GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
C-4016 NEW ALLIED SCIENCE BUILDING
CONTRA COSTA COLLEGE
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA
KLEINFELDER PROJECT No.: 20181569.001A

October 17, 2017

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Contra Costa Community College District (District)
2600 Mission Bell Drive
San Pablo, California 94806
c/o Mr. Ron Johnson
ronj@csipm.com

SUBJECT: Geotechnical Engineering Investigation Report
C-4016 New Allied Science Building
Contra Costa College
2600 Mission Bell Drive
San Pablo, California

Dear Mr. Johnson:

Kleinfelder is pleased to present this geotechnical engineering investigation report for the planned new Allied Science building at Contra Costa College in San Pablo, California. The project site is currently occupied by the Liberal Arts and Health Sciences buildings, which are abandoned and earmarked for demolition.

The purpose of our geotechnical engineering investigation was to explore and characterize the subsurface conditions and provide mitigation measures for the identified geologic seismic hazards in addition to recommendations for grading, foundations, drainage, and construction considerations. It is our opinion that the project is feasible from a geotechnical engineering standpoint provided our recommendations are incorporated into the final plans and specifications of the project. The proposed new science building may be supported on a shallow foundation system. Based on the results of our field investigation and the current conceptual design, varying materials, from weathered claystone, to undocumented clay fill which are unsuitable materials, to sandy lean clay, clayey sand, and clayey sand with gravel, are expected at the foundation and lower floor slab bearing levels; therefore, over-excavation is recommended in order to provide a more uniform support for the proposed foundation and lower floor slab. Our geotechnical recommendations are provided in this report.

Design plans and specifications should be reviewed by Kleinfelder prior to their issuance for conformance with the general intent of the recommendations presented in the enclosed report.

If you have any questions regarding the information or recommendations presented in our report, please contact us at your convenience at (925) 484-1700.

Sincerely,

KLEINFELDER, INC.

Don Adams, PE
Project Manager

Edward Mak, PE, GE #2212
Geotechnical Engineer

Reviewed by

Timothy A. Williams, PE, GE
Principal Geotechnical Engineer

TABLE OF CONTENTS

FIGURES

APPENDICES

GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
C-4016 NEW ALLIED SCIENCE BUILDING
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1 INTRODUCTION

This report presents the results of our geotechnical engineering investigation performed for the planned new Allied Science building at Contra Costa College in San Pablo, California. The approximate location of the school campus is shown on the Site Vicinity Map (Figure 1), and the approximate limit of the planned new science building is shown on the Site Plan (Figure 2).

We understand that the campus plans to demolish the existing abandoned Liberal Arts and Health Sciences buildings and construct a new 3-story building with an approximate footprint of up to about 20,000 square feet. No information on the design and construction of the existing Liberal Arts and Health Sciences building was provided to us. The foundation type and size of the existing building are unknown. There is a retaining wall adjacent to the existing service road on the northeast side, and outside, of the existing building. The foundation type and size of the retaining wall are also unknown to us at this time. Based on conceptual drawings that were provided to us, the first, second, and third floors of the new building will be near the Lower Plaza elevation of 72 feet, the Upper Plaza elevation of 92 feet, and the Upper Campus elevation of 114 feet, respectively. For a lower floor elevation of 72 feet it is anticipated that cuts up to about 9 feet may be required for the construction of the new building. These could change since the project is currently in conceptual design phase. Structural loads are assumed to be less than 500 kips for column loads. The final layout of the new building and proposed grading have not been determined at this time.

If the project differs from that presented above, we should be contacted to review the applicability and potential modifications to our scope of services.

1.1 GENERAL SITE DESCRIPTIONS

The western part of the campus is located mostly on a level alluvial plain west of Rheem Creek. The eastern portion of the campus slopes upward to the northeast. The active Hayward fault, which crosses the campus, approximately separates the flat lying portion of the campus with the elevated/hillside portion of the campus. Rheem Creek flows through the campus in a northwesterly direction generally parallel to the base of the hillside. Most of the academic buildings on the campus are located on the hillside portion of the campus, while the flat lying portion of the campus contains mostly the athletic buildings and facilities. The ground surface elevation at the campus ranges from about 50 feet above mean sea level along the southwestern margin of the campus to about 130 feet in the northeast corner along Campus Drive.

According to the U.S. Geological Survey (USGS, 1993) 7½-Minute Richmond Topographic Quadrangle map, the existing ground elevation at the subject site ranges between about 70 and 100 feet above mean sea level. The coordinates at the center of the planned new science center location are approximately:

Latitude: 37.9697° N
Longitude: 122.3369° W

1.2 PREVIOUS INVESTIGATIONS

Kleinfelder previously performed several fault trench and geotechnical investigations at the campus. The results of these previous investigations were presented in the following reports:

- Kleinfelder's report titled *Subsurface Fault Investigation, Proposed Addition to the Student Activities Building, Contra Costa College, San Pablo, California*, dated December 2, 2003 (File No. 33133/SSA);
- Kleinfelder's report titled *Geotechnical Investigation Report, Student Activities Building Addition, Contra Costa College, San Pablo, California*, dated April 16, 2004 (File No. 40698/GEO);
- Kleinfelder's report titled *Subsurface Fault Investigation at the Existing Student Activities Building, Contra Costa College, San Pablo, California*, dated August 7, 2007 (File No. 82074/Report);
- Kleinfelder's report titled *Subsurface Fault Investigation in the Vicinity of the Existing Humanities Building, Contra Costa College, San Pablo, California*, dated February 20, 2008 (File No. 86352/Report);

- Kleinfelder's report titled *Master Plan Seismic Study, Contra Costa College Campus, San Pablo, California*, dated July 15, 2009 (Project No. 80412/Report);

- Kleinfelder report titled *Geotechnical Investigation Report, Campus Center, Contra Costa College, San Pablo, California*, dated February 17, 2011;

- Kleinfelder report titled *Re-Assessment of Fault-Related Exclusionary Boundaries Pertaining to Habitable Structures for the Campus Center Project/New Student Activities Building Proposed within the Contra Costa College Campus, San Pablo, California*, dated March 24, 2011 (Project No. 112252/PWPortables/PLE11L027); and

- Kleinfelder report titled *Amendment to Master Plan Seismic Study, Contra Costa College Campus, San Pablo, California*, dated April 16, 2012 (Project No. 124348/SRO12R0273).

- Kleinfelder report titled *Subsurface Fault Investigation, Lower Parking Area, Contra Costa Community College, San Pablo, California,* dated November 16, 2016.

- Kleinfelder report titled *Subsurface Fault Investigation, Proposed C-4001 Campus Safety Center, Contra Costa Community College, San Pablo, California,* dated June 29, 2016.

- Kleinfelder report titled *Geotechnical Investigation Report, Campus Safety Center, Contra Costa Community College, 2600 Mission Bell Drive, San Pablo, California*, dated March 17, 2017 (20164720.001A).

- Kleinfelder report titled *Geologic and Seismic Hazards Assessment Report, Planned Campus Safety Center, Contra Costa College, 2600 Mission Bell Drive, San Pablo, California*, dated March 30, 2017 (20164720.001A).

- Kleinfelder report titled *Geologic and Seismic Hazards Assessment and Geotechnical Investigation Report, C-608 PE/Kinesiology Renovation Project, Contra Costa Community College, 2600 Mission Bell Drive, San Pablo, California, dated August 28, 2017 (Project No. 20181293.001A)*

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of our geotechnical investigation was to explore and evaluate the subsurface conditions at the site in order to develop recommendations related to the geotechnical aspects of project design and construction. The proposed scope of our services was outlined in our proposal

(MF180192.001P/PLE17P62057) dated June 30, 2017, revised July 18, 2017. Our services as presented in this report include the following:

- A site reconnaissance to observe the surface conditions
- A field investigation that consisted of drilling four borings to explore the subsurface conditions
- Laboratory testing of selected soil samples obtained during the field investigation to evaluate relevant physical and engineering parameters of the subsurface soils
- Evaluation of the field and laboratory data obtained and performing engineering analyses to develop our geotechnical conclusions and recommendations
- Preparation of this report which includes:
    - Site Vicinity Map, and Site Plan showing the approximate test boring locations;
    - Description of the project;
    - Discussion of general site subsurface conditions, as encountered in our test borings;
    - Discussion of liquefaction analysis and settlement potential and magnitude;
    - Conclusions pertaining to feasibility of the proposed development, impacts of geotechnical and geologic features on the proposed development;
    - Recommendations for site preparation, subgrade preparation, earthwork, and fill compaction specifications;
    - Recommendations for design of footings including allowable soil pressures and embedment depths;
    - Anticipated total and differential settlements;
    - Recommendations for retaining walls including active and at-rest earth pressures, seismic surcharges, static surcharges, and passive resistance;
    - Slab-on-grade and flatwork support recommendations;
    - Recommendations for surface and subsurface drainage;
    - Soil corrosivity test results;
    - Construction considerations, and
    - An appendix including boring logs and laboratory test results;

Our current scope excluded an assessment of pipeline locations within 1,500 feet of the project site. Our evaluation also specifically excluded the assessment of environmental spills and hazardous substances at the site.

2 GEOLOGIC AND SEISMIC HAZARDS SUMMARY

A Geologic and Seismic Hazards Assessment was conducted for the subject project, and the results are presented in a separate report titled *Geologic and Seismic Hazards Assessment Report, C-4016 New Allied Science Building, Contra Costa College, 2600 Mission Bell Drive, San Pablo, California*, Project No. 20181569.001A, October 2017. We have also conducted an updated site-specific ground motion analysis for the subject project, and the results are presented in Appendix E of our Geologic and Seismic Hazards Assessment report dated.

More detailed discussion and our opinions regarding geologic and seismic hazards are presented in our Geologic and Seismic Hazards report. Brief summaries of our opinions regarding geologic and seismic hazards that are more related to geotechnical engineering, such as seismic shaking, fault-related ground surface rupture, liquefaction and lateral spreading, dynamic compaction, expansive soils/bedrock, and landslides, are provided below.

2.1 SEISMIC SHAKING

We expect the site to be subjected to substantial ground shaking due to a major seismic event on the surrounding faults, especially the active Hayward fault. Much of the campus, including the project site, is located within an Alquist-Priolo Earthquake Fault Zone, associated with the active Hayward fault.

2.2 FAULT-RELATED GROUND SURFACE RUPTURE

In 2009, Kleinfelder completed a Master Plan Seismic Study for the entire campus. The purpose of that study was to provide a campus-wide guidance document and map showing areas where the presence of active faulting has been cleared for future development at the campus (and no additional fault studies would be needed), as well as those areas that have been documented to be underlain by active faulting (building exclusion zones) and those areas that would require further studies to determine building potential. That study was reviewed and the conclusions were accepted by California Geological Survey (CGS). The current proposed project is located within the limits of the cleared or "Habitable Zone".

Much of the campus, including the subject project site, is located within an Alquist-Priolo Earthquake Fault Zone, associated with the active Hayward fault. Evidence of fault creep across the campus has been documented for several decades (CDMG, 1980) and was observed and mapped during previous site reconnaissance and studies by our project Certified Engineering Geologist (CEG). Therefore, it is our opinion that the potential for continued surface creep along the main fault trace located to the west/southwest of the project site is high. Because the Hayward fault is known to be active and has been the locus of historic earthquakes with associated ground rupture, the potential for future ground rupture during an earthquake along active traces of this fault within the Contra Costa College campus cannot be ruled out. However, based on historic performance, the knowledge that the main trace is more than 50 feet away from the planned project site, and the setback from the nearest mapped secondary fault trace is about 50 feet, which is adequate, we conclude that the potential for fault-related ground surface rupture to impact the planned project is considered low because of the adequate setback distance noted.

2.3 LIQUEFACTION AND LATERAL SPREADING

Based on the subsurface data obtained from our field investigation, the project site subsurface consists mostly of interbedded layers of firm to hard fine-grained clayey soils underlain by bedrock. As a result, liquefaction potential at the site is considered minimal due to the soil types encountered. Also, we conclude that the potential for lateral spreading to occur at the site as a result of a future seismic event is low.

2.4 DYNAMIC (SEISMIC) COMPACTION

Based on the subsurface conditions observed during our investigation, we conclude that densification is not likely to occur at the site and would not result in significant settlement if it did occur.

2.5 EXPANSIVE SOILS/BEDROCK

Our laboratory test data indicate that the site soils and bedrock have low to high expansion potential. Recommended options for mitigation of expansive soil/rock behavior include deepening the footings (if a shallow foundation system is selected), blanketing the slab areas with “non-expansive” soil, and using special earthwork procedures, such as moisture-conditioning.

2.6 LANDSLIDES

No landslides are mapped in the project area and slope creep or cracks were not observed. Therefore, it is our opinion that the potential for seismically induced (or otherwise) landslides and slope failure to occur at the proposed site is considered low.

3 FIELD INVESTIGATION AND LABORATORY TESTING

3.1 FIELD INVESTIGATION

3.1.1 Pre-Field Activities

Prior to the start of the field investigation, Underground Service Alert (USA) was contacted to locate utilities in the vicinity of the boring locations. We also subcontracted the services of a private utility locator who identified and marked underground utilities in the vicinity of our boring locations. As required by local ordinance, a drilling permit was obtained from the Contra Costa County Environmental Health Division.

3.1.2 Exploratory Borings

We drilled four test borings at the planned new science building site on August 11, 2017 and August 18, 2017 to depths between approximately 31 and 41½ feet. The approximate locations of the borings are shown on Figure 2. The borings were drilled by Gregg Drilling & Testing, Inc., of Martinez, California, using a truck-mounted drill rig equipped with 6-inch outside-diameter hollow-stem augers. The boring locations were located in the field by measuring from existing landmarks. Horizontal coordinates and elevations of the borings were not surveyed.

