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GEOTECHNICAL STUDY REPORT

SCOTTY CREEK 80,000 GALLON WATER TANK
HIGHWAY 1
BODEGA BAY, CALIFORNIA

Project Number:

2817.015.PW.1

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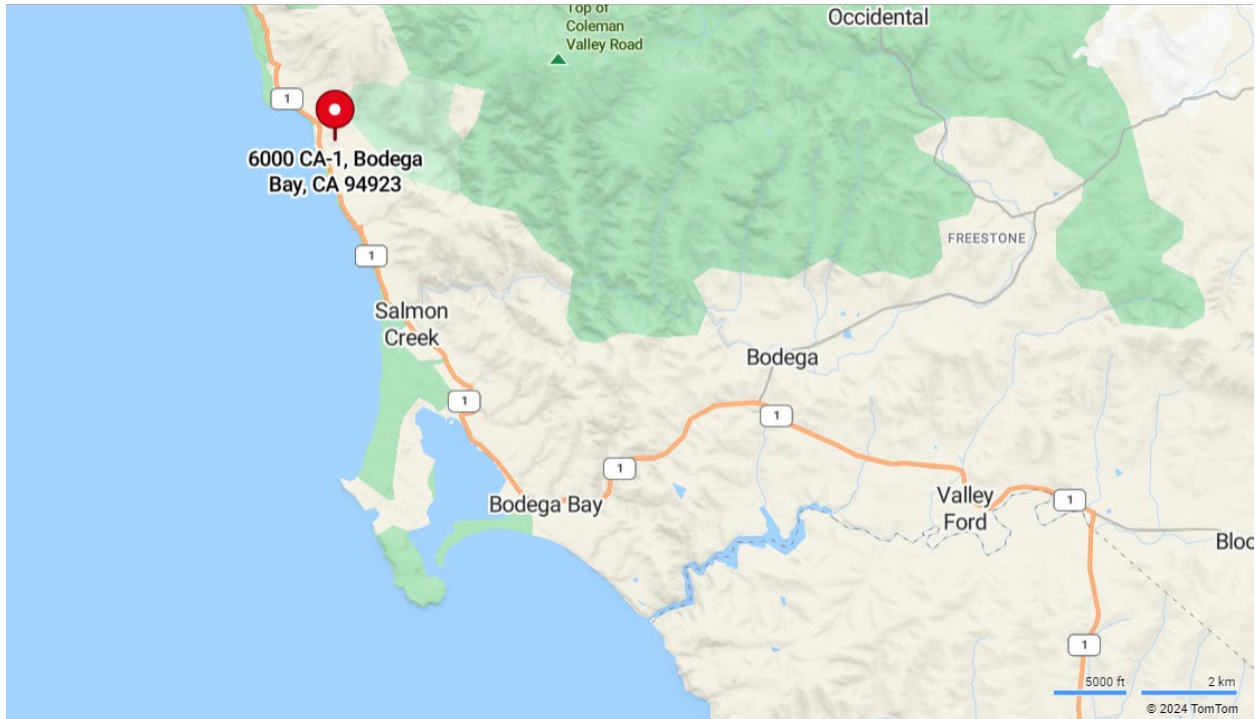
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INTRODUCTION

This report presents the results of our geotechnical study for the water tank to be constructed off Highway 1 in Sonoma County, California. The undeveloped property presently contains relatively level to gently sloping terrain. The site location is shown below.



We understand it is planned to construct an 80,000-gallon water tank for livestock. Actual foundation loads are not known at this time. We anticipate the loads will be typical for the light type of construction planned. Grading plans are not available, but we anticipate that the planned grading will be the minimum amount needed to provide the tank site with positive drainage.

Utility plans are not available, but we have assumed for this study that the project utilities will extend no deeper than 5 feet below the existing ground surface. If project utilities extend deeper, supplemental exploration may be required to evaluate the soil conditions within and below the utility excavations.

SCOPE

The purpose of our study, as outlined in our Professional Service Agreement dated March 15, 2024, 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 the subsurface conditions with borings and laboratory tests; analyzing the field and laboratory data; and presenting this report with the following geotechnical information:

1. A brief description of the soil and groundwater conditions observed during our study;
2. A discussion of seismic hazards that may affect the proposed improvements; and
3. Conclusions and recommendations regarding:
 - a. Primary geotechnical engineering concerns and mitigating measures, as applicable;
 - b. Site preparation and grading including remedial grading of weak and/or expansive surface soil;
 - c. Foundation type(s), design criteria, and estimated settlement behavior;
 - d. Support of concrete slabs-on-grade;
 - e. Utility trench backfill;
 - f. Geotechnical engineering drainage improvements; and
 - g. 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 March 21, 2024, we performed a geotechnical reconnaissance of the site and explored the subsurface conditions by drilling two borings to depths ranging from about 16 to 16½ feet. The borings were drilled with a Bobcat-mounted drill rig equipped with 4-inch diameter, solid stem augers at the approximate locations shown below. The boring locations were determined approximately and should be considered accurate only to the degree implied by the method used. Our personnel located and logged the borings and obtained samples of the materials encountered for visual examination, classification, and laboratory testing.



