4.5 GEOLOGY AND SOILS

INTRODUCTION

This section describes existing conditions and relevant regulations associated with geology and soils and analyzes the potential impacts of the Project regarding fault rupture, seismic hazards, ground shaking, liquefaction, soil erosion or the loss of topsoil, expansive soils, and landform/landslide in the County of Orange and in the vicinity of the project site. Information in this section is largely based on information and findings obtained in the following documents: *Geotechnical Feasibility Study* (herein referred to as the "Geotechnical Feasibility Study"), *Proposed Development of Tentative Tract Map No. 17341, County of Orange, California*, prepared by LGC Geotechnical, Inc. March 1, 2013; and *Geologic and Geotechnical Evaluation* (herein referred to as the "Geotechnical Evaluation"), prepared by Pacific Soils Engineering, Inc., June 8, 2006. Both documents are included in Appendix E of this EIR.

1. ENVIRONMENTAL SETTING

a. Regulatory Framework

(1) Federal

(a) Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act was enacted in 1997 to "reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program." To accomplish this, the Act established the National Earthquake Hazards Reduction Program (NEHRP). The program was significantly amended in November 1990 by NEHRP, which refined the description of agency responsibilities, program goals, and objectives. NEHRP's mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improvement of building codes and land use practices; risk reduction through post-earthquake investigation and education; development and improvement of design and construction techniques; improvement of mitigation capacity; and accelerated application of research results. The NEHRP designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns it several planning, reports, and coordinating responsibilities. Programs under NEHRP inform and guide planning and building code requirements such as emergency evacuation responsibilities and seismic code standards such as those to which the Project would be required to adhere.

(b) Federal Soil Protection Act

The purpose of the Federal Soil Protection Act is to protect or restore the functions of the soil on a permanent sustainable basis. Protection and restoration activities include prevention of harmful soil changes, rehabilitation of the soil of contaminated sites and of water contaminated by such sites, and precautions against negative soil impacts. If impacts are made on the soil, disruptions of its natural functions and of its function as an archive of natural and cultural history should be avoided, as far as practicable. In addition, the requirements of the Federal Water Pollution Control Act, also referred to as the Clean Water Act (CWA) through the National Pollution Discharge Elimination System (NPDES) permit provide guidance for protection of geologic and soil resources.

(c) International Building Code

The International Building Code (IBC) is the national model building code providing standardized requirements for construction. The IBC replaced earlier regional building codes, including the Uniform Building Code (UBC), in 2000 and established consistent construction guidelines for the nation. The 2009 IBC is the most recent edition of the IBC, which was incorporated into the 2010 California Building Code (CBC) that currently applies to all structures being constructed in California. The national model codes are therefore incorporated by reference into the building codes of local municipalities, such as the CBC discussed below. The CBC includes building design and construction criteria that take into consideration the State's seismic conditions.

(2) State

(a) Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (Public Resources Code Section 2621) was enacted by the State of California in 1972 to address the hazard of surface faulting to structures for human occupancy.[1] The Alquist-Priolo Earthquake Fault Zoning Act was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged homes, commercial buildings, and other structures. The primary purpose of the Alquist-Priolo Earthquake Fault Zoning Act is to prevent the construction of buildings intended for human occupancy on the surface traces of active faults. The Alquist-Priolo Earthquake Fault Zoning Act is also intended to provide the citizens with increased safety and to minimize the loss of life during and immediately following earthquakes by facilitating seismic retrofitting to strengthen buildings against ground shaking. The Alquist-Priolo Earthquake Fault Zoning Act requires the State Geologist to establish regulatory zones, known as "earthquake fault zones", around the surface traces of active faults and to issue appropriate maps to assist cities and counties in planning, zoning, and building regulation functions. Maps are distributed to all affected cities and counties for the controlling of new or renewed construction and are required to sufficiently define potential surface rupture or fault creep. The State Geologist is charged with continually reviewing new geologic and seismic data, and revising existing zones and delineating additional earthquake fault zones when warranted by new information. Local agencies must enforce the Alquist-Priolo Earthquake Fault Zoning Act in the development permit process, where applicable, and may be more restrictive than State law requires. According to the Alquist-Priolo Earthquake Fault Zoning Act, before a project that is within an earthquake fault zone can be permitted, cities and counties shall require a geologic investigation, prepared by a licensed geologist, to demonstrate that buildings would not be constructed across active faults. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back. Furthermore, unless proven otherwise by an appropriate geologic investigation and report, the area within 50 feet of an active fault is presumed to be underlain by active branches of that fault. The Alquist-Priolo Earthquake Fault Zoning Act and its regulations are presented in California Department of Conservation, California Geological Survey, Special Publications (SP) 42, Fault-rupture Hazard Zones in California.

(b) Seismic Hazards Mapping Act

In order to address the effects of strong ground shaking, liquefaction, landslides, and other ground failures due to seismic events, the State of California passed the Seismic Hazards Mapping Act of 1990 (Public

[1] *The Act was originally entitled the Alquist-Priolo Geologic Hazards Zone Act.*

Resources Code Section 2690-2699). Under the Seismic Hazards Mapping Act, the State Geologist is required to delineate "seismic hazard zones." Cities and counties must regulate certain development projects within these zones until the geologic and soil conditions of the project site are investigated and appropriate mitigation measures, if any, are incorporated into development plans. The State Mining and Geology Board provides additional regulations and policies to assist municipalities in preparing the Safety Element of their General Plan and encourage land use management policies and regulations to reduce and mitigate those hazards to protect public health and safety. Under Public Resources Code Section 2697, cities and counties shall require, prior to the approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard. Each city or county shall submit one copy of each geotechnical report, including mitigation measures, to the State Geologist within 30 days of its approval. Under Public Resources Code Section 2698, nothing is intended to prevent cities and counties from establishing policies and criteria which are stricter than those established by the Mining and Geology Board.

State publications supporting the requirements of the Seismic Hazards Mapping Act include the California Geological Survey SP 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, and SP 118, *Recommended Criteria for Delineating Seismic Hazard Zones in California*. The objectives of SP 117 are to assist in the evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations and to promote uniform and effective statewide implementation of the evaluation and mitigation elements of the Seismic Hazards Mapping Act. SP 118 implements the requirements of the Seismic Hazards Mapping Act in the production of Probabilistic Seismic Hazard Maps for the State.

(c) California Building Code

The California Building Code (also known as the "California Building Standards Code" or CBC) is promulgated under the California Code of Regulations (CCR) (Title 24, Parts 1 through 12) and is administered by the California Building Standards Commission (CBSC). The national model code standards adopted into Title 24 apply to all occupancies in California except for modifications adopted by State agencies and local governing bodies. The CBSC published the 2010 triennial edition in June 2010, which incorporated the 2009 IBC, discussed above, and became effective January 1, 2011. The CBS may be adopted entirely or with revisions by State and local municipalities. The County of Orange adopted entirely and amended the 2010 CBC by Ordinance No. 11-001 on January 25, 2011.

