APPENDIX R

GEOTECHNICAL/GEOLOGIC FEASIBILITY MEMORANDUM

TECHNICAL MEMORANDUM

To: Mr. Thomas Bors
Suncal Companies

Date: August 16, 2019
Revised September 19, 2019

Project No.: 7102.000.000

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Project Name: Point Molate, Richmond, California

Subject: **GEOTECHNICAL/GEOLOGIC FEASIBILITY MEMORANDUM**

This memorandum is intended to discuss mapped and known geohazards that may be present on the Point Molate project in Richmond, California. The information presented here in based on published maps, reports and other readily available resources, including a 2006 geotechnical report we published for a 30-acre portion of the current project site. We also reviewed the Final Environmental Impact Report, Point Molate Mixed-Use Tribal Destination Resort and Casino prepared by Analytical Environmental Services (2011) and the U.S. Navy's Final EIS/EIR for the Disposal and Reuse of Point Molate (2002).

PROJECT LOCATION

The Point Molate project site is located on a portion of a peninsula in the San Francisco Bay to the northwest of Highway 580 and the Richmond Bridge; Figure 1 displays a site Vicinity Map. The site is approximately 413 acres in area; 140 acres are submerged under San Pablo Bay, leaving 273 acres of land. A Site Plan showing existing topography and existing structures is provided as Figure 2. The Property is identified as Assessor's Parcel Number (APN) 561-100-008. The project site was historically occupied by a winery in the early 1900s and the U.S. Navy in the late 1900s. The land since then has been undeveloped and overseen by the City and local tribes.

PROJECT DESCRIPTION

Based on our discussions with you and review of publically available information about the development, we understand the current project development will include redevelopment of 80 acres of the approximately 271 acres of Point Molate Site that is above water. The project will include a variety of residential and commercial uses, as well as supporting road and utility infrastructure. Approximately 180 acres of the Point Molate site will remain as open space that is enhanced with the incorporation of natural trails.

The proposed project would be divided into eight Planning Areas delineated as A through H. Planning Areas A, B, C, and D will be developed with approximately 492 medium-density residential units and E will be developed with approximately 317 high-density residential units. Planning Areas F, G, and H will be developed with approximately 625 high-density residential units and will include rehabilitation of existing buildings in the

Winehaven historic district (located in Planning Area H) and rehabilitation of existing cottages and a few other buildings for commercial, retail and restaurant uses with an approximate square footage of 394,572 square feet.

A preliminary development plan has been developed but structural loads, and grading plan are yet to be determined.

GEOLOGY AND SEISMICITY

Regional Geology

The site is located in the California Coast Range Province, a region of generally northwest trending fault and folds. Specifically, it is located on a northwest oriented, resistant ridge located next to San Francisco Bay. The northwest trending ridge, which includes the site, is mapped as bedrock of the Late Jurassic to Cretaceous age Franciscan Formation. On a regional basis, bedrock of this formation generally consists of serpentinite, greenstone, graywacke, chert, shale, sandstone, and glaucophane schist. These rocks all contain significant amounts of clay materials, which are expansive. The interlayed rocks and clay-rich soil form slopes that are particularly susceptible to landsliding.

Site Geology

The site geology is mapped as predominantly bedrock of the Franciscan Complex (Knox, 1973), specifically Franciscan sandstone and shale (Kfs) (Graymer and Jones, 2000) as depicted in the Regional Geologic Map (Figure 3). Nilsen (1975) mapped shallow landslides, colluvium and Artificial Fill on the project site, as shown in Figure 4. The US Navy Feasibility Environmental Impact Report (FEIR) includes a figure (3.8-2) showing more specific geologic mapping and indicating three areas of “undifferentiated fill” placed along the western shoreline (Figure 8). The Navy indicates this fill was transported from other parts of the former base and consists of gravel, silt, sandy silt, sandy clay and bedrock fragments; the Navy indicates the fill is up to 57 feet in thickness but does not provide a mapping of the fill thickness. The geologic mapping on Figures 3, 4, and 8 shows isolated areas immediately near the shoreline where fill was placed over soft marine sediment locally referred to as Young Bay Mud; the Navy indicates the Young Bay Mud may be as thick as 30 feet. In general, the mapped areas of Young Bay Mud (Qmf on Figure 3) are outside the areas of planned development excepting a corner of Planning Areas D1 and D2.

Faulting and Seismicity

Numerous small earthquakes occur every year in the San Francisco Bay Area and larger earthquakes have been recorded and can be expected to occur in the future. Figure 5 shows the approximate location of faults and epicenters of significant historic earthquakes recorded within the Greater Bay Area Region. We provide a list of the most significant active faults near the site and their estimated maximum earthquake magnitudes in the following table. The California Geological Survey defines an active fault as one that has had surface displacement within Holocene time (approximately the last 11,000 years) (Bryant and Hart, 2007).

