4.5 GEOLOGY AND SOILS

This section describes the existing geologic and soils conditions on and in the vicinity of the site for the proposed Belmont Pool Revitalization Project (proposed Project), the potential impacts of and on the proposed Project related to geology and soils, and measures to avoid, lessen, and/or mitigate these impacts. This section also addresses the potential for damage to occur to the Project site due to the local geology underlying the proposed Project site, as well as slope stability, ground settlement, soil conditions, and regional seismic conditions. The information and analyses provided in this section are summarized from the following reports:

- Report of Preliminary Geotechnical Investigation for the Proposed Belmont Plaza Olympic Pool Revitalization Project (Preliminary Geotechnical Investigation), prepared by MACTEC (April 14, 2009);
- Geotechnical Investigation for the Temporary Myrtha Pool and Associated Improvements, Belmont Plaza Revitalization, prepared by GMU Geotechnical, Inc. (April 3, 2013);
- Preliminary Geotechnical Report for the Belmont Plaza Pool Rebuild-Revitalization Project (Preliminary Geotechnical Report), prepared by AESCO (April 24, 2014); and
- Soil Corrosivity Evaluation for the Belmont Plaza Pool Facility Rebuild/Revitalization Project, prepared by HDR Schiff (April 23, 2014).

These reports are collectively referred to as the *Geotechnical Evaluations* and are included in Appendix E of this Draft Environmental Impact Report (EIR).

Scoping Process

The City of Long Beach (City) distributed the first Notice of Preparation (NOP) for the Draft EIR from April 18 to May 17, 2013. The City received three comment letters in response to the original NOP. No comments related to geology and soils were received in response to the original NOP circulated for the proposed Project. Due to revisions in the Project Description, the City re-issued the NOP for the Draft EIR from April 9, 2014, to May 8, 2014. The City received five comment letters in response to the re-issued NOP during the public review period. No Geology and Soils issues were raised in those comment letters.

4.5.1 Methodology

The purpose of the *Preliminary Geotechnical Investigation* (2009) and the Preliminary *Geotechnical Report* (2014) was to evaluate the potential for structural damage due to the local geology underlying the proposed Project area, as well as slope instability, ground settlement, unstable soil conditions, and regional seismic conditions. Geologic/geotechnical conditions affecting the site are summarized from compiled information and analyses, including referenced documents/publications and the site-specific *Geotechnical Evaluations* (MACTEC 2009, GMU Geotechnical Inc. 2013, and AESCO 2014), included in Appendix E of this EIR.

4.5.2 Existing Environmental Setting

Regional Geology. The Project site lies within the southwestern block of the Los Angeles Basin in the coastal plain of the Peninsular Ranges Geomorphic Province. The Geomorphic Province encompasses an area that extends approximately 125 miles from the Transverse Ranges and the Los Angeles Basin south to the Mexican border and the tip of Baja California. The Peninsular Ranges vary in width from approximately 30 to 100 miles and are generally characterized by northwest-trending mountain ranges separated by subparallel fault zones. Structurally, the Project site is between the active fault traces of the Newport-Inglewood Fault Zone 1.5 miles to the north, and the Palos Verdes Fault, 7 miles to the southwest (see Figure 4.5.1).

Subsurface Conditions. According to the *Geotechnical Evaluations* prepared for the proposed Project, the site is located within an area that has been significantly altered by previous construction activities, and as a result, is underlain by 3 feet (ft) of undifferentiated Artificial Fill material generally comprised of silty sands that has been placed over native young alluvium and estuarine deposits. These alluvial sediments consist of sands, silty sands, sandy silt, and sandy clays. During the subsurface explorations, groundwater was encountered in the borings at depths ranging between 5 and 9 ft below existing grade during testing for the *Preliminary Geotechnical Investigation* conducted in 2009 and at depths between 6 and 9 ft below ground surface (bgs) during testing for the *Preliminary Geotechnical Report* conducted in 2014. Additionally, according to the *Preliminary Geotechnical Report*, historical high groundwater is anticipated to occur at a depth of less than 10 ft.

