2.5. Geology and Soils

This section addresses potential impacts to geology and soils impacts may result from construction and/or operation of the Safari Highlands Ranch (SHR) project. The following discussion addresses existing geology and soils conditions of the affected environment, evaluates the SHR project's consistency with applicable goals and policies, identifies and analyzes environmental impacts, and recommends measures to reduce or avoid adverse impacts anticipated from implementation of the SHR project, as applicable.

The analysis in this section is largely based on a geologic reconnaissance report prepared by Geocon, Inc. (2014) and peer reviewed by Ninyo & Moore. The report is included in its entirety in **Appendix 2.5**.

The table below summarizes the geology and soils impacts detailed in **Section 2.5.4**.

Summary of Geology and Soils Impacts

Threshold Number	Issue	Determination	Mitigation Measures	Impact After Mitigation
1a	Rupture of Known Earthquake Faults	Less than Significant Impact	None required	Less than Significant Impact
1b	Strong Seismic Ground Shaking	Less than Significant Impact	None required	Less than Significant Impact
1c	Seismic-Related Ground Failure	Less than Significant Impact	None required	Less than Significant Impact
1d	Landslides	Less than Significant Impact	None required	Less than Significant Impact
2	Soil Erosion or Loss of Topsoil	Less than Significant Impact	None required	Less than Significant Impact
3	Unstable Geologic Unit or Soil	Less than Significant Impact	None Required	Less than Significant Impact
4	Expansive Soil	Less than Significant Impact	None required	Less than Significant Impact
5	Septic Tanks	No Impact	None required	No Impact

2.5.1. Existing Conditions

Geologic Setting

The following section describes the location and existing geologic conditions for the proposed on-site development and off-site infrastructure improvements with respect to local and regional geology.

Regional Geology

The proposed project site is located in northeastern San Diego County. The county is located along the Pacific Rim, an area characterized by island arcs with subduction zones forming mountain ranges and deep oceanic trenches, active volcanoes, and earthquakes. The US Geological Survey (USGS) defines a subduction zone as any area where one lithospheric plate sinks under another (Escondido 2012).

Four general rock types are found in San Diego County: (1) Cretaceous Age crystalline and Upper Jurassic metavolcanics; (2) Mesozoic Age metamorphic rocks; (3) Tertiary Age sedimentary rocks; and (4) recent alluvium.

Local Geology

The project site is located in the Peninsular Ranges geomorphic province of Southern California. This geomorphic province encompasses an area that extends 900 miles from the Transverse Ranges and the Los Angeles Basin south to the tip of Baja California. In general, the province consists of rugged mountains composed of Mesozoic igneous and metamorphic rocks to the east and a dissected coastal plain on Cenozoic sediments to the west. The province varies in width from approximately 30 to 100 miles and is traversed by a group of faults and fault zones trending roughly northwest (Geocon 2014, page 6; **Appendix 2.5**).

Locally, the project site is located in the inland foothills and valleys of San Diego County. Topographical elements on-site consist of a rolling hills, rock outcroppings, and steep topography dissected by drainage courses that drain primarily to the southwest. On-site elevations range from approximately 400 feet above mean sea level (amsl) to 1,800 feet amsl.

Soils and Geologic Conditions

Geologic Conditions

The geologic conditions exposed on the property consist of crystalline igneous rocks of the Southern California Batholith (granodiorite and tonalite), metamorphic rocks, alluvium, and topsoil/colluvium. Although some of these units may not be encountered during grading, they are described herein to characterize the general geologic conditions. They are listed below in order of increasing age.

Topsoil/Colluvium (Unmapped). Topsoil consisting of loose, silty to clayey sand with occasional gravel typically covers most of the geologic formations at an average thickness of 1 to 3 feet.

Alluvium (Qal). Alluvial soils were mapped during the field reconnaissance performed in May 2014 and are most prevalent in the major drainages. These deposits may contain large amounts of cobble and boulders, especially in the larger drainages, and may be surrounded by a matrix of fine-grained sand, silt, and clay.

Granitic Rock (Klw), Cretaceous-age granitic rock consisting of the Lake Wohlford granodiorite is present in the northern half of the property and underlies the surficial and alluvial units at depth. This rock is anticipated to have a variable weathering pattern ranging from completely weathered decomposed granite to outcrops of fresh, extremely strong, hard rock that will require blasting to excavate. Portions of the granite that are deeply weathered contain corestones and floater boulders that will require special handling and/or secondary breaking in order to be properly placed in fill areas. In other areas, the granite consists of solid knobs, ribs, and ledges.

