3.5 GEOLOGY

3.5.1 Introduction

This section provides information about the geologic conditions of the project site and surrounding area, and identifies potential geologic hazard impacts that have the potential to result from implementation of the Proposed Action. Potential geologic hazards that are evaluated include: ground rupture from fault movement, earthquake caused ground shaking, liquefaction, subsidence, tsunamis, seiches, and expansive soil and erosion. This section also evaluates the potential for the Proposed Action to result in significant impacts to mineral resources. Information regarding the geologic conditions of the Port (POLA) has been based on previously prepared reports and existing information sources.

3.5.2 Environmental Setting

Descriptions of geologic hazards that have the potential to adversely affect the project region, the Port, and development that would result from the Proposed Action are based on existing literature sources. Since seismic and soil hazards do not change substantially over short periods of time (geologic changes occur on the order of thousands and tens of thousands of years), the existing information sources provide a reasonable description of geological hazard conditions that existed in and around the Port in 2004.

3.5.2.1 Regional Geologic Setting

The Port is located in the southeastern portion of the Los Angeles Basin, a northwest-trending alluvial plain approximately 50 miles long and 20 miles wide. The project area is located along the northern portion of San Pedro Bay, which is formed by a westerly extension of the shoreline and the Palos Verdes Peninsula to the west. The Port is adjacent to the east side of the Palos Verdes Hills, which is a structural block that has been elevated along the Palos Verdes fault.

Except for LA-2, which is located in the Pacific Ocean approximately 5.8 miles from shore and lies approximately 360 ft to 1,115 ft below the water surface, all of the proposed disposal sites are located throughout the Port area and generally overlie recent sediments or artificial fill placed over Holocene alluvium and beach deposits. Underlying the Holocene sediments is the Miocene Monterey Formation.

3.5.2.2 Topography, Bathymetry, and Sediments

The Port consists of a network of upland/artificial fill areas, and deep channels and basins that have been created by dredge operations in the gradually sloping sediments that underlie the harbor. Upland areas within the harbor are generally one to five feet above mean sea level. Outside of the harbor, the gently sloping ocean floor does not reach depths of 70 to 75 feet until more than two miles from Queens Gate (USACE, 2000).

In addition to geotechnical studies conducted for the Deep Draft Navigation Improvements Project (Kinnetics 1991), sediment sampling was conducted to identify appropriate disposal site options for the Channel Deepening Project (Fugro West, Inc., 1997). Thirty-seven locations were sampled within areas of predominantly coarse-grained sediments (locations denoted by CG in Figure 3.5-1), and 45 locations were sampled within areas of predominantly fine-grained and formation sediments (locations denoted by FG and FM in Figure 3.5-1). The coarse-grained sediments consisted primarily of sand, with minor proportions of silt and clay, whereas the fine-grained and formation sediments consisted primarily of silt and clay, with lesser proportions of sand.

3.5.2.3 Seismicity and Faulting

The southern California region is seismically active and has experienced strong earthquake-related ground shaking during historic times. Due to the proximity and number of known faults in the project region, it is likely that a strong seismic event will occur in the project area during the lifetime of the disposal areas developed as part of the Proposed Action.

The Los Angeles Basin is cut by numerous geologically young faults. Known major faults located within 25 miles of the harbor area include the Palos Verdes fault system, Newport-Inglewood structural zone, Whittier-Elsinore fault zone and the Malibu-Santa Monica-Raymond Hill fault system. The San Andreas fault zone is located approximately 50 miles north of the project area and also has the potential to result in strong ground shaking effects in the Port area. The locations of the major faults in the project region are depicted on Figure 3.5-2. Additional information regarding each of the major regional faults is provided below and is summarized on Table 3.5-1.

Table 3.5-1 Significant Regional Faults

Fault	Distance from Project Areas (miles)	Maximum Credible Earthquake Magnitude (Richter)	Estimated Peak Horizontal Ground Acceleration (g)
Palos Verdes Fault Zone	0 to 2	7.0	0.42
Newport-Inglewood Structural Zone	5 to 7	7.0	0.34
Whittier-Elsinore Fault Zone	20	7.1	0.05-0.10
Malibu-Santa Monica-Raymond Hill Fault System	24	7.5	0.16-0.36
San Andreas Fault Zone	50	8.2	0.06-0.10

