9.0 GEOLOGY, SOILS, AND SEISMICITY

This chapter describes existing geology, soils, minerals, and seismicity, and analyzes the proposed project's potential effects on these resources, should implementation occur. Conversely, the effects of geologic and seismic hazards on the proposed project are also considered. Additional related discussion is presented in Chapter 10.0: Hazards and Hazardous Materials and Chapter 17.0: Water Resources.

Guidelines and key sources of data used in the preparation of this chapter include the following:

- Various geological and seismic reference publications
- U.S. Geological Survey (USGS) 7.5-minute quadrangles, California (1968 and 1980)
- *City of Pittsburg General Plan* Health and Safety and Resource Conservation elements
- United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) and Web Soil Survey 2.0, Natural Cooperative Soil Survey

9.1 ENVIRONMENTAL SETTING

9.1.1 Regulatory Context

A variety of federal, state, and local regulations apply to geologic hazards, geotechnical practice, and soil and mineral resources, primarily as they relate to grading and construction activities, but also inclusive of industrial operations.

9.1.1.1 Federal Regulations

<u>Clean Water Act</u>

The Clean Water Act (Title 33, United States Code, Section, 1251, *et seq*.) (CWA) empowers the U.S. Environmental Protection Agency (EPA) to regulate wastewater and stormwater discharges into surface waters via the National Pollutant Discharge Elimination System (NPDES) program's permits and pre-treatment standards. In California, these permits are issued by the Regional Water Quality Control Board (RWQCB), but the EPA may retain jurisdiction at its discretion. Under the NPDES Phase II Rule, promulgated in 1999 and effective as of 2003, any construction activity disturbing 1 acre of land or more must obtain coverage under the State's General Permit for Storm Water Discharges Associated with Construction Activity (General Construction Permit). General Construction Permit applicants are required to prepare a Notice of Intent stating that stormwater will be discharged from a construction site, and prepare a Storm Water Pollution Prevention Plan (SWPPP) that describes best management practices (BMPs) that will be implemented to avoid adverse effects on receiving water quality as a result of construction activities, including earthwork. The CWA's primary effect on the project site would be with respect to the control of soil erosion during construction.

International Building Code

Acceptable design criteria for excavations and structures for static and dynamic loading conditions are specified by the International Building Code (IBC), which is published by the International Conference of Building Officials. These provisions have been developed to help promote seismically safe construction practices.

9.1.1.2 State Regulations

Marine Oil Terminal Engineering and Maintenance Standards

The California State Lands Commission's Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS), Chapter 31F, Title 24, Part 2 of the California Code of Regulations, apply to all existing and new marine oil terminals in California, and include rigorous criteria for inspection, structural analysis and design, mooring and berthing, geotechnical considerations, and mechanical and electrical systems.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1972 (California Water Code, Section 13000, *et seq*.) is the California equivalent of the federal CWA, and its effect on the project would be similar to that of the CWA. The San Francisco Bay RWQCB has jurisdiction over the project area. As part of the General Construction Permit, a SWPPP would be prepared that would include implementation of BMPs to prevent soil erosion.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (California Public Resources Code, Section 25523(a) and California Code of Regulations, Title 14, Division 2, Chapter 8, Subchapter 1, Article 3), amended in 1994, was passed to mitigate the hazard of surface faulting to structures for human occupancy. Its main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The law requires the California Geological Survey State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults and to issue fault zone maps. The maps are distributed to all affected cities, counties, and State agencies for their use in planning and controlling new or renewed construction. Prior to a project being permitted, cities and counties must require that a geologic investigation be performed to demonstrate that proposed buildings for human occupancy will not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet).

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (SHMA) of 1990 (California Public Resources Code, Division 2, Chapter 7.8, Sections 2690-2699.6) authorizes the State Mining and Geology Board to provide policy and guidance through regulations for a statewide seismic hazards mapping and technical advisory program to assist cities, counties, and State agencies in fulfilling their responsibilities for protecting the public from the effects of strong ground shaking, liquefaction or other ground failure, and landslides and other seismic hazards caused by earthquakes, including tsunami and seiche threats. The SHMA establishes the authority to provide programs to identify and map seismic hazard zones in the State in order for cities and counties to adequately prepare the safety element of their general plans and to encourage land use management policies and regulations that reduce and mitigate those hazards so as to protect public health and safety.

Section 2697 of the SHMA mandates that, prior to the approval of a project in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard must be prepared. Once a report is approved, subsequent geotechnical reports would not be required, provided that new geologic information warranting further investigation was not recorded. The California Building Code (CBC) requires that the recommendations of the report be incorporated in the building design.

Surface Mining and Reclamation Act

The Surface Mining and Reclamation Act of 1975 (SMARA) (California Public Resources Code, Division 2, Chapter 9, Articles 1-7, Sections 2710-2796) provides a comprehensive surface mining and reclamation policy, regulating surface mining operations to ensure that adverse environmental impacts are minimized and mined lands are reclaimed to a usable condition. SMARA also encourages the production, conservation, and protection of the State's mineral resources.

California Building Code

The CBC (California Code of Regulations, Title 24) contains the minimum standards for design and construction of structures in California, including considerations for withstanding seismic hazards. The CBC provides standards for all phases of construction, including excavation, grading, earthwork, fill embankments, expansive soils, foundation investigations, liquefaction potential, and soil strength loss. Local standards, if stricter, may be adopted. The CBC includes the standards associated with seismic engineering detailed in the IBC.

<u>CEQA Statute and Guidelines</u>

The California Environmental Quality Act (CEQA) requires that public agencies identify the environmental consequences of proposed projects. Pursuant to Appendix G of the CEQA Guidelines (Public Resources Code, Sections 15000, *et seq*.), a project would have a significant impact if it would directly or indirectly destroy a unique paleontological resource or site. Refer to discussion in Chapter 8.0: Cultural Resources.

9.1.1.3 Local Regulations

<u>City of Pittsburg Municipal Code</u>

Grading and building during construction would be regulated by the City of Pittsburg (City). The City's Municipal Code contains requirements for excavation, filling, and grading associated with new development projects. Permits are issued prior to land-disturbing or land-filling activities.

Acceptable design criteria for excavations and structures for static and dynamic loading conditions are specified by the IBC. The City has adopted the IBC per Section 15.08.010 of the Municipal Code.

<u>City of Pittsburg General Plan</u>

The Health and Safety Element of the *City of Pittsburg General Plan* identifies various hazards that may occur in the City. It provides basic policies that consider geologic conditions in the selection of land for development and the design of developments to preserve life and protect property in the event of a disaster. The Resource Conservation Element of the general plan identifies the City's basic policies pertaining to natural resources, including soil and mineral resources.

9.1.2 Existing Conditions

9.1.2.1 Geologic Setting and Topography

<u>Regional Geology and Structure</u>

The proposed project is located on the southern side of Suisun Bay near the western edge of the Sacramento River Delta (Delta) (see Figure 9-1: Regional Geology). To the south, the Diablo Range's Los Medanos Hills reach elevations of approximately 1,300 feet. To the north, the Sacramento River Delta is at sea level, and many of the Delta's islands are surrounded by manmade levees.