TABLE 1: Nearby Active Faults, Latitude**:** 37.9510 Longitude**:** -122.4118

FAULT NAME	DISTANCE FROM SITE (MILES)	MAXIMUM MOMENT MAGNITUDE
Hayward-Rodgers Creek	7.4	7.3
San Andreas	22.4	8.0

The United States Geologic Survey evaluated California seismicity through a study by the 2014 Working Group on California Earthquake Probabilities (WGCEP) (Field, 2014) which led to development of Uniform California Rupture Forecast (Version 2) (UCERF3). The 2014 WGCEP evaluated the 30-year probability of M_W 6.7 or greater earthquake occurring on the known active fault systems in the San Francisco Bay Area, and the 2014 WGCEP estimated an overall probability of 72 percent for this area.

The site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone and no known surface expression of active faults is believed to exist within the site; therefore, fault rupture through the site is not anticipated.

GEOLOGIC AND GEOTECHNICAL HAZARDS

Shallow Groundwater

In our previous 2006 geotechnical investigation within a portion of the site, we encountered groundwater between 2 and 13 feet below the ground surface. The lower areas of the site are likely to have shallow groundwater conditions. During underground construction in these areas, temporary dewatering procedures should be anticipated to lower the free water so that excavation and working areas are kept reasonably dry and stable during construction. Additionally, to reduce long-term effects from potential rises in groundwater, buildings could be underlain by foundation subdrainage to collect and discharge accumulations of water.

Existing Fill

The geologic mapping for the site shows artificial fill in the low-lying areas of the site, adjacent to the Bay. In addition, some portions of the project site may be underlain by undocumented, non-engineered fill associated with previous development of the site. Non-engineered fill can undergo excessive settlement, especially under loading from new fill or buildings. Without proper documentation of existing fill placed on the site, we recommend complete removal and recompaction of the existing fill. If the fill is free of debris and deleterious matter, and deemed environmentally suitable, these may be reused as engineered fill at the site. We show the areas where fill was mapped by the US Navy on Figure 8. In Planning Area A. we encountered fill ranging in thickness from 9 feet to 2½ feet in thickness in our 2006 exploration. Based on the mapping by the U.S. Navy, there also is existing fill in Planning Areas E, D1, and D2 and portions of Planning Areas F, G and H2. The thickness of this fill outside of Planning Area A is unknown at this time, and additional research or exploration is needed to evaluate the fill. In Planning Areas A, E, D1, and D2 there is planned fill placement in locations mapped as being underlain by existing fill, so remedial earthwork is likely necessary to remove and replace fill from building areas prior to placing new fill.

Expansive Soil

Laboratory testing from the 2006 geotechnical study indicated that the existing fill was low to highly expansive. Expansive soil shrinks and swells when subjected to fluctuations in moisture content. Such soil movement may cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations.

Building damage due to volume changes associated with expansive soil can be reduced by: (1) using a mat foundation that is designed to resist the settlement and heave of expansive soil (such as post-tensioned), (2) deepening the foundations to below the zone of moisture fluctuation, i.e. by using deep footings or drilled piers, and/or (3) using footings at normal shallow depths but bottomed on a layer of select fill having a low expansion potential.

Liquefaction

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. The soil considered most susceptible to liquefaction is clean, loose, saturated and uniformly graded fine-grained sand; research indicated that low-plasticity silt and clay is also potentially subject to liquefaction (or cyclic-softening under the ideal circumstances).

In our 2006 geotechnical report, we did not encounter liquefiable soil within the areas we explored; although the US Navy indicates liquefiable soil could exist in low-lying areas of the site with granular fill and shallow groundwater. Based on the U.S. Geological Survey Liquefaction Susceptibility Map (2006), the low-lying areas of the site, adjacent to the bay are mapped as having a “moderate to high” susceptibility to liquefaction and the upland areas are shown as having a low susceptibility to liquefaction (Figure 6). The majority of the potentially liquefiable soil is mapped outside of the areas planned for development as shown on Figure 6; although some areas mapped as having a high potential for liquefaction encroach into Planning Areas E, D1, and D2. This liquefaction susceptibility mapping is based on regional geologic mapping of soil and rock deposits and is not based on site-specific exploration or analyses. Exploration using either borings or cone penetration testing should be performed in areas where the development encroaches into the low lying areas to evaluate if the types of soil are potentially liquefiable. If liquefaction is identified, it could be mitigated by not developing areas susceptible to liquefaction, designing structures and improvements for the potential ground movement due to liquefaction, or reducing the liquefaction hazard through ground improvement or densification. In areas where liquefaction could occur outside development areas, it would likely be economically unfeasible to design open space and park features for liquefaction, so some maintenance or repair may be necessarily should liquefaction occur. The magnitude of any potential liquefaction in development areas should be assessed prior to determining the mitigation method, if any is needed.

