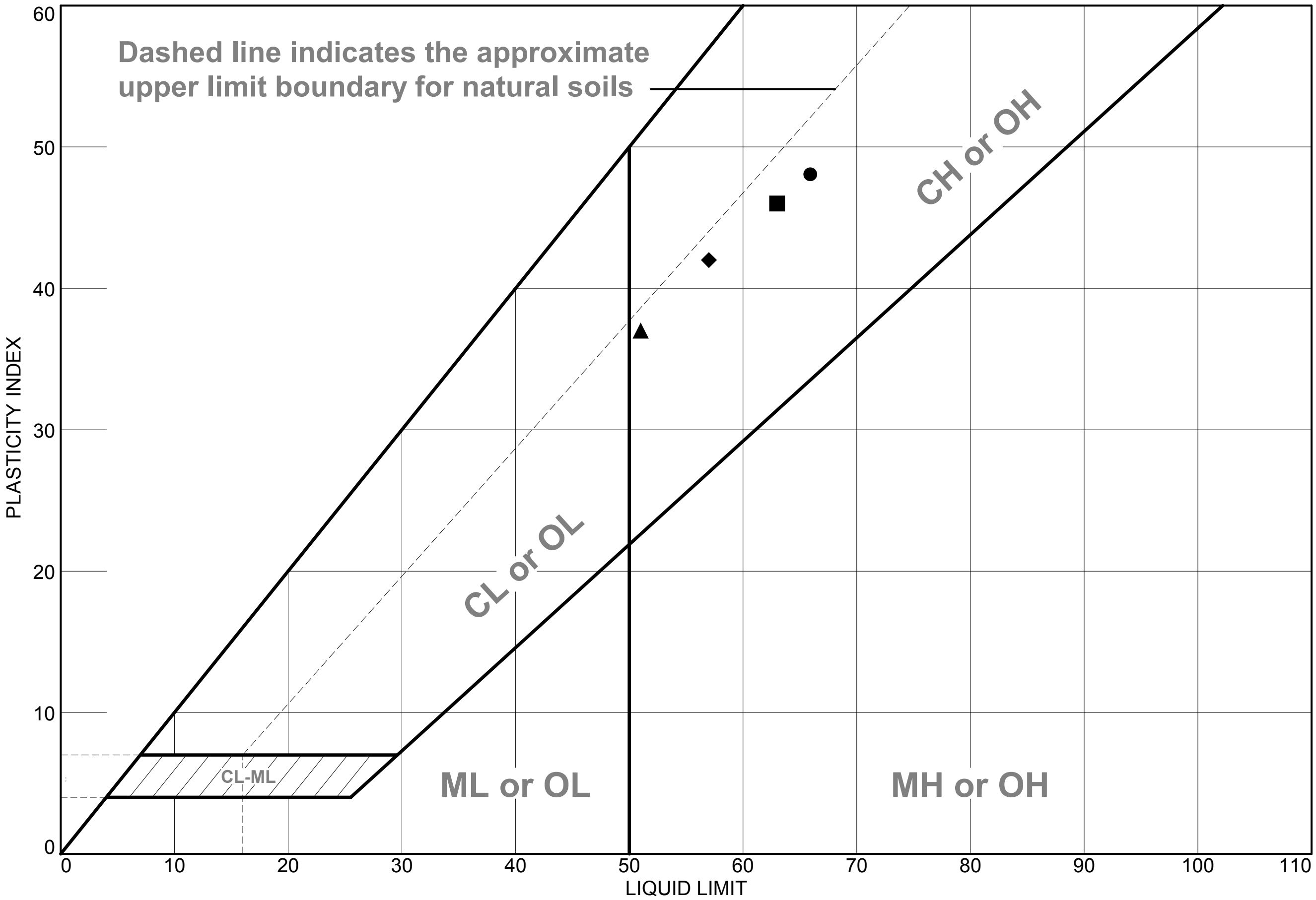
STRENGTH

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

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brn Clay W/ Sand (CH)	66	18	48			CH
■	Brn Clay W/ Sand (CH)	63	17	46		76.5	CH
▲	Brn Clay W/ Sand (CH)	51	14	37		75.5	CH
◆	Brn Clay W/ Sand (CH)	57	15	42		82.4	CH

