Section 3.4
Geology & Soils

SECTION SUMMARY

The Geology and Soils section evaluates the potential impacts of the Proposed Project and alternatives related to geological and soil conditions at the Project site. The primary features of the Proposed Project that could involve geology and soils include the construction, on currently-vacant land, of raw material and product storage facilities, and operation of a new facility that would receive and stockpile large quantities of dry bulk raw materials (granulated blast furnace slag [GBFS] and gypsum) and process those materials into a dry-bulk product (i.e., a type of cement) that would be stored in silos pending loading onto trucks.

Section 3.4, Geology and Soils, provides the following:

- A description of existing conditions at the Project site;
- A description of existing regulations and policies relevant to geology and soils;
- An impact analysis of both the Proposed Project and alternatives; and
- A description of any mitigation measures proposed to reduce any potential impacts, as applicable.

The Initial Study/Notice of Preparation (IS/NOP) for the Proposed Project concluded that impacts related to CEQA Guidelines Appendix G checklist issues VII a, b, and d through f, would be either less than significant or there would be no impact. Accordingly, the analysis in this Draft Environmental Impact Report (EIR) considers only checklist issue VIIc: *Would the project 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 an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?*

Key Points of Section 3.4

The Proposed Project would involve driving piles to support buildings and silos that would be constructed on potentially unstable soils. The Proposed Project site is in an area of known seismic activity, being close to several known faults, and consists of dredged and imported fill materials placed over native bay muds and sands. The geotechnical analysis for the Proposed Project (Geosyntec 2022) identified ground shaking, soil liquefaction, subsidence, and lateral soil movement during a seismic event as the primary geotechnical risk issues. The report also identified the design features and construction methods necessary to reduce those risks to acceptable levels. Because those measures would be incorporated into the Proposed Project, the Reduced Project Alternative (Alternative 2), and the Product Import Terminal Alternative (Alternative 3), impacts of the Proposed Project and Alternatives 2 and 3 would be less than significant. Because there would be no construction and no resultant structures or activity at the site under the No Project Alternative (Alternative 1), that alternative would have no impacts.

3.4.1 Introduction

This analysis presents the geologic conditions for the Proposed Project area and analyzes: seismic hazards related to potentially unstable soils and slopes. The Initial Study/Notice of Preparation (Appendix A) concluded that impacts related to seismic hazards and other geological conditions would be less than significant. However, because a site-specific geotechnical analysis had not been completed at the time the Initial Study/Notice of Preparation was released, the risks associated with unstable soils are evaluated in this draft EIR.

3.4.2 Environmental Setting

The Proposed Project site, located at Berths 191-194 (Figure 2-1 in Chapter 2 Project Description) in the United States Geological Survey (USGS) 7.5-minute Torrance topographic quadrangle map, occupies approximately 6.1 acres adjacent to the East Basin of Los Angeles Harbor. Formerly occupied by a succession of water-related uses, the site is now largely vacant. Although, a small portion of the site is occupied by a boat restoration operation, loading and unloading of supplies for barges, tugs, and work vessels, and a Port equipment storage site. The site was constructed in the 1920s from dredged material and imported fill and is essentially flat, with very little variation in elevation across the entire 6.1 acres.

