



**MILLER PACIFIC
ENGINEERING GROUP**

**GEOTECHNICAL FEASIBILITY STUDY
SAN RAFAEL LANDMARK
900 A STREET
SAN RAFAEL, CALIFORNIA**

February 17, 2025

Project 502.307

Prepared For:
SR Landmark LLC
1101 5th Avenue
San Rafael, California 94901

Attn: Mr. Collin Monahan

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, toxic mold and other biological pollutants, and other hazardous materials. The document is for the sole use of the client and consultants on this project. Use by third parties or others is expressly prohibited without written permission. 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.

MILLER PACIFIC ENGINEERING GROUP
(a California corporation)



Benjamin S. Pappas
Geotechnical Engineer No. 2786
(Expires 9/30/26)

**GEOTECHNICAL FEASIBILITY STUDY
SAN RAFAEL LANDMARK
900 A STREET
SAN RAFAEL, CALIFORNIA**

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
2.0	PROJECT DESCRIPTION	1
3.0	SITE SETTING.....	1
3.1	Regional Geology	2
3.2	Seismicity	2
3.2.1	<i>Historic Fault Activity</i>	2
3.2.2	<i>Probability of Future Earthquakes</i>	3
3.3	Surface Conditions	4
3.4	Anticipated Subsurface Conditions	4
4.0	GEOLOGIC HAZARDS.....	4
4.1	Fault Surface Rupture.....	4
4.2	Seismic Shaking	5
4.2.1	<i>Deterministic Seismic Hazard Analysis</i>	5
4.2.2	<i>Probabilistic Seismic Hazard Analysis</i>	7
4.3	Liquefaction and Related Effects	8
4.4	Settlement	8
4.5	Seismic Densification.....	9
4.6	Expansive Soils	9
4.7	Erosion	9
4.8	Flooding	10
4.9	Tsunami and Seiche	10
5.0	PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS	10
5.1	Seismic Design.....	10
5.2	Site Grading	11
5.2.1	<i>Site Preparation</i>	11
5.2.2	<i>Excavations</i>	12
5.2.3	<i>Fill Materials, Placement and Compaction</i>	12
5.3	Preliminary Foundation Design.....	12
5.4	Retaining Walls.....	13
5.5	Interior Concrete Slabs-On-Grade	13
5.6	Exterior Concrete Slabs.....	14
5.7	Site and Foundation Drainage	14
5.8	Underground Utilities	14
6.0	SUPPLEMENTAL GEOTECHNICAL SERVICES	15
7.0	LIMITATIONS	15

FIGURES

Site Location Map.....Figure 1
Site Plan2
Regional Geologic Map3
Active Fault Map.....4
Historical Earthquake Map.....5
Liquefaction Map6
Flood Zone Susceptibility Map.....7

**GEOTECHNICAL FEASIBILITY STUDY
SAN RAFAEL LANDMARK
900 A STREET
SAN RAFAEL, CALIFORNIA**

1.0 INTRODUCTION

This report summarizes Miller Pacific Engineering Group's (MPEG) Geotechnical Feasibility study for the planned multi-use development located at the southwestern corner of 3rd Street and A Street (APN 011-263-21) in San Rafael, California. A Site Location Map is presented on Figure 1. The purpose of our feasibility study is to provide potential geologic hazards which may impact the proposed project and provide preliminary geotechnical recommendations. A design level Geotechnical Investigation, which will include a subsurface exploration and laboratory testing, should be performed to verify the preliminary geotechnical recommendations given herein. Our services were provided in accordance with our agreement dated December 13, 2024 and authorized January 16, 2025. This Feasibility Study report completes Phase 1 of our agreement and includes the following:

- Review of readily available published geologic and geotechnical reference data;
- Evaluation of geologic hazards relevant to site development;
- Development of preliminary geotechnical recommendations for the project; and,
- Preparation of this report summarizing our findings.

We anticipate providing an additional 3-phases of work for this project. These three phases include; Phase 2: Geotechnical Investigation; Phase 3: Supplemental Geotechnical Consultation; and, Phase 4: Geotechnical Construction Observation & Testing.

2.0 PROJECT DESCRIPTION

Based on our review of the preliminary plan set (Stackhouse, De La Pena, Trachtenberg Architects, "900 A Street," February 06, 2025), the project includes demolishing the existing improvements located on the property and constructing an 8-story apartment/condominium structure with basement parking lot. Additionally, the first floor will include parking and commercial space, and the remaining 7-stories will consist of residential space. We anticipate the proposed structure will exert significant foundation loads on the bearing soils. Minor site grading is anticipated and will likely consist of excavations up to 12-feet to construct the basement level and construct a relative building pad. Ancillary improvements are likely to include concrete flatwork; site utilities with tie-ins to the main utility lines located under the city streets; minor landscaping; and other improvements typical of projects of this size.

3.0 SITE SETTING

San Rafael is located in the Coast Ranges geomorphic province of California. Regional topography within the Coast Ranges province is characterized by northwest-southeast trending mountain ridges and intervening valleys that parallel the major geologic structures, including the San Andreas Fault System. The province is also generally characterized by abundant landsliding and erosion, owing in part to its typically high levels of precipitation and seismic activity.

3.1 Regional Geology

The project site lies within the Coast Ranges geomorphic province of California. Regional topography within the Coast Ranges province is characterized by northwest-southeast trending mountain ridges and intervening valleys that parallel the major geologic structures, including the San Andreas Fault System. The province is also generally characterized by abundant landsliding and erosion, owing in part to its typically high levels of precipitation and seismic activity.

The oldest rocks in the region are the sedimentary, igneous, and metamorphic rocks of the Jurassic-Cretaceous age (190- to 65-million years old) Franciscan Assemblage. Within Marin County, a variety of sedimentary and volcanic rocks of Tertiary (1.8- to 65-million years old) and Quaternary (less than 1.8-million years old) age locally overlie the basement rocks of the Franciscan Assemblage. Tectonic deformation and erosion during late Tertiary and Quaternary time (the last several million years) formed the prominent coastal ridges and intervening valleys typical of the Coast Ranges province. The youngest geologic units in the region are Quaternary-age (last 1.8 million years) sedimentary deposits, including alluvial deposits which partially fill most of the valleys and colluvial deposits which typically blanket the lower portions of surrounding slopes.

Geologic mapping (Rice, Strand & Smith, 1976), indicates the site is located on alluvial deposits (map symbol, Qa) which typically consist of unconsolidated gravel, sand, silt, and clay deposited by streams and rivers. Artificial fill overlying Bay Mud (map symbol Qaf/Qm) is mapped in the southeastern most corner of the project site. Artificial fill consists of various amounts of gravel, sand, silt, and clay mixtures that were placed by man. Bay Mud consists of soft, compressible silt and clay deposited in a marine environment. A regional Geologic Map is presented on Figure 3.

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, among others. 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 2010 Fault Activity Map of California (Jennings and Bryant, 2010) depicts various active and inactive faults in the region, which are shown in relation to the project site on Figure 4. The San Andreas and Hayward/Rodgers Creek Faults are the nearest known active faults to the project site and located roughly 14.3 kilometers southwest and 14.4 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 between 1985 and 2021 have been plotted on a map shown on Figure 5. Additionally, we reviewed the California Geological Survey (CGS) Historic Earthquake Online Database (<https://earthquake.usgs.gov/earthquakes/search/>), and judge the most significant historic earthquakes to have impacted San Rafael and the greater Marin County area are outlined below:

1906 San Francisco Earthquake – The April 18, 1906, magnitude 7.9 earthquake occurred on the northern segment of the San Andreas Fault. The earthquake resulted in catastrophic damage throughout the greater Bay Area. Significant damage, including complete structural collapses, and 498 deaths were reported in San Francisco.