Source: Los Angeles Harbor Department, 2005

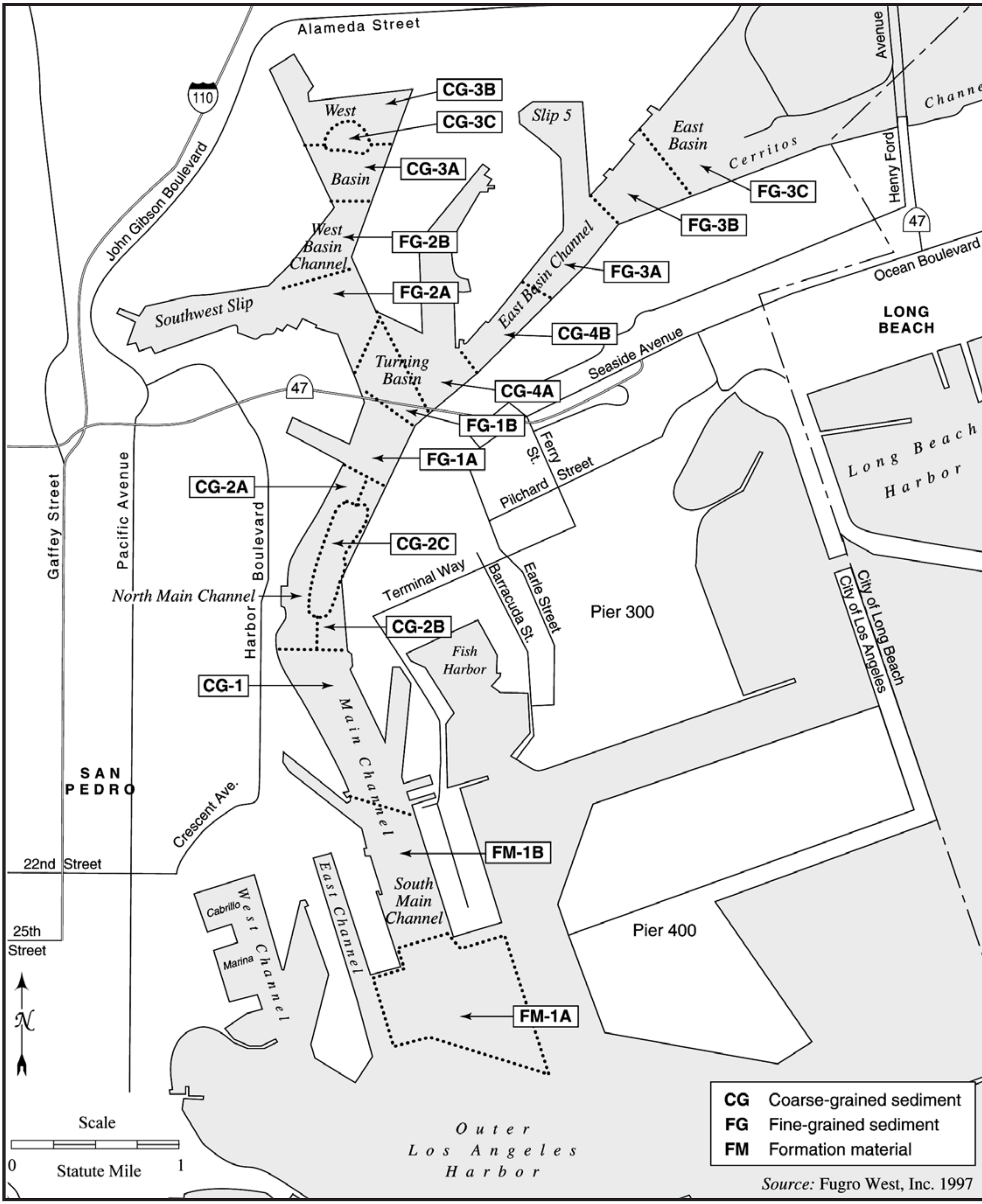
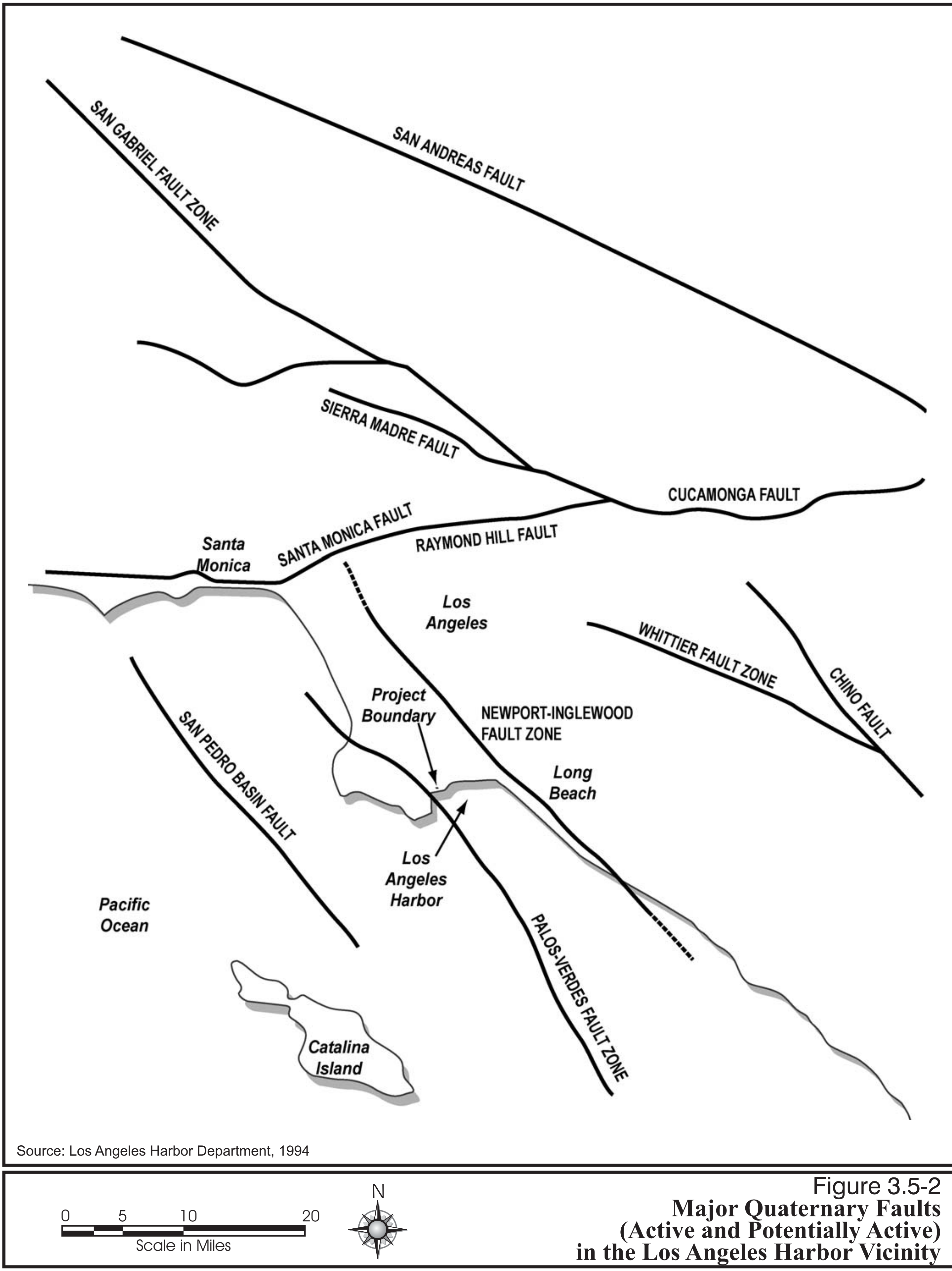


Figure 3.5-1
Sediment Sampling Areas



Source: Los Angeles Harbor Department, 1994

Figure 3.5-2
Major Quaternary Faults (Active and Potentially Active) in the Los Angeles Harbor Vicinity

Palos Verdes Fault Zone. Portions of the Palos Verdes fault zone have been mapped by different geologists as crossing the harbor area in several locations. In general, the suspected fault traces occupy a corridor approximately one-half mile wide that crosses the central portion of the harbor in a southeast to northwest direction. The suspected locations of the Palos Verdes fault are depicted on Figure 3.5-3.

