3.6 GEOLOGY AND SOILS

This EIR section analyzes the potential for adverse impacts on existing geologic and soil conditions resulting from implementation of the proposed project. The Initial Study (Appendix A) identified the potential for impacts associated with hazards that would result from seismic activity, development on an unstable geologic unit or expansive soil, and potential erosion from project construction and operation. Issues scoped out from detailed analysis in the EIR include exposure of people or structures to hazards related to rupture of a known earthquake fault since the project site is not located on an earthquake fault, and landslides since the project site is generally flat in nature and not located within a slope stability hazard zone. In addition, the proposed project would not include septic tanks or alternative wastewater disposal systems. Data used to prepare this section were taken from the City's General Plan Environmental Hazards Element and the Preliminary Geotechnical Investigation prepared for the project site (Appendix J). The Preliminary Geotechnical Investigation includes review of available data, field exploration, laboratory testing, geotechnical analyses of collected data, and preparation of a report containing general conclusions and recommendations regarding the existing geotechnical conditions and their constraints on the design of the proposed project. Full bibliographic entries for all reference materials are provided in Chapter 7 (References) of this document.

3.6.1 Existing Conditions

Geologic Setting

The project site is located in the southern portion of the City of Huntington Beach, California. The general Huntington Beach area, including the project site, lies within the northern/northwestern portion of the Peninsular Ranges Geomorphic Province of Southern California, which is characterized by northwest-southeast trending faults, folds, and mountain ranges. During the time from the Pliocene period to the Pleistocene period (the past 2 to 3 million years), activities on the Newport-Inglewood Fault (located approximately 0.6 mile from the site), combined with regional tectonic effects (such as uplift), climatic forces, and changes in sea level, have resulted in the formation of the underlying basement materials and structure that underlay and support the project site. The forces that have created the geomorphology of the project site and vicinity are still active today.

Much of the regional area of the project site is underlain by terrace deposits, which are unconsolidated sediments (i.e., loose soil materials, such as sand, silt, etc.) left by streams on shore benches cut by the ocean. These deposits were laid in a shallow marine to near-shore terrestrial environment in the Pleistocene time frame (about 2 million to about 10 thousand years ago). The source of these sediments was erosion of the rocky highlands of San Bernardino, Santa Ana, and other mountain belts. Tectonic forces associated with regional faulting from the Newport-Inglewood, San Andreas, and offshore zones resulted in the uplift of these deposits, thus exposing the terrace materials to erosion that removed much of their cover. In late Pleistocene time, the action of coastal plain rivers/streams dissected the terrace materials and subsequently formed "gaps." As sea levels subsequently rose with the melting of continental ice sheets, sediments filled these gaps.

Geomorphically, the site is situated in the northerly/northwesterly fringe of the Talbert Gap (also known as the Santa Ana Gap) and the southerly limit of the Huntington Beach terrace mesa. The Talbert Gap, along with the Bolsa and Los Alamitos Gaps located to the northwest, are the result of the combination of downcutting and subsequent flooding/depositions. The mesas, which are isolated and relatively flat-topped natural elevations formed by these gaps, represent the remaining portions of a now strongly dissected coastal terrace. Terrace materials comprise predominantly fine, relatively well-consolidated to slightly firm marine and oceanic sediments. In contrast, the gap materials are notably less consolidated, contain significant silty fines and zones of peat, and have prevalent groundwater and saturated zones of relatively shallow nature.

Subsurface Soil and Groundwater Conditions

The northerly and easterly portions of the project site are underlain by consolidated terrace deposits (i.e., soils), which consist of several characteristics. Deposit colors range from reddish-brown to brown and yellowish to grayish. These deposits are generally over-consolidated and are formed by interlayered lenses of silty to clayey sands and clayey silt and silty clay, with some interbeds of gravel and cobbles. Soils on the project site are generally slightly moist to moist and dense to very dense.

The southerly to southwest portion of the project site is underlain by a wedge of softer, less consolidated sediments that include alluvial and lagoonal deposits. Within the site, these materials are characterized by zones of brown to gray sandy clay to sandy silt and clayey sands to clayey silt with zones of silty and poorly graded sands. In addition, artificial fills are found in several areas of the site. These fills generally consist of silty sands, sandy silts, and silty clays. Engineered fills, consisting generally of silty sands to clayey sands, were found within the bottom of or near an area referred to as the "borrow pit" in the northwestern two-thirds of the project site. The borrow pit is the area from where approximately 200,000 cubic yards of material were exported in 1999 for use as fill for the Hyatt Regency Resort project. The bottom of this pit was backfilled in August 2000 with approximately 2 feet of soil.

Free groundwater was encountered in all the borings conducted as part of the preliminary geotechnical investigation for the project site. Groundwater was encountered at depths ranging from 5 to 24 feet below the ground surface (bgs) during the geotechnical investigation, which corresponds to approximate elevations of 0.5 foot below to four feet above mean sea level (msl). A subsequent measurement of groundwater levels on July 30, 2001, identified groundwater levels at the project site to be between approximately nine and 20 feet bgs. Localized perched zones and areas subject to concentrated climatic effects or surface water channeling may cause localized higher areas of seepage or groundwater. As the surficial/near surface groundwater is essentially an unconfined aquifer system, it may have some response to localized climatic effects (e.g., intense prolonged rainfall, strong prolonged drought) that may temporarily change the water table on a limited basis.

Seismic Setting

The faulting and seismicity of Southern California is dominated by the San Andreas Fault zone. The San Andreas Fault zone separates two of the major tectonic plates that comprise the earth's crust. West of the San Andreas Fault zone lies the Pacific Plate. This plate is moving in a northwesterly direction relative to the North American Plate, which lies east of the San Andreas Fault zone. This relative movement between the two plates is the driving force of fault ruptures in western California. The San Andreas Fault generally trends northwest/southeast; however, north of the Transverse Ranges Province, the fault trends more in an east/west direction, causing a north/south compression between the two plates. North/south compression in Southern California has been estimated from five to 20 millimeters/year (SCEC 1995). This compression has produced rapid uplift of many of the mountain ranges in Southern California.