1969 Rodgers Creek/Healdsburg Fault Earthquake – Two earthquakes of magnitudes 5.6 and 5.7 originated on the Rodgers Creek and Healdsburg Faults. The resulting damage was concentrated in Santa Rosa with partial and near structural collapses. No loss of life was reported.

1989 Loma Prieta Earthquake – The magnitude 6.9 earthquake was a result of a rupture along the San Andreas Fault in the Santa Cruz Mountains. Significant damage was reported throughout the Bay Area, with a majority occurring in San Francisco, Oakland, and Santa Cruz in the form of structural collapses and loss of life. Significant damage was not reported in the San Rafael area.

2014 South Napa Earthquake – The magnitude 6.0 earthquake was a result of a rupture along the West Napa Fault with the epicenter located in southern Napa. The earthquake resulted in moderate to significant damage in the City of Napa and neighboring cities. Effects included surface fault rupture, partial building collapse, and structural fires. Over 300 people were injured, and one fatality was reported.

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. 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 (UCERF), 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 (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 Hayward/Rodgers Creek Fault, located approximately 14.4-kilometers northeast of the site, at 33%. The second nearest known active fault, the San Andreas Fault, is located 14.3-kilometers southwest of the site and 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

As shown on the Site Plan, Figure 2, the project site is located in central downtown San Rafael. The property consists of an approximate 29,000-square foot, rectangular parcel with elevations ranging from approximately +18-feet, on the northwest corner, to +11-feet (NAVD88), on the southeast corner. The property is located approximately 0.4-miles west of Highway 101 and roughly 0.2-miles south of the foot of San Rafael Hill. The site is bounded by A Street to the west and 3rd Street to the south, while existing parking lots and mixed use structures are located to the north and south.

The property is currently occupied with a 1-story, roughly 9,250-square foot, commercial structure with stucco facing located on the southern end of the property. A majority of the remaining property space consists of paved asphalt parking areas; concrete flatwork; and minor landscaping. The existing structure appears to be performing well with little to no evidence of distress from the exterior. The asphalt parking area also appears to be performing well with little to no cracks or rutting.

3.4 Anticipated Subsurface Conditions

The scope of our feasibility study did not include a subsurface exploration; however, we have provided subsurface explorations throughout the Downtown San Rafael Area. Therefore, based on geologic mapping, and our experience in this area of downtown San Rafael, we anticipate the subsurface conditions will include clayey alluvial deposits overlying weathered bedrock. Weathered bedrock is anticipated at a depth roughly 10-feet+/- below the ground surface. Additionally, we anticipate groundwater may be located within the upper 5-feet of the ground surface, depending on the season.

4.0 GEOLOGIC HAZARDS

This section summarizes our review of commonly considered geologic hazards and discusses their potential impacts on the planned improvements. The primary geologic hazard which could affect the proposed development is strong seismic ground shaking from future earthquakes in the San Francisco Bay region and liquefaction. Other geologic hazards are judged less than significant regarding the proposed project. Geologic hazards, potential impacts and mitigation measures are discussed in further detail in the following sections.

4.1 Fault Surface Rupture

Under the Alquist-Priolo Earthquake Fault Zoning Act (1972), the California Geological Survey produces 1:24,000 scale maps showing all known active faults and defining zones within which special fault studies are required. We reviewed digitized versions of these maps made available through the California Geological Survey (CGS) Earthquake Hazards Zone Application (EQZAPP, <https://maps.conservation.ca.gov/cgs/EQZApp/app/>).

The site is not located within an Alquist-Priolo Earthquake Fault Zone. The Hayward Fault is the nearest known active fault and is located approximately 14.3 kilometers southwest of the site. As shown on Figure 3. We did not observe any indications of active or historic faulting during our site reconnaissance. Therefore, the potential for fault surface rupture at the site is considered to be low.

Evaluation: No significant impact.

Recommendations: No special engineering measures are required.

4.2 Seismic Shaking

The site will likely experience seismic ground shaking similar to other areas in the seismically active Bay Area. The intensity of ground shaking will depend on the characteristics of the causative fault, distance from the fault, the earthquake magnitude and duration, and site-specific geologic conditions. Estimates of peak ground accelerations are based on either deterministic or probabilistic methods.

4.2.1 Deterministic Seismic Hazard Analysis

Deterministic methods use empirical attenuation relations that provide approximate estimates of median peak ground accelerations. A summary of the active faults that could most significantly affect the planning area, their maximum credible magnitude, closest distance to the center of the planning area, probable peak ground accelerations, and 84th percentile peak ground accelerations are summarized in Table 1. The calculated accelerations should only be considered as reasonable estimates. Many factors (e.g., soil conditions, orientation to the fault, etc.) can influence the actual ground surface accelerations.

Table 1 – Deterministic Peak Ground Accelerations for Active Faults

Fault	Magnitude¹	Distance²	Median PGA^{3,4}	84% PGA^{2,4}
San Andreas Fault: SAN+SAP+SAP+SAS	8.0	14.3 km	0.28 g	0.51 g
Hayward Fault: RC+HN+HS+HE	7.6	14.4 km	0.22 g	0.40 g
San Gregorio	7.4	15.3 km	0.25 g	0.45 g
Rodgers Creek – Healdsburg Fault	7.3	23.0 km	0.16 g	0.28 g
West Napa	6.6	32.4 km	0.08 g	0.14 g

Notes:

1. Values determined using USGS Earthquake Scenario Map (BSSC 2014), accessed 2023.
2. Google Earth – KML Files showing Quaternary Faults & Folds in the US obtained from USGS
3. Values determined using $V_{S30} = 2,500$ ft/s based on the anticipated shallow bedrock subsurface conditions.
4. Abrahamson, Silva & Kamai (2014), Boore, Stewart, Seyhan & Atkinson (2014), Campbell & Bozorgnia (2014), and Chiou & Youngs (2014) NGA models.

Key:

RC – Rodgers Creek – Healdsburg Fault
 HN – Hayward Fault, Northern Section
 HS – Hayward Fault, Southern Section
 HE – Hayward Fault, Southern Extension
 SAO – San Andreas Fault, Offshore
 SAN – San Andreas Fault, North Coast
 SAP – San Andreas Fault, Peninsula
 SAS – San Andreas Fault, Santa Cruz Mountains

4.2.2 *Probabilistic Seismic Hazard Analysis*

Probabilistic Seismic Hazard Analysis 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 peak ground acceleration for two separate probabilistic conditions; the 2 percent chance of exceedance in 50 years (2,475-year statistical return period) and the 10 percent chance of exceedance in 50 years (475-year statistical return period). The peak ground acceleration values were calculated utilizing the USGS Unified Hazard Tool (USGS, 2023). The results of the probabilistic analyses are presented below in Table 2.

Table 2 – Probabilistic Peak Ground Accelerations for Active Faults¹

Probability of Exceedance	Return Period	Magnitude	PGA (g)
2% in 50 years	2,475 years	7.7	0.71 g
10% in 50 years	475 years	7.6	0.40

Reference: USGS Unified Hazard Tool accessed, 2025.

Ground shaking can result in structural failure and collapse of structures or cause non-structural building elements (such as light fixtures, shelves, cornices, etc.) to fall, presenting a hazard to building occupants and contents. Compliance with provisions of the most recent version of the California Building Code (2022 CBC) should result in structures that do not collapse in an earthquake. Damage may still occur, and hazards associated with falling objects or non-structural building elements will remain.

The potential for strong seismic shaking at the project site is high. Due to their proximity and historic rates of activity, the San Andreas and Hayward-Rodgers Creek Faults present the highest potential for severe ground shaking. The significant adverse impact associated with strong seismic shaking is potential damage to structures and improvements.

