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 also evaluates potential impacts to paleontological resources. Data used to prepare this section were taken from the *Geotechnical Evaluation of Proposed Residential and School Site Development* (NMG Geotechnical, Inc. 2017) and the *Preliminary Geotechnical Exploration* (NMG Geotechnical, Inc. 2018) (both of which are included in Appendix F in this Environmental Impact Report [EIR]), as well as the City of Lake Forest General Plan (City of Lake Forest 2015), the City of Lake Forest Municipal Code, numerous State and federal studies of geologic and seismic hazards in the vicinity of Lake Forest, site-specific investigations in the Project area, and field observations.

4.7.1 Scoping Process

The City of Lake Forest (City) received 28 comment letters during the public review period of the Initial Study/Notice of Preparation (IS/NOP). For copies of the IS/NOP comment letters, refer to Appendix A of this EIR. No comments related to geology and soils were received during the IS/NOP public review period.

4.7.2 Existing Environmental Setting

4.7.2.1 Project Site

Historically, the Project site has been used primarily for agricultural production. From 1938 through the late 1960s, the Nakase Nursery was developed with orchards. In the late 1960s, the northwestern portion of the Project site continued operation as an orchard while the remainder of the Project site was developed as a plant nursery. In 1988, the orchards were removed, and the entire Project site has been used as an agricultural wholesale plant nursery since the 1990s. The 122-acre (ac) Project site is currently operating as the Nakase Brothers Wholesale Nurseries.

The Project site is bounded on the northwest by Bake Parkway, on the northeast by Rancho Parkway, on the southeast by Serrano Creek and Serrano Creek Trail, and on the southwest by commercial, industrial, and office uses, with Dimension Drive beyond. Although not immediately adjacent to the Project site, single-family and multifamily residential uses exist to the northwest, northeast, and south of the Project site.

According to the 2018 geotechnical report (NMG Geotechnical, Inc. 2018), in the existing condition, the topography of the Project site is gently sloping hillside terrain ranging in elevation from 675 feet (ft) in the southwestern portion to 750 ft in the central portion. It appears the Project site was lowered along portions of Bake Parkway by 3 to 8 ft and from the northern flank of the bedrock ridge by 5 to 12 ft, and that material was placed in the northern portion of the Project site to level out the topography.

4.7.2.2 Regional Geology

The Project site is located within the Los Angeles Basin, a northwest-trending alluviated lowland situated at the north end of the Peninsular Ranges geomorphic province of coastal Southern California. The Los Angeles Basin is bounded on the north by the Santa Monica Mountains and the Elysian, Repetto, and Puente Hills, and bounded on the east and southeast by the Santa Ana Mountains and San Joaquin Hills. The Los Angeles Basin is subdivided into four primary structural blocks that are distinguished from one another by contrasting basement rock types and stratigraphy. The Project site is located within the boundaries of the southwestern block of the Los Angeles Basin, most of which is a low plain that extends from Santa Monica at the northwest to Long Beach to the southeast.

4.7.2.3 Local Geology and Subsurface Conditions

The City of Lake Forest comprises about 17 square miles in a transition zone between an elevated coastal terrace and the Santa Ana Mountains. The western portion of Lake Forest, on the coastal terrace, is about 200 ft in elevation. The land becomes progressively higher and steeper to the east, eventually reaching elevations above 1,500 ft along the ridgeline of the Santa Ana Mountains.

Traces of fault segments associated with the Newport-Inglewood Fault Zones parallel the ocean edge of the coastal terrace. Traces of the Elsinore Fault Zone follow the ridge of the Santa Ana Mountains.

The geology of the region is complex and has undergone several alternating periods of subsidence and uplift, mass wasting (erosion), and sediment deposition. In the Santa Ana Mountains, igneous, metavolcanic, and metasedimentary rocks of Jurassic age (201.3 million to 145.0 million years ago) and younger form the core of the range. The exposed rocks in the mountainous areas are slightly metamorphosed volcanics, which have been intruded by granitic rocks of Cretaceous age (145.0 million to 66.0 million years ago), principally granites, gabbros, and tonalites. Overlying these rocks are about 15,000 ft of younger sandstones, siltstones, and conglomerates of upper Cretaceous age, composed largely of material eroded from the older igneous and metavolcanic rocks now underlying the Santa Ana Mountains. The valleys of creeks and washes cross the city, providing additional topographic relief in the foothills and on the coastal terrace. In Lake Forest, Aliso Creek, Serrano Creek, and Borrego Canyon Wash are major waterways whose ancestral channels cut deeply into the marine sediments of the terrace during the lower sea levels of the last Ice Age in late Pleistocene time. Over the last 17,000 years, the rivers have filled their channels to their present levels with unconsolidated sand, silt, and gravel (alluvium).

The subsurface investigation revealed that the majority of the Project site is underlain by deep quaternary alluvium deposited in three distinct canyons trending roughly northeast across the site. The central canyon and Serrano Creek merge together at the site, and the canyon parallel to Bake Parkway extends through the site. The quaternary alluvium is exposed throughout the majority of the site in the old canyon areas. The alluvium consisted of silty to clayey sands with occasional layers of gravel and beds of silt and clay. Based on the collected data and experience on adjacent properties, the alluvium is most likely up to 70 to 80 ft thick in the deepest part of the old canyons.

Slope wash is exposed on the lower flanks of the main bedrock ridge and the tips of the ridges exposed along Bake Parkway and Rancho Parkway. This material is similar to colluvium.

Undocumented fill covers the alluvium in the northern half of the site and along Serrano Creek. Based on a comparison of the 1949 United States Geological Survey (USGS) topographic map to the current topography, the site has been raised about 5 to 15 ft along Serrano Creek and about 4 to 10 ft adjacent to Rancho Parkway. Sandstone of the Capistrano Formation is exposed in the ridge in the south-central portion of the Project site and in limited exposure along Bake Parkway and Rancho Parkway. Bedding generally dips at low angles (8 to 19 degrees) northeast and northwest.