There are numerous faults in Southern California that are categorized as active, potentially active, and inactive. A fault is classified as active if it has either moved during the Holocene epoch (during the last 11,000 years) or is included in an Alquist-Priolo Earthquake Fault zone (as established by the California Division of Mines and Geology). A fault is classified as potentially active if it has experienced movement within the Quaternary period (during the last 1.8 million years). Faults that have not moved in the last 1.8 million years are generally considered inactive. Surface displacement can be recognized by the existence of cliffs in alluvium, terraces, offset stream courses, fault troughs and saddles, the alignment of depressions, sag ponds, and the existence of steep mountain fronts.

The severity of an earthquake is generally expressed in two ways—magnitude and intensity. The energy released, measured on the Richter scale, represents the magnitude of an earthquake. The intensity of an earthquake is measured by the Modified Mercalli Intensity scale, which emphasizes the current seismic environment at a subject site and measures groundshaking severity according to damage done to structures, changes in the earth surface, and personal accounts. Table 3.6-1 compares the Mercalli scale to the Richter magnitude scale.

Table 3.6-1 Relationship between Greatest Measure Intensity and Magnitude

Richter Magnitude (M)	Modified Mercalli Intensity Scale	Description
3	I	Detected by only sensitive instruments
	II	Felt by a few people at rest
	III	Felt noticeably indoors, but not always recognized as a quake; vibration like a passing truck
4	IV	Felt indoors by many and outdoors by few
	V	Felt by most people. Some breakage of windows, dishes, and plaster
5	VI	Felt by all; falling plaster and chimneys; damage small
	VII	Damage to buildings varies; depends on quality of construction
6	VIII	Walls, monuments, chimneys fall; panel walls thrown out of frames
	IX	Buildings shift off foundations; foundations crack; ground cracks; underground pipes break
7	X	Most masonry and frame structures destroyed; ground cracks; landslides
8	XI	Ground fissures; pipes break; landslides; rails bent; new structures remain standing
	XII	Damage total; waves seen on ground surface; objects thrown into the air

SOURCE: *City of Santa Monica Planning Department 2002, Table 4-4.*

Ground motions are often also measured in percentage of gravity (percent g), where g = 32 feet per second per second on the earth. One hundred percent of gravity (1 g) is the acceleration a skydiver would experience during free-fall. An acceleration of 0.4 g is equivalent to accelerating from 0 to 60 miles (0 to 97 km) per hour in approximately seven seconds.

In 1997 the State incorporated revisions into the California Building Code (CBC) based on recommendations identified by the Seismology Committee of the Structural Engineers Association of California, which require that the moment magnitude (Mw, identified on Table 3.6-2) of the "characteristic earthquake" be used in geotechnical calculations for design purposes. The new criterion for describing the energy release (i.e., the "size" of the earthquake along a particular fault segment) was determined by the Seismology Committee to represent a more reliable descriptor of future fault activity than previously used standards. The proposed project would be required by State law and regulation to comply with all adopted geotechnical design criteria.

According to the 1998 CBC, the proposed project site is located in Seismic Zone 4. Seismic Zone 4 also includes those areas that lie within a zone of major historic earthquakes (i.e., Richter magnitude greater than seven) and recent high levels of seismicity. Major damage corresponding to intensities VIII or higher on the Modified Mercalli Intensity Scale should be expected within this zone.

Table 3.6-2 Nearest Regional Faults Affecting the Proposed Pacific City Site in Huntington Beach

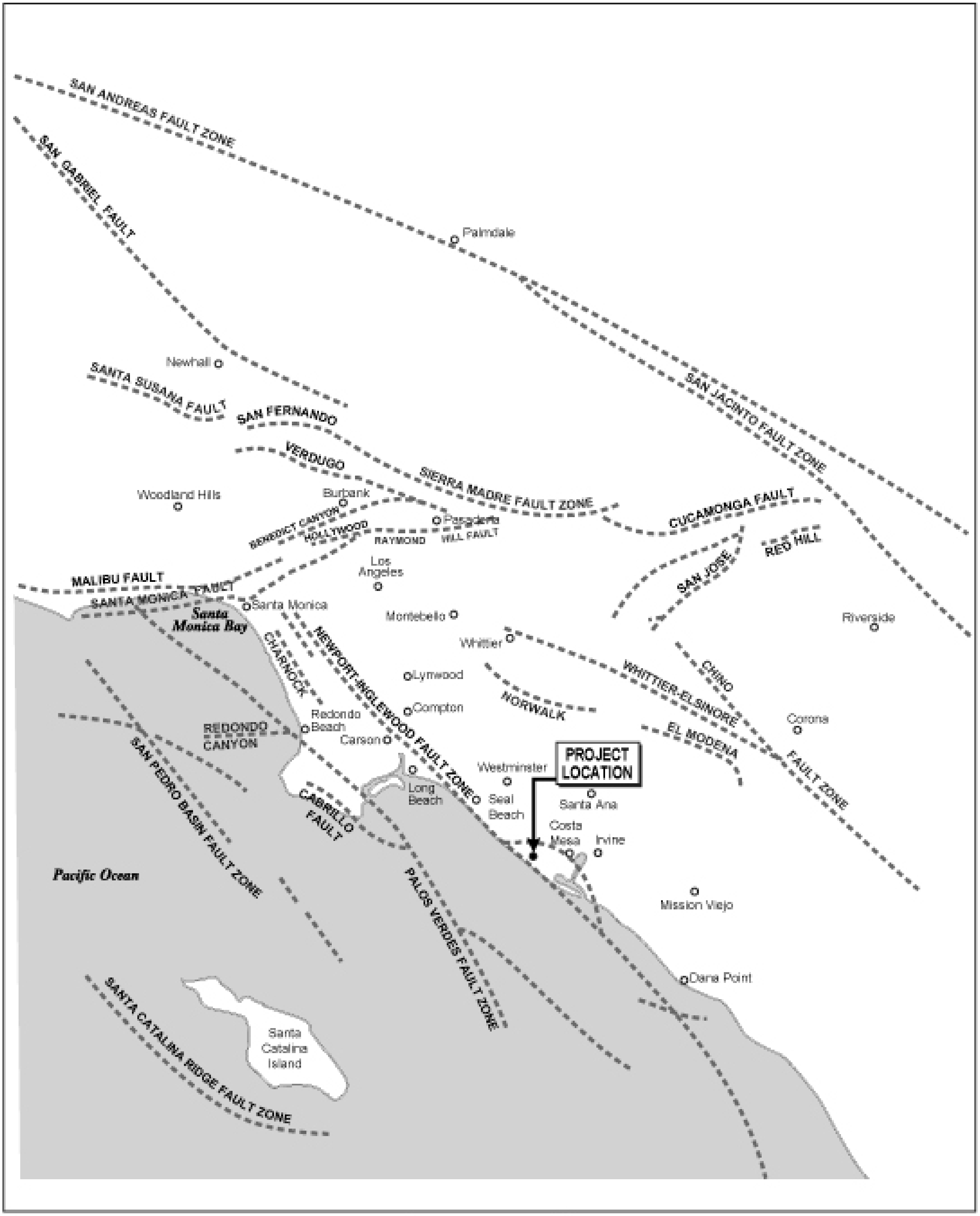
Fault Name	*Approximate Distance from Site (miles)*	*Maximum Event (Moment Magnitude) Mw*
Newport-Inglewood (L.A. Basin)	0.6	6.9
Compton Thrust	4.3	6.8
Newport-Inglewood (Offshore)	6.5	6.9
Palos Verdes	10.0	7.1
Elysian Park Thrust	14.0	6.7
Whittier	20.6	6.8
Chino-Central Ave. (Elsinore)	22.4	6.7
Elsinore-Glen Ivy	24.8	6.8
Coronado Bank	27.0	7.4
San Jose	27.3	6.5
Verdugo	34.1	6.7
Sierra Madre	34.3	7.0
Cucamonga	35.9	7.0
Anacapa-Dume	46.2	7.3
San Andreas (Southern)	52.5	7.8

