APPENDIX E

Geotechnical Study Report

From: Eric Chase <echase@rghgeo.com>
Date: Monday, May 23, 2022 at 1:27 PM
To: Jane Valerius <jane@jvenvironmental.com>, Karen Massey <KMassey@burbankhousing.org>
Cc: 'Nuno, Elena' <Elena.Nuno@stantec.com>, 'Becky Duckles' <bduckles@comcast.net>, 'Trish Tatarian' <trish@wildliferesearchassoc.com>, 'Eileen' <eileen@origer.com>, 'Walter Beach' <walt@hlenv.com>, 'Dalene Whitlock' <dwhitlock@w-trans.com>, 'Jade Kim' <jkim@w-trans.com>
Subject: Re: 155 Dry Creek Road Project Area Update - Request for Response

[CAUTION----FROM EXTERNAL EMAIL]

Hi Karen,

The acreage change does not impact the geotechnical report as we assumed that area was part of the project from the beginning.

Thanks,

RGH CONSULTANTS

Eric Chase
Principal Geotechnical Engineer

A 1305 N Dutton Ave, Santa Rosa, CA
P 707.544.1072 **M** 707.799.6341
E eric@rghgeo.com **W** http://www.rghgeo.com/

From: Karen Massey <KMassey@burbankhousing.org>
Sent: Monday, May 23, 2022 10:10 AM
To: Karen Massey <KMassey@burbankhousing.org>
Cc: 'Nuno, Elena' <Elena.Nuno@stantec.com>; Becky Duckles <bduckles@comcast.net>; Jane Valerius <jane@jvenvironmental.com>; 'Trish Tatarian' <trish@wildliferesearchassoc.com>; Eileen <eileen@origer.com>; Eric Chase <echase@rghgeo.com>; Walter Beach <walt@hlenv.com>; Dalene Whitlock <dwhitlock@w-trans.com>; Jade Kim <jkim@w-trans.com>
Subject: 155 Dry Creek Road Project Area Update - Request for Response

Good Morning,
It has come to our attention the site acreage previously provided to you (3.53 acres) does not include the area along Dry Creek Road that will accommodate the Project's frontage improvements (0.17 acres).

To correct the technical studies and City's record, please reply to this email acknowleding the total project area of 3.70 acres and indicating no changes to your technical studies as a result.
Thank you,

Karen

Karen Massey

Senior Project Manager

Burbank Housing

mailto:kmassey@burbankhousing.org

c: 707-490-8467

w: burbankhousing.org

-

Opening Doors. Changing Lives

RGH CONSULTANTS

Experience is the difference

GEOTECHNICAL STUDY REPORT

DRY CREEK COMMONS
155 DRY CREEK ROAD
HEALDSBURG, CALIFORNIA

Project Number:

1259.10.PW.1

Prepared For:

Burbank Housing
1425 Corporate Center Parkway
Santa Rosa, CA 95407

Prepared By:

RGH Consultants

Santa Rosa Office
1305 North Dutton Avenue
Santa Rosa, CA 95401
707-544-1072

Napa Office
1041 Jefferson Street, Suite 4
Napa, CA 94559
707-252-8105

Travis A. Whitted
Principal Geotechnical Engineer

Eric G. Chase
Principal Geotechnical Engineer
Project Manager

REGISTERED PROFESSIONAL ENGINEER TRAVIS A. WHITTED No. 2782 GEOTECHNICAL STATE OF CALIFORNIA

January 31, 2022

REGISTERED PROFESSIONAL ENGINEER ERIC G. CHASE No. 2628 GEOTECHNICAL STATE OF CALIFORNIA

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

INTRODUCTION

This report presents the results of our geotechnical study for the Dry Creek Commons project to be constructed at 155 Dry Creek Road in Healdsburg, California. The undeveloped property extends over variable terrain adjacent to Foss Creek, which runs along the western side of the property. The ground surface is relatively flat adjacent to the creek and then slopes up at the eastern side of the property. The terrain near Dry Creek Road is elevated and appears to be old fill. The site location is shown on Plate 1, Appendix A.

We understand it is planned to construct a 58-unit multifamily project. The project consists of two 4-story structures with one building housing 35 units and one building housing 23 units. A bridge will connect the two buildings. There will be a covered arcade and walkways around the buildings with two play areas. Asphalt paved parking will be provided along the eastern side of the property. There will be bioretention areas on the perimeter of the asphalt paved parking.

Actual foundation loads are not known at this time. We anticipate the loads will be typical for the heavy type of construction planned. Grading plans are not available, but we anticipate that the planned grading will be the minimum amount needed to construct level building pads and provide the building sites and paved areas with positive drainage.

SCOPE

The purpose of our study, as outlined in our Consultant Service Contract DEV-0995, 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, porous, compressible and expansive soil;
    c. Foundation 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 soil and projects and the results of an R-value test on the anticipated subgrade soil;
    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 December 3 and 6, 2021, we performed a geotechnical reconnaissance of the site and explored the subsurface conditions by drilling six borings to depths ranging from about 3½ to 33 feet. The borings were drilled with a truck-mounted drill rig equipped with 6-inch diameter, solid stem augers and 8-inch diameter, hollow stem augers at the approximate locations shown on the Exploration Plan, Plate 2. The boring 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 staff engineer 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 “grab” samples were obtained at selected depths from the borings and placed in plastic bags. Additionally, a disturbed “bulk” sample of the anticipated subgrade soil was obtained from borings P-1 and P-2 and placed in a bucket.

The logs of the borings showing the materials encountered, groundwater conditions, converted blow counts, and sample depths are presented on Plates 3 through 8. The soil is described in accordance with the Unified Soil Classification System, outlined on Plate 9.

The boring logs show our interpretation of the subsurface soil and groundwater 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), expansion potential (Expansion Index – EI), shear strength, and R-value. The test results are presented on the boring logs and on Plates 10 through 18.

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 (Delattre, et al., 2010) indicate the property is underlain by alluvial deposits (Qha and Qa). The deposits are shown to consist of poorly to moderately sorted sand, silt, gravel, and clay.

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. The vegetation consists of seasonal grasses and young to mature trees. The building site is located off Dry Creek Road, to the east of Foss Creek, and to the west of the SMART Right-of-Way. In general, the ground surface is soft and spongy. This is a condition generally associated with weak, porous surface soil. Natural drainage consists of sheet flow over the ground surface and slopes that concentrates in man made surface drainage elements such as roadside ditches and gutters, and natural drainage elements such as swales and creeks.

Subsurface

Our borings and laboratory tests indicate that a portion of the building area encompassed by borings B-1, B-2, and B-3 is covered by 4½ to 6½ feet of heterogenous fill. Heterogeneous fill is a material with varying density, strength, compressibility, and shrink-swell characteristics that often has an unknown origin and placement history. This fill exhibits medium to high plasticity (LL = 39.2, 39.6, PI = 20.0, 20.8) and low expansion potential (EI = 23, 40). Outside of heterogeneous fill areas (B-4), the site is underlain by about 3½ feet of weak, compressible, clayey soil. Weak soil appears hard and strong when dry but becomes weak and compressible as its moisture content increases towards saturation. This soil exhibits high plasticity (LL = 51.4; PI = 32.7) and medium expansion potential (EI = 86). In borings B-1 and B-2, the heterogeneous fill soils are underlain by compressible soils to depths of 7 to 8½ feet below the existing ground surface. These surface materials are underlain by clay with varying amounts of sand and sand with varying amounts of clay and gravel.

A detailed description of the subsurface conditions found in our borings is given on Plates 3 through 8, 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 D should be used for the site.

Infiltration Testing

Infiltration tests were performed by drilling borings using a truck-mounted drill rig equipped with 6-inch diameter, solid stem augers in the planned bioretention areas. Infiltration test locations are shown on the Exploration Plan, Plate 2 in Appendix A. The infiltration tests consisted of extending a 2-inch diameter PVC pipe to a depth of about 5 feet. The pipe was sealed around the bottom so that water could not flow up the sides of the pipe. Water was then poured into the pipe and allowed to infiltrate for a minimum of 8½ minutes which we define as the short-term test. For the long-term test, we allowed water to infiltrate for at least three hours. For boring I-1, we ran three of the short-term tests and one of the long-term tests. There was no measurable infiltration. For boring I-2, we ran six short-term tests, three on Friday, December 3, 2021, and three on Monday, December 6, 2021, and one long-term test, from Friday to Monday. The volume of water that infiltrated for each measured time period was then divided by the time period to obtain the infiltration rate. The average rate for boring I-2 for the six short-term tests is determined as 0.036394 cubic centimeters per second.

Corrosion Potential

Mapping by the Natural Resources Conservation Service (2022) indicates that the corrosion potential of the near surface soil is moderate for uncoated steel and low 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 first detected in our borings at depths ranging from 11 to 15½ feet below the ground surface at the time of drilling. When the holes were backfilled after drilling was completed, the water level had risen to depths ranging from about 4½ to 13½ feet. Fluctuation in the groundwater level typically occurs because of a variation in rainfall intensity, duration, and other factors such as flooding and periodic irrigation.

Flooding

Our review of the Federal Emergency Management Agency (FEMA) Flood Zone Map for Sonoma County, California, City of Healdsburg (No. 06097C0344E and 06097C0363E) dated December 2, 2008, indicates that a portion of the building site is located within Zone "AE," the 100-year flood boundary. Zone "AE" is defined as an area of possible, flood hazards with base flood elevation ranging from 129.4 to 135 feet. Evaluation of flooding potential is typically the responsibility of the project civil engineer.

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 2019 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 38.6266°N and 122.8747°W, respectively, and a site soil Class of D, the PGA for the site is 0.874g. Using this information, the CSR for a M_M 7.5 earthquake at the site ranges from 0.56 to 0.57. The Rodgers Creek-Healdsburg 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 Rogers Creek-Healdsburg fault is capable of a M_M 7.57 earthquake. Therefore, the CRR values at the site must be scaled to account for the difference between M_M 7.57 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 from 14 to 16 feet in boring B-1, 15½ to 16½ feet in boring B-2, and 11½ to 15½ feet in boring B-4. Therefore, we judge that there is potential for liquefaction at the site.

It should also be noted that the old fill has CRR values that do not exceed the CSR values. However, these soils have fines contents of 29.9 to 35.5 percent and with Liquid Limits of 39.2 and 39.6 and Plasticity Indexes of 20.0 and 20.8. According to Seed et. al, (2003), these near surface soils have a low potential for liquefaction.

There are three potential consequences of liquefaction: bearing capacity failure, lateral spreading toward a free face (e.g. riverbank) and settlement. Bearing capacity failure is sudden and extreme settlement of foundations that typically occurs when the liquefied layer is relatively close (typically within two times the footing width, depending on the loads) to the bottom of the foundation. Because the liquefiable layer is a minimum of 11½ feet below the ground surface, we judge that the potential for bearing capacity failure is low.

Lateral spreading can occur where continuous layers of liquefiable soil extend to a free face, such as a creek bank. It is possible that continuous layers would spread to the creek bank. However, the $(N_1)_{60}$ blow counts are generally greater than 15 blows per foot. Therefore, according to the work of Youd, Hansen, and Bartlett (2002), lateral spreading is not a hazard at the site.

The third potential consequence of liquefaction is settlement due to densification of the liquefied soil. Potential settlements based on the blow count data and cyclic stress ratio were calculated using the methods of Ishihara and Yoshimine (1992). For the layers encountered at 11½ to 15½ feet below the surface, we calculated total settlement of less than ½-inch. Differential settlement could be about ¼-inch.

