4.7 GEOLOGY AND SOILS

This section provides a discussion of the existing geologic and soils environment and an analysis of potential impacts from implementation of the proposed project. This section also addresses the potential for structural damage due to the local geology underlying the proposed project site, as well as slope stability, ground settlement, soil conditions, grading, and regional seismic conditions. This section summarizes information provided in the Geotechnical Study for the Proposed City Hall and Park Development Plan for the Environmental Impact Report (EIR), Newport Beach, California prepared by Leighton Consulting, Inc., July 2009. The Geotechnical Study is included in Appendix K of this EIR.

Scoping Process

During the scoping process for this EIR, it was determined that the proposed project would potentially result in impacts associated with four of the five criteria for determining significance related to geology and soils, including criteria related to potential seismic impacts, soil erosion, unstable geologic units, and expansive soils. It was determined that the proposed project would not result in a potentially significant impact related to the use of septic tanks or alternative waste disposal systems because the proposed project does not include the use of septic tanks or alternative methods for disposal of wastewater into the subsurface soils. The proposed project would connect to existing public wastewater infrastructure. Therefore, issues related to septic tanks and alternative waste disposal systems are not included in the detailed analysis presented in this EIR. Refer to Appendix A, IS/Notice of Preparation (NOP), for additional discussion.

4.7.1 Methodology

To assess the impacts of the proposed project with respect to geologic and soil conditions, a field exploration was undertaken by Leighton Consulting, Inc. The scope of the exploration included site reconnaissance, background review, pre-field exploration activities, geologic mapping, field exploration including soil borings, laboratory tests, engineering analysis, and report preparation.

Soils and geologic and seismic hazards, as identified based upon the report/literature reviews and the site investigation, were assessed with respect to significance within the context of Appendix G of the Guidelines for the California Environmental Quality Act (State CEQA Guidelines) and the City's Initial Study Checklist.

4.7.2 Existing Environmental Setting

Proposed Site Description and Topography. The current site elevations range from approximately 130 to 210 feet (ft) above mean sea level (amsl) south of San Miguel Drive and approximately 210 to 250 ft amsl north of San Miguel Drive. Light vegetation is present within both of the vacant northern and central parcels. Some heavy vegetation, bushes, and a ravine are present within the northern area of the central parcel.

Existing City Hall Site. The existing City Hall site is generally flat. The site is occupied by 47,809 gross square feet (sf) of floor area in five permanent buildings and five temporary building (trailers); approximately 3,417 sf are occupied by the Fire Station No. 2, which would remain after project implementation. The buildings on site were constructed at various times between 1945 (City Hall Building B) and 2008 (Human Resources recruitment trailer).

The proposed project includes the reuse of the existing buildings on the City Hall site with other public facilities uses. The project does not propose any physical changes to the structures, infrastructure, topography, or soils on the existing City Hall site.

Regional Geologic Setting. The City is located in an area of widely diverse terrain at the southern margin of the Los Angeles Basin. The Los Angeles Basin represents the transition between the Transverse Ranges geomorphic province on the north and the Peninsular Ranges geomorphic province on the south. The Transverse Ranges province is characterized by roughly east–west trending, convergent (compressional) deformational structural features in contrast to the predominant northwest–southeast structural trend of the Peninsular Ranges and other geomorphic provinces in California.

The City's landscape can best be described by geographic area, each reflective of its distinct topographic features. The central and northwestern portions of the City are situated on a broad mesa that extends southeastward to join the San Joaquin Hills. Commonly known as Newport Mesa, this upland has been deeply dissected by stream erosion, resulting in moderate to steep bluffs along the Upper Newport Bay estuary. The nearly flat-topped mesa rises from approximately 50 to 75 ft amsl at the northern end of the estuary in the Santa Ana Heights area, to approximately 100 ft amsl in the Newport Heights, Westcliff, and Eastbluff areas.

In the southern part of the City, the San Joaquin Hills rise abruptly from the sea, separated from the present shoreline by a relatively flat, narrow shelf. Originally formed by wave abrasion, this platform (also called a terrace) is now elevated well above the water and is bound by steep bluffs along the shoreline. The coastal platform occupied by Corona Del Mar ranges from approximately 95 to 100 ft amsl, and the San Joaquin Hills, site of the Newport Coast development area, rise to an elevation of 1,164 ft at Signal Peak.

Local Geologic Setting. The project site is on the northwestern flank of the northern San Joaquin Hills. The San Joaquin Hills lie within the northern part of the Peninsular Ranges geomorphic province, which extends 900 miles southward from the Santa Monica Mountains to the tip of Baja California (Leighton 2009). Regional tectonic activity has uplifted the San Joaquin Hills into an elongated arched fold (anticlinorium) trending to the northwest from San Juan Capistrano and Huntington Mesa. This anticlinal folding has occurred as this entire section of the Southern California coast was uplifted by the San Joaquin Hills Blind Thrust Fault (Leighton 2009). The San Joaquin Hills expose mainly Tertiary-aged marine and nonmarine sedimentary rocks, including thinly bedded shale, siltstone, and sandstone of the upper Miocene-age Monterey Formation.

