4.5 GEOLOGY/SOILS

This section evaluates the potential for significant impacts to occur due to the proposed project. Consistent with the discussion in Section 4.0 (Introduction to the Analysis), based on a preliminary environmental analysis of the proposed project prepared prior to commencement of this EIR and analysis completed for the BECSP Program EIR, substantial additional analysis of geology and soil impacts is not required. Rather, this section includes a discussion of the current environmental setting, the proposed project and its relationship to the BECSP, where applicable; a discussion of consistency with the environmental analysis prepared for the BECSP, where applicable; any new information or analysis pertinent to the current analysis and identification of impacts; identification of mitigation measures required to address potential impacts of the proposed project; and significance conclusions regarding the proposed project after mitigation incorporation. Mitigation measures included applicable measures from the BECSP EIR as well as any new or additional mitigation measures required to reduce potential impacts. All impacts are considered to be less than significant with incorporation of mitigation.

Data used to prepare this section were taken primarily from the Report on Foundation Investigation Proposed Mola Office Complex prepared for the proposed project site by Lerdy Crandall and Associates[5] (the report prepared for the existing commercial development), the Environmental Hazards Element of the City of Huntington Beach (General Plan 1996); and the Beach and Edinger Corridors Specific Plan (BECSP) Environmental Impact Report (EIR). Other sources of information include maps and reports published by the California Geological Survey (CGS) and the United States Geological Survey (USGS); and other geotechnical or environmental investigations pertinent to the conditions at the project site. Bibliographic entries for selected reference materials are provided in Section 4.5.5 of this section. Some reference materials are included in the appendices to this EIR.

4.5.1 Environmental Setting

The 9.4-acre project site is an L-shaped parcel developed with office, retail, and restaurant uses, a fitness center, a movie theater, and a parking structure. A portion of the project site on the corner of Cypress Avenue and Elm Street is currently undeveloped. All existing development is built at-grade, and no subterranean levels currently exist on the project site. The project site is bound on all sides by improved roadways. Surrounding development includes commercial and residential uses. The project site is roughly level and there are no pronounced topographic highs or lows.

Geologic Setting

The City is on a coastal plain underlain by relatively recent sediments ranging in age from Quaternary deposits of the Pleistocene epoch (11,000 to 1, 600,000 years) through the Holocene epoch (less than 11,000 years). The older sediments typically are shallow marine terrace deposits that have been uplifted

[5] Lerdy Crandall and Associates, Report of Foundation Investigation Proposed Mola Office Complex, Beach Boulevard and Warner Avenue, Hunting Beach, California for the Mola Development Corporation (April 8, 1981). While this report was prepared some time ago for the existing commercial uses on site, geologic conditions do not change over short periods of time. Therefore, information from this report is provided here for reference and to supplement additional, more recent information available.

by ongoing seismic movement and eroded to form the Bolsa Chica and Huntington Beach mesas. The mesas are bordered by younger (unconsolidated) alluvial soils that fill the gaps near Seal Beach, Bolsa Chica, and the Santa Ana River. Older alluvial and/or terrace deposits are present at this site. These sediments are estimated to be in excess of 50 feet thick. The project site is several miles inland from the coastal bluffs and the surface geology varies from the majority of Huntington Beach.

The major active fault of most concern to the City is the Newport-Inglewood fault. The fault zone is visible on the surface as a series of northwest-trending elongated hills, including Signal Hill and the Dominguez Hills, extending from Newport Beach to Beverly Hills.

Soil and Groundwater Conditions

The proposed project site is located within the southern portion of the Los Angeles Basin (LA Basin), a structural depression located within the northern margin of the Peninsular Ranges geomorphic province of California. According to Figure EH-1 (Surface Geology) of the City's General Plan Environmental Hazards Element, the proposed project site is underlain by older alluvial materials. All older alluvium in the City is unconsolidated to semi-consolidated, contains "aquifers" in the thicker sand units, has low-moderate expansive soil qualities, has a moderate to high erosion potential, and is susceptible to landslide/slope instability/erosion at the edge of the bluffs and in the canyons.

