APPENDIX C

GEOTECHNICAL INVESTIGATION

ROCKRIDGE
GEOTECHNICAL

Prepared for **Pacific Charter School Development**

GEOTECHNICAL INVESTIGATION
PROPOSED CALIBER CHARTER SCHOOL
500 OREGON STREET
Vallejo, California

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January 22, 2016
Project No. 15-1013

ROCKRIDGE
GEOTECHNICAL

January 22, 2016
Project No. 15-1013

Ms. Whitney Rubin
Pacific Charter School Development
210 S. Hudson Street
Seattle, Washington 98134

Subject: Geotechnical Investigation Report
Proposed Caliber Charter School
500 Oregon Street
Vallejo, California

Dear Ms. Rubin,

We are pleased to present the results of our geotechnical investigation for the proposed charter school to be constructed at 500 Oregon Street in Vallejo, California. Our services were provided in accordance with our proposals dated November 2, 2015 and January 6, 2016.

The site is bordered by Valle Vista Avenue to the north and Oregon Street to the south. The subject site is a rectangular-shaped parcel measuring approximately 440 feet by 550 feet and is located about 225 feet east of the intersection of Couch Street and Valle Vista Avenue. The gross area of the parcel is approximately 5.4 acres including the right-of-ways for Valle Vista Avenue, Napa Street and Oregon Street. The net area is approximately 3.7 acres. The site is currently occupied by a four one-story classroom buildings, one former building foundation slab, a vacant field, and an asphalt-paved parking lot.

Based on drawings prepared by Tef Design, dated November 4, 2015, we understand the proposed project will consist of constructing an L-shaped two-story school building in the northeastern portion of the site. The structure will be constructed at-grade. Other improvements include landscaping and a parking lot in the southwestern portion of the site. Future planned development includes an L-shaped high school building in the southeastern portion of the site, although the future high school building is not included in the scope of this investigation.

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical concern at the site is the potential for seasonal foundation and pavement movement due to shrinking and swelling of the moderately to very highly expansive near-surface clay.

We conclude the building may be supported on deepened spread footings with a conventional concrete slab-on-grade floor, provided the slab is underlain by at least 12 inches of select fill or lime-treated on-site soil (measured below the capillary moisture break). Alternatively, the building may be supported on a stiffened mat foundation.

Our report contains specific recommendations regarding earthwork and grading, foundation design, and other geotechnical issues. The recommendations contained in our report are based on limited subsurface exploration. Consequently, variations between expected and actual soil conditions may be found in localized areas during construction. Therefore, we should be engaged to observe foundation installation, grading, and fill placement, during which time we may make changes in our recommendations, if deemed necessary.

We appreciate the opportunity to provide our services to you on this project. If you have any questions, please call.

Sincerely yours,
ROCKRIDGE GEOTECHNICAL, INC.

Darcie Maffioli

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GEOTECHNICAL INVESTIGATION
PROPOSED CALIBER CHARTER SCHOOL
500 OREGON STREET
Vallejo, California

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation performed by Rockridge Geotechnical, Inc. for the proposed charter school to be constructed at 500 Oregon Street in Vallejo, California. The site is bordered by Valle Vista Avenue to the north and Oregon Street to the south, as shown on the Site Location Map, Figure 1.

The subject site is a rectangular-shaped parcel measuring approximately 440 feet by 550 feet and is located about 225 feet east of the intersection of Couch Street and Valle Vista Avenue. The gross area of the parcel is approximately 5.4 acres including the right-of-ways for Valle Vista Avenue, Napa Street and Oregon Street. The net area is approximately 3.7 acres. The site is currently occupied by a four one-story classroom buildings, one former building foundation slab, a vacant field, and an asphalt-paved parking lot. The existing site grades vary from about Elevation 12 to 20 feet[1].

Based on drawings prepared by Tef Design, dated November 4, 2015, we understand the proposed project will consist of constructing an L-shaped two-story school building in the northeastern portion of the site. The structure will be constructed at-grade. Other improvements include landscaping and a parking lot in the southwestern portion of the site. Future planned development includes an L-shaped high school building in the southeastern portion of the site, although the future high school building is not included in the scope of this investigation.

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[1] Unless otherwise noted, Elevations in this report are based on topographic information shown on the drawing titled “A.L.T.A/A.C.S.M. Land Title Survey,” prepared by Meridian Associates, Inc., dated September 18, 2015, North American Vertical Datum 1988 (NAVD 88).

2.0 SCOPE OF SERVICES

Our geotechnical investigation was performed in accordance with our proposals dated November 2, 2015 and January 6, 2016. Our scope of services consisted of evaluating subsurface conditions at the site by drilling five test borings, advancing six shallow hand-auger borings, performing laboratory testing on select soil samples collected from the borings, and performing engineering analyses to develop conclusions and recommendations regarding:

- the most appropriate foundation type(s) for the proposed structure
- design criteria for the recommended foundation type(s), including vertical and lateral capacities
- estimates of static and seismically induced foundation settlement
- subgrade preparation for slab-on-grade floors and concrete flatwork
- site grading and excavation, grading and excavation, including criteria for fill quality and compaction
- site seismicity and seismic hazards, including the potential for liquefaction and liquefaction-induced ground failure
- 2013 California Building Code (CBC) site class and design spectral response acceleration parameters
- construction considerations.

3.0 FIELD INVESTIGATION

Subsurface conditions at the site were investigated by drilling five borings, advancing six shallow hand-auger borings, and performing laboratory testing on select soil samples. Prior to our field investigation, we contacted Underground Service Alert (USA) to notify them of our work, as required by law, and retained 1st Call Utility Locating, a private utility locator, to check that the boring locations were clear of existing utilities. We also obtained a drilling permit from Solano County Environmental Health Services (SCEHS). Upon completion, the test borings were backfilled with cement grout in accordance with SCEHS requirements. Details of the field investigation and laboratory testing are described below.

3.1 Test Borings

The five deep borings were drilled on November 8, 2015 by Taber Drilling of West Sacramento, California. The borings, designated B-1 through B-5, were drilled to depths of about 16 to 30 feet below the existing ground surface (bgs) using a CME-75 drill rig equipped with 6-1/2-inch-outside-diameter hollow-stem augers. One shallow boring designated “Bulk” on the Site Plan was drilled to a depth of approximately 5 feet bgs to obtain surficial soil for resistance value (R-Value) testing. During drilling, our field engineer logged the soil encountered and obtained representative samples for visual classification and laboratory testing. Boring logs are presented on Figures A-1 through A-5 in Appendix A. The soil encountered in the borings was classified in accordance with the classification chart shown on Figure A-12. The approximate boring locations are shown on the Site Plan, Figure 2.

Soil samples were obtained using the following samplers:

- Sprague and Henwood (S&H) split-barrel sampler with a 3.0-inch outside diameter and 2.5-inch inside diameter, lined with 2.43-inch inside diameter stainless steel tubes
- Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside and 1.5-inch inside diameter, without liners.

The type of sampler used was selected based on soil type and the desired sample quality for laboratory testing. In general, the S&H sampler was used to obtain samples in medium stiff to very stiff cohesive soil and the SPT sampler was used to evaluate the relative density of sandy soil or to sample hard clays or bedrock. The samplers were driven with a 140-pound, automatic hammer falling about 30 inches per drop. The samplers were driven up to 18 inches and the hammer blows required to drive the samplers were recorded every six inches and are presented on the boring logs. A "blow count" is defined as the number of hammer blows per six inches of penetration or 50 blows for six inches or less of penetration. The blow counts required to drive the S&H and SPT samplers were converted to approximate SPT N-values using factors of 0.9 and 1.5, respectively, to account for sampler type and approximate hammer energy, as well as the fact that the SPT sampler was used without liners, but could accommodate liners. The blow counts used for this conversion were: (1) the last two blow counts if the sampler was driven more than 12 inches, (2) the last one blow count if the sampler was driven more than six inches but less than 12 inches, and (3) the only blow count if the sampler was driven six inches or less. The converted SPT N-values are presented on the boring logs.

Upon completion of drilling, the borings were backfilled with cement grout and observed by the SCEHS inspector. Soil cuttings generated during drilling the borings were spread onsite near the boreholes.

3.2 Hand Auger Borings

Six hand auger borings, designated as HA-1 through HA-6, were advanced on January 6, 2016 to further investigate the thickness of fill and the lateral extent of the very highly expansive surficial soils at the site. The hand auger borings were advanced using a three-inch-diameter hand auger to depths ranging from 3 to 4 feet, bgs in the approximate locations noted on Figure 2. Upon completion, the boreholes were backfilled with the soil cuttings. The subsurface conditions encountered in the hand auger borings are also presented on Figures A-6 through A-11.

3.3 Laboratory Testing

We re-examined each soil sample obtained from our borings to confirm the field classifications and select representative samples for laboratory testing. Soil samples were tested to measure Atterberg limits (plasticity), moisture content, density, resistance value (R-Value), and corrosivity. The results of the geotechnical laboratory tests are presented on the boring logs and in Appendix B.

4.0 SUBSURFACE CONDITIONS

As presented on the Regional Geologic Map (Figure 3), the site is mapped as being underlain by Pleistocene-age alluvial deposits (Qpa) (Graymer, 2000). The results of our borings indicate the alluvial deposits consist of medium stiff to hard fine-grained deposits with varying sand content to the top of bedrock.

