

## 4.5 GEOLOGY, SEDIMENTS, AND SEISMICITY

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Section 4.5 describes the environmental conditions and impacts analysis of geology, sediments, and seismicity issues associated with the granting of a new off-shore lease to the Amorco Marine Oil Terminal (Amorco Terminal) to continue to operate in the southeastern Carquinez Strait. The environmental setting provides information on the existing geologic and geotechnical conditions regionally, as well as in the immediate vicinity of the Amorco Terminal. Also included is a summary of laws and regulations that may affect geologic resources and seismicity analyses. This is followed by an analysis of the potential Project impacts. Geologic issues associated with renewing the Amorco Terminal lease primarily involve the effects of seismic events on Amorco Terminal structures and systems, including but not limited to pipelines, valves, supports, anchors, and electrical and mechanical equipment.

### 4.5.1 ENVIRONMENTAL SETTING

The Amorco Terminal is located in Martinez, Contra Costa County, along the southern edge of the Carquinez Strait approximately 0.5 mile southwest of the Benicia-Martinez Bridge, in the seismically active San Francisco Bay Area (Bay Area).

#### 4.5.1.1 Regional Geology

California is located on the boundary between the Pacific and North American Tectonic Plates. The Pacific Plate comprises much of the Pacific Ocean and includes the western edge of the North American continent. The North American Plate includes the remainder of the North American continent and the western half of the Atlantic Ocean. The Pacific Plate is drifting northwesterly relative to the North American Plate, and the main line of contact between these two plates is the San Andreas Fault system.

The Bay Area lies within the geologically active part of the Coast Ranges geomorphic province of California, which is characterized by a series of nearly parallel mountain ranges (Goldman 1969) trending northwest-southeast. Figure 4.5-1 depicts the locations of the major faults that characterize the area. Active faults, including the Concord/Green Valley, West Napa, Calaveras, Hayward, San Gregorio, and San Andreas Faults, are roughly parallel to the western and eastern limits of the Bay Area. The San Francisco Bay itself began forming during the Pleistocene Epoch, approximately 2 million years ago, when the land masses now known as San Francisco and Marin began to tilt eastward along the Hayward Fault, forming a depression that filled with sediment and water.

The bedrock units underlying the area east of the Hayward Fault (which includes the Amorco Terminal; see Figure 4.5-1), and west of the Sierran basement rock boundary zone, range from Jurassic-Cretaceous to Quaternary-age (approximately 135 million

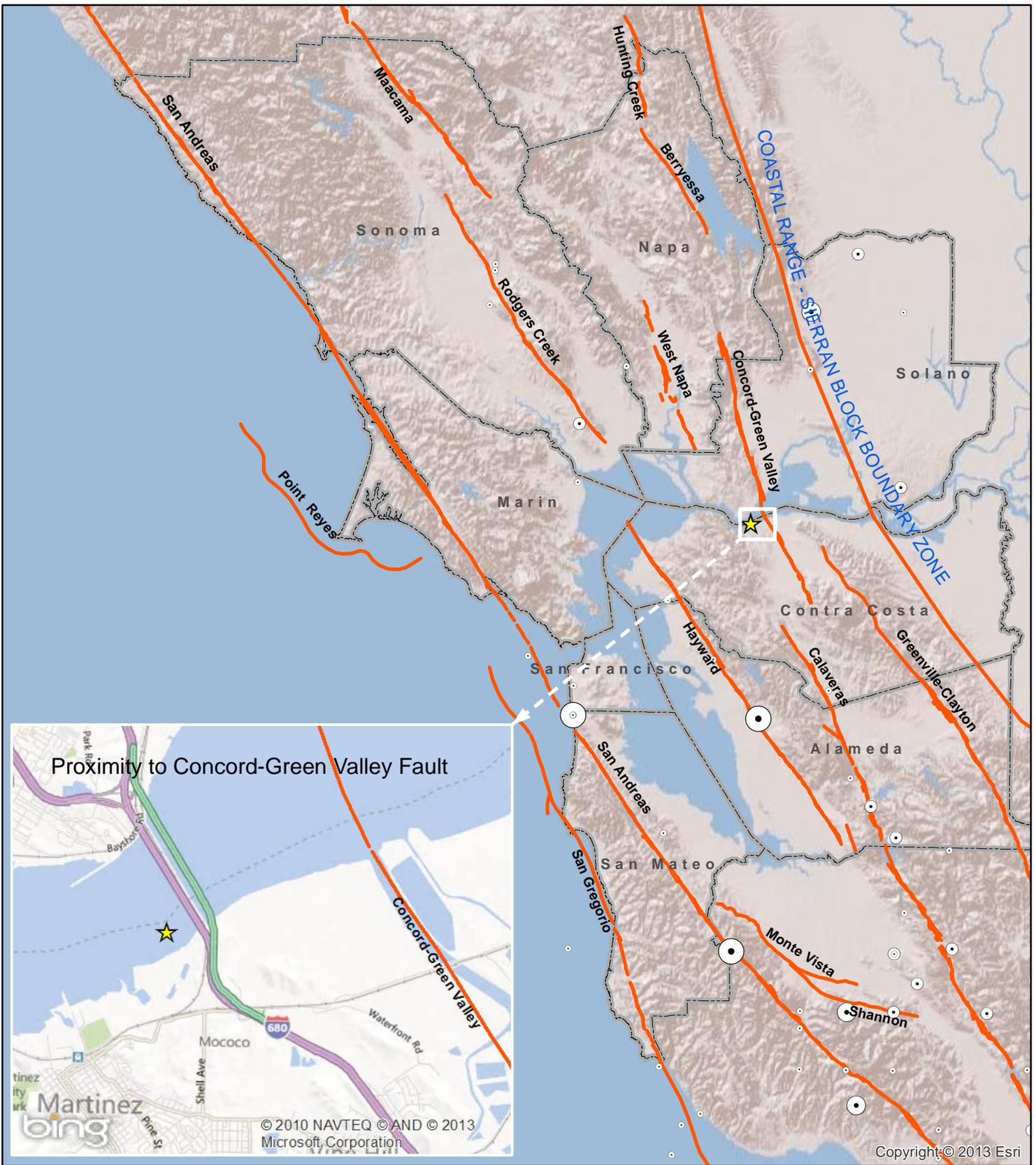
1 years old to current). The oldest unit, the Franciscan Formation, is believed to have  
2 originated on the Pacific Ocean floor and was welded to the western margin of the  
3 American continent by plate movement. Subsequently, it was uplifted through the younger  
4 sedimentary rock to form the backbone of the Diablo Range, which is part of the Coast  
5 Ranges. The strata of this bedrock formation are highly distorted and partially  
6 metamorphosed through heat and compression. The Franciscan Formation primarily  
7 consists of interbedded sandstone and shale, limestone, radiolarian chert, and  
8 metavolcanic rocks (Goldman 1969).