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, are susceptible to densification if not saturated. As discussed in the "Liquefaction" section, the near surface granular soils at the site have a low potential for liquefaction. Therefore, we judge that there is a low potential for densification to impact structures at the site.

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 3½ feet of expansive, weak, compressible, clayey surface soil and 4½ to 6½ heterogeneous fill underlain by weak, compressible soil;

2. The presence of soils susceptible to liquefaction;

3. The detrimental effects of uncontrolled surface runoff and groundwater seepage on the long-term satisfactory performance of improvements given the erosion potential and porous nature of the surface soil; 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, Compressible Soil

Weak, compressible 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, slabs, and pavements 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, slabs, and pavements. 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. Alternatively, satisfactory foundation support could be obtained below the weak surface soil.

Expansive Soil

In addition, some of the surface soil is expansive. Expansive surface soil shrinks and swells as it loses and gains 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 project area, the active layer is generally considered to range in thickness from about 2 to 3 feet. The detrimental effects of the above-described movements can be reduced by pre-swelling the expansive soil and covering it 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 soil 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 soil, 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. Alternatively, foundation support can be obtained from mat slabs or post-tensioned slabs designed for the movements associated with expansive soil.

Potentially Liquefiable Soil

As discussed previously, there are layers of the subsurface soil that are susceptible to liquefaction. Potentially liquefiable soils present at the site are susceptible to settlement due to the densification of the liquefied soils. Our analysis found that the total settlements should be less than ½-inch.

Foundation Support - As discussed previously, our borings encountered heterogeneous fill and weak, compressible soil to depths ranging from about 3½ to 8 feet below the ground surface. Grading performed, including remedial grading of old fill and weak soil, to create level building pads with positive drainage will result in variable thicknesses of engineered fill. This grading also has the potential to leave compressible soils in place as it may not be feasible to over-excavate and re-compact to the depth required. Given that these structures are four stories in height and the variable conditions that will result from grading, satisfactory foundation support for the two structures needs to be obtained from mat slabs or post-tension slabs supported on engineered fill. Foundation support for free standing site walls and retaining walls can be obtained from spread footings supported in engineered fill or below weak surface soils.

Exterior Slabs and Pavements

Exterior slabs and pavements will heave and crack as the expansive soil shrinks and swells 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 soil. Slab and pavement performance can be improved, and the incidence of repair can be reduced, but not eliminated, by covering the pre-swelled expansive soil 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 12 inches of exterior slab and pavement subgrade must be select fill, 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 and engineered fill below mat and post-tensioned slabs, 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 soil or import materials with a low expansion potential or lime stabilized on-site clayey soil. Lime stabilized soil 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 soil as select fill during grading.

Settlement

If remedial grading is performed and the mat slab or post tension slabs are installed in accordance with the recommendations presented in this report, we estimate that total settlements of heavily loaded interior footings will be about 1 inch and settlement of the exterior wall be about ½ inch. We estimate that post-construction differential settlements between columns and lightly loaded exterior walls will be about ½ inch. Earthquake-induced differential settlement could be as high as ½-inch.

Surface Drainage

Because of topography and location, the site will be impacted by surface runoff. 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 and/or seep into the slab rock. Therefore, strict control of surface runoff is necessary to provide long-term satisfactory performance. It will be necessary to divert surface runoff around improvements, provide positive drainage away from structures, and install energy dissipaters at discharge points of concentrated runoff. 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

Seismic Design

Seismic design parameters presented below are based on Section 1613 titled “Earthquake Loads” of the 2019 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 D should be used for the site. Using a site latitude and longitude of 38.6266°N and 122.8747°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.

2019 CBC Seismic Criteria	
Spectral Response Parameter	**Acceleration (g)**
S_S (0.2 second period)	2.173
S_1 (1 second period)	0.842
S_{MS} (0.2 second period)	2.173
S_{M1} (1 second period)	2.110
S_{DS} (0.2 second period)	1.449
S_{D1} (1 second period)	1.400

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.

Within the entirety of the building pads and extending 5 feet beyond the edge of the foundations, the old fill and weak, compressible soils should be excavated to at least 4 feet below finished pad grade for the mat slab or post-tensioned slab or 2 feet below the deepest portion of the mat slab or post-tensioned slab, whichever is deeper. Additional excavation should be performed, as necessary, to remove old fill within building areas. The excavation of old fill and weak, compressible, expansive soil should also extend at least 12 inches below exterior slab and pavement subgrade to allow space for the installation of the select fill blanket discussed in the conclusions section of this report. This excavation should extend at least 3 feet beyond the edge of exterior slabs and pavements. Additional excavation should be performed to remove old fill within exterior slab and pavement areas. The excavated materials should be stockpiled for later use as compacted fill, or removed from the site, as applicable.

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.

Subsurface Drainage

A subdrain should be installed where evidence of seepage is observed. The subdrain should consist of a 4-inch diameter (minimum) perforated plastic pipe with SDR 35 or better embedded in Class 2 permeable material. The permeable material should be at least 12 inches thick and extend at least 12 inches above and below the seepage zone.

In addition, subdrains should be installed at a minimum slope of 1 percent and should have cleanouts located at their ends and at turning points. “Sweep” type elbows and wyes should be used at all turning points and cleanouts, respectively. Subdrain outlets and riser cleanouts should be fabricated of the same material as the subdrain pipe as specified herein. Outlet and riser pipe fittings should not be perforated. A licensed land surveyor or civil engineer should provide “record drawings” depicting the locations of subdrains and cleanouts.

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 general and engineered fill below mat and post-tensioned slabs but will not be suitable for use as select fill unless they are stabilized with lime. Lime stabilized soil may prevent the growth of landscape vegetation due to the inherent elevated pH level of the soil. The suitability of the on-site soil 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 soil may be used as select fill if it is 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 soil. 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 soil should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to at least 3 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 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 soil 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 soil used as fill should be moisture-conditioned to at least 4 percent above optimum.

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.
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 3:1 (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. The geotechnical engineer is not responsible for measuring the angles of these slopes.

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

The proposed structures can be supported on either mat slabs or post-tensioned slabs. Free standing site walls and retaining walls can be supported on engineered fill or firm, native soil.

Mat Slabs or Post-Tension (PT) Slabs

A mat or PT slab installed in accordance with the recommendations presented herein may be designed using allowable bearing pressures of 1,600, 2,400 and 3,200 pounds per square foot (psf), for dead loads, dead plus code live loads, and total loads (including wind and seismic), respectively. In addition, a modulus of subgrade reaction (k) of 70 pounds per cubic inch (pci) may be used for design. The portion of the foundation extending into engineered fill 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 soils are confined by concrete slabs.

The mat or PT slabs should be designed for non-seismic differential settlement of ½-inch between columns and earthquake-induced differential settlement of ¼-inch over a distance of 40 feet. The post-tension (PT) slab should be a designed to accommodate edge moisture variation distances of 4.9 and 7.8 feet for edge and center lift conditions, respectively, a differential edge swell of 0.8 inches and a center swell of 1-inch. These parameters were developed using the Post-Tensioning Institute manual “Design and Construction of Post-Tensioned Slabs-On-Ground, Third Edition” (2004). The mat slab should be designed to cantilever 5 feet at the edges and to span 10 feet of non-support on the interior.

Excavations for thickened areas of the mat or PT slab should be thoroughly cleaned out, wetted, and compacted prior to placing steel and concrete. This will remove the soils disturbed during excavations, restore their adequate bearing capacity, and reduce post-construction settlements.

With the exception of the thickened areas, the mat or PT slab 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. A vapor barrier should be provided where moisture-sensitive floor coverings, coatings, underlayments, adhesives, moisture sensitive goods, humidity-controlled environments, or climate-cooled environments are anticipated initially, or in the future. The vapor barrier should consist of a minimum 15 mil extruded polyolefin plastic (no recycled content or woven materials permitted); permeance as tested before and after mandatory conditioning (ASTM E1745 Section 7.1 and sub-paragraphs 7.1.1 – 7.1.5): less than 0.01 Perms [grains/(ft2 hr inhg)] and comply with the ASTM E1745 Class A requirements. The vapor barrier should also meet paragraph's 8.1 and 9.3 of ASTM E1745; subsequent documentation should be provided by the vapor barrier manufacturer. Install vapor barrier in accordance with ASTM E1643, including proper perimeter seal.

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.

Other Spread Footings

Spread footings can be used for foundation support of free-standing site walls and retaining walls that are not associated with the structures. The spread footings should be at least 18 inches wide and should bottom on engineered fill at least 12 inches below lowest adjacent grade or firm, native soil 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 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 soil disturbed during footing excavations, or restore their adequate bearing capacity, and reduce postconstruction settlements.

Bearing Pressures - Footings installed in accordance with these recommendations may be designed using allowable bearing pressures of 1,200, 1,800, and 2,400 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 engineered fill or firm native soil may impose a passive equivalent fluid pressure and a friction factor of 300 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.

Retaining Walls

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.

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	17
Active - Sloping Backfill 3:1 or Flatter	53	46
At Rest - Level Backfill	63	43

* 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 spread footings 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 19, 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. Expansive soil should not be used for wall backfill. Where expansive soil is 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.

Slab-On-Grade

Provided grading is performed in accordance with the recommendations presented herein, exterior slabs should be underlain by select engineered fill. 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. 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. A vapor barrier should be incorporated into the floor slab design in all areas where moisture-sensitive floor coverings, coatings, underlayments, adhesives, moisture sensitive goods, humidity-controlled environments, or climate-cooled environments are anticipated initially, or in the future. Vapor barrier should consist of a minimum 15 mil extruded polyolefin plastic (no recycled content or woven materials permitted); permeance as tested before and after mandatory conditioning (ASTM E1745 Section 7.1 and Sub-paragraphs 7.1.1 – 7.1.5): less than 0.01 perms [grains/(ft2 per hour in Hg)] and comply with the ASTM E1745 class a requirements. The vapor barrier should also meet paragraph’s 8.1 and 9.3 of ASTM E1745; subsequent documentation should be provided by the vapor barrier manufacturer. Install vapor barrier in accordance with ASTM E1643, including proper perimeter seal.

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 City of Healdsburg, 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

Due to the presence of expansive soils, there are three options for pavement subgrade materials: on-site expansive soil, import select fill, or lime-stabilized on-site clay soils. Specific pavement section recommendations for various Traffic Indices are presented in the tables below for each subgrade soil option.

An R-value of 14 was measured on a bulk sample of near-surface soil obtained in the parking lot area. Because of potential variation in the on-site soil, we selected an R-value of 10 for use in pavement design calculations. Based on the selected R-value, we have computed pavement sections for Traffic Indices (TI) ranging from 5.0 to 7.0 in the table below. The project engineer should choose the pertinent (TI) for this project.

PAVEMENT SECTIONS WITH ON-SITE CLAY SUBGRADE		
TI	ASPHALT CONCRETE (feet)	CLASS 2 AGGREGATE BASE (feet)
7.0	0.35	1.30
6.0	0.35	1.10
5.0	0.35	0.90

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

It should be noted that because of the expansion potential of the soil at the site and the difficulty in controlling seasonal moisture variation beneath and adjacent to the driveway, significant cracking may develop in the pavement even if 12-inches of select fill is installed. Increasing the thickness of select fill or installing moisture cutoffs may reduce but not eliminate the potential for cracks to develop. It should be understood that pavements will likely require regular maintenance including crack sealing and the aesthetics may not be desirable.

