ROCKRIDGE GEOTECHNICAL

Prepared for **MidPen Housing Corporation**

GEOTECHNICAL INVESTIGATION REPORT
PROPOSED RESIDENITAL DEVELOPMENT
480 EAST 4TH AVENUE AND 400 EAST 5TH AVENUE
SAN MATEO, CALIFORNIA

December 12, 2018
Project No. 18-1546

270 Grand Avenue
Oakland, CA 94610

www.rockridgegeo.com

510 420-5738 tel
510 652-3096 fax

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GEOTECHNICAL

December 12, 2018
Project No. 18-1546

Ms. April Mo
Associate Project Manager
MidPen Housing Corporation
303 Vintage Park Drive, Suite 250
Foster City, California 94404

Subject: Geotechnical Investigation Report
Proposed Residential Development
480 East 4th Avenue and 400 East 5th Avenue
San Mateo, California

Dear Ms. Mo,

The results of our geotechnical investigation for the proposed residential development to be constructed at 480 East 4th Avenue and 400 East 5th Avenue in San Mateo, California are presented in the attached report. Our geotechnical investigation was performed in accordance with our proposal dated July 19, 2018.

The project site encompasses two parcels located at 480 East 4th Avenue (APN 034-183-060) and 400 East 5th Avenue (APN 033-281-140) encompassing 1.16 and 1.25 acres, respectively. The two parcels are located to the east and west of East 5th Avenue. The parcels are rectangular-shaped and relatively flat. The site is bordered to the north by S. Claremont Street and a PG&E power facility, to the east by an office building, to the south by existing Caltrain tracks, and to the west by East 4th Avenue. The parcels are currently asphalt- and concrete-paved parking lots with a small warehouse at the southeast corner of the East 5th Avenue lot.

Plans are to demolish the existing parking lots and construct three structures: two at-grade residential buildings on the western parcel (480 East 4th Avenue) and an at-grade parking garage on the eastern parcel (400 East 5th Avenue). The residential buildings will be five stories of Type IIIA (wood-framed) construction consisting of 164 residential units. The parking garage will consist of six levels of Type IA (concrete) construction to accommodate 699 passenger vehicles. Other improvements include a pedestrian bridge going over East 5th Avenue to connect the residential buildings and the parking garage, plazas, a courtyard, and community space.

On the basis of the results of our geotechnical investigation, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical issue affecting the proposed development is providing adequate foundation support. We conclude the proposed buildings can be supported on conventional spread footings bearing on firm alluvium.

The recommendations contained in our report are based on a limited subsurface investigation. Consequently, variations between expected and actual subsurface conditions may be found in localized areas during construction. Therefore, we should be engaged to observe site grading and fill placement and footing preparations, during which time we may make changes in our recommendations, if deemed necessary.

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

Sincerely yours,
ROCKRIDGE GEOTECHNICAL, INC.

Linda H. J. Liang, P.E., G.E.	Craig S. Shields, P.E., G.E.
Associate Engineer	Principal Geotechnical Engineer

Enclosure

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
480 EAST 4TH AVENUE AND 400 EAST 5TH AVENUE
San Mateo, California

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation performed by Rockridge Geotechnical, Inc. for the proposed residential development to be constructed at 480 East 4th Avenue and 400 East 5th Avenue in San Mateo, California. The subject properties are located to the east and west of East 5th Avenue, between the Caltrain tracks and South Claremont Street, as shown on the Site Location Map, Figure 1.

The project site encompasses two parcels encompassing 1.16 acres and 1.25 acres. The parcels are rectangular-shaped and relatively flat. The site is bordered to the north by South Claremont Street and a PG&E power facility, to the east by an office building, to the south by existing Caltrain tracks, and to the west by East 4th Avenue. East 5th Avenue bisects the two parcels. The parcels are currently asphalt- and concrete-paved at-grade parking lots owned by the City of San Mateo with a small warehouse at the southeast corner of the East 5th Avenue lot.

Plans are to construct three structures; two at-grade residential buildings on the western parcel (480 East 4th Avenue) and an at-grade parking garage on the eastern parcel (400 East 5th Avenue), as shown on the Site Plan, Figure 2. The residential buildings will be 5 stories of Type IIIA (wood-framed) construction consisting of 164 residential units. The parking garage will consist of 6 levels of Type 1A (concrete) construction to accommodate 699 passenger vehicles. Other improvements include a pedestrian bridge going over East 5th Avenue to connect the residential buildings and the parking garage, plazas, a courtyard, and community space.

2.0 SCOPE OF SERVICES

Our geotechnical investigation was performed in accordance with our proposal dated July 19, 2018. Our scope of services consisted of reviewing available information, exploring subsurface conditions at the site by drilling five test borings, advancing six cone penetration tests (CPTs) and performing engineering analyses to develop conclusions and recommendations regarding:

- subsurface conditions
- site seismicity and seismic hazards, including the potential for liquefaction and liquefaction-induced ground failure
- the most appropriate foundation type(s) for the proposed buildings
- design criteria for the recommended foundation type(s), including vertical and lateral capacities
- estimates of foundation settlement
- site grading and excavation, including criteria for fill quality and compaction
- subgrade preparation for slab-on-grade floors and concrete flatwork
- lateral earth pressures for permanent below-grade walls
- 2016 California Building Code (CBC) site class and design spectral response acceleration parameters
- corrosivity of the near-surface soil and the potential effects on buried concrete and metal structures and foundations
- construction considerations.

3.0 FIELD INVESTIGATION AND LABORATORY TESTING

Subsurface conditions at the site were explored by drilling five test borings, performing six CPTs, and performing laboratory testing on selected soil samples. Prior to performing the field exploration, we obtained a drilling permit from the San Mateo County Environmental Health Services Division (SCEHSD) and contacted Underground Service Alert (USA) to notify them of our work, as required by law. We also retained a private utility locator, Precision Locating, LLC, to check that the boring and CPT locations were clear of existing utilities. Details of the field investigation and laboratory testing are described below.

3.1 Test Borings

The test borings were drilled on September 6 and 7, 2018 by Exploration Geoservices of San Jose, California. The borings, designated as B-1 through B-5, were drilled to depths ranging from 31-1/2 to 51-1/2 feet below the existing ground surface (bgs) using a Mobil B-61 drill rig equipped with eight-inch-diameter hollow-stem augers. During drilling, our field engineer logged the soil encountered and obtained representative samples for visual classification and laboratory testing. The approximate locations of the borings are shown on Figure 2. The logs of the borings are presented on Figures A-1 through A-5 in Appendix A. The soil encountered in the borings was classified in accordance with the classification system shown on Figure A-6.

Soil samples were obtained using the following samplers:

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

The samplers were driven with a 140-pound down-hole safety hammer falling about 30 inches per drop. The samplers were driven up to 18 inches and the hammer blows required to drive the samplers were recorded every six inches and are presented on the boring logs. A “blow count” is defined as the number of hammer blows per six inches of penetration or 50 blows for six inches or less of penetration. The blow counts required to drive the S&H and SPT sampler were converted to approximate Standard Penetration Test (SPT) N-values using factors of 0.63 and 1.08, respectively, to account for sampler type and approximate hammer energy. The blow counts used for this conversion were the last two blow counts. The converted SPT N-values are presented on the boring logs.

Upon completion of drilling, the boreholes were backfilled with cement grout in accordance with SCEHSD requirements. The soil cuttings generated by the borings were placed in five 55-gallon drums and temporarily stored on site. Laboratory analytical testing was performed on representative samples of the drum contents. The test results indicated the material was non-hazardous and the drums were picked-up and disposed of at a non-hazardous facility on September 27, 2018.

3.2 Cone Penetration Tests

Six CPTs, designated as CPT-1 through CPT-6, were performed at the approximate locations shown on Figure 2. The CPTs were performed by Middle Earth Geo Testing, Inc. of Orange, California on September 21, 2018 and October 6, 2018 to depths ranging from 50.5 to 77.9 feet bgs.

The CPTs were performed by hydraulically pushing a 1.7-inch-diameter cone-tipped probe with a projected area of 15 square centimeters into the ground using a 20-ton truck rig. The cone-tipped probe measured tip resistance and the friction sleeve behind the cone tip measured frictional resistance. Electrical strain gauges within the cone continuously measured soil parameters for the entire depth advanced. Soil data, including tip resistance and frictional resistance, were recorded by a computer while the test was conducted. Accumulated data were processed by computer to provide engineering information such as the soil behavior types and approximate strength characteristics of the soil encountered. The CPT logs showing tip resistance, friction ratio, and pore pressure, as well as interpreted soil behavior type, are presented in Appendix A on Figures A-7 through A-12. Upon completion, the CPT holes were backfilled with cement grout in accordance with SCEHSD requirements.

3.2 Laboratory Testing

We re-examined the soil samples obtained from our borings to confirm the field classifications and selected representative samples for laboratory testing. Soil samples were tested to measure moisture content, dry density, plasticity, particle size distribution, and corrosivity. The results of the laboratory tests are presented on the boring logs and in Appendix B.

4.0 SUBSURFACE CONDITIONS

A Regional Geologic Map (Figure 3) of the area indicates the site is mostly underlain by Holocene-age alluvium (Qha) in addition to a narrow band of artificial fill (af) from the Caltrain tracks running along the southwestern perimeter of the site. The results of our field investigation indicate the site is blanketed by about 1-1/2 to 5 feet of fill overlying native alluvium. The fill consists of mixtures of medium dense to dense sand and very stiff to hard clay. The fill is underlain by native alluvium that extends to the maximum depth explored of 77.9 feet bgs. The alluvium consists of very stiff to hard clay with variable amounts of sand interbedded with medium dense to very dense sand and gravel with variable amounts of clay.

4.1 Groundwater Level

Groundwater was measured in the borings and CPTs between depths of 19 and 30 feet bgs during our field investigation. Because the boreholes were backfilled with neat cement grout soon after completion of drilling, there may not have been sufficient time for the groundwater to stabilize prior to grouting. To further evaluate depth to groundwater at the site, we reviewed groundwater data on the State of California Water Resources Control Board GeoTracker website (http://geotracker.swrcb.ca.gov). There is a monitoring well (M-2) in the northeast corner of 400 East 4th Avenue and another monitoring well (M-1) across the street at 405 East 4th Avenue. Readings taken at these two monitoring wells between January 2000 and March 2012 showed the groundwater fluctuated about 5 feet over the 12-year monitoring period with the shallowest groundwater measurement at 10.75 feet bgs taken on December 26, 2001. In addition, according to the California Geologic Survey (CGS) report *Seismic Hazard Zone Report for the San Mateo 7.5-Minute Quadrangle, San Mateo County, California,* the historic high groundwater at the site is approximately 11 feet bgs.

Based on the groundwater conditions encountered during our investigation and available historic groundwater information of the site vicinity, we judge the high groundwater level at the site is about 11 feet bgs. The groundwater level at the site is expected to fluctuate several feet seasonally, depending on the amount of annual rainfall.

5.0 SEISMIC CONSIDERATIONS

5.1 Regional Seismicity and Faulting

The site is located in the Coast Ranges geomorphic province that is characterized by northwest-southeast trending valleys and ridges. These are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent shearing along the San Andreas Fault system. Movements along this plate boundary in the Northern California region occur along right-lateral strike-slip faults of the San Andreas Fault system.

The major active faults in the area are the San Andreas, Hayward, and Calaveras faults. These and other known Quaternary-aged faults that are believed to be sources of major earthquakes (i.e. Magnitude>6.0) in the region are shown on Figure 4, as accessed from the U.S. Geological Survey (USGS) database (USGS, 2010). Active faults within a 50-kilometer radius of the site, the distance from the site and mean characteristic moment magnitude[1] [2007 Working Group on California Earthquake Probabilities (USGA 2008) and Cao et al. (2003)] are summarized in Table 1.

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

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approximate Distance from Site (km)	Direction from Site	Maximum Magnitude
N. San Andreas – Peninsula	5.1	West	7.23
N. San Andreas (1906 event)	5.1	West	8.05
Monte Vista-Shannon	15	Southeast	6.50
San Gregorio Connected	17	West	7.50
Total Hayward	24	Northeast	7.00
Total Hayward-Rodgers Creek	24	Northeast	7.33
N. San Andreas - North Coast	33	Northwest	7.51
Total Calaveras	37	East	7.03
Mount Diablo Thrust	42	Northeast	6.70
Green Valley Connected	47	Northeast	6.80

Since 1800, four major earthquakes have been recorded on the San Andreas Fault. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale occurred east of Monterey Bay on the San Andreas Fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, M_w, for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to an M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas Fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), an M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Preita Earthquake of October 17, 1989 had an M_w of 6.9 and occurred about 70 kilometers south of the site.

In 1868, an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward Fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably an M_w of about 6.5) was reported on the Calaveras Fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake ($M_w = 6.2$).

The U.S. Geological Survey's 2014 Working Group on California Earthquake Probabilities has compiled the earthquake fault research for the San Francisco Bay area in order to estimate the probability of fault segment rupture. They have determined that the overall probability of moment magnitude 6.7 or greater earthquake occurring in the San Francisco Region during the next 30 years (starting from 2014) is 72 percent. The highest probabilities are assigned to the Hayward Fault, Calaveras Fault, and the northern segment of the San Andreas Fault. These probabilities are 14.3, 7.4, and 6.4 percent, respectively.