Title 24, as adopted by the County of Orange, sets forth the fire, life safety, and other building related regulations applicable to any structure fit for occupancy statewide for which a building permit is sought. Title 24 establishes general standards for the design and construction of buildings, including provisions related to seismic safety. The CBC provides standards that must be met 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 its jurisdiction. Chapter 18, Soils and Foundations, of the CBC specifies level of soil investigation that is required by law in California. Requirements in Chapter 18 apply to building and foundations systems and consider reduction of potential seismic hazards.

(3) Local

(a) Orange County General Plan

The California Government Code sections 65300 and following, requires general plans to include "a safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides, subsidence and other geologic hazards known to the legislative body; flooding; and wildland and urban fires." As such, the Safety Element is a primary document for identifying hazards which must be considered in the physical development of a jurisdiction. The purpose of the Safety Element is to comprehensively inventory hazards which primarily impact persons and property in the unincorporated areas of Orange County. The Safety Element of the Orange County General Plan contains County policies on identified and potential hazards and safety consideration, their mitigation and implications for development. The Project's consistency with the applicable goals and policies is discussed in the impact analysis below.

(b) City of Yorba Linda General Plan

The City's General Plan contains goals and policies that are relevant to geology and soils in the General Plan Safety Element. The Project's consistency with the applicable goals and policies of the Safety Element is discussed in the impact analysis below.

b. Existing Conditions

The topography of the project site is characterized by moderate to steeply sloping hillsides with three deeply incised southerly and westerly draining canyons along with moderately incised secondary canyons. Elevations range from approximately 560 feet above mean sea level (AMSL) in the southern portions of the project site to approximately 885 feet above AMSL at the highest point in the northern portions of the project site. Previous earthwork has included minor cuts and fills and limited grading for dirt roadways and pads associated with on-site operations that consist of several active oil wells, abandoned oil wells, fuel storage tanks, pipelines, and associated improvements.

(1) Regional Geologic Setting

The project site is located in the southern Puente Hills. The Puente Hills are the foothills of the northwestern portion of the Santa Ana Mountains which are separated from the mountain range by the Santa Ana River. The Puente Hills and Santa Ana Mountains form the eastern boundary of the larger Los Angeles Basin within the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are generally characterized by regional northwest trending mountain ranges, intervening valleys, and multiple sub-parallel fault systems. The major and currently active faults are dominated by right-lateral strike slip motion with local variations.[2]

(2) Local Geologic Setting

The underlying bedrock formation at the project site is a Miocene-age sedimentary bedrock mapped as the Tertiary Puente Formation. The bedrock unit consists of predominately thin to massively bedded sandstone, siltstone, and shale with minor amounts of overlying topsoil and colluvium. Abandoned steam terrace deposits and older alluvial materials are present on some hilltops and hillsides on the project site. These materials are inactive deposits from drainages which have subsequently cut into lower elevations, where they no longer contribute to the deposits. Younger, active alluvial deposits are mapped along canyon

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[2] *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

bottoms. Although the bedrock is moderately hard, thin weak planes along and across the bedding are subject to localized instability within unsupported slopes. Several large-scale landslide areas have been identified in the northwestern portion of the project site. **Figure 4.5-1**, *Preliminary Geologic Map*, illustrates the geologic units within the project site, as well as those areas subject to landslides (Qls).

Review of available literature and maps indicate portions of the Puente Formation bedrock at the project site are highly folded with multiple east-west trending synclines and anticlines, likely due to regional uplift and the close proximity of the Whittier Fault. Bedding generally strikes North-45-West (N45W) to East to West (E-W) with layers dipping both to the north and south between 25 and 75 degrees, with local variations. The folding and variable dip of bedding is observed on both sides of the northwest trending Whittier Fault. Bedrock structure can be expected to be highly weathered and jointed near the surface, especially along ridges, and fresher with depth. Minor cementation and zones of concretions can be expected within the bedrock. Some cementation and zones of concretions localized along bedding flexural-slip and pre-lithification shearing is typical for the formation.[3,4]

Historic high groundwater levels within the project site range from 0 to 30 feet. These levels are reflective of the canyon areas in the southern portion of the site. The groundwater levels fluctuate seasonally owing to rainfall and other factors.

(3) Regional Faults

There are several large active faults in the Southern California region surrounding the project site. The prominent active fault systems are the San Joaquin Hills Thrust Fault, Newport-Inglewood Fault, San Andreas Fault, and the Whittier-Elsinore Fault. The San Joaquin Hills Thrust Fault system extends from San Clemente State Beach to the Santa Ana River. The Newport-Inglewood Fault system extends northwest from a point approximately five miles offshore of Laguna Beach to the Santa Monica Mountains. This fault system is characterized by a series of sub-parallel faults, which exhibit considerable offset with only minor evidence of surface displacement. The San Andreas Fault extends northeast from the Mexican border to Point Arena where it continues offshore before turning to the west in the vicinity of Cape Mendocino. The San Andreas Fault is a major structural feature in California and defines a boundary between the Pacific and North American tectonic plates. Due to the length and complexity of this fault system, it has been divided into sections on the basis of general trend. The southern portion of the fault system, which extends from the Gulf of California to the Transverse Range, is the nearest to the project site. Displacement along this section is right-lateral. The Whittier Fault is the main spur of the Whittier-Elsinore Fault System and extends northwest from the Santa Ana Canyon through the Puente Hills to the Santa Monica Mountains. The Whittier Fault system is a right-lateral reverse fault that dips to the northeast.[5]

(4) Local Faults

The dominant structural feature of the project site is the presence of the Whittier Fault trace. This right lateral strike-slip fault has greatly influenced the development of the regional geomorphic landforms. The Whittier Fault, which is considered to be active by the State of California, crosses the central portion of the

[3] *Ibid.*

[4] *Geologic and Geotechnical Evaluation, prepared by Pacific Soils Engineering, Inc., dated June 8, 2006.*

[5] *Saddle Crest Homes Draft Environmental Impact Report, prepared by ESA, dated April 2012.*

project site in a northwest orientation, as identified on the regional seismic hazard maps. A fault that has ruptured within the Holocene, approximately the last 11,000 years, is considered active. The State of California Fault-Rupture Hazard Zone (i.e., Alquist-Priolo Special Studies Zone) identified for the Whittier Fault trace within the project site is approximately 1,000 feet wide.[6] As identified in the Geotechnical Feasibility Study, the Whittier Fault trace was identified as being located along the mid-point of the Whittier Fault Zone.[7] The fault trace is approximately 1,600 feet long within the project site traversing in a northwest-southeast direction. Figure 4.5-1 illustrates the location of the fault zone and fault trace per the Fault-Rupture Hazard Map.

(5) Site Soils

According to the Geotechnical Feasibility Study, the soils underlying the project site consist of artificial fill, topsoil/colluvium, alluvium, terrace deposits, and landslide debris. Brief descriptions of the underlying soils within the project site are set forth below, from youngest to oldest.[8]

Artificial Fill – Undocumented. Minor amounts of undocumented artificial fill were observed in various locations throughout the project site as associated with the existing dirt roads and oil derrick pads. The material was observed to be up to several feet thick and was likely derived from onsite soils.

