5.8 Geology and Soils

5.8 GEOLOGY AND SOILS

5.8.1 PURPOSE

This section describes the existing geologic, soil, and seismic conditions within the Study Area and provides an analysis of potential impacts associated with implementation of the General Plan Update. Potential impacts are identified and mitigation measures to address potentially significant impacts are recommended, as necessary.

5.8.2 EXISTING REGULATORY SETTING

FEDERAL REGULATIONS

Soil and Water Resources Conservation Act

The purpose of the Soil and Water Resources Conservation Act of 1977 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.

STATE REGULATIONS

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This State law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards.

The 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. Local agencies must regulate most development projects within these zones. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist. 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 from the fault (typically 50 feet setbacks are required).

Effective June 1, 1998, 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, including Earthquake Fault Zones. The City is not affected by a State-designated Alquist-Priolo Earthquake Fault Zone.1

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (SHMA) of 1990 provides a Statewide seismic hazard mapping and technical advisory program to assist cities and counties in fulfilling their responsibilities for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other seismic hazards caused by earthquakes. Mapping and other information generated pursuant to the SHMA is to be made available to local governments for planning and development purposes. The State requires: (1) local governments to incorporate site-specific geotechnical hazard investigations and associated hazard mitigation, as part of the local construction permit approval process; and (2) the agent for a property seller or the seller if acting without an agent, must disclose to any prospective buyer if the property is located within a Seismic Hazard Zone. The State Geologist is responsible for compiling seismic hazard zone maps. The SHMA specifies that the lead agency of a project may withhold development permits until geologic or soils investigations are conducted for specific sites and mitigation measures are incorporated into plans to reduce hazards associated with seismicity and unstable soils.

International Building Code

Development standards require projects to comply with appropriate seismic design criteria in the International Building Code (IBC) (with California Amendments), adequate drainage facility design, and preconstruction soils and grading studies. Seismic design standards have been established to reduce many of the structural problems occurring because of major earthquakes. In 1998, the IBC was revised, as follows:

- Upgrade the level of ground motion used in the seismic design of buildings;
- Add site amplification factors based on local soils conditions; and
- Improve the way ground motion is applied in detailed design.

California Building Code

California building standards are published in the California Code of Regulations Title 24, also known as the CBC. The recently published 2016 CBC took effect January 1, 2017. The CBC, which applies to all applications for building permits, consists of 12 parts, including among others Part 2 - California Building Code and Part 11 - California Green Building Standards Code (CALGreen Code). CBC Part 2 is based upon the 2009 IBC. Local

1 State of California Department of Conservation, *Alquist-Priolo Fault Zone and Seismic Hazard Zone Maps*, http://www.conservation.ca.gov/cgs/rghm/ap/Pages/index.aspx, accessed June 14, 2016.

agencies must ensure that all development complies with the CBC guidelines. Cities and counties have the ability to adopt additional building standards beyond the CBC.

LOCAL

City of Rancho Santa Margarita Municipal Code

The "Building Code of the City of Rancho Santa Margarita" (Building Code) is codified in Title 10, *Buildings and Construction*, of the *Rancho Santa Margarita Municipal Code* (Municipal Code). The City's Building Code adopts the 2016 California Building Code, with amendments. The purpose of the City's Building Code is to establish the minimum requirements necessary to protect the health, safety and general welfare of the occupants and the public by governing accessibility, erection, construction, reconstruction, enlargement, conversion, alteration, repair, moving, removal, demolition, occupancy, use, height, area, sanitation, ventilation, maintenance and safety to life and property from fire and other hazards attributed to the built environment.

City of Rancho Santa Margarita Emergency Operations Plan

The City of Rancho Santa Margarita Emergency Operations Plan (EOP) addresses the planned response to extraordinary emergency situations associated with natural disasters, national security emergencies, and technological incidents affecting the City of Rancho Santa Margarita. The EOP's primary focus is the provision of coordinated mutual aid within the City of Rancho Santa Margarita and fulfilling reporting requirements to the Orange County Operational Area. The EOP also provides an overview of the operational concepts related to various emergency situations, identifies components of the City of Rancho Santa Margarita's emergency response organization, and describes the overall responsibilities of the City in protecting life and property and assuring the overall well-being of the population. The EOP is designed to provide the framework for Rancho Santa Margarita Emergency Operations Center (EOC) operations during incidents requiring the activation and use of the Rancho Santa Margarita EOC. As the EOP establishes the City's policies and procedures for response to emergencies, it identifies authorities and assigns responsibilities for response and recovery activities and supports responders in the field by providing needed resources and works closely with the County level EOC. In addition, the EOP provides a hazard assessment, which consists of information on earthquake severity and the City's risk due to fault lines in the surrounding areas.