Igneous and Metamorphic Rock, Undifferentiated (Ki/Km). Granitic (igneous) rock and metamorphic rock were observed at multiple locations throughout the southern portion of the property (and have been undifferentiated for the purpose of the geotechnical report). The Cretaceous-age granitic formations identified include the Lake Wohlford granodiorite (Klw) and Japatul Valley tonalite (Kjv), both containing leucocratic dikes. Additionally, Cretaceous-age metamorphosed volcanic rock (Kmw, Western metavolcanic rocks) and metamorphosed silica granite were observed at isolated locations in the southern half of the property. Localized zones of contact metamorphism were noted in the rock as well. The metamorphic rock was generally less weathered than the granite and decomposes to a more clayey soil.

Soils

The US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey characterizes the surficial on-site soil as Cieneba very rocky coarse sandy loam, Cieneba-Fallbrook rocky sandy loams, Vista coarse sandy loam, Vista rocky coarse sandy loam, and Visalia sandy loam (NRCS 2016). **Table 2.5-1** discusses the characteristics of the soils properties found on-site.

Table 2.5-1. Soil Properties Summary

Soil Name	Description	Surface Texture	Drainage	Permeability	Clay Percentage	Shrink-Swell Potential
Cieneba Series (Cieneba and Cieneba-Fallbrook)	The Cieneba series consists of very shallow and shallow, somewhat excessively drained soils that formed in material weathered from granitic rock. Cieneba soils are on hills and mountains and have slopes of 9 to 85 percent. The mean annual precipitation is about 635 mm (25 inches), and the mean annual air temperature is about 16 degrees C (60 degrees F).	Very rocky coarse sandy loam; coarse sandy loam	Somewhat excessively drained	Moderately rapid in the soil and much slower in the weathered bedrock	<18 percent	Low
Vista Series (Vista coarse sandy loam and Vista rocky coarse loam)	The Vista series consists of moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks. Vista soils are on hills and mountainous uplands and have slopes of 2 to 85 percent. The mean annual precipitation is about 40 cm (16 inches), and the mean annual air temperature is about 17 degrees C (62 degrees F).	Coarse sandy loam; rocky coarse sandy loam	Well drained	Moderately rapid	<18 percent	Low
Visalia Series (Visalia sandy loam)	Visalia series consist of recent alluvial outwash from granitic materials in the hills and mountains to the east and have 0 to 2 percent slopes.	Sandy loam	Well drained	Rapid	<18 percent	Low

Source: NRCS 2016
Note: mm = millimeters; cm = centimeters; F = Fahrenheit; C = Celsius

Collapsible and Expansive Soils

Soil permeability is the property of the soil to transmit water and air. The more permeable the soil, the greater the seepage (FAO 2006), resulting in higher rates of infiltration. Pore size and number of pores closely relate to soil texture and structure, and also influence permeability (FAO 2006). Soils that transmit water faster (such as sandy soils) and have higher permeability have less shrink-swell potential because less water retention occurs with these types of soils.

Conversely, soils that transmit water at a slower rate (such as soils with high clay content) have lower permeability and therefore higher shrink-swell potential and the potential for significant expansion. Expansive clay minerals include smectite, bentonite, montmorillonite, beidellite, vermiculite, attapulgite, nontronite, illite, and chlorite. When structures are located on expansive soils, foundations have the tendency to rise during the wet season and shrink during the dry season. This movement can create new stresses on various sections of the foundation and connected utilities and can lead to structural failure and damage to infrastructure. Swelling soils may cause cracked foundations, floors, and basement walls. Damage to the upper floors of a building can occur when motion in the structure is significant. As shown in **Tables 2.5-1** and **2.5-2**, the soils found on the project site have low shrink-swell potential.

Table 2.5-2. Criteria for Rating Shrink-Swell Potential of Soils

Factors Affecting Shrink-Swell Potential	Shrink-Swell Potential		
	Low	Moderate	High
Amount of Clay and Predominant Clay Mineral	0–18 percent clay and any clay mineral	18 to 35 percent mixed clays	More than 35 percent mixed clays

Source: USDA 1973

Subsidence refers to the sudden sinking or gradual downward settling and compaction of soil and other surface material with little or no horizontal motion. It may be caused by a variety of human and natural activities, including earthquakes. The underlying geologic formations in the city are mostly granitic and therefore have very low potential for subsidence (Escondido 2012).

Faults and Seismicity

Ground Shaking

Ground shaking is the earthquake effect that produces the vast majority of damage. Several factors control how ground motion interacts with structures, making the hazard of ground shaking difficult to predict. Earthquakes, or earthquake-induced landslides, can cause damage near and far from fault lines. The potential damage to public and private buildings and infrastructure can threaten public safety and result in significant economic loss. Ground shaking is the most common effect of earthquakes that adversely affects people, animals, and constructed improvements. Seismic waves propagating through the earth's crust are responsible for the ground vibrations normally felt during an earthquake. Seismic waves can vibrate in any direction and at different frequencies, depending on the frequency content of the earthquake rupture mechanism and the path and material through which the waves are propagating. The earthquake rupture mechanism is the distance from the earthquake source, or epicenter, to an affected site.