A Kleinfelder professional maintained logs of the borings, visually classified the soils/bedrock encountered and obtained relatively undisturbed and bulk samples of the subsurface materials. Soil classifications made in the field from samples and auger cuttings were in accordance with American Society for Testing and Materials (ASTM) Method D 2488. These classifications were re-evaluated in the laboratory after further examination and testing in accordance with ASTM D 2487. Sample classifications, blow counts recorded during sampling, and other related information were recorded on the boring logs. The blow counts listed on the boring logs have not been corrected for the effects of overburden pressure, rod length, sampler size, or hammer efficiency. Correction factors were applied to the raw blow counts to estimate the sample apparent density noted on the boring logs and for engineering analyses. After the borings were completed, they were backfilled with cement grout and patched with asphalt at the surface, where applicable. Excess drill cuttings were spread in landscape areas on site.

Keys to the soil descriptions and symbols used on the boring logs are presented on Figures A-1 and A-2 in Appendix A. Rock description key is presented on Figure A-3. Logs of the borings are presented on Figures A-4 through A-7.

3.1.3 Sampling Procedures

Soil/bedrock samples were collected from the borings at depth intervals of approximately 5 feet. Samples were collected from the borings at selected depths by driving either a 2.5-inch inside-diameter (I.D.) California sampler or a 1.4-inch I.D. Standard Penetration Test (SPT) sampler driven 18 inches (unless otherwise noted) into undisturbed soil/bedrock. The samplers were driven using a 140-pound automatic hammer free-falling a distance of about 30 inches. Blow counts were recorded at 6-inch intervals for each sample attempt and are reported on the logs.

The SPT sampler did not contain liners, but had space for them. The 2.5-inch I.D. California sampler contained stainless steel liners. The California sampler was in general conformance with ASTM D 3550. The SPT sampler was in general conformance with ASTM D 1586.

Soil/bedrock samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance. Following drilling, the samples were returned to our Hayward laboratory for further examination and testing.

3.2 LABORATORY TESTING

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory testing program included unit weight and moisture content, Atterberg limits, unconsolidated-undrained triaxial, and sieve analysis (percentage passing the No. 200 sieve) tests. Most of the laboratory test results are presented on the boring logs. A summary of geotechnical laboratory tests is presented on Figure B-1. The results of the Atterberg Limits and unconsolidated-undrained triaxial tests are presented graphically on Figures B-2 through B-5 in Appendix B.

Limited corrosion analyses as listed below were performed on a composite sample by CERCO Analytical of Concord, California.

- Corrosion - Soluble Sulfate Content (ASTM D 4327)
- Corrosion - Soluble Chloride Content (ASTM D 4327)

- pH (ASTM D 4972)
- Minimum Resistivity (ASTM G57)

The soluble sulfate, soluble chloride, pH, and minimum resistivity test results are discussed in Section 6.9 of this report and the results are presented in Appendix C. Please note that our scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included in this report. A qualified corrosion engineer should be retained to review the laboratory test results and design protective systems that may be required. Kleinfelder may be able to provide those services, if requested.

4 SURFACE AND SUBSURFACE CONDITIONS

4.1 SURFACE CONDITIONS

The existing buildings of the subject site are currently situated northeast of Rheem Creek along the elevated portion of the campus. As shown on Figure 2, the buildings are situated in between the Physical Sciences building (located to the northeast), Administrative and Applied Arts building (located to the southeast), and Library and Learning Resource Center (located to the west). In between the Library and Learning Resource Center and Liberal Arts and Health Sciences buildings is an open, grass covered courtyard area gently sloping to the southwest. A fire access road runs parallel with the Liberal Arts and Health Sciences buildings along the northeastern end of the buildings, situated at a higher topographic level than the grass covered open area. The project site generally slopes to the southwest. Sloped walkways and stairways are located around the buildings.

4.2 SUBSURFACE CONDITIONS

The subsurface conditions described herein are based on the soil/bedrock and groundwater conditions encountered during the current and previous geologic and geotechnical investigations in the vicinity of the site area. The project site subsurface consists mostly of fill and native soils underlain by claystone. The fill was encountered in Borings B-3 and B-4 measuring between depths of about 8 to 13 feet and generally consisting of very stiff to hard sandy clays. The native soil consisted stiff sandy clays interbedded with clayey sands and gravels, which in turn were underlain by weathered claystone. The claystone was generally weak to strong, moderately to highly weathered, and highly fractured.

Groundwater was not observed or encountered in our current borings. However, groundwater was observed in our previous borings and fault trenches at depths of about 9 to 23 feet below the ground surface. It should be noted that groundwater levels can fluctuate depending on factors such as seasonal rainfall, landscape irrigation, and construction activities on this or adjacent properties, and may rise several feet during a normal rainy season. It is also common to find perched layers of groundwater at the soil/rock interface.

The above is a general description of soil/bedrock and groundwater conditions encountered in the borings from this investigation and our experience at the campus. More detailed descriptions of the subsurface conditions encountered are presented on the Boring Logs on Figures A-4 through A-7 in Appendix A.

Soil/bedrock and groundwater conditions can deviate from those conditions encountered at the boring locations. If significant variations in the subsurface conditions are encountered during construction, Kleinfelder should be notified immediately, and it may be necessary for us to review the recommendations presented herein and recommend adjustments as necessary.

5 DISCUSSION AND CONCLUSIONS

5.1 GENERAL

Based on our findings, it is our professional opinion that the proposed project is feasible from a geotechnical engineering standpoint provided the recommendations contained herein are incorporated into the final plans and specifications. The proposed new science building may be supported on a shallow foundation system bearing on firm engineered fill or native soils. Specific conclusions and recommendations regarding the geotechnical aspects of design and construction are presented in the following sections.

The primary geotechnical concern for the project is the presence of the nearby Hayward fault and the high likelihood that the site will be exposed to a significant seismic event within the project's design life. The proposed structure should be designed to accommodate the anticipated seismic shaking. We understand the layout of the new science building has not been finalized. The final layout of the new building should be located within areas of the site previously designated as habitable zones. Also, according to the California Administrative Code (CAC) Section 4-317(e), the new structure cannot be located within 50 feet of the trace of an active fault.

The second primary geotechnical concern is that varying subsurface conditions are expected at the lower floor level, which could potentially create differential settlement and heaving of the footings as well as the lower level floor slabs. Based on data obtained from our borings and the current layout of the new building with a Lower Plaza elevation of 72 feet, either claystone bedrock, highly expansive undocumented fill with unsuitable materials, or loose native clayey sand, is expected at the foundation and floor slab bearing levels (see Cross Sections A-A' and B-B' on Figures 3 and 4). Instead of supporting the new science building on a deep foundation system, which is expensive, we recommend conducting over-excavation during site grading and supporting the new science building on a shallow foundation system. Also, we recommend that a layer of non-expansive import material be provided below the lower level floor slab.

Additional discussions of the conclusions drawn from our investigation, including general recommendations, are presented below. Specific recommendations regarding geotechnical design and construction aspects for the project are presented in Section 6 of this report.

5.2 FOUNDATIONS AND SLAB SUPPORT

As stated above, over-excavation is recommended. After over-excavation, the new building can be supported on shallow footings or mat slabs, while retaining walls can be supported on shallow footings. Because the site surface soils have high expansion potential, the foundations for the new structures will need to extend deeper than usual if the new buildings are supported on shallow footings. Also, footings (if used) should be continuous around the perimeter of the buildings to reduce the potential for moisture content fluctuations within the expansive soils and bedrock underlying the building footprint. This measure should reduce the development of swell and shrinkage cycles of soils underneath the buildings.

Although mat slabs can be used at the site, our experience shows that it is more difficult to adapt future tenant improvements to this type of foundation because such improvements usually require re-routing of underground utility lines and cutting of the floor slab. Therefore, we suggest using shallow footings to support the new buildings instead of mat slabs. Cast-in-drilled-hole (CIDH) piers may be used to resist uplift loads for the new buildings. Therefore, Section 6 of this report includes design recommendations for shallow footings, mat slabs, and CIDH piers.

Total and differential foundation settlements due to static loads are estimated to be less than 1 inch over a horizontal distance of 70 feet. Our estimated static settlements are based on the anticipated building loads and the assumption that the geotechnical recommendations contained in Section 6 of this report will be incorporated into the design and construction of the project. Static foundation settlements should be primarily elastic in nature, with a majority of the estimated settlement occurring upon application of the load during construction.

The building slabs can be supported on grade. However, due to the presence of expansive soils at the site, the 6-inch layer of ¾-inch crushed rock or slab capillary break material should be underlain by 12 inches of "non-expansive" fill material. The slab subgrade soils will also need to be properly moisture-conditioned prior to the placement of the "non-expansive" material. In a similar fashion, exterior concrete flatwork should be underlain by 6 inches of "non-expansive" material along with proper moisture conditioning of the subgrade soil.

5.3 EXISTING FOUNDATIONS

No information on the foundation type and size of the existing Liberal Arts building is available to us at this time. If the existing building is supported on a shallow foundation system, the existing building and all shallow foundations should be removed and the resulting excavations properly backfilled with compacted engineered fill. On the other hand, if the existing building is supported on a deep foundation system such as drilled piers connected by grade beams, the upper portion of the existing deep foundations should be cutoff to provide a minimum vertical clearance of 3 feet below the bottom of new footings, slabs, and underground utility lines to reduce the risk they will adversely impact their performance and/or constructability.

5.4 EXCAVATION CONDITIONS

We anticipate that excavations at the site can be made with standard earthwork equipment, such as excavators, dozers, backhoes, and trenchers. Claystone bedrock material was encountered in our borings. However, the degree of weathering of the bedrock material varies from moderately to highly weathered. For this reason, we expect the degree of excavation difficulty in the bedrock material would be similar to that of hard/dense soils.

5.5 SOIL/BEDROCK TRANSITION LINES

Based on the subsurface conditions encountered at the site, the southwestern portion of the new building will be founded on soil, while the northeastern portion will be founded on bedrock. To help mitigate possible floor slab distress along bedrock/soil transition lines, over-excavation is recommended.

5.6 UNDOCUMENTED FILL

The undocumented fill encountered during our current investigation is likely the result of past grading at the site during construction of the existing campus buildings and related improvements. The fill appears to be relatively free of organic and deleterious matter and to have been mechanically compacted during grading based on its consistency. Because the site was developed in the 1950's and 1960's, we believe the fill has been in place for several decades. If soft/loose areas are encountered within the fill during excavation of foundations and mass grading for the subject project, additional over-excavation may be required. Deleterious matter encountered in the fill, such as organic laden soil, should be either removed and disposed offsite or possibly be used as general fill in landscaping areas of the site if it is not considered environmentally hazardous. The final vertical and lateral extents of additional over-excavation should be determined by the project Geotechnical Engineer during construction based on exposed subsurface conditions.

6 RECOMMENDATIONS

6.1 GENERAL EARTHWORK

We recommend that Kleinfelder be retained to provide observation and testing services during earthwork and foundation construction. This will allow us the opportunity to compare conditions exposed during construction with those inferred from our investigation and, if necessary, to expedite supplemental recommendations if warranted by the exposed subsurface conditions. We also recommend that, prior to construction, Kleinfelder be retained to review foundation plans and specifications to verify conformance with our recommendations. It has been our experience that this review provides an opportunity to detect misinterpretation or misunderstandings prior to the completion of design and start of construction.

No major filling to raise site grade is expected. Based on the current conceptual design, cutting of about 9 feet may be required to create the building pad. As stated in previous sections of this report, over-excavation is recommended.

We recommend that all permanent cut and fill slopes, if any, be designed to be no steeper than 2 (horizontal) to 1 (vertical).

6.1.1 Site Preparation

Prior to the start of construction, all obstructions, debris and deleterious materials, including any existing structures such as foundations, pavements, concrete slabs, underground utility lines, and wells, if any, should be removed from the construction areas. Stumps and primary roots of any trees and brush should be grubbed. Removal of existing underground utilities should include removal of associated granular bedding material.

After site clearing, we recommend that over-excavation be conducted by excavating the soil/bedrock to a level at least 4 feet below the lower floor slab over the entire building footprint, scarifying and recompacting the over-excavation bottom, and backfilling the over-excavation with moisture-conditioned and compacted onsite soils. The over-excavation should extend laterally to about 5 feet beyond the footprint of the new building, where physically possible. With this over-excavation requirement and a recommended footing embedment depth of 2½ feet (see Section

6.3.1 of this report), there should be at least 1½ feet of engineered fill below the bottoms of footings, and at least 2 feet of engineered fill (not including the non-expansive import materials as described in the next paragraph) below the lower floor slab. Final over-excavation depths should be determined by Kleinfelder during construction based on the exposed subsurface conditions. Additional over-excavations may be required. Geotechnical recommendations related to scarifying, fill material specifications, backfilling, and compacting are presented in Section 6.1.5 of this report.

As stated in Section 5.2 of this report, we recommend that at least 12 inches of non-expansive import materials meeting the import fill requirements be provided beneath the lower floor slab. Imported material may also be used to backfill the over-excavation. However, they should be placed in the upper portion of the over-excavation so that the new exterior continuous footings are keyed at least one foot into the onsite recompacted clayey soils. This requirement reduces the risk of excessive moisture accumulating in the granular fill below the new floor slabs. If restricting the thickness of the granular fill layer is not possible, deepening the exterior continuous footings may be required.

Depressions, voids, and holes (including excavations from removal of underground improvements) that extend below the proposed finished grades should be cleaned and backfilled with engineered fill compacted to the requirements given in Section 6.1.5 of this report. All clearing and backfill work should be performed under the observation of the project Geotechnical Engineer.

6.1.2 Subgrade Preparation

The bottom of the over-excavation and all subgrade areas that will receive engineered fill for support of structures should be scarified to a depth of 12 inches, uniformly moisture-conditioned to a moisture content of at least 2 percent above the optimum moisture content, and compacted as engineered fill to at least 90 percent relative compaction (ASTM D 1557). Over-excavation of disturbed soil, scarification and compaction of the exposed subgrade, and replacement with engineered fill may be required to sufficiently densify all disturbed soil. If the over-excavation bottom or subgrade surface consists of undisturbed bedrock, this scarifying and re-compacting processes are not required.

Following rough grading, construction and trenching activities often loosen or otherwise disturb the subgrade soils. On occasion, this disturbance can lead to isolated movement of the subgrade soils following construction and cracking of overlying slabs and pavement. Accordingly, loose/disturbed areas should be repaired and trench backfill should be properly compacted prior to placement of concrete.