Topsoil/Colluvium. Topsoil at the project site generally consists of one to three-foot-thick dark brown, silty sand with clay. This unit mantles most of the project site except for the steeper canyon sides, and is typically porous with roots and desiccation cracks. Colluvium is a residual soil derived from accumulation of slopewash and deep weathering of onsite terrace materials and bedrock. It generally consists of gray to dark brown, clayey residuum and scattered clasts of sandstone, commonly with abundant carbonate stringers.

Quaternary Alluvium (Map Symbol: Qal). Quaternary alluvial deposits at the project site are generally observed within the lower portions of the drainages. These deposits typically consist of dark brown to light brown, unconsolidated, loose mixtures of sand, silt, and clay with scattered pebbles and cobbles. The alluvium is expected to be up to approximately ten feet thick in minor drainages, and as thick as approximately 20 feet in major drainages.

Quaternary Terrace Deposits (Map Symbol: Qt). The non-marine Terrace Deposits at the project site are interpreted to be abandoned deposits of the Santa Ana River that currently flows to the south of the project site. The material consists of moderately consolidated sands, silts, and clays.

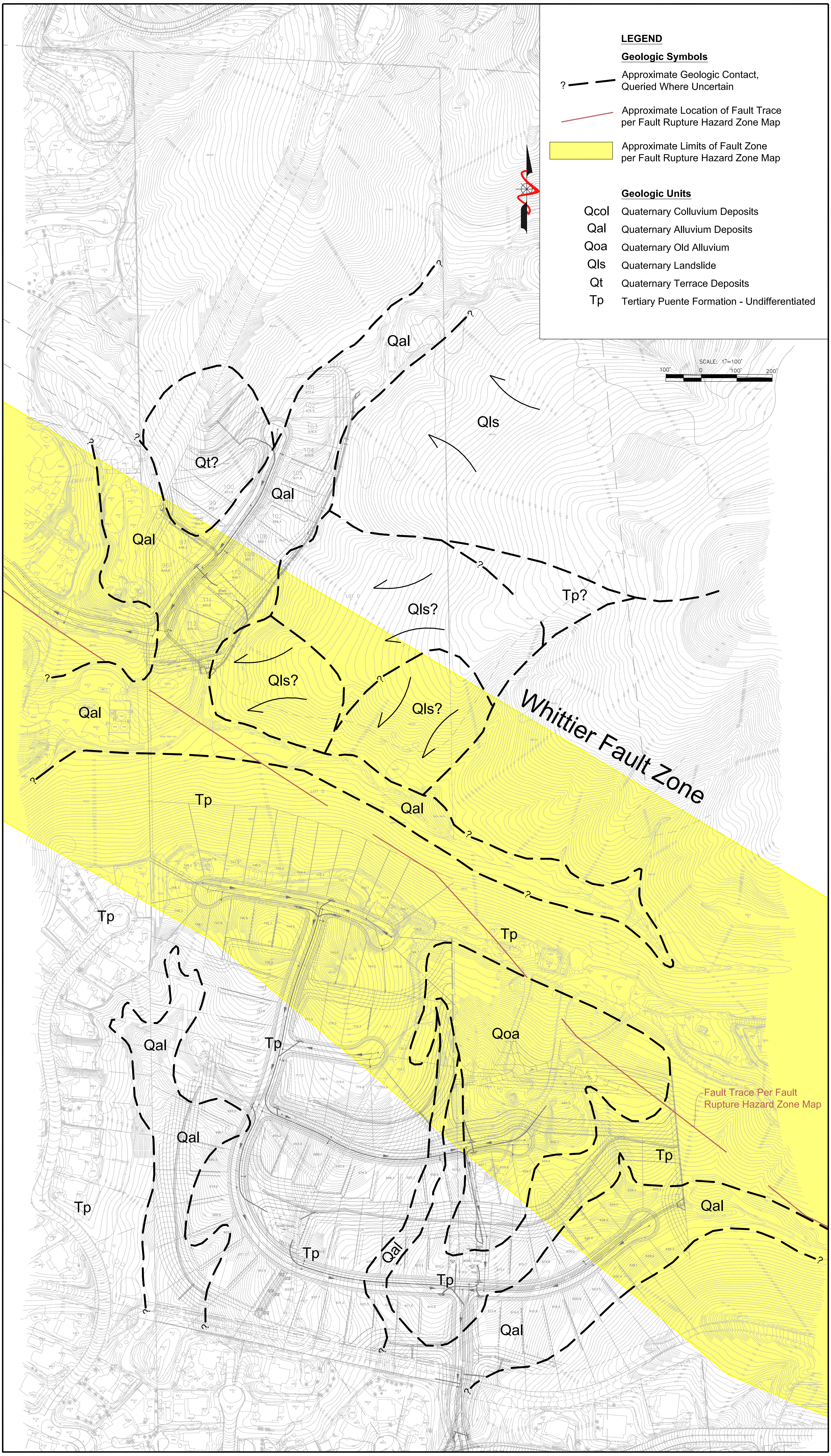
Quaternary Landslide (Map Symbol: Qls). The landslides identified on the regional maps are shown as large block features with steep surface expression and vertically extensive limits. The landslides are derived from the onsite bedrock, the Puente Formation. Smaller, surficial landslides and shallow failures, not depicted on regional maps, can be expected at local hillside areas throughout the project site.

Tertiary Puente Formation (Map Symbol: Tp). The Tertiary Puente Formation has several members, and two of them are mapped within the limits of the project site. The Yorba Member of the Puente Formation is noted north of the Whittier Fault on regional maps of the area, and the Sycamore Canyon Member of the Puente Formation is noted south of the Whittier Fault. The members are not significantly different within

[6] *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

[7] *The Whittier Fault Zone is mapped on the State of California Special Studies Zone Map, Yorba Linda Quadrangle, January 1980.*

[8] *Ibid.*



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Preliminary Geologic Map

Cielo Vista Project

Source: LGC Geotechnical, Inc., 2013.

FIGURE 4.5-1

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the project area. The Puente Formation onsite has been described as light yellowish brown, massive to thinly interbedded fine-grained sandstone, brownish gray to dark gray siltstone with zones of platy shale and pebble conglomerate. The material can be dry to moist and dense to very dense. Variable materials such as clay lenses and concretions are typical. The formation can be tightly folded and exhibits signs of along bedding flexural slip within zones of folding, plus minor, tight, pre-lithification shears of small offset.

(6) Hazards

The following discussion summarizes the potential for geologic-related hazards to occur on the project site.