A soil investigation performed for the project site in 1981 by Lerdy Crandall and Associates encountered shallow fill soils ranging up to three feet in thickness. The fill consisted of clay and silty sand, and was generally free of debris and moderately firm to firm. The natural soils beneath the site consist of clay, silt, silty sand, and sand, and were generally moderately firm to firm. The clay soils were identified as somewhat expansive. Water was encountered at depths of 19 to 27 feet below the existing grade, consistent with Figure EH-3 of the City's General Plan which identifies the depth of groundwater beneath the proposed project site as being about 10 to 30 feet below ground surface (bgs).

Regional and Local Faults

All of Southern California is seismically active. The region is crossed by a network of major regional faults and minor local faults. This faulting and seismicity is dominated by the San Andreas Fault System, which separates two of the major tectonic plates that represent part of Earth's continental and oceanic crust: the Pacific plate is west of the San Andreas Fault System; the North American plate is to the east.

There are numerous faults in Southern California that are categorized as active, potentially active, and inactive by the CGS. 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 CGS). A fault is classified as potentially active if it has experienced movement within the Quaternary period (during the last 1.6 million years). Faults that have not moved in the last 1.6 million years generally are 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 project site is not in an Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards. No active or potentially active faults with the potential for surface fault rupture are known to pass directly beneath the site.[6]

The nearest known active fault is the Newport-Inglewood Fault Zone, an active northwest trending fault with the potential for fault-line ground-surface rupture. A buried segment of the north branch of the Newport-Inglewood fault underlies the BECSP area at the intersection of Beach Boulevard and Adams Avenue in an Alquist-Priolo Earthquake Fault Zone that is approximately 800 feet wide where it crosses the intersection. The closest well-documented surface projection of the Newport-Inglewood Fault Zone is the Bolsa Bay portion of the Seal Beach segment. Other nearby active faults include the Palos Verdes fault, the Whittier Fault Zone, and the Elsinore Fault Zone. Additionally, there are several potentially active faults in the vicinity of the project site. These include the Los Alamitos fault, the Pelican Hill fault, the El Moderno fault, and the Norwalk fault.

Historic and Future Seismicity

According to the City's General Plan Environmental Hazards Element, the estimated maximum earthquake assigned to the Newport-Inglewood fault zone is Richter magnitude (M) 7.0. The expected (average) amount of surface fault rupture on any given fault trace would range from zero to about 1 foot for events with magnitudes under M 6.0, and from 1 foot to about 10 feet for events with magnitudes between M 6.0–7.5. Large earthquakes occurred in the area of the City in 1769 (fault unknown), 1812 (possibly the Newport-Inglewood fault), 1855 (the Newport-Inglewood fault or an unnamed concealed fault), and in 1920, 1933, and 1941 (all the Newport-Inglewood fault).

Earthquakes greater than Moment Magnitude (M_W) 7.0 (refer to Section 4.5.5 [Glossary]) may occur on the Newport-Inglewood fault once in 200 to 2000 years. According to the Uniform California Earthquake Rupture Forecast, the probability of a M_W7.0 earthquake occurring in the Los Angeles area (although probably on the San Andreas fault rather than on the Newport-Inglewood fault) during the next 30 years is 82 percent.[7]

Seismic Hazards

The principal seismic hazard to the project site is groundshaking resulting from an earthquake occurring along any of several major active and potentially active faults in Southern California. A secondary seismic hazard affecting the project site may include soil liquefaction. As there are no significant ground slopes in the vicinity of the site, the potential for seismically induced landslides are not considered to be a potential seismic hazard for the proposed project site. No major dams or water-retaining structures are located near the project site which could be caused to fail as the result of an earthquake, the potential for earthquake induced flooding to occur at the project site is considered to be very low. Seiches are large waves generated in enclosed bodies of water in response to groundshaking. Due to the lack of the presence of enclosed bodies of water in the vicinity of the project site, seiches are not considered to be a

[6] California Geological Survey, CGS Special Publication 42, *Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with index to Earthquake Fault Zones Maps* (2003).
[7] Southern California Earthquake Center, Uniform California Earthquake Rupture Forecast 2 (December 31, 2007; modified April 13, 2008), http://www.scec.org/ucerf/ (accessed by PBS&J geologist on April 14, 2008).

seismic hazard to the site. Tsunamis are waves generated in large bodies of water by fault displacement or major ground movement. Based on the location of the project site relative to the coast and the elevation above sea level, tsunamis are not anticipated to be a hazard to the project site.

