

IV. Environmental Impact Analysis

G. Geology and Soils

1. Introduction

This section of the Draft EIR analyzes the Proposed Project's potential impacts with regard to geology and soils. The analysis includes an evaluation of the potential geologic hazards associated with fault rupture, seismic ground shaking, liquefaction, landslides, inundation, other geologic conditions, and underlying soils. The analysis is based on the Geotechnical Evaluation prepared by AMEC E&I, Inc., dated March 2012, which is provided in Appendix N of this Draft EIR.

2. Environmental Setting

a. Regulatory Setting

There are numerous State, and local regulations and plans regarding geology and soils that are relevant to and would be implemented by the Proposed Project. As described in detail in Appendix G, such regulations at the State level include the California Building Code (CBC), the Alquist-Priolo Earthquake Fault Zoning Act, and the Seismic Hazards Mapping Act. City of Los Angeles plans and regulations relevant to geology and soils include the Los Angeles General Plan Safety Element and the Los Angeles Municipal Code (LAMC).

b. Existing Conditions

(1) Geologic Setting and Topography

The Project Site is located in the northern Peninsular Ranges geomorphic province close to the boundary with the Transverse Ranges geomorphic province. The Peninsular Range province is characterized by northwest/southeast trending alignments of mountains and hills and intervening basins, reflecting the influence of northwest trending major faults and folds controlling the general geologic structural fabric of the region. This province extends northwesterly from Baja California into the Los Angeles Basin and westerly into the offshore area, including Santa Catalina, Santa Barbara, San Clemente and San Nicolas Islands. It is bounded by the Colorado Desert along the San Jacinto Fault on the east. The Los Angeles Basin is the northernmost part of the Peninsular Ranges province. The

Transverse Ranges geomorphic province is characterized by east-west trending mountain ranges that include the Santa Monica Mountains. The southern boundary of the Transverse Ranges province is marked by the Malibu Coast, Santa Monica, Hollywood, Raymond, Sierra Madre, and Cucamonga Faults.

(a) Faults

The Project Site is located in the seismically active region of Southern California. The numerous faults in Southern California are classified as active, potentially active, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS), previously the California Division of Mines and Geology, for the Alquist-Priolo Earthquake Fault Zoning Program. An active fault is defined as one that has had surface displacement within Holocene time (i.e., within the last 11,000 years). A potentially active fault is a fault that has demonstrated surface displacement of Quaternary age deposits (i.e., within the last 1.6 million years), but activity in the last 11,000 years (i.e., surface displacement of Holocene deposits) cannot be demonstrated. Inactive faults have not moved in the last 1.6 million years.

Numerous active and potentially active faults have been mapped within the Los Angeles metropolitan region. However, the Project Site itself is not located within an established State of California Alquist-Priolo Earthquake Fault Zone for surface fault rupture, and no active or potentially active faults are known to underlay the Project Site. Additionally, the Project Site is not included in a City of Los Angeles Fault Rupture Study Area. The closest Alquist-Priolo Earthquake Fault Zone to the Project Site is associated with the Newport-Inglewood Fault, located approximately 5.6 miles to the southwest. This fault can produce an earthquake of 7.1 moment magnitude.¹ Described below and illustrated in Figure IV.G-1 on page IV.G-3 are the active faults with surface rupture potential and potentially active faults within the vicinity of the Project Site. Table IV.G-1 and Table IV.G-2 on pages IV.G-4 and IV.G-5, respectively, describe the major named faults considered to be active or potentially active in Southern California, including their distance from the Project Site, maximum moment magnitude, and slip rate.

(i) Active Faults with Surface Rupture Potential

Hollywood Fault

The Hollywood Fault is located approximately 4.6 miles north-northwest of the Project Site. This fault trends east-west along the base of the Santa Monica Mountains from the West Beverly Hills Lineament in the West Hollywood–Beverly Hills area to the

¹ The moment magnitude (M_w) is based on the moment of the earthquake, which is equal to the rigidity of the earth multiplied by the average amount of slip on the fault and the size of the area that slipped.



**Table IV.G-1
Major Named Faults Considered to be Active
in Southern California**

Fault (in increasing distance)	Maximum Magnitude	Type of Fault	Slip Rate (mm/yr.)	Distance from Site (miles)	Direction from Site
Puente Hills Blind Thrust	7.1	BT	0.7	—	—
Upper Elysian Park Thrust	6.4	BT	1.3	0.8	NE
Hollywood	6.4	RO	1.0	4.6	NNW
Newport-Inglewood	7.1	SS	1.0	5.6	WSW
Raymond	6.5	SS/RO	1.5	5.9	NNE
Verdugo	6.9	R	0.5	7.4	NNE
Santa Monica	6.6	RO	1.0	8.8	WNW
Sierra Madre	7.2	R	2.0	12	NNE
Northridge Thrust	7.0	BT	1.5	14	NW
Whittier	6.8	RO	2.5	14	ESE
Malibu Coast	6.7	RO	0.3	15	W
Palos Verdes Hills	7.3	SS	3.0	16	SW
Sierra Madre–San Fernando Section	6.7	R	2.0	16	N
San Gabriel	7.2	SS	1.0	17	NNE
Clamshell Sawpit	6.5	R	0.5	17	ENE
San Jose	6.4	RO	0.5	22	E
Santa Susana	7.0	RO	5.0	23	NNW
Anacapa	7.5	RO	3.0	24	W
Simi–Santa Rosa	7.0	RO	1.0	30	NW
Holser	6.5	RO	0.4	30	NNW
Central Avenue	6.7	NO	1.0	31	E
San Joaquin Thrust	6.6	BT	0.5	31	SSE
Cucamonga	6.9	RO	5.0	33	E
San Andreas–Mojave South Section	7.4	SS	29.0	34	NNE
Oak Ridge	7.0	R	4.0	36	NW
Elsinore–Glen Ivy Section	6.8	SS	5.0	37	ESE
San Cayetano	7.0	R	6.0	39	NW
San Jacinto–San Bernardino Valley Section	6.7	SS	6.0	44	ENE
San Andreas–San Bernardino North Section	7.5	SS	22.0	47	ENE
Santa Ynez	7.1	SS	2.0	65	NW
Santa Cruz Island	7.0	RO	1.0	71	W
SS = Strike Slip NO = Normal Oblique RO = Reverse Oblique BT = Blind Thrust R = Reverse					