6.1.3 Temporary Excavations

Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. The contractor should be aware that slope heights, slope inclinations, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a lateral distance equal to one-third the slope height from the top of any excavation. During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water, seepage, and/or groundwater encountered within excavations should be collected and disposed of outside the construction limits.

6.1.4 Fill Materials

The native soils and existing fill materials encountered in our borings and broken-down bedrock materials, minus debris, rock particles larger than 3 inches in maximum dimension, and deleterious materials, may be suitable for use as engineered fill in the proposed building area. This material, however, should not be used as retaining wall backfill due to additional pressure it might impose on the retaining wall. Import non-expansive material should be used as retaining wall backfill. The native soils and broken-down bedrock materials should be well-mixed and moisture-conditioned. It should be reviewed and tested by Kleinfelder prior to being used as engineered fill.

Import fill soils should be nearly free of organic or other deleterious debris, essentially non-plastic, and contain rock particles less than 3 inches in maximum dimension. In general, well-graded mixtures of gravel, sand, non-plastic silt, and small quantities of cobbles, rock fragments, and/or clay are acceptable for use as import fill. All import fill materials to be used for engineered fill should be sampled and tested by the project Geotechnical Engineer prior to being transported to the site. Import fill guidelines are provided below.

Table 6-1
Import Fill Guidelines

Fill Requirement		Test Procedures	
		ASTM[1]	**Caltrans**[2]
Gradation			
Sieve Size	**Percent Passing**		
3 inch	100	D422	202
¾ inch	70-100	D422	202
No. 200	20-50	D422	202
Plasticity			
Liquid Limit	**Plasticity Index**		
<30	<12	D4318	204
Organic Content			
No visible organics		---	---
Expansion Potential			---
20 or less		D4829	---
Soluble Sulfates			
Less than 1,000 ppm		---	417
Soluble Chloride			
Less than 300 ppm		---	422
Resistivity			
Greater than 2,000 ohm-cm		---	643

[1]American Society for Testing and Materials Standards (latest edition)
[2]State of California, Department of Transportation, Standard Test Methods (latest edition)

Trench backfill and bedding placed within existing or future City right-of-ways should meet or exceed the requirements outlined in the current City specifications. Trench backfill or bedding placed outside existing or future right-of-ways could consist of native or imported soil that meets the requirements for fill material provided above. However, coarse-grained sand and/or gravel should be avoided for pipe bedding or trench zone backfill unless the material is fully enclosed in a geotextile filter fabric such as Mirafi 140N or an equivalent substitute. In a very moist or saturated condition, fine-grained soil can migrate into the coarse sand or gravel voids and cause "loss of ground" or differential settlement along and/or adjacent to the trenches, thereby leading to pipe joint displacement and pavement distress.

Trench backfill recommendations provided above should be considered minimum requirements only. More-stringent material specifications may be required to fulfill bedding requirements for specific types of pipe. The project Civil Engineer should develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

6.1.5 Engineered Fill

All fill soils, either native or imported, required to bring the site to final grade should be compacted as engineered fill. Onsite clayey fill should be uniformly moisture-conditioned to a moisture content of at least 2 percent above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to between 90 and 93 percent of the maximum dry density as determined by ASTM Test Method D 1557. Imported granular fill should be uniformly moisture-conditioned to a moisture content to near the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent of the maximum dry density. Additional fill lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Discing and/or blending may be required to uniformly moisture-condition soils used for engineered fill. The uppermost 6 inches of exterior slabs or pavements where vehicular traffic is expected should be compacted to at least 95 percent of the maximum dry density. The subgrade should be stable, or non-pumping, prior to the construction of slabs or pavements.

All trench backfill in building or other structural areas should be placed and compacted in accordance with the recommendations provided above for engineered fill. During backfill, mechanical compaction of engineered fill is recommended.

New fill slopes, if any, should be constructed in level lifts, and proper keying and benching techniques should be used. Fill slopes should be constructed “fat” and trimmed back to expose the firm compacted surface.

6.1.6 Wet/Unstable Subgrade Mitigation

If construction is to proceed during the winter and spring months, the moisture content of the near-surface soils may be significantly above optimum. This condition, if encountered, could seriously delay grading by causing an unstable subgrade condition. Typical remedial measures include discing and aerating the soils, mixing the soils with dryer materials, removing and replacing the soils with an approved fill material, stabilization with a geotextile fabric or grid, or mixing the soils with an approved hydrating agent such as a lime or cement product. Our firm should be consulted prior to implementing any remedial measure to observe the unstable subgrade condition and provide site-specific recommendations.

6.2 SEISMIC DESIGN CRITERIA

We have conducted an updated site-specific ground motion analysis for the subject project, and the results are presented in Appendix E of our Geologic and Seismic Hazards Assessment report dated October 2017.

6.3 FOUNDATIONS

6.3.1 Footings

The building may be supported on shallow isolated spread footings and/or continuous wall footings founded on engineered fill. We recommend that a continuous exterior wall footing be used. A net allowable bearing pressure of 3,000 pounds per square foot (psf) for dead plus sustained live loading may be used to size column and continuous footings. A one-third increase in the allowable bearing pressures may be applied when considering short-term loading due to wind or seismic forces.

Footings should have a minimum width of 18 inches for continuous footings and 36 inches for isolated square footings. Spread or strip footings should be founded at least 30 inches below the lowest adjacent finished grade. Footings on slope, or near the top of slope, may have to be either deepen or have setback in accordance with the requirements as shown in Figure 1808A.7.1 of the 2016 California Building Code.

Total settlement of an individual foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based on the anticipated/assumed foundation dimensions and loads, we estimate the total and differential settlement to be on the order of 1 inch, provided the recommendations presented in this report are followed.

Prior to placing steel or concrete, footing excavations should be cleaned of all debris, loose or soft soil, and water. All footing excavations should be observed by the project Geotechnical Engineer just prior to placing steel or concrete to verify the recommendations contained herein are implemented during construction. The project Structural Engineer should evaluate footing configurations and reinforcement requirements to account for loading and settlement.

6.3.2 Mat Slabs

Mat slabs may be used as an alternative to shallow footings. The mats may be designed for an allowable pressure of 1,500 psf and should have a minimum depth at the edges of 18 inches. The allowable pressure may be increased by one-third for supporting total loads, including wind and seismic loads. The dead plus live load bearing pressure includes a safety factor of at least 2 and the total design bearing pressure of 2,000 psf (including wind and seismic) includes a safety factor of at least 1.5.

6.3.3 CIDH Piers

If piers are required to resist uplift loads for the new science building, Cast-in-drilled-hole (CIDH) piers can be used. The piers should derive their load capacities through skin friction on the side of the piers. For resistance to uplift loads, the effective weight of the piers and the skin friction between the piers and native soils may be used. An allowable skin friction value of 800 psf may be used to resist downward loads. A one-third increase is permitted for downward wind and/or seismic loading. The dead plus live load friction resistance includes a safety factor of at least 2 and the total design downward frictional resistance of about 1,100 psf (including wind and seismic) includes a safety factor of at least 1.5. Uplift loads for short-term conditions should not exceed 2/3 of the allowable downward skin friction (about 500 psf). These values may be doubled for the portion of piers that are in the claystone. Kleinfelder should review the design of any piers that use this increase. The piers should have a minimum depth of 10 feet for structures that are sensitive to seasonal shrinkage and swell movements, and 5 feet for stand-alone structures, such as light poles. The piers should have a minimum diameter of 18 inches and should be spaced at least 3 diameters apart (center to center) or skin friction capacity reductions may be necessary.

We recommend that steel reinforcement and concrete be placed within about 4 to 6 hours upon completion of each pier hole. As a minimum, the holes should be poured the same day they are drilled. The steel reinforcement should be centered in the pier hole. Concrete used for pier construction should be discharged vertically into the pier holes to reduce aggregate segregation. Under no circumstances should concrete be allowed to free-fall against either the steel reinforcement or the sides of the excavation during construction.

If water more than 6 inches deep is present during concrete placement, either the water needs to be pumped out or the concrete needs to be placed into the hole using tremie methods. Tremie methods may also be needed if after pumping the water quickly returns to the hole. If tremie methods are used, the end of the tremie pipe must remain below the surface of the in-place concrete at all times. In order to develop the design skin friction value provided above, concrete used for pier construction should have a design slump of from 4 to 6 inches if placed in a dry shaft without temporary casing, and from 6 to 8 inches if temporary casing is used. Casing is not anticipated for most of the piers due to the clayey nature of the soils within their probable depth. However, localized sandy layers found below the site may experience caving below the ground water level, which may require casing of some piers during construction. We expect conventional drilling equipment can be used for the installation of CIDH piers. However, hard drilling, especially in sandstone bedrock, could be encountered during construction. Also, old caissons or piers, if exist, could interfere with the installation of new CIDH piers. Unit prices for casing, de-watering, placement of concrete using tremie methods, and contingencies for removal of existing deep foundations and for slower than anticipated drilling should be obtained during bidding.

The bottom of the pier holes should be cleaned such that no more than two inches of loose soil remains in the hole prior to the placement of concrete. A concrete mix with a low water/cement ratio should be used in the construction of the piers to reduce shrinkage of the concrete. To increase the fluidity of the mix for improved consolidation and bond with the reinforcing steel, increased slump may be desirable. If this is the case, the slump should be increased via use of a plasticizer, rather than by adding water to the mix, because a low water to cement ratio is desired for shrinkage control.

A representative from Kleinfelder should be present to observe pier holes on a full-time basis to confirm bottom conditions prior to placing steel reinforcement. The soils exposed in the holes should not be allowed to dry prior to the placement of concrete, since such drying could have an adverse impact on the performance of the piers.

6.3.4 Resistance to Lateral Loads

Lateral loads applied against footings and mats may be resisted by a combination of friction between the foundation bottoms and the supporting subgrade, and by passive resistance acting against the vertical faces of the foundation. The frictional and passive resistance may be assumed in design to act concurrently. An allowable friction coefficient of 0.30 between the foundations and supporting subgrade soils may be used. For passive resistance at this site, an allowable equivalent fluid pressure (unit weight) of 350 pounds per cubic foot (pcf) may be used against the sides of foundations. For footings located near the top of a slope, or on a slope, an allowable passive equivalent fluid weight of 175 pcf is recommended. The friction coefficient and passive pressure values include factors of safety of about 1.5. We based these lateral load resistance values on the assumption that the concrete for footings are either placed directly against undisturbed soils or that the voids created from the use of forms are backfilled with soil (compacted to a minimum of 90 percent compaction, ASTM D 1557), or other approved material such as lean concrete.

Resistance to lateral loads for CIDH piers can be provided by passive resistance against the piers using an allowable equivalent fluid pressure of 350 pcf up to a maximum of 2,000 psf acting against the piers. The passive resistance may be applied to a width of twice the diameter of the piers. Piers should be spaced at least 6 diameters apart (center to center) or lateral resistance capacity reductions may be necessary. The passive pressure value includes a factor of safety of about 1.5.

Passive resistance in the upper foot of soil cover below finished grades should be neglected unless the ground surface is protected from erosion (or other disturbance that could remove this upper foot) by concrete slabs, pavements, or other such positive protection. If load-deflection (p-y) curves are needed for the design of the CIDH piers, we should be consulted.

6.4 MODULUS OF SUBGRADE REACTION

A modulus of subgrade reaction (Kv1) of 150 pounds per cubic inch (pci) may be used for the design of slabs-on-grade and mat slabs bearing on undisturbed site soils or properly compacted engineered fill. This value is based on the correlations to soil strength using one foot by one foot plate-load tests and should therefore be scaled (adjusted) to the mat/slab width. If the slab-on-grade floor is also underlain by sand, a vapor retarder, and gravel, the impact of those materials on the modulus of subgrade reaction must be taken into account in the structural design of the slab. The actual floor slab thickness and reinforcing should be designed by the structural engineer for the actual use and loads to be carried by the floor slab.

6.5 RETAINING WALLS

Retaining walls should be designed to resist lateral pressures caused by wall backfill/soil/bedrock, seismic pressures, and external surface loads. As stated in Section 6.1.4 of this report, the onsite materials could impose additional lateral pressure on the wall due to their potential expansive characteristic; therefore, should not be used as retaining wall backfill. Wall backfill should consist of a 1:1 wedge of import non-expansive fill. The magnitude of the lateral pressures will depend on wall flexibility, wall backslope configuration, backfill properties, the magnitude of seismic load, the magnitude of surcharge loads, and the back-drainage provisions. Basement walls or building walls are expected to be braced and restrained from deflection. Therefore, pressures against the basement walls or building walls should be based on at-rest earth pressures. The recommended lateral pressures presented as equivalent fluid weights are show in Table 6-2 below. The resultant force should be applied at a distance of H/3 above the bottom of the wall, where H = wall height. These recommended pressures contain a safety factor of 1.

Table 6-2

Recommended Lateral Pressures for Wall Design

	Equivalent Fluid Weight (pcf)*		
Backslope Condition	**Active**	**At-Rest**	**Seismic (active + seismic increment)**
Level	45	65	108
2H to 1V	65	94	167

Note: *Does not include lateral pressures due to groundwater and surcharges

The additional pressure due to a surcharge at the ground surface behind the wall acting against unrestrained walls may be taken as a uniform pressure estimated by multiplying the surface load by a factor of 0.3. The additional pressure due to a surcharge at the ground surface behind the wall acting against restrained walls may be taken as a uniform pressure estimated by multiplying the surface load by a factor of 0.5. These resultant forces should be applied at a distance of H/2 above the bottom of the wall, where H = wall height.

The recommended lateral pressures presented above were developed assuming that the walls are fully drained. Wall drainage should consist of a drain rock layer at least 12 inches thick and extend to within 1 foot of the ground surface. A 4-inch diameter perforated rigid-wall PVC, or similar material, pipe should be installed along the base of the walls in the drain rock with the perforations facing down. The bottom of pipe should rest on an about 2-inch thick bed of drain rock, and designed to slope to drain by gravity to a sump or other drainage facility. Drain rock should conform to Caltrans specifications for Class 2 Permeable Material. A 1-foot thick cap of clayey soil should be placed over the drain rock to inhibit surface water infiltration.