SOURCE: Zeiser Kling Consultants, Inc., 2001b.

Regional Seismic Conditions

Major regional faults are shown in Figure 3.6-1, and local faults are shown in Figure 3.6-2; Table 3.6-2 presents nearest distances of the site from various nearby active faults. Of those listed in Table 3.6-2, the nearest known active fault zones that are considered to be most active are the Newport-Inglewood, Compton Thrust, and Palos Verdes fault zones, located approximately 0.6, 4.3, and 10.0 miles from the site, respectively. Although an active fault is not believed to traverse the site, active traces of the Newport-Inglewood Fault have been mapped north and northwest of the project site within the Huntington Mesa. As a result, the Fault Rupture Hazard Zone (formerly Alquist-Priolo zone) for the Newport-Inglewood Fault has been established by the State of California approximately 0.5 mile to the north of the site. During the life of the project, seismic activity associated with active faults in the area may generate moderate to strong ground shaking at the site.

By performing a search for earthquakes of moment magnitude (M_w, the measure of total energy released by an earthquake that is calculated on the basis of seismic movement) greater than 5 that have occurred in the past within the project site vicinity, and based on present understandings of the regional tectonic framework, the Preliminary Geotechnical Investigation concluded that the largest magnitude earthquake at the project site will most likely be generated by the Newport-Inglewood Fault, with a $6.9M_w$. In addition,



0 5 10 20 Scale in Miles

SOURCE: EIP Associates 2003

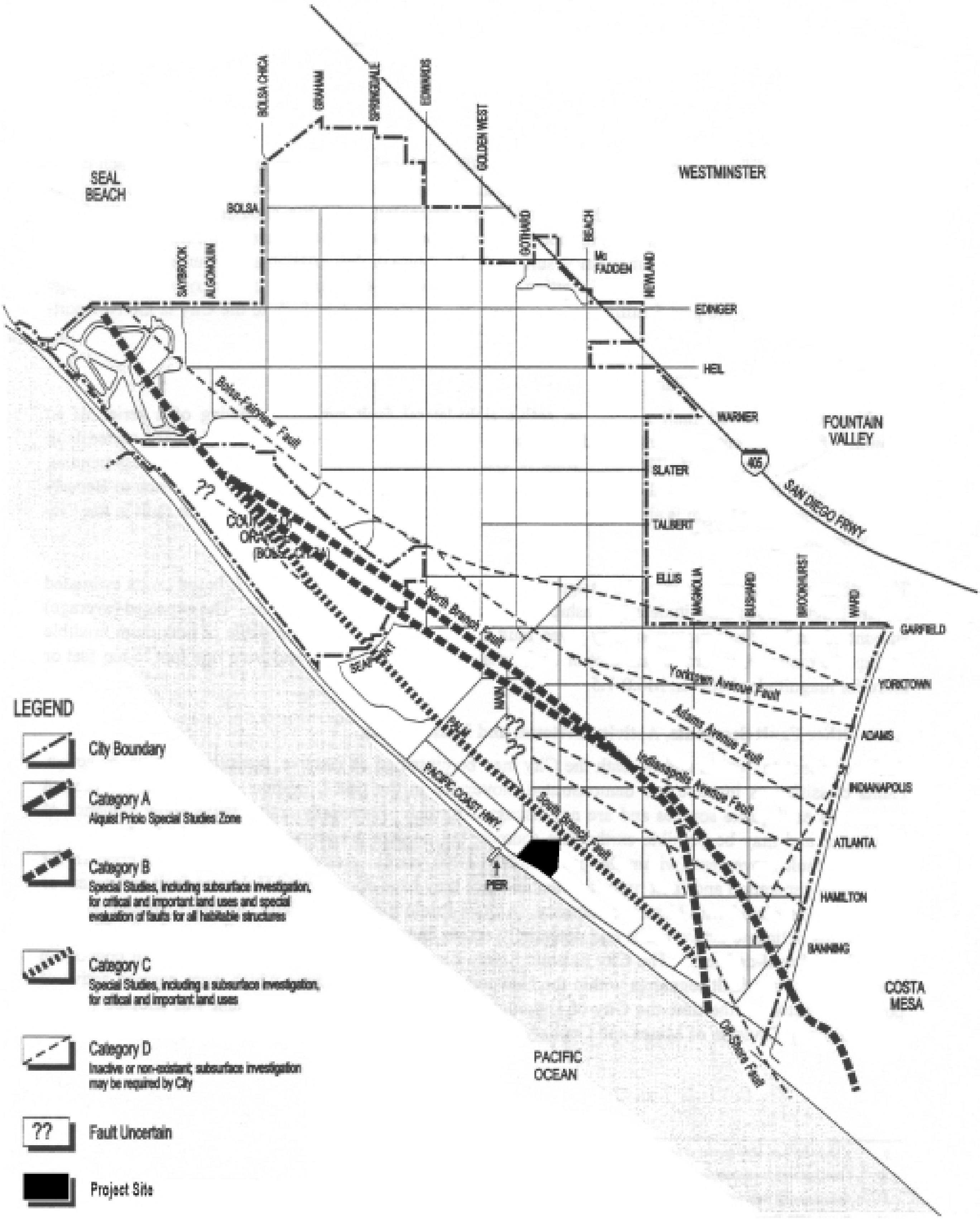
10281-00

EIP ASSOCIATES

FIGURE **3.6-1**

Major Regional Faults

City of Huntington Beach • Pacific City EIR



Not to Scale

SOURCE: City of Huntington Beach 1996b

10261-00

EIP ASSOCIATES

FIGURE **3.6-2**

Local Faults

active "blind thrust faults" (i.e., faults which lack surface expression, commonly associated with fold belts and compressional deformation) or other potentially active sources (currently not zoned) may be capable of generating earthquakes. Blind thrust faults were responsible for both the 1987 Whittier Narrows (5.9M_w) and the 1994 Northridge (6.7M_w) earthquakes.