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 the Caltrans Highway Design Manual 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 for self-loading dumpster trucks should be provided with reinforced concrete slabs.

Prior to placement of aggregate base, the upper 6 inches of the pavement subgrade soil should be prepared as described below depending on the subgrade soils. Where on-site clay soils are present in pavement subgrade, the upper 6 inches should be scarified, uniformly moisture-conditioned to about 3 percent above optimum moisture content and compacted to at least 93 percent relative compaction to form a firm, non-yielding surface. Where 12 inches of select fill is used, the upper 6 inches 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 soil 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 City of Healdsburg 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.

Parking Lot Drainage

Water tends to migrate under pavements and collect in the aggregate courses at low areas on parking lot subgrade soil, such as around storm drain inlets and the thread of paved swales leading to inlets. The ponded water will soften subgrade soil and, under repetitive heavy-wheel loads, will induce inordinately high stresses on the subgrade and pavement components that could result in untimely maintenance. Under-pavement drainage can be improved and maintenance reduced by replacing a 12-inch wide strip (extending at least 15 feet on either side of the inlet) of the select subbase layer or subgrade soil with a subdrain consisting of ¾-inch or 1½-inch free-draining Class 1 Permeable Material. The drain rock should be outletted into the storm drain inlet. Storm drain trenches can be made to serve as pavement subdrains. We should be consulted to verify the suitability of storm drain trenches as pavement subdrains in a case-specific basis.

Where pavements will abut landscaped areas, the pavement baserock layer and subgrade soil should be protected against saturation from irrigation and rainwater with a subdrain, similar to that previously discussed. The subdrain should extend to a depth of at least 6 inches below the bottom of the baserock layer. Alternatively, a grouted moisture cut-off that extends 6 inches below the bottom of the baserock layer should be provided below or immediately behind the curb and gutter.

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 soil. 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 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 well away from foundations, onto paved areas or erosion resistant natural drainages or 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 20. 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 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 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 the Burbank Housing Development Corporation 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.

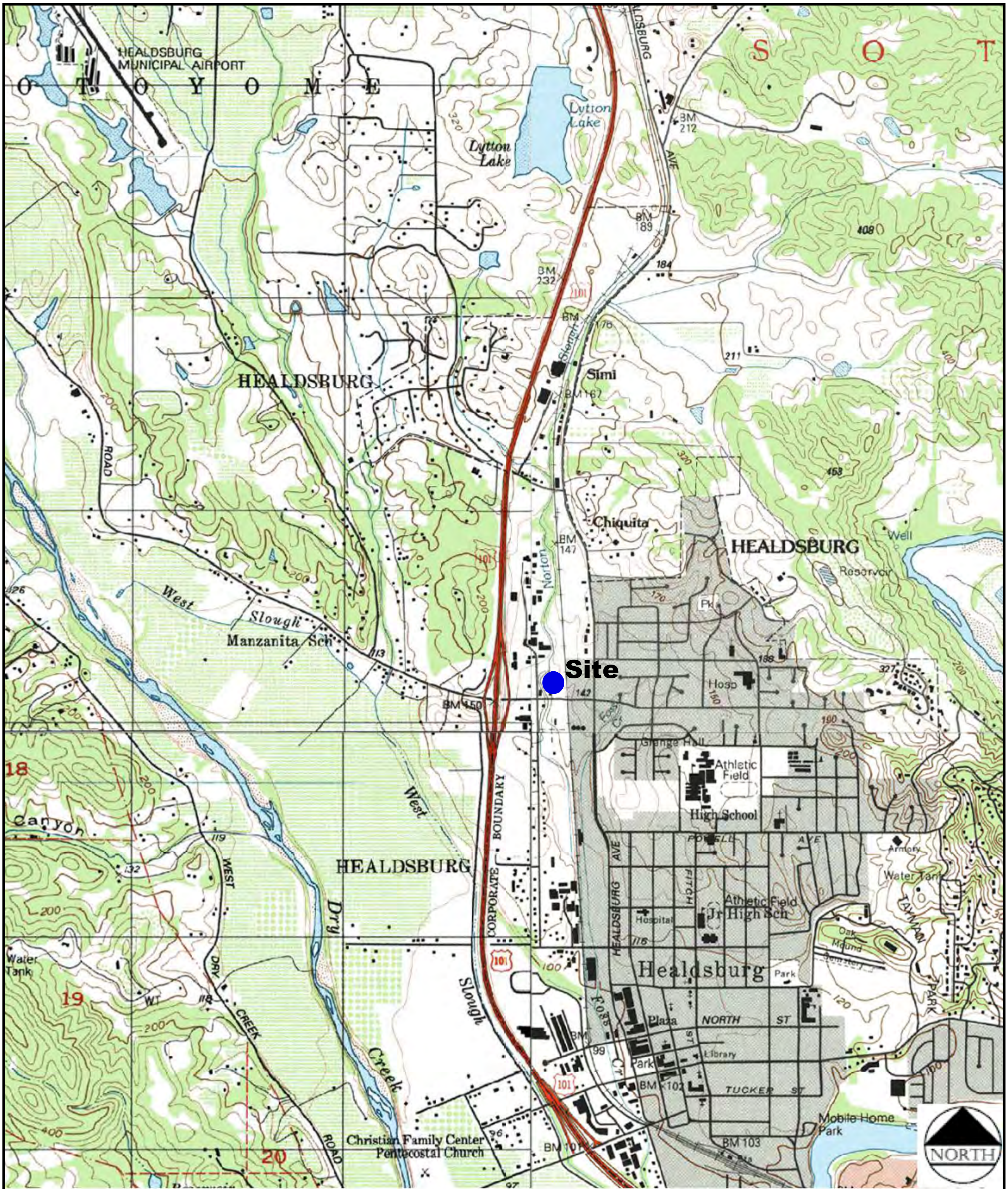
Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided to us regarding 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.

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



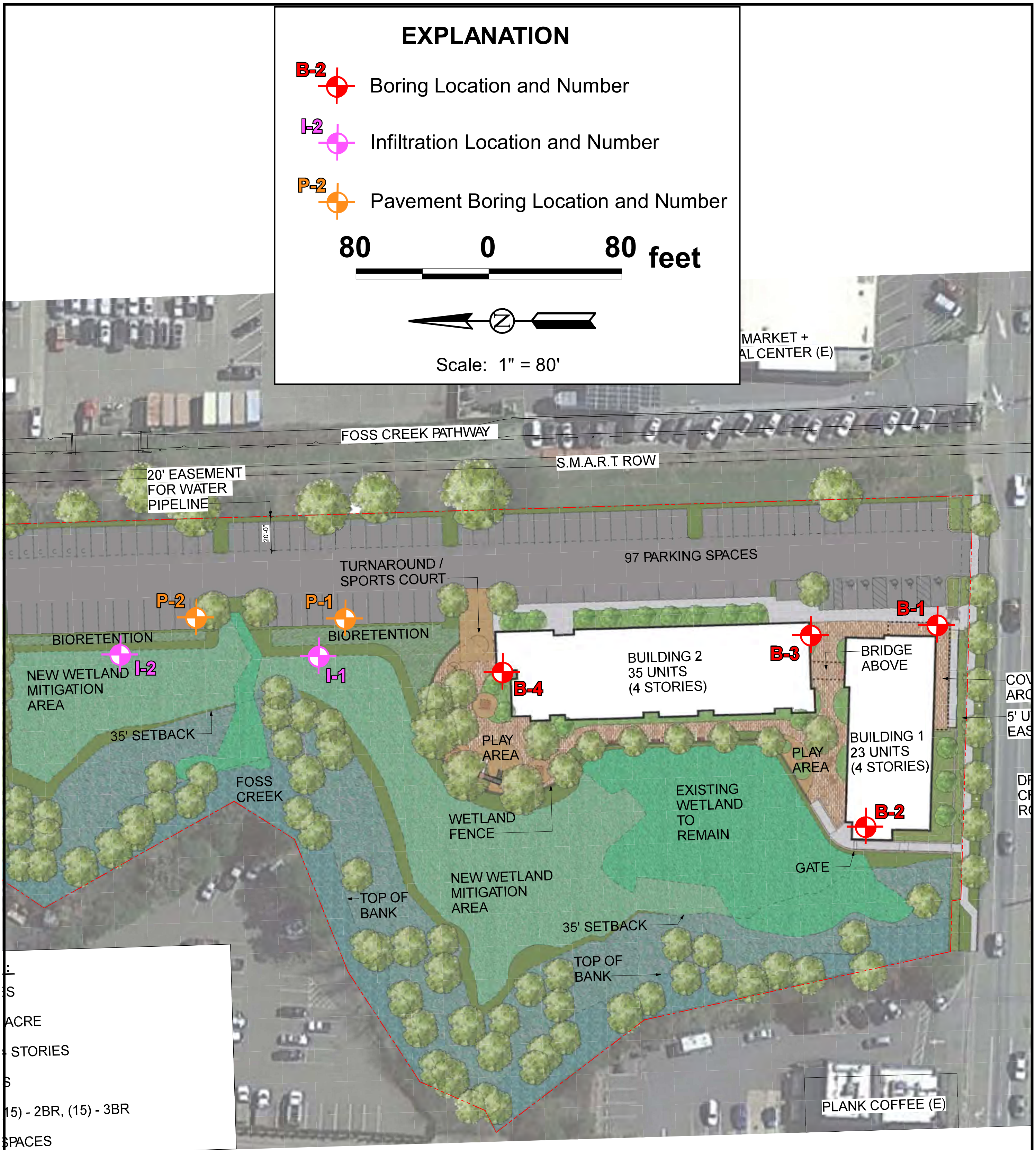
Reference: Maptech Topoquads, Jimtown, Healdsburg, Guerneville and Gyserville, California Quadrangle Scale: 1" = 2000'

RGH CONSULTANTS

SITE LOCATION MAP
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE 1

Job No: 1259.10.PW.1 Date: JAN 2022



Reference: Site Plan Titled Dry Creek Commons at 155 Dry Creek Road by Van Meter Williams Pollack LLP, Sheet A1.02

RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

EXPLORATION PLAN
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
2

Date Drilled	**12/3/2021**	Logged By	**AKU**	Checked By	**EGC**
Drilling Method	**Solid-Stem Auger**	Drill Bit Size/Type	**6 inch**	Total Depth of Borehole	**3 1/2 feet**
Drill Rig Type	**B-53 Mobile**	Drilling Contractor	**Pearson**	Approximate Surface Elevation	**Existing Ground Surface**
Groundwater Level	**No Groundwater Encountered**	Sampling Method(s)	**Bulk**	Hammer Data	**N/A**

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	Bulk			BROWN CLAYEY SAND WITH GRAVEL (SC), loose to medium dense, moist								
				BROWN CLAY WITH SAND (CH), medium stiff to stiff, moist								
				Boring terminated at 3 1/2 feet No groundwater encountered								
5												
10												
15												
20												
25												
30												
35												

RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

LOG OF PAVEMENT BORING P-1
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

Date Drilled	**12/3/2021**	Logged By	**AKU**	Checked By	**EGC**
Drilling Method	**Solid-Stem Auger**	Drill Bit Size/Type	**6 inch**	Total Depth of Borehole	**3 1/2 feet**
Drill Rig Type	**B-53 Mobile**	Drilling Contractor	**Pearson**	Approximate Surface Elevation	**Existing Ground Surface**
Groundwater Level	**No Groundwater Encountered**	Sampling Method(s)	**Bulk**	Hammer Data	**N/A**