Based on the results of our geotechnical investigation, we conclude the site is partially underlain by 1-1/2 to 2 feet of clayey to granular fill in the western portion of the site, near the former building foundation. Atterberg limits tests performed on near-surface native clay indicate the material in the northern portion of the proposed building footprint is highly to very highly expansive. The expansive material, where encountered, is approximately 1-1/2 to 3 feet thick. The fill and near-surface expansive clay is underlain by stiff to hard clays to a depth of approximately 14 to 24 feet below ground surface (bgs). Beneath the stiff to hard clay, sandstone and mudstone bedrock was encountered between a depth of 14 and 23 feet.

Groundwater was encountered during drilling at depths of about 17-1/2 to 18-1/2 feet bgs in Borings B-2 and B-1, respectively. Groundwater was not encountered in the other borings. The measured groundwater levels correspond to approximately Elevation -2.5 and -4.8 feet. Groundwater may not have had sufficient time to stabilize at the time the measurements were taken during our exploration. The depth to groundwater is expected to vary several feet annually, depending on rainfall amounts. Note that this winter (2014-2015) has been particularly dry, and therefore, our readings likely do not reflect the high water levels anticipated for wetter years.

5.0 SEISMIC CONSIDERATIONS

Because the project site is in a seismically active region, we evaluated the potential for earthquake-induced geologic hazards, including ground shaking, ground surface rupture, liquefaction,[2] lateral spreading,[3] cyclic densification[4]. The results of our evaluation regarding seismic considerations for the project site are presented in the following sections.

5.1 Regional Seismicity and Faulting

The major active faults in the area are the West Napa, Green Valley, and Hayward Faults. For these and other active faults within a 50-kilometer radius of the site, the distance from the site and mean characteristic Moment magnitude[5] [Working Group on California Earthquake Probabilities (WGCEP, 2008) and Cao et al. (2003)] are summarized in Table 1.

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[2] Liquefaction is a phenomenon where loose, saturated, cohesionless soil experiences temporary reduction in strength during cyclic loading such as that produced by earthquakes.

[3] Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

[4] Cyclic densification is a phenomenon in which non-saturated, cohesionless soil is compacted by earthquake vibrations, causing ground-surface settlement.

[5] Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approximate Distance from Site (km)	Direction from Site	Mean Characteristic Moment Magnitude
West Napa	5.1	North	6.70
Green Valley Connected	13	East	6.80
Total Hayward	15	West	7.00
Total Hayward-Rodgers Creek	15	West	7.33
Rodgers Creek	16	West	7.07
Great Valley 5, Pittsburg Kirby Hills	29	East	6.70
Great Valley 4b, Gordon Valley	32	Northeast	6.80
Mount Diablo Thrust	33	Southeast	6.70
Hunting Creek-Berryessa	37	North	7.10
Total Calaveras	40	Southeast	7.03
N. San Andreas - North Coast	44	West	7.51
N. San Andreas (1906 event)	44	West	8.05
Greenville Connected	45	Southeast	7.00
N. San Andreas - Peninsula	47	Southwest	7.23

In the past 200 years, four major earthquakes (i.e., Magnitude > 6) have been recorded on the San Andreas Fault. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) Intensity Scale occurred east of Monterey Bay on the San Andreas Fault (Toppozada and Borchardt 1998). The estimated moment magnitude, M_w, for this earthquake is about 6.25. In 1838, an earthquake occurred on the Peninsula segment of the San Andreas Fault. Severe shaking occurred with an MM of about VIII-IX, corresponding to an M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas Fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), an M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Prieta Earthquake of October 17, 1989 had an M_w of 6.9. On August 24, 2014 an earthquake with an estimated maximum intensity of VIII (severe) on the MM scale occurred on the West Napa fault. This earthquake was the largest earthquake event in the San Francisco Bay Area since the Loma Prieta Earthquake. The M_w of the 2014 South Napa Earthquake was 6.0.

The USGS's 2007 WGCEP has compiled the earthquake fault research for the San Francisco Bay area in order to estimate the probability of fault segment rupture. They have determined that the overall probability of moment magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Region during the next 30 years is 63 percent. The highest probabilities are assigned to the Hayward/Rodgers Creek Fault and the northern segment of the San Andreas Fault. These probabilities are 31 and 21 percent, respectively (USGS, 2008).

5.2 Geologic Hazards

During a major earthquake on a segment of one of the nearby faults, strong to very strong ground shaking is expected to occur at the project site. Strong shaking during an earthquake can result in ground failure such as that associated with soil liquefaction, lateral spreading, and cyclic densification. We used the results of the borings to evaluate the potential of these phenomena occurring at the project site.

5.2.1 Ground Shaking

The ground shaking intensity felt at the project site will depend on: 1) the size of the earthquake (magnitude), 2) the distance from the site to the fault source, 3) the directivity (focusing of earthquake energy along the fault in the direction of the rupture), and 4) subsurface conditions. The site is about 5 kilometers from the West Napa Fault. Therefore, the potential exists for a large earthquake to induce strong to very strong ground shaking at the site during the life of the project.

5.2.2 Liquefaction and Associated Hazards

When a saturated, cohesionless soil liquefies, it experiences a temporary loss of shear strength created by a transient rise in excess pore pressure generated by strong ground motion. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits. Flow failure, lateral spreading, differential settlement, loss of bearing strength, ground fissures and sand boils are evidence of excess pore pressure generation and liquefaction.

The site is in a low liquefaction susceptibility zone, as shown on Figure 5 from the map titled *Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region*, prepared by the USGS in cooperation with the California Geological Survey (CGS), dated 2006.

The borings performed as part of our investigation indicate that the soil below the groundwater is generally sufficiently cohesive to resist liquefaction. Therefore, we conclude the potential for liquefaction adversely impacting the proposed development is very low.

Considering the subsurface soils are likely not susceptible to liquefaction, we conclude the risk of lateral spreading is also very low.

5.2.3 Cyclic Densification

Cyclic densification (also referred to as differential compaction) of non-saturated sand (sand above groundwater table) can occur during an earthquake, resulting in settlement of the ground surface and overlying improvements. Based on our geotechnical investigation, we conclude the soil above the groundwater table contains sufficient cohesion such that the risk of cyclic densification is very low.

5.2.4 Fault Rupture

Historically, ground surface displacements closely follow the trace of geologically young faults. The site is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act, and no known active or potentially active faults exist on the site. We therefore conclude the risk of fault offset at the site from a known active fault is very low. In a seismically active area, the remote possibility exists for future faulting in areas where no faults previously existed; however, we conclude the risk of surface faulting and consequent secondary ground failure from previously unknown faults is also very low.

6.0 DISCUSSIONS AND CONCLUSIONS

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical concern at the site is the potential for seasonal foundation and pavement movement due to shrinking and swelling of the moderately to very highly expansive near-surface clay. This and other geotechnical issues as they pertain to the proposed development are discussed in the remainder of this section.

6.1 Foundations and Settlement

The primary geotechnical concern for design of the foundations for the proposed structure is the presence of moderately to very highly expansive native clay in the northern portion of the site. Expansive near-surface soil is subject to volume changes during long-term and seasonal fluctuations in moisture content. These volume changes can cause cracking of foundations and floor slabs. Therefore, foundation and floor slab should be designed and constructed to resist the effects of the expansive soil. In general, these effects can be mitigated by moisture conditioning the expansive soil, providing select, non-expansive fill below interior and exterior slabs, and either supporting foundations below the zone of severe moisture change or providing a stiff, shallow foundation that can limit deformation of the superstructure as the underlying soil shrinks and swells.

The soils beneath the site are generally overly consolidated and adequately stiff to support the proposed building on shallow foundations without excessive settlement under static and seismic loads. We estimate total settlement of the two-story structure supported on spread footings or a mat foundation would be less than 3/4 inch and differential settlement will be less than about 1/2 inch over a horizontal distance of 30 feet.

6.2 Expansive Soil

Atterberg limits tests of near-surface clay indicates that the northeastern portion of the site near Borings B-2, B-3, HA-2, HA-3, HA-4, HA-5, and HA-6 is moderately to very highly expansive to a depth between 1-1/2 to 3 feet. Expansive near-surface soil is subject to volume changes during seasonal fluctuations in moisture content. These volume changes can cause movement and cracking of foundations, flatwork, and pavements. Differential ground movement caused by the shrinking and swelling of this expansive soil should be expected. Differential ground movement can damage exterior concrete slabs.

To reduce the potential for differential movement, the highly expansive soil within the upper 12 inches of the slab subgrade should be removed and replaced with non-expansive, select fill, such as Class 2 aggregate base material. Alternatively, a lime-based admixture can be mixed into the upper 12 inches of the interior and exterior slab subgrade. These alternatives will reduce the expansion potential of the near-surface soil by controlling the moisture content of soil beneath the slab and/or by changing the plasticity of the clay through chemical admixtures. However based on our experience, lime treatment is generally not cost-effective for small areas. Lime-treatment of the entire building pad and concrete flatwork areas may be more cost-effective than off-hauling the upper 12 inches and importing select fill, assuming the site is close to balanced from a grading standpoint.

6.3 Construction Considerations

Considering the past site development, there may be buried debris (e.g., foundations and pipes) encountered during site grading, especially beneath the existing building slab in the northwestern portion of the site. No buried foundations, slabs, utilities, etc. from previous structures should remain within proposed building areas. In new pavement and landscape areas, it may be possible to abandon some existing utility lines in place (if present) provided they do not interfere with construction or performance of the pavements. The feasibility of leaving utility lines in place should be determined on a case-by-case basis.