Kleinfelder should review and approve the proposed wall backfill materials before they are used in construction. Over-compaction of wall backfill should be avoided because increased compaction effort can result in lateral pressures significantly greater than those used in design.

We recommend that all backfill placed with 3 feet of the walls be compacted with hand-operated equipment. Placement of wall backfill should not begin until the wall concrete strength has reach a specific level as determined by the project Structural Engineer.

6.6 BUILDING SLABS-ON-GRADE

6.6.1 Subgrade Preparation

Prior to constructing interior concrete slabs supported-on-grade, surficial soils should be processed as recommended in Section 6.1.1 of this report.

6.6.2 Capillary Break

For floor slabs with moisture-sensitive floor coverings, or where moisture-sensitive storage is anticipated, we recommend the compacted subgrade be overlain with a minimum 4-inch thick of compacted crushed rock to serve as a capillary break. The material should have less than 5 percent by weight passing the No. 4 sieve size. A capillary break may reduce the potential for soil moisture migrating upwards toward the slab. In general, Caltrans Class 2 aggregate base or similar materials do not meet the above recommendations and should not be used to underlay interior concrete slabs supported-on-grade where moisture sensitive floor coverings or storage is anticipated.

6.6.3 Vapor Barrier

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building or pavement, this subsurface moisture will collect. To reduce the impact of this subsurface moisture and the potential impact of introduced moisture (such as landscape irrigation or plumbing leaks) the current industry standard is to place a vapor retarder membrane (meeting ASTM E 1745 specifications) over the capillary break crushed rock layer. This membrane typically consists of polyvinyl or similar plastic sheeting at least 10 mils in thickness. Thicker polyolefin vapor barrier membranes (meeting ASTM E 1745 Class A) are currently available that are less prone to punctures and have much lower water vapor transmission rates. They should be installed according to American Concrete Institute (ACI) publication 302. The vapor retarder should be properly lapped and sealed. The joints between the sheets and the openings for utility piping should be lapped and taped. The sheeting should also be lapped into the sides of the footing trenches a minimum of 6 inches. Any puncture of the vapor retarder should be repaired prior to casting concrete.

Normally, a thin layer of moist clean sand (about two inches thick) is placed on the sheeting to facilitate concrete curing and to decrease the likelihood of slab curling. The final decision for the need and thickness of sand above the vapor barrier is the purview of the slab designer/structural engineer. The moisture vapor retarder is intended only to reduce moisture vapor transmission from the soil beneath the concrete and will not provide a waterproof or vapor proof barrier or reduce vapor transmission from sources above the retarder.

It should be noted that this system, although currently the industry standard, may not be completely effective in preventing moisture transmission through the floor slab and related floor covering problems. These systems typically will not necessarily assure that floor slab moisture transmission rates will meet floor-covering manufacturer standards and that indoor humidity levels will be appropriate to inhibit mold growth. The design and construction of such systems are totally dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab-on-grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may produce excessive moisture in a building and affect indoor air quality.

Various factors such as surface grades, adjacent planters, the quality of slab concrete (water-cement ratio) and the permeability of the on-site soils affect slab moisture and can influence performance. In many cases, floor moisture problems are the result of water-cement ratio, improper curing of floor slabs, improper application of flooring adhesives, or a combination of these factors. Studies have shown that concrete water-cement ratios lower than 0.5 and proper slab curing can significantly reduce the potential for vapor transmission through floor slabs. We recommend contacting a flooring consultant experienced in the area of concrete slab-on-grade floors for specific recommendations regarding your proposed flooring applications.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend that all concrete placement and curing operations be performed in accordance with the ACI Manual.

It is emphasized that we are not concrete slab-on-grade floor moisture-proofing experts. We make no guarantee nor provide any assurance that use of the capillary break/vapor retarder system will reduce concrete slab-on-grade floor moisture penetration to any specific rate or level, particularly those required by floor covering manufacturers. The builder and designers should consider all available measures for slab moisture protection.

All exterior utility trenches within 5 feet of perimeter foundations should be backfilled with compacted non-pervious fill material. Special care should be taken during installation of sub-floor water and sewer lines to reduce the possibility of leaks. Any utility penetrations through perimeter foundations should be completely sealed to prevent water intrusion beneath the floor slab.

6.7 EXTERIOR FLATWORK

Subgrade soils underlying exterior flatwork should be scarified 12 inches, moisture conditioned, and recompacted in accordance with the compaction requirements presented in this report. The subgrade preparation should extend beyond the proposed improvements a horizontal distance of at least 2 feet. The moisture content of the subgrade soils should be maintained at least 2 percent above optimum prior to the placement of any flatwork or engineered fill.

Where exterior flatwork is anticipated to be subjected to vehicular traffic, we recommend the flatwork be designed as pavement.

Moisture conditioning to the full 12-inch depth should be verified by the project Geotechnical Engineer's representative. Careful control of the water/cement ratio should be performed to avoid shrinkage cracking due to excess water or poor concrete finishing or curing. Unreinforced slabs should not be built in areas where further saturation may occur following construction. Proper moisture conditioning and compaction of subgrade soils is important. Even with proper site preparation, we anticipate that over time there will be some soil moisture change on the subgrade soil supporting the concrete flatwork. For example, exterior flatwork will be subjected to edge effects (shrink-swell) due to the drying out or wetting of subgrade soils where adjacent to landscaped or vacant areas. To help reduce edge effects, lateral cutoffs such as an inverted curb are suggested. Control joints should be also used to reduce the potential for flatwork panel cracks as a result of minor soil shrink-swell. Steel reinforcement will aid in keeping the control joints and other cracks closed.

6.8 SITE DRAINAGE

Proper site drainage is important for the long-term performance of the planned building, pavements, and concrete flatwork. The site should be graded to carry surface water away from the building foundations at a minimum gradient of 5 percent for a minimum lateral distance of 10 feet from the building limits (defined as the outside perimeter of building walls or footing outer limits, whichever results in the greatest building envelope), where feasible. Impervious surfaces, such as concrete flatwork and pavements, adjacent to the buildings should be sloped a minimum gradient of 2 percent. To reduce inducing surface water into the moisture sensitive clayey surface soil/rock, all roof gutters/leaders should be connected directly into a storm drainage system or drain on an impervious surface sloping away from the building, provided this does not create a safety hazard.

We recommend that landscape planters either not be located adjacent to buildings and pavement areas or be properly drained to area drains. Drought resistant plants and minimum watering are recommended for planters immediately adjacent to structures. No raised planters should be installed immediately adjacent to structures unless they are damp-proofed and have a drainpipe connected to an area drain outlet. Planters should be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. Where slabs or pavement areas abut landscaped areas, the aggregate base and subgrade soil should be protected against saturation.

Vertical cut-off structures are recommended to reduce lateral seepage under slabs from adjacent landscaped areas. Vertical cut-off structures may consist of deepened concrete perimeters, or equivalent, extending at least four (4) inches below the base/subgrade interface. Vertical cut-off structures should be poured neat against undisturbed native soil or compacted clayey fill. The cut-off structures should be continuous.

Roof water should be directed to fall on hardscape areas sloping to an area drain, or roof gutters and downspouts should be installed and routed to area drains.

In any event, maintenance personnel should be instructed to limit irrigation to the minimum actually necessary to properly sustain landscaping plants. Should excessive irrigation, waterline breaks or unusually high rainfall occur, saturated zones and "perched" groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscaped areas. Potential sources of water such as water pipes, drains, and the like should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired. Wet utilities should also be designed to be watertight.

Surface water collected on top of slope should not be designed to flow over the top of slope and onto the slope surface. The top of slope should either be sloped back, or ditches be installed to intercept the water from flowing onto the slope. Erosion control measures should be provided on permanent cut or fill slope to reduce the potential of slope erosion.

6.9 SOIL CORROSIVITY

A composite sample of the near-surface soils of the near-surface soils encountered at the site was subjected to chemical analysis for the purpose of corrosion assessment. The sample was tested for chloride concentration, sulfate concentration, pH, oxidation reduction potential, and electrical resistivity by CERCO of Concord, California. The results of the tests are presented in Appendix C and are summarized in Table 6-3. If fill materials will be imported to the project site, similar corrosion potential laboratory testing should be completed on the imported material. Our scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included in this report. A qualified corrosion engineer should be retained to review the test results and design protective systems that may be required. Kleinfelder may be able to provide those services.

Table 6-3
Corrosivity Laboratory Test Results

Boring and Depth	Resistivity, ohm-cm		pH	Oxidation Reduction Potential, mV	Water-Soluble Ion Concentration, ppm		
	Saturated	In-Situ Moisture			Chloride	Sulfide	Sulfate
B-3, sample 2C at 6'	1,100	720	7.86	+440	N.D.	N.D.	N.D.

Note: N.D. - None Detected

Ferrous metal and concrete elements in contact with soil, whether part of a foundation or part of the supported structure, are subject to degradation due to corrosion or chemical attack. Therefore, buried ferrous metal and concrete elements should be designed to resist corrosion and degradation based on accepted practices.

Based on the “10-point” method developed by the American Water Works Association (AWWA) in standard AWWA C105/A21.5, the soils at the site are extremely to highly corrosive to buried ferrous metal piping, cast iron pipes, or other objects made of these materials. We recommend that a corrosion engineer be consulted to recommend appropriate protective measures.

The degradation of concrete or cement grout can be caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds within the concrete, causing cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete or cement grout. The American Concrete Institute (ACI) in their publication “Guide to Durable Concrete*”* (ACI 201.2R-08) provides guidelines for this assessment. The sulfate test indicated the sample had a concentration below the detectable limit. The results of sulfate test indicate the potential for deterioration of concrete is mild, no special requirements should be necessary for the concrete mix.

Concrete and the reinforcing steel within it are at risk of corrosion when exposed to water-soluble chloride in the soil or groundwater. Chloride tests indicated the sample had concentrations below the detection limit. The project structural engineer should review this data to determine if remedial measures are necessary for the concrete reinforcing steel.

7 ADDITIONAL SERVICES

The review of final plans and specifications, and field observations and testing during construction by Kleinfelder is an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client agrees to assume Kleinfelder's responsibility for any potential claims that may arise during construction. The actual tests and observations by Kleinfelder during construction will vary depending on type of project and soil/bedrock conditions. The tests and observations would be additional services provided by our firm. The costs for these services are not included in our current fee arrangements.

As a minimum, our construction services should include observation and testing during site preparation, grading, and placement of engineered fill, observation of foundation excavations prior to placement of reinforcing steel, and observation of CIDH construction. Many of our clients find it helpful to have concrete compressive tests performed for each building even though this information may not be required by any agency. It may also be helpful to perform a floor level and crack survey of all slab-on-grade floors prior to the application of any floor covering. The floor level survey can be readily performed by the client or as an additional service provided by Kleinfelder using a manometer device.

8 LIMITATIONS

The conclusions and recommendations of this report are provided for the design and construction of the proposed new science building at the Contra Costa College campus in San Pablo, California, as described in the text of this report. The conclusions and recommendations in this report are invalid if:

- The assumed structural or grading details change
- The report is used for adjacent or other property
- Any other change is implemented which materially alters the project from that proposed at the time this report was prepared

The scope of services was limited to the drilling of four test borings in area accessible to our drill rig. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on our subsurface exploration including four test boring drilled to a maximum depth of about 41½ feet; groundwater level measurements in the test borings during our field exploration; and geotechnical engineering analyses.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more-detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involve greater expense, our clients participate in determining levels of service which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues covered in this report with Kleinfelder so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, and our present knowledge of the proposed construction. It is possible that soil/bedrock or groundwater conditions could vary between or beyond the points explored. If soil/bedrock or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the estimated building loads and the design depths or locations of the foundations, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed and the conclusions of this report are modified or approved in writing by Kleinfelder.

As the geotechnical engineering firm that performed the geotechnical evaluation for this project, Kleinfelder should be retained to evaluate whether the recommendations of this report are properly incorporated in the design of this project and properly implemented during construction. This may avoid misinterpretation of the information by other parties and will allow us to review and modify our recommendations if variations in the soil/bedrock conditions are encountered. As a minimum, Kleinfelder should be retained to provide the following continuing services for the project:

- Review the project plans and specifications, including any revisions or modifications
- Observe the site earthwork operations to assess whether the subgrade soils/bedrock are suitable for construction of foundations, slabs-on-grade, pavements and placement of engineered fill
- Evaluate whether engineered fill for the structure and other improvements is placed and compacted per the project specifications
- Observe foundation bearing soils to evaluate whether conditions are as anticipated
- Observe the construction of CIDH piers, if any

The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil/bedrock, surface water, or groundwater at this site.

Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field. Kleinfelder must be retained so that all geotechnical aspects of construction will be monitored on a full-time basis by a representative from Kleinfelder, including site preparation, preparation of foundations, and placement of engineered fill and trench backfill. These services provide Kleinfelder the opportunity to observe the actual soil/bedrock and groundwater conditions encountered during construction and to evaluate the applicability of the recommendations presented in this report to the site conditions. If Kleinfelder is not retained to provide these services, we will cease to be the engineer of record for this project and will assume no responsibility for any potential claim during or after construction on this project. If changed site conditions affect the recommendations presented herein, Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinions, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to evaluate those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction. Furthermore, the contractor should be prepared to handle contamination conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers.

This report was prepared in accordance with the generally accepted standard of practice that existed in Contra Costa County at the time the report was written. No warranty, expressed or implied, is made.

It is the CLIENT'S responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety.

This report may be used only by the client and only for the purposes stated within a reasonable time from its issuance, but in no event later than two years from the date of the report. Land use, site conditions (both on- and off-site), or other factors may change over time, and additional work may be required. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else, unless specifically agreed to in advance by Kleinfelder in writing, will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

9 REFERENCES

Kleinfelder, 2003, Subsurface Fault Investigation, Proposed Addition to the Student Activities Building, Contra Costa College, San Pablo, California, dated December 2, 2003 (File No. 33133/SSA).

