4.5 GEOLOGY AND SOILS

This section discusses the proposed project's potential impacts relating to geologic hazards. This section is partially based on the *Preliminary Soil Engineering and Geologic Hazards Evaluation* conducted by Hoover & Associates in January 1998 and The *Preliminary Foundation Investigation* conducted by Pacific Materials Laboratory of Santa Barbara, 2009. Both the Hoover & Associates and Pacific Materials Laboratory studies are included in Appendix E.

4.5.1 Setting

a. Geological Setting.

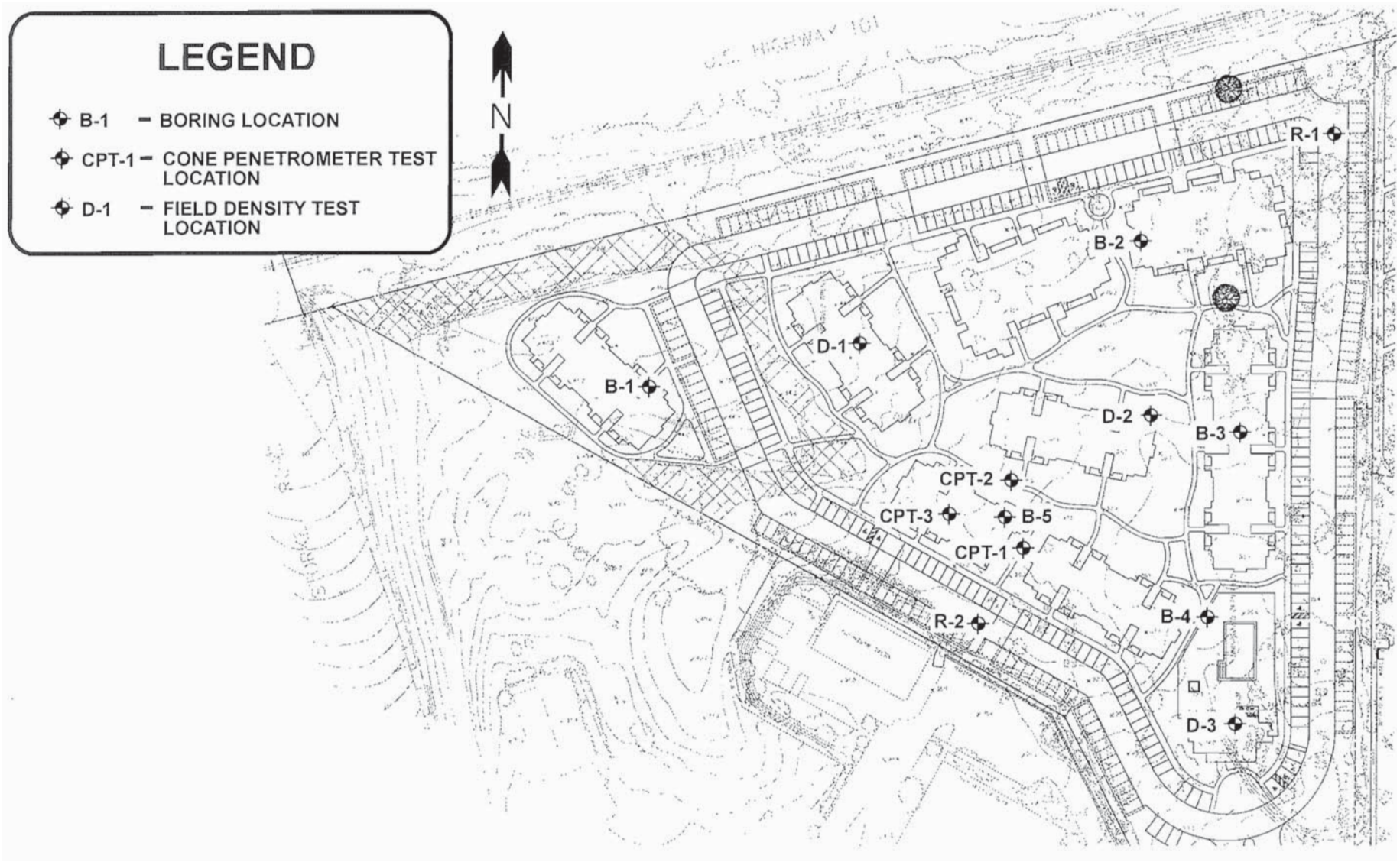
Regional. The City of Goleta occupies a portion of the eight-mile long and three-mile wide flat alluvial plain known as the Goleta Valley (City of Goleta General Plan/Coastal Land Use Plan FEIR, 2006). The Goleta Valley is a broad, flat alluvial plain bordered on the south by the bluffs of the Pacific coastline, and on the north by foothills and terraces of the foreland of the Santa Ynez Mountain Range. It generally slopes gently into the Goleta Slough, which is located in the south central portion of the valley (City of Goleta Background Report #16, Geology/Geologic Hazards, March 19, 2004).