4.7.2.4 Local Groundwater Conditions

Groundwater is present within the alluvium beneath the site. The groundwater encountered during the geologic evaluation ranged from 20 to 45 ft deep. Based on maps published by the State of California, the historic high groundwater levels at the site ranged from 15 to 20 ft deep. Currently, there is a water-well located in the southwest corner of the site that provides irrigation water for the nursery operation.

4.7.2.5 Fault Systems and Seismic Conditions

The faulting and seismicity of Southern California are dominated by the San Andreas Fault Zone. The San Andreas Fault Zone separates two of the major tectonic plates that comprise the earth's crust. West of the San Andreas Fault Zone lies the Pacific Plate. This plate is moving northwest relative to the North American Plate, which is east of the San Andreas Fault Zone. This relative movement between the two plates is the driving force of fault ruptures in the western portion of Southern California. The San Andreas Fault generally trends northwest-southeast. North of the Transverse Ranges Province, the fault trends more in an east-west direction, causing a north-south compression between the two plates. The rate of north-south compression in Southern California has been estimated at between 5 and 20 millimeters per year. This compression has produced rapid uplift of many of the mountain ranges in Southern California, including those surrounding the Los Angeles Basin.

There are numerous faults in the Los Angeles Basin that are categorized as active, potentially active, and inactive. A fault is classified as active if it has either moved during the Holocene epoch (the last 10,000 to 11,500 years) or is included in an Alquist-Priolo Earthquake Fault Zone (as established by the California Geological Survey [CGS], formerly the Division of Mines and Geology). A fault is classified as potentially active if it has experienced movement during the Quaternary period (the last 1.8 million years), but shows little or no evidence of movement during the Holocene. Faults that have not moved in the last 1.8 million years generally are considered inactive. Surface displacement can be recognized by the existence of cliffs in alluvium, terraces, offset stream courses, fault troughs and saddles, the alignment of depressions, sag ponds, and the existence of steep mountain fronts.

The most significant active fault traces in the vicinity of Lake Forest are along the Newport-Inglewood and Elsinore Fault Zones, which are considered active. The Newport-Inglewood Fault Zone was responsible for both the 1933 Long Beach Earthquake and the 1920 Inglewood Earthquake. This zone is visible on the surface as a series of northwest-trending elongated hills

extending from Newport Beach to Beverly Hills, including Signal Hill and Dominguez Hills. The fault zone exhibits as much as 6,000 ft of right-lateral displacement that has occurred since mid-Pliocene time, about 3.4 million years ago, with a maximum displacement of 10,000 ft since late Miocene time, at least 5.3 million years ago. Active or potentially active fault segments of the Newport-Inglewood Fault Zone closest to Lake Forest include the north and south branches of the Newport-Inglewood Fault.

Other known active segments of faults at greater distances from Lake Forest that could pose seismic groundshaking hazards for the Project site include those of the Palos Verdes Fault Zone (about 26 miles [mi] southwest of the city), the San Jacinto Fault Zone (about 35 mi northeast of the city), the San Andreas Fault Zone (about 43 mi northeast of the city), the Sierra Madre Fault Zone (about 32 mi north of the city), and the Santa Monica–Raymond Fault Zone (about 42 mi northwest of the city).

There are no active faults within or immediately adjacent to the Project site based on review of the reports and maps published by the CGS. The closest active fault is the San Joaquin Hills Blind Thrust Fault, located 3.9 mi southwest of the site.

4.7.2.6 Liquefaction and Lateral Spreading

Soil liquefaction is a phenomenon that occurs during strong ground shaking, most commonly in generally low- to medium-density, saturated, low-cohesion soils, where the soils experience a temporary loss of strength and behave essentially as a fluid. In extreme cases, the soil particles can become suspended in groundwater, resulting in the soils becoming mobile and fluid like. 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. This loss of support can produce local ground failure such as settlement or lateral spreading that may damage overlying improvements. As discussed in the 2018 geotechnical report (NMG Geotechnical, Inc. 2018), a significant portion of the Project site along the southern edge parallel to Serrano Creek is located within a potential liquefaction zone as defined by the State's seismic hazard mapping.

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 is often associated with liquefaction. Because of the potential for liquefaction in the Project site and the proximity of the Project site to Serrano Creek, there is a potential for lateral spreading at the site as a result of seismic activity.

Secondary seismic hazards, such as tsunami or seiche, are considered negligible because the site is located away from the ocean and confined bodies of water and is at elevations well above sea level (700± ft).

4.7.2.7 Subsidence

Subsidence refers to broad-scale changes in the elevation of land. Common causes of land subsidence are pumping water, oil, and gas from underground reservoirs; dissolution of limestone

aquifers (sinkholes); collapse of underground mines; drainage of organic soils, and initial wetting of dry soils (hydrocompaction). Subsidence is also caused by heavy loads generated by large earthmoving equipment. The Project site is not located within an area of known subsidence that may be associated with groundwater, peat loss, or oil extraction.[1]

4.7.2.8 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 densification of the underlying soil. Soils susceptible to seismically induced settlement typically include loose granular materials. Ground settlement could occur on sites within a short distance of alluvial valleys or where a site is partially on bedrock formation, or partially on fill with inadequate internal compaction or consolidation of unsuitable soils. According to the geotechnical evaluation conducted by NMG Geotechnical, Inc. in 2017, there is a potential for minor settlement of the quaternary alluvium underlying the majority of the Project site.

4.7.2.9 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. According to the 2018 geotechnical report (NMG Geotechnical, Inc. 2018), on-site soils are granular in nature and are expected to have low to medium expansion potential.