5.2 Geologic Hazards

Because the project site in in a seismically active region, we evaluated the potential for earthquake-induced geologic hazards, including ground shaking, ground surface rupture, liquefaction[2], lateral spreading[3] and cyclic densification.[4] We used the results of our field investigation to evaluate the potential of these phenomena occurring at the project site.

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

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

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

5.2.1 Ground Shaking

The seismicity of the site is governed by the activity of the San Andreas Fault, although ground shaking from future earthquakes on other faults will also be felt at the site. The intensity of earthquake ground motion at the site will depend upon the characteristics of the generating fault, distance to the earthquake epicenter, and magnitude and duration of the earthquake. We judge that strong to very strong ground shaking could occur at the site during a large earthquake on one of the nearby faults.

5.2.2 Ground Surface Rupture

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

5.2.3 Liquefaction and Associated Hazards

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

The CGS has prepared a map titled *State of California Seismic Hazard Zones, San Mateo Quadrangle, Official Map*, dated January 11, 2018 (Figure 5). This map was prepared in accordance with the Seismic Hazards Mapping Act of 1990. As shown on Figure 5, the project site is **not** within one of the designated liquefaction hazard zones.

Considering the soil encountered in our borings and CPTs below the historic high groundwater level of 11 feet bgs generally consists of stiff to very stiff clay with variable sand content and dense to very dense sand and gravel with variable clay content, we judge the soil is not susceptible to liquefaction because of its cohesion and/or relative density. Therefore, we conclude the potential for liquefaction and associated hazards to occur at the site is very low.

5.2.4 Cyclic Densification

Cyclic densification (also referred to as differential compaction) of non-saturated sand (sand above groundwater table) can occur during an earthquake, resulting in settlement of the ground surface and overlying improvements. The soil encountered above the groundwater table is not susceptible to cyclic densification because of its cohesion and/or relative density. Accordingly, we conclude the potential for ground surface settlement resulting from cyclic densification is very low.

6.0 CONCLUSIONS AND RECOMMENDATIONS

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical issue affecting the proposed development is providing adequate foundation support. The foundation level of the proposed buildings is underlain by firm alluvium (stiff to hard clay and medium dense to very dense sand and gravel) that can provide adequate foundation support for moderate to high loads. Therefore, we conclude the proposed buildings may be supported on conventional spread footings.

Our conclusions and recommendations for site preparation and grading, foundation support, and other geotechnical aspects of the project are presented in this section.

6.1 Site Preparation and Grading

Site clearing should include removal of all existing pavements, foundations and underground utilities. If any voids are left from demolition of existing structures, they should be properly backfilled following the recommendations provided below in Section 6.1.2. Any vegetation and organic topsoil (if present) should be stripped in areas to receive improvements (i.e., building or flatwork). Tree roots with a diameter greater than 1/2 inch within three feet of subgrade should be removed. Excessively dry soil at tree removal locations, as determined in the field by the Geotechnical Engineer, should also be excavated and replaced. Demolished asphalt concrete should be taken to a recycling facility. Aggregate base beneath existing pavements may be re-used as select fill if carefully segregated. We anticipate the stiff to hard clay and medium dense to very dense sand and gravel encountered can be excavated with conventional grading equipment (i.e. excavators, bull dozers, etc.).

6.1.1 Soil Subgrade Preparation

In areas that will receive fill or improvements (i.e. building pad subgrade), the soil subgrade exposed should be scarified to a depth of at least eight inches, moisture-conditioned to near optimum moisture content, and compacted to at least 90 percent relative compaction[5]. If the subgrade is within eight inches of finished subgrade in areas to receive vehicular traffic (i.e. garage subgrade), it should be moisture-conditioned to above optimum moisture content and compacted to at least 95 percent relative compaction. The soil subgrade should be kept moist until it is covered by fill.

6.1.2 Fill Quality and Compaction

Material excavated at the site will primarily consist of clayey sand or sandy clay that may be reused as fill or backfill. If imported fill (select fill) is required, it should be free of organic matter, contain no rocks or lumps larger than three inches in greatest dimension, have a liquid limit less than 40 and plasticity index less than 12, and be approved by the Geotechnical

Engineer. Samples of proposed select fill material should be submitted to the Geotechnical Engineer at least three business days prior to use at the site. The grading contractor should provide analytical test results or other suitable environmental documentation indicating the imported fill is free of hazardous materials at least three days before use at the site. If this data is not available, up to two weeks should be allowed to perform analytical testing on the proposed imported material.

Fill should be placed in lifts not exceeding eight inches in loose thickness, moisture-conditioned near optimum moisture content, and compacted to at least 90 percent relative compaction. Fill consisting of clean sand or gravel (defined as poorly-graded soil with less than 5 percent fines by weight) and fill that is more than five feet thick should be compacted to at least 95 percent relative compaction. Fill placed within six inches of soil subgrade for pavement (concrete or asphalt concrete) that will be subjected to vehicular traffic and Class 2 aggregate base beneath vehicular pavements should be compacted to at least 95 percent relative compaction and be non-yielding.

6.1.3 Exterior Concrete Flatwork

We recommend a minimum of four inches of Class 2 aggregate base be placed below exterior concrete flatwork, including patio slabs and sidewalks; the aggregate base should extend at least six inches beyond the slab edges where adjacent to landscaping. Class 2 aggregate base beneath exterior slabs-on-grade, such as patios and sidewalks, should be compacted in accordance with the requirements provided above in Section 6.1.2.

6.1.4 Utility Trench Backfill

Excavations for utility trenches can be readily made with a backhoe. All trenches should conform to the current CAL-OSHA requirements. To provide uniform support, pipes or conduits should be bedded on a minimum of four inches of clean sand or fine gravel. After pipes and

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

conduits are tested, inspected (if required) and approved, they should be covered to a depth of six inches with clean sand or fine gravel, which should be mechanically tamped. Backfill for utility trenches and other excavations is also considered fill and should be placed and compacted in accordance with the recommendations previously presented. If imported clean sand or gravel (defined as poorly-graded soil with less than 5 percent fines) is used as backfill, it should be compacted to at least 95 percent relative compaction. Jetting of trench backfill should not be permitted. Special care should be taken when backfilling utility trenches in pavement areas. Poor compaction may cause excessive settlements, resulting in damage to the pavement section.

Foundations for the proposed buildings should be bottomed below an imaginary line extending up at a 1.5:1 (horizontal to vertical) inclination from the base of utility trenches. Alternatively, the portion of the utility trench (excluding bedding) that is below the 1.5:1 line can be backfilled with controlled low-strength material (CLSM) with a 28-day unconfined compressive strength of at least 100 pounds per square inch (psi) or Class 2 aggregate base compacted to at least 95 percent relative compaction.

6.1.5 Surface Drainage and Bioswales

Positive surface drainage should be provided around the building to direct surface water away from the foundations. To reduce the potential for water ponding adjacent to the building, we recommend the ground surface within a horizontal distance of five feet from the building slope down away from the building with a surface gradient of at least two percent in unpaved areas and one percent in paved areas. In addition, roof downspouts should be discharged into controlled drainage facilities to keep the water away from the foundations.

Care should be taken to minimize the potential for subsurface water to collect beneath pavements and pedestrian walkways. Where landscape beds and tree wells are immediately adjacent to pavements and flatwork, we recommend vertical cutoff barriers be incorporated into the design to prevent irrigation water from saturating the subgrade and aggregate base. These barriers may consist of either flexible impermeable membranes or deepened concrete curbs.

We recommend bio-retention areas (bioswales) at the site be constructed at least five feet from the buildings and garage. Where bio-retention areas are constructed within five feet of the new buildings or garage, we recommend the bottom of the treatment area be lined with an impermeable liner. Where a vertical curb or foundation is constructed near a bio-retention area, the curb and the edge of the foundation should be founded below an imaginary line extending up at an inclination of 1.5:1 (horizontal to vertical) from the base of the bio-retention area. Vertical curbs should be designed to resist lateral earth pressures acting against the back of the curbs by either providing lateral restraint at the top of the curb or by designing the curb as a retaining wall. The design of curbs should assume no lateral restraint (i.e., passive pressure) is provided above the gravel drainage layer at the base of the bio-retention feature.

6.2 Foundation Support and Settlement

We conclude the proposed buildings may be supported on spread footings bearing on firm alluvium. Continuous footings should be at least 18 inches wide and isolated spread footings should be at least 24 inches wide. Footings should extend at least 24 inches below the lowest adjacent exterior soil subgrade grade and at least 18 inches below the lowest adjacent interior soil subgrade. Footings should also be bottomed below an imaginary line extending up at a 1.5:1 (horizontal to vertical) inclination from the base of utility trenches and bio-retention features. Alternatively, the portion of the utility trench (excluding bedding) that is below the 1.5:1 line can be backfilled with CLSM with a 28-day unconfined compressive strength of at least 100 psi or Class 2 aggregate base compacted to at least 95 percent relative compaction.

Footings may be designed using allowable bearing pressures of 6,000 pounds per square foot (psf) for dead plus live loads and 8,000 psf for total design loads, which include wind or seismic forces. The allowable bearing pressures recommended for dead-plus-live and total load conditions include factors of safety of at least 2 and 1.5, respectively. Our settlement analyses indicate total settlement of spread footings designed using the allowable bearing pressures presented in this section will be less than 3/4 inch and differential settlement will be less than 1/2 inch over a 30-foot horizontal distance.

Lateral loads may be resisted by a combination of passive pressure on the vertical faces of the footings and friction between the bottoms of the footings and the supporting soil. To compute passive resistance, we recommend using an equivalent fluid weight of 300 pounds per cubic foot (pcf); the upper foot of soil should be ignored unless confined by a slab or pavement. Frictional resistance should be computed using a base friction coefficient of 0.35. The passive pressure and frictional resistance values include a factor of safety of at least 1.5 and may be used in combination without reduction.

Footing excavations should be free of standing water, debris, and disturbed materials prior to placing concrete. Where fill is encountered at the bottom of footing excavations, the footing should be deepened to bottom on firm alluvium. Overexcavations below footings (i.e. from removal of fill) should be backfilled with lean concrete or CLSM with a 28-day unconfined compressive strength of at least 100 psi.

The bottoms and sides of the footing excavations should be kept moist until concrete is placed in the excavations. We should check footing excavations prior to placement of reinforcing steel to check for proper bearing. We should re-examine the excavations just prior to placement of concrete to confirm the bottoms and sides of the excavations have sufficient moisture content. If the footings will be constructed during the rainy season, two inches of CLSM should be placed to protect the bottoms of the excavations from softening from standing rainwater, after we have approved the condition of the bottom of the footings.

6.3 Concrete Slab-on-Grade Floors

The subgrade for slab-on-grade floors should be prepared following the recommendations presented in Section 6.1.1. Where the parking garage floor slab is less than six inches thick, we recommend the slab be constructed on six inches of Class 2 aggregate base.

We recommend a capillary break and vapor retarder be installed beneath the floor slabs in the residential buildings to limit water vapor transmission through the slabs. The vapor retarder should meet the requirements for Class B vapor retarders stated in ASTM E1745 and should be placed in accordance with the requirements of ASTM E1643. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder.

A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The particle size of the capillary break material should meet the gradation requirements presented in Table 2.

TABLE 2
Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6

A capillary moisture break and water vapor retarder are generally not required beneath parking garage floor slabs because there is sufficient air circulation to allow evaporation of moisture that is transmitted through the slab; however, we recommend a vapor retarder be placed below the floor slab in utility rooms and any areas in or adjacent to the parking garage that will be used for storage and/or will receive a floor covering or coating. The vapor retarder may be placed directly on top of the compacted Class 2 aggregate base.

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and can result in excessive vapor transmission through the slab. Where the concrete is poured directly over the vapor retarder, we recommend the w/c ratio of the concrete not exceed 0.45. Water should not be added to the concrete mix in the field. If necessary, workability should be increased by adding plasticizers. In addition, the slab should be properly cured. Before the floor covering is placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

6.4 Permanent Below-Grade Walls

Permanent below-grade walls (e.g., elevator pit walls) should be designed to resist static and seismic lateral earth pressures, vehicular surcharge pressures, and surcharges from adjacent foundations, where appropriate. We recommend restrained below-grade walls at the site be designed for the more critical of the following criteria:

- at-rest equivalent fluid weight of 55 pcf (triangular distribution), or
- active pressure of 35 pcf plus a seismic increment of 34 pcf (triangular distribution).

Where traffic loads are expected within 10 feet of the walls, an additional design load of 50 psf should be applied to the upper 10 feet of the wall. Proposed below-grade walls should be designed for surcharge pressures if new foundations are founded above the zone-of-influence for the below-grade walls. This zone is defined as an imaginary line extending up from the bottom of the basement wall at an inclination of 1.5:1 (horizontal to vertical). The influence on a wall from a foundation that is founded within this zone of influence should be analyzed on an individual basis after the geometry has been determined.