**Table IV.G-2
Major Named Faults Considered to be Potentially Active
in Southern California**

Fault (in increasing distance)	Maximum Magnitude	Type of Fault	Slip Rate (mm/yr.)	Distance from Site (miles)	Direction from Site
MacArthur Park	5.7	RO	0.1	0.8	NE
Overland	6.0	SS	0.1	7.4	WSW
Charnock	6.5	SS	0.1	8.7	WSW
Norwalk	6.7	RO	0.1	14	SE
Los Alamitos	6.2	SS	0.1	17	SSE
Northridge Hills	6.6	SS	1.2	17	NNW
Duarte	6.7	RO	0.1	17	ENE
El Modeno	6.5	NO	0.1	24	SE
Indian Hill	6.6	RO	0.1	24	E
Peralta Hills	6.5	RO	0.1	29	SE
Pelican Hill	6.3	SS	0.1	36	SSE
<i>SS = Strike Slip</i> <i>NO = Normal Oblique</i> <i>RO = Reverse Oblique</i> <i>BT = Blind Thrust</i>					

Los Feliz area of Los Angeles. The Hollywood Fault is the eastern segment of the reverse oblique Santa Monica–Hollywood Fault. Based on geomorphic evidence, stratigraphic correlation between exploratory borings, and fault trenching studies, this fault is classified as active.

Until recently, the approximately 9.3-mile long Hollywood Fault was considered to be expressed as a series of linear ground-surface geomorphic expressions and south-facing ridges along the south margin of the eastern Santa Monica Mountains and the Hollywood Hills. Multiple recent fault rupture hazard investigations have shown that the Hollywood Fault is located south of the ridges and bedrock outcroppings along Sunset Boulevard. The Hollywood Fault has not produced any damaging earthquakes during the historical period and has had relatively minor micro-seismic activity. The CGS estimates an average slip rate of 1.0 millimeters per year and an estimated maximum moment magnitude of 6.4 for the Hollywood Fault. An Alquist-Priolo Earthquake Fault Zone has not been established for the Hollywood Fault. However, the Hollywood Fault is considered active by the State and the City of Los Angeles.

Newport-Inglewood Fault

The Newport-Inglewood Fault, a right-lateral strike-slip fault, is located approximately 5.6 miles southwest of the Project Site. This fault zone is composed of a series of discontinuous northwest-trending en echelon faults (i.e., separate, parallel faults having a step-like pattern) extending from Ballona Gap southeastward to the area offshore from Newport Beach. The Newport-Inglewood Fault is reflected at the surface by a line of hills and mesas formed by the folding and faulting of a thick sequence of Pleistocene age sediments and Tertiary age sedimentary rocks. Readings from seismographs for 39 small earthquakes (between 1977 and 1985) show mostly strike-slip faulting (i.e., a vertical fault where the two sides of the fault move horizontally past each other with little or no vertical movement) with some reverse faulting (i.e., a more horizontal fault where the upper block is pushed upwards toward the ground surface) along the north segment (north of Dominguez Hills) and some normal faulting (i.e., a more horizontal fault where the upper block slips downwards from the ground surface) along the south segment (south of Dominguez Hills to Newport Beach). The CGS estimates an average slip rate of 1.0 millimeter per year and an estimated maximum moment magnitude of 7.1 for the Newport-Inglewood Fault. An Alquist-Priolo Earthquake Fault has been established for the Newport-Inglewood Fault, and it is considered active by the State and the City of Los Angeles.

Raymond Fault

The Raymond Fault is located approximately 5.9 miles north-northeast of the Project Site. The Raymond Fault is primarily a strike-slip fault with minor components of a reverse oblique. The Raymond Fault has numerous geomorphic features along its entire length (such as fault scarps, sag ponds, springs, and pressure ridges) demonstrate the fault's activity during the last 11,000 years. The most recent fault movement, based on radiocarbon ages from materials collected in an excavation exposing the fault, occurred sometime between 2,160 (± 105) and 1,630 (± 100) years before present. The CGS estimates an average slip rate of 1.5 millimeters per year and an estimated maximum moment magnitude of 6.5 for the Raymond Fault. An Alquist-Priolo Earthquake Fault Zone has been established for this fault, and it is considered active by the State and the City of Los Angeles.

Verdugo Fault

The active Verdugo Fault is composed of several faults including the Verdugo Fault, the San Rafael Fault, and the Eagle Rock Fault. The Verdugo Fault, a reverse fault, is located approximately 7.4 miles north-northeast of the Project Site. The most recent

documented activity along this fault occurs in the Holocene age alluvial deposits along the western flank of the Verdugo Mountains in the Burbank area.² A State of California Alquist-Priolo Earthquake Fault Zone has not been established for the Verdugo Fault by the State; however, this portion of the fault is considered active by the State.³ The CGS estimates an average slip rate of 0.5 millimeter per year and an estimated maximum moment magnitude of 6.9 for the Verdugo Fault.

