MILLER PACIFIC ENGINEERING GROUP

GEOTECHNICAL INVESTIGATION
NOVATO UNIFIED SCHOOL DISTRICT
SAN MARIN HIGH SCHOOL STEM BUILDING
NOVATO, CALIFORNIA

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Project 769.176

Prepared for:
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CERTIFICATION

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1.0 INTRODUCTION

This report summarizes Miller Pacific Engineering Group's (MPEG) Geotechnical Investigation for the planned STEM (Science, Technology, Engineering and Math) Building at San Marin High School, located at 15 San Marin Drive in northern Novato, California. A Site Location Map is shown on Figure 1. The purpose of our Geotechnical Investigation is to explore subsurface conditions, evaluate geotechnical hazards that may affect the planned development, and provide geotechnical design criteria for the project. In accordance with our proposal dated December 8, 2017, we are providing our geotechnical engineering services in three phases: 1) Geotechnical Investigation for the proposed improvements, 2) supplemental consultation and geotechnical design review, and 3) construction observation and testing. This report completes our Phase 1 services and includes the following:

- Review of readily available published geologic and geotechnical reference data;
- Exploration of subsurface conditions with five exploratory soil borings;
- Laboratory testing of select samples to determine the pertinent engineering properties of the soil layers;
- Evaluation of geologic hazards and development of conceptual mitigation measures;
- Development of geotechnical recommendations and design criteria (i.e., site grading, seismic, foundation, etc.) for the project; and,
- Preparation of this report summarizing our findings.

2.0 PROJECT DESCRIPTION

The project includes constructing a 160-foot by 160-foot (approximately 25,600 square feet) Science, Technology, Engineering and Math (STEM) Building in the southwestern corner of the existing high school campus, as shown on the Site Plan, Figure 2. We anticipate the proposed structure will consist of relatively lightly loaded wood and/or steel framed construction. Ancillary improvements may include approximately 14,000-square feet of pedestrian flat work and courtyard space. Site utilities will also be constructed to provide service to the proposed structure.

3.0 SITE CONDITIONS

3.1 Regional Geology

Marin County lies within the Coast Ranges geomorphic province of California, a region characterized by active seismicity, steep, young topography, and abundant landsliding and erosion owing partly to its relatively high annual rainfall. The regional basement rock consists of sedimentary, igneous, and metamorphic rock of the Jurassic-Cretaceous age (65-190 million years ago) Franciscan Complex and marine sedimentary strata of the Great Valley Sequence, which is of similar age. Within central and northern California, the Franciscan and Great Valley rocks are locally overlain by a variety of late Cretaceous and Tertiary-age sedimentary and volcanic rocks which have been deformed by episodes of folding and faulting. The youngest geologic units in the region are Quaternary-age (last 1.8 million years) sedimentary deposits. These unconsolidated deposits partially fill many of the valleys of the region.

As shown on the Regional Geologic Map (Rice, et. al., 1974), Figure 3, the site vicinity is underlain by Quaternary alluvial deposits (map symbol Qa). Alluvium typically consists of unconsolidated fluvial deposits, including mixtures of sands, silts, and clays, that grade with gravel at depth. The

surrounding uplands are underlain by mélange and metamorphic rock of the Franciscan Complex (KJsch and fm).

3.2 Surface Conditions

The project site is located in the southwest corner of the existing San Marin High School campus. The site is generally flat, with elevations ranging from roughly +110 to +112-feet above mean sea level, and is currently occupied by portable classroom structures and low grasses. An existing stockpile of soil is located south of the portables, within the planned building footprint, consisting of soils removed during construction of the synthetic turf stadium complex. Large, mature oak trees are present on the south side of the project site and an asphalt paved driveway and parking area is located west of proposed building location. The existing fine arts building is located just east of the project site.

3.3 Field Exploration and Laboratory Testing

We explored subsurface conditions in the general vicinity of the planned improvements on with five exploratory soil borings drilled at the approximate locations shown on Figure 2. Borings were drilled on January 3rd and 4th 2017, to maximum depth of 41.5 feet below the ground surface, using truck mounted equipment. The approximate boring locations are shown on Figure 2. Our Geologist logged the borings in the field and collected soil samples at select intervals for laboratory testing. Soil and Rock Classification Charts are presented along with the Boring Logs on Figures A-1 through A-12.

Laboratory testing of select soil samples included determination of moisture content, dry density, unconfined compressive strength, and percent passing the #200 sieve. The results of the moisture content, dry density, unconfined compressive strength, and percent passing the #200 sieve are presented on the boring logs. The field exploration and laboratory testing program is discussed in further detail in Appendix A.

We previously conducted a subsurface exploration at San Marin High School to aid in the design of the Multi-Purpose Building (MPEG, 2011), approximately 300-feet southeast of the project site. Reference borings from our 2011 exploration along with an additional boring conducted by Cooper Clark & Associates in 1967, are presented in Appendix B.

3.4 Subsurface Conditions

Our subsurface exploration generally confirms the regionally-mapped geologic conditions at the site. The project site is underlain by interbedded alluvial deposits variously composed of medium stiff to very stiff, low to high plasticity clay and medium dense to very dense silty and clayey lithified sand. Simplified geologic cross sections are provided on Figure 4.

Groundwater was encountered in two of the five borings, at depths between approximately 14.0- and 15.5-feet below the ground surface. Because the borings were not left open for an extended period, a stabilized depth to groundwater may not have been observed. Typically, groundwater levels fluctuate seasonally with higher levels expected during the wet winter months.

We researched the both the California Department of Water Resources Water Library (http://www.water.ca.gov/waterdatalibrary) and the California Waterboard Geotracker (https://geotracker.waterboards.ca.gov) websites to determine if existing groundwater elevation data was available in the immediate vicinity of the existing project site. The results of the search

indicate that existing well data was not available within a 2,500-feet of the project site. Therefore, for analysis purposes, we assumed a historic high groundwater surface of 10.0-feet below the ground surface.

3.5 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 5. The Rodgers Fault is the nearest known active fault and is located approximately 14.4 kilometers northeast of the site (Caltrans ARS, 2018).

3.5.1 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 6.

3.5.2 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” (USGS, 2003/2008 & Field, et. al., 2015) 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 2015 study (UCERF3) further expanded the database of faults considered and allowed for consideration of multi-fault ruptures, among other improvements.

Conclusions from the most recent UCERF3 and USGS (Aagard et. al., 2016) 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 Rodgers Creek Fault, located approximately 14.4-kilometers northeast at 33%. 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.

4.0 GEOLOGIC HAZARDS EVALUATION

The principal geologic hazards which could potentially affect the project site are strong seismic shaking from future earthquakes in the San Francisco Bay Region and liquefaction. Other hazards, such as fault surface rupture, liquefaction, tsunami inundation, slope instability, and others, are not considered significant at the site. More detailed discussion of each geologic hazard considered, their anticipated impacts, and recommended mitigation measures are discussed below.

4.1 Fault Surface Rupture

Under the Alquist-Priolo Earthquake Fault Zoning Act, the California Geological Survey (CDMG)/California Geologic Survey (CGS) (1972, 2000) 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 neither located within an Alquist-Priolo Earthquake Fault Zone (CGS, 2000). The potential for fault surface rupture on the campus is therefore considered to be low.

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

4.2 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 5, could cause moderate to strong ground shaking at the site.

4.2.1 Probability of Future Earthquakes

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 & Chiou and Youngs, (2008)) for the very dense/soft rock subsurface conditions were utilized 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 median and +1 standard deviation (+1σ), 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
Novato Unified School District
San Marin High School STEM Building
Novato, California

Fault	Fault Distance[1]	Moment Magnitude[1]	Fault Mechanism	Median PGA[2,3,4,]	+1σ PGA[2,3,4]
San Andreas	17.8 km	8.0	Strike Slip	0.25 g	0.42 g
Rodgers Creek	14.4 km	7.3	Strike Slip	0.23 g	0.39 g
Hayward	21.4 km	7.3	Strike Slip	0.17 g	0.29 g
San Gregorio	25.1 km	7.4	Strike Slip	0.16 g	0.27 g
Maacama	45.9 km	7.4	Strike Slip	0.10 g	0.17 g

Reference:
1. Caltrans ARS (2017)
2. Campbell and Borzognia (2008)
3. Chiou and Youngs (2008)
4. Values determined using Vs_{30} = 560 m/s for Site Class "C". See Section 5.2 of this report for additional discussion regarding site classification.

4.2.2 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 USGS Uniform Hazard Tool (USGS, 2017). The results of the probabilistic analyses are presented below in Table B.

TABLE B
PROBABILISTIC SEISMIC HAZARD ANALYSES
Novato Unified School District
San Marin High School STEM Building
Novato, California

	Statistical Return Period	Magnitude	PGA
2% in 50 years	2,475 years	7.1	0.71 g
10% in 50 years	475 years	7.1	0.46 g

Reference: USGS Unified Hazard Tool (USGS, 2018)

The potential for strong seismic shaking at the project site is high. Due to its close proximity, the San Andreas and Rodgers Creek Faults (approximately 17.8 kilometers and 14.4 kilometers southwest and northeast of the site, respectively) presents 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. Recommended seismic coefficients are provided in Section 5.2 of this report.*

4.3 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 where there are saturated, loose, granular deposits. Recent advances in liquefaction studies indicate that liquefaction can occur in granular materials with a high, 35 to 50%, fines content (soil particles that pass the #200 sieve), provided the fines exhibit a plasticity less than 7. Although the project site is not mapped within an area susceptible to liquefaction (ABAG, 2018); saturated sand layers were observed during our subsurface exploration.

