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GEOTECHNICAL INVESTIGATION
VENETIA VALLEY K-8 SCHOOL
SAN RAFAEL CITY SCHOOLS
SAN RAFAEL, CALIFORNIA

April 27, 2017

Project 779.253

Prepared For:
San Rafael City Schools
310 Nova Albion Way
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Attn: Mr. Dan Zaich,
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CERTIFICATION

This document is an instrument of service, prepared by or under the direction of the undersigned professionals, in accordance with the current ordinary standard of care. The service specifically excludes the investigation of radon, asbestos or other hazardous materials. The document is for the sole use of the client and consultants on this project. No other use is authorized. If the project changes, or more than two years have passed since issuance of this report, the findings and recommendations must be reviewed by the undersigned.

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GEOTECHNICAL INVESTIGATION
VENETIA VALLEY K-8 SCHOOL
SAN RAFAEL CITY SCHOOLS –
SAN RAFAEL, CALIFORNIA

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1.0 INTRODUCTION

This report summarizes our geotechnical investigation for the proposed improvements to Venetia Valley K-8 school Campus located in San Rafael, California, as shown on the Site Map, Figure 1. Our work was performed in accordance with our Agreement for Professional Services, dated June 2, 2017. The purpose of our services is to evaluate site conditions and provide geotechnical recommendations for the proposed improvements. We are providing our services in three phases: 1) Geotechnical Investigation, 2) Geotechnical Investigation, and 3) Geotechnical Construction Observation and Testing. This report concludes our Phase 2 services and includes:

- Review of readily available published geologic and geotechnical reference data;
- Subsurface exploration of subsurface conditions with 4 exploratory soil borings;
- Laboratory testing of selected samples to determine the pertinent engineering properties of the soil layers;
- Evaluation of geologic hazards relevant to site development;
- Development of geotechnical recommendations for the project; and,
- Preparation of this report summarizing our findings.

2.0 PROJECT DESCRIPTION

As shown on the Site Plan, Figure 2, the project includes constructing new classroom structures and additions to existing campus buildings. The improvements include two new, two-story, classroom structures, with footprints of approximately 6,800 and 5,000 square feet, and a new, approximate 12,200-square foot, multipurpose/administration building. Ancillary improvements include concrete pedestrian areas, covered walkways, site utilities and asphalt paved parking and drop-off areas. Minor site grading is anticipated to create building pads and improve localized drainage conditions.

3.0 SITE CONDITIONS

3.1 Regional Geology

The project site is located in the Coast Ranges geomorphic province of California, which is typified by generally northwest-trending ridges and intervening valleys formed as a result of movement along a group of northwest-trending fault systems, including the San Andreas Fault. Bedrock geology within Marin County is dominated by sedimentary, igneous, and metamorphic rocks of the Jurassic-Cretaceous age Franciscan Complex. Sandstone and shale comprise the majority of Franciscan rock types, while less common rocks include chert, serpentinite, basalt, greenstone, and exotic low- to high-grade metamorphic rocks, including phyllite, schist, and eclogite.

As shown on Figure 3, regional geologic mapping (Rice, S.J, 1974) indicates that the project site is located on alluvial deposits (Qa). Alluvium, generally consists of unconsolidated deposits of clay, silt, sand and gravel deposited by streams.

3.2 Seismicity

The project site is located within a seismically active region that includes the Central and Northern Coast Mountain Ranges. Several active faults are present east and west of the site including the San Andreas, San Gregorio, and Hayward Faults. An “active” fault is defined as one that shows displacement within the last 11,000 years and, therefore, is considered more likely to generate a future earthquake than a fault that shows no sign of recent rupture. The California Department of Conservation, Division of Mines and Geology has mapped various active and inactive faults in the region (CDMG, 1972 and 2000). Faults are shown in relation to the project site on the attached Active Fault Map, Figure 4. The San Andreas and Hayward Faults are the nearest known active faults to the site, located approximately 16.8-kilometers southwest and 12.2 kilometers northeast of the site, respectively.

3.2.1 Historic Fault Activity

Numerous earthquakes have occurred in the region within historic times. Earthquakes (magnitude 2.0 and greater) that have occurred in the San Francisco Bay Area since 1985 have been plotted on a map shown on Figure 5.

3.2.2 Probability of Future Earthquakes

The site will likely experience moderate to strong ground shaking from future earthquakes originating on any of several active faults in the San Francisco Bay region. The historical records do not directly indicate either the maximum credible earthquake or the probability of such a future event. To evaluate earthquake probabilities in California, the USGS has assembled a group of researchers into the “Working Group on California Earthquake Probabilities” (Aagaard, et. al., 2016) to estimate the probabilities of earthquakes on active faults. These studies have been published cooperatively by the USGS, CGS, and Southern California Earthquake Center (SCEC) as the Uniform California Earthquake Rupture Forecast, Versions 1, 2, and 3. In these studies, potential seismic sources were analyzed considering fault geometry, geologic slip rates, geodetic strain rates, historic activity, micro-seismicity, and other factors to arrive at estimates of earthquakes of various magnitudes on a variety of faults in California.

The study specifically analyzed fault sources and earthquake probabilities for the seven major regional fault systems in the Bay Area region and the entire state of California and updated some of the analytical methods and models. The most recent study (UCERF3) further expanded the database of faults considered and allowed for consideration of multi-fault ruptures, among other fractures.

Conclusions from the most recent UCERF3 and USGS (Field, 2015) studies indicate the highest probability of a M>6.7 earthquake on any of the active faults in the San Francisco Bay region by 2043 is assigned to the Hayward and Rodgers Creek Faults, located approximately 13.8-kilometers northeast of the site, at 33%. The second nearest known active fault, the San Andreas Fault; located 14.3-kilometers southwest, is assigned a 22% probability of a M>6.7 earthquake by 2043. Additional studies by the USGS regarding the probability of large earthquakes in the Bay Area are ongoing. These current evaluations include data from additional active faults and updated geological data.

3.3 Surface Conditions

The existing, approximate 10.7-acre, elementary and middle school campus is located within a residential area at 177 N San Pedro Road in San Rafael, California. The site is bounded by Edward Avenue at the northeast, Madison Avenue at the northwest, Roosevelt Avenue at the southwest, and North San Pedro Road at the southeast. Campus structures consist of one-story wood framed and portable classrooms. The central portion of the campus consists of asphalt paved play areas and a large natural turf field is located on the northeastern end of the property. Much of the Venetia Valley K-8 school campus is relatively flat with elevations ranging from 50-feet at the southeast to 30-feet above sea level at the northwest.

3.4 Field Exploration and Laboratory Testing

We explored subsurface conditions in the general vicinity of the planned improvements on July 31, 2017 with 4 soil borings drilled with track mounted equipment. The approximate locations of our borings are shown on Figure 2. Our geologist logged the borings in the field and collected select soil samples for laboratory testing. A Soil Classification and Rock Classification Chart is presented along with the Boring Logs on Figures A-1 through A-6.

Laboratory testing of select soil samples collected during our exploration included determination of moisture content, dry density, unconfined compressive strength, and material passing the #200 sieve and the results are presented on the Boring Logs. Additionally, we performed corrosion resistance tests on soil obtained from the upper two feet and the results of these tests are presented on Figure A-7.

We previously performed a subsurface exploration at the project site on August 18th through the 21st in 2003 to evaluate the subsurface conditions. Our investigation consisted of 18 soil borings drilled with truck mounted drilling equipment throughout the campus at the approximate locations shown on Figure 2. Our Engineer logged the borings in the field and collected soil samples at select intervals for laboratory testing. The results of our previous subsurface exploration are presented in Appendix B.

3.5 Subsurface Conditions

Our subsurface exploration generally confirms the regionally-mapped geologic conditions at the site. The project site is underlain by interbedded layers of medium dense to dense clayey sands and medium stiff to stiff, low to medium plasticity sandy clay alluvium. Weathered sandstone bedrock was observed in all borings between 6 to 20-feet-feet below the ground surface. Simplified geologic cross section are provided on Figures 6 and 7.

Groundwater was not observed in any of our borings. However the borings were not left open for an extended period of time; therefore a stabilized depth to groundwater was not observed. Typically, groundwater levels fluctuate seasonally with higher levels expected during the wet winter months.

We researched both the California State Water Resource Control Board's GeoTracker website (http://geotracker.waterboards.ca.gov/) and the Department of Water Resources Water Library website (http://www.water.ca.gov/waterdatalibrary) to determine if existing groundwater elevation data was available in the immediate vicinity of the Venetia Valley K-12 campus. The Department of Water Resources Water Library search did not indicate any wells within 1-mile of the project site. The results of our California State Water Resource Control Board search indicate that a well was installed in 1991 at the National Guard Armory located approximately 800-feet west of the project site (Edd Clark & Associates, 1991). Groundwater levels were measured at an elevation of approximately 25-feet above sea level. The groundwater data from this monitoring well indicate a highest historic groundwater level of 13.5-feet below the ground surface. However, the approximate elevation in the general vicinity of the proposed improvements are 40 to 45-feet above sea level. Therefore, we anticipate the highest historic groundwater level at the project site would be located near the soil/bedrock contact.

4.0 GEOLOGIC HAZARDS EVALUATION

4.1 General

The principal geologic hazards which could potentially affect the project site are strong seismic shaking from future earthquakes in the San Francisco Bay Region, seismically induced settlement, slightly corrosive soils, and erosion. Other commonly considered geologic hazards are not considered significant at the site. Geologic hazards, their impacts, and recommended mitigation measures are discussed below.

4.2 Fault Surface Rupture

Under the Alquist-Priolo Earthquake Fault Zoning Act, the California Geological Survey (CGS, 2007) produced 1:24,000 scale maps showing all known active faults and defining zones within which special fault studies are required. Based on currently available published geologic information, the project site is not located within an Alquist-Priolo Earthquake Fault Zone. The potential for fault surface rupture on the project site is therefore considered to be low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.3 Seismic Shaking

The site will likely experience seismic ground shaking from future earthquakes in the San Francisco Bay Area. Earthquakes along several active faults in the region, as shown on Figure 4, could cause moderate to strong ground shaking at the site.

4.3.1 Deterministic Seismic Hazard Analysis

Deterministic Seismic Hazard Analysis (DSHA) predicts the intensity of earthquake ground motions by analyzing the characteristics of nearby faults, distance to the faults and rupture zones, earthquake magnitudes, earthquake durations, and site-specific geologic conditions. Empirical relations (Campbell and Borzognia, and Chiou and Youngs (2008)) for the soft rock profile conditions were utilized along with the Caltrans online ARS program to provide approximate estimates of median peak site accelerations. A summary of the principal active faults affecting the site, their closest distance, moment magnitude of characteristic earthquake and probable peak ground accelerations (PGA), which an earthquake on the fault could generate at the site are shown in Table A.

TABLE A
DETERMINISTIC PEAK GROUND ACCELERATION
Venetia Valley K-8 school
San Rafael, California

Fault	Fault Mechanism	Distance to Fault[1]	Moment Magnitude	Median PGA[2,3]	+1σ PGA[2,3]
Hayward	Strike Slip	12.2 km	7.3	0.26 g	0.44 g
San Andreas	Strike Slip	16.8 km	8.0	0.26 g	0.43 g
San Gregorio	Strike Slip	17.7 km	7.4	0.20 g	0.35 g
Rodgers Creek	Strike Slip	19.8 km	7.3	0.18 g	0.31 g
West Napa	Strike Slip	29.9 km	6.6	0.09 g	0.16 g

References:

1) Caltrans ARS (2016)
2) Campbell and Borzognia (2008)
3) Chiou and Youngs (2008)

4.3.2 Probabilistic Seismic Hazard Analysis

Probabilistic Seismic Hazard Analysis (PSHA) analyzes all possible earthquake scenarios while incorporating the probability of each individual event to occur. The probability is determined in the form of the recurrence interval, which is the average time for a specific earthquake acceleration to be exceeded. The design earthquake is not solely dependent on the fault with the closest distance to the site and/or the largest magnitude, but rather the probability of given seismic events occurring on both known and unknown faults.

We calculated the PGA for two separate probabilistic conditions, the 2% chance of exceedance in 50 years (2,475-year statistical return period), and the 10% chance of exceedance in 50 years (475-year statistical return period), utilizing the 2008 Interactive Deaggregation (USGS, 2008). The results of the probabilistic analyses are presented below in Table B.

TABLE B
PROBABILISTIC SEISMIC HAZARD ANALYSES
Venetia Valley K-8 School
San Rafael, California

	Statistical Return Period	Magnitude	Stiff Soil PGA	Soft Soil PGA
2% in 50 years	2,475 years	7.1	0.74 g	0.75 g
10% in 50 years	475 years	7.1	0.48 g	0.49 g

Reference: USGS Beta - Unified Hazard Tool (2017)

The potential for strong seismic shaking at the project site is high. Due to their proximity, and probability of future rupture, the San Andreas and Hayward Faults present the highest potential for strong ground shaking. The most significant adverse impact associated with strong seismic shaking is potential damage to structures and improvements.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Minimum mitigation measures should include designing the structures and foundations in accordance with the most recent version (2016) of the California Building Code.*

4.4 Liquefaction Potential and Related Impacts

Liquefaction refers to the sudden, temporary loss of soil shear strength during strong ground shaking. Liquefaction-related phenomena include liquefaction-induced settlement, flow failure, and lateral spreading. These phenomena can occur within saturated, loose, granular deposits. Recent advances in liquefaction studies (Idriss & Boulanger, 2008, 2010, & 2014) indicate that liquefaction can occur in granular materials with a high fines content (35 to 50% clay and silt particles that pass the #200 sieve) provided the fines exhibit a plasticity index (PI) less than 7.

