Appendix E

Geotechnical Investigation

GEOTECHNICAL INVESTIGATION

CUBBERLEY COMMUNITY CENTER
RESTROOM BUILDING
4000 MIDDLEFIELD ROAD
PALO ALTO, CALIFORNIA 94303

Prepared for
City of Palo Alto
Public Works Department
250 Hamilton Avenue
Palo Alto, California 94301

May 2018
Project No. 2520-3

May 11, 2018
2520-3

City of Palo Alto
Public Works Department
250 Hamilton Avenue
Palo Alto, California 94301

RE: GEOTECHNICAL INVESTIGATION
CUBBERLEY COMMUNITY CENTER
RESTROOM BUILDING
4000 MIDDLEFIELD ROAD
PALO ALTO, CALIFORNIA

Attention: Ms. Gloria Yu

Ladies and Gentlemen:

In accordance with your request, we have performed a geotechnical investigation for the proposed restroom building to be constructed at the Cubberley Community Center located at 4000 Middlefield Road in Palo Alto, California. The accompanying report summarizes the results of our field exploration, laboratory testing, and engineering analysis, and presents our geotechnical recommendations for the proposed building.

We refer you to the text of our report for specific recommendations.

Thank you for the opportunity to work with you on this project. If you have any questions or comments about the findings or recommendations from our investigation, please call.

Very truly yours,

ROMIG ENGINEERS, INC.

REGISTERED PROFESSIONAL ENGINEER THOMAS W. PORTER No. 77883 CIVIL STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER GLENN A. ROMIG 002157 GEOTECHNICAL STATE OF CALIFORNIA

Tom W. Porter, P.E. Glenn A. Romig, P.E., G.E.

Copies: Addressee (4)

GAR:TWP:dr

GEOTECHNICAL INVESTIGATION
CUBBERLEY COMMUNITY CENTER
RESTROOM BUILDING
4000 MIDDLEFIELD ROAD
PALO ALTO, CALIFORNIA 94303

PREPARED FOR:

CITY OF PALO ALTO

PUBLIC WORKS DEPARTMENT

250 HAMILTON AVENUE

PALO ALTO, CALIFORNIA 94301

PREPARED BY:

ROMIG ENGINEERS, INC.

1390 EL CAMINO REAL, SECOND FLOOR

SAN CARLOS, CALIFORNIA 94070

MAY 2018

TABLE OF CONTENTS

Page No.

Letter of transmittal
Title Page
TABLE OF CONTENTS
INTRODUCTION....1
Project Description....1
Scope of Work....1
Limitations....2
SITE EXPLORATION AND RECONNAISSANCE....2
Surface Conditions....3
Subsurface Conditions....3
Ground Water....3
GEOLOGIC SETTING....4
Faulting and Seismicity....4
Table 1. Earthquake Magnitudes and Historical Earthquakes....5
Earthquake Design Parameters....6
Table 2. 2016 CBC Seismic Design Criteria....6
CONCLUSIONS....6
SLABS-ON-GRADE....7
General Slab Considerations....7
Building Slab....8
Building Slab Settlement....8
Moisture Considerations....8
Exterior Flatwork....9
EARTHWORK....9
Clearing and Subgrade Preparation....9
Material For Fill....10
Compaction....10
Table 3. Compaction Recommendations....10
Temporary Slopes and Excavations....11
Surface Drainage....11
FUTURE SERVICES....11
Plan Review....11
Construction Observation and Testing....12

REFERENCES
FIGURE 1 - VICINITY MAP
FIGURE 2 - SITE PLAN
FIGURE 3 - VICINITY GEOLOGIC MAP
FIGURE 4 - REGIONAL FAULT AND SEISMICITY MAP

TABLE OF CONTENTS
(Continued)

APPENDIX A - FIELD INVESTIGATION
Figure A-1 - Key to Exploratory Boring Logs
Exploratory Boring Log EB-1

APPENDIX B - SUMMARY OF LABORATORY TESTS
Figure B-1 - Plasticity Chart

GEOTECHNICAL INVESTIGATION
FOR
CUBBERLEY COMMUNITY CENTER
RESTROOM BUILDING
4000 MIDDLEFIELD ROAD
PALO ALTO, CALIFORNIA

INTRODUCTION

We are pleased to present this geotechnical investigation report for the proposed restroom building to be constructed at the Cubberley Community Center located at 4000 Middlefield Road in Palo Alto, California. The location of the site is shown on the Vicinity Map, Figure 1. The purpose of this investigation was to evaluate subsurface conditions at the site and to provide geotechnical design and construction recommendations for the proposed building.

Project Description

The project consists of constructing an approximately 300 square-foot restroom building at the Cubberley Community Center in Palo Alto. The proposed restroom will be a prefabricated building which will be supported on a structural slab-on-grade floor. The proposed restroom will be located adjacent to the existing track and sports field. Structural loads are expected to be relatively light as is typical for this type of construction.

Scope of Work

Our scope of work for this investigation was presented in detail in our agreement with the City of Palo Alto dated March 21, 2018. In order to complete our investigation, we performed the following work.

- Reviewed readily available geologic and geotechnical literature pertinent to the general area of the site.
- Subsurface exploration consisting of shallow hand-sampling of the near surface soil at one location to a depth of about 2 feet in the area of the proposed restroom building.
- Laboratory testing of selected sample to aid in soil classification and to help evaluate their engineering properties.

- Engineering analysis and evaluation of the subsurface data to develop geotechnical design criteria for the project.

- Preparation of this report presenting our findings and geotechnical recommendations for the proposed restroom building.

Limitations

This report has been prepared for the exclusive use of the City of Palo Alto for specific application to developing geotechnical design criteria for the proposed restroom building to be constructed at the Cubberley Community Center located at 4000 Middlefield Road in Palo Alto, California. We make no warranty, expressed or implied, except that our services were performed in accordance with geotechnical engineering principles generally accepted at this time and location. This report was prepared to provide engineering opinions and recommendations only. In the event there are any changes in the nature, design or location of the project, or if any future improvements are planned, the conclusions and recommendations contained in this report should not be considered valid unless 1) the project changes are reviewed by us, and 2) the conclusions and recommendations presented in this report are modified or verified in writing.