4.3.1 Liquefaction Evaluation

To evaluate soil liquefaction, the seismic energy from an earthquake is compared with the ability of the soil to resist pore pressure generation, known as the Cyclic Resistance Ratio (CRR). The earthquake energy is termed the cyclic stress ratio (CSR) and is a function of the maximum considered earthquake peak ground acceleration (PGA) and depth. Soil resistance to liquefaction is based on its relative density, and the amount and plasticity of the fines (silts and clays). The relative density of cohesionless soil is correlated with the Cone Penetration Test (CPT) tip resistance and Standard Penetration Test (SPT) blow count data measured in the field and corrected for hammer efficiency, overburden and percent fines.

We analyzed the potential for liquefaction utilizing the data from our borings and the procedures outlined by Idriss and Boulanger (2008 & 2010), considering a magnitude 8.0 earthquake producing a PGA of 0.50 g which corresponds to the PGA_M value (ASCE 7-13 Section 18.1). The results of our analyses, shown on Figures 6 and 7, indicate the granular layers observed during our exploration are not prone to liquefaction or other liquefaction related phenomena.

Based on our analyses, as described above, it is our opinion that liquefaction presents a low risk of damage to the planned improvements.

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

4.4 Seismically Induced Ground Settlement

Seismic ground shaking can induce settlement of unsaturated, loose, granular soils. Settlement occurs as the loose soil particles rearrange into a denser configuration when subjected to seismic ground shaking. We did not observe loose, clean, granular soil layers above the historic high groundwater table. Therefore, we judge seismically induced ground settlement is not considered a significant geologic hazard at the project site.

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

4.5 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. These conditions do not exist at the site, therefore the risk of lurching and ground cracking at the project site is low.

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

4.6 Erosion

Sandy soils on moderate slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated water runoff. Granular soils are located at the ground surface; however, the site is relatively flat. Therefore, widespread erosion is not considered a significant geologic hazard. However, there is always some potential for localized erosion due to concentrated surface water flows.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Mitigation measures include designing a site drainage system to collect surface water and discharging it into an established storm drainage system. The project Civil Engineer of Architect is responsible for designing the site drainage system and, an erosion control plan could be developed prior to construction per the current guidelines of the California Stormwater Quality Association's Best Management Practice Handbook (2015).*

4.7 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 or tsunami would be dependent upon ground motions and fault offset from nearby active faults. The project site is at an increased elevation and not located near a large body of water. Therefore, seiche and tsunami events are not considered significant geologic hazards at the site.

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

4.8 Flooding

The project site is not mapped within a FEMA 100-year or 500-year flood zone (ABAG, 2018); therefore, large scale flooding does not present a significant risk to the project. However, the project Civil Engineer or Architect 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 evaluate the risk localized flooding and provide appropriate storm drain design.*

4.9 Dam Failure Inundation

The project site is located approximately 1.5-miles southeast from Stafford Lake Dam. Stafford Lake Dam is under the Division of Dam Safety (DSOD) jurisdiction which routinely monitors and evaluates the dam conditions. Additionally, an inundation map of Novato Creek from a hypothetical failure of Stafford Dam (City of Novato) shows the limit of inundation at the site as being along Novato Boulevard to the south. Therefore, based on the aforementioned references the threat of dam failure inundation is low.

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

4.10 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. Highly plastic and/or expansive soils were not observed within the upper 5-feet 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.*

4.11 Settlement/Subsidence

Significant settlement can occur when new loads are placed at sites due to consolidation of soft compressible clays (i.e., Bay Mud) or compression of loose granular soils. Large deposits of soft

compressible materials were not observed during our subsurface exploration that has a significant potential for compression settlement and consolidation with an applied surface load. Therefore, the risk of long term settlement to the proposed structures at the project site is low.

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

4.12 Slope Instability/Landsliding

Slope instability generally occurs on relatively steep slopes and/or on slopes underlain by weak materials. The campus lies on level terrain, therefore, slope instability/landsliding is not considered a significant geologic hazard at the project site.

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

4.13 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-13.

The results of our corrosivity testing indicate the upper soil layers have a pH of 6.7, a chloride concentration of 66 parts per million (ppm), and a sulfate concentration of 183 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. Therefore, based on the results of the corrosion testing, corrosive soil is not considered a significant geologic hazard at the project site.

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

4.14 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 Napa County, California, which is mapped in radon gas Zone 3 by the United States Environmental Protection Agency (USEPA, 2018). 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.*

4.15 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 60-miles northeast 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, 2018). 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.*

4.16 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. 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.*

4.17 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 low to 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

5.1 General

Based on our experience with similar projects in the Novato area, we conclude that, from a geotechnical standpoint, the site is feasible for the planned improvements. The primary geotechnical issues to address in design of the project are designing structures to withstand strong seismic shaking and providing uniform foundation support.

5.2 Seismic Design

The project site is located in a seismically active area. Therefore, the structure should be designed in conformance with the seismic provisions of the California Building Code (CBC, 2016) to mitigate the potential effects of strong seismic ground shaking to the proposed structures. We judge "Site Class C" is appropriate for the purpose of project seismic design. At a minimum, we recommend the project Structural Engineer utilize the 2016 CBC coefficients shown in Table C below to determine the base shear values.

TABLE C
2016 CBC FACTORS
Novato Unified School District
San Marin High School STEM Building
Novato, 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	1.0
Site Coefficient	F_v	1.3
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 Penetration Test (SPT) blow counts greater than 50 blows per foot, and undrained shear strength greater than 2,000 psf.
2. Maximum Considered Earthquake Geometric Mean.

5.3 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.

5.3.1 Surface Preparation

Clear all trees, brush, roots, over-sized debris, loose stockpiled soils, 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.

5.3.2 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% relative compaction.

5.3.3 Materials

Based on our laboratory testing, onsite soils are suitable as use for 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, and (3) have a maximum particle size of 6 inches. Any imported fill material needs to be tested to determine its suitability for use as fill material.

5.4 Foundation Design

Based on our experience with similar projects, the proposed structures may be supported on a shallow foundation or a rigid mat slab. Shallow foundation (spread footings and mat slabs) design criteria are presented in Table D below.

TABLE D
SHALLOW FOUNDATION DESIGN CRITERIA
Novato Unified School District
San Marin High School STEM Building
Novato, California

Continuous Shallow Foundations

Minimum Width[1]:	
One-story	12 inches
Two-story	15-inches
Minimum Depth:	18 inches
Allowable Bearing Pressure[2]:	2,500 psf
Lateral Passive Resistance[3,4]:	350 pcf
Base Friction Coefficient:	0.35

Rigid Mat Slab

Minimum embedment:	12 inches
Modulus of Subgrade Reaction, k_s:	250 pci
Minimum unsupported interior span[5]:	8 feet
Minimum unsupported edge(corner) cantilever[5]:	4 feet

Notes:
1. Size footing widths to avoid significantly different foundation pressures.
2. Dead plus live loads. Can increase values by 1/3 for total loads including seismic.
3. Neglect upper 6-inches unless concrete or asphalt surfacing exists adjacent to foundation.
4. Equivalent Fluid Pressure, not to exceed 3,500 psf.
5. Assumes rigid slab behavior with idealized pinned end conditions. May increase design values by 1/3 for total design loads.

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

Where interior concrete slabs are needed, we recommend they be at least 5-inches thick and reinforced with steel bars (not wire mesh). Contraction joints should be incorporated in the concrete slab in both directions, no greater than 10 feet on center. Additionally, the reinforcing

bars shall extend through the control joints. For improved performance, concrete slabs on grade may be increased to 6-inches thick. To improve interior moisture conditions, a 4-inch minimum layer of clean, free draining, 3/4-inch angular gravel should be placed on a properly moisture conditioned and compacted subgrade to form a capillary moisture break. A plastic membrane vapor barrier, 15-mils or thicker, should be placed over the drain rock. The vapor barrier shall meet the Class A requirements outlined in ASTM E 1745 and be installed per ASTM 1643. Eliminating the capillary moisture break and/or plastic vapor barrier may result in excess moisture intrusion through the floor slabs resulting in poor performance of floor coverings, mold growth or other adverse conditions.

Exterior concrete slabs should be at least 4-inches thick and reinforced as described above for interior slabs. For improved performance, exterior concrete slabs shall be underlain with at least 4-inches or more of Caltrans Class 2 Aggregate Base compacted to at least 92 percent relative compaction. Some movement should be expected for exterior concrete slabs as the underlying soils react to seasonal moisture changes.

5.7 Asphalt Pavement

We understand asphalt pavement areas for vehicular parking and pedestrian use may be constructed. 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. We have calculated pavement sections for the project site in accordance with Caltrans procedures for flexible pavement design utilizing the values described above and various Traffic Index (T.I.) values. The resulting supplemental pavement sections are presented in Table E below.

TABLE E
ASPHALT PAVEMENT SECTION
Novato Unified School District
San Marin High School STEM Building
Novato, California

T.I.	Asphalt Concrete	Aggregate Base Rock
4.0	2.5 inches	6.5 inches
5.0	3.0 inches	8.0 inches
6.0	3.5 inches	10.5 inches

The aggregate baserock should conform to Caltrans Class 2 Aggregate Baserock (Class 2 AB) outlined in Section 26 of the Caltrans Standard Specifications. The Class 2 AB shall be placed in layers on a properly prepared and firm and unyielding subgrade as described in the previously discussed grading recommendations. The Class 2 AB should be compacted to at least 95% relative compaction. Additionally, the Class 2 AB section should be firm and unyielding under heavy construction equipment.