Groundshaking

The major cause of structural damage from earthquakes is groundshaking. The intensity of ground motion expected at a particular site depends on the magnitude of the earthquake, the distance and direction to the epicenter, and the geology of the area between the epicenter and the property. Greater movement can be expected at sites on poorly consolidated material, such as loose alluvium, in proximity to the causative fault, or in response to an earthquake of great magnitude.

Known regional active faults that could produce significant groundshaking at the project site include the Newport-Inglewood and San Joaquin Blind Thrust, among others. The nearest known active fault is the North Branch of the Newport-Inglewood Fault Zone, located within the BECSP area, at the intersection of Beach Boulevard and Adams Avenue.

Fault Rupture

According to BECSP EIR Section 4.5 (Geology and Soils), the project site is not located within a currently designated Alquist-Priolo Earthquake Zone. No known active faults are mapped on the site. As such, the potential for surface fault rupture is considered to be low at the site.

Liquefaction

Liquefaction is the phenomenon in which uniformly sized, loosely deposited, saturated, granular soils with low clay content undergo rapid loss of shear strength through the development of excess pore pressure during strong earthquake-induced groundshaking of sufficient duration to cause the soil to behave as a fluid for a short period of time. Liquefaction generally occurs in saturated or near-saturated cohesionless soils at depths shallower than 50 feet below the ground surface. If the liquefying layer were near the surface, the effect for any structure supported on it would be much like that of quicksand, resulting in sinking or tilting. If the layer were deeper in the subsurface, it could provide a sliding surface for materials above it, resulting in lateral motion (spreading or lurching) toward any nearby 'free face' (shore bluff, river embankment, excavation wall). According to the Foundation Investigation, liquefaction potential at the project site has been found to be the greatest where the groundwater level is shallow and 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.[8]

The project site is located within an area that has been identified by the State of California as being potentially susceptible to liquefaction. According to the Liquefaction Potential map included as Figure EH-7 of the Huntington Beach General Plan, Environmental Hazards Element, the project site is located in area identified as having both a high to medium potential (northern portion of the proposed project site), and low potential for liquefaction (southern portion of the proposed project site). However, based on analysis performed in the Foundation Investigation, liquefaction would be remote in the event

[8] Lerdy Crandall and Associates, *Report on Foundation Investigation Proposed MOLA Office Complex* (April 14, 1981).

of an earthquake, and the probability of liquefaction occurring during the lifetime of development would be low.

Expansive and Collapsible Soils

Expansive soils contain types of clays (principally montmorillonite, illite, and kaolinite) that can give up water (shrink) or take on water (swell) during changes in soil moisture content. The change in volume exerts stress on building foundations and other loads placed on these soils. The occurrence of these clays often is associated with geologic units of marginal stability. Expansive soils can be widely dispersed and are found in hillside areas as well as low-lying areas in alluvial basins. Soils testing to identify expansive characteristics and appropriate remediation measures are required routinely by grading and building codes.

According to the Expansive Soil Distribution Map in the Environmental Hazard Element of the City's General Plan, the project site is in an area of "moderate to high" and "low to moderate" potential for expansive soils. Soils in this area are required by Section 1802.2.2 Expansive Soils, of the 2007 CBC, to be tested for expansive characteristics and, if unacceptable, be treated to reduce the hazards they pose. The Foundation Investigation identified clays beneath the project site as being somewhat expansive.

4.5.2 Regulatory Framework

Refer to Section 4.5.2 (Regulatory Framework) of the BECSP Program EIR, for applicable federal, state, and local regulations that would apply to the proposed project. No new regulations have been implemented since the certification of the Program EIR.

The BECSP Development Code, which includes development standards, development regulations, and guidelines, governs all development actions with the BECSP area, including the proposed project site. The proposed project would be subject to development standards specific to the proposed project site's BECSP designation as a Neighborhood Center, included as BECSP Section 2.1.5 (Neighborhood Center).

General Plan and BECSP Consistency Analysis

The proposed project would be required to be constructed in accordance with *Huntington Beach Municipal Code* design requirements for structures for human occupancy. Minimum requirements for protection from seismic hazards, including foundation support and structural design, are specified in the *Building Code*. Minimum grading requirements, including erosion control, excavation stability, and fill material acceptability are specified in the Grading and Excavation Code. Site preparation and structural design recommendations included in the geotechnical report prepared for the project site, as required by code requirement BECSP CR4.5-1, would be incorporated into the proposed project's final grading plan, consistent with mitigation measure BECSP MM4.5-1. Compliance with code requirement BECSP CR4.5-1 and mitigation measure BECSP MM4.5-1 would ensure that earthquake survivability is addressed in the design and construction of future development. Implementation of the proposed project would not conflict with applicable regulations, including Policy EH 1.2-1 of the City's General Plan, which requires appropriate engineering and building practices for all new structures to withstand

groundshaking and liquefaction through adherence with the City's Building Code, Grading and Excavation Code and all State requirements pertaining to geologic, soil, and seismic hazards.