The probability of a moderate or major earthquake along the Palos Verdes fault is low when compared to the potential for movements on either the Newport-Inglewood or San Andreas faults. However, this fault is capable of producing strong to intense ground motion and ground surface rupture. The Palos Verdes fault zone has not been designated as an Alquist-Priolo Special Studies Zone by the California Geological Survey; however, the segment of the fault zone that extends through the harbor area has been identified as a Fault Rupture Study Area by the City of Los Angeles General Plan, Safety Element (City of Los Angeles, 1996).

Newport-Inglewood Fault Zone. The Newport-Inglewood fault zone is approximately five to seven miles northeast of the project area and is a major tectonic structure within the Los Angeles Basin. This structural zone is composed of a series of step-like fault and subparallel fault segments and folds. The magnitude 6.3 Long Beach earthquake of 1933 occurred on an offshore portion of the Newport-Inglewood fault zone.

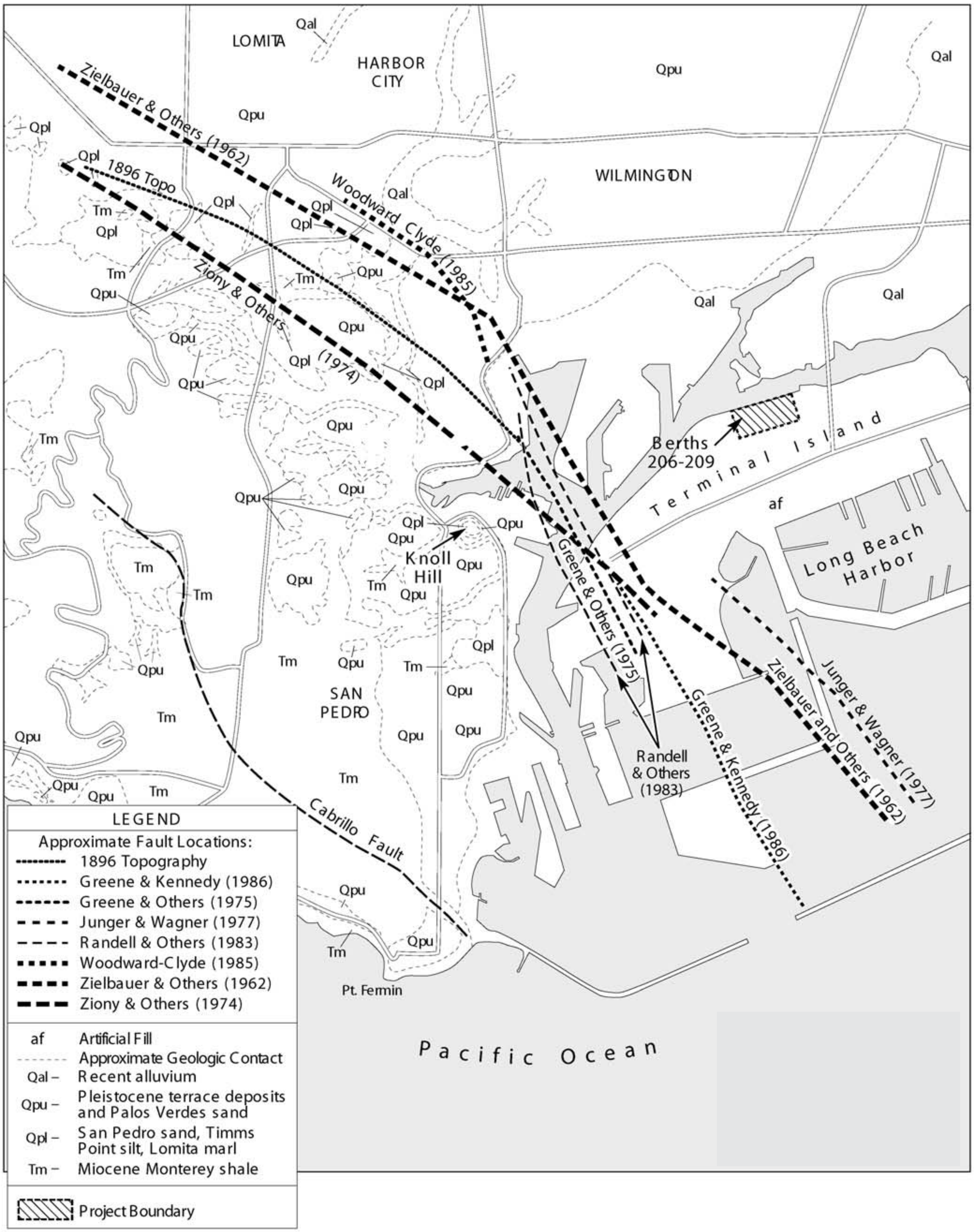
Whittier-Elsinore Fault Zone. The Whittier fault is located approximately 20 miles north of the project area and is one of the more prominent structural features in the Los Angeles Basin.

Malibu-Santa Monica-Raymond Hills Fault Zone. The Raymond Hills fault is approximately 24 miles northwest of the site. This fault zone extends from the base of the San Gabriel Mountains westward to beyond the Malibu coastline. The fault has been relatively quiet with no recorded seismic events in historic times; however, recent studies have found evidence of surface rupture within the last 1,000 to 2,000 years.

San Andreas Fault Zone. The San Andreas fault is located approximately 50 miles northeast of the project area. This fault is recognized as the longest and most active fault in California. There is a high probability that Southern California will experience a magnitude 7.0 or greater earthquake along the San Andreas fault, which could generate strong ground motion in the project area.

