IV. ENVIRONMENTAL IMPACT ANALYSIS

G. GEOLOGY AND SOILS

INTRODUCTION

The information and analysis in this section is based primarily on the following report, which is included in Appendix IV.G of this EIR:

- *Preliminary Geotechnical Evaluation for Garrett Ranch, City of Hemet, Riverside County, California,* GeoTek, August 16, 2006.

ENVIRONMENTAL SETTING

Regulatory Setting

State

California Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (the "Act") was signed into state law in 1972, as amended, with its primary purpose to mitigate the hazard of fault rupture by prohibiting the location of structures for human occupancy across the trace of an active fault. The Act requires the State Geologist to delineate "Earthquake Fault Zones" along faults that are "sufficiently active" and "well defined." The Act also requires that cities and counties withhold development permits for sites within an Earthquake Fault Zone until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. Pursuant to this Act, structures for human occupancy are not allowed within 50 feet of the trace of an active fault.

Seismic Hazard Mapping Act

The Seismic Hazard Mapping Act (SHMA) was adopted by the state in 1990 for the purpose of protecting the public from the effects of non-surface fault rupture earthquake hazards, including strong ground shaking, liquefaction, seismically induced landslides, or other ground failure caused by earthquakes. The goal of the Act is to minimize loss of life and property by identifying and mitigating seismic hazards. The California Geological Survey (CGS) prepares and provides local governments with seismic hazard zones maps that identify areas susceptible to amplified shaking, liquefaction, earthquake-induced landslides, and other ground failures.

California Building Code

Current law states that every local agency enforcing building regulations, such as cities and counties, must adopt the provisions of the California Building Code (CBC) within 180 days of its publication. The California Building Standards Commission establishes the publication date of the CBC, and the code is also known as Title 24 of the California Code of Regulations. The most recent building standard adopted by the legislature and used throughout the state is the 2013 version of the CBC, often with local, more restrictive amendments that are based upon local geographic, topographic, or climatic conditions. These codes provide minimum standards to protect property and the public welfare by regulating the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system height, and seismic zoning for Seismic Zone 4. Seismic ratings are derived from the Uniform Building Code (UBC) specifications, which divide the U.S. into five geographical zones (0 through 4), of which Seismic Zone 4 - comprising most of central, coastal and southern California - is the most prone to earthquake activity.

Natural Hazards Disclosure Act

The Natural Hazards Disclosure Act requires that sellers of real property and their agents provide prospective buyers with a "Natural Hazard Disclosure Statement" when the property being sold lies within one or more state-mapped hazard areas. If a property is located in a Seismic Hazard Zone, as shown on a map issued by the State Geologist, the seller or the seller's agent must disclose this fact to potential buyers. California law also requires that when houses built before 1960 are sold, the seller must give the buyer a completed earthquake hazards disclosure report and a booklet titled "The Homeowners Guide to Earthquake Safety." This publication was written and adopted by the California Seismic Safety Commission.

Local

City of Hemet General Plan

The Hemet General Plan includes policies related to geological and geotechnical impacts. The following are policies contained within the City's General Plan that are relevant to the Project:

PS-1.1 Seismic Standards Strictly enforce the most recent state regulations governing seismic safety and structural design to minimize damage to structures from seismic or geologic hazards.

PS-1.2 Risk Reduction Reduce the risk associated with structures that would likely be seriously damaged during a major earthquake, such as those located in high-risk seismic areas, critical or emergency facilities, and buildings that do not meet current seismic codes through on-site building placement, seismic retrofitting development outside of geologically hazardous zones, and other means.

PS-1.4 Subsidence Encourage and support efforts for long-term, permanent monitoring of topographic subsidence in all producing groundwater basins, irrespective of past subsidence.