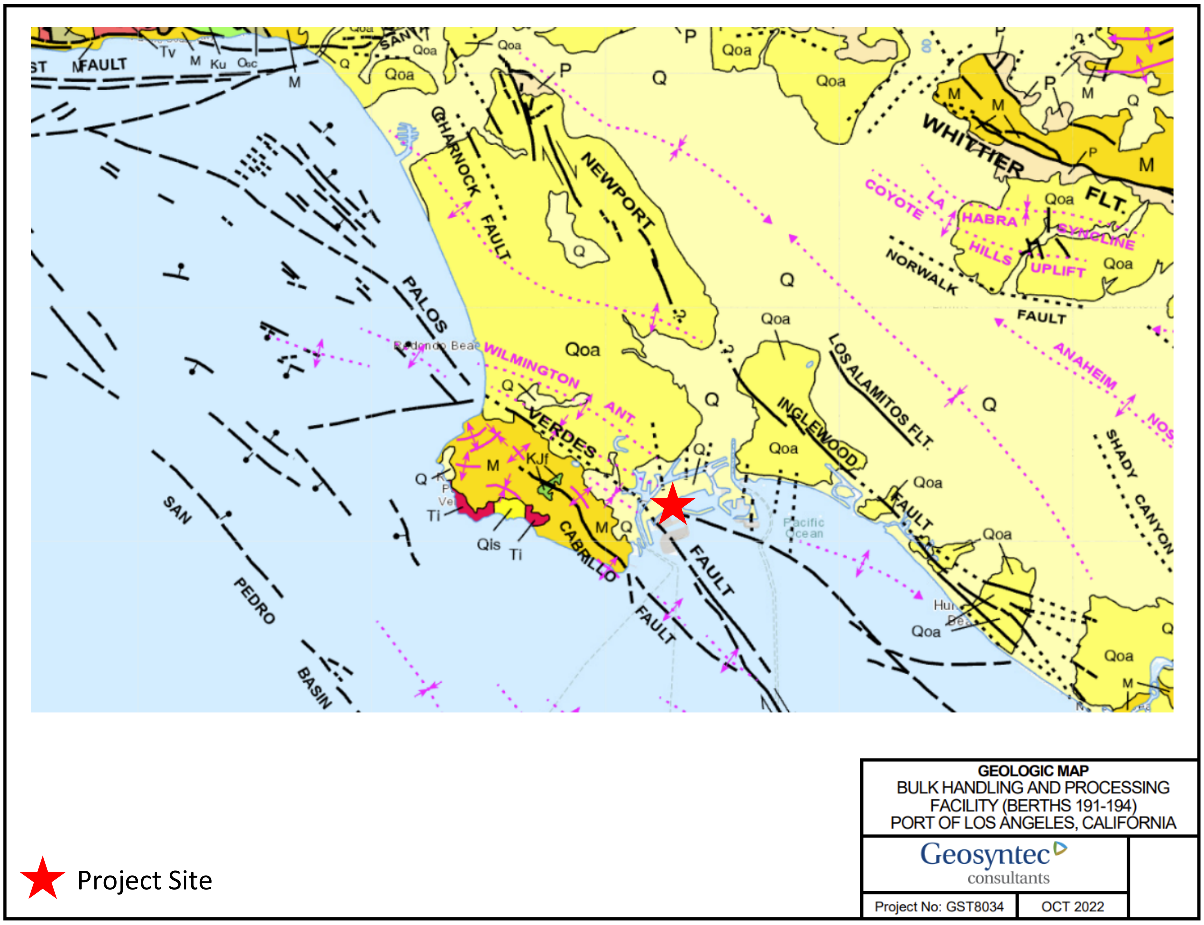
The site is located within the southwestern structural block of the Los Angeles Basin Province (Yerkes et al. 1965). The site is near sea level on approximately 18 to 20 feet of artificial fill that was deposited on top of the native Holocene alluvial outwash materials, Pleistocene terrace deposits, and Pleistocene Palos Verdes Sand. The southwestern block (Figure 3.4-1) is bounded on the east by the Newport-Inglewood Structural Zone, which can be traced from Beverly Hills to Newport Bay, where it trends offshore.

3.4.2.1 Seismicity and Faulting

An earthquake is classified by the magnitude of wave movement (related to the amount of energy released), which traditionally has been quantified using the Richter scale. This is a logarithmic scale, wherein each whole number increase in Richter magnitude (M) represents a tenfold increase in the wave magnitude generated by an earthquake. A Richter magnitude 8.0 earthquake is not twice as large as a M4.0 earthquake; it is 10,000 times larger (i.e., 10^4, or 10 x 10 x 10 x 10). Damage typically begins at M5.0. Earthquakes of M6.0 to 6.9 are classified as moderate; those between 7.0 and 7.9 are classified as major; and those of 8.0 or greater are classified as great.