4.7.2.10 Corrosive Soils

Corrosive soils contain chemical constituents that 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) levels are indicators of the soil's tendency to corrode ferrous metals. The geotechnical evaluation conducted by NMG Geotechnical, Inc. in 2017 determined that on-site soils are expected to be corrosive to metals.

4.7.2.11 Seismically Induced Landslides

The downslope movement of loose rock or soil is a potential secondary seismic effect that can occur during strong ground shaking. The proposed Project is not located within an area of earthquake-induced landslides, as defined by the State's seismic hazard mapping.

[1] United States Geological Survey (USGS). California Water Science Center, Areas of Land Subsidence in California Map. Website: https://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html (accessed June 13, 2019).

4.7.2.12 Paleontological Resources

The land within Lake Forest is mapped as containing 28 different geologic units, ranging in age from less than 200 years old to approximately 66 million years old (De Novo, 2018: 9-45 to 9-46). Geologic mapping by Morton and Miller (2006) indicates the Project site contains Holocene to late Pleistocene (less than 126,000 years ago) Young Alluvial Fan Deposits (i.e., Quaternary alluvium as described in Section 4.7.2.3) and the late Miocene to early Pliocene Oso Member of the Capistrano Formation (described in Section 4.7.2.3 as the Capistrano Formation). The marine Capistrano Formation is divided into two members, one informal and one formal: the siltstone member and the Oso Member, which is the member mapped in the Project site (Morton and Miller, 2006). These two members are laterally equivalent and date to the latest Hemphillian North American Land Mammal Age (approximately 7–4.9 million years ago) (Barnes and Raschke, 1991; Morton et al., 1976). Although not mapped by Morton and Miller (2006), as noted in Section 4.7.2.3, undocumented fill is also present at the surface in the Project site.

While undocumented fill may contain fossils, these fossils have been removed from their original location and are thus out of stratigraphic context. Therefore, they are not considered important for scientific study. With the exception of undocumented fill, the geologic units within the Project site have the potential to produce scientifically important paleontological resources. Pleistocene sediments similar to those found at depth in the Young Alluvial Fan Deposits have produced scientifically important fossils elsewhere in Orange County and the region (Bell et al., 2004; Jefferson 1991a, 1991b; Miller, 1971; Reynolds and Reynolds, 1991; Springer et al., 2009). Fossils from this time include large and small mammals, reptiles, fish, invertebrates, and plants. The Oso Member of the Capistrano Formation has produced specimens of algae, land plants, bivalves, gastropods, molluscs, bryozoans, echinoderms, shrimp, sharks, rays, bony fish, sea turtles, crocodiles, birds, dolphins, whales, sea lions, sea cows, walruses, camels, elephants, horses, and rhinoceros (Fierstine, 2008; Minch and Hull, 1993; Minch and Leslie, 1994; Schoellhamer et al., 1981; Sundberg, 1991). Moreover, the Recreation and Resources Element of the City's General Plan identifies the proposed Project site as being sensitive for important paleontological resources (City of Lake Forest, 2015).

4.7.3 Regulatory Setting

4.7.3.1 Federal Regulations

There are no federal regulations for geology and soils that are applicable to the proposed Project.

4.7.3.2 State Regulations

Alquist-Priolo Earthquake Fault Zoning Act (1972). The Alquist-Priolo Earthquake Fault Zoning Act of 1972 and updates (California Public Resources Code [PRC], Section 2621, et seq.) is the principal California State guidance to prevent the construction of habitable structures on the surface trace of active earthquake faults. If an active fault is found, a structure for human occupancy must be set back from the fault (generally 50 ft). The Alquist-Priolo Earthquake Fault Zoning Act only addresses the hazard of surface fault rupture; it does not consider other earthquake hazards. There are no known earthquake fault zones on or in the near vicinity of the Project site; therefore, regulations recommended by the 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 to address the potential hazards posed by secondary effects of seismic activity, including strong ground shaking, soil liquefaction, and associated ground failure and seismically induced landslides. The CGS prepares and provides local governments with seismic hazard zone maps that identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures. The seismic hazard 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 the potential hazards can be successfully mitigated.

California Building Code (2016). The California Code of Regulations (CCR), Title 24, Part 2, the California Building Code (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 designs of structures are based on site characteristics, occupancy type, configuration, structural system height, and seismic design category. 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 has adopted these provisions by reference (Title 8, Chapter 8.02, Section 8.02.001 of the City of Lake Forest Municipal Code) and also includes amendments to the CBC (Title 8, Chapter 8.02, Section 8.02.020 of the City's Municipal Code). Sections of Volume 2 of the CBC specifically apply to select geologic hazards. Chapter 16 of the 2016 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.

Public Resources Code. Section 5097.5 of the Public Resources Code provides for the protection of cultural and paleontological resources and prohibits the removal, destruction, injury, or defacement of archaeological and paleontological features on any lands under the jurisdiction of State or local authorities.

Construction General Permit. Stormwater discharges from construction activities in California are regulated by the State Water Resources Control Board (SWRCB) *National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities*, Order No. 2009-009-DWQ, NPDES No. CAS000002 (Construction General Permit). The Construction General Permit regulates construction activity that disturbs of at least 1 ac of total land area. The Construction General Permit requires preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) that describes the Erosion Control and Sediment Control Best Management Practices (BMPs) that would be implemented during construction to control erosion and sedimentation, particularly during storm events.