Relatively undisturbed samples were obtained from the borings at selected intervals by driving a 2.43-inch inside diameter, split spoon sampler, containing 6-inch-long brass liners, using a 140-pound hammer dropping 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 data. Disturbed samples were also obtained at selected depths by driving a 1.375-inch inside diameter (2-inch outside diameter) 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 boring logs. Disturbed samples were also obtained at selected depths from the borings and placed in plastic “grab” bags.

The logs of the borings showing the materials encountered, groundwater conditions, converted blow counts, and sample depths are presented on Plates 1 and 2. The soil is described in accordance with the Unified Soil Classification System, outlined on Plate 3. The boring logs show our interpretation of the subsurface soil 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 samples, laboratory test results, and interpretation of drilling and sampling resistance. The location of the soil boundaries should be considered approximate. The transition between soil types may be gradual.

Laboratory Testing

The samples obtained from the borings 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 water content, dry density, classification (Atterberg Limits, percent of silt and clay), shear strength, and expansion potential (Expansion Index - EI). The test results are presented on the boring logs and are presented on Plates 4 through 7.

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 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 soil.

Geology

Published geologic maps (Wagner et al., 2017) indicate the property is underlain by Holocene alluvium (Qha) and mélangé (KJfm).

Landslides

Published landslide maps (Huffman, 1980) 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 to gently sloping terrain. In general, the ground surface is moderately hard. However, soil in the area that appears hard and strong when dry will typically lose strength rapidly and settle under the loads of fills, foundations and slabs as its moisture content increases and approaches saturation. This typically occurs because the surface soil is weak, porous, and compressible. Natural drainage consists of sheet flow over the ground surface and slopes that concentrates in 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 4½ to 5½ feet of clay soil that is generally weak in the upper 2 feet. This soil exhibits high plasticity (LL = 53.4; PI = 22.3) and moderate expansion potential (EI = 83). Weak surface soil is a material with varying density, strength, compressibility, and shrink-swell characteristics that often has an unknown settlement behavior under new loads. These surface materials are underlain by sand with varying amounts of clay, gravel with varying amounts of clay, and clay with varying amounts of sand. A detailed description of the subsurface conditions found in our borings is given on Plates 1 and 2, Appendix A. Based on Table 20.3-1 of American

Society of Civil Engineers (ASCE) Standard 7-16, titled “Minimum Design Loads and Associated Criteria for Buildings and Other Structures” (2017), we have determined a Site Class of E should be used for the site.

Corrosion Potential

Mapping by the Natural Resources Conservation Service (202438.) 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 observed in our borings at depths ranging from 13 to 13½ feet below the ground surface at the time of drilling. 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

Faulting and Seismicity

We did not observe landforms within the area that would indicate the presence of active faults and the site is not within a current Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). Therefore, we believe the risk of fault rupture at the site is low. However, the site is within an area affected by strong seismic activity and 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.

Liquefaction

Liquefaction is a rapid loss of shear strength experienced in saturated, predominantly granular soil 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.

Granular soil was encountered at the site below the groundwater table. Therefore, we performed an analysis of the blow count data from our borings using the methods of Seed and Idriss (1982), Seed and others (1985), Youd and Idriss (2001), Idriss and Boulanger (2004) and Idriss and Boulanger (2008). These procedures normalize the blow counts to account for overburden pressure, rod length, hammer energy, and fines (percent of silt and clay) content. Once the blow counts are normalized and adjusted to a clean sand blow count, the cyclic resistance ratio (CRR) for each blow count is then determined using the same procedures referenced above. The CRR is compared to the cyclic stress ratio (CSR) induced by the earthquake. Calculating the CSR requires a peak ground acceleration and design earthquake magnitude.

Peak ground acceleration (PGA) was determined using the methods in the 2022 California Building Code (CBC) and the American Society of Civil Engineers (ASCE) Standard 7-16, titled "Minimum Design Loads and Associated Criteria for Buildings and Other Structures" (2017). Using the site-specific seismic criteria developed in accordance with Chapter 21 of ASCE 7-16, the site's latitude and longitude of 38.3877°N and 123.079°W, respectively, and a site soil Class of E, the PGA for the site is 0.891g. Using this information, the CSR for a M_M 7.5 earthquake at the site ranges from 0.57 to 0.62. The San Andreas fault is most likely controlling the ground motions at the site. According to the Building Seismic Safety Council Earthquake Scenario Event Set (BSSC, 2014) and the USGS Earthquake Scenario Map (available at <http://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=14d2f75c7c4f4619936dac0d14e1e468>), the closest segment of the San Andreas fault is capable of a M_M 8.04 earthquake. Therefore, the CRR values at the site must be scaled to account for the difference between M_M 8.04 and M_M 7.5. When the scaling factor for magnitude and confining stress corrections presented in Idriss and Boulanger (2004) are applied, the CRR values at the site do not exceed the CSR values for a layer from about 5 ½ and 7 ½ feet in boring B-1 and 4 ½ and 12 feet in boring B-2. Therefore, we judge that there is potential for liquefaction at the site. These layers are currently above the groundwater table, which was around 13 feet when drilling in March 2024, during a year with above average rainfall. Therefore, it is likely that these layers will not be below the groundwater table for extended periods of time. Therefore, we judge that the potential for liquefaction is low at the site.

