“F”

Geotechnical Feasibility Report
JAMCAN Tentative Parcel Map
P19-00456-TPM

GEOTECHNICAL FEASIBILITY REPORT
WATSON LANE SUBDIVISION
AMERICAN CANYON, CALIFORNIA

November 11, 2019

Job No. 2949.001

Prepared For:
Jamcan LLC
Attn: Mr. Jeffrey Jaeger
2180 Oak Knoll Avenue
Napa, California 94558

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 polychlorinated byphenols, radon, asbestos or any other hazardous materials. The document is for the sole use of the client and consultants on this project. No other use is authorized. If the project changes, or more than two years have passed since issuance of this report, the findings and recommendations must be updated.

MILLER PACIFIC ENGINEERING GROUP
(a California corporation)

REVIEWED BY:

Nathan Klemin
Civil Engineer No. 83411
(Expires 3/31/21)

Rusty Arend
Geotechnical Engineer No. 3031
(Expires 6/30/21)

504 Redwood Blvd., Suite 220 ■ Novato, California 94947 ■ T (415) 382-3444 F (415) 382-3450

MILLER PACIFIC
ENGINEERING GROUP

GEOTECHNICAL FEASIBILITY REPORT
WATSON LANE SUBDIVISION
AMERICAN CANYON, CALIFORNIA

TABLE OF CONTENTS

GEOTECHNICAL FEASIBILITY REPORT
WATSON LANE SUBDIVISION
AMERICAN CANYON, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of our geotechnical feasibility evaluation for the proposed subdivision located near the east end of Watson Lane in unincorporated Napa County. The project site is located within an approximately 537-acre property just east of American Canyon, as shown on Figure 1. The purpose of our report is to identify and address potential geotechnical and geologic issues at the project site, offer our opinion on project feasibility, prepare preliminary geotechnical design recommendations and summarize our findings in this report for use in planning, permitting, and preliminary design of the project.

Our feasibility evaluation was performed in accordance with our Agreement for Professional Services authorized October 18, 2019. Our scope of services includes the following:

- Review of readily available geologic reference information to describe geologic setting and local geologic conditions.
- A site reconnaissance to observe and document existing surface conditions throughout the project area.
- An evaluation of geologic hazards that could affect the site and preliminary recommendations to mitigate identified hazards.
- Description of other geotechnical constraints that should be addressed during project design and preliminary recommendations for probable foundation types.
- Preparation of this report which summarizes our evaluation of geologic hazards and preliminary geotechnical recommendations for design and construction.

Issuance of this report completes our initial phase of services. Future phases of work are expected to include a design-level geotechnical report with subsurface exploration and laboratory testing, supplemental geotechnical consultation and plan review, and observation and testing of geotechnical-related items during construction.

2.0 PROJECT DESCRIPTION

While the project is in the planning phase and design details are not defined, we understand the project consists of subdividing the existing 537-acre parcel (APN 059-020-041) into three separate parcels of about 160- to 190-acres each. Three residential properties of about three to five acres in size will be located in the westernmost “Parcel 1”, while the remaining two parcels will be conservation easements, as shown on the Tentative Map prepared by Terra Firm dated September 25, 2019. It is anticipated that the new buildings will be up to two stories in height, wood-framed and will induce relatively light foundation loads. Ancillary improvements may include site grading, new driveways and parking areas, exterior hardscape, underground utilities, site drainage, landscaping and other improvements typical of such developments. The proposed project area is shown on the Site Plan, Figure 2.

3.0 SITE CONDITIONS

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 landsliding and erosion owing in part to its typically high levels of precipitation and seismic activity.

The oldest rocks in Napa County are the sedimentary, igneous, and metamorphic rocks of the Mesozoic-age (225- to 65-million years old) Franciscan Assemblage. Within Napa County, Franciscan rocks are in fault contact with marine sedimentary rocks of the Great Valley Sequence, which are of similar age. Locally, 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 overlie the basement rocks of the Franciscan Assemblage and Great Valley Sequence. The late Miocene to Pliocene-age (approximately 2.6- to 11.6-million years old) Sonoma Volcanics comprise the majority of these rocks.

The project site is located within moderately to steeply sloping terrain south of Highway 12 and east of Highway 29. Regional geologic mapping by the California Geological Survey (CGS, 1998) indicates the majority of the project site is underlain by Eocene-age sandstone of the Markley Formation. This unit is generally described as yellow-brown, marine sandstone and well-bedded to laminated, light yellow to white, chalky shale. Several mapped landslides are shown in the eastern portion of the 537-acre site, several hundred feet east of the proposed development areas. An unnamed fault is also mapped as traversing the central portion of the property. A Regional Geologic Map and descriptions of the mapped geologic units are shown on Figure 3.

3.2 Seismicity

The project site is located within the seismically active San Francisco Bay Area and will therefore experience the effects of future earthquakes. Earthquakes are the product of the build-up and sudden release of strain along a “fault” or zone of weakness in the earth's crust. Stored energy may be released as soon as it is generated or it may be accumulated and stored for long periods of time. Individual releases may be so small that they are detected only by sensitive instruments, or they may be violent enough to cause destruction over vast areas.

Faults are seldom single cracks in the earth's crust but are typically comprised of localized shear zones which link together to form larger fault zones. Within the Bay Area, faults are concentrated along the San Andreas Fault zone. The movement between rock formations along either side of a fault may be horizontal, vertical, or a combination and is radiated outward in the form of energy waves. The amplitude and frequency of earthquake ground motions partially depends on the material through which it is moving. The earthquake force is transmitted through hard rock in short, rapid vibrations, while this energy becomes a long, high-amplitude motion when moving through soft ground materials, such as Bay Mud.