Lateral Spreading

Lateral spreading is a failure within a nearly horizontal soil zone (possibly due to liquefaction) that causes the overlying soil mass to move toward a free face or down a gentle slope. If the low-lying areas of the site are determined to have a potential liquefaction hazard, then these areas could also have a lateral spreading hazard. If a lateral spreading hazard is identified, it could be mitigated by setting back development from areas subject to significant lateral movement, stabilization of the liquefiable soil along the shoreline, or mitigation of the liquefiable soil. The majority of the improvements associated with the development are outside areas mapped as potentially liquefiable, so lateral spreading would not likely extend into most of the development areas. The areas in Planning Areas E, D1, and D2 where the high potential mapping overlaps with building areas will need to be evaluated for lateral spreading.

Landslides and Colluvium

The Regional Landslide Map by Nilsen (1975) presented in Figure 4 shows shallow landslides and colluvium mapped on the subject property. Shallower, surficial landslides typically consist of rock fragments and soil. Deep-seated bedrock landslides could also be present on the project site. Geologic mapping and exploration will be necessary to delineate actual shallow landslides and identify deep-seated landslides. Colluvial soil deposits mapped along the side slopes may be subject to instability and slope creep as well. Figure 4 shows the development plan and mapped landslides and colluvium overlaid. Landslides and colluvium will need to be mitigated where they overlap with development. Based on Figure 4, there are areas where mapped of landslides and colluvium that fall within planned building areas.

To mitigate landslide and other areas of slope instability, many factors should be considered in planning, including the size and type of landsliding and risk to planned development. The most common way to mitigate these hazards is to remove the landslide debris or colluvium and rebuild the excavation with engineered fill. In areas where significant portions of these deposits lie outside and above areas of development, an alternate approach is to provide an avoidance setback, or construct a toe buttress fill and debris bench as a catchment area. In this case, the debris bench should be of sufficient width to act as a run-out or catchment area for potential upslope debris.

Seismically Induced Landsliding

Seismically induced landslides are triggered by earthquake ground shaking. The risk of this hazard is greatest in the late winter when groundwater levels are highest and hillside colluvium is saturated. As with all slopes in the region, this risk is also present at the site to varying degrees depending on the slope conditions and time of year. Due to the mapped landslides at the site, there is a high risk of seismically induced landslifding if the landslides are not mitigated. The hazard can be best mitigated by properly engineered stabilization of landslides and removal of colluvial deposits. Evaluation of landslide and slope stability risk should include evaluation of seismic performance.

Tsunamis

Tsunamis are long sea waves, generated by displacements associated with earthquakes. These waves can reach great heights when they encounter shallow water. The California Emergency Management Agency publishes a Tsunami Inundation Map (2009). This map shows low-lying areas of the site, adjacent to the Bay as mapped in the Tsunami Inundation Area (Figure 7). Based on historical records, the greatest tsunami recorded at the Golden Gate was 3 feet high.

Seismic Seiches

An earthquake in the Bay Area could cause seismic seiches, which are standing waves that oscillate back and forth across the Bay. Since low-lying areas of the site, adjacent to the Bay are mapped in an area of possible Tsunami inundation, they are also at risk for seiches. According to historical data, the largest seiche wave ever measured in the San Francisco Bay followed the 1906 earthquake and was four inches high. Seiches have not been recorded to have previously caused damage in the Bay Area.

Bedrock Rippability

Bedrock rippability will be evaluated through a geotechnical exploration. However, based on our experience in this formation in the Richmond area, the Franciscan sandstone and shale bedrock mapped at the project site can typically be ripped to moderate depth with conventional heavy equipment, such as a Bulldozer D-9 or greater, deep excavations (over 20 feet) may require significant effort or larger equipment.

Naturally Occurring Chrysotile Asbestos

Some portions of the Franciscan formation may be serpentinite derived and, therefore, may contain naturally occurring chrysotile asbestos. The major Franciscan bedrock at the project site is sandstone and shale, which do not typically contain serpentinite; therefore, the risk of naturally occurring chrysotile asbestos at the project site is low.

If ultramafic bedrock lenses are encountered, such as serpentinite, an assessment will be performed for the presence of chrysotile asbestos. If tested and confirmed, construction in and handling of chrysotile-asbestos materials will follow site-specific testing and development of specific work plans under the requirements of the California Air Resources Board. In some instances, mitigation measures include perimeter and/or interior air monitoring during construction, capping cuts and fills with suitable fill materials, and confirmation sampling and testing.

CLOSING AND LIMITATIONS

We hope this document presents useful information regarding preliminary geohazards that may be present for initial land planning purposes. If you have any questions or comments please contact us.

If changes occur in the nature or design of the project, we should be allowed to review this document and provide additional recommendations, if any. The conclusions and recommendations contained herein are solely professional opinions and are valid for a period of no more than 2 years from the date of this memorandum issuance.