9 The Great Valley Sequence, a thick sequence of Mesozoic sandstones and shales that  
10 overlies the Franciscan Formation, comprises sedimentary rock formed under ancient  
11 seas that once existed on the American continent. The youngest formations are the  
12 deposits of Quaternary-age marine sediments, known as “bay mud,” and Quaternary  
13 alluvium deposited by stream erosion. Figure 4.5-2 depicts the regional surface geology  
14 of the Suisun Bay and Carquinez Strait region near the Project site.

#### 15 **4.5.1.2 Site-specific Geology**

16 The site-specific geologic characteristics described in this section are based on the  
17 regional studies of the Bay Area conducted by the California Geological Survey (CGS),  
18 formerly known as the California Division of Mines and Geology (Goldman 1969, Treaser  
19 1963), and geotechnical investigations conducted by MACTEC Engineering and  
20 Consulting (MACTEC 2005) at the Amorco Terminal. Local surface conditions primarily  
21 comprise early Quaternary-age (Pleistocene) alluvium and late Quaternary-age  
22 (Holocene) bay mud. Goldman’s (1969) contour maps of the top of bedrock suggest that  
23 bedrock lies approximately 80 feet below mean lower low water (MLLW) near the Amorco  
24 Terminal shoreline to a depth of approximately 120 feet below MLLW along the Amorco  
25 wharf.

26 Three geotechnical investigations have been conducted to characterize the geology in  
27 the vicinity of the Amorco wharf (MACTEC 2005, Treadwell and Rollo 2008, Treadwell  
28 and Rollo 2010). Treadwell and Rollo (2010), in a geotechnical report that compiled  
29 geologic boring data from all previous investigations, concluded that approximately 15 to  
30 20 feet of recently deposited soils, characterized as dredged spoils/bay sediments, exist  
31 in the area under the Amorco wharf. The report indicates that approximately 40 to 56 feet  
32 of compressible clay, characterized as bay mud, underlies the recent deposits. Stiff clays  
33 with occasional thin lenses of sand and gravel, described as older bay deposits, were  
34 encountered beneath the bay mud at thicknesses ranging from approximately 10 to 30  
35 feet. Bedrock was encountered approximately 98 feet below the mudline, dipping from  
36 northeast to southwest. In general, the bedrock was found to consist of moderately to  
37 deeply weathered, weak to moderately strong claystone and siltstone, interbedded with  
38 layers of crushed to intensely fractured sandstone.