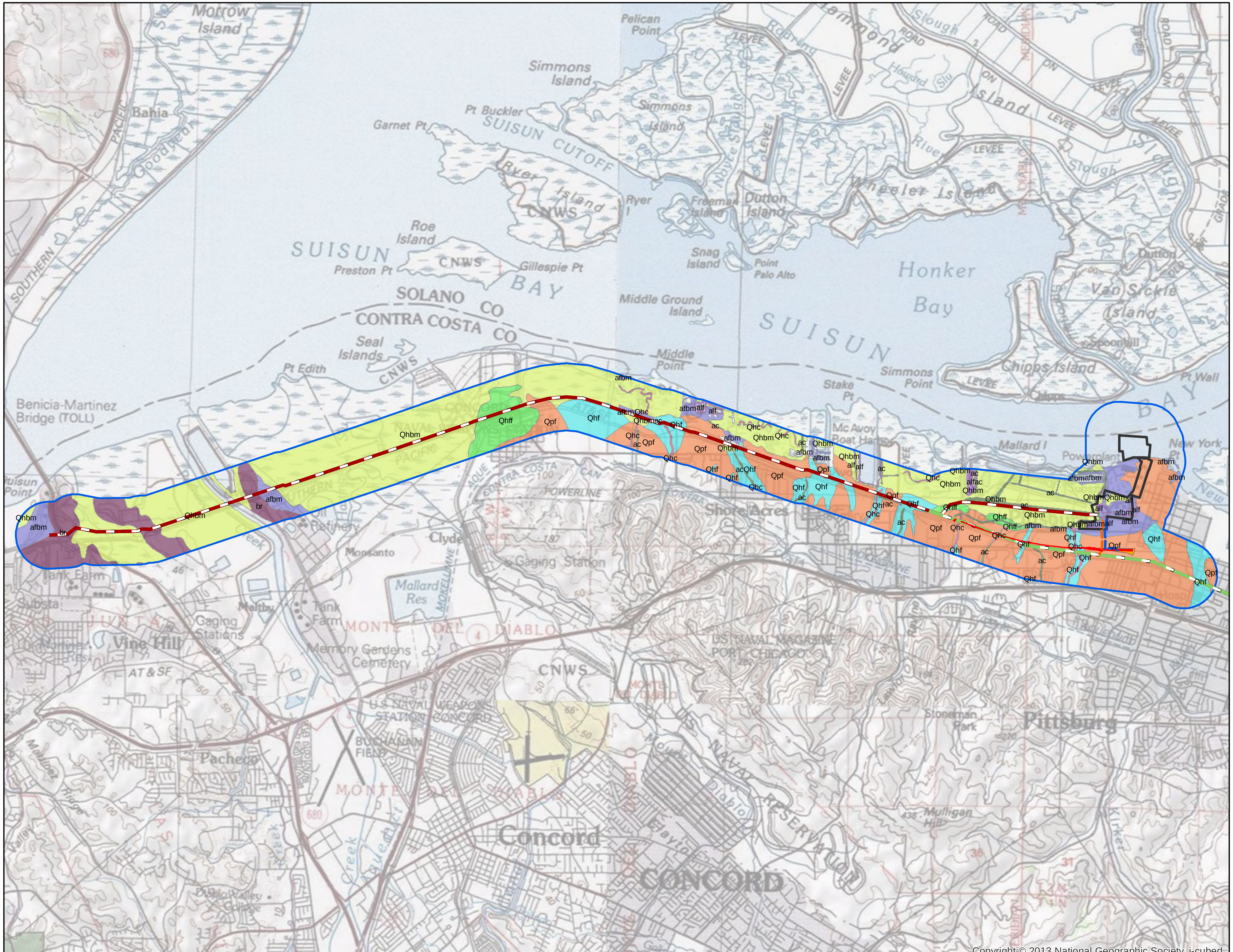

Figure 9-1
Regional Geology
City of Pittsburg
WesPac Pittsburg Energy Infrastructure Project

Proposed Landing Track
Existing San Pablo Bay Pipeline
Existing KLM Pipeline
Proposed Pipeline from Rail Transload Facility
Proposed KLM Pipeline Connection
Rail Transload Facility
Terminal Boundary
2000' Project Buffer

Quaternary Deposits

afbm-Artificial fill over San Francisco Bay mud
alf-Artificial fill, levee
ac-Artificial stream channel
Qhc-Modern stream channel deposits
Qhbm-Holocene San Francisco Bay mud
Qhff-Fine-grained Holocene alluvial fan deposits
Qhf-Holocene alluvial fan deposits
Qpf-Latest Pleistocene alluvial fan deposits
br-bedrock

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1 inch = 5,500 feet

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0 0.5 1 mi

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The Diablo Range is part of the northern Coast Ranges physiographic province. The province is characterized by north-northwest-trending mountains and intervening valleys that extend from the Oregon border to the Transverse Ranges of southern California. The ridge and valley topographic character of the Coast Ranges province is predominantly controlled by the structural composition of the underlying geologic units and ongoing landform modification due to tectonic and erosion processes.

The Coast Ranges are a series of northwest-southeast-trending structural blocks comprising a variety of basement lithologies that are juxtaposed by major geologic structures. The Coast Ranges-Sierra Block (CRSB) boundary zone lies to the east. To the west, the major boundary is the San Andreas fault zone, which separates Franciscan Complex rocks on the North American plate from the Salinian basement rocks on the Pacific plate. The Coast Ranges ophiolites within the Franciscan Complex have been deformed by a series of thrust faults, most of which appear to be inactive (Reeg, 1999).

The faults and folds of the San Andreas system predominantly strike north to northwest, with some folding occurring approximately east to west. The proposed project site is located within the Mount Diablo fold and thrust belt (Unruh and Sawyer, 1995), at the northern end of the Diablo Range. A fold and thrust belt occurs in orogenic zones where plate tectonics contract and fold existing formations, and push older strata above younger strata. Folds are closely related to thrust faults because movement on the thrusts causes the formation of folds in the overlying strata.

The Mount Diablo fold and thrust belt is bounded by the Pittsburg-Kirby Hills fault to the east, the Potrero Hills thrust to the north, and by the right-lateral Concord fault to the south and west. Movement on the Potrero Hills thrust and other thrusts has resulted in the formation of the Potrero Hills and multiple anticlines (folds with strata sloping downward on both sides from a common crest) in the vicinity of the project.

Faults of the San Andreas system separate the Diablo Range from the remainder of the Coast Ranges. Mount Diablo is separated from the western East Bay Hills by the Calaveras fault and from the southern extension of the Diablo Range by the Livermore Valley, an east-west-trending Cenozoic basin. The Diablo Range is bounded to the east by the CRSB boundary zone (Unruh and Moores, 1997; Wong *et al*., 1988). The eastern side of Mount Diablo is bounded by the San Joaquin fault (Sowers *et al*., 1992). Rocks of the Mesozoic Great Valley sequence are thrust upon Franciscan basement rocks along the San Joaquin Valley margin, and are covered locally by younger sediments of Paleocene to Pleistocene age.

The Diablo Range comprises a series of large en echelon (i.e., parallel or subparallel, and closely spaced to overlapping or step-like) anticlines, with intervening synclines (folds with strata sloping upward on both sides from a common trough). The anticlines are composed of Franciscan Complex rocks, and the synclines contain younger rocks. The folds are frequently cut by east- and west-verging thrust faults. These thrust faults are displaced or truncated by strike-slip movement on the northwest-striking, right-lateral faults of the San Andreas fault system.

Local Geology

The surficial geology in the vicinity of the proposed project is underlain by fluvial/deltaic deposits of Pleistocene and Holocene age (Knudsen *et al*., 2000) with recent artificial fill (refer to Figure 9-1). The geologic units were formed as a result of deposition of sediments from the San Joaquin River, windblown transport of fine-grained silts and sand, and local drainages originating from the Diablo Range to the south.

Elevations within most of the project site generally range from approximately 5 to 8 feet above mean sea level (USGS, 1980). The site is essentially flat with topographic relief limited to slope faces along the shoreline and around buildings, tanks, or other developed features.

Local Stratigraphy

The stratigraphy beneath the proposed project is comprised of a mix of Pleistocene and Holocene alluvial sediments. Bedrock outcrops are mapped to the south of the site along the lower northern flank of Mount Diablo (Graymer *et al*., 1994). Mapping indicates that these outcrops dip to the north at approximately 20 to 30 degrees and, therefore, likely underlie the site at depth; bedrock also outcrops along the western segments of the San Pablo Bay Pipeline (refer to Figure 9-1), which would be reactivated as part of the proposed project. Quaternary sediments, artificial stream channels, and artificial fill over bay mud (afbm) are located beneath the storage terminal site and pipelines.

The geologic deposits beneath the proposed project site and pipelines are shown on Figure 9-1, and the most prevalent deposits are described below.