We strived to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

This memorandum is based upon mapped conditions discovered at the time of this writing and limited subsurface explorations previously performed on a small portion of the site. Our services did not include excavation sloping or shoring, soil volume change factors, flood potential, or a geohazard exploration. In addition, this memorandum did not include work to determine the existence of possible hazardous materials.

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Attachments: Figures 1 - 8

jf/sos/jam/cjn

BASEMAP SOURCE: ESRI MAPPING SERVICE

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VICINITY MAP
POINT MOLATE
RICHMOND, CALIFORNIA

PROJECT NO.: 07102.000.000
SCALE: AS SHOWN
DRAWN BY: MAT
CHECKED BY: JAM
FIGURE NO. 1

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EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

PROJECT SITE

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BASEMAP SOURCE: ESRI MAPPING SERVICE

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SITE PLAN

POINT MOLATE

RICHMOND, CALIFORNIA

PROJECT NO.: 07102.000.000	FIGURE NO. 2
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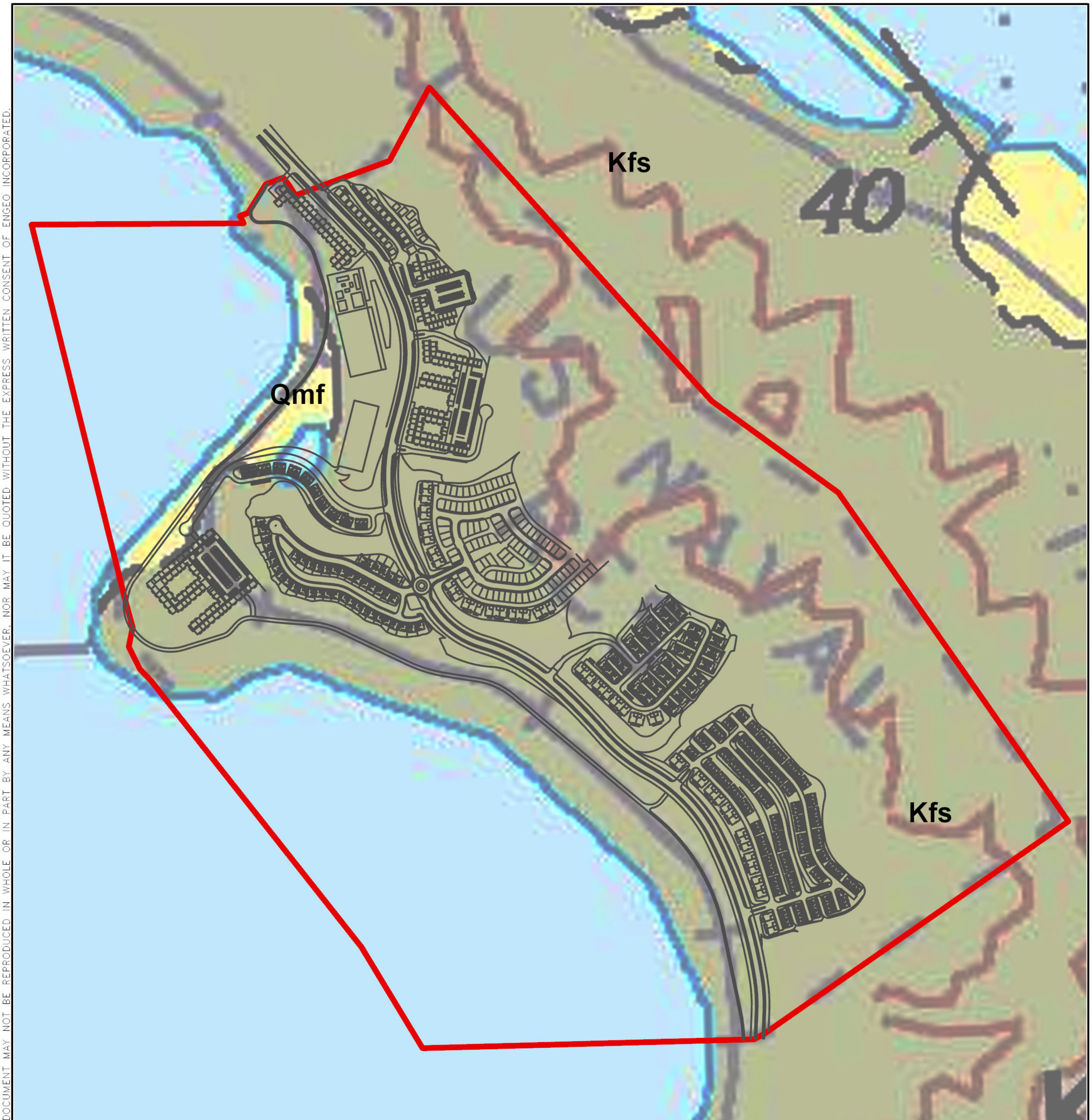