3.2.1 Regional Active Faults

The California Geological Survey (previously known as the California Division of Mines and Geology), defines a "Holocene-active fault" as one that has had surface displacement within Holocene time (the last 11,700 years). CGS has mapped various faults in the region as part of their Fault Activity Map of California (CGS, 2010). Many of these faults are shown in relation to the project site on the attached Active Fault Map, Figure 4. The nearest known Holocene-active faults are the West Napa Fault and the Contra Costa Shear Zone. The West Napa Fault is located roughly 2.1 kilometers (1.3 miles) southwest of the site, while the Contra Costa Shear Zone is located approximately 4.2 kilometers (2.6 miles) to the south[1].

3.2.2 Historic Fault Activity

Numerous earthquakes have occurred in the region within historic times. The results of our USGS earthquake catalog search indicates that at least 14 earthquakes (Richter Magnitude 5.0 or larger) have occurred within 100 kilometers (62 miles) of the site between 1900 and 2019. The approximate locations of earthquakes which occurred between 1985 and 2014 are shown on the Historic Earthquake Map, Figure 5.

3.2.3 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, 2013) 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.

Conclusions from the most recent UCERF3 and USGS indicate the highest probability of an earthquake with a magnitude greater than 6.7 originating on any of the active faults in the San Francisco Bay region by 2043 is assigned to the Hayward/Rodgers Creek Fault system. The Rodgers Creek Fault is located approximately 17.7 kilometers (11.0 miles)

[1] Distances to faults estimated using Caltrans ARS Online (v2.3.09), accessed November 5, 2019.

southwest of the site and is assigned a probability of 33 percent. The West Napa Fault is located approximately 2.1 kilometers (1.3 miles) southwest of the site and is assigned a two percent probability of an earthquake with a magnitude greater than 6.7 by 2043. The West Napa Fault was most recently active in August 2014 and generated a magnitude 6.0 earthquake. 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

We performed a site reconnaissance on November 5, 2019 to observe and document surface conditions within the proposed home sites. “Home Site 1” comprises the irregularly shaped, five-acre site within the northwestern corner of the proposed Parcel 1. The home site is located mainly within currently planted vineyards, as shown on Figure 2. Elevations within this site range from approximately 150 to 250 feet above sea level[2]. The site is located on a topographic “nose” with the ground surface generally sloping downwards from the east to the west. Slopes within the proposed home site are as steep as about 2:1 (horizontal:vertical) and generally become less steep moving west. Areas upslope/east of the home site appear to be inclined as steeply as 1.5:1. Two small landslides were observed on the slopes directly east of the proposed home site while another small slide was observed on the slopes to the south. Five test pits were previously excavated by others toward the southeastern portion of the home site. The test pits expose approximately two- to four-feet of clayey soils over sandstone bedrock. Some desiccation cracking was observed within the surface soils.

“Home Site 2” comprises the square-shaped, five-acre building site toward the southwestern portion of the proposed Parcel 1, as shown on Figure 2. Elevations within this site range from approximately 250 to 350 feet above sea level. The ground surface is sloping with inclinations of about 3:1 in the northeastern portion of the home site, and as steep as about 2:1 in the western portion. A natural drainage swale extends westward through the center portion of the proposed building area. Six test pits were previously excavated by others in the western portion of the home site. The pits expose approximately two to three feet of clayey surface soils over sandstone bedrock. Some desiccation cracking was observed within the soil cover.

“Home Site 3” comprises the rectangular-shaped, three-acre building site within the southeastern corner of the proposed Parcel 1. The site is located mainly within currently planted vineyards, as shown on Figure 2. Surface elevations range from approximately 500 to 600 feet above sea level. The site is also located on a topographic “nose” with the ground surface generally sloping downwards from the east to the west. The ground surface is relatively level within the existing vineyard area near the center of proposed home site. Slopes in the adjacent areas are as steep as about 2:1 (horizontal:vertical). A small landslide was noted just east of the proposed home site. Four pits were previously excavated by others toward the northern of the home site. The pits expose approximately two to three feet of clayey soils over shale bedrock.

---

[2] Elevations referenced herein are based on those shown on the Napa County GIS website (www.gis.napa.ca.gov), accessed on November 5, 2019.

4.0 GEOLOGIC HAZARDS

This section summarizes our review of commonly considered geologic hazards, discusses their potential impacts on the proposed improvements, and identifies preliminary mitigation options. The primary geologic hazards which could affect the proposed development are slope instability, expansive soils and strong ground shaking during future seismic events. Other geologic hazards are judged relatively insignificant with regard to the proposed project. Each geologic hazard considered is discussed in further detail in the following paragraphs.

4.1 Fault Surface Rupture

Under the Alquist-Priolo Earthquake Fault Zoning Act, the California Division of Mines and Geology (now known as the California Geological Survey) produced 1:24,000 scale maps showing known active and potentially active faults and defining zones within which special fault studies are required. The nearest Alquist-Priolo Earthquake Fault Zone is associated with the West Napa Fault which is located approximately 2.1 kilometers (1.3 miles) to the southwest. Based on currently available published geologic information, the site is not located within an Alquist-Priolo Earthquake Fault Zone, as shown on Figure 6. We therefore judge the potential for fault surface rupture in the development area to be low.

Evaluation: *Less than significant.*
Mitigation: *No mitigation measures are anticipated.*

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 (PGA) are based on either deterministic or probabilistic methods. Deterministic methods are typically used in estimating the peak ground acceleration for residential developments.

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, and probable peak ground accelerations are summarized in Table 1.

Table 1 – Estimated Peak Ground Accelerations for Principal Active Faults

Fault	Moment Magnitude for Characteristic Earthquake	Closest Estimated Distance (km)	Median PGA (g)	Median PGA + 1 Std Dev (g)
West Napa	6.6	2.1	0.48	0.81
Contra Costa Shear	6.5	4.2	0.40	0.67
Green Valley	6.8	7.8	0.31	0.52
Cordelia	6.5	9.7	0.25	0.42
Rodgers Creek	7.3	17.7	0.20	0.33

Reference: Campbell & Bozorgnia, and Chiou & Youngs, 2008 using V_{s30} = 560 m/s.