Project Site. Four geologic units are exposed at the surface on the project site: Santa Barbara Formation which is of a marine origin composed of unconsolidated sand, silt, and clay; Older Alluvium comprised of upper Pleistocene-age stream alluvium and slough deposits; Younger alluvium of a similar composition to the Older alluvium but of different density; and artificial fill deposited onsite as part of the Caltrans project to widen the Storke Road/U.S. 101 interchange. The alluvial sequence is bounded on the north by the foothills of the Santa Ynez Range, while the underlying basis is bounded on the south by the More Ranch Fault and smaller east/west trending faults (Hoover & Associates, 1998).

Topography/Soils. The project site is relatively flat and generally slopes from the northwest to the southeast between 1% and 3%. Onsite elevations range from 49 feet above mean sea level (msl) at the northwest corner of the property to 31 feet above msl at Cortona Drive. The majority of the site consists of Goleta fine sandy loam, which is subject to medium runoff and a moderate erosion hazard. This soil type is generally considered suitable for all irrigated crops and urban development. An area of cut/fill soils (xerorthents) that remains from construction of the Storke Road overpass over U.S. 101 is located in the northwest corner of the project site. Such soils are typically well drained and subject to variable runoff and erosion hazards. These soils are typically used for urban development but site specific soil studies are needed on a case-by-case basis to accurately evaluate their development potential/possible development constraints.

b. Seismic and Other Geologic Hazards. Similar to much of California, the project site is located within a seismically active region. The Transverse Ranges are characterized by east-west trending structural features in contrast to the dominant northwest-southeast structural trend of California. The nearest confirmed, seismically active fault to the project site is the North Channel Slope Fault located four miles offshore. The closest Alquist-Priolo mapped earthquake fault is over 20 miles to the southeast (Pitas Point/Red Mountain Faults).

Other potential seismic hazards known to occur within the vicinity of the project site include ground rupture, ground acceleration, and liquefaction. The site is approximately 1.6 miles from the Pacific



Source: Pacific Materials Laboratory, Inc., 2009

Soil Boring Locations

Figure 4.5-1

Ocean and at an elevation of 31-49 feet. The project site is not within a Potential Tsunami Runup Area according to the City of Goleta General Plan Fire, Flood, and Tsunami Hazards Map.

Fault Rupture. Seismically-induced ground rupture occurs as the result of differential movement across a fault. An earthquake occurs when seismic stress builds to the point where rocks rupture. As the rocks rupture, one side of a fault block moves relative to the other side. The resulting shock wave is the earthquake. If the rupture plane reaches the ground surface, ground rupture occurs. Potentially active faults are those that have moved during the last 2.5 million years but not during the last 10,000 years while active faults show evidence of movement within the last 10,000 years. Neither active nor potentially active faults were mapped at this site by previous investigations and no faults were found at the site by Hoover & Associates. No significant hazard related to fault rupture is present at the project site.

Groundshaking. The Uniform Building Code (UBC) defined different regions of the United States and ranked them according to their seismic hazard potential, with Seismic Zone 4 having the highest seismic potential (Note: the UBC is no longer in use has been replaced by the International Building Code). Pursuant to Figure 16-2 in Chapter 16 of the UBC (International Conference of Building Officials, 1997), all of Santa Barbara County lies within Seismic Zone 4.

Liquefaction. Liquefaction is a seismic phenomenon in which loose, saturated granular and non-plastic fine grained soils lose their structure/strength when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater (within the top 50 feet of the ground surface); 2) low density non-plastic soils; and 3) high intensity ground motion. These conditions are present at the project site and the foundation soils may be subject to liquefaction. Loose granular soil can also settle (compact) during liquefaction and as pore pressures dissipate following an earthquake. The *Preliminary Foundation Investigation* for the project site (Pacific Materials Laboratory of Santa Barbara, 2009) indicates that groundwater was encountered during test borings at depths of 20 to 30 feet. While these test borings may not be indicative of the year round water table, the Pacific Materials Laboratory of Santa Barbara concludes that the project site contains soils that have the potential to liquefy between the depths of 20 to 50 feet below the present grade.