Past Seismic Activity

The project region has experienced moderate seismic activity from various regional faults over the past 201 years. Based on analysis of historical seismic events, the maximum-recorded magnitude in the project region was 7.0M_w, which occurred on December 16, 1858, and was caused by the San Andreas Fault. The maximum historic site acceleration in the project region was estimated to be 0.4 g on March 11, 1933, caused by an earthquake of 6.3M_w on the Newport Inglewood Fault.

Seismic Hazards

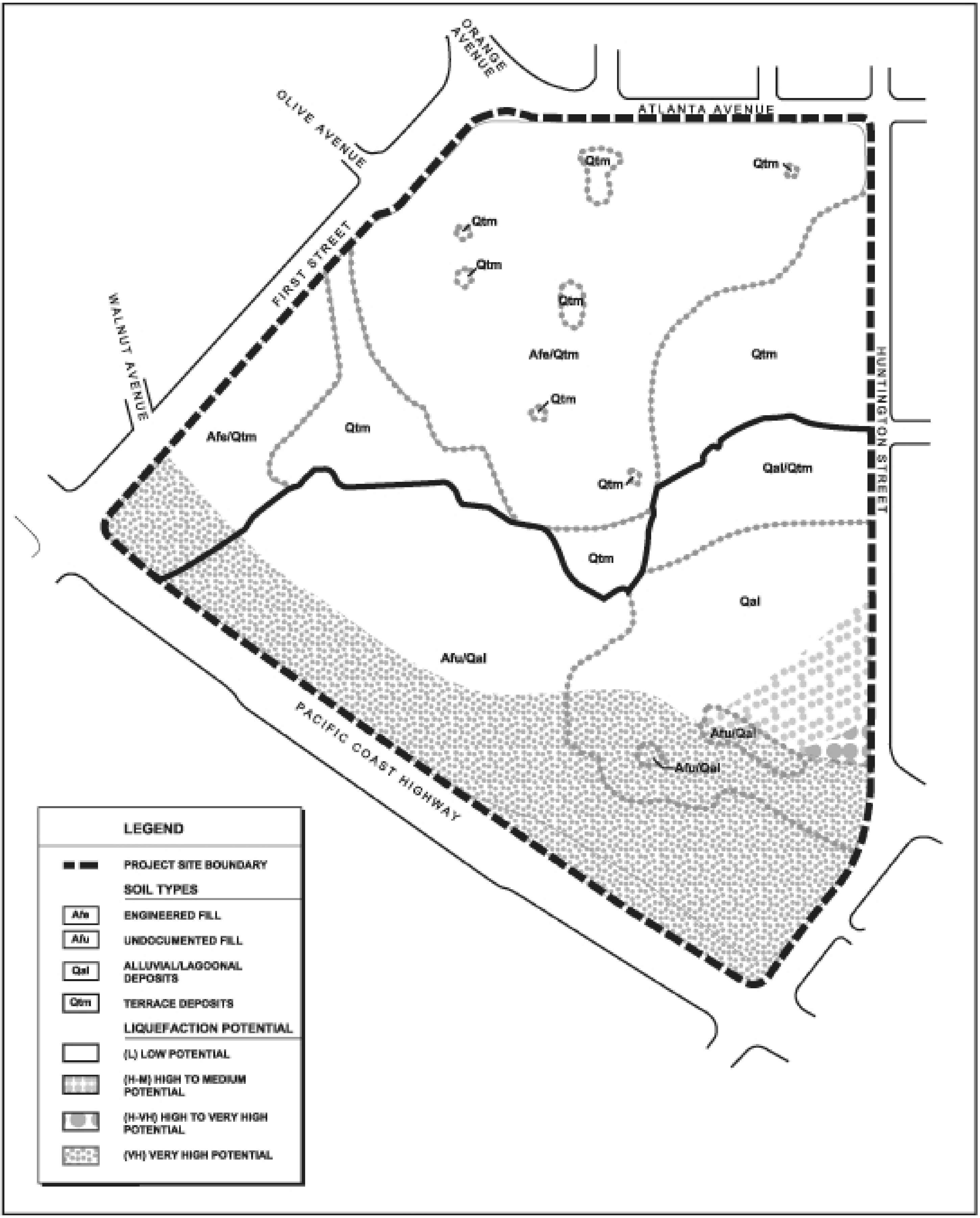
Groundshaking

The major cause of structural damage from earthquakes is groundshaking. The intensity of ground motion expected at a particular site depends upon the magnitude of the earthquake, the distance to the epicenter, and the geology of the area between the epicenter and the property. Greater movement can be expected at sites located on poorly consolidated material, such as alluvium, within close proximity to the causative fault, or in response to an event of great magnitude. Table 3.6-1 above describes the relationship between the Richter Scale Magnitude and the effects of groundshaking.

Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils lose internal shear strength and behave similarly to fluid when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: (1) shallow groundwater; (2) low-density, fine, clean, sandy soils; and (3) high-intensity ground motion. From a liquefaction hazard standpoint, the site may be divided into two types of regions: those underlain by competent natural soils (terrace deposits) and those underlain by recent alluvium.