(a) Seismic Hazards

Seismicity is the geographic and historical distribution of earthquakes, including their frequency, intensity, and distribution. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking. A common measure of ground motion is the peak ground acceleration (PGA). It is not a measure of total energy of an earthquake, such as the Richter and moment magnitude scales, but rather of how hard the ground shakes in given geographic area. PGA is expressed as the percentage of the acceleration due to gravity (G), which is approximately 980 centimeters per second squared. According to the United States Geological Survey (USGS), the following chart shows the extent of perceived shaking and potential damage associated with a given acceleration:

Acceleration (g)	Perceived Shaking	Potential Damage
< 0.0017	Not felt	None
0.0017 - 0.014	Weak None	None
0.014 - 0.039	Light	None
0.039 - 0.092	Moderate	Very Light
0.092 - 0.18	Strong	Light
0.18 - 0.34	Very Strong	Moderate
0.34 - 0.65	Severe	Moderate to Heavy
0.65 - 1.24	Violent	Heavy
> 1.24	Extreme	Very Heavy

Source: United States Geological Survey. Accessed from website at: http://en.wikipedia.org/wiki/Peak_ground_acceleration. October 2013.

Per the California Building Code, an estimated PGA is determined for a site of proposed construction based on the mapping by the USGS along with detailed analysis as an estimate of anticipated ground shaking for use by the project structural engineer in design of the proposed structures to resist. There is potential for significant ground shaking at the project site during a strong seismic event on the Whittier Fault as well as on the other large active faults in the Southern California region surrounding the project site. According to the Geotechnical Feasibility Study, a maximum probable event could produce a PGA value at the project site of 0.53g.[9]

[9] *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

Research has shown that the Whittier Fault is capable of generating large, infrequent earthquakes. It is estimated that the fault could generate an earthquake of M_W6.0 to 7.2 on the moment magnitude scale (see chart below).[10] The moment magnitude scale is used by seismologists to measure the size of an earthquake in terms of the energy released. This scale is calibrated to, but replaces the more limited Richter magnitude scale. Although similar in the continuum of magnitude values, the scales are calculated differently and the moment magnitude scale does not have the limitations associated with the Richter scale.[11] The following chart shows the extent of earthquake effects in terms of magnitude associated with a given acceleration:

Magnitude	Description	Potential Damage
Less Than 2.0	Micro	Microearthquakes, not felt, or felt rarely by sensitive people. Recorded by seismographs
2.0 to 2.9	Minor	Felt slightly by some people. No damage to buildings.
3.0 to 3.9	Minor	Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable.
4.0 to 4.9	Light	Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally causes none to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over.
5.0 to 5.9	Moderate	Can cause damage of varying severity to poorly constructed buildings. At most, none to slight damage to all other buildings. Felt by everyone. Casualties range from none to a few.
6.0 to 6.9	Strong	Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly-designed structures receive moderate to severe damage. Felt in wider areas; up to hundreds of miles/kilometers from the epicenter. Strong to violent shaking in epicentral area.
7.0 to 7.9	Major	Causes damage to most buildings, some to partially or completely collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter.
8.9 to 8.9	Great	Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions.
9.0 and greater	Great	Near or at total destruction - severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography.

Source: United States Geological Survey. Accessed from website at: http://en.wikipedia.org/wiki/Richter_magnitude_scale#cite_note-18 October 2013.

(b) Fault Rupture

Surface rupture is displacement of the ground surface by actual fault slip during seismic events. Such rupture often occurs along pre-existing fault traces. As mentioned above, the Whittier Fault, which is considered to be active by the State of California, crosses the central portion of the project site in a northwest orientation. The State of California Fault-Rupture Hazard Zone (i.e., Alquist-Priolo Special Studies Zone)

10 The moment magnitude scale (abbreviated as MMS; denoted as M_W or M)

11 Ibid.

identified for the Whittier Fault trace within the project site is approximately 1,000 feet wide.[12] The fault trace is approximately 1,600 feet long within the project site traversing in a northwest-southeast direction.

(c) Ground Failure

Secondary seismic hazards such as liquefaction generally occur when underlying materials consist of loose saturated cohesionless soils that essentially become liquefied when agitated by significant ground shaking. This subsurface process can lead to near-surface or surface ground failure that can result in property damage and structural failure. Surface ground failures resulting from liquefaction usually take forms such as lateral spreading, flow failures, ground oscillations, sand boils, and/or general loss of bearing strength. According to the Geotechnical Evaluation, a small portion of the project site, along the southern edge, within Blue Mud Canyon has been delineated as having potential for liquefaction due to a possible shallow groundwater table and potential presence of loose cohesionless soils. Figure 7 in the Geotechnical Evaluation (See Appendix E) illustrates the location of the potential liquefaction area. In addition, it is possible the alluvial sediments within the two main canyons that exist within the central and northern portion of the project are also susceptible to liquefaction and seismic settlement.[13]

(d) Landslides/Slope Stability

According to the Geotechnical Feasibility Study and the Geotechnical Evaluation, there is significant information indicating the presence of landslides and other gross slope instability conditions within the project site. The State of California Seismic Hazard Zones Yorba Linda 7.5 Minute Quadrangle map depicts several potential earthquake induced landslide areas within and adjacent to the limits of the project site. A potential ancient landslide complex exists along the primarily northwest facing slope located within the northerly portion of the project site. Additionally, some of the existing natural slopes are relatively steep and may be susceptible to slope stability hazards.[14,15]

(e) Expansive Soils

Soils with shrink-swell or expansive properties typically occur in fine-grained sediments and cause damage through volume changes as a result of a wetting and drying process. Structural damage may occur over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. According to the Geotechnical Feasibility Study and the Geotechnical Evaluation, a large portion of the project site has been mapped as a thinly bedded shale with moderate soil expansion potential. Shale typically contains appreciable amounts of expansive clay that have a medium to high expansion potential when processed and placed as artificial fill. Other potentially expansive soils underlying the project site consist of artificial fill, topsoil/colluvium, alluvium, terrace deposits, and landslide debris.[16,17]

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12 *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

13 *Geologic and Geotechnical Evaluation, prepared by Pacific Soils Engineering, Inc., dated June 8, 2006.*

14 *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

15 *Geologic and Geotechnical Evaluation, prepared by Pacific Soils Engineering, Inc., dated June 8, 2006.*

16 *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

(f) Oil Fields

Oil wells located within the project site, drilled within a portion of the Esperanza Oil Field, are understood to be pumping small volumes of oil from great depth, exceeding 2,000 feet below ground. Apart from the surface mitigation of well heads and potential mitigation of directly adjacent soils, due to the depth of the oil (greater than 2,000 feet below ground) and limited extent to drilling required for the wells, oil wells are not anticipated to affect site geotechnical conditions.[18,19]

2. ENVIRONMENTAL IMPACTS

a. Methodology

This impact analysis is based on the Geotechnical Feasibility Study and the Geotechnical Evaluation, which are both included in Appendix E of this EIR. These reports included the following:

- Review of geologic and geotechnical literature, reports, maps and agency information;
- Interpretation of historic aerial photos of the site and surrounding regions at various dates;
- Geologic field reconnaissance mapping to verify the aerial distribution of earth units and significance of surficial features as compiled from documents, literature and reports reviewed;
- A geophysical survey using non-destruction seismic methods; and
- Development of geotechnical recommendations the Project.