During the geotechnical Cone Penetration Tests (CPTs) conducted for the *Preliminary Geotechnical Investigation* and other subsurface explorations, it was determined that the site is underlain by approximately 8 to 13 ft of poorly graded sand and silty sand, a 4 to 15 ft thick layer of intermixed clay and silty clay, and then poorly graded sand and silty sand to 50 ft. The poorly graded sands and silty sands are loose-to-medium dense with rootlets in the upper 12 to 18 inches, becoming medium-dense to dense below, while the underlying clays and silty clays are firm.

The *Preliminary Geotechnical Report* (2014) bored to depths ranging from 35 ft to 80 ft bgs, and concluded that below the 3 ft of silty sand fill material, medium dense to very dense sand, very soft to very stiff sandy silt, very soft to very stiff sandy clay and silty clay, medium dense to very dense sand/silty sand, and medium dense to dense silty sand exist below the Project site.

Faulting and Seismic Shaking. There is a high potential for strong seismic shaking to occur in the Project area during the design life of the Project because the Project site is located in highly seismic southern California within the influence of several active or potentially active fault systems. An "active" fault is defined by the State of California as being a "…sufficiently active and well defined fault…" that has exhibited surface displacement within Holocene time (about the last 11,000 years). A "potentially active" fault is defined as showing evidence of surface displacement during the Quaternary time (about the last 1.6 million years). These terms are used, however, by the State primarily for use in evaluating the potential for surface rupture along faults and are not intended to describe possible seismic activity associated with displacement along a fault. These definitions are not applicable to blind thrust faults that have only limited, if any, surface exposures. The active and







FEET SOURCE: Geologic Map of the Long Beach 30' x 60' Quadrangle, California Regional Geologic Map Series Map No. 5 Sheet 1 of 2 I:\CLB1302\G\2016\Geology_Fault.cdr (3/2/16) FIGURE 4.5.1

Belmont Pool Revitalization Project Regional Geology and Fault Map This page intentionally left blank

potentially active faults are capable of producing potentially damaging seismic shaking at the Project site. It is anticipated that the Project site will periodically experience ground acceleration as the result of earthquakes. Active faults without surface expression (blind faults) and other potentially active seismic sources, which are capable of generating earthquakes, are not known to be locally present under the region. The closest mapped active faults to the Project site are the Newport-Inglewood Fault and the Palos Verdes Fault Zones, which are approximately 1.5 miles and 7 miles from the site, respectively.

Ground or seismic shaking is typically considered to have the greatest potential for damage associated with earthquakes for the Project site. Seismic shaking is characterized by the physical movement of the land surface during and subsequent to an earthquake. Seismic shaking has the potential to cause destruction and damage to buildings and property, including damage resulting from damaged or destroyed gas or electrical utility lines; disruption of surface drainage; blockage of surface seepage and groundwater flow; changes in groundwater flow; dislocation of street alignments; displacement of drainage channels and drains; and possible loss of life. In addition, ground shaking can induce several kinds of secondary seismic effects, including liquefaction, differential settlement, and landslides.

The intensity of seismic shaking during an earthquake depends largely on the geologic foundation conditions of the materials composing the upper several hundred feet of the Earth's surface. The greatest amplitudes and longest durations of ground shaking occur on thick, water-saturated, unconsolidated alluvial sediments, which may lead to liquefaction (further described below). Ground shaking can also cause ground failure or deformation due to lurching and liquefaction.

Surface fault rupture refers to the displacement of the ground surface along a fault, which can occur during strong earthquakes. The potential for seismic hazards at the Project site is a consequence of ground shaking caused by events on nearby active faults. The primary seismic hazard for the proposed Project site is ground shaking due to the proximity of major active faults. According to the *Geotechnical Evaluations* prepared for the Project site, the proposed Project area is not located within an Alquist-Priolo Earthquake Fault Zone, so the possibility for surface fault rupture is low. However, based on the current understanding of the geologic framework of the area, ground shaking resulting from an earthquake occurring along regional faults is the seismic hazard with the highest probability of affecting the Project site. A fault is described as the area where two tectonic or continental plates meet.