5.8 Utility Trench Excavations and Backfills

Excavations for utilities will most likely extend into loose to medium 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 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 continuation of wintertime construction.

6.0 SUPPLEMENTAL GEOTECHNICAL SERVICES

We must review the plans and specifications for the project when they are nearing completion to confirm that the intent of our geotechnical recommendations has been incorporated and provide supplemental recommendations, if needed. During construction, we must observe and test site grading, foundation excavations for the structures and associated improvements to confirm that the soils encountered during construction are consistent with the design criteria.

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 Novato Unified School District and/or its 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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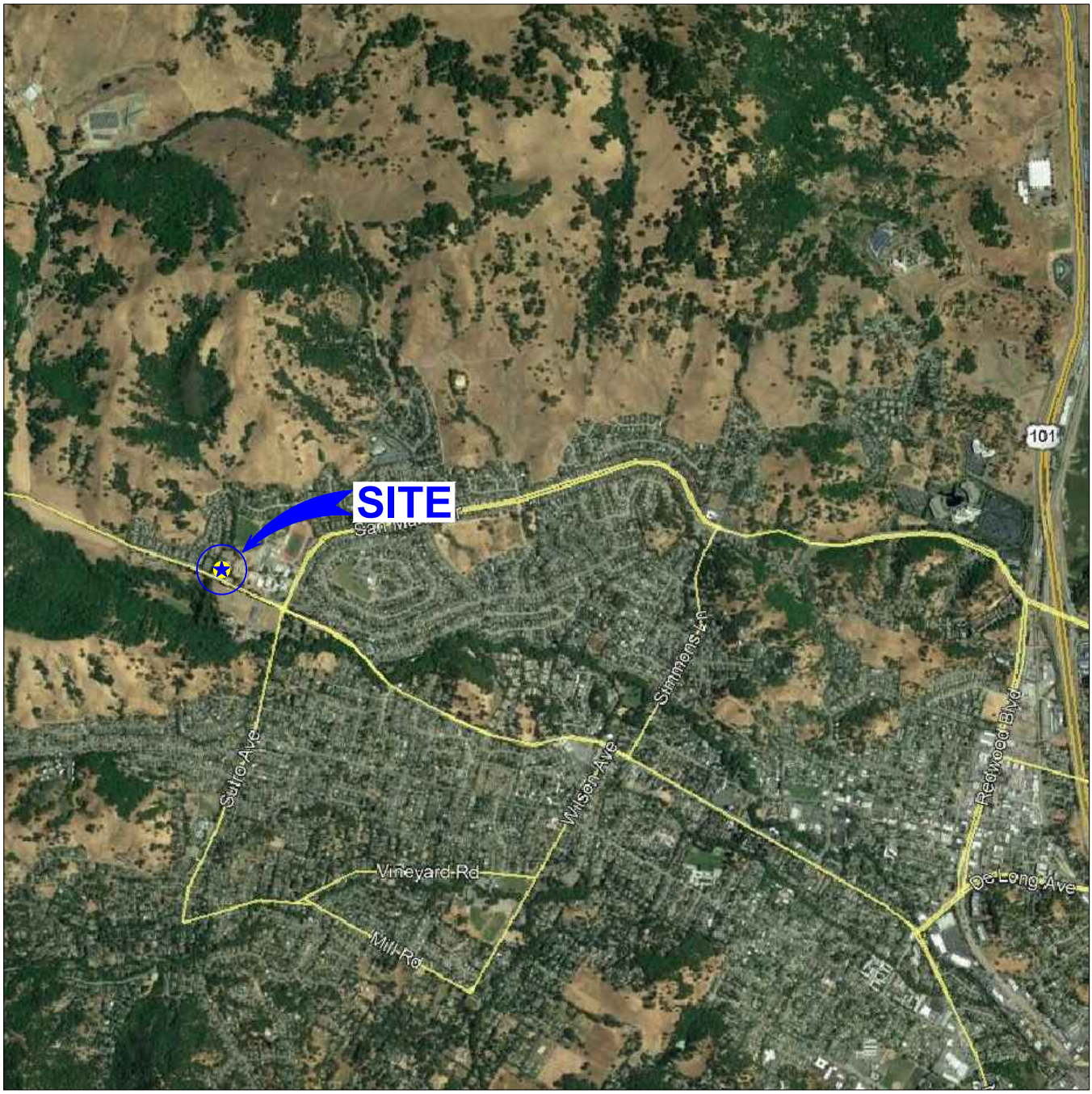

SITE COORDINATES
LAT. 38.1196°
LON. -122.6122°

SITE LOCATION

N.T.S.

NORTH

REFERENCE: Google Earth, 2018

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SITE LOCATION MAP

San Marin High School
STEM Building
Novato, California

Project No. 769.176 Date: 1/25/2018

Drawn ZMS
Checked

1
FIGURE

SITE PLAN AND GEOLOGIC MAP

1" = 100'

NORTH

LEGEND

Approximate boring location completed by MPEG, 2018

Approximate boring location completed by MPEG, 2011

Approximate boring location completed by Cooper Clark& Assoc., 1967

Qa - Alluvium (See Figure 3)

REFERENCE: Google Earth, 2018

SCALE

0 50 100 200 FEET

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SITE PLAN AND GEOLOGIC MAP

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Project No. 769.176 Date: 1/25/2018

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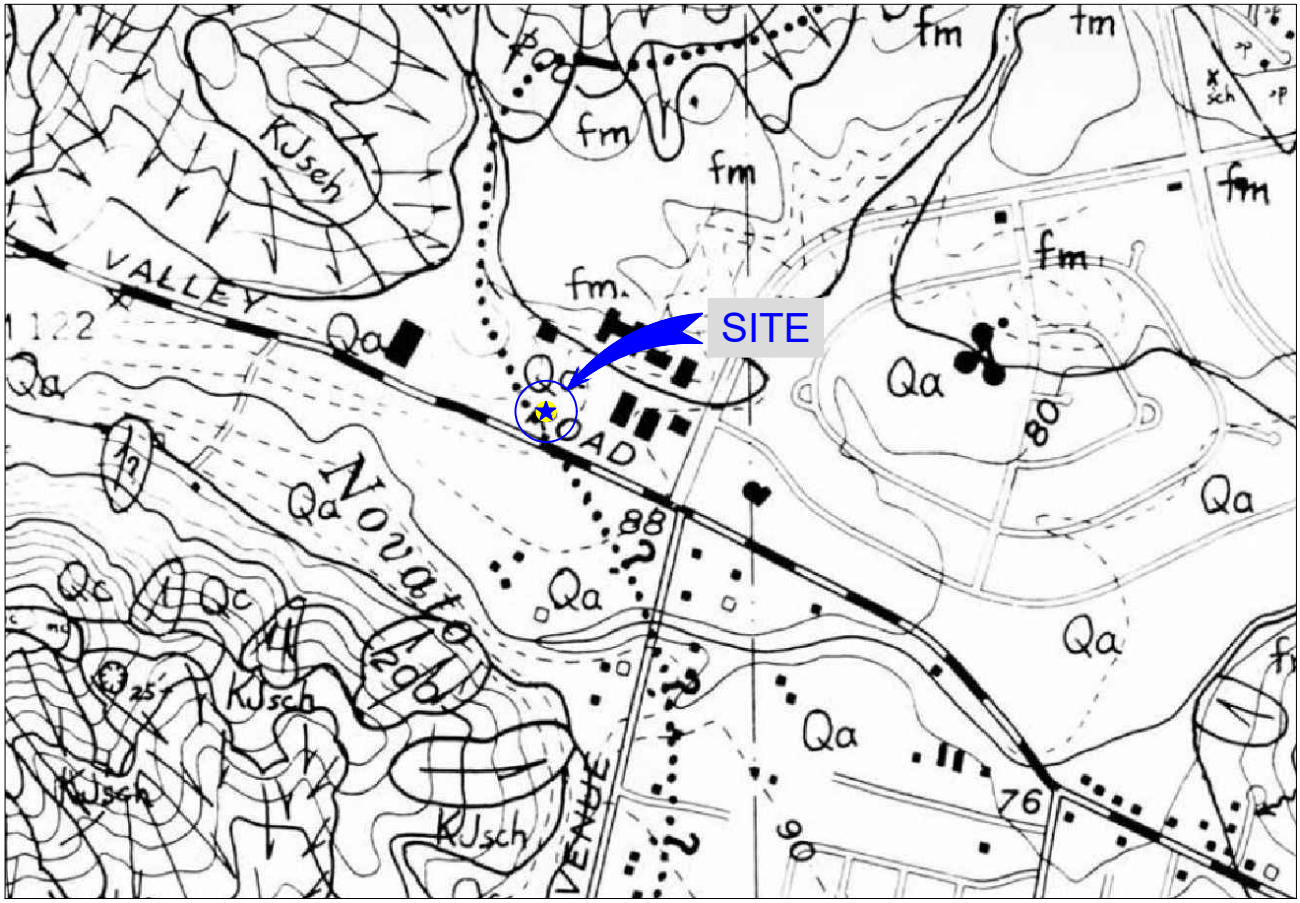
2
FIGURE



REGIONAL GEOLOGIC MAP

(NOT TO SCALE)

NORTH

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 streams.

Qc Colluvium:Unconsolidated and unsorted soil material and weathered rock fragments accumulated at or on the base of slopes by natural gravitational processes.

fm Franciscan Melange: A tectonic mixture consisting of small to large masses of resistant rocks (principally sandstone, greenstone, chert, and serpentintie) entrained in a matrix of pervasively sheared shale. Includes lesser quantities of exotic metamorphic rock types.