The site is not mapped within an area susceptible to liquefaction by the Association of Bay Area Governments (ABAG). Granular soils were observed during our previous and our supplemental subsurface explorations throughout the campus. However, these soils were encountered above the historic high ground water level. Therefore, the risk of damage due to liquefaction at the site is low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.5 Seismically Induced Ground Settlement

Seismic ground shaking can induce settlement of unsaturated, loose, clean, granular soils. Settlement occurs as the loose soil particles rearrange into a denser configuration when subjected to seismic ground shaking. Varying degrees of settlement can occur throughout a deposit, resulting in differential settlement of structures founded on such deposits. Granular soils were observed above the historic high groundwater level. We analyzed the predicted settlement due to seismically induced ground settlement of dry sands utilizing the procedure outlined by Tokimatsu and Seed (1984). The results of our analyses are presented on Figure 8 and indicate less than 0.25-inches of seismically induced settlement may be expected.

Evaluation: *Less than significant with mitigation.*
Mitigation: *The foundation system supported the proposed structures should be able to withstand up to 0.25-inches of settlement over a 30-feet. The foundation design criteria given in section 5.2 in this report.*

4.6 Lurching and Ground Cracking

Lurching and associated ground cracking can occur during strong ground shaking. The ground cracking generally occurs along the tops of slopes where stiff soils are underlain by soft deposits or along steep slopes or channel banks. We did not observe these conditions at the project site. Therefore, we do not anticipate lurching or ground cracking will be a significant geologic hazard at the project site.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.7 Erosion

Sandy soils on moderate slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated water runoff. A majority of the project site is relatively flat. Based on our previous subsurface exploration a majority of the surficial soils consist of granular soils. Therefore, the risk of erosion of surficial soils during construction when the surficial soils are exposed is moderate.

Evaluation: *Less than significant with mitigation.*
Mitigation: *The project Civil Engineer is typically responsible for site drainage design. Erosion control during and after construction should conform to a site-specific Stormwater Pollution Prevention Plan (SWPPP) prepared by the project Civil Engineer and the guidelines of the most recent edition of the Marin County Stormwater Pollution Prevention Program (2015).*

4.8 Seiche and Tsunami

Seiche and tsunamis are short duration, earthquake-generated water waves in large enclosed bodies of water and the open ocean, respectively. The extent and severity of a seiche would be dependent upon ground motions and fault offset from nearby active faults. The project site is located about 1.75-miles from San Pablo Bay and is not within a mapped Tsunami Zone (ABAG, 2016), therefore seiche and tsunami are not considered significant geologic hazards at the project site.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.9 Flooding

The project site is not mapped within a FEMA 500-year flood zone. Therefore, widespread flooding is not considered a geologic hazard at the project site. However, as with all development sites, localized ponding/flooding is possible due to changes in the natural drainage patterns. The project Civil Engineer is responsible for site drainage and should evaluate localized flooding potential and provide appropriate mitigation.

Evaluation: *Less than significant with mitigation.*
Mitigation: *The project Civil Engineer or Architect should locate finished floor elevations above flood levels and provide appropriate storm drain design for the maximum credible rainfall event.*

4.10 Dam Failure Inundation

Based on the San Rafael Local Hazard Mitigation Plan (San Rafael, 2017) the site is not mapped in a Dam Failure Inundation zone. Therefore, the threat of inundation of the site from dam failure is judged to be low.

Evaluation: *No significant Impact.*
Mitigation: *No mitigation measures are required.*

4.11 Expansive Soil

Expansive soils will shrink and swell with fluctuations in moisture content and are capable of exerting significant expansion pressures on building foundations, interior floor slabs and exterior flatwork. Distress from expansive soil movement can include cracking of brittle wall coverings (stucco, plaster, drywall, etc.), racked door and/or window frames, and uneven floors and cracked slabs. Flatwork, pavements, and concrete slabs-on-grade are particularly vulnerable to distress due to their low bearing pressures. We did not encounter expansive soils during our subsurface exploration, therefore, the risk of expansive soil affecting the proposed improvements is low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.12 Settlement/Subsidence

Significant settlement can occur when new loads are placed at sites causing consolidation of soft compressible clays (i.e., Bay Mud) or compression of loose soils. The site is most likely blanketed in relatively shallow granular soils overlying weathered bedrock. We did not observe soft compressible soils (i.e., Bay Mud, lacustrine deposits, marsh deposits, etc.) during our subsurface exploration. Therefore, consolidation settlement is not considered a significant hazard at the project site.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.13 Slope Instability and Landslides

Slope instability generally occurs on relatively steep slopes and/or on slopes underlain by weak materials. The project site is relatively flat and the campus is not located at the base of slopes. Therefore, we judge the risk of damage to new improvements due to slope instability is low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.14 Soil Corrosion

Corrosive soil can damage buried metallic structures, cause concrete spalling, and deteriorate rebar reinforcement. Laboratory testing was performed on representative samples of the near-surface site soils to evaluate pH, electrical resistivity, chloride and sulfate contents. These laboratory test results are presented on Figure A-7.

The results of our corrosivity testing indicate the upper soil layers have a pH of 5.4, a chloride concentration of 67 parts per million (ppm), and sulfate concentrations less than 1 ppm. Per Caltrans Corrosion Guidelines (2003) a soil is considered corrosive if the pH level is less than 5.5, the chloride concentration is greater than 500 ppm, and/or the sulfate concentration is 2,000 ppm or greater. Based on the results of the corrosion testing it appears the soils are slightly acidic and therefore corrosive soil is considered a minor geologic hazard at the project site.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Concrete and site utilities should consist of materials resistant to acidic environments. Additionally, non-reactive pipe bedding material should be utilized.*

4.15 Radon-222 Gas

Radon-222 is a product of the radioactive decay of uranium-238 and raduim-226, which occur naturally in a variety of rock types, mainly phosphatic shales, but also in other igneous, metamorphic, and sedimentary rocks. While low levels of radon gas are common, very high levels, which are typically caused by a combination of poor ventilation and high concentrations of uranium and radium in the underlying geologic materials, can be hazardous to human health.

The project site is located in Sonoma County, California, which is mapped in radon gas Zone 3 by the United States Environmental Protection Agency (USEPA, 2017). Zone 3 is classified by the EPA as exhibiting a "low" potential for Radon-222 gas with average predicted indoor screening levels less than 2 pCi/L. Therefore, the potential for hazardous levels of radon at the project site is low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.16 Volcanic Eruption

Several active volcanoes with the potential for future eruptions exist within northern California, including Mount Shasta, Lassen Peak, and Medicine Lake in extreme northern California, the Mono Lake-Long Valley Caldera complex in east-central California, and the Clear Lake Volcanic Field, located in Lake County approximately 68-miles north of the project site. The most recent volcanic eruption in northern California was at Lassen Peak in 1917, while the most recent eruption at the nearest volcanic center to the project site, the Clear Lake Volcanic Field, was about 10,000 years ago. All of northern California's volcanic centers are currently listed under "normal" volcanic alert levels by the USGS California Volcano Observatory (USGS, 2017a). While the aforementioned volcanic centers are considered "active" by the USGS, the likelihood of damage to the proposed improvements due to volcanic eruption is generally low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.17 Naturally Occurring Asbestos (NOA)

Naturally occurring asbestos is commonly found in association with serpentinite and associated ultramafic rock types. These rocks are a major constituent of the Franciscan Complex, which underlies vast portions of the greater San Francisco Bay Area. The site is underlain by relatively thick native alluvial soils, and while it lies in a region dominated in part by Franciscan Complex bedrock, no evidence suggesting the presence of serpentinite or related rock types was observed during our exploration. Therefore, the likelihood that significant deposits of naturally-occurring asbestos will be encountered at the site is low.

Evaluation: *No significant impact.*
Mitigation: *No mitigation measures are required.*

4.18 Hazardous Materials

Hazardous materials were not observed during our subsurface exploration. While environmental testing for hazardous materials was beyond the scope of our services, we did observe enclosures that contain HVAC units and other industrial equipment that has the potential for creating hazardous materials. Therefore, we judge the potential for hazardous materials being present on the project site, currently or in the future, is moderate.

Evaluation: *Less than significant with mitigation.*
Mitigation: *The campus should comply with all local, state, and federal guidelines to minimize the exposure to hazardous materials. If a possible hazardous material spill occurs on campus, a qualified environmental specialist should be consulted.*

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our review of readily available geologic data, and experience with similar projects, it is our professional opinion that the site is suitable for the planned elementary/middle school development. The primary geotechnical issues to be considered during project development and design include appropriate seismic design seismically induced settlement, erosion during construction and slightly corrosive soils. Geotechnical recommendations and development guidelines to address these and other issues are discussed in more detail below.

5.1 Seismic Design

Minimum mitigation of ground shaking includes seismic design of new structures in conformance with the provisions of the most recent edition (2016) of the California Building Code (CBC). The magnitude and character of these ground motions will depend on the particular earthquake and the site response characteristics. Based on our subsurface exploration we anticipate the site may be classified as a Site Class C. The 2016 CBC Seismic design parameters are presented below on Table C.

TABLE C
2016 CBC FACTORS
Venetia Valley K-8 school
San Rafael, California

Factor Name	Coefficient	2016 CBC Site Specific Value
Site Class[1]	$S_{A,B,C,D,E,\text{ or }F}$	S_C
Site Coefficient	F_a	1.00
Site Coefficient	F_v	1.30
Spectral Acc. (short)	S_S	1.50 g
Spectral Acc. (1-sec)	S_1	0.60 g
Spectral Response (short)	SM_S	1.50 g
Spectral Response (1-sec)	SM_1	0.78 g
Design Spectral Response (short)	SD_S	1.00 g
Design Spectral Response (1-sec)	SD_1	0.52 g
MCE_G[2] PGA adjusted for Site Class	PGA_M	0.50 g
Seismic Design Category	A,B,C,D, or E	D

Notes:

1) Site Class C Description: Very dense soil and soft rock profile with shear wave velocities between 1,200 and 2,500 ft/sec, standard blow counts between greater than 50 blows per foot, and undrained shear strength greater than 2,000 psf.
2) Maximum Considered Earthquake Geometric Mean

5.2 Site Preparation and Grading

The general grading recommendations presented below are appropriate for construction in the late spring through fall months. From winter through the early spring months, on-site soils may be saturated due to rainfall and may be difficult to compact without drying by aeration or the addition of lime and/or cement (or a similar product) to dry the soils. Site preparation and grading should conform to the recommendations and criteria outlined below. General recommendations for wintertime construction are provided later in this report.

5.2.1 Surface Preparation

Clear all trees, brush, roots, over-sized debris, and organic material from areas to be graded. Trees that will be removed (in structural areas) must also include removal of stumps and roots larger than two inches in diameter. Excavated areas (i.e., excavations for stump removal) should be restored with properly moisture conditioned and compacted fill as described in the following sections. Any loose soil or rock at subgrade will need to be excavated to expose firm natural soils or bedrock. Debris, rocks larger than six inches and vegetation are not suitable for structural fill and should be removed from the site. Alternatively, vegetation strippings may be used in landscape areas.

Where fills or other structural improvements are planned on level ground, the subgrade surface should be scarified to a depth of about eight inches, moisture conditioned to above the optimum moisture content, and compacted to a minimum of 90% relative compaction (ASTM D-1557). Relative compaction should be increased to a minimum of 95% where new asphalt pavements are planned. Relative compaction, maximum dry density, and optimum moisture content of fill materials should be determined in accordance with ASTM Test Method D 1557, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 10-lb. Rammer and 18-in. Drop." If soft, wet or otherwise unsuitable materials are encountered at the subgrade elevation during construction, we will provide supplemental recommendations/field directives to address the specific condition.

5.2.2 Compacted Fill

On-site fill, backfill, and scarified subgrades should be conditioned to within 2% of the optimum moisture content. Properly moisture conditioned and cured on-site materials should subsequently be placed in loose horizontal lifts of 8 inches thick or less, and uniformly compacted to a minimum of 90% R.C.

5.2.3 Materials

Based on our laboratory testing, onsite soils are acceptable for use as fill, provided they are prepared as described above, some seasonal movement should be expected. If imported fill is required, the material shall consist of soil and rock mixtures that: (1) are free of organic material, (2) have a Liquid Limit less than 40 and a Plasticity Index of less than 20, (3) have a maximum particle size of 6 inches, and (4) contain less than 50% silt and/or clay (material passing the #200 sieve). Any imported fill material needs to be tested to determine its suitability for use as fill material.

5.3 Foundation Design

As previously discussed, the site is underlain by granular soils that may settle up to 0.25-inches during the design seismic event. Provided soils are moisture conditioned and compacted as described above, a rigid interconnected shallow foundation system may be utilized to support the proposed structure.

Additionally, we understand bio-retention areas are planned adjacent to the proposed foundations. Based on our review of the preliminary project details the bio-retention areas will be drained via a perforated pipe, surrounded by Caltrans Class 2 Permeable material, and lined with a 40-mil vapor barrier. Therefore, the bearing soil will not be affected by the water introduced to the bioretention area. However, typically bio-retention structures are filled with lighter soil than typical. Therefore, that lateral resistance of bio-retention soil should be half of the native soil. Foundations should be designed utilizing the criteria shown below in Table D.

TABLE D
FOUNDATION DESIGN CRITERIA
Venetia Valley K-8 school
San Rafael, California

Minimum embedment below existing grade:	18-inches
Minimum width[2]:	
One-story:	12 inches
Two-story:	15-inches
Three-story:	18-inches
Allowable bearing pressure:	
Dead plus live loads:	2,500 psf
Total including wind and seismic	3,000 psf
Bulk Modulus[3,4]:	$100[(B+1)/2B]^2$ pci
Base friction coefficient:	0.35
Lateral passive resistance[4,5]:	
Native soil:	350 pcf
Bio-retention area:	175 pcf

Notes:

1.) Assumes rigid slab behavior with idealized fixed conditions.

2.) Design shallow foundations to similar bearing pressures, i.e., size footing widths to maintain uniform bearing loads. Maintain above optimum moisture contents until concrete slabs are completed.

3.) B = foundation width.

4.) Bulk modulus value not to exceed 67 pci

5.) May increase design values by 1/3 for total design loads including wind and seismic.

6.) Neglect upper 6-inches unless confined by concrete. Equivalent Fluid Pressure, not to exceed 3,500 psf.