Potential seismic hazards at the subject site include ground shaking, seismically induced liquefaction, and various manifestations of liquefaction-related hazards, including lateral spreading. A brief description of these hazards and the potential for their occurrences on site are discussed below.

Ground Motion. The *Geotechnical Evaluations* included an assessment of ground shaking hazards, including a review of a probabilistic seismic hazard assessment that consisted of statewide estimates of peak horizontal ground accelerations conducted for California. In addition, a site-specific probabilistic seismic hazard analysis was performed to evaluate anticipated peak ground acceleration (PGA), which is a measure of earthquake acceleration on the ground and an important input parameter for earthquake engineering. A PGA of 0.34 g can be expected at the site, with a 10 percent chance of exceeding that rate in 50 years. The "predominant earthquake"

that would contribute most to the ground-shaking hazard at 10 percent probability of exceedance in 50 years is a magnitude 7.1 event on the nearby portion of the Newport-Inglewood Fault Zone.

Liquefaction and Lateral Spreading. Lateral spreading typically occurs as a form of horizontal displacement of relatively flat-lying alluvial material toward an open or "free" face such as an open body of water, channel, or excavation. In soils, this movement is generally due to failure along a weak plane and may often be associated with liquefaction. Liquefaction is caused by sudden, temporary increases in pore water pressure due to seismic densification or other displacement of submerged granular soils. Intervals of loose sand may, therefore, be subject to liquefaction if these materials are or were to become submerged and also exposed to strong seismic ground shaking. Seismic ground shaking of relatively loose granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. This loss of support can produce local ground failure such as settlement or lateral spreading that may damage overlying improvements. The Geotechnical Evaluations prepared for the Project indicate that the site is within a State of California-designated Liquefaction Hazard Zone, and the City's General Plan Seismic Safety Element indicates that the entire Project site is within an area determined to have significant liquefaction potential. The liquefaction analysis indicated the underlying soils below the groundwater level may be subject to liquefaction during a design seismic event.

Subsidence. The phenomenon of soil liquefaction may result in hazards, including liquefactioninduced settlement. The amount of soil settlement during a strong seismic event depends on the thickness of the liquefiable layers and the density and/or consistency of the soils. Results from the *Geotechnical Evaluations* conducted in 2009 and 2013 determined that the area surrounding and including the Project site is subject to post-earthquake dynamic ground settlements ranging from approximately 0.75 to 2.75 inches that are estimated to occur in relatively saturated soil.

4.5.3 Regulatory Setting

Federal Policies and Regulations.

National Pollution Discharge Elimination System. A Storm Water Pollution Prevention Plan (SWPPP) prepared in compliance with a National Pollutant Discharge Elimination System (NPDES) Phase I Permit describes erosion and sediment controls, runoff water quality monitoring, means of waste disposal, implementation of approved local plans, control of postconstruction sediment and erosion control measures and maintenance responsibilities, and nonstorm water management controls. Dischargers are also required to inspect construction sites before and after storms to identify storm water discharge from construction activity and to identify and implement controls where necessary.

State Policies and Regulations.

Alquist-Priolo Earthquake Fault Zoning Act (1972). Regulations that are applicable to geologic, seismic, and soil hazards include the Alquist-Priolo Earthquake Fault Zoning Act of

1972 and updates (Public Resources Code, Section 2621 et seq.), State-published Seismic Hazards maps, and provisions of the applicable edition of the California Building Code (CBC). The Project site is not located within an Alquist-Priolo Earthquake Fault Zone; therefore, procedures and regulations recommended by the California Geological Survey (CGS) for investigations conducted in such zones do not specifically apply.

Seismic Hazard Mapping Act (1990). The Seismic Hazard Mapping Act (SHMA) was adopted by the State in 1990 for the purpose of protecting public safety from the effects of (nonsurface fault rupture) earthquake hazards. The CGS prepares and provides local governments with seismic hazard zones maps that identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures. The seismic hazards zones are referred to as "zones of required investigation" because site-specific geological investigations are required for construction projects located within these areas. Before a project can be permitted, a geologic investigation, evaluation, and written report must be prepared by a licensed geologist to demonstrate that proposed buildings will not be constructed across active faults. If an active fault is found, a structure for human occupancy must be set back from the fault (generally 50 ft). In addition, sellers (and their agents) of real property within a mapped Seismic Hazard Zone must disclose that the property lies within such a zone at the time of sale.