The analysis, conclusions, and recommendations presented in this report are based on site conditions as they existed at the time of our investigation; the currently planned improvements; review of previous reports relevant to the site conditions; and laboratory test results. In addition, it should be recognized that certain limitations are inherent in the evaluation of subsurface conditions, and that certain conditions may not be detected during an investigation of this type. Changes in the information or data gained from any of these sources could result in changes in our conclusions or recommendations. If such changes occur, we should be advised so that we can review our report in light of those changes.

SITE EXPLORATION AND RECONNAISSANCE

Site reconnaissance and subsurface exploration were performed on April 27, 2018, using hand-auger and sampling equipment. A sample of near surface soil was collected from a shallow boring at the approximate location of the building. One soil sample was collected from a depth of 1.5 to 2 feet below existing grade. The location of hand-sampled boring is shown on the Site Plan, Figure 2. The boring log and the results of our laboratory tests are attached in Appendices A and B, respectively.

Surface Conditions

The Cubberley Community Center is located in a residential area along the southwest side of Middlefield Road. The park is also generally bordered by residential properties along the northwest and southeast sides and by Nelson Road along the southwest property boundary. At the time of our investigation, the site was a relatively flat public recreation facility. Multiple one and two story classroom, multi-use room and office buildings were located at the northeast side of the site. Asphaltic concrete paved parking lots and drive aisles were located along the northeast (front), southeast, and southwest (rear) sides of the buildings. Concrete walkways were present along the perimeter of the buildings. Multiple baseball and soccer sports fields were located along the southwest side of the site. A decomposed granite track extended along the perimeter of the soccer field and an asphaltic concrete path extended between the baseball and soccer field areas. Multiple tennis courts were located between the buildings and the basement fields. The site was landscaped with lawn grass, small to large shrubs, and medium to large trees.

We did not observe the condition of the existing buildings as part of our investigation. The asphalt pavements had extensive hairline to 1-inch wide cracks and areas of alligator cracking. Where observed, the concrete flatwork had hairline to ½-inch cracks.

Subsurface Conditions

At the location of our shallow boring, which was advanced within in an exposed dirt area at the location of the proposed building, beneath the decomposed granite surface, we encountered stiff sandy lean clay mixed with some clayey sand (possible fill) that extended to a depth of about 1 foot underlain by very stiff sandy fat clay of high plasticity which extended to the maximum depth explored of approximately 2 feet.

A Liquid Limit of 58 and a Plasticity Index of 31 were measured on a sample of near-surface soil. These test results indicate that the surface and near-surface soils at the site have a high plasticity and a high potential for expansion.

Ground Water

Since a deeper subsurface exploration was not conducted, a site specific stabilized ground water level was not obtained. The information presented in Seismic Hazard Zones Map of the Mountain View Quadrangle prepared by the California Division of Mines and Geology in 2006 indicates the historic high depth to ground water to be approximately 5 to 6 feet below existing grades at the site. Please be cautioned that fluctuations in the level of ground water can occur due to variations in rainfall, landscaping, underground drainage patterns, and other factors.

We also reviewed our files for ground water data from several sites located in close proximity to the Cubberley Community Center. Ground water was measured at a depth of 5.5 feet during our investigations at 3994 Sutherland Drive (Romig Engineers, 1999) and encountered at a depth of 16 feet at 4103 Middlefield Road (Romig Engineers, 2016) located approximately 200 feet and 125 feet to the northeast of the site, respectively. Our research also indicated that ground water was encountered at a depth of 9 feet at 4160 Mackay Drive (Romig Engineers, 2015) located approximately 950 feet to the south of the site and at a depth of 16 feet at 3875 Mumford Place located approximately 850 feet to the west of the site. Ground water was not encountered during our investigation at 211 Ely Place (Romig Engineers, 2001) located approximately 1,700 feet to the west of the site.

GEOLOGIC SETTING

We have briefly reviewed our local experience and geologic literature pertinent to the area of the site. The information that we reviewed for this study indicates the site is underlain by Holocene-age basin deposits, Qhb (Brabb, Graymer and Jones, 2000). These deposits are generally expected to consist of firm to stiff, fine silty clay to clay with interbeds of medium dense sand at the edge of alluvial fans between floodplain deposits and soft Bay Mud. The geology of the site vicinity is shown on the Vicinity Geologic Map, Figure 3.

The lot and the immediate vicinity are located in an area that slopes gently to the north (approximately 10 feet vertically per 1000 feet laterally, although locally the topography may be steeper). The site is located at an elevation approximately 22 feet above sea level.

The Seismic Hazard Zones Map of the Mountain View Quadrangle prepared by the California Division of Mines and Geology in 2006 indicates the site is located in an area that may be underlain by soils potentially susceptible to liquefaction during a major earthquake. Based on the limited scope of the project, deep subsurface exploration and laboratory testing to help evaluate the liquefaction potential of the soils below the site was not included in our workscope.

Faulting and Seismicity

There are no mapped through-going faults within or adjacent to the site and the site is not located within a State of California Earthquake Fault Zone (formerly known as a Special Studies Zone), an area where the potential for fault rupture is considered probable. The closest active fault is the San Andreas fault, located approximately 6.5 miles southwest of

the property. Thus, the likelihood of surface rupture occurring from active faulting at the site is remote.

The San Francisco Bay Area is, however, an active seismic region. Earthquakes in the region result from strain energy constantly accumulating because of the northwestward movement of the Pacific Plate relative to the North American Plate. On average about 1.6-inches of movement occur per year. Historically, the Bay Area has experienced large, destructive earthquakes in 1838, 1868, 1906 and 1989. The faults considered most likely to produce large earthquakes in the area include the San Andreas, San Gregorio, Hayward, and Calaveras faults. The San Gregorio fault is located approximately 18 miles southwest of the site. The Hayward and Calaveras faults are located approximately 12 and 17 miles northeast of the site, respectively. These faults and significant earthquakes that have been documented in the Bay Area are listed in Table 1 on the following page and are shown on the Regional Fault and Seismicity Map, Figure 4.