If site grading is performed during the rainy season, the near-surface clay will likely be wet and will have to be dried before compaction can be achieved. Heavy rubber-tired equipment, such as scrapers and vibratory rollers, could cause excessive deflection (pumping) of the wet clay and therefore should be avoided. If the project schedule or weather conditions do not permit sufficient time for drying of the soil by aeration, the subgrade can be treated with lime prior to compaction. The appropriate amount of lime should be determined during construction based on visual examination and, if necessary, laboratory testing of the soil to be treated. It is also important that the moisture content of subgrade soil is sufficiently high to reduce the expansion potential. If the grading work is performed during the dry season, moisture-conditioning may be required.

7.0 RECOMMENDATIONS

In accordance with our scope of services, the remainder of this report presents our recommendations for site preparation and grading, foundation support, flatwork and pavements, seismic design, and other geotechnical aspects of the project.

7.1 Site Preparation and Grading

Site clearing should include removal of all existing pavements, former foundation elements, and underground utilities. Demolished asphalt concrete should be taken to an asphalt recycling facility. Aggregate base beneath existing pavements may be re-used as select fill if carefully segregated. Any vegetation and the upper 3 to 4 inches of organic topsoil should be stripped in areas to receive improvements (i.e., building, pavement, or flatwork). Tree roots with a diameter greater than 1/2 inch within four feet of building subgrade should be removed.

In general, abandoned underground utilities should be removed to the property line or service connections and properly capped or plugged with concrete. Where existing utility lines are outside of the proposed building footprint and will not interfere with the proposed construction, they may be abandoned in-place provided the lines are filled with lean concrete or cement grout to the property line. Any excavations created during demolition should be properly backfilled with compacted fill under the direction of our field engineer.

After site clearing is completed, any fill resulting from removal of former foundations or utilities, or any zones of former fill (where encountered) should be excavated to expose the native clay. The excavations should extend at least five feet beyond the perimeters of the proposed buildings, except where constrained by the property line. The native soil exposed at the base of the excavations should be scarified to a depth of at least eight inches, moisture-conditioned to at least four percent above moisture content, and compacted to between 87 and 92 percent relative compaction.[6] The excavated material should then be placed in lifts not exceeding eight inches in loose thickness, moisture-conditioned, and compacted in accordance with the requirements provided below in Table 2. Any existing fill beneath proposed structure or concrete flatwork should also be moisture-conditioned and recompacted to provide a firm, non-yielding surface. The proposed building pad (unless a stiffened mat foundation is selected for the proposed building) and areas to received concrete flatwork should be graded to accommodate either 12 inches of select fill or 12 inches of lime-treated on-site soil.

If material to be used as fill is imported to the site, it should meet the requirements for select fill provided below in Section 7.1.1. A summary of the compaction requirements for the various types of fill that may be used at the site is presented in Table 2.

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[6] Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557-09 laboratory compaction procedure.

TABLE 2
Summary of Compaction Requirements

Location	Required Relative Compaction (percent)	Moisture Requirement
Building pad area – expansive clay	87 – 92	4+% above optimum
General fill – lime-treated clay	90+	Above optimum
General fill – expansive clay	87 – 92	4+% above optimum
General fill – low-plasticity soil	90+	Above optimum
Utility trench backfill – expansive clay	87 – 92	4+% above optimum
Utility trench backfill – low-plasticity	90+	Above optimum
Utility trench - clean sand or gravel	95+	Near optimum
Pavement subgrade – expansive clay	90+	Above optimum
Pavement subgrade – low-plasticity	95+	Above optimum
Pavement - aggregate base	95+	Near optimum
Exterior slabs – expansive clay	87 – 92	4+% above optimum
Exterior slabs – lime-treated clay	90+	Above optimum
Exterior slabs – select fill	90+	Above optimum

7.1.1 Select Fill

Select fill should consist of soil that is free of organic matter, contain no rocks or lumps larger than three inches in greatest dimension, have a liquid limit less than 40 and plasticity index less than 12, and be approved by the geotechnical engineer. Select fill should be placed in lifts not exceeding eight inches in loose thickness, moisture-conditioned to above optimum moisture content, and compacted in accordance with the compaction requirements presented in Table 2. Samples of proposed imported select fill material should be submitted to the geotechnical engineer at least three business days prior to use at the site.

Prior to importing fill to the site, the grading contractor should provide analytical test results or other suitable environmental documentation indicating the imported fill is free of hazardous materials at least three days before use at the site. If this data is not provided, a minimum of two weeks will be required to perform any necessary analytical testing.

7.1.2 Lime-Treated Soil

Lime treatment of fine-grained soils generally includes site preparation, application of lime, mixing, compaction, and curing of the lime treated soil. Field quality control measures should include checking the depth of lime treatment, degree of pulverization, lime spread rate measurement, moisture content and density measurements, and mixing efficiency.

The lime treatment process should be designed by a contractor specializing in its use and who is experienced in the application of lime in similar soil conditions. Based on our experience with lime treatment, we judge that the specialty contractor should be able to treat the moderately to highly expansive on-site material to produce a non-expansive fill for the building pad subgrades and, if desired, for exterior flatwork and pavement subgrades. Lime-treated on-site soil can serve as a cost-effective alternative to imported select fill required beneath building pads and concrete flatwork. For planning purposes, we recommend assuming the lime treatment will consist of at least five percent of Quicklime by dry weight of soil. An average dry unit weight of 105 pounds per cubic foot (pcf) should be assumed for design purposes. The specialty contractor should confirm the appropriate amount lime required to achieve low expansion potential (defined by plasticity index (PI) less than 15) and prepare a treatment specification for our review prior to construction.

7.1.4 Exterior Concrete Flatwork

We recommend a minimum of 12 inches of select fill or lime-treated on-site soil be placed beneath proposed exterior concrete flatwork, including patio slabs and sidewalks; the select fill should extend at least 12 inches beyond the slab edges, except where constrained by property lines. Select fill beneath exterior slabs-on-grade, such as patios and sidewalks, should be moisture-conditioned and compacted in accordance with the requirements provided above in Table 2. Lime treatment of the upper 12 inches of the native clay may be used in lieu of placement of select fill.

Even with 12 inches of select fill or lime treatment, exterior slabs may experience some cracking due to shrinking and swelling of the underlying expansive soil. Thickening the slab edges and adding additional reinforcement will control this cracking to some degree. Where slabs are adjacent to landscaped areas, thickening the concrete edge will help control water infiltration beneath the slabs. In addition, where slabs provide access to buildings, it would be prudent to dowel the entrance to the building to permit rotation of the slab as the exterior ground shrinks and swells and to prevent a vertical offset at the entries.

7.1.3 Utility Trench Backfill

Excavations for utility trenches can be readily made with a backhoe. All trenches should conform to the current CAL-OSHA requirements. To provide uniform support, pipes or conduits should be bedded on a minimum of four inches of clean sand or fine gravel. After the pipes and conduits are tested, inspected (if required) and approved, they should be covered to a depth of six inches with sand or fine gravel, which should be mechanically tamped. The pipe bedding and cover should be eliminated where an impermeable plug is required as described below. Backfill for utility trenches and other excavations is also considered fill, and should be placed and compacted in accordance with the recommendations previously presented. If imported clean sand or gravel (clean is defined as soil with less than 10 percent fines) is used as backfill, it should be compacted to at least 95 percent relative compaction. Jetting of trench backfill should not be permitted. Special care should be taken when backfilling utility trenches in pavement areas. Poor compaction may cause excessive settlements, resulting in damage to the improvements above the fill.

Where utility trenches enter the building pads, an impermeable plug consisting of lean concrete, at least three feet in length, should be installed where the trenches enter the building footprint.

Furthermore, where sand- or gravel-backfilled trenches cross planter areas and pass below asphalt or concrete pavements, a similar plug should be placed at the edge of the pavement. The purpose of these recommendations is to reduce the potential for water to become trapped in trenches beneath the building or pavements. This trapped water can cause heaving of soils beneath slabs and softening of subgrade soil beneath pavements.

Foundations for the proposed structure should be bottomed below an imaginary line extending up at a 1.5:1 (horizontal:vertical) inclination from the base of the utility trench. Alternatively, the portion of the utility trench (excluding bedding) that is below the 1.5:1 line can be backfilled with controlled low-strength material (i.e., sand-cement slurry) with a 28-day unconfined compressive strength of at least 100 pounds per square inch (psi).

7.1.4 Drainage and Landscaping

Positive surface drainage should be provided around the building to direct surface water away from foundations. To reduce the potential for water ponding adjacent to the building, we recommend the ground surface within a horizontal distance of five feet from the building slope down away from the building with a surface gradient of at least two percent in unpaved areas and one percent in paved areas. In addition, roof downspouts should be discharged into controlled drainage facilities to keep the water away from the foundations. The use of water-intensive landscaping around the perimeter of the buildings should be avoided to reduce the amount of water introduced to the expansive clay subgrade. If bio-swales are included in the final site design, they should include, impermeable liners, subdrains, and overflow drain inlets because of the low permeability and high expansion potential of the near-surface soil. Bio-swales should be constructed no closer than five feet from buildings.