City of Rancho Santa Margarita Natural Hazard Mitigation Plan

The City of Rancho Santa Margarita Natural Hazard Mitigation Plan's (HMP) overall intent is to reduce or prevent injury and damage from natural hazards in the City. The HMP serves as a strategic planning tool to guide hazard mitigation activities by establishing hazard mitigation goals and objectives, identifies current mitigation activities, policies and programs, as well as mitigation strategies for the future. The HMP identifies the probability and danger ranking and disaster rating of the hazards affecting the City of Rancho Santa Margarita including earthquake, fire, flood/storm, landslides, drought, dam failure, and vector issues. Earthquakes and fires were assigned the highest disaster rating at nine, flood/storm and landslides were assigned the second highest disaster

rating at six while drought was assigned a lower rating at two, and both dam failure and vector issues were assigned the lowest rating at one. It is noted that a FEMA-approved HMP is required to be updated every five years to maintain grant funding eligibility. The City's HMP was adopted in January 2008 and has since expired. The City anticipates updating the HMP in 2019/2020.

5.8.3 EXISTING ENVIRONMENTAL SETTING

GEOLOGIC AND SEISMIC HAZARDS

Geology

REGIONAL CONDITIONS

Orange County is a geographically diverse area of mountains, hills, flatlands, and shoreline. The City of Rancho Santa Margarita is located in the southeast portion of Orange County, along the foothills of the Santa Ana Mountains. The City is bordered by the cities of Mission Viejo and Lake Forest on the west, the Cleveland National Forest on the east, the unincorporated areas of Coto de Caza and Las Flores on the south, and Trabuco Canyon on the north.

The coastal plain of Los Angeles County and Orange County is bounded by the Santa Ana Mountains, and the areas of Elysian, Repetto, and Puente Hills to the northeast; the Santa Ana Mountains to the southeast; the San Joaquin Hills to the south; and the Pacific Ocean on the west. The primary rivers traversing this coastal plain include the Los Angeles, San Gabriel, Rio Hondo, and Santa Ana rivers. The Rio Hondo River flows in a southwest direction across the coastal plain and merges with the Los Angeles River. The San Gabriel River flows south on the eastern portion of the coastal plain generally parallel to the Los Angeles River. The Santa Ana River originates in the San Bernardino Mountains and traverses through San Bernardino, Riverside, and Orange counties.

The coastal plain of Los Angeles County and Orange County was formed from recent (Holocene) alluvial deposits. The alluvial fans of the Los Angeles, San Gabriel, Rio Hondo, and Santa Ana rivers resulted from the formation of a gently sloping plain through stream deposition.

The portion of the coastal plain within Orange County is underlain by deep structural depression primarily containing sedimentary rocks. The subsurface of the County varies in thickness and lithology due to the rapid rate of deposition of rock units, folding, and faulting. The sedimentary deposits of the coastal plain are a hybrid of marine and continental sediment. A significant amount of the sedimentary deposits have been removed over time due to erosion.

LOCAL CONDITIONS

Topographically, the City of Rancho Santa Margarita lies primarily on a long narrow older river terrace called the Plano Trabuco and consists of a series of low hills along the western drainages, rising to ridges of moderate to steep relief in the northern part of the City and areas east of the City. The land rises and steepens eastward while, across

Trabuco Creek to the north and Tijeras Canyon Creek to the south, the land becomes more rolling and underlain by less stable geologic materials. Elevations range from about 350 feet above mean sea level in the valleys to about 2,400 feet at the highest ridgeline north of the City. Most of the City sits on competent alluvial materials that are less prone to natural hazards than the perimeter portions of the City.

The bedrock units that occur in the City, from oldest to youngest, include tonalite bedrock, Ladd Formation, Williams Formation, Santiago Peak volcanics, Topanga Formation, Santiago Formation, Vaqueros Formation, and Sespe Formation.

Most of Rancho Santa Margarita is underlain by sedimentary units (both bedrock and alluvium) that are composed primarily of granular soils (silty sand, sand, and gravel). Such units are typically in the low to moderately-low range for expansion potential. However, every sedimentary unit in the area contains layers of fine-grained soils that are typically in the moderate to highly expansive range. The areas that are most susceptible to expansive soils are located along the western boundary of the City.

Ground subsidence is the gradual settling or sinking of the ground surface with little or no horizontal movement. Most ground subsidence is man-induced and is usually associated with the extraction of oil, gas, or ground water from below the ground surface in valleys filled with recent alluvium. No regional subsidence as a result of either groundwater pumping or oil extraction has been reported for the Rancho Santa Margarita area.

The City of Rancho Santa Margarita consists of surficial deposits comprised of artificial fill, alluvium, colluvium, landslide debris, and older alluvium or non-marine terrace deposits. Artificial fill occurs throughout the City, along roadways, and as canyon fills. Alluvial (stream-deposited) sediments typically occur in canyons. In the smaller canyons, the alluvium is about 15 feet thick; whereas in larger canyons, such as Trabuco Canyon, the alluvium thickness can be 30 to 40 feet thick. Colluvium is the loose soil and weathered rock debris that typically erodes off ridges and hillsides in response to gravity, and accumulates along the lower flanks and at the base of slopes. Landslides are typical on moderate to steep slopes in the City. Older alluvium is generally comprised of sediments that were deposited more than 11,000 years ago by precursors to the present-day streams (ancestral Trabuco Creek).