Densification

Densification is the settlement of loose, granular soil above the groundwater level due to earthquake shaking. Typically, granular soil that would be susceptible to liquefaction, if saturated, is susceptible to densification, if not saturated. As discussed in the "Liquefaction" section, liquefiable soil was encountered at the site and would be susceptible to densification above the groundwater table. Densification-related settlement was calculated using the procedures described in Tokimatsu and Seed (1987) and could range from ½ to 1½ inches with differential settlement of about 1 inch across the tank.

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 soil susceptible to densification;
2. The presence of about 2 feet of weak, moderately expansive surface soil;
3. The detrimental effects of uncontrolled surface runoff on the long-term satisfactory performance of the project; and
4. The strong ground shaking predicted to impact the site during the life of the project.

Soil Susceptible to Densification

As discussed previously, there are layers of the subsurface soil that are susceptible to densification. Our analysis found that the total densification related settlement could range from ½ to 1½ inches with differential settlement of 1 inch across the tank.

Weak, Moderately Expansive Surface Soil

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

In addition, the surface soil is moderately expansive. Expansive surface soil shrinks and swells as it loses and gains moisture throughout the yearly weather cycle. Near the surface, the resulting movement can heave and crack lightly loaded shallow foundations (spread footings) and slabs. The zone of significant moisture variation (active layer) is dependent on the expansion potential of the soil and the extent of the dry season. Given the expansion potential of the soil, the active layer is generally considered to range in thickness from about 2 to 3 feet. The detrimental effects of the above-described movement can be reduced by pre-swelling the expansive soil before constructing the tank and equipment slabs on these

materials. If the concrete ring foundation is used, the footings need to extend to at least 24 inches below the finished pad grade.

Foundation and Slab Support - After remedial grading, satisfactory foundation support for the tank can be obtained from the gravel within a steel ring or concrete ring bottomed on the engineered fill. Equipment slabs can be supported on 12 inches of engineered fill.

On-Site Soil Quality

All fill materials must be approved by the geotechnical engineer. We anticipate that, with the exception of organic matter and of rocks or concrete debris larger than 6 inches in diameter, the excavated material will be suitable for re-use as engineered fill.

Engineered Fill

Engineered fill can consist of approved on-site soil or import materials with a low expansion potential. The geotechnical engineer must approve the use of on-site or import soil as engineered fill during grading.

Settlement

Since all foundations will bear on engineered fill or firm native soil, we estimate that post-construction differential settlement across the tank should be about ½ inch. Earthquake-induced settlement could range from ½ to 1½ inches with 1 inch of differential settlement across the tank.

Surface Drainage

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 the tank. Therefore, strict control of surface runoff is necessary to provide long-term satisfactory performance. It will be necessary to divert surface runoff around slopes and improvements, provide positive drainage away from the tank, and install energy dissipaters at discharge points of concentrated runoff. This can be achieved by constructing the tank pad several inches above the surrounding area and conveying the runoff into manmade drainage elements or natural swales that lead downgradient of the site.

RECOMMENDATIONS

Seismic Design

Seismic design parameters presented below are based on Section 1613 titled “Earthquake Loads” of the 2022 California Building Code (CBC). Based on Table 20.3-1 of American Society of Civil Engineers (ASCE) Standard 7-16, titled “Minimum Design Loads and Associated Criteria for Buildings and Other Structures” (2017), we have determined a Site Class of E should be used for the site. Using a site latitude and longitude of 38.3877°N and 123.079°W, respectively, and the procedures outlined in Chapter 21 of ASCE Standard 7-16, we recommend that the following site-specific seismic design criteria be used for applicable structures at the site.

2022 CBC Seismic Criteria	
Spectral Response Parameter	Acceleration (g)
S _s (0.2 second period)	2.369
S ₁ (1 second period)	0.992
S _{MS} (0.2 second period)	1.916
S _{M1} (1 second period)	4.150
S _{DS} (0.2 second period)	1.278
S _{D1} (1 second period)	2.766

Grading

Site Preparation

Areas to be developed should be cleared of vegetation and debris. 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 recommended herein. Excavations extending below the proposed finished grade should be backfilled with suitable materials compacted to the requirements given below.

Weak Surface Soil - Within tank and fill areas, the weak surface soil should be excavated in their entirety, which is about 2 feet in our borings. Within equipment slab area, the weak soils should be removed to a depth of at least 12 inches below subgrade. The excavation of weak surface materials should extend at least 5 feet beyond the outside edge of the exterior foundation of the proposed tank and 3 feet beyond the edge of equipment slabs. The excavated materials should be stockpiled for later use as compacted fill, or removed from the site, as applicable.

Excavation Safety - 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. We judge the on-site soil is generally suitable for use as engineered fill in tank and equipment slab areas, but we should verify its suitability during grading.

Import Fill

In general, imported fill, if needed, should be select. 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

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.

Fill Placement

The surface exposed by stripping and removal of weak surface soil should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to at least 2 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. Approved fill material should then be spread in thin lifts, uniformly moisture-conditioned to at least 2 percent above 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.

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. 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/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 the on-site soil is 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 soil. Special and relatively expensive construction procedures, including dewatering of excavations and importing granular soil, should be anticipated if grading must be completed during the winter and early spring or if localized areas of soft saturated soil 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 weak surface soil is removed or strengthened by remedial grading as recommended herein, the proposed tank can be supported on gravel in a steel ring or concrete ring foundation that bottoms on engineered fill or firm, native soil.