The recommended lateral earth pressures are applicable to walls that are backdrained above the water table to prevent the buildup of hydrostatic pressure. One acceptable method for backdraining the walls is to place a prefabricated drainage panel (Miradrain 6000 or equivalent) against the shoring or the back of the walls. The drainage panel should extend down to a four-inch-diameter perforated PVC collector pipe at the base of the walls. The pipe should be surrounded on all sides by at least four inches of Caltrans Class 2 permeable material (see Caltrans Standard Specifications Section 68-1.025) or 3/4-inch drain rock wrapped in filter fabric (Mirafi 140NC or equivalent). We should check the manufacturer's specifications regarding the proposed prefabricated drainage panel material to verify it is appropriate for its intended use.

To protect against moisture migration, below-grade walls should be waterproofed and water stops should be placed at all construction joints. If backfill is required behind below-grade walls, the walls should be braced, or hand compaction equipment used, to prevent unacceptable surcharges on walls (as determined by the structural engineer).

6.5 Seismic Design

For design in accordance with the 2016 CBC, we recommend Site Class D be used. The latitude and longitude of the site are 37.5649° and -122.3199°, respectively. Hence, in accordance with the 2016 CBC, we recommend the following:

- S_S = 1.915g, S_1 = 0.895g
- S_{MS} = 1.915g, S_{M1} = 1.343g
- S_{DS} = 1.277g, S_{D1} = 0.895g
- Seismic Design Category E for Risk Categories I, II, and III.

6.6 Soil Corrosivity

Laboratory testing was performed by Project X Corrosion Engineering of Murrieta, California on a sample of clayey sand obtained from Boring B-4 at a depth of 3.5 feet bgs. The results of the tests are presented in Appendix B of this report. The resistivity test results (3,417 ohm-cm) indicate the near-surface soil is “mildly corrosive” to buried metallic structures. Accordingly, all buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric-coated steel or iron may need to be protected against corrosion depending upon the critical nature of the structure. If it is necessary to have metal in contact with soil, a corrosion engineer should be consulted to provide recommendations for corrosion protection. The results indicate that sulfate ion concentrations are sufficiently low such that they do not pose a threat to buried concrete. In addition, the chloride ion concentrations have a “mild” impact to steel reinforcement in concrete structures below ground adversely. The results of the pH test indicate the near-surface soil has a pH of 6.8 and has a “mild” impact to buried metal.

7.0 ADDITIONAL GEOTECHNICAL SERVICES

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

8.0 LIMITATIONS

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

REFERENCES

2016 California Building Code

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U.S. Geological Survey, (2008), The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF 2): prepared by the 2007 Working Group on California Earthquake Probabilities, U.S. Geological Survey Open File Report 2007-1437.

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ROCKRIDGE GEOTECHNICAL

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ROCKRIDGE GEOTECHNICAL

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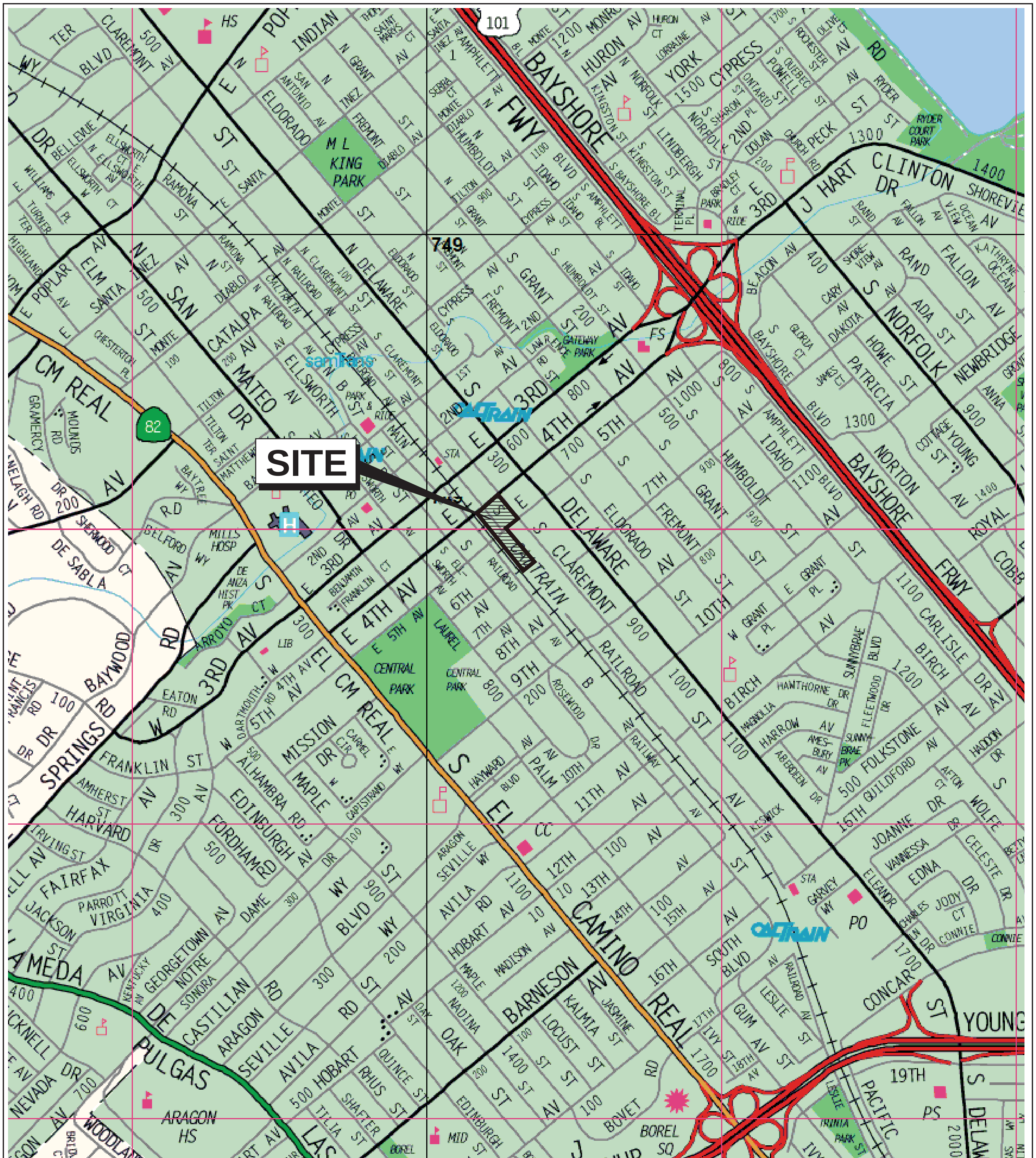
FIGURES



Base map: The Thomas Guide
San Francisco County
2002

0 1/4 1/2 Mile

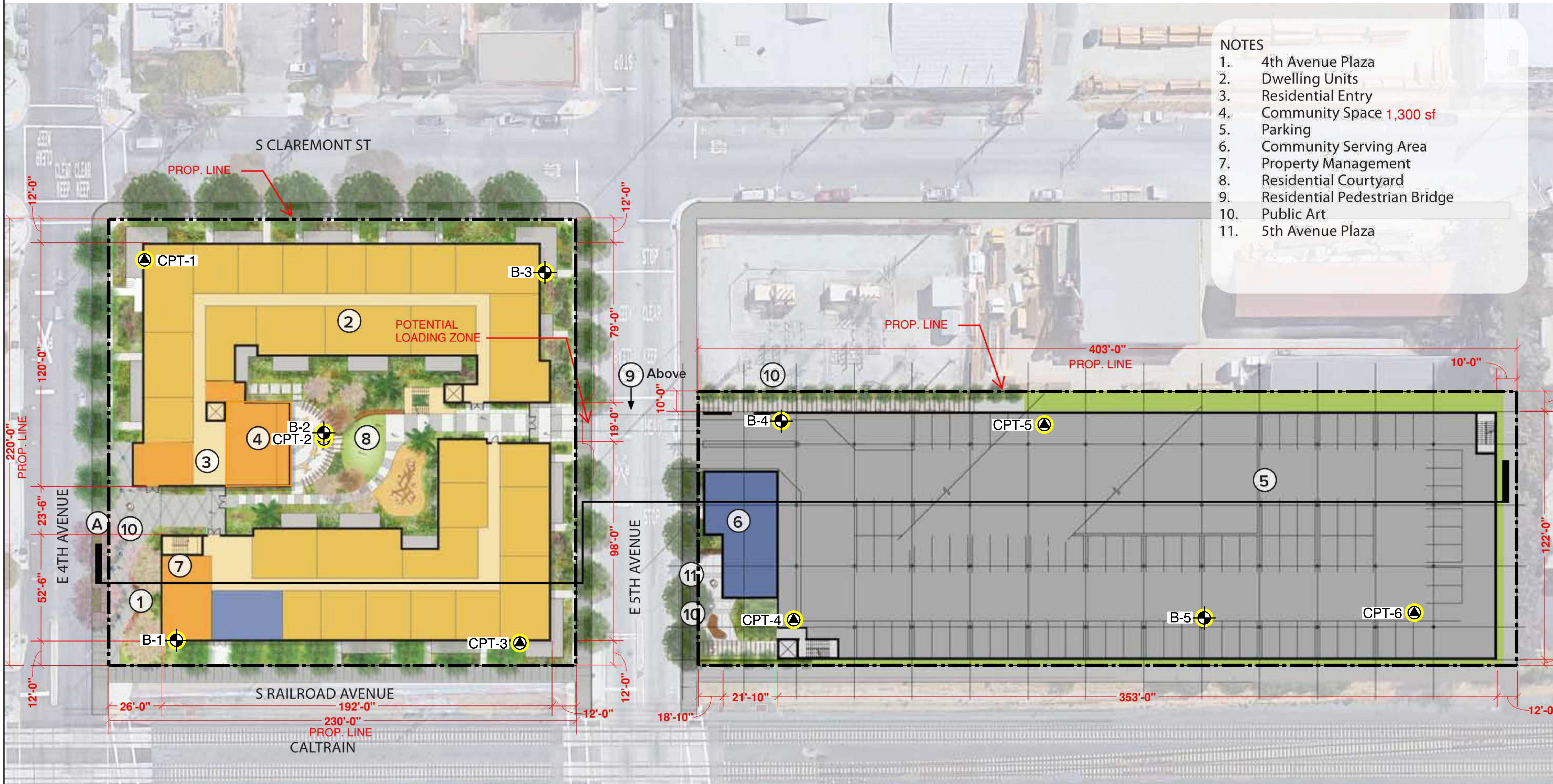
Approximate scale

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE
GEOTECHNICAL

SITE LOCATION MAP

Date 08/30/18 | Project No. 18-1546 | Figure 1



EXPLANATION

CPT-1 — Approximate location of cone penetration test by Rockridge Geotechnical Inc., September 21 & October 6, 2018

B-1 — Approximate location of boring by Rockridge Geotechnical Inc., September 6 & 7, 2018

Project limits

Reference: Base map from a drawing titled "Ground Floor", by BAR Architects, dated October 30, 2017.