Evaluation: Less than significant with mitigation.
Recommendation: Minimum mitigation includes design of new structures in accordance with the provisions of the 2022 California Building Code or subsequent codes in effect when final design occurs. Additional subsurface exploration and analysis will be required to provide seismic design criteria.

4.3 Liquefaction and Related Effects

Liquefaction refers to the sudden, temporary loss of soil strength during strong ground shaking. The strength loss occurs as a result of the build-up of excess pore water pressures and subsequent reduction of effective stress. While liquefaction most commonly occurs in saturated, loose, granular deposits, recent studies indicate that it can also occur in materials with relatively high fines content provided the fines exhibit lower plasticity. The effects of liquefaction can vary from cyclic softening, resulting in limited strain potential, to post liquefaction settlements and lateral ground movements.

The anticipated subsurface conditions include variable alluvial deposits overlying weathered bedrock. Alluvial deposits typically consist of layers of clayey, sandy, and gravelly soils with the granular layers being potentially susceptible to liquefaction. Liquefaction susceptibility mapping by the Association of Bay Area Governments (MarinMap.org, accessed 2025) indicates that the project site has a low liquefaction potential, as shown on Figure 6. Considering we anticipate weathered bedrock is located within the upper 20-feet below the ground surface and the current project includes removing up to 10 to 20-feet of existing soil to construct below grade parking, the potential for liquefiable soils below the structure is low.

Evaluation: Less than significant with mitigation.

Recommendation: A subsurface exploration, including laboratory testing, should be performed to fully evaluate the liquefaction risk at the project site. Mitigation measures will be dependent on the results of a subsurface exploration and laboratory testing and liquefaction analysis.

4.4 Settlement

Significant settlement can occur when new loads are placed over soft, compressible clays or loose granular soils or significant structural loads are transferred to the underlying soils. We do not anticipate soft compressible soils (i.e., Bay Mud, lacustrine deposits, marsh deposits, etc.) will underlie the project site; however, we anticipate the foundation loads will be significant. These loads can cause the underlying soils to consolidate, resulting in surface settlements. However, we anticipate excavations up to 10-feet may be required to construct the parking and basement levels. We anticipate the proposed structure will most likely span between bedrock and alluvial soils that can result in differential settlements. Therefore, differential settlement is considered a low to moderate hazard at the project site.

Evaluation: Less than significant with mitigation.

Recommendation: A subsurface exploration, including laboratory testing, should be performed to fully evaluate the settlement risk at the project site. Mitigation measures will be dependent on the results of a subsurface exploration, laboratory testing and settlement analysis. We anticipate mitigation will include utilizing shallow foundations to support the structure where bedrock is at or near the excavated surface. A deep foundation system (i.e., drilled piers, piles, etc.) that extend through the alluvial soils and bear on the underlying weathered bedrock will be utilized where the overlying soils are thicker.

4.5 Seismic Densification

Seismic ground shaking can induce settlement in unsaturated, loose, 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. We do not anticipate encountering loose, dry granular soils below the bearing soil strata. However, a subsurface exploration should be performed to verify unsaturated, loose, granular soils do not underly the site.

Evaluation: Less than significant with mitigation.

Recommendation: A subsurface exploration, including laboratory testing, should be performed to fully evaluate the seismic densification risk at the project site. Mitigation measures will be dependent on the results of lab testing and analysis.

4.6 Expansive Soils

Soil expansion occurs when clay particles interact with water causing seasonal volume changes in the soil matrix. The clay soil swells when saturated and then contracts when dried. This phenomenon generally decreases in magnitude with increasing confinement pressures at increasing depths. These volume changes may damage lightly loaded foundations, concrete slabs, pavements, retaining walls and other improvements. Expansive soil also causes soil creep on sloping ground. Near surface soils are likely to include silts and clays that may be prone to expansive behavior. However, these soils if encountered, would most likely be removed from the project site to construct the subterranean levels. Therefore, the risk of expansive soil affecting the proposed improvements appears low.

Evaluation: Less than significant with mitigation.

Recommendation: A subsurface exploration, including laboratory testing, should be performed to fully evaluate the expansive soil risk at the project site. Mitigation measures will be dependent on the results of lab testing.

4.7 Erosion

Sandy soils on moderately steep slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated surface water flow. The potential for erosion is increased when established vegetation is disturbed or removed during normal construction activity. The proposed improvement plans indicate that the entirety of the property will be developed with the apartment building, pavements, or concrete flatwork. Therefore, erosion is not considered to be a significant geologic hazard.

Evaluation: Less than significant.

Recommendation: Designing a site drainage system for the maximum credible rainfall event, and to collect surface water and discharging it into an established storm drainage system. The project Civil Engineer is typically responsible for designing the site drainage system and, an erosion control plan should be developed prior to construction per the current guidelines of the California Stormwater Quality Association's Best Management Practice Handbook.

4.8 Flooding

The project site is located at about at elevations approximately +11 and +18-feet and mapped within a flood hazard zone with a 0.2% chance of annual flooding (MarinMap.org, 2025), as shown on Figure 7. Therefore, large scale flooding is considered a low hazard to the inhabitable spaces at the project site. However, subterranean spaces may be susceptible to localized flooding. Additionally, changes to existing grades and drainage patterns associated with site development can result in localized flooding. Therefore, the risk of flooding at the project site is low to moderate.

Evaluation: Less than significant with mitigation.

Recommendation: The project Civil Engineer is responsible for site drainage and should evaluate localized flooding potential and provide appropriate mitigation. Additionally, finished livable floor elevations should be above potential flood levels.

4.9 Tsunami and Seiche

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. Tsunami hazard mapping of the project area (MarinMap.org, 2025) indicates the site is not located within an area that is susceptible to tsunami inundation. Therefore, the likelihood of inundation by seiche or tsunami is low.

Evaluation: Less than significant.

Recommendation: No mitigation measures are required.

5.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on our review of readily available geologic and geotechnical data and our experience in the Downtown San Rafael area, we anticipate the site conditions are geologically and geotechnically feasible for the proposed development. The primary geotechnical considerations for the project will include designing the improvements to resist strong seismic ground shaking, potential differential settlement, and excavation safety. Additional discussion and preliminary conclusions and recommendations addressing these, and other considerations are presented in the following sections.

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 (2022) of the California Building Code. The magnitude and character of these ground motions will depend on the earthquake and the site response characteristics. Based on the anticipated site grading, subsurface conditions, and proximity of active faults, we recommend the CBC coefficients and site values shown in Table 3 be used to preliminarily calculate the design base shear of new structures as applicable. The values presented in Table 3 should be confirmed based on supplemental subsurface exploration and laboratory testing.

Table 3 – Preliminary 2022 California Building Code Seismic Design Criteria

Parameter	Design Value
Site Class	B
Site Latitude, Longitude	37.9746°, 122.5303°
Spectral Response (short), S_s	1.50 g
Spectral Response (1-sec), S_1	0.60 g
Site Coefficient, F_a	1.0
Site Coefficient, F_v	1.0

Reference: SEAC/OSHPD Seismic Design Maps, accessed 2023.

Depending on the building period, supplemental exploration and updated liquefaction analyses performed during the design-level investigation, the soil site class may be Site Class “F” (liquefiable soils) requiring a site-specific seismic response evaluation.

5.2 Site Grading

Moderate to significant grading (cut or fill placement) is anticipated to develop the project site. Site grading will consist of excavations up to roughly 10-feet deep on the north side of the project site to construct the parking level and additional excavations on the southern end of the property to create a basement level. Earthwork should be performed in accordance with the recommendations and criteria outlined in the following sections.

5.2.1 Site Preparation

Clear pavements, old foundations, over-sized debris, and organic material from areas to be graded. Debris, rocks larger than six inches, and vegetation are not suitable for structural fill and should be removed from the site. Existing foundations and utilities which are to be abandoned as part of the work should be removed from structural areas. In non-structural areas, utilities could be abandoned in place provided cement grout completely fills any void in the utility.