Gravel with a Steel Ring

A gravel and steel ring system can be used for tank support provided the pad consists of engineered fill. The compacted gravel within the steel ring acts as the foundation system for the tank. This system may be designed using allowable bearing pressures of 1,200, 1,800, and 2,400 pounds per square foot (psf), for dead loads, dead plus code live loads, and total loads (including wind and seismic), respectively.

Concrete Ring

A concrete ring system should be at least 12 inches wide and should bottom on engineered fill or firm, native soil, as applicable, at least 24 inches below lowest adjacent grade. Additional embedment or width may be needed to satisfy code and/or structural requirements.

The bottoms of all 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 soil disturbed during footing excavations, or restore their adequate bearing capacity, and reduce post-construction settlement. Footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks appear in soil 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 1,200, 1,800, and 2,400 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 foundations extending into compacted fill or firm, native soil may impose a passive equivalent fluid pressure and a friction factor of 300 pounds per cubic foot (pcf) and 0.30, respectively, to resist sliding. Passive pressure should be neglected within the upper 6 inches, unless the soil is confined by concrete slabs or pavements.

Slab-On-Grade

Provided grading is performed in accordance with the recommendations presented herein, equipment slabs should be underlain by engineered fill or firm soil. Slab-on-grade subgrade should be rolled to produce a dense, uniform surface. The future expansion potential of the subgrade soil should be reduced by thoroughly presoaking the slab subgrade prior to concrete placement. The moisture condition of the subgrade soil 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. Class 2 aggregate base can be used for slab rock under equipment slabs.

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.

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, 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.

Geotechnical Drainage

Surface water should be diverted away from foundations. Surface drainage gradients should slope away from foundations in accordance with the requirements of the CBC or local governing agency. Water seepage or the spread of extensive root systems into the soil subgrade of foundations and slabs could cause differential movements and consequent distress in these structural elements. Landscaping should be planned with consideration for these potential problems.

Maintenance

Periodic land maintenance, especially on hillsides, 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 Consultants (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 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 soil related work during construction, including, but not limited to:

- Site stripping, over-excavation, grading, and compaction of near surface soil;
- 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 five years 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, or a significant code change occurs, 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 the Gold Ridge Resource Conservation District and their consultants as an aid in the design and construction of the proposed improvements 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 borings represent the 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 and may not necessarily be the same or comparable at other times.

It should be understood that slope failures including landslides, debris flows and erosion are on-going natural processes which gradually wear away the landscape. Residual soil 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, unpredictable slope failure and erosion and deposition of the residual soil and weathered bedrock materials are irreducible risks and hazards of building upon or near the base of any hillside or any steeper slope area throughout northern California. By accepting this report, the client and other recipients acknowledge their understanding and acceptance of these risks and hazards, and the terms and conditions herein.

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

Plates 1 and 2	Logs of Borings B-1 and B-2
Plate 3	Soil Classification Chart and Key to Test Data
Plate 4	Classification Test Data
Plates 5 through 7	Strength Test Data

Date Drilled 3/21/2024	Logged By AKU	Project Manager EGC
Drilling Method Solid-Stem Auger	Drill Bit Size/Type 4 inch	Total Depth of Borehole 17 feet
Drill Rig Type Bobcat-Mounted Drill Rig	Drilling Contractor Stapleton	Approximate Surface Elevation Existing Ground Surface
Groundwater Level 13 1/2 feet	Sampling Method(s) Bulk, Modified California, SPT	Hammer Data 140 lb., 30" drop














Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0				DARK BROWN CLAY (CH), stiff, moist, trace gravel and sand								
12												
14					104.9	19.3						Su = 2,411.5 psf
15				GRAY BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, moist	118.5	11.8						Su = 894 psf
10				GRAY BROWN SANDY CLAY (CL), stiff, moist								
10				BROWN CLAY WITH SAND (CL), stiff, moist, orange oxidation								
15				DARK BROWN CLAY (CL), medium stiff, moist								
8				Boring terminated at 17 feet Groundwater encountered at 13 1/2 feet								

	LOG OF BORING B-1 Scotty Creek 80,000 Gallon Water Tank Highway 1 Sonoma County, California	PLATE 1
	Job No: 2817.015.PW.1 Date: APR 2024	