California Building Code (2013). California Code of Regulations (CCR), Title 24, Part 2, the CBC, provides minimum standards for building design in the State. Local codes are permitted to be more restrictive than Title 24, but not less restrictive. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system height, and seismic zoning. Seismic ratings from the CBC divide the United States into four geographical zones. Most of central and coastal California, including the proposed Project site, is located in Seismic Category D. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching as specified in California Occupational Safety and Health Administration (Cal/OSHA) regulations (CCR, Title 8).

California Health and Safety Code. Sections 17922 and 17951–17958.7 of the California Health and Safety Code require cities and counties to adopt and enforce the current edition of the CBC, including a grading section. The City enforces these provisions as part of the Long Beach Municipal Code (LBMC Chapter 18.40). Sections of Volume 2 of the CBC specifically apply to select geologic hazards. Chapter 16 of the 2010 CBC addresses requirements for seismic safety. Chapter 18 regulates excavation, foundations, and retaining walls. Chapter 33 contains specific requirements pertaining to site demolition, excavation, and construction.

Local Policies and Regulations.

City of Long Beach Municipal Code. Building and construction in the City of Long Beach are subject to the regulations of the City of Long Beach Municipal Code. Municipal Code 18.40, Building Codes, adopts and incorporates by reference the CBC. This Municipal Code chapter includes amendments and modifications to the CBC that are specific to the City of Long Beach.

City of Long Beach General Plan. The City of Long Beach adopted the Seismic Safety Element of the General Plan in October 1988. The purpose of this Element is to provide a comprehensive analysis of seismic factors in order to reduce the loss of life, injuries, damage to property, and social and economic impacts resulting from future earthquakes. The Seismic Safety Element contains goals and recommendations that provide guidance for development in seismically active areas. Specifically, the Element contains goals such as: (1) reducing public exposure to seismic risks; (2) providing an urban environment which is as safe as possible from seismic risk; and (3) providing the maximum feasible level of seismic safety protection services.

4.5.4 Impact Significance Criteria

The thresholds for impacts related to geology and soils used in this analysis are consistent with Appendix G of the *State California Environmental Quality Act* (CEQA) *Guidelines*. The proposed Project may be deemed to have a significant impact with respect to geology and soils if it would:

Threshold 4.5.1:	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; refer to Division of Mines and Geology Special Publication 42;
	ii) Strong seismic ground shaking;
	iii) Seismic-related ground failure, including liquefaction; or
	iv) Landslides;
Threshold 4.5.2:	Result in substantial soil erosion or the loss of topsoil;
Threshold 4.5.3:	Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-site or off- site landslide, lateral spreading, subsidence, liquefaction, or collapse;
Threshold 4.5.4:	Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (UBC 1994), creating substantial risks to life or property; or
Threshold 4.5.5:	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.

The Initial Study (IS) provided in Appendix A substantiates the determination that the proposed Project would not result in impacts associated with landslides because the site is relatively flat, and there are no substantial hillsides or unstable slopes immediately adjacent to the site boundary Thresholds 4.5.1 (iv). No impacts were associated with Threshold 4.5.5 because septic tanks and/or alternative waste water disposal systems are not proposed for this Project. As a result, these thresholds are not considered any further in the analyses of the potential impacts of the proposed Project related to geology and soils. **CEQA Baseline.** At the time the NOP was published (April 2014), the Project site contained both the Belmont Pool facilities and the outdoor temporary pool (opened in December 2013 to provide swimming facilities while the permanent facility was under construction). Although the site contained the former Belmont Pool building at the time of the NOP, the facility was subsequently demolished in February 2015 to alleviate an imminent public safety threat due to the seismically unsafe condition of the building.