The California Building Code (CBC) defines different Seismic Design Categories based on building occupancy type and the severity of the probable earthquake ground motion at the site. The six Seismic Design Categories are designated A through F, with Category A having the least seismic potential and Category F having the highest seismic potential. All of San Diego County, including the project site, is located in Seismic Design Categories E and F. Therefore, buildings on the project site will be required to conform to the CBC's Seismic Design Categories E and F.

Active Faults

The USGS (2016a) defines an active fault as a fault that has had surface displacement within Holocene times (about the last 11,000 years) and therefore is considered more likely to generate a future earthquake. The 1994 Alquist-Priolo Earthquake Fault Zoning Act requires the California State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults that pose a risk of surface ground rupture and to issue appropriate maps in order to mitigate the hazard of surface faulting to structures for human occupancy and to prevent the construction of buildings used for human occupancy on the surface trace of active faults (CGS 2016). Seven known active faults are located within a search radius of 50 miles from the project site (Geocon 2014, page 7; **Appendix 2.5**). The nearest known active fault is the Elsinore fault, located approximately 13 miles northeast of the site, which is the dominant source of potential ground motion in the region. No active faults traverse the project site.

Groundwater

No groundwater was encountered at the surface within on-site drainages during the 2014 site reconnaissance or the field investigation conducted in 2001. However, it is likely that perched groundwater exists within the larger drainages, particularly during the winter/rainy season. Seepage has also been previously observed at two on-site locations within the granitic rock. Additionally, due to joint patterns within the various bedrock units, seeps and springs may occur during the rainy season (Geocon 2014, page 6; **Appendix 2.5**).

It is not uncommon for groundwater or seepage to develop in areas where such conditions did not previously exist. Groundwater elevations are generally dependent upon seasonal precipitation, irrigation, and land use conditions (e.g., building coverage, uses requiring large surface parking areas, undeveloped land, etc.), among other factors, and vary as a result. As it is anticipated that depth to groundwater on the project site will vary seasonally, it is recommended that such conditions be further evaluated as part of the final geotechnical report and considered during final engineering design.

Liquefaction

Liquefaction occurs when loose sand and silt that is saturated with water behaves like a liquid when shaken by an earthquake. Earthquake waves cause water pressures to increase in the sediment and the sand grains to lose contact with each other, causing the sediment to lose strength and behave like a liquid. The soil can lose its ability to support structures, flow down even very gentle slopes, and erupt to the ground surface to form sand boils. Many of these phenomena are accompanied by settlement of the ground surface, usually in uneven patterns that damage buildings, roads, and pipelines (USGS 2016a).

Three factors are required for liquefaction to occur: (1) loose, granular sediment (typically "made" land and beach and stream deposits that are young enough (late Holocene) to be loose); (2) saturation of the sediment by shallow groundwater (water fills the spaces between sand and silt grains); and (3) strong shaking. Liquefaction causes three types of ground failure: lateral spreads, flow failures, and loss of bearing strength. In addition, liquefaction enhances ground settlement and sometimes generates sand boils (fountains of water and sediment emanating from the pressurized liquefied zone). According to the geotechnical study, saturated alluvial deposits (Qal) found on-site may be prone to seismically induced liquefaction (Geocon 2014, page 10; **Appendix 2.5**).

Landslides

A landslide is the downslope movement of soil and/or rock. Landslides can range in speed from very rapid to an imperceptible slow creep. Landslides can be caused by ground shaking from an earthquake or water from rainfall, septic systems, landscaping, or other origins that infiltrate slopes with unstable material. Boulder-strewn hillsides can pose a boulder-rolling hazard from ground shaking, blasting, or a gradual loosening of their contact with the surface.

The likelihood of a landslide depends on an area's geologic formations, topography, ground shaking potential, and human influences. Improper or excessive grading can increase the probability of a landslide. Land alterations such as excavation, placement of fill, removal of vegetative cover, and introduction of water from drainage, irrigation, or septic systems may contribute to the instability of a slope and increase the likelihood of a landslide. Undercutting support at the base of a slope, or adding too much weight to the slope, can also produce a landslide.

The site reconnaissance concluded that no landslides were encountered on-site. Additionally, no landslides are known to exist on the property or at a location that would impact the proposed development (Geocon 2014, page 9; **Appendix 2.5**).

2.5.2. Regulatory Framework

Federal

International Building Code

The International Building Code (IBC) is a model building code developed by the International Code Council and provides the basis for the CBC. The IBC provides minimum standards for building construction to ensure public safety, health, and welfare. Prior to the creation of the IBC, several building codes were used. By the year 2000, the IBC replaced these previous codes. The IBC is updated every 3 years.