KJsch Metavolcanics: Predominantly slightly to well foliated or lineated metamorphosed sedimentary and volcanic rocks. Includes primarily graywacke and shale with minor outcrops of greenstone and meta-chert.

Geologic contact; dashed where inferred and dotted where concealed.

Reference: Rice, Salem J., 1974, Geology of the Western Part of the Novato Area, Marin County, California [scan]: California Division of Mines and Geology, scale 1:12,000

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REGIONAL GEOLOGIC MAP

San Marin High School
STEM Building
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Project No. 769.176 Date: 1/25/2018

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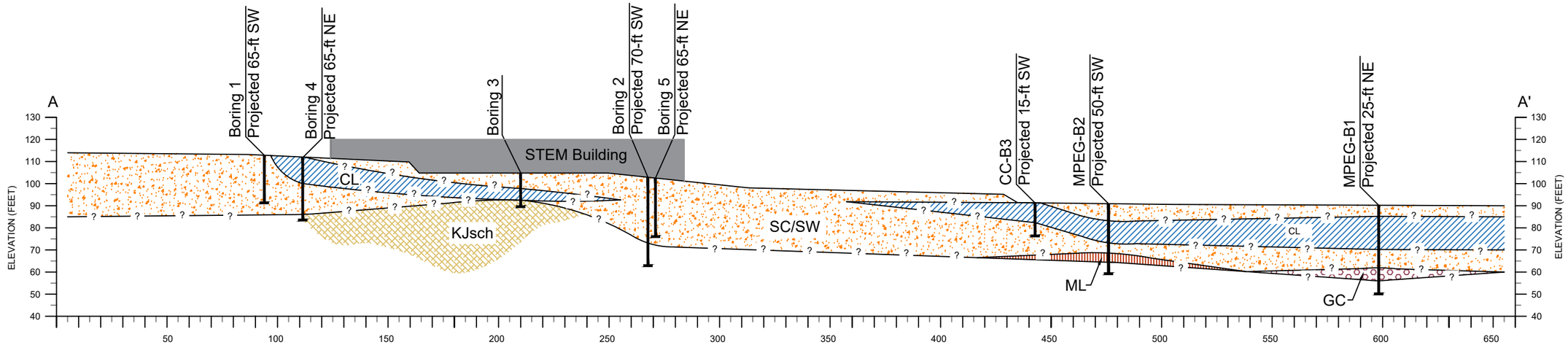
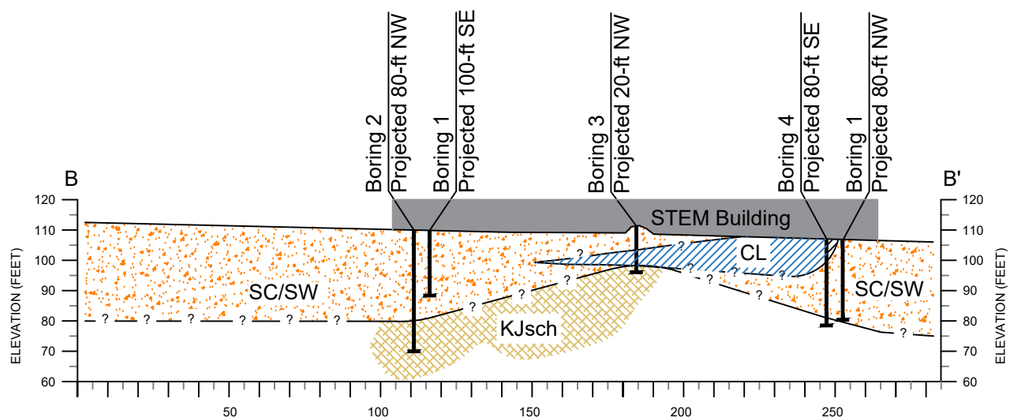
Checked

3
FIGURE



CROSS SECTION A-A'

Scale 1" = 50'



CROSS SECTION B-B'

Scale 1" = 50'

LEGEND

CL	Silt and Clay: Soil with at least 50% fine-grained material, includes sandy clay, sandy clay with gravel, and sandy gravelly clay [Alluvium]
SC	Sand with Fines: Soils containing at least 50% coarse grained material, includes clayey sand, gravelly sand, and clayey gravelly sand [Alluvium]
ML	Silt and Clay: Soil with at least 50% fine-grained material, includes silts and very fine sands, silty or clayey fine sands, or clayey silts [Alluvium]
GC	Gravel with Fines: Soils containing at least 50% coarse grained material, includes clayey gravels and gravel-sand- clay mixtures [Alluvium]
KJsch	Sandstone. Tan where weathered, gray where fresh, hard, strong, slightly weathered

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GEOLOGIC CROSS SECTION

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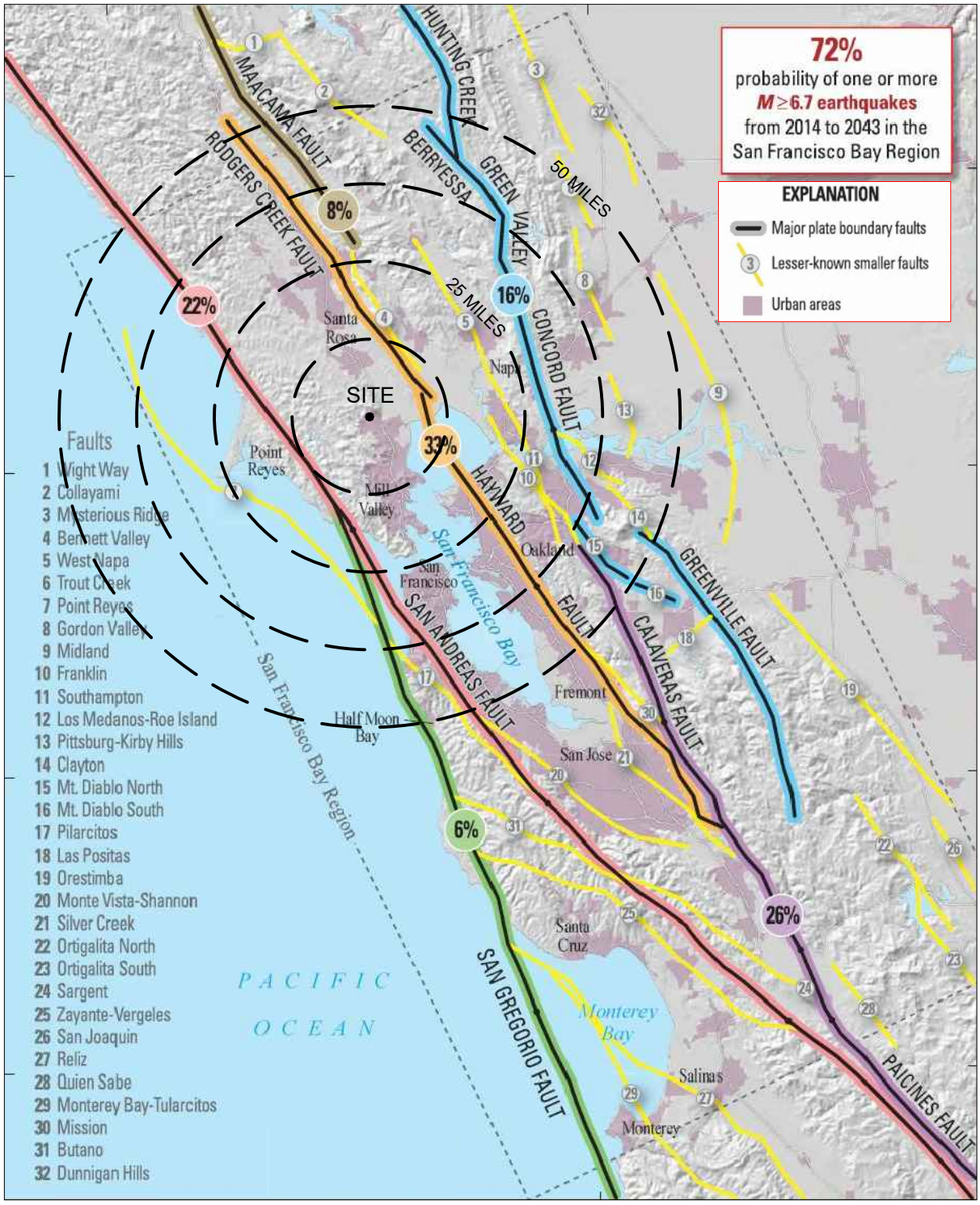
Novato, California

Project No. 769.176 Date: 2/15/2018

Designed ZMS
Drawn ZMS
Checked BSP

4
FIGURE



SITE COORDINATES
LAT. 38.1196°
LON. -122.6122°

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).