The analysis and findings in the Geotechnical Feasibility Study and the Geotechnical Evaluation serve as the basis for identifying the potential for the Project to result in significant impacts. Determinations of impact significance were established using the thresholds of significance listed in the proceeding section.

b. Thresholds of Significance

Appendix G of the *CEQA Guidelines* and the County of Orange Environmental Analysis Checklist provide thresholds of significance to determine whether a project would have a significant environmental impact regarding geology and soils. Based on the size and scope of the Project and the potential for geology and soils impacts, the thresholds identified below are included for evaluation in this Draft EIR. Please refer to Section 6.0, *Mandatory Findings of Significance*, for a discussion of other issues associated with the evaluation of geology and soils where the characteristics of the Project made it clear that effects would not be significant and further evaluation in this section was not warranted.

Would the Project:

Threshold 1: Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death, involving (refer to Impact Statement 4.5-1):

[17] *Geologic and Geotechnical Evaluation, prepared by Pacific Soils Engineering, Inc., dated June 8, 2006.*

[18] *Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California, prepared by LGC Geotechnical, Inc., dated March 1, 2013.*

[19] *Geologic and Geotechnical Evaluation, prepared by Pacific Soils Engineering, Inc., dated June 8, 2006.*

- Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault,
- Strong seismic ground shaking,
- Seismic-related ground failure, including liquefaction, or
- Landslides;

Threshold 2: Result in substantial soil erosion or the loss of topsoil (refer to Impact Statement 4.5-2);

Threshold 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 (refer to Impact Statement 4.5-1); and

Threshold 4: Be located on expansive soil, as defined in Table 18-1-B of the California Building Code (2010), creating substantial risks to life or property (refer to Impact Statement 4.5-3).

c. Project Design Features

There are no specific Project Design Features (PDFs) that relate to potential geology and soils impacts.

d. Analysis of Project Impacts

SEISMIC AND GEOLOGIC STABILITY HAZARDS

Threshold	Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death, involving: (i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issues by the State Geologist for the area or based on other substantial evidence of a known fault? (ii) Strong seismic ground shaking? (iii) Seismic-related ground failure, including liquefaction? (iv) Landslides?
Threshold	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?

4.5-1 Implementation of the Project could expose people or structures to fault rupture, strong seismic ground shaking, strong seismic-related ground failure, liquefaction, landslides and other ground failure hazards. However, compliance with applicable regulatory requirements and implementation of the prescribed mitigation measure would reduce potentially significant impacts in these regards to a less than significant level.

(1) Fault Rupture

As shown in Figure 4.5-1, the Whittier Fault crosses the central portion of the project site in a northwest orientation. The State of California Fault-Rupture Hazard Zone (i.e., Alquist-Priolo Special Studies Zone) delineated for the Whittier Fault Zone within the project site is approximately 1,000 feet wide. The Whittier Fault trace is approximately 1,600 feet long within the project site, and traverses through the central portion of the site in a northwest-southeast direction. The Alquist-Priolo Earthquake Fault Zoning Act prohibits the construction of buildings for human occupancy across the trace of a known fault and structures intended for human occupancy must be set back a minimum of 50 feet from the fault trace. As currently shown on the site plan for the Project, while some residential lots are proposed within the fault rupture hazard zone, potential residential structures would be located at a distance of greater than approximately 100 feet from the Whittier Fault trace, which is consistent with the requirements of the Alquist Priolo 50-foot setback requirement. As discussed in the Existing Conditions section above, the Whittier Fault trace was identified as being located along the mid-point of the Whittier Fault Zone. However, as the specific location of the fault trace has not been determined at this time, impacts regarding fault rupture are conservatively considered to be potentially significant. To address this potentially significant impact, Mitigation Measure 4.5-1has been prescribed. Mitigation Measure 4.5-1 requires the Project to prepare a final site specific, design-level geotechnical report prepared by a California-licensed professional geologist and geotechnical engineer to the County for review and approval prior to the issuance of grading permits. Per Mitigation Measure 4.5-1, as part of the preparation of the site specific, design-level geotechnical report, a subsurface investigation consisting of boring and trenching activities within the project site would be conducted to identify the specific Whittier Fault trace location. The fault trace would be mapped and shown in the design-level geotechnical report. Based on the specific location of the fault trace, the Project's proposed residences would be set back a minimum of 50 feet from the fault trace (per Alquist-Priolo Earthquake Fault Zoning Act) or as otherwise determined appropriate in accordance with applicable regulatory requirements. With implementation of Mitigation Measure 4.5-1, the potentially significant impacts regarding fault rupture would be reduced to a less than significant level.

(2) Seismic Ground Shaking

As indicated in the Existing Conditions section above, the Project is located in a seismically active region. There is potential for significant ground shaking at the project site during a strong seismic event on the Whittier Fault and other active regional faults in the Southern California area. According to the Geotechnical Feasibility Study, based on the location of the Whittier Fault (within the project site) and other faults in the region, the design PGA calculated in accordance with the requirements of the California Building Code is 0.53g. This is a relatively high acceleration do to the close proximity of the fault. If this relatively high ground acceleration was not considered in the design and construction phase, ground shaking at this intensity could result in significant damage to buildings and improvements associated with Project implementation. This is considered to be a potentially significant impact. The County of Orange requires that all new construction meet or exceed the County ordinances and policies including those within the County of Orange Building Regulations, the County of Orange Development Code, County Grading Ordinance, and the latest standards of the 2010 CBC for construction in seismic hazard zones, which requires structural design that can accommodate maximum ground accelerations expected from known faults. Further, the Project would comply with the California Geological Survey (CGS) *Special Publications 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California*, which provides guidance for evaluation and mitigation of earthquake-related hazards. While the Project would be required to comply with applicable seismic-related regulatory requirements, implementation of Mitigation Measure 4.5-1 would further ensure that potentially significant seismic-related groundshaking impacts would be reduced to a less than significant level. As part of the design-level geotechnical report that would be prepared for the Project pursuant to Mitigation Measure 4.5-1, final design recommendations and parameters for the walls, foundations, foundation slabs, and surrounding related improvements including roadways, sidewalks, and utilities would be developed for the Project. Implementation of the design parameters and recommendations would reduce the potential for significant damage to structures resulting from strong seismic ground shaking and the exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, to the maximum extent practical. With implementation of Mitigation Measure 4.5-1 and compliance to applicable regulatory requirements (e.g. Orange County Grading Ordinance, CBC, etc.), potentially significant seismic-related impacts would be reduced to a less than significant level.