Occupational Safety and Health Administration Regulations

Excavation and trenching are among the most hazardous construction activities. The Occupational Safety and Health Administration (OSHA) Excavation and Trenching Standard (29 CFR, Part 1926(P) et seq.) covers requirements for excavation and trenching operations. OSHA requires that all excavations in which employees could potentially be exposed to cave-ins be protected by sloping or benching the sides of the excavation, supporting the sides of the excavation, or placing a shield between the side of the excavation and the work area.

State

California Building Code

The design standards provided in the CBC are largely based upon the IBC. However, the CBC includes the addition of more specific design provisions for structures located within seismic zones, due to geological conditions in California. The provisions of the CBC apply to the construction, alteration, movement, replacement, and/or demolition of all buildings and structures or any appurtenances connected or attached to such buildings or structures throughout California.

California Environmental Quality Act

Primary environmental legislation in California is found in the California Environmental Quality Act (CEQA) and its implementing guidelines (CEQA Guidelines) which require that discretionary projects with the potential to result in adverse effects (or impacts) on the environment undergo environmental review. Adverse environmental impacts are typically mitigated to the extent feasible as a result of the environmental review process, and in accordance with existing laws and regulations. Relative to geology and soils, CEQA requires evaluation of regional, local, and site-specific geological conditions (e.g., seismic activity, soil and slope stability, erosion potential) to determine if the project could create or exacerbate a hazardous condition in the effected environment.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. Passed by the California legislature in 1990, this law was codified in the Public Resources Code (PRC) as Division 2, Chapter 7.8A and became operative in April 1991. The act resulted in a mapping program that is intended to reflect areas with the potential for liquefaction, landslide, strong earth ground shaking, or other earthquake and geologic hazards. The project site does not have an official seismic-hazard zone map (DOC 2016a).

Alquist-Priolo Earthquake Fault Zoning Act

As a result of the 1971 San Fernando earthquake, the California State Legislature passed the Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code Section 2621 et seq.) in 1972. The act provides a mechanism for reducing losses from surface fault rupture on a statewide basis. Specifically, the act requires that proposed developments incorporating tracts of four or more dwelling units investigate the potential for ground rupture within designated Alquist-Priolo Zones. These zones serve as an official notification of the probability of ground rupture during potential earthquake events. Where such zones are designated, no building may be constructed on the line of fault, and before any construction is allowed, a geologic study must be conducted to determine the location of all active fault lines within the zone. In general, local agencies are required to regulate development proposed within such designated fault zones.

Regional

<u>San Diego County Multi-Jurisdictional Hazard Mitigation Plan</u>

The Disaster Mitigation Act of 2000, Public Law 106-390 (Section 322(a–d)), requires that local governments, as a condition of receiving federal disaster mitigation funds, adopt a mitigation plan that describes the process for identifying hazards, vulnerabilities, and risks, identifies and prioritizes mitigation actions, encourages the development of local mitigation, and provides technical support for those efforts. In response to this and the requirements of the California Office of Emergency Services, the County prepared the San Diego County Multi-Jurisdictional Hazard Mitigation Plan (MJHMP). While the City of Escondido cannot prevent natural disasters from occurring, it can reduce and eliminate their effects through well-organized public education and awareness efforts, preparedness, and mitigation set forth in the County's MJHMP.

Local

<u>City of Escondido General Plan</u>

The Community Protection Element addresses seismicity and soils within the city (Escondido 2012). The City aims to avoid new development projects in areas susceptible to erosion and sediment loss and also requires new development projects to complete a City-approved geotechnical study to mitigate any potential geologic or seismic hazards. The following goals and policies are pertinent to the SHR project:

Chapter I. Vision and Purpose

<u>GOAL 7: Minimization of adverse effects to residents, property, and critical facilities caused by geologic and seismic hazards.</u>

Chapter VI. Community Protection

<u>GOAL 7: Minimization of adverse effects to residents, property, and critical facilities caused by geologic and seismic hazards.</u>

Soils and Seismicity Policy 7.1

Regularly review, adopt, and enforce seismic and geologic safety standards, including the Uniform Building Code, in site design and building construction methods to protect public health and safety.

Soils and Seismicity Policy 7.3

Require that development applications in areas where the potential for geologic and seismic hazards exist, such as slopes of 25 percent or greater, submit a site-specific geotechnical analysis prepared by a certified geotechnical engineer to identify potential hazards and recommend measures to avoid or mitigate said hazards (see Resource Conservation Element).

Soils and Seismicity Policy 7.4

Approve new development in areas identified with geologic or seismic hazards only after completion of a City-approved geotechnical report with appropriate mitigation of such hazards.

Soils and Seismicity Policy 7.5

Avoid developing in areas that are susceptible to erosion and sediment loss. Where avoidance is not feasible, require the restoration of natural patterns of surface water runoff after grading to minimize erosion.