Prior experience and industry literature indicate that some species of high water-demand[7] trees can induce ground-surface settlement by drawing water from the expansive clay, causing it to

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[7] “Water-demand” refers to the ability of the tree to withdraw large amounts of water from the soil subgrade, rather than soil suction exerted by the root system.

shrink. Where these types of trees are planted near buildings, the ground-surface settlement may result in damage to structure. This problem usually occurs 10 or more years after planting, as the trees reach mature height. To reduce the risk of tree-induced, building settlement, we recommend trees of the following genera are not planted within 25 feet of the proposed buildings: *Eucalyptus, Populus, Quercus*, *Crataegus, Salix*, *Sorbus* (simple-leafed), *Ulmus, Cupressus, Chamaecyparis,* and *Cupressocyparis.* Because this is a limited list and does not include all genera that may induce ground-surface settlement, a tree specialist should be consulted prior to selection of trees to be planted at the site.

7.2 Foundation Support

We conclude the building may be supported on deepened spread footings with a conventional concrete slab-on-grade floor, provided the slab is underlain by at least 12 inches of select fill or lime-treated on-site soil (measured below the capillary moisture break). Alternatively, the building may be supported on a stiffened mat foundation. Our recommendations for each foundation type are presented in the following subsections.

7.2.1 Spread Footings

The proposed structure may be supported on continuous perimeter and isolated interior spread footings bearing on undisturbed native soil. Continuous footings should be at least 18 inches wide and isolated spread footings should be at least 24 inches wide. Exterior footings should be bottomed at least 30 inches below the lowest adjacent exterior finished grade. Interior footings should be bottomed at least 24 inches below the adjacent building pad subgrade (measured from the top of the select fill or lime-treated soil). Footings to be constructed near underground utilities should be bottomed below an imaginary line extending up at an inclination of 1.5:1 (horizontal:vertical) from the bottom of the utility trench.

Footings may be designed using allowable bearing pressures of 4,000 pounds per square foot (psf) for dead plus live loads and 5,330 psf for total design loads, which include wind or seismic forces.

Lateral loads may be resisted by a combination of passive pressure on the vertical faces of the footings and friction between the bottoms of the footings and the supporting soil. To compute lateral resistance of new footings, we recommend using an allowable passive pressure of 2,000 psf (uniform distribution) for transient loads and an equivalent fluid weight (triangular distribution) of 300 pcf for sustained loads. Passive pressure in the upper one foot of soil should be neglected unless confined by a slab or pavement. Frictional resistance should be computed using a base friction coefficient of 0.3. The passive pressure and frictional resistance values include a factor of safety of at least 1.5 and may be used in combination without reduction.

Footing excavations should be free of standing water, debris, and disturbed materials prior to placing concrete. If footings are excavated during the rainy season they should incorporate a rat slab to protect the footing subgrade. This will involve over-excavating the footing by about 3 inches and placing lean concrete or sand-cement slurry in the bottom (following inspection by our engineer). A rat slab will help protect the footing subgrade during placement of reinforcing steel. Water can then be pumped from the excavations prior to placement of structural concrete, if present. The bottoms and sides of the footing excavations should be moistened following excavation and maintained in a moist condition until concrete is placed. We should check footing excavations prior to placement of reinforcing steel to check for proper bearing. We should re-examine the excavations just prior to placement of concrete to confirm the bottoms and sides of the excavations have sufficient moisture content.

7.2.2 Mat Foundation

The proposed structure may be supported on well-reinforced concrete mats. The edges of the mat should be thickened such that the mat edge is bottomed at least 12 inches below the adjacent exterior grade where the mat is immediately adjacent to an asphalt or concrete surface and at least 18 inches below grade where adjacent to landscaped areas.

Conventionally reinforced mat foundations should be designed in accordance with the Wire Reinforcement Institute's (WRI's) publication title *Design of Slab-on-Ground Foundations, An Update* (1996). We recommend the following parameters should be used in conjunction with the WRI design method:

- Climatic rating (Cw) – 15
- Equivalent Plasticity Index (PI) – 35
- Slope Correction Coefficient (Cs) – 1.0
- Consolidation Correction Coefficient (Co) – 0.85

Passive pressure recommendations provided for spread footings may be used for the mat foundation design (see Section 7.2.1). Since the mat will be underlain by a vapor retarder, the friction factor should be reduced to 0.20 (this value include a factor of safety of at least 1.5).

The mat subgrade should be free of standing water, debris, and disturbed materials prior to placing the vapor retarder and concrete. The subgrade should be wetted following excavation and maintained in a moist condition until it is covered with the vapor retarder. If the foundation soil dries during construction, the foundation will eventually heave, which may result in cracking and distress. We should check the foundation subgrade prior to placement of the vapor retarder.

7.3 Capillary Moisture Break and Water Vapor Retarder

If water vapor transmission through the floor slab is undesirable, which is typically the case in spaces to receive floor coverings, we recommend a vapor retarder be placed between the bottom of the slab-on-grade (or mat foundation, if used) and the underlying subgrade.

If the building is supported on deepened footings with a conventional slab-on-grade floor, a capillary moisture break should be installed beneath the vapor retarder. A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The 4-inch-thick layer of rock does not count towards the 12-inches of select fill required beneath a slab-on-grade floor (as discussed in Sections 6.2 and 7.1) The vapor retarder beneath a slab-on-grade should meet the requirements for Class B vapor retarders stated in ASTM E1745. The vapor retarder beneath a mat foundation should meet the requirements for Class A vapor retarders stated in ASTM E1745. The vapor retarder should be placed in accordance with the requirements of ASTM E1643. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder. *If required by the structural engineer*, the vapor retarder may be covered with two inches of sand to aid in curing the concrete and to protect the vapor retarder during slab construction, however, this is not a requirement from a geotechnical standpoint. The sand overlying the vapor retarder should be moist at the time concrete is placed. However, excess water trapped in the sand could eventually be transmitted as vapor through the slab. Therefore, if rain is forecast prior to pouring the slab, the sand should be covered with plastic sheeting to avoid wetting. If the sand becomes wet, concrete should not be placed until the sand has been dried or replaced.

The particle size of the capillary break material and sand (if used) should meet the gradation requirements presented in Table 3.

TABLE 3
Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
Gravel or Crushed Rock	
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6
Sand	
No. 4	100
No. 200	0 – 5

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and results in excessive vapor transmission through the slab. Therefore, concrete for the floor slab (or mat foundation, if used) should have a low w/c ratio - less than 0.50. If the concrete is poured directly over the vapor retarder (no sand layer), we recommend the w/c ratio of the concrete not exceed 0.45 and water not be added in the field. If necessary, workability should be increased by adding plasticizers. In addition, the slab should be properly cured. Before floor coverings, if any, are placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

7.4 Pavement Design

7.4.1 Flexible (Asphalt Concrete) Pavement Design

The State of California flexible pavement design method was used to develop the recommended asphalt concrete pavement sections. Based on the resistance value test performed in the near surface soils in "Bulk" (shown on the Site Plan), we used a design R-value of 7.

Table 4 presents our pavement section recommendations for traffic indices (TIs) of 4.5 through 7.5. The Civil Engineer for the project should check that the TI's presented in this report are appropriate for the intended use. We can provide additional pavement sections for different TIs if needed.

TABLE 4
Recommended Asphalt Pavement Sections

Traffic Index	Asphaltic Concrete (inches)	Class 2 Aggregate Base R = 78 (inches)
4.5	2.5	9.0
5.0	3.0	9.5
5.5	3.0	11.5
6.0	3.5	12.5
6.5	4.0	13.5
7.0	4.0	15.0
7.5	4.5	16.0

Asphalt concrete pavement that will receive only passenger vehicle traffic with occasional trucks is typically designed using a TI of 4.5. Pavement that will receive weekly garbage truck traffic is typically designed using a TI of 5.5. The appropriate TI for new AC pavement areas should be determined by the Project Civil Engineer depending on the amount of anticipated truck traffic and City of Vallejo requirements.

The upper six inches of the subgrade should be moisture conditioned and compacted in accordance with requirements presented in Table 2 in Section 7.1. The aggregate base should be moisture conditioned to near optimum and compacted to at least 95 percent relative compaction.

If pavements are adjacent to irrigated landscaped areas, curbs adjacent to those areas should extend through the aggregate base and at least three inches into the underlying soil to reduce the potential for irrigation water to infiltrate into the pavement section. If drip irrigation is used in the landscaping adjacent to the pavement, however, the deepened curb is not required.

7.4.2 Rigid (Portland Cement Concrete) Pavement

Concrete pavement design is based on a maximum single-axle load of 20,000 pounds and a maximum tandem axle load of 32,000 pounds and light truck traffic (i.e., a few trucks per week). The recommended rigid pavement section for these axle loads is 6.5 inches of Portland cement concrete over six inches of Class 2 aggregate base. Where fire truck traffic is expected, the pavement section should consist of seven inches of Portland cement concrete over six inches of Class 2 aggregate base.

The modulus of rupture of the concrete should be at least 500 psi at 28 days. Contraction joints should be constructed at 15-foot spacing. Where the outer edge of a concrete pavement meets asphalt concrete pavement, the concrete slab should be thickened by 50 percent at a taper not to exceed a slope of 1 in 10. For areas that will receive weekly garbage truck traffic, we recommend the slab be reinforced with a minimum of No. 4 bars at 16-inch spacing in both directions. Recommendations for subgrade preparation and aggregate base compaction for concrete pavement are the same as those we have described above for asphalt concrete pavement.