A majority, roughly 90%, of the foundation pressure is exerted on the underlying soil within a “zone-of-influence”. This “zone-of-influence” is typically an area below a projected 1:1 line. Utilities planned parallel to the foundations should be constructed outside this “zone-of-influence”.

5.4 Retaining Wall Design

We anticipate retaining walls may be required to retain the excavations needed to construct level building pads. Walls free to rotate at the top, “unrestrained”, or walls structurally connected at the top, “restrained”, should be designed using the criteria shown on Table E below.

TABLE E
RETAINING WALL DESIGN CRITERIA
Venetia Valley K-8 school
San Rafael, California

Foundations	See Table E
Unrestrained Earth Pressure[1, 2]:	
Level Ground	40 pcf
2:1 Slope	60 pcf
Restrained Earth Pressure[1, 3]:	
Level Ground	60 pcf
2:1 Slope	75 pcf
Seismic Surcharge[3]:	10 x H psf

Notes:
1) Interpolate earth pressures for intermediate slopes.
2) Equivalent fluid pressure.
3) Rectangular distribution. The factor of safety for short-term seismic conditions can be reduced to 1.0 or greater.

Drainage shall be provided for all retaining walls taller than 3-feet. Either Caltrans Class 1B permeable material within filter fabric or Caltrans Class 2 permeable material can be used. The seepage should be collected in a 4-inch perforated PVC drain line at the base of the wall. The permeable material shall extend at least 12-inches from the back of the wall and be continuous from the bottom of the wall to within 12-inches of the ground surface. Alternatively, drainage panels, such as Mirafi 100N, may be utilized. A schematic retaining wall backdrain detail is provided on Figure 8.

Seepage collected in the drain line should be conveyed into the storm drain system by gravity in a solid pipe. The pipe shall have a minimum slope of one percent to drain. To maintain the wall drainage system, clean outs shall be installed at the upstream end and at all major changes in direction.

5.5 Site and Foundation Drainage

The site is relatively flat and there is a possibility that new grading could result in adverse drainage patterns and water ponding around buildings. Careful consideration should therefore be given to design of finished grades at the site. We recommend that landscaped areas adjoining new structures be sloped downward at least 0.25 feet for 5 feet (5%) from the perimeter of building foundations. Where hard surfaces, such as concrete or asphalt adjoin foundations, slope these surfaces at least 0.10 feet in the first 5 feet (2%). Roof gutter downspouts may discharge onto the pavements, but should not discharge onto any landscaped areas. Provide area drains for landscape planters adjacent to buildings and parking areas and collect downspout discharges into a tight pipe collection system. Site drainage improvements should be connected into the existing campus storm drainage system.

5.6 Concrete Slabs-On-Grade

We generally recommend that interior concrete slabs have a minimum thickness of 5-inches and be reinforced with steel reinforcing bars (not mesh). Slabs should be placed on a moist subgrade as previously described above. To reduce (i.e., improve) interior moisture conditions, a minimum of four inches of clean, free draining, ¾-inch angular gravel should be placed beneath interior concrete slabs to form a capillary moisture break. The drain rock must be placed on a properly moisture conditioned and compacted subgrade that has been approved by the Geotechnical Engineer. A 15-mil, or thicker, vapor barrier should be placed over the compacted drain rock. The vapor barrier shall meet the ASTM E 1745 Class A requirements and be installed per ASTM E 1643. Eliminating the capillary moisture break and/or plastic visqueen may result in excess moisture intrusion through the floor slabs resulting in poor performance of floor coverings, mold growth, or other adverse conditions.

The industry standard approach to floor slab moisture control, as discussed above, does not assure that floor slab moisture transmission rates will meet the building use requirements or that indoor humidity levels will be low enough to inhibit mold growth. Building design, construction, and intended use have a significant role in moisture problems and should be carefully evaluated by the owner, designer, and builder in order to meet the project requirements.

Exterior concrete slabs should be at least 5-inches thick and reinforced with steel bars (not wire mesh). Additionally, contraction joints should be incorporated in the concrete slab in both directions, no greater than 10 feet on center and the reinforcing bars should extend through these control joints. For improved performance, exterior concrete slabs may be underlain with at least 4-inches of Caltrans Class 2 Aggregate Base compacted to at least 92% relative compaction.

5.7 Asphalt Pavement

Typically, asphalt pavement sections are designed utilizing two variables, the R-Value (a measure of the subgrade resistance) and the Traffic Index (a measure of the amount of daily traffic). Based on the subsurface conditions we judge an R-Value of 15 is appropriate for the site. The project Civil Engineer should select an appropriate Traffic Index for the driveway or the existing section could be “matched”. Based on this assumed R-value, we calculated pavement sections for a range of Traffic Indexes in accordance with Caltrans procedures for flexible pavement design (2006). The results of our analysis are presented on Table F.

TABLE F
PAVEMENT DESIGN CRITERIA
Venetia Valley K-8 school
San Rafael, California

Traffic Index	Asphalt Concrete	Aggregate Baserock
4.0	2.5 inches	6.5 inches
5.0	3.0 inches	8.0 inches
6.0	3.5 inches	11.0 inches
7.0	4.0 inches	13.0 inches

Note:

To reduce the section thickness the general rule of thumb of 2-inches of Class 2 Aggregate Baserock is equivalent to 1-inch od asphalt may be applied.

Preparation of the existing subgrade soils should be performed per the recommendations in Section 5.2, including removal of existing vegetation, scarifying to a depth of about eight inches, moisture conditioning to above optimum, and compacting the finished subgrade to at least 95% relative compaction (ASTM D1557). The base rock should consist of Class 2 Aggregate Base (Caltrans, 2016), compacted to at least 95 percent relative compaction. Asphalt concrete should be placed to conform to the 2016 Caltrans Standard Specifications.

5.8 Utility Trench Excavations and Backfills

Excavations for utilities will most likely extend into medium dense to dense granular soils. Trench excavations having a depth of five feet or more that will be entered by workers must be sloped, braced, or shored in accordance with current Cal/OSHA regulations. On-site soils appear to be Type C. All excavations where collapse of excavation sidewall, slope or bottom could result in injury or death of workers, should be evaluated by the contractor’s safety officer and designated competent person prior to entering in accordance with current Cal/OSHA regulations.

Bedding materials for utility pipes should be well graded sand with 90 to 100% of particles passing the No. 4 sieve and no more than 5% finer than the No. 200 sieve. Provide the minimum bedding beneath the pipe in accordance with the manufacturer’s recommendation, typically 3 to 6 inches. Trench backfill may consist of on-site soils, moisture conditioned to within 2% of the optimum moisture content, placed in thin lifts and compacted to a minimum of 90% relative compaction. Backfill for trenches within pavement areas should consist of non-expansive granular fill. Use equipment and methods that are suitable for work in confined areas without damaging utility conduits. Where utility lines cross under or through perimeter footings, they should be sealed to reduce moisture intrusion into the areas under the slabs and/or footings.

5.9 Wintertime Construction

Wintertime/wet weather site work is feasible during the construction phase of this project, provided that weather conditions do not adversely impact the planned grading and proper erosion control measures are implemented to prevent excessive silt and mud from entering the storm drain system. High soil moisture contents and muddy site conditions may impact placing fills, compacting subgrades, and excavating foundation trenches. Several alternatives may be considered to improve the site conditions to allow site work to proceed in rainy conditions:

- Prior to the onset of winter rains, maintain a drier site by covering the work area and any stockpiled materials with plastic visqueen sheeting or other impermeable membrane. Where asphalt pavements, other hardscape or drainage improvements currently exist in work areas, consider leaving these improvements in place until the last possible moment to maintain a drier subgrade condition.

- Cement treat the subgrade soils when site work commences to “weatherproof” the site. The disadvantage to this alternative is that future landscaping will likely require excavation and replacement of the treated soils for acceptable plant growth.

- Finally, imported, drier fill materials could be used to stabilize the site. Soft or wet on-site materials could be excavated to firm materials and drier (preferably granular) soils with good drainage characteristics would be imported to restore site grades. This alternative might also require future excavation and replacement of landscaping soils.

If construction occurs relatively early in the winter, we judge the first option (covering the site prior to winter rains) could be an effective method of maintaining a workable site. When the construction schedule and weather conditions are known, we can meet with the project team to further discuss alternatives to continuing wintertime construction.

6.0 SUPPLEMENTAL GEOTECHNICAL SERVICES

We should review the plans and specifications for the structures when they are nearing completion to confirm that the intent of our geotechnical recommendations has been incorporated and to provide supplemental recommendations, if needed. During construction, we must observe the site preparation, grading, and foundation preparation to confirm that the subsurface conditions are as expected and to adjust foundation depths, if required. We also must test compaction of new fill, backfill, pavement subgrade and aggregate baserock.

7.0 LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practices in the San Francisco Bay Area at the time the report was prepared. This report has been prepared for the exclusive use of San Rafael City Schools and/or their assignees specifically for this project. No other warranty, expressed or implied, is made. Our evaluations and recommendations are based on the data obtained during our subsurface exploration program and our experience with soils in this geographic area.

Our approved scope of work did not include an environmental assessment of the site. Consequently, this report does not contain information regarding the presence or absence of toxic or hazardous wastes.
The evaluations and recommendations do not reflect variations in subsurface conditions that may exist between boring locations or in unexplored portions of the site. Should such variations become apparent during construction, the general recommendations contained within this report will not be considered valid unless MPEG is given the opportunity to review such variations and revise or modify our recommendations accordingly. No changes may be made to the general recommendations contained herein without the written consent of MPEG.

We recommend that this report, in its entirety, be made available to project team members, contractors, and subcontractors for informational purposes and discussion. We intend that the information presented within this report be interpreted only within the context of the report as a whole. No portion of this report should be separated from the rest of the information presented herein. No single portion of this report shall be considered valid unless it is presented with and as an integral part of the entire report.

8.0 LIST OF REFERENCES

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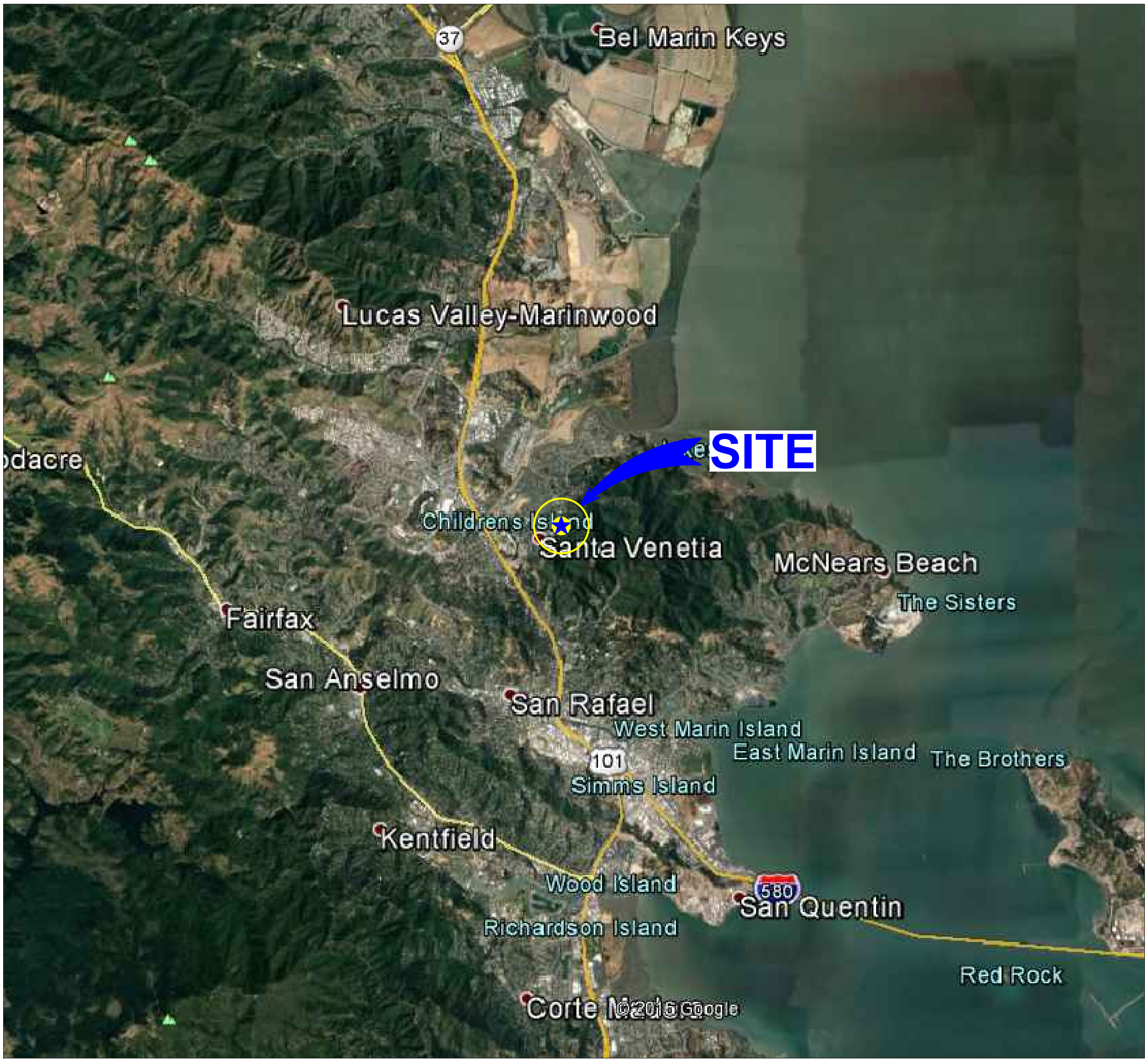

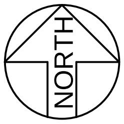

SITE: LATITUDE, 38.0001°
LONGITUDE, -122.5246°

SITE LOCATION

N.T.S.