City of Escondido Municipal Code

Chapter 6, Article 1 (Section 6-1.2) of the City of Escondido Municipal Code adopts the report and application of the 2013 CBC, Title 24. The purpose of this chapter is to ensure compliance with development standards pursuant to the requirements of Title 24 of the 2013 CBC.

Chapter 22, Article 2 (Section 22-19) establishes regulations related to storm water management and discharge control, harmful waters and wastes, sewer service charges, private sewage disposal systems, sewer connection fees, sewer-connection laterals, and industrial wastewaters.

Chapter 22, Article 5 (Section 22-82) requires all subsurface sewage disposal units and systems to be designed, placed, and maintained in accordance with the rules and regulations of the County of San Diego. The County Department of Environmental Health (DEH) is the primary agency charged with regulating the design, construction, and maintenance of septic tanks, leach lines, seepage pits, and alternative on-site wastewater treatment systems throughout the county through a delegation from the Regional Water Quality Control Board (RWQCB).

Chapter 33, Article 55 (Section 33-1050) establishes the grading and erosion control regulations for Escondido. The purpose of this article is to ensure that development occurs in a manner which protects the natural and topographic character and identity of the environment, visual integrity of hillsides and ridgelines, sensitive species and unique geologic/geographic features, and the health, safety, and welfare of the general public. This article regulates grading on private and public property and includes standards and design criteria to control storm water and erosion during construction activities. The ordinance sets forth rules and regulations to control excavation, grading, earthwork construction (including fills and embankments), and development on hillsides and along ridgelines; establishes the administrative procedures for the issuance of permits; and provides for approval of plans and inspection of grading construction in compliance with storm water management requirements.

2.5.3. Thresholds for Determination of Significance

The City of Escondido Environmental Quality Regulations (Zoning Code Article 47) and Appendix G of the CEQA Guidelines contain analysis guidelines related to the assessment of geology and soils impacts. A project would result in a significant impact if it would:

1. Expose people or structures to potentially substantial adverse effects, including the risk of loss, injury, or death involving:
    a. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. (Refer to Division of Mines and Geology Special Publication 42).
    b. Strong seismic ground shaking.
    c. Seismic-related ground failure, including liquefaction.
    d. Landslides.
2. Result in substantial soil erosion or the loss of topsoil.
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.
4. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.
5. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.

2.5.4. Analysis of Project Effects and Determination of Significance

Threshold 1a: Would the project expose people or structures to potentially 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).

Southern California, including the project site, is subject to the effects of seismic activity because of the active faults that traverse the region. Active faults are defined as those that have experienced surface displacement within Holocene time (approximately the last 11,000 years) and/or are in a state-designated Alquist-Priolo Earthquake Fault Zone. As discussed in **Section 2.5.1, Existing Conditions**, there are no known active faults in the vicinity of the project site, nor are there any Alquist-Priolo Special Earthquake Study Zones on the site. As a result, the potential for fault surface rupture on the site is low (Geocon 2016, page 1; **Appendix 2.5**).

The geological reconnaissance report concluded that the site is not underlain by active, potentially active, or inactive faults (Geocon 2014, page 6; **Appendix 2.5**). Although no active faults traverse the project site, all new development would be required to comply with the requirements of the Alquist-Priolo Fault Zoning Act and the CBC. As discussed, the SHR project is in CBC Seismic Design Category E/F and therefore would require specific design measures, intended to maximize structural stability in the event of an earthquake. CBC requirements address structural seismic safety and include design criteria for seismic loading and other geologic hazards, including design criteria for geologically induced loading that govern sizing of structural members, building supports, and materials, and provide calculation methods to assist in the design process. The CBC includes provisions for buildings to structurally survive an earthquake without collapsing and includes measures such as anchoring to the foundation and structural frame design.

Due to the distance of the nearest fault and magnitude of past seismic activity, the project would neither negate nor supersede the requirements of the Alquist-Priolo Earthquake Fault Zoning Act, nor would the project expose people or structures to potentially substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, as delineated on the current Alquist-Priolo Earthquake Fault Zoning Map. Therefore, impacts would be **less than significant**.

Threshold 1b: Would the project expose people or structures to potentially substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking?

Southern California has numerous active seismic faults subjecting people to potential earthquake- and seismic-related hazards. Seismic activity poses two types of potential hazards for people and structures, categorized as either primary or secondary hazards. Primary hazards include ground rupture, ground shaking, ground displacement, subsidence, and uplift from earth movement. Secondary hazards include ground failure (lurch cracking, lateral spreading, and slope failure), liquefaction, water waves (seiches), movement on nearby faults (sympathetic fault movement), dam failure, and fires.