Generally, the majority of the site is underlain by terrace and engineered fill, which are, in turn, underlain by terrace deposits. Figure 3.6-3 shows the soil regions on the project site. Based on the dense nature of the terrace and fill materials, and from analysis in the Preliminary Geotechnical Investigation report, the potential for liquefaction is considered to be low in these areas. The southeastern corner of the project site, however, is underlain by loose to medium dense alluvial deposits. The potential for liquefaction within the



Not to Scale

SOURCE: Zeiser King Consultants, Inc. 2002b

10261-00

FIGURE 3.6-3
On-Site Soil Regions

City of Huntington Beach • Pacific City EIR alluvial area, according to the preliminary Geotechnical Investigation, varies from moderate to high to very high, with most of the area designated high to medium potential, as shown in Figure 3.6-3. In addition, these alluvial soils in the southeastern portion of the project site are located within a State of California Seismic Hazard Zone Map for Liquefaction.

Ground Lurching, Cracking, or Seismically Induced Spreading

The geologic units that underlay the project site are dense to over-consolidated terrace alluvium, and medium dense alluvium. The potential for ground lurching, cracking, or seismically induced spreading or compaction effects within these areas are considered low, especially considering the engineering controls and corrective grading anticipated to be performed for the proposed project.

Soil Settlement

Soil settlement is the condition where soils deform in a vertical direction when a vertical load is placed on top of it. The compression of the soil bed by the vertical load results from the characteristics of the soil particles that are contained in the soil bed, as the spaces that are filled with either air or water between the soil particles are squeezed out. The southeastern portion of the site is underlain by approximately 15 to 20 feet of settlement-prone alluvial/lagoonal deposits, identified as "Afu/Qal" and "Qal" on Figure 3.6-3.. Under currently proposed fill loads for the project site, settlement of these soils could be on the order of ½-inch for each foot of fill placed over a period of several months. The Preliminary Geotechnical Investigation indicates that the settlement potential of each building should be determined on a case-by-case basis to ensure that final project design incorporates all necessary and appropriate engineering features to reduce settlement-related impacts.

Subsidence

Land subsidence is the condition where the elevation of a land surface decreases due to the withdrawal of fluid. The location of major oil drilling areas and state-designated oil fields are areas with subsidence potential in the City of Huntington Beach. According to the Huntington Beach General Plan, the site is not within an area that has been impacted by long-term subsidence due to local oil extraction.

Oil Wells and Methane

The project site is located within the Huntington Beach Oil Field operated by Chevron and several abandoned oil wells exist within the site. Although operation of the oil field has been shut down for many years, the former oil drilling activities at the site have resulted in alterations to the previous landform.

The project site is located within a Methane Overlay District identified in the City's General Plan. As such, the Huntington Beach Fire Department requires the developer to implement a site soils testing plan at the project site (City Specification 429), after the plan has been reviewed by the Fire Department, to determine the presence of methane gas and/or soil contamination. Zeiser Kling Consultants, Inc. indicates that this study was performed by Harding Lawson ESE, Inc. and the results are included in their Remediation Plan, along with recommended remedial grading to be implemented by Chevron and their representatives. This plan, with inclusion of a few Fire Department comments, was approved as Revision 3 on May 22, 2002.

Ocean-Related Corrosion Potential

The project site is subject to ocean breezes and winds that are considered to be corrosive to building materials associated with the proposed structures, due to the site's location approximately 500-feet from the Pacific Ocean. Building materials, such as metal, stucco, plastics, etc., are prone to corrosion and deterioration due to the presence of salts in the air and humidity from the evaporation from the ocean.

Storm Surge and Transient Groundwater

Storm surge is a phenomenon that occurs primarily during severe storm events. It is a rise above normal water levels along a coastline due to the action of wind stress on the water surface. Because the site is located approximately 500 feet from the ocean and due to the lack of hurricane-like storm conditions in this region, the potential for the site to be impacted by surging is low.

The groundwater beneath the project site may be impacted by rises in the ocean tides, water infiltration during heavy storm events, and surrounding irrigation, thus resulting in transient rises in groundwater. This condition results because the saturated sediments on the project site have interconnected spaces between fairly coarse soil grains, which allow for the passage of high tides, storm water, and irrigation water.

The potential hazards associated with tsunamis at the project site are discussed in Section 3.8 (Hydrology and Water Quality).

3.6.2 Regulatory Framework

Federal

Uniform Building Code

The Uniform Building Code (UBC) defines different regions of the United States and ranks them according to their seismic hazard potential. There are four types of these regions, which include Seismic Zones 1 through 4, with Zone 1 having the least seismic potential and Zone 4 having the highest seismic potential. The project site is located in Seismic Zone 4; accordingly, any future development would be required to comply with all design standards applicable to Seismic Zone 4.

State

California Building Code

The State of California provides a minimum standard for building design through the California Building Code (CBC). The CBC is based on the UBC, with amendments for California conditions.

Chapter 23 of the CBC contains specific requirements for seismic safety. Chapter 29 of the CBC regulates excavation, foundations, and retaining walls. Chapter 33 of the CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion control. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching as specified in Cal-OSHA regulations (Title 8 of the California Code of Regulations [CCR], as discussed below) and in Section A33 of the CBC.

Seismic Hazards Mapping Act

CDMG also provides guidance with regard to seismic hazards. Under the Seismic Hazards Mapping Act, seismic hazard zones are to be identified and mapped to assist local governments in land use planning. The intent of this publication is to protect the public from the effects of strong ground shaking, liquefaction, landslides, ground failure, or other hazards caused by earthquakes. In addition, CDMG's Special Publications 117, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," provides guidance for the evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

Local Regulations

Southern California Association of Governments

SCAG's Regional Comprehensive Plan and Guide (RCPG) and RHNA are tools for coordinating regional planning and development strategies in southern California. Policies contained in the RCPG identified by SCAG as relevant to the proposed project are identified in Table 3.6-3, and this table also includes an assessment of the proposed project's consistency with these policies.

Table 3.6-3 SCAG Regional Comprehensive Plan and Guide—Policies Applicable to Geology and Soils

Policy	*Project Consistency*
Policy 3.22. Discourage development, or encourage the use of special design requirements, in areas with steep slopes, high fire, flood, and seismic hazards.	As described above in Section 3.6.1 (Existing Conditions), the southernmost and southeastern portions of the proposed project site are considered to have a high to very high potential for liquefaction; however, development on the project site would be subject to the requirements of Chapter 16 of the UBC (as amended) and Chapter 23 of the CBC (as amended), which includes specific design requirements for seismic hazards. Additionally, as described in Impacts GEO-1 and GEO-2, a geotechnical report has been prepared for the project site, and MM GEO-1 requires the incorporation of site preparation and structural design recommendations from the report into the project to ensure that impacts to project structures would be less than significant.
Policy 3.23. Encourage mitigation measures that reduce noise in certain locations, measures aimed at preservation of biological and ecological resources, measures that would reduce exposure to seismic hazards, minimize earthquake damage, and to develop emergency response and recovery plans.	The proposed project includes mitigation measures, where necessary, to reduce potentially significant geology and soils impacts to less-than-significant levels: this EIR proposes MM GEO-1 to reduce potential impacts related to seismic hazards to less-than-significant levels, as well as to minimize earthquake damage, by incorporating applicable site preparation and structural design recommendations of the geotechnical report prepared for the project site.