REFERENCE: Google Earth, 2016

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FILE: 779.254 Standard Figures.dwg

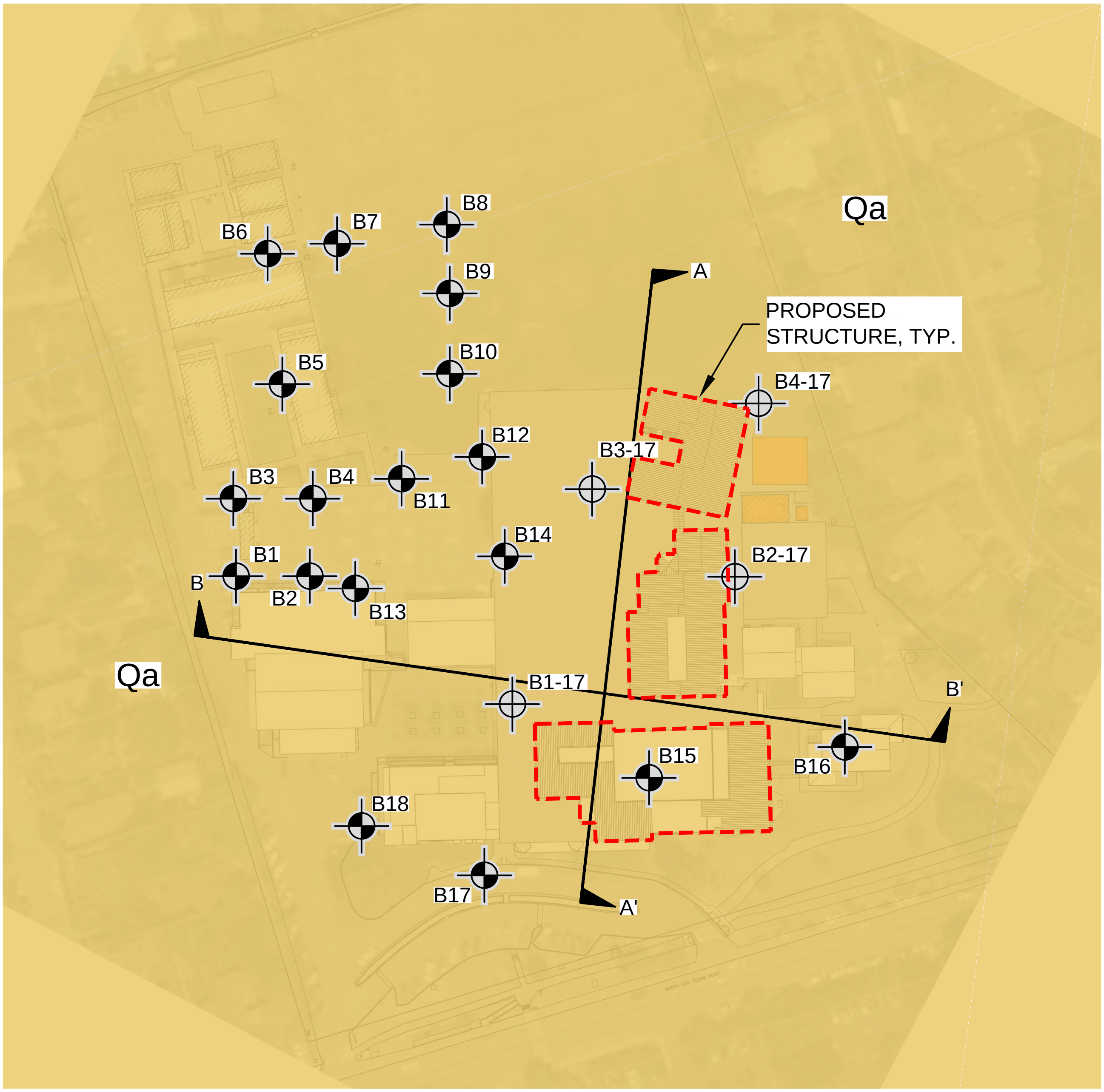
SITE LOCATION MAP

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

Drawn MMT
Checked

1
FIGURE



SITE PLAN

SCALE

⊕ Approximate boring location completed by MPEG, 2003.

⊕ Approximate boring location completed by MPEG, 2017.

Qa	**Alluvium**

REFERENCE: Site Plan provided by SVA Architects

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SITE PLAN

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

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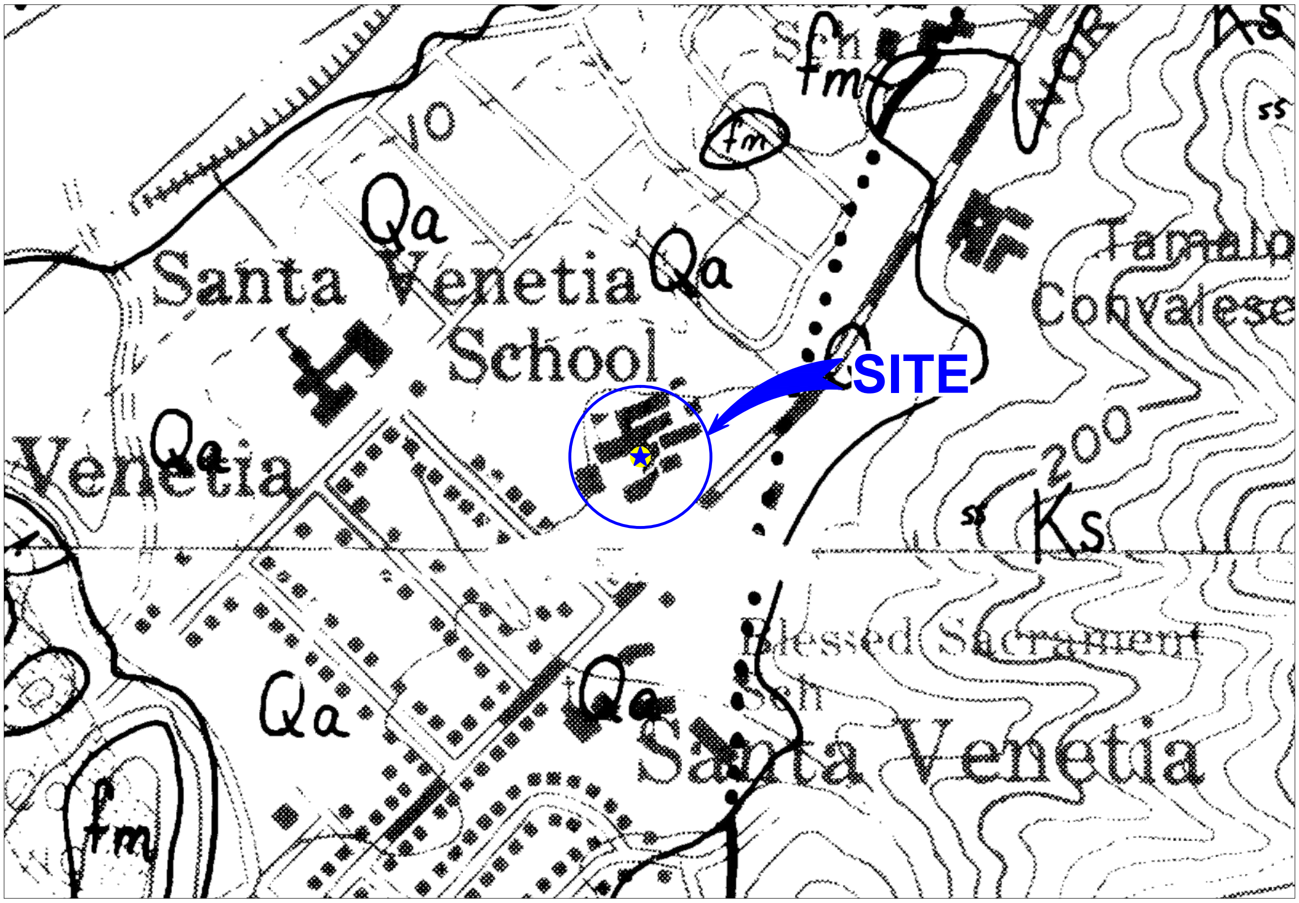
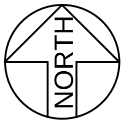
2
FIGURE



REGIONAL GEOLOGIC MAP

(NOT TO SCALE)



LEGEND

Qa **Alluvium:** Unconsolidated deposits of clay, silt, sand, and gravel underlying the bottom lands of the main stream valleys, consisting of materials transported and deposited by the streams.

Ks **Sandstone and Shale:** With very minor amounts of conglomerate.

ss **Sandstone:** Thickly bedded, medium to coarse grained arkose composed predominantly of fairly well sorted, angular to sub-rounded grains of quartz and feldspar, with minor fine-grained matrix. Also includes arkosic-wacke, which contains grains of rock fragments as well as quartz and feldspar. Color is light gray to white.

fm **Franciscan Melange:** A tectonic mixture consisting of small to large masses of resistant rock types, principally sandstone, greenstone, chert, and serpentine, but including various exotic metamorphic rock types embedded in a matrix of pervasively sheared shale or other rock material.

Reference: Rice, Salem J., Strand, Rudolph G., and Smith, Theodore C. 1976. "Geology of the Eastern Part of the San Rafael Area, Marin County, California"

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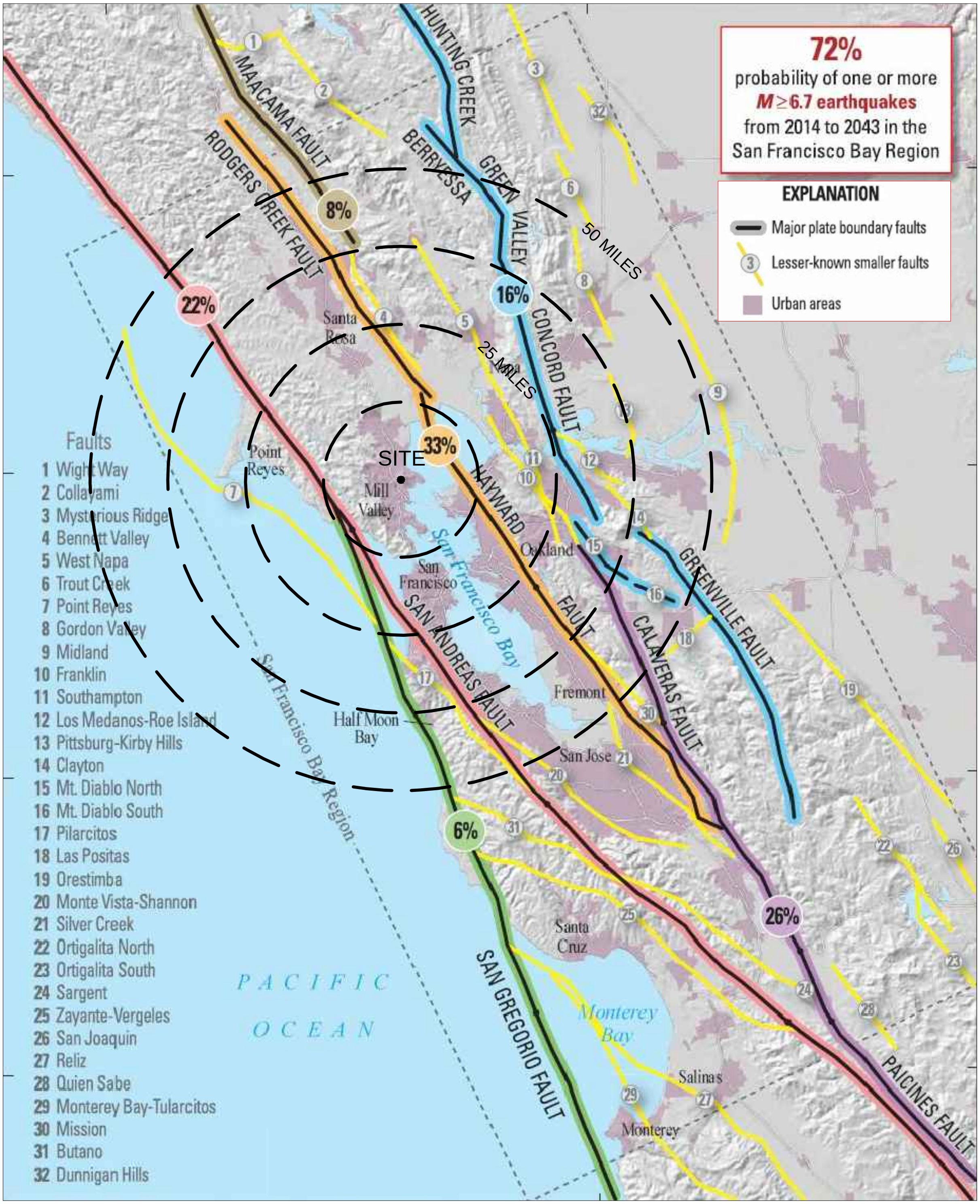
REGIONAL GEOLOGIC MAP

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

Drawn NGK
Checked

3
FIGURE



SITE COORDINATES
LAT. 38.0001°
LON. -122.5246°

SCALE
0 12.5 25 50 MILES

NORTH

DATA SOURCE:
1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Known Active Faults in the San Francisco Bay Region, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