The project site is located in a seismically active area and could experience ground shaking associated with an earthquake along nearby faults, including the Elsinore fault located approximately 13 miles from the site, Newport-Englewood fault located approximately 21 miles from the site, and Rose Canyon fault located approximately 21 miles from the site (Geocon 2014, page 7; **Appendix 2.5**). Geocon used a computer program known as EZ-FRISK to perform a probabilistic seismic hazard analysis. The EZ-FRISK computer program operates under the assumption that the occurrence rate of earthquakes on each mappable Quaternary fault is proportional to the fault's slip rate. The program accounts for fault rupture length as a function of earthquake magnitude, and site acceleration estimates are made using the earthquake magnitude and distance from the site to the rupture zone.

The program also accounts for uncertainty in each of following: (1) earthquake magnitude, (2) rupture length for a given magnitude, (3) location of the rupture zone, (4) maximum possible magnitude of a given earthquake, and (5) acceleration at the site from a given earthquake along each fault. By calculating the expected accelerations from considered earthquake sources, the program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value. **Table 2.5-3** shows the site-specific probabilistic seismic hazard parameters including acceleration-attenuation relationships and the probability of exceedance.

Table 2.5-3. Probabilistic Seismic Hazard Parameters

Probability of Exceedance	Peak Ground Acceleration		
	Boore-Atkinson, 2007 (g)	**Campbell-Bozorgnia, 2008 (g)**	**Chiou-Youngs, 2008 (g)**
2% in a 50-Year Period	0.42	0.41	0.48
5% in a 50-Year Period	0.31	0.30	0.34
10% in a 50-Year Period	0.24	0.23	0.25

Source: Geocon 2014; **Appendix 2.5**

To better understand what **Table 2.5-3** illustrates, 2 percent exceedance in a 50-year period can be used as an example. As shown in **Table 2.5-3**, there is estimated to be a 2 percent probability of exceedance in 50 years for ground motions (measured as peak ground acceleration, or PGA) at the project site. In other words, there is a 98 percent chance that the ground motions (expressed as PGA in **Table 2.5-3**) will not be exceeded in the next 50 years. Similarly, for the 5 percent in a 50-year period, it is estimated that there is a 95 percent chance that the ground motions (expressed as PGA in **Table 2.5-3**) will not be exceeded in the next 50 years. These percentages can be translated to mean that the probability of lower magnitude earthquakes increases at the project site, with a lower probability of higher magnitude earthquakes occurring. This probability level allows engineers to design buildings for larger ground motions than what is estimated to occur during a 50-year interval, which will make buildings safer than if they were only designed for the ground motions expected to occur in the next 50 years (CGS 2016).

In addition, the California Geological Survey (CGS) has a program that calculates the ground motion with a 10 percent probability of exceedance in 50 years based on an average of several attenuation relationships. **Table 2.5-4** shows the calculated results from the Probabilistic Seismic Hazards Mapping Ground Motion Page from the CGS website (Geocon 2014, page 8; **Appendix 2.5**). As shown in **Table 2.5-4**, the soil and rock types found on-site have the potential to result in moderate to severe ground motion.

Table 2.5-4. Probabilistic Seismic Parameters for Selected Faults

Calculated Acceleration (g) Firm Rock	Calculated Acceleration (g) Soft Rock	Calculated Acceleration (g) Alluvium
0.29	0.31	0.34

Source: Geocon 2014

The project site is likely to be subjected to strong ground motion from seismic activity similar to that of the rest of the San Diego County and Southern California, due to the seismic activity of the region as a whole. Regardless of the seismic activity anticipated to occur on-site, the project would be designed in accordance with CBC requirements that address structural seismic safety. All new development would be required to comply with the CBC, which includes design criteria for seismic loading and other geologic hazards. Specifically, the SHR project would be required to meet development design measures specific to Seismic Design Category E/F intended to maximize structural stability in the event of an earthquake. These measures include design criteria for geologically induced loading that govern sizing of structural members and provide calculation methods to assist in the design process. Thus, while shaking impacts would be potentially damaging, they would also tend to be reduced in their structural effects due to CBC criteria that recognize this potential. The CBC includes provisions for buildings to structurally survive an earthquake without collapsing and includes measures such as anchoring to the foundation and structural frame design.

Project conformance with CBC and local requirements relative to grading and construction would ensure that the project does not result in exposure of people or structures to potentially substantial adverse effects involving strong seismic ground shaking. Therefore, impacts would be **less than significant**.

Threshold 1c: Would the project expose people or structures to potentially substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction?

Liquefaction typically occurs primarily in saturated, loose, fine to medium-grained soils in areas where the groundwater table is generally 50 feet or less below the surface. When these sediments are shaken during an earthquake, a sudden increase in pore water pressure can cause the soils to lose strength and behave as a liquid. There may be a potential for liquefaction in areas with loose sandy soils combined with a shallow groundwater table, which typically are located in alluvial river valleys/basins and floodplains. According to the geotechnical study, shallow groundwater is found within the alluvial deposits on-site (Geocon 2014, page 10; **Appendix 2.5**); consequently, there is a potential for liquefaction to occur in these areas.