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	Bulk			BROWN CLAYEY SAND WITH GRAVEL (SC), loose to medium dense, moist								
				BROWN CLAY WITH SAND (CH), medium stiff to stiff, moist								
				Boring terminatedat 3 1/2 feet No groundwater encountered								
5												
10												
15												
20												
25												
30												
35												

RGH
CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

LOG OF PAVEMENT BORING P-2

Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
4

Date Drilled **12/3/2021**	Logged By **AKU**	Checked By **EGC**
Drilling Method **Hollow-Stem Auger**	Drill Bit Size/Type **8 inch**	Total Depth of Borehole **29 1/2 feet**
Drill Rig Type **B-53 Mobile**	Drilling Contractor **Pearson**	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)	Sampling Resistance, blows/ft	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0		BROWN SAND WITH CLAY AND GRAVEL (SP-SC), medium dense, moist (Fill)								
	14	BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, moist (Fill)			29.9	20.0	39.6	23		
5	6	BROWN CLAYEY SAND WITH GRAVEL (SC), loose, moist (Fill)								
		DARK GRAY CLAY (CH), medium stiff, moist, trace organics								
	11	GRAY BROWN SANDY CLAY (CH), stiff, moist, some orange oxidation	113.1	17.6						Su = 1,448 psf
10										
	9	GRAY CLAYEY SAND (SC), loose, moist								
15	16	GRAY AND BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, wet			22.0					
		ORANGE/BROWN SANDY SILT (MH), stiff to very stiff, wet								
20	17		102.2	24.0						Su = 1,592 psf
		BROWN CLAYEY SAND WITH GRAVEL (SC), very dense, wet								
25	57									
	24	BROWN SANDY CLAY (CH), very stiff, wet								
30		Boring terminated at 29 1/2 feet Groundwater first encountered at 14 1/2 feet Groundwater measured at 13 1/2 feet after augers were pulled								
35										

RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

LOG OF BORING B-1
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE **5**

Date Drilled	12/3/2021	Logged By	AKU	Checked By	EGC
Drilling Method	Hollow-Stem Auger	Drill Bit Size/Type	8 inch	Total Depth of Borehole	33 feet
Drill Rig Type	B-53 Mobile	Drilling Contractor	Pearson	Approximate Surface Elevation	Existing Ground Surface
Groundwater Level	14 feet	Sampling Method(s)	Modified California, SPT	Hammer Data	140 lb 30" drop

Depth (feet)	Sampling Resistance, blows/ft	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0		DARK BROWN SILT (ML), stiff, moist (Top Soil)								
	8	GRAY BROWN CLAYEY SAND WITH GRAVEL (SC), loose to 2-1/2 feet then medium dense, moist (Fill)			35.5	20.8	39.2	40		
	13									
5	14									
		GRAY CLAYEY SAND WITH GRAVEL (SC), medium dense, moist								
	9	GRAY SANDY CLAY (CH), stiff, moist								
10	6	GRAY/BROWN CLAY (CH), medium stiff, moist, trace organics, stiff to 11 feet	91.0	29.9						Su = 818.5 psf
		GRAY SANDY CLAY WITH GRAVEL (CH), stiff, moist								
15	9									
	12	BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, wet								
		GRAY BROWN CLAY WITH SAND (CL), stiff to very stiff, wet, trace gravel								
20	27									
		BROWN CLAYEY SAND (SC), medium dense, wet								
	25				27.9	7.6	26.4			
25		BROWN CLAYEY SAND WITH GRAVEL (SC), dense, wet, cobbles at 30 feet								
30	42									
	40									
35		Drilling refusal at 33 feet due to cobbles Groundwater first encountered at 15 1/2 feet Groundwater measured at 14 feet after augers were pulled								

RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

LOG OF BORING B-2
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
6

Date Drilled **12/3/2021**	Logged By **AKU**	Checked By **EGC**
Drilling Method **Hollow-Stem Auger**	Drill Bit Size/Type **8 inch**	Total Depth of Borehole **25 1/2 feet**
Drill Rig Type **B-53 Mobile**	Drilling Contractor **Pearson**	Approximate Surface Elevation **Existing Ground Surface**
Groundwater Level **6 1/2 feet**	Sampling Method(s) **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 (ML), medium stiff, moist, trave gravel (Topsoil)								
		16		BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, moist (Fill)								
		11										
5		14		GRAY BROWN SANDY CLAY WITH GRAVEL (CH), stiff, moist								
		12		BROWN SANDY CLAY (CL), stiff, moist	98.7	26.0						Su = 1,065.5 psf
10		19		GRAY/BROWN CLAY (CH), very stiff, moist	105.5	21.4						Su = 2,726.5 psf
15		27		BROWN CLAYEY SAND (SC), medium dense, wet, trace gravel								
		36		BROWN CLAYEY SAND WITH GRAVEL (SC), dense, wet								
20		45										
				BROWN CLAYEY SAND WITH GRAVEL (SC), very dense, wet								
25		25/3"										
				Drilling refusal at 25 1/2 feet Groundwater first encounteredat 15 1/2 feet Groundwater measured at 6 1/2 feet after augers were pulled								
30												
35												

RGH CONSULTANTS

LOG OF BORING B-3

Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE

7

Job No: 1259.10.PW.1 | Date: JAN 2022

Date Drilled **12/3/2021**	Logged By **AKU**	Checked By **EGC**
Drilling Method **Hollow-Stem Auger**	Drill Bit Size/Type **8 inch**	Total Depth of Borehole **23 1/2 feet**
Drill Rig Type **B-53 Mobile**	Drilling Contractor **Pearson**	Approximate Surface Elevation **Existing Ground Surface**
Groundwater Level **4 1/2 feet**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140 lb 30" drop**

Depth (feet)	Sampling Resistance, blows/ft	MATERIAL DESCRIPTION	Dry Density (pcf)	Water Content (%)	% <#200 Sieve	PI, %	LL, %	Expansion Index (EI)	UC, ksf	REMARKS AND OTHER TESTS
0		BROWN CLAY WITH SAND (CH), medium stiff to 2-1/2 feet then stiff, moist								
	10		99.4	23.6	81.7	32.7	51.4	86		Su = 1,411.5 psf
		GRAY CLAY WITH SAND (CH), stiff, moist								
5	10	DARK BROWN CLAY (CH), stiff, moist								
		GRAY/BROWN SANDY CLAY (CH), medium stiff to stiff, moist to wet								
10	8									
	20		102.8	23.3						Su = 1,070.5 psf
		BROWN CLAYEY SAND (SC), medium dense, wet, trace gravel								
15	18				13.8					
	26	BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, wet			12.6					
		BROWN CLAYEY SAND WITH GRAVEL (SC), dense, wet								
20	49									
	40									
25		Drilling refusal at 23 1/2 feet Groundwater first encountered at 11 feet Groundwater measured at 4 1/2 feet after augers were pulled								
30										
35										

RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

LOG OF BORING B-4

Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE

8

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
1	2	3	4	5	6	7	8	9	10	11	12	13

COLUMN DESCRIPTIONS

1 Depth (feet): Depth in feet below the ground surface.
2 Sample Type: Type of soil sample collected at the depth interval shown.
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.
4 Graphic Log: Graphic depiction of the subsurface material encountered.
5 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
6 Dry Density (pcf): Dry density, in pcf.
7 Water Content (%): Water content, percent.
8 % <#200 Sieve: % <#200 Sieve
9 PI, %: Plasticity Index, expressed as a water content.
10 LL, %: Liquid Limit, expressed as a water content.
11 Expansion Index (EI): Expansion Index (EI)
12 UC, ksf: Unconfined compressive strength, in kips per square foot.
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)

FIELD AND LABORATORY TEST ABBREVIATIONS

LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
Su: Undrained Shear Strength, in pounds per square foot (psf)

MATERIAL GRAPHIC SYMBOLS

Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)
Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
SILT, SILT w/SAND, SANDY SILT (MH)
SILT, SILT w/SAND, SANDY SILT (ML)
Clayey SAND (SC)
Poorly graded SAND with Clay (SP-SC)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Bulk Sample
2.5-inch-ID Modified California w/ brass liners
2-inch-OD unlined split spoon (SPT)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
? Queried contact between strata

GENERAL NOTES

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.
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.

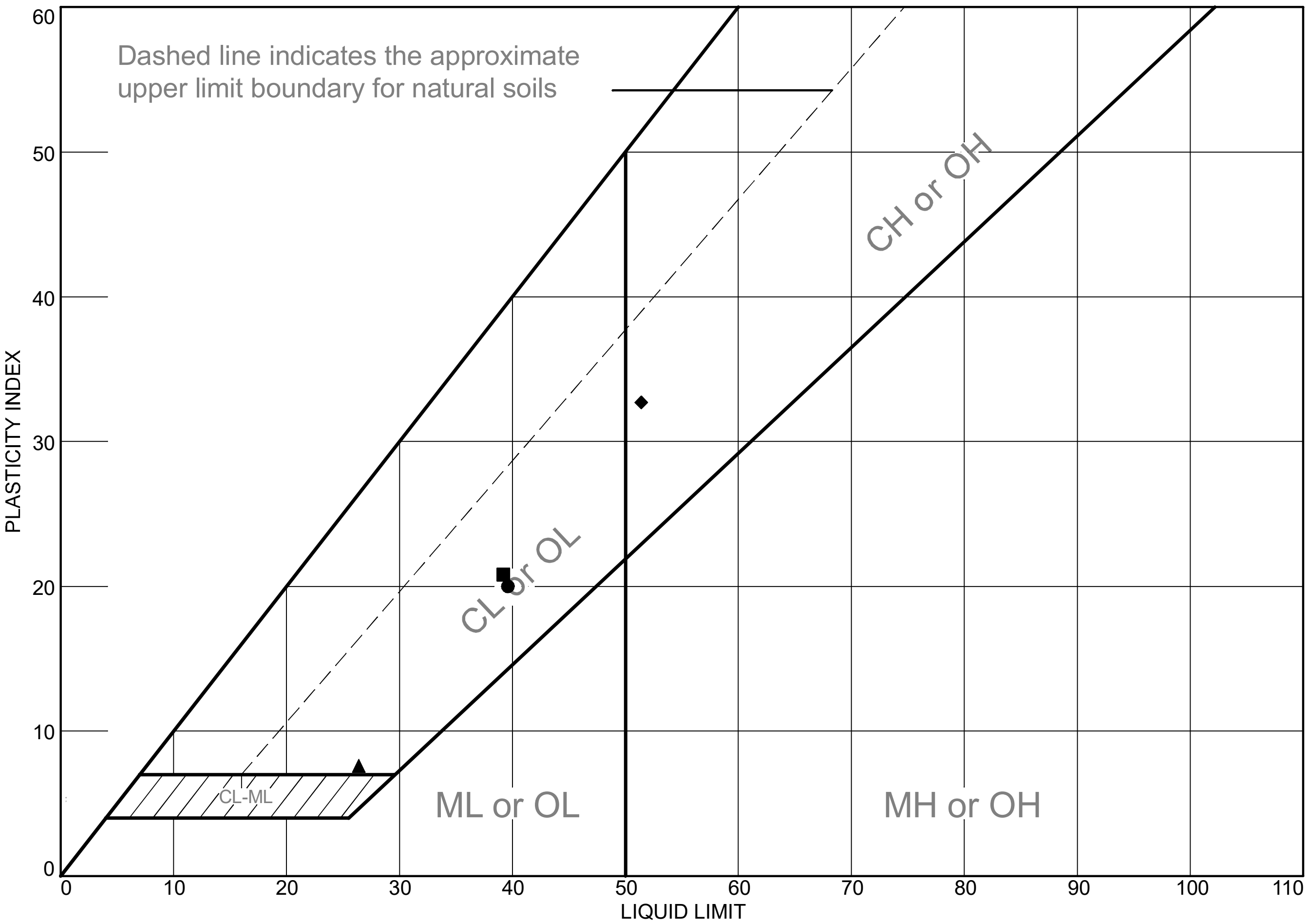
RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