The City of Huntington Beach advances public safety and welfare in the City through its Environmental Hazards Element and compliance with applicable local regulations in the Huntington Beach Municipal Code. Policies specific to geologic, soil, and seismic hazards are listed in the Environmental Hazards Element. In addition, site development work in the City of Huntington Beach is required to comply with the CBC and all State requirements pertaining to these hazards. As such, the CBC has been incorporated and adopted into the Huntington Beach Building Code as described below.

General Plan Environmental Hazards Element

The Environmental Hazards Element identifies various policies addressing natural and human-related hazards and the potential methods to reduce risks associated with those hazards. Table 3.6-4 identifies goals and objectives presented in the Environmental Hazards Element of the General Plan related to geologic resources that are potentially relevant to the proposed project. This table also includes an assessment of the proposed project's consistency with the policies adopted in support of these goals and objectives.

Table 3.6-4 General Plan Environmental Hazards Element—Policies Applicable to Geology and Soils

Goal, Objective, or Policy	*Project Consistency*
Goal EH 1. Ensure that the number of deaths and injuries, levels of property damage, levels of economic and social disruption, and interruption of vital services resulting from seismic activity and geologic hazards shall be within acceptable levels of risk.	Conformance with implementing policies, as discussed below, results in conformance with this goal.
Objective EH 1.1. Ensure that land use planning in the City accounts for seismic and geologic risk, including ground shaking, liquefaction, subsidence, soil and slope stability, and water table levels.	Conformance with implementing policies, as discussed below, results in conformance with this objective.
Policy EH 1.1.4. Evaluate the levels of risk based on the nature of the hazards and assess acceptable risk based on the human, property, and social structure damage compared to the cost of corrective measures to mitigate or prevent damage.	Section 3.6.4 (Project Impacts) describes the potential geology and soils impacts that could result from implementation of the proposed project, and proposes MM GEO-1 and MM GEO-2 to reduce these impacts to less-than-significant levels. If, as the Lead Agency, the City decides to certify this EIR, it must adopt Findings, as required by Section 15091 of the CEQA Guidelines, which include a rationale for each significant effect of the project identified in the EIR, and the status (including feasibility) of mitigation for each effect. Consideration of this project would, therefore, occur in a manner that is consistent with this policy.
Objective EH 1.2. Ensure that new structures are designed to minimize damage resulting from seismic hazards, ensure that existing unsafe structures are retrofitted to reduce hazards and mitigate other existing unsafe conditions.	Conformance with implementing policies, as discussed below, results in conformance with this objective.
Policy EH 1.2.1. Require appropriate engineering and building practices for all new structures to withstand groundshaking and liquefaction such as stated in the Uniform Building Code.	The structures proposed by the project, if the project is approved, would be constructed in accordance with applicable provisions of the UBC and CBC regarding seismic hazards and structural design. Additionally, the project would incorporate MM GEO-1, which requires the incorporation of site preparation and structural design recommendations included in the geotechnical report prepared for the project site.
Objective EH 1.3. Enhance emergency preparedness through community education, effective emergency response, and efficient post-disaster recovery.	Conformance with implementing policies, as discussed below, results in conformance with this objective
Policy EH 1.3.4. Require that earthquake survival and efficient post disaster functioning be a primary concern in the siting, design, construction, operations, and retrofitting standards for critical, essential, and high occupancy facilities, including public safety facilities.	The structures proposed by the project, if the project is approved, would be constructed in accordance with applicable provisions of the UBC and CBC regarding seismic hazards and structural design. Additionally, the project would incorporate MM GEO-1, which requires the incorporation of site preparation and structural design recommendations included in the geotechnical report prepared for the project site. These measures would ensure that earthquake survivability is a primary concern in the design and construction of the proposed project.

General Plan Coastal Element

The City of Huntington Beach Coastal Element identifies policies that address hazards related to geologic conditions and seismic hazards in particular within the City. Table 3.6-5 identifies goals and objectives presented in the Coastal Element of the General Plan related to geologic resources that are potentially relevant to the proposed project. This table also includes an assessment of the proposed project's consistency with the policies adopted in support of these goals and objectives.

Table 3.6-5 General Plan Coastal Element—Policies Applicable to Geology and Soils

Goal, Objective, or Policy	Project Consistency
Goal C 10. Minimize risks to life and property in areas of high hazards (e.g., geologic, flood and fire) within the Coastal Zone and ensure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs.	Conformance with implementing policies, as discussed below, results in conformance with this goal.
Objective C 10.1. Identify potential hazard areas in the City and manage/mitigate potential risks and impacts through land use regulation, public awareness and retrofitting where feasible.	Conformance with implementing policies, as discussed below, results in conformance with this objective.
Policy C 10.1.2. Promote land use patterns, zoning ordinances and locational criteria that mitigate potential risks posed by development in hazard areas, or which significantly reduce risk from seismic hazards.	Section 3.6.4 (Project Impacts) describes and discloses the potential geology and soils impacts (GEO-1 to GEO-4) that could result from the proposed project and includes mitigation measures where necessary to reduce such impacts to less-than-significant levels. As discussed in Impacts GEO-1 to GEO-4, the proposed project would not, after implementation of the mitigation measures proposed in this EIR, result in any significant geology- or soils-related impacts.
Policy C 10.1.4. Require appropriate engineering and building practices for all new structures to withstand ground shaking and liquefaction such as those stated in the Uniform Building Code.	The structures proposed by the project, if the project is approved, would be constructed in accordance with applicable provisions of the UBC and CBC regarding seismic hazards and structural design. Additionally, the project would incorporate MM GEO-1, which requires the incorporation of site preparation and structural design recommendations included in the geotechnical report prepared for the project site. The project would, therefore, be consistent with this policy.
Policy C 10.1.22. Subsidence shall be monitored and groundwater re-pressurization or other methods shall be used to limit potential subsidence impacts.	As described in Impact GEO-4, the proposed project site could be susceptible to subsidence; however, implementation of MM GEO-1 would reduce this impact to a less-than-significant level by requiring the incorporation into the project of site preparation and structural design recommendations of the geotechnical report prepared for the project site. The proposed project would, therefore, be consistent with this policy.