During Quaternary times, the eustatic fluctuations in sea level formed broad wave cut platforms upon which marine terrace sediments were deposited. Due to the continued uplift of the San Joaquin Hills,

some of these ancient stepped sequences of marine terrace deposits have been elevated above present-day sea level. Erosion and grading activity have formed the present-day landscape.

Subsurface Conditions. A portion of the proposed project site is underlain by terrace deposits over bedrock. Quaternary terrace deposits at the site consist of varying amounts of sand, silt, and clay. In general, the terrace deposits are medium-dense to very dense granular soils and stiff to hard cohesive soils. A portion of the proposed project site is also underlain by Tertiary age Monterey Formation bedrock, which was also encountered beneath the terrace deposits. The bedrock at the site consists of sandstone and siltstone. Bedrock was encountered at depths ranging from 0 to 9 ft below ground surface (bgs) at exploration locations (approximately 161 and 250 ft amsl), depending on the location of each exploration.

During on-site explorations of the proposed project site, sandstone with thin silt beds or clay beds was observed at various depths. Based on recent geologic mapping at the site, artificial fill was determined to exist in the southern portion of the central parcel. The fill is expected to comprise the slope that descends toward the existing library. The limits and depth of the artificial fill are unknown at this time.

Weathered bedrock was also observed to be exposed in the southern portion of the central parcel in an area that appears to have been recently graded to some degree. Bedrock was also observed at various locations along the perimeter of the central parcel on the slope that descends toward MacArthur Boulevard. Weathered bedrock was also observed in the small ravines associated with the main drainage divide that cuts through the central parcel.

Groundwater Conditions. Groundwater was encountered or measured between approximately 45 to 67.2 ft bgs (between 117.7 and 131 ft amsl) immediately after drilling, depending on the exploration location. In general, the groundwater elevation is higher in the northern region of the site and gently slopes down toward the existing Library. The groundwater level in groundwater monitoring wells south of the wetlands area, was measured to be at 42–46 ft bgs (130–140 ft amsl).

Seismicity and Faulting. As stated above, the project site is located within the Peninsular Range Geomorphic Province, which is dominated by northwest-trending, right-lateral strike-slip faults. A fault is described as the area where two tectonic or continental plates meet. An “active” fault is defined by the State of California as having had surface displacement within the Holocene time (i.e., within the last 11,000 years). A “potentially active” fault is defined as showing evidence of surface displacement during the Quaternary time (i.e., during the last 1.6 million years). These terms are, however, used by the State primarily 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. A blind thrust fault is a thrust fault that does not rupture the surface, so there is no evidence of it on the ground.

The project site would potentially be affected by seismically active faults in the region. Several active and potentially active faults have been mapped within several miles of the property. There are,

however, no known active or potentially active faults or fault traces crossing the site. Therefore, the project site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone, and the potential for surface fault rupture is low.

Regional geologic mapping by the State of California shows that the closest active fault is the Newport-Inglewood Fault (offshore), located approximately 2.4 miles from the site. The Newport-Inglewood Fault is a right-lateral fault in Southern California. The fault extends for 75 kilometers (46 miles) from the Santa Monica Mountains southeast to the offshore area of the City. This zone has a history of moderate to high seismic activity and has produced numerous earthquakes higher than moment magnitude (Mw) 4.0, including the March 11, 1993 Mw, 6.3 Long Beach earthquake. The fault is considered to be capable of producing an earthquake with an Mw of 6.0–7.4.[1]

Although not exposed at the surface, it is estimated that an upward projection of the dipping San Joaquin Hills Blind Thrust Fault would intersect the ground surface at a location approximately 3.5 miles southeast of the project site. Although the fault has not been observed directly at the surface, structural modeling indicates that this fault has a slip rate of approximately 0.5 millimeters per year.

The San Andreas Fault is the largest fault in the region and is located approximately 52.7 miles from the site. The San Andreas Fault is the primary surface boundary between the Pacific and North American plates, and it is generally considered to be the most likely source for strong ground motion in the County of Orange (County). There have been numerous historic earthquakes along the fault, and it is considered capable of producing an earthquake Mw of 6.8 to 8.0.[2]

Nonseismic Geologic Constraints.