Where fills or other structural improvements are planned, the subgrade surface should be scarified to a depth of 8 inches, moisture conditioned to above the optimum moisture content, and compacted to at least 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density, as determined by ASTM D1557. Subgrade preparation should extend a minimum of 5 feet beyond the planned building envelope in all directions. The subgrade should be firm and unyielding when proof-rolled with heavy, rubber-tired construction equipment. If soft, wet, or otherwise unsuitable materials are encountered at subgrade elevation during construction, we can provide supplemental recommendations to address the specific condition. If weathered bedrock is exposed at the subgrade level, ripping and recompacting is not required with the approval of the geotechnical engineer.

5.2.2 Excavations

Based on geologic mapping, site excavations will likely encounter unconsolidated alluvial soil deposits containing clay, silt, sand, and gravel. Weathered bedrock should be anticipated within the upper 20-feet and will likely be encountered during excavation. Soils and highly weathered bedrock encountered should be “diggable” with standard excavation equipment (i.e., excavators, back-hoes, etc.). However, more competent and less weathered bedrock should be anticipated that may require hard rock excavation equipment (i.e., hoe-ram, large teeth excavators, etc.).

We anticipate onsite subsurface soils generally classify as OSHA Type B while weathered bedrock will classify as OSHA Type A. Temporary support of excavations will be required to ensure the safety of workers and to reduce the potential for failure of the excavation sidewalls and damage to surrounding improvements. Excavation stability and the structural design of temporary shoring should be made the sole responsibility of the Contractor. For excavation deeper than 5 feet, the design of temporary dewatering systems should be made the sole responsibility of the Contractor. Additional design criteria for temporary and permanent retaining structures (based on the subsurface conditions at the project site) should be provided in a design level geotechnical report

5.2.3 Fill Materials, Placement and Compaction

Fill materials should consist of non-expansive materials that are free of organic matter, have a Liquid Limit of less than 40 (ASTM D 4318), a Plasticity Index of less than 15 (ASTM D 4318), and a minimum R-value of 20 (California Test 301). The fill material should contain less than 50 percent of particles passing a No. 200 sieve and should have a maximum particle size of 4 inches. Onsite soils may be suitable for use as fill provided, they meet the criteria specified above. Any imported fill material needs to be tested to determine its suitability.

Fill materials should be moisture conditioned to above the optimum moisture content prior to compaction. Properly moisture conditioned fill materials should subsequently be placed in loose, horizontal lifts of 8 inches-thick or less and uniformly compacted to at least 90 percent relative compaction. Where fill thickness is greater than 5-feet, fill materials should be compacted to at least 92 percent relative compaction. In pavement areas, the upper 12 inches of fill should be compacted to at least 95 percent relative compaction. The maximum dry density and optimum moisture content of fill materials should be determined in accordance with ASTM D1557.

5.3 Preliminary Foundation Design

Based on our experience with similar projects in the general vicinity of the project site, we judge the proposed 8-story apartment/condominium building should be supported on a foundation system that bears on the anticipated underlying weathered bedrock. Shallow foundations may be utilized where weathered bedrock is exposed at, or near, the ground surface. Drilled piers will likely be required to extend through deeper soils, likely located on the southern portion of the project site, and embed into the weathered bedrock. We will provide additional foundation recommendations and design criteria in a design level Geotechnical Investigation Report.

5.4 Retaining Walls

Retaining walls will be required to support the basement parking level. These walls should be supported on a foundation system as described above. Walls free to rotate at the top, (i.e., “unrestrained”) and walls structurally connected at the top (i.e., “restrained”). If retaining walls are greater than 10-feet in retained height tie-backs may be utilized to reduce foundation depths. Additionally, retaining walls greater than 5-feet should not be constructed without temporary cut slopes or shoring.

Drainage shall be provided for all retaining walls taller than two 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 Mirifi 100N, may be utilized. Additionally, waterproofing should be constructed behind retaining walls that abut interior space and considered for the parking and basement levels. The Project Architect and/or waterproofing expert should design the waterproofing system.

5.5 Interior Concrete Slabs-On-Grade

Reinforced concrete slab-on-grade floors are judged to be appropriate for the site conditions. The concrete slabs-on-grade may be poured monolithically or separated with a cold joint. We recommend that interior concrete slabs have a minimum thickness of 5 inches and be reinforced with steel reinforcing bars (not mesh) with rebar extending through crack control joints. Slabs should be placed on a moist subgrade to reduce potential for future expansive behavior. The project Structural Engineer should specifically design the concrete slabs, including locations of crack control joints. Under slab drainage should also be considered below the subterranean garage to alleviate buoyancy effects and reduce potential moisture infiltration.

To reduce the potential for moisture to move upward through the slab, a four-inch layer of clean, free draining, $\frac{3}{4}$ -inch angular gravel should be placed beneath interior concrete slabs to form a capillary moisture break. The gravel must be placed on a properly moisture conditioned and compacted subgrade that has been approved by the Geotechnical Engineer. A plastic membrane vapor barrier, 15 mils or thicker, should be placed over the compacted base rock. The vapor barrier shall meet the ASTM E1745 Class A requirements and be installed per ASTM E1643. 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.

We note that over time, placing sand between the vapor barrier and concrete is becoming less common because of elevated interior moisture contents. If sand is used, it should be dry, and if it is not used, the slab should be carefully designed with a lower water-cement ratio (generally less than 0.45) since eliminating the sand can cause cracking or “curling” of the new concrete. For slabs that are not sensitive to moisture vapor, we recommend at least four inches of Class 2 aggregate base (Caltrans, 2015) compacted to 95 percent relative compaction.

5.6 Exterior Concrete Slabs

Exterior concrete walkway slabs and other concrete slabs that are not subjected to vehicle loads should be a minimum of 4 inches thick and underlain with 4 inches or more of Class 2 aggregate base. The aggregate base should be moisture conditioned to near optimum and compacted to at least 95 percent relative compaction. The upper 8 inches of subgrade on which aggregate base is placed should be prepared as previously discussed under Section 5.2.

Where improved performance is desired (i.e., reduced risks of cracking or small movements), exterior slabs can be thickened to 5 inches and reinforced with steel reinforcing bars (not welded wire mesh). We recommend crack control joints no farther than 10 feet apart in both directions and that the reinforcing bars extend through the control joints. Some movement or offset at sidewalk joints should be expected as the underlying soils expand and shrink from seasonal moisture changes.

5.7 Site and Foundation Drainage

New grading could result in adverse drainage patterns causing water to pond around the development. Careful consideration should be given to design of finished grades at the site. We recommend that the building areas be raised slightly and that the adjoining landscaped areas be sloped downward at least 0.25 feet for 5 feet (5 percent) 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 percent).

Roof gutter downspouts may discharge onto the pavements but should not discharge onto landscaped areas immediately adjacent to the buildings. Provide area drains for landscape planters adjacent to buildings and collect downspout discharges into a tight pipe collection system that discharges well away from the building foundations. Site drainage should be discharged away from the building area and outlets should be designed to reduce erosion. Site drainage improvements should be connected into an established storm drainage system.

5.8 Underground Utilities

Excavations for utilities will likely encounter unconsolidated alluvial soils deposits containing variable amounts of clay, silt, sand, and gravel. Groundwater may be encountered at shallow depths. Trench excavations having a depth of 5 feet or more must be excavated and shored in accordance with OSHA regulations, as discussed in Section 5.2.2.