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- PROJECT SITE
- Kfs — FRANCISCAN SANDSTONE AND SHALE (CRETACEOUS)
- Qmf — ARTIFICIAL FILL OVER MARINE AND MARSH DEPOSITS (QUATERNARY)

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BASEMAP SOURCE: BLAKE, GRAYMER, AND JONES, 2000

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REGIONAL GEOLOGIC MAP POINT MOLATE RICHMOND, CALIFORNIA	PROJECT NO.: 07102.000.000		FIGURE NO.
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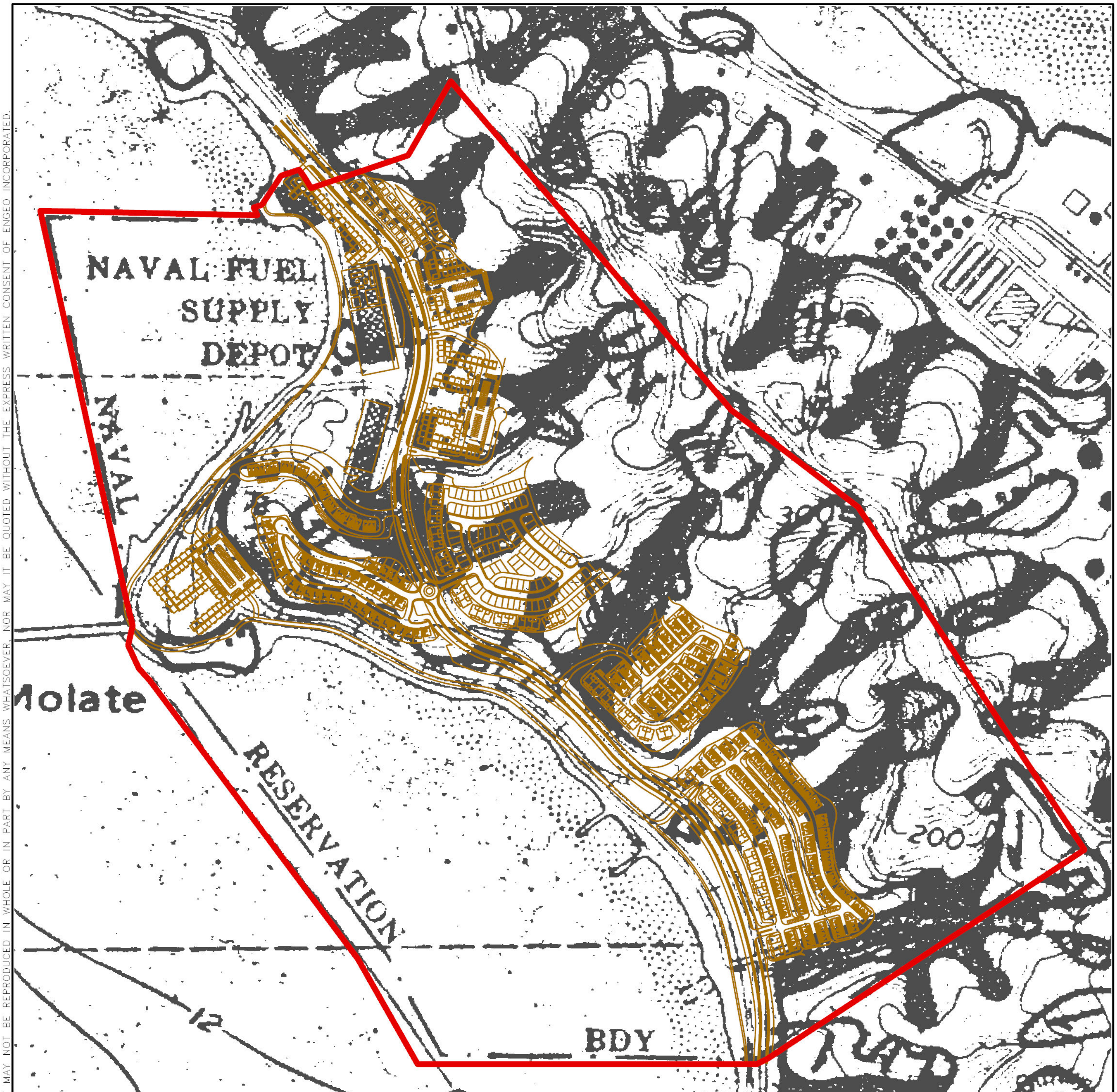