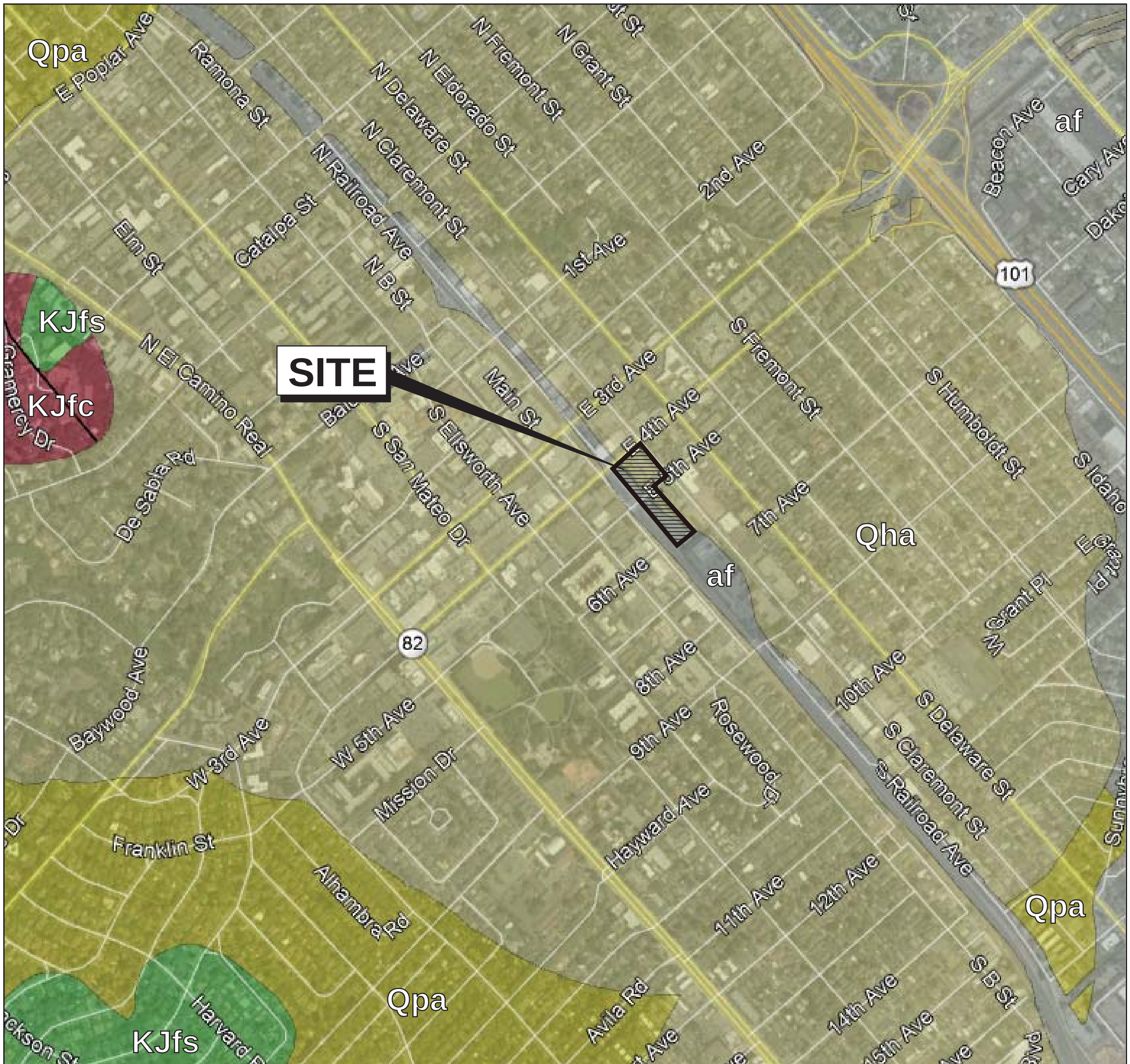
0 — 60 Feet
Approximate scale

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

SITE PLAN

Date 10/04/18	Project No. 18-1546	Figure 2

ROCKRIDGE GEOTECHNICAL



Base map: Google Earth with U.S. Geological Survey (USGS), San Mateo County, 2018.

EXPLANATION

af	Artificial Fill
Qha	Alluvium (Holocene)
Qpa	Alluvium (Pleistocene)
KJfs	Franciscan Complex sedimentary rocks (Early Cretaceous and (or) Late Jurassic)
KJfc	Franciscan Complex chert (Early Cretaceous and (or) Late Jurassic)

Geologic contact: dashed where approximate and dotted where concealed, queried where uncertin

0 1000 2000 Feet

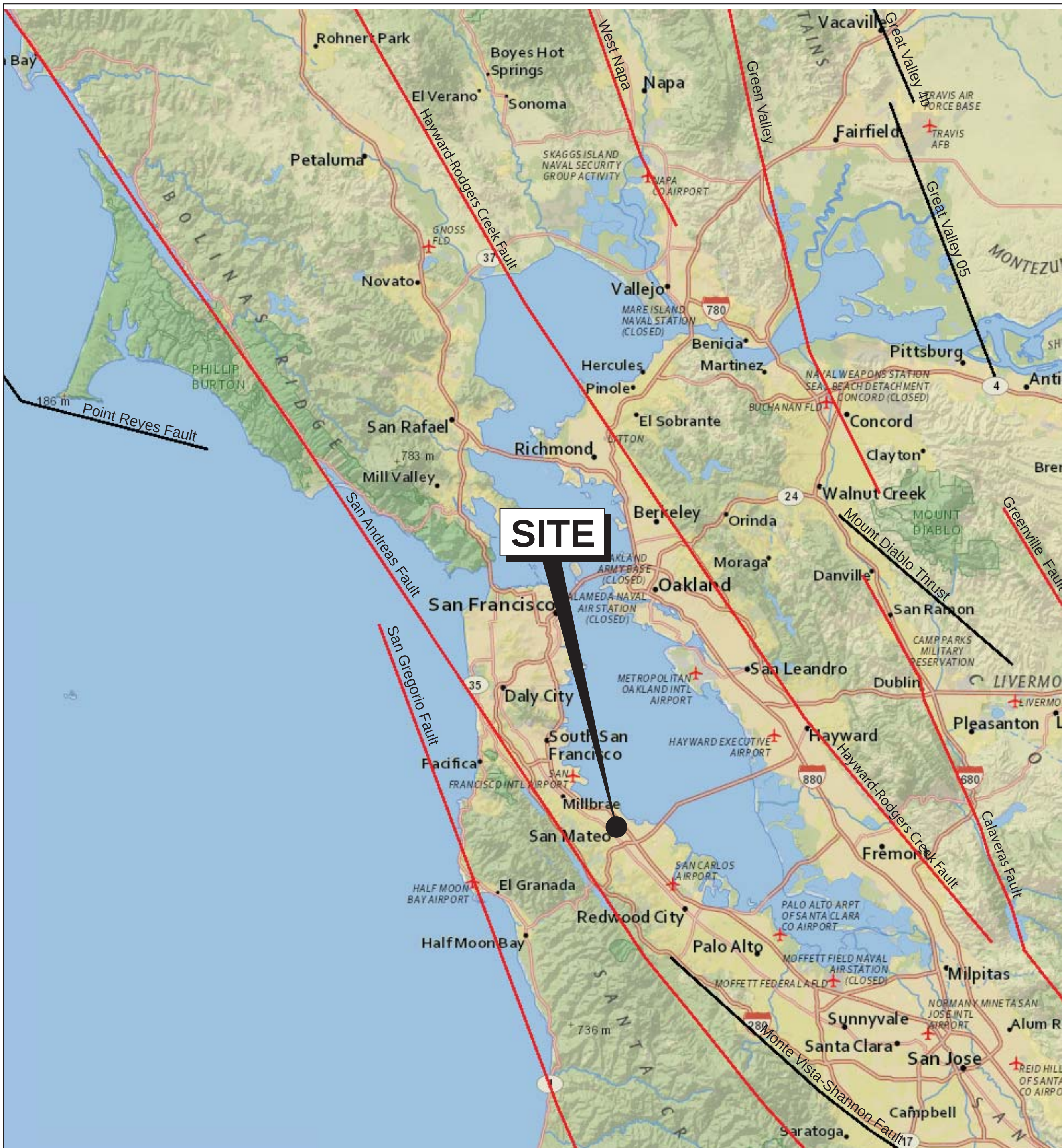
Approximate scale

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

REGIONAL GEOLOGIC MAP

Date 09/26/18 | Project No. 18-1546 | Figure 3



Base Map: U.S. Geological Survey (USGS), National Seismic Hazards Maps - Fault Sources, 2008.

EXPLANATION

Strike slip

Thrust (Reverse)

Normal

0 5 10 Miles

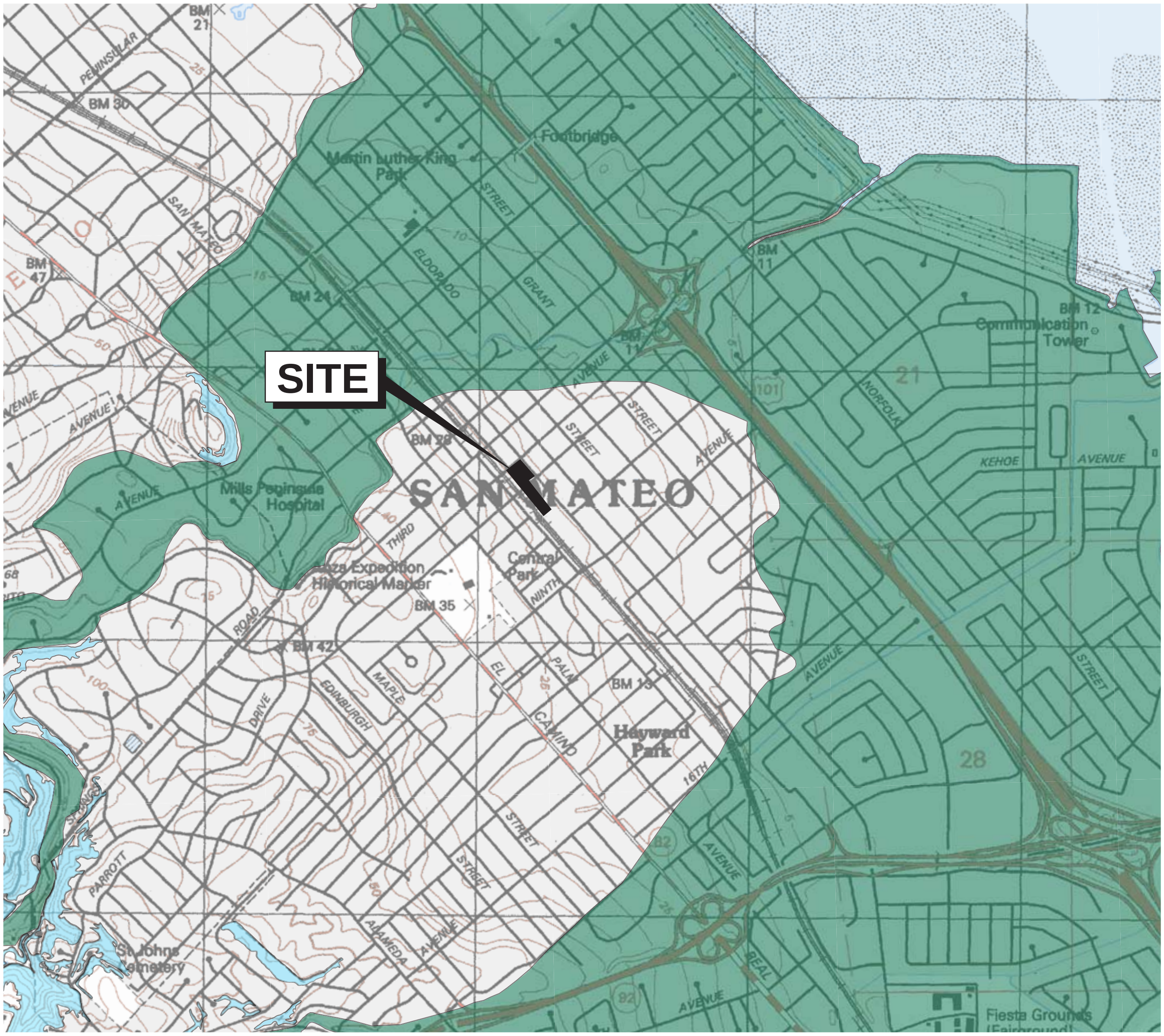
Approximate scale

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

REGIONAL FAULT MAP

Date 08/30/18	Project No. 18-1546	Figure 4



MAP EXPLANATION

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

Earthquake Fault Zones
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture: Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where Inferred; Dotted Line in Black or Solid Line in Rose where Concealed; Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by fault creep.

SEISMIC HAZARD ZONES

Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

OVERLAPPING ALQUIST-PRIOLO AND SEISMIC HAZARD ZONES

Overlap of Earthquake Fault Zone and Liquefaction Zone
Areas that are covered by both Earthquake Fault Zone and Liquefaction Zone.

Overlap of Earthquake Fault Zone and Earthquake-Induced Landslide Zone
Areas that are covered by both Earthquake Fault Zone and Earthquake-Induced Landslide Zone.

Note: Mitigation methods differ for each zone – AP Act only allows avoidance; Seismic Hazard Mapping Act allows mitigation by engineering/geotechnical design as well as avoidance.