Quaternary Alluvial Fan Deposits – Qpf and Qhf

The unconsolidated quaternary alluvial fan deposits are divided by Knudsen *et al*. (2000) into older Pleistocene and younger Holocene units. Alluvial fan deposits of Pleistocene age consist of brown, dense gravelly and clayey sand or clayey gravel that fine upward to sandy clay. They are distinguished from younger alluvial fan deposits by higher topographic position, greater degree of dissection, and development of a more extensive soil profile. They are overlain by Holocene deposits on lower parts of the alluvial fan, and incised by channels that are partly filled with Holocene alluvium on higher parts of the alluvial fan.

Holocene Deposits – Qhbm

Bay Mud sediment generally includes silt, clay, peat, and fine sand. Bay Mud deposits thin landward and may be as thick as 130 feet along the bay margin.

Fine-grained Holocene Alluvial Fan Deposits – Qhff

The Holocene alluvial deposits overlie the older Pleistocene deposits on the lower parts of the alluvial fan. The fine-grained deposits in this section occur on the flatter distal portions of the fan and consist primarily of silt and clay-rich sediments with interbedded lobes of coarser sand and occasional gravel.

Historic Artificial Fills – afbm

A series of manmade fills has been placed in the vicinity of the project site over the years to increase the surface grade and provide more stable ground for industrial development. The fill soil types have varied with time but are generally believed to be relatively coarse-grained soils (e.g., sands and gravels), rather than finer grained soils (e.g., silts and clays) (Knudsen, *et al*., 2000).

9.1.2.2 Soils

Soil types at the storage terminal, Rail Transload Operations Facility (Rail Transload Facility), and pipelines are shown on Figures 9-2: Soil Units in Terminal Vicinity and 9-3: Soil Units in Pipeline Vicinity. The project site and pipelines are comprised predominantly of Clear Lake Clay, Omni Silty Clay, Joice Muck soil, Antioch Loam, and Capay Clay components, which are described below, based on information gathered from the USDA NRCS Web Soil Survey 2.0, and the SSURGO Soil Database (USDA, 2007b).

<u>Map Unit Cc – Clear Lake Clay</u>

The Clear Lake Clay soil component is found on basin floors with slopes of 0 to 2 percent. The parent material consists of alluvium. Roots can penetrate this soil component to depths of more than 60 inches, and water is highly available to a depth of 60 inches. It is poorly drained and water movement is moderately low. Clear Lake Clay is occasionally flooded but is not ponded, and there is no zone of water saturation within a depth of 72 inches. Its shrink-swell potential is high. Organic matter content in the surface horizon is approximately 2 percent. Clear Lake Clay soil meets the USDA NRCS criteria for hydric soils.

<u>Map Unit Ob – Omni Silty Clay</u>

The Omni Silty Clay component is found on flood plains with slopes of 0 to 2 percent. The parent material consists of alluvium derived from sedimentary rock. Roots can penetrate to depths of more than 60 inches, and water is moderately available to a depth of 60 inches. It is poorly drained and water movement is moderately low. Omni Silty Clay is occasionally ponded; however, it is rarely flooded. Its shrink-swell potential is high. A seasonal zone of water saturation is present at 39 inches. Organic matter content in the surface horizon is approximately 2 percent. Omni Silty Clay meets hydric criteria.

Map Unit Ja – Joice Muck

Joice Muck is found in salt marshes with slopes of 0 to 1 percent. The parent material consists of organic material. Roots can penetrate to depths of more than 60 inches, and water is moderately available to a depth of 60 inches. It is very poorly drained and water movement is high to very high. Joice Muck is occasionally flooded and is frequently ponded. Its shrink-swell potential is low. A zone of water saturation is present at 24 inches year-round. Organic matter content in the surface horizon is approximately 45 percent. This soil meets hydric criteria.

Map Units AdA and AdC – Antioch Loam

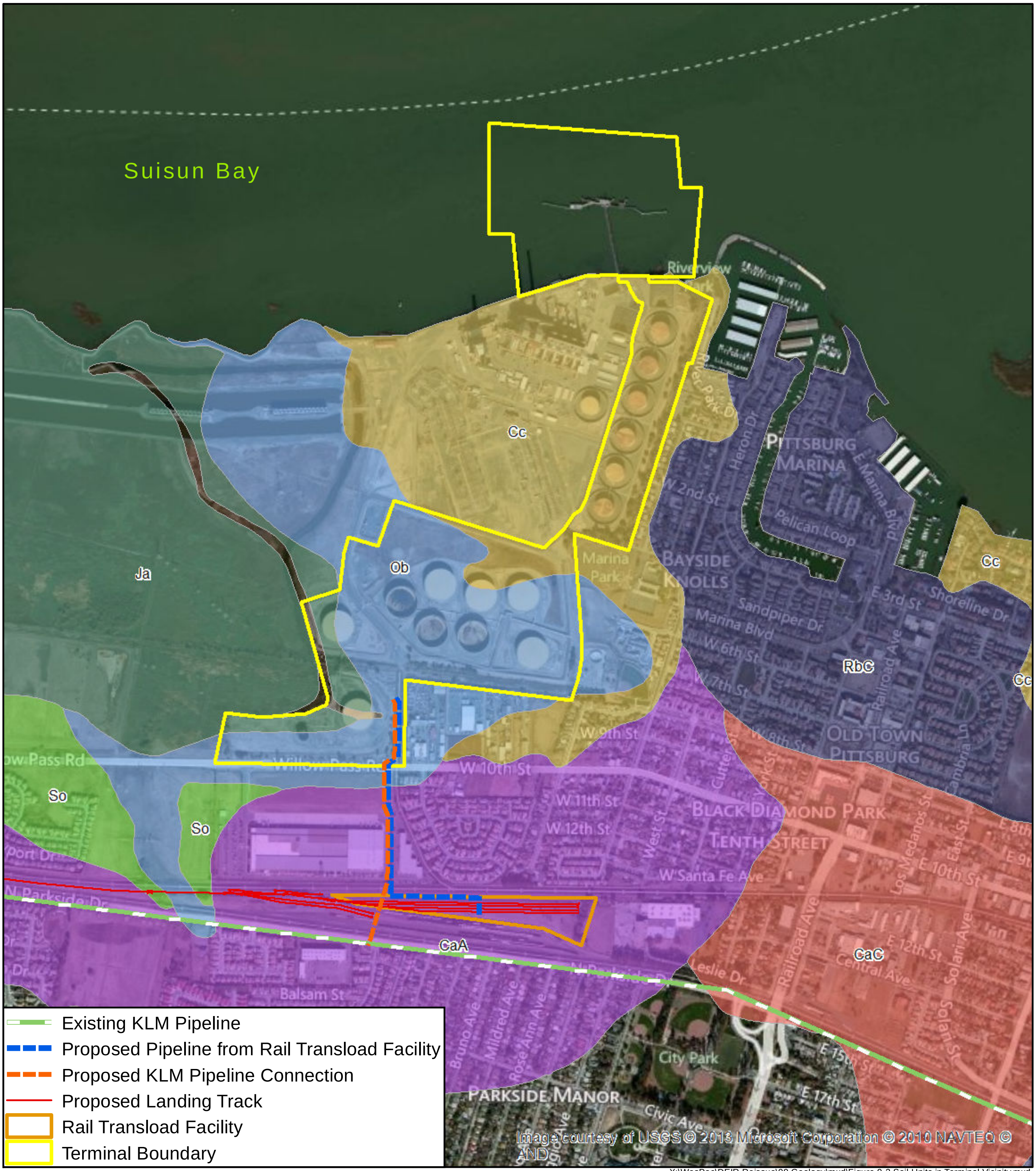
Antioch Loam is found in terraces with slopes of 0 to 2 percent (AdA) and 2 to 9 percent (AdC). The parent material consists of alluvium derived from igneous and sedimentary rock. Roots can penetrate to depths of more than 80 inches, and water has low availability to a depth of more than 80 inches. It is moderately well drained and water movement is very low to low. Flooding and ponding in the Antioch Loam is not likely. Its shrink-swell potential is high. A zone of water saturation is deeper than 80 inches year-round. Organic matter content in the surface zone is approximately 1 to 2 percent. The soil meets hydric criteria.