Santa Monica Fault

The north strand of the reverse oblique Santa Monica Fault is located approximately 8.8 miles west-northwest of the Project Site. The Santa Monica Fault and Hollywood Fault form a portion of the Transverse Ranges Southern Boundary fault system, which includes the Malibu Coast Fault to the west of the Santa Monica Fault and the Raymond Fault and Cucamonga Fault to the east of the Hollywood Fault. The Santa Monica Fault is the western segment of the Santa Monica–Hollywood Fault. The Santa Monica–Hollywood Fault trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east. Urbanization and development within the greater Los Angeles area has resulted in a poor understanding of the lateral extent, location and rupture history of the Santa Monica Fault. However, the surface expression of the Santa Monica Fault Zone includes fault-related geomorphic features, offset stratigraphy, and groundwater barriers within late Quaternary deposits. The CGS estimates an average slip rate of 1.0 millimeter per year and a maximum moment magnitude of 6.6 for the Santa Monica Fault.

Research indicates that the Santa Monica Fault Zone is separated into an east segment and a west segment, divided by the West Beverly Hills Lineament. The Project Site is located within the eastern portion of the Santa Monica Fault Zone, which is not considered active. Although the north strand of the west segment of the Santa Monica Fault is considered active, it has not yet been included in an Alquist-Priolo Earthquake Fault Zone due to its poorly understood surface trace.⁴

² Refer to page 9 of the Report of Geotechnical Evaluation for Environmental Impact Report, included as Appendix N.

³ Refer to page 29 of the Report of Geotechnical Evaluation for Environmental Impact Report, included as Appendix N.

⁴ California Division of Mines and Geology. State of California Special Studies Zones, Beverly Hills Quadrangle. Revised Official Map. 1986.

Sierra Madre Fault

The Sierra Madre Fault is located approximately 12 miles northeast of the Project Site. The Sierra Madre Fault consists of five recognized sections of north-dipping reverse faults that separate the Sierra Madre Mountains from the San Fernando and San Gabriel Valleys.⁵ The fault zone offsets Holocene deposits, has a reported slip rate of approximately 2 millimeters per year, and is capable of producing an estimated maximum moment magnitude earthquake of 7.2. An Alquist-Priolo Earthquake Fault Zone has not been established for this fault; however, it is considered active by the State and the City of Los Angeles.

Malibu Coast Fault

The active Malibu Coast Fault, located approximately 15 miles west of the Project Site, is a series of east-west trending reverse faults extending westward from Santa Monica to offshore of Point Mugu. Fault trenching conducted in 1985 and 1986 on south Winter Mesa in the Malibu area of Los Angeles County exposed several faults, with one fault offsetting deposits estimated to be 6,000 years old. The observed faults, named the Winter Mesa Faults, are believed to be outward extensions of the Malibu Coast Fault. Thus, the Holocene faulting on the Winter Mesa Faults is considered representative of active faulting along the Malibu Coast Fault. The CGS estimates an average slip rate of 0.3 millimeter per year and an estimated maximum moment magnitude of 6.7 for the Malibu Coast Fault. Portions of the Malibu Coast Fault have been included as an Alquist-Priolo Earthquake Fault Zone, and it is considered active by the State and the City of Los Angeles.

Palos Verdes Fault

Studies indicate that there are several active on-shore extensions of the strike-slip Palos Verdes Fault, which is located approximately 16 miles southwest of the Project Site. Geophysical data also indicate the off-shore extensions of the fault are active, offsetting Holocene age deposits. No historic large magnitude earthquakes are associated with this fault. However, the fault is considered active by the CGS. The CGS estimates an average slip rate of 3.0 millimeters per year and an estimated maximum moment magnitude of 7.3 for the Palos Verdes Fault Zone. An Alquist-Priolo Earthquake Fault Zone has not been established for this fault.

⁵ Refer to page 34 of the Report of Geotechnical Evaluation for Environmental Impact Report, included as Appendix N.

San Andreas Fault

The Mojave section of the active San Andreas Fault is located approximately 34 miles northeast of the Project Site. This fault zone, California's most prominent structural feature, trends generally northwest for almost the entire length of the state, and is divided into several sections. The CGS estimates an average slip rate of 29.0 millimeters per year and an estimated maximum moment magnitude of 7.4 for the San Andreas Fault Mojave section. A single event, however, can rupture multiple sections, producing a more powerful quake. The last major earthquake along the San Andreas Fault in Southern California was the 1857 magnitude 7.9 Fort Tejon earthquake, in which four sections ruptured along a 345-kilometer length of the fault. An Alquist-Priolo Earthquake Fault Zone has been established for this fault, and it is considered active by the State and the City of Los Angeles.

(ii) Blind Thrust Faults

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Los Angeles Basin. Blind thrust faults do not come to the surface, and thus are not shown on the regional faults and seismicity map. These faults are not exposed at the ground surface and are typically identified at depths greater than 1.9 miles. These faults do not present a potential surface fault rupture hazard. However, the following described blind thrust faults are considered active and potential sources for future earthquakes.

Puente Hills Blind Thrust

The Puente Hills Blind Thrust Fault extends eastward from Downtown Los Angeles to the City of Brea in northern Orange County. The Puente Hills Blind Thrust Fault includes three north-dipping segments, named from east to west as the Coyote Hills segment, the Santa Fe Springs segment, and the Los Angeles segment. These segments are overlain by folds expressed at the surface as the Coyote Hills, Santa Fe Springs Anticline, and the Montebello Hills. The Puente Hills Blind Thrust fault lies directly beneath downtown Los Angeles and the Project Site.

The Santa Fe Springs segment of the Puente Hills Blind Thrust fault is believed to be the cause of the October 1, 1987, Whittier Narrows Earthquake. Earthquake scenarios for the Puente Hills Blind Thrust fault include single segment fault ruptures capable of producing an earthquake of magnitude 6.5 to 6.6 moment magnitude and a multiple segment fault rupture capable of producing an earthquake of magnitude 7.1. Based on deformation of late Quaternary age sediments above this fault system and the occurrence of the Whittier Narrows earthquake, the Puente Hills Blind Thrust Fault is considered an active fault capable of generating future earthquakes beneath the Los Angeles Basin. An

average slip rate of 0.7 millimeter per year and a maximum moment magnitude of 7.1 are estimated by the CGS for the Puente Hills Blind Thrust.