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ACTIVE FAULT MAP

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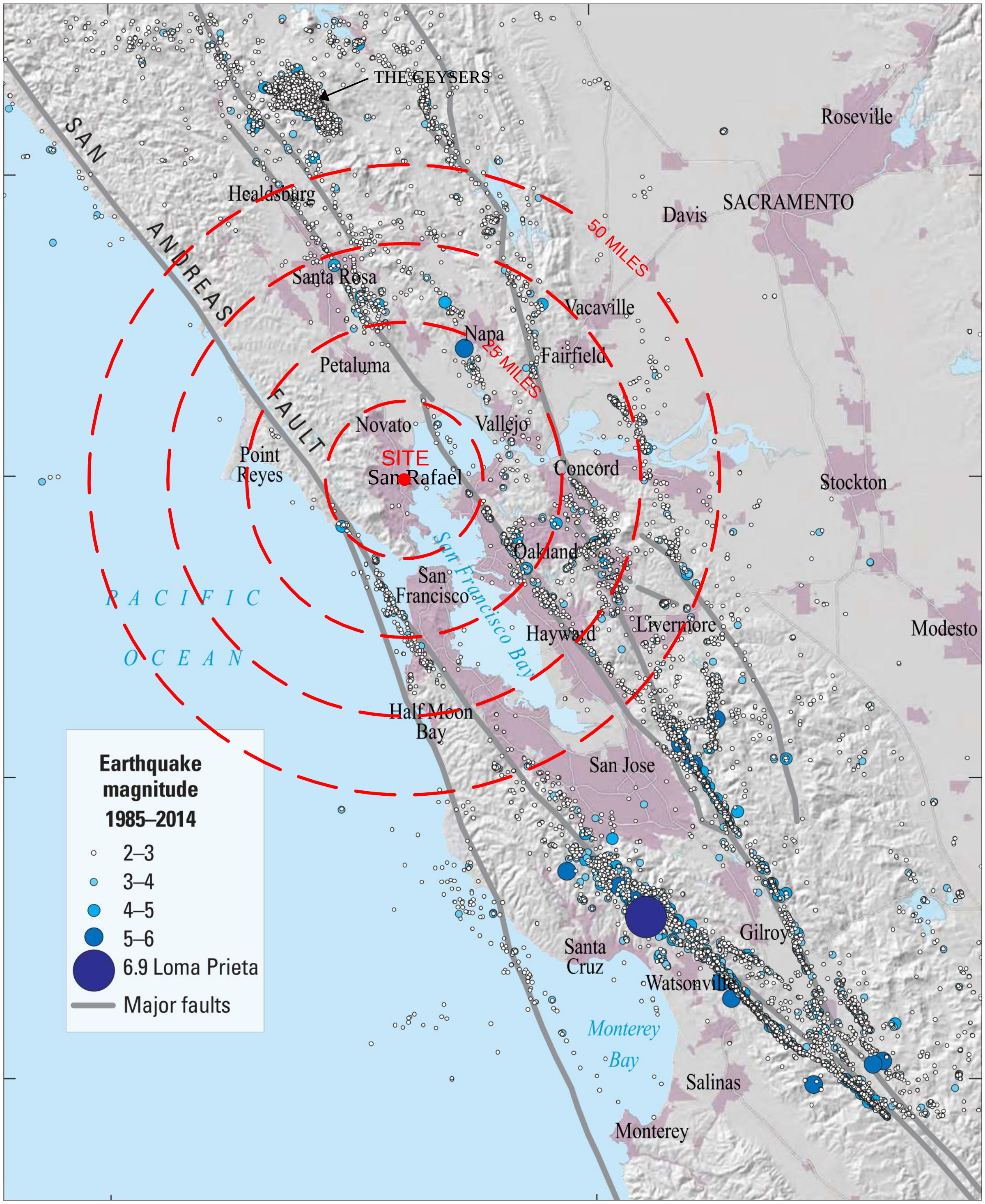
4
FIGURE



SITE COORDINATES: LAT. 38.0001, LON. -122.5246

SCALE

0 12.5 25 50 MILES

NORTH

DATA SOURCE:

1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Earthquakes Greater Than Magnitude 2.0 in the San Francisco Bay Region from 1985-2014, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

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HISTORIC FAULT ACTIVITY

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San Rafael, California

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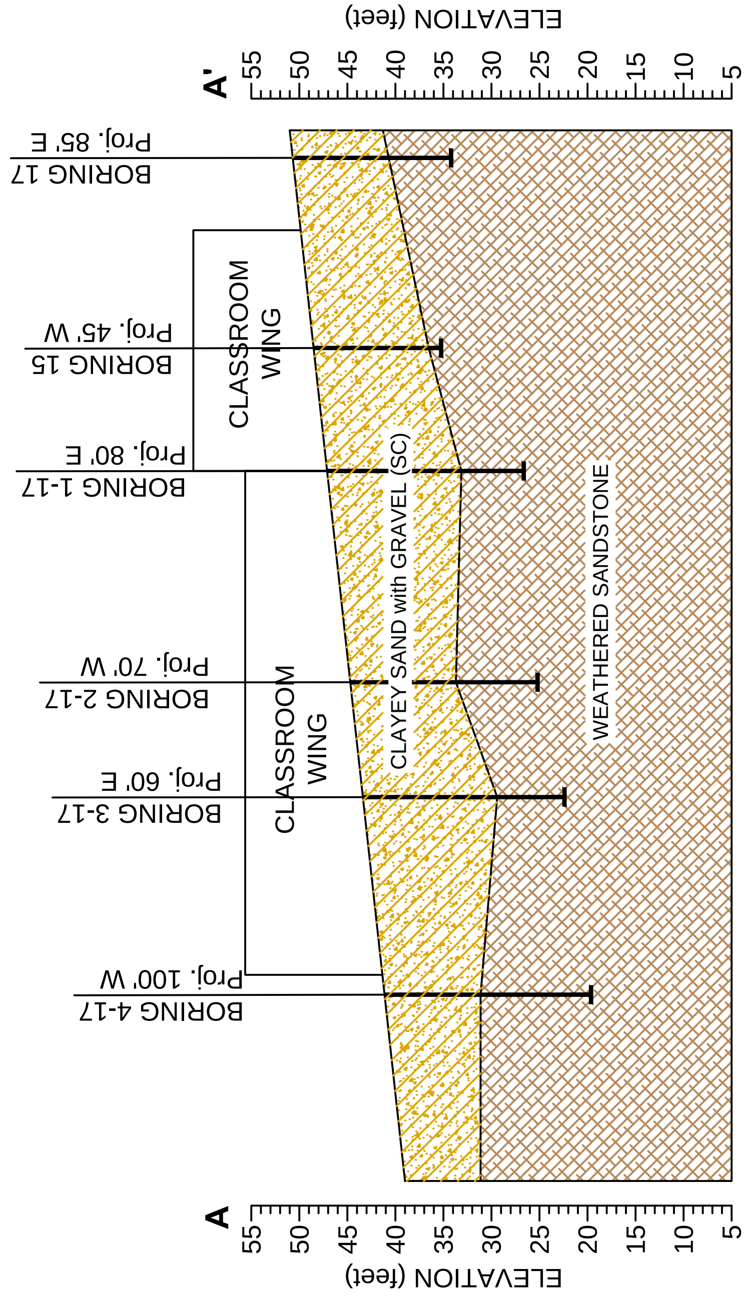
5

FIGURE



GEOLOGIC CROSS SECTION A-A'

Horizontal 1" = 140'

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GEOLOGIC CROSS SECTION

San Rafael City Schools
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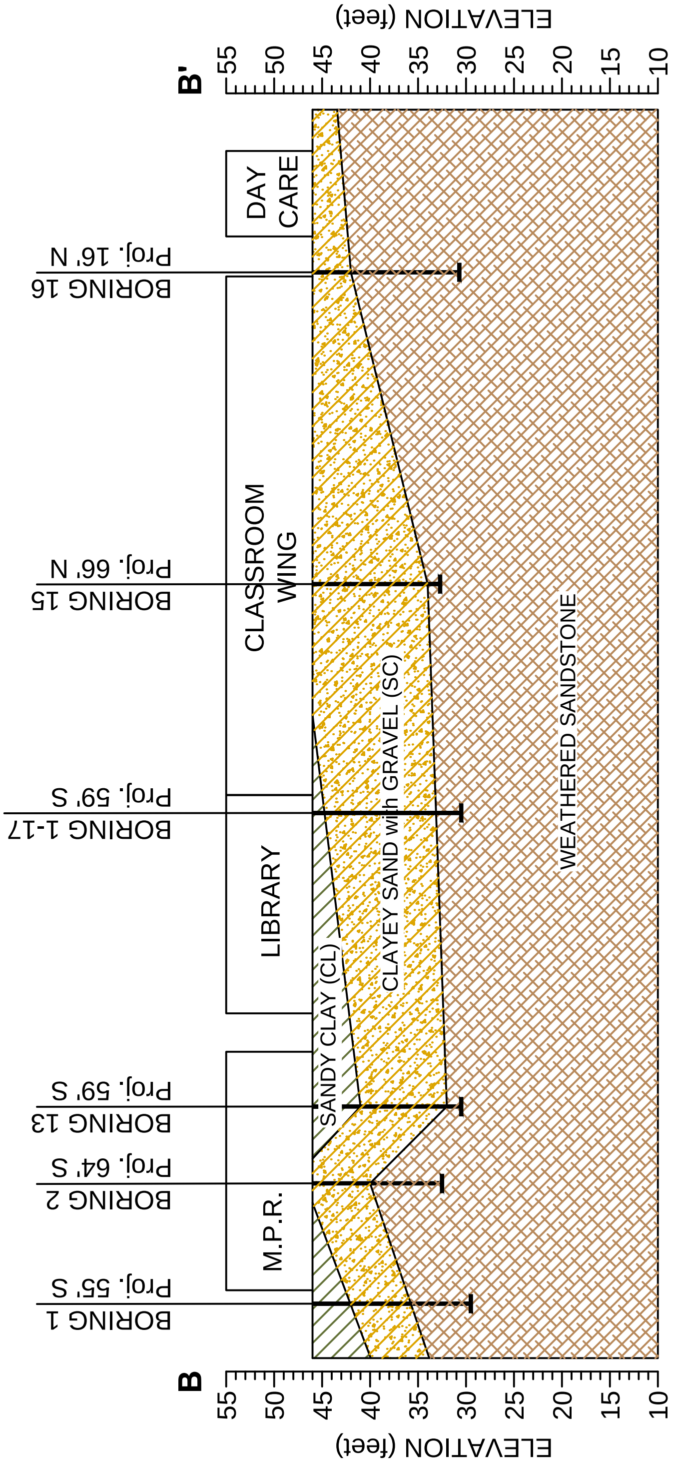
Project No. 779.254 Date: 4/25/17

Drawn NGK
Checked

6
FIGURE



GEOLOGIC CROSS SECTION B-B'

Horizontal 1" = 140'

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GEOLOGIC CROSS SECTION

San Rafael City Schools
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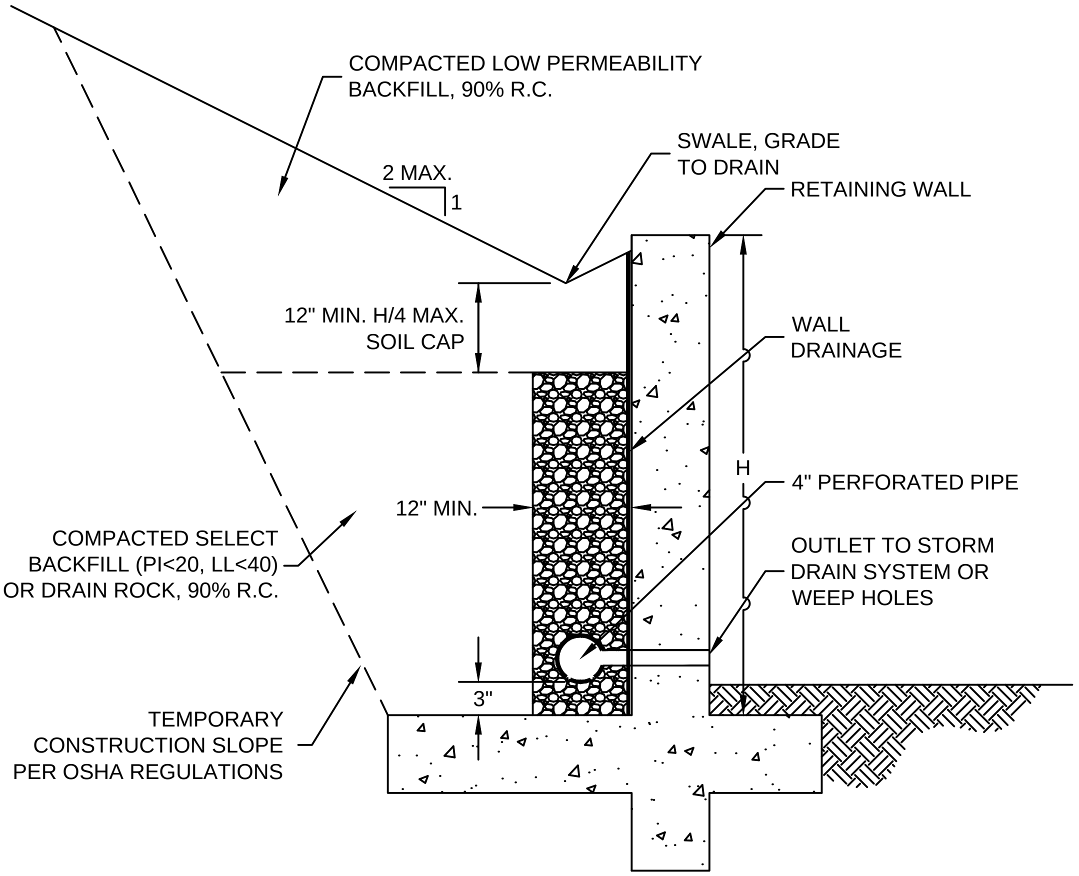
Project No. 779.254 Date: 4/25/17

Drawn NGK
Checked

7
FIGURE



NOTES:

1. Wall drainage should consist of clean, free draining 3/4 inch crushed rock (Class 1B Permeable Material) wrapped in filter fabric (Mirafi 140N or equivalent) or Class 2 Permeable Material. Alternatively, pre-fabricated drainage panels (Miradrain G100N or equivalent), installed per the manufacturers recommendations, may be used in lieu of drain rock and fabric.

2. All retaining walls adjacent to interior living spaces shall be water/vapor proofed as specified by the project architect or structural engineer.

3. Perforated pipe shall be SCH 40 or SDR 35 for depths less than 20 feet. Use SCH 80 or SDR 23.5 perforated pipe for depths greater than 20 feet. Place pipe perforations down and slope at 1% to a gravity outlet. Alternatively, drainage can be outlet through 3" diameter weep holes spaced approximately 20' apart.

4. Clean outs should be installed at the upslope end and at significant direction changes of the perforated pipe. Additionally, all angled connectors shall be long bend sweep connections.