4.5.3 Project Impacts and Mitigation

This section provides a discussion of impacts related to geology/soil based on Appendix G of the 2010 CEQA Guidelines thresholds of significance, as follows:

- 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 or based on other substantial evidence of a known fault
  - > Strong seismic groundshaking
  - > 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 wastewater disposal systems where sewers are not available for the disposal of wastewater

Seismic Hazards

The proposed project site is not located within a designated Alquist-Priolo Earthquake Zone. No known active faults are mapped on the site. As such, the potential for surface fault rupture is considered to be low at the site. However, the project site is within the seismically active Southern California region, and would be subject to moderate to strong groundshaking in the event of an earthquake on one of the many active Southern California faults.

Potential effects associated with strong seismic ground shaking include ground failure, including liquefaction, and landslide. Seismically induced landslides are not considered to be a potential seismic hazard for the proposed project site due to the lack of significant ground slopes in the vicinity of the project site. However, the proposed project site is located in an area identified as being potentially susceptible to liquefaction, although the Foundation Investigation performed at the project site concluded that the probability of liquefaction occurring on the project site is considered low. Impacts associated with seismic hazards, including liquefaction, would be addressed through adherence to applicable regulations including the City of Huntington Beach Building Code, which has adopted the 2007 CBC, the Grading and Excavation Code, and State requirements pertaining to geologic, soil and seismic hazards. Additionally, as required by mitigation measure BECSP MM4.5-1, a soils and geotechnical report would be prepared for the proposed project. The design, grading, and structural recommendations of this report would be incorporated into the project's grading plan. In light of the

strict regulations in place to control development of structures in a seismically active region, and the incorporation of project-specific design recommendations into the project's grading plan, the project's impact due to exposure to seismically induced groundshaking, and seismic-related ground failure would be ***less than significant***.

Result in Substantial Soil Erosion or Loss of Topsoil

Proposed development would require earth-moving activities, including excavation below the existing ground surface. Grading and excavation associated with proposed development would expose soil to erosional processes and could result in the loss of topsoil during construction. The City's *Grading and Excavation Code* sets forth rules and regulations to control excavation, grading, earthwork and site improvement construction, including erosion control systems. The potential impacts of grading and excavation would be reduced to a less than significant level through the implementation of Best Management Practices during construction activities as required by the Grading and Excavation Code and the City's National Pollution Discharge Elimination System (NPDES) permit. The potential for soil erosion or the loss of top soil to occur would be addressed through compliance with the Grading and Excavation Code and incorporation of the recommendations of the final soil and geotechnical report into the project's final grading plan, as required by mitigation measure BECSP MM4.5-1. As such, a ***less than significant*** impact would result.

Located on a Unstable Geologic Unit or Soil

According to Figure EH-3 in the City of Huntington Beach General Plan, the depth to groundwater at the proposed project site is approximately 10 to 30 feet below ground surface (bgs), which is consistent with the findings of the Foundation Investigation performed at the project site that encountered groundwater at depths ranging from 19 to 27 feet.[9] Due to the shallow depth of groundwater, dewatering activities could be needed during construction of subterranean parking. Temporary shoring, dewatering wells, storage tanks, filters, and erosion control measures would be required to comply with the City's Grading Manual (Chapter 17.05.030 of the Huntington Beach Municipal Code). Dewatering activities would be required in order to comply with the NPDES Permit for Groundwater Discharge from the Santa Ana Regional Water Quality Control Board. Additionally, subterranean structures would be designed according to the recommendations of the project-specific Geotechnical Report, required by code requirement BECSP CR4.5-1, to resist hydrostatic pressures and be watertight. Future development would be designed, constructed, and operated in conformance with Section 1802.2.1 (Questionable Soils) of the City's Municipal Code and Title 17 Excavation and Grading Code.