Table 1. Earthquake Magnitudes and Historical Earthquakes
Cubberley Community Center Restroom Building
Palo Alto, California

Fault	Maximum Magnitude (Mw)	Historical Earthquakes		Estimated Magnitude
San Andreas	7.9	1989	Loma Prieta	6.9
		1906	San Francisco	7.9
		1865	N. of 1989 Loma Prieta Earthquake	6.5
		1838	San Francisco-Peninsula Segment	6.8
		1836	East of Monterey	6.5
Hayward	7.1	1868	Hayward	6.8
		1858	Hayward	6.8
Calaveras	6.8	1984	Morgan Hill	6.2
		1911	Morgan Hill	6.2
		1897	Gilroy	6.3
San Gregorio	7.3	1926	Monterey Bay	6.1

In the future, the subject property will undoubtedly experience severe ground shaking during moderate and large magnitude earthquakes produced along the San Andreas fault or other active Bay Area fault zones. Using information from recent earthquakes, improved mapping of active faults, ground motion prediction modeling, and a new model for estimating earthquake probabilities, a panel of experts convened by the U.S.G.S. have concluded there is a 72 percent chance for at least one earthquake of Magnitude 6.7 or larger in the Bay Area before 2043. The Hayward fault has the highest likelihood of an earthquake greater than or equal to magnitude 6.7 in the Bay Area, estimated at 33

percent, while the likelihood on the San Andreas and Calaveras faults is estimated at approximately 22 and 26 percent, respectively (Aagaard et al., 2016).

Earthquake Design Parameters

The State of California currently requires that buildings and structures be designed in accordance with the seismic design provisions presented in the 2016 California Building Code and in ASCE 7-10, "Minimum Design Loads for Buildings and Other Structures." Based on site geologic conditions and on information from our subsurface exploration at the site, the site may be classified as Site Class D, stiff soil, in accordance with Chapter 20 of ASCE 7-10. Spectral Response Acceleration parameters and site coefficients may be taken directly from the U.S.G.S. website based on the longitude and latitude of the site. For site latitude (37.4157), longitude (-122.1083) and Site Class D, design parameters are presented on Table 2 below.

Table 2. 2016 CBC Seismic Design Criteria
Cubberley Community Center Restroom Building
Palo Alto, California

Spectral Response Acceleration Parameters			Design Value
Mapped Value for Short Period	-	S_S	1.00
Mapped Value for 1-sec Period	-	S_1	0.647
Site Coefficient	-	F_a	1.0
Site Coefficient	-	F_v	1.5
Adjusted for Site Class	-	S_{MS}	1.50
Adjusted for Site Class	-	S_{M1}	0.970
Value for Design Earthquake	-	S_{DS}	1.00
Value for Design Earthquake	-	S_{D1}	0.647

CONCLUSIONS

From a geotechnical viewpoint, the site is suitable for the proposed restroom building provided the recommendations presented in this report are followed during design and construction. Specific recommendations are provided in the following sections of this report.

The primary geotechnical concern at the site is the presence of highly expansive near surface soils underlying the proposed building site. We understand that the prefabricated restroom building will have relatively light structural loads. We understand that the restroom building has been designed using code minimum values for geotechnical parameters; in our opinion, this is acceptable from a geotechnical viewpoint. In our

opinion, in order to help reduce the potential for damage from the effects of the expansive soils on the proposed building, we recommend the floor slab should be designed more heavily reinforced and at least 7 to 8 inches in thickness and that a layer of non-expansive fill be placed below structural slab floor as well as below exterior concrete flatwork.

Our staff will need to observe the condition of the existing surface fill encountered below the building slab floor, however we expect that the surface fills will be removed during excavation of the recommended non-expansive fill section below the slab. However, in our opinion, where fill or disturbed surface soil is not removed during site grading below the proposed slab floor, it should be excavated down to stiff native soil during site preparation. The reworking of designated surface soils and subgrade preparation should proceed as recommended in the section of this report titled "Earthwork."

Because subsurface conditions may vary from those anticipated from our study, and to observe that our recommendations are properly implemented, we recommend that we be retained to 1) review the project plans for conformance with our report recommendations and 2) observe and test the earthwork and foundation installation phases of construction.

SLABS-ON-GRADE

General Slab Considerations

The near surface soils at the site have a high expansion potential. Expansive soils have a tendency to expand due to increases in moisture content and shrink as they dry. This can result in some slab cracking and heave regardless of the geotechnical measures implemented. Our recommendations below will help mitigate the impacts of the expansive soils beneath slabs-on-grade, but will not eliminate the risk entirely.

To reduce the potential for movement of the slab subgrade, at least the upper 6-inches of expansive soil should be scarified and compacted at a moisture content at least 3 percent above the laboratory optimum. The native soil subgrade should be kept moist up until the time the non-expansive fill, crushed rock and vapor barrier, and/or aggregate base is placed. Slab subgrades and non expansive fill should be prepared and compacted as recommended in the section of this report titled "Earthwork." Exterior flatwork and interior slabs-on-grade should be underlain by a layer of non expansive fill as discussed below. The non expansive fill should consist of aggregate base rock or a clayey soil with a plasticity index of 15 or less.

Considering the potential for expansive soil movements of the surface soils, we expect that a reinforced slab will perform better than an unreinforced slab. Consideration should

also be given to using a control joint spacing on the order of 2 feet in each direction for each inch of slab thickness for exterior flatwork.

Building Slab

We recommend that the concrete slab-on-grade building floor be constructed on a layer of non-expansive fill at least 24-inches thick. The lower 18-inches of non expansive fill should be an aggregate base rock or other non expansive soil approved by our office.

Due to the expansive soils underlying the proposed building for improved performance, we recommend the structural floor slab should be designed more heavily reinforced and at least 7 to 8 inches in thickness, in our opinion.

Building Slab Settlement

Thirty year post-construction differential settlement due to static loads is not expected to exceed about 1-inch across the proposed structural slab supported the restroom building, provided the structural slab is designed and constructed as recommended.

Moisture Considerations

In areas where dampness of concrete floor slabs would be undesirable, such as within building interiors, concrete slabs should be underlain by at least 6 inches of clean, free-draining gravel, such as ½-inch to ¾-inch clean crushed rock with no more than 5 percent passing the ASTM No. 200 sieve. Pea gravel should not be used. The crushed rock should be compacted with vibratory equipment. To reduce vapor transmission up through at-grade concrete floor slabs, the crushed rock section should be covered with a high-quality, UV-resistant membrane vapor retarder meeting the minimum ASTM E 1745, Class C requirements or better. If moisture-sensitive floor coverings are proposed and/or additional protection is desired by the owner, a higher quality vapor barrier conforming to the requirements of ASTM E 1745 Class A, with a water vapor transmission rate less than or equal to 0.01 perms (such as 15-mil thick "Stego Wrap Class A") may be used rather than a Class C vapor retarder. The vapor retarder or barrier should be placed directly below the concrete slab. Sand above the vapor retarder/barrier is not recommended. The vapor retarder/barrier should be installed in accordance with ASTM E 1643. All seams and penetrations of the vapor barrier should be sealed in accordance with manufacturer's recommendations. The crushed rock may be considered as the 6-inches of the non-expansive fill recommendation.