Geologic Hazards

Hazards associated with earthquakes include primary seismic hazards, such as strong ground shaking and surface rupture, and secondary seismic hazards, such as liquefaction, lateral spreading, seismically-induced settlement, and landsliding.

FAULT RUPTURE

The Rancho Santa Margarita Study Area is situated in the western part of the Peninsular Ranges province, a region with a characteristic northwest trend to its landforms and to its underlying geologic structures.

Earthquake severity is normally classified according to magnitude (a measure of the amount of energy released when a fault ruptures), and seismic intensity (a qualitative

estimate of the damage caused by an earthquake at a given location). Because the amount of destruction generally decreases with increasing distance away from the epicenter (the point at the Earth's surface directly above where the earthquake originated), earthquakes are assigned several intensities. The most commonly used seismic intensity scale, called the Modified Mercalli Intensity (MMI) scale, has 12 levels of damage. The higher the number, the greater the damage.

The largest earthquake likely to occur on a fault or fault segment is termed the maximum credible (MCE) or characteristic earthquake. Depending on the planned use, lifetime, or importance of a facility, a maximum probable earthquake (MPE) is the earthquake most likely to occur in a specified period of time, (such as 30 to 500 years). In general, the longer the time period between earthquakes on a specific fault segment (recurrence interval), the larger the earthquake. The State of California, under the guidelines of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 classifies faults according to the following criteria:

- *Active:* Faults showing proven displacement of the ground surface within about the last 11,000 years; and

- *Potentially Active:* Faults showing evidence of movement within the last 1.6 million years (modified to 750,000 years by the U.S. Geological Survey).

An earthquake along one of the active or potentially active faults in the vicinity could cause a number of casualties and extensive property damage. The effects of such a quake could be aggravated by aftershocks and secondary effects such as fires, landslides, dam failure, liquefaction, and other threats to public health, safety, and welfare. The potential direct and indirect consequences of a major earthquake would require a high level of self-help, coordination, and cooperation.

California is a seismically active area with numerous faults throughout the region. The City of Rancho Santa Margarita is not listed within a State designated Alquist-Priolo Earthquake Fault Zone.2 According to the City's Natural Hazard Mitigation Plan (HMP), the closest active faults are the Elsinore-Glen Ivy fault (10.1 miles away), the Chino fault (11.1 miles away), and the Newport Inglewood fault (14.4 miles away) and are discussed below. The occurrence of surface rupture on these segments would not be expected to produce fault surface rupture within the City.

Elsinore Fault Zone (Elsinore-Glen Ivy Fault). The Elsinore Fault follows a general line easterly of the Santa Ana Mountains into Mexico. The main trace of the Elsinore Fault zone is approximately 112 miles long. The last major earthquake on this fault occurred in 1910 (magnitude 6.0), and the interval between major ruptures is estimated to be about 250 years. The Southern California Earthquake Center (SCEC) reports probable earthquake magnitudes for the main trace of the Elsinore fault to be in the range of 6.5 to 7.5. At the northern end of the Elsinore Fault zone, the fault splits into two segments: the 25-mile-long Whittier Fault (probable magnitudes between 6.0 and 7.2), and the 25-mile-long Chino Fault (probable magnitudes between 6.0 and 7.0).

2 State of California Department of Conservation, *Alquist-Priolo Fault Zone and Seismic Hazard Zone Maps*, http://www.conservation.ca.gov/cgs/rghm/ap/Pages/index.aspx, accessed June 14, 2016.

Chino Fault. The Chino Fault is a right-reverse fault and is part of the Whittier-Elsinore Fault system which is located northeast of Chino Hills. The fault is approximately 17.4 miles long and extends from the Santa Ana Mountains northwest to the City of Pomona, where it joins the San Jose Fault. The SCEC reports probable earthquake magnitudes for the Chino fault to be in the range of 6.0 to 7.0. The last earthquake reported was on July 29, 2008, with a magnitude of 5.4.

Newport-Inglewood Fault Zone. The Newport-Inglewood Fault extends from the Santa Monica Mountains southeastward through the western part of Orange County to the offshore area near Newport Beach and was the source of the destructive 1933 Long Beach earthquake (magnitude 6.4), which caused 120 deaths and considerable property damage. During the past 60 years, numerous aftershocks ranging from magnitude 3.0 to over 5.0 have been recorded. SCEC reports probable earthquake magnitudes for the Newport-Inglewood fault to be in the range of 6.0 to 7.4.

The two known local faults, Aliso and the Cristianitos, are thought to be inactive and are not zoned under the State's Alquist-Priolo Earthquake Fault Zone Act. An earthquake on either of these two faults would be damaging to residential buildings, particularly those of wood or reinforced masonry construction, and to mobile homes. Other buildings that do not typically perform well in earthquakes are soft-story buildings. These have a story (typically the first floor) that lacks adequate strength or toughness due to too few shear walls.