Upper Elysian Park Thrust

The Upper Elysian Park Blind Thrust is a blind thrust fault that overlies the Los Angeles and Santa Fe Springs segments of the Puente Hills Blind Thrust. The eastern edge of the Upper Elysian Park Blind Thrust is defined by the northwest-trending Whittier Fault. The closest point of the vertical surface projection of the Upper Elysian Park Fault is approximately 0.8 mile northeast of the Project Site. The Upper Elysian Park should be considered an active feature capable of generating future earthquakes. An average slip rate of 1.3 millimeters per year and a 6.4 maximum moment magnitude are estimated by the CGS for the Upper Elysian Park Blind Thrust.

Northridge (Blind) Thrust

The Northridge Thrust is located beneath the majority of the San Fernando Valley and is the causative fault of the January 17, 1994, 6.7 moment magnitude Northridge earthquake. The Northridge Thrust is an active feature that can generate future earthquakes. The vertical surface projection of the Northridge Blind Thrust is approximately 14 miles northwest of the Project Site at the closest point. The CGS estimates an average slip rate of 1.5 millimeters per year and 7.0 maximum moment magnitude for the Northridge Thrust.

(iii) Potentially Active Faults

As described above, a potentially active fault is a fault that has demonstrated surface displacement of Quaternary age deposits (i.e., within the last 1.6 million years), but surface displacement of Holocene deposits (i.e., activity in the last 11,000 years) cannot be demonstrated. When deposits of specified ages are not offset, it is implied that a fault has not been active since that time.

MacArthur Park Fault

The MacArthur Park Fault is a potentially active fault located approximately 0.8 mile northeast of the Project Site. The fault, inferred west of Downtown Los Angeles, is approximately 5 miles long, extending northwest from the Pershing Square area in Downtown Los Angeles through MacArthur Park to Hollywood. Current information suggests the fault is potentially active. The CGS estimates an average slip rate of 0.1 millimeter per year and an estimated maximum moment magnitude of 5.7 for the MacArthur Park Fault.

Overland Fault

The Overland Fault is a potentially active strike-slip fault located approximately 7.4 miles west-southwest of the Project Site. The Overland Fault trends northwest between the Charnock Fault and the Newport-Inglewood Fault. The fault extends from the northwest flank of the Baldwin Hills to Santa Monica Boulevard in the vicinity of Overland Avenue. The west side of the fault has apparently moved downward, relative to the east side, forming a graben (a depressed block of land bordered by parallel faults) between the Charnock and Overland Faults. However, there is no evidence that this fault has offset late Pleistocene or Holocene age alluvial deposits. The CGS estimates an average slip rate of 0.1 millimeter per year and an estimated maximum moment magnitude of 6.0 for the Overland Fault.

Charnock Fault

The Charnock Fault is a potentially active fault located approximately 8.7 miles west-southwest of the Project Site. The Charnock Fault trends northwest-southeast subparallel to the trend of the Newport-Inglewood Fault Zone and the Overland fault. Differential water levels across the fault occur in the early Pleistocene age San Pedro Formation. However, there is no evidence that this fault has offset late Pleistocene or Holocene age alluvial deposits. The CGS estimates an average slip rate of 0.1 millimeter per year and a maximum moment magnitude of 6.5 for the Charnock Fault.

Norwalk Fault

The Norwalk fault is a potentially active fault located approximately 14 miles southeast of the Project Site. The fault is a known groundwater barrier along the southern edge of the Coyote Hills, trending southeasterly toward the Santa Ana Mountains. This fault offsets lower Pleistocene age and older deposits near the mouth of the Santa Ana Canyon. However, there is no evidence that this fault has offset Holocene age alluvial deposits. The CGS estimates an average slip rate of 0.1 millimeter per year and an estimated maximum moment magnitude of 6.7 for the Norwalk Fault.

Northridge Hills Fault

The Northridge Hills fault is a potentially active fault located approximately 17 miles to the north-northwest. The Northridge Hills Fault is a high-angle fault and its location is based primarily on the numerous oil test holes that have been drilled in the Northridge Hills. Logs of these wells indicate that the Modelo Formation has been displaced between 150 to 300 meters along the dip of the fault. The fault is considered potentially active. However, a recent publication suggests that deformation of young sediments could be related to the

Northridge Hills Fault. The CGS estimates an average slip rate of 1.2 millimeters per year and an estimated maximum moment magnitude of 6.6 for the Northridge Hills Fault.

(b) Summary of Historic Earthquakes

As described in detail in Appendix N, within a radius of approximately 100 kilometers (62.1 miles) of the Project Site, 302 earthquakes of magnitude 4.0 and greater (including three earthquakes greater than magnitude 6.0) occurred between 1932 and 2011; three earthquakes of magnitude 6.0 or greater occurred between 1889 and 1931; and four earthquakes of magnitude 6.0 or greater occurred between 1769 and 1888. Faults and epicenters of earthquakes greater than magnitude 5 in the greater Los Angeles area are shown in Figure IV.G-1 on page IV.G-3. In addition, Table IV.G-3 on page IV.G-13 provides a partial list of the moderate to large magnitude (greater than 5.5 with aftershocks excluded) earthquakes have occurred in the Southern California area within the last 78 years.

(2) Site-Specific Geologic and Seismic Conditions

(a) Surface Fault Rupture

Based on the above discussion of faults, the Project Site is not located within a currently established Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards. The closest Alquist-Priolo Earthquake Fault Zone is for the Newport-Inglewood Fault, located approximately 5.6 miles to the southwest. The closest active fault to the Project Site with the potential for surface fault rupture is the Hollywood Fault located approximately 4.6 miles to the north-northwest. As there are no active or potentially active faults with the potential for surface fault rupture known to be located directly beneath the Project Site or projecting toward the Project Site, the potential for surface rupture is considered low.