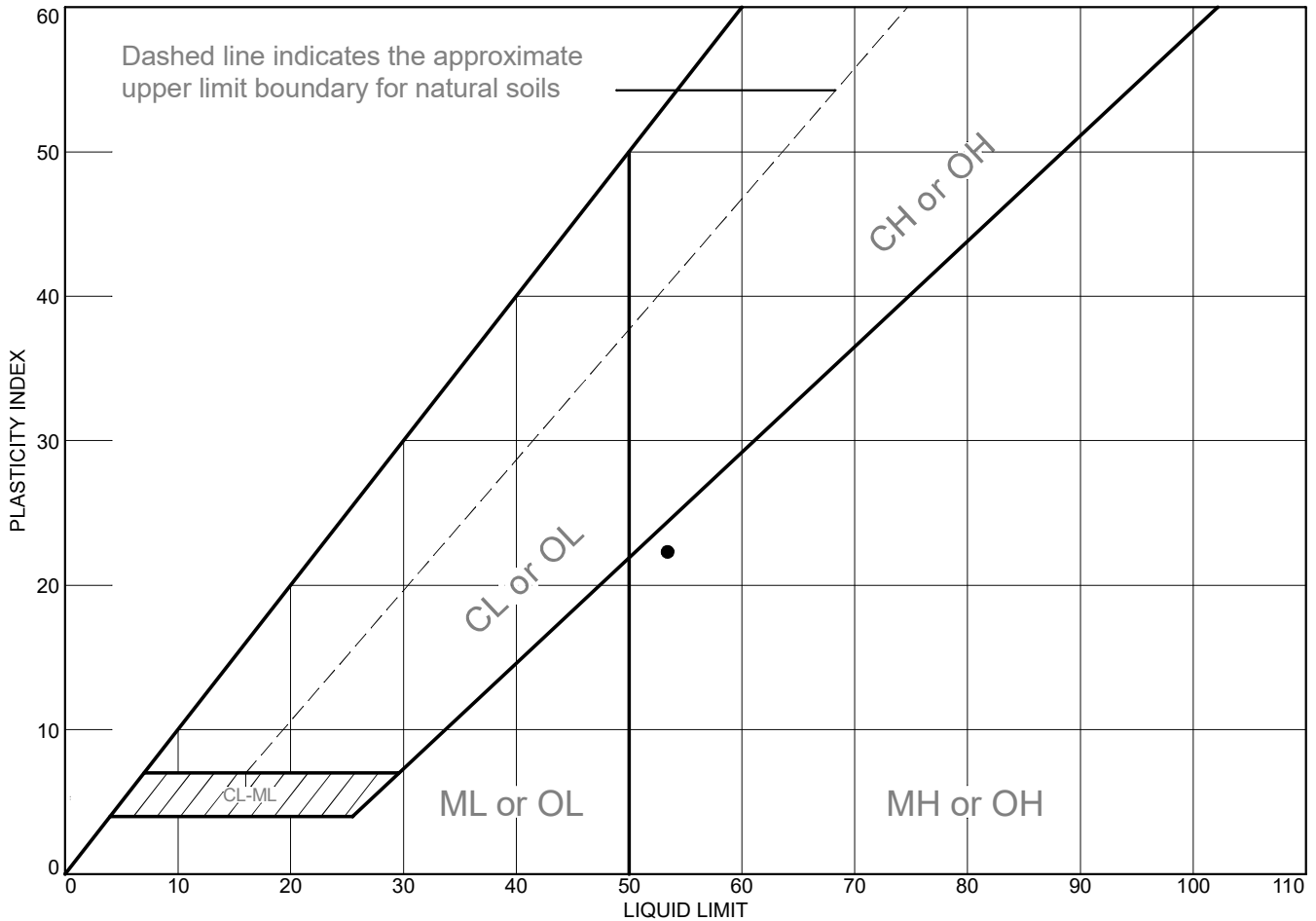
Date Drilled 3/21/2024	Logged By AKU	Project Manager EGC
Drilling Method Solid-Stem Auger	Drill Bit Size/Type 4 inch	Total Depth of Borehole 16 feet
Drill Rig Type Bobcat-Mounted Drill Rig	Drilling Contractor Stapleton	Approximate Surface Elevation Existing Ground Surface
Groundwater Level 13 feet	Sampling Method(s) Bulk, Modified California, SPT	Hammer Data 140 lb., 30" drop

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0				DARK BROWN SILT WITH SAND (MH), stiff, moist								
12		12			82.6	27.7		22.3	53.4	83		Su = 854 psf
5		13		DARK BROWN CLAYEY GRAVEL (GC), medium dense, moist								
10		12		GRAY BROWN CLAYEY SAND (SC), medium dense, moist								
15		11		DARK BROWN SANDY CLAY (CL), stiff, wet								
16				Boring terminated at 16 feet Groundwater encountered at 13 feet								

	LOG OF BORING B-2 Scotty Creek 80,000 Gallon Water Tank Highway 1 Sonoma County, California	PLATE 2
	Job No: 2817.015.PW.1 Date: APR 2024	

1	2	3	4	5	6	7	8	9	10	11	12	13
Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Graphic Log	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
<p>COLUMN DESCRIPTIONS</p> <p>1 Depth (feet): Depth in feet below the ground surface.</p> <p>2 Sample Type: Type of soil sample collected at the depth interval shown.</p> <p>3 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.</p> <p>4 Graphic Log: Graphic depiction of the subsurface material encountered.</p> <p>5 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.</p> <p>6 Dry Density (pcf): Dry density, in pcf.</p> <p>7 Water Content (%): Water content, percent.</p> <p>8 % <#200 Sieve: % <#200 Sieve</p> <p>9 PI, %: Plasticity Index, expressed as a water content.</p> <p>10 LL, %: Liquid Limit, expressed as a water content.</p> <p>11 Expansion Index (EI): Expansion Index (EI)</p> <p>12 UC, ksf: Unconfined compressive strength, in kips per square foot.</p> <p>13 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel. Su, psf: Undrained Shear Strength, in pounds per square foot (psf)</p> <p>FIELD AND LABORATORY TEST ABBREVIATIONS</p> <p>LL: Liquid Limit, percent PI: Plasticity Index, percent</p> <p>SA: Sieve analysis (percent passing No. 200 Sieve) Su: Undrained Shear Strength, in pounds per square foot (psf)</p> <p>MATERIAL GRAPHIC SYMBOLS</p> <p> Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)</p> <p> Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)</p> <p> Clayey GRAVEL (GC)</p> <p> SILT, SILT w/SAND, SANDY SILT (MH)</p> <p> Clayey SAND (SC)</p> <p>TYPICAL SAMPLER GRAPHIC SYMBOLS</p> <p> Bulk Sample</p> <p> 2.5-inch-OD Modified California w/ brass liners</p> <p> 2-inch-OD unlined split spoon (SPT)</p> <p>OTHER GRAPHIC SYMBOLS</p> <p> Water level (at time of drilling, ATD)</p> <p> Water level (after waiting)</p> <p> Minor change in material properties within a stratum</p> <p> Inferred/gradational contact between strata</p> <p> Queried contact between strata</p> <p>GENERAL NOTES</p> <p>1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.</p> <p>2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.</p>												

LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
• Dark Brown Silt W/ Sand (MH)	53.4	31.1	22.3			MH

Project No. 2817.015.PW.1
 Project: Scotty Creek 80,000 Gallon Water Tank
 • Source of Sample: B-2 Depth: 0.5' & 1.0'

Remarks:
 • Expansion Index= 83 (Medium)



Figure

Tested By: SCW

Checked By: SEF

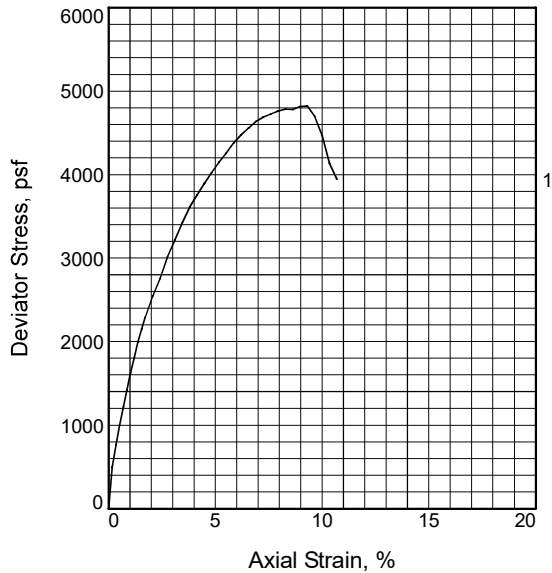
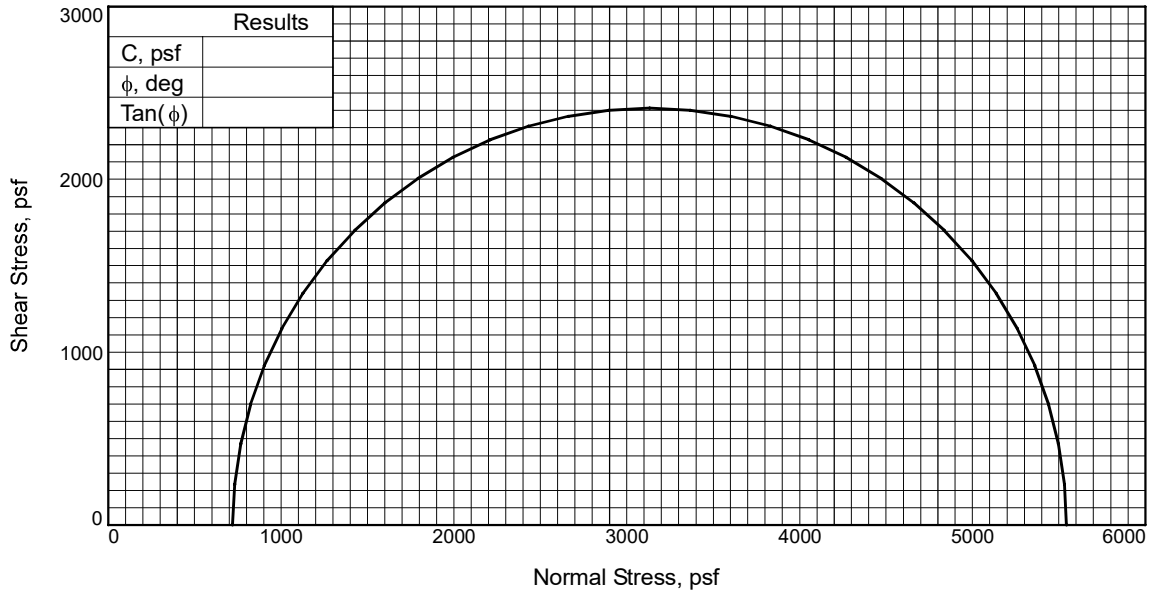


CLASSIFICATION TEST DATA

Scotty Creek 80,000 Gallon Water Tank
 Highway 1
 Sonoma County, California

PLATE

4



Sample No.		1
Initial	Water Content, %	19.3
	Dry Density, pcf	104.9
	Saturation, %	85.9
	Void Ratio	0.6075
	Diameter, in.	2.41
At Test	Height, in.	5.80
	Water Content, %	19.3
	Dry Density, pcf	104.9
	Saturation, %	85.9
	Void Ratio	0.6075
	Diameter, in.	2.41
	Height, in.	5.80
	Strain rate, in./min.	0.060
	Back Pressure, psi	0.00
	Cell Pressure, psi	5.00
Fail. Stress, psf		4823
	Strain, %	9.3
Ult. Stress, psf		4823
	Strain, %	9.3
σ_1 Failure, psf		5543
σ_3 Failure, psf		720