GROUND SHAKING

Under certain conditions, strong ground shaking can cause the densification of soils, resulting in local or regional settlement of the ground surface. During strong shaking, soil grains become more tightly packed due to the collapse of voids and pore spaces, resulting in a reduction of the thickness of the soil column. This type of ground failure typically occurs in loose granular, cohesionless soils, and can occur in either wet or dry conditions. Unconsolidated young alluvial deposits are especially susceptible to this hazard. Artificial fills may also experience seismically induced settlement. Damage to structures typically occurs as a result of local differential settlements. Those portions of the Study Area that may be susceptible to seismically induced settlement are generally the floodplains and larger drainages that are underlain by late Quaternary alluvial sediments (similar to the liquefaction-susceptible areas below). These include areas in Trabuco Canyon, Live Oak Canyon and especially the flatter areas along these drainages. Also included are the areas along Tijeras Canyon Creek. Sites near the base of natural hills (valley margins) may be particularly vulnerable.

LIQUEFACTION

Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. Liquefaction is caused by a sudden temporary increase in pore water pressure due to seismic densification or other displacement of submerged granular soils. Liquefaction more often occurs in earthquake-prone areas underlain by young (i.e., Holocene age) alluvium where the groundwater table is higher than 50 feet below ground surface.

The California Geological Survey maintains Seismic Hazards Zone Maps (the City is located within the Santiago Peak and Canada Gobernadora Quadrangles) that depict seismic hazards such and liquefaction and landslides.[3,4] According to the California Geologic Survey Quadrangles, liquefaction susceptibility is located along Trabuco Canyon and Tijeras Canyon Creek traversing through the City; refer to Exhibit 5.8-1, *Liquefaction/Landslide Potential*. Most of the lowlands in the Rancho Santa Margarita area have a high liquefaction potential because shallow ground water, within 50 feet of the ground surface, has been historically reported.

SEISMIC-INDUCED LANDSLIDES

Strong ground motions can worsen existing unstable slope conditions, particularly if coupled with saturated ground conditions. Seismically-induced landslides can overrun structures, people or property, sever utility lines, and block roads, thereby hindering rescue operations after an earthquake. Areas underlain by shale and siltstone are more prone to landslides when compared to other bedrock geology, and the Capistrano, Monterey and Topanga Formations, prevalent throughout hillside areas in the City, are most prone to slow-developing, slump-type failure. The area east of Rancho Santa Margarita and some steep slopes within the City would be most vulnerable to seismically-induced slope failure, due to the steep terrain and the presence of weak sedimentary rock units. Areas on the gentler slopes may also be susceptible where slopes have been undercut by streams or roadcuts. Exhibit 5.8-1 shows areas mapped by the State as having a potential for seismically-induced landsliding.

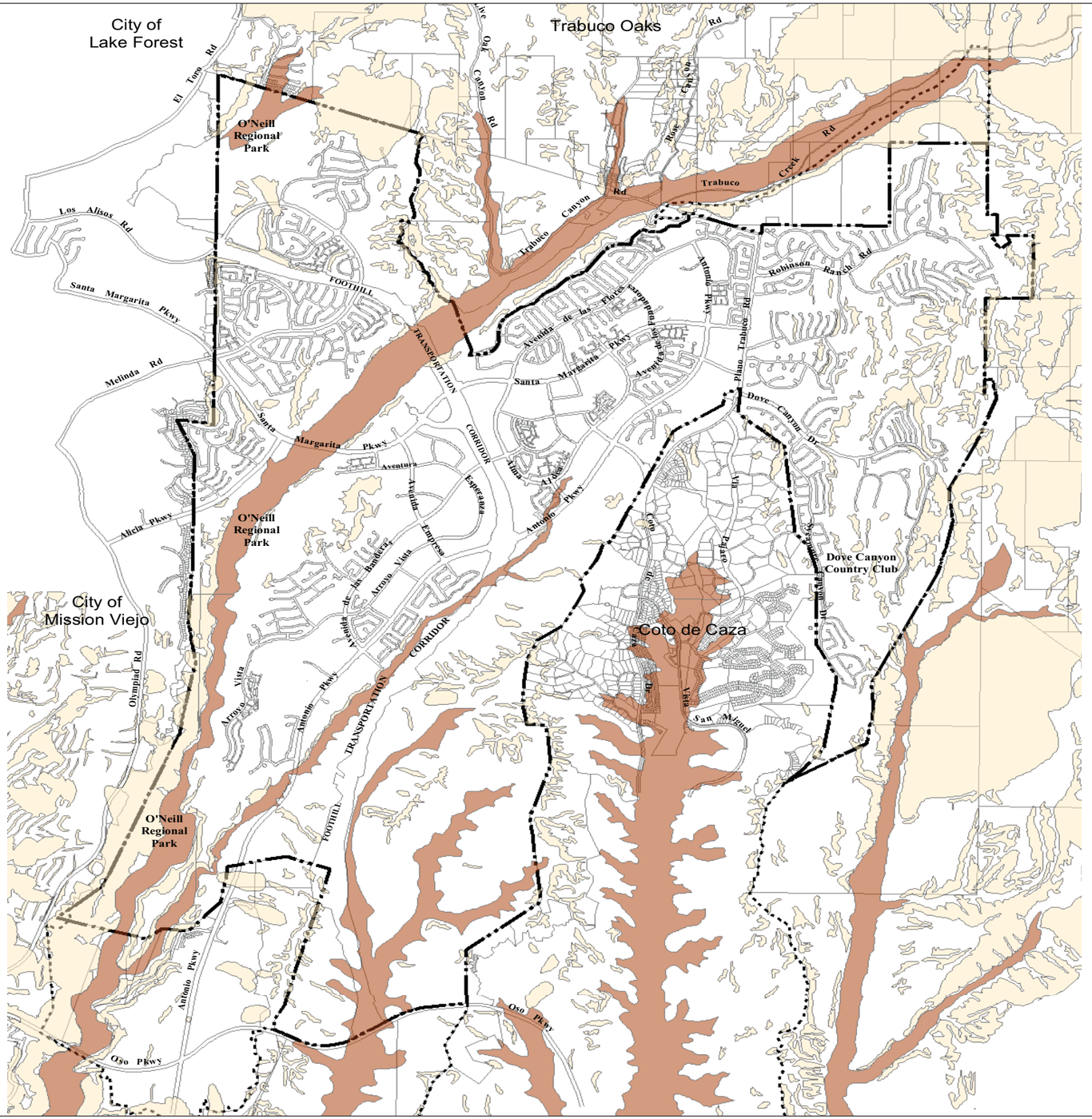
A combination of geologic conditions leads to landslide vulnerability. The hilly and mountainous areas within the Study Area are underlain by soft sedimentary bedrock. The sedimentary bedrock units that underlie the hillside areas appear to be grossly stable in their natural conditions, as few landslides have been mapped in the Study Area. However, an earthquake on a nearby seismic source could trigger landslides.