5. During compaction, the contractor should use appropriate methods (such as temporary bracing and/or light compaction equipment) to avoid over-stressing the walls. Walls shall be completely backfilled prior to construction in front of or above the retaining wall.

6. Refer to the geotechnical report for lateral soil pressures.

7. All work and materials shall conform with Section 68, of the latest edition of the Caltrans Standard Specifications.

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RETAINING WALL BACKDRAIN CRITERIA

San Rafael CIty Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 9/14/2017

Designed BSP
Drawn BSP
Checked

8
FIGURE

APPENDIX A
SUBSURFACE EXPLORATION AND LABORATORY TESTING

1.0 Subsurface Exploration

We explored subsurface conditions at the site with four exploratory borings drilled with track mounted drilling equipment on July 31, 2017. The approximate boring locations are shown on Figure 2. The borings were drilled to a maximum depth of 21.5-feet below the ground surface. The samples obtained were examined in the field, sealed to prevent moisture loss, and transported to our laboratory.

The soils encountered were logged and identified in the field in general accordance with ASTM Standard D 2487, "Field Identification and Description of Soils (Visual-Manual Procedure)." This standard is briefly explained on Figures A-1 and A-2, Soil and Rock Classification Charts, respectively. The boring logs are presented on Figures A-3 through A-6.

2.0 Laboratory Testing

We conducted laboratory tests on selected intact samples to verify field identifications and to evaluate engineering properties. The following laboratory tests were conducted in accordance with the ASTM standard test method cited:

- Laboratory Determination of Water (Moisture Content) of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D 2216;
- Density of Soil in Place by the Drive-Cylinder Method, ASTM D 2937;
- Unconfined Compressive Strength of Cohesive Soil, ASTM D 2166;
- Resistivity in Soil, SM 2510;
- Anions in Soil (sulfate and chloride), EPA 300; and
- pH in Soil, EPA 532, and

The moisture content, dry density and unconfined compression test results are shown on the exploratory Boring Logs. The results of the resistivity in soil, anions in soil and pH in soil tests are presented on Figure A-7. The exploratory boring logs, description of soils encountered and the laboratory test data reflect conditions only at the location of the boring at the time they were excavated or retrieved. Conditions may differ at other locations and may change with the passage of time due to a variety of causes including natural weathering, climate and changes in surface and subsurface drainage.

MAJOR DIVISIONS		SYMBOL	DESCRIPTION
COARSE GRAINED SOILS over 50% sand and gravel	CLEAN GRAVEL	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
	GRAVEL with fines	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	CLEAN SAND	SW	Well-graded sands or 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
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS over 50% silt and clay	SILT AND CLAY liquid limit <50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	SILT AND CLAY liquid limit >50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	Peat, muck, and other highly organic soils
ROCK			Undifferentiated as to type or composition

KEY TO BORING AND TEST PIT SYMBOLS

CLASSIFICATION TESTS

PI	PLASTICITY INDEX
LL	LIQUID LIMIT
SA	SIEVE ANALYSIS
HYD	HYDROMETER ANALYSIS
P200	PERCENT PASSING NO. 200 SIEVE
P4	PERCENT PASSING NO. 4 SIEVE

SAMPLER TYPE

▮	MODIFIED CALIFORNIA	⊠	HAND SAMPLER
▯	STANDARD PENETRATION TEST	⊠	ROCK CORE
▨	THIN-WALLED / FIXED PISTON	X	DISTURBED OR BULK SAMPLE

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the excavation location during the time of exploration. Subsurface rock, soil or water conditions may vary in different locations within the project site and with the passage of time. Boundaries between differing soil or rock descriptions are approximate and may indicate a gradual transition.

STRENGTH TESTS

TV	FIELD TORVANE (UNDRAINED SHEAR)
UC	LABORATORY UNCONFINED COMPRESSION
TXCU	CONSOLIDATED UNDRAINED TRIAXIAL
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL
	UC, CU, UU = 1/2 Deviator Stress

SAMPLER DRIVING RESISTANCE

Modified California and Standard Penetration Test samplers are driven 18 inches with a 140-pound hammer falling 30 inches per blow. Blows for the initial 6-inch drive seat the sampler. Blows for the final 12-inch drive are recorded onto the logs. Sampler refusal is defined as 50 blows during a 6-inch drive. Examples of blow records are as follows:

25	sampler driven 12 inches with 25 blows after initial 6-inch drive
85/7"	sampler driven 7 inches with 85 blows after initial 6-inch drive
50/3"	sampler driven 3 inches with 50 blows during initial 6-inch drive or beginning of final 12-inch drive

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SOIL CLASSIFICATION CHART

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Venetia Valley K-8 School
San Rafael, California

Project No. 779.254
Date: 8/2/2017

Drawn MMT
Checked

A-1
FIGURE

FRACTURING AND BEDDING

Fracture Classification	Spacing	Bedding Classification
Crushed	less than 3/4 inch	Laminated
Intensely fractured	3/4 to 2-1/2 inches	Very thinly bedded
Closely fractured	2-1/2 to 8 inches	Thinly bedded
Moderately fractured	8 to 24 inches	Medium bedded
Widely fractured	2 to 6 feet	Thickly bedded
Very widely fractured	greater than 6 feet	Very thickly bedded

HARDNESS

Low	Carved or gouged with a knife
Moderate	Easily scratched with a knife, friable
Hard	Difficult to scratch, knife scratch leaves dust trace
Very hard	Rock scratches metal

STRENGTH

Friable	Crumbles by rubbing with fingers
Weak	Crumbles under light hammer blows
Moderate	Indentations <1/8 inch with moderate blow with pick end of rock hammer
Strong	Withstands few heavy hammer blows, yields large fragments
Very strong	Withstands many heavy hammer blows, yields dust, small fragments

WEATHERING

Complete	Minerals decomposed to soil, but fabric and structure preserved
High	Rock decomposition, thorough discoloration, all fractures are extensively coated with clay, oxides or carbonates
Moderate	Fracture surfaces coated with weathering minerals, moderate or localized discoloration
Slight	A few stained fractures, slight discoloration, no mineral decomposition, no affect on cementation
Fresh	Rock unaffected by weathering, no change with depth, rings under hammer impact

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the location and time of exploration. Subsurface rock, soil and water conditions may differ in other locations and with the passage of time.

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ROCK CLASSIFICATION CHART

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

Drawn MMT
Checked

A-2
FIGURE

BORING 1

EQUIPMENT: Track-Mounted DN2000 Drill Rig with 4.0-inch Solid Flight Auger
DATE: 7/31/2017
ELEVATION: 43 - feet*
*REFERENCE: Google Earth, 2017

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0			4" Asphalt Concrete						
				8" Aggregate Base						
1		■		Silty SAND (SM) Medium brown, moist, loose, fine to medium grained sand, ~30% low plasticity silt. [Alluvium]	12	102	15.2	UC 1050		
2	5	■		Clayey SAND with Gravel (SC) Medium yellow brown, moist, medium dense, fine to coarse grained sand, ~20% angular to subrounded gravel, ~40-45% low plasticity clay. [Alluvium]	24	113	12.6	UC 900		
3 4	10	■		Grades orange brown mottled gray. [Residual Soil]	49	110	15.3		P200 41.5%	
5 6	15	▨		SANDSTONE Orange brown mottled gray, low hardness, weak, highly to completely weathered. [Bedrock]	39		17.7			
	20	▨		Boring terminated at 20.5 feet. No groundwater encountered during exploration.	50/5"		8.7			

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING LOG

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

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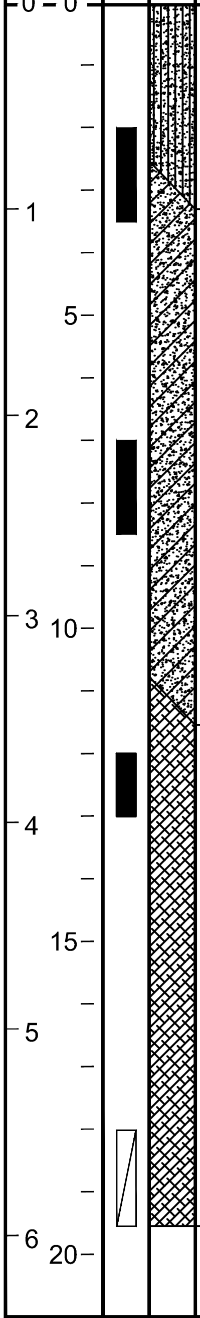
A-3
FIGURE

BORING 2

EQUIPMENT: Track-Mounted DN2000 Drill Rig with 4.0-inch Solid Flight Auger
DATE: 7/31/2017
ELEVATION: 41 - feet*
*REFERENCE: Google Earth, 2017



DESCRIPTION	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
Silty SAND (SM) Light gray, dry, medium dense, fine to medium grained sand, ~30-40% low plasticity silt. [Alluvium]	19	104	14.5	UC 3700		
Clayey SAND (SC) Orange and gray, moist, medium dense, fine to coarse grained sand, ~25-30% low plasticity clay. [Alluvium]						
Grades medium yellow brown, dense, ~15-20% subangular to subrounded gravel.	60	119	13.0		P200 29.6%	
SANDSTONE AND SHALE Sandstone is yellow brown, low hardness, weak, highly weathered. Shale is light gray, low hardness, friable, thinly bedded, highly weathered. [Bedrock]	50/5"	120	11.7			
	69		9.6			
Boring terminated at 19.5 feet. No groundwater encountered during exploration.						

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING LOG

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

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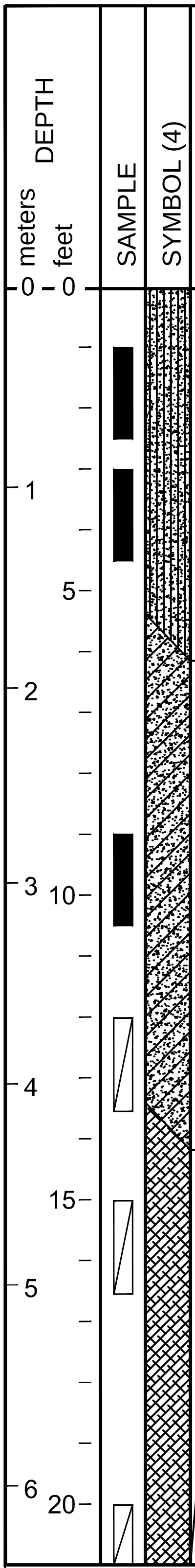
A-4
FIGURE

BORING 3

EQUIPMENT: Track-Mounted DN2000 Drill Rig with 4.0-inch Solid Flight Auger
DATE: 7/31/2017
ELEVATION: 42 - feet*
*REFERENCE: Google Earth, 2017



	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
Silty SAND (SM) Light brown, dry, medium dense, fine to medium grained sand, ~20-30% low plasticity silt. [Alluvium]	26	96	7.5			
	17	102	6.9			
Clayey SAND (SC) Medium yellow brown, moist, medium dense, fine to coarse grained sand, ~25-30% low plasticity clay. [Alluvium]						
	34	118	9.7		P200 27.1%	
Grades ~15-20% subangular to subrounded gravel.	45		15.1			
SANDSTONE Light gray and yellow brown, low hardness, weak, highly weathered. [Bedrock]	87		13.6			
Boring terminated at 21.0 feet. No groundwater encountered during exploration.	47/6"		12.3			

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING LOG

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

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A-5
FIGURE

BORING 4

EQUIPMENT: Track-Mounted DN2000 Drill Rig with 4.0-inch Solid Flight Auger
DATE: 7/31/2017
ELEVATION: 41 - feet*
*REFERENCE: Google Earth, 2017

DEPTH meters	DEPTH feet	DESCRIPTION	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0	Silty SAND (SM) Light brown, dry, medium dense, fine to medium grained sand, ~20-30% low plasticity silt. [Alluvium]	26	101	6.4			
1	5	Sandy CLAY (CL) Yellow brown, moist, very stiff, medium plasticity clay, ~35-40% fine to coarse grained sand. [Alluvium]	28	110	18.7		P200 63.5%	
2, 3	10	SANDSTONE Orange brown, low hardness, weak, highly to completely weathered. [Bedrock]	53	113	17.1			
4, 5	15	SANDSTONE AND SHALE Sandstone is orange brown, low hardness, moderately strong. Shale is light to dark gray, laminated, friable, low hardness. [Bedrock]	55		12.5			
6	20	Boring terminated at 21.5 feet. No groundwater encountered during exploration.	46		12.8			