Kleinfelder, 2004, Geotechnical Investigation Report, Student Activities Building Addition, Contra Costa College, San Pablo, California, dated April 16, 2004 (File No. 40698/GEO).

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SMITHGROUP JJR, 2017, Meeting notes for Contra Costa College New Science Building, Project Number CCCCD C-4016, dated May 30, 2017.

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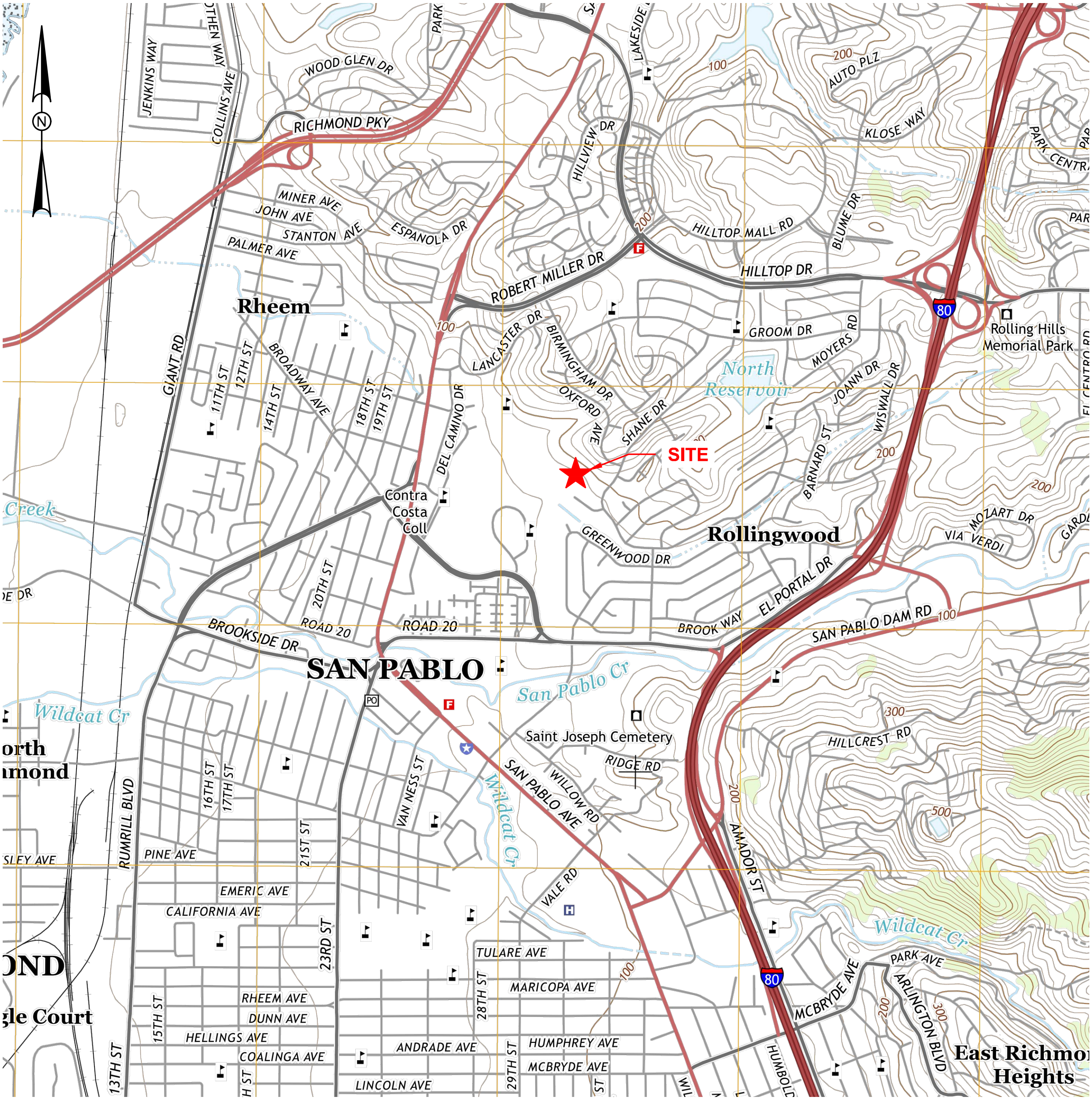
FIGURES

PLOTTED: 10/5/2017 5:27 PM BY: jeff sala



REFERENCE:

VICINITY MAP CREATED FROM DATA COMPILED BY USGS US TOPO RICHMOND, CA. QUADRANGLE 7.5-MINUTE, 2015

0 2000 4000

SCALE: 1" = 2000' SCALE IN FEET

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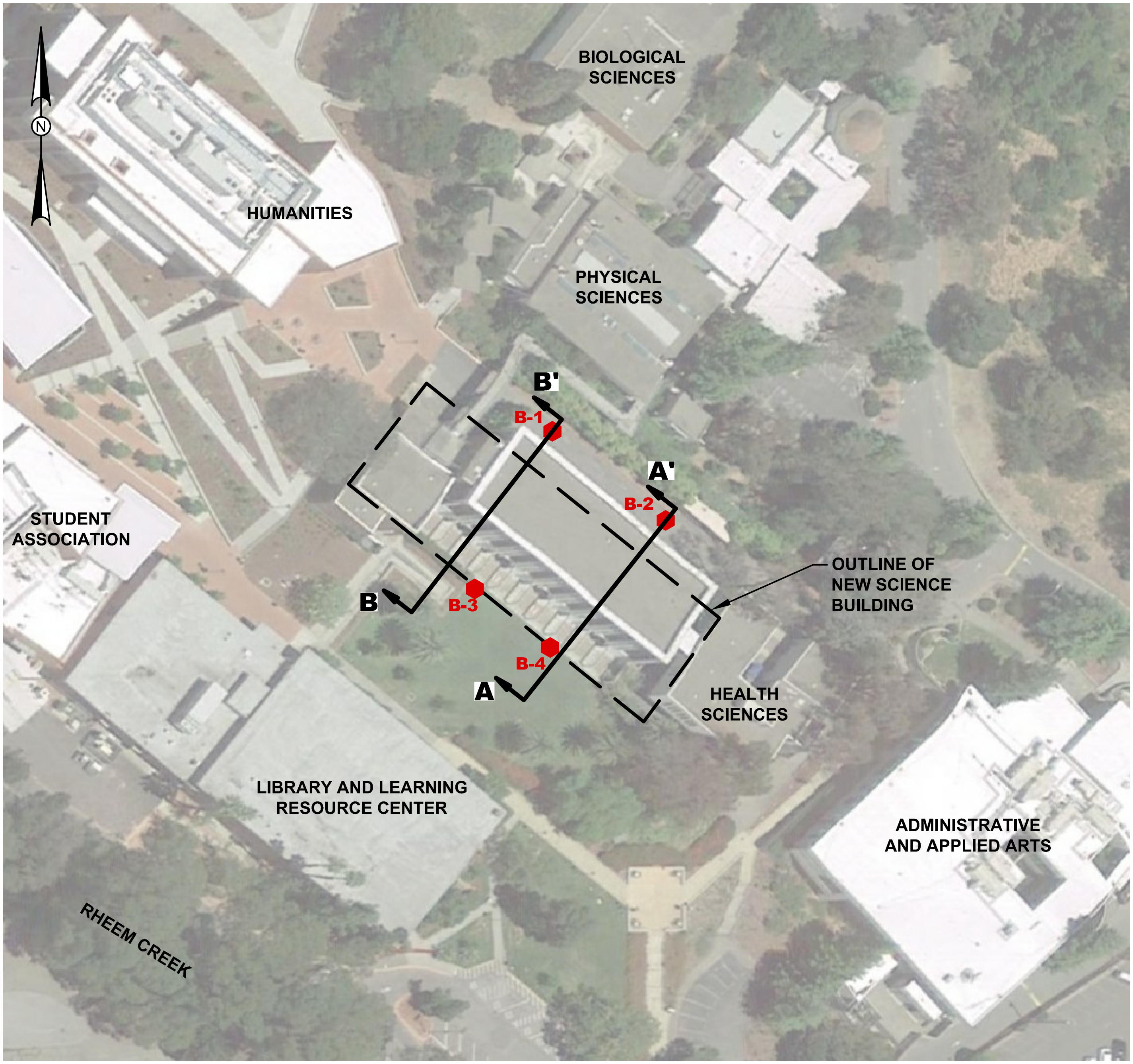
PROJECT NO.	20181569
DRAWN BY:	JDS
CHECKED BY:	JA
DATE:	08/30/2017
REVISED:	

SITE VICINITY MAP

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE 1

CAD FILE: W:\2018\20181569.001A_CCCCD_C-4016 GeoSeis\GRAPHICs\20181569.dwg



0 100 200

SCALE: 1" = 100' SCALE IN FEET

REFERENCE:

IMAGE CREATED FROM DATA COMPILED BY GOOGLE EARTH PRO., DATED 5-20-2017

LEGEND

SOIL BORING (By Kleinfelder, 2017)

B' B

CROSS SECTION LINE (See Figures 3 & 4 for cross section view)

NOTE: All locations are approximate.

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PROJECT NO.	20181569
DRAWN BY:	JDS
CHECKED BY:	EM
DATE:	10/01/2017
REVISED:	

SITE PLAN

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE 2

PLOTTED: 10/12/2017 9:53 AM BY: jeff sala

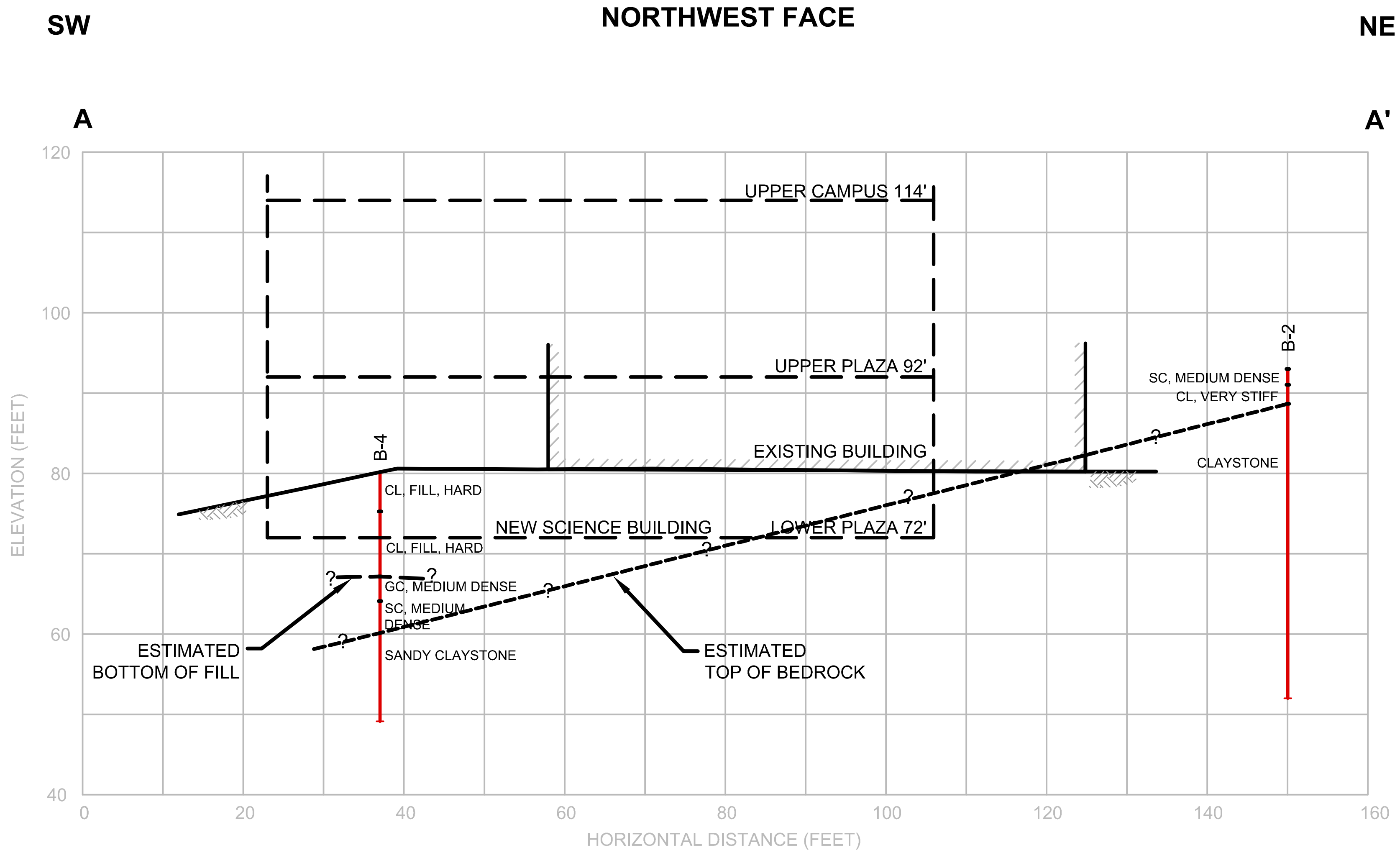
CAD FILE: W:\2018\20181569.001A_CCCCD_C-4016 GeoSeis\GRAPHICs\20181569.dwg

PLOTTED: 10/5/2017 5:21 PM BY: jeff sala

LAYOUT: SECT A-A

CAD FILE: W:\2018\20181569.001A_CCCCD_C-4016 GeoSeis\GRAPHICs\20181569.dwg

NORTHWEST FACE



0 20 40

SCALE: 1" = 20' SCALE IN FEET
VERTICAL AND HORIZONTAL

NOTES:

1. SEE FIGURE 2 FOR LOCATION OF CROSS SECTION.
2. " BOTTOM OF FILL LINE" AND "TOP OF BEDROCK LINE" ARE ROUGH ESTIMATED INTERFACE LINES BASED ON LIMITED SUBSURFACE INFORMATION. THE ACTUAL SUBSURFACE CONDITIONS COULD BE SIGNIFICANTLY DIFFERENT FROM THOSE SHOWN ABOVE DUE TO PAST GRADING AND CONSTRUCTION AT THE SITE.