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

PROJECT SITE

LANDSLIDE DEPOSIT. ARROWS INDICATE GENERAL DIRECTION OF DOWNSLOPE MOVEMENT. QUERIED WHERE UNCERTAIN

COLLUVIAL DEPOSIT AND/OR SMALL ALLUVIAL FAN DEPOSIT

Qaf ARTIFICIAL FILL

BEDROCK. QUERIED WHERE IDENTIFICATION UNCERTAIN

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BASEMAP SOURCE: NILSEN, 1975

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REGIONAL LANDSLIDE MAP (NILSEN)

POINT MOLATE

RICHMOND, CALIFORNIA

PROJECT NO.: 07102.000.000		FIGURE NO. 4
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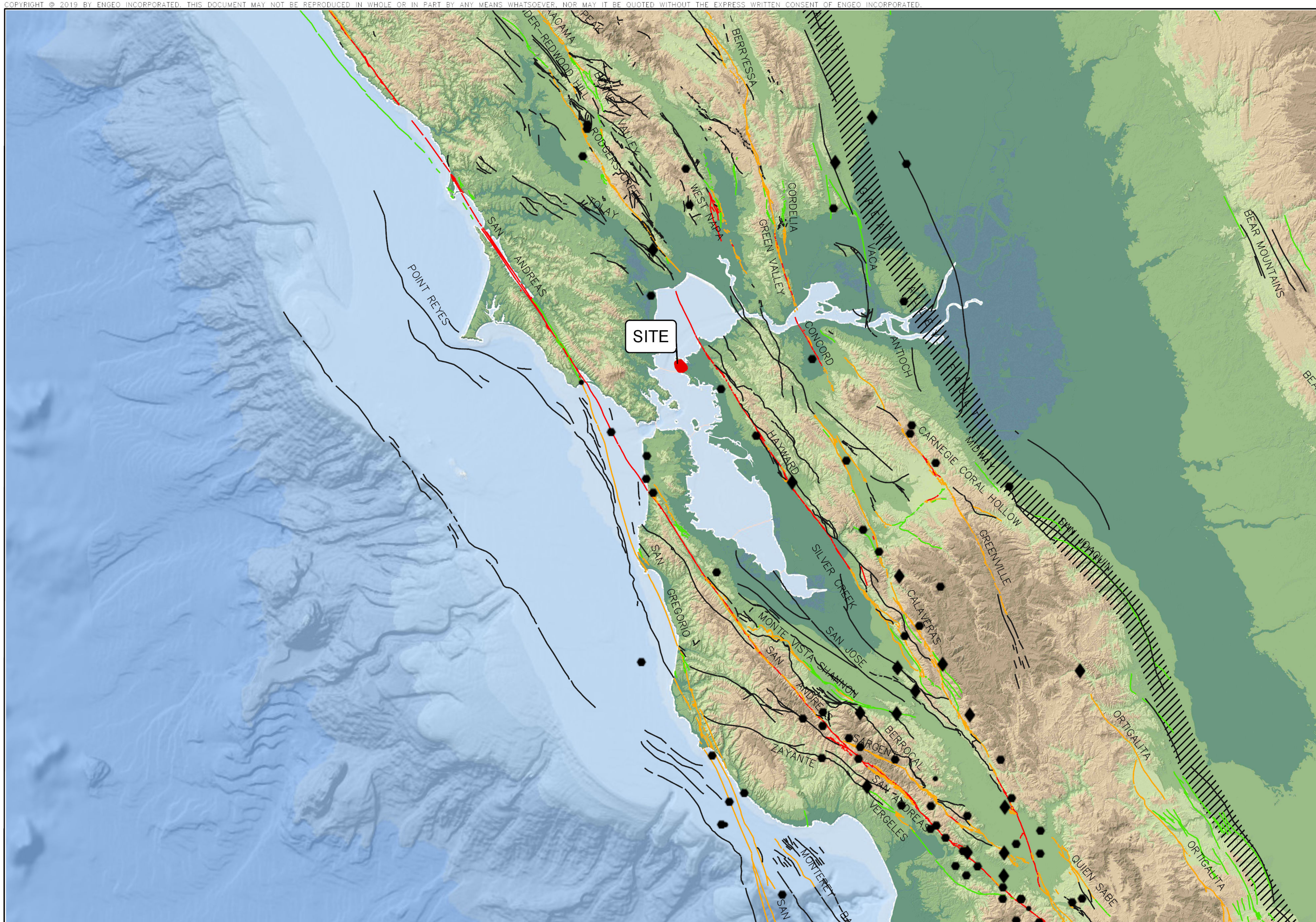

N

0 7.5 15

Miles

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

EARTHQUAKE

- MAGNITUDE 7+
- MAGNITUDE 6-7
- MAGNITUDE 5-6

USGS QUATERNARY FAULTS

- HISTORICAL
- LATEST QUATERNARY
- LATE QUATERNARY
- UNDIFFERENTIATED QUATERNARY

- HISTORIC BLIND THRUST FAULT ZONE

BASE MAP SOURCE

ESRI, GARMIN, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS
COLOR HILLSHADE IMAGE BASED ON THE NATIONAL ELEVATION DATA SET (NED) AT 30 METER RESOLUTION
U.S.G.S. QUATERNARY FAULT DATABASE, 2018
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-PRESENT)