(3) Ground Failure

According to the Geotechnical Evaluation, a small portion of the project site, near the southwest corner, within Blue Mud Canyon has been delineated as having potential for liquefaction. Figure 7 in the Geotechnical Evaluation (See Appendix E) illustrates the location of the potential liquefaction area. In addition, it is possible the alluvial sediments within the two main canyons that exist within the central and northern portion of the project site are also susceptible to liquefaction and seismic settlement. Liquefaction, as well as other ground failure hazards such as lateral spreading, flow failures, ground oscillations, sand boils, and/or general loss of bearing strength can lead to near-surface or surface ground failure that can result in property damage and structural failure. Should any structures be located in areas potentially susceptible to ground failure hazards, a potentially significant impact would occur. However, the Project would comply with the California Geological Survey (CGS) *Special Publications 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California*, which provides guidance for evaluation and mitigation of earthquake-related hazards, including liquefaction. In addition, the Project would comply with current State and local building and safety codes, including other CGS requirements, the CBC, the County of Orange Building Regulations, and the County of Orange Development Code. Moreover, implementation of Mitigation Measure 4.5-1 would further ensure that potentially significant liquefaction and other related potential ground failure hazard impacts would be reduced to a less than significant level. As part of the design-level geotechnical report that would be prepared for the Project pursuant to Mitigation Measure 4.5-1, final design recommendations and parameters would be identified, as appropriate, which may include, but not limited to, overexcavation/recompaction, ground modification, increase of overburden stresses through embankment construction, foundation design, and/or combinations of those techniques. Implementation of the design parameters and recommendations would reduce the potential for significant liquefaction and other ground failure hazard impacts to structure and people, including the risk of loss, injury, or death, to the maximum extent feasible. As such, less than significant impacts regarding liquefaction and other ground failure hazards would occur with implementation of the prescribed mitigation measure and compliance with applicable regulatory requirements.

(4) Landslides/Slope Stability

As discussed in the Existing Conditions section above, there is significant information indicating the presence of landslides and other gross slope instability conditions within the northern portion of the project site to the east of Planning Area 2. Figure 4.5-1 illustrates the of the landslide areas (Qls). In recognition of these potential hazards, the Project's proposed grading is presently planned to avoid most areas suspected to be underlain by landslides or susceptible to slope stability hazards. **Figure 2-9**, *Conceptual Grading Plan* and **Figure 2-10**, *Grading Cut and Fill*, in Section 2.0, *Project Description*, illustrate the Project's proposed grading activities. As shown in Figure 4.5-1, the residential lots within Planning Area 2 would generally avoid the Qls geologic units. The Project's grading activities would be conducted in compliance with applicable regulatory requirements pertaining to grading, including the County's Grading Ordinance. Compliance with the applicable regulatory requirements would be expected to minimize the potential for landslide and slope stability hazards. Nonetheless, Mitigation Measure 4.5-1 has been prescribed for the Project to address potentially significant landslide/slope stability hazards.

As part of the implementation of Mitigation Measure 4.5-1, which requires a design-level geotechnical report, the stability of the existing and proposed slopes would be confirmed. If areas of development are proposed near or within suspected landslide areas, the design-level geotechnical report is to include a stability analysis consisting of down-hole logging of large-diameter borings in the areas of suspected landslides and other areas of potential slope stability issues to characterize the slopes and engineering analysis to determine what, if any, stabilization measures are necessary. Similarly, assessment of the stability of cut and fill and natural slopes during design would be required to conform to state and local agency requirements. In general, cut slopes that expose landslide or out-of-slope or neutral bedding conditions would be subject to design-level recommendations. In cases where cut slopes expose into-slope bedding conditions, a replacement fill may be appropriate to reduce the potential for surficial stability concerns and/or to provide a more suitable soils condition for desired landscaping. Stability of any natural slope ascending or descending from planned development areas would also be subject to design-level recommendations.

For potential global and local slope failures, a factor of safety for slope stability of equal to or greater than 1.5 and 1.1 for static and seismic loading conditions, respectively, is the generally accepted minimum for new residential construction.[20] Where existing and/or proposed slopes are found to have a factor of safety lower than these minimum requirements, the slopes would either need to be setback from or mitigation methods implemented to improve the stability of the slopes to these minimum levels. Slopes to remain with less than the minimum factor of safety must be sufficiently setback so that at the location of the proposed residential structures, at least the minimum required factor of slope stability safety is achieved. Potential methods of mitigation against slope stability issues related to potentially unstable existing and proposed slopes, including existing landslides, would typically include partial or complete landslide removal, excavation and construction of earthen buttresses, and/or shear keys. Landslide removal requirements, the locations, depths, widths, and lengths of the buttresses/shear keys would be determined via geotechnical investigation and analysis during the design phase of the project and confirmed during site grading.

Overall, the Project's design-level geotechnical report prescribed in Mitigation Measure 4.5-1 would address these geotechnical issues such that potentially significant impacts regarding landslides and slope stability would be reduced to a less than significant level. This mitigation measure requires a site specific design level geotechnical investigation to ensure that the project site is fully stabilized and completed after grading of the developed areas and residential pads in preparation for construction. This includes precise mapping of the fault trace so that a sufficient safe distance is provided for residences. Additionally, boring and testing would determine slope stability as well as the presence of expansive soils. The project site would be remediated pursuant to the County Grading Code and foundation and structures would be designed to meet Building Code requirements to ensure the safety of the physical site and structures for future residents.

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[20] *Please refer to the Geotechnical Feasibility Study in Appendix E of this EIR for details regarding the seismic design values applicable to the Project.*

Mitigation Measure

Mitigation Measure 4.5-1 Prior to the issuance of grading permits unless noted as otherwise below, the Project Applicant/developer shall submit a final site specific, design-level geotechnical investigation prepared by a California-licensed professional engineering geologist and geotechnical engineer to the County of Orange Public Works Manager, Subdivision and Grading, or his/her designee and the County's registered geotechnical engineer or third-party registered engineer for review, approval and implementation pursuant to the final site specific, design-level geotechnical investigation as outlined below. The investigation shall comply with all applicable State and local code requirements, including the current building code in effect at the time of grading permit issuance, and:

a) Prior to recordation of the final map, the geotechnical evaluation shall identify the Whittier Fault trace location, orientation, and frequency of activity by subsurface investigations consisting of boring and trenching activities. The fault trace shall be mapped and based on the specific location of the fault trace, the Project's proposed residences shall be set back from the fault trace in accordance with State setback requirements. The investigation and report shall comply with the Alquist-Priolo Earthquake Fault Zone Act.

b) Include a stability analysis consisting of down-hole logging of large-diameter borings in the areas of suspected landslides and other areas of potential slope stability issues to characterize the slopes and engineering analysis to determine what, if any, stabilization measures are necessary. For potential global and local slope failures, a factor of safety for slope stability of equal to or greater than 1.5 and 1.1 for static and seismic loading conditions, respectively, is the generally accepted minimum for new residential construction. Where existing and/or proposed slopes are found to have a factor of safety lower than these minimum requirements, the slopes shall either need to be setback from or mitigation methods implemented to improve the stability of the slopes to these minimum levels. Slopes with less than the minimum factor of safety must be sufficiently setback so that at the location of the proposed residential structures, at least the minimum required factor of safety is achieved. Potential methods of mitigation against slope stability issues related to potentially unstable existing and proposed slopes, including existing landslides, typically include partial or complete landslide removal, excavation and construction of earthen buttresses, and/or shear keys. Landslide removal requirements, the locations, depths, widths, and lengths of the buttresses/shear keys shall be determined via geotechnical investigation and analysis during the design phase of the Project and confirmed during site grading.

c) Conduct representative sampling and laboratory expansion testing of the onsite soils to identify the locations of on-site expansive soils. Where expansive soils are found, site-specific design criteria (i.e., foundation design parameters) and remedial grading techniques (i.e., primarily removal, moisture conditions and recompaction of unsuitable soils) shall be identified in the design-level geotechnical report to remove expansive soils that could create geotechnical stability hazards to the Project.

d) Determine structural design requirements as prescribed by the most current version of the California Building Code, including applicable County amendments, to ensure that structures and infrastructure can withstand ground accelerations expected from known active faults.