Assessing geology and soils impacts without the former building is appropriate because the structure was removed due to a probability of collapse from a seismic event. The demolition of the structure was conducted under an emergency permit (Statutory Exemption SE14-01). No other structures have been placed on the site of the former building, and there are no remaining structural concerns related to geological conditions at the site. Substantial evidence supports the determination that a baseline condition without that structure is appropriate because seismic and geological concerns associated with the former structure have been remedied through its removal.

4.5.5 Project Impacts

Threshold 4.5.1: Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, involving:

i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault; refer to Division of Mines and Geology Special Publication 42?

Less than Significant Impact. According to the *Geotechnical Evaluations* prepared for the proposed Project, there are no known active fault or fault traces crossing the site. As stated above, the Project site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone, nor is it currently identified by the regulatory community as being located within zones of either primary or secondary co-seismic surface deformation (e.g., pressure ridges, escarpments, or fissures). Therefore, the site is not expected to experience primary surface fault rupture or related ground deformation, and no mitigation is required.

Threshold 4.5.1: Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, involving:

ii) Strong seismic ground shaking?

Less than Significant Impact with Mitigation Incorporated. The closest mapped active faults to the Project site are the Newport-Inglewood and Palos Verdes Fault Zones. Since the site is located approximately 1.5 miles northeast of the Newport-Inglewood Structural Zone, significant ground shaking or secondary seismic ground deformation effects could occur at the site should a major seismic event occur along the Newport-Inglewood Structural Zone. A peak ground acceleration of 0.34 g can be expected at the site, with a 10 percent chance of exceeding that rate in 50 years. The "predominant earthquake" that would contribute most to the ground-shaking hazard at 10 percent probability of exceedance in 50 years is a magnitude 7.1 event on the nearby portion of the Newport-Inglewood Fault Zone. This strong ground-motion potential could result in significant seismic ground

shaking. On February 17, 2014, the City conducted a structural assessment of the former Belmont Pool facility that evaluated the performance of the building under two different earthquake scenarios. The report acknowledged the determination that the pool building probability of collapse was higher than acceptable standards, and either repair or demolition was recommended. Therefore, the City demolished the former pool building under an emergency permit (Statutory Exemption SE14-01) under a separate project. This proposed Project is intended to provide both the City and the public with a new seismically sound structure.

As with most areas in Southern California, damage to proposed Belmont Pool facilities and infrastructure could be expected as a result of significant ground shaking during a strong seismic event in the region. However, the proposed structures would be designed and built in conformance with the most current adopted CBC, including seismic safety standards. Mitigation Measure 4.5.1 requires the City to comply with the recommendations of the Geotechnical Evaluations and the most current CBC, which stipulates appropriate seismic design provisions that shall be implemented with Project design and construction. With implementation of Mitigation Measure 4.5.1 potential Project impacts related to seismic ground shaking would be reduced to a less than significant level.

Threshold 4.5.1: Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, involving:

iii) Seismic-related ground failure, including liquefaction?

Less than Significant Impact with Mitigation Incorporated. See response to Threshold 4.5.3 (Lateral Spreading and Liquefaction), below.

Threshold 4.5.2: Would the project result in substantial soil erosion or the loss of topsoil?

Less than Significant Impact with Mitigation Incorporated. During the construction activities of the proposed Project, there is a potential for disruption of the soils on the entire Project site. Construction of the proposed Project includes excavation of soils to install the proposed pools, trenching for utilities, and finish grading and site preparation for the proposed structures and hardscaping. These activities could potentially result in erosion and loss of topsoil.

All excavation, trenching, and compaction activities would be performed under the observation of a qualified engineer. The Project would be required to adhere to all applicable construction standards with regard to erosion control. Erosion control measures typically identify how all construction materials, wastes, or demolition debris, etc., shall be properly covered, stored, and secured to prevent transport into local drainages or coastal waters by wind, rain, tracking, tidal erosion, or dispersion.