Erosion. The erosion potential of soil is governed by the physical properties of the soil along with environmental factors such as rainfall, wind, topography, and vegetative cover. Erosion typically occurs from concentrated runoff on unprotected slopes or along unlined channels that are underlain by relatively erosion-prone earth materials (e.g., topsoil, soft alluvium, uncemented sandstone). Quaternary terrace deposits at the proposed project site consist of varying amounts of sand, silt, and clay that may be easily eroded under conditions of uncontrolled, concentrated surface runoff.

Expansive Soils. Expansive soils contain types of clay minerals that occupy considerably more volume when they are wet or hydrated than when they are dry or dehydrated. Volume changes associated with changes in the moisture content of near-surface expansive soils can cause uplift or heave of the ground when they become wet or, less commonly, cause settlement when they dry out. Results of laboratory testing of soils on site indicated a low to very low expansion potential in accordance with Table 18-1-B of the California Building Code (CBC). Bedrock on site includes strata of claystone that may be potentially expansive.

1 Southern California Earthquake Data Center. *Newport-Inglewood Fault Zone.* July 2009.
2 Southern California Earthquake Data Center. *San Andreas Fault Zone.* July 2009.

Subsidence. Subsidence is the sinking or settlement of the ground surface relative to the surrounding area, with little or no horizontal movement. Four types of land subsidence are known to occur in California. In descending order of significance, these are (1) subsidence caused by aquifer system compaction related to the lowering of groundwater levels, generally due to pumping activities, (2) subsidence caused by hydrocompaction of soils above the groundwater table, (3) subsidence related to extraction of oil and gas deposits, and (4) subsidence related to seismic activity. The project does not have an oil, gas, or water pump on site and has not been used for the extraction of any of these resources. The majority of the materials underlying the proposed project site consist of dense terrace deposits and bedrock, which has a lower potential to subside during seismic events. The potential for subsidence to occur on the proposed project site is considered to be very low and is therefore not considered a potential constraint on the proposed project.

Corrosive Soils. Corrosive soils contain chemical constituents that may cause damage to construction materials such as concrete and ferrous metals. One such constituent is water-soluble sulfate, which, if high enough in concentration, can react with and damage concrete. Electrical resistivity, chloride content, and percentage of hydrogen (pH) level are indicators of the soil's tendency to corrode ferrous metals. Corrosion tests have been performed on composite soil samples obtained from depths of 35 to 45 ft below current site grade. Results of the testing show the on-site soil is severely corrosive to ferrous metals. Sulfate and chloride exposure for concrete is deemed negligible.

Seismically Induced Hazards.

Ground Shaking and Surface Fault Rupture. The primary seismic effects associated with earthquakes are ground shaking and surface fault rupture.

Ground shaking due to seismic events (earthquakes) would typically be considered to be the greatest source of potential damage to structures. 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; 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, groundshaking can induce several kinds of secondary seismic effects, including liquefaction, differential settlement, and landslides, all of which are described below.

The intensity of seismic shaking during an earthquake depends largely on geologic formation conditions of the materials comprising 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. Ground shaking can also cause ground failure or deformation due to lurching and liquefaction.

Surface rupture is the displacement and cracking of the ground surface that occurs along a fault trace. Unlike seismically induced ground shaking, which can affect a wide geographic area, surface rupture is confined to the area very near the fault. As previously stated, the project site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone, so the possibility for surface fault rupture is considered to be low. The primary seismic hazard for the proposed project site is ground shaking due to the proximity of major active faults. Known active faults capable of producing strong ground shaking at the site include the Newport-Inglewood Fault, San Joaquin Hills Blind Thrust Fault, and San Andreas Fault.

There are two approaches that are typically used to assess how seismic activity will affect a site. Deterministic analysis, which is the approach utilized in the CBC, considers the predominant fault in the area (i.e., the fault that is most likely to cause a nearby earthquake), the magnitude of earthquake this fault is considered capable of generating, the distance of the fault from the site, and the characteristic soil at the site. A seismic response spectra is developed. The second commonly used approach is a probabilistic analysis, where all the known faults in the vicinity that could reasonably affect the site are taken into account. A variety of earthquakes that could occur on these faults and their recurrence intervals are analyzed to ascertain the most probable earthquake. A second seismic response spectra is developed based upon this analysis. The results of both analyses are compared, and the design of structures is typically based upon the more conservative of the two analyses.

A Probable Seismic Hazards Assessment (PSHA) was performed for the proposed project. The PSHA was performed using the FRISKSP computer program (Blake 2000). This approach accounts for the site-specific response characteristics, historical seismicity, and the geological characteristics of the regional faults under consideration. Based on the site-specific probabilistic evaluation that was performed, the peak horizontal ground accelerations (PHGA) for the project site were calculated to be approximately 0.70 g (acceleration due to gravity) with a two percent probability of exceedance in 50 years (recurrence interval of 2,475 years). In accordance with the 2007 CBC, this level of ground motion is considered the “maximum considered earthquake” for design purposes. Maximum considered earthquakes are repeat earthquakes that have the same faulting mechanism, magnitude, rupture length, location, and, in some cases, the same epicenter and direction of rupture propagation as earlier shocks.