SOIL CLASSIFICATION AND KEY TO TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
9

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Clayey Sand W/ Gravel (SC)	39.6	19.6	20.0		29.9	SC
■	Brown Clayey Sand W/ Gravel (SC)	39.2	18.4	20.8		35.5	SC
▲	Brown Clayey Sand (SC)	26.4	18.8	7.6		27.9	SC
◆	Brown Clay W/ Sand (CH)	51.4	18.7	32.7		81.7	CH

Project No. 1259.10.PW.1

Project: Dry Creek Commons

● Source of Sample: B-1 Depth: 2.5, 3, 4.5, & 5'

■ Source of Sample: B-2 Depth: 1.5, 2, 3.5, & 4'

▲ Source of Sample: B-2 Depth: 24.0'

◆ Source of Sample: B-4 Depth: 2.5' & 3.0'

RGH CONSULTANTS

Remarks:

● Expansion Index= 23 (Low)

■ Expansion Index= 40 (Low)

◆ Expansion Index= 86 (Medium)

Figure

Tested By: SCW Checked By: SEF

RGH CONSULTANTS

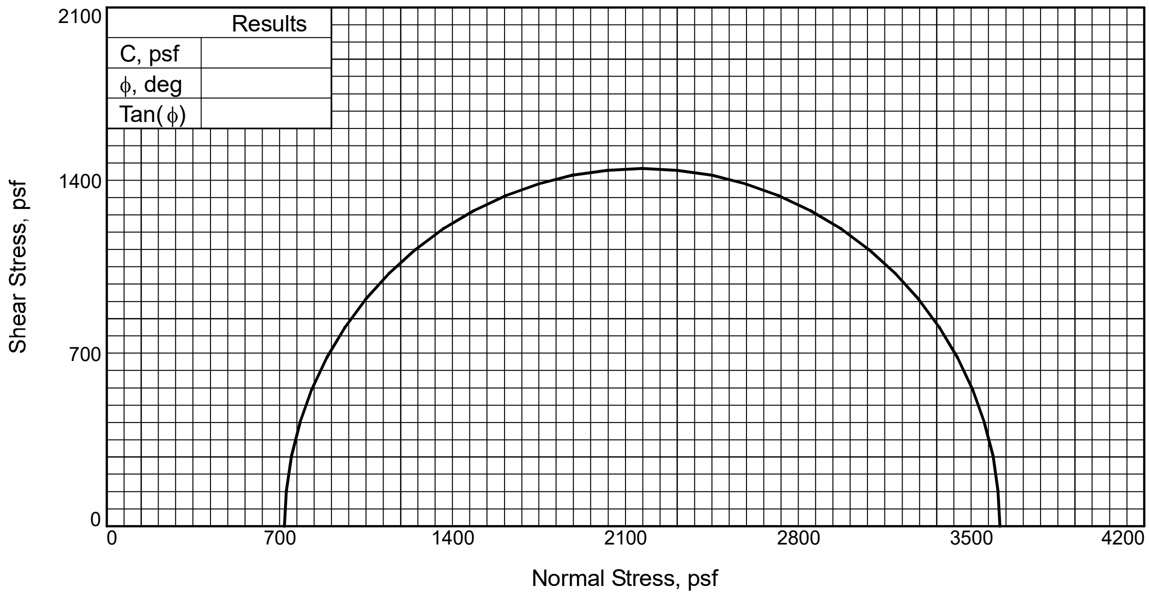
Job No: 1259.10.PW.1 Date: JAN 2022

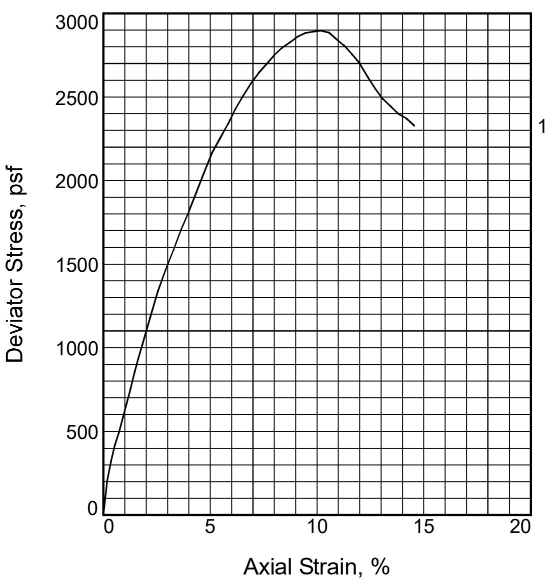
CLASSIFICATION TEST DATA

Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE

10





Sample No.		1
Initial	Water Content, %	17.6
	Dry Density, pcf	113.1
	Saturation, %	96.9
	Void Ratio	0.4909
	Diameter, in.	2.42
	Height, in.	5.50
At Test	Water Content, %	17.6
	Dry Density, pcf	113.1
	Saturation, %	96.9
	Void Ratio	0.4909
	Diameter, in.	2.42
	Height, in.	5.50
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		5.00
Fail. Stress, psf		2896
Strain, %		10.2
Ult. Stress, psf		2896
Strain, %		10.2
σ_1 Failure, psf		3616
σ_3 Failure, psf		720

Type of Test:
Unconsolidated Undrained
Sample Type: California Modified Tube
Description: Gray Sandy Clay (CH)

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-1 Depth: 9.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

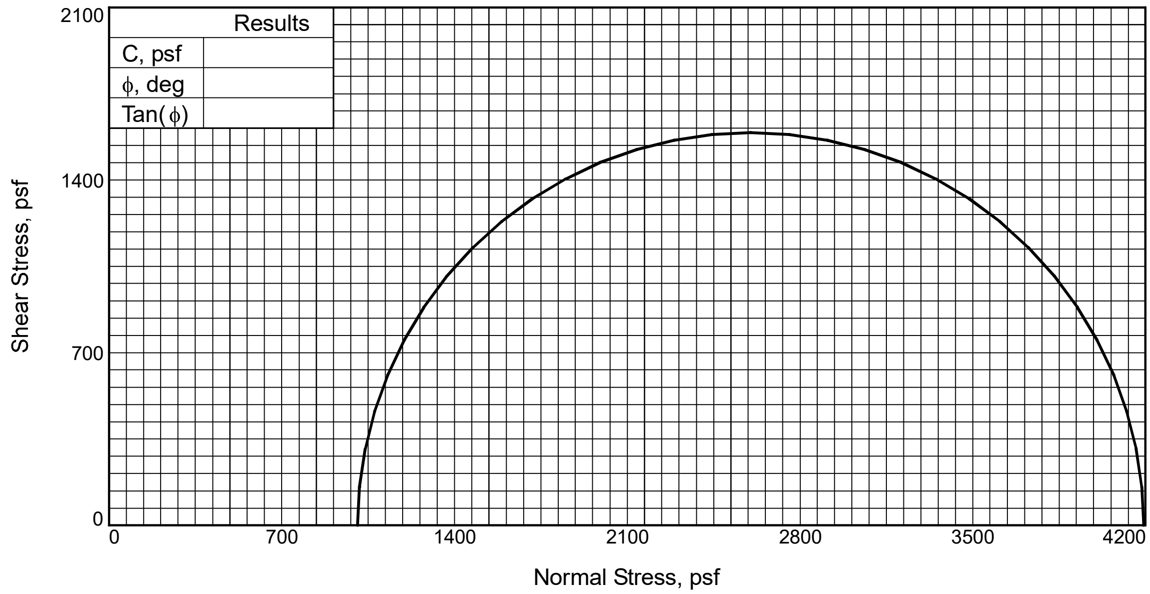
Tested By: SCW Checked By: SEF

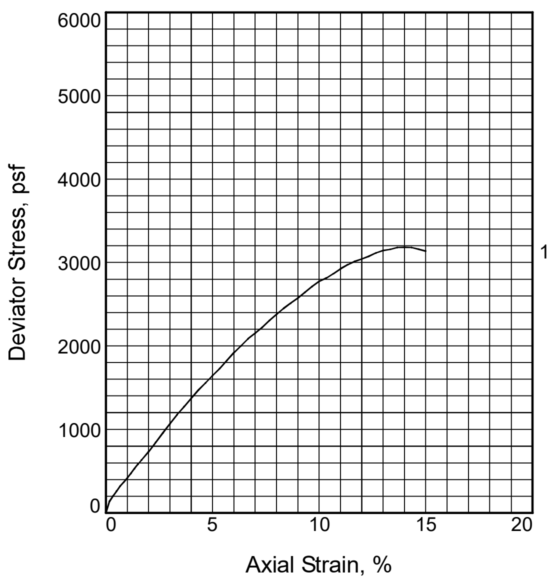
RGH CONSULTANTS

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
11

Job No: 1259.10.PW.1 Date: JAN 2022





Sample No.		1
Initial	Water Content, %	24.0
	Dry Density, pcf	102.2
	Saturation, %	99.9
	Void Ratio	0.6489
	Diameter, in.	2.43
	Height, in.	6.00
At Test	Water Content, %	24.0
	Dry Density, pcf	102.2
	Saturation, %	99.9
	Void Ratio	0.6489
	Diameter, in.	2.43
	Height, in.	6.00
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		7.00
Fail. Stress, psf		3184
Strain, %		14.0
Ult. Stress, psf		3184
Strain, %		14.0
σ_1 Failure, psf		4192
σ_3 Failure, psf		1008

Type of Test:
Unconsolidated Undrained
Sample Type: California Modified Tube
Description: Orange/Brown Sandy Silt (MH)

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-1 Depth: 20.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