Map Units CaA and CaC – Capay Clay

Capay Clay is found on benches with slopes of 2 to 9 percent. The parent material consists of alluvium derived from sedimentary rock. Roots can penetrate to depths of more than 80 inches, and water is highly available to a depth of more than 80 inches. It is moderately well drained, and water movement in the most restrictive layer is moderately low to moderately high. Flooding and ponding in the Capay Clay is not probable. Its shrink-swell potential is high. A zone of water saturation is deeper than 80 inches year-round. Organic matter content in the surface horizon is about 1 to 2 percent. Capay Clay meets hydric criteria.

9.1.2.3 Bay Sediments

Sediment in Suisun Bay comprises predominately fine and cohesive silt and clay, except for sandy bed sediment in some of the deeper channels (Conomos and Peterson, 1977). The surficial sediments around these channels change seasonally. During the rainy season, high flows from rivers winnow the fine sediment of Suisun Bay and transport it downstream into San Pablo Bay. As a result, the percentage of surficial sediments that is coarse-grained material in Suisun Bay increases from approximately 5 to 10 percent to approximately 35 percent. As



X:\WesPac\DEIR Reissue\09 Geology\mxd\Figure 9-2 Soil Units in Terminal Vicinity.mxd

Figure 9-2 Soil Units in Terminal Vicinity
City of Pittsburg
WesPac Pittsburg Energy Infrastructure Project

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- CaA - CAPAY CLAY, 0 TO 2 % SLOPES
- CaC - CAPAY CLAY, 2 TO 9 % SLOPES
- Cc - CLEAR LAKE CLAY
- Ja - JOICE MUCK
- Ob - OMNI SILTY CLAY
- RbC - RINCON CLAY LOAM, 2 TO 9 % SLOPES
- So - SYCAMORE SILTY CLAY LOAM

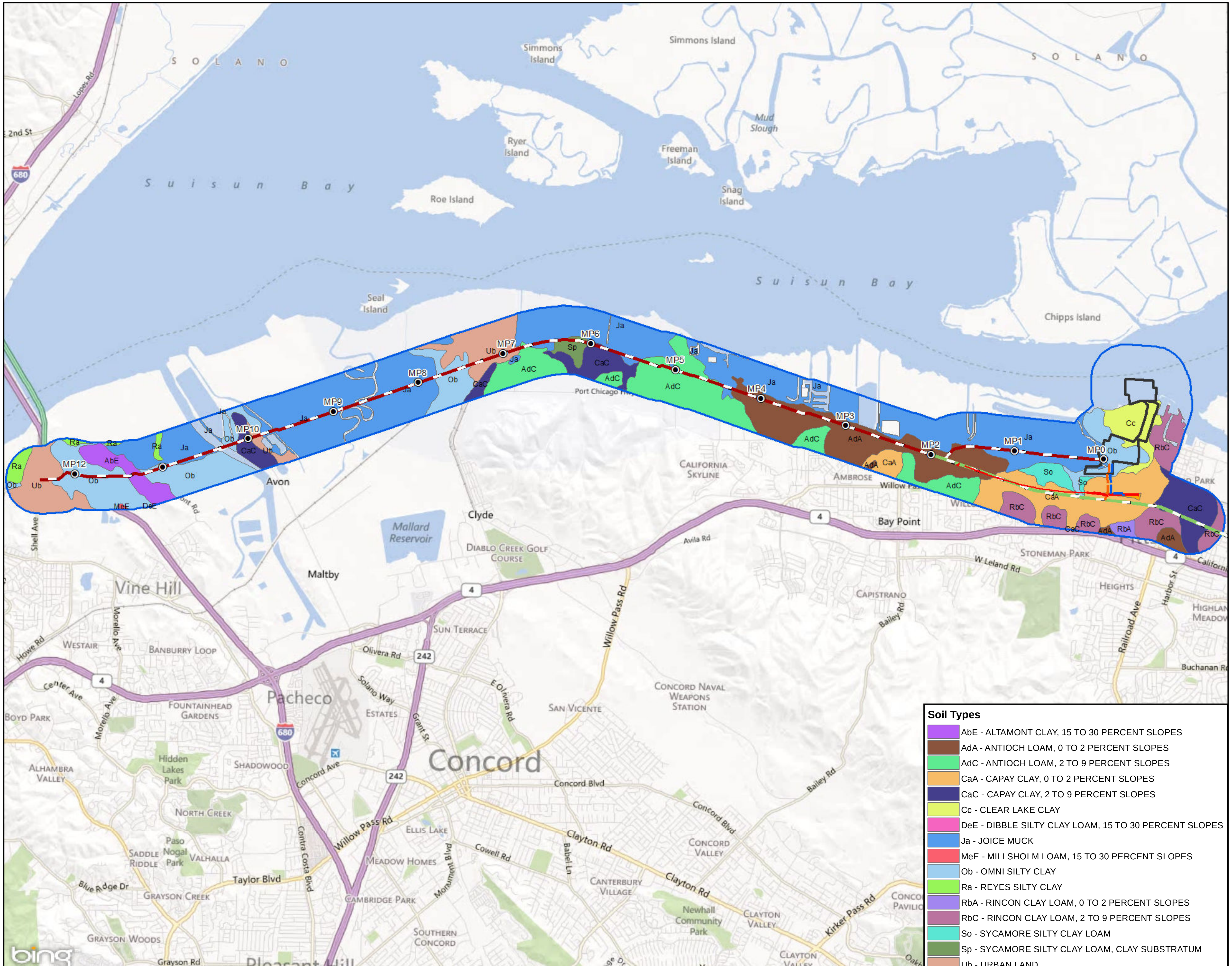
N

1:14,000

1 inch = 1,167 feet

0 600 1,200 ft

Figure 9-3
Soil Units in Pipeline Vicinity
City of Pittsburg
WesPac Pittsburg Energy Infrastructure Project



Mileposts
Existing San Pablo Bay Pipeline
Existing KLM Pipeline
Proposed Pipeline from Rail Transload Facility
Proposed KLM Pipeline Connection
Proposed Landing Track
Rail Transload Facility
Terminal Boundary
2000' Project Buffer

6/11/2013

1 inch = 1 miles

1:66,000

0 0.75 1.5 mi

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CH X:\WesPac\DEIR Reissue\09 Geology\mxd\Figure 9-3 Soil Units in Pipeline Vicinity.mxd

river flow decreases during the summer, silt again is deposited in Suisun Bay and the primary surficial sediments again become fine silt and clay (Nichols and Pamatmat, 1988).

For more detail regarding sediment quality in Suisun Bay, see Chapter 17.0: Water Resources.

9.1.2.4 Faulting and Seismicity

The proposed project lies within the broad San Andreas fault system, which accommodates the majority of the motion between the Pacific and North American plates. Although the most active faults within the system lie to the west of the site, active deformation related to the system occurs in the vicinity. Compressional tectonics reflected in the Coast Ranges also result in folds and thrusts sub-parallel to the San Andreas fault system.

<u>Significant Faults</u>

The software product EQFault (Blake, 2006) using the 2002 California Fault Model was used to produce Table 9-1, which lists the most significant Quaternary faults within 60 miles of the storage terminal site, as well as estimates of the maximum earthquake magnitude for each fault. Maximum earthquake magnitude estimates are based on the Working Group on California Earthquake Probabilities (WGCEP) (2008). Figure 9-4: Major Faults in Project Vicinity illustrates the location of the project site with respect to the major faults.

San Andreas Fault

The San Andreas fault is the largest active fault in California, extending from the Gulf of Mexico approximately 750 miles north to Cape Mendocino. The San Andreas fault was the source of the 7.9 moment magnitude (M_W) San Francisco earthquake of 1906 (Wallace, 1990). The San Andreas fault can be divided into a number of segments based on differences in geomorphology, geometry, paleoseismic chronology, seismicity, and historic displacements. In the San Francisco Bay Area, these segments include the Southern Santa Cruz Mountains segment (possible source of the 6.9 M_W Loma Prieta earthquake of 1989), Peninsula segment, and North Coast segment (south).