Numerous landslides have been mapped in the eastern half of the Rancho Santa Margarita area, as sediments in the area have the potential to fail (by landsliding) during an earthquake. Sections of Trabuco Canyon Road or Live Oak Canyon Road could be blocked by fallen rock debris immediately following an earthquake, or worse, could be destroyed by landsliding. This would hinder rescue and evacuation operations.

Earthquake-induced landslides could also impact developments adjacent to the mountain front. In addition to geologic processes, climatic conditions, man-induced topographical alterations and earthquakes also trigger failure to unstable slopes. Slope stability hazards in the City relate to the undeveloped hillside areas, as grading activities and soil remediation techniques are used to mitigate these hazards prior to development.

3 State of California Department of Conservation, *Santiago Peak Quadrangle Official Map*, December 20, 2002.

4 State of California Department of Conservation, *Canada Gobernadora Quadrangle Official Map*, September 23, 2002.



RANCHO SANTA MARGARITA
January 1, 2000

LEGEND

- Landslide
- Liquefaction
- City Boundary
- Sphere of Influence

0 2,400 4,800 Feet

Source: Orange County Local Area Formation Commission, 2013 and California Geological Survey, 2002.

Michael Baker INTERNATIONAL

01/19 | JN 152779

Liquefaction / Landslide Potential

Exhibit 5.8-1

This page intentionally left blank.

SUBSIDENCE

Ground subsidence is the gradual settling or sinking of the ground surface with little or no horizontal movement. Most ground subsidence is human-induced and is usually associated with the extraction of oil, gas, or ground water from below the ground surface in valleys filled with recent alluvium. No regional subsidence as a result of either groundwater pumping or oil extraction has been reported for the Rancho Santa Margarita area.

EXPANSIVE SOILS

Expansive soils create a shrink-swell hazard. Structural damage may result over a long period of time, usually from inadequate soils and foundation engineering or the placement of structures directly on expansive soils.

Most of Rancho Santa Margarita is underlain by sedimentary units (both bedrock and alluvium) that are composed primarily of granular soils (silty sand, sand, and gravel). Such units are typically in the low to moderately-low range for expansion potential. However, every sedimentary unit in the area contains layers of fine-grained soils that are typically in the moderate to highly expansive range. The areas that are most susceptible to expansive soils are located along the western boundary of the City.

5.8.4 SIGNIFICANCE THRESHOLDS AND CRITERIA

Appendix G of the California Environmental Quality Act (CEQA) Guidelines contains the Initial Study Environmental Checklist, which includes questions relating to geology and soils. The issues presented in the Initial Study Environmental Checklist have been utilized as thresholds of significance in this section. Accordingly, a project may create a significant environmental impact if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving;
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault (as explained in Section 9.0, *Effects Found Not To Be Significant*, further analysis of this topic is not required in this EIR);
    - Strong seismic ground shaking;
    - Seismic-related ground failure, including liquefaction;
    - Landslides;
- Result in substantial soil erosion or the loss of topsoil;
- 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 landslides, lateral spreading, subsidence, liquefaction or collapse;

- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risk to life or property; and/or

- 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 explained in Section 9.0, *Effects Found Not To Be Significant*, further analysis of this topic is not required in this EIR).