0 1,000 2,000 Feet
Approximate scale

San Mateo Quadrangle
Seismic Hazard Zones
Released: January 11, 2018

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

SEISMIC HAZARDS ZONES MAP

Date 08/30/18	Project No. 18-1546	Figure 5

APPENDIX A
Logs of Borings and Cone Penetration Test Results

PROJECT: **480 EAST 4TH AND 400 EAST 5TH AVENUE**
San Mateo, California

Log of Boring B-1

Boring location: See Site Plan, Figure 2
Date started: 9/6/18 | Date finished: 9/6/18
Drilling method: 8-inch-diameter Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Downhole Wireline
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled by: Exploration Geoservices
Rig: B-61

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0–1					3.5 inches of asphalt concrete 7 inches of aggregate base						
1–2	S&H	19 27 37	40	CL	SANDY CLAY with GRAVEL (CL) red-brown, hard, moist, with brick fragments (FILL)						
3–4	SPT	14 13 17	32	SC	CLAYEY SAND (SC) red-yellow, dense, moist, trace fine subrounded gravel Particle Size Distribution; see Appendix B				50	13.1	
5–6	SPT	22 26 36	67	SC	CLAYEY SAND with GRAVEL (SC) light brown mottled gray, very dense, moist, fine subangular to subrounded gravel						
10–11	SPT	14 9 20	31	SC	Particle Size Distribution; see Appendix B dense				14	9.6	
15–16	SPT	13 20 27	51	CL	SANDY CLAY (CL) yellow-brown, hard, moist						
20–21	S&H	28 44 55	62	CL	mottled yellow-orange, trace subangular gravel present						
25–26	SPT	9 16 22	41	CL	Particle Size Distribution; see Appendix B decrease in gravel content				68	21.7	
29					▽ 9:08 AM; 9/6/2018						
29–31	SPT	16 28 30	63	SP	SAND with GRAVEL (SP) brown, very dense, wet, coarse-grained sand and fine gravel						

Boring terminated at a depth of 31.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 29 feet during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.63 and 1.08, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546
Figure: A-1

PROJECT: **480 EAST 4TH AND 400 EAST 5TH AVENUE** San Mateo, California

Log of Boring B-2

Boring location: See Site Plan, Figure 2

Date started: 9/6/18 Date finished: 9/6/18

Drilling method: 8-inch-diameter Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Downhole Wireline

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled by: Exploration Geoservices
Rig: B-61

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0–1				FILL	2 inches of asphalt concrete 8 inches of aggregate base						
1–2	SPT	11 16 22	41	SC	CLAYEY SAND (SC) yellow-brown mottled gray, dense, moist						
3–4	S&H	9 23 34	36		LL = 29, PI = 10; see Appendix B yellow-brown, trace fine subrounded gravel present					11.7	121
5–6	SPT	8 11 16	29		Particle Size Distribution; see Appendix B				19	9.2	
6				SC	CLAYEY SAND with GRAVEL (SC) yellow-brown, medium dense, moist, fine- to coarse-grained sand, fine subangular to subrounded gravel						
10–11	SPT	17 18 24	45		mottled orange, dense						
15–16	SPT	11 22 26	52	CL	CLAY (CL) olive-brown, hard, moist, trace fine gravel present						
19					slight petroleum odor present						
20–21	S&H	16 32 50	52	CL	SANDY CLAY with GRAVEL (CL) olive-brown, hard, moist						
24–26	SPT	11 10 10	22	CL	CLAY with SAND (CL) brown, very stiff, moist Particle Size Distribution; see Appendix B ▽ 10:36 AM; 9/6/2018				73	23.8	
26–31	SPT	15 16 30	50	SP	SAND with GRAVEL (SP) yellow-brown, dense to very dense, wet, fine- to coarse-grained sand, fine gravel						

Boring terminated at a depth of 31.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 26 feet during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.63 and 1.08, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546

Figure: A-2

PROJECT: **480 EAST 4TH AND 400 EAST 5TH AVENUE**
San Mateo, California

Log of Boring B-3

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 9/6/18 | Date finished: 9/6/18
Drilling method: 8-inch-diameter Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Downhole Wireline
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled by: Exploration Geoservices
Rig: B-61

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0–1					3 inches of asphalt concrete; 7 inches of aggregate base						
1–2	SPT	26, 12, 16	30	GP	GRAVEL (GP) gray-brown, medium dense to dense, moist (FILL)						
2–4	SPT	16, 24, 29	57	SC	CLAYEY SAND (SC) yellow-brown, medium dense to dense, moist, coarse-gained sand; very dense						
5–6	S&H	28, 32, 27	37	SC	dense, trace fine gravel present						
10–11	SPT	15, 26, 30	61	SC	very dense						
13.5–16	S&H	18, 28, 42	44	CL	CLAY with SAND (CL) yellow-brown to yellow-orange, hard, moist, trace fine gravel; Particle Size Distribution; see Appendix B				79	17.8	116
20–21	SPT	7, 11, 16	29	CL	SANDY CLAY with GRAVEL (CL) olive-brown, very stiff, moist						
24–26	SPT	18, 28, 48	82	SC	CLAYEY SAND with GRAVEL (SC) yellow-brown, very dense, moist to wet, coarse-grained sand, fine gravel						
30–31.5	SPT	12, 28, 30	63	SC	Particle Size Distribution; see Appendix B				16	11.5	

Boring terminated at a depth of 31.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.63 and 1.08, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546 | Figure: A-3

PROJECT: **480 EAST 4TH AND 400 EAST 5TH AVENUE**
San Mateo, California

Log of Boring B-4

Boring location: See Site Plan, Figure 2
Date started: 9/7/18 Date finished: 9/7/18
Drilling method: 8-inch-diameter Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Downhole Wireline
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled by: Exploration Geoservices
Rig: B-61

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					3 inches of asphalt concrete						
					8 inches of aggregate base						
1–3	SPT	14, 10, 9	21	ML	SANDY SILT (ML) olive-gray, very stiff, moist, with brick debris (FILL)						
3–4	S&H	8, 20, 40	38	ML	hard						
4–9.5				SC	CLAYEY SAND with GRAVEL (SC) yellow-brown, dense, moist, fine subangular to subrounded gravel; Corrosion Test; see Appendix B						
5–6.5	SPT	14, 15, 17	35	SC							
10–11.5	SPT	18, 38, 24	67	GP-GC	GRAVEL with CLAY and SAND (GP-GC) yellow-brown and yellow-orange, very dense, moist, coarse-grained sand, fine gravel; Particle Size Distribution; see Appendix B				12	6.0	
15–16.5	SPT	22, 20, 12	35	GP-GC	dense						
16–20				CL	SANDY CLAY (CL) yellow-brown mottled yellow-orange, hard, moist, trace fine gravel						
20–21.5	S&H	21, 27, 44	45	SC	CLAYEY SAND (SC) yellow-brown mottled yellow-orange, dense, moist						
21.5–				CL	SANDY CLAY (CL) yellow-brown mottled red, hard, moist						
25–26.5	SPT	11, 17, 30	51	CL	trace fine gravel and coarse-grained sand						
28				CL	▼ 9:15 AM; 9/7/2018						
30–31.5	S&H	9, 17, 23	24	CL	▽ 8:15 AM; 9/7/2018 very stiff, wet						
32											

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546
Figure: A-4a

PROJECT: **480 EAST 4TH AND 400 EAST 5TH AVENUE**
San Mateo, California

Log of Boring B-4

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
33–34						SANDY CLAY (CL) (continued)						
35–36	SPT		8 13 26	42	CL	Particle Size Distribution; see Appendix B olive-brown, hard				57	17.8	
40–41	S&H		24 49 50/3"	94		SANDY CLAY with GRAVEL (CL) gray mottled yellow-orange, hard, wet, fine gravel						
44						olive-brown						
45–46	SPT		25 27 30	62	CL							
50–51	SPT		11 17 32	53		increase in sand content						
52–64												

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 30 feet and 28 feet during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.63 and 1.08, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546

Figure: A-4b

PROJECT:	**480 EAST 4TH AND 400 EAST 5TH AVENUE** San Mateo, California

Log of Boring B-5

Boring location: See Site Plan, Figure 2

Date started: 9/7/18 | Date finished: 9/7/18

Drilling method: 8-inch-diameter Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Downhole Wireline

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: R. Ford
Drilled by: Exploration Geoservices
Rig: B-61

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						2.5 inches of asphalt concrete						
						10-12 inches of aggregate base						
1–2	SPT		14 30 48	84	GW	GRAVEL with SAND (GW) brown mottled gray, very dense, dry, fine gravel (FILL)						
3–4	SPT		21 18 21	42	CL	CLAY (CL) dark brown, hard, moist, with brick debris (FILL)						
5–6	S&H		12 17 23	25	SC	CLAYEY SAND with GRAVEL (SC) yellow-brown, medium dense, moist, fine subrounded to subangular gravel						
10–11	SPT		21 27 30	62	GP-GC	GRAVEL with CLAY and SAND (GP-GC) yellow-brown mottled red-brown and yellow-orange, very dense, moist, fine gravel						
13–14						increase in sand content						
15–16	SPT		35 33 38	77								
20–21	SPT		12 20 40	65								
25–26	SPT		7 8 10	19	CL	SANDY CLAY (CL) olive, very stiff, moist, trace fine gravel						
30–31	S&H		30 50/6"	50		▽ 11:35 AM; 9/7/2018 yellow-brown, hard, wet Particle Size Distribution; see Appendix B ▽ 12:10 PM; 9/7/2018				70	21.8	109
32												

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546 | Figure: A-5a

ROCKRIDGE 18-1546.GPJ TR.GDT 10/21/18

PROJECT: **480 EAST 4TH AND 400 EAST 5TH AVENUE**
San Mateo, California

Log of Boring B-5

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
33–34					CL	SANDY CLAY (CL) (continued)						
35–36	SPT		6 7 10	18	SM	SILTY SAND (SM) yellow-brown, medium dense, wet, trace fine gravel						
36–39					CL	SANDY CLAY (CL) yellow-brown mottled yellow-orange, very stiff, wet, fine-grained sand						
40–41	SPT		15 20 26	50	CL	yellow-orange mottled gray and yellow-red, hard, trace fine subrounded gravel Particle Size Distribution; see Appendix B				51	17.5	
45–46	SPT		22 30 30	65	CL							
50–51	SPT		10 13 17	32	CL	SANDY CLAY with GRAVEL (CL) olive-gray mottled yellow-brown, hard, wet						
52–64												

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 32 feet and 30 feet during drilling.

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.63 and 1.08, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 18-1546