The calculated bedrock accelerations should only be considered as reasonable estimates. Many factors (soil conditions, orientation to the fault, etc.) can influence the actual ground surface accelerations. 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 (2016 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 its proximity and historic rate of activity, the West Napa Fault presents 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.*
Mitigation: *Minimum mitigation includes design of new structures in accordance with the provisions of the 2016 California Building Code or subsequent codes in effect when final design occurs.*

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 flow failure which cause large settlements and lateral ground movements. Lateral spreading refers to a specific type of liquefaction-induced ground failure characterized primarily by horizontal displacement of surficial soil layers as a consequence of liquefaction of a subsurface granular layer (Youd, 1995). Lateral spreads generally move down gentle slopes or slip toward a free face such as an incised river channel.

Regional liquefaction hazard maps indicate the site is mapped within a zone of "low" susceptibility to liquefaction (Association of Bay Area Governments, 2019). The site is underlain by clayey soils over relatively shallow bedrock. Therefore, we judge there is generally a low risk of liquefaction during future seismic events.

Evaluation: *Less than significant.*
Mitigation: *No mitigation measures are anticipated.*

4.4 Seismic Densification

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. Varying degrees of settlement can occur throughout a deposit, resulting in differential settlement of structures founded on such deposits. The shallow test pits exposed clayey near-surface and bedrock is relatively shallow. Therefore, we judge the likelihood of seismically-induced settlement is low .

Evaluation: *Less than significant.*
Mitigation: *No mitigation measures are anticipated.*

4.5 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, uneven floors, and cracked slabs. Flatwork, pavements, and concrete slabs-on-grade are particularly vulnerable to distress due to their low bearing pressures.

Based on our site reconnaissance and experiences at nearby sites, near-surface soils in the area are typically fine-grained and of moderate to high plasticity. We observed desiccation cracking in soils exposed in the test pits that were excavated previously by others. Additionally, we observed several small landslides on the slopes near Home Sites 1 and 3 which may be related to creep of near-surface soils. These features suggest near-surface soils likely exhibit a moderate to high expansion potential. Therefore, we judge the risk of damage due to expansive soils at the site is moderate to high.

Evaluation: *Less than significant with mitigation.*
Mitigation: *The expansion potential of near-surface soils should be evaluated based upon subsurface exploration and laboratory testing performed as part of a future design-level investigation. We anticipate that mitigation measures will likely include supporting new structures on a rigid foundation system (e.g. mat slab, post-*

tensioned slabs or similar) and designing retaining walls and other improvements to accommodate potential seasonal movements. Replacing expansive soils with non-expansive fill below new building areas or improving the soils with lime and/or cement may also be considered as potential mitigation alternatives. Additionally, soils should be moisture conditioned to slightly above the optimum moisture content during site grading and maintained at this moisture content until imported aggregate base and/or surface flatwork is completed to "seal" in the higher moisture content and therefore reduce future expansive potential.

4.6 Settlement

Significant settlement can occur when new loads are placed over soft, compressible clays, loose soils or across cut-to-fill transitions. While the proposed building areas appear to be underlain by shallow bedrock, site grading may include a combination of cutting and filling to create a level building pad. Non-uniform subsurface conditions will exist where new structures cross cut/fill transitions. We also anticipate that loose soils may be encountered within the existing vineyard areas near Home Sites 1 and 3 as the upper few feet of soils within vineyard areas are often ripped and loosened to facilitate planting. Therefore, we judge the risk of damage due to settlement is moderate if the new structures are sited across a cut/fill transition or within the former vineyard areas.

Evaluation: *Less than significant with mitigation.*
Mitigation: *To reduce the magnitude of potential settlements, planned fill thicknesses could be minimized and/or fill materials can be compacted to higher levels of relative compaction. The risk of damage due to settlement may be further reduced by siting new structures entirely within cut areas such that they bear uniformly on firm, native materials, or by stiffening or deepening the foundation system. The upper few feet of soils within areas previously or currently planted with vineyards should be over-excavated and recompacted.*

4.7 Erosion

Sandy soils on most 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.

Construction of the proposed improvements will require grading and changes to existing surface drainage patterns which, if not properly addressed during design and construction, could lead to concentrated surface water flows and increased erosion. Considering the sloping terrain that surrounds the project site, and the disturbance to existing vegetation and drainage patterns that may result from site grading, we judge the risk of damage to improvements due to erosion is moderate to high.

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 or Architect is responsible for designing the site drainage system. An erosion control plan should be developed prior to construction per the current guidelines of the Napa Countywide Stormwater Pollution Prevention Program (NCSPPP).

4.8 Flooding

The project site is located at elevations ranging from about 150 to 600 feet above sea level and is not mapped within a FEMA-designated Special Flood Hazard Area (Federal Emergency Management Agency, 2015). Therefore, large scale flooding is not considered a significant hazard at the project site. The project Civil Engineer or Architect is responsible for site drainage and should evaluate localized flooding potential and provide appropriate mitigation measures.

Evaluation: *Less than significant.*
Mitigation: *No mitigation measures are anticipated.*

4.9 Slope Instability/Landsliding

Slope instability generally occurs on relatively steep slopes and/or on slopes underlain by weak materials. The proposed home sites are located on sloping terrain inclined as steeply as about 2:1 within the building areas and locally steeper beyond. The existing test pits indicate the sites are underlain by clayey soils over shallow sandstone and shale bedrock. Previous geologic mapping indicates the presence of several landslides east of the proposed home sites. We also observed several scarps along the slopes near Home Sites 1 and 3, as well as in other areas of the property. Based on our site reconnaissance and review of regional geologic mapping, we anticipate the risk of damage to the planned improvements due to slope instability is moderate to high. Once the locations of buildings and related improvements are determined, supplemental subsurface exploration and laboratory testing will be required for final design of landslide mitigation measures.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Mitigation measures for slope instability are expected to include a combination of avoidance/minimum building setbacks, surface and subsurface drainage improvements, landslide improvements and landslide repairs. As project design advances and the locations of buildings and other improvements are determined, additional subsurface exploration, laboratory testing and slope stability analyses should be performed to confirm existing and proposed slopes will have adequate factors of safety against slope instability.*

5.0 CONCLUSIONS AND PRELIMINARY RECOMMENDATIONS

Based on our site reconnaissance and review of available data, we judge that the proposed development is feasible from a geotechnical standpoint. Primary geologic and geotechnical considerations for the project will include: incorporating appropriate mitigation measures for landslides and expansive soils; providing proper foundation design for the new residences, retaining walls, and other structures; and designing new structures to resist strong seismic shaking. Additional discussion and recommendations addressing these and other considerations are presented in the following sections.