X:\CSL\Amorco MOT\4.5 Geology\mxd\Figure 4.5-1 Major Faults and Earthquake Epicenters in the San Francisco Bay Area.mxd

**Figure 4.5-1 Major Faults and Earthquake Epicenters in the San Francisco Bay Area**  
 California State Lands Commission  
 Amorco Marine Oil Terminal Lease

**Earthquake Epicenter**

Magnitude

- 5.5 - 5.9
- 6.0 - 6.4
- 6.5 - 6.9
- 7.0 +

— Fault Lines

★ Approximate Terminal Location

1:1,000,000

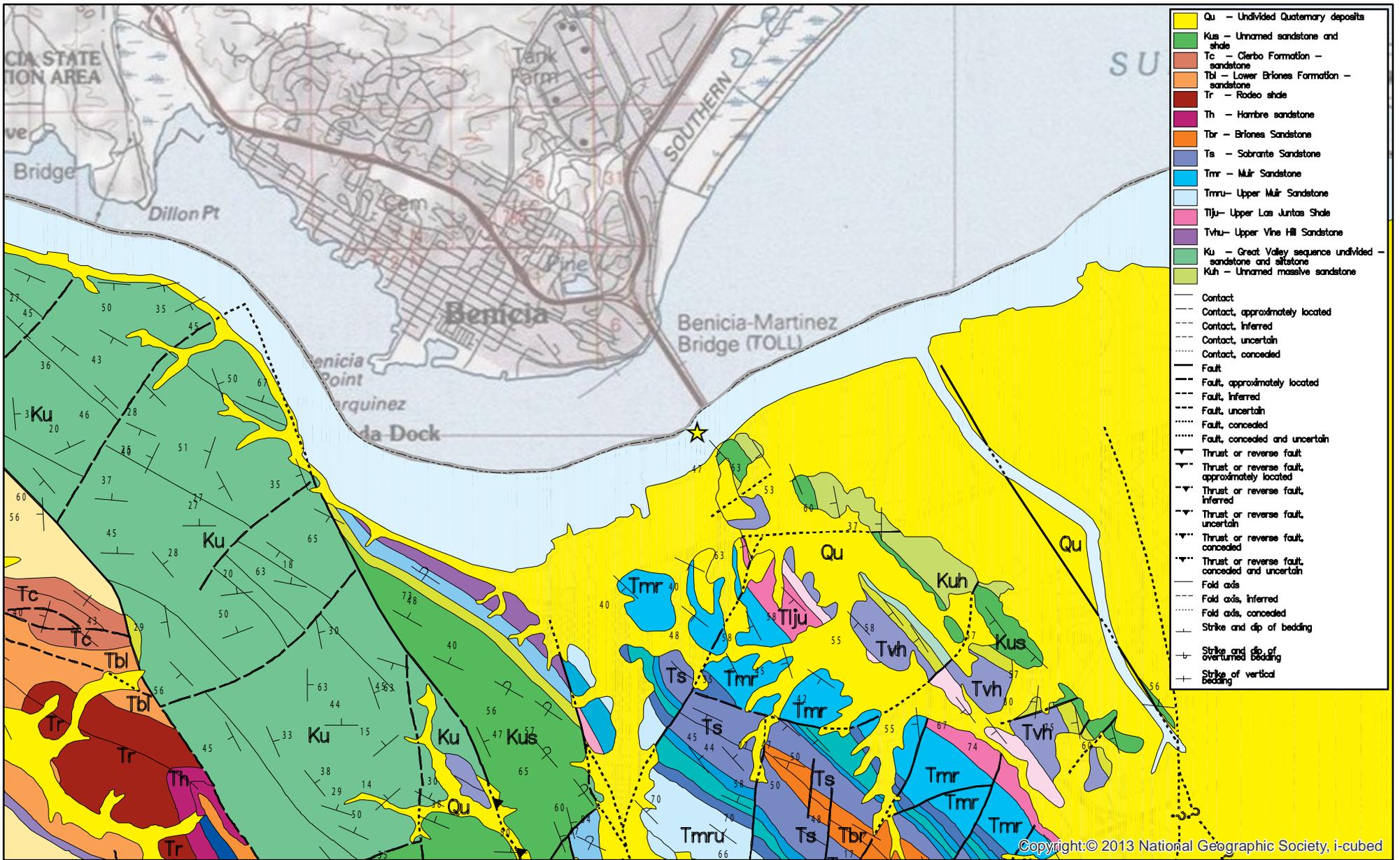
1 inch = 16 miles

0 5 10 mi



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 X:\CSLCAmorco MOT4.6 Geology\mxd\Figure 4.5-2 Regional Surface Geology.mxd

**Figure 4.5-2**  
**Regional Surface Geology**  
 California State Lands Commission  
 Amorco Marine Oil Terminal Lease Consideration Project

**TRC**

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★ Amorco Terminal Location

1:60,000

1 inch = 5,000 feet

0 0.5 1 mi

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