Regional Geology

California is divided into "geomorphic provinces," which are distinctive, generally easy-to-recognize natural regions in which the geologic record, types of landforms, pattern of landscape features, and climate in all parts are similar. The project site is located in the Peninsular Ranges Geomorphic Province, which characterizes the southwest portion of Southern California. The Peninsular Ranges geomorphic province extends from the Transverse Ranges to deep within Mexico, passing through the Los Angeles Basin and continuing 775 miles south of the US-Mexico border. The Peninsular Ranges are bounded on the west by the Transverse Ranges and on the east by the Colorado Desert, and include Orange County and the San Jacinto Mountains and the Coachella Valley in the central portion of Riverside County. The ranges are comprised of a series of northwest–southeast trending mountains that are separated by several active faults, including the San Jacinto and Elsinore Fault zones.

The Peninsular Ranges is one of the largest geologic regions in western North America. Its highest elevations are found in the San Jacinto and Santa Rosa Mountains, with San Jacinto Peak reaching 10,805 feet above mean sea level (amsl). The orientation and shape of the Peninsular Ranges is similar to the Sierra Nevada, in that the west slope is gradual and the eastern face is steep and abrupt.

The Peninsular Ranges comprise: Cretaceous-age plutonic rock, that is, igneous rock which solidified deep underground between 144 and 65 million years ago; Jurassic-age (206 to 144 million-year-old) metamorphic rock; lesser amounts of Tertiary-age (65 to 1.8 million-year-old) volcanic and sedimentary rock; and Quaternary-age sediments (less than 1.8 million years old). The Peninsular Ranges are divided into northwest-rending sub-blocks. The Project site is located in the San Jacinto Basin, one of those sub-blocks that has subsided to become a broad valley containing scattered hills. The San Jacinto Basin is surrounded by the San Jacinto Mountains to the east, the San Timoteo Badlands to the north, and the Santa Ana Mountains to the west. The hills mainly consist of Mesozoic igneous and sedimentary rocks, while the valleys are filled with Quaternary alluvium.

Project Site

The Project site is generally flat and ranges in elevation from approximately 1,502 feet amsl in the northern portion of the project site to 1,507 feet amsl in the southern portion. Fifteen exploratory borings were conducted at the Project site. The soil encountered was categorized as older quaternary alluvium. This soil consists of silty sands, clayey sands, and sandy clay. Undocumented fill soils consisting of silty sands may be encountered where construction work has been performed on the site in the past, particularly adjacent to the San Diego Aqueduct. Undocumented fill was not found in any of the exploratory borings.

Seismicity and Seismic Hazards

In general, seismic hazards include ground surface fault rupture, ground motion, liquefaction, settlement, lateral spreading, and seismically-induced slope instabilities. The Project site is located within a seismically active region of California, within the zone of influence of several active and potentially active fault systems. The site is subject to moderate to intense earthquake-induced ground shaking as a result of periodic movement along nearby faults.

Fault Rupture and Ground Shaking

The Alquist-Priolo Earthquake Fault Zoning Act mandates that Fault Rupture Hazard Zones in California be delineated. Under the Urban Seismic Hazards Mapping Act, zones potentially susceptible to the secondary seismic hazards of liquefaction and earthquake-induced landsliding must be identified.

The geologic structure of southern California is dominated by northwest trending faults associated with the San Andreas Fault system. There are no known earthquake faults within the Project site boundaries, and the site is not within an Alquist-Priolo Earthquake Fault Zone. However, the site is located in a seismically active region. Known faults in western Riverside County and their approximate distances and directions from the project site include the following:

- Casa Loma Fault 3.7 miles northeast
- San Jacinto Fault 4.6 miles northeast
- San Andreas Fault 19 miles northeast
- Elsinore Fault 17 miles southwest

The Project site's proximity to the San Jacinto and Elsinore Faults is shown on Figure IV.G-1. Historical earthquakes that have caused sever damage or strong ground shaking in the region are listed on Table IV.G-1.