The permeability of concrete is affected significantly by the water:cement ratio of the mix, with lower water:cement ratios producing more damp-resistant slabs (or basement retaining walls) and higher strength. Where moisture protection is important and/or

where the concrete will be placed directly on the vapor barrier, the water:cement ratio should be 0.45 or less. To increase the workability of the concrete, mid-range plasticizers may be added to the mix. Water should not be added to the mix unless the slump is less than specified and the water:cement ratio will not exceed 0.45. Other steps that may be taken to reduce moisture transmission through concrete slabs-on-grade include moist curing for 5 to 7 days and allowing the slab to dry for a period of two months or longer prior to placing floor coverings. Prior to installation of floor coverings, it may be appropriate to test the slab moisture content for adherence to the manufacturer's requirements to determine whether a longer drying time is necessary.

Exterior Flatwork

Concrete walkways and exterior flatwork should be at least 4 inches thick and should be constructed on at least 12 inches of Class 2 aggregate base. The potential for distress to exterior slabs due to expansive soil movements could be reduced by placing and compacting at least 12 inches of non-expansive fill, or aggregate base, below the minimum 12-inch thick layer of aggregate base recommended above. We recommend that exterior slabs-on-grade be constructed with a thickened edge to improve edge stiffness and to reduce the potential for water seepage under the edge of the slabs.

EARTHWORK

Clearing and Subgrade Preparation

All deleterious materials, such as existing slabs, soft surface soils, pavements, utility lines, vegetation, roots, topsoil, existing fill, etc., should be cleared from areas of the site to be built on or paved. The actual stripping depth should be determined by a member of our staff in the field at the time of construction. Excavations that extend below finished grade should be backfilled with structural fill that is water-conditioned, placed, and compacted as recommended in the section of this report titled "Compaction."

After the site has been properly cleared and stripped, and excavations to proposed grade have been made, exposed soil surfaces in areas to receive structural fill, foundations, slabs-on-grade, and pavements should be scarified to a depth of 6 inches, moisture conditioned, and compacted as recommended for structural fill in the section of this report titled "Compaction."

In our opinion, any surface fill or disturbed surface soils which are not removed during site grading, the fill/disturbed surface soil should be excavated down to stiff native soil during site preparation under the direction of our staff.

On-site soils should be kept in a moist condition throughout the construction period to mitigate the potential effects of the expansive on-site soils on the proposed improvements.

Material For Fill

On-site soil containing less than 3 percent organic material by volume (ASTM D2974) should be suitable for use as structural fill (but not as non-expansive fill below concrete slabs-on-grade). Structural fill should not contain rocks or pieces larger than 6 inches in greatest dimension and no more than 15 percent larger than 2.5 inches. Imported non-expansive fill should have a Plasticity Index no greater than 15, should be predominately granular, and should have sufficient binder so as not to slough or cave into foundation excavations or utility trenches. Our representative should approve proposed import materials prior to their delivery to the site.

Compaction

Scarified surface soils and all structural fill should be compacted in uniform lifts no thicker than 8-inches in uncompacted thickness, conditioned to the appropriate moisture content, and compacted as recommended for structural fill in Table 3 below. The relative compaction and moisture content recommended in Table 3 is relative to ASTM Test D1557, latest edition.

Table 3. Compaction Recommendations
Cubberley Community Center Restroom Building
Palo Alto, California

General	Relative Compaction*	Moisture Content*
• Scarified subgrade in areas to receive structural fill.	87 to 92 percent	At least 3 percent above optimum
• Structural fill composed of non-expansive fill.	90 percent	Above optimum
Utility Trench Backfill		
• On-site soil.	87 to 92 percent	At least 3 percent above optimum
• Imported sand.	93 percent	Near optimum

* Relative to ASTM Test D1557, latest edition.

Temporary Slopes and Excavations

The contractor should be responsible for the design and construction of all temporary slopes and any required shoring. Shoring and bracing should be provided in accordance with all applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards.

Because of the potential for variation of the on-site soils, field modification of temporary cut slopes may be required. Unstable materials encountered on slopes during and after excavation should be trimmed off even if this requires cutting the slopes back to a flatter inclination. Protection of structures near excavations will also be the responsibility of the contractor.

Surface Drainage

Finished grades should be designed to prevent ponding and to drain surface water away from foundations, edges of slopes, slabs and pavements, and toward suitable collection and discharge facilities. Slopes of at least 2 percent are recommended. At a minimum, splash blocks should be provided at the ends of downspouts to carry surface water away from perimeter of the building. Preferably, downspout drainage should be collected in a closed pipe system that is routed to a storm drain system or other suitable discharge outlet.

Drainage facilities should be observed to verify that they are adequate and that no adjustments need to be made, especially during the first two years following construction. We recommend preparing an as-built plan showing the locations of surface and subsurface drain lines and clean-outs. The drainage facilities should be periodically checked to verify that they are continuing to function properly. It is likely the drainage facilities will need to be periodically cleaned of silt and debris that may build up in the lines.

FUTURE SERVICES

Plan Review

Romig Engineers should review the completed grading and foundation plans for conformance with the recommendations contained in this report. We should be provided with these plans as soon as possible upon completion in order to limit the potential for delays in the permitting process that might otherwise be attributed to our review process. In addition, it should be noted that many of the local building and planning departments now require “clean” geotechnical plan review letters prior to acceptance of plans for their

final review. Since our plan reviews typically result in recommendations for modification of the plans, our generation of a "clean" review letter often requires two iterations. At a minimum, we recommend the following note be added to the plans:

"Earthwork, foundation construction, slab subgrade preparation, utility trench backfill, and site drainage should be performed in accordance with the geotechnical report prepared by Romig Engineers, Inc., dated May 11, 2018. Romig Engineers should be notified at least 48 hours in advance of any earthwork and should observe and test during earthwork and foundation construction as recommended in the geotechnical report."