7.5 Seismic Design

We understand the proposed building will be designed using the seismic provisions in the 2013 California Building Code (CBC), we recommend Site Class C be used. The site latitude and longitude of 38.1183^o and -122.2507^o, respectively. In accordance with the 2013 CBC, we recommend the following:

- S_S = 1.585 g, S_1 = 0.600 g
- S_{MS} = 1.585 g, S_{M1} = 0.780 g
- S_{DS} = 1.057 g, S_{D1} = 0.520 g
- Seismic Design Category D for Risk Categories I, II, and III.

7.6 Soil Corrosivity

Corrosivity analyses were performed by Sunland Analytical on a sample of the native clay from Boring B-2 at a depth of 2-1/2 feet bgs. The corrosivity test results are presented in more detail in Appendix B of this report. The results of the corrosivity analyses indicate the sample is "corrosive" with respect to resistivity. Accordingly, all buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric-coated steel or iron may need to be protected against corrosion depending upon the critical nature of the structure. If it is necessary to have metal in contact with soil, a corrosion engineer should be consulted to provide recommendations for corrosion protection. The results indicate that sulfate ion concentrations are sufficiently low to not pose a threat to buried concrete. In addition, the chloride ion concentrations are insufficient to adversely impact steel reinforcement in concrete structures below ground.

8.0 GEOTECHNICAL SERVICES DURING CONSTRUCTION

Prior to construction, Rockridge should review the project plans and specifications to verify that they conform to the intent of our recommendations. During construction, our field engineer should provide on-site observation and testing during site preparation, placement and compaction of fill, installation of foundations, and shoring installation. These observations will allow us to compare actual with anticipated soil conditions and to verify that the contractor's work conforms to the geotechnical aspects of the plans and specifications.

9.0 LIMITATIONS

This geotechnical study has been conducted in accordance with the standard of care commonly used as state-of-practice in the profession. No other warranties are either expressed or implied. The recommendations made in this report are based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed in the test borings. If any variations or undesirable conditions are encountered during construction, we should be notified so that additional recommendations can be made. The foundation recommendations presented in this report are developed exclusively for the proposed development described in this report and are not valid for other locations and construction in the project vicinity.

REFERENCES

2010 Caltrans Standard Specifications.

2013 California Building Code (CBC).

Cao, T., Bryant, W. A., Rowshandel, B., Branum D. and Wills, C. J. (2003). "The Revised 2002 California Probabilistic Seismic Hazard Maps"

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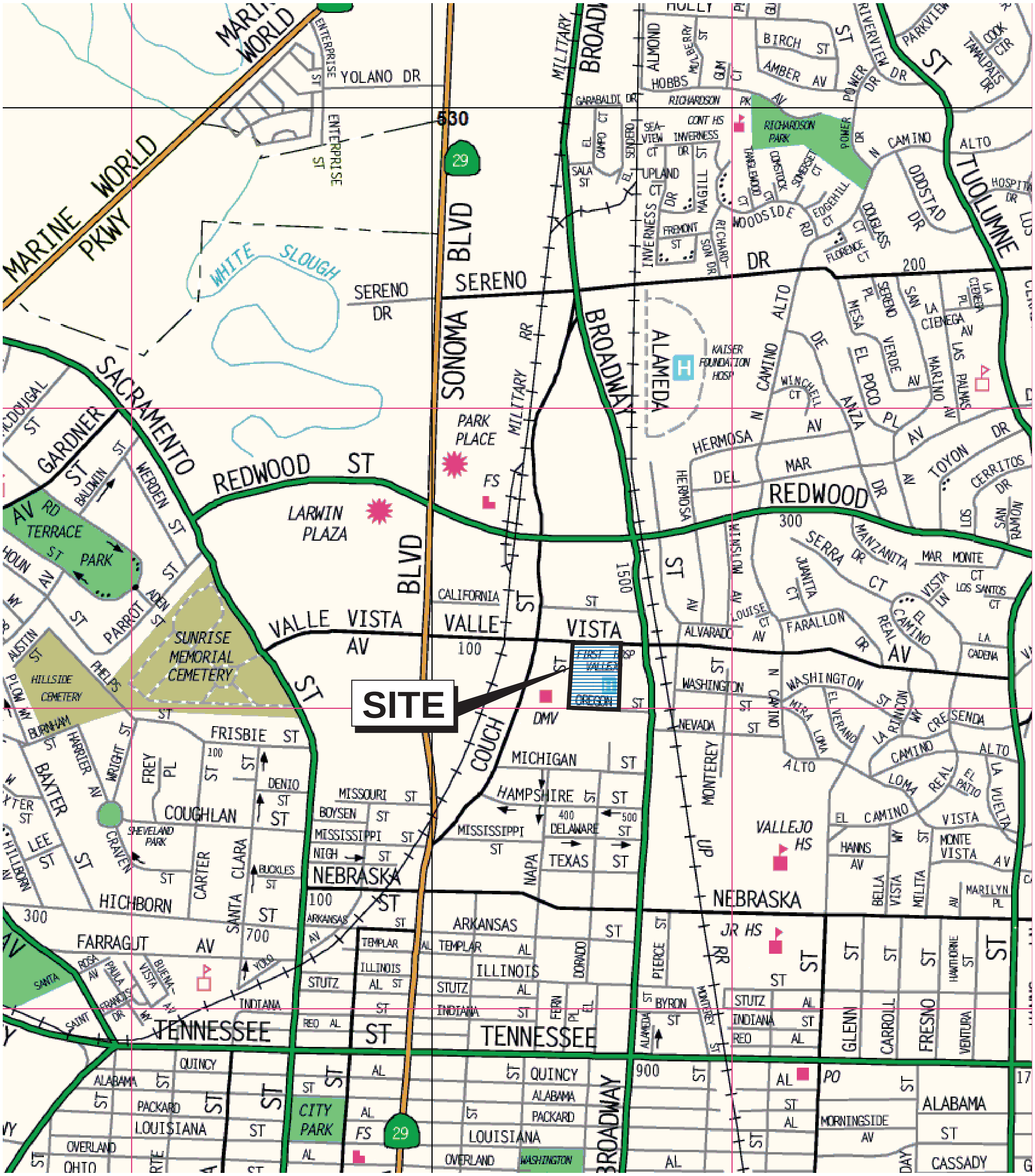
U.S. Geological Survey, (2016), U.S. Seismic Design Maps, accessed January 12, 2016 http://earthquake.usgs.gov/designmaps/us/application.php

FIGURES



Base map: The Thomas Guide
Solano County
2002

0 1/4 1/2 Mile

Approximate scale

N

CALIBER CHARTER SCHOOL
Vallejo, California

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SITE LOCATION MAP

Date 11/25/15	Project No. 15-1013	Figure 1

EXPLANATION

B-1 ⊕ Approximate location of boring by Rockridge Geotechnical, Inc., November 18, 2015

HA-1 ● Approximate location of hand auger boring by Rockridge Geotechnical, Inc., January 6, 2016

0
80 Feet
Approximate scale

Base map: Google Earth, 2015.
Overlay: Caliber Charter School - Vallejo, Site Plan,
by TEF Design, dated November 4, 2015.

CALIBER CHARTER SCHOOL
Vallejo, California

SITE PLAN

Date 01/07/16	Project No. 15-1013	Figure 2

ROCKRIDGE
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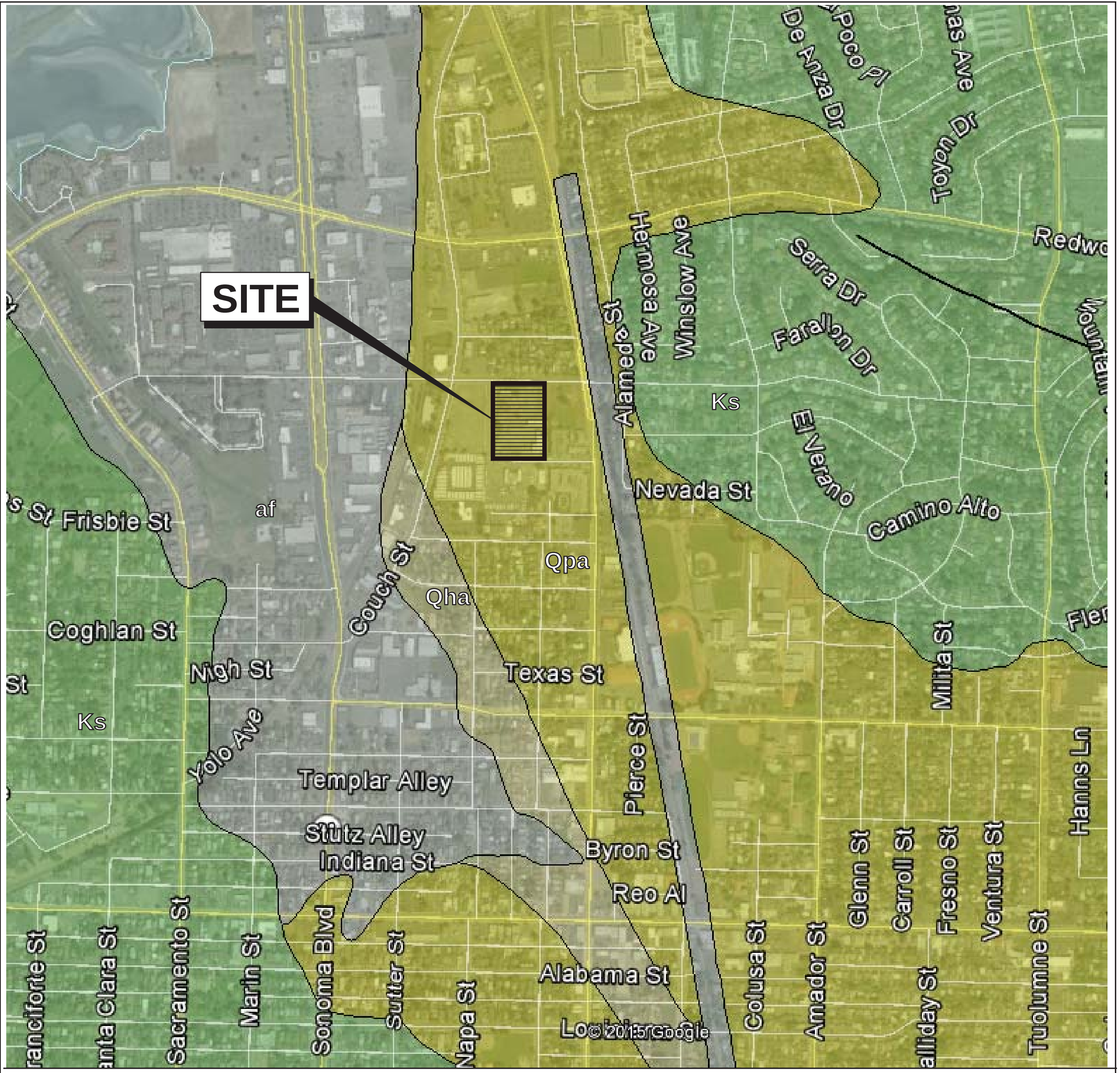