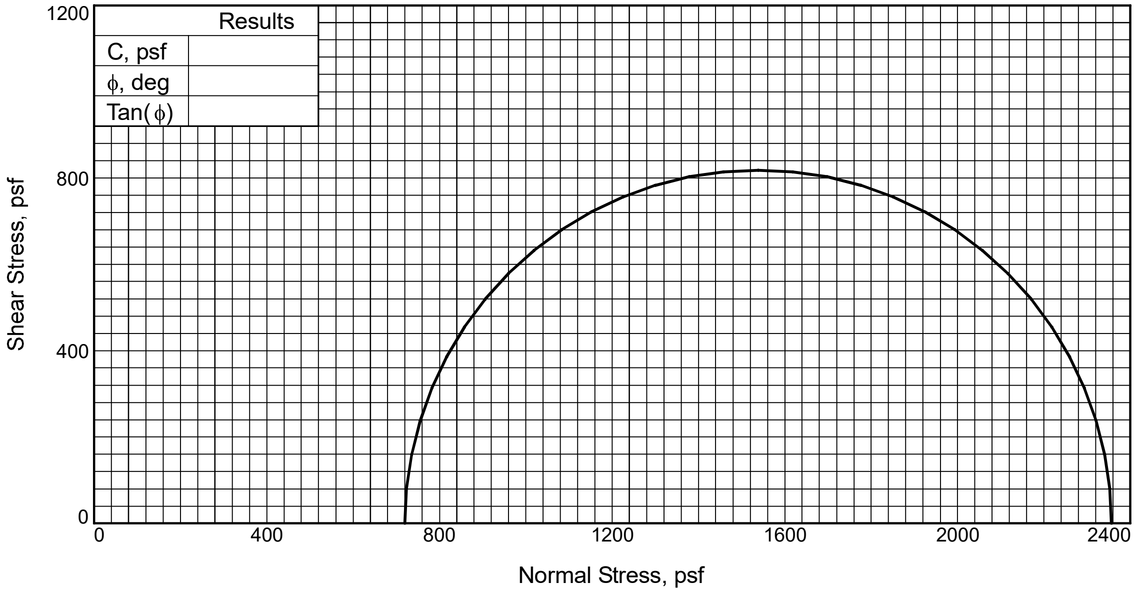
Tested By: SCW Checked By: SEF

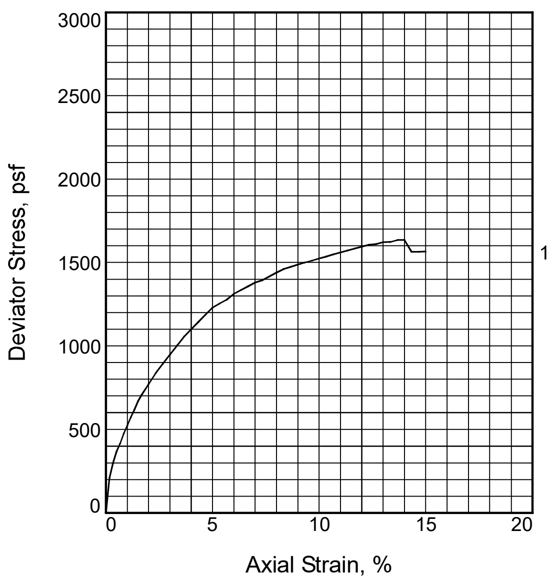
RGH CONSULTANTS

Job No: 1259.10.PW.1 Date: JAN 2022

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
12





Sample No.		1
Initial	Water Content, %	29.9
	Dry Density, pcf	91.0
	Saturation, %	94.7
	Void Ratio	0.8516
	Diameter, in.	2.40
	Height, in.	6.00
At Test	Water Content, %	29.9
	Dry Density, pcf	91.0
	Saturation, %	94.7
	Void Ratio	0.8516
	Diameter, in.	2.40
	Height, in.	6.00
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		5.00
Fail. Stress, psf		1637
Strain, %		14.0
Ult. Stress, psf		1637
Strain, %		14.0
σ_1 Failure, psf		2357
σ_3 Failure, psf		720

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

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-2 Depth: 10.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

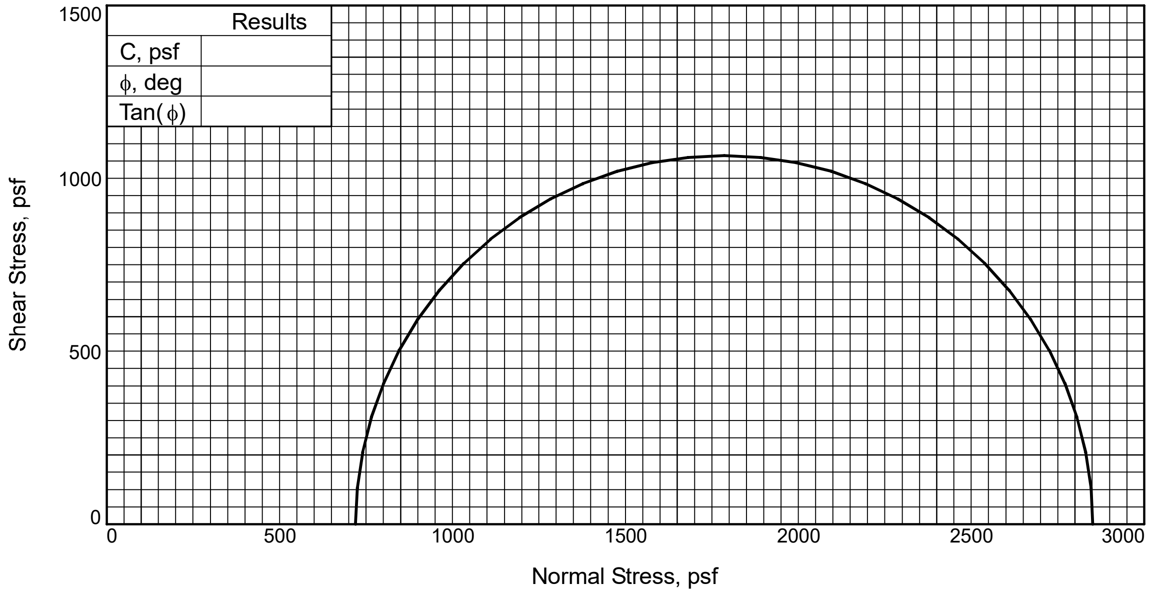
Tested By: SCW
Checked By: SEF

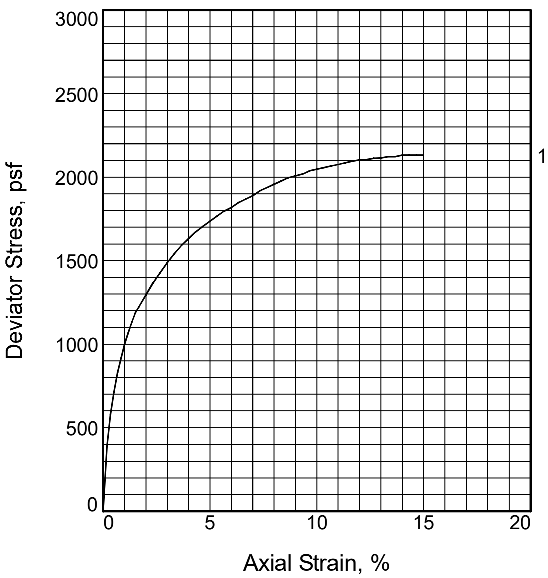
RGH CONSULTANTS

Job No: 1259.10.PW.1 Date: JAN 2022

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
13





	Sample No.	1
Initial	Water Content, %	26.0
	Dry Density, pcf	98.7
	Saturation, %	99.4
	Void Ratio	0.7070
	Diameter, in.	2.43
	Height, in.	6.00
At Test	Water Content, %	26.0
	Dry Density, pcf	98.7
	Saturation, %	99.4
	Void Ratio	0.7070
	Diameter, in.	2.43
	Height, in.	6.00
	Strain rate, in./min.	0.060
	Back Pressure, psi	0.00
	Cell Pressure, psi	5.00
	Fail. Stress, psf	2131
	Strain, %	15.0
	Ult. Stress, psf	2131
	Strain, %	15.0
	σ_1 Failure, psf	2851
	σ_3 Failure, psf	720

Type of Test:
Unconsolidated Undrained
Sample Type: California Modified Tube
Description: Brown Sandy Clay (CL)

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-3 Depth: 8.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

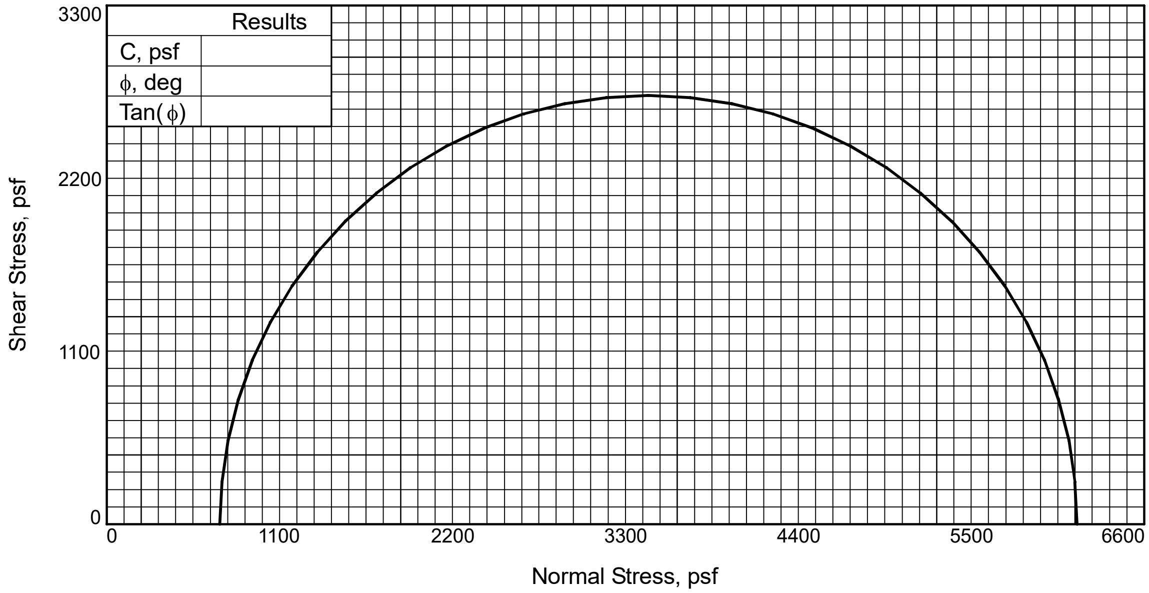
Tested By: SCW Checked By: SEF

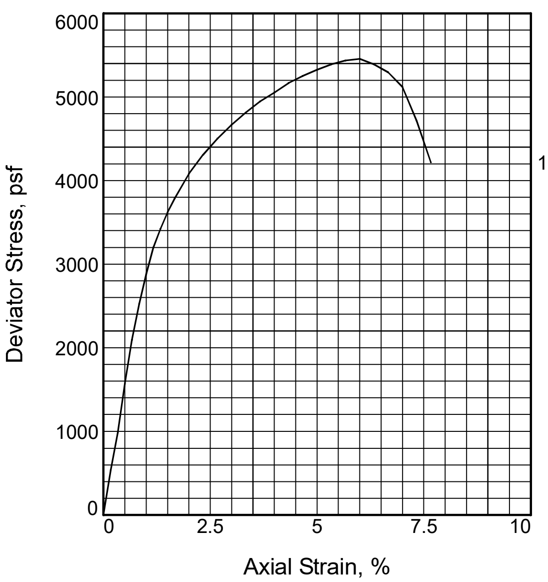
RGH CONSULTANTS

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
14

Job No: 1259.10.PW.1 Date: JAN 2022





Sample No.		1
Initial	Water Content, %	21.4
	Dry Density, pcf	105.5
	Saturation, %	96.7
	Void Ratio	0.5980
	Diameter, in.	2.42
	Height, in.	6.00
At Test	Water Content, %	21.4
	Dry Density, pcf	105.5
	Saturation, %	96.7
	Void Ratio	0.5980
	Diameter, in.	2.42
	Height, in.	6.00
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		5.00
Fail. Stress, psf		5453
Strain, %		6.0
Ult. Stress, psf		5453
Strain, %		6.0
σ_1 Failure, psf		6173
σ_3 Failure, psf		720

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

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-3 Depth: 11.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