Recommendations are provided below to aid in planning and preliminary design for the project. As project planning advances, we must perform a design-level Geotechnical Investigation which includes subsurface exploration and laboratory testing. The results of our design-level investigation will be used to provide site-specific recommendations for the project.

5.1 Preliminary Seismic Design

Minimum mitigation of ground shaking includes seismic design of new structures in conformance with the provisions of the most recent edition (2016) of the California Building Code. The magnitude and character of these ground motions will depend on the particular earthquake and the site response characteristics. Based on the anticipated subsurface conditions and close proximity of several nearby faults, we recommend the preliminary CBC coefficients and site values shown in Table 2 be used to calculate the design base shear of the new construction. The preliminary CBC coefficients should be confirmed based upon the results of future subsurface exploration.

Table 2 – Preliminary 2016 California Building Code Seismic Design Criteria

Parameter	Design Value
Site Class	C
Site Latitude	38.192°N
Site Longitude	-122.242°W
Spectral Response (short), S_S	2.063 g
Spectral Response (1-sec), S_1	0.736 g
Site Coefficient, F_a	1.0
Site Coefficient, F_V	1.3
Spectral Response (Short), S_{MS}	2.063 g
Spectral Response (1 sec), S_{M1}	0.957 g
Design Spectral Response (short), S_{DS}	1.375 g
Design Spectral Response (1 sec), S_{D1}	0.638 g
MCE_G PGA Adjusted, PGA_M	0.72 g

Reference: SEA/OSHPD US Seismic Design Maps web application, accessed on November 6, 2019.

5.2 Preliminary Grading Considerations

While preliminary grading plans have not yet been developed, site grading is generally expected to include cuts and fills of a few feet or less to create level building pads for the new structures, to construct new driveways and parking areas, and to develop appropriate surface drainage patterns. We anticipate the majority of site grading can be performed with standard grading equipment, such as medium-size dozers, excavators, and rollers.

Specialized grading measures may be required if future subsurface exploration and laboratory testing indicate near-surface soils are expansive. Within building areas, we anticipate this would include either removing the expansive soils and replacing with non-expansive fill, using a relatively rigid post-tensioned or mat slab foundation system, or treating the soils with lime or cement to reduce the potential for expansion. In driveways and parking areas, we anticipate that relatively thick pavement sections would be required and/or the soils would be treated with lime or cement to provide additional strength and reduce the expansion potential of the underlying subgrade.

Home Sites 1 and 3 are currently planted with vineyards. Vineyards are often underlain by loose, tilled soils in the upper few feet to facilitate vineyard growth. If new improvements are planned within current or previously planted vineyard areas, these soils should be over-excavated, and recompacted to reduce potential settlements from new loads. Site grading criteria will be provided as part of a future design-level geotechnical investigation.

5.3 Potential Foundation Alternatives

While the building structural types are unknown at this time, we anticipate wood-framing will be selected which will induce relatively light foundation loads. If near-surface soils are characterized as expansive, foundation systems for the new structures may include a relatively rigid post-tensioned or mat slab. Relatively rigid, interconnected spread footings with slabs-on-grade or raised floors may also be appropriate provided that expansive soils are replaced with non-expansive fill or treated with lime or cement, and load-induced settlements are within acceptable limits. If structures are planned on cut/fill pads, drilled pier foundations should be considered to reduce the potential for differential movement. Subsurface exploration and laboratory testing along with further evaluation of proposed building layouts, structural loads, and load-induced building settlements will be necessary prior to selecting a preferred foundation system. Foundation design criteria will be provided as part of a future design-level geotechnical investigation.

6.0 SUPPLEMENTAL GEOTECHNICAL SERVICES

This report provides preliminary geotechnical and geological information and is therefore suitable for planning purposes only. Detailed geotechnical exploration, testing and engineering analysis will be required to develop design-level geotechnical criteria and recommendations for project design. We should consult with the project professionals during design. When the project improvement plans have been prepared, we must review the documents to confirm that the intent of our recommendations has been understood and incorporated. Supplemental recommendations can be prepared during the design phase as needed.

During construction, we must inspect geotechnical items relating to site grading, retaining walls, pavements and construction of new building foundations. We should observe foundation excavations, subgrade preparation and compaction, retaining wall drainage and backfill and other geotechnical-related work items.

7.0 LIMITATIONS

We believe 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 Jamcan 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 site reconnaissance and our experience with soils in this geographic area. Our approved scope of work did not include subsurface exploration, laboratory testing or a detailed environmental assessment of the site. Consequently, this report does not contain information regarding the presence or absence of toxic or hazardous wastes.

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

American Society of Civil Engineers (ASCE) (2010), "Minimum Design Loads for Buildings and Other Structures" (2010 ASCE-7), Structural Engineering Institute of the American Society of Civil Engineers.

American Society for Testing and Materials, (2009) "2009 Annual Book of ASTM Standards, Section 4, Construction, Volume 4.08, Soil and Rock; Dimension Stone; Geosynthetics," ASTM, Philadelphia.

California Building Code, 2016 Edition, California Building Standards Commission/International Conference of Building Officials, Whittier, California.

California Department of Conservation, Division of Mines and Geology (1972), Special Publication 42, "Alquist-Priolo Special Studies Zone Act," (Revised 2018).

California Department of Conservation, Division of Mines and Geology (2000), "Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Central Coast Region", DMG CD 2000-004.

California Department of Transportation (Caltrans) (2015), 2015 Standard Specifications.