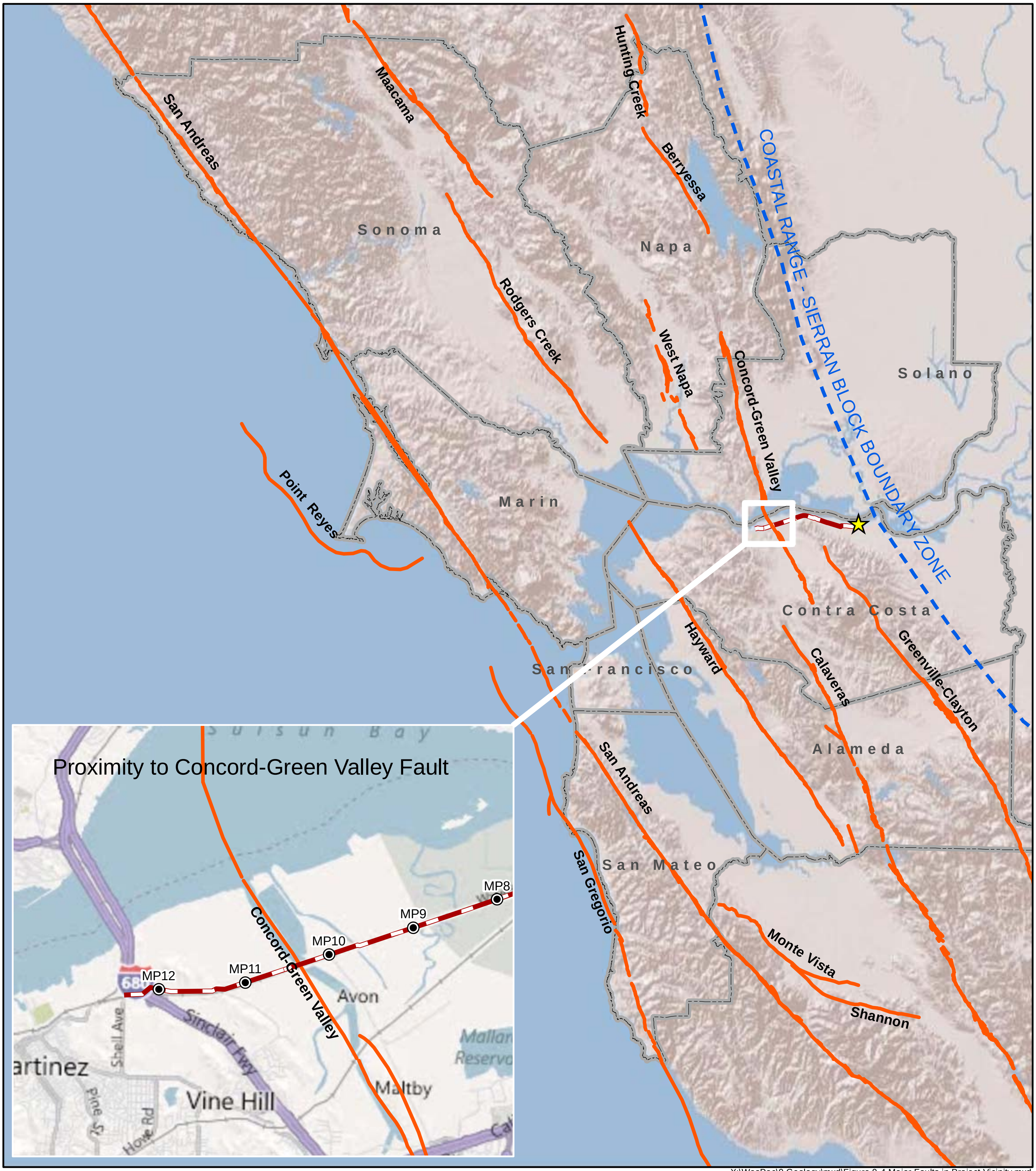
Hayward Fault

The Hayward fault is approximately 62 miles long and extends from Evergreen (east of San Jose) to Point Pinole, where it projects offshore into San Pablo Bay. The October 1868 local magnitude 6.8 event was the last major earthquake to occur on the Hayward fault. The WGCEP has divided the Hayward fault into a southern segment (longer) and a northern segment (shorter). The Hayward fault is considered to be the most likely source of the next major earthquake in the San Francisco Bay Area (WGCEP, 2008).

Table 9-1: Significant Faults within 60 Miles of the Site

Fault Name	Approximate Distance[1] (miles)	Maximum Earthquake Magnitude (M_W[2])
Greenville-Clayton	5.4	6.6
Concord-Green Valley (Mount Diablo Thrust)	6.0	6.6
Concord-Green Valley	9.0	6.2
Calaveras (North)	14.7	6.8
West Napa	21.0	6.5
Hayward (total length)	22.7	7.1
Hayward (North)	22.7	6.4
Rodgers Creek	24.5	7.0
Hayward (South)	24.9	6.7
Hunting Creek-Berryessa	33.1	6.9
Hayward (SE Extension)	39.6	6.4
San Andreas (1906)	41.1	7.9
San Andreas (Peninsula)	41.1	7.1
San Andreas (North Coast)	41.2	7.6
Calaveras (South)	42.2	6.2
San Gregorio	43.4	7.3
Monte Vista-Shannon	47.7	6.8
Point Reyes	50.3	6.8
Maacama (South)	57.2	6.9
San Andreas (Santa Cruz)	60.0	7.0

[1]Distances are from the proposed storage terminal location
[2] M_W = Moment magnitude
Source: Blake, 2006



X:\WesPac\9 Geology\mxd\Figure 9-4 Major Faults in Project Vicinity.mxd

Figure 9-4 Major Faults in Project Vicinity
City of Pittsburg
WesPac Pittsburg Energy Infrastructure Project

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- ☆ Approximate Terminal Location
- Fault Lines
- Coastal Range - Sierran Block Boundary Zone
- Existing San Pablo Bay Pipeline

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1 inch = 16 miles

0 5 10 mi

Concord-Green Valley Fault

The Concord-Green Valley fault extends approximately 33 miles from the Walnut Creek area across Suisun Bay to the north. The Concord segment extends approximately 12 miles from the northern slopes of Mount Diablo to Suisun Bay. North of Suisun Bay, the Green Valley fault continues to the north for approximately 28 miles. The Concord fault crosses the San Pablo Bay Pipeline, and is an actively creeping geologic structure that has a long-term creep rate of approximately 5 millimeters per year (mm/yr). Recent investigations yielded geological evidence of previous large surface-fault rupturing events for this system.

Calaveras Fault

The Calaveras fault represents a significant seismic source in the southern and eastern San Francisco Bay Area. It extends from an intersection with the Paicines fault south of Hollister through the Diablo Range east of San Jose and along the Pleasanton-Dublin-San Ramon urban corridor. The fault consists of three major sections: The 15-mile-long southern Calaveras fault, the 38-mile-long central Calaveras fault, and the 24-mile-long northern Calaveras fault. The level of contemporary seismicity along the southern section is low to moderate, whereas the central section has generated numerous moderate earthquakes both in historic and recent time. The northern section, which is located closest to the project site, has a relatively low level of seismicity and may be locked (i.e., not slipping because frictional resistance on the fault is greater than the shear stress on the fault). The timing of the most recent rupture on the northern Calaveras fault is unknown, but may have been several hundred years ago (Kelson, 1999).

Greenville-Clayton Fault

The Greenville fault is on the eastern side of the Diablo Range, extending approximately 45 miles from Bear Valley to just north of the Livermore Valley. This fault produced a moderate earthquake in 1980 that caused minor surface fault rupture and damage to Interstate 580 east of Livermore, as well as damage to the Livermore Valley area. Research is currently being conducted on the fault zone to better define its slip rate and its history of past earthquakes. This fault is judged capable of generating a maximum earthquake of 6.25 M_W.

Rodgers Creek Fault

The Rodgers Creek fault is a 28-mile-long fault that extends northward from the projection of the Hayward fault on the south side of San Pablo Bay. The Rodgers Creek fault produced a large-magnitude historical earthquake in the late 1800s. Marine geophysical evidence suggests that the Hayward and Rodgers Creek faults are connected by a series of normal faults that extend across a 3-mile right step beneath San Pablo Bay. Current research suggests a low probability for the two faults to connect across this step-over during a large earthquake; instead, they are more likely to behave as separate structures.