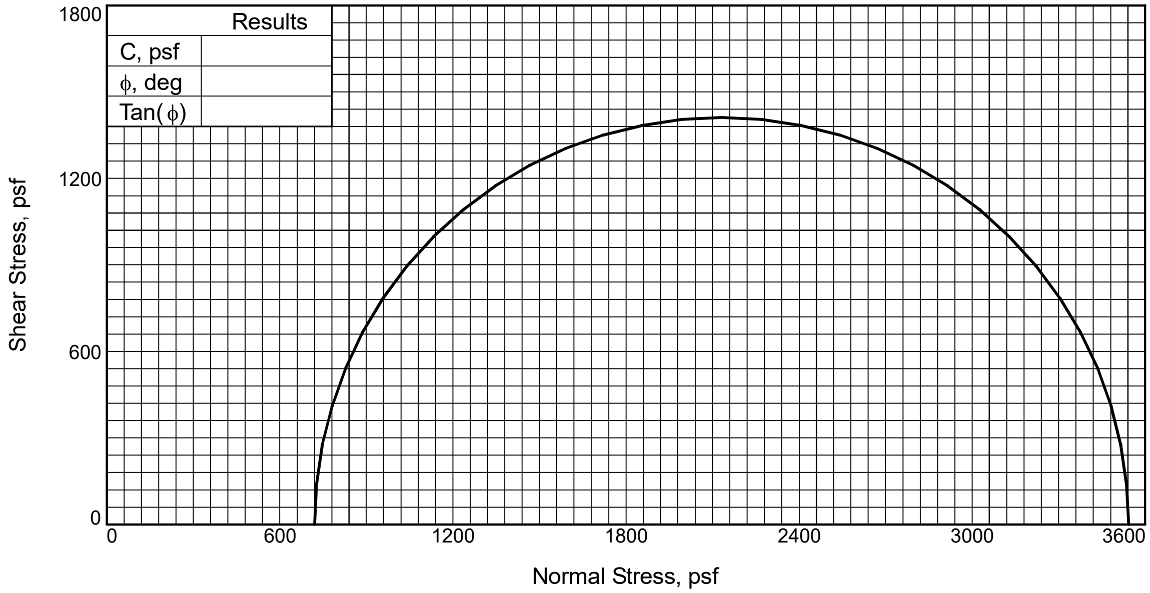
Tested By: SCW Checked By: SEF

RGH CONSULTANTS

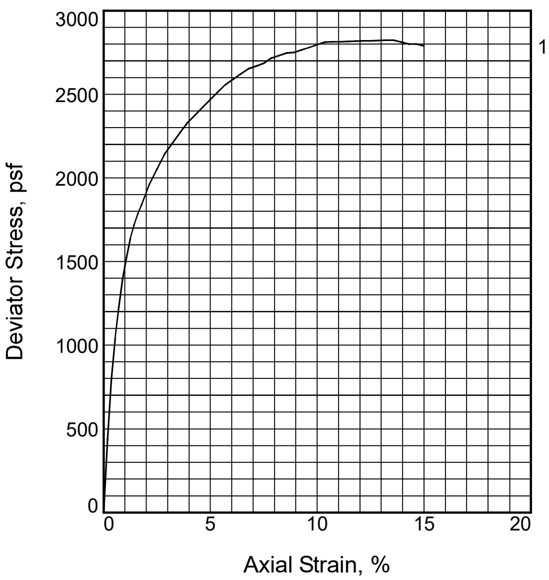
Job No: 1259.10.PW.1 Date: JAN 2022

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
15



Results	
C, psf	
ϕ, deg	
Tan(ϕ)	



	Sample No.	1
Initial	Water Content, %	23.6
	Dry Density, pcf	99.4
	Saturation, %	91.8
	Void Ratio	0.6956
	Diameter, in.	2.40
	Height, in.	5.60
At Test	Water Content, %	23.6
	Dry Density, pcf	99.4
	Saturation, %	91.8
	Void Ratio	0.6956
	Diameter, in.	2.40
	Height, in.	5.60
	Strain rate, in./min.	0.060
	Back Pressure, psi	0.00
	Cell Pressure, psi	5.00
	Fail. Stress, psf	2823
	Strain, %	13.6
	Ult. Stress, psf	2823
	Strain, %	13.6
	σ_1 Failure, psf	3543
	σ_3 Failure, psf	720

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

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-4 Depth: 3.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

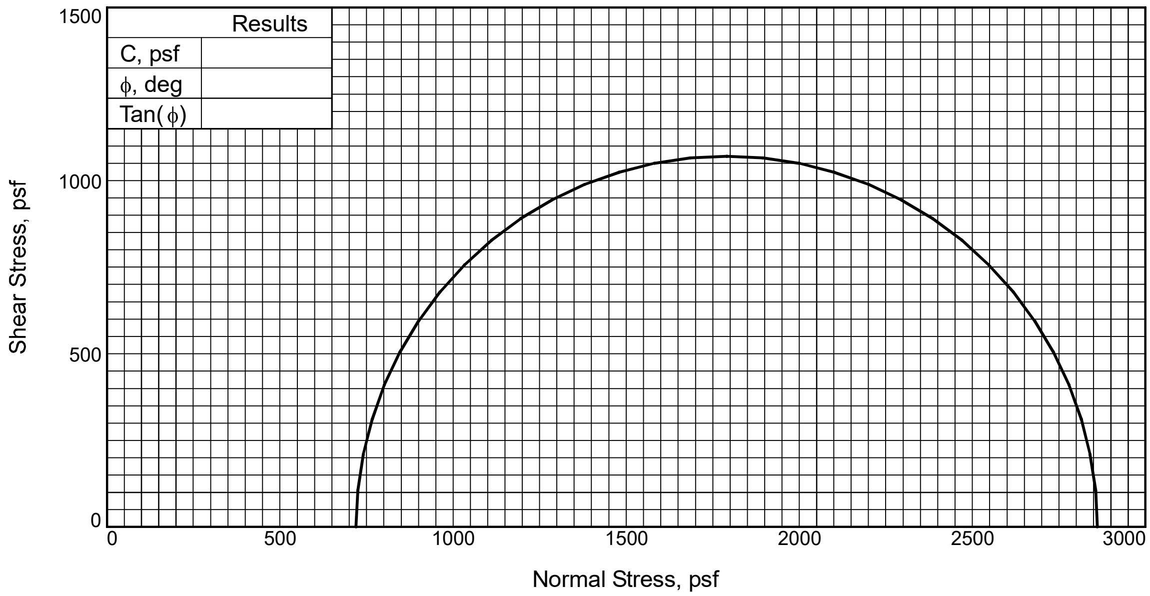
Tested By: SCW Checked By: SEF

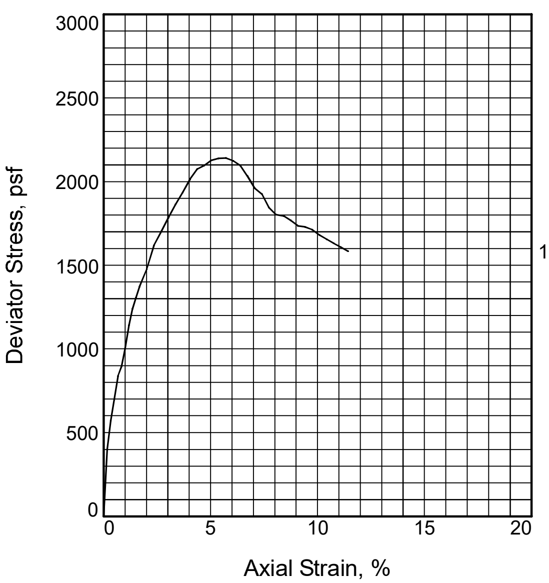
RGH CONSULTANTS

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
16

Job No: 1259.10.PW.1 | Date: JAN 2022





Sample No.		1
Initial	Water Content, %	23.3
	Dry Density, pcf	102.8
	Saturation, %	98.3
	Void Ratio	0.6400
	Diameter, in.	2.39
	Height, in.	5.95
At Test	Water Content, %	23.3
	Dry Density, pcf	102.8
	Saturation, %	98.3
	Void Ratio	0.6400
	Diameter, in.	2.39
	Height, in.	5.95
Strain rate, in./min.		0.060
Back Pressure, psi		0.00
Cell Pressure, psi		5.00
Fail. Stress, psf		2141
Strain, %		5.7
Ult. Stress, psf		2141
Strain, %		5.7
σ_1 Failure, psf		2861
σ_3 Failure, psf		720

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

Assumed Specific Gravity= 2.70
Remarks:

Figure ________

Project: Dry Creek Commons

Source of Sample: B-4 Depth: 10.0'

Proj. No.: 1259.10.PW.1 Date Sampled: 12/3/21

RGH CONSULTANTS

Tested By: SAA Checked By: SEF

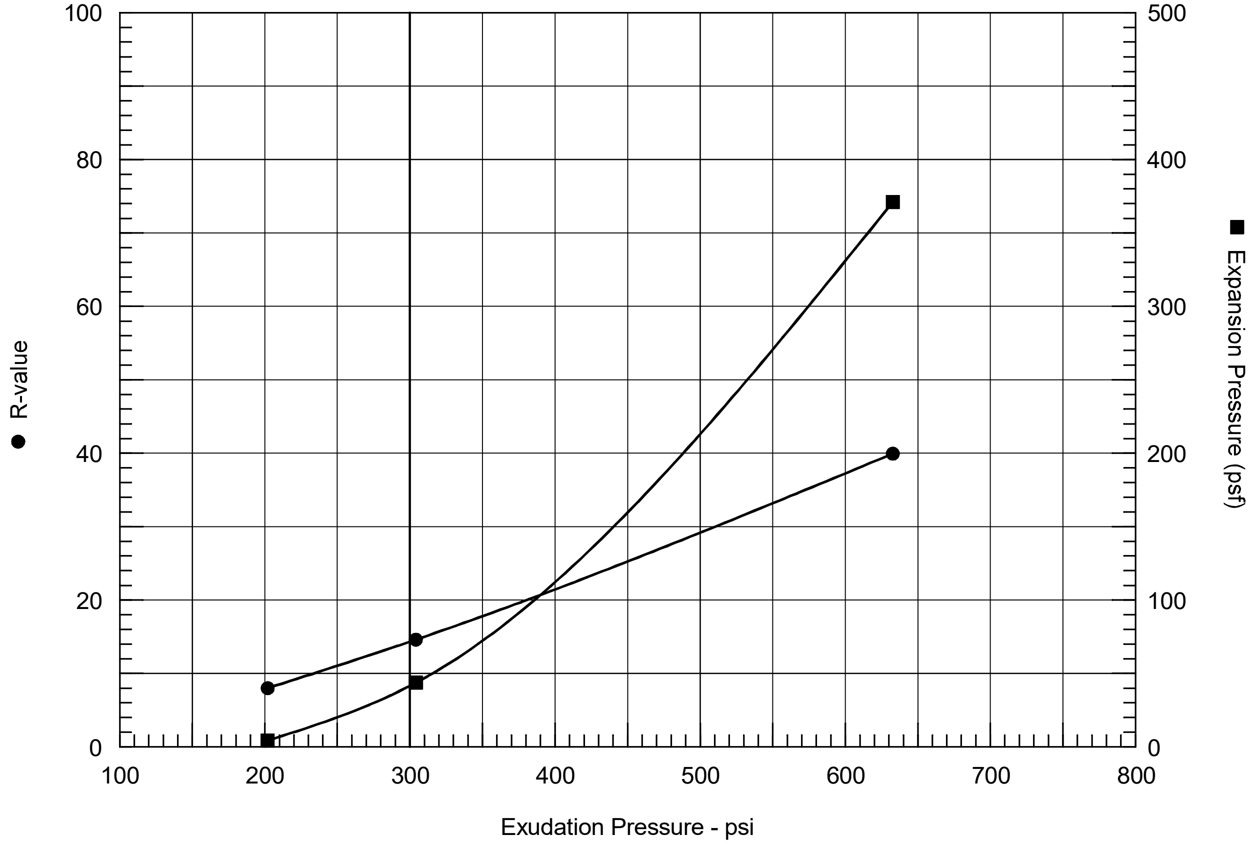
RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