Liquefaction and Lateral Spreading. Lateral spreading typically occurs as a form of horizontal displacement of relatively flat-lying alluvial material toward an open or “unconfined” 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 are 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. This proposed project site is not located within a potential liquefaction hazard zone as delineated by the California Division of Mines and Geology (CDMG). The depth to bedrock at the site ranges from 0 to 9 ft below current grade, and no

significant amounts of loose granular soils were found within the terrace deposits during on-site investigations. As such, the potential for liquefaction at the site is considered to be very low. Since the site has a very low liquefaction potential, the potential for lateral spreading to occur is also considered to be very low.

Seismically Induced Ground Settlement. This type of secondary seismic effect can result in damage to property when an area settles to different degrees over a relatively short distance. The sinking or settlement of a structure, area of fill, or other imposed load is usually the result of compaction or consolidation of the underlying soil. Soils susceptible to seismically induced settlement typically include loose granular materials. The majority of the materials underlying the proposed project site consist of dense terrace deposits and bedrock. Accordingly, the potential for seismically induced settlement is low.

Slope Instability and Seismically Induced Landslides. The downslope movement of loose rock or soil is also a potential secondary seismic effect that can occur during strong ground shaking. The City's General Plan EIR (Figure 4.5-2) indicates that there is an area of potential landslide within the wetlands area on site. The proposed project site is not, however, located in an area mapped as potentially susceptible to seismically induced landslides as shown on the CDMG Seismic Hazard Zones Map. Although the proposed project site has graded slopes along the perimeter descending to the adjacent streets (e.g., Avocado Avenue and San Miguel Road) and smaller natural slopes within the central portion of the site related to the east-west wetlands area, there are no significant slopes (greater than 30 ft in height) located near the site. Therefore, the potential for seismically induced landslides on site is considered low.

4.7.3 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.

Additionally, the City operates under a municipal separate storm sewer system (MS4) permit under the NPDES. MS4 permits require an aggressive water quality ordinance, specific municipal practices, and the use of best management practices (BMPs) in many development-related activities to further reduce the amount of contaminants in urban runoff. MS4 permits also require local agencies to cooperatively develop a public education campaign to inform people about what they can do to protect water quality.

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 (AP, Public Resources Code, Section 2621, et seq.), State-published Seismic Hazards maps, and provisions of the applicable edition of the CBC. There are no Earthquake Fault zones established at or in the near vicinity of the site, and procedures and regulations as 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 (2007). 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 existing City Hall site and proposed project site, is located in Seismic Zone 4. 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 requires cities and counties to adopt and enforce the current edition of the CBC, including a grading section. The City enforces these provisions (refer to Title 15 of the City's Municipal Code). Sections of Volume 2 of the CBC specifically apply to select geologic hazards. Chapter 16 of the 2007 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.

Unreinforced Masonry Law. In California, unreinforced masonry (URM) buildings are generally brick buildings constructed prior to 1933 and predating modern earthquake-resistant

design. In earthquakes, the brick walls (especially parapets) tend to disconnect from the building and fall outward, creating a hazard for people below and sometimes causing the building to collapse. The Unreinforced Masonry Law, enacted by the state in 1986, requires cities and counties within Seismic Zone 4 to identify hazardous URM buildings and to consider local regulations to abate potentially dangerous buildings through retrofitting or demolition, as outlined in the State Office of Planning and Research Guidelines. No URM buildings are located on the proposed project site or the existing City Hall site.

Local Policies and Regulations.

Title 15 of the City's Municipal Code. The City adopted, with amendments, and enforces Appendix Chapter 1 of the 2007 edition of the CBC as published by the International Code Council. Title 15 of the City's Municipal Code is the City's building code. The purpose of a building code is to provide minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all buildings and structures within the City. Building Code provisions apply to the construction, alteration, moving, demolition, repair, and use of any building or structure within the City.

Safety Element of the City's General Plan. The primary goal of the Safety Element is to reduce the potential risk of death, injuries, property damage, and economic and social dislocation resulting from natural and human-induced hazards. This element specifically addresses coastal hazards, geologic hazards, seismic hazards, flood hazards, wildland and urban fire hazards, hazardous materials, aviation hazards, and disaster planning.