4.7.3.3 Local Regulations

North Orange County MS4 Permit. The City is a co-permittee of an NPDES Municipal Separate Storm Sewer System (MS4) permit for North Orange County. The Santa Ana Regional Water Quality Control Board (RWQCB) *Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the Incorporated Cities of Orange County within the Santa Ana Region Areawide Urban Storm Water Runoff, Orange County*, Order No. R8-2009-0030, NPDES No. CAS618030, as amended by Order No. R8-2010-0062 (North Orange County MS4 Permit) regulates stormwater discharges into the City's MS4 system (i.e., storm drain system) and surface waters. The MS4 Permit stipulates operational requirements for new development and significant redevelopment, including implementation of Source Control, Site Design, Low Impact Development (LID), and Treatment Control BMPs to address pollutants of concern in stormwater runoff during operation. As specified by the North Orange County MS4 Permit, the proposed project is considered a "priority" project because it is a redevelopment project that would add or replace at least 5,000 square feet (sf) or more of impervious surface. As a priority project, the proposed Project is required to prepare a Water Quality Management Plan (WQMP) and implement BMPs to address pollutants in stormwater runoff, including pollutants associated with erosion, during operation. Please refer to Subsection 4.9.3, Regulatory Setting, in Section 4.9, Hydrology and Water Quality, of this EIR for additional discussion of the North Orange County MS4 Permit.

City of Lake Forest General Plan Safety and Noise Element. The Safety and Noise Element addresses hazards as mandated in State law (Government Code Section 65302(g)). This element also serves as a comprehensive program to identify and temper environmental factors that potentially threaten community health and safety. The Safety and Noise Element contains policies and programs to regulate existing and proposed development located in hazard-prone areas.

The following goal and policy apply to the proposed Project:

> **Goal 1.0** Reduction in the risk to the community from hazards associated with geologic conditions, seismic activity, and flooding.
>
> **Policy 1.1** Reduce the risk of impacts from geologic and seismic hazards.

City of Lake Forest General Plan Recreation and Resource Element. The existing City of Lake Forest General Plan identifies goals and policies related to cultural resources. Goal 4.0 in the Recreation and Resources Element of the City's General Plan addresses historical, archaeological, and paleontological resources (and potential resources) and indicates that conservation of the resources and investigation of potential resource areas is an important undertaking for connecting with the community's past (City of Lake Forest 2015: 7-8).

The following goal and policy apply to the proposed Project:

> **Goal 4.0** Conservation of important historic, archaeological, and paleontological resources.

Policy 4.1 Protect areas of important historic, archaeological, and paleontological resources.

City of Lake Forest Municipal Code, Chapter 8.02. Chapter 8.02 of the City's Municipal Code includes the adoption of the CBC by reference and amendments to the CBC.

- **Section 8.30.030** adopts the CBC for the purpose of prescribing regulations for the erection, construction, enlargement, alteration, repair, improving, removal, conversion, demolition, occupancy, equipment, use, height, area and maintenance of all buildings and structures. The California Building Code, 2016 Edition, is based on the 2015 International Building Code as published by the International Code Council with the amendments provided in Section 8.02.020.

- **Section 8.30.020** outlines amendments to the 2016 CBC, including modifications to design, plan review, permit, and payment of fee requirements.

City of Lake Forest Municipal Code, Chapter 8.30. Chapter 8.30 of the City's Municipal Code regulates grading and excavation activities.

- **Section 8.30.030** requires a grading permit obtained from the City Engineer prior to any grading, clearing of brush, grubbing excavation, or any other land disturbance activities.

- **Section 8.30.058** requires a soil engineering and engineering geology report for grading projects. The reports shall include information appropriate for the site including any information required by the City Engineer. Recommendations included in the reports and approved by the City Engineer shall be incorporated in the grading plans or specifications.

- **Section 8.30.100** specifies that cut slopes shall be no steeper than two horizontal to one vertical (2:1) unless otherwise recommended in the soil engineering or engineering geology report and approved by the City Engineer.

- **Section 8.30.110** specifies that unless otherwise approved by the City Engineer and recommended in the approved soil engineering report, fills shall conform to Subarticle 9 of the grading manual. The provisions therein may be waived for minor fills not intended to support structures upon written request by the applicant on a form prescribed by the City Engineer.

- **Section 8.30.150** specified that grading activities be undertaken in compliance with NPDES and City requirements. Each grading project shall implement BMPs to ensure that discharges of pollutants are effectively prohibited and will not cause or contribute to an exceedance of water quality standards. Section 8.30.150 also specifies that, prior to the issuance by the City of a grading permit, the Department of Public Works and/or Development Services Department shall review the project plans.

- **Section 8.30.152** species that projects with a grading permit shall submit an erosion control plan to the Building Official for approval by September 15th of each year.

City of Lake Forest Municipal Code, Chapter 15.14. Chapter 15.14 of the City's Municipal Code regulates stormwater quality and prohibits discharges of pollutants into surface waters unless the discharge is authorized by an NPDES permit.

- **Section 15.14.040** requires all new development and redevelopment projects to comply with the requirements of the North Orange County MS4 Permit. Section 15.14.040 specifies that, prior to the issuance of a grading permit or building permit, the Department of Public Works and/or Development Services Department shall review the project plans.

- **Section 15.14.050** requires preparation of an erosion and sediment control plan as a condition of approval for issuance of a construction or grading permit. Section 15.14.050 also requires implementation of construction BMPs to ensure that the discharge of pollutants from the site will be effectively prohibited and will not cause or contribute to an exceedance of water quality standards. Section 15.14.050 specified that construction and grading activities be undertaken in compliance with NPDES and City requirements.

- **Section 15.14.060** requires implementation of operational BMPs on all sites that have the potential to discharge a pollutant to the City's MS4.

4.7.4 Methodology

To assess the impacts of the proposed Project with respect to geologic and soil conditions, geotechnical investigation and field explorations were undertaken by NMG Geotechnical, Inc. in 2017 and 2018. The discussion below describes the scope of the geotechnical exploration.

- **Background Research and Data Review:** Various sources, including published geologic maps, historic stereographic aerial photographs, and data pertinent to the subject site were acquired and reviewed by NMG Geotechnical, Inc. in 2017 and 2018.