The project applicant will be required to demonstrate to planning, engineering, and building staff that the recommendations of the geotechnical study have been incorporated into the project design and that the proposed project complies with all applicable requirements of the CBC. Therefore, adherence to CBC and local requirements, and the incorporation of engineering design outlined in the geotechnical report (Geocon 2014; **Appendix 2.5**), will ensure that the project does not result in exposure of people or structures to potentially substantial adverse effects involving seismic-related ground failure, including liquefaction. Impacts would be **less than significant**.

Threshold 1d: Would the project expose people or structures to potentially substantial adverse effects, including the risk of loss, injury, or death involving landslides?

Non-seismically-induced landslides can be caused by water from rainfall, septic systems, landscaping, or other origins that infiltrate slopes with unstable material. Boulder-strewn hillsides can pose a boulder rolling hazard from blasting or a gradual loosening of their contact with the surface. According to Figure VI-9 in the City of Escondido General Plan (2012), the project site is not located in a landslide hazard area. Additionally, site reconnaissance conducted by Geocon concluded that no landslides were encountered on-site and none are known to exist on the property or at a location that would impact the proposed development (Geocon 2014, page 9; **Appendix 2.5**). Therefore, impacts would be **less than significant**.

Threshold 2: Would the project result in substantial soil erosion or the loss of topsoil?

Soil erosion may result during construction of the proposed project, as grading and construction can loosen surface soils and make soils susceptible to the effects of wind and water movement across the surface; however, all construction activities related to the proposed project would be subject to compliance with the CBC. Additionally, all development associated with the project would be subject to compliance with the requirements set forth in the National Pollutant Discharge Elimination System (NPDES) Storm Water General Construction Permit (Order No. 2009-0009-DWQ) for construction activities (discussed in further detail in **Section 2.8, Hydrology and Water Quality**, of this EIR). Compliance with the CBC and the NPDES would minimize effects from erosion and ensure consistency with San Diego Regional Water Quality Control Board requirements, which establish water quality standards for the groundwater and surface water of the region.

Prior to grading plan approval, the project applicant will be required to comply with Escondido Municipal Code Chapter 22, Article 2, Stormwater Management and Discharge Control, which establishes requirements for stormwater and non-stormwater quality discharge and control that require new development or redevelopment projects to control stormwater runoff by implementing appropriate best management practices (BMPs) to prevent deterioration of water quality. The displacement of soil through cut and fill will be controlled by Chapter 33 of the 2013 CBC relating to grading and excavation, other applicable building regulations, and standard construction techniques.

A stormwater pollution prevention plan (SWPPP) is required as part of the grading permit submittal package. The SWPPP will provide a schedule for the implementation and maintenance of erosion control measures, and a description of the erosion control measures, including appropriate design details, to be implemented during the construction phase. The SWPPP would consider the full range of erosion control BMPs with consideration for any additional site-specific and seasonal conditions, as appropriate.

Erosion control BMPs include but are not limited to the application of straw mulch, hydroseeding, the use of geotextiles, plastic covers, silt fences, and erosion control blankets, as well as construction site entrance/outlet tire washing. The State General Permit also requires that those implementing SWPPPs meet prerequisite qualifications that demonstrate the skills, knowledge, and experience necessary to implement those plans. NPDES requirements would substantially reduce the potential for erosion or topsoil loss to occur in association with new development. Water quality features intended to reduce construction-related erosion impacts will be clearly noted on the grading plans for implementation by the construction contractor.

The potential for erosion to occur during project construction would be minimized by limiting certain construction activities to dry weather, covering exposed excavated dirt during periods of rain, and protecting excavated areas from flooding with temporary berms. As a result, the project would comply with required erosion and runoff control measures included as part of the approval of a grading plan. With conformance to applicable federal, state, and local regulations, and implementation of appropriate BMPs, the project would not result in substantial soil erosion or the loss of topsoil. Impacts would be **less than significant**.

Threshold 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?

Refer also to Threshold 1, above. Subsidence refers to the sudden sinking or gradual downward settling and compaction of soil and other surface material with little or no horizontal motion. Subsidence may be caused by a variety of human and natural activities, including earthquakes. The geotechnical study did not identify any issues associated with subsidence at the proposed project site.

The project site is currently undeveloped. According to the geotechnical study (see **Appendix 2.5**), the subject property is underlain at depth by Cretaceous-age granitic bedrock. Surficial deposits consist of colluvium and alluvium. Topsoil, colluvium, and alluvium are considered unsuitable for development. The major soil types encountered are classified per the NRCS, as discussed in **Section 2.5.1, Existing Conditions**.