Figure: A-5b

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

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

Unstabilized groundwater level

Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered

Classification sample taken with Standard Penetration Test sampler

Undisturbed sample taken with thin-walled tube

Disturbed sample

Sampling attempted with no recovery

Core sample

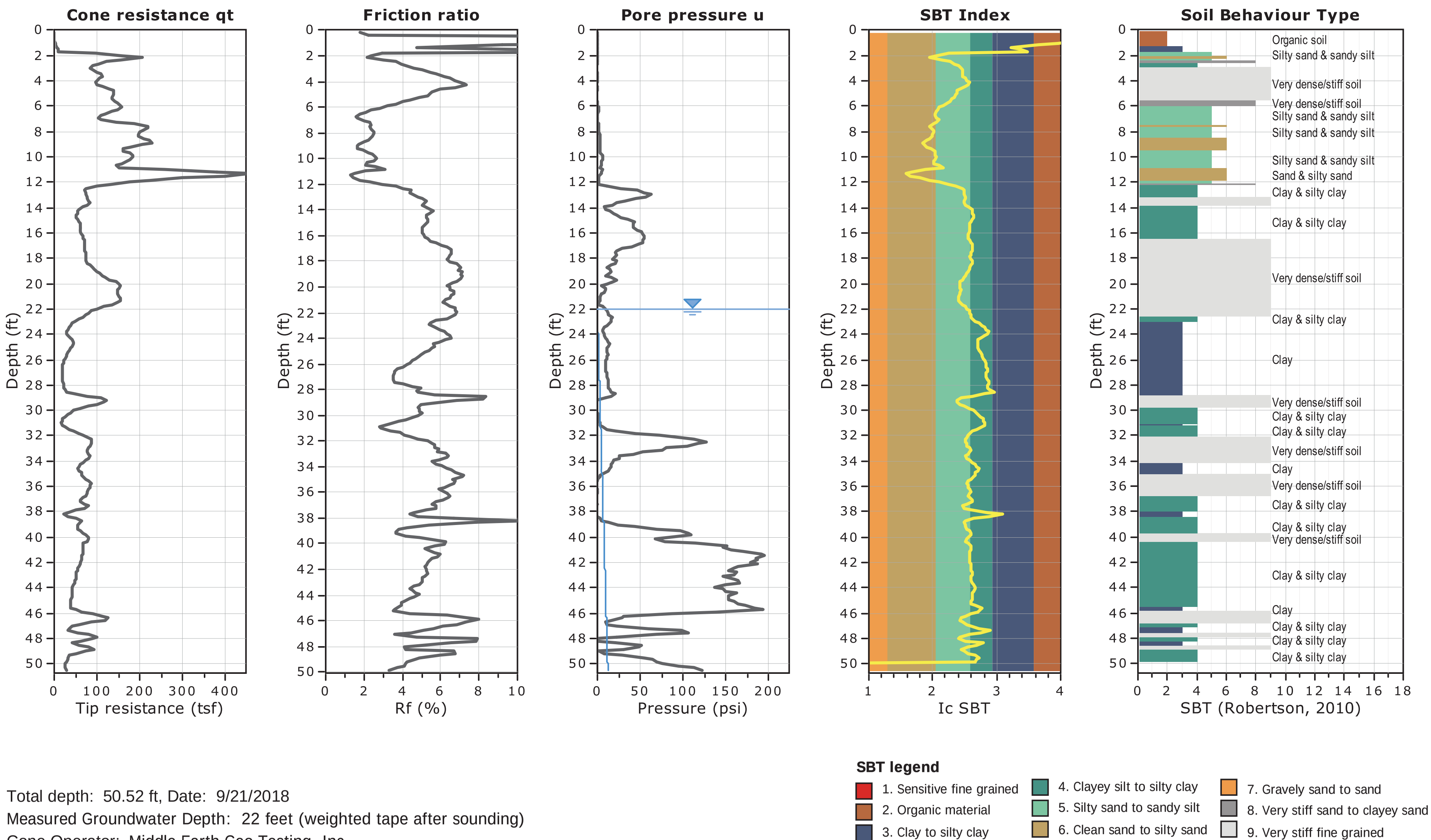
Analytical laboratory sample

Sample taken with Direct Push sampler

Sonic

SAMPLER TYPE

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



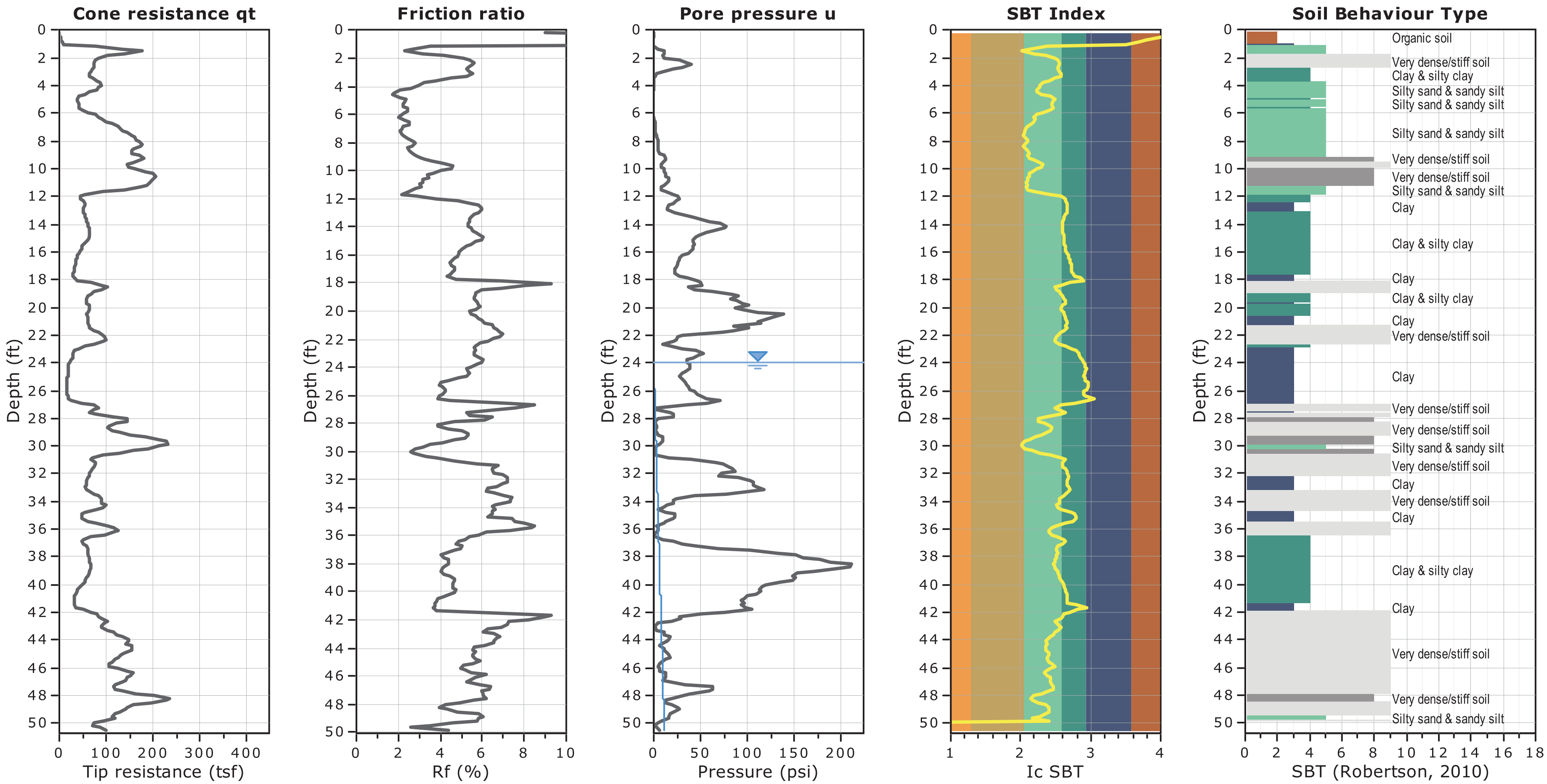
Total depth: 50.52 ft, Date: 9/21/2018
Measured Groundwater Depth: 22 feet (weighted tape after sounding)
Cone Operator: Middle Earth Geo Testing, Inc.

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

CONE PENETRATION TEST RESULTS
CPT-1

Date 10/04/18	Project No. 18-1546	Figure A-7



SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

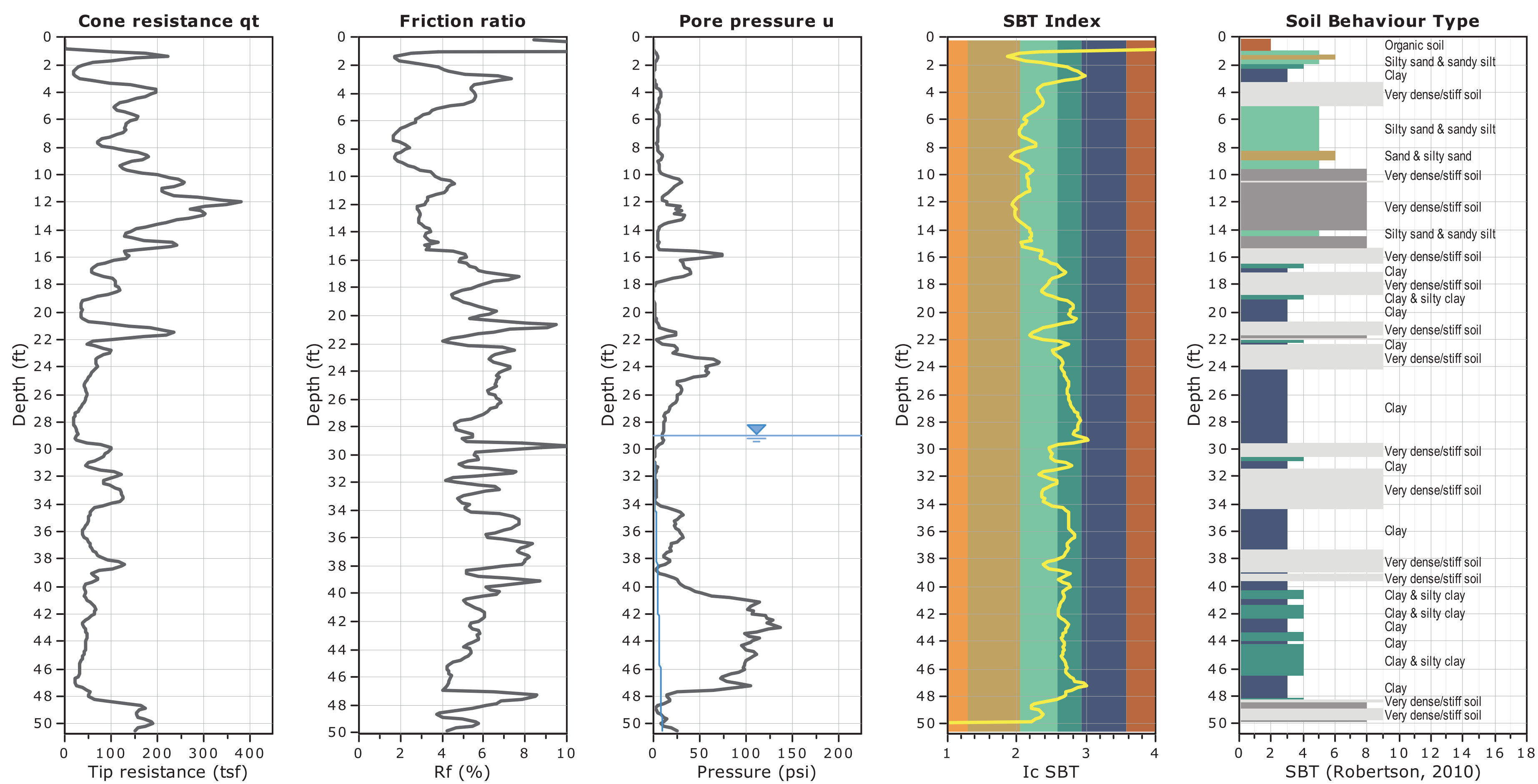
Total depth: 50.52 ft, Date: 9/21/2018
Measured Groundwater Depth: 24 feet (weighted tape after sounding)
Cone Operator: Middle Earth Geo Testing, Inc.

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

CONE PENETRATION TEST RESULTS
CPT-2

Date 10/04/18	Project No. 18-1546	Figure A-8



SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

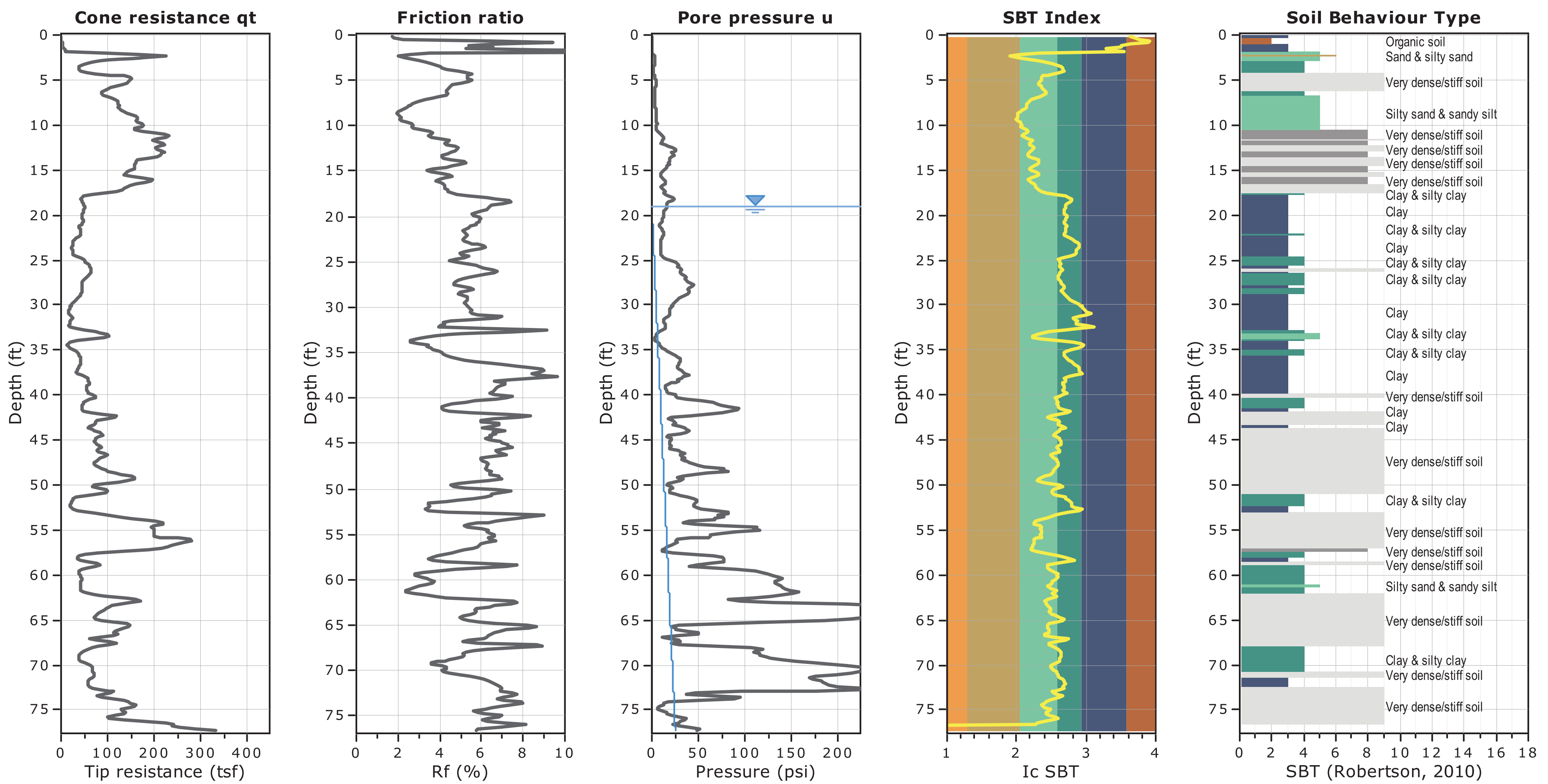
Total depth: 50.52 ft, Date: 9/21/2018
Measured Groundwater Depth: 29 feet (weighted tape after sounding)
Cone Operator: Middle Earth Geo Testing, Inc.

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

CONE PENETRATION TEST RESULTS
CPT-3

Date 10/04/18	Project No. 18-1546	Figure A-9



Total depth: 77.26 ft, Date: 9/21/2018
Measured Groundwater Depth: 19 feet (weighted tape after sounding)
Cone Operator: Middle Earth Geo Testing, Inc.