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 8/2/2017

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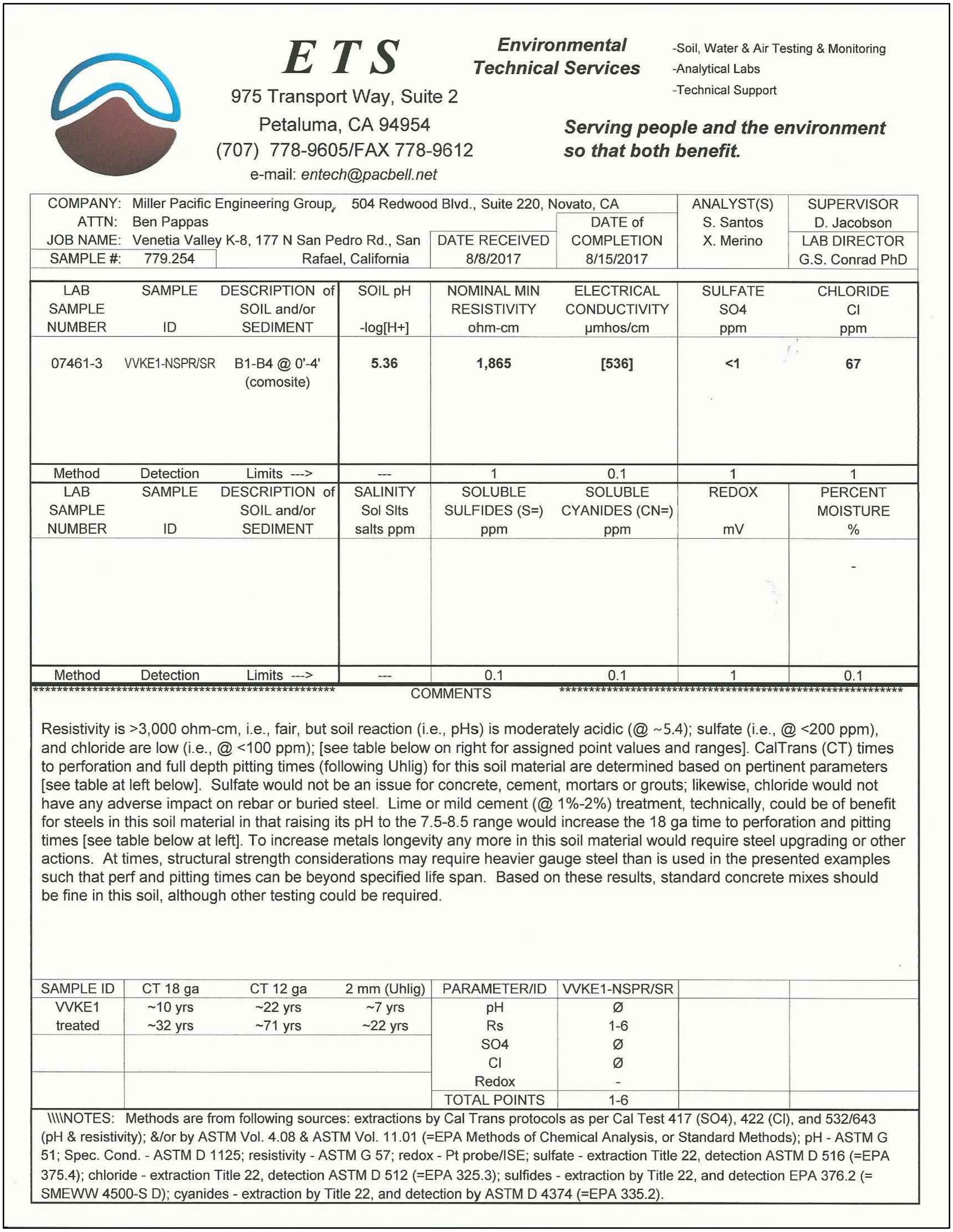
A-6
FIGURE



E T S

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COMPANY: Miller Pacific Engineering Group, 504 Redwood Blvd., Suite 220, Novato, CA			ANALYST(S)	SUPERVISOR
ATTN: Ben Pappas		DATE of COMPLETION	S. Santos X. Merino	D. Jacobson
JOB NAME: Venetia Valley K-8, 177 N San Pedro Rd., San Rafael, California	DATE RECEIVED			LAB DIRECTOR
SAMPLE #: 779.254	8/8/2017	8/15/2017		G.S. Conrad PhD

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	SOIL pH -log[H+]	NOMINAL MIN RESISTIVITY ohm-cm	ELECTRICAL CONDUCTIVITY µmhos/cm	SULFATE SO4 ppm	CHLORIDE Cl ppm
07461-3	VVKE1-NSPR/SR	B1-B4 @ 0'-4' (comosite)	**5.36**	**1,865**	**[536]**	**<1**	**67**
Method	Detection	Limits --->	---	1	0.1	1	1

LAB SAMPLE NUMBER	SAMPLE ID	DESCRIPTION of SOIL and/or SEDIMENT	SALINITY Sol Slts salts ppm	SOLUBLE SULFIDES (S=) ppm	SOLUBLE CYANIDES (CN=) ppm	REDOX mV	PERCENT MOISTURE %
							-
Method	Detection	Limits --->	---	0.1	0.1	1	0.1

** COMMENTS **

Resistivity is >3,000 ohm-cm, i.e., fair, but soil reaction (i.e., pHs) is moderately acidic (@ ~5.4); sulfate (i.e., @ <200 ppm), and chloride are low (i.e., @ <100 ppm); [see table below on right for assigned point values and ranges]. CalTrans (CT) times to perforation and full depth pitting times (following Uhlig) for this soil material are determined based on pertinent parameters [see table at left below]. Sulfate would not be an issue for concrete, cement, mortars or grouts; likewise, chloride would not have any adverse impact on rebar or buried steel. Lime or mild cement (@ 1%-2%) treatment, technically, could be of benefit for steels in this soil material in that raising its pH to the 7.5-8.5 range would increase the 18 ga time to perforation and pitting times [see table below at left]. To increase metals longevity any more in this soil material would require steel upgrading or other actions. At times, structural strength considerations may require heavier gauge steel than is used in the presented examples such that perf and pitting times can be beyond specified life span. Based on these results, standard concrete mixes should be fine in this soil, although other testing could be required.

SAMPLE ID	CT 18 ga	CT 12 ga	2 mm (Uhlig)	PARAMETER/ID	VVKE1-NSPR/SR		
VVKE1	~10 yrs	~22 yrs	~7 yrs	pH	Ø		
treated	~32 yrs	~71 yrs	~22 yrs	Rs	1-6		
				SO4	Ø		
				Cl	Ø		
				Redox	-		
				TOTAL POINTS	1-6		

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

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CORROSION RESISTIVITY TEST RESULTS

San Rafael City Schools
Venetia Valley K-8 School
San Rafael, California

Project No. 779.254 Date: 9/15/2017

Drawn MMT
Checked

A-7
FIGURE

APPENDIX B
PREVIOUS SUBSURFACE EXPLORATION AND LABORATORY TESTING

BORING: 1

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 57 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0			ASPHALT (2.0")
	350	9	12.2	110.0					SANDY CLAY (CL) dark brown to brown clay, dry, medium stiff, low plasticity, sand is orange to red, poorly graded fine grained sand
					1				
		15	11.1	109.0		5			CLAYEY SAND (SC) orange-yellow to brown well graded fine to medium grained sand, 15% - 20% light brown low plasticity clay
					2				
		60	13.9	119.0	3	10			SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
					7				
		48	17.0	113.0		15			grades to orange-red
					8				Bottom of boring at 16.5 feet No groundwater observed while drilling
					9	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: Boring Log.dwg

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San Rafael, California

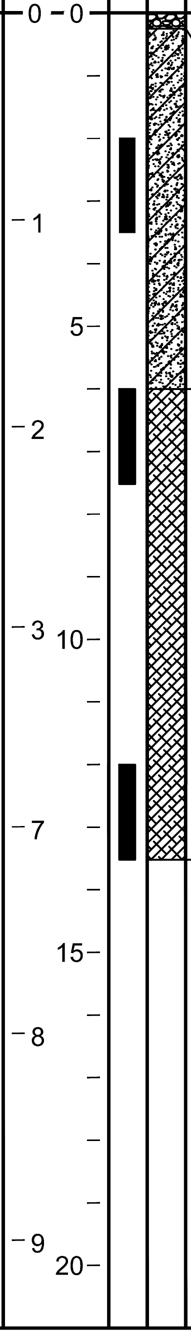
A-3

Project No. 779.12
Date 09/03/03
Approved By:
Figure

BORING: 2

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 53 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
	350	22	9.9	113.0
	125	21	9.7	112.0
		49	10.8	126.0



ASPHALT (3.0")

CLAYEY SAND WITH GRAVEL (SC)
light brown to brown, dry, medium dense, fine to medium grained, 15% - 25% low plasticity clay, 10% - 15% gravel up to 3/4" in diameter

SANDSTONE
mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands, with occasional gravels up to 1" in diameter

grades yellow to light brown

Bottom of boring at 13.5 feet
No groundwater observed while drilling

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael, California

A-4

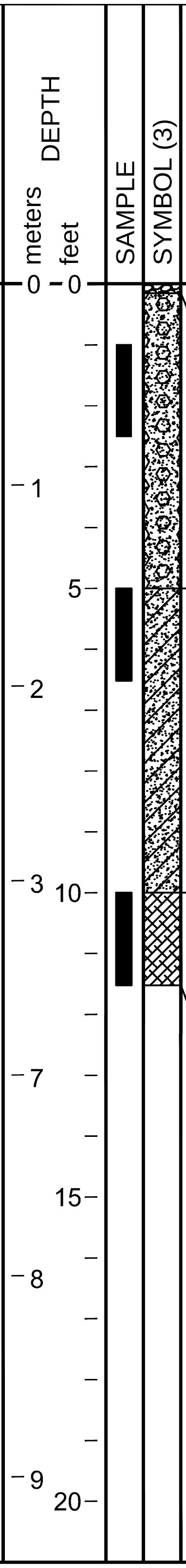
Project No. 779.12 | Date 09/03/03 | Approved By:

Figure

BORING: 3

EQUIPMENT: CME 75 - 6" Solid Stem
Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 55 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
		15	8.9	106.0
		32	9.3	115.0
		49	15.5	116.0



ASPHALT (2.5")

SANDY GRAVEL (GP)
orange to brown, dry to moist, medium dense, fine to medium grained sandstone fragments, 25% - 30% fine to medium grained sand

CLAYEY SAND WITH GRAVEL (SC)
orange to brown, dense, dry to moist, fine to coarse grained sand, 15% - 20% low plasticity clay, 15% - 20% fine grained gravel

SANDSTONE
mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands, with occasional gravels up to 1" in diameter

Bottom of boring at 11.5 feet
No groundwater observed while drilling

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael, California

A-5

Project No. 779.12
Date 09/03/03
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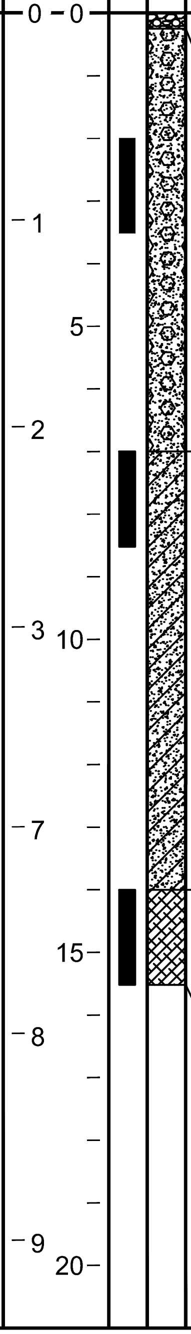
Figure

BORING: 4

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 53 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999



OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	
					ASPHALT (3.0")
		10	10.3	104.0	SANDY GRAVEL (GP) orange to brown, dry to moist, medium dense, fine to medium grained sandstone fragments, 25% - 30% fine to medium grained sand
		28	9.6	117.0	CLAYEY SAND WITH GRAVEL (SC) orange to brown, dry to moist, dense, fine to coarse grained sand, 15% - 20% low plasticity clay, 15% - 20% fine grained gravel
		71	11.5	128.0	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands, with occasional gravels up to 1" in diameter
					Bottom of boring at 15.5 feet No groundwater observed while drilling

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
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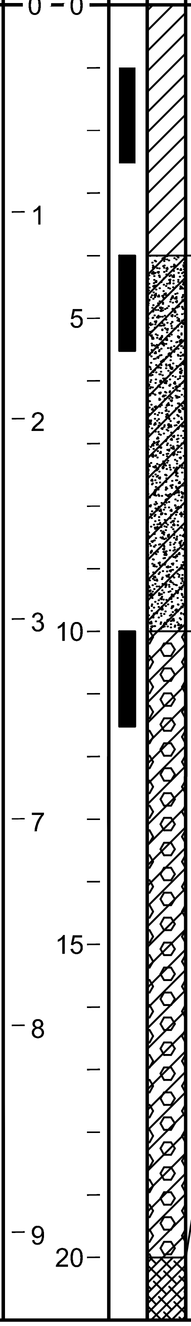
Figure

BORING: 5

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/19/03
ELEVATION: 50 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999



OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	
		21	7.1	98.0	SANDY CLAY (CL) dark brown to brown, dry, stiff, low plasticity, 15% - 20% fine to medium grained sand, occasional sandstone fragments up to 3/4" in diameter.
	1450	37	10.5	113.0	CLAYEY SAND WITH GRAVEL (SC) orange to brown, dry to moist, very dense, fine to coarse grained sand, 15% - 20% low plasticity clay, 15% - 20% fine grained gravel
		69	9.8	122.0	SANDY GRAVEL WITH CLAY (GC) reddish-brown to brown, dry to moist, very dense, fine to coarse grained gravels and sands, 15% - 20% low plasticity clay
					SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands, with occasional gravels up to 1" in diameter

Continued

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
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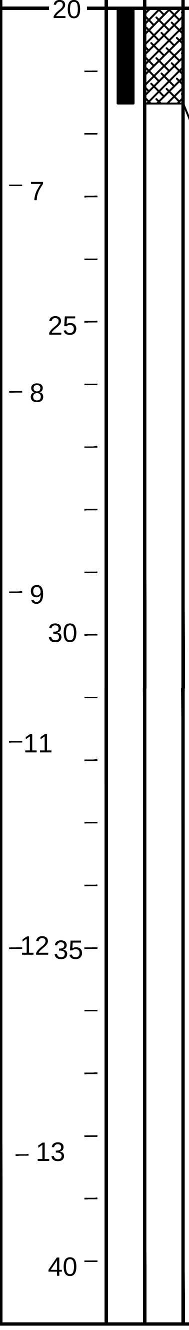
BORING 5
(CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters feet	SAMPLE	SYMBOL (3)
		26	10.3	123.0	20		



SANDSTONE
mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands, with occasional gravels up to 1" in diameter

Bottom of boring at 21.5 feet
No groundwater observed while drilling

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael, California

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Project No. 779.12
Date 09/03/03
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Figure