3.5.2.4 Seismic Hazards

Ground Rupture. Surface fault rupture can occur in cases where earthquakes are large or hypocenters (location) of actual fault failure are shallow. The California Geological Survey



Source: Jahns 1954 (ed) Geology of Southern California, CDMG Bull 170

Figure 3.5-3
Palos Verdes Fault Zone

(CGS) defines “active” faults as those offsetting materials less than 11,000 years old or exhibiting significant seismic activity. Because surface fault rupture is more likely on active faults, the State of California, through the Alquist-Priolo Earthquake Zoning Fault Act, created zones around active faults to restrict development.

Of the major faults located in the project region, only the Palos Verdes fault is located within the harbor area. As depicted on Figure 3.5-2, several geologists have mapped suspected traces of the fault through the central portion of the harbor. The Palos Verdes fault zone has not been identified as an Alquist-Priolo fault zone by the California Geological Survey, however, the area containing the suspected fault locations has been identified as a Fault Rupture Study Area by the City of Los Angeles Safety Element of the General Plan. The proposed Northwest Slip project site is located within the designated Fault Rupture Study Area.

Ground Shaking. The most significant potential geologic hazard at the project site is seismic ground shaking from future earthquakes generated by faults in the region. The ground shaking in an earthquake depends on the magnitude, the distance from the fault, and local geologic conditions.

The level of ground shaking is controlled, in part, by characteristics of the local geology. Two important characteristics are ground softness at a site and total thickness of sediments beneath a site. Seismic waves travel faster through hard rocks than through softer rocks and sediments. As the waves pass from harder to softer rocks and slow down, they must get bigger in amplitude to carry the same amount of energy. Thus, shaking tends to be stronger at sites with softer surface layers where seismic waves move more slowly.

Ground shaking potential can be expressed qualitatively using the Modified Mercalli Scale or quantitatively by the peak horizontal ground acceleration (PHGA). The PHGA value is calculated based on the MCE, or the seismic event considered likely to occur on an active fault. Estimated PHGA generated on the faults (listed in Table 3.5-1) range from about 0.05 g (g represents the acceleration as a result of gravity) to 0.42 g. These earthquakes would generate enough energy and spectral content and would have a sufficiently long duration to damage structures in the area.

Liquefaction. Liquefaction is defined as the transformation of a granular material from a solid state into a liquefied state as a consequence of increased pore pressure, which results in the loss of grain-to-grain contact. Seismic ground shaking is capable of providing the mechanism for liquefaction, usually in fine-grained, loose to medium-dense, saturated sands and silts. Total and/ or differential settlement associated with liquefaction could affect structures on liquefiable soils.

Terminal Island has been backfilled with undocumented fill materials. Dredged materials from the harbor area were spread across lower Wilmington from 1905 until 1910 or 1911. In addition, the natural alluvial deposits below the site generally are unconsolidated, soft, and saturated. The liquefaction potential in the Harbor area during a major earthquake on either the San Andreas fault or the Newport-Inglewood fault is high. The project site is identified as an area susceptible to liquefaction in the City of Los Angeles General Plan, Safety Element because of the presence of recent alluvial deposits and groundwater less than 30 feet below ground surface (USACE and LAHD, 2006).

Subsidence. Subsidence is the phenomenon where soils and other earth materials underlying a site settle or compress, resulting in a lower ground surface elevation. Fill and native materials can be water saturated, and a net decrease in the pore pressure and contained water will allow the soil grains to pack closer together. This closer grain packing results in less volume and the lowering of the ground surface.

Subsidence has been a historic problem in the Los Angeles Harbor because of the removal of subsurface oil and gas reserves from the Wilmington Oil Field. The project site lies within the Wilmington Oil Field, but not within the active drilling area. To remedy the subsidence situation, water injection programs were initiated by the City of Long Beach in 1958. The Los Angeles Harbor area has subsequently rebounded to elevations equal to or slightly higher than the original elevation as a result of water injection programs. In 2001, the elevation of the Wilmington Oil Field remained stable except for minor fluctuations at the western area at the Port of Long Beach. The project site remained stable from November 2000 through November 2001. The site area has rebounded 0.6 foot from the time of the lowest measured benchmark elevation through November 2001 (USACE and LAHD 2006).

Tsunamis and Seiches. A tsunami is a series of gravity waves of long wavelength generated by a sudden disturbance in a body of water. Typically, tsunamis are the result of sudden vertical movement along a fault rupture in the ocean floor, submarine landslides or subsidence, or volcanic eruption where the sudden displacement of water sets off transoceanic waves with wavelengths of up to 125 miles and with periods generally from 5 to 60 minutes. The trough of the tsunami wave usually arrives first leading to the classic retreat of water from the shore as the ocean level drops. The trough is followed by the arrival of the crest of the wave, which can run up the shore in the form of bores or surges in shallow water, or simple rising and lowering of the water level in relatively deeper water such as in harbor areas.

Tsunamis are a relatively common natural hazard, although most of the events are small in amplitude and not particularly damaging. However, in the event of a large submarine earthquake or landslide, coastal flooding may occur. Flooding is capable of damaging buildings and resulting in loss of human life.

The Port is subject to diurnal tides, meaning two high tides and two low tides during a 24-hour period. For ease of reference, the average of the lowest water level during low tide periods each day is typically set as a benchmark of 0 feet and is defined as the MLLW level. The overall average sea level during a 24-hour period in the Port is +2.8 feet above MLLW. Maximum high tide within the Port is +7 feet MLLW. The height of a location above sea level and its vulnerability to inundation are related to several factors including the elevation of the location, any intervening topography (e.g., a hill or slope) that would impede or block the tsunami, and the height of the tide when the tsunami arrives. When the tide is highest, the distance between the site and the sea is less; during low tide, the distance is greater.