Safety factors are used to evaluate liquefaction potential. The potential for liquefaction to occur is considered low to non-existent when the safety factor is between 1.2 to 1.5. Safety factors lower than 1.2 indicate a potential for liquefaction. The results of the analysis of on-site soils indicate that the Liquefaction Factor of Safety is from 0.83 to 1.08 between the depths of 24 and 26 feet. This indicates a potential for liquefaction on-site.

Settlement and Compressible/Collapsible Soils. Compressible soils typically consist of organic material and are common in estuaries and other areas where deposits of organic matter are found. Collapsible soils are typically low density, fine-grained, and dominantly granular, characteristic of loamy sands, such as a majority of the soils on the site. Collapsible soils can settle under relatively low loads when saturated and destroy foundations. Due to the presence of the sand, silt and clay soils in the top 20 feet of the soil profile, which are considered collapsible-compressible soils, seismic settlement has the potential to occur on-site. Additionally, the top 5 feet of the surface soils were found to be compressible and sensitive to collapse when subjected to increased moisture content. According to the Pacific Materials Laboratory Preliminary Foundation Investigation, the total anticipated settlement was determined to be 1 inch. During a seismic event, on-site structures would be expected to settle 0.5 inches.

Expansive Soils. Soils with relatively high clay content are expansive due to the capacity of clay minerals to take in water and swell (expand) to greater volumes. According to the Pacific Materials Laboratory of Santa Barbara reports, surface soils on the project site were found to have a very low potential for expansion.

Erosive Soils. Soil erosion is the removal of soil by water and wind. Factors that influence erosion potential include the amount of rainfall and wind, the length and steepness of the slope, and the amount and type of vegetative cover. Soil erosion may be short-term issues during construction and grading activities; however, the Hoover & Associates and Pacific Materials Laboratory studies do not indicate that erosion is a significant long-term concern on the project site.

c. Regulatory Setting. The California Building Code (CBC); the Goleta General Plan; and the Goleta Municipal Code prescribe measures to safeguard life, health, property and public welfare from geologic hazards. Each of these is described below:

California Building Code. California law provides a minimum standard for building design through the California Building Code (CBC) (C.C.R. Title 24). Chapter 23 of the CBC contains specific requirements for seismic safety. Chapter 29 regulates excavation, foundations, and retaining walls. Chapter 33 OF THE CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion control. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching as specified in California Division of Occupational Safety and Health (Cal/OSHA) regulations (C.C.R. Title 8).

Alquist-Priolo Earthquake Fault Zoning Act. The Alquist-Priolo Earthquake Fault Zoning Act was signed into law in 1972 (14 C.C.R. §§ 3600 *et seq.*). The purpose of this Act is to prohibit the location of most structures for human occupancy across the traces of active faults and to thereby mitigate the hazard of fault rupture. Under the Act, the State Geologist is required to delineate "Earthquake Fault Zones" along known active faults in California (14 C.C.R. §3601). Cities and counties affected by the zones must regulate certain development projects within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting (14 C.C.R. §3603).

Seismic Hazards Mapping Act. The California Geologic Survey, formerly the California Department of Conservation, Division of Mines and Geology (CDMG), provides guidance with regard to seismic hazards. Under CDMG's Seismic Hazards Mapping Act (1990), seismic hazard zones are to be identified and mapped to assist local governments in land use planning (California Public Resources Code §§ 2690 *et seq.*). The intent of these maps is to protect the public from the effects of strong ground shaking, liquefaction, landslides, ground failure, or other hazards caused by earthquakes. In addition, CDMG's Special Publications 117, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," provides guidance for the evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

City of Goleta Regulations. The Safety Element in the Goleta General Plan contains policies intended to reduce the potential for geologic hazards to adversely affect people and property, including the following:

SE 1.3 ***Site-Specific Hazards Studies.*** *Applications for new development shall consider exposure of the new development to coastal and other hazards. Where appropriate, an application for new development shall include a geologic/soils/geotechnical study and any other studies that identify geologic hazards affecting the proposed project site and any necessary mitigation measures. The study report shall contain a statement certifying that the project site is suitable for the proposed development and that the development will be safe from geologic hazards. The report shall be prepared and signed by a licensed certified engineering geologist or geotechnical engineer and shall be subject to review and acceptance by the City.*

SE 1.6 ***Enforcement of Building Codes. [GP]*** *The City shall ensure through effective enforcement measures that all new construction in the city is built according to the adopted building and fire codes.*