4.7.4 Impact Significance Criteria

The following criteria are based on the City's Initial Study, the Initial Study Checklist, and Appendix G of the State CEQA Guidelines. The effects of the proposed project on Geology and Soils are considered to be significant if the proposed project would:

Threshold 4.7.1: Expose people or structure to potential substantial adverse effect, including the risk of loss, injury, or death involving:

a) 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,

b) Strong seismic ground shaking,

c) Seismic-related ground failure, including liquefaction, or

d) Landslides

Threshold 4.7.2: Result in substantial soil erosion or loss of topsoil

Threshold 4.7.3: 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- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse

Threshold 4.7.4: Be located on expansive soil, as defined by Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property

Threshold 4.7.5: 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

The Initial Study, included as Appendix A, substantiates that the project would not result in an impact related to Threshold 4.7.5. This threshold will not be addressed in the following analysis.

4.7.5 Project Impacts

Threshold 4.7.1: **Would the project expose people or structure to potential substantial adverse effect, including the risk of loss, injury, or death involving:**

a) 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?

Less than Significant. There are no known active or potentially active faults or fault traces crossing the site. As stated above, the project site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone. The closest active fault is the Newport-Inglewood Fault (offshore), located approximately 2.4 miles from the site. It is estimated that an upward projection of the dipping San Joaquin Hills Blind Thrust Fault would intersect the ground surface at a location approximately 3.5 miles southeast of the project site. As the project site is not located in an Alquist-Priolo Earthquake Fault Zone and there is no evidence of active faulting on or around the immediate project site, the potential for ground rupture to affect the proposed project site is considered to be less than significant, and no mitigation is necessary.

Threshold 4.7.1: **Would the project expose people or structures to potential substantial adverse effect, including the risk of loss, injury, or death involving:**

b) Strong seismic ground shaking?

Less than Significant with Mitigation. As with all of Southern California, the project site is subject to strong ground motion resulting from earthquakes on nearby faults. There are several faults in the vicinity of the project site that are capable of producing strong ground motion, including the San Andreas Fault, the Newport-Inglewood Fault, and that San Joaquin Hills Blind Thrust Fault. During an earthquake along any of these faults, seismically induced ground shaking would be expected to occur. The severity of the shaking would be influenced by the distance of the site to the seismic source, the soil conditions, and the depth to groundwater.

To characterize the seismicity at the site, a PSHA was conducted for the proposed project. Based upon the results of the PSHA, the PHGA is estimated to be 0.70 g with a 2 percent probability of exceedance in 50 years (recurrence interval of 2,475 years). This level of ground motion is considered to be the maximum considered earthquake for the 2007 CBC evaluation. These accelerations are consistent with other sites in this region of central California and indicate that strong seismic ground shaking generated by seismic activity is considered a potentially significant impact that may affect the proposed project. Mitigation Measures 4.7.1 and 4.7.2 require the City to comply with the recommendations of the project Geotechnical Study and the most current CBC, which stipulates appropriate seismic design provisions that shall be implemented with project design and construction. With implementation of Mitigation Measures 4.7.1 and 4.7.2, potential project impacts related to seismic ground shaking would be reduced to a less than significant level.

Threshold 4.7.1: Would the project expose people or structures to potential substantial adverse effect, including the risk of loss, injury, or death involving:

c) Seismic-related ground failure, including liquefaction?

Less than Significant. Liquefaction commonly occurs when three conditions are present simultaneously: (1) high groundwater; (2) relatively loose, cohesionless (sandy) soil; and (3) earthquake-generated seismic waves. The presence of these conditions may cause a loss of shear strength and, in many cases, ground settlement. Seismic Hazard Maps published by CDMG indicate that the proposed project site is not located in an area within a potential liquefaction zone. As previously stated, the depth to bedrock at the project site ranged from 0 ft to 9 ft below current grade, and no significant amounts of loose granular soils were found within the terrace deposits during on-site explorations. Therefore, potential impacts associated with seismically induced ground failure and liquefaction would be very low and is considered to be a less than significant impact, and no mitigation is required.

Threshold 4.7.1: Would the project expose people or structures to potential substantial adverse effect, including the risk of loss, injury, or death involving:

d) Landslides?

No Impact. As previously stated, no existing landslides are present on the property, and no significant slopes (greater than 30 ft) are located near the site. Most of the slopes along the perimeter of the site (along Avocado Avenue, MacArthur Boulevard, and San Miguel Drive) would be graded as part of project construction. Project grading and resulting slopes would be subject to the City Building Code and CBC regulations. Although the City General Plan EIR indicates that there is an area of potential landslide in the wetlands area, the proposed project site is not located in an area mapped as potentially susceptible to seismically induced landslides as shown on the Seismic Hazards Zones Map published by CDMG, and the remaining slopes in the wetlands area are not considered to be substantial slopes. Therefore, the potential for on-site landslides is low, and the proposed project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides, and no mitigation is required.

Threshold 4.7.2: Would the project result in substantial soil erosion or loss of topsoil?