MPEG MILLER PACIFIC ENGINEERING GROUP	504 Redwood Blvd. Suite 220 Novato, CA 94947 T 415 / 382-3444 F 415 / 382-3450 www.millerpac.com	ACTIVE FAULT MAP San Marin High School STEM Building Novato, California Project No. 769.176 Date: 1/25/2018	Drawn ZMS Checked	4 FIGURE

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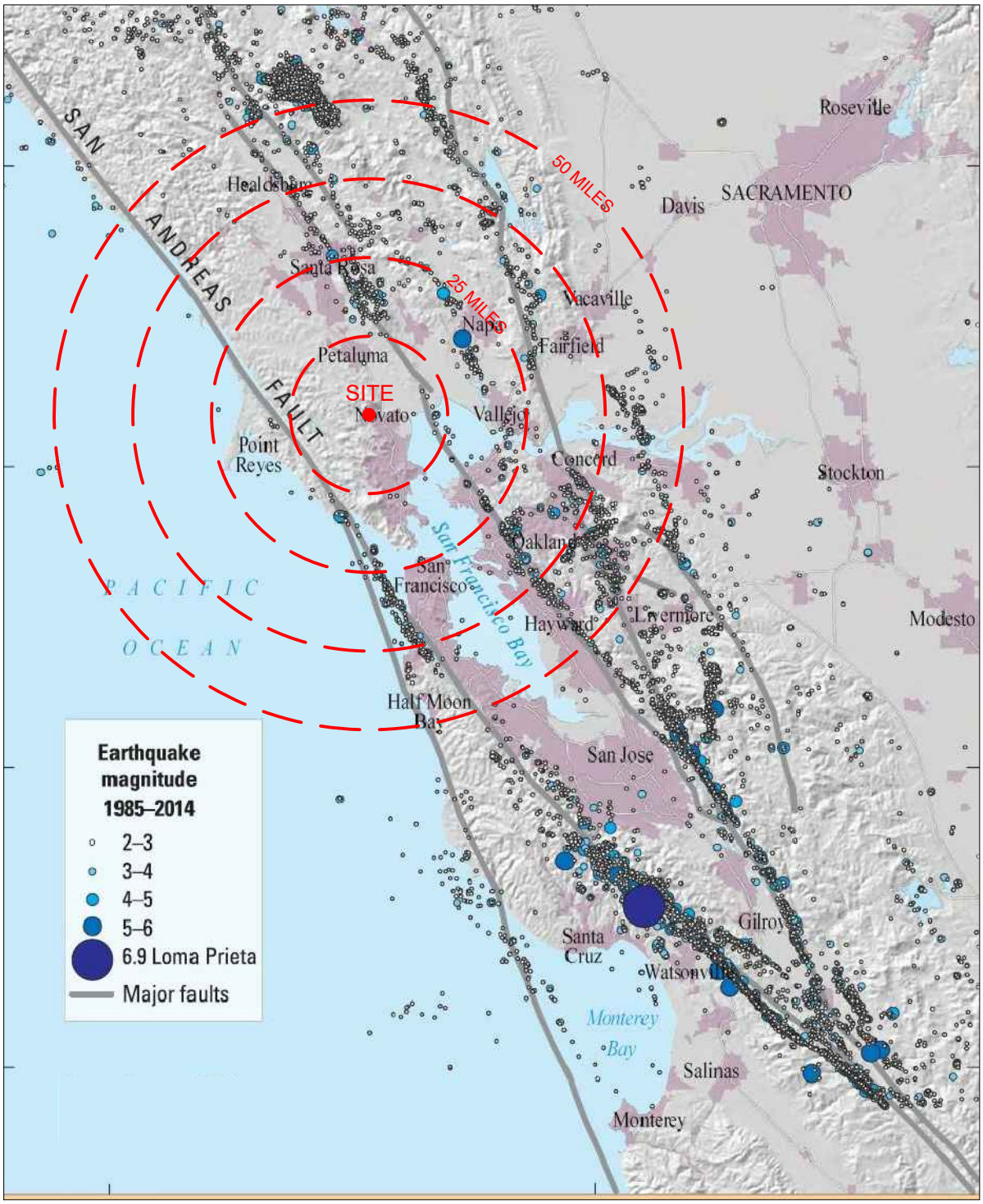

SITE COORDINATES
LAT. 38.1196°
LON. -122.6122°

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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HISTORICAL FAULT MAP

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STEM Building
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5
FIGURE

Liquefaction Analysis Utilizing
Standard Penetration Test Data

Project: **SMHS STEM Building**
Job No: **769.176**

Analyzed by: **NGK**
Date: **2/21/2018**

Soil & Seismic Properties

Magnitude, M_w: **8.0**
PGA, g: **0.50**

Layer	UCS Type	γ_d, pcf	ω%	Depth, ft Upper	Depth, ft Lower	γ_t, pcf	Thickness, ft
1	**SC**	**120**	**18%**	0	**21**	142	21

GW Depth: **10.0** feet

Cyclic Resistance Ratio (CRR)

MC to SPT: **0.6**
Borehole Dia: **6.0**
Hammer Eff: **0.8**

Sample	Depth, ft	N_{FIELD}, bpf	Fines Cont., %	Sampler Type	Liner Correction	UCS Type	σ, psf	σ', psf	Sampler Corr.	$N_{COR.}$, bpf
B1	**10.0**	**31**	**42**	**SPT**	**YES**	SC	1416	1416	1.0	31.0
B1	**15.0**	**24**	**49**	**SPT**	**YES**	SC	2124	1812	1.0	24.0

Sample	Depth (ft)	C_E	C_B	C_R	C_S	C_N	**N_{60}, bpf**	**$(N_1)_{60}$, bpf**	**$\Delta(N_1)_{60}$, bpf**	**$(N_1)_{60CS}$, bpf**	**$CRR_{M=7.5,\sigma'=1}$**
B1	10.0	1.33	1.05	0.80	1.30	1.08	**41.3**	**48.7**	**5.6**	**54**	**2.00E+04**
B1	15.0	1.33	1.05	0.85	1.30	1.03	**32.0**	**38.2**	**5.6**	**44**	**17.50**

Cyclic Stress Ratio Induced by Earthquake (CSR)

Sample	Depth, ft	σ, psf	σ', psf	r_d	C_σ	K_σ	MSF	**$CSR_{M,\sigma'}$**	**$CSR_{M=7.5,\sigma'=1}$**	**F.S.**
B1	10	1416	1416	0.99	0.30	1.10	0.88	**0.32**	**0.33**	**3.00+**
B1	15	2124	1812	0.98	0.30	1.03	0.88	**0.37**	**0.41**	**3.00+**

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LIQUEFACTION CALCULATIONS

San Marin High School
STEM Building
Novato, California

Project No. 769.176 Date: 1/25/2018

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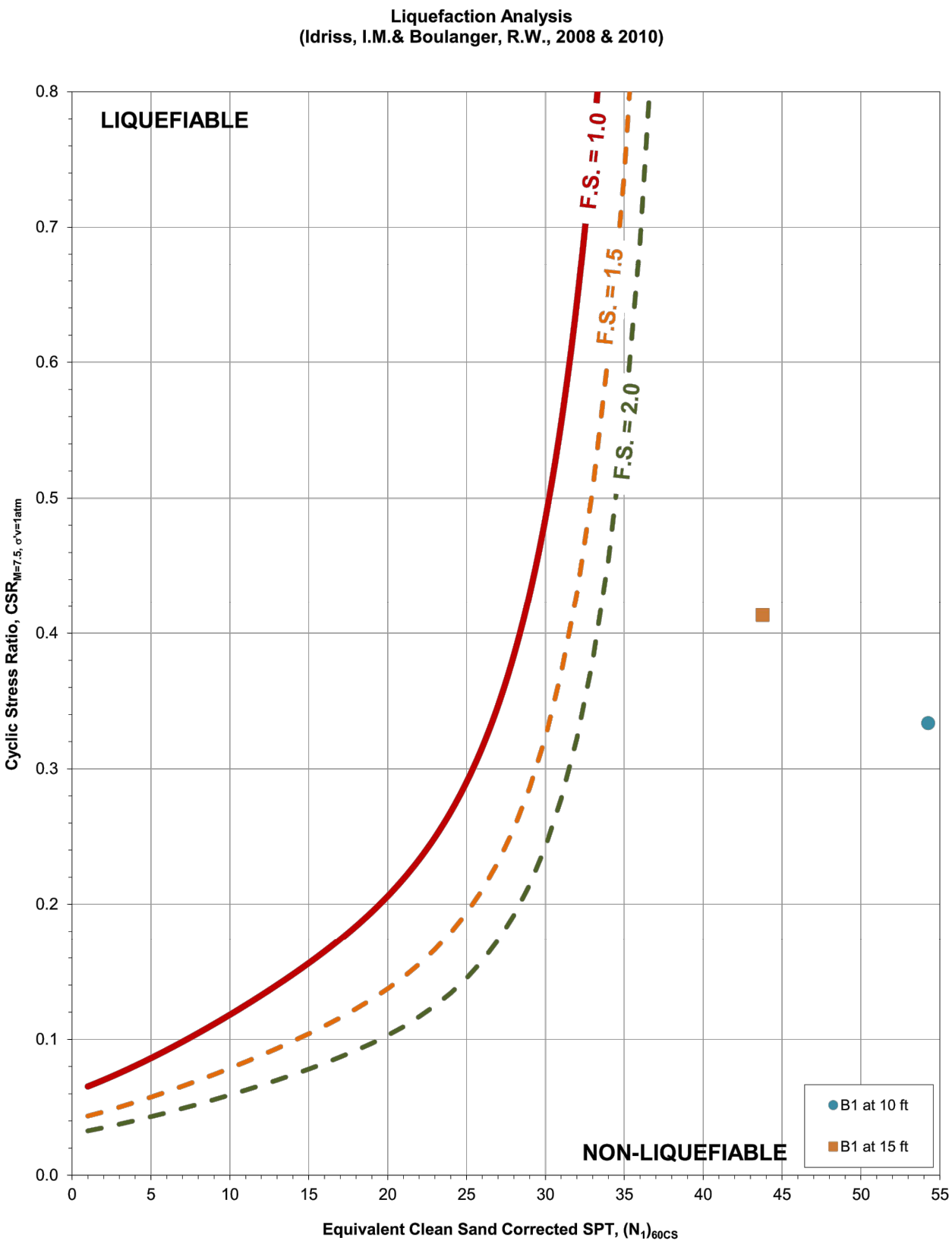
6
FIGURE



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LIQUEFACTION PLOTTED RESULTS

San Marin High School
STEM Building
Novato, California

Project No. 769.176 Date: 1/25/2018

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7
FIGURE

APPENDIX A
SUBSURFACE EXPLORATION (BORINGS) AND LABORATORY TESTING

1.0 Subsurface Exploration

We explored subsurface conditions at the site by drilling 5-test borings utilizing truck mounted drilling equipment with 6-inch hollow stem augers on January 3rd and 4th, 2018. The approximate boring locations are shown on Figure 2. The borings were drilled to a maximum depth of 51.5-feet below the ground surface.