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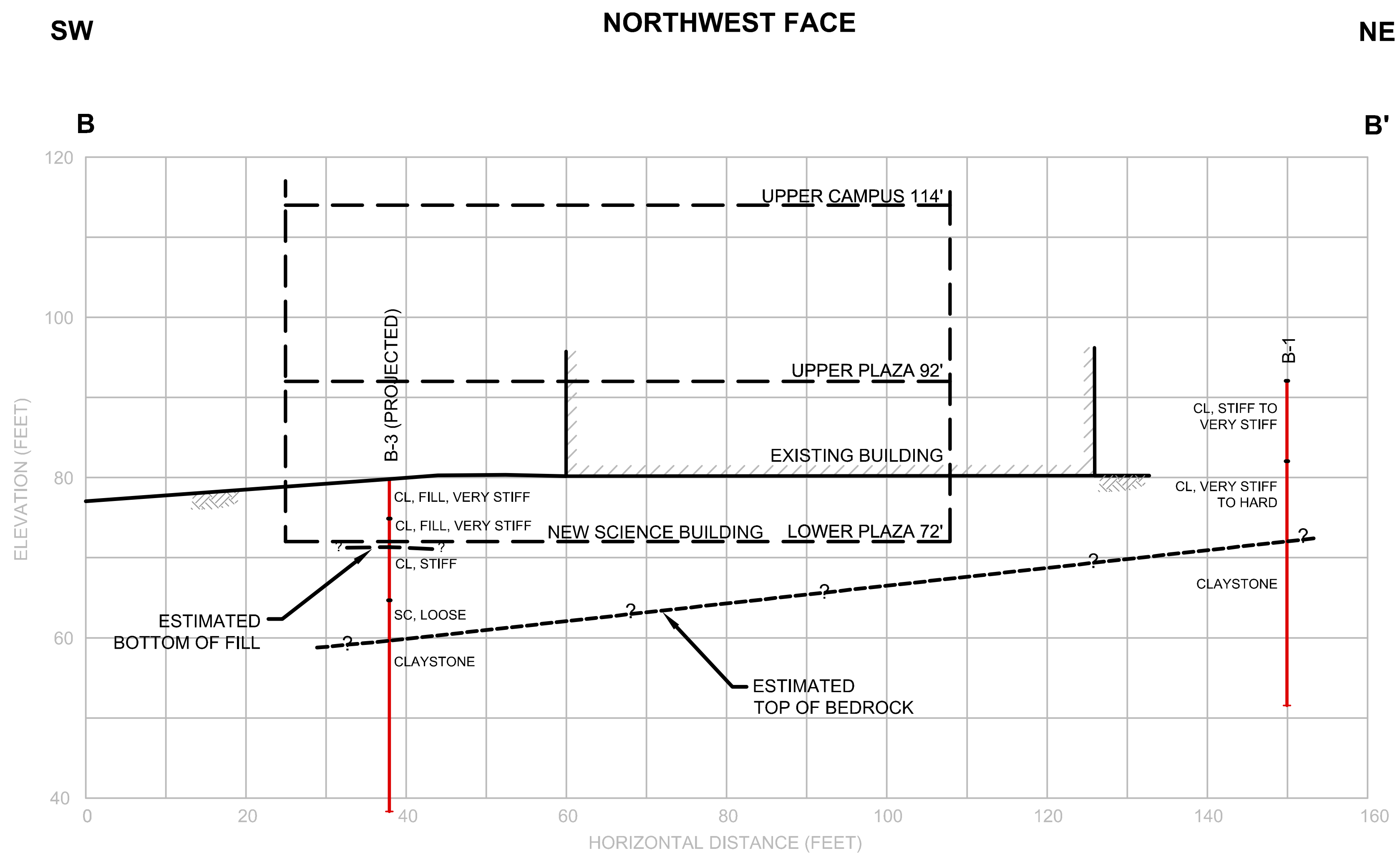
PROJECT NO. 20181569		CROSS SECTION A-A'	PLATE
DRAWN BY	JDS		3
CHECKED BY	EM	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
DATE:	10/04/2017		
REVISED:			



0 20 40

SCALE: 1" = 20' SCALE IN FEET
VERTICAL AND HORIZONTAL

NOTES:

1. SEE FIGURE 2 FOR LOCATION OF CROSS SECTION.
2. " BOTTOM OF FILL LINE" AND "TOP OF BEDROCK LINE" ARE ROUGH ESTIMATED INTERFACE LINES BASED ON LIMITED SUBSURFACE INFORMATION. THE ACTUAL SUBSURFACE CONDITIONS COULD BE SIGNIFICANTLY DIFFERENT FROM THOSE SHOWN ABOVE DUE TO PAST GRADING AND CONSTRUCTION AT THE SITE.

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PROJECT NO. 20181569	CROSS SECTION B-B'	PLATE
DRAWN BY JDS		
CHECKED BY EM	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	4
DATE: 10/04/2017		
REVISED:		

APPENDIX A
LOGS OF TEST BORINGS

SAMPLER AND DRILLING METHOD GRAPHICS

- BULK / GRAB / BAG SAMPLE
- MODIFIED CALIFORNIA SAMPLER (2 or 2-1/2 in. (50.8 or 63.5 mm.) outer diameter)
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)
- SHELBY TUBE SAMPLER
- HOLLOW STEM AUGER
- SOLID STEM AUGER
- WASH BORING

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	**GRAVELS** (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			$Cu < 4$ and/ or $1 > Cc > 3$	**GP**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	$Cu \geq 4$ and $1 \leq Cc \leq 3$	**GW-GM**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GW-GC	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			$Cu < 4$ and/ or $1 > Cc > 3$	**GP-GM**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				GP-GC	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		**GM**	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				GC-GM	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$	**SW**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			$Cu < 6$ and/ or $1 > Cc > 3$	**SP**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	$Cu \geq 6$ and $1 \leq Cc \leq 3$	**SW-SM**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SW-SC	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			$Cu < 6$ and/ or $1 > Cc > 3$	**SP-SM**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				SP-SC	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		**SM**	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				SC-SM	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	**ML**	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		CL-ML	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit greater than 50)	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

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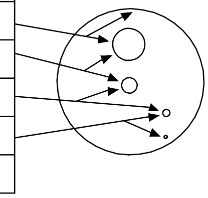
PROJECT NO.: 20181569	GRAPHICS KEY	FIGURE
DRAWN BY: MAP/JDS		
CHECKED BY: OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	A-1
DATE: 9/19/2017		
REVISED: -		

PLOTTED: 09/19/2017 09:36 AM BY: JSala
OFFICE FILTER: PLEASANTON
PROJECT NUMBER: 20181569.001A
gINT FILE: Klf_gint_master_2017
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2017.GLB [LEGEND 1 (GRAPHICS KEY) USCS_STANDARD]

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

	AMOUNT	
Term of Use	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4≤ PP	>8000	Thumbnail will not indent soil.

FROM TERZAGHI AND PECK, 1948; LAMBE AND WHITMAN, 1969; FHWA, 2002; AND ASTM D2488

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL	FIELD TEST
Non-plastic	NP	A 1/8-in. (3 mm.) thread cannot be rolled at any water content.
Low (L)	< 30	The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit.
Medium (M)	30 - 50	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit.
High (H)	> 50	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

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PROJECT NO.:	20181569
DRAWN BY:	MAP/JDS
CHECKED BY:	OK
DATE:	9/19/2017
REVISED:	-

SOIL DESCRIPTION KEY

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-2

INFILLING TYPE

NAME	ABBR	NAME	ABBR
Albite	Al	Muscovite	Mus
Apatite	Ap	None	No
Biotite	Bi	Pyrite	Py
Clay	Cl	Quartz	Qz
Calcite	Ca	Sand	Sd
Chlorite	Ch	Sericite	Ser
Epidote	Ep	Silt	Si
Iron Oxide	Fe	Talc	Ta
Manganese	Mn	Unknown	Uk

DENSITY/SPACING OF DISCONTINUITIES

DESCRIPTION	SPACING CRITERIA
Unfractured	>6 ft. (>1.83 meters)
Slightly Fractured	2 - 6 ft. (0.061 - 1.83 meters)
Moderately Fractured	8 in - 2 ft. (203.20 - 609.60 mm)
Highly Fractured	2 - 8 in (50.80 - 203.30 mm)
Intensely Fractured	<2 in (<50.80 mm)

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	RECOGNITION
Pit (Pitted)	Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings
Vug (Vuggy)	Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.)
Cavity	An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used
Honeycombed	If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form.
Vesicle (Vesicular)	Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification.

ADDITIONAL TEXTURAL ADJECTIVES

DESCRIPTION	CRITERIA
Unweathered	No evidence of chemical / mechanical alternation; rings with hammer blow.
Slightly Weathered	Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered.
Moderately Weathered	Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered.
Highly Weathered	Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out.
Decomposed	Rock reduced to soil with relic rock texture/structure; Generally molded and crumbled by hand.

RELATIVE HARDNESS / STRENGTH DESCRIPTIONS

GRADE		UCS (Mpa)	FIELD TEST
R0	Extremely Weak	0.25 - 1.0	Indented by thumbnail
R1	Very Weak	1.0 - 5.0	Crumbles under firm blows of geological hammer, can be peeled by a pocket knife.
R2	Weak	5.0 - 25	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.
R3	Medium Strong	25 - 50	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of a geological hammer.
R4	Strong	50 - 100	Specimen requires more than one blow of geological hammer to fracture it.
R5	Very Strong	100 - 250	Specimen requires many blows of geological hammer to fracture it.
R6	Extremely Strong	> 250	Specimen can only be chipped with a geological hammer.

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION	RQD (%)
Very Poor	0 - 25
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100

APERTURE

DESCRIPTION	CRITERIA [in (mm)]
Tight	<0.04 (<1)
Open	0.04 - 0.20 (1 - 5)
Wide	>0.20 (>5)

BEDDING CHARACTERISTICS

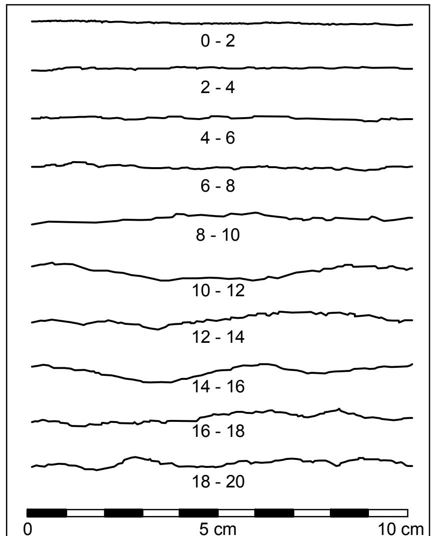
DESCRIPTION	Thickness [in (mm)]
Very Thick Bedded	>36 (>915)
Thick Bedded	12 - 36 (305 - 915)
Moderately Bedded	4 - 12 (102 - 305)
Thin Bedded	1 - 4 (25 - 102)
Very Thin Bedded	0.4 - 1 (10 - 25)
Laminated	0.1 - 0.4 (2.5 - 10)
Thinly Laminated	<0.1 (<2.5)

Bedding Planes — Planes dividing the individual layers, beds, or stratigraphy of rocks.

Joint — Fracture in rock, generally more or less vertical or traverse to bedding.

Seam — Applies to bedding plane with unspecified degree of weather.

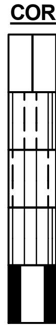
JOINT ROUGHNESS COEFFICIENT (JRC)



From Barton and Choubey, 1977

RQD — Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm. or more.

CORE SAMPLER TYPE GRAPHICS



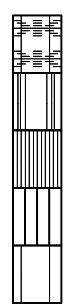
CORE SAMPLER

AQ CORE BARREL (1.067 in. (27.1 mm.) core diameter)

AX CORE BARREL (1.185 in. (30.1 mm.) core diameter)

BQ CORE BARREL (1.433 in. (36.4 mm.) core diameter)

CONTINUOUS CORE SAMPLE (2.000 in. (50.8 mm.) core diameter)



EX CORE BARREL (0.846 in. (21.5 mm.) core diameter)

HQ CORE SAMPLE (2.500 in. (63.5 mm.) core diameter)

NQ CORE SAMPLE (1.874 in. (47.6 mm.) core diameter)

NO RECOVERY CORE SAMPLE

NX CORE SAMPLE (2.154 in. (54.7 mm.) core diameter)

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PROJECT NO.:	20181569
DRAWN BY:	MAP/JDS
CHECKED BY:	OK
DATE:	9/19/2017
REVISED:	-

ROCK DESCRIPTION KEY

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-3

BORING LOG B-1

Date Begin - End: 8/11/2017
Logged By: J. Anderson
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Cloudy
Drilling Co.-Lic.#: Gregg - #CA107979
Drill Crew: Jeremy
Drilling Equipment: Truck Mounted M11
Drilling Method: Hollow Stem Auger
Exploration Diameter: Approx. 6 in.
Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 37.96986° N
Longitude: -122.33678° E
Approximate Ground Surface Elevation (ft.): 92.00
Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		approximately 2-inches of asphalt											
90		**Sandy Lean CLAY with Gravel (CL)**: low plasticity, yellowish brown, moist, stiff to very stiff, subrounded to subangular gravel		BC=5 7 9	12"		18.9	109.7					
85	5	olive brown, stiff to very stiff		BC=5 6 8	12"		19.1	108.8					TXUU: c = 2.12 ksf
80	10	**Sandy Lean CLAY (CL)**: fine-grained sand, some gravel, medium plasticity, reddish yellow mottled, moist, very stiff		BC=6 10 14	12"		14.0	115.8					TXUU: c = 2.55 ksf
75	15	some angular claystone fragments, yellowish brown, hard		BC=12 18 22	12"								
70	20	**CLAYSTONE**: fine-grained, medium plasticity, yellowish brown, moderately weathered, weak to medium strong		BC=22 36 50/5"	11"								
65	25			BC=11 29 50	12"								
60	30	moderately weathered, weak to medium strong, interbedded with siltstone		BC=29 50/3"	8"								

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PROJECT NO.:	20181569
DRAWN BY:	MAP/JDS
CHECKED BY:	OK
DATE:	9/19/2017
REVISED:	-

BORING LOG B-1

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-4

BORING LOG B-1

Date Begin - End: 8/11/2017 | **Drilling Co.-Lic.#:** Gregg - #CA107979
Logged By: J. Anderson | **Drill Crew:** Jeremy
Hor.-Vert. Datum: Not Available | **Drilling Equipment:** Truck Mounted M11 | **Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge: -90 degrees | **Drilling Method:** Hollow Stem Auger
Weather: Cloudy | **Exploration Diameter:** Approx. 6 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 37.96986° N
Longitude: -122.33678° E
Approximate Ground Surface Elevation (ft.): 92.00
Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
55			**CLAYSTONE**: fine-grained, yellowish brown, moderately weathered, medium strong		BC=26 50	2"								
	40		- light brownish gray, slightly weathered, medium strong to strong		BC=44 50/2"	8"								
50														
	45													
45														
	50													
40														
	55													
35														
	60													
30														
	65													
25														

The boring was terminated at approximately 40.5 ft. below ground surface. The boring was backfilled with cement grout on August 11, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.:	20181569
DRAWN BY:	MAP/JDS
CHECKED BY:	OK
DATE:	9/19/2017
REVISED:	-

BORING LOG B-1

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-4

BORING LOG B-2

Date Begin - End:	8/11/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979		
Logged By:	J. Anderson	**Drill Crew:**	Jeremy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Truck Mounted M11	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy	**Exploration Diameter:**	Approx. 6 in.		