- **Site Reconnaissance:** Site reconnaissance and subsurface explorations of the Project site were conducted by NMG Geotechnical, Inc. in 2017 and 2018.

- **Field Investigation:** Preliminary field investigations were conducted by NMG Geotechnical, Inc. in 2017 and 2018 to identify subsurface conditions on the Project site related to soil types, groundwater, liquefaction, corrosive soils, and settlement. In 2017, the field investigation included drilling, logging, and sampling six hollow-stem auger borings (B-1 through B-6) to depths of 51.5 to 55 ft below ground surface (bgs) and advancing 13 cone penetrometer test (CPT) soundings (CPT-1 through CPT-13) to depths of 50 ft bgs. In 2018, 21 hollow-stem augered borings were drilled, logged, and sampled (B-1 through B-21) on the Project site to depths of 25.5 to 55 ft bgs; 23 CPT soundings (CPT-1 through CPT-23) were advanced to depths of 50 ft bgs; and 22 trench/test pits (T-1 through T-22) were excavated to depths of up to 16 ft bgs.

- **Geotechnical Laboratory Testing:** In 2017 and 2018, NMG Geotechnical, Inc. conducted limited laboratory testing on selected samples to determine in-situ moisture and density, consolidation potential, shear strength, expansion potential, grain size distribution, and maximum density/ optimum moisture content.

Per the City's General Plan, the proposed Project site is sensitive for paleontological resources; therefore, no paleontological field studies or locality searches were conducted because the paleontological sensitivity of the proposed Project site was previously determined.

Paleontological resources and soils, geology, and seismic hazards were assessed with respect to significance within the context of Appendix G of the *State CEQA Guidelines*.

4.7.5 Thresholds of Significance

The thresholds for geology and soils impacts used in this analysis are consistent with Appendix G of the *State CEQA Guidelines* and the City's CEQA Significance Thresholds Guide (March 2009). The proposed Project may be deemed to have a significant impact with respect to geology and soils if it would:

Threshold 4.7.1(i): Directly or indirectly cause 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.

Threshold 4.7.1(ii): Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking

Threshold 4.7.1(iii): Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction

Threshold 4.7.1(iv): Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides

Threshold 4.7.2: Result in substantial soil erosion or the 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 in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect 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

Threshold 4.7.6: Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature

The Initial Study, included as Appendix A, substantiates that there would be no impacts associated with Thresholds 4.7.1(i), 4.7.1(iv), and 4.7.5. These thresholds will not be addressed in the following analysis.

4.7.6 Project Impacts

Threshold 4.7.1(ii): Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking?

Potentially Significant Impact. 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. The San Joaquin Hills Blind Thrust Fault is the closest active fault, located 3.9 mi southwest of the Project site. Other major regional active faults include Whittier-Elsinore, Newport-Inglewood, San Jacinto, and San Andres Faults. During an earthquake along any of these faults or faults in the region, seismically induced ground shaking would be expected to occur. The severity of the shaking would be influenced by the magnitude of the earthquake, the distance of the Project site to the seismic source, the soil conditions, and the depth to groundwater.

Peak ground acceleration (PGA) is a measure of earthquake acceleration on the ground and an important input parameter for earthquake engineering. Based on the geotechnical evaluation conducted in 2017 (NMG Geotechnical, Inc. 2017), a PGA of 0.53g was identified for the Project site. This acceleration is consistent with other areas in this region of California that are underlain by similar geologic materials and indicates that strong seismic ground shaking generated by seismic activity is considered a potentially significant impact that may affect people or structures associated with the proposed Project. Mitigation Measure 4.7.1 and Regulatory Compliance Measure (RCM) GEO-1 require the applicant to comply with the recommendations of a Final Geotechnical Evaluation and the most current CBC adopted by the City as its Building Code, which stipulates appropriate seismic design provisions that shall be implemented with Project design and construction. With implementation of Mitigation Measure 4.7.1 and RCM GEO-1, potential project impacts related to seismic ground shaking would be reduced to a less than significant level.

Threshold 4.7.1(iii): Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction?

Potentially Significant Impact. Liquefaction occurs when saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong ground motion during an earthquake. Structures on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements, and/or lateral spreading. Factors known to influence the potential for liquefaction include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration

of the seismic ground shaking. Assessment of liquefaction potential for a particular site requires knowledge of a number of regional and site-specific parameters, including the estimated design earthquake magnitude, the distance to the assumed causative fault, and the associated probable peak horizontal ground acceleration at the site, subsurface stratigraphy, and soil characteristics. Parameters such as distance to causative faults and estimated probable peak horizontal ground acceleration were determined using published references and online computer programs by the United States Geological Survey (USGS). Stratigraphy and soil characteristics were determined by means of a site-specific subsurface investigation combined with appropriate laboratory analysis of representative samples of on-site soils.

As discussed above, a significant portion of the Project site along the southern edge parallel to Serrano Creek is located within a potential liquefaction zone as defined by the State's seismic hazard mapping. As previously discussed, groundwater was observed at depths of 20 to 45 ft. These depths are generally consistent with published maps that indicate the historic high groundwater level in the vicinity of the Project site, which ranged from 15 to 20 ft deep. Because of the granular nature of some of the layers within the alluvium and the shallow groundwater over most of the site, there is a potential for liquefaction to occur during a future major earthquake, impacting the Project site.

Mitigation Measure 4.7.1 and RCM GEO-1 require the applicant to comply with the recommendations of a Final Geotechnical Evaluation and the most current CBC adopted by the City as its building code, which stipulates appropriate seismic design provisions that shall be implemented with Project design and construction. Adherence to the Seismic Zone 4 soil and foundation support parameters and the grading requirements in the CBC and City of Lake Forest Municipal Code will ensure the maximum practicable protection available from soil failure under static or dynamic conditions for structures and their associated trenches, slopes, and foundations. With implementation of Mitigation Measure 4.7.1 and RCM GEO-1 potential project impacts related to seismically induced liquefaction would be reduced to a less than significant level.