(b) Geologic Materials

The Project Site is underlain by Holocene to Pleistocene age alluvial deposits. The geotechnical foundation investigation for STAPLES Center reported firm natural soil 2.5 to 6.5 feet below the surface at approximate elevations of 228 to 236 feet above sea level. The firm natural soil located 2 to 10 feet below the surface consists primarily of sand containing varying amounts of silt/clay, gravel, cobbles, and boulders. Layers of weaker and more compressible silt, silty sand, and clay were reported within the underlying firm sand deposits. Sand typically has a low expansion potential; however, layers of silt and clay could have medium to high expansion potential. The result of a percolation test at the

Table IV.G-3
List of Selected Major Historic Earthquakes in Southern California Since 1933

Earthquake	Date of Earthquake	Magnitude	Distance to Epicenter (miles)	Direction to Epicenter
Long Beach	March 11,1933	6.4	41	SE
Tehachapi	July 21,1952	7.5	70	NW
San Fernando	February 9,1971	6.6	24	N
Whittier Narrows	October 1,1987	5.9	20	E
Sierra Madre	June 28,1991	5.8	29	NE
Landers	June 28,1992	7.3	115	ENE
Big Bear	June 28, 1992	6.4	92	E
Northridge	January 17,1994	6.7	11	NNW
Hector Mine	October 16, 1999	7.1	130	ENE
Sierra El Mayor	April 4, 2010	7.2	≈170	SE
<i>Source: Refer to page 28 of the Report of Geotechnical Evaluation for Environmental Impact Report, included as Appendix N.</i>				

Bond Street Parking Lot indicated a percolation rate of 7.5 inches per hour in firm sand deposits less than 10 feet below the ground surface.⁶

(c) Groundwater

Based on information from the California Division of Mines and Geology, now CGS, the historic high groundwater level in the vicinity of the Project Site is estimated to be on the order of 90 feet below ground surface.⁷ For further information regarding groundwater refer to Section IV.H.2, Water Resources—Groundwater, of this Draft EIR.

(d) Liquefaction and Seismic-Induced Settlement

Liquefaction is the process in which loose granular soils below the groundwater table temporarily lose strength during strong ground shaking as a consequence of increased pore pressure and thereby, reduced effective stress. The vast majority of

⁶ Refer to page 31 of the Report of Geotechnical Evaluation for Environmental Impact Report, included as Appendix N.

⁷ California Division of Mines and Geology, 1998, "Seismic Hazard Zone for the Hollywood 7.5 Minute Quadrangle, Los Angeles County, California, Seismic Hazard Zone Report 026, updated 2006.

liquefaction hazards are associated with sandy soils and silty soils of low plasticity. Potentially liquefiable soils must be saturated or nearly saturated to be susceptible to liquefaction.

Significant factors that affect liquefaction include water level, soil type, particle size and gradation, relative density, confining pressure, intensity of shaking, and duration of shaking. These factors must be evaluated on a site-specific basis to assess the potential for ground failure caused by liquefaction at the Project Site. Liquefaction potential has been found to be the greatest where the groundwater level is shallow and submerged, loose, fine sands occur within a depth of about 50 feet or less. Liquefaction potential decreases with increasing grain size and clay and gravel content, but increases as the ground acceleration and duration of shaking increase.

Based on the City of Los Angeles Safety Element and the CGS, the Project Site is not within an area identified as having a potential for liquefaction. As discussed above and in more detail in Section IV.H.2, Water Resources—Groundwater, of this Draft EIR, groundwater has historically been as high as approximately 90 feet below the existing ground surface. Therefore, based on the Proposed Project's maximum excavation depth of approximately 50 feet, the potential for liquefaction to occur at the Project Site is low.

Seismic-induced settlement is often caused by loose to medium-dense granular soils densified during ground shaking. Uniform settlement beneath a given structure would cause minimal damage. However, due to variations in distribution, density, and confining conditions of the soils, seismic-induced settlement is generally non-uniform and can cause serious structural damage. Dry and partially saturated soils, as well as saturated granular soils, are subject to seismic-induced settlement. The soils underlying the Project Site are anticipated to be dense and are not considered susceptible to significant seismic induced settlement.

(e) Slope Stability

The Project Site is relatively level, containing no significant slopes. In addition, there are no known landslides at the Project Site, nor is the Project Site in the path of any known or potential landslides. The Project Site is also not within an area identified as having a potential for slope instability in the City of Los Angeles Safety Element of the General Plan, nor is the Project Site located within a CGS Seismically Induced Landslide Hazard Zone.

(f) Tsunamis, Inundation, and Seiches

The Project Site is located approximately 12 miles from San Pedro Bay and at an elevation of 230 to 235 feet above mean sea level. In addition, neither the City of Los

Angeles Seismic Safety Element nor the State of California designate the Project Site as being within a tsunami run-up zone. A small portion of the southeastern corner of the Project Site is within a potential inundation hazard zone. Dams in California are continually monitored by various governmental agencies (such as the State of California Division of Safety of Dams and the U.S. Army Corps of Engineers) to guard against the threat of dam failure. The possibility of dam failures during an earthquake has been addressed by the CGS in the earthquake planning scenarios for a magnitude 8.3 earthquake on the San Andreas fault zone and a magnitude 7.0 earthquake on the Newport-Inglewood fault zone. Based on these documents, catastrophic failure of a major dam as a result of a scenario earthquake is regarded as unlikely. Current design and construction practices and ongoing programs of review, modification, or total reconstruction of existing dams are intended to ensure that all dams are capable of withstanding the maximum credible earthquake for the site. Furthermore, mitigation of potential seiche hazards has also been implemented by the Los Angeles Department of Water and Power through regulation of the level of water in its storage facilities and the provision of walls of extra height to contain seiches and prevent overflow or inundation. Dams and reservoirs are monitored during storms, and measures are instituted in the event of potential overflow. These measures apply to facilities within the City's borders and facilities owned and operated by the City within other jurisdictions.⁸

(g) Flooding

The Project Site is not located within a FEMA flood zone nor a flood influence area of the City of Los Angeles Seismic Safety Element. Please refer to Section IV.H.1.a, Hydrology and Surface Water Quality, of this Draft EIR for a detailed analysis regarding flooding.