The southern California region is known to be seismically active. The Uniform Building Code (UBC) designates Seismic Risk Zones for the United States, using a scale from 0 to 4, with Zone 4 being the highest-risk zone. The Project site is located in Seismic Risk Zone 4. When comparing the sizes of earthquakes, the most meaningful feature is the amount of energy released. The amount of energy released by an earthquake determines the amplitude of the waves that the earthquake generates. The Richter scale is a logarithmic scale of the amplitude of earthquake waves as measured at a specific location. Each one-point increase in magnitude represents a tenfold increase in wave amplitude and a 32-fold increase in energy. That is, a magnitude 7 earthquake produces 100 times (10 ×10) the ground motion amplitude of a magnitude 5 earthquake, and releases approximately 1,000 times (32 × 32) more energy. Another measure of earthquake size is the seismic intensity scale, which is a subjective, qualitative assessment of an earthquake's effects at a given location. However, one earthquake will produce many levels of intensity, which varies with the location and the perceptions of the observer.

Legend

Site Boundary

Source: Jennings 1994.

NORTH

Not To Scale

CAJA Environmental Services, LLC

Figure IV.G-1
Fault Map

Table IV.G-1
Selected Historic Earthquakes in the Region

Earthquake	Date	Location	Fault	Magnitude
Wrightwood	December 8, 1812	Near Wrightwood, approximately 54 miles northwest of the Project site	Unknown; possibly San Andreas	7.5
Fort Tejon	January 9, 1857	San Andreas Fault, from Parkfield to Cajon Pass, north and northwest of the Project site	San Andreas	7.9
San Jacinto Fault	December 25, 1899	Southeast of Hemet, approximately 13 miles southeast of the Project site	San Jacinto	6.5
Elsinore	May 15, 1910	Temescal Valley, approximately 34 miles west of the Project site	Elsinore	6.0
San Jacinto	April 21, 1918	San Jacinto, approximately 5 miles northeast of the Project site	San Jacinto	6.8
North San Jacinto Fault	July 22, 1923	Highgrove, approximately 26 miles northwest of the Project site	San Jacinto	6.3
Desert Hot Springs	December 4, 1948	5 miles east of Desert Hot Springs, approximately 39 miles northeast of the Project site	San Andreas	6.0
Landers	June 28, 1992	Landers, approximately 52 miles northeast of the Project site	Several	7.3
Big Bear	June 28, 1992	5 miles southeast of Big Bear Lake, approximately 36 miles northeast of the Project site	Unknown	6.4

Source: Garrett Ranch Specific Plan Draft EIR, 2007.

Fault dimensions and proximity are key factors in any hazard assessment. It is also important to know a fault's style of movement (dip-slip, i.e., vertical movement, or strike-slip, i.e., horizontal movement), the age of its most recent activity, its total displacement, and its slip rate. These values allow an estimation of how often a fault produces damaging earthquakes, and how big an earthquake should be expected the next time the fault ruptures.

The computer program EQFAULT was used to determine the distance to known faults from the Project site and estimate the peak ground acceleration at the project site. The San Jacinto Fault is located approximately 4.6 miles northeast of the Project site and is considered most likely to produce the strongest ground shaking at the site (refer to Figure IV.G-1). A maximum earthquake magnitude of 6.9 was used in the analysis, and the estimated peak ground acceleration at the site would be 0.42 g, where g is the acceleration of gravity.

Liquefaction and Related Ground Failure

Liquefaction is a process whereby strong earthquake shaking causes sediment layers that are saturated with groundwater to lose strength and behave as a fluid. This subsurface process can lead to near-surface or surface ground failure that can result in property damage and structural failure. If surface ground failure does occur, it is usually expressed as lateral spreading, flow failures, ground oscillation, and/or general loss of bearing strength. Sand boils (ejections of fluidized sediment) can commonly accompany these different types of failure.