Based on these standards, the effects of the General Plan Update have been characterized as either a "less than significant impact" or a "potentially significant impact." Mitigation measures are recommended for potentially significant impacts. If a potentially significant impact cannot be reduced to a less than significant impact level through the application of mitigation, it is categorized as a significant unavoidable impact.

5.8.5 PROJECT IMPACTS AND MITIGATION MEASURES

SEISMIC-RELATED HAZARDS

- **IMPLEMENTATION OF THE GENERAL PLAN UPDATE WOULD NOT EXPOSE PEOPLE AND STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS, INCLUDING THE RISK OF LOSS, INJURY, OR DEATH INVOLVING STRONG SEISMIC GROUND SHAKING, SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION, OR LANDSLIDES.**

Impact Analysis: The project area, like the rest of Southern California, is situated within a seismically active region as the result of being located near the active margin between the North American and Pacific tectonic plates. Development associated with the General Plan Update could expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking, seismic-related ground failure (i.e., liquefaction), and seismic-related landslides.

STRONG SEISMIC GROUND SHAKING

As discussed above, the two known local faults within the City of Rancho Santa Margarita (the Aliso fault and the Cristianitos fault) are thought to be inactive. The closest active faults are the Elsinore-Glen Ivy fault (10.1 miles away), the Chino fault (11.1 miles away), and the Newport Inglewood fault (14.4 miles away).

Future development accommodated through implementation of the General Plan Update could expose persons or structures to the effects of strong seismic ground shaking. The intensity of ground shaking and the degree of impact would depend upon the magnitude of the earthquake, distance to the epicenter, and the geology of the area between the epicenter to the City. Additionally, the soil and geologic structure underlying the development site would influence the amount of damage that the site may experience. Impacts concerning strong seismic ground shaking would be addressed by compliance with the seismic design requirements identified in the CBC. In accordance with the CBC and Municipal Code Title 10, *Buildings and Construction*, structures built for human occupancy must be designed to meet or exceed the CBC

standards for earthquake resistance. The CBC includes earthquake safety standards based on a variety of factors including occupancy type, types of soils and rocks on-site, and strength of probable ground motion at the project site. The General Plan Update includes several policies intended to avoid or minimize adverse geologic or seismic hazards to people or structures. Pursuant to Safety Element Policy 2.1, the City would ensure future development reduces the risk of impacts from geologic and seismic hazards by applying and enforcing development standards and building construction codes to meet the minimum State standards for seismic safety. Overall, compliance with the CBC, as adopted by reference in Municipal Code Title 10, *Buildings and Construction* would ensure impacts related to strong seismic ground shaking to be less than significant.

SEISMIC-RELATED GROUND FAILURE (LIQUEFACTION)

According to the California Geologic Survey, liquefaction susceptibility is located along Trabuco Canyon and Tijeras Canyon Creek traversing through the City; refer to Exhibit 5.8-1. Most of the lowlands in the Rancho Santa Margarita area have a high liquefaction potential due to the presence of shallow ground water. However, most of these areas susceptible to liquefaction are designated as Open Space, Open Space Golf, or Regional Open Space (e.g., O'Neill Regional Park, Tijeras Creek Golf Club, and open space areas along State Route 241 [SR-241]), and thus, would generally not expose people or structures to significant liquefaction risk. Additionally, compliance with the CBC, as adopted by reference in Municipal Code Title 10 would ensure impacts related to seismic-related ground failure to be less than significant.

SEISMIC-RELATED LANDSLIDES

Numerous landslides have been mapped in the eastern half of the Rancho Santa Margarita area, as sediments in the area have the potential to fail (by landsliding) during an earthquake. As shown on Exhibit 5.8-1, most areas identified with landslide potential are located in areas designated as Open Space or Regional Open Space, including the O'Neill Regional Park and open space areas along SR-241 and north of Dove Canyon. Thus, since development in accordance with the General Plan Update would predominantly be infill and redevelopment, the project would not expose people or structures to significance landslide hazards associated with these open space areas. Further, compliance with the CBC, as adopted by reference in Municipal Code Title 10 would ensure impacts related to seismic-related landslides to be less than significant.

CONCLUSION

As indicated above, numerous controls would be imposed on future developments through the City's permitting process, in order to lessen impacts associated with seismic-related ground failure. A site-specific Soil Engineering and Engineering Geology report may be required for grading projects, as determined by the City engineer, stating the effect of geological or soils conditions on the proposed development; refer to Municipal Code Section 10.12.200, *Soil Engineering and Engineering Geology Reports*. Development would be evaluated by the City engineer on a site-by-site basis to determine potential for seismic-related ground failure and adverse soil conditions. The City's structures would be subject to compliance with the CBC pursuant to Municipal Code Title 10, *Buildings and Construction*, which include regulations for how buildings are

designed, engineered, and constructed, and are intended to ensure the maximum structural integrity and safety of private and public buildings. The General Plan Update includes several policies intended to protect and prepare the community from/for natural hazards and avoid or minimize adverse geologic or seismic hazards to people or structures. In accordance with Safety Element Policy 1.3, the City would update its LHMP and Safety Element every five years to ensure consistency and relevancy of hazards within the City. Pursuant to Safety Element Policy 2.1, the City would ensure future development reduces the risk of impacts from geologic and seismic hazards by applying and enforcing development standards and building construction codes to meet the minimum State standards for seismic safety. Overall, compliance with the CBC, as adopted by reference in Municipal Code Title 10, *Buildings and Construction* would ensure impacts related to seismic-related ground shaking, ground failure, and landslides to be less than significant.