Less than Significant. During construction activities, soil would be exposed and there would be an increased potential for soil erosion compared to existing conditions due to soil disturbance and the exposure of substantial amounts of soil to weather conditions (e.g., wind, rain). During a storm event, soil erosion could occur at an accelerated rate. The increased erosion potential could result in short-term water quality impacts as identified in Section 4.10, Hydrology and Water Quality. During construction, the City is required to adhere to the requirements of the General Construction Permit and utilize typical BMPs specifically identified in the SWPPP (PDF WQ-1) for the project in order to prevent construction pollutants from contacting storm water and to keep all products of erosion from moving off site into receiving waters. Water-related impacts during construction would be less than significant through implementation of construction site BMPs, as specified in PDF WQ-1 (described in Section 4.10, Hydrology and Water Quality).

The proposed project would result in a net increase in storm water runoff; however, the proposed project also incorporates two on-site detention storage tanks and biofiltration swales to manage increased peak runoff from the site. These detention basins would be sized to detain the volume of storm water necessary to reduce peak discharge from the project site. As a result, any increase in peak discharge would be negligible. Therefore, the proposed project would not result in substantial on-site or downstream erosion, siltation, or flooding, and no mitigation is required.

Threshold 4.7.3 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- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

Slope Stability.

Less than Significant with Mitigation. As previously stated, no existing landslides are present on or adjacent to the property. Natural slopes are present on site within the wetlands area, and graded slopes are presents along the perimeter of the project site (e.g., along Avocado Avenue and in the southern portion of the central parcel). The natural slopes in the wetlands area will remain during and after project construction. The majority of the graded slopes will be moved during project grading. Although no indications of landslide activity or gross slope instability were observed at the proposed project site, grading is proposed that would result in significant site alteration. In addition, remedial grading required for removal and recompaction of existing terrace deposits and artificial fills will produce temporary construction slopes in some areas.

Due to the topography of the project site and the design of the proposed project, grading would entail significant cut-and-fill slopes, and construction of retaining walls would be necessary in some areas. According to the conceptual grading plan (June 2009), cuts of up to 50 ft are planned. The most significant grading would occur in conjunction with construction of the City Hall facility, parking structure, Emergency Operations Center, and Civic Green. In addition, shoring would be required during excavation for the retaining wall proposed along MacArthur Boulevard due to anticipated space constraints. Leighton also indicated that the bedrock structure includes bedding that dips (slopes) toward the general alignment of the proposed retaining wall and/or the

eastern wall of the proposed parking structure building. Unstable cut-and-fill slopes and an adverse bedrock structure could create significant short-term and long-term hazards. Mitigation Measure 4.7.1 requires planned grading and shoring to conform with the recommendations of the Geotechnical Study (Leighton, July 2009), which contains specific recommendations for addressing potential slope instability and an adverse bedrock structure. With implementation of these recommendations, potential impacts related to slope instability and an adverse bedrock structure would be reduced below a level of significance.

Unsuitable Soils.

Corrosive Soils and Soluble Sulfate Content. Less than Significant with Mitigation. 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 could potentially lead to structural instability. Structural damage and foundation instability caused by corrosive soils is a potentially significant impact.

Laboratory testing indicates that on-site soils are not corrosive to concrete but are severely corrosive to ferrous metals. Mitigation Measure 4.7.3 requires protection of steel 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 4.7.3, potential impacts related to corrosive soils would be reduced to a less than significant level.

Settlement Potential. Less than Significant. The amount of settlement for a site is dependent on the thickness of design fills, the loading conditions, and the nature of the native materials underlying the fill. Potential ground settlement may be separated into three types: (1) hydroconsolidation of alluvium left in place above the water table, (2) consolidation settlement of compressible alluvium left in place below the water table, and (3) liquefaction-induced settlement of a few loose, granular layers below the water table. The majority of the materials underlying the proposed project site consist of dense terrace deposits and bedrock, and the site is not located within a potential liquefaction zone. Therefore, potential impacts related to ground settlement are considered to be less than significant. Compliance with the recommendations contained in the Geotechnical Study for the proposed project, as required by Mitigation Measure 4.7.1, would further reduce a potential impact related to ground settlement, and no additional mitigation is required.

Subsidence. Less than Significant. The phenomenon of widespread land sinking, or subsidence, is generally related to substantial overpumping of groundwater or petroleum reserves from deep underground reservoirs. Overpumping and excessive groundwater withdrawal have not occurred in the project area. In addition, the project does not have an oil, gas, or water pump on site and none are located in the vicinity of the site and has not been used for the extraction of either resource. Subsidence is therefore not considered a potential constraint or a potentially significant impact of the project, and no mitigation is required.