Unless otherwise recommended by the pipe manufacturer, pipe bedding and embedment materials should consist of well-graded sand with 90 to 100 percent of particles passing the No. 4 sieve and no more than 5 percent finer than the No. 200 sieve. Crushed rock or pea gravel may also be considered for pipe bedding. Provide the minimum bedding thickness beneath the pipe in accordance with the manufacturer's recommendations (typically 3 to 6 inches). Trench backfill may consist of on-site soils, provided that the soil meets the fill criteria outlined in Section 5.2.3 or imported aggregate baserock. Trench backfill should be moisture conditioned and placed in thin lifts and compacted to at least 90 percent. Use equipment and methods that are suitable for work in confined areas without damaging utility conduits.

6.0 SUPPLEMENTAL GEOTECHNICAL SERVICES

We should perform a design level geotechnical investigation on the project site prior to structural design. Our services will include soil borings to confirm the anticipated subsurface conditions and to collect select soil samples for laboratory testing to determine the pertinent engineering properties. We will summarize the results of our subsurface exploration in a report that will include the results of our subsurface exploration and laboratory testing and will include seismic and foundation design criteria.

As project plans near completion, we should review them to ensure that the intent of our recommendations has been sufficiently incorporated. During construction, we should be present intermittently to observe and test the geotechnical portions of the work. The purpose of our observation and testing is to confirm that site conditions are as anticipated, to adjust our recommendations and design criteria if needed, and to confirm that the Contractor's work is performed in accordance with the project plans and specifications.

7.0 LIMITATIONS

We believe this report has been prepared in accordance with generally accepted geotechnical engineering practices in Marin County at the time the report was prepared. This report has been prepared for the exclusive use of the project Owner (San Rafael Landmark, LLC) 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 detailed 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, designers, 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.

LIST OF REFERENCES

Abrahamson, Silva and Kamai, "Summary of the ASK14 Ground Motions Relation for Active Crustal Regions," Earthquake Engineering Research Institute, Spectra Vol 30 Issue 3, August 2014.

Aagard, B.T. et al (2016), "Earthquake Outlook for the San Francisco Bay Region 2014-2043", United States Geological Survey Fact Sheet 2016-3020, Version 1.1, Revised August 2016.

American Society of Civil Engineers (ASCE), "Minimum Design Loads for Buildings and Other Structures" (ASCE 7-16), Structural Engineering Institute of the American Society of Civil Engineers, 2016.

Boore, Stewart, Seyhan and Atkinson, "NGA-West2 Equations for Predicting PGA, PGV and 5% Damped PSA for Shallow Crustal Earthquakes," Earthquake Engineering Research Institute, Spectra Vol 30 Issue 3, August 2014.

California Building Code, 2022 Edition, California Building Standards Commission/International Conference of Building Officials, Whittier, California.

California Geologic Survey, CGS Regulatory Maps Geo Application, "Earthquake Zones of Required Investigation" <https://maps.conservation.ca.gov/cgs/EQZApp/app/>, 2023.

California Division of Mines and Geology, Special Publication 42, "Alquist-Priolo Special Studies Zone Act," 1972 (Revised 1988).

Campbell and Borzogna, "NGA-West2 Ground Motion Model for the Average Horizontal Components of PGA, GV and 5% Damped Linea Acceleration Response Spectra," Earthquake Engineering Research Institute, Spectra Vol 30 Issue 3, August 2014.

Chiou and Youngs, "Update of the Chiou and Youngs NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra," Earthquake Engineering Research Institute, Spectra Vol 30 Issue 3, August 2014.

Field, E.H., Biasi, G.P., Bird, P., Dawson, T.E., Felzer, K.R., Jackson, D.D., Johnson, K.M., Jordan, T.H., Madden, C., Michael, A.J., Milner, K.R., Page, M.T., Parsons, T., Powers, P.M., Shaw, B.E., Thatcher, W.R., Weldon, R.J., II, and Zeng, Y., 2013, Uniform California earthquake rupture forecast, version 3 (UCERF3) – The time-independent model: U.S. Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, <http://pubs.usgs.gov/of/2013/1165/>.

Jennings, C.W. and Bryant, W.A. (2010), "2010 Fault Activity Map of California", California Department of Conservation, California Geological Survey Geologic Data Map No. 6, <https://maps.conservation.ca.gov/cgs/fam/>

Occupational Safety and Health Administration (OSHA)(2005), Title 29 Code of Federal Regulations, Part 1926 (www.OSHA.gov).

Miller Pacific Engineering Group “Geotechnical Investigation, 1001 4th Street Development, San Rafael, California,” July 18, 2017

Miller Pacific Engineering Group “Geotechnical Investigation, Market Hall Mixed-Use Development, San Rafael, California,” July 1, 2021

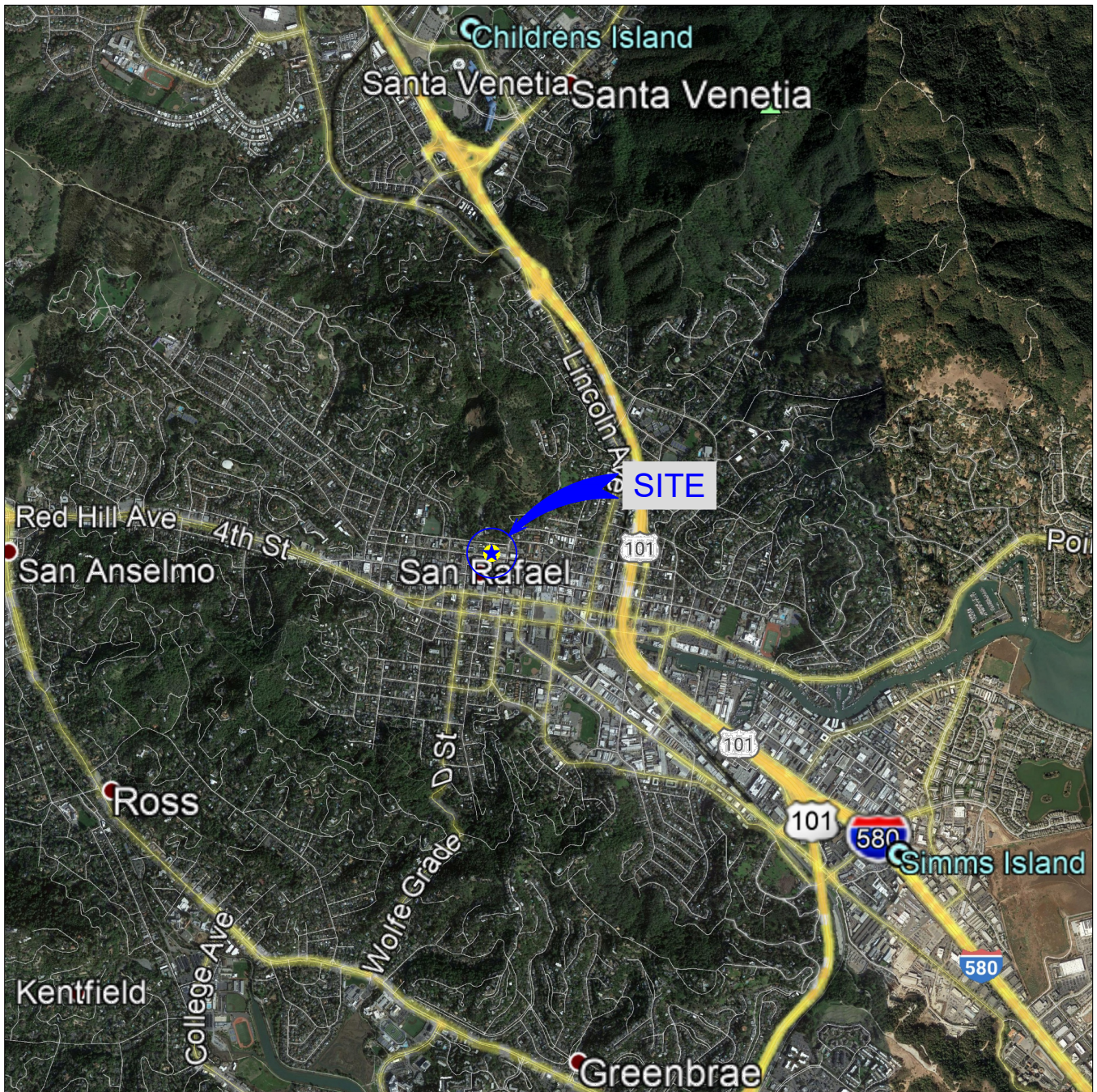
Rice, S.J., Strand, R.G. & Smith, T.C., “Geology of the Eastern Part of the San Rafael Area, Marin County, California” in “Geology for Planning in Marin County, California”, California Department of Conservation, Division of Mines and Geology Open File Report 76-222, Plate 1C, Map Scale 1:12,000, 1976.