SBT legend

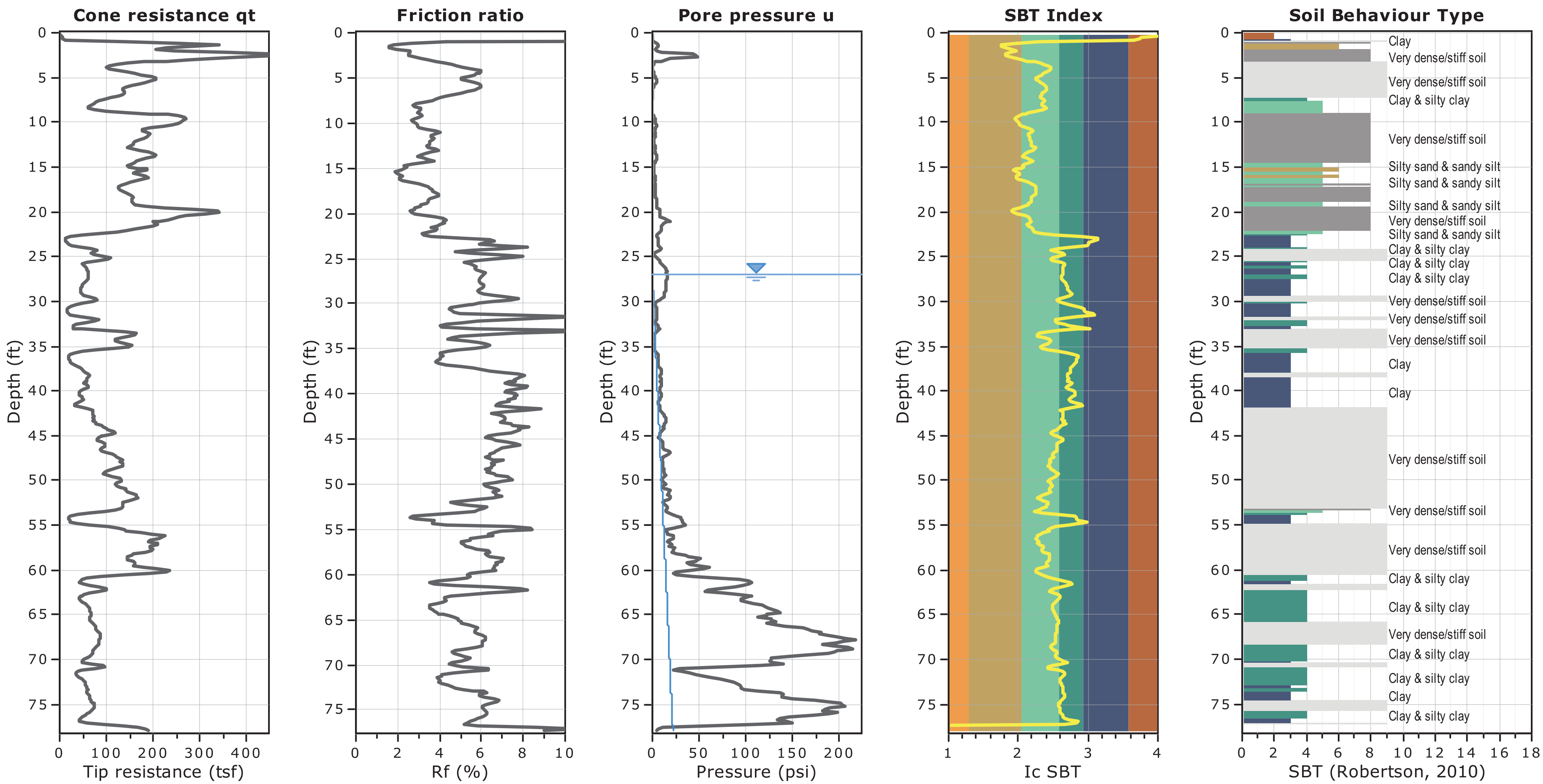
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

CONE PENETRATION TEST RESULTS
CPT-4

Date 10/04/18 | Project No. 18-1546 | Figure A-10

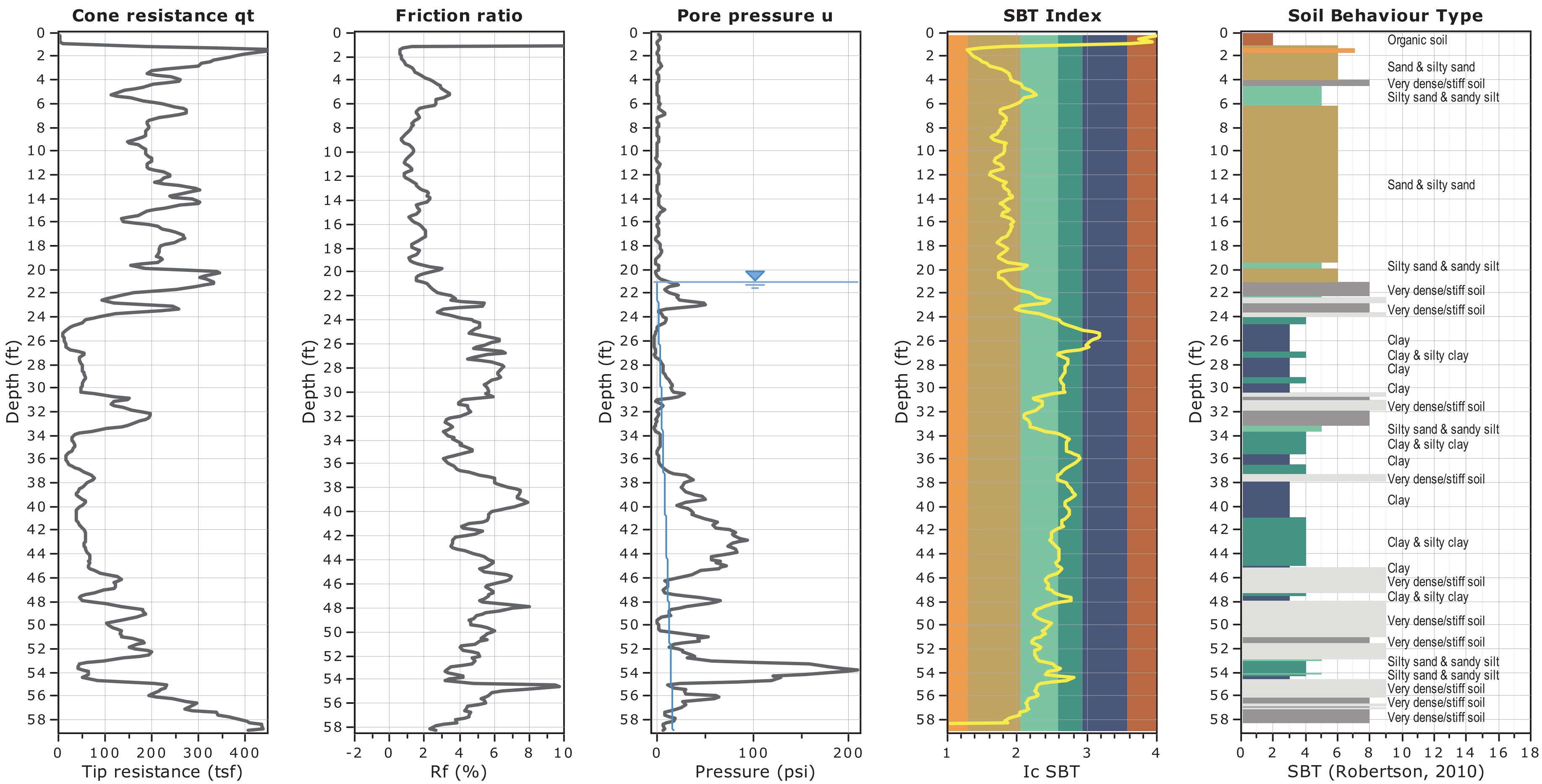


SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Total depth: 77.92 ft, Date: 9/21/2018
Measured Groundwater Depth: 27 feet (weighted tape after sounding)
Cone Operator: Middle Earth Geo Testing, Inc.

480 EAST 4TH AND 400 EAST 5TH AVENUE San Mateo, California	**CONE PENETRATION TEST RESULTS** **CPT-5**
ROCKRIDGE GEOTECHNICAL	Date 10/04/18	Project No. 18-1546	Figure A-11



SBT legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Total depth: 58.89 ft, Date: 10/06/2018
Measured Groundwater Depth: 21 feet (weighted tape after sounding)
Cone Operator: Middle Earth Geo Testing, Inc.

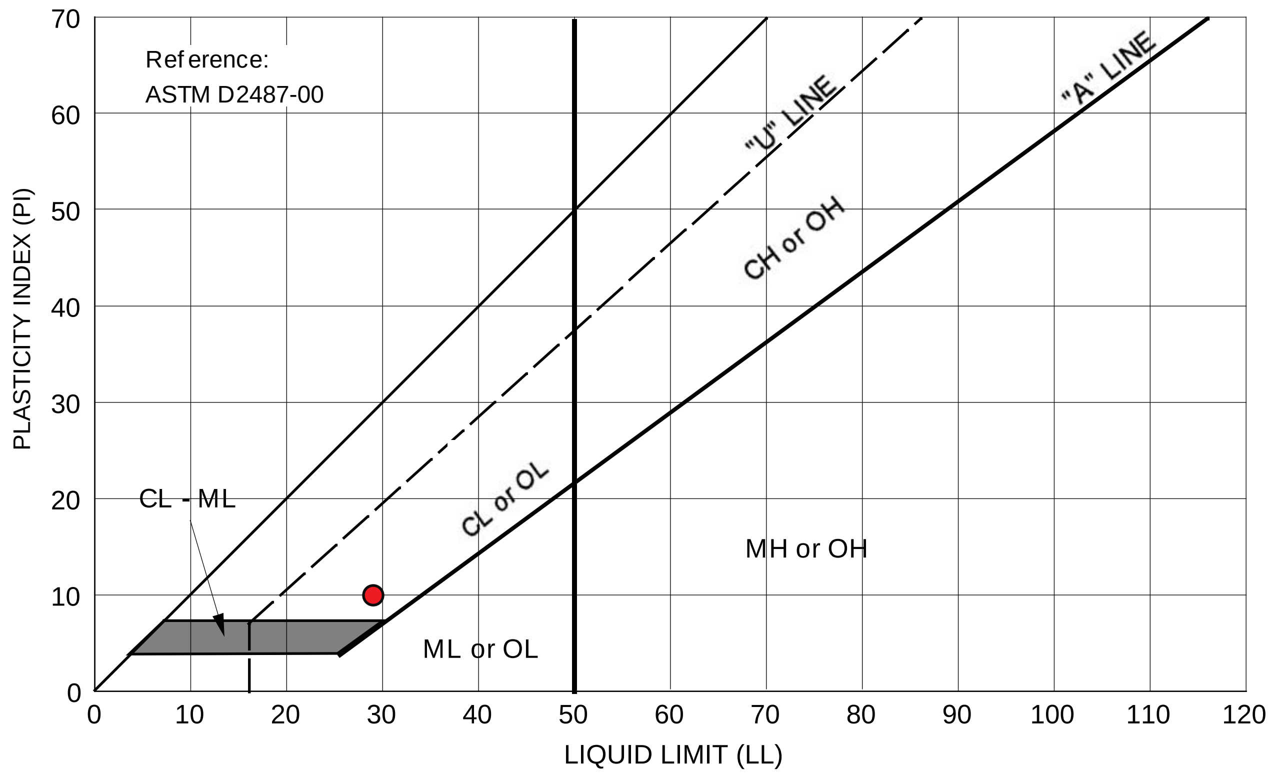
480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

CONE PENETRATION TEST RESULTS
CPT-6

Date 10/08/18 | Project No. 18-1546 | Figure A-12

APPENDIX B
Laboratory Test Results



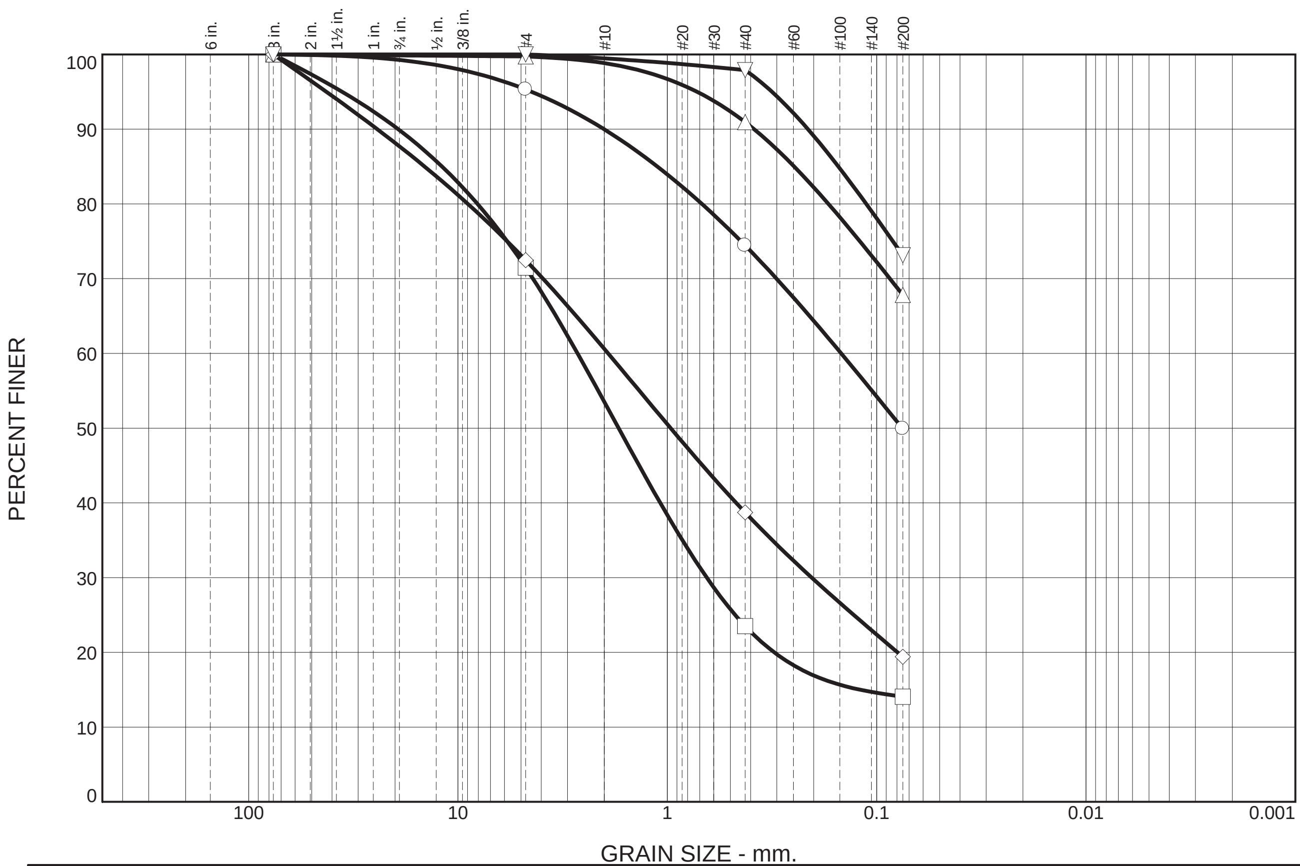
Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-2 at 4.0 feet	CLAYEY SAND (SC), yellow-brown	11.7	29	10	--