Municipal Code—Building Code and Grading and Excavation Code

Site development in the City of Huntington Beach is required to comply with the California Building Code and all State requirements pertaining to these hazards. As such, the California Building Code has been incorporated and adopted into the Huntington Beach Building Code. The California Building Code, discussed above under State regulations, is adopted by the City as Chapter 17.04, Building Code, of the Municipal Code. The Building Code, as adopted, includes minor variations to the California Building Code related to minimum slab thickness, fire-extinguishing systems, building security, and methane district regulations. The Grading and Excavation Code sets forth rules and regulations to control excavation, grading, earthwork and site improvement construction and establishes administrative requirements for issuance of permits and approvals of plans and inspection of grading construction. Specifically, the Grading and Excavation Code identifies, defines, and regulates hazardous conditions, plans and specifications, soils and geology reports, fills, setbacks, drainage and terracing, asphalt concrete pavement, and erosion control systems.

3.6.3 Thresholds of Significance

Project impacts would be considered significant if any of the following would occur:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving
  - Strong seismic groundshaking
  - Seismic-related ground failure, including liquefaction
- Result in substantial soil erosion, loss of topsoil, or changes in topography or unstable soil conditions from excavation, grading, or fill
- 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
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property

3.6.4 Project Impacts

For the purposes of this analysis, the evaluation of exposure to seismic effects and geologic stability considers if the project would accelerate geologic hazards and as a result, substantial damage to structures or infrastructure, or exposure of people to this risk would result.

Impact GEO-1 Project implementation could expose people or structures on-site to strong seismic ground shaking and seismic-related ground failure associated with liquefaction.

The project site is located approximately 0.6 mile southeast from the Newport-Inglewood Fault. In addition, active traces of the Newport-Inglewood Fault have been mapped north and northwest of the project site within the Huntington Mesa, prompting the State of California to establish the Fault Rupture Hazard Zone (formerly Alquist-Priolo zone) for the fault to be approximately 0.5 mile to the north of the project site. Consequently, the proposed project may expose on-site structures and people to substantial seismic hazards if an earthquake occurs along this fault. Based upon the regional tectonic framework surrounding the project site, the Preliminary Geotechnical Report prepared for the project site projects that the largest magnitude earthquake at the project site would likely be generated by the Newport-Inglewood fault, with a 6.9 moment magnitude. Damage from an earthquake of this range in intensity could include general damage to foundations, shifting of frame structures if not bolted, and breaking of underground pipes.

Since the proposed project site is located in Seismic Zone 4 of the 1997 UBC, structures would be designed in accordance with parameters given within Chapter 16 of the current UBC. In addition, as required by CBC Chapter 33 for the construction of new buildings and/or structures, specific engineering design and construction measures would be implemented to anticipate and avoid the potential for adverse impacts to human life and property caused by seismically induced groundshaking. However, active and potentially active faults within Southern California are capable of producing seismic shaking at the project site, and it is anticipated that the project site would periodically experience ground acceleration as a result of exposure to small and moderate magnitude earthquakes occurring on active distant and blind thrust faults. Therefore, impacts related to seismically induced groundshaking would be potentially significant.

As discussed in Section 3.6.1 (Existing Conditions), the potential for liquefaction of the subsurface soils on the majority of the project site, which is underlain by terrace and engineered fill, is considered low. However, the potential for liquefaction is moderate to high in the southeastern corner of the project site, which is underlain by loose to medium dense alluvial deposits (refer to Figure 3.6-3). In addition, the alluvial soils in the southeastern portion of the project site are located within a State of California Seismic Hazard Zone Map for Liquefaction. As such, the potential for liquefaction is present in this portion of the site. The 400-room hotel, which is proposed to be developed in this area, could thus experience substantial damages in the event of an earthquake. Moreover, the largest concentration of persons would be in this area of the site, and could potentially be exposed to these risks. As such, this impact is considered to be potentially significant.

Impact GEO-2 Project implementation would locate structures on soils that are considered potentially expansive, unstable, prone to settlement, and corrosive.

As discussed in Section 3.6.1 (Existing Conditions), the geologic units that underlay the project site consist of dense to over-consolidated terrace alluvium, and medium-dense alluvium. According to the Preliminary Geotechnical Investigation prepared for the project site, the majority of the on-site, near-surface soils exhibit a medium to high potential for expansion. With the consideration that engineering controls and corrective grading would be performed for the proposed project, the potential for ground lurching, cracking, or seismically induced spreading or compaction effects within the project site is considered low. In addition, according to the City of Huntington Beach General Plan, the project site is not located within an area that has been impacted by long-term subsidence due to local oil extraction. However, the 15 to 20 feet of loose to medium-dense alluvial deposits that are found in the southeastern portion of the site are settlement-prone.

Soil settlement resulting from typical foundation loading of new structures on the project site could affect the foundation materials by causing structural and service-related distress to structures. As discussed above, the southeastern portion of the site is underlain by settlement-prone deposits. Under the proposed project, structures that would be located in the southeastern portion of the project site would include the hotel and a portion of the commercial component that includes visitor-serving commercial uses. The building mass of the taller structures, including the hotel towers in particular, coupled with the soil type, would increase the potential magnitude of settlement that could occur. Consequently, structures proposed in this area would require the establishment of deep foundations with enough depth to encounter competent soils. In addition, the project includes development of mid-rise structures of four stories plus subterranean parking within an area of the project site consisting of terrace deposits, generally located in the northern and western portions of the site (Figure 3.6-3). These structures would also require the establishment of deep foundations. In addition to effects from settlement, existing engineered fill soils that are not compacted properly within the project site could also result in unstable foundations. Therefore, impacts related to soil expansion potential, unstable soils, and settlement would be potentially significant.

The on-site soils at the proposed project site also exhibit corrosive effects, and thus it is anticipated that steel components in contact with the on-site soils would have a potential for corrosion. This could affect buried utility lines and other support structures for the proposed project. As such, this would be a potentially significant impact.

Impact GEO-3 Construction activities would temporarily increase soil exposure to wind and water erosion.