Construction Observation and Testing

The earthwork and foundation phases of construction should be observed and tested by us to 1) establish that subsurface conditions are compatible with those used in the analysis and design; 2) observe compliance with the design concepts, specifications and recommendations; and 3) allow design changes in the event that subsurface conditions differ from those anticipated. The recommendations in this report are based on a limited amount of subsurface exploration. The nature and extent of variation across the site may not become evident until construction. If variations are exposed during construction, it will be necessary to reevaluate our recommendations.

❖ ❖ ❖ ❖ ❖

REFERENCES

Aagaard, B.T., Blair, J.L., Boatwright, J., Garcia, S.H., Harris, R.A., Michael, A.J., Schwartz, D.P., and DiLeo, J.S., 2016, Earthquake outlook for the San Francisco Bay region 2014–2043 (ver. 1.1, August 2016): U.S. Geological Survey Fact Sheet 2016–3020, 6 p., http://dx.doi.org/10.3133/fs20163020.

American Society of Civil Engineers, 2010, Minimum Design Loads for Buildings and Other Structures, ASCE Standard 7-10.

Brabb, E.E., Graymer, R.W., and Jones, D.L., 2000, Geology of the Palo Alto 30 x 30 Minute Quadrangle, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-2332.

California Building Standards Commission, and International Code Council, 2016 California Building Code, California Code of Regulations, Title 24, Part 2.

California Geological Survey, 2006, Seismic Hazard Zone Report for the Palo Alto 7.5-Minute Quadrangle, San Mateo and Santa Clara Counties, California, Seismic Hazard Zone Report 111.

California Geological Survey, 2006, Seismic Hazard Zones Map of the Palo Alto Quadrangle.

California Geological Survey, 2011, Probabilistic Seismic Hazards Mapping Ground Motion Page, http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamap.asp/

Romig Engineers, Inc., January 19, 1999, Geotechnical Investigation, Sherman Residence, 3994 Sutherland Drive, Palo Alto, California, Project No. 327-1.

Romig Engineers, Inc., October 2, 2001, Geotechnical Investigation, Residence Addition, 211 Ely Place, Palo Alto, California, Project No. 795-1.

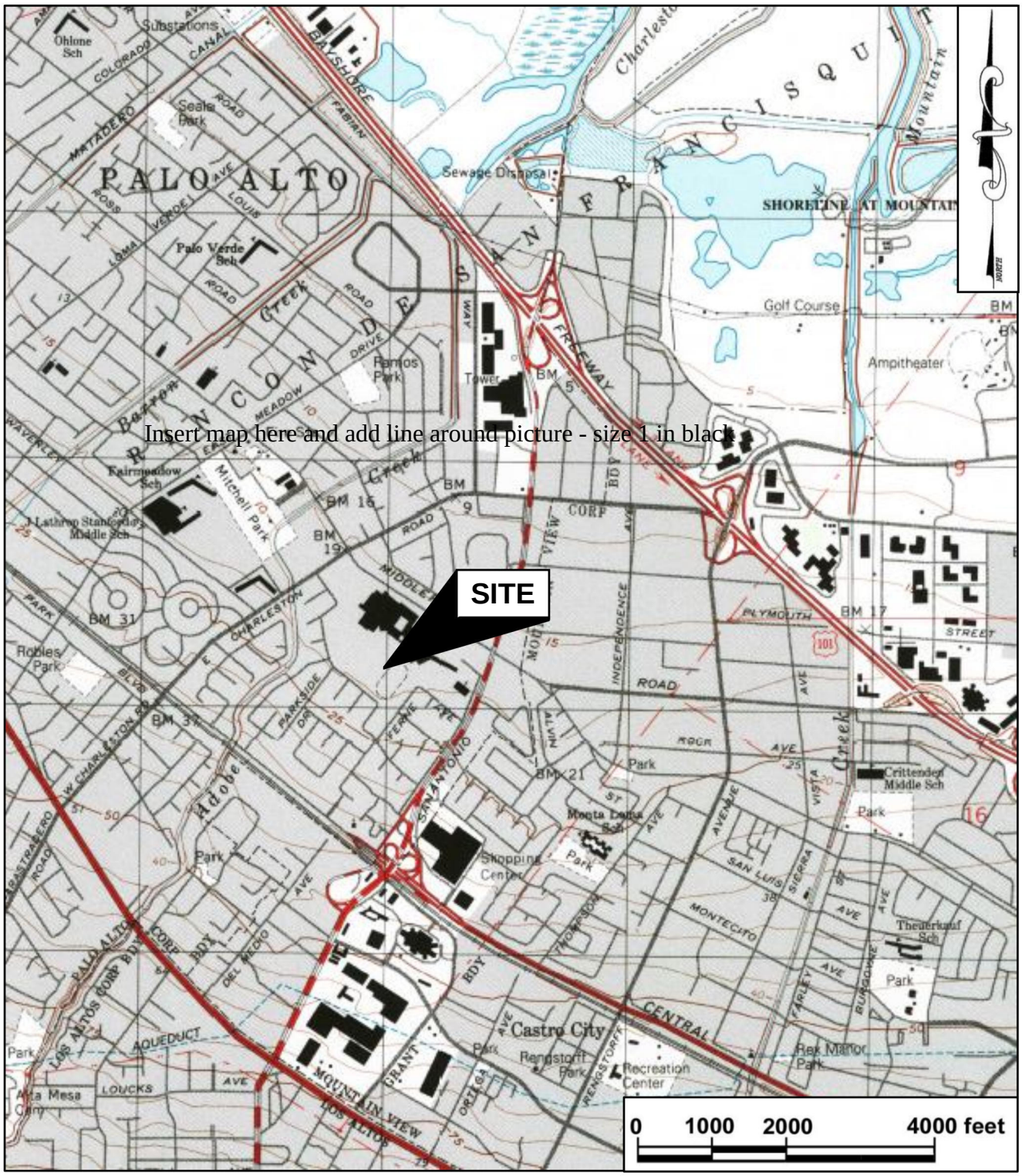
Romig Engineers, Inc., January 6, 2015, Geotechnical Investigation, Chong Residence, 4160 Mackay Drive, Palo Alto, California, Project No. 3310-1.