West Napa Fault

The West Napa fault is a north-northwest-striking zone of short right-lateral strike-slip fault segments in the hills to the west of the City of Napa (Bryant, 1982). The fault extends about 19 miles from Napa to Yountville. It is characterized by well-defined active fault features such as lineations, scarps in late Pleistocene and Holocene alluvium, closed depressions, and right-laterally deflected drainages.

CRSB Boundary Zone (Great Valley Fault Sequence)

The CRSB boundary zone is a complex zone of thrust faulting that marks the boundary between the Coast Ranges block and the Sierran basement rocks. The CRSB extends from near Red Bluff in the northern Sacramento Valley to Wheeler Ridge in the southern San Joaquin Valley (Wakabayashi and Smith, 1994; Wong *et al*., 1988) and is concealed beneath sedimentary sequence of the Sacramento and San Joaquin valleys.

The CRSB is a complex array of west-dipping thrusts and east-dipping back-thrusts. The CRSB boundary zone was the probable source of the two 6.25 to 6.75 M_W earthquakes recorded in 1892 near Winters and the 1983 6.5 M_W Coalinga earthquake in the western San Joaquin Valley (Wong *et al*., 1988). Empirical relationships between fault length and earthquake magnitude suggest that these segments of the CRSB are capable of generating maximum earthquakes of 6.5 to 6.75 M_W, with an average recurrence interval of 360 to 440 years (Wakabayashi and Smith, 1994). The CRSB boundary zone is approximately 6.4 miles west of the storage terminal.

9.1.2.5 Geologic Hazards

<u>Surface Fault Rupture</u>

No active or potentially active faults are mapped on the storage or marine terminal sites, the Rail Transload Facility, or along the proposed KLM Pipeline connection or the pipeline between the WesPac Energy–Pittsburg Terminal (Terminal) and the Rail Transload Facility (Rail Pipeline). The closest fault zone to the proposed project site zoned under the Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) is the Greenville-Clayton fault, approximately 5.4 miles to the southwest. The Alquist-Priolo Act requires the California Geological Survey to establish earthquake fault zones around the surface traces of active faults. For new or renewed construction within these zones, geologic investigations are required to show that none of the proposed structures involving human occupancy will be built across an active or potentially active fault.

The Concord-Green Valley fault crosses the San Pablo Bay Pipeline approximately 9 miles west of the project site. As discussed in Section 9.1.2.3, recent geologic investigations yielded evidence of previous large surface-rupturing events for the Concord-Green Valley fault.

Earthquake Ground Shaking, Liquefaction, and Settlement

Strong ground shaking due to future seismic events is potentially the most significant geologic hazard for the project. Based on the USGS Seismic Hazard Mapping Program (Petersen *et al*., 2008), bedrock ground motions with a 10 percent probability of being exceeded within the next 50 years are estimated at 0.4 standard gravity units (g). Ground motions exceeding 0.3 g, which are common during earthquakes of magnitude 5.5 and larger, may cause significant damage to even well-designed buildings.

Liquefaction is the phenomenon during which loose, saturated, cohesionless (i.e., sandy) soils temporarily lose shear strength during strong ground shaking. Significant factors known to affect the liquefaction potential of soils are grain-size distribution, relative density, degree of saturation, the initial stresses acting on the soils, degree of soil compaction, and the characteristics of the earthquake (e.g., intensity and duration of ground shaking). Dissipation of excess pore pressure generated by ground shaking could produce volume changes within the liquefied soil layers, which would be manifested at the ground surface as settlement.

Mass Wasting and Slope Stability

The storage terminal and associated pipeline alignments are on a flat alluvial plain approximately 2 miles north of the Mount Diablo range front, and the marine terminal is located above Suisun Bay sediments. Because of the lack of significant slopes on or near the site, the risk of hazards from slope instability generated by landslides and debris flows is very low.

Subsidence

Subsidence of the land surface can be attributed to: (1) natural phenomena such as tectonic deformation, consolidation, hydro-compaction, collapse of underground cavities, oxidation of organic-rich soils, or rapid sedimentation; and (2) the activities of man such as the withdrawal of groundwater. Most of the physical conditions responsible for land subsidence are not known to exist at the project site.

Expansive Soils

The majority of the project site is underlain by soils identified as Clear Lake Clay and Omni Silty Clay, characterized by poor drainage and high shrink-swell potential (refer to Figure 9-2). The proposed KLM Pipeline connection, proposed Rail Pipeline, and the Rail Transload Facility are underlain by Capay Clay, which exhibits high shrink-swell potential (refer to Figure 9-2).

The majority of the existing San Pablo Bay Pipeline is within Antioch Loam, Omni Silty Clay, and Joice Muck soil. The other portions of the pipeline are in smaller sections of Sycamore Silty Clay Loam and Capay Clay. All of these soil types, except the Joice Muck soil, have a high shrink-swell potential.

<u>Tsunamis and Seiches</u>

A tsunami is a water wave or a series of waves generated by an impulsive displacement of the surface of the ocean or other body of water. Tsunamis can travel across oceanic basins and cause damage several thousand miles from their sources. Most tsunamis are caused by a rapid vertical movement along a break in the Earth's crust (i.e., a tectonic fault rupture on the bottom of the ocean), resulting in displacement of the column of water directly above it. The majority of tsunamis are triggered by earthquake rupture along subduction zones; however, tsunamis can also result from local landslides into the San Francisco Bay.

A seiche is a long, rolling wave with periodic oscillation or "sloshing" of water in an enclosed basin and can be caused from strong winds. The period of oscillation can range from minutes to hours and have the potential to produce large changes in water levels.

Tsunamis and seiches are rare, and there is not enough data in the historical record to adequately derive a reoccurrence period.

9.1.2.6 Minerals

<u>Coal Resources</u>

Per the *City of Pittsburg General Plan*, the Planning Area that encompasses the proposed project area contains one of only two places in the San Francisco Bay Area where coal was historically mined. Following the discovery of coal in the 1850s, the Black Diamond Mines, the first source of fossil fuel in California, were constructed. Sand mining was also conducted starting in the late 1920s in Nortonville, approximately 5.5 miles south of the project site. Due to competition from other energy sources, the mines closed in 1949. There are currently no significant mineral deposits or active mining operations in the Planning Area, which, as stated above, includes the proposed project area.

<u>Sand and Gravel Aggregate Resources</u>

Per SMARA, the State Geologist was authorized to develop a comprehensive mineral land classification for aggregate materials (SMARA, Article 4, Section 2761b). Mineral Resource Zones (MRZ) delineated by the State Geologist are broken into categories to identify the presence and significance of mineral deposits within a specified area. MRZ categories are defined as follows:

MRZ-1: Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.

MRZ-2: Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.

MRZ-3: Areas containing mineral deposits, the significance of which cannot be evaluated from available data.

9.2 IMPACT ANALYSIS

9.2.1 Methodology for Impact Analysis

Geologic impacts were evaluated in two ways: (1) impact of the proposed project on the local geologic environment; and (2) impacts of geologic hazards on proposed project components that may result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

9.2.2 Significance Criteria

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would result in any of the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, involving:
  - rupture of a known earthquake fault as delineated by the State Geologist on the most recent Alquist-Priolo fault zoning maps, or based on other substantial evidence
  - strong seismic ground shaking or seismically induced ground failure, including liquefaction
  - tsunamis and seiches in Suisun Bay
  - landslides

- Cause substantial soil erosion or loss of topsoil
- Construct structures or facilities on a geologic unit or soil that is unstable or that would become unstable as a result of construction
- Construct structures or facilities that would be at risk of damage because they are located on soils with high erosion potential
- Construct structures or facilities on expansive soils, as defined in the CBC, creating substantial risks to life or property
- Cause the loss of availability of a known mineral resource that is of value to the region and/or the residents of the State
- Cause the loss of availability of a locally known important mineral resource recovery site delineated in a general plan, specific plan, or other land use plan

9.2.3 Impacts and Mitigation Measures

9.2.3.1 Proposed Project

Construction-related Impacts

Impact Geology, Soils, and Seismicity (GSS)-1: Potential to cause substantial soil erosion or compaction. (Less than significant.) Because the fill material on which the proposed Terminal project lies was placed in an engineered and controlled manner, and has already been supporting structures and infrastructure for decades, the potential for erosion is low. In addition, Environmental Commitment GGS-1, described in Chapter 2.0: Project Description and Alternatives, commits the project to incorporate BMPs into the required SWPPPs for construction and excavation operations to minimize on-site soil erosion and off-site sedimentation. Temporary erosion-control measures would be implemented during the construction period to help maintain water quality, protect property, and prevent accelerated soil erosion. Potential specific stormwater BMPs are listed in Chapter 17: Water Resources, Impact WR-1.