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REGIONAL FAULTING AND SEISMICITY
POINT MOLATE
RICHMOND, CALIFORNIA

PROJECT NO.: 07102.000.000	
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FIGURE NO.: 5

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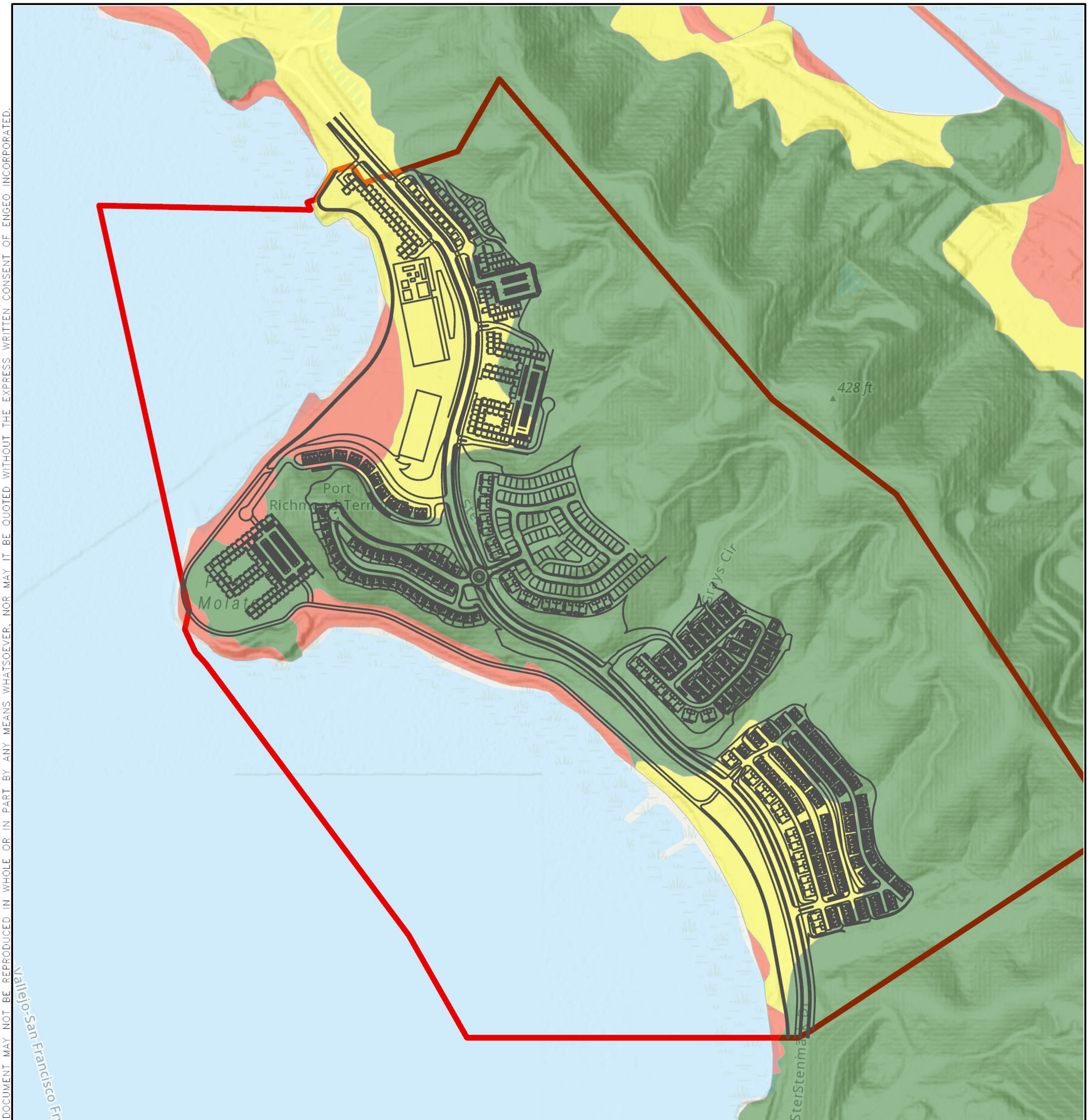

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

Bay Area Liquefaction Risk

- Very Low
- Low
- Moderate
- High
- Very High
- PROJECT SITE

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BASEMAP SOURCE: WENTWORTH, 2006

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LIQUEFACTION SUSCEPTIBILITY MAP

POINT MOLATE

RICHMOND, CALIFORNIA

PROJECT NO. : 07102.000.000	
SCALE: AS SHOWN	
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FIGURE NO. 6

