3.6 GEOLOGY AND SOILS

GEOLOGY AND SOILS - Would the Project:	**Potentially Significant Impact**	**Less Than Significant with Mitigation**	**Less Than Significant Impact**	**No Impact**
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒

3.6.1 Environmental Setting

The following setting is based primarily upon the geologic information included within a desktop study performed by Fugro West, Inc. (2006) (see Appendix C).

3.6.1.1 Regional Setting

The study area lies along the western margin of the Central Valley in the Great Valley geomorphic province bounded to the west by the northwest-trending mountain ranges and valleys of the Coast Ranges Province. Together, the Sacramento and San Joaquin

Rivers drain most of the Central Valley, emptying westward into the upper part of San Francisco Bay through the Sacramento - San Joaquin Delta and the Carquinez Strait.

The western margin of the Great Valley, the Coast Ranges-Great Valley geomorphic boundary, is underlain by a system of folds and seismically active thrust faults. This tectonic boundary separates the relatively undeformed sediment-fill of the Great Valley from the highly deformed rocks of the Coast Ranges. In the study area, the basement rocks of the Great Valley Sequence are overlain by younger fluvial (river-deposited) and eolian (wind-deposited) sediments that are hundreds of feet thick. These sediments are primarily layered clays, silts, sands, and gravels, derived from the Coast Ranges and Sierra Nevada far to the east, and deposited in alluvial fans, flood plains, flood basins, and lake and marsh environments.

The nearest earthquake faults to the Project area are the Concord-Green Valley Fault, which is located approximately 15 miles west of the Project site, and the Greenville Fault, which is located approximately 12 miles southwest of the Project site.

3.6.1.2 Site-Specific Setting

Onshore

Holocene-age peat and muddy peat (Qhpm) deposited in tidal wetlands comprise the surficial geologic units on Sherman Island north of the San Joaquin River. These deposits are the time equivalents of the bay mud. Eolian dune deposits comprise the fine grained, very well-sorted, well-drained sand that are the predominate geologic unit (Qds) south of the San Joaquin River. Within the Lauritzen Yacht Harbor area, modern artificial fill deposits (af), comprise the levee and improved shoreline soils, and are often derived from dredge spoils from the surrounding rivers and marshes. Sediments on the modern river bed are laterally discontinuous deposits of predominately sand, with clay, silt, and gravel that locally may be reworked by variable flow and sediment load conditions.

The urban and wetland soils at the onshore portion of the Project site(s) are mapped as highly or very highly susceptible to liquefaction. The Project site has been assigned a ground shaking rating of 50 to 70 (very strong shaking) by the Association of Bay Area Governments based on information compiled by the U.S. Geological Survey, California Geological Survey, and others (CSLC 2013).

Offshore

Divers observed predominately sandy river bed sediments, with occasional clay and mud (mixed silt and clay), along the pipeline routes. Diver observations of mud were limited to the river bed adjacent to the northern river margin within the Project corridor.

The river bed sediments gradually transitioned to fine sand and sand toward the center of the channel. Mixed sand and clay were noted along the Line 114, Line 114-1, and Line SP4Z pipeline route between approximately 540 and 600 feet from the northern river margin, while the river bed along the rest of the route was described as "sandy."

Riverbed Morphology

Throughout the Project area, well-formed, mobile sediment waves and longitudinal bars are observed on the river bed. Sand waves with amplitudes of 1 to 4 feet were observed by divers and visible in the bathymetry and side-scan sonar survey data. The wave crests are oriented generally transverse to the direction of downstream flow. Sand wave wavelengths are variable across the river channel, but are generally between 20 and 60 feet.

Observed Scour

An elongate depression (defined by the 40 feet contour) extends from approximately 25 feet west of the middle PG&E pipeline group (Line 114, Line 114-1, and Line SP4Z) downstream for about 1,000 feet, and measures about 600 feet wide at the widest point under the bridge structure. The water depths in the depression around the bridge piers are up to 14 feet deeper than the average ship channel depths of about 36 feet. Notably, the bridge piers on either side of the deep water ship channel are larger than the piers under the rest of the over-water bridge sections. Scour pits observed around the smaller bridge piers are roughly 100-foot-diameter depressions that are 5 to 10 feet deeper than the surrounding river bed.

Along the pipeline corridor route, survey bathymetric data indicate an elongate, steep-sided depression where water depths are 40 feet or deeper along the northern river margin. The depression measures 65 feet wide and 85 feet long, and is oriented parallel to the river channel axis. The depression is nearly continuous with the larger depression observed under the Antioch bridge to the west. Divers reported sandy bottom sediments in the area. A second, shallower (4 foot) depression is located closer to the river bank and has a maximum water depth of 30 feet.

Exposed and suspended pipelines were observed by divers north of the deep water ship channel. The three pipelines had various lengths of exposure and suspension along their respective routes, with observed spans between 55 feet and 75 feet long and suspended heights along the river bottom of eight feet. The areas of exposure and spanning were located by divers as between 366 and 666 feet from the pipeline crossing marker located on the northern San Joaquin River shoreline, limits generally confirmed with underwater survey data acquired by Fugro (2006).