California Department of Conservation (Caltrans) (2015), "Caltrans ARS Online, V 2.3.06" (web-based deterministic acceleration response spectra calculator tool), http://dap3.dot.ca.gov/ARS_Online/, accessed November 4, 2019.

California Geological Survey, "Geologic Map of the Cordelia 7.5' Quadrangle, Solano and Napa Counties, California", 1998, scale 1:24,000.

California Geological Survey, "Fault Activity Map of California" (http://maps.conservation.ca.gov), 2002

Federal Emergency Management Agency (FEMA), "Flood Insurance Rate Map, Napa County, California and Incorporated Areas, Panel 650 of 650 (Map Number 06055C0650E)", dated September 26, 2008

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

Youd, T.L. "Liquefaction-Induced Lateral Ground Displacement" (April 2, 1995). *International Conferences on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics.* Paper 3.

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 (2008), “The Uniform California Earthquake Rupture Forecast, Version 2,” The 2007 Working Group on California Earthquake Probabilities, Open File Report 2007-1437, 2008.

SITE COORDINATES
LAT. 38.1916°
LON. -122.2422°

SITE LOCATION

(NO SCALE)

NORTH

REFERENCE: Google Earth, 2019

MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2949.001 Figures.dwg

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

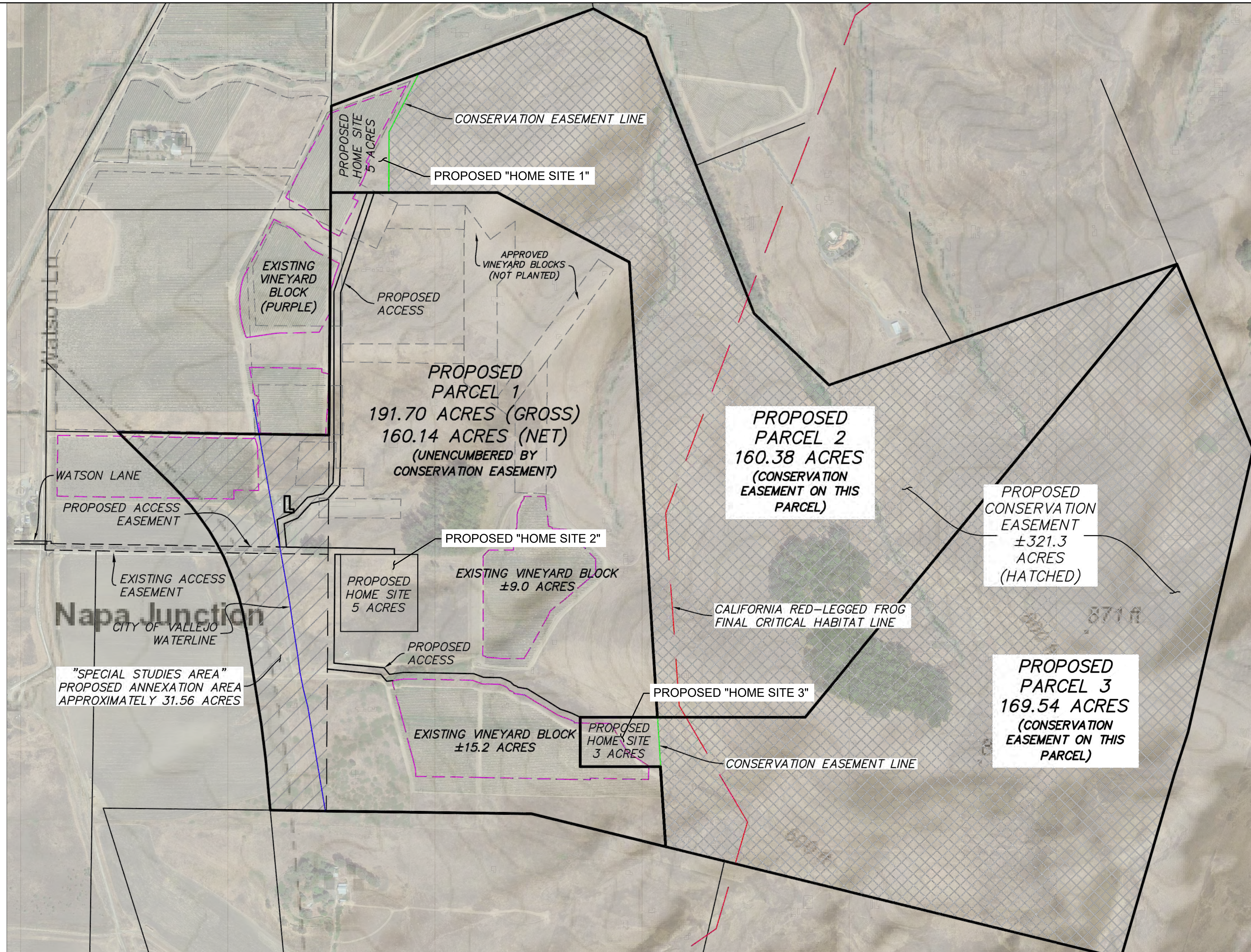
SITE LOCATION MAP

Watson Lane Subdivision
APN 059-020-041
American Canyon, California

Project No. 2949.001 Date: 11/6/2019

Drawn NGK
Checked

1
FIGURE



REFERENCES:

1. Aerial Imagery by Google Earth, 2019
2. Topographic Map by Napa County GIS, 2019
3. Tentative Map by Terra Firma, 9/25/19