Base map: Goolge Earth with U.S. Geological Survey (USGS), Solano County, 2015.

EXPLANATION

af	**Artificial Fill**
Qha	**Alluvium (Holocene)**
Qpa	**Alluvium (Pleistocene)**
Ks	**Great Valley Complex sedimentary rocks (Cretaceous)**
—	**Geologic contact:** dashed where approximate and dotted where concealed, queried where uncertin

N

0 1000 2000 Feet

Approximate scale

CALIBER CHARTER SCHOOL
Vallejo, California

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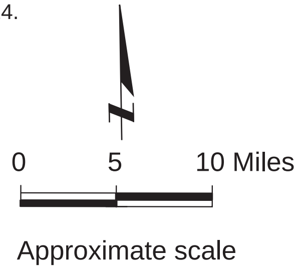
REGIONAL GEOLOGIC MAP

Date 11/25/15 | Project No. 15-1013 | Figure 3

Base Map: U.S. Geological Survey (USGS), National Seismic Hazards Maps - Fault Sources, 2014.

EXPLANATION

- Strike slip
- Thrust (Reverse)
- Normal



CALIBER CHARTER SCHOOL
Vallejo, California

ROCKRIDGE
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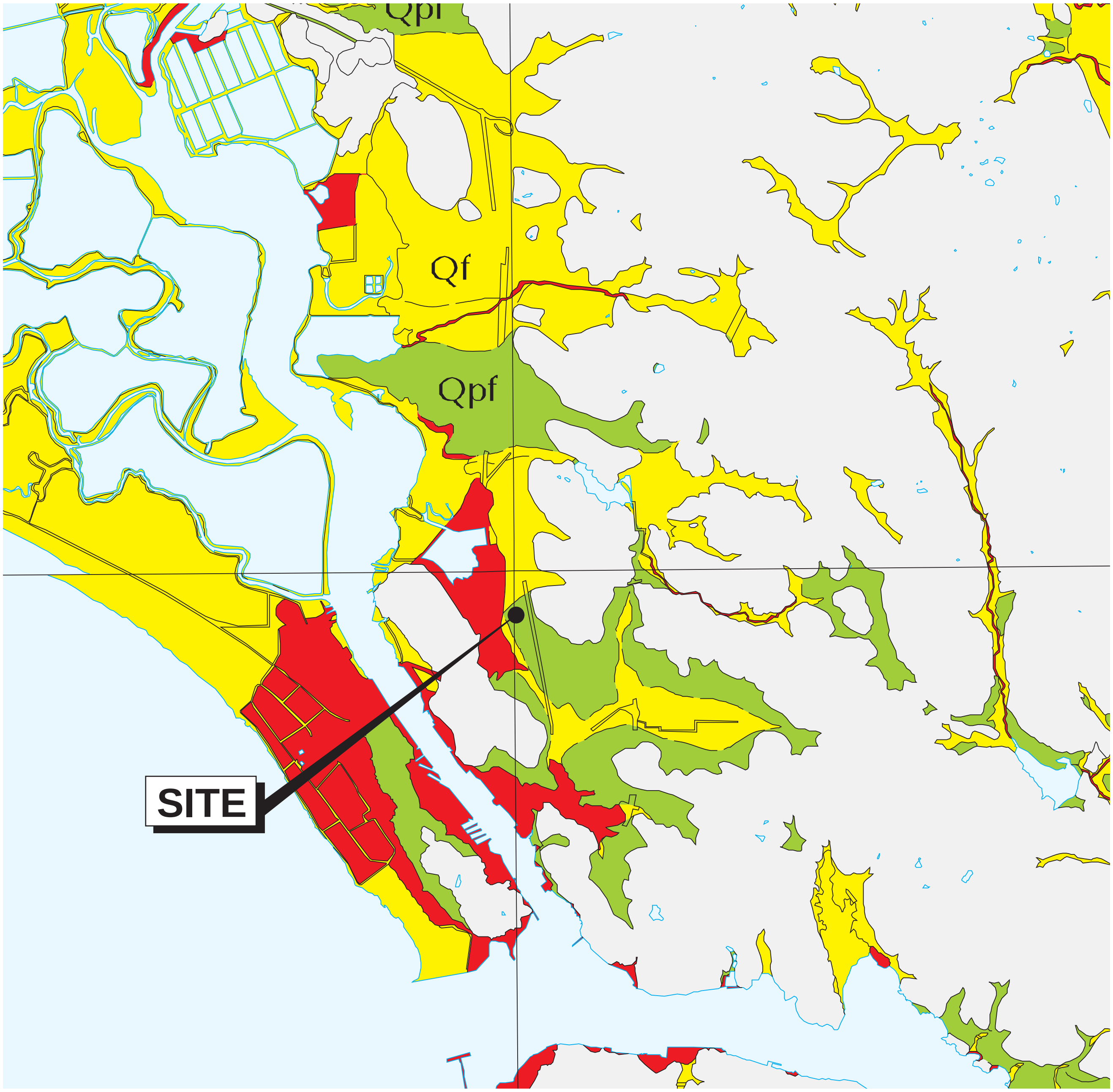
REGIONAL FAULT MAP

Date 11/25/15	Project No. 15-1013	Figure 4



LIQUEFACTION SUSCEPTIBILITY

🟥 VERY HIGH

🟧 HIGH

🟨 MODERATE

🟩 LOW

⬜ VERY LOW

Lines

———— — — —

Contact, dashed where location uncertainty
is greater than about +- 100 m.

0 1.5 3 Miles

Approximate scale

Reference:
Maps of Quaternary Deposits and Liquefaction Susceptibility
in the Central San Francisco Bay Region, California, by USGS, 2006

CALIBER CHARTER SCHOOL
Vallejo, California

ROCKRIDGE
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LIQUEFACTION SUSCEPTIBILITY MAP

Date 11/25/15 | Project No. 15-1013 | Figure 5

APPENDIX A
Logs of Borings

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring B-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/18/15
Date finished: 11/18/15
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic Hammer
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)
Logged by: D. Maffioli

LABORATORY TEST DATA

Approximate Ground Surface Elevation: 13.7 feet[2]

DEPTH (feet)	SAMPLES Sampler Type	SAMPLES Sample	SAMPLES Blows/ 6"	SAMPLES SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
1					GM	SILTY GRAVEL with SAND (GM) light brown, very dense, dry, fine sand, platy sandstone fragments up to 3-inches diameter FILL						
2	S&H	▨	30 36 18	49		CLAY with SAND (CH) yellow-brown mottled with olive, very stiff, moist, fine sand, black subrounded medium sand, trace rootlets						
3												
4	S&H	▨	6 10 16	23								
5					CH							
6												
7												
8												
9	S&H	▨	8 18 25	39		SANDY CLAY (CL) yellow-brown, hard, moist, fine to medium sand						
10												
11					CL							
12												
13												
14	SPT	◩	3 3 5	12		CLAY (CL) olive and yellow, stiff, moist, 1/2-inch thick lens of soft, light tan clay						
15												
16					CL							
17												
18						▽ (11/18/15; 1:25 PM)						
19	SPT	◩	4 6 8	21		SANDY CLAY (CL) yellow-brown mottled with olive, very stiff, wet, fine sand, black subrounded medium sand						
20												
21					CL							
22												
23												
24	SPT	◩	24 43 42	127		SANDSTONE yellow and red-yellow, moist, low hardness, weak						
25												
26												

Boring terminated at a depth of 25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 18.5 feet during drilling.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.9 and 1.5, respectively, to account for sampler type and hammer energy.