In addition, the Project would be subject to the SWPPP requirements for erosion and sedimentation control during construction (refer to Section 4.8, Hydrology and Water Quality). Best management practices (BMPs), including biofiltration, capture and retention, and infiltration techniques, would be undertaken to control runoff and erosion from any earthmoving activities such as excavation and compaction. The objective of erosion control BMPs is to control runoff and erosion so that sediments do not impact water quality. Standard Condition 4.2.2 (Applicable Rules 403 and 402 Measures) and Mitigation Measure 4.8.1 (Construction General Permit) would be implemented to reduce potential significant impacts related to soil erosion to levels considered less than significant by reducing the

amount of fugitive dust and the transport of soil. With implementation of these mitigation measures, soil erosion potential related to construction activities would be reduced to less than significant levels.

Threshold 4.5.3: Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Landslides and Unstable Slopes.

Less than Significant Impact with Mitigation Incorporated. Landslides and other forms of mass wasting, including mud flows, debris flows, and soil slips occur as soil moves downslope under the influence of gravity. Landslides are frequently triggered by intense rainfall or seismic shaking. Because the site is located in a relatively flat area, landslides or other forms of natural slope instability do not represent a significant hazard to the Project. In addition, as stated above, the site is not within a State-designated hazard zone for Earthquake-Induced Landsliding. Therefore, potential impacts related to landslides would be less than significant, and no mitigation is required.

Although no indications of landslide activity or gross slope instability were observed at the Project site, grading activities during construction would produce temporary construction slopes in some areas. Unstable cut-and-fill slopes could create significant short-term and long-term hazards, and vertical or steeply sided trench excavations should not be attempted without proper shoring or bracings. All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes, as discussed in the *Preliminary Geotechnical Investigation*. Mitigation Measure 4.5.1 requires that planned grading and shoring conform with the recommendations of the *Preliminary Geotechnical Investigation*, which contains specific recommendations for addressing potential slope instability during construction. With implementation of these recommendations in accordance with Mitigation Measure 4.5.1, potential impacts related to slope instability during construction would be reduced to a less than significant level.

Lateral Spreading and Liquefaction.

Less than Significant Impact with Mitigation Incorporated. Damage from earthquakes may result from liquefaction, which occurs when loose, unconsolidated, water-laden soils are subject to shaking, causing the soils to lose cohesion, and the soil behaves as a fluid for a short period of time. Liquefaction is known generally to occur at depths shallower than 50 ft bgs.

As stated above, the Project site is located within a Liquefaction Hazard Zone as designated by CGS. The *Preliminary Geotechnical Report* (2014) concluded that the proposed Project would experience a high liquefaction or lateral spreading potential due to its location, historical high groundwater levels, and the presence of soil conditions common to liquefaction areas. As a result, the Project site and the development proposed for the Project site would be subject to impacts related to liquefaction of the on-site soils as a result of seismic shaking, and mitigation is required.

Mitigation Measure 4.5.1 requires the City to comply with the recommendations of the *Geotechnical Evaluations*, as well as the requirements of the City's Municipal Code (Title 18) and the CBC applicable at the time of grading. Mitigation Measure 4.5.1 also requires the City to review and approve a final geotechnical report prior to commencement of grading. Design measures that may be used to address liquefaction include, but are not limited to, ground modification (such as chemical or pressure grouting, dynamic compaction, geogrid-stabilized building pads, or dewatering) alternate foundation types (such as mats, caissons, or driven piles), or establishment of appropriate setbacks. Appropriate recommendations would be developed by the soils engineer and/or geotechnical consultant during preparation of the final geotechnical report. Compliance with applicable building codes and the incorporation of the design recommendations in the final geotechnical report into final design plans would reduce potential impacts related to liquefaction to a less than significant level. With implementation of Mitigation Measure 4.5.1, potential Project impacts related to liquefaction would be reduced to a less than significant level.

Assuming the soils between the site and the Pacific Ocean are similar to those beneath the site, the *Geotechnical Evaluations* determined that several feet of lateral spreading towards the Pacific Ocean could occur in the event of earthquake ground motions. The movement of the soils due to lateral spreading would not be expected to be uniform. Therefore, differential lateral spreading should be expected in the building area with the potential of seismically induced lateral spreading of approximately 9 to 80 inches to occur during an earthquake event. However, the *Geotechnical Evaluations* concluded that the proposed Project is feasible with implementation of the final engineering design recommendations and compliance with the recommendations contained in the *Geotechnical Evaluations* and the final geotechnical report would ensure that potential impacts related to lateral spreading are reduced to less than significant levels.