Romig Engineers, Inc., May 2, 2016, Geotechnical Investigation, Ruskus-Mulkey Residence Addition, 4103 Middlefield Drive, Palo Alto, California, Project No. 3726-1.

Romig Engineers, Inc., August 15, 2016, Geotechnical Investigation, Chu-Yu Residence, 3875 Mumford Place, Palo Alto, California, Project No. 3831-1.

U.S.G.S., 2018, U.S. Seismic Design Maps, Earthquake Hazards Program, http://earthquake.usgs.gov/designmaps/us/application.php

❖ ❖ ❖ ❖ ❖



Scale: 1 inch = 2000 feet
Base is United States Geological Survey Mountain View 7.5 Minute Quadrangle, dated 1997.

VICINITY MAP **FIGURE 1**
CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING MAY 2018
PALO ALTO, CALIFORNIA PROJECT NO. 2520-3

ROMIG ENGINEERS

LEGEND

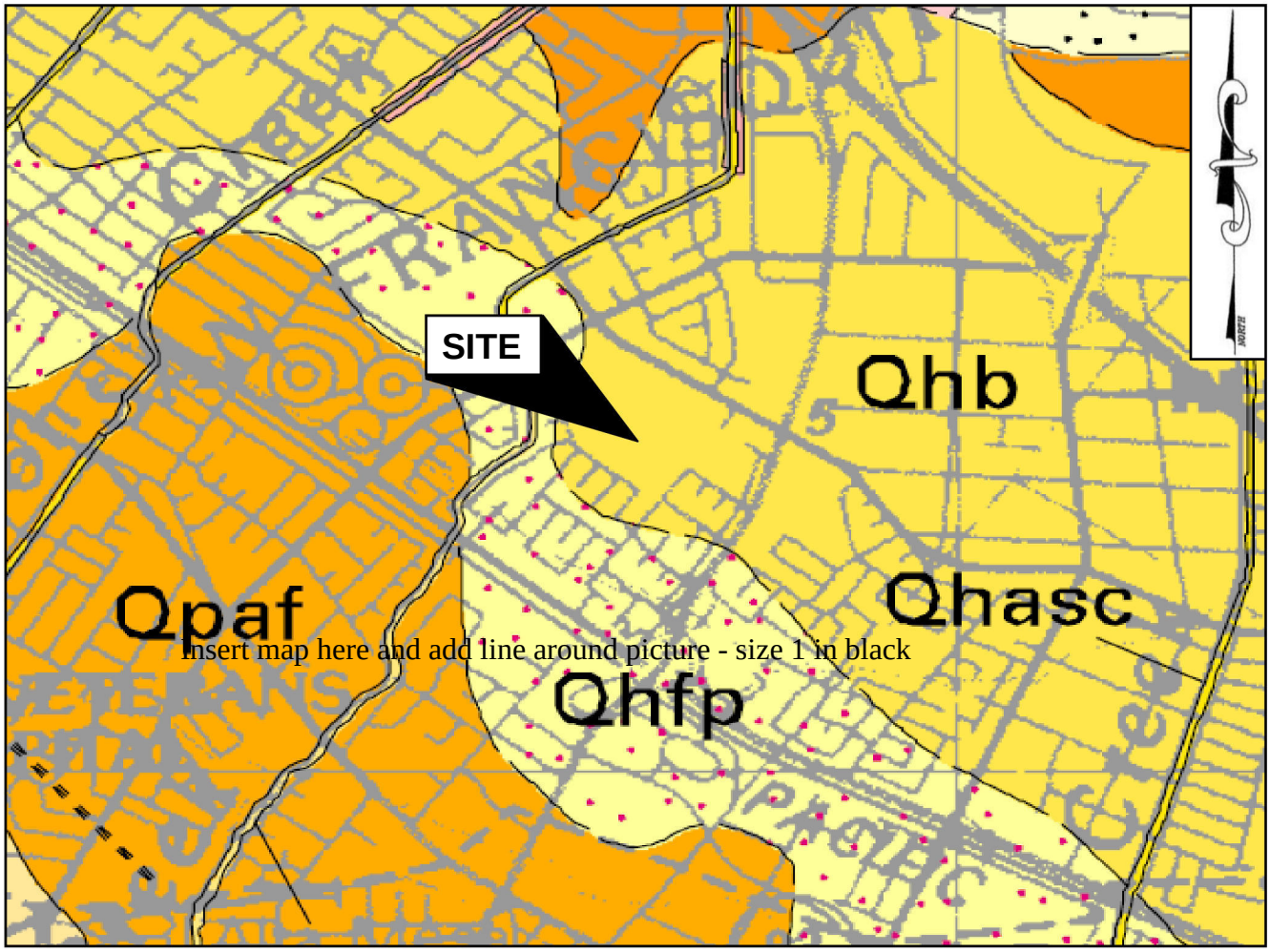
EB-1 Approximate Locations of Exploratory Boring.
Approximate Scale: 1 inch = 200 feet.
Base is aerial photo from Google Earth, 2018.

0 100 200 400 feet

SITE PLAN
CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING
PALO ALTO, CALIFORNIA

FIGURE 2
MAY 2018
PROJECT NO. 2520-3

ROMIG ENGINEERS



MAP LEGEND

Qhasc	Artificial stream channels
Qhb	Basin deposits
Qhfp	Floodplain Deposits
Qpaf	Alluvial Fan and fluvial deposits