Threshold 4.7.4: Would the project be located on expansive soil, as defined by Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

Less than Significant with Mitigation. Expansive soils contain types of clay minerals that occupy considerably more volume when they are wet or hydrated than when they are dry or dehydrated. Volume changes associated with changes in the moisture content of near-surface expansive soils can cause uplift or heave of the ground when they become wet or, less commonly, cause settlement when they dry out. Based on the laboratory test results, the on-site soils have an Expansion Index ranging from 0 to 29, indicating a very low to low expansion potential in accordance with Table 18-1-B of the CBC. However, bedrock on site includes strata of claystone that may be potentially expansive. The potential for expansive soils in areas proposed for construction would be considered a potentially significant impact. Construction techniques that are employed to address potential adverse effects of expansive soils may include, but are not limited to, deepened foundations, post-tension foundations, and moisture conditioning. The Geotechnical Study provided as Appendix K of this EIR contains specific construction recommendations to reduce project impacts associated with expansive soils to a less than significant level. Mitigation Measure 4.7.4 incorporates the recommendations in the Geotechnical Study related to expansive soils. Specifically, Mitigation Measure 4.7.4 requires addition expansion index tests if bedrock claystone is encountered at subgrade levels and requires specific remedial actions if expansive soils are found on site. Therefore, adherence to Mitigation Measure 4.7.4 will reduce project impacts related to expansive soils to a less than significant level.

4.7.6 Cumulative Impacts

Less than Significant. For geology and soils, the study area considered for the cumulative impact of other projects consisted of (1) the area that could be affected by proposed project activities and (2) the areas affected by other projects whose activities could directly or indirectly affect the geology and soils of the proposed project site. The analysis above indicated no rare or special geological features or soil types on the project site that would be affected by project activities and no other known activities or projects with activities that affect the geology and soils of this site.

In addition, the proposed project, as well as foreseeable projects (refer to Table 4.1.C), would be required to comply with the applicable state and local requirements, including, but not limited to, the City of Newport Beach Building Code. Therefore, the project-specific impacts, as well as the impacts associated with other projects, would be reduced to a less than significant level. Seismic impacts are a regional issue and are also addressed through compliance with applicable codes and design standards. For these reasons, the project's contribution to cumulative geotechnical and soil impacts is less than significant.

4.7.7 Level of Significance Prior to Mitigation

The project would not result in any impacts related to on- or off-site landslides. Potential impacts related to surface fault rupture, liquefaction, subsidence, and ground settlement are less than significant, and no mitigation is required. Impacts related to strong seismic ground shaking, erosion,

slope stability, unsuitable (corrosive) soils, and expansive soils are considered potentially significant, and mitigation is required.

4.7.8 Mitigation Measures

Mitigation Measure 4.7.1 **Incorporation of and compliance with the recommendations in the Geotechnical Study.** All grading operations and construction shall be conducted in conformance with the recommendations included in the geotechnical report on the proposed project site that has been prepared by Leighton Consulting, Inc. titled *Geotechnical Study for the Proposed City Hall and Park Development Plan for the Environmental Impact Report (EIR), Newport Beach, California* (July 2009) (included in Appendix K of this EIR). Design, grading, and construction shall be performed in accordance with the requirements of the City of Newport Beach Building Code and the California Building Code (CBC) applicable at the time of grading, appropriate local grading regulations, and the recommendations of the project geotechnical consultant as summarized in a final written report, subject to review by the Director of the City of Newport Beach Building Department or designee prior to commencement of grading activities.

Recommendations in the *Geotechnical Study for the Proposed City Hall and Park Development Plan for the Environmental Impact Report (EIR), Newport Beach, California* are summarized below.

- **Site Grading.** The subgrade below the planned foundations for buildings and improvements planned in the area of the Library expansion shall be overexcavated in order to provide uniform support for the buildings. Additional remedial grading shall be required to develop relatively uniform support characteristics and reduce the potential for postconstruction swell and distortions to the building in areas where claystone is exposed.
- **Shoring.** Shoring shall be required during excavation for the retaining wall proposed along MacArthur Boulevard due to the anticipated space constraint for slope lay back and adverse bedrock structure. Design parameters of the temporary shoring and retaining wall shall be based on the bedrock strike and dip and the final configuration of the wall. In addition, the retaining wall shall be designed to include possible geologic surcharge from the bedrock. Shoring systems feasible for the site are expected to include cantilever shoring such as soldier piles and lagging in conjunction with tiebacks in areas when the depth of excavation exceeds 10 to 15 feet (ft).
- **Dewatering.** If groundwater or perched water is encountered during project grading and construction, dewatering may be

necessary. Methods of dewatering shall be submitted by the contractor and reviewed and approved by the geotechnical consultant and City Building Official prior to commencement of grading activities.