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 Soil and Rock Classification Charts. Figures A-1 and A-2, respectively. The boring logs are presented on Figures A-3 through A-12.

We obtained "undisturbed" samples using a 3-inch diameter, split-barrel modified California sampler with 2.5 by 6-inch brass tube liners or with a 2-inch diameter, split-barrel Standard Penetration Test (SPT) sampler. The sampler was driven with a 140-pound hammer falling 30 inches. The number of blows required to drive the samplers 18 inches was recorded and is reported on the boring logs as blows per foot for the last 12 inches of driving. The samples obtained were examined in the field, sealed to prevent moisture loss, and transported to our laboratory.

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;
- Amount of Material in Soils Finer Than the No. 200 (75 µm) Sieve, ASTM D 1140;
- Standard Test Method for Expansion Index of Soils, ASTM D4829;
- pH in soil, EPA 9040;
- Resistivity in Soil, SM 2510; and
- Anions in soil (sulfate and chloride), EPA 300.

The moisture content, dry density, unconfined compressive strength, and percent passing the #200 sieve results are shown on the exploratory Boring Logs and the results of our corrosion resistance tests are presented on Figure A-13. 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
- STANDARD PENETRATION TEST
- THIN-WALLED / FIXED PISTON
- HAND SAMPLER
- ROCK CORE
- 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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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

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A-2
FIGURE

BORING 1

EQUIPMENT: Truck Mounted Drill Rig with 4.0-inch Solid Flight Auger
DATE: 1/4/18
ELEVATION: 114 feet*
*REFERENCE: Google Earth, 2018

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			Gravelly SAND with Clay (SC) Red brown, moist, medium dense, ~10% low plasticity clay, ~15-20% sub-rounded to sub-angular gravel, medium to coarse grained sand [Fill]	37	105	15.5	1355		
1	5			Clayey SAND (SC) Orange and gray mottled, moist, medium dense, fine to medium grained sand, ~20% low to medium plasticity clay [Alluvium]	87	120	12.6	760		
2				Clayey SAND with Gravel (SC) Red brown to yellow brown, moist, medium dense, gravel content varies from 10-20% with depth, fine to coarse grained sand, ~40% low to moderate plasticity clay [Alluvium]						
3	10			As above, lens of sandy clay present, well cemented	31		17.5		42.3% P200	
4	15			As above, gravels grade to predominantly sandstone and shale	24		21.3	3642	49.0% P200	
5										
6	20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

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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A-3
FIGURE

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	BORING 1 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			Gravelly Clayey SAND (SC) Red brown, moist, dense, variable gravel content (10-20%), fine to coarse grained sand, well cemented, ~20% low plasticity clay [Alluvium]	49		13.0		20.8% P200	
				End of boring at 21.5 feet Groundwater encountered at 15.5 feet						
7										
	25									
8										
9	30									
10										
	35									
11										
12	40									

Water level encountered during drilling

Water level measured after drilling

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)
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A-4
FIGURE

BORING 2

EQUIPMENT: Truck Mounted Drill Rig with 4.0-inch Solid Flight Auger
DATE: 1/4/18
ELEVATION: 114 - feet*
*REFERENCE: Google Earth, 2018

DEPTH meters / 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			6" Topsoil over 12" Aggregate Base						
			Gravelly SAND (SW) Light brown, dry to moist medium dense, ~25% sub-angular gravel, fine to coarse grained sand, trace fines [Fill/Alluvium]	33	80	7.6			
1 / 5				30	107	14.5			
2									
3 / 10			Clayey SAND with Gravel (SC) Red brown, moist to wet, very dense, fine to coarse grained sand, ~10-15% fine sub-rounded gravel, ~30-40% low plasticity clay (varies slightly throughout sample), moderate to well cemented [Alluvium]	64	111	14.1		38.3% P200	
4									
15			Sandy Gravelly CLAY (CL) Red brown, moist to wet, very dense, moderately plastic, 30-35% fine to coarse sand, ~20-25% small to medium sub-rounded gravel [Alluvium]	89	116	18.9		51.8% P200	
5									
6 / 20			Clayey SAND with Gravel (SC) Red brown to yellow brown, medium dense, ~20% sub-rounded to sub-angular gravel, fine to coarse sand, ~40% moderate plasticity clay, well-lithified						

Water level encountered during drilling
Water level measured after drilling

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)
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A-5
FIGURE

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	BORING 2 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			Clayey SAND with Gravel (SC) Red brown to yellow brown, medium dense, ~10-15% sub-rounded to sub-angular gravel, fine to coarse sand, ~40% moderate plasticity clay, well cemented [Alluvium]	43		19.0		41.6% P200	
7										
	25				43		13.6			
8				Stiffer drilling at 28 feet						
9	30			Sandstone Mottled orange and gray, moderately hard, moderately strong, highly to completely weathered [Franciscan Bedrock]	59		21.3			
10										
	35									
11										
12	40									

▽ Water level encountered during drilling

▼ Water level measured after drilling

NOTES:
(1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
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A-6
FIGURE

DEPTH meters / feet	SAMPLE	SYMBOL (4)	BORING 2 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
40			Sandstone Mottled orange and gray, moderately hard, moderately strong, highly to completely weathered, fine grained, massive [Franciscan Bedrock]	86/11"		21.4			
13			End of boring at 41.5-feet Groundwater encountered at 14.0 feet						
45									
14									
15									
50									
16									
55									
17									
18									
60									

Water level encountered during drilling

Water level measured after drilling

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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A-7
FIGURE

BORING 3

EQUIPMENT: Truck Mounted Drill Rig with 4.0-inch Solid Flight Auger
DATE: 1/3/18
ELEVATION: 110 - feet*
*REFERENCE: Google Earth, 2018

DEPTH (meters / 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			Topsoil/Organics						
			Clayey SAND with Gravel (SC) Medium brown, moist, medium dense, fine to medium grained sand, ~15-20% low plasticity clay, ~10% small sub-angular to sub-rounded gravel [Fill]	41	118	9.6	2330		
1 / 5			Slight increase in clay to 25-30%, reddish brown color, fine to medium grained sand, few highly weathered sandstone gravels present	54	111	11.2	1035		
2			Sandy CLAY with Gravel (CL) Medium red brown, moist to dry, stiff, ~20% fine, sub-angular to sub-rounded highly to completely weathered gravel, ~20% fine to medium grained sand, well cemented [Alluvium]	86/11"	107	21.6	3020	62.8% P200	
3 / 10									
4			Sandstone Tan where weathered, gray where fresh, hard, strong, slightly weathered [Franciscan Bedrock]	50/3"		4.7			
15				50/2"		4.2			
5			End of boring at 15 feet 2 inches No groundwater encountered						
6 / 20									

Water level encountered during drilling
Water level measured after drilling

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)
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A-8
FIGURE

BORING 4

EQUIPMENT: Truck Mounted Drill Rig with 4.0-inch Solid Flight Auger
DATE: 1/3/18
ELEVATION: 112 - 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			Topsoil/Organics						
				Sandy CLAY with Gravel (CL) Medium brown, dry to moist, very stiff, low to moderate plasticity clay, ~20% fine to medium grained sand, ~10-12% small, sub-angular to sub-rounded gravel [Fill/Alluvium]	35	101	12.9	2010	69.3% P200	
1				Slight increase in gravel to ~15%	70	120	10.2			
	5									
2										
				Slight increase in gravel size and percentage to 15-20%, sand is medium to coarse grained	55		5.6			
3	10									
4				Clayey SAND with Gravel (SC) Medium red brown, moist, medium dense to dense, fine to medium grained sand, ~15-20% low to moderate plasticity clay, ~10-15% highly weathered sandstone gravel, moderately to well cemented [Alluvium]	56	116	16.0		49.5% P200	
	15									
5				Increased fine gravels	92/5"	119	13.0			
6	20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

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)
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A-9
FIGURE

DEPTH meters / feet	SAMPLE	SYMBOL (4)	BORING 4 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
20			Clayey SAND with Gravel (SC) Medium red brown, moist, medium dense to dense, fine to medium grained sand, ~15-20% low to moderate plasticity clay, ~10-15% highly weathered sandstone gravel [Alluvium] Grades to very dense gravels present						
7				76/11"		10.4			
25									
8									
			Sandstone Light tan, hard, strong, slightly weathered, fine grained, [Franciscan Bedrock]	50/3"		9.4			
9 30			End of boring at 28 feet 3 inches No groundwater encountered						
10									
35									
11									
12 40									

Water level encountered during drilling

Water level measured after drilling

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)
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BORING LOG