Project plans for foundation design, earthwork, and site preparation shall incorporate all of the mitigations in the site-specific investigations. The County's registered geotechnical engineer shall review the site-specific investigations, provide any additional necessary measures to meet Building Code requirements, and incorporate all applicable recommendations from the investigation in the design plans and shall ensure that all plans for the Project meet current Building Code requirements.

SOIL EROSION OR THE LOSS OF TOPSOIL

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

4.5-2 Implementation of the Project could result in substantial soil erosion or the loss of topsoil. Compliance with applicable regulatory requirements would ensure impacts in these regards are less than significant.

Soil erosion refers to the process by which soil or earth material is loosened or dissolved and removed from its original location. Erosion can occur by varying processes and may occur in the project area where bare soil is exposed to wind or moving water (both rainfall and surface runoff). The processes of erosion are generally a function of material type, terrain steepness, rainfall or irrigation levels, surface drainage conditions, and general land uses. During construction, approximately 48 acres of the project site would be subject to ground-disturbing activities (e.g., removal of the existing vegetation, excavation and grading, foundation and infrastructure construction, the installation of utilities). These activities would expose soils for a limited time, allowing for possible erosion.

Although Project construction activities have the potential to result in the erosion of soils, this potential would be reduced by implementation of standard erosion control measures imposed during site preparation and grading activities. For instance, the Project would be subject to all existing regulations associated with the protection of water quality. Construction activities would be carried out in accordance with the requirements of the National Pollutant Discharge Elimination System (NPDES) General Construction Permit issued by the Regional Water Quality Control Board (RWQCB) and in accordance with the Project's Storm Water Pollution Prevention Plan (SWPPP). The SWPPP would incorporate Best Management Practices (BMPs) in accordance with the County of Orange regulations to control erosion during the Project's construction period. BMPs could include, but are not limited to, water bars, silt fences, staked straw bales, development of and adherence to the construction SWPPP, avoidance of water bodies during construction, and development of and adherence to erosion and sediment control BMPs. Section 4.8, *Hydrology and Water Quality*, includes a detailed discussion of the applicable regulatory requirements and the Project's consistency with such requirements. Section 4.8 identifies PDF 8-1 to ensure that the Project's construction activities implement erosion control features and practices that conform to applicable regulatory requirements. Implementation of a SWPPP and associated BMPs consistent with applicable regulatory requirements and implementation of PDF 8-1 would ensure that soil erosion or loss of topsoil impacts from construction activities are less than significant.

Project Design Features (PDFs) and BMPs included in the Project's Water Quality Management Plan (WQMP), as described in detail in Section 4.8 of this EIR, would be implemented to ensure that potential development erosion and runoff impacts remain less than significant. For instance, stormwater generated by the Project would be contained on-site within stormwater detention basins. Additionally, on-site soils would be stabilized with either established existing native vegetation, structures/paving materials, or landscaping, which would minimize the potential for substantial on-site erosion to occur. On hillsides, established native vegetation would be retained where practical, and native vegetation would be hydro-seeded on manufactured hillsides. Moreover, on-site hillsides would be regularly inspected for visible soil erosion, and bare areas would be revegetated and stabilized until a root system is firmly established. The Cielo Vista Homeowner Association (HOA) would be formed to own and maintain the open space lands proposed, and any infrastructure that would not be accepted by the public agencies. Section 4.8 of this EIR identifies BMPs and PDFs to ensure that Project operation implements erosion control features and practices that conform to applicable regulatory requirements. Implementation of applicable PDFs and BMPs in the WQMP and compliance with applicable regulatory and permit requirements mentioned above would ensure that impacts related to erosion and topsoil loss during long-term operation of the Project are less than significant.

Mitigation Measures

Refer to BMPs and PDFs in Section 4.8, *Hydrology and Water Quality*. No mitigation measures are necessary.

EXPANSIVE SOILS

Threshold	Would the project be located on expansive soil, as defined in Table 18-1-B of the California Building Code (2010), creating substantial risks to life or property?

4.5-3 Implementation of the Project could expose people or property to substantial risks associated with expansive soils. Implementation of the prescribed mitigation measure would reduce potentially significant impacts in this regard to a less than significant level.

Soils with shrink-swell or expansive properties typically occur in fine-grained sediments and cause damage through volume changes as a result of a wetting and drying process. Structural damage may occur over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. According to the Geotechnical Feasibility Study and the Geotechnical Evaluation, a large portion of the project site has been mapped as a thinly bedded shale with moderate soil expansion potential. Shale typically contains appreciable amounts of expansive clay that have a medium to high expansion potential when processed and placed as artificial fill. Other potentially expansive soils underlying the project site consist of artificial fill, topsoil/colluvium, alluvium, terrace deposits, and landslide debris. Given that on-site soils include expansive characteristics, impacts in this regard are determined to be potentially significant. As part of the implementation of Mitigation Measure 4.5-1, which requires a design-level geotechnical report, representative sampling and laboratory expansion testing of the onsite soils would be performed to identify the locations of on-site expansive soils. Where expansive soils are found, site-specific design criteria (i.e., foundation design parameters) and remedial grading techniques (i.e., primarily removal, moisture conditions and recompaction of unsuitable soils) would be identified and implemented per the design-level geotechnical report to minimize the potential for risks due to expansive soils. Therefore, the Project's potentially significant impacts with regards to expansive soil would be reduced to a less than significant level with implementation of the prescribed mitigation measure.

Mitigation Measures

Refer to Mitigation Measure 4.5-1. No additional mitigation measures are necessary.

CONSISTENCY WITH COUNTY OF ORANGE AND CITY OF YORBA LINDA PLANS AND POLICIES

(1) County of Orange General Plan

The County's General Plan contains a goals and policies that are relevant to geology and soils, which are presented in the General Plan Safety Element. As discussed below in **Table 4.5-1**, *Project Consistency with Orange County General Plan*, the Project would be consistent with the applicable goals and policies of the County of Orange General Plan pertaining to geology and soils.