Type of Test:
 Unconsolidated Undrained
 Sample Type: California Modified Tube
 Description: Dark Brown Clay (CH)

Assumed Specific Gravity= 2.70
 Remarks:

Project: Scotty Creek 80,000 Gallon Water Tank

Source of Sample: B-1 Depth: 4.0'

Proj. No.: 2817.015.PW.1 Date Sampled: 3/21/24



Figure _____

Tested By: SAM

Checked By: SEF

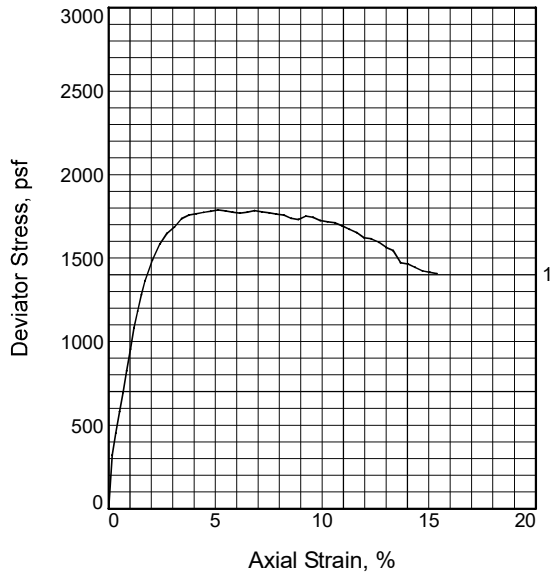
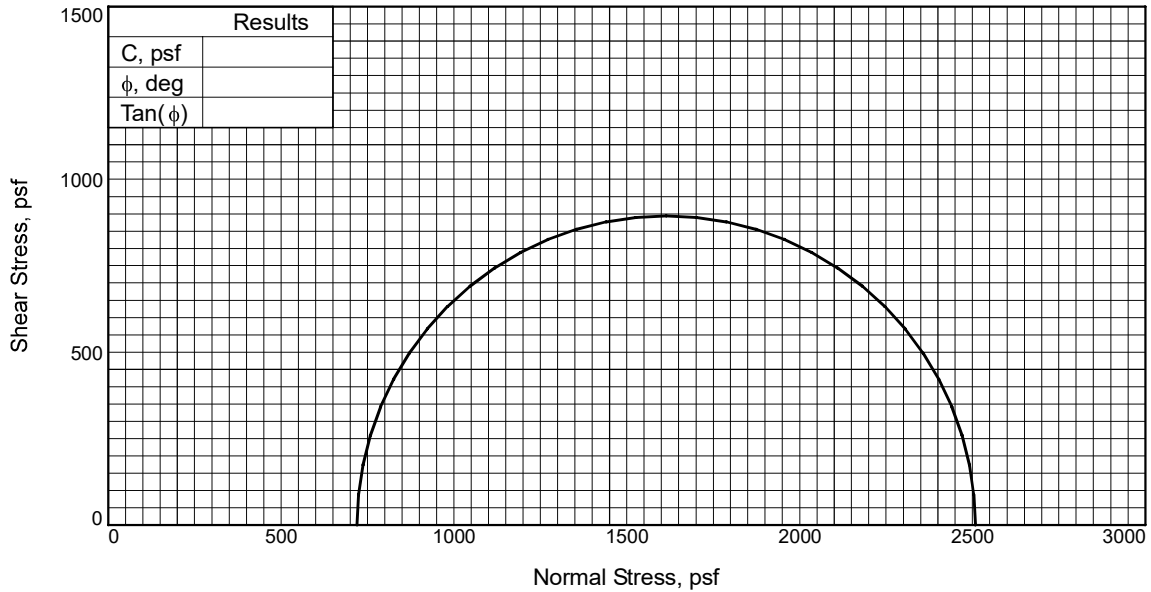


TRIAXIAL TEST DATA

Scotty Creek 80,000 Gallon Water Tank
 Highway 1
 Sonoma County, California

PLATE

5



Sample No.		1
Initial	Water Content, %	11.8
	Dry Density, pcf	118.5
	Saturation, %	75.6
	Void Ratio	0.4230
	Diameter, in.	2.40
At Test	Height, in.	5.85
	Water Content, %	11.8
	Dry Density, pcf	118.5
	Saturation, %	75.6
	Void Ratio	0.4230
Diameter, in.		2.40
Height, in.		5.85
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		5.00
Fail. Stress, psf		1788
Strain, %		5.1
Ult. Stress, psf		1788
Strain, %		5.1
σ_1 Failure, psf		2508
σ_3 Failure, psf		720

Type of Test:
 Unconsolidated Undrained
 Sample Type: California Modified Tube
 Description: Gray Brown Clayey Sand W/
 Gravel (SC)

Assumed Specific Gravity= 2.70
 Remarks:

Project: Scotty Creek 80,000 Gallon Water Tank

Source of Sample: B-1 Depth: 5.5'