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

FILE: 2949.001 Figures.dwg

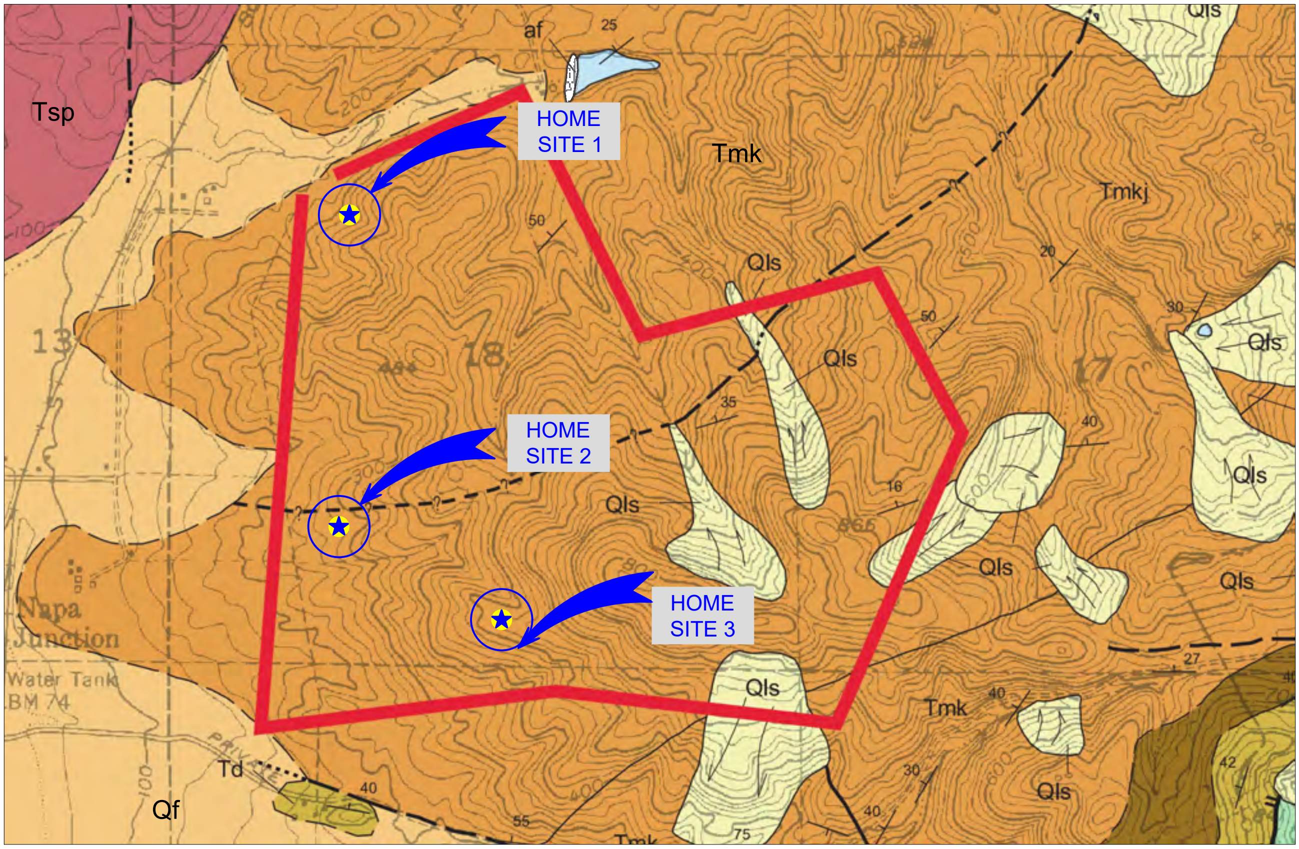
SITE PLAN

Watson Lane Subdivision
APN 059-020-041
American Canyon, California

Project No. 2949.001 Date: 8/3/2016

Designed RCA
Drawn NGK
Checked RCA

2
FIGURE



REGIONAL GEOLOGIC MAP

(NO SCALE)

NORTH

LEGEND:

Qf **Alluvial Fan Deposits (Late Pleistocene to Holocene) -** Gently sloping, fan-shaped, relatively undissected alluvial surfaces with sediments including poorly sorted and moderately to poorly bedded sand, gravel, silt, and clay.

Qls **Landslide Deposits (Holocene and Pleistocene) -** Soil and rock fragments transported downslope by gravitational forces. Arrows indicate direction.

Tsp **San Pablo Group (Miocene) -** Brown, gray, and white marine sandstone and minor conglomerates.

Tmk **Markley Formation (Eocene) -** Gray to yellow-brown, massive to well-bedded marine sandstone.

Tmkj **Markley Formation (Eocene) -** Light yellow to white, well bedded to laminated chalky shale.

Td **Domengine Formation (Eocene) -** Light gray to light brown sandstone, commonly cross-bedded with minor shale and conglomerate.

——— – –?– · ·?· · Contact; solid where well located; dashed where approximately located or inferred; dotted where concealed; queried where uncertain.

– – ? – ••?•• Fault; solid where certainly located; dashed where approximately located or inferred; dotted where concealed; queried where existence or continuation is uncertain. Arrows show direction of dip when known.

MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2949.001 Figures.dwg

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

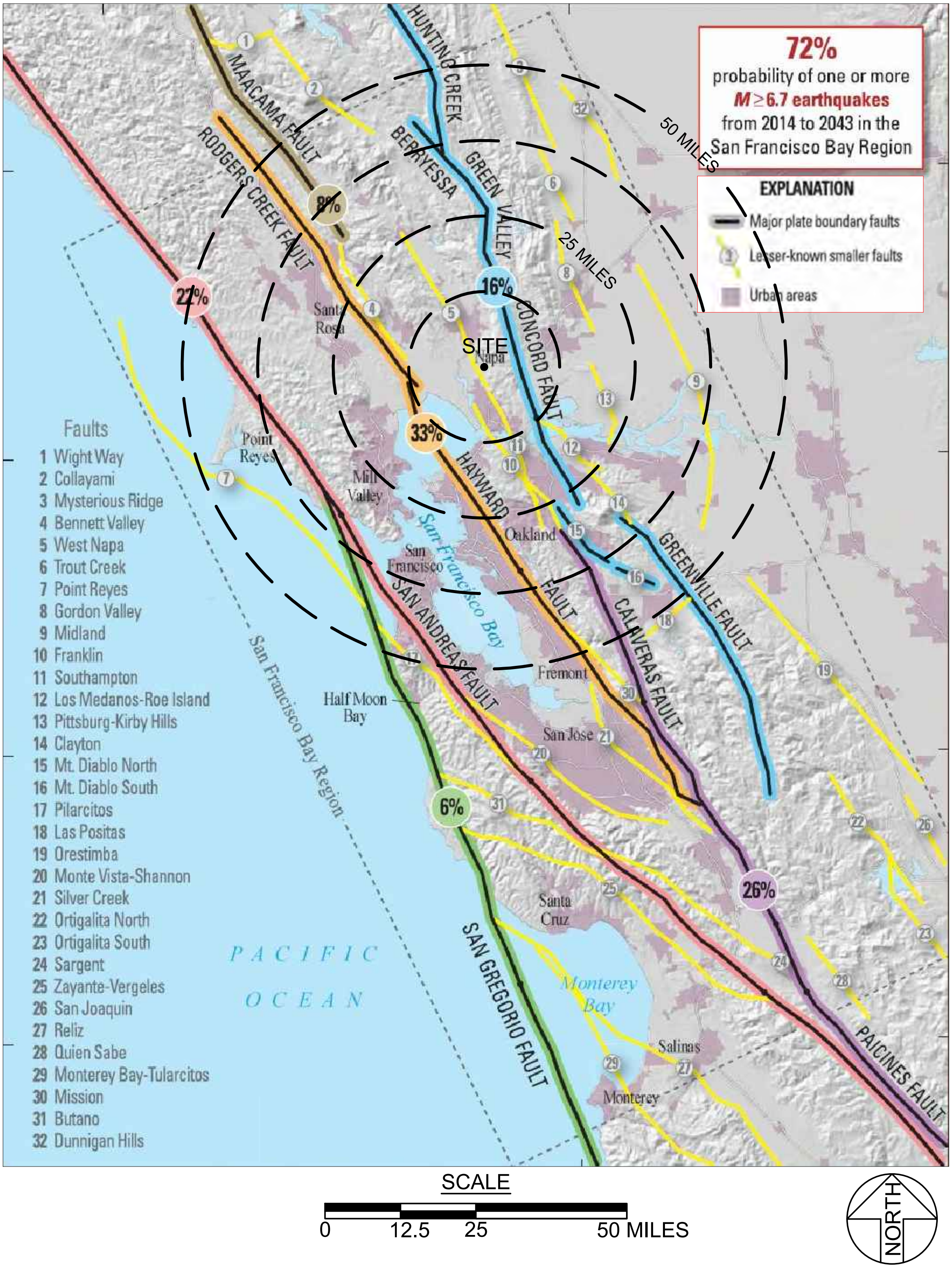
REGIONAL GEOLOGIC MAP

Watson Lane Subdivision
APN 059-020-041
American Canyon, California

Project No. 2949.001 Date: 11/6/2019

Drawn NGK
Checked

3
FIGURE



MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2949.001 Figures.dwg

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

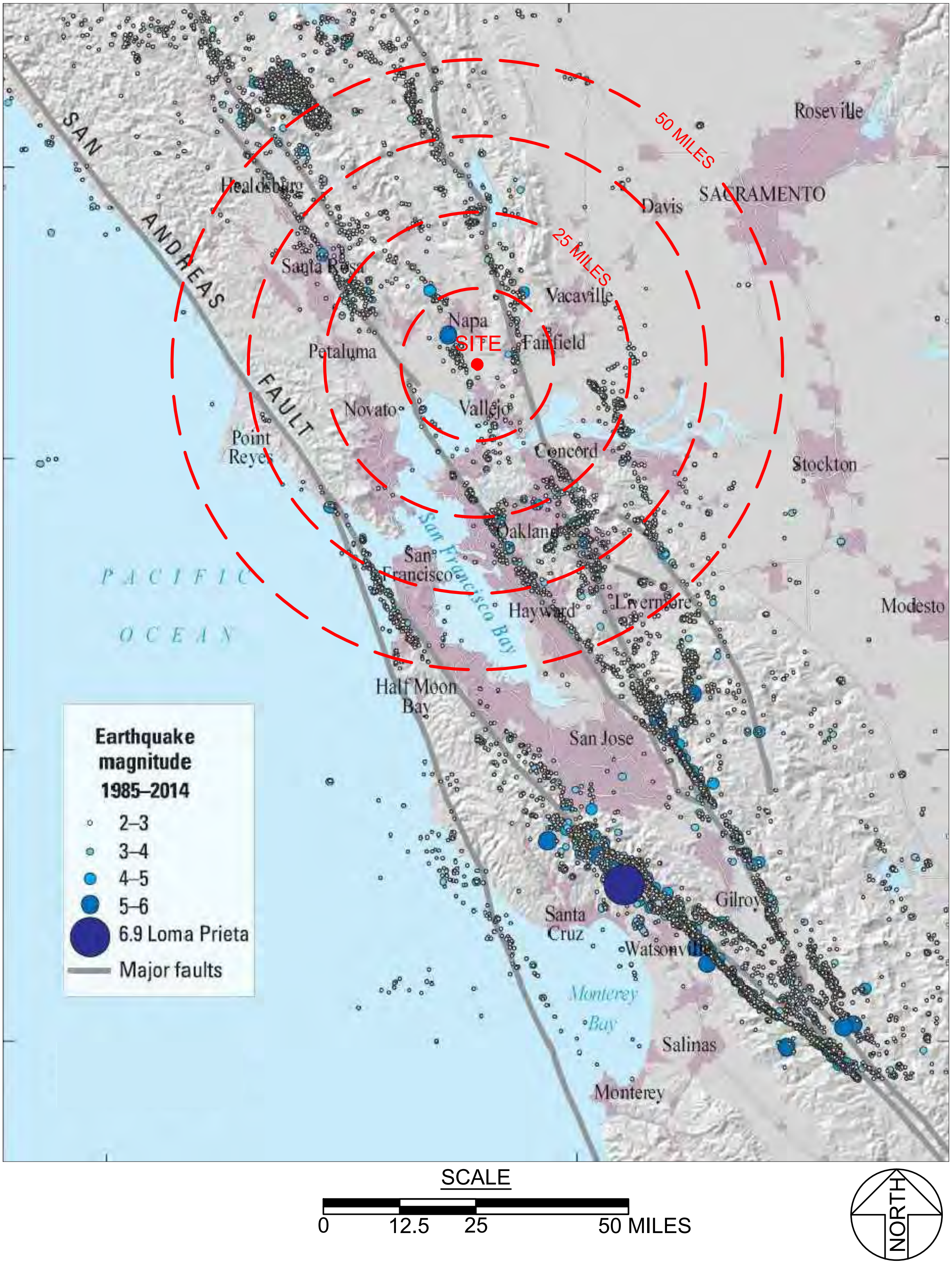
ACTIVE FAULT MAP

Watson Lane Subdivision
APN 059-020-041
American Canyon, California

Project No. 2949.001 Date: 11/6/2019

Drawn NGK
Checked

4
FIGURE



MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2949.001 Figures.dwg

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

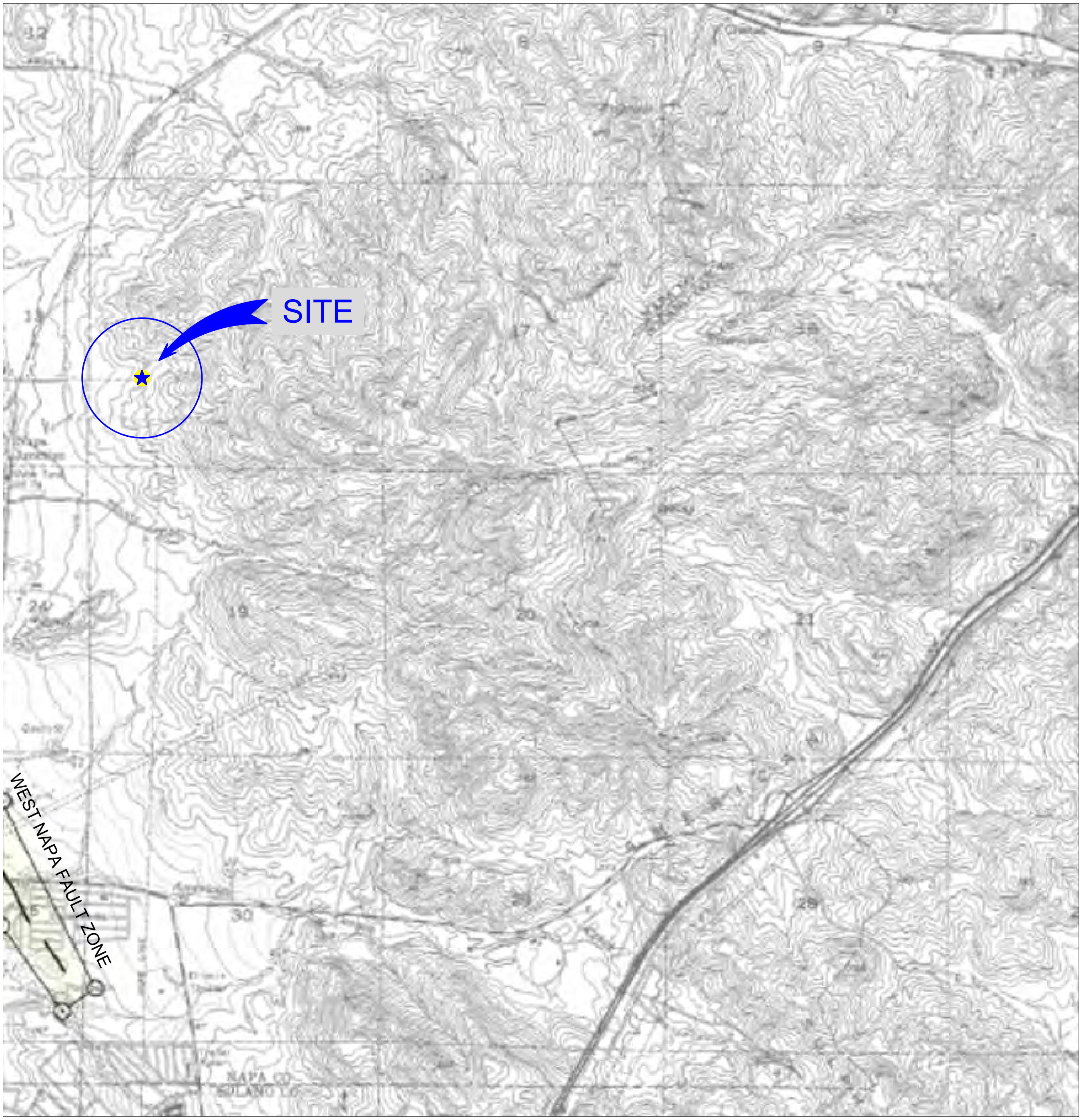
HISTORIC EARTHQUAKE ACTIVITY MAP

Watson Lane Subdivision
APN 059-020-041
American Canyon, California

Project No. 2949.001 Date: 11/6/2019

Drawn NGK
Checked

5
FIGURE



ALQUIST-PRIOLO SPECIAL STUDIES ZONE

(NO SCALE)

NORTH

LEGEND:

— — ········ Fault Trace - Long dash where approximate, dotted where concealed.

Alquist-Priolo Special Studies Zone

REFERENCE: Davis, James F., "State of California Special Studies Zones, Cordelia Quadrangle," California Department of Conservation, California Department of Mines and Geology, July 1, 1993, Scale 1:24,000.

MPEG MILLER PACIFIC ENGINEERING GROUP

FILENAME: 2949.001 Figures.dwg

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

ALQUIST-PRIOLO SPECIAL STUDIES ZONES

Watson Lane Subdivision
APN 059-020-041
American Canyon, California

Project No. 2949.001 Date: 11/6/2019

Drawn NGK
Checked

6
FIGURE