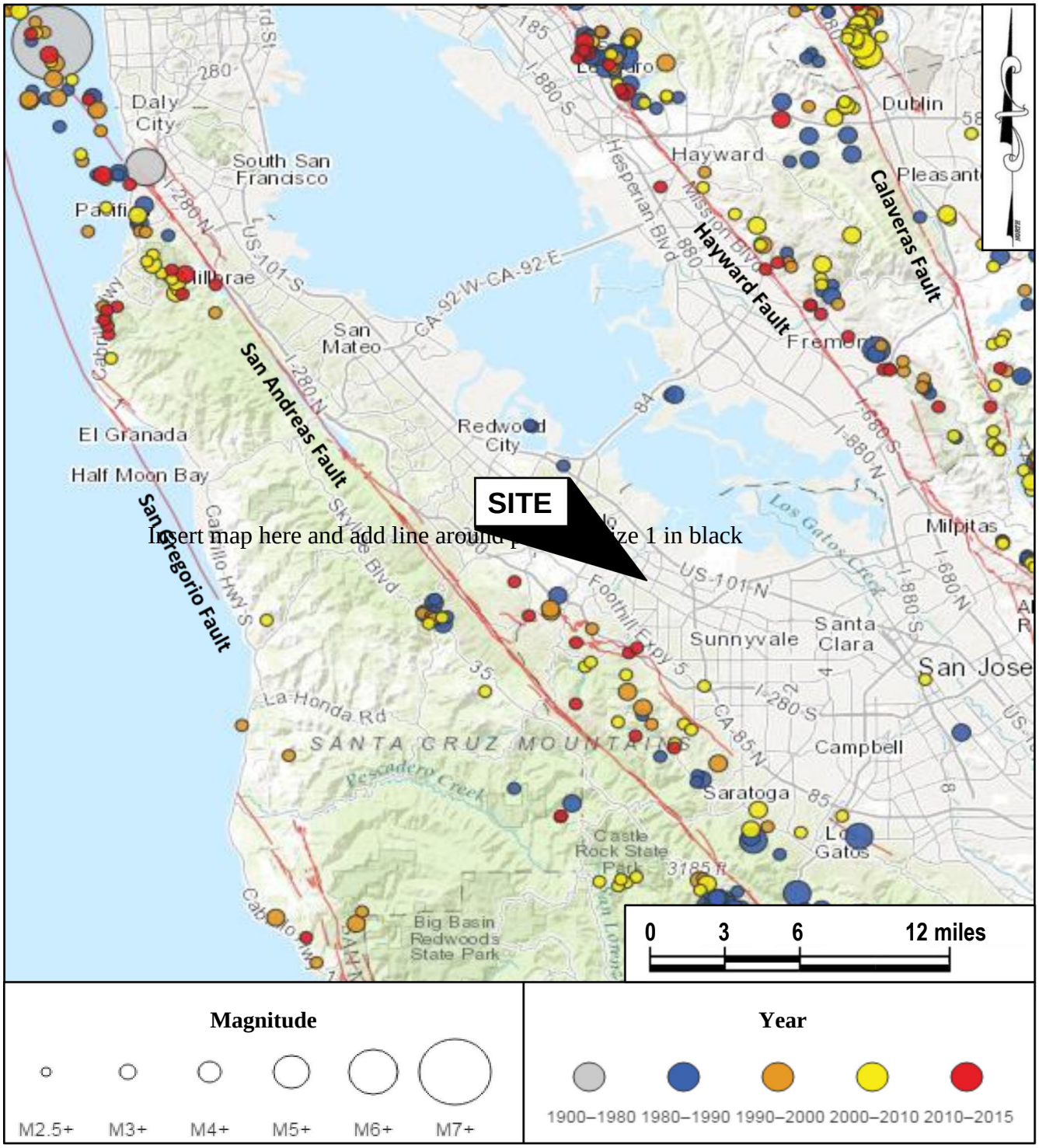
Geologic Contact - dashed where approximate, dotted where inferred.

0 1000 2000 4000 feet

Scale: 1 inch = 2000 feet
Base is Geologic Map of Palo Alto 30 x 60 Minute Quadrangle (Brabb, Graymer, and Jones, 2000).

VICINITY GEOLOGIC MAP **FIGURE 3**
CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING MAY 2018
PALO ALTO, CALIFORNIA PROJECT NO. 2520-3

ROMIG ENGINEERS, INC.



Earthquakes with M5+ from 1900 to 1980, M2.5+ from 1980 to January 2015. Faults with activity in last 15,000 years. Based on data sources from Northern California Earthquake Data Center and USGS Quaternary Fault and Fold Database, accessed May 2015.

REGIONAL FAULT AND SEISMICITY MAP **FIGURE 4**

CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING MAY 2018

PALO ALTO, CALIFORNIA PROJECT NO. 2520-3

ROMIG ENGINEERS

APPENDIX A

FIELD INVESTIGATION

The soils encountered during hand-sampling were logged by our representative and the sample was obtained at a depth appropriate to the investigation. The samples were taken to our laboratory where they were evaluated and classified in accordance with the Unified Soil Classification System. The log of our boring, as well as a summary of the soil classification system (Figure A-1), are attached.

The location of the boring was established by pacing using the site plan provided to us. The location of the boring should be considered accurate only to the degree implied by the method used.

The boring log and related information depict our interpretation of subsurface conditions only at the specific location and time indicated. Subsurface conditions and ground water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time may also result in changes in the subsurface conditions.

❖ ❖ ❖ ❖ ❖

USCS SOIL CLASSIFICATION

PRIMARY DIVISIONS			SOIL TYPE	SECONDARY DIVISIONS
COARSE GRAINED SOILS (< 50 % Fines)	GRAVEL	CLEAN GRAVEL (< 5% Fines)	**GW**	Well graded gravel, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravel or gravel-sand mixtures, little or no fines.
		GRAVEL with FINES	**GM**	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SAND	CLEAN SAND (< 5% Fines)	**SW**	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SAND WITH FINES	**SM**	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS (> 50 % Fines)	SILT AND CLAY Liquid limit < 50%		**ML**	Inorganic silts and very fine sands, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, lean clays.
			OL	Organic silts and organic clays of low plasticity.
	SILT AND CLAY Liquid limit > 50%		**MH**	Inorganic silt, micaceous or diatomaceous fine sandy or silty soil.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			**Pt**	Peat and other highly organic soils.
BEDROCK			**BR**	Weathered bedrock.

RELATIVE DENSITY

SAND & GRAVEL	BLOWS/FOOT*
VERY LOOSE	0 to 4
LOOSE	4 to 10
MEDIUM DENSE	10 to 30
DENSE	30 to 50
VERY DENSE	OVER 50

CONSISTENCY

SILT & CLAY	STRENGTH^	BLOWS/FOOT*
VERY SOFT	0 to 0.25	0 to 2
SOFT	0.25 to 0.5	2 to 4
FIRM	0.5 to 1	4 to 8
STIFF	1 to 2	8 to 16
VERY STIFF	2 to 4	16 to 32
HARD	OVER 4	OVER 32

GRAIN SIZES

BOULDERS	COBBLES	GRAVEL		SAND			SILT & CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	
	12 "	3"	0.75"	4	10	40	200
	SIEVE OPENINGS			U.S. STANDARD SERIES SIEVE			

Classification is based on the Unified Soil Classification System; fines refer to soil passing a No. 200 sieve.