TRAXIAL TEST DATA
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE
17

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

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	104.6	20.8	4	136	2.55	202	8	8
2	50	106.6	17.9	44	126	2.63	304	13	15
3	200	115.2	15.3	371	73	2.38	633	43	40

Test Results	Material Description
R-value at 300 psi exudation pressure = 14 Exp. pressure at 300 psi exudation pressure = 41 psf	Brown Clay W/ Sand (CL)

Project No.: 1259.10.PW.1

Project: Dry Creek Commons

Source of Sample: P-1 & P-2 Composite Depth: 0.0'-3.5'

Date: 1/3/2022

RGH CONSULTANTS

Tested by: SAM

Checked by: SEF

Remarks:

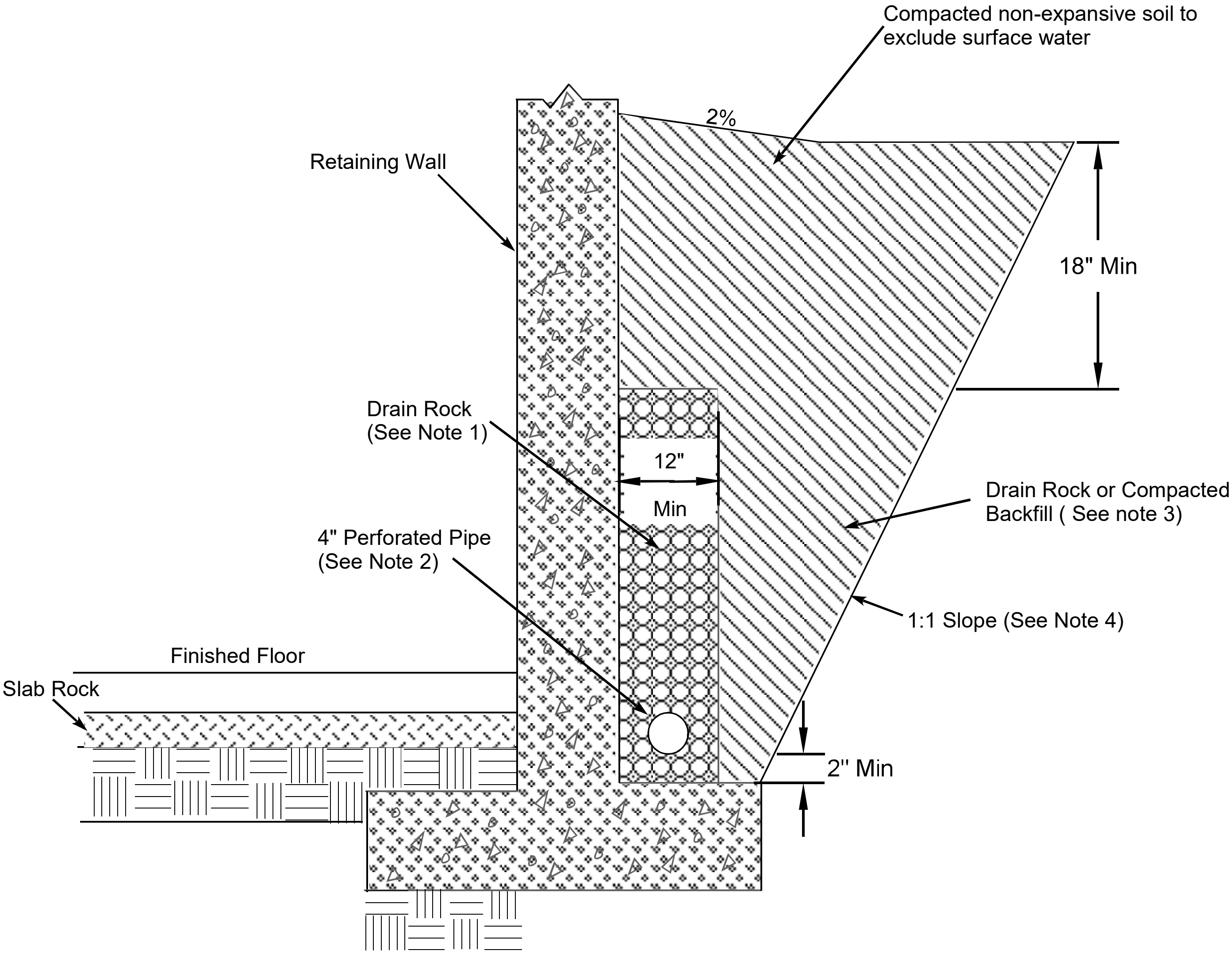
Figure ______

RGH CONSULTANTS

RESISTANCE (R) VALUE
Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE **18**

Job No: 1259.10.PW.1 | Date: JAN 2022



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.

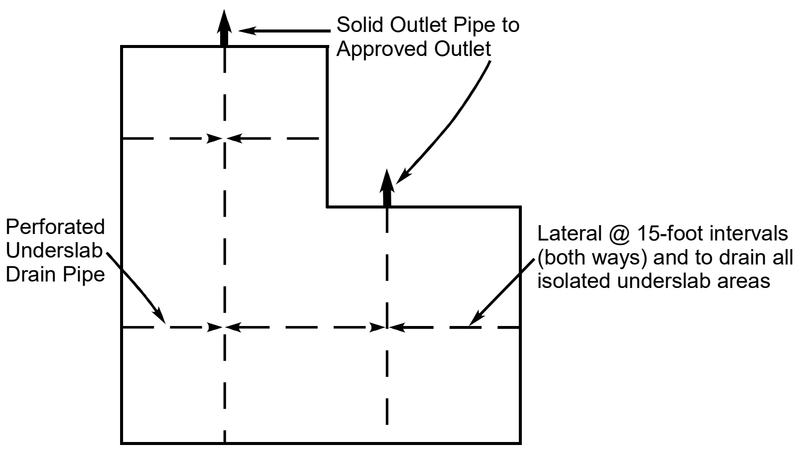
2. Pipe should conform to the requirements of Section 68 of State of California "Caltrans" Standards, perforations placed down, sloped at 1% for gravity flow to outlet or sump with automatic pump. The pipe invert should be located at least 8 inches below the lowest adjacent finished surface.

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.

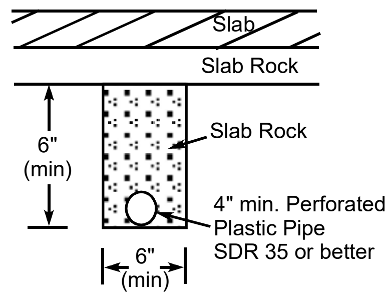
4. Slope excavation back at a 1:1 gradient from the back of footing where expansive materials are exposed.

Not to Scale

RGH CONSULTANTS	**RETAINING WALL BACKDRAIN ILLUSTRATION** Dry Creek Commons 155 Dry Creek Road Healdsburg, California	PLATE **19**
Job No: 1259.10.PW.1 — Date: JAN 2022		



TYPICAL UNDERSLAB DRAIN PLAN



SLAB UNDERDRAIN

RGH CONSULTANTS

Job No: 1259.10.PW.1 | Date: JAN 2022

TYPICAL SUBDRAIN DETAILS

Dry Creek Commons
155 Dry Creek Road
Healdsburg, California

PLATE 20

APPENDIX B - REFERENCES

American Society of Civil Engineers, 2017, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE Standard ASCE/SEI 7-16.

Bryant, W.A., and Hart, E.W., Interim Revision 2007, Fault-Rupture Zones in California; California Geological Survey, Special Publication 42, p. 21 with Appendices A through F.

Building Seismic Safety Council (BSSC), 2014, Building Seismic Safety Council 2014 Event Set, accessed between October 2019 and February 2020. Available online at https://earthquake.usgs.gov/scenarios/catalog/bssc2014/.

California Building Code, 2019, California Building Standard Commission.

California Department of Transportation, 2020, Highway Design Manual, Chapter 630 - Flexible Pavement.

Delattre, M.P., and MacLaughlin, R.J., 2010, Geologic Map of Jimtown 7.5' Quadrangle: Sonoma County, California: A Digital Database, California Geological Survey, Scale 1:24,000

Federal Emergency Management Agency, December 2, 2008, Flood Insurance Rate Map, Sonoma County, California, City of Healdsburg, Community Panel Numbers 06097C0344E and 06097C036E.

Huffman, M.E., and Armstrong, C.F, 1980, Geology for Planning in Sonoma County, California: California Division of Mines and Geology Special Report 120, 31 p., 5 plates.

Idriss, I.M. and Boulanger, R.W., 2004, Semi-Empirical Procedures for Evaluating Liquefaction Potential During Earthquakes, Proceedings of the 11th ICSDEE and 3rd ICEGE, pp. 32-56.

Idriss, I.M. and Boulanger, R.W., 2008, Soil Liquefaction During Earthquakes.

Ishihara, K., and Yoshimine, M., 1992, Evaluation of settlements in sand deposits following liquefaction during earthquakes, *Soils and Foundations* 32(1), 173-88.

Natural Resources Conservation Service, United States Department of Agriculture, accessed January 2022. Web Soil Survey, available online at http://websoilsurvey.nrcs.usda.gov/.

Seed, H.B. and Idriss, I.M., 1982, Ground Motion and Soil Liquefaction During Earthquakes: Earthquake Engineering Research Institute, Berkeley, California.

Seed, H.B., Tokimatsu, K., Harder, L.F., and Chung, R.M., 1985, Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations: Journal of Geotechnical Engineering Division, American Society of Civil Engineers, v. III, no. 12, December, p. 1425-1445.

Seed, R.B., Cetin, K.O., Moss, R.E.S., Kammerer, A.M., Wu, J., Pestana, J.M., Riemer, M.F., Sancio, R.B., Bray, J.D., Kayen, R.E., and Faris, A., 2003, Recent Advances in Soil Liquefaction: A Unified and Consistent Framework: Earthquake Engineering Research Center Report No. EERC 2003-06, College of Engineering, University of California, Berkeley.

Tokimatsu, A.M., and Seed, H.B., 1987, Evaluation of Settlements in Sands due to Earthquake Shaking: Journal of the Geotechnical Division, American Society of Civil Engineers, v. 113, no. 8, August, p. 581-878.

Youd, T.L., Hansen, C.M., and Bartlett, S.F., 2002, Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement: Journal of Geotechnical and Geoenvironmental Engineering, v 128, No. 12, p. 1007-1017.

Youd, T.L., and Idriss, I.M., and 19 others, 2001, Liquefaction Resistance of Soils: summary report from the 1996 NCEER and 1998 NCEER/NSF workshops on evaluation of liquefaction resistance of soils: ASCE Geotechnical and Geoenvironmental Journal, v. 127, no. 10, p. 817-833.

APPENDIX C - DISTRIBUTION

Burbank Housing (e)
Attention: Karen Massey
1425 Corporate Center Parkway
Santa Rosa, CA 95407
kmassey@burbankhousing.org

EGC:TAW:aku:brw

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 alight 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.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone:' 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org