In the past, abrupt sea level changes associated with tsunamis generated by distant earthquakes have caused damage within the Los Angeles Harbor. The worst of these, the Chilean Earthquake of May 1960, caused local damages of over $1 million and closure of the Harbor. One person drowned at Cabrillo Beach, and one was injured. Small craft moorings in the Harbor area, especially in the Cerritos Channel, where a seiche occurred, were damaged seriously. Currents of up to 8 knots and a 6-foot rise of water were observed in the West Basin within a few minutes. The maximum water level fluctuations recorded by gauges were 5.0 feet (1.5 m) at Port Berth 60 (near Pilot Station) and 5.8 feet (1.8 m) in Long Beach Harbor. Until recently, projected tsunami run-ups along the western U.S. were based on submarine earthquakes or landslides occurring at great distances from the U.S., as described for the Chilean earthquake of May 1960. The tsunami wave heights generated by the Chilean 1960 earthquake are near the maximum that theoretically could be generated by a distant earthquake (USACE and LAHD, 2006).

More recent studies have projected larger tsunamis, from local offshore faults, than previous predicted. For example, one of the largest such features, the Catalina fault, lies directly underneath Catalina Island, located only 22 miles (35 km) from the Port. Simulations of tsunamis generated by uplift on this fault suggest waves in the Port in excess of 12 feet (3.7 m) with an arrival time within 20 minutes. These simulations were based on rare events, representing worst-case scenarios. Based on these studies, the California SLC has developed tsunami run-up projections for the Ports of Los Angeles and Long Beach of 8.0 feet (2.4 m) and 15.0 feet (4.6 m) above mean sea level, at 100- and 500-year intervals, respectively, as a part of their Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS). These models predict tsunami wave action from local earthquakes the within the Los Angeles/Long Beach Port Complex, they do not take into account the complex bathymetric and shore features to predict tsunami wave action (USACE and LAHD, 2006).

Most recently, a report has been prepared to study the tsunami hazard within the Ports of Los Angeles and Long Beach. This effort resulted in development of a Port Complex model to study tsunami behavior within the ports. The model draws on the same methodology as the above studies to generate a tsunami wave from local offshore earthquakes; however, it incorporates consideration of the landfill configurations, bathymetric features, and the interaction of the diffraction, reflection, and refraction of the tsunami wave within the Los Angeles/Long Beach Port Complex to predict tsunami water levels. The model also can be used to predict the tsunami water levels from a submarine landslide. Using the model, a magnitude 7.5 earthquake on the Catalina fault was concluded to be capable of producing a reasonable maximum tsunami for future near-field events. The evaluations presented in this SEIS/SEIR are based on this assumption (USACE and LAHD, 2006).

The frequency that earthquakes occur on a fault cannot be predicted with certainty. However, an assumed slip rate or plotting earthquake magnitude against frequency of occurrence for all historical earthquakes in the offshore Southern California area were used as the basis to estimate the recurrence of earthquakes of a certain size from offshore faults. Estimated recurrence rates for M7 and M7.5 earthquakes on the Catalina fault are 1,900 years and 4,500 years; and 5,000 and 10,000 years (USACE and LAHD, 2006).

Tsunamis can be generated by local submarine landslides. In recent studies of potential tsunami generation by such events it was concluded "…large possibly catastrophic submarine landslides appear to be relatively rare offshore southern California." Other studies have concluded, "…recurrence intervals for tsunami-generating slides on the order of about 10,000 years would be reasonable and probably even conservative" (USACE and LAHD, 2006).

Seiches are seismically induced water waves that surge back and forth in an enclosed basin, such as could be expected in the Harbor as a result of earthquakes. Any significant wave front could cause damage to seawalls and docks, and could breach seawalls at the project sites. Modern shoreline protection techniques are designed to resist seiche damage. The Los Angeles/Long Beach Port Complex model referenced below considered impacts from tsunamis and seiches. In each case, impacts from a tsunami were equal to or more severe than those from a seiche. As a result, the impact discussion below refers primarily to tsunamis because this will be considered the worst-case scenario of potential impacts.

Expansive Soil. Expansive soils are clay rich soils that experience changes in volume in direct response to water content. These soils can swell in volume when water is added, and shrink when they become desiccated. The water may be derived from moisture in the air, precipitation or ground water. When structures are placed on expansive soils, foundations may rise each wet season and fall with the succeeding dry season. Movement may vary under different parts of a structure, resulting in cracks and distortions to the foundation and structural members.

The characteristics of the sediments within the harbor and that may be used to construct proposed fill areas vary from coarse-grained sands to sediments consisting primarily of silt and clay. Fine-grained sediments with high clay content would be most susceptible to potential expansive soil impacts.

3.5.2.5 Erosion

The sediment disposal areas that would be used for disposal of dredge material under the Proposed Action are presently submerged, with the exception of the ARSSS. Existing erosion control measures provided at the ARSSS prevent this area from being a substantial source of sediment. As a result, the potential disposal sites are not presently a substantial source of erosion or sediment production.

Proposed sediment disposal areas would be used to accept sediment that is presently stockpiled on the Southwest Slip. Existing erosion control measures provided at the Southwest Slip site prevent the stockpile from being a substantial source of sediment.

3.5.2.6 Mineral Resources

The project area is located within the Wilmington Oil Field, but is not within an active drilling/oil production area. The Wilmington Field was discovered in 1936, and produced 84.4 million barrels of oil from January 1998 through October 2002. This rate of production makes the Wilmington Field the sixth largest producing oil field in the state (LAHD, 2005).

The project area is predominately underlain by recent alluvium and dredged fill material. Therefore, the project area has been designated by the California Department of Conservation as having a Mineral Resource Zone classification of “MRZ-1.” This means that there is adequate information about the area to indicate that no significant mineral deposits are present or it has been judged that little likelihood exists for their presence (LAHD, 2005).

3.5.3 Applicable Regulations

3.5.3.1 Geological Hazards

State Requirements. The Alquist-Priolo Earthquake Fault Zoning Act of 1972 is intended to minimize the chance for structures used for human occupancy to be built over active faults. This is accomplished by requiring a geological investigation for new development located within designated active earthquake fault zones. For purposes of implementing the Act, it is assumed that the area within 50 feet of an active fault is underlain by active branches of the fault, until proven otherwise by an appropriate geologic investigation. There are no designated Alquist-Priolo zones on or adjacent to the project site (USACE, 2000).