Table 4.5-1

Project Consistency with Orange County General Plan

Goals, Objectives and Policies	Project Consistency
Safety Element	
Public Safety	
Goal 1 Provide for a safe living and working environment consistent with available resources.	**Consistent.** As discussed above, there is the potential for geologic hazards such as those relating to slope stability/landslides, earthquakes, and fault rupture, to occur within the project site. However, compliance with applicable regulatory requirements and implementation of the prescribed mitigation measure would reduce potentially significant impacts regarding natural hazards to a less than significant level. As such, a safe living environment would be provided by the Project.
Objective 1.1 To identify natural hazards and determine the relative threat to people and property in Orange County.	**Consistent.** Please refer to response for Goal 1 above.
Goal 2 Minimize the effects of natural safety hazards through implementation of appropriate regulations and standards which maximize protection of life and property.	**Consistent.** Please refer to response for Goal 1 above.
Objective 2.1 To create and maintain plans and programs which mitigate the effects of natural hazards.	**Consistent.** Please refer to response for Goal 1 above.
Source PCR Services Corporation, 2013.	

(2) City of Yorba Linda General Plan

The City's General Plan contains goals and policies that are relevant to geology and soils in the General Plan Safety Element. As discussed below in **Table 4.5-2**, *Project Consistency with Yorba Linda General Plan*, the Project would be potentially consistent with the applicable goals and policies of the City of Yorba Linda General Plan pertaining to geology and soils. The notation of "Potentially Consistent" is in deference to the City's authority for making such determinations for projects located within the city limits.

Table 4.5-2

Project Consistency with Yorba Linda General Plan

Goals, Objectives and Policies	Project Consistency
Safety Element	
Goal 1 Protect the community from hazards associated with geologic instability, seismic hazards. **Policy 1.1** Require review of soil and geologic conditions to determine stability and relate to development decisions, especially in regard to type of use, size of facility, and ease of evacuation of occupants.	**Potentially Consistent.** The Whittier Fault crosses the central portion of the project site in a northwest direction with the fault trace being approximately 1,000 feet long (see Figure 4.5-1). The Project's site specific, design level geotechnical report would determine the limits of the fault trace to ensure that habitable structures are not located within 50 feet of the fault's center line and as such, not subject to damage from seismic ground shaking and fault rupture (refer to Mitigation Measure 4.5-1). A small portion of the project site, near the southwest corner, within the Blue Mud Canyon area, has been delineated as having potential for liquefaction. Figure 7 in the Geotechnical Evaluation (See Appendix E) illustrates the location of the potential liquefaction area. The area near the two main canyons within the central and northern portion of the project site is also potentially subject to liquefaction and resultant ground failure. Design level parameters to address liquefaction can include over-excavating/recompaction, ground modification, increase of overburden stresses through embankment construction, and foundation design to be determined in the project's design level geotechnical report. Areas of the project site are subject to landslides and slope instability (see Figure 4.5-1). The design level geotechnical report would assess techniques such as use of a replacement fill to reduce the potential for surficial stability with down-hole logging of larger diameter borings to assist with characterizing conditions and the required engineering solutions.
Policy 1.3 Provide standards and requirements for grading and construction to mitigate the potential for landslides and seismic hazards.	**Potentially Consistent.** In addition to meeting fault trace setback requirements and in establishing setbacks or soil remediation from areas subject to ground failure and landslides, the Project would comply with the most recent requirements of the 2010 California Building Code, the City Grading and Building Codes, as well as the California Geologic Survey Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

Table 4.5-2 (Continued)

Project Consistency with Yorba Linda General Plan

Goals, Objectives and Policies	Project Consistency
Policy 1.6 Prohibit the location of habitable facilities within an Alquist-Priolo Special Study Zone (APSSZ) or within 50 feet of either side of the centerline of an active or potentially active fault.	**Potentially Consistent.** No habitable structures are proposed to be placed within these areas. Please see response to Policy 1.1.
Source PCR Services Corporation, 2013.	

3. CUMULATIVE IMPACTS

4.5-4 The Project combined with the related projects would not result in substantial adverse effects related to geology and soils in the project area. Thus, cumulative geology and soils impacts would be less than significant.

The geographic scope for considering cumulative impacts related to geology and soils can be generally considered as the entire County of Orange. However, due to widely varying conditions on a site-by-site basis, the impacts related to geology and soils are generally site specific as there is typically minimal, if any, cumulative relationship between the development of a project and development within a larger cumulative area. As discussed above, the project site is located within a seismically active area, with the Whittier Fault traversing the central portion in a northwest to southeast orientation. All areas of the County are subject to potential effects of seismic activity associated with one or more active regional faults. Therefore, past, present, and future development projects (including the Esperanza Hills Project), all share similar seismic hazards. However, each project would be constructed in accordance with the CBC, which contains seismic design criteria, and relevant City and County ordinances and policies for construction in seismic hazard zones. In addition, projects would comply with project-specific geotechnical recommendations by certified geologists and geotechnical engineers. While there would be some level of seismic risk for all related projects, project-specific geotechnical evaluations and compliance with relevant seismic design criteria and regulations would ensure that such risks are reduced to the extent feasible, and as such cumulative impacts due to seismic risk are considered less than significant. For the Project, compliance with applicable regulations and implementation of Mitigation Measure 4.5-1, would ensure that seismic risks are reduced to the extent feasible, and therefore, the Project's contribution to seismic risk would be less than significant and not cumulatively considerable.

Additionally, implementation of site specific SWPPPs and BMPs, required of all development projects that would disturb at least one acre, would reduce soil erosion or loss of topsoil from the project sites. All planned projects in the vicinity of the Project, including the Esperanza Hills Project) are subject to review under separate environmental documents that would require compliance to the local grading and building code requirements, which provide mitigation of erosion and seismic hazards to less than significant levels. With implementation of existing regulatory requirements, the Project would not substantially contribute to cumulative impacts regarding seismic hazards or related seismic events.

Development of the project site would have geotechnical conditions and constraints similar to other planned projects in the area, including the Esperanza Hills project site. Furthermore, similar geologic conditions exist in undeveloped areas and in most hillside areas of the County and Southern California. The primary geotechnical constraints that require mitigation are seismic-shaking fault rupture, slope stability, landslides, lateral spreading, subsidence, liquefaction hazards, soil expansion, and erosion. With regards to the adjacent Esperanza Hills site, there are geologic units subject to landslides (Qls) (refer to Figure 4.5-1) to the east of Planning Area 2 within the Esperanza Hills site. In general, mitigation of these potential hazards is through commonly performed and widely accepted construction methods practiced through building and/or grading code compliance within the County of Orange (generally similar to those previously discussed above for the Project), as well as development of site-specific design-level geotechnical evaluations, when necessary. With implementation of these mitigation methods and compliance to applicable regulatory requirements similar to those required for the Project, significant geologic hazards, including landslide-related hazards, would not occur to either the Cielo Vista or Esperanza Hills site. Overall, with implementation of Mitigation Measure 4.5-1 and compliance with applicable regulatory requirements, the Project would not substantially contribute to a significant cumulative impact.

4. REFERENCES

LGC Geotechnical, Inc., Geotechnical Feasibility Study Proposed Development of Tentative Tract Map No. 17341, County of Orange, California. March 1, 2013.

Pacific Soils Engineering, Inc. *Geologic and Geotechnical Evaluation.* June 8, 2006.