FIELD EXPLORATION

Latitude: 37.96973° N
Longitude: -122.33647° E
Approximate Ground Surface Elevation (ft.): 93.00
Surface Condition: Asphalt

LABORATORY RESULTS

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			approximately 2-inches of asphalt											
			Clayey SAND (SC): fine to medium-grained sand, low plasticity, mottled yellowish brown, dry, medium dense		BC=10 12 14	12"								
90			**Lean CLAY (CL)**: medium plasticity, yellowish brown, moist, very stiff					11.3	110.8					
	5		**CLAYSTONE**: fine-grained, yellowish brown, moderately weathered to highly weathered, weak to medium strong		BC=17 18 26	6"								
85														
			reddish yellow, fragmented moderately weathered, weak to medium strong											
	10				BC=16 14 50/4"	10"		9.5	118.9					
80														
	15		olive brown, weak to medium strong		BC=14 36 50/5"	2"								Very hard drilling
75														
	20		- yellowish brown with reddish brown stains, moderately weathered, intensely fractured medium strong		BC=23 50	4"								
70														
	25		weak		BC=13 14 20	2"								
65														
	30		medium-grained, yellow, moderately weathered, weak, highly fractured, interbedded with subrounded gravel		BC=11 18 34	10"								
60														

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DATE:	9/19/2017
REVISED:	-

BORING LOG B-2

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-5

Date Begin - End:	8/11/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979		**BORING LOG B-2**
Logged By:	J. Anderson	**Drill Crew:**	Jeremy		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	Truck Mounted M11	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy	**Exploration Diameter:**	Approx. 6 in.		

Latitude: 37.96973° N
Longitude: -122.33647° E
Approximate Ground Surface Elevation (ft.): 93.00
Surface Condition: Asphalt

Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			CLAYSTONE: fine-grained, yellowish brown, moderately weathered to highly weathered, weak to medium strong		BC=9 29 50/5"	3"								
55			fine-grained, light brownish gray, weak to medium strong, highly fractured											
	40				BC=21 50									
50	45													
45	50													
40	55													
35	60													
30	65													
25														

The boring was terminated at approximately 41 ft. below ground surface. The boring was backfilled with cement grout on August 11, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

BORING LOG B-3

Date Begin - End:	8/18/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979
Logged By:	J. Anderson	**Drill Crew:**	Jeremy and Leo
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	D42
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Overcast	**Exploration Diameter:**	Approx. 6 in.

Hammer Type - Drop: 140 lb. Auto - 30 in.

Latitude: 37.96965° N
Longitude: -122.33695° E
Approximate Ground Surface Elevation (ft.): 80.00
Surface Condition: Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Sandy Lean CLAY (CL): medium plasticity, olive brown, moist, very stiff, (FILL)	BC=3 8 13	12"						27	12	
75	5	**Lean CLAY with Sand (CL)**: medium plasticity, olive brown, moist, very stiff, (FILL)	BC=4 8 12	11"								
		Sandy Lean CLAY (CL): medium plasticity, yellowish brown, moist, stiff										
70	10		BC=2 4 7	12"		26.8	94.7					TXUU: c = 1.25 ksf
65	15	**Clayey SAND (SC)**: non-plastic to low plasticity, yellowish brown, moist, loose	BC=4 4 5	12"	SC				49	33	18	
60	20	**CLAYSTONE**: fine-grained, olive brown, weak to medium strong, interbedded with siltstone	BC=20 42 50/5"	11"								
55	25	light gray, medium strong to strong	BC=40 50/5"	11"								
50	30	moderately to slightly weathered, weak, highly fractured	BC=20 25 26	12"								

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PROJECT NO.:	20181569
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DATE:	9/19/2017
REVISED:	-

BORING LOG B-3

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-6

BORING LOG B-3

Date Begin - End: 8/18/2017
Logged By: J. Anderson
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Overcast
Drilling Co.-Lic.#: Gregg - #CA107979
Drill Crew: Jeremy and Leo
Drilling Equipment: D42
Drilling Method: Hollow Stem Auger
Exploration Diameter: Approx. 6 in.
Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 37.96965° N
Longitude: -122.33695° E
Approximate Ground Surface Elevation (ft.): 80.00
Surface Condition: Grass

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		CLAYSTONE: fine-grained, olive gray, weak		BC=18 27 30	12"								
40	40	olive, medium strong		BC=17 36 50/5"									
35	45												
30	50												
25	55												
20	60												
15	65												

The boring was terminated at approximately 41.5 ft. below ground surface. The boring was backfilled with cement grout on August 18, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.:	20181569
DRAWN BY:	MAP/JDS
CHECKED BY:	OK
DATE:	9/19/2017
REVISED:	-

BORING LOG B-3

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
A-6

Date Begin - End:	8/18/2017	**Drilling Co.-Lic.#:**	Gregg - #CA107979		**BORING LOG B-4**
Logged By:	J. Anderson	**Drill Crew:**	Jeremy and Leo		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	D42	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Overcast	**Exploration Diameter:**	Approx. 6 in.		

Latitude: 37.96953° N
Longitude: -122.33673° E
Approximate Ground Surface Elevation (ft.): 80.00
Surface Condition: Grass

Approximate Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION: Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	LABORATORY RESULTS: USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			Lean Fat CLAY with Sand (CL): medium to high plasticity, olive brown, moist, hard, (FILL)											
					BC=11 13 16 PP=4-4.5+	11"								
75	5		**Lean CLAY with Sand (CL)**: medium plasticity, olive brown, moist, hard, (FILL)		BC=9 12 23 PP=4.5	12"						43	28	
70	10		increase in sand content, very stiff, organics, brick fragments		BC=9 11 12 PP=1.5-1.75									
			with gravel and brick at 11.5 feet											
			Clayey GRAVEL with Sand (GC): dark brown, moist, medium dense, fine to coarse gravel											
65	15				BC=17 18 12									
			Clayey SAND with Gravel (SC): medium to coarse-grained, olive brown, moist, medium dense								16			
60	20		**Sandy CLAYSTONE**: fine-grained, olive, weak to medium strong, moderately weathered, interbedded with siltstone		BC=20 27 25	12"								
55	25		medium strong		BC=18 33 48	12"								
50	30		medium strong to strong		BC=27 50/5"									

The boring was terminated at approximately 31 ft. below ground surface. The boring was backfilled with cement grout on August 18, 2017.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration location and elevation are approximate and were estimated by Kleinfelder.

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PROJECT NO.:	20181569	BORING LOG B-4	FIGURE
DRAWN BY:	MAP/JDS		A-7
CHECKED BY:	OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	
DATE:	9/19/2017		
REVISED:	-		PAGE: 1 of 1

APPENDIX B
LABORATORY DATA

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	2.5	YELLOWISH BROWN SANDY LEAN CLAY WITH GRAVEL (CL)	18.9	109.7							
B-1	6.0	OLIVE BROWN SANDY LEAN CLAY (CL)	19.1	108.8							TXUU: c = 2.12 ksf
B-1	11.0	REDDISH YELLOW MOTTLED SANDY LEAN CLAY (CL)	14.0	115.8							TXUU: c = 2.55 ksf
B-2	2.5	YELLOWISH BROWN LEAN CLAY (CL)	11.3	110.8							
B-2	11.0	REDDISH YELLOW CLAYSTONE	9.5	118.9							
B-3	2.5	OLIVE BROWN CLAYEY SAND (SC)						27	15	12	
B-3	11.0	YELLOWISH BROWN SANDY LEAN CLAY (CL)	26.8	94.7							TXUU: c = 1.25 ksf
B-3	16.0	OLIVE BROWN CLAYEY SAND (SC)					49	33	15	18	
B-4	6.0	OLIVE BROWN LEAN CLAY WITH SAND (CL)						43	15	28	
B-4	16.0	OLIVE BROWN CLAYEY SAND WITH GRAVEL (SC)					16				

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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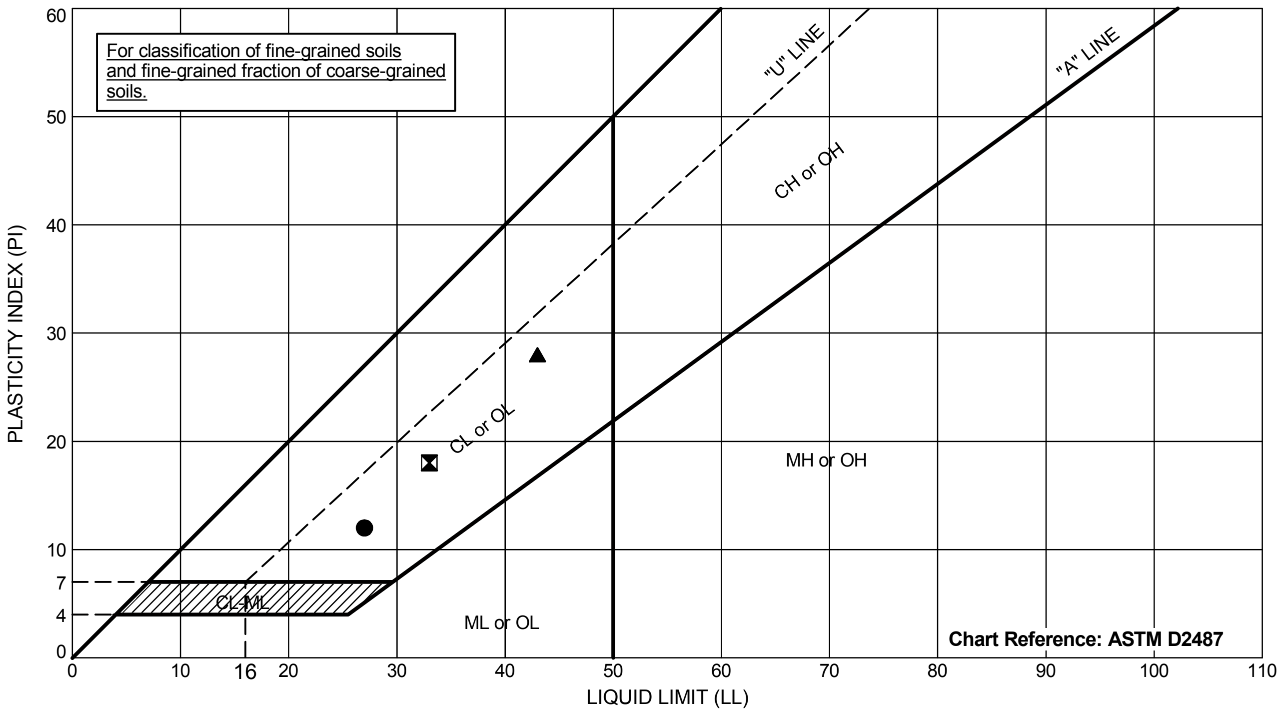
PROJECT NO.: 20181569
DRAWN BY: MAP/JDS
CHECKED BY: OK
DATE: 9/19/2017
REVISED: -

LABORATORY TEST
RESULT SUMMARY

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE
B-1



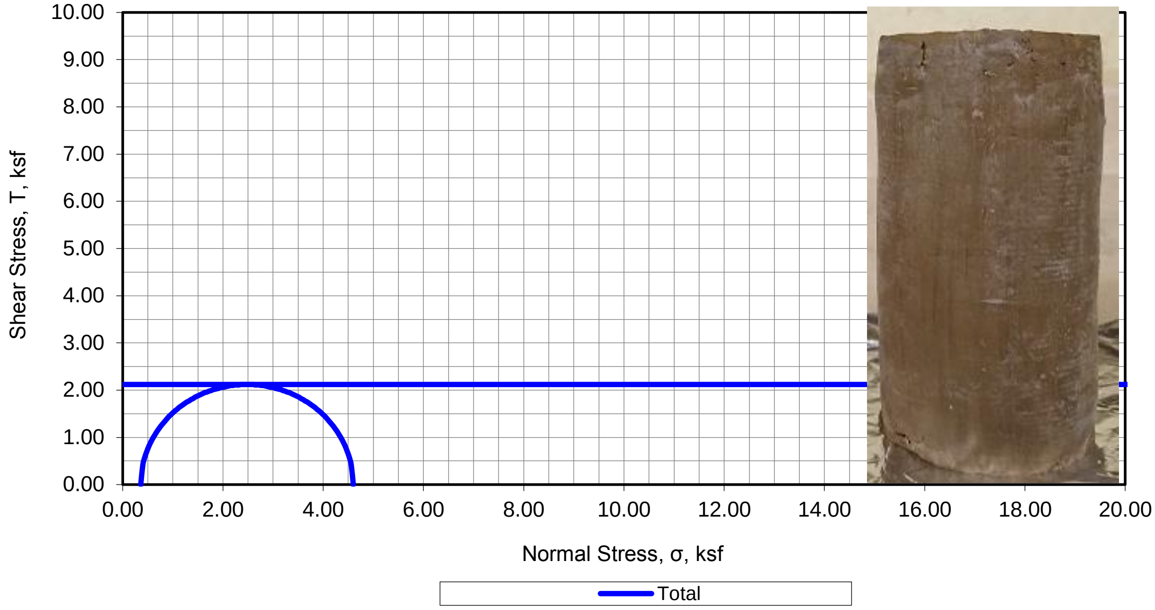
	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B-3	2.5	OLIVE BROWN CLAYEY SAND (SC)	NM	27	15	12
⊠	B-3	16	OLIVE BROWN CLAYEY SAND (SC)	49	33	15	18
▲	B-4	6	OLIVE BROWN LEAN CLAY WITH SAND (CL)	NM	43	15	28