(h) Expansive and Corrosive Soils

Sandy soils typically have a low expansion potential. However, silts and local clays could have medium to high expansion potential and could shrink and swell with variations in moisture content. Corrosion testing of soils within 0.5 mile of the Project Site indicated that soils are mildly to severely corrosive to ferrous metals and aggressive to copper. In addition the testing indicated that exposure of concrete to sulfate attack was considered negligible to moderate. The soils within the Project Site are likely to exhibit similar corrosive properties.

⁸ City of Los Angeles, Department of City Planning, *Safety Element of the Los Angeles General Plan*, adopted by the City Council November 26, 1996, page II-16.

(i) Oil Wells and Methane Gas

As discussed in Section IV.L, Environmental Hazards, of this Draft EIR, the Project Site is situated above the Los Angeles Downtown oil field, which was discovered in 1965. One oil well is known to exist within the Project area and other wells may also be present within the Project area. In addition, the Project Site is located in a City of Los Angeles methane zone.

(j) Subsidence

Subsidence occurs when fluids from the ground (such as petroleum or groundwater) are withdrawn. The Project Site is not within an area of known subsidence associated with fluid withdrawal (groundwater or petroleum), peat oxidation, or hydro-compaction. A potential for subsidence may be present as a result of pumping oil, water, and gas in the Los Angeles Downtown Oil Field. However, the area is not known for subsidence and oil field operations include water flooding and gas injection that tend to counteract the potential for subsidence to occur. Furthermore, the City of Los Angeles is responsible for monitoring oil extraction activities and administering oil drilling permits. In addition water and gas extraction activities are not known to occur within the Project Site. In the event that such activities were to occur, requirements addressing the potential for subsidence would be implemented as deemed necessary.

3. Environmental Impacts

a. Methodology

To evaluate potential hazards relative to geology and soils, a Geotechnical Evaluation (Geotechnical Report) was prepared by Amec E&I, Inc. This report is provided in Appendix N of this Draft EIR. The Geotechnical Report is based on a review of boring logs for a portion of the Project Site, previous geotechnical reports for portions of the Project Site and immediate area, and available published and unpublished geologic and seismic literature pertinent to the Project Site.

b. Thresholds of Significance

Appendix G of the CEQA Guidelines provides a set of sample questions that address impacts with regard to geology and soils. These questions are as follows:

Would the project:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.
 - Strong seismic ground shaking?
 - Seismic-related ground failure, including liquefaction?
 - Landslides?
 - Result in substantial soil erosion or the loss of topsoil?
 - 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 (1994), creating substantial risks to life or property?
 - Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?

In the context of the above questions from Appendix G of the CEQA Guidelines, the City of Los Angeles CEQA Thresholds Guide states that a project would normally have a significant geology and soils impact if the project would:

(1) Geologic Hazards

- Cause or accelerate geologic hazards, which would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.

(2) Sedimentation and Erosion

- 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.

(3) Landform Alteration

- Destroy, permanently cover, or materially and adversely modify one or more distinct and prominent geologic or topographic features. Such features may include, but are not limited to, hilltops, ridges, hillslopes, canyons, ravines, rock outcrops, water bodies, streambeds, and wetlands.

c. Project Design Features

Construction activities for the Proposed Project would require earthwork, including grading. With regard to the Event Center, it is anticipated that approximately 12.6 acres would be excavated to a maximum depth of 50 feet. These activities with regard to the Event Center would result in approximately 807,000 cubic yards of export during construction. With regard to the L.A. Live Way Garage, approximately 2.7 acres would be excavated, resulting in approximately 38,700 cubic yards of export. At the New Hall, approximately 6 acres would be excavated to a depth of up to approximately 1 foot, resulting in approximately 15,800 cubic yards of export during construction. At the Bond Street Garage, approximately 1.0 acre would be excavated resulting in approximately 5,400 cubic yards of export. In total, it is anticipated that up to approximately 866,900 cubic yards of soil would be graded and exported to construct the Proposed Project.

Earthwork activities associated with the grading and export of soil would occur in accordance with City requirements, as specified in the LAMC and CBC and through the grading plan review and approval process. As part of these regulatory requirements, grading, erosion and sedimentation control measures would be implemented during site grading to reduce erosion impacts. Project building design and construction would also conform to the current building and safety design provisions of the LAMC, which incorporates the CBC, including all provisions related to seismic activity. In addition, construction of the Proposed Project would comply with the construction and design recommendations provided within the site-specific geotechnical report(s).

d. Project Impacts

(1) Geologic-Hazards

(a) Surface Fault Rupture

As discussed above, no known active or potential active faults with the potential for surface fault rupture cross or project toward the Project Site, and the potential for surface fault rupture at the Project Site is low. Therefore, Proposed Project impacts related to surface fault rupture would be less than significant, and no mitigation measures would be required.

(b) Seismicity and Ground Shaking

The Project Site is located in the seismically active region of Southern California. Thus, the Project Site would be subject to strong seismic groundshaking, typical of areas within Southern California. The seismic source type and closest distance to a known seismic source were determined by the Geotechnical Report using the CGS mapping. As discussed above, the closest active fault to the Project Site is the Hollywood Fault.