Grading quantities for the project are estimated at 4,625,930 cubic yards of soil that would be redistributed within the project site. The site has no known history of landslide, lateral spreading, subsidence, liquefaction, or collapse occurring on-site. Proper placement and compaction of backfill and adherence to CBC guidelines would minimize the risk of unstable soil conditions at the project site. The project is also required to adhere to Article 55, Grading and Erosion Control (Chapter 33, Zoning, of the Escondido Municipal Code). A grading exemption discretionary permit is required for the project in accordance with the Escondido Municipal Code, Article 55, Grading and Erosion Control, Section 33-1066, Design Criteria, subsection (b), because the project proposes cut slopes greater than 20 feet in height and fill slopes greater than 10 feet in height. All proposed manufactured slopes would be landscaped with drought-tolerant vegetation, requiring minimal landscape irrigation. Slope areas would be designed to ensure proper drainage and would be maintained to reduce the potential for erosion to occur (**Figure 1-2A, Illustrative Site Plan**).

Additionally, soil stability can also be affected by near-surface groundwater. According to the geotechnical study, no groundwater was observed at the surface within the on-site drainages; however, it is likely that perched groundwater exists within the larger drainages, especially during the winter/rainy season, as noted previously. In general, saturated soils resulting from groundwater seepage may have the potential to become unstable.

However, the project site would be graded and the areas underlying the building pads would be soil engineered in accordance with the recommendations of the design-level geotechnical study conducted by Geocon (2014) (**Appendix 2.5**) and the requirements of the CBC. Compliance with the requirements of the CBC ensures a more rigorous seismic design and construction to provide an acceptable risk to the public and better seismic resistance, thereby reducing impacts associated with unstable soils. Therefore, in combination with the above discussion of planned grading and landscaping to avoid soil erosion, implementation of these other practices would ensure that proposed structures are located on stable soils and geologic units and would not be susceptible to settlement or ground failure. Impacts would be **less than significant**.

Threshold 4: Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to large uplifting forces caused by the swelling. Without proper measures taken, heaving and cracking of both building foundations and slabs-on-grade could result. Primary soil types found on-site have relatively rapid permeability rates due to low clay content; therefore, are not expected to have high expansion potential.

The project would comply with the design standards in found in Chapter 18, Soils and Foundation, of the CBC, which includes requirements for development consistent with the conditions found on the project site and are based on a very low expansion potential for the supporting material. Additionally, the City evaluates each foundation plan separately using information from the building permit and the site-specific soils analysis. Further, although Geocon did not perform laboratory testing for expansive soils, it was their opinion that on-site soils will not pose a risk to life or property upon the completion of the project (Geocon 2016, page 1; **Appendix 2.5**). Based on on-site conditions and design measures specific to Seismic Design Categories E/F, as outlined in the CBC, impacts associated with expansive soils would be **less than significant**.

Threshold 5: Would the project have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?

The project site will be connected to public sewer lines and septic disposal is not proposed. As such, development on the project site will not require use of septic tanks or septic systems **No impact** would occur.

2.5.5. Sources Cited

CGS (California Geological Survey). 2002. Note 32, How Earthquakes and Their Effects Are Measured. Sacramento: CGS. http://www.conservation.ca.gov/cgs/information/publications/cgs_notes/note_32/Documents/note_32.pdf.

———. 2016. Probabilistic Seismic Hazard Analysis. Accessed May 2016. http://www.conservation.ca.gov/cgs/rghm/psha/Pages/Index.aspx.

Christenson, Gary E. 1994. *Earthquake Ground Shaking in Utah*. http://files.geology.utah.gov/online/pdf/pi-29.pdf.

DOC (California Department of Conservation). 2016a. Regulatory Maps Portal. Accessed February 2016. http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.

———. 2016b. Seismic Hazards Zonation Program. Accessed February 2016. http://gmw.consrv.ca.gov/shmp/MapProcessor.asp?Action=IMap&Location=SoCal&FClass=County&FID=San%20Bernardino&Liq=true&Land=true&Road=true&City=false.

Escondido, City of. 2012. *General Plan*. https://www.escondido.org/general-plan.aspx.

FAO (Food and Agriculture Organization of the United Nations). 2006. Soil Permeability. Accessed February 2016. ftp://ftp.fao.org/fi/CDrom/FAO_Training/FAO_Training/General/x6706e/x6706e09.htm.

Geocon, Inc. 2014. *Geologic Reconnaissance*. Appendix 2.5

———. 2016. Response to Third Party Peer Review, Safari Highlands Ranch, San Diego, California. May 25.

NRCS (Natural Resources Conservation Service). 2016. Web Soil Survey. Accessed February 2016. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

USDA (US Department of Agriculture). 1973. *Soil Survey, San Diego Area, California, Part 1*. https://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/california/CA638/0/part1.pdf.

USGS (US Geological Survey). 2016a. USGS website. Accessed February 2016. http://www.usgs.gov/.

———. 2016b. The Modified Mercalli Intensity Scale. Accessed May 2016. http://earthquake.usgs.gov/learn/topics/mercalli.php.

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