Mitigation Measure: No mitigation required.

Impact GSS-2: Potential to cause adverse effects to natural resources as a result of disposal of dredged material during restoration of the navigation channel. (Less than significant.) Impacts from the disposal of dredged sediment could occur if the dredged material were placed upon a natural geologic resource, rendering it inaccessible and/or unsuitable for future use. This is not expected to occur as sediment samples collected from the proposed dredging area indicate that the dredged material would be suitable for disposal at either an upland disposal site on Winter Island or within the Montezuma Wetlands (see Appendix A). No disposal activities would occur until approval has been obtained from the appropriate regulatory agencies.

Mitigation Measure: No mitigation required.

Operational Impacts

Impact GSS-3: Expose people or structures to surface faulting, resulting in substantial structural damage and risk of injury or loss of life. (Less than significant.) Fault rupture beneath engineered structures can lead to damage if the fault displacement is large enough, and in extreme conditions, catastrophic collapse. Even minor fault displacements can cause significant structural damage. The facility is not within an Alquist-Priolo Zone; therefore, the potential for exposure and damage from surface fault displacement is very low to non-existent.

Portions of the San Pablo Bay Pipeline are located within an Alquist-Priolo Zone where the pipeline crosses the active Concord-Green Valley fault (refer to Figure 9-4). In this area, surface displacements may occur during an earthquake, causing the pipeline to be stretched or compressed. In 1974, Harding-Lawson

Associates estimated tectonic creep on the Concord-Green Valley fault to be 6 mm/yr, which could result in 4 inches of lateral offset in 10 years, with 1 inch in 10 years of elongation. With surface fault displacements along the pipeline, the potential for substantial damage is present.

However, per CBC standards, appropriate stress and strain evaluations were incorporated into the design of the pipeline and conduit to ensure that the pipe would withstand dynamic loads from lateral offset of the fault. The pipeline was designed to compensate for axial elongation or compression through flexibility provided by a U-shaped pipe configuration. A specially designed concrete conduit encasement was implemented for the pipeline to compensate for seismically induced displacement caused by tectonic creep (PG&E, 2005). In addition, the pipeline employs remote-control isolation valves on either side of the Concord-Green Valley fault crossing to stop the flow of product through the pipeline in the event that an earthquake causes the pipeline to displace and rupture. Further details on the isolation valve locations, potential crude oil release volumes, and contingency planning and response measures in place following a release are discussed in Chapter 10.0: Hazards and Hazardous Materials (see Impacts HM-4 and HM-5).

In addition, prior to operation of the San Pablo Bay Pipeline, the California Public Utilities Commission would require an evaluation of the historical effect of tectonic creep on the pipeline, as well as an overall pipeline inspection (PG&E, 2005). If it is determined, based on this evaluation, that the pipeline would be unable to withstand a major seismic event or further tectonic creep, necessary repairs or modifications would be undertaken. During pipeline operation, inspections would be performed on a regular basis in accordance with United States Code of Federal Regulations, Title 49, Section 195, which governs transportation of hazardous liquids by pipeline, and findings of the inspections would be reported to the State Fire Marshal. Environmental Commitment GSS-2, described in Chapter 2.0: Project Description and Alternatives, commits the project to adhere to these requirements, described in detail as mitigation measures in the *Final Mitigated Negative Declaration for PG&E's Richmond-to-Pittsburg Pipeline Divestiture* (PG&E, 2005).

The relevant provisions of the CBC, which were incorporated into the pipeline design, are intended to promote structural safety in the event of an earthquake. Additionally, prior to operation, mitigation measures in the form of inspections and design upgrades, if needed, would be implemented (PG&E, 2005). The required design and constraints would ensure that unacceptable risk from surface faulting would be reduced to levels consistent with professional engineering practices and public health and safety standards. Accordingly, impacts from surface faulting would be less than significant.

Mitigation Measure: No mitigation required.

Impact GSS-4: Expose people or structures to strong ground shaking, causing substantial structural damage and risk of injury or loss of life. (Less than significant.) Due to the site's proximity to earthquake faults and the characteristics of the soil profile, there is a high risk of strong ground shaking in the event of a large-magnitude earthquake in the project vicinity.

The proposed project would be designed per MOTEMS, which apply to all existing and new marine oil terminals in California, and include rigorous criteria for inspection, structural analysis and design, mooring and berthing, geotechnical considerations, and mechanical and electrical systems. A site-specific geotechnical investigation and report would be prepared to allow for detailed structural design, including exploratory soil borings, laboratory testing, and analysis by a geotechnical engineer. The report would include seismic design criteria for the engineer's use in completing design work.

Existing structures that would remain as part of the marine and storage terminals would be seismically upgraded to meet current applicable codes stipulated in the CBC (including MOTEMS) and the IBC. Engineering controls such as leak detection and shut-off valves would be installed and operated to minimize impacts from a potential release from a storage tank or pipeline, as further discussed in Chapter 10.0: Hazards and Hazardous Materials (see Impacts HM-4 and HM-5).

The proposed Rail Transload Facility would be designed in accordance with national standards, including the American Railway Engineering and Maintenance-of-Way Association *Manual of Railway Engineering* (2012), BNSF Railway Company (BNSF) *Design Guidelines for Industrial Track Projects* (BNSF, 2011), and the Joint BNSF/Union Pacific Railroad *Guidelines for Railroad Grade Separation Projects* (BNSF and UPRR, 2007). The Rail Transload Facility would also be designed to meet the seismic requirements of the CBC.

The required design and constraints would ensure that unacceptable risk from ground shaking would be reduced to levels consistent with professional engineering practices and public health and safety standards. Accordingly, impacts from ground shaking would be less than significant.

Mitigation Measure: No mitigation required.

Impact GSS-5: Expose people or structures to the risk of loss, injury, or death as a result of tsunamis and/or seiches. (Less than significant.) Tsunamis and seiches are rare, and there is not enough data in the historical record to adequately derive a reoccurrence period. Ritter and Dupre (1972) show that for a tsunami originating outside San Francisco Bay, the amount of inundation based on tsunami run-up decreases to 50 percent of its maximum at the Golden Gate by the time it passes the Richmond-San Rafael Bridge. By the time the tsunami reaches the Carquinez Strait approximately 12.5 miles west of the site, the run-up would only be approximately 10 percent of its maximum at the Golden Gate.

This impact would be less than significant due to the rare chance that a tsunami or seiche would reach the project site. Additionally, in the very unlikely event that a tsunami or seiche would reach the project site, its effect would be minor due to its weakened strength.

Mitigation Measure: No mitigation required.

Impact GSS-6: Cause substantial soil erosion or compaction. (Less than significant.) Following construction and facility upgrades, most of the storage terminal would either be covered with structures or paved; therefore, the potential for soil erosion would be minimal. Routine vehicle traffic to and from the storage terminal would be limited to paved roads and, therefore, standard operations would not disrupt soils. In addition, BMPs for stormwater control would be implemented, as discussed in Chapter 17.0: Water Resources.

Mitigation Measure: No mitigation required.

Impact GSS-7: Construct structures or facilities overlying expansive soils, creating major risks to life and/or risk of property damage. (Less than significant.) The storage terminal is underlain with expansive soils, which can shrink or swell as a result of moisture changes. This expansion or contraction of underlying soils can cause heaving and/or cracking of slabs-on-grade, pavements, railways, and structures on shallow foundations such as the proposed office and control building, parking area, electrical substation, and above-grade piping supports.