Project No. 6838.01.08.2 **Client:** RGH Consultants

Project: Truchard Winery

●**Source of Sample:** TP-1 **Depth:** 0-3.0'
■**Source of Sample:** TP-2 **Depth:** 2.0'
▲**Source of Sample:** TP-3 **Depth:** 2.0'
◆**Source of Sample:** TP-4 **Depth:** 0.0'

Remarks:
■Expansion Index=129
▲Expansion Index=113
◆Expansion Index=131

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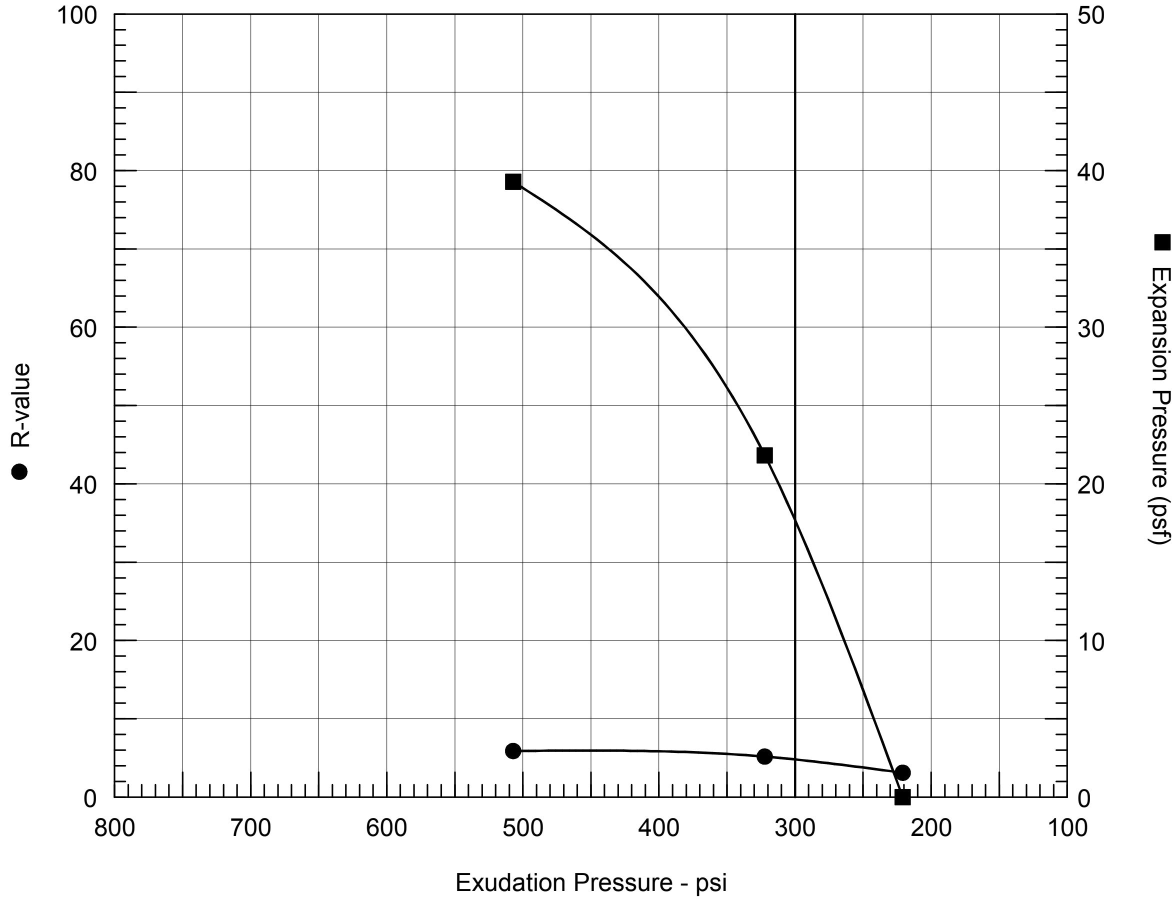
CLASSIFICATION TEST DATA
Truchard Winery
4062 Old Sonoma Road
Napa, California