[2] Surface elevation estimated from A.L.T.A./ A.C.S.M. Land Title Survey by Meridian Associates, Inc., dated September 8, 2015. Datum: NAVD88

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-1

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring B-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/18/15
Date finished: 11/18/15
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic Hammer
Sampler: Sprague & Henwood (S&H)
Logged by: D. Maffioli

Approximate Ground Surface Elevation: 15 feet[2]

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						3 inches Asphalt 9 inches Aggregate Base						
1						CLAY with SAND (CH)						
2	S&H	▨	4 6 9	14	CH	olive-brown, stiff to very stiff, moist, fine sand, trace rootlets Corrosion Test, see Appendix B						
3												
4	S&H	▨	6 10 15	23		SANDY CLAY (CL) yellow-brown mottled with olive-gray, very stiff, fine sand, with black medium sand	PP		4,525			
5												
6												
7												
8					CL							
9	S&H	▨	4 15 21	32		hard	PP		4,000			
10												
11												
12												
13												
14	S&H	▨	5 11 13	22	CL	CLAY (CL) olive with red-yellow, stiff, moist, trace fine sand						
15						SILTY SAND (SM) yellow, medium dense, moist, fine sand						
16					SM							
17						∇ (11/18/15; 8:07 AM)						
18						∇ (11/18/15; 7:50 AM)						
19	S&H	▨	13 30 50	72		SANDSTONE/MUDSTONE yellow-brown and gray, moist, soft hardness to plastic, friable, oxidized gravel-size particles						
20												
21												
22												
23												
24												
25												
26												

Boring terminated at a depth of 20 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 18.5 and 17.5 feet during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.9 and 1.5, respectively, to account for sampler type and hammer energy.

[2] Surface elevation estimated from A.L.T.A./ A.C.S.M. Land Title Survey by Meridian Associates, Inc., dated September 8, 2015. Datum: NAVD88

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-2

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring B-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Logged by: D. Maffioli
Date started: 11/18/15
Date finished: 11/18/15
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic Hammer
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Approximate Ground Surface Elevation: 17.5 feet[2]

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
2	S&H	8 9 11	18	CH	SANDY CLAY (CH) yellow-brown mottled with olive-brown, very stiff, moist, trace black subrounded medium sand, fine sand, trace rootlets LL = 66, PI = 50, see Appendix B					15.4	105
4	S&H	7 11 18	26	CL	SANDY CLAY (CL) yellow-brown, very stiff, moist, medium to fine sand						
9	S&H	6 14 21	32		1-inch diameter subrounded gravel at bottom 3 inches of sampler						
14	SPT	4 5 7	18		light brown and olive with lenses of yellow, medium stiff, 1/2 inch lenses of soft CLAY (CL)						
18					RESIDUAL SOIL yellow-brown and olive						
19	S&H	19 50/4"	45/4"		MUDSTONE yellow-brown and olive, soft, plastic to friable, deeply weathered						

Boring terminated at a depth of 20 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.9 and 1.5, respectively, to account for sampler type and hammer energy.

[2] Surface elevation estimated from A.L.T.A./ A.C.S.M. Land Title Survey by Meridian Associates, Inc., dated September 8, 2015. Datum: NAVD88

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-3

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring B-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/18/15
Date finished: 11/18/15
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic Hammer
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)
Logged by: D. Maffioli

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION Approximate Ground Surface Elevation: 17.4 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
1						SANDY CLAY (CL) yellow with light yellow, very stiff to hard, moist, fine to medium sand, trace rootlets LL = 26, PI = 10, see Appendix B						
2	S&H	■	16 17 15	29							10.8	
3												
4	S&H	■	9 15 21	32		yellow-brown with mottled olive, hard, trace fine gravel						
5												
6												
7					CL							
8												
9	SPT	◪	6 8 11	28		very stiff						
10												
11												
12												
13												
14	S&H	■	5 16 29	40		MUDSTONE red-yellow and olive, moist, soft, plastic, deeply weathered to gravel sized fragments						
15												
16												
17												
18												
19	SPT	◪	9 21 28	73		yellow, deep to moderate weathering						
20												
21												
22												
23												
24												
25												
26												

Boring terminated at a depth of 20 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.9 and 1.5, respectively, to account for sampler type and hammer energy.

[2] Surface elevation estimated from A.L.T.A./ A.C.S.M. Land Title Survey by Meridian Associates, Inc., dated September 8, 2015. Datum: NAVD88

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-4

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring B-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 11/18/15
Date finished: 11/18/15
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Automatic Hammer
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)
Logged by: D. Maffioli

	SAMPLES					MATERIAL DESCRIPTION	LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	Approximate Ground Surface Elevation: 18.5 feet[2]	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
1						SANDY CLAY (CL) yellow-brown, hard, moist, fine to medium black sand, trace rootlets						
2	S&H		12 17 20	33		LL = 30, PI = 15, see Appendix B					7.3	103
3												
4	S&H		6 16 27	39		decomposed 1-inch diameter white gravel						
5												
6												
7					CL							
8												
9	SPT		5 9 12	31		yellow-brown and olive with black mottling						
10												
11												
12												
13												
14	S&H		6 20 50/ 4.5"	63/ 10.5"		RESIDUAL SOIL yellow and olive mottling, fine sand, wet						
15	SPT		24 50/6"	75/6"		MUDSTONE yellow-brown, moist, plastic, soft, some oxidation on coarse gravel-size particles						
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												

Boring terminated at a depth of 16 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

---

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.9 and 1.5, respectively, to account for sampler type and hammer energy.

[2] Surface elevation estimated from A.L.T.A./ A.C.S.M. Land Title Survey by Meridian Associates, Inc., dated September 8, 2015. Datum: NAVD88

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-5

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring HA-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Date started: 1/7/16

Date finished: 1/7/16

Drilling method: Hand Auger

Hammer weight/drop: N/A

Hammer type: N/A

Sampler: N/A

Logged by: J. Sarmiento

	SAMPLES						LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value^1	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						CLAY with SAND (CH) olive-brown, soft, moist						
1					CH							
2												
						SANDY CLAY (CL) yellow-brown, medium stiff to stiff, moist, fine sand						
3	GRAB	☒			CL							
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 3.25 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during drilling.

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013

Figure: A-6

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring HA-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Logged by: J. Sarmiento
Date started: 1/7/16
Date finished: 1/7/16
Drilling method: Hand Auger
Hammer weight/drop: N/A
Hammer type: N/A
Sampler: N/A

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
					CH	SANDY CLAY (CH) olive-brown mottled with light gray and yellow brown, medium stiff, moist, fine gravel throughout FILL						
1												
2					CL	CLAY with SAND (CL) olive-brown, soft, moist						
	GRAB	☒				LL = 35, PI = 20, see Appendix B					27.9	
	GRAB	☒			CL	SANDY CLAY (CL) yellow-brown, stiff, moist						
3												
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 3 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during drilling.

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-7

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring HA-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2

Logged by: J. Sarmiento

Date started: 1/6/16

Date finished: 1/6/16

Drilling method: Hand Auger

Hammer weight/drop: N/A

Hammer type: N/A

Sampler: N/A

DEPTH (feet)	SAMPLES Sampler Type	SAMPLES Sample	SAMPLES Blows/ 6"	SAMPLES SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	LABORATORY TEST DATA Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA Fines %	LABORATORY TEST DATA Natural Moisture Content, %	LABORATORY TEST DATA Dry Density Lbs/Cu Ft
					CH	SANDY CLAY (CH) olive-brown, stiff, moist						
1												
	GRAB	☒			CL	SANDY CLAY (CL) yellow-brown, medium to fine sand, hard, moist						
2												
3	GRAB	☒										
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 3.5 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during drilling.

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013

Figure: A-8

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring HA-4

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 1/6/16
Date finished: 1/6/16
Drilling method: Hand Auger
Hammer weight/drop: N/A
Hammer type: N/A
Sampler: N/A
Logged by: J. Sarmiento

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
					CH	SANDY CLAY (CH) olive-brown, stiff, moist, coarse gravel						
1												
					CL	SANDY CLAY (CL) yellow-brown, soft, moist, medium fine sand						
2	GRAB	☒				stiff						
3												
	GRAB	☒										
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 4 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during drilling.

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-9

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring HA-5

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 1/6/16
Date finished: 1/6/16
Drilling method: Hand Auger
Hammer weight/drop: N/A
Hammer type: N/A
Sampler: N/A
Logged by: J. Sarmiento

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
					CH	SANDY CLAY (CH) olive-brown, moist, rootlets						
1												
	GRAB	☒			CL	SANDY CLAY (CL) yellow-brown, medium stiff, moist						
2												
	GRAB	☒										
3												
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 3 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during drilling.

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013

Figure: A-10

PROJECT: **CALIBER CHARTER SCHOOL**
Vallejo, California

Log of Boring HA-6

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 1/6/16
Date finished: 1/6/16
Drilling method: Hand Auger
Hammer weight/drop: N/A
Hammer type: N/A
Sampler: N/A
Logged by: J. Sarmiento

	SAMPLES						LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
					CL	SANDY CLAY (CL) olive-brown mottled with yellow-brown, soft, moist, fine sand						
1												
						stiff						
2	GRAB	☒				LL = 45, PI = 30, see Appendix B					22.7	
3	GRAB	☒			CL	SANDY CLAY (CL) yellow-brown, hard, moist, fine sand						
4												
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 4 feet below ground surface.
Boring backfilled with soil cuttings.
Groundwater not encountered during drilling.