Local Requirements. New construction that occurs within the harbor is regulated by the Los Angeles Building Code (Sections 91.000 through 91.7016) of the Los Angeles Municipal Code (LAMC). The Los Angeles Building Code incorporates the structural seismic requirements of the 1997 Uniform Building Code and provides requirements for construction, grading, excavations, use of fill, and foundation work including type of materials, design, procedures, etc., which are intended to limit the probability of occurrence and the severity of consequences from geological hazards. Necessary permits, plan checks, and inspections are also specified.

3.5.3.2 Erosion

Federal and State Requirements. Under the NPDES permit program, the SWRCB has issued two general stormwater discharge permits for Los Angeles County to cover industrial and construction activities. The permits are required for specific industry types based on standard industrial classification and for construction activities on more than one acre.

The RWQCB oversees implementation and enforcement of the general permits, including Waste Discharge Requirements (WDR). The City of Los Angeles Public Works Department, Bureau of Engineering, Stormwater Management Division, is the agency responsible for overseeing implementation of permit requirements for the City. Presently, under the General Construction Stormwater Permit, projects of more than one acre in size are required to incorporate, to the maximum extent possible, permanent or post-construction best management practices (BMPs) in project planning and design.

The City is covered under the Permit for Municipal Storm water and Urban Runoff Discharges within Los Angeles County (LARWQCB Order No. 01-182) and is obligated to incorporate provisions of this document in City permitting actions. The municipal permit incorporates requirements of the Standard Urban Storm Water Mitigation Plans (SUSMPs), which include implementation of treatment control BMPs for projects falling within certain development and redevelopment categories.

Local Requirements. New construction within the Port is regulated by the Los Angeles Building Code (Sections 91.7000 through 91.7016 of the LAMC). The Los Angeles Building Code provides requirements for construction, grading, excavations, use of fill, and foundation work including type of materials, design, procedures, etc., which are intended to limit the probability of occurrence and the severity of consequences from sedimentation and erosion. Necessary permits, plan checks, and inspections are specified. Also included in these requirements is the provision that any grading work in excess of 200 cubic yards that will occur between November 1 and April 15 (the "rainy season") must include an erosion control system approved by the Department of Building and Safety.

3.5.4 Methodology

The evaluation of geology and topography impacts is based on a review of existing information sources pertaining to geological hazards and other conditions at and near the Port area, and an evaluation of how existing geologic and topographic conditions have the potential to adversely affect the facilities developed as part of the Proposed Action. The impact evaluation considers short-term impacts that have the potential to result from construction activities, as well as long-term impacts resulting from the development of new facilities.

The CEQA and NEPA Baseline for the Proposed Action comprises a total of approximately 115 acres of water areas at Berths 243-245, the Northwest Slip, the CSWH, and LA-2, as well as approximately 31 acres at the ARSSS.

3.5.5 Thresholds of Significance

The City of Los Angeles' *L.A. CEQA Thresholds Guide* (City of Los Angeles, 2006) provides thresholds of significance pertaining to geologic hazards, sedimentation and erosion, landform alteration and mineral resource impacts. The geologic hazard and sedimentation/erosion thresholds applicable to the Proposed Action are provided below.

GEO-1 A project would normally have a significant geologic hazard impact if it would cause or accelerate geologic hazards, which would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

GEO-2 A project would normally have significant sedimentation or erosion impacts if it would:

- Constitute a geologic hazard to other properties by causing or accelerating instability from erosion; or
- Accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition which would not be contained or controlled on-site.

The *L.A. CEQA Thresholds Guide* indicates that a project would normally result in a significant topography or landform alteration if "one or more distinct and prominent geologic or topographic features would be destroyed, permanently covered or materially and adversely modified. Such features may include, but are not limited to, hilltops, ridges, hillslopes, canyons, ravines, rock outcrops, water bodies, streambeds and wetlands." As indicated in Section 3.5.2, there are no substantial topographic features on the project sites, and water bodies within the Port, which consist primarily of dredged channels, would not be destroyed, permanently covered or substantially modified. Therefore, the Proposed Action would not have the potential to result in significant landform alteration impacts and no further analysis of project-related impacts related to this threshold is required.

The *L.A. CEQA Thresholds Guide* also indicates that a project would normally have a significant mineral resource impact if it would result in "the permanent loss of, or loss of access to, a mineral resource that is located in a MRZ-2 or other known or potential mineral resource area." As indicated in Section 3.5.2, the project area does not have an MRZ-2 designation. Therefore, the Proposed Action would not have the potential to result in significant mineral resource impacts and no further analysis of project-related impacts related to this threshold is required.

The evaluation of the significant impacts related to geologic hazards assumes that each project component would be consistent with the following design measures and requirements. These assumptions are consistent with preliminary project design plans and existing regulatory requirements.

- A project-specific geotechnical investigation would be conducted prior to the final design of each disposal area and the placement of fill material. Project-specific design measures would be implemented as recommended by the geotechnical investigation to minimize the potential effects of ground shaking, liquefaction and expansive soil at each proposed sediment disposal area, and potential impacts to buildings and structures that may subsequently be developed on the project sites.
- Rock containment dikes would be provided at Berths 243-245, Northwest Slip, CSWH Expansion Area, and Eelgrass Habitat Area sites to accommodate the proposed quantities of disposed sediment. In general, the dikes would be constructed of quarry rock and would have side slope gradients of 1.75 to 1 (horizontal to vertical). The containment dikes would be adequately designed and installed to reduce potential fill material slope stability impacts to a less than significant level.
- Buildings or structures that may ultimately be developed in upland areas created by the proposed sediment disposal areas would be designed and constructed in accordance with applicable building code requirements, including the requirements of Sections 91.000 through 91.7016 of the LAMC.