SE 4.3 ***Geotechnical and Geologic Studies Required. [GP/CP]*** *Where appropriate, the City shall require applications for planning entitlements for new or expanded development to address potential geologic and seismic hazards through the preparation of geotechnical and geologic reports for City review and acceptance.*

SE 4.5 ***Adoption of Updated California Building Code Requirements. [GP]*** *The City shall review, amend, and adopt new California Building Code requirements, when necessary, to promote the use of updated construction standards. The City shall consider and may adopt new optional state revisions for Seismic Hazards.*

The Goleta Municipal Code (GMC) adopts the most recent CBC and contains additional requirements for construction in the City (Chapter 15, Buildings and Construction) (15 GMC, § 15.01 *et seq*.).

4.5.2 Impact Analysis

a. Methodology and Significance Thresholds. Assessment of impacts is based on review of site information and conditions and City information regarding geologic issues. In accordance with the CEQA Guidelines, a project would result in a significant 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, strong seismic ground shaking, seismic-related ground failure, including liquefaction, or landslides;*
- *Result on 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 on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;*
- *Be located on expansive soil, creating substantial risks to life or property; 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.*

Per the City's *Environmental Thresholds and Guidelines Manual* (published 1992, revised 2002), impacts are classified as potentially significant with regard to geology if:

- *The project site or any part of the project is located on land having substantial geologic constraints, as determined by Planning and Development or Public Works Department. Areas constrained by geology include parcels located near active or potentially active faults and property underlain by rock types associated with compressible/collapsible soils or susceptible to landslides or severe erosion. "Special Problems" areas designated by the Board of Supervisors have been established based on geologic constraints, flood hazards and other physical limitations to development;*
- *The project results in potentially hazardous geologic conditions such as the construction of cut slopes exceeding a grade of 1.5 horizontal to 1 vertical;*
- *The project proposes construction of a cut slope over 15 feet in height as measured from the lowest finished grade; and*
- *The project is located on slopes exceeding 20% grade.*

Based on the Initial Study, the *Preliminary Soil Engineering and Geologic Hazards Evaluation* prepared by Hoover & Associates (1998), a subsequent *Preliminary Foundation Investigation* prepared by Pacific Materials Laboratory of Santa Barbara (2009), and the geologic hazards mapping in the Goleta General Plan geologic hazards posed by unstable soils, onsite septic systems, fault rupture, landslides, and slopes exceeding 20% grade are less than significant. In addition, the project involves no construction of cut slopes exceeding a grade of 1.5:1 or construction of a cut slope over 15 feet in height. Consequently, impacts related to these thresholds are considered less than significant are discussed in Section 4.15, *Effects Found Not to be Significant.*

Also based on the Initial Study, the *Preliminary Soil Engineering and Geologic Hazards Evaluation* conducted by Hoover & Associates, Inc. (1998) found that clay soils are present on the project site. Clay soils are potentially expansive. Therefore, the Initial Study identified expansive soils as a Class II, significant but mitigable impact. However, according to a subsequent soils report, the *Preliminary Foundation Investigation* prepared by the Pacific Materials Laboratory of Santa Barbara, discussed in the *Setting*, a more detailed analysis of the surface soils found them to have a very low potential for expansion. Therefore, impacts related to expansive soils on the project site are less than significant. These impacts are discussed further in Section 4.15, *Effects Found Not to be Significant*.

b. Project Impacts and Mitigation Measures.

Impact GEO-1 Project site soils are prone to liquefaction, which could cause settlement in a seismic event and expose on-site structures to property damage. This is a Class II, *significant but mitigable* impact.

As discussed in Section 4.5.1, *Setting*, the *Preliminary Foundation Investigation* for the project site (Pacific Materials Laboratory of Santa Barbara, 2009) indicates that groundwater was encountered

during test borings at depths of 20 to 30 feet. Based on this and soil testing conducted on-site, the Pacific Materials Laboratory concluded that the project site contains soils that have the potential to liquefy. Liquefaction could result in settlement that could cause property damage.

Pacific Materials Laboratory calculated the potential settlement due to liquefaction-induced soil compression to be 1.0 inch. This total anticipated settlement of 1.0 inch could contribute a differential settlement of 0.5 inch in site structures in a seismic event. Such settlement would not be expected to pose risks to human life, but could cause cosmetic damage to structures and require re-leveling of foundations. Impacts are therefore considered potentially significant.

Mitigation Measure. Mitigation Measure GEO-1 would reduce impacts related to seismically induced liquefaction to a less