To determine a region's susceptibility to liquefaction, the following three major factors must be analyzed:

- The intensity and duration of ground shaking.
- The age and texture of the sediments: Generally, younger and less compacted sediments tend to have a higher susceptibility to liquefaction. Sand and silty sands deposited in river channels and floodplains tend to be more susceptible to liquefaction than coarser or finer grained alluvial materials.
- The depth to the groundwater. Groundwater saturation of sediments is required in order for earthquake-induced liquefaction to occur. In general, groundwater depths shallower than 10 feet to the surface can cause the highest liquefaction susceptibility.

Research and historical data indicate that loose, granular materials at depths of less than 50 feet with silt and clay contents of less than 30 percent and saturated by a relatively shallow groundwater table are most susceptible to liquefaction. These geological conditions are typical in parts of southern California, including the City of Hemet, and in valley regions and alluvial floodplains.

The potential for liquefaction on the Project site is considered to be low for two reasons: (1) the relatively dense nature of the site soils, and (2) the lack of shallow groundwater. Of 15 exploratory borings drilled to depths ranging from 15.5 feet to 51.5 feet as a part of the geotechnical investigation, the shallowest depth at which groundwater was encountered was 40 feet below ground surface.

Collapsible Soils

A collapsible soil is one that compacts considerably when the soil is wet, when a load is placed on the soil, or under both conditions. The potential for hydrocollapse was evaluated to be low, that is, less than one percent of soil thickness.

Landslides and Slope Instability

The Project site is generally flat. Evidence of ancient landslides or slope instability was not observed on the project site. Therefore, the potential for landslides is considered to be negligible.

Expansive Soils

Expansive soils shrink or swell as the moisture content decreases or increases. Structures built on these soils may experience shifting, cracking, and breaking damage as soils shrink and subside or expand. Two samples of soil from the Project site were tested for expansion potential as a part of the geotechnical investigation. The expansion indices of the samples were 78 and 79, indicating a medium expansion potential. The California Building Code requires special design considerations for foundations of structures built in soils with expansion indices greater than 20.

ENVIRONMENTAL IMPACT ANALYSIS

Threshold of Significance

In accordance with Appendix G of the CEQA Guidelines, a project could have a significant environmental impact if the project would result in one or more of the following:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

    i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;

    ii) Strong seismic ground-shaking;

    iii) Seismic-related ground failure, including liquefaction; or

    iv) Landslides;

b) Result in substantial soil erosion or the loss of topsoil;

c) 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;

d) 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; or

e) 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.

As discussed in Section IV.A (Impacts Found to be Less Than Significant), the Project would not result in any impacts related to issues “ai, ” “aiv,” and “e.” Thus, no further analysis of these issues is required.

Regarding issue "b," Project impacts related to soil erosion or the loss of topsoil is addressed in Section IV.I (Hydrology and Water Quality).

Project Impacts

Impact IV.G-1: The Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground-shaking, and impacts related to this issue would be less than significant.

The Project site is located within seismically active southern California (Seismic Risk Zone 4, encompassing most of southern California). The nearest fault zone is approximately three miles northeast of the Project site, as shown on Figure IV.G-1. Several earthquakes within historic time have caused strong seismic ground shaking in the Project area, as shown on Table IV.G-1. The computer program EQFAULT was used to determine the distance to known faults from the Project site and to conduct a deterministic estimate of peak ground acceleration at the project site. The San Jacinto Fault is approximately 4.6 miles northeast of the Project site and is considered most likely to produce the strongest ground shaking at the site. A maximum earthquake of magnitude 6.9 was used in the analysis, and the estimated peak ground acceleration at the site would be 0.42 g, where g is the acceleration of gravity.

All development associated with the Project would be required by state law to meet UBC and CBC requirements for structures in Seismic Risk Zone 4. The maximum expected magnitude of an earthquake in this zone is 8.5, and structures built in this zone are required to be designed to withstand an earthquake of this magnitude. Upon compliance with existing laws and UBC requirements, the risk that seismic ground shaking would pose to the Project would be less than significant.