The probability that a ground motion of a certain intensity would be exceeded at a given site due to earthquakes from all regional seismic sources with their respective probabilities of occurrence has been determined by the CGS in Open-File Report 98-20 for the Los Angeles 7.5-Minute Quadrangle. The maximum ground motion, measured in peak ground acceleration (PGA), for the Project Site having a 10 percent probability of exceedance in 50 years (or a return period of 475 years) has been determined for alluvium conditions.⁹ Based on information from the CGS, there is a 10 percent probability that PGA of 0.46g (0.46 times the acceleration of gravity) would be exceeded in 50 years in the Project area.

As with any new development in the State of California, building design and construction for the Proposed Project would be required to conform to the current seismic design provisions of the CBC. The 2010 CBC incorporates the latest seismic design standards for structural loads and materials, as well as provisions from the National Earthquake Hazards Reduction Program, to mitigate losses from an earthquake and provide for the latest in earthquake safety. Additionally, construction of the Proposed Project would be required to adhere to the seismic safety requirements contained in the Los Angeles Building Code, which incorporates portions of the International Building Code,

⁹ The return period is defined as the frequency of occurrence between past earthquake events.

and the 2010 CBC with amendments that are specific to the City of Los Angeles. Therefore, the Proposed Project would not cause or accelerate geologic hazards that would result in substantial damage to structures or infrastructure, nor expose people to substantial risk of injury impacts from strong seismic ground shaking. Impacts associated with seismicity and ground shaking would be less than significant, and no mitigation measures are required.

(c) Liquefaction

As discussed above, the Project Site is not located within a State-designated seismic hazard zone for liquefaction potential or within a City-designated liquefiable area or potentially liquefiable area. Furthermore, groundwater has historically been as high as approximately 90 feet below the existing ground surface level, whereas the Proposed Project would require a maximum depth of excavation of approximately 50 feet. Thus, the potential for liquefaction to occur at the Project Site is considered low. Therefore, the Proposed Project would not result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury involving liquefaction. Impacts associated with liquefaction would be less than significant, and no mitigation measures are required.

(d) Settlement

Seismic-induced settlement is often caused by loose to medium-dense granular soils densified during ground shaking. It is anticipated that site soils that could be susceptible to seismic-induced settlement will be removed from excavations; therefore, the risk of seismic-induced settlement is considered low. Therefore, impacts associated with the potential for settlement to occur at the Project Site would be less than significant, and no mitigation measures are required.

(e) Slope Stability

The Project Site and surrounding area is relatively flat and, thus, is not susceptible to landslide hazards. Furthermore, the Project Site is not located within a State-designated seismic hazard zone for landslide potential or a City-designated landslide inventory area. However, temporary excavations at the Project Site with slopes steeper than approximately 1:1 may not be stable and slope stability impacts are potentially significant. However, with the implementation of requirements set forth in the site-specific geotechnical report prepared for the Proposed Project, potential impacts related to slope stability during construction would be less than significant. In addition, as discussed below, Mitigation Measure G-2 has been included to ensure that such requirements would be implemented and that impacts related to slope stability during construction would be less than significant.

(f) Groundwater

Prior borings drilled to a depth of 100 feet in the vicinity of the Project Site did not report groundwater above that depth, except for minor seepage between approximately 17 and 36 feet below the surface level. According to CGS, historically the peak groundwater depth is estimated at 90 feet as previously stated. Thus, based on the proposed depth of excavation and the existing impervious nature of the Project Site, impacts with regards to groundwater would be less than significant. No mitigation measures are required. Please refer to Section IV.H.2, Water Resources—Groundwater, of this Draft EIR for a more detailed analysis regarding groundwater.

(g) Expansive and Corrosive Soils

As discussed in the Geotechnical Report, the expansion potential of fine-grained soils at the Project Site is expected to range from low to medium. Project Site soils are expected to be mildly to severely corrosive to ferrous metals, aggressive to copper, and exposure of concrete to sulfate attack is expected to be negligible to moderate. Thus, potential impacts associated with expansive and corrosive soils could occur. However, as discussed below, Mitigation Measure G-3 is included to ensure that potential impacts associated with expansive and corrosive soils would be reduced to a less than significant level.

(h) Tsunamis, Inundation, Seiches

As discussed above, the Project Site is located approximately 12 miles from San Pedro Bay and at an elevation of 230 to 235 feet above mean sea level. The Project Site is not within a tsunami or seiche hazard zone and the risk of tsunami or seiche affecting the site is low. However, as discussed above, a very small portion of the southeastern corner of the Project Site is within a potential inundation hazard zone. Dams in California are continually monitored by various governmental agencies (such as the State of California Division of Safety of Dams and the U.S. Army Corps of Engineers) to guard against the threat of dam failure. In addition, the possibility of dam failures during an earthquake has been addressed by the CGS in the earthquake planning scenarios for a magnitude 8.3 earthquake on the San Andreas fault zone and a magnitude 7.0 earthquake on the Newport-Inglewood fault zone. Based on these documents, catastrophic failure of a major dam as a result of a scenario earthquake is regarded as unlikely. Current design and construction practices, and ongoing programs of review, modification, or total reconstruction of existing dams are intended to ensure that all dams are capable of withstanding the maximum credible earthquake for the site. In addition, mitigation of potential seiche hazards has also been implemented by the Los Angeles Department of Water and Power through regulation of the level of water in its storage facilities and the provision of walls of extra height to contain seiches and prevent overflow or inundation.

Dams and reservoirs are monitored during storms, and measures are instituted in the event of potential overflow. These measures apply to facilities within the City's borders and facilities owned and operated by the City within other jurisdictions.¹⁰ Therefore, the potential for inundation at the Project Site as a result of an earthquake-induced dam failure is considered low. Thus, the Proposed Project would not expose people to substantial risk of injury due to inundation by seiche/dam failure, and impacts with respect to tsunamis, inundation, and seiches would be less than significant. No mitigation measures are required.

(i) Flooding

The Project Site is not within a flood influence area of the City of Los Angeles Seismic Safety Element. Please refer to Section IV.H.1.a, Hydrology and Surface Water Quality, of this Draft EIR for a detailed analysis regarding flooding. As indicated therein, potential impacts associated with flooding would be less than significant, and no mitigation measures are required.