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

PLASTICITY CHART

Date 09/17/18 | Project No. 18-1546 | Figure B-1



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.7	4.0	5.3	15.6	24.5	49.9	
□	0.0	10.1	18.4	18.0	30.0	9.4	14.1	
△	0.0	0.1	0.2	0.9	7.9	23.1	67.8	
◇	0.0	12.3	15.2	11.9	21.9	19.3	19.4	
▽	0.0	0.0	0.0	0.5	1.6	24.8	73.1	

SOIL DATA

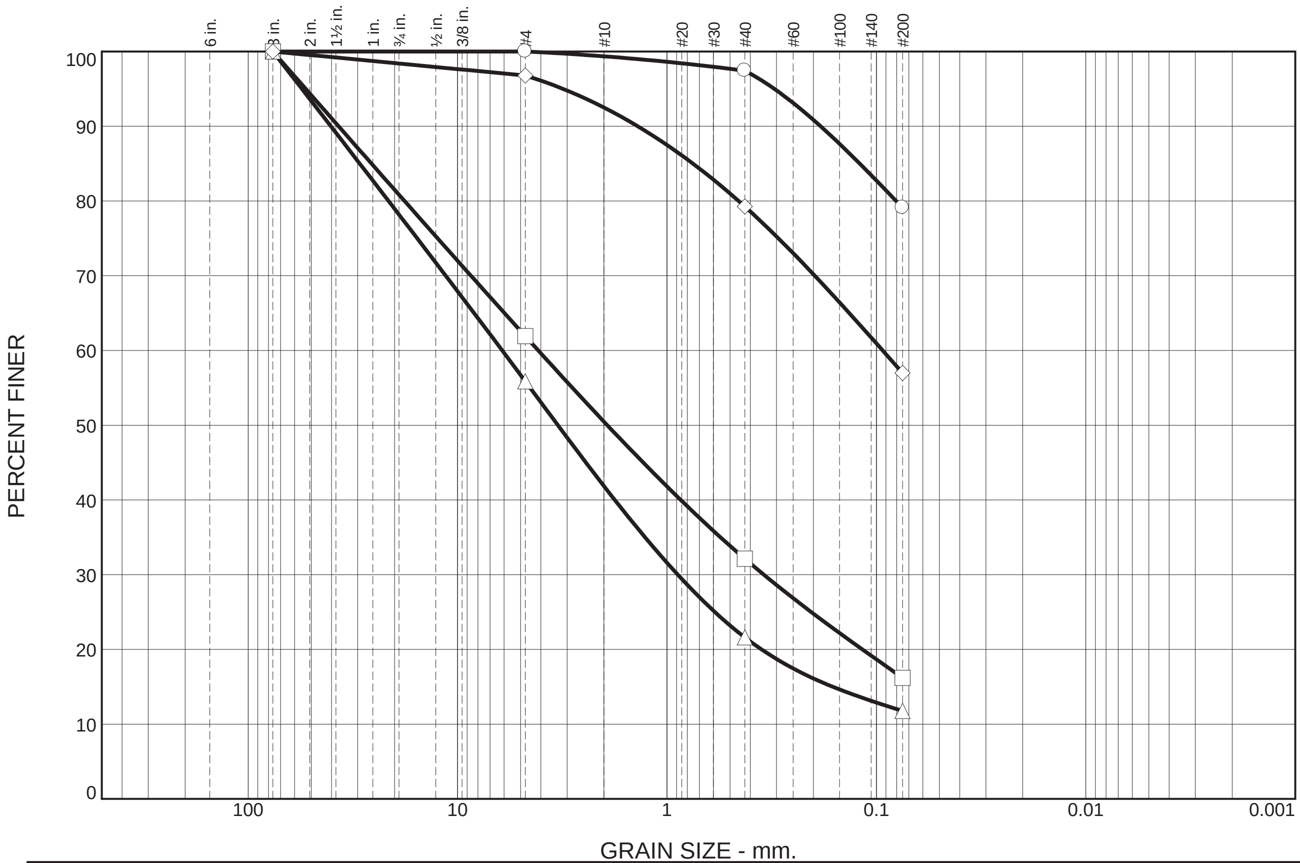
SYMBOL	SOURCE	DEPTH (ft.)	Material Description	USCS
○	B-1	3.0 - 4.5'	CLAYEY SAND, red-yellow	SC
□	B-1	10.0 - 11.5'	CLAYEY SAND with GRAVEL, light brown mottled gray	SC
△	B-1	25.0 - 26.5'	SANDY CLAY, yellow-brown mottled yellow-orange	CL
◇	B-2	5.0 - 6.5'	CLAYEY SAND with GRAVEL, yellow-brown	SC
▽	B-2	25.0 - 26.5'	CLAY with SAND, brown	CL

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION REPORT

Date 09/17/18 | Project No. 18-1546 | Figure B-2



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.6	2.0	18.3	79.1	
□	0.0	19.2	18.9	11.4	18.4	15.9	16.2	
△	0.0	21.8	22.3	14.0	20.3	9.8	11.8	
◇	0.0	1.6	1.6	4.3	13.2	22.3	57.0	

SOIL DATA

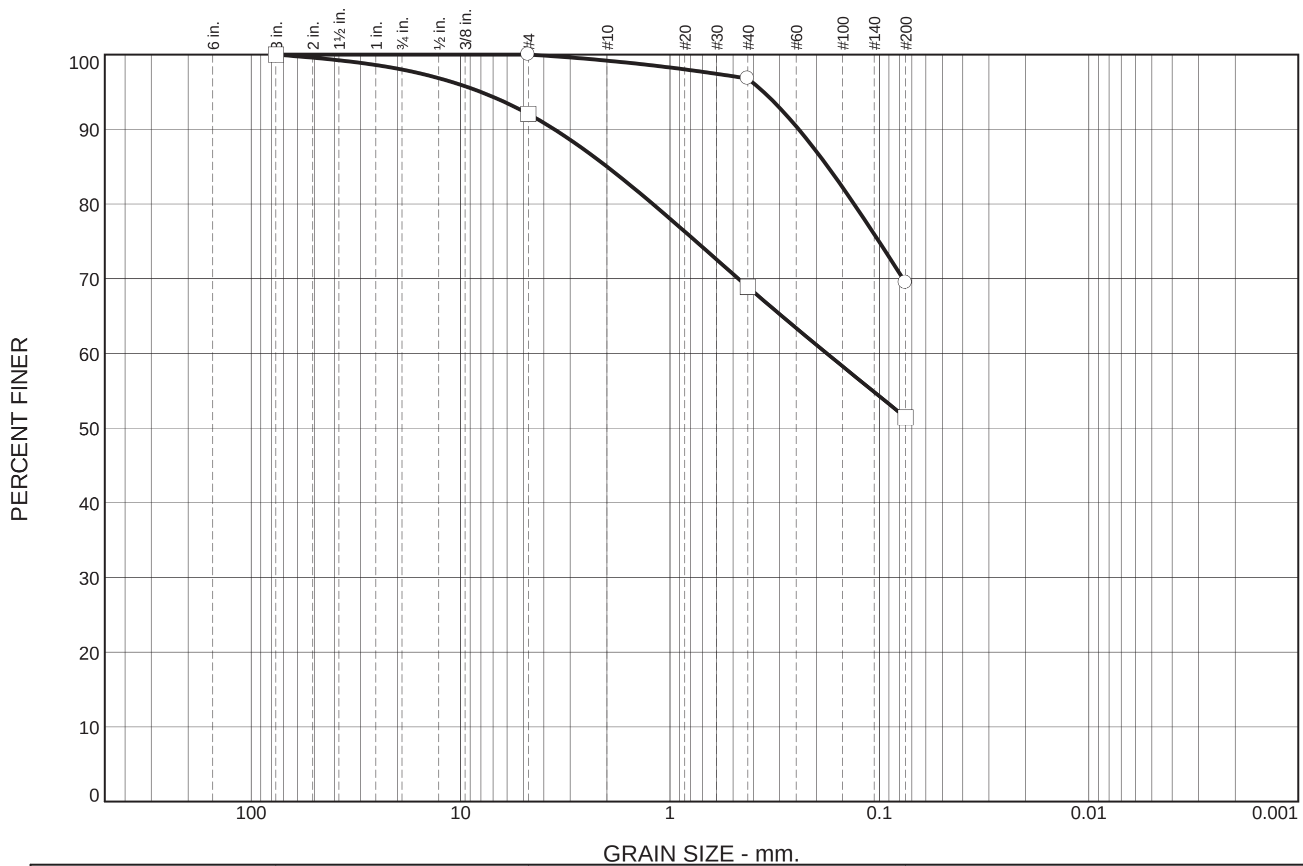
SYMBOL	SOURCE	DEPTH (ft.)	Material Description	USCS
○	B-3	16.0'	CLAY with SAND, yellow-brown to yellow-orange	CL
□	B-3	30.0 - 31.5'	CLAYEY SAND with GRAVEL, yellow-brown	SC
△	B-4	10.0 - 11.5	GRAVEL with CLAY and SAND, yellow-brown and yellow-orange	GP-GC
◇	B-4	35.0 36.5'	SANDY CLAY, olive-brown	CL

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION REPORT

Date 09/17/18 | Project No. 18-1546 | Figure B-3



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.8	2.4	27.3	69.5	
□	0.0	2.0	5.9	7.1	16.1	17.5	51.4	

SOIL DATA

SYMBOL	SOURCE	DEPTH (ft.)	Material Description	USCS
○	B-5	30.5	SANDY CLAY, yellow-brown	CL
□	B-5	40.0 - 41.5'	SANDY CLAY, yellow-orange mottled gray and yellow-red	CL

480 EAST 4TH AND 400 EAST 5TH AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

PARTICLE SIZE DISTRIBUTION REPORT

Date 09/17/18	Project No. 18-1546	Figure B-4

Results Only Soil Testing
for
480 E 4th & 400 E 5th

September 13, 2018

Prepared for:
Katie Dickinson
Rockridge Geotechnical
270 Grand Ave,
Oakland, CA 94610
ksdickinson@rockridgegeo.com

Project X Job#: S180911A
Client Job or PO#: 18-1546

Soil Analysis Lab Results

Client: Rockridge Geotechnical
Job Name: 480 E 4th & 400 E 5th
Client Job Number: 18-1546
Project X Job Number: S180911A
September 13, 2018

	Method	ASTM G187		ASTM D516		ASTM D512B		SM 4500-NO3-E	SM 4500-NH3-C	SM 4500-S2-D	ASTM G200	ASTM G51
Bore# / Description	**Depth**	**Resistivity**		**Sulfates**		**Chlorides**		**Nitrate**	**Ammonia**	**Sulfide**	**Redox**	**pH**
		As Rec'd	Minimum									
	(ft)	(Ohm-cm)	(Ohm-cm)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(mg/kg)	(mg/kg)	(mg/kg)	(mV)	
B-4-2A / Sandy clay with gravel, red brown	3.5	20,100	3,417	60	0.0060	114	0.0114	54	6.5	0.66	239	6.84

Unk = Unknown
NT = Not Tested
ND = 0 = Not Detected
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
Chemical Analysis performed on 1:3 Soil-To-Water extract

Please call if you have any questions.

Prepared by,

Nathan Jacob
Lab Technician

Respectfully Submitted,

Eddie Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com