BORING: 6

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/19/03
ELEVATION: 43 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0		▨	SANDY CLAY (CL) light brown, dry, stiff, low plasticity, 15% - 20% fine to medium grained sand, occasional sandstone fragments up to 1/2" in diameter
		21	7.4	105.0			■	▨	
					1	5		▨	
					2			▨	
		79/9"	6.8	113.0			■	▩	CLAYEY SAND WITH GRAVEL (SC) reddish-brown to dark brown, dry, very dense to hard, fine to coarse grained sand, 15% - 20% low plasticity clay, 20% - 25% sandstone fragments up to 3/4" in diameter
					3	10		▩	
					7			▩	
		53	12.6	120.0		15	■	▦	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
					8				Bottom of boring at 15.0 feet No groundwater observed while drilling
					9	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING LOG
San Rafael Schools - Gallinas Elem.
San Rafael, California

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Project No. 779.12 Date 09/03/03 Approved By:

Figure

BORING: 7

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/19/03
ELEVATION: 44 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0			SANDY CLAY (CL) light brown, dry, very stiff, low plasticity, 15% - 20% fine to medium grained sand
	1900	45	8.8	106.0			■		
					1				
						5			CLAYEY SAND WITH GRAVEL (SC) reddish-brown to light brown, dry, very dense, fine to coarse grained sand, 15% - 20% low plasticity clay, 20% - 25% sandstone fragments up to 3/4" in diameter
		61	11.5	111.0			■		
					2				
					3	10			
									SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
		43	11.1	104.0	7		■		
						15			
					8				
					9	20			
									Continued

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
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Figure

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	BORING 7 (CONTINUED)
		76/ 11.5"	17.5	114.0		20	■	▨	SANDSTONE mottled orange-brown and white, moderately to highly weathered, friable, low hardness, fine to medium grained sands
					7			▨	
						25		▨	
					8			▨	
		58/8"	7.7	110.0			■	▨	grades more greyish-white in color
					9				
						30			Bottom of boring at 29.5 feet No groundwater observed while drilling
					11				
					12	35			
					13				
						40			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
Date 09/03/03
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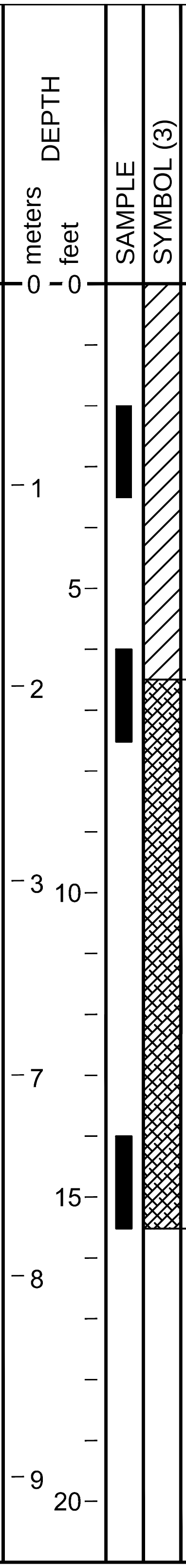
Figure

BORING: 8

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/20/03
ELEVATION: 37 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	
					SANDY CLAY (CL) light brown to brown, dry, very stiff, low plasticity, 15% - 20% fine to coarse grained sand
	2750	43	10.0	111.0	
		30	11.4	100.0	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
		48	11.6	119.0	grades more orangish-brown in color
					Bottom of boring at 15.5 feet No groundwater observed while drilling



NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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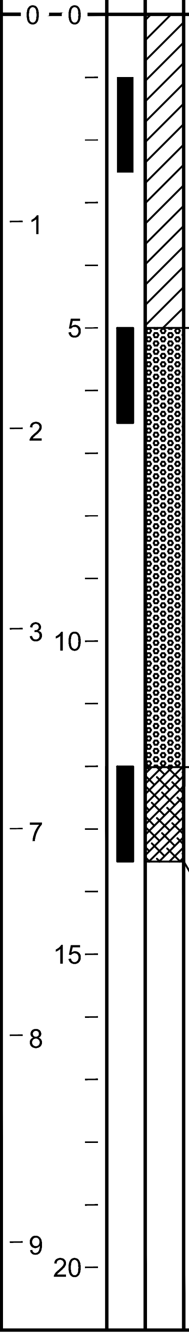
Project No. 779.12 Date 09/03/03 Approved By:

Figure

BORING: 9

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/20/03
ELEVATION: 42 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
	400	10	13.0	110.0
		21	10.7	107.0
	3000	45	12.0	112.0



SANDY CLAY (CL)
dark brown, moist, medium stiff, low plasticity, 15% - 20% fine to medium grained sand

SAND (SW)
well graded light brown to brown, moist, dense to very dense, fine to coarse grained, with occasional sandstone fragments up to 1/2" in diameter

SANDSTONE
mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands

Bottom of boring at 13.5 feet
No groundwater observed while drilling

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING: 10

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/20/03
ELEVATION: 42 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0			SANDY CLAY (CL) brown, moist, medium stiff, low plasticity, 15% - 20% fine to coarse grained sand
		9	12.0	98.0	1		■		
						5			
					2				
		29	9.0	118.0	3	10	■		CLAYEY SAND WITH GRAVEL (SC) reddish-brown to dark brown, dry, dense, fine to coarse grained sand, 15% - 20% low plasticity clay, 20% - 25% sandstone fragments up to 3/4" in diameter
					7				
						15			
		42	17.9	113.0	8		■		SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
									Bottom of boring at 17.5 feet No groundwater observed while drilling
					9	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
Date 09/03/03
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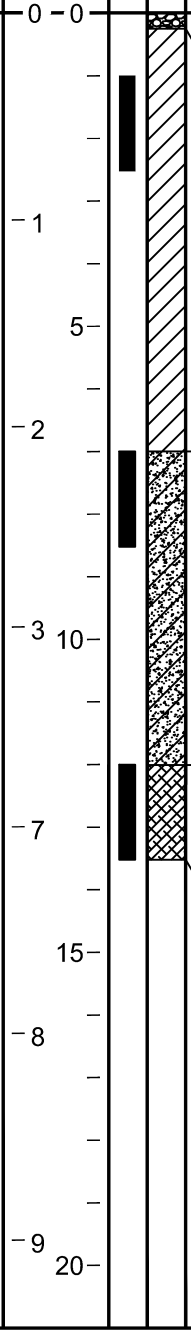
Figure

BORING: 11

EQUIPMENT: CME 75 - 6" Solid Stem
Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 47 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999



OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	
					ASPHALT (3.0")
		6	13.2	99.0	SANDY CLAY WITH GRAVEL (CL) dark brown, dry, medium stiff, low plasticity, 20% - 25% fine to medium grained sand, 15% - 20% fine to medium graded sub-rounded gravel
		17	13.5	114.0	CLAYEY SAND WITH GRAVEL (SC) orange-brown and grey, dry, medium dense, fine to coarse grained sand, 15% - 20% low plasticity clay, 20% - 25% sandstone fragments up to 1/2" in diameter
		64	9.6	122.0	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
					Bottom of boring at 13.5 feet No groundwater observed while drilling

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael, California

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Project No. 779.12
Date 09/03/03
Approved By:
Figure

BORING: 12

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/19/03
ELEVATION: 43 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0			ASPHALT (3.0")
		9					■		SANDY CLAY (CL) dark brown, dry to moist, medium stiff, low plasticity, 20% - 30% fine to coarse grained sand
					1				
						5			
	300	16	14.0	103.0	2		■		GRAVELLY SAND (SC) orange-brown to dark brown, dry, dense, well-graded fine to coarse grained sand, 15% - 20% gravel up to 1/2" in diameter
		23	10.4	110.0			■		grades more sandy with gravel up to 3/4" in diameter
					3	10			
		38	10.4	120.0	7		■		SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
									Bottom of boring at 13.5 feet No groundwater observed while drilling
						15			
					8				
					9	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael, California

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Project No. 779.12
Date 09/03/03
Approved By:
Figure

BORING: 13

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/19/03
ELEVATION: 46 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0			ASPHALT (3.0")
	600	6	13.7	102.0			■	▨	SANDY CLAY (CL) dark brown, dry to moist, medium stiff, low plasticity, 20% - 30% fine to coarse grained sand
					1			▨	
		23	9.4	113.0		5	■	▨	GRAVELLY SAND (SC) orange-light brown to brown, dry, dense, well-graded fine to coarse grained sand, 15% - 20% sandstone fragments up to 3/4" in diameter
					2			▨	
					3	10		▨	
					7			▨	
		76/ 11.5"	13.0	122.0		15	■	▩	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
					8				Bottom of boring at 15.5 feet No groundwater observed while drilling
					9	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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San Rafael, California

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Project No. 779.12 | Date 09/03/03 | Approved By:

Figure

BORING: 14

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/19/03
ELEVATION: 43 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0		▨	ASPHALT (2.0")
								▨	SANDY CLAY (CL) dark brown, dry to moist, medium stiff to stiff, low plasticity, 20% - 30% fine to coarse grained sand
		17	13.5	101.0	1		■	▨	
						5		▨	
					2			▨	
		18	14.7	108.0			■	▨	GRAVELLY SAND (SW) orange-light brown to brown, dry, dense, well-graded fine to coarse grained sand, 15% - 20% sandstone fragments up to 3/4" in diameter
					3	10		▨	
					7			▨	
		53	15.5	116.0			■	▨	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
						15			
					8				Bottom of boring at 14.5 feet No groundwater observed while drilling
					9	20			

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
Date 09/03/03
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Figure

BORING: 15

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 48 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0		▨	**GRAVELLY SAND WITH CLAY (SC)** light brown, dry to moist, very dense, fine to medium grained sand, 15% - 25% low plasticity clay, 25% - 30% fine grained sandstone gravel up to 1/2" in diameter.
		44	7.5				■	▨	
					1			▨	
						5		▨	
		26	8.8	104.0			■	▨	grades orange to light brown and more moist
					2			▨	
					3	10		▨	
		63/9"	11.0	113.0	7		■	▦	**SANDSTONE** mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
						15			Bottom of boring at 13.3 feet No groundwater observed while drilling
					8				
					9	20			

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
Date 09/03/03
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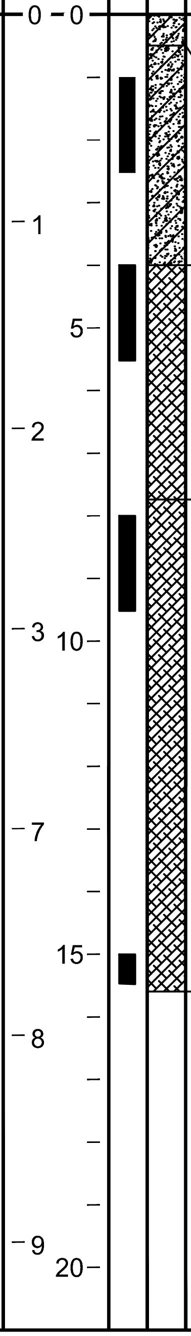
Figure

BORING: 16

EQUIPMENT: ALL-TERRAIN - 6" Solid Stem Continuous Flight Auger
DATE: 8/21/03
ELEVATION: 42 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
		50/6"	11.0	109.0
	3900	50/4"	18.5	107.0
		60/6"	17.7	110.0
		50/2"	14.8	98.0



CLAYEY SAND (SC) (TOPSOIL)
light brown, low plasticity

CLAYEY SAND (SC)
brown, very dense, moist, low plasticity, fine grained sand

increased clay content

SANDSTONE
mottled gray and brown, moist, completely weathered, friable, low hardness, fine grained sand

grades to light brown, fine grained sandstone

SANDSTONE
brown to dark brown, fine to medium grained, low to moderate strength

light brown with some gray, moist, fine grained, weathered, moderate strength and hardness

Bottom of boring at 15.3 feet
No groundwater observed while drilling

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Project No. 779.12
Date 09/03/03
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Figure

BORING: 17

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 58 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0		▨	ASPHALT (2.5")
	800	15	13.8	108.0	1		■	▨	CLAYEY SAND WITH GRAVEL (SC) brown to light brown, dry to moist, medium dense, fine to medium grained sand, 15% - 25% low plasticity clay, 10% - 15% fine grained gravel up to 3/4" in diameter
		10	16.4	105.0	2	5	■	▨	grades orange to light brown, moist and gravels up to 1/2" in diameter.
		49	16.4	111.0	3	10	■	▨	SANDSTONE mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands
					7			▨	
		50/6"	7.6	114.0	8	15	■	▨	grades darker brown
					9	20			Bottom of boring at 16.5 feet No groundwater observed while drilling

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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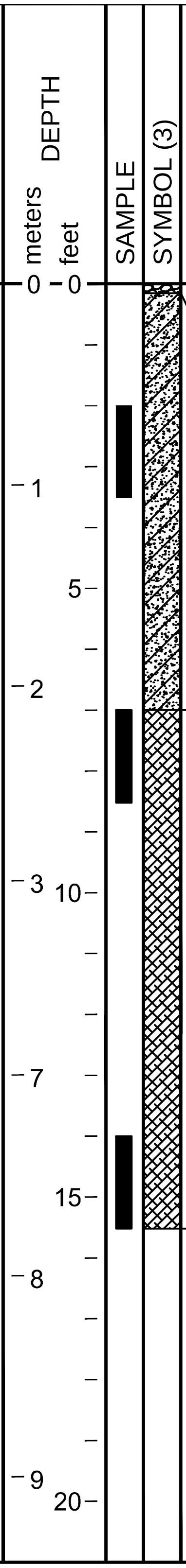
Figure

BORING: 18

EQUIPMENT: CME 75 - 6" Solid Stem Continuous Flight Auger
DATE: 8/18/03
ELEVATION: 56 feet*
*REFERENCE: DeLorme 3-D TopoQuads, 1999

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
		18	7.6	108.0
		41	20.0	108.0
		66/ 10"	10.1	120.0



ASPHALT (2.0")

CLAYEY SAND WITH GRAVEL (SC)
light brown to dark brown, dry, dense, fine to medium grained sand, 15% - 25% low plasticity clay, 10% - 15% fine grained gravel up to 1/2" in diameter

SANDSTONE
mottled orange-brown and white, highly to completely weathered, friable, low hardness, fine to medium grained sands

Grades the same

Bottom of boring at 14.8 feet
No groundwater observed while drilling

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3= 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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Figure