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A-10
FIGURE

BORING 5

EQUIPMENT: Truck Mounted Drill Rig with 4.0-inch Solid Flight Auger
DATE: 1/3/18
ELEVATION: 110 - feet*
*REFERENCE: Google Earth, 2018

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			Topsoil and Organics						
				Clayey SAND (SC) Gray brown with inclusions of multicolored gravel, moist and medium dense, ~15-20% low plasticity clay, ~15% sub-angular gravel [Fill/Alluvium]	13	109	14.0			
1										
	5				26	113	12.4			
2				Stiff drilling at 9.0 feet						
3	10			Clayey SAND with Gravel (SC) Red brown, moist, medium stiff to stiff, low to moderate plasticity, slight inbrication of gravels, ~35-40% clay, ~10% small, sub-angular to sub-rounded gravel [Alluvium]	46		11.5			
4										
	15				62		16.7			
5										
6	20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

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)
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BORING LOG

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A-11
FIGURE

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)	BORING 5 (CONTINUED)	BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			Clayey SAND (SC)						
				Variable color, orange brown to light gray, moist, medium dense, fine to medium grained sand, ~40% stiff, low plasticity clay and silt [Alluvium]	57	104	21.5			
7										
	25									
8					53		20.7			
				End of boring at 26.5 feet No groundwater encountered						
9	30									
10										
	35									
11										
12	40									

Water level encountered during drilling

Water level measured after drilling

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)
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BORING LOG

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A-12
FIGURE

E T S

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COMPANY:	Miller Pacific Engineering Group, 504 Redwood Blvd., Suite 220, Novato, CA 94947			ANALYST(S)	SUPERVISOR
ATTN:	Ben Pappas		DATE of	S. Santos	D. Jacobson
JOB NAME:	San Marin High School, 15 San Marin Drive,	DATE RECEIVED	COMPLETION	L. Quijano	LAB DIRECTOR
JOB #:	759.176 Novato, California	1/18/2018	1/26/2018		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
07625-1	SMHS1-SMD/N	Native Soil B1-B5 @ 0.0'-4.0'	**6.74**	**1,253**	**798**	**183**	**66**
Method	Detection	Limits --->	---	1	0.1	1	1

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

***

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APPENDIX B
PREVIOUS SUBSURFACE EXPLORATION

BORING 1

EQUIPMENT: Simco 4000TR with 4-inch Solid Flight Augers

DATE: 4/27/11

ELEVATION: x-Feet*

*REFERENCE: Topo Map Used For Elevation

OTHER TEST DATA	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			WELL GRADED SAND WITH SILT (SW-SM) Medium reddish brown, dry, loose to medium dense, very fine to coarse grained, ~15% fine to medium angular to subrounded gravels, <10% silt. [Fill]
P200 40.9%			7	11.1	100					
						1				SILTY SAND (SM) Medium reddish brown, dry, loose to medium dense, ~40% low plasticity silt, <5% gravels. [Fill]
		880 UC	8	15.7	111					
							5			SANDY CLAY (CL) Medium brown to reddish brown, moist, medium stiff, medium plasticity, ~30-35% very fine to medium sand. [Alluvium]
		1550 UC	14	11.7	125	2				
										SANDY CLAY WITH GRAVEL (CL) Medium brown to reddish brown, moist, medium stiff, medium plasticity, ~30-35% very fine to medium sand, ~15-20% fine to medium subangular to rounded gravels. [Alluvium]
						3	10			Grades to less gravels at 8.0 feet.
		2870 UC	22	15.9	120					Grades to less sand at 12.0 feet.
						4				
							15			
		2210 UC	19	14.9	121	5				
						6	20			CLAYEY SAND (SC) Dark brown with light brown mottling, moist, dense, ~40% medium plasticity clay, ~10% fine to medium subangular to subrounded gravels. [Alluvium]

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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FILE: 769.13 BL.dwg

BORING LOG

NUSD - San Marin High School Cafeteria
Novato, California

Project No. 769.13 Date: 5/9/11

Drawn JSC
Checked

A-3
FIGURE

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	BORING (CONTINUED)
P200 36.7	LL= 42 PI= 20	1280 UC	16	18.5	117	20 / 7 / 25 / 8			CLAYEY SAND (SC) Dark brown with light brown mottling, moist, dense, ~40% medium plasticity clay, ~10% fine to medium subangular to subrounded gravels. [Alluvium]
P200 10.7	SA		70	8.8	140	9 / 30 / 10			SANDY GRAVEL WITH CLAY (GC) Dark red-brown, saturated, very dense, fine to course grained, angular to subrounded, ~30% fine to course sand, ~10% medium plasticity clay. [Alluvium] Slow drilling from 28.5-34.0 feet.
						35 / 11 / 12			SANDSTONE Light gray, very fine to fine grained, thinly bedded, moderately well-cemented, hard, strong, moderately weathered, faint green oxidation staining. [Bedrock]
			50/1.5"	13.3		40			Bottom of boring at 40.1 feet, groundwater measured at 15.5 feet, 10 minutes after completion.

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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NUSD - San Marin High School
Cafeteria
Novato, California

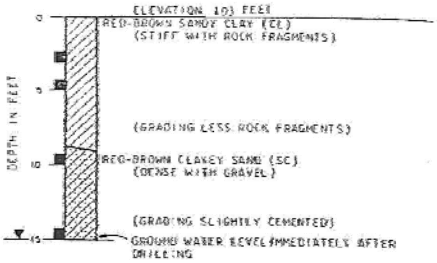
Project No. 769.13 Date: 5/9/11

Drawn JSC
Checked

A-4
FIGURE

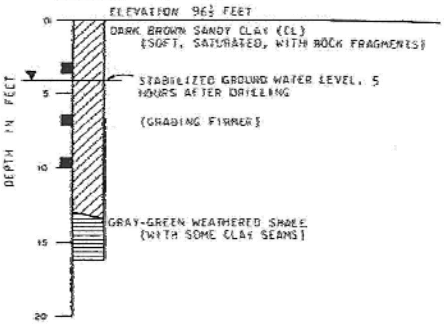
CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
			DS DS	300 2000	NATURAL	1150 2000	19.2 20.1	109 109
							18.1	113
							13.3	119

BORING 6



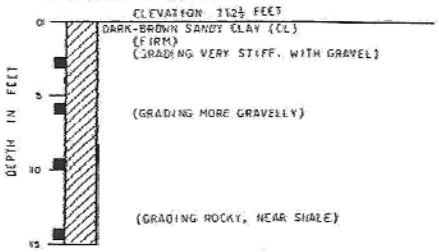
CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
			DS DS	500 2000	NATURAL	270 750	27.1	93
			DS DS	700 2500	NATURAL	600 750	17.0	114
			DS	1200	NATURAL	800	17.0	114

BORING 7



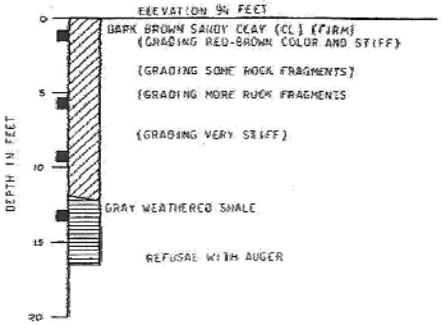
CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
			TR	4300 7000	10.1	4700 5700	10.1	124
							14.7	113
							10.6	125
							13.9	121

BORING 8



CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
							17.3	114
			DSK DSK	700 2300	16.0 17.7	1600 2500	14.1	131
							14.4	117
							9.1	128

BORING 9



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Novato, California

Drawn BSP
Checked

A-5
FIGURE

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Project No. 769.13 Date: 5/16/11

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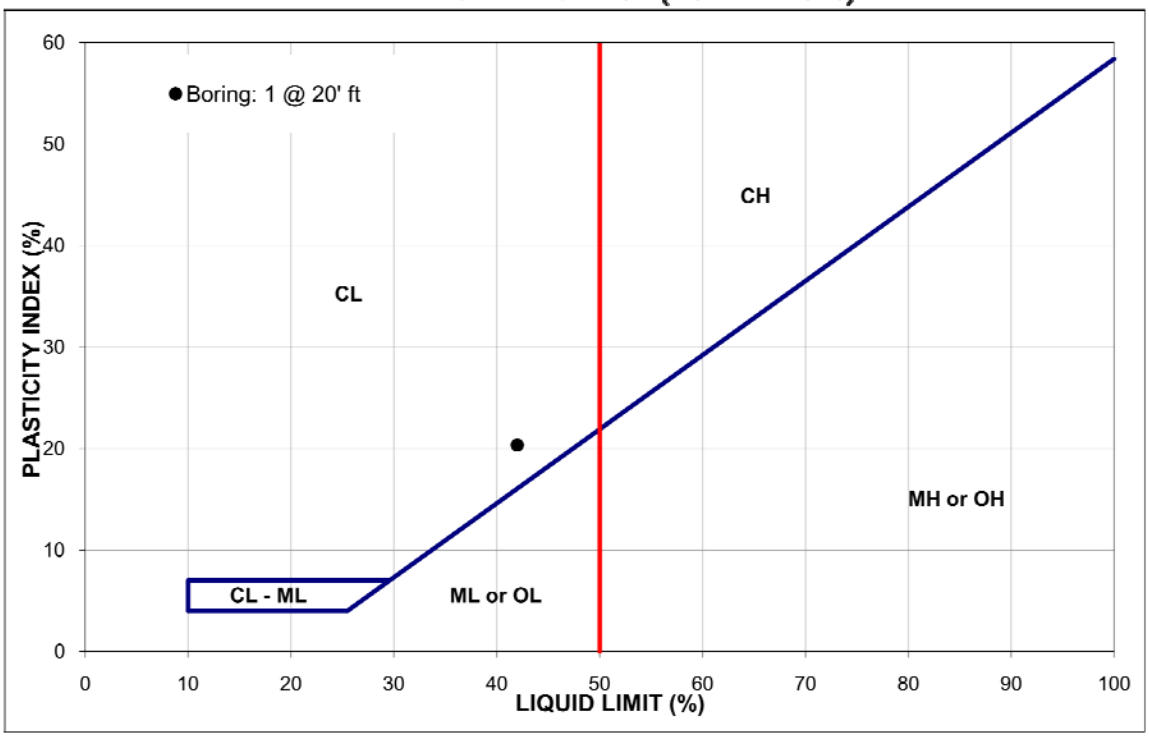
ATTERBERG LIMITS TEST (ASTM D 4318)