Southern California is recognized as one of the most seismically active areas in the United States. The region has been subjected to at least 52 earthquakes of M6.0 or greater since 1796. Ground motion in the region is generally the result of sudden movements of large blocks of the earth's crust along faults. Great earthquakes, like the 1857 San Andreas Fault earthquake (see Table 3.4-1), are quite rare in Southern California. Earthquakes of magnitude 7.8 or greater occur at the rate of about two or three per 1,000 years, corresponding to a 6 to 9 percent probability in 30 years. However, the probability of a magnitude 7 or greater earthquake in the Los Angeles region before 2045 has been estimated at 45 percent (WGCEP 2015).

Figure 3.4-1. Project Site in the Southwestern Structural Block (Geosyntec, 2022)



The numerous faults in Southern California include active, potentially active, and inactive faults. As defined by the Department of Conservation, active faults are faults that have ruptured during the Holocene (approximately the last 11,000 years). Potentially active faults are those that show evidence of movement during Quaternary time (approximately the last 1.6 million years), but for which evidence of Holocene movement has not been established. Inactive faults have not ruptured in the last approximately 1.6 million years. Major active fault zones within approximately 20 miles of the Project site (CGS 2015) include the Cabrillo, Palos Verdes, and Newport-Inglewood faults in the vicinity of the Port (Figure 3.4-1), and the Whittier-Elsinore, Malibu-Santa Monica-Raymond Hill (includes the Santa Monica, Hollywood, and Malibu Coast faults) and Cucamonga fault zones to the east. The San Andreas fault zone lies approximately 60 miles east of the Proposed Project site. Table 3.4-1 provides a summary of the key characteristics of the listed major active faults within 60 miles of the Project site.

The Cabrillo fault underlies the Palos Verdes Peninsula west of the Project site, and its seaward portion is considered active (CGS 2015). The Palos Verdes fault zone trends southeast-northwest through Los Angeles Harbor, approximately 1.3 mile southwest of the Project site, and the portion from I-110 southward is considered active (CGS 2015). Northeast of the Project site, the Newport-Inglewood fault zone trends northwest-southeast and is considered active throughout the region (CGS 2015). Based on the proximity of the Project site to known active faults, it is reasonable to expect that a strong ground motion seismic event (earthquake) will occur during the lifetime of the Proposed Project. Under the assumption that the Project site consists of alluvium, CDMG (1998) predicts a 10% exceedance in 50 years peak ground acceleration of 0.52 of the force of gravity in a magnitude 7.1 predominant earthquake.

3.4.2.2 Liquefaction

Liquefaction is a phenomenon in which soil loses its shear strength for short periods of time during an earthquake. Ground shaking of sufficient duration results in the loss of grain-to-grain contact, due to a rapid increase in pore water pressure, causing the soil to behave as a fluid for short periods of time. The effects of liquefaction may include excessive total and/or differential settlement for structures founded in the liquefying soils. To be susceptible to liquefaction, a soil is typically cohesionless, with a grain-size distribution of a specified range (generally sand and silt), loose to medium dense, below the groundwater table, and subjected to a sufficient magnitude and duration of ground shaking.

Table 3.4-1. Major Regional Active Faults within 60 miles of the Proposed Project Site.

Fault	Magnitude	Fault Mechanism	Slip Rate (mm/yr)	Approximate Distance From the Proposed Project Site (miles [kilometers])
Compton Thrust Fault	7.5	RV	0.90	3.3 (5.3)
Palos Verdes Fault Zone	7.4	SS	3.00	0.9 (1.5)
Newport-Inglewood-Rose Canyon Fault Zone	7.2	SS	1.00	5.3 (8.4)
Puente Hills	7.1	RV	0.90	15 (24.1)
Whittier-Elsinore Fault Zone	7.0	SS	2.50	20.1 (32.1)
Elysian Park (Upper)	6.7	RV	1.90	21.2 (33.9)
Santa Monica Fault	6.8	SS	1.00	22 (35.1)
San Andreas Fault	7.2	SS	34.00	105.1 (168.1)

Notes:
Magnitude is the mean characteristic magnitude calculated using the Ellsworth-B magnitude-area scaling relationship.
Fault geometry, mechanism, and geologic slip rate information is based on the UCERF3 source model (Field et al, 2013).
Mechanisms: SS = strike-slip, RV = reverse, RVO = reverse oblique, NM = normal, NMO = normal oblique.
R_{RUP} is the closest distance from the site to the fault plane.
Reference: Field, E.H., et al. (2013)