Proj. No.: 2817.015.PW.1 Date Sampled: 3/21/24



Figure _____

Tested By: SAM

Checked By: SEF

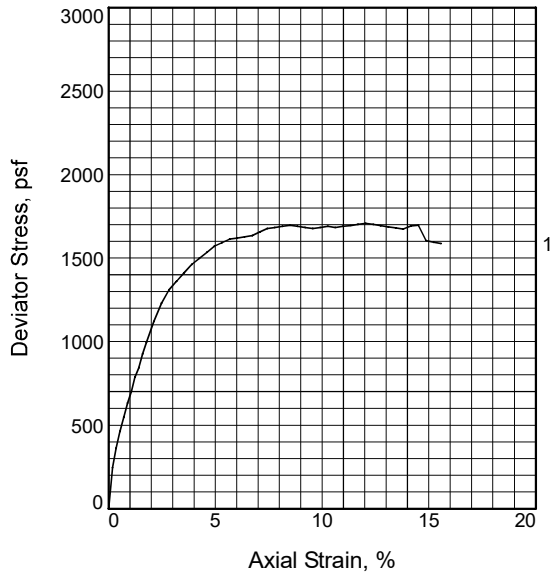
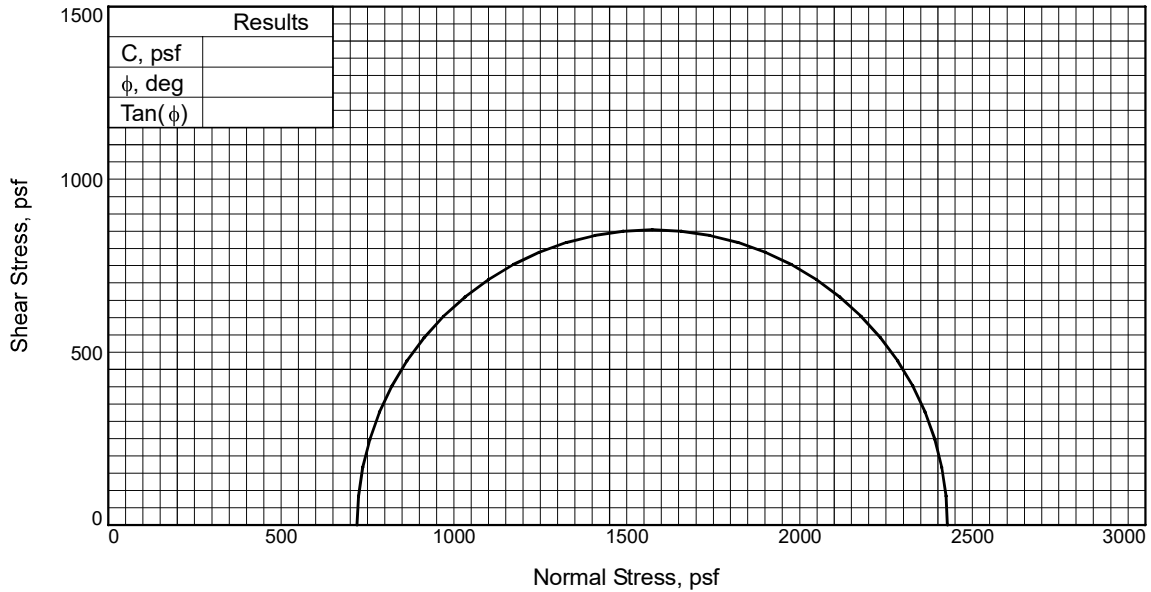


TRIAXIAL TEST DATA

Scotty Creek 80,000 Gallon Water Tank
 Highway 1
 Sonoma County, California

PLATE

6



Sample No.		1
Initial	Water Content, %	27.7
	Dry Density, pcf	82.6
	Saturation, %	72.0
	Void Ratio	1.0401
	Diameter, in.	2.41
At Test	Height, in.	5.65
	Water Content, %	27.7
	Dry Density, pcf	82.6
	Saturation, %	72.0
	Void Ratio	1.0401
Diameter, in.		2.41
Height, in.		5.65
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		5.00
Fail. Stress, psf		1708
Strain, %		12.0
Ult. Stress, psf		1708
Strain, %		12.0
σ_1 Failure, psf		2428
σ_3 Failure, psf		720

Type of Test:
 Unconsolidated Undrained
 Sample Type: California Modified Tube
 Description: Dark Brown Silt W/ Sand (MH)

Assumed Specific Gravity= 2.70
 Remarks:

Project: Scotty Creek 80,000 Gallon Water Tank

Source of Sample: B-2 Depth: 1.0'

Proj. No.: 2817.015.PW.1

Date Sampled: 3/21/24



Figure _____

Tested By: SAM

Checked By: SEF



TRIAXIAL TEST DATA

Scotty Creek 80,000 Gallon Water Tank
 Highway 1
 Sonoma County, California

PLATE

7

APPENDIX B - REFERENCES

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APPENDIX C- DISTRIBUTION

Gold Ridge Resource Conservation District (e)
Attention: John Green, Will Spangler
john@goldridgercd.org
wspangler@goldridgercd.org

EGC:JJP:aku:brw

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https://rghgeo.sharepoint.com/sites/shared/shared_documents/project_files/2751-3000/2817/2817.015.pw.1_scotty_creek_80,000_gallon_water_tank/.01_-_pgs/2817.015.pw.1_gs_report.docx

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 overrely 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* preface 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 infestations, 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 your ASFE-member geotechnical engineer for more information.



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