- **Subsurface Drainage.** Groundwater is not expected to be a project constraint. In the unlikely event groundwater is encountered during construction and is at a depth that would impact project structures (postconstruction), the subterranean slabs shall be designed to resist hydrostatic uplift, or a permanent subfloor drainage system shall be included in the design of the slab. The design of subterranean slabs shall be reviewed and approved by the City Building Official prior to issuance of building permits.
- **Temporary Excavations.** All temporary excavations shall be treated in accordance with the State of California version of Occupational Safety and Health Administration (OSHA) excavation regulations, Construction Safety Orders for Excavation General Requirements. The sides of excavations shall be shored or sloped in accordance with OSHA regulations. OSHA allows the sides of unbraced excavations, up to a maximum height of 20 ft, to be cut to a ¾H:1V (horizontal:vertical) slope for Type A soils, 1H:1V for Type B soils, and 1.5H:1V for Type C soils. The on-site soils (Terrace Deposits) within the proposed excavation depths generally conform to OSHA Soil Type B. The formational bedrock may be classified as Soil Type A but will require careful evaluation by the project Certified Engineering Geologist. The Type A classification is not recommended where adverse (out-of-slope) bedding orientations exist, and special site-specific design parameters will be required in those areas. Heavy construction loads, such as those resulting from stockpiles and heavy machinery, shall be kept a minimum distance equivalent to the excavation height or 5 ft, whichever is greater, from the excavation unless the excavation is shored and these surcharges are considered in the design of the shoring system.
- **Spread Footing Foundations.** Upon completion of the grading (cutting) required to establish the proposed building pad elevations, the proposed structures may be supported by a spread footing foundation system. Bearing capacities shall be dependent on the final foundation elevation and structural loadings of the buildings and shall be reviewed by the geotechnical consultant prior to implementation.
- **Slab on Grade.** At-grade floor slabs of the proposed structures may be designed and constructed as a slab-on-grade supported directly on properly compacted fill or competent bedrock. If a

bedrock artificial fill transition is encountered, the planned subgrade elevation shall be overexcavated at least 3 ft and replaced with properly compacted fill. The structural engineer shall design the slab and determine the required thickness and reinforcement based on structural load requirements.

- **Retaining Walls.** The proposed development is expected to require various types of earth-retaining structures: free-standing cantilever retaining walls; temporary shoring; and belowgrade walls for several of the proposed structures. In general, free-standing retaining structures planned at the site shall be backfilled with granular, very low expansive soil and be constructed with a backdrain.
- **Geotechnical Review and Future Testing.** Additional site testing and final design evaluation shall be conducted by the project geotechnical consultant to refine and enhance these recommendations. Grading plan review shall also be conducted by the project geotechnical consultant and the Director of the City of Newport Beach Building Department or designee prior to the start of grading to verify that the recommendations developed during the geotechnical design evaluation have been appropriately incorporated into the project plans. Final design shall be based on testing and analyses of the near-surface soils following the completion of grading. 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 of Newport Beach 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 4.7.2 **California Building Code Compliance and Seismic Standards.** Structures and retaining walls shall be designed in accordance with the seismic parameters presented in the geotechnical study (Leighton, 2009; Appendix K) and applicable sections of Section 1613 of the 2007 California Building Code (CBC). Prior to issuance of building permits for planned structures, the project soils engineer and the Director of the City of Newport Beach Department of Building, or designee, shall review building plans to verify that structural design conforms to the recommendations of the geotechnical study and the City of Newport Beach Building Code.

Mitigation Measure 4.7.3 **Corrosive Soils.** Prior to issuance of a building permit, the Director of the City of Newport Beach (City) Building Department or designee shall verify that the City has retained the services of a

licensed corrosion engineer to provide detailed corrosion protection measures. Where steel may come in contact with on-site soils, project construction shall include the use of steel that is protected against corrosion. Corrosion protection may include, but is not limited to, sacrificial metal, the use of protective coatings, and/or cathodic protection. Additional site testing and final design evaluation regarding the possible presence of significant volumes of corrosive soils on site shall be performed by the project geotechnical consultant to refine and enhance these recommendations. On-site inspection during grading shall be conducted by the project geotechnical consultant and City Building Official to ensure compliance with geotechnical specifications as incorporated into project plans.

Mitigation Measure 4.7.4 **Expansive Soils.** Prior to issuance of building permits, the Director of the City of Newport Beach (City) Building Department or designee shall verify that building plans require additional expansion index tests if bedrock claystone is encountered at the planned subgrade elevation or during other grading activities. If expansion index tests determine that expansive soils are present on the proposed project site, mitigation may include, but is not limited to, additional remedial grading, premoistening of soils, use of nonexpansive material, post-tensioned slabs, construction of nonexpansive building pads, or use of caisson foundations. During construction, the project soils engineer shall verify that expansive soil mitigation measures are implemented, and the City Building Official shall make site inspections to ensure compliance with approved measures.

4.7.9 Level of Significance after Mitigation

The mitigation measures identified above would reduce all potentially significant impacts related to soils and geology to a less than significant level.