To reduce the likelihood of damage to overlying structures from soil expansion/contraction, a site-specific geotechnical investigation and report would be prepared to allow for detailed structural design, taking soil properties into account. The geotechnical investigation would include exploratory soil borings, laboratory testing, and analysis by a geotechnical engineer. As such, new infrastructure would be designed to withstand the effects of expansive soils. All structures would be designed and built according to applicable regulations and codes stipulated in the CBC (CCR Title 24, Part 2 [MOTEMS]), the IBC, and standards for railway design (see list provided in GSS-4 above). The required design and constraints would ensure that unacceptable risk from expansive soils would be reduced to levels consistent with professional engineering practices and public health and safety standards. Accordingly, impacts from soil expansion would be less than significant.

Mitigation Measure: No mitigation required.

Impact GSS-8: Cause adverse effects to natural resources as a result of disposal of dredged material during ongoing maintenance of the navigation channel. (Less than significant.) Impacts from the disposal of dredged sediment could occur if the dredged material were placed on a natural geologic resource, rendering it inaccessible and/or unsuitable for future use. This is not expected to be the case, as sediment samples collected from the proposed dredging area indicate that the dredged material would be suitable for disposal at either an upland disposal site on Winter Island or within the Montezuma Wetlands (see Appendix A). No disposal activities would occur until approval has been obtained from the appropriate regulatory agencies.

Mitigation Measure: No mitigation required.

Impact GSS-9: Cause the loss of availability of a known mineral resource that is of value to the region or locally. (No impact.) According to the State Mines and Geology Board SMARA Designation Report No. 7, the only MRZ-2 areas within Contra Costa County are located in the cities of Antioch and Byron. The vicinity of the project is classified as MRZ-1; no significant mineral deposits are present and/or the likelihood of their presence is small.

Mitigation Measure: No mitigation required.

9.2.3.2 Alternative 1: Reduced Onshore Storage Capacity

Construction-related Impacts

Impact GSS-10: Cause substantial soil erosion or compaction. (Less than significant.) Land-disturbing construction activities would be the same under Alternative 1 as for the proposed project. Refer to Impact GSS-1.

Mitigation Measure: No mitigation required.

Impact GSS-11: Cause adverse effects to natural resources as a result of disposal of dredged material during restoration of the navigation channel. (Less than significant.) Dredging and disposal activities during construction would be the same under Alternative 1 as for the proposed project. Refer to Impact GSS-2.

Mitigation Measure: No mitigation required.

Operational Impacts

Impact GSS-12: Expose people or structures to surface faulting, resulting in substantial structural damage and risk of injury or loss of life. (Less than significant.) Under Alternative 1, the impacts due to surface faulting would be the same as for the proposed project. Although Tanks 1 though 6 would not be in use, there would be no reduction in impacts to the project overall because the storage facility is not within an Alquist-Priolo Zone; therefore, in either case the potential for damage from surface fault displacement at the storage facility is very low to non-existent. Portions of the San Pablo Bay Pipeline are located within an Alquist-Priolo Zone where the pipeline crosses the active Concord-Green Valley fault (refer to Figure 9-4). Even with fewer storage tanks in operation at the facility, the San Pablo Bay Pipeline would be vulnerable to surface displacements during an earthquake, similar to the proposed project.

However, as discussed in Impact GSS-3, the required design and constraints would ensure that unacceptable risk from surface faulting would be reduced to levels consistent with professional engineering practices and public health and safety standards. Accordingly, impacts from surface faulting would be less than significant.

Mitigation Measure: No mitigation required.

Impact GSS-13: Expose people or structures to strong ground shaking, causing substantial structural damage and risk of injury or loss of life. (Less than significant.) Due to the site's proximity to earthquake faults and the characteristics of the soil profile, there is a high risk of strong ground shaking in the event of a large-magnitude earthquake in the project vicinity. The risk of a release following structural damage is somewhat reduced because Tanks 1 through 6 would not be in use; however, the risk of damage to the other project facilities and pipelines would be the same as for the proposed project (refer to Impact GSS-4). However, as discussed under Impact GSS-4, the required design and constraints would ensure that unacceptable risk from ground shaking would be reduced to levels consistent with professional engineering practices and public health and safety standards. Accordingly, impacts from ground shaking would be less than significant.

Under Alternative 1, the risk of damage to Tanks 1 through 6 may be greater than for the proposed project, as seismic upgrades to these tanks would not occur. However, as these tanks would not be operational, the risk of injury, loss of life, or a release is less than significant.

Mitigation Measure: No mitigation required.

Impact GSS-14: Expose people or structures to the risk of loss, injury, or death as a result of tsunamis and/or seiches. (Less than significant.) Impacts from tsunamis and seiches would be the same under Alternative 1 as for the proposed project. Refer to Impact GSS-5.

Mitigation Measure: No mitigation required.

Impact GSS-15: Cause substantial soil erosion or compaction. (Less than significant.) Facility operations that would cause soil erosion or compaction would be the same as for the proposed project. Refer to Impact GSS-6.

Mitigation Measure: No mitigation required.

Impact GSS-16: Construct structures or facilities on expansive soils, creating major risks to life and/or risk of property damage. (Less than significant.) The presence of new structures and facilities on expansive soils would be the same as for the proposed project. Refer to Impact GSS-7.

Mitigation Measure: No mitigation required.

Impact GSS-17: Cause adverse effects to natural resources as a result of disposal of dredged material during ongoing maintenance of the navigation channel. (Less than significant.) Impacts on natural resources from the disposal of dredged material would be the same under Alternative 1 as for the proposed project. Refer to Impact GSS-8.

Mitigation Measure: No mitigation required.

Impact GSS-18: Cause the loss of availability of a known mineral resource that is of value to the region or locally. (No impact.) According to the State Mines and Geology Board SMARA Designation Report No. 7, the only MRZ-2 areas within Contra Costa County are located in the cities of Antioch and Byron. The vicinity of the project is classified as MRZ-1; no significant mineral deposits are present and/or the likelihood of their presence is small.

Mitigation Measure: No mitigation required.

9.2.3.3 Alternative 2: No Project

Impact GSS-19: Expose people or structures to surface faulting, resulting in substantial structural damage and risk of injury or loss of life. (Less than significant.) Under Alternative 2, as for the proposed project and Alternative 1, impacts to the storage facility due to surface faulting are not expected, as the areas are not within an Alquist-Priolo Zone. Portions of the existing San Pablo Bay Pipeline are located within an Alquist-Priolo Zone, where the pipeline crosses the active Concord-Green Valley fault (refer to Figure 9-4), and would still be vulnerable to surface displacements during an earthquake. However, the pipeline would not be in use. Therefore, structural damage would not result in an oil release, and no damage to water quality or biological resources would occur. Hazards associated with released oil would also not be present.

Mitigation Measure: No mitigation required.

Impact GSS-20: Expose people or structures to strong ground shaking, causing substantial structural damage and risk of injury or loss of life. (Less than significant.) Due to the site's proximity to earthquake faults and the characteristics of the soil profile, there is a high risk of strong ground shaking in the event of a large-magnitude earthquake in the project vicinity. There may be a somewhat higher risk of structural damage to existing tanks and on-site pipelines, as these would not be seismically upgraded under Alternative 2. However, there is no risk of a release following structural damage, as tanks and pipelines would not be in use. This impact would be less than significant.

Mitigation Measure: No mitigation required.

Impact GSS-21: Expose people or structures to the risk of loss, injury, or death as a result of tsunamis and/or seiches, cause substantial soil erosion or compaction, construct structures or facilities on expansive soils, creating major risks to life and/or risk of property damage, or cause adverse effects to natural resources as a result of disposal of dredged material. (No impact.) Under Alternative 2, existing facilities would remain in place at the Terminal. No new construction or operations would occur. Therefore, there would be no impacts associated with compaction or erosion of site soils during construction, or disposal of dredged materials (refer to Impacts GSS-1 and GSS-2). Additionally, there would be no operational impacts due to erosion, expansive soils, tsunamis/seiches, or maintenance dredging (refer to Impacts GSS-5, GSS-6, GSS-7, and GSS-8).

Mitigation Measure: No mitigation required.

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