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

Less than Significant Impact. As discussed in Section 4.9, Hydrology and Water Quality, 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 soil to weather conditions (e.g., wind and rain). During a storm event, soil erosion and loss of topsoil could occur at an accelerated rate. As specified in RCM WQ-1, the project would comply with the requirements of the Construction General Permit. Under the Construction General Permit, the project would be required to prepare a SWPPP and implement the construction BMPs detailed in the SWPPP during construction. In addition, as specified in RCM WQ-2 in Section 4.9, Hydrology and Water Quality, an erosion and sediment control plan would be prepared and submitted to the Director of the City of Lake Forest Public Works Department, or designee, prior to issuance of a grading or building permit. An erosion and sediment control plan would also be prepared annually during construction and submitted to the Director of the City of Lake Forest Public Works Department, or designee, for approval prior to September 15th of each year during construction. The SWPPP and erosion and sediment control plans would detail the BMPs to be implemented during construction. Construction BMPs would include, but not be limited to, Erosion Control and Sediment Control BMPs designed to

minimize erosion and retain sediment on site. With implementation of Erosion Control and Sediment Control BMPs, as required by RCM WQ-1 and RCM WQ-2, construction impacts related to erosion or the loss of topsoil would be less than significant.

As also discussed in Section 4.9, Hydrology and Water Quality, in the proposed condition, 80.3 ac (65.8 percent) of the Project site would be impervious surface area and not prone to on-site erosion or siltation because no soil would be included in these areas. The remaining 41.7 ac (41.7 percent) of the site would consist of pervious area, which would contain landscaping that would minimize on-site erosion and siltation by stabilizing the soil. However, the proposed project would increase impervious area on the Project site by 68.2 ac, which would result in a net increase in storm water runoff that can lead to downstream erosion in receiving waters (Serrano Creek). However, as specified in RCM WQ-3, the proposed Project would be required to comply with the hydromodification requirements of the North Orange County MS4 Permit and reduce stormwater runoff from the Project site so it does not exceed pre-development runoff rates or time of concentration by more than 5 percent. To achieve this, the proposed Project would include a subsurface detention vault below Central Park, underground detention vaults in combination with proprietary biotreatment BMPs at each of the five neighborhood parks, a biotreatment facility along Serrano Creek, and a linear biotreatment facility along "A" Street. These features will reduce flows during storm events so it does not exceed pre-development runoff rates or time of concentration by more than 5 percent. Compliance with the hydromodification requirements of the North Orange County MS4 Permit, as specified in RCM WQ-3, would ensure that the proposed Project would not result in downstream erosion impacts. For these reasons, operation impacts related to substantial soil erosion or loss of topsoil would be less than significant, 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?

Landslides and Unstable Slopes.

Potentially Significant. 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 Landslide. Therefore, potential impacts related to landslides would be less than significant, and no mitigation is required.

Slope stability issues do exist along the edge of the Project site adjacent to Bake Parkway and Rancho Parkway. Additional soil testing and borings will be required to determine graded conditions beneath the roadbed (e.g., fill thickness, topsoil/colluvium left in place, subdrains installed). Depending on the final grading plan for the proposed Project and the results of additional soil testing, a structural setback may be required to prevent undermining the existing road or excessive differential settlement induced by new fill loading that would cause structure damage to planned structures. Mitigation Measure 4.7.1 and RCM GEO-1 require the applicant

to comply with the recommendations of a Final Geotechnical Evaluation and the most current CBC adopted by the City as its building code. With implementation of Mitigation Measure 4.7.1 and RCM GEO-1, potential project impacts related to slope stability and differential settlement would be reduced to a less than significant level.

Lateral Spreading.

Potentially Significant. Lateral spreading often occurs on very gentle slopes or flat terrain. The dominant mode of movement is lateral extension accompanied by shear or tensile fracture. This failure is caused by liquefaction and is usually triggered by rapid ground motion, such as that experienced during an earthquake, but can also be artificially induced. When coherent material, either bedrock or soil, rests on materials that liquefy, the upper units may undergo fracturing and extension and may then subside, translate, rotate, disintegrate, or liquefy and flow. During the subsurface investigation, the potential for lateral slope failure was explored with CPTs advanced to 50 ft deep, in selected areas along the perimeter of Serrano Creek. Due to the effects of liquefaction potential in the alluvium during a significant seismic shaking event, the exposed slope associated with Serrano Creek may be subject to lateral slope failure. According to the geotechnical evaluations prepared for the proposed Project (NMG Geotechnical, Inc. 2017, 2018), a seismic shear key would be required to reduce impacts related to lateral spreading to a less than significant level. The top of the front cut for the sheet key would start at the environmental setback boundary and would extend along the Serrano Creek edge. The actual dimensions of the key would depend on additional subsurface exploration and site-specific analysis to be performed as part of the preparation of the Final Geotechnical Report. With implementation of these recommendations in accordance with Mitigation Measure 4.7.1, potential impacts related to lateral spreading would be reduced below a level of significance.

Subsidence.

No Impact. Subsidence refers to broad-scale changes in the elevation of land. Common causes of land subsidence are pumping water, oil, and gas from underground reservoirs; dissolution of limestone aquifers (sinkholes); collapse of underground mines; drainage of organic soils; and initial wetting of dry soils (hydrocompaction). Subsidence is also caused by heavy loads generated by large earthmoving equipment. The Project site is not located within an area of known subsidence that may be associated with groundwater, peat loss, or oil extraction.[1] Therefore, the proposed Project would not be subject to potential geotechnical hazards related to subsidence, and no mitigation is required.