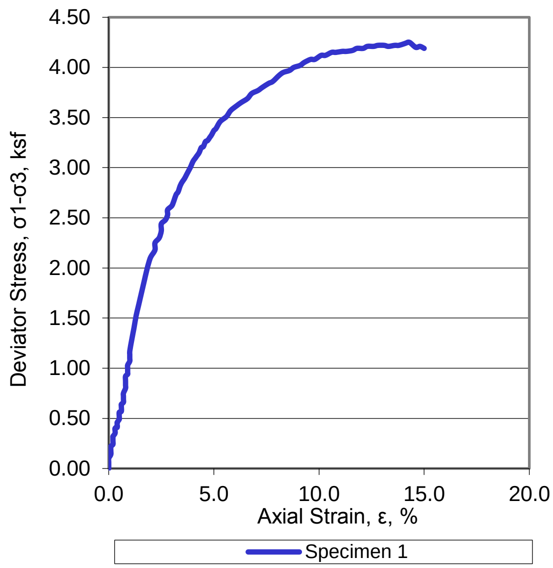
Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20181569	ATTERBERG LIMITS	FIGURE
	DRAWN BY: MAP/JDS		
	CHECKED BY: OK	CONTRA COSTA COMMUNITY COLLEGE NEW SCIENCE BUILDING 2600 MISSION BELL DRIVE SAN PABLO, CALIFORNIA	B-2
	DATE: 9/19/2017		
	REVISED: -		

Total	
c = 2.12	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.39
	Height, in	H_O	5.69
	Water Content, %	ω_O	19.1
	Dry Density, lbs/ft^3	γd_o	108.8
	Saturation, %	S_O	97
	Void Ratio	e_O	0.519
Minor Principal Stress, ksf		σ_3	0.36
Maximum Deviator Stress, ksf		$(\sigma1-\sigma3)_{max}$	4.25
Time to $(\sigma_1\text{-}\sigma_3)_{max}$, min		t_f	14.33
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	4.19
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		'ε	1.00
Axial Strain at Failure, %		ε_f	14.33

Description of Specimen: Olive Brown Sandy Lean Clay (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm	PL: nm	PI: nm	G_S: 2.65 Assumed	Specimen Type: Undisturbed	Test Method: ASTM D2850

Membrane correction applied

Boring:	B-1
Sample:	2C
Depth, ft:	6.0
Test Date:	9/8/17

Remarks: nm= not measured, na = not applicable

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2601 Barrington Ct, Hayward, CA 94545

Project No.:	20181569
Date:	9/11/17
Entry By:	CP
Checked By:	CP
File Name:	HL10558

TRIAXIAL COMPRESSION TEST (UU)

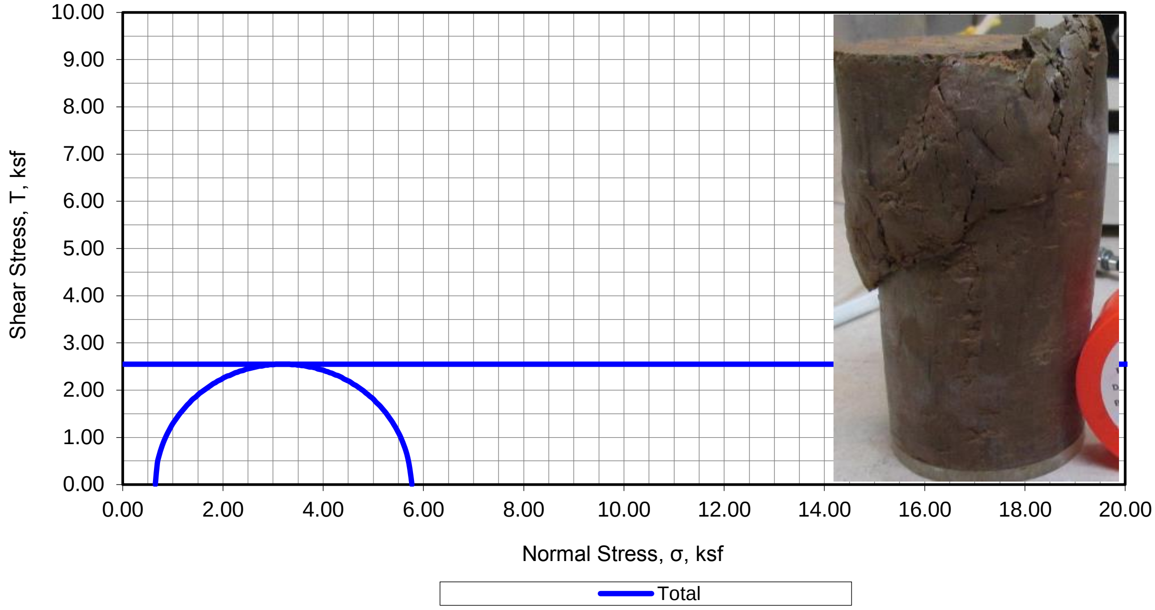
CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

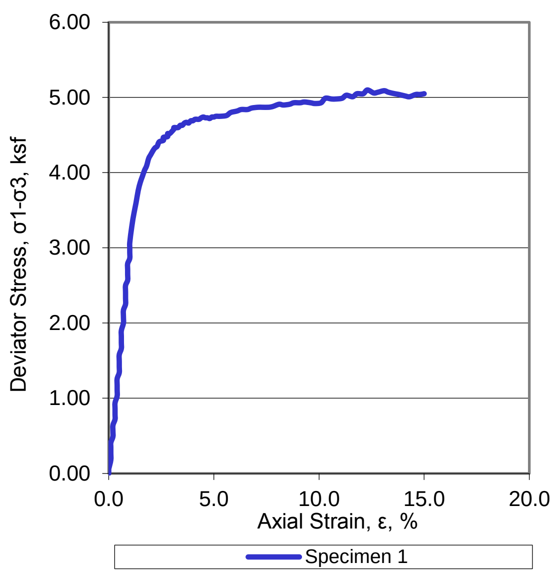
FIGURE

B-3

Total	
c = 2.55	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.43
	Height, in	H_O	5.67
	Water Content, %	ω_O	14.0
	Dry Density, lbs/ft^3	γ_{d_O}	115.8
	Saturation, %	S_O	87
	Void Ratio	e_O	0.428
Minor Principal Stress, ksf		σ_3	0.65
Maximum Deviator Stress, ksf		$(\sigma1-\sigma3)_{max}$	5.10
Time to $(\sigma_1\text{-}\sigma_3)_{max}$, min		t_f	12.33
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	5.05
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		'ε	1.00
Axial Strain at Failure, %		ε_f	12.33

Description of Specimen: Brown Lean Clay with Sand (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm	PL: nm	PI: nm	G_S: 2.65 Assumed	Specimen Type: Undisturbed	Test Method: ASTM D2850

Membrane correction applied

Boring:	B-1
Sample:	3C
Depth, ft:	11.0
Test Date:	9/8/17

Remarks: nm= not measured, na = not applicable

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2601 Barrington Ct, Hayward, CA 94545

Project No.:	20181569
Date:	9/11/17
Entry By:	CP
Checked By:	CP
File Name:	HL10558

TRIAXIAL COMPRESSION TEST (UU)

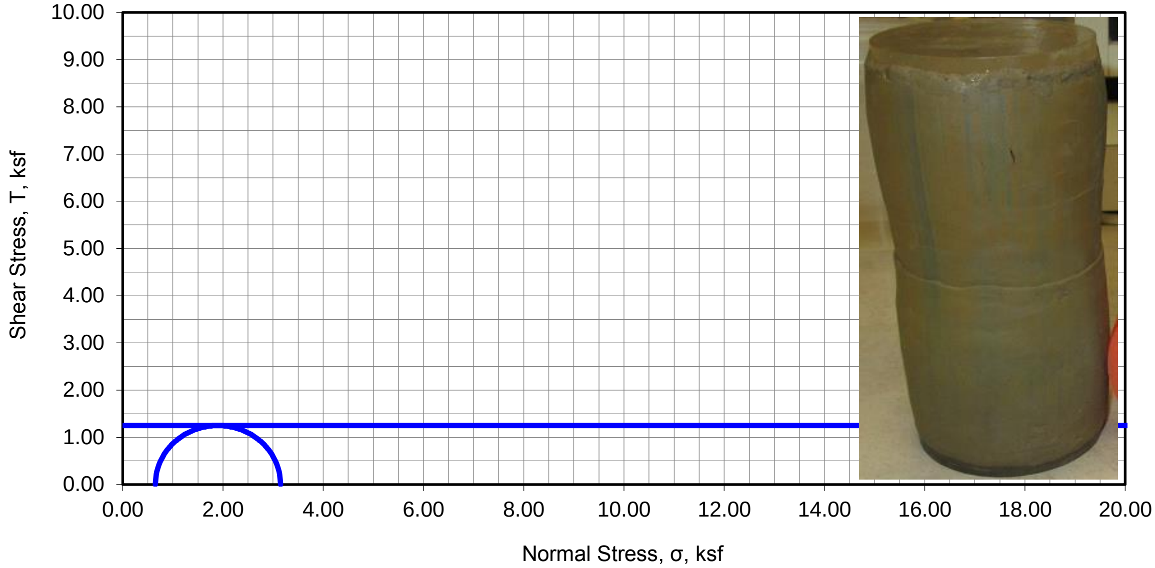
CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

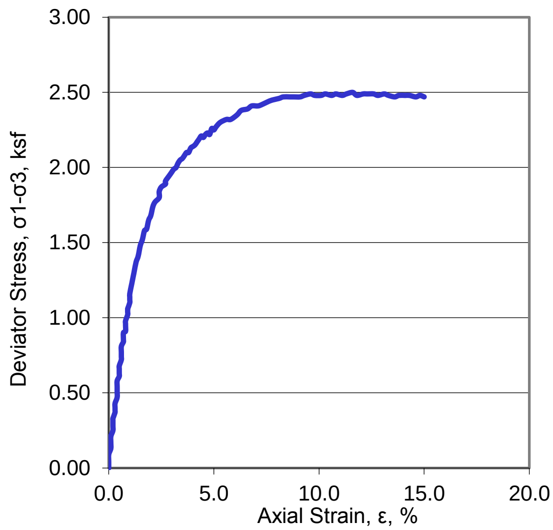
FIGURE

B-4

Total	
c = 1.25	ksf

Specimen Shear Picture





Specimen No.			1
Initial	Diameter, in	D_O	2.43
	Height, in	H_O	5.70
	Water Content, %	ω_O	26.8
	Dry Density, lbs/ft^3	γd_o	94.7
	Saturation, %	S_O	95
	Void Ratio	e_O	0.747
Minor Principal Stress, ksf		σ_3	0.65
Maximum Deviator Stress, ksf		$(\sigma 1-\sigma 3)_{max}$	2.50
Time to $(\sigma_1-\sigma_3)_{max}$, min		t_f	11.58
Deviator Stress @ 15% Axial Strain, ksf		$(\sigma_1-\sigma_3)_{15\%}$	2.47
Ultimate Deviator Stress, ksf		$(\sigma_1-\sigma_3)_{ult}$	na
Rate of strain, %/min		'ε	1.00
Axial Strain at Failure, %		ε_f	11.58

Description of Specimen: Brown Lean Clay (CL)

Amount of Material Finer than the No. 200, %: nm

LL: nm	PL: nm	PI: nm	G_S: 2.65 Assumed	Specimen Type: Undisturbed	Test Method: ASTM D2850

Membrane correction applied

Boring:	B-3
Sample:	3C
Depth, ft:	11.0
Test Date:	9/8/17

Remarks: nm= not measured, na = not applicable

KLEINFELDER
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2601 Barrington Ct, Hayward, CA 94545

Project No.:	20181569
Date:	9/11/17
Entry By:	CP
Checked By:	CP
File Name:	HL10558

TRIAXIAL COMPRESSION TEST (UU)

CONTRA COSTA COMMUNITY COLLEGE
NEW SCIENCE BUILDING
2600 MISSION BELL DRIVE
SAN PABLO, CALIFORNIA

FIGURE

B-5

APPENDIX C
CORROSIVITY TEST RESULTS

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Kleinfelder
Client's Project No.: 20181569
Client's Project Name: Contra Costa College-New Allied Science Bldg. (C-4016)
Date Sampled: 08/11 & 18/17
Date Received: 8-Sep-2017
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 21-Sep-2017

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (As Received) (ohms-cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1709047-001	B-3 2C @ 6'	+440	7.86	720	1,100	N.D.	N.D.	N.D.

	Redox	pH	Resistivity (As Received)	Resistivity (100% Saturation)	Sulfide	Chloride	Sulfate
Method:	ASTM D1498	ASTM D4972	ASTM G57	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	-	-	50	15	15
Date Analyzed:	14-Sep-2017	14-Sep-2017	13-Sep-2017	13-Sep-2017	20-Sep-2017	14-Sep-2017	14-Sep-2017

* Results Reported on "As Received" Basis
N.D. - None Detected

Cheryl McMillen
Laboratory Director

Quality Control Summary - **All laboratory quality control parameters were found to be within established limits**

APPENDIX D

GBA INFORMATION SHEET

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering 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 given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the 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. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include 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 personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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