* Standard Penetration Test (SPT) resistance, using a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler; blow counts not corrected for larger diameter samplers.

^ Unconfined Compressive strength in tons/sq. ft. as estimated by SPT resistance, field and laboratory tests, and/or visual observation.

KEY TO SAMPLERS

Modified California Sampler (3-inch O.D.)
Mid-size Sampler (2.5-inch O.D.)
Standard Penetration Test Sampler (2-inch O.D.)

KEY TO EXPLORATORY BORING LOGS **FIGURE A-1**
CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING MAY 2018
PALO ALTO, CALIFORNIA PROJECT NO. 2520-3

ROMIG ENGINEERS

DRILL TYPE: Hand Auger **LOGGED BY:** TWP

DEPTH TO GROUND WATER: Not Encountered **SURFACE ELEVATION:** NA **DATE DRILLED:** 4/27/18

CLASSIFICATION AND DESCRIPTION	SOIL CONSISTENCY/ DENSITY or ROCK HARDNESS* (Figure A-2)	SOIL TYPE	SOIL SYMBOL	DEPTH (FEET)	SAMPLE INTERVAL	PEN. RESISTANCE (Blows/ft)	WATER CONTENT (%)	SHEAR STRENGTH (TSF)*	UNCONFIN. COMP. (TSF)*
2 to 3 inches of decomposed granite surface.				0					
Brown, Sandy Lean Clay, moist, fine to medium sand, low plasticity, mixed with clayey sand (possible fill).	Stiff	CL			■		16		
Dark brown, Sandy Fat Clay, moist, fine sand, high plasticity. ■ Liquid Limit = 58, Plasticity Index = 31.	Very Stiff	CH					13		
Bottom of Boring at 2 feet.				5					
				10					
				15					

Note: The stratification lines represent the approximate boundary between soil and rock types, the actual transition may be gradual.

*Measured using Torvane and Pocket Penetrometer devices.

EXPLORATORY BORING LOG EB-1
CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING
PALO ALTO, CALIFORNIA

BORING EB-1
MAY 2018
PROJECT NO. 2520-3

ROMIG ENGINEERS

APPENDIX B

LABORATORY TESTS

The sample from our subsurface exploration was selected for tests to establish the physical and engineering properties of the soils. The test performed is briefly described below.

The Atterberg Limits were determined on one sample of soil in accordance with ASTM D4318. The Atterberg limits are the moisture content within which the soil is workable or plastic. The results of this test are presented in Figure B-1 and on the boring log at the appropriate sample depth.

❖ ❖ ❖ ❖ ❖

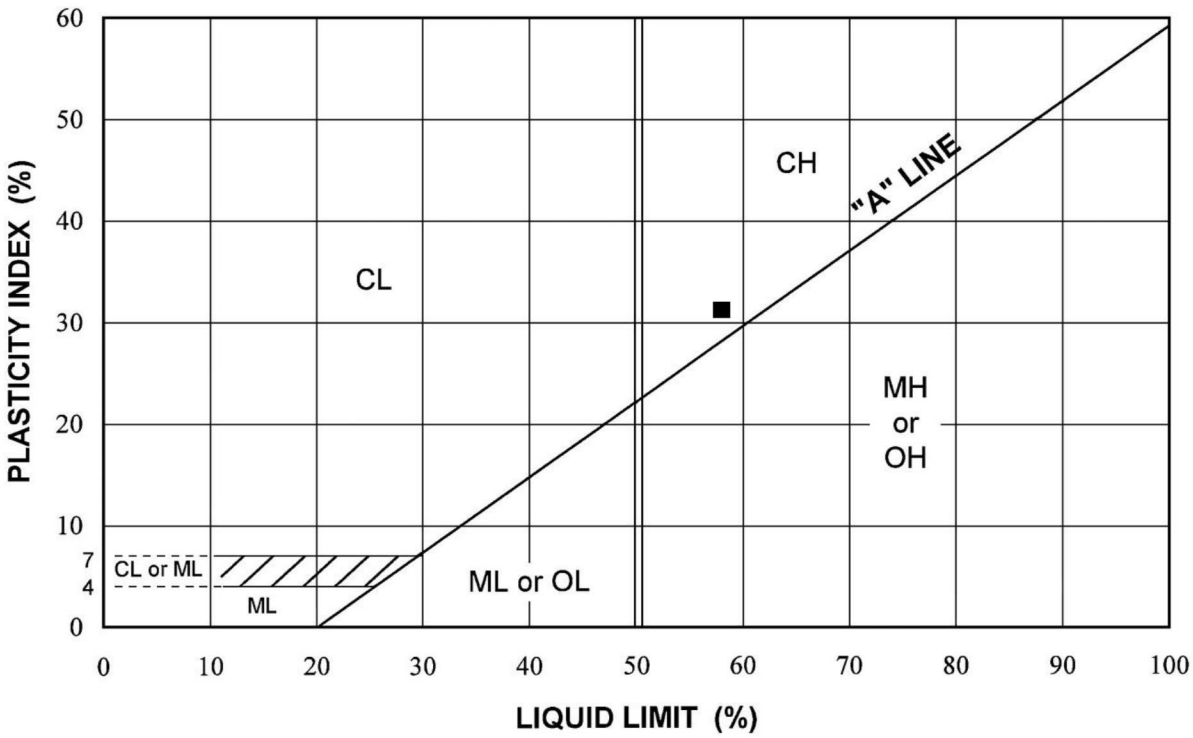


Chart Symbol	Boring Number	Sample Depth (feet)	Water Content (percent)	Liquid Limit (percent)	Plasticity Index (percent)	Liquidity Index (percent)	Passing No. 200 Sieve (percent)	USCS Soil Classification
■	EB-1	0-1	16	58	31		-35	CH

PLASTICITY CHART **FIGURE B-1**
CUBBERLEY COMMUNITY CENTER RESTROOM BUILDING MAY 2018
PALO ALTO, CALIFORNIA PROJECT NO. 2520-3

ROMIG ENGINEERS

ROMIG ENGINEERS, INC.

1390 El Camino Real, 2nd Floor

San Carlos, California 94070

Phone: (650) 591-5224

www.romigengineers.com