United States Geological Survey, “Database of Potential Sources for Earthquakes Larger than Magnitude 6 in Northern California,” The Working Group on Northern California Earthquake Potential, Open File Report 96-705, 1996.

United States Geological Survey (2003), “Summary of Earthquake Probabilities in the San Francisco Bay Region, 2002 to 2032,” The 2003 Working Group on California Earthquake Probabilities, 2003.

United States Geological Survey (2013), “The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) – The Time Independent Model”, USGS Open-File Report 2013-1165, CGS Special Report 228, Southern California Earthquake Center Publication 1792.

United States Geological Survey (2018), “Unified Hazard Tool, Dynamic-Conterminous US 2014, v4.1.1” (interactive web-based probabilistic deaggregation calculator tool), <https://earthquake.usgs.gov/hazards/interactive/index.php>, accessed 2023.



SITE COORDINATES
 LAT. 37.9746°
 LON. -122.5303°

SITE LOCATION
 N.T.S.



REFERENCE: Google Earth, accessed 2023



A CALIFORNIA CORPORATION, © 2020, ALL RIGHTS RESERVED
 FILENAME: 502.307 Figures.dwg

504 Redwood Blvd.
 Suite 220
 Novato, CA 94947
 T 415 / 382-3444
 F 415 / 382-3450
 www.millerpac.com

SITE LOCATION MAP

San Rafael Landmark
 1030 3rd Street
 San Rafael, California

Project No. 502.307

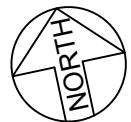
Date: 2/17/2025

Drawn _____
 BSP
 Checked _____

1
 FIGURE



SITE PLAN
(Not to Scale)



REFERENCE: GoogleEarth. Accessed 2025

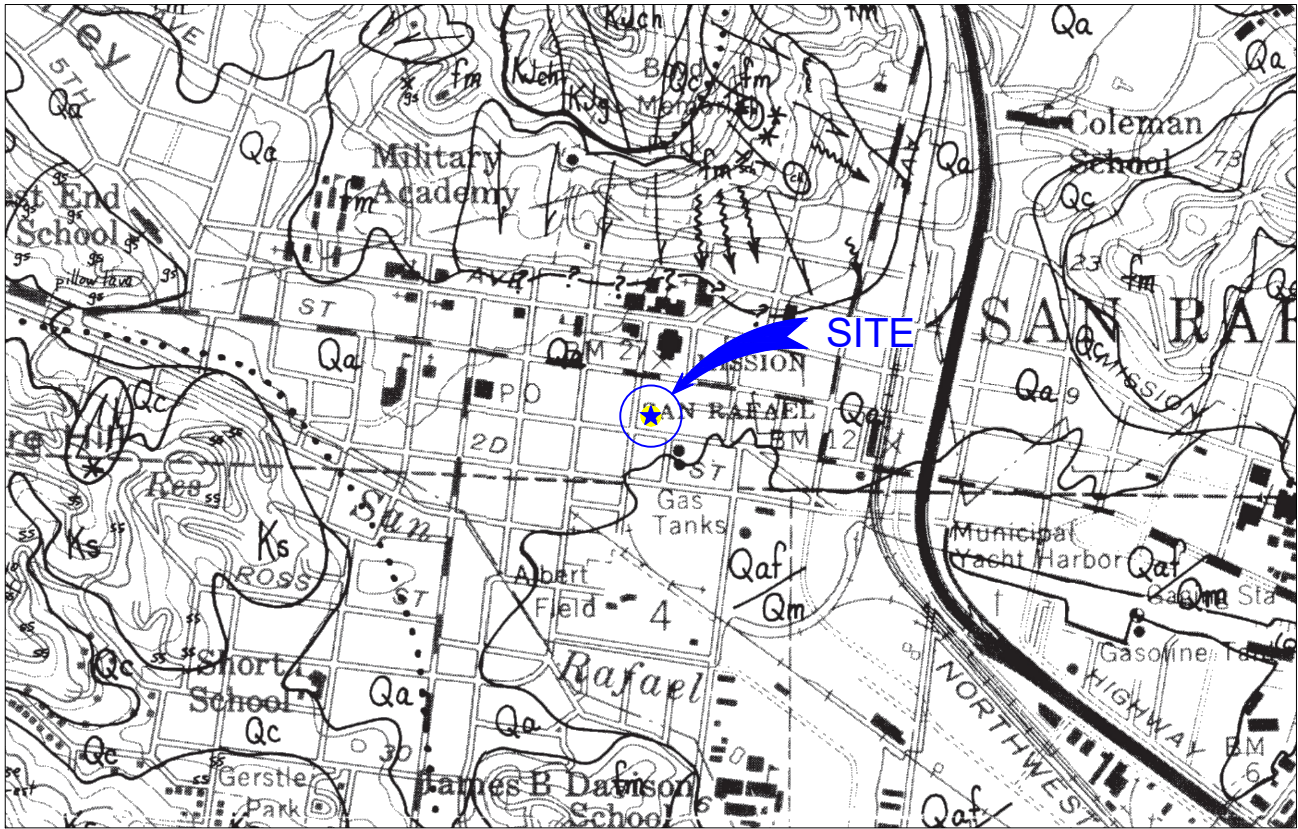
 MILLER PACIFIC ENGINEERING GROUP	504 Redwood Blvd.
	Suite 220
	Novato, CA 94947
	T 415 / 382-3444
	F 415 / 382-3450
A CALIFORNIA CORPORATION, © 2020, ALL RIGHTS RESERVED	
FILENAME: 502.307 Figures.dwg	

www.millerpac.com

SITE PLAN	
San Rafael Landmark, LLC 1030 3rd Street San Rafael, California	
Project No. 502.307	Date: 2/17/2025

Drawn	_____
Checked	BSP

2
FIGURE



REGIONAL GEOLOGIC MAP



LEGEND AND KEY TO MAP SYMBOLS

- Qc - Colluvium (Quaternary)**
Unsorted deposits of gravel, clay, sand, and silts at the base of hillsides due to the weathering process of slopes.

- Qaf/Qm - Artificial Fill over Marine and Marsh Deposits, Bay Mud (Quaternary)**
Bay Mud, including organic material, silty mud, silt, and sand, overlain by artificial fill.

- Qa - Alluvium (Quaternary)**
Unconsolidated sand, gravel, silt and clay deposited by streams.

- fm - Franciscan Melange**
Highly sheared weathered bedrock consisting of varying amounts of sandstone, siltstone, chert, greenstone and conglomerate. Intermittent competent rock is sometimes present within the weathered bedrock matrix.

- KJch - Chert (Cretaceous and Jurassic)**
Chert with shale interbeds. Chert is thin bedded, closely fractured, and parts along bedding planes.

- Ks - Sandstone and Shale (Cretaceous)**
Consists of pillow lava and less abundant tuff, breccia, and intrusive basalt, diabase, and rare gabbro.