Subsidence.

Less than Significant Impact. Subsidence, the sinking of the land surface due to oil, gas, and water production, causes loss of pore pressure as the weight of the overburden compacts the underlying sediments. Subsidence began to occur in the City of Long Beach, which is over the Wilmington Oil Field, in the 1940s with the pumping of groundwater at the Terminal Island Naval Shipyard. By 1958, the affected area was 20 square miles and extended beyond the Harbor District. Total subsidence reached 29 ft in the center of the Subsidence Bowl. Water injection was begun in 1958 to repressurize the oil field and the area has been stabilized (MACTEC 2009) and, therefore, is not expected to result in subsidence on the Project site. As a result, subsidence-related impacts are considered to be less than significant, and no mitigation is required.

Corrosive Soils.

Less than Significant Impact with Mitigation Incorporated. Corrosive soils contain constituents or physical characteristics that attack concrete (water-soluble sulfates) and/or ferrous metals (chlorides, ammonia, nitrates, low pH levels, and low electrical resistivity). Corrosive soils could potentially create a significant hazard to the Project by weakening the structural integrity of

the concrete and metal used to construct the building and potentially lead to structural instability. Structural damage and foundation instability caused by corrosive soils are potentially significant impacts.

Laboratory testing indicates that on-site soils contain a negligible concentration of sulfates and severe concentrations of chlorides. Thus, the on-site soils should be considered severely corrosive to ferrous metals. Mitigation Measure 4.5.2 requires protection of ferrous metals and copper against corrosion. Corrosion protection may include, but is not limited to, sacrificial metal, the use of protective coatings, and/or cathodic protection. With implementation of Mitigation Measure 4.5.2, potential impacts related to corrosive soils would be reduced to a less than significant level.

Threshold 4.5.4: Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property?

Less than Significant Impact. Expansive soils are characterized by their ability to undergo substantial volume changes (shrink or swell) due to variations in moisture content as a result of precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors. Liquefaction may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. The on-site granular soil depths of at least 8 ft are non-expansive while the underlying clay can be classified as having a moderate expansion potential based on the assessment of the soil classifications provided in the CPT logs and results of expansion index testing contained in the *Geotechnical Evaluations*. A non-expansive potential should, therefore, be assumed for planning purposes of the proposed structures. Impacts related to expansive soils would be less than significant, and no mitigation is required.

4.5.6 Cumulative Impacts

The cumulative study area for Geology and Soils is the Project site and the immediately adjacent properties that physically abut the Project site. The study area is essentially the area that could be affected by proposed Project activities and the areas affected by other projects for which activities could directly or indirectly affect the geology and soils of the proposed Project site. The Project site is in a fully built out area in which new development is infrequent. Any new development projects would also be required to meet similar engineering standards to reduce their own potential geologic impacts to a less than significant level. In addition, there are no other known activities or projects with activities that would affect the geology and soils at the Project site (e.g., projects requiring significant structural blasting or drilling, high vibration activities, or deep excavation).

As discussed above, there are no geotechnical conditions on site that would prohibit construction, and no activities associated with the Project that would contribute to any cumulative geological effects such as risk of ground failure, slope failure, or settlement problems in the Project vicinity. Implementation of Mitigation Measure 4.5.1 ensures that the proposed Project complies with recommendations in the *Geotechnical Evaluations* and Mitigation Measure 4.5.2 requires protection of ferrous metals and copper against corrosion; adherence to this measure would ensure that the Project would have a less than significant impact on Geology and Soils. Therefore, with

implementation of the proposed mitigation, the Project's geological impacts are considered less than cumulatively considerable.

4.5.7 Level of Significance Prior to Mitigation

The potential for surface fault rupture, subsidence, landslides, and subsidence is less than significant, and no mitigation is required. The potential impacts related to seismic ground shaking, soil erosion and loss of top soil, unstable slopes, lateral spreading, liquefaction, corrosive soil, and expansive soil would be potentially significant prior to mitigation.