According to the Department of Conservation's Seismic Hazard Zone Report, the Project site is in an area considered susceptible to liquefaction. The site is located on artificial fill that overlies "estuarine and alluvial deposits that have a high liquefaction susceptibility" (CDMG 1998). The site-specific geotechnical study (Geosyntec 2022) confirmed the presence of soils subject to liquefaction throughout the site. As noted above, there is a high probability that the area will experience a major earthquake during the next 30 years. Extended duration of ground shaking could result in liquefaction and settlement of saturated subsurface materials. The potential damaging effects of liquefaction include differential settlement, loss of ground support for foundations, ground cracking, and heaving and cracking of structure slabs.

3.4.2.3 Soil Conditions

Prior to development of the Los Angeles Harbor, extensive estuarine deposits were present at the mouth of Bixby Slough, Dominguez Channel, and the Los Angeles River, in the general vicinity of the Project site. During harbor development in the first half of the 20th Century, the estuarine deposits were mostly covered with artificial fill consisting of dredged sediments and imported natural alluvial soils. According to the site-specific geotechnical study (Geosyntec 2022), soil borings advanced to 95 feet below the ground surface (bgs) identified approximately 18 to 20 feet of sandy fill material overlying layers of native soils alternating between fine-grained silts and clays potentially subject to liquefaction and coarser-grained sands and silty sands.

The site-specific geotechnical study concluded that because of the shallow groundwater (approximately 5 feet bgs) and the mostly coarse-grained nature of the surface soils, expansive soils do not pose a hazard to development at the Project site. No other geological hazards were identified by the site-specific geotechnical study.

3.4.3 Applicable Regulations

Regulatory guidelines regarding geologic hazards and mineral resources on and around the Proposed Project area are promulgated by the State of California and the City of Los Angeles. These regulations are summarized below.

3.4.3.1 State Regulations and Standards

The California Building Standards Code is promulgated under California Code of Regulations (CCR), Title 24, Parts 1 through 12 and is administered by the California Building Standards Commission (CBSC). The CBSC is responsible for administering California's building codes.

The Alquist-Priolo Fault Zoning Act was enacted in 1972 by the State of California (Pub. Res. Code sections 2621 et seq.) to mitigate the damage caused by fault rupture during an earthquake. Under this act, faults throughout the state have been evaluated for surface rupture potential during an earthquake event, and Earthquake Fault Zones have been established around active faults (Hart and Bryant 1997).

The Seismic Hazards Mapping Act of 1990 was passed by the State legislature to aim at reducing the threat to public safety and minimizing potential loss of life and property in the event of a damaging earthquake event. A product of the resultant Seismic Hazards Mapping Program, Seismic Zone Hazard Maps have been developed which identify Zones of Required Investigation; most developments designed for human occupancy within these zones must conduct site-specific geotechnical investigations to identify the hazard and develop appropriate mitigation measures prior to permitting by local jurisdictions. Public Resources Code sections 2690–2699.6 direct the State Department of Conservation to identify and map areas subject to earthquake hazards, such as liquefaction, earthquake-induced landslides, and amplified ground shaking.

3.4.3.2 City of Los Angeles Regulations and Standards

The City of Los Angeles General Plan contains conservation and safety elements for the protection of geologic features and avoidance of geologic hazards. The procedures for construction-related earthwork and excavation are established by local grading ordinances.

The City of Los Angeles Municipal Code has established building codes and design standards for buildings located within the city limits. The City of Los Angeles Building Code, sections 91.000 through 91.7016 of the Los Angeles Municipal Code, regulates construction in the City of Los Angeles. Provided in these building codes are the requirements for construction, grading, excavations, use of fill, and foundation work, including design and material type. These codes are intended to limit the probability of the occurrence and severity of the impact from geologic hazards (i.e., earthquakes). The Los Angeles Municipal Code also incorporates structural seismic requirements from the California Building Code.

3.4.4 Impacts and Mitigation Measures

3.4.4.1 Methodology

The potential impacts on the Proposed Project and alternatives have been evaluated with respect to the geologic environment and soils, and are addressed in two ways: 1) evaluation of the impacts of the Proposed Project on the local geologic environment; and 2) impacts of geohazards related to the Proposed Project that may result in damage to structures, infrastructure, or exposure of the population to substantial risk of injury.