The proposed project site is identified as having the potential for liquefaction to occur.[10] However the Foundation Investigation determined that the probability of liquefaction occurring is low. In the event that liquefaction does occur, the primary effect is expected to be ground surface settlement due to the consolidation of the liquefied material. Settlement could also be caused by loads generated by large earthmoving equipment or occur as a result of the placement of new fill or structural loads above the existing grade. Potential impacts associated with settlement would be addressed through the

[9] Lerdy Crandall and Associates, *Report on Foundation Investigation Proposed MOLA Office Complex* (April 14, 1981).
[10] City of Huntington Beach, *City of Huntington Beach General Plan*, *Environmental Hazards Element, Figure EH-7* (May 13, 1996).

incorporation of specific engineering recommendations to be included in the final soils and geology report prepared for the proposed project, as required by code requirement BECSP CR4.5-1, and included in the project's final grading plans consistent with mitigation measure BECSP MM4.5-1. Additionally, the proposed structures would be designed, constructed, and operated in conformance with Section 1802.2.1 (Questionable Soils) of the 2007 CBC and Title 17 Excavation and Grading Code. As such, the proposed project would not be located on an unstable geologic unit or soil that could become unstable. This is a ***less than significant*** impact.

Be Located on Expansive Soil

The proposed project site is identified as having both a "moderate to high" and "low to moderate" potential for expansive soils on the Expansive Soils Distribution map, Figure EH-12 of the Huntington Beach General Plan Environmental Hazards Element. The Foundation Investigation identified clays beneath the project site as being somewhat expansive. Risks associated with expansive soil are addressed through adherence to Section 1802.2.1 Questionable Soils, from the 2007 CBC and Title 17 Excavation and Grading Code, as well the incorporation of recommendations of the final soils and geology study, as required by code requirement BECSP CR4.5-1 into the project's grading plans. As such, potential risks to life and property associated with expansive soils would be ***less than significant***.

Soils Incapable of Supporting the Use of Waste Water Disposal Systems

The proposed project site is currently served by sanitary sewer service maintained by the City of Huntington Beach. The City would continue to provide these services to the project. No septic tanks or alternative wastewater systems are proposed. ***No impact*** would occur.

Potentially significant impacts related to geology and soils have been mitigated through compliance with code requirement BECSP CR4.5-1 and mitigation measure BECSP MM4.5-1. All other impacts were determined to be less than significant based on the project's consistency with the analysis performed in the BECSP EIR.

Applicable Mitigation of the BECSP EIR

BECSP CR4.5-1 *A California-licensed Civil Engineer (Geotechnical) shall prepare and submit to the City a detailed soils and geotechnical analysis with the first submittal of a grading plan for future development. This analysis shall include Phase II Environmental soil sampling and laboratory testing of materials to provide detailed recommendations for grading, chemical and fill properties, liquefaction, and landscaping.*

BECSP MM4.5-1 *Future development in the Beach Boulevard and Edinger Avenue Corridors Specific Plan area shall prepare a grading plan to contain the recommendations of the final soils and geotechnical report. These recommendations shall be implemented in the design of the project, including but not limited to measures associated with site preparation, fill placement, temporary shoring and permanent dewatering, groundwater seismic design features, excavation stability, foundations, soil stabilization, establishment of deep foundations, concrete slabs and pavements, surface drainage, cement type and corrosion measures, erosion control, shoring and internal bracing, and plan review.*

4.5.4 Cumulative Impacts

Project-related impacts for environmental issue areas that did not require substantial additional analysis from what was provided in the BECSP EIR are considered to be less than significant with mitigation. In addition, the proposed project would not result in impacts different from or greater than previously analyzed in the BECSP EIR. Therefore, additional cumulative impact analysis is not required for these issue areas, including Geology and Soils.

4.5.5 References

Huntington Beach, City of. *Beach and Edinger Corridors Specific Plan Environmental Impact Report*, November 2009.

———. *City of Huntington Beach General Plan*, May 13, 1996.

Lerdy Crandall and Associates. 1981. Report of Foundation Investigation Proposed Mola Office Complex, Beach Boulevard and Warner Avenue, Hunting Beach, California for the Mola Development Corporation. April 8.

Southern California Earthquake Center. Uniform California Earthquake Rupture Forecast 2, December 31, 2007, modified April 13, 2008. http://www.scec.org/ucerf/ (accessed by PBS&J geologist on April 14, 2008).