- Geologic contact, dashed where approximate, dotted where concealed.
- Fault contact, dashed where approximate, dotted where concealed.

REFERENCE: Rice, S.J. Strand, R.G., and Smith, T.C. (1976), "Geology of the Eastern Part of the San Rafael Area, Marin County, California" in Geology of the Eastern Part of the San Rafael Area, Marin County, California", California Department of Conservation, Division of Mines and Geology Open-File Report 76-22, Plate 1C, Map Scale 1:12,000.



A CALIFORNIA CORPORATION, © 2020, ALL RIGHTS RESERVED
FILENAME: 502.307 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

REGIONAL GEOLOGIC MAP

San Rafael Landmark, LLC
1030 3rd Street
San Rafael, California

Project No. 502.307

Date: 2/17/2025

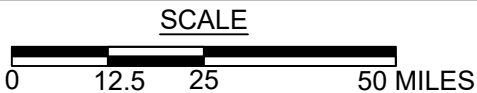
Drawn _____
BSP
Checked _____

3

FIGURE



SITE COORDINATES
LAT. 37.9746°
LON. -122.5303°



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).



**MILLER PACIFIC
ENGINEERING GROUP**

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

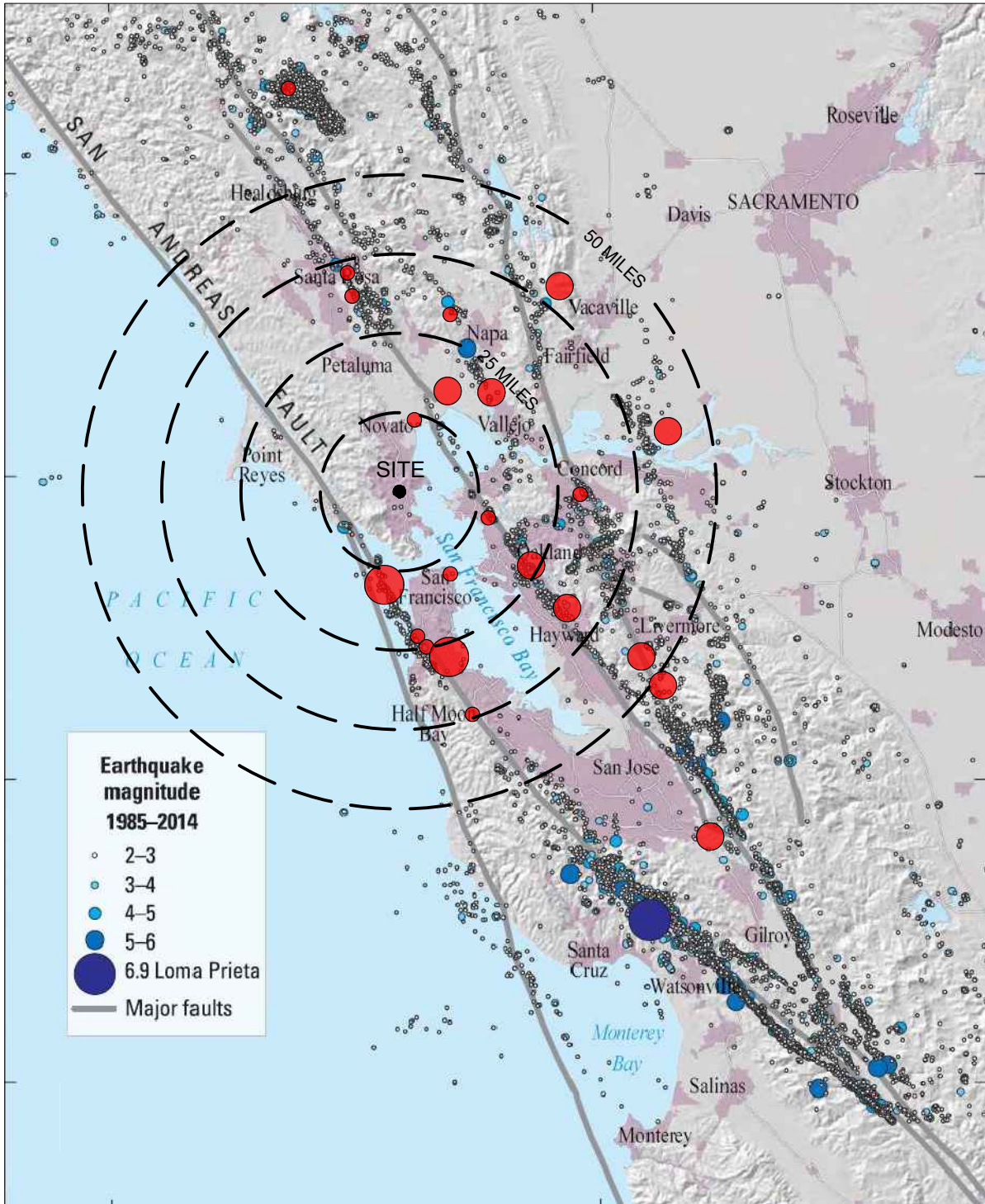
ACTIVE FAULT MAP

San Rafael Landmark, LLC
1030 3rd Street
San Rafael, California

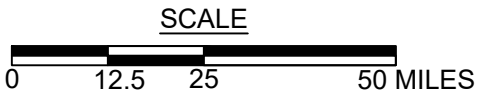
Drawn _____
Checked BSP

4

FIGURE



SITE COORDINATES
 LAT. 37.9746°
 LON. -122.5303°



LEGEND & DATA SOURCE:

- See legend above. 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).
- Large circles indicate earthquakes $M > 7.0$, medium circles indicate $6.0 < M < 7.0$ and small circles indicate $5.0 < M < 6.0$. U.S. Geological Survey, Earthquake Catalog Search, <https://earthquake.usgs.gov/earthquakes/search/>. Earthquakes between 1830 and 2021.