3.6.2 Regulatory Setting

3.6.2.1 Federal and State

Federal and State laws and regulations pertaining to this issue area and relevant to the Project are identified in Table 3.6-1.

Table 3.6-1. Laws, Regulations, and Policies (Geology and Soils)

CA	Alquist-Priolo Earthquake Fault Zoning Act (Pub. Resources Code, §§ 2621-2630)	This Act requires that "sufficiently active" and "well-defined" earthquake fault zones be delineated by the State Geologist and prohibits locating structures for human occupancy across the trace of an active fault.
	California Building Code (CBC) (Cal. Code Regs., tit. 23)	The CBC contains requirements related to excavation, grading, and construction of pipelines alongside existing structures. A grading permit is required if more than 50 cubic yards of soil are moved. Sections 3301.2 and 3301.3 contain provisions requiring protection of adjacent properties during excavations and require a 10-day written notice and access agreements with adjacent property owners.
	California Seismic Hazards Mapping Act (Pub. Resources Code, § 2690 and following as Division 2, Chapter 7.8)	This Act and the Seismic Hazards Mapping Regulations (Cal. Code Regs., tit. 14, Div. 2, Ch. 8, Art. 10) are designed to protect the public from the effects of strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. The Act requires that site-specific geotechnical investigations be conducted identifying the hazard and formulating mitigation measures prior to permitting most developments designed for human occupancy. Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California (California Geological Survey 2008), constitutes guidelines for evaluating seismic hazards other than surface fault rupture and for recommending mitigation measures as required by section 2695, subdivision (a).

3.6.2.2 Local

Sacramento County

The Safety Element of the Sacramento County General Plan 2005-2030 (County of Sacramento 2011) includes goals and policies to address seismic hazards within the County. The primary goal is to minimize the loss of life, injury, and property damage due to seismic and geological hazards. There are no specific policies that are applicable to the proposed Project.

Contra Costa County

The Safety Element of the Contra Costa County General Plan 2005-2020 (County of Contra Costa 2010) includes goals and policies to address seismic hazards within the County. There are no seismic hazard goals or policies that are applicable to the Project site.

City of Oakley

The City's 2020 General Plan Health and Safety Element identifies the goals and policies related to seismic and other earth movement hazards. The primary goal (8.1) is to protect human life, reduce the potential for serious injuries, and minimize the risk of property losses from the effects of earthquakes, including fault rupture, ground shaking, and liquefaction-induced ground failure. There are no policies applicable to the proposed Project.

3.6.3 Impact Analysis

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

(i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

No Impact. The Project site is not located within or adjacent to a delineated Alquist-Priolo Earthquake Fault Zone. The nearest earthquake fault is the Greenville Fault, which is located 12 miles southwest of the Project site. However, no structures are proposed as part of the Project that could be affected by earthquake activity. No impact would result.

(ii) Strong seismic ground shaking?

No Impact. Although the Project site is located in an area that is subject to strong seismic ground shaking, the proposed removal of the previously abandoned pipelines and valve box would not create substantial adverse effects to people or structures related to ground shaking. No impact would result.

(iii) Seismic-related ground failure, including liquefaction?

No Impact. Although the Project site is located in an area that is moderately to very highly susceptible to liquefaction, removal of the previously abandoned pipelines and valve box would not create substantial ground-failure or liquefaction effects to people or structures. No impact would result.

(iv) Landslides?

No Impact. The Project site(s), including the proposed shore base at Mare Island, are flat and not subject to landslides.

b) Result in substantial soil erosion or the loss of topsoil?

Less Than Significant Impact. During removal and abandonment of the pipelines and northern valve box; soils within the levee and leading to the valve box at Sherman Island would be temporarily disturbed. However, upon completion of removal activities, all soils would be backfilled with native soils and the Project site would be restored in accordance with CVFPB/RD 341 standards. No significant impact would result. Additional information regarding potential soil erosion is discussed in Section 3.9, Hydrology and Water Quality.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

No Impact. The Project would remove portions of unused and previously abandoned pipelines from the Lauritzen Yacht Harbor valve box across the San Joaquin River through the Sherman Island levee to a valve box on the northern bank of Sherman Island. Although portions of this area are subject to liquefaction, no structures would be constructed on a geologic unit or soil that is unstable or would become unstable. No impact would result.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

No Impact. The Project would remove portions of inactive pipelines from the Lauritzen Yacht Harbor valve box across the San Joaquin River through the Sherman Island levee to a valve box on the northern bank of Sherman Island. No structures would be constructed that would create a substantial risk to life or property if they failed due to the presence of expansive soils. No impact would result.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

No Impact. No septic tank or wastewater disposal systems are proposed.

3.6.4 Mitigation Summary

The Project would not result in significant impacts to geology; therefore, no mitigation is required.