Unsuitable Soils.

Potentially Significant. The results of the subsurface investigation within the Project site indicate that approximately 200,000 yards of fill were placed to create the site conditions. Given that this fill is undocumented, it is unlikely that most of the on-site fill materials were placed in

[1] United States Geological Survey (USGS). California Water Science Center, Areas of Land Subsidence in California Map. Website: https://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html (accessed June 13, 2019).

accordance with current grading standards and certified by a geotechnical professional. It is assumed that remedial grading was not performed for this work and that the undocumented fill is underlain by unsuitable alluvium. Therefore, the future settlement behavior of the existing on-site fill under the loading conditions during operation of the proposed Project cannot be accurately predicted, and the on-site fill is considered unsuitable for support of the proposed buildings and associated site improvements. As described in Mitigation Measure 4.7.1, to mitigate differential settlement in the design cut-and-fill transition areas, over-excavation will be performed. Undocumented fill and any soft or poor quality fill[1] would also be removed during remedial grading. Provided design and remedial grading are performed in accordance with the applicable requirements in the CBC adopted by the City as its building code with certain amendments (RCM GEO-1), excessive settlement resulting from compression of existing undocumented fill and alluvial soils on the Project site would be reduced to a less than significant level.

Corrosive Soils.

Potentially Significant Impact. 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.

As discussed previously, on-site soils are not corrosive to concrete but are very corrosive to metals. Project impacts related to corrosive soils would be less than significant with implementation of Mitigation Measure 4.7.2. Mitigation Measure 4.7.2 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 4.7.2, potential impacts related to corrosive soils would be reduced to a less than significant level.

Threshold 4.7.4: Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect 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. According to the geotechnical evaluations prepared for this project (NMG

[1] Fill dirt used in construction projects must meet specifications outlined by the project's geotechnical engineer. Generally, good quality, inorganic, clean fill dirt from subsoil consists of at least 50 percent clay and does not contain any additives or dangerous materials (e.g., refuse, rubble, muck, metal, glass, wood, or other foreign materials).

Geotechnical, Inc., 2017, 2018), on-site soils are generally granular in nature and are expected to have low to medium expansion potential. Therefore, the potential for expansive soils impacting the proposed Project is considered to be less than significant, and no mitigation is required.

Threshold 4.7.6: Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Potentially Significant Impact. According to the City of Lake Forest General Plan, the proposed Project site is located in an area that has been previously determined as sensitive for paleontological resources. As such, it is possible that ground-disturbing construction activities could impact significant previously undiscovered paleontological resources. To mitigate adverse impacts to unknown buried paleontological resources that may exist on site, Mitigation Measure 4.7.3 requires that an Orange County Certified Paleontologist be retained to develop a Paleontological Resources Impact Mitigation Program (PRIMP), that paleontological monitoring occur during ground-disturbing activities in paleontologically sensitive deposits, and that a final paleontological monitoring report be prepared describing the results of the monitoring effort. The PRIMP should follow guidelines developed by the Society of Vertebrate Paleontology and should include, but not be limited to, the methods that will be used to protect paleontological resources that may exist within the Project site, as well as procedures for monitoring, fossil preparation and identification, curation into a repository, and preparation of a report at the conclusion of grading. Implementation of Mitigation Measure 4.7.3 would ensure that impacts to paleontological resources are reduced below a level of significance.

4.7.7 Cumulative Impacts

As defined in the *State CEQA Guidelines*, cumulative impacts are the incremental effects of an individual project when viewed in connection with the effects of past, current, and probable future projects within the cumulative impact area for geology and soils. Typically, geology and soils impacts are specific to a particular Project site and there is little, if any, cumulative relationship between the development of a proposed project and development within a larger cumulative area. Moreover, while seismic conditions are regional in nature, seismic impacts on a given Project site are site-specific. For example, development within the Project site would not alter geologic events or soil features/characteristics (e.g., ground shaking, seismic intensity, or soil expansion or compression). Therefore, 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 Project site. In general, only projects occurring adjacent to or very close to the Project site were considered. None of the 11 cumulative projects identified in Table 4.A (Section 4.0) are located adjacent to or in the immediate vicinity of the proposed project, and therefore would not contribute to cumulative geology and soils impacts.

In addition, the proposed Project, as well as foreseeable projects, would be required to comply with the applicable State and local requirements, including but not limited to the CBC that has been adopted by the City as its building code. Therefore, the Project-specific geology and soils 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.

Potential impacts of the proposed Project to unknown paleontological resources and unique geologic features, when combined with the impacts of past, present, and reasonably foreseeable projects in the City of Lake Forest, could contribute to a cumulatively significant impact due to the overall loss of paleontological remains unique to the region. However, each development proposal received by the City is required to undergo environmental review pursuant to the California Environmental Quality Act (CEQA). If there were any potential for significant impacts to paleontological resources or unique geologic features, an investigation would be required to determine the nature and extent of the resources and identify appropriate mitigation measures. When resources are assessed and/or protected as they are discovered, impacts to these resources are less than significant.

As such, implementation of Mitigation Measure 4.7.3 would ensure that the proposed Project, together with cumulative projects, would not result in significant cumulative impacts to unique paleontological resources or unique geologic features.

4.7.8 Level of Significance Prior to Mitigation

The potential for surface fault rupture, erosion, subsidence, landslides, and expansive soil is less than significant, and no mitigation is required. The potential impacts related to seismic shaking, liquefaction, lateral spreading, settlement due to undocumented fill, and corrosive soil would be potentially significant prior to mitigation. The proposed Project would also have potential impacts on paleontological resources prior to mitigation.

4.7.9 Regulatory Compliance Measures and Mitigation Measures

4.7.9.1 Regulatory Compliance Measures

The following RCM is a requirement of the CBC that is applicable to the proposed Project and is considered in the analysis of potential impacts related to geology and soils. The City of Lake Forest considers these requirements to be mandatory; therefore, they are not mitigation measures.