CEQA Baseline

The CEQA Guidelines (§15125) require EIRs to include a description of the physical environmental conditions in the vicinity of a project that exist at the time of the NOP. The NOP for the Proposed Project was published in late 2021; accordingly, the LAHD has determined that 2021 is the baseline year for the CEQA analysis. The CEQA baseline conditions are described in Section 2.6. In 2021, the Project site was largely vacant and activity consisted of occasional light vehicles and maintenance equipment activity. Small amounts of maintenance materials were stored on the site, so ground loading was minimal.

3.4.4.2 Thresholds of Significance

The following criteria are based on the CEQA Appendix G Thresholds and are the basis for determining the significance of impacts associated with geology and soils (CEQA Appendix G Issue VI) resulting from development of the Proposed Project or an alternative. The IS/NOP for the Proposed Project issued on March 10, 2022, concluded that the Proposed Project would have no impact or that impacts would be less than significant for the following CEQA issues:

a) Would the project directly or indirectly cause 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) Would the project result in substantial soil erosion or the loss of topsoil?

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

e) Would the project have soils that are incapable of supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?

f) Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Accordingly, these issues are not included in the Draft EIR.

Because the Proposed Project would be located on artificial fill and the site-specific geotechnical evaluation was not yet completed at the time of the IS/NOP's release, the IS/NOP concluded that the issue of potentially unstable soils should be evaluated in the Draft EIR. Accordingly, significance threshold GEO-1, below, analyzes CEQA Guidelines Appendix G issue VI(c).

GEO-1: Would the Project 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?

3.4.4.3 Impact Determination

Proposed Project

Impact GEO-1: Would the Project 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?

The Proposed Project would place heavy loads (i.e., GBFS stockpile, grinding mill, product storage silos, and truck loading facility) on soils containing units subject to liquefaction, settlement, and lateral slope displacement during a seismic event. Those risks raise the possibility of damage to structures and infrastructure, including the seawall along Berths 192-194.

The site-specific geotechnical report (Geosyntec 2022) concluded that the Proposed Project could be safely implemented with incorporation of specific engineering methods to address the geotechnical risks. Specifically, the report recommended that soils beneath the heaviest components (i.e., the grinding mill, product storage silo, GBFS stockpile, and truck loading/weighing building) be stabilized, and their shear strength and load-bearing capacities enhanced, by stone columns or deep soil mixing. Stone columns are an engineering technique in which drilled holes filled with aggregate are installed under a structure in a grid pattern. The report also recommended that the central support for the GBFS stockpile spreader be supported by pilings extending to approximately 90 feet bgs.

Appropriate placement of stone columns would also reduce the potential for lateral displacement to the extent that the seawall would not be compromised. Incorporation of these recommendations into the Proposed Project would reduce geotechnical risks to acceptable levels.

Impact Determination

Because the Proposed Project would incorporate engineering design elements that would increase soil stability and substantially reduce the risk of lateral spreading, subsidence, liquefaction and collapse, impacts would be less than significant. The flat topography of the Proposed Project site eliminates the potential for landslides.

Mitigation Measures

No mitigation is required.

Residual Impacts

Impacts would be less than significant.

Alternative 1 – No Project

Under the No Project Alternative (Alternative 1), no construction or operational activities would take place. The Proposed Project site would continue to be largely vacant, likely used, as at present, for temporary storage and other small-scale activities. The No Project Alternative (Alternative 1) would not preclude future improvements to the Berths 192-194 site. However, any future changes in use or new improvements that could have significant impacts on the environment would be analyzed in a separate environmental document.

Impact GEO-1: Would Alternative 1 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?

Under the No Project Alternative (Alternative 1), no improvements would be constructed. Accordingly, existing soil conditions would not be altered, and no structures would be placed that would be at risk from movement of unstable soil.

Impact Determination

Because the No Project Alternative (Alternative 1) would not increase the risk of landslides, lateral spreading, subsidence, liquefaction, or collapse, there would be no impact. The flat topography of the site eliminates the potential for landslides.

Mitigation Measures

No mitigation is required.