3.5.6 Impact Analysis and Mitigation Measures

3.5.6.1 Alternative 1: Port Development and Environmental Enhancement

Alternative 1 would consist of disposing dredged material at the following disposal sites: Berths 243-245; Northwest Slip; CSWH Expansion Area; Eelgrass Habitat Area; and LA-2. In addition, a Confined Disposal Facility (CDF) would be created at the Berths 243-245 disposal site and would be covered with clean dredge material placed as surcharge to an elevation of approximately +30 feet MLLW, which would remain in place until a future geotechnical investigation/monitoring determines the fill has been consolidated. In the future if the Port decides to remove the surcharge material, an appropriate CEQA document would be prepared to analyze impacts of surcharge removal. Potential environmental impacts of future development of the new 5-acre land area at the Northwest Slip have been addressed in the Berth 136-147 Container Terminal Project Final EIS/EIR, which is summarized in Section 3.14.

Impact GEO-1: Alternative 1 would not cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

Geologic hazards, such as ground rupture, ground shaking, liquefaction and tsunamis, have the potential to affect the project region and proposed sediment disposal areas while the proposed disposal sites are under construction or when sediment disposal operations are occurring. However, geologic hazards that have the potential to adversely affect the project sites have an infrequent to rare occurrence interval. The duration of construction activities required to complete the proposed sediment disposal areas would be limited. Therefore, it is unlikely that a major geologic hazard event would occur during the development of a proposed sediment disposal area.

Should earthquake-related ground shaking or other geologic hazards occur in the Port area during sediment disposal site construction activities, potential impacts would likely be limited to damage to construction equipment and other temporary facilities. Proposed construction activities would not require the use or development of permanent structures, facilities, infrastructure, or buildings used for human habitation. Therefore, project-related construction activities would not result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury, and would not result in a significant impact.

All of the proposed sediment disposal areas would be subject to the potential long-term effects of ground shaking, and it is likely that they will experience moderate to strong ground shaking effects sometime during the life of the project sites. The Berths 243-245 disposal site would be designed as a CDF for contaminated dredge material. Strong ground motion at the Berths 243-

245 disposal site would have the potential to result in damage to the containment structure, which could result in a release of contaminated sediments as well as subsequent water quality and other related impacts. However, the long-term impacts related to groundshaking would be less than significant because of the proposed design of the facility, which would be constructed of quarry rock and would have side slope gradients of 1.75 to 1 (horizontal to vertical). The containment dikes the Berths 243-245, Northwest Slip, CSWH, and Eelgrass Habitat Area would be designed and installed to reduce potential slope stability impacts to a less than significant level.

If subsidence-related impacts were to affect the project area, such effects would occur over an extended period of time and would not adversely affect project-related construction activities. Similarly, expansive soil-related impacts would occur over an extended period of time and would not have the potential to adversely affect project-related construction activities.

The LA-2 disposal site is located approximately 5.8 miles offshore in open ocean waters approximately 360 ft to 1,115 ft below the water surface. Disposal of sediments at this location would have not have the potential to cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

Impact Determination

Sediment dredge and disposal activities associated with implementation of Alternative 1 would not accelerate the severity or occurrence of geologic hazards in the Port area or at LA-2, or result in the development of new structures or infrastructure that would expose people to a substantial risk of injury. Compliance with applicable building codes and regulations would be adequate to ensure potential geologic hazard impacts would be less than significant.

Mitigation Measures. Under Alternative 1, no significant adverse impacts would occur; therefore, no mitigation measures are required.

Residual Impacts. No mitigation measures for implementation of Alternative 1 are required. Therefore, no residual impacts would occur.

Impact GEO-2: Alternative 1 would not:

- **Constitute a geologic hazard to other properties by causing or accelerating instability from erosion, or**
- **Accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on-site.**

Short-term construction activities required for the development of the proposed sediment disposal sites could require the use of temporary soil stockpiles and would result in the placement of unconsolidated sediments into disposal areas. Proposed sediment disposal site construction activities would not result in the disturbance of the ground surface in areas located beyond the proposed disposal sites. Although the existing sediment stockpile at the Southwest Slip is not a substantial source or erosion and sediment, the removal of the existing stockpile would eliminate a potential source of sedimentation, resulting in a beneficial impact.

After the Berths 243-245 and Northwest Slip project areas achieve elevations above water level, the exposed sediments could be affected by erosion and sedimentation processes, which could result in significant erosion-related impacts, including impacts to water quality and other related resources. The CSWH Expansion Area, Eelgrass Habitat Area, and LA-2 would not achieve an elevation above water level and would not result in accelerated erosion-related impacts.

Short-term construction-related erosion and sedimentation impacts from sediment disposal at the Berths 243-245 and Northwest Slip disposal areas would be minimized by implementation of existing regulatory requirements, including preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP), as required by the RWQCB and the Los Angeles Building Code. It is anticipated that implementation of best management practices for erosion and sedimentation control at the proposed disposal locations would minimize the potential for erosion-related impacts.

The CDF created at Berths 243-245 would be capped with clean surcharge material to a final elevation of approximately +30 feet MLLW, which would remain in place until a future geotechnical investigation determines the fill has consolidated sufficiently to support a future use. Implementation of BMPs for erosion and sedimentation control at the project site would prevent the surcharge soil from causing a significant erosion impact.

Impact Determination

With the implementation of BMPs as required by existing regulatory requirements, implementation of Alternative 1 would not accelerate erosion in the Port area, or result in significant erosion-related impacts, therefore, project-related erosion and sedimentation impacts would be less than significant.

Mitigation Measures. Under Alternative 1, no significant adverse impacts would occur; therefore, no mitigation measures are required.

Residual Impacts. No mitigation measures for implementation of Alternative 1 are required. Therefore, no residual impacts would occur.

3.5.6.2 Alternative 2: Environmental Enhancement and Ocean Disposal

Alternative 2, Environmental Enhancement and Ocean Disposal, consists of placing dredge material at the following locations: CSWH Expansion Area, Eelgrass Habitat Area, Anchorage Road Soil Storage Site (ARSSS), and LA-2. No new land area would be created as result of this alternative.