PLATE
8

Job No: 6838.01.04.2 | Date: NOV 2015

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	30	81.4	38.6	0	149	2.54	221	3	3
2	60	87.3	33.1	22	144	2.57	322	5	5
3	95	92.8	30.1	39	143	2.47	507	6	6

Test Results	Material Description
R-value at 300 psi exudation pressure = 5 **Exp. pressure at 300 psi exudation pressure =** 18 psf	Brn Clay W/ Sand (CH)

Project No.: 6838.01.08.2
Project: Truchard Winery
Source of Sample: TP-1 **Depth:** 0-3.0’
Date: 12/3/2014

Tested by: SEF
Checked by: GEF
Remarks:

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Job No: 6838.01.04.2 | Date: NOV 2015

R-VALUE TEST DATA
Truchard Winery
4062 Old Sonoma Road
Napa, California

PLATE
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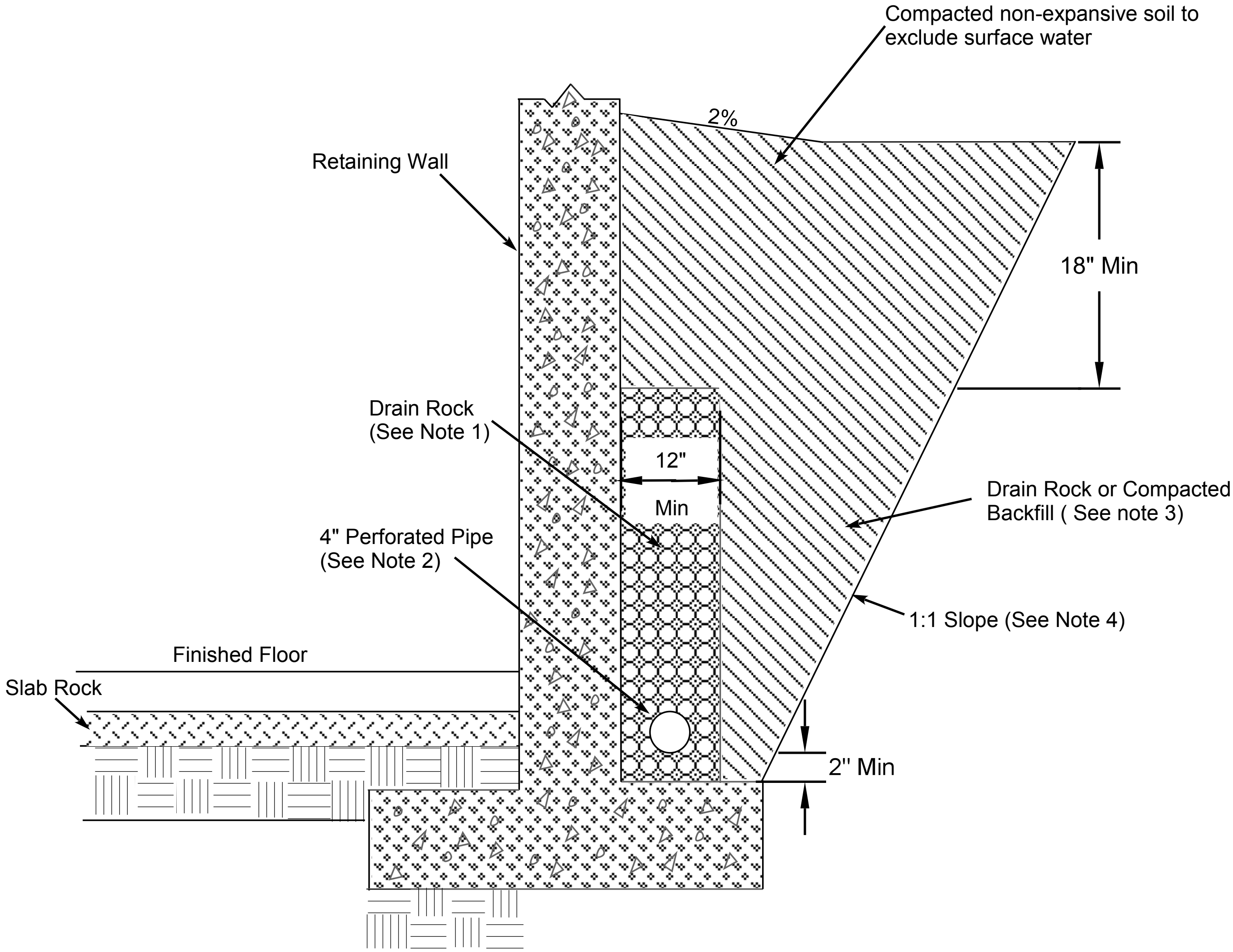