RCM GEO-1 **California Building Code Compliance Seismic Standards.** Structures and retaining walls shall be designed in accordance with the seismic parameters presented in the geotechnical evaluations prepared for this project (NMG Geotechnical, Inc., 2017, 2018) and applicable sections of Section 1613 of the most current California Building Code (CBC). Prior to issuance of building permits for planned structures, the Project soils engineer and the Director of Public Works, or designee, shall review building plans to verify that the structural design conforms to the requirements of the geotechnical study and the City of Lake Forest Municipal Code.

4.7.9.2 Mitigation Measures

In addition to regulatory requirements, the following mitigation measures would reduce potential impacts related to seismic ground shaking, liquefaction, and compressible/collapsible soils to a less than significant level.

Mitigation Measure 4.7.1 Incorporation of and compliance with the recommendations in the Project Geotechnical Assessment. All grading operations and construction shall be conducted in conformance with the recommendations included in the geotechnical evaluations for the Project site prepared by NMG Geotechnical, Inc., specifically the *Geotechnical Evaluation of Proposed Residential and School Site Development, Nakase Property, Lake Forest, California* dated April 19, 2017, and the *Preliminary Geotechnical Exploration, Proposed Development, Nakase Nursery, Tentative Tract 18142, Lake Forest, Orange County, California* dated July 13, 2018. Specific recommendations in the geotechnical evaluations address the following and shall be incorporated into the final Project plans and construction-level geotechnical report:

1. Removal of undocumented fill on the northern half of the Project site during remedial grading.

2. Removal of any soft or poor quality fill during remedial grading. If some of this material cannot be removed in order to prevent undermining the existing road, then a structural setback would be required to protect the planned structures from excessive differential settlement induced by the new fill loading.

3. Compact fill placement to reduce the potential for surface manifestations of liquefaction during seismic shaking.

4. Installation of a seismic shear key to mitigate the potential of lateral slope failure due to the effects of liquefaction potential in the alluvium during a significant seismic shaking event.

5. Evaluation of the stability of the slopes If existing slopes are to essentially remain in place to ensure they have been graded to a standard that resulted in a 1.5 safety factor for gross and surficial stability. If there are any deficiencies with the existing slope, they would have to be regraded to project standards or a structural setback established to protect the planned structures.

6. Over-excavation to mitigate differential settlement in the design cut-and-fill transition areas.

7. Placement of cement-treated soil or equivalent to be installed along the southeastern edge of the seismic shear key to protect the planned development from future potential erosion associated with the adjacent Serrano Creek.

Additional site testing and final design evaluation shall be conducted by the Project Geotechnical Consultant to refine and enhance these requirements. The Project Applicant/Developer 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 Project Applicant/Developer shall require appropriate changes to the final Project design and specifications. Design, grading, and construction shall be performed in accordance with the requirements of the City of Lake Forest (City) Municipal Code (Title 8) 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 by the City of Lake Forest Director of Public Works, or designee, prior to commencement of grading activities.

Grading plan review shall also be conducted by the Director of Public Works 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's Building Code. On-site inspection during grading shall be conducted by the Project Geotechnical Consultant and the City of Lake Forest Director of Public Works/City Engineer, or designee, to ensure compliance with geotechnical specifications as incorporated into project plans. Prior to final of grading permits, the Project geotechnical engineer shall submit a Final Testing and Observation Geotechnical Report for Rough Grading to the City of Lake Forest Director of Public Works/City Engineer, or designee..

Mitigation Measure 4.7.2 **Corrosive Soils.** Prior to issuance of a building permit, the Director of the City of Lake Forest Public Works Department, or designee, shall verify that the Project Applicant/Developer 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 on-site presence of significant volumes of corrosive soils 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 of Lake Forest Director of Public Works/City Engineer, or designee, to ensure compliance with geotechnical specifications as incorporated into Project plans.

Mitigation Measure 4.7.3 **Paleontological Resources Impact Mitigation Program.** Prior to the issuance of the first preliminary or precise grading permit, the Project Applicant/Developer shall provide a letter to the Director of the City of Lake Forest Community Development Department, or designee, stating that they have retained a qualified paleontologist (defined as a practicing paleontologist that is recognized in the paleontological community and proficient in vertebrate paleontology) who is listed on the County of Orange list of certified paleontologists. The paleontologist shall prepare a Paleontological Resources Impact Mitigation Program (PRIMP) for this Project. The PRIMP shall include the methods that will be used to protect paleontological resources that may exist within the Project site, as well as procedures for monitoring, fossil preparation and identification, curation into a repository, and preparation of a report at the conclusion of grading. The PRIMP shall be consistent with the guidelines of the Society of Vertebrate Paleontology.

Excavation and grading activities in deposits with high paleontological sensitivity shall be monitored by a paleontological monitor following a PRIMP. No monitoring is required for excavations in deposits with no or low paleontological sensitivity.

If paleontological resources are encountered during the course of ground disturbance, the paleontological monitor shall have the authority to temporarily redirect construction away from the area of the find in order to assess its significance. In the event that paleontological resources are encountered when a paleontological monitor is not present, work in the immediate area of the find shall be redirected and a paleontologist shall be contacted to assess the find for significance.

Collected resources shall be prepared to the point of identification, identified to the lowest taxonomic level possible, cataloged, and curated into the permanent collections of a scientific institution.

Prior to approval of any occupancy permits, a report of findings shall be prepared to document the results of the monitoring program.

4.7.10 Level of Significance after Mitigation

With implementation of RCM GEO-1 and Mitigation Measures 4.7.1, 4.7.2, and 4.7.3, all identified potentially significant impacts related to geotechnical hazards and paleontological resources would be reduced below a level of significance.