Implementation of Alternative 2 would result in the same type and extent of development at the CSWH Expansion Area and the Eelgrass Habitat Area disposal locations as described for Alternative 1. Alternative 2 would also result in the same disposal activities at LA-2, although more sediment would be disposed of under Alternative 2 (0.420 mcy) than Alternative 1 (0.004 mcy), which would result in a longer duration of construction activities at this location, but would not affect geologic hazards because this site is fully submerged and located approximately 5.8 miles from shore. As such, Alternative 2 would result in identical less than significant impacts as described for Alternative 1 at the CSWH Expansion Area, the Eelgrass Habitat Area, and LA-2. Therefore, the impact discussion for Alternative 2 is focused on the disposal site that was not included or discussed under Alternative 1, the ARSSS.

Impact GEO-1: Alternative 2 would not cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

The ARSSS could be used for the disposal of material that is unsuitable for ocean disposal, and has been previously used for minor amounts of contaminated material storage. Strong ground motion at the ARSSS would have the potential to result in the exposure of contaminated sediments and subsequent water quality and other related impacts. However, the long-term impacts related to groundshaking would be less than significant because of the proposed design of the disposal site, which would comply with applicable slope stability regulatory standards to resist movement during an earthquake.

Impact Determination

Implementation of Alternative 2 would not accelerate the severity or occurrence of geologic hazards in the Port area, or result in the development of new structures or infrastructure that would expose people to a substantial risk of injury. Compliance with applicable building codes and regulations would ensure that geologic hazard impacts would be less than significant.

Mitigation Measures. Under Alternative 2, no significant adverse impacts would occur; therefore, no mitigation measures are required.

Residual Impacts. No mitigation measures for implementation of Alternative 2 are required. Therefore, no residual impacts would occur.

Impact GEO-2: Alternative 2 would not:

- **Constitute a geologic hazard to other properties by causing or accelerating instability from erosion, or**
- **Accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on-site.**

The use of the ARSSS would have the potential to incrementally increase erosion-related impacts associated with the current use of this existing storage area. However, compliance with regulatory requirements and continued implementation of BMPs for erosion and sedimentation control would ensure that significant erosion impacts do not occur as a result of the project-related use of this disposal site.

Impact Determination

With the implementation of existing regulatory requirements, the implementation of Alternative 2 would not accelerate erosion in the Port area, or result in significant erosion-related impacts, therefore, project-related erosion and sedimentation impacts would be less than significant.

Mitigation Measures. Under Alternative 2, no significant adverse impacts would occur; therefore, no mitigation measures are required.

Residual Impacts. No mitigation measures for implementation of Alternative 2 are required. Therefore, no residual impacts would occur.

3.5.6.3 Alternative 3: No Action

Under the No Action Alternative, no construction activities related to the Proposed Action would occur. No new landfills or new shallow water areas would be created. Since all approved disposal sites have been completed, no further dredging would take place and the Channel Deepening Project would not be completed. Existing environmental conditions at the Proposed Action disposal sites would continue to exist. Approximately 1.025 mcy of material within the federally-authorized channel and 0.675 mcy of berth dredging would remain to be dredged and disposed. In addition the 0.815 mcy of surcharge on the Southwest Slip Area would remain to be removed and disposed. Additionally, the 0.08 mcy of contaminated dredge material would remain within the Main Channel of the Port.

Impact GEO-1. Alternative 3 would not cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

Under Alternative 3, no activities that would have the potential to accelerate the severity or occurrence of geologic hazards in the Port area, or result in the development of new structures or infrastructure that would expose people to a substantial risk of injury would occur.

Impact Determination

Since Alternative 3 would not accelerate the severity or occurrence of geologic hazards or expose people to a substantial risk of injury, no impacts would occur.

Mitigation Measures. Under Alternative 3, no significant adverse impacts would occur; therefore, no mitigation measures are required.

Residual Impacts. No mitigation measures for implementation of Alternative 3 are required. Therefore, no residual impacts would occur.

Impact GEO-2: Alternative 3 would not:

- **Constitute a geologic hazard to other properties by causing or accelerating instability from erosion, or**
- **Accelerate natural processes of wind and water erosion and sedimentation, resulting in sediment runoff or deposition that would not be contained or controlled on-site.**

Under Alternative 3, construction activities related to the Proposed Action would not occur. Alternative 3 would not accelerate the potential for erosion or sedimentation to occur.

Impact Determination

Since Alternative 3 would not accelerate erosion in the Port, no impacts would occur.

Mitigation Measures. Under Alternative 3, no significant adverse impacts would occur; therefore, no mitigation measures are required.

Residual Impacts. No mitigation measures for implementation of Alternative 3 are required. Therefore, no residual impacts would occur.

3.5.7 Impact Summary

This section summarizes the conclusions of the impact analysis presented above in Section 3.5.6. Table 3.5-2 lists each impact identified for each alternative of the Proposed Action, along with the significance of each impact.

Table 3.5-2 Impact Summary

Impact	Alternative 1	Alternative 2	Alternative 3
GEO-1. Geologic hazards that would result in substantial damage to structures or infrastructure would not be caused or accelerated and people would not be exposed to substantial risk of injury.	LTS	LTS	NI
GEO -2. A geologic hazard to other properties would not occur through causing or accelerating instability from erosion, and natural processes of wind and water erosion and sedimentation would not be accelerated or result in sediment runoff or deposition that would not be contained or controlled on-site.	LTS	LTS	NI

S&U = Significant and Unavoidable **SM** = Significant but Mitigated
LTS = Less than Significant **NI** = No Impact

Implementation of Alternative 1 or Alternative 2 would result in less than significant geologic hazard impacts. Implementation of Alternative 3 would not result in any geologic hazard impacts.

3.5.8 Mitigation Measures

No significant geologic hazard impacts would occur; therefore, no mitigation measures are required.

3.5.9 Significant Unavoidable Adverse Impacts

No significant unavoidable impacts would occur.

3.5.10 Mitigation Monitoring Plan

Since no mitigation measures are required for geologic hazard impacts, a mitigation monitoring plan is not required.