Notes:

1. Drain rock should meet the requirements for Class 2 Permeable Material, Section 68, State of California "Caltrans" Standard Specification, latest edition. Drain rock should be placed to approximately three-quarters the height of the retaining wall.

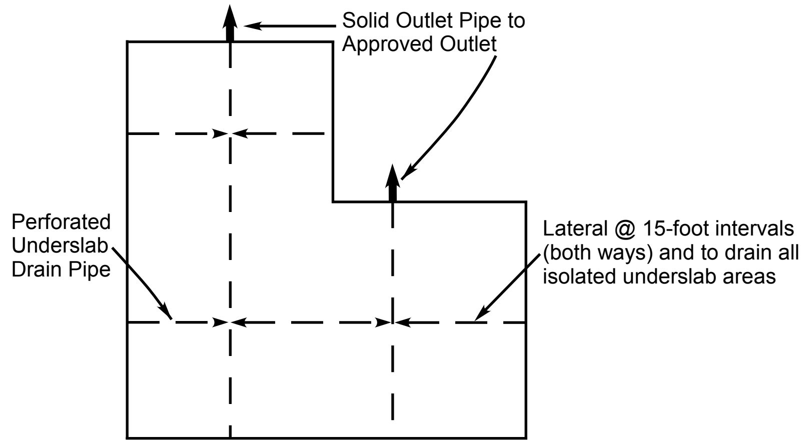
2. Pipe should conform to the requirements of Section 68 of State of California "Caltrans" Standards, perforations placed down, sloped at 1% for gravity flow to outlet or sump with automatic pump. The pipe invert should be located at least 8 inches below the lowest adjacent finished surface.

3. During construction the contractor should use appropriate methods such as temporary bracing and/or light compaction equipment to avoid overstressing the walls. Non-expansive soils to be used as backfill.

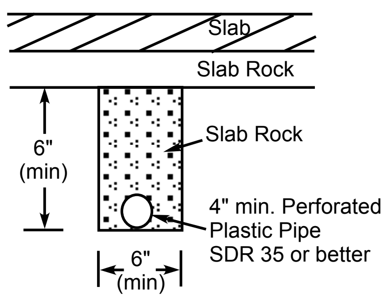
4. Slope excavation back at a 1:1 gradient from the back of footing where expansive materials are exposed.

Not to Scale

RGH CONSULTANTS	**RETAINING WALL BACKDRAIN ILLUSTRATION** Truchard Winery 4062 Old Sonoma Road Napa, California	PLATE **10**
Job No: 6838.01.04.2 — Date: NOV 2015		



TYPICAL UNDERSLAB DRAIN PLAN



SLAB UNDERDRAIN

RGH CONSULTANTS

Job No: 6838.01.04.2 | Date: NOV 2015

TYPICAL SUBDRAIN DETAILS

Truchard Winery
4062 Old Sonoma Road
Napa, California

PLATE
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APPENDIX B - REFERENCES

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APPENDIX C - DISTRIBUTION

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