Residual Impacts

No impacts would occur.

Alternative 2 – Reduced Project

This alternative would differ from the Proposed Project in the total annual throughput of the facility, which in turn would affect the amount of raw materials and product that would be on site at any time and the activity levels of the facility (see section 2.7.1.2). However, the location of the storage piles and the size, number, and configuration of structures would be the same as for the Proposed Project, meaning that construction details and maximum ground loading would be the same as those of the Proposed Project.

Impact GEO-1: Would Alternative 2 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?

The Reduced Project Alternative (Alternative 2) would not differ from the Proposed Project in terms of soil and geotechnical conditions and in terms of the impacts of those conditions on the stability of the structures that would be constructed for the Reduced Project Alternative (Alternative 2). Accordingly, the Reduced Project Alternative (Alternative 2) would incorporate the design features and construction methods of the Proposed Project, which would reduce the potential for adverse soil conditions that could cause lateral spreading, subsidence, liquefaction, or collapse. As with the Proposed Project, the flat topography of the Project site eliminates the potential for landslides.

Impact Determination

Because the Reduced Project Alternative (Alternative 2) would incorporate the same design features and construction techniques as the Proposed Project, which would increase soil stability and substantially reduce the risk of lateral spreading, subsidence, liquefaction, and collapse, impacts would be less than significant.

Mitigation Measures

No mitigation is required.

Residual Impacts

Impacts would be less than significant.

Alternative 3 – Product Import Terminal

This alternative would differ from the Proposed Project in that raw materials (GBFS and gypsum) would not be stored on the site. Instead, imported product would be stored in a domed facility located approximately where the GBFS stockpile of the Proposed Project would be located (see section 2.7.1.3). Accordingly, ground loading at the Project site would be generally similar to that of the Proposed Project.

Impact GEO-1: Would Alternative 3 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?

Construction of the Product Import Terminal (Alternative 3) would employ the same soil stabilizing and strengthening techniques as described for the Proposed Project, modified to suit the specific layout of the Product Import Terminal (Alternative 3)'s facilities.

Impact Determination

Because the Product Import Terminal (Alternative 3) would incorporate construction techniques that would increase soil stability and substantially reduce the risk of lateral spreading, subsidence, liquefaction, and collapse, impacts would be less than significant. As with the Proposed Project, the flat topography of the site eliminates the potential for landslides.

Mitigation Measures

No mitigation is required.

Residual Impacts

Impacts would be less than significant.

3.4.4.4 Summary of Impact Determinations

Table 3.4-2 presents a summary of the impact determinations of the Proposed Project and alternatives related to geology and soils, as described above. This table is meant to allow easy comparison between the potential impacts of the Proposed Project and alternatives with respect to this resource. Identified potential impacts may be based on federal, state, or City significance criteria; LAHD criteria; and the scientific judgment of the report preparers.

For each impact threshold, the table describes the impact, notes the CEQA impact determination, describes any applicable mitigation measures, and notes the residual impacts (i.e., the impact remaining after mitigation). All impacts, whether significant or not, are included in this table.

Table 3.4-2: Summary Matrix of Potential Impacts and Mitigation Measures for Geology and Soils Associated with the Proposed Project and Alternatives

Alternative	Environmental Impacts	Impact Determination	Applied Mitigation/Lease Measures or Controls	Residual Impacts
Proposed Project	**GEO-1:** Would the Proposed Project 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?	Less than significant	No mitigation is required	Less than significant
Alternative 1 – No Project	**GEO-1:** Would Alternative 1 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?	No impact	Not applicable	No impact
Alternative 2 – Reduced Project	**GEO-1:** Would Alternative 2 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?	Less than significant	No mitigation is required	Less than significant
Alternative 3 – Product Import Terminal	**GEO-1**: Would Alternative 2 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 landslides, lateral spreading, subsidence, liquefaction, or collapse?	Less than significant	No mitigation is required	Less than significant

3.4.4.5 Mitigation Monitoring

In the absence of significant impacts associated with geology and soils, mitigation measures are not required.

3.4.5 Significant Unavoidable Impacts

No significant unavoidable impacts to geology and soils would occur as a result of construction or operation of the Proposed Project or any of the alternatives.

References

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