A CALIFORNIA CORPORATION, © 2020, ALL RIGHTS RESERVED
 FILENAME: 502.307 Figures.dwg

504 Redwood Blvd.
 Suite 220
 Novato, CA 94947
 T 415 / 382-3444
 F 415 / 382-3450
 www.millerpac.com

HISTORIC EARTHQUAKE MAP

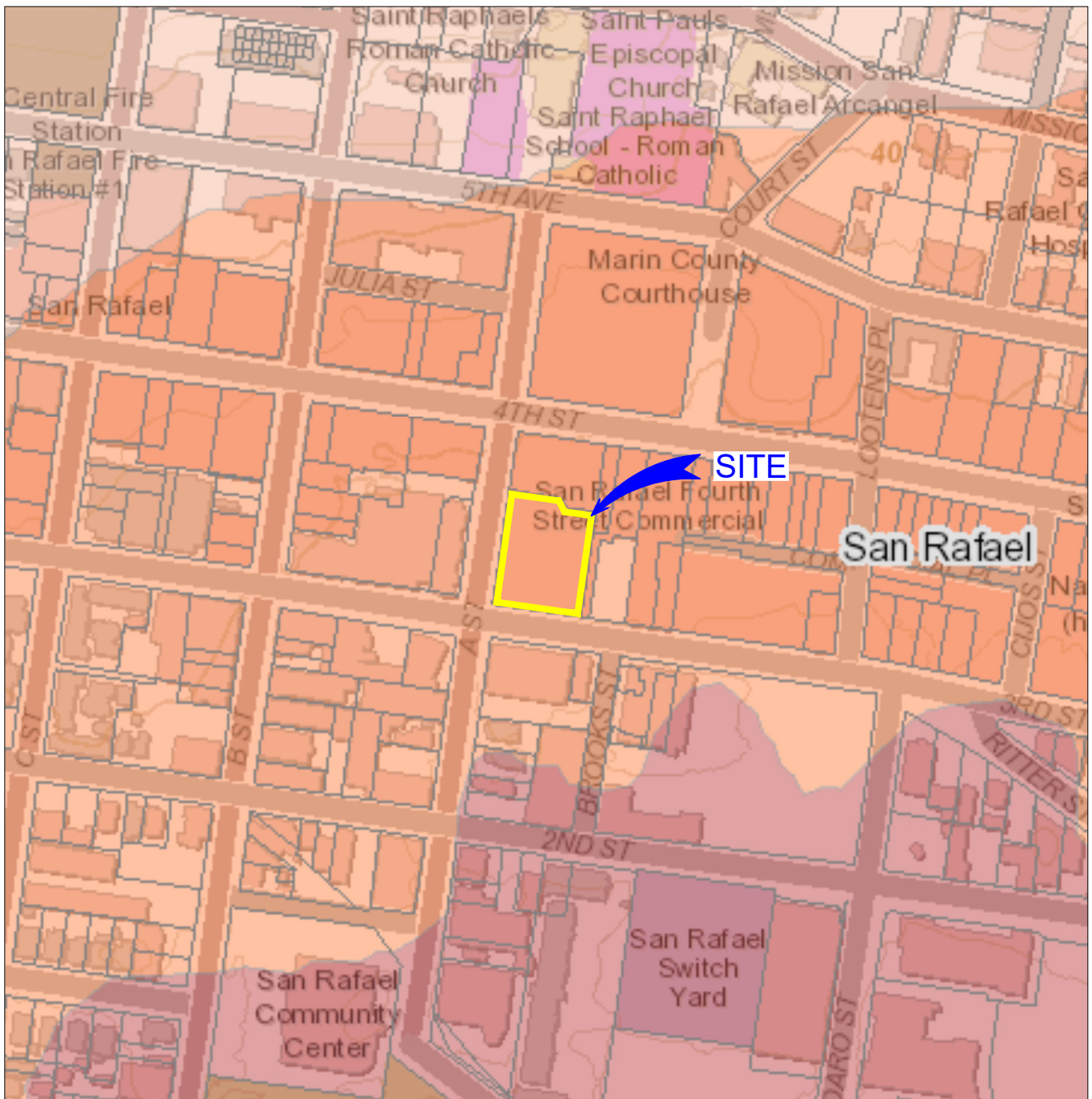
San Rafael Landmark, LLC
 1030 3rd Street
 San Rafael, California

Project No. 502.307

Date: 2/17/2025

Drawn _____
 BSP
 Checked _____

5
 FIGURE



LIQUEFACTION SUSCEPTIBILITY MAP

No Scale



Susceptibility Level:

- Very High
- High
- Moderate
- Low
- Very Low

Reference: MarinMap.org, accessed 2023

MILLER PACIFIC
ENGINEERING GROUP

A CALIFORNIA CORPORATION, © 2020, ALL RIGHTS RESERVED
FILENAME: 502.307 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

LIQUEFACTION SUSCEPTIBILITY MAP

San Rafael Landmark, LLC
1030 3rd Street
San Rafael, California

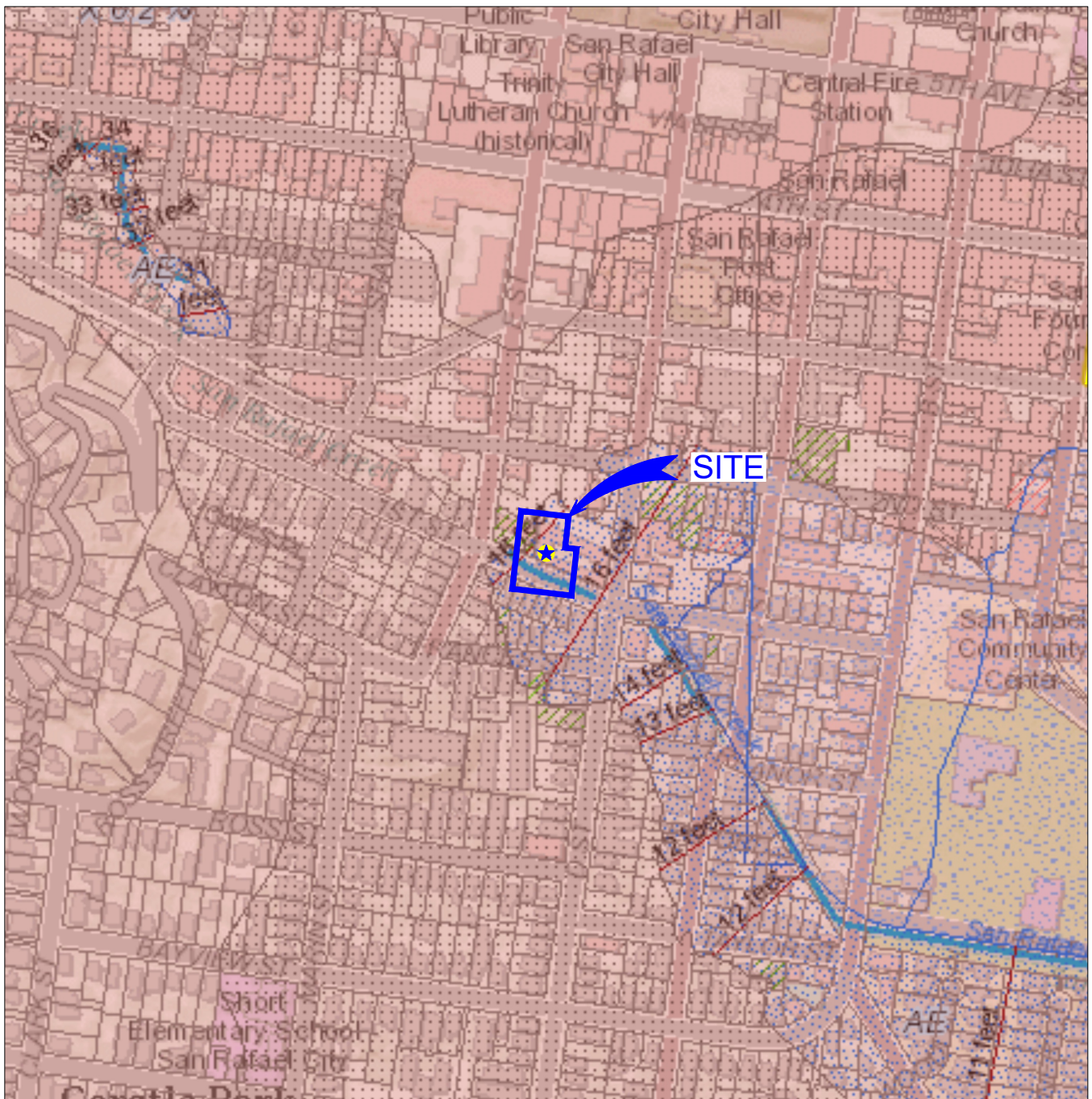
Project No. 502.307

Date: 2/17/2025

6




FIGURE

Drawn _____
BSP
Checked _____



FEMA FLOOD MAP
No Scale

FEMA Flood Hazard Legend:

-  0.2% annual chance of flooding
-  1.0% annual chance of flooding
-  1.0% annual chance of shallow flooding



Reference: MarinMap.org, accessed 2025

MPEG
MILLER PACIFIC
ENGINEERING GROUP

A CALIFORNIA CORPORATION, © 2020, ALL RIGHTS RESERVED
FILENAME: 502.307 Figures.dwg

504 Redwood Blvd.
Suite 220
Novato, CA 94947
T 415 / 382-3444
F 415 / 382-3450
www.millerpac.com

FEMA FLOOD MAP

San Rafael Landmark, LLC
1030 3rd Street
San Rafael, California

Project No. 502.307 Date: 2/17/2025

Drawn BSP
Checked _____

7
FIGURE