Proposed General Plan Update Goals and Policies:

SAFETY ELEMENT

Goal 1: Protect and prepare the community for natural and man-made hazards.

Policy 1.3: Update the City's Local Hazard Mitigation Plan in conjunction with the General Plan Safety Element every five years, to ensure consistency and relevancy of hazards and issues within the City.

Policy 1.4: Educate City staff, residents, and businesses regarding appropriate actions to safeguard life and property before, during, and immediately following emergencies.

Goal 2: Reduce the risk to the community from hazards related to geologic conditions and seismic activity.

Policy 2.1: Reduce the risk of impacts from geologic and seismic hazards by applying and enforcing development standards and building construction codes to meet minimum State standards for seismic safety.

Policy 2.5: Participate in local, regional, State, and Federal programs that educate residents and businesses about how to protect themselves and their property from hazards.

Mitigation Measures: No mitigation is required.

Level of Significance: Less Than Significant Impact.

SOIL EROSION

- **IMPLEMENTATION OF THE GENERAL PLAN UPDATE WOULD NOT RESULT IN SUBSTANTIAL SOIL EROSION OR THE LOSS OF TOPSOIL.**

Impact Analysis: Soil erosion typically occurs within unconsolidated alluvium and surficial soils in sloping topographies. Construction activities associated with future development would include clearing, excavation, and grading, which would displace soils and temporarily increase the potential for soils to be subject to wind and water erosion.

Short-term erosion impacts associated with the construction of future development would be prevented through required grading permits. Pursuant to Municipal Code Section 10.12.370, *Erosion and Sediment Control Plans*, all projects requiring a grading permit would be required to submit an Erosion and Sediment Control Plan to the City engineer for review and approval. In compliance with the National Pollutant Discharge Elimination System (NPDES) program, individual projects involving one or more acres of site disturbance would be required to prepare and implement a stormwater pollution prevention plan (SWPPP) and associated best management practices (BMPs) in compliance with the Construction General Permit during grading and construction. Potential BMPs could include installing vegetated swales and sediment barriers; stabilizing soils with hydroseeding; regular dust control; implementing desilting basins and storm drain inlet protectors; and providing public education/outreach materials. Adherence to the BMPs in the SWPPP would reduce, prevent, or minimize soil erosion from grading and construction activities. Future development would also be required to comply with South Coast Air Quality Management District (SCAQMD) Rule 403, which would reduce the potential for wind erosion by requiring implementation of dust control measures during construction; refer to Section 5.5, *Air Quality*. In addition, Safety Element Policy 2.2 promotes design or development techniques to avoid or minimize and mitigate the development of areas that are susceptible to erosion and sediment loss, and Conservation Element Policy 3.1 ensures water quality regulations are enforced to eliminate pollution from urban runoff.

Following compliance with the established regulatory framework (i.e., Municipal Code Section 10.12.370, *Erosion and Sediment Control Plans*, NPDES, and SCAQMD Rule 403), project construction would result in less than significant impacts involving soil erosion and loss of topsoil.

Proposed General Plan Update Goals and Policies:

SAFETY ELEMENT

Goal 2: **Reduce the risk to the community from hazards related to geologic conditions and seismic activity.**

Policy 2.2: Incorporate design and development techniques to avoid or minimize and mitigate development of areas that are particularly susceptible to erosion and sediment loss.

CONSERVATION ELEMENT

Goal 3: Protect the beneficial uses of ground and surface waters.

Policy 3.1: Adopt and enforce water quality regulations and support water quality educational efforts to eliminate pollution from urban runoff.

Mitigation Measures: No mitigation is required.

Level of Significance: Less Than Significant Impact.

UNSTABLE GEOLOGIC UNITS AND EXPANSIVE SOILS

- **IMPLEMENTATION OF THE GENERAL PLAN UPDATE WOULD NOT RESULT IN DEVELOPMENT/ IMPROVEMENTS THAT ARE LOCATED ON A GEOLOGIC UNIT OR SOIL THAT IS UNSTABLE, RESULTING IN LANDSLIDES, LATERAL SPREADING, SUBSIDENCE, LIQUEFACTION, OR COLLAPSE, OR ON EXPANSIVE SOILS CREATING SUBSTANTIAL RISK TO LIFE OR PROPERTY.**

Impact Analysis: Project implementation could result in development/improvements that are located on a geologic unit or soil that is unstable, or that would become unstable, and potentially result in landslides or subsidence. Refer to the "Seismic Related Ground Failure" responses above for a discussion concerning the project's potential liquefaction and landslide hazards.