ROCKRIDGE GEOTECHNICAL

Project No.: 15-1013
Figure: A-11

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size)	Gravels (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	Silts and Clays LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel coarse fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
Sand coarse medium fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.075 4.76 to 2.00 2.00 to 0.420 0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

▽	Unstabilized groundwater level
▼	Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

⬒	Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
◪	Classification sample taken with Standard Penetration Test sampler
◨	Undisturbed sample taken with thin-walled tube
☒	Disturbed sample
⊙	Sampling attempted with no recovery
◫	Core sample
◉	Analytical laboratory sample
▥	Sample taken with Direct Push sampler
▥	Sonic

SAMPLER TYPE

C	Core barrel
CA	California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter
D&M	Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube
O	Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube
PT	Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
S&H	Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
SPT	Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
ST	Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

CALIBER CHARTER SCHOOL
Vallejo, California

ROCKRIDGE
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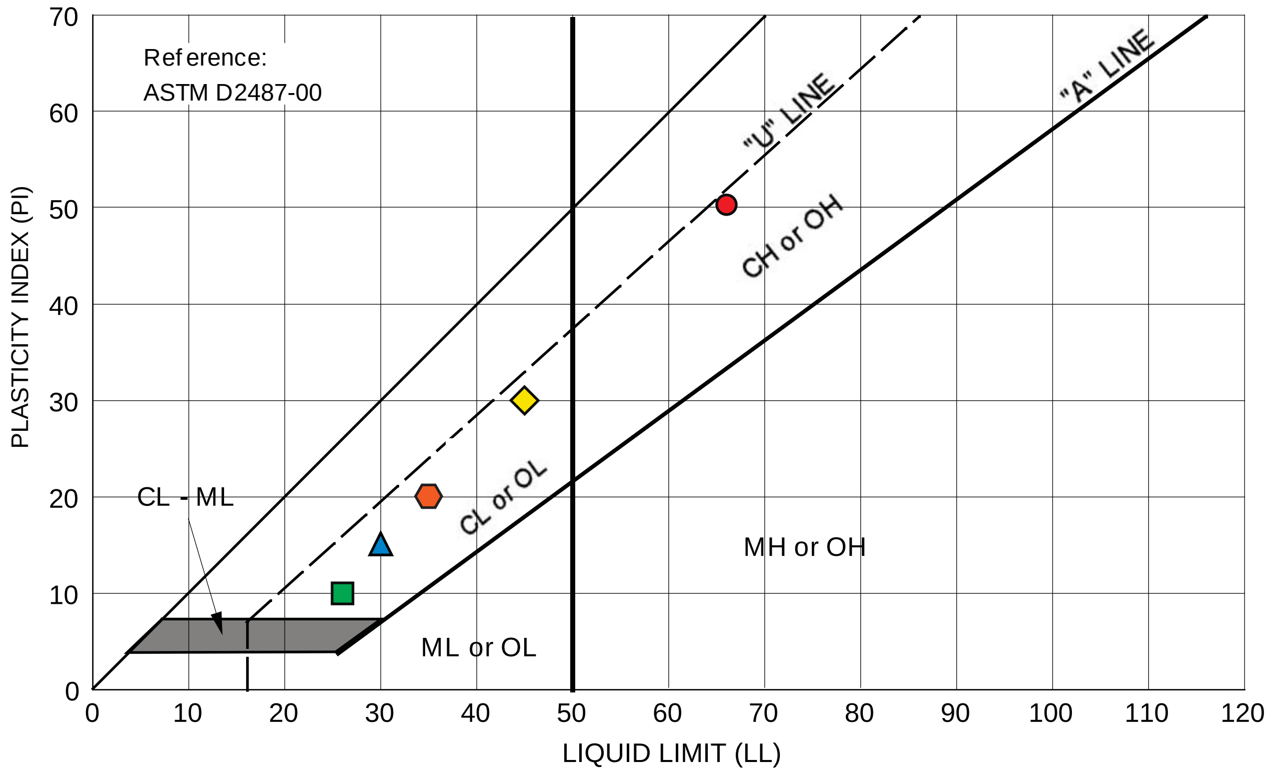
CLASSIFICATION CHART

Date 01/07/16 | Project No. 15-1013 | Figure A-12

APPENDIX B
Laboratory Test Results



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-3 at 1.5- 2 feet	SANDY CLAY (CH), yellow-brown mottled with olive-brown	15.4	66	50	--
🟩	B-4 at 2- 2.5 feet	SANDY CLAY (CL), yellow with light yellow	10.8	26	10	--
▲	B-5 at 1.5- 2 feet	SANDY CLAY (CL), yellow-brown	7.3	30	15	--
⬢	HA-2 at 2.5 feet	CLAY with SAND (CL), olive-brown	27.9	35	20	--
◆	HA-6 at 2 feet	SANDY CLAY (CL), olive-brown mottled with yellow-brown	22.7	45	30	--

CALIBER CHARTER SCHOOL
Vallejo, California

ROCKRIDGE
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PLASTICITY CHART

Date 01/11/16 | Project No. 15-1013 | Figure B-1

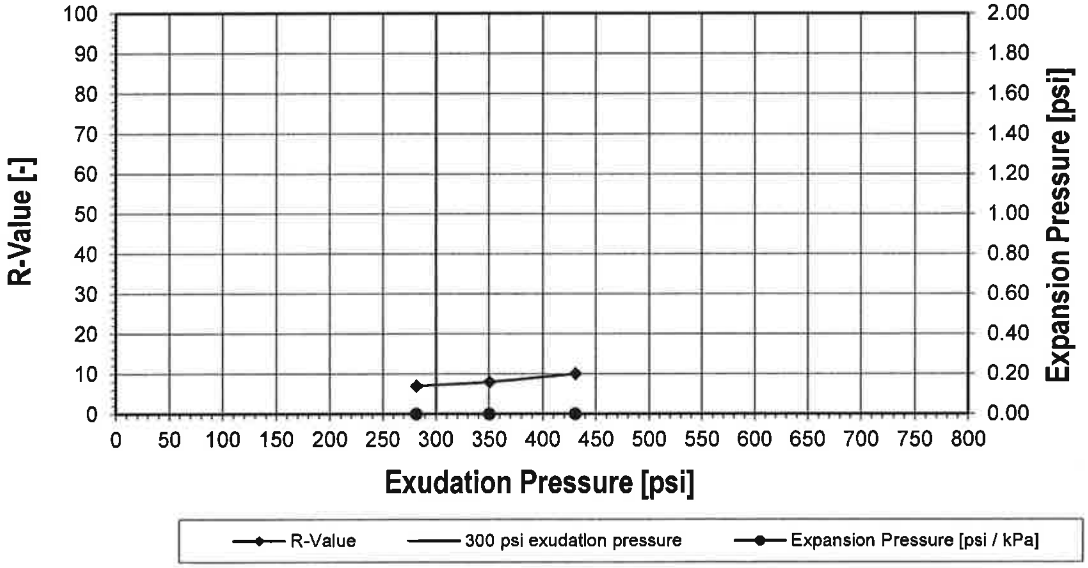
R-Value ASTM D2844 / CT301

Clients Project No.: 15-1013
ISI Project No.: 2656-005
ISI Lab No.: G-58914

Project Name: Caliber Charter School, Vallejo
Client Name: Rockridge GEO
Descripton (Visual): Brown clay
Boring: Pot hole
Sample No.: Bulk
Depth (ft):

Test Date: 12/3/15
Run By: JH/LL
Checked By: LL/PH

Specimen #	1		2		3	
Compaction Pressure [psi / kPa]	70	----	90	----	120	----
Total Moisture [%]	18.8		17.9		17.0	
Density[pcf]	106.8		109.7		111.5	
Expansion Pressure [psi / kPa]	0.00	0.00	0.00	0.00	0.00	0.00
Horizontal Pressure at 160 psi [psi / kPa]	141	972	139	958	135	931
Number of Turns D [-]	4.65		4.30		4.03	
Sample Height [in. / mm]	2.66	67.6	2.58	65.5	2.63	66.8
Exudation Pressure [psi / kPa]	282	1943	350	2416	431	2969
R-Value [-]	6.8		8.1		10.3	
Corrected R-Value [-]	7		8		10	



Corrected R-Value at 300 psi / 2.07 MPa Exudation Pressure = 7

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/02/2015
Date Submitted 11/24/2015

To: Darcie Maffioli
Rockridge Geotechnical, Inc.
270 Grand Ave
Oakland, CA 94610

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 15-1013 Site ID : B-2-1 @ 1.5-2FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 70886-147893.

EVALUATION FOR SOIL CORROSION

Soil pH	7.61	
Moisture	18.1 %	
Minimum Resistivity	1.57 ohm-cm (x1000)	
Chloride	20.6 ppm	00.00206 %
Sulfate	42.4 ppm	00.00424 %
Redox Potential	(+) 17 mv	
Sulfides	Presence - TRACE	

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422
Redox Potential ASTM G-200, Sulfides AWWA C105/A25.5

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/02/2015
Date Submitted 11/24/2015

To: Darcie Maffioli
Rockridge Geotechnical, Inc.
270 Grand Ave
Oakland, CA 94610

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following:
Location : 15-1013 Site ID : B-2-1 @ 1.5-2FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 70886-147894.

Extractable Sulfide Analysis

TYPE OF TEST	RESULTS	UNITS
Sulfide	0.20	mg/kg

DETECTION LIMITS
Sulfide 0.05

Method 9031m, ND = Below Detection Limits