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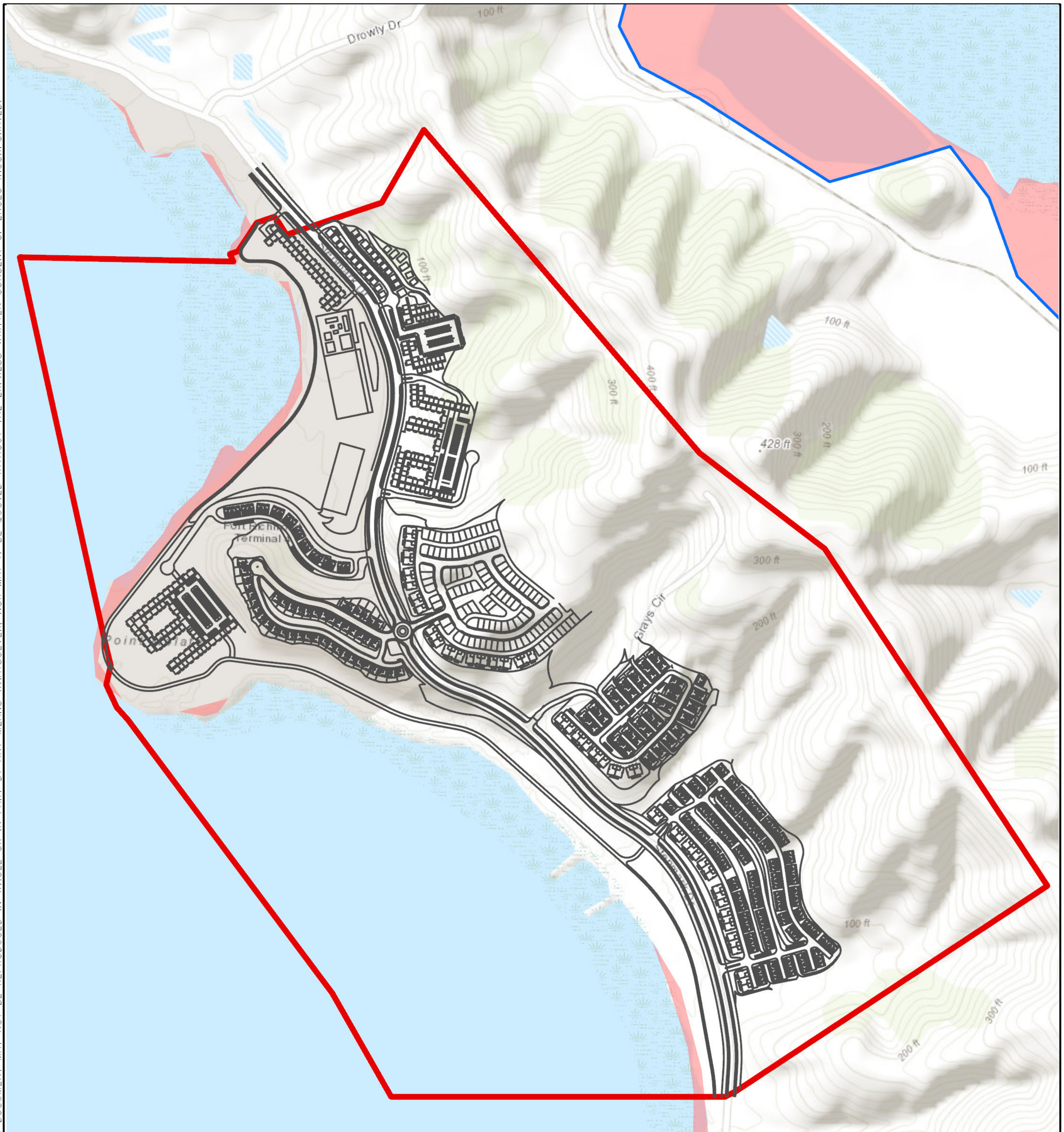

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

PROJECT SITE

TSUNAMI INUNDATION AREA

TSUNAMI INUNDATION LINE

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BASEMAP SOURCE: CALIFORNIA GEOLOGICAL SURVEY, 2009

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TSUNAMI INUNDATION MAP	PROJECT NO. : 07102.000.000	FIGURE NO. 7
POINT MOLATE	SCALE: AS SHOWN	
RICHMOND, CALIFORNIA	DRAWN BY: MAT / CHECKED BY: JAM	

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EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

PROJECT SITE

UNDIFFERENTIATED FILL

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BASEMAP SOURCE: U.S. DEPARTMENT OF THE NAVY, 2002

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MAPPED EXISTING FILL POINT MOLATE RICHMOND, CALIFORNIA	PROJECT NO. : 07102.000.000		FIGURE NO. 8
	SCALE: AS SHOWN		
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