(j) Oil Wells and Methane Gas

As indicated above, the Project Site is situated above the Los Angeles Downtown oil field, which was discovered in 1965. In addition, the Project Site is located in a City of Los Angeles methane zone. Please refer to Section IV.L, Environmental Hazards, of this Draft EIR for an analysis of potential impacts associated with oils wells and methane gas. As discussed therein, with the implementation of regulatory requirements, potential impacts related to oil wells and methane gas would be less than significant. In addition, as discussed in Section IV.L, Environmental Hazards, Mitigation Measure L-1 has been included to ensure that such requirements would be implemented and that impacts related to oil wells and methane gas would be less than significant.

(k) Subsidence

The Project Site is not located within an area known subsidence associated with oil or groundwater withdrawal, peat oxidation, or hydro-compaction. The potential for subsidence to affect the Proposed Project is considered to be low. Therefore, impacts related to subsidence would be less than significant, and no mitigation measures are required.

¹⁰ City of Los Angeles, Department of City Planning, *Safety Element of the Los Angeles General Plan*, adopted by the City Council November 26, 1996, page II-16.

(2) Sedimentation and Erosion

Sedimentation and erosion could potentially occur from exposed soils during Project construction. However, construction activities would occur in accordance with erosion control requirements, including grading and dust control measures, imposed by the City pursuant to grading permit regulations. Specifically, Project construction would comply with building code provisions in the LAMC, which requires necessary permits, plans, plan checks, and inspections to ensure that the Proposed Project would reduce the sedimentation and erosion effects. In addition, the Proposed Project would be required to have an erosion control plan approved by the City of Los Angeles Department of Building and Safety, as well as a Storm Water Pollution Prevention Plan (SWPPP) pursuant to the National Pollutant Discharge Elimination System (NPDES) permit requirements. As part of the SWPPP, Best Management Practices (BMPs) would be implemented during construction to reduce sedimentation and erosion levels to the maximum extent possible. In addition, Project construction contractors would be required to comply with City grading permit regulations, which require necessary measures, plans, and inspections to reduce sedimentation and erosion. Therefore, construction-related impacts associated with sedimentation and erosion would be less than significant, and no mitigation measures are required.

During operation, the Proposed Project may result in a limited degree of soil erosion effects from vegetated areas. However, in accordance with NPDES requirements, the Proposed Project would be required to have a Standard Urban Stormwater Mitigation Plan (SUSMP) in place during the operational life of the Proposed Project. The SUSMP would include BMPs that would reduce on-site erosion from vegetated areas on the Project Site. As such, operational impacts associated with sedimentation and erosion would be less than significant, and no mitigation measures are required.

Please refer to Section IV.H.1.b, Hydrology and Surface Water Quality, of this Draft EIR for a more detailed analysis regarding sedimentation and erosion effects during construction and operation of the Proposed Project.

(3) Landform Alteration

There are no distinct and prominent geologic or topographic features (e.g., hilltops, ridges, hillslopes, canyons, ravines, rock outcrops, water bodies, streambeds, or wetlands) on the Project Site or vicinity. Therefore, the Proposed Project would not destroy, permanently cover, or materially and adversely modify any distinct and prominent geologic or topographic features. Impacts associated with landform alteration would not occur, and no mitigation measures are required.

4. Cumulative Impacts

Geotechnical impacts related to future development in the City of Los Angeles would involve hazards associated with site-specific soil conditions, erosion, and ground-shaking during earthquakes. The impacts on each site would be specific to that site and its users and would not be common or contribute to the impacts on other sites. In addition, development on each site would be subject to uniform site development and construction standards that are designed to protect public safety, including the requirements specified by the LAMC and the CBC. Therefore, cumulative geology and soil impacts would be less than significant.

5. Project Design Features and Mitigation Measures

a. Project Design Features

Project Design Feature G-1: All Project construction shall conform to the requirements of the LAMC, which incorporates the requirements of the CBC, including all provisions related to seismic safety.

b. Mitigation Measures

Mitigation Measure G-1: Prior to issuance of the building permit for a building or structure, a site-specific geotechnical report shall be prepared in accordance with the City of Los Angeles requirements, including those set forth in the LAMC, which incorporates the CBC. The recommendations contained within the site-specific geotechnical report, including those pertaining to site preparation, fill placement, and compaction, seismically induced ground acceleration, liquefaction; foundations; pavement design; footings; and foundations shall be implemented. The site-specific geotechnical reports shall include all applicable recommendations included in the *Report of Geotechnical Investigation* prepared by AMEC E&I, Inc. included as Appendix N to this Draft EIR.

Mitigation Measure G-2: Pursuant to the geotechnical report prepared in accordance with LADBS requirements, a temporary shoring system shall be implemented during Proposed Project construction to ensure slope stability during excavation activities. If the necessary space is available, temporary excavations up to 25 feet in depth may be sloped back at a 1:1 (horizontal to vertical), in lieu of shoring. Deeper excavations shall be sloped at an inclination of 1.25:1. Where there is not sufficient space for sloped embankments, temporary shoring shall be erected, to a reasonable satisfaction of the LADBS. This may include, but is not limited to, installing steel

soldier piers in drilled holes that would be backfilled with concrete and restrained with tie-in anchors. The shoring shall be designed by a professional geotechnical engineer with experience in the design of excavation shoring. The excavation shoring design shall be approved by LADBS prior to its installation.

Mitigation Measure G-3: Testing of Project Site soils by a civil engineer shall be performed as part of the site-specific geotechnical report, and structure and site improvements shall be designed to resist the effects of expansive and corrosive soils.

6. Level of Significance After Mitigation

Implementation of the mitigation measure listed above and compliance with applicable regulations would reduce all Project impacts related to geology and soils to a less than significant level.