For the purposes of this analysis, erosional effects considers whether or not the effects of project activities would accelerate the natural erosional processes.

Currently, the project site is undeveloped and consists primarily of exposed and disturbed vegetation. Proposed development would require the removal and recompaction of soils on site and grading, followed by construction of buildings and landscaping of open spaces. Trenching, grading, and compacting associated with construction of structures, modification/relocation of underground utility lines, and landscape/hardscape installation could expose areas of soil to erosion by wind or water during these construction processes. In addition, grading for the proposed subterranean parking is expected to be substantial and may also result in erosion during construction. Cut and fill operations would include

274,660 cubic yards of soil balanced on site. As the site is undeveloped, it is currently exposed to the potential for erosion. The addition of paved and landscaped areas would, over the long term, decrease the potential for erosion because fewer exposed soils would exist on site.

Since the project site does not contain steep slopes, the potential for erosion by water through surface drainage at the project site during construction would be reduced. Earth-disturbing activities associated with demolition and construction would be temporary and would not result in a permanent or significant alteration of significant natural topographic features that could increase or exacerbate erosion. Specific erosion impacts would depend largely on the areas affected and the length of time soils are subject to conditions that would be affected by erosion processes. Although the potential for erosion on the project site would be limited, exposure of soil to wind and water during construction would still occur.

The proposed site is greater than 5 acres in size, and is subject to the provisions of the General Construction Activity Stormwater Permit adopted by the State Water Resources Control Board (SWRCB). The developer for the proposed project must submit a Notice of Intent (NOI) to the SWRCB for coverage under the Statewide General Construction Activity Stormwater Permit and must comply with all applicable requirements, including the preparation of a Stormwater Pollution Prevention Plan (SWPPP), applicable NDPES Regulations, and best management practices (BMP). The SWPPP must describe the site, the facility, erosion and sediment controls, runoff water quality monitoring, means of waste disposal, implementation of approved local plans, control of post-construction sediment and erosion control measures, maintenance responsibilities, and nonstormwater management controls. Inspection of construction sites before and after storms is required to identify stormwater discharge from the construction activity and to identify and implement controls where necessary.

In addition, all construction activities would comply with Chapter 29 of the CBC, which regulates excavation activities and the construction of foundations and retaining walls, and Chapter 70 of the CBC, which regulates grading activities, including drainage and erosion control. Compliance with this permit process and the CBC requirements would minimize effects from erosion. Therefore, compliance with the Statewide General Construction Activity Stormwater Permit requirements and the CBC requirements would ensure that erosional impacts resulting from project construction would be less than significant.

3.6.5 Cumulative Impacts

This cumulative impact analysis considers development of the proposed project, in conjunction with other development within the vicinity of the project in the City of Huntington Beach. Risks associated with geologic hazards are largely site specific and limited to the project site. As such, the potential for cumulative impacts to occur is limited.

The proposed project and cumulative projects would also be exposed to potential geologic hazards related to soil and other conditions and individual building sites, and groundshaking from seismic events on known and unknown faults in the region. These effects would be site specific, and impacts would not be compounded by additional development. Buildings and facilities within the City of Huntington Beach would be sited and designed in accordance with appropriate geotechnical and seismic guidelines and recommendations consistent with the CBC and UBC. The adherence to all relevant plans, codes, and regulations with respect to project design and construction would reduce impacts to the extent feasible, and impacts would not be cumulatively considerable. The project would have a less-than-significant contribution to cumulative effects.

Implementation of the proposed project would result in the modification of site conditions to accommodate site development and to provide a stable and safe project. The modification of the project site during the construction phase could expose areas of soil to erosion by wind or water. Development of other cumulative projects in the vicinity of the project site will cumulatively expose and engineer soil surfaces, and this will further alter soil conditions and subject soils to erosional processes during construction. To minimize the potential for cumulative impacts that could cause erosion, the proposed project and cumulative projects in the adjacent area are expected to be developed in conformance with the provisions of applicable federal, State, county, and City laws and ordinances. It is also anticipated that adequate mitigation will be incorporated into individual projects as a result of current legal requirements for control of erosion storm water discharges. Furthermore, project sites more than 1 acre in size would be required to comply with the provisions of the National Pollution Discharge Elimination System, which would minimize the potential for erosion during construction and operation of the facilities. Compliance with this permit process, in addition to the legal requirements related to erosional control practices, would minimize effects from erosion. Therefore, impacts on erosion would not be cumulatively considerable, and the project would have a less-than-significant contribution to cumulative effects.

3.6.6 Mitigation Measures and Residual Impacts

The following standard City requirements (CR) would apply to the project.

CR GEO-A *Prior to recordation of the final map, a qualified, Licensed Engineer shall prepare a detailed soils and geotechnical analysis. This analysis shall include Phase II Environmental on-site soil sampling and laboratory testing of materials to provide detailed recommendations for grading, chemical and fill properties, liquefaction,* *foundations, landscaping, dewatering, ground water, retaining walls, pavement sections and utilities.*

In addition to the standard City requirement listed above, the mitigation measure (MM) listed below would be required to address Impacts GEO-1 and GEO-2.

MM GEO-1 *The grading plan prepared for the proposed project shall contain the recommendations of the final soils and geotechnical analysis prepared pursuant to CR GEO-A, as approved by the City. These recommendations shall be implemented in the design of the project, including but not limited to measures associated with site preparation, fill placement and compaction, seismic design features, excavation stability and shoring requirements, dewatering, establishment of deep foundations, concrete slabs and pavements, cement type and corrosion measures, surface drainage, erosion control, ground improvements, tsunami protection, and plan review. All geotechnical recommendations provided in the soils and geotechnical analysis shall be implemented during site preparation and construction activities.*

Establishment of deep foundations, as identified in the Preliminary Geotechnical Investigation and MM GEO-1, would require pile driving on at least the southeastern portion of the site. It is possible that cast-in-drilled hole piles may be used in the northwestern portion of the site, although this has not been determined conclusively. The impacts of pile driving from foundation installation are discussed under the evaluation of construction noise impacts in Section 4.10 (Noise).

Implementation of MM GEO-1 would reduce Impacts GEO-1 and GEO-2 to a less-than-significant level by ensuring the incorporation of recommendations from the Preliminary Geotechnical Investigation into the grading plan for the proposed project, which includes measures to address seismic hazards and foundation design. Impact GEO-3 would be less than significant, as described above.