Sample	Classification	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
Boring: 1 @ 20' ft	SANDY CLAY (CL) light brown	42	22	20

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		NUSD - San Marin High School Cafeteria Building Novato, California	Drawn BSP Checked	A-6 FIGURE
		Project No. 769.13 Date: 5/16/11		

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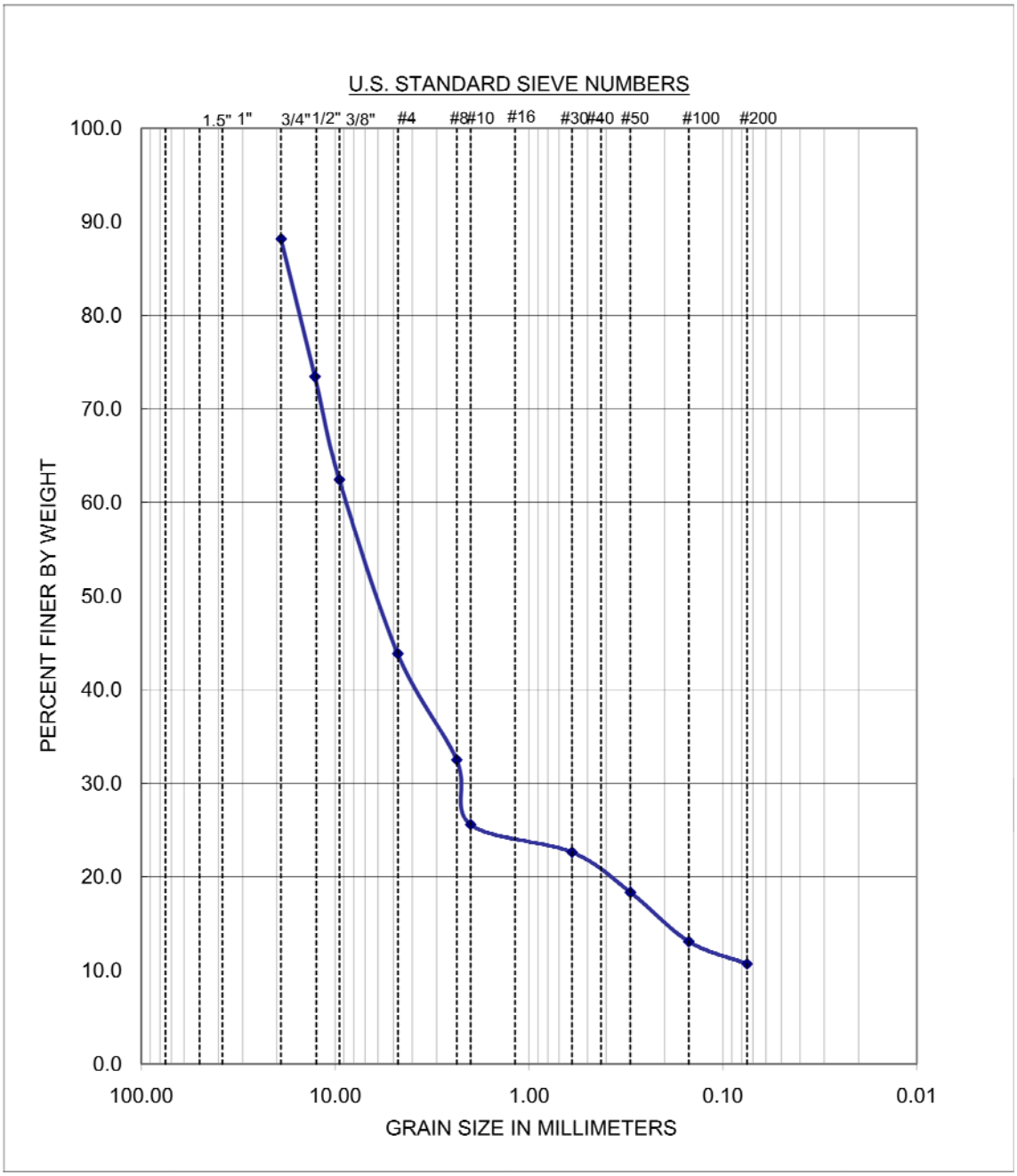
PARTICLE SIZE ANALYSIS CHART



SYMBOL	SAMPLE SOURCE	CLASSIFICATION
—◆—	B1@31.0	SANDY GRAVEL WITH SILT (GW)

Test: ASTM D-422

Miller Pacific ENGINEERING GROUP	504 Redwood Blvd. Suite 220 Novato, CA 94947 T 415 / 382-3444 F 415 / 382-3450 www.millerpac.com	SIEVE ANALYSIS RESULTS	Drawn BSP Checked	A-7 FIGURE
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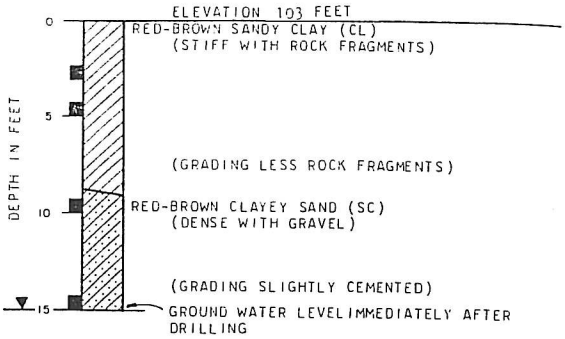
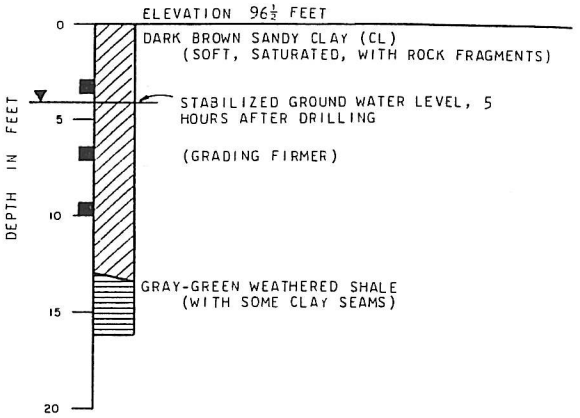
BORING 6

CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO. 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
							19.2	108
			DS DS	700 2000	NATURAL	1150 2000	20.1	108
							18.1	113
							13.3	119



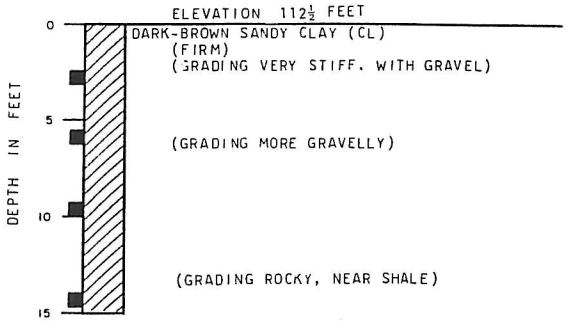
BORING 7

CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO. 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
			DS DS	500 2000	NATURAL	270 750	27.1	91
			DS DS	700 2500	NATURAL	600 750	17.0	114
			DS	1200	NATURAL	800	17.0	114



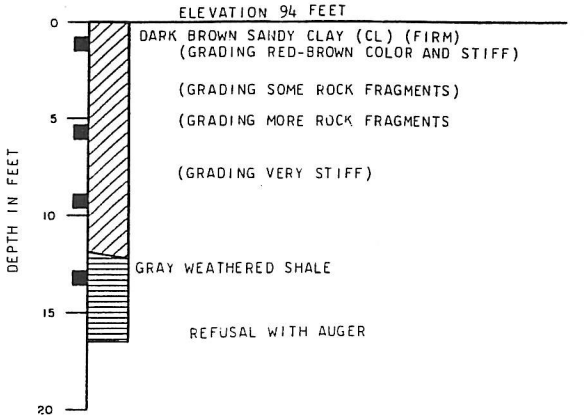
BORING 8

CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO. 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
			TR	4300 7000	10.1	4700 5700	10.1	124
							14.7	113
							10.6	125
							13.9	121



BORING 9

CLASSIFICATION DATA			STRENGTH DATA				MOISTURE-DENSITY DATA	
% FINES (-NO. 200)	LIQUID LIMIT	PLASTICITY INDEX	TYPE OF STRENGTH TEST	TEST SURCHARGE PRESSURE, LBS/SQ FT	TEST MOISTURE CONTENT, %	SHEAR STRENGTH, LBS/SQ FT	NATURAL MOISTURE CONTENT, %	DRY DENSITY, LBS/CU FT
							17.3	114
			DSX DSX	700 2300	16.0 17.7	1600 2500	14.1	111
							14.4	117
							9.1	128



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