Impact IV.G-2: The Project would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure/geologic/soil instability, and impacts related to this issue would be less than significant.

Liquefaction

Two of the factors that contribute to the risk of liquefaction, poorly compacted sediments and shallow groundwater, were not found to occur on the Project site. According to the geotechnical investigation, site soils are relatively dense and the shallowest depth at which groundwater was encountered in exploratory borings was 40 feet below ground surface. Additionally, according to Figure S-3 (Generalized Liquefaction) of the Riverside County General Plan, the Project site is located in an area of Low Liquefaction Susceptibility. As such, the potential for liquefaction to occur within the Project site is considered to be low. The third factor, strong seismic ground shaking, is potentially present. However, all development associated with the Project would be designed to resist seismic forces in accordance with the criteria and seismic design parameters of the UBC, CBC, and Structural Engineers Association of

California (SEAOC). Compliance with these building design standards would ensure that impacts related to liquefaction would be less than significant.

Collapsible Soils

The potential for hydrocollapse was evaluated as a part of the geotechnical investigation and was found to below, that is, less than one percent of soil thickness. Therefore, hazards associated with the potential for collapsible soils due to development of the Project would be a less than significant impact.

Impact IV.G-3: With implementation of mitigation, the Project would not result in any significant impacts related to expansive soils.

Expansive soils shrink or swell as the moisture content decreases or increases. Two samples of soil from the Project site were tested for expansion potential as a part of the geotechnical investigation. The expansion indices of the samples were 78 and 79, indicating a medium expansion potential. The CBC requires special design considerations for foundations of structures built in soils with expansion indices greater than 20. As such, additional testing of site soils would need to be performed by a registered geotechnical engineer to verify the potential for soil expansion. As mitigation (refer to Mitigation Measure G-1), the developers of individual projects under the Specific Plan would be required to submit a detailed geotechnical investigation report with engineered grading plans that would further evaluate but not be limited to expansive soils, settlement, foundations, grading constraints, and other soil engineering design conditions and provide site-specific recommendations to mitigate these issues/hazards. Compliance with the measures outlined in the Project's preliminary geotechnical investigation (e.g., removal and replacement of near surface soils with engineered fill); the criteria and seismic design parameters of the UBC, CBC, and the SEAOC; and submittal of a detailed geotechnical investigation report would ensure that impacts related to expansive soils would be less than significant.

CUMULATIVE IMPACTS

Impacts relating to soils and geologic influences are site specific and generally cannot be considered in cumulative terms. Mitigation of geologic, seismic, and soil impacts associated with the related projects would be specific to each site. Compliance with modern building standards, such as the UBC, CBC and SEAOC, serves to ensure that seismic-related impacts would be less than significant. Therefore, no cumulatively considerable impacts related to soils and geology would occur.

MITIGATION MEASURES

Because the Project could result in impacts associated with expansive soils, the following mitigation measure is required:

G-1: Prior to issuance of grading permits, a detailed geotechnical investigation report shall be submitted with engineered grading plans to further evaluate expansive soils, and provide site-specific recommendations to mitigate (e.g., removal and replacement of near surface soils with engineered fill) potential hazards as a result of expansive soils in accordance with the criteria and seismic design parameters of the UBC, CBC, and the SEAOC. The geotechnical report shall be prepared and signed/stamped by a Registered Civil Engineer specializing in geotechnical engineering and a Certified Engineering Geologist. The recommendations contained in the geotechnical report shall be implemented by the developer. Geotechnical rough grading plan review reports shall be prepared in accordance with the City of Hemet Grading Ordinance.

LEVEL OF SIGNIFICANCE AFTER MITIGATION

With implementation of Mitigation Measure G-1, impacts related to expansive soils would be less than significant. All other impacts related to geology and soils would be less than significant.