4.5.8 Mitigation Measures

The *Geotechnical Evaluations* provide a number of recommendations for the final design and construction of the proposed Project, to address the potential geotechnical and soils concerns on the Project site and their potential effects on the development proposed on the Project site. Implementation of the following mitigation measure will ensure that potential geological and soil impacts resulting from Project implementation would be reduced to less than significant levels.

Mitigation Measure 4.5.1: Conformance with the Project Geotechnical Studies. All grading operations and construction shall be conducted in conformance with the recommendations included in the *Report of Preliminary* Geotechnical Investigation for the Proposed Belmont Plaza Olympic Pool Revitalization Project, prepared by MACTEC (April 14, 2009); the Geotechnical Investigation for the Temporary Myrtha Pool and Associated Improvements, Belmont Plaza Revitalization, prepared by GMU Geotechnical, Inc. (April 3, 2013); the Preliminary Geotechnical Report for the Belmont Plaza Pool Rebuild-Revitalization prepared by AESCO (April 24, 2014); and Soil Corrosivity Evaluation for the Belmont Plaza Pool Facility *Rebuild/Revitalization Project*, prepared by HDR Schiff (April 23, 2014), which together are referred to as the Geotechnical Evaluations. Design, grading, and construction shall be performed in accordance with the requirements of the City of Long Beach (City) Municipal Code (Title 18) and the California Building Code (CBC) applicable at the time of grading, appropriate local grading regulations, and the requirements of the Project geotechnical consultant as summarized in a final written report, subject to review and approval by the Development Services Director, or designee, prior to commencement of grading activities. Specific requirements in the Final Geotechnical Report shall address: 1. Seismic design considerations and requirements for structures

- and nonstructural components permanently attached to structures
- 2. Foundations including ground improvements (deep soil mixing and stone columns) and shallow foundation design

- 3. Earthwork, including site preparation for structural areas (building pad) and sidewalks, pavements, and other flatwork areas; fill material; temporary excavations; and trench backfill
- 4. Liquefaction
- 5. Site drainage
- 6. Slabs-on-grade and pavements
- 7. Retaining walls

Additional site testing and final design evaluation shall be conducted by the Project geotechnical consultant to refine and enhance these requirements, if necessary. The City shall require the Project geotechnical consultant to assess whether the requirements in that report need to be modified or refined to address any changes in the Project features that occur prior to the start of grading. If the Project geotechnical consultant identifies modifications or refinements to the requirements, the City shall require appropriate changes to the final Project design and specifications.

Grading plan review shall also be conducted by the City's Development Services Director, or designee, prior to the start of grading to verify that the requirements developed during the geotechnical design evaluation have been appropriately incorporated into the Project plans. Design, grading, and construction shall be conducted in accordance with the specifications of the Project geotechnical consultant as summarized in a final report based on the CBC applicable at the time of grading and building and the City Building Code. On-site inspection during grading shall be conducted by the Project geotechnical consultant and the City Building Official to ensure compliance with geotechnical specifications as incorporated into Project plans.

Mitigation Measure 4.5.2:Corrosive Soils. Prior to issuance of any building permits, the City
of Long Beach (City) Development Services Director, or designee,
shall verify that structural design conforms to the requirements of the
geotechnical study with regard to the protection of ferrous metals
and copper that will come into contact with on-site soil. In addition,
on-site inspections shall be conducted during construction by the
Project geotechnical consultant and/or City Building Official to
ensure compliance with geotechnical specifications as incorporated
into Project plans.

The measures specified in the geotechnical study for steel pipes, iron pipes, copper tubing, plastic and vitrified clay pipe, other pipes, concrete, post tensioning slabs, concrete piles, and steel piles shall be incorporated into the structural design and Project plans where ferrous metals (e.g., iron or steel) and/or copper may come into contact with on-site soils.

4.5.9 Level of Significance after Mitigation

The potential impacts to the Project site and the development related to geotechnical and soil impacts would be reduced to below a level of significance based on implementation of Mitigation Measures 4.5.1 and 4.5.2, and Mitigation Measures 4.2.2, and 4.8.1, from the Air Quality section and the Hydrology and Water Quality section, respectively.