LATERAL SPREADING

Based on their high liquefaction potential, most of the lowlands of Rancho Santa Margarita, as well as areas within Trabuco Canyon and near Tijeras Canyon Creek, could be susceptible to liquefaction-induced lateral spreading.

SUBSIDENCE

As discussed, no regional subsidence events have been reported for the Rancho Santa Margarita area.

SEISMICALLY-INDUCED SETTLEMENT

Those portions of the Study Area that may be susceptible to seismically induced settlement are generally the floodplains and larger drainages that are underlain by late Quaternary alluvial sediments (similar to the liquefaction-susceptible areas). These include areas in Trabuco Canyon, Live Oak Canyon, and especially the flatter areas along these drainages. Also included are the areas along Tijeras Canyon Creek. Sites near the base of natural hills (valley margins) may also be particularly vulnerable.

EXPANSIVE SOILS

Project implementation could result in future development sited on expansive soils. As discussed, most of the City is underlain by sedimentary units (both bedrock and alluvium) that are composed primarily of granular soils (silty sand, sand, and gravel). Such units are

typically in the low to moderately-low range for expansion potential. However, every sedimentary unit in the area contains layers of fine-grained soils that are typically in the moderate to highly expansive range. The areas that are most susceptible to expansive soils are located along the western boundary of the City.

CONCLUSION

Numerous controls would be imposed on future developments/improvements through the City's permitting process, in order to lessen impacts associated with unstable geologic/soil units (i.e., lateral spreading, subsidence, and settlement) and expansive soils. A site-specific Soil Engineering and Engineering Geology report may be required for grading projects, as determined by the City engineer, stating the effect of geological or soils conditions on the proposed development; refer to Municipal Code Section 10.12.200, *Soil Engineering and Engineering Geology Reports*. Development would be evaluated by the City engineer on a site-by-site basis to determine potential for unstable geologic/soils units. Further, all future structures would be subject to compliance with the CBC pursuant to Municipal Code Title 10, *Buildings and Construction*, which include regulations for how buildings are designed, engineered, and constructed. According to the CBC, special foundation design consideration must be employed where unstable soils exist.

Additionally, the General Plan Update includes several policies intended to avoid or minimize adverse geologic or seismic hazards to people or structures. Pursuant to Safety Element Policy 2.1, the City would ensure future development reduces the risk of impacts from geologic and seismic hazards by applying and enforcing development standards and building construction codes to meet the minimum State standards for seismic safety. Overall, compliance with the CBC, as adopted by reference in Municipal Code Title 10, *Buildings and Construction* would ensure impacts related to unstable geologic units and expansive soils would be less than significant.

Proposed General Plan Update Goals and Policies: Refer to the General Plan Update goals and policies cited above.

Mitigation Measures: No mitigation is required.

Level of Significance: Less Than Significant Impact.

5.8.6 CUMULATIVE IMPACTS

- **FUTURE DEVELOPMENT RESULTING FROM IMPLEMENTATION OF THE GENERAL PLAN UPDATE WOULD NOT RESULT IN CUMULATIVE IMPACTS RELATED TO SEISMIC, GEOLOGIC, AND SOIL CONDITIONS.**

Impact Analysis: Seismic, geologic, and soil conditions within the City of Rancho Santa Margarita would vary by location and site-specific suitability for development would not be uniform. Future development within the region, including the City of Rancho Santa Margarita, would contribute to the exposure of people and structures to geologic and seismic hazards. As concluded above, geologic and seismic hazards would be reduced to less than significant levels following conformance with the established regulatory

framework (i.e., CBC, SCAQMD Rule 403, and Municipal Code requirements). If determined necessary, project-specific mitigation would be incorporated to reduce cumulative seismic, geologic, and soil impacts to a less than significant level. If a specific site were determined to create a significant impact that could not be feasibly mitigated, the site would not be appropriate for development. These processes, along with compliance with Federal and State laws, local building codes, and public safety standards, would result in less than significant cumulative impacts related to potential seismic, geologic, and soil hazards. As a result, implementation of the General Plan Update would not result in cumulatively considerable impacts involving seismic and geologic hazards.

Proposed General Plan Update Goals and Policies: Refer to the General Plan Update goals and policies cited above.

Mitigation Measures: No mitigation is required.

Level of Significance: Less Than Significant Impact.

5.8.7 SIGNIFICANT UNAVOIDABLE IMPACTS

Geology and soils impacts associated with implementation of the General Plan Update would be less than significant. No significant unavoidable geology and soils impacts would occur as a result of the General Plan Update.

5.8.8 SOURCES CITED

City of Rancho Santa Margarita, *City of Rancho Santa Margarita Municipal Code*.

State of California Department of Conservation, *Alquist-Priolo Fault Zone and Seismic Hazard Zone Maps*, http://www.conservation.ca.gov/cgs/rghm/ap/Pages/index.aspx, accessed June 14, 2016.

State of California Department of Conservation, *Canada Gobernadora Quadrangle Official Map*, September 23, 2002.

State of California Department of Conservation, *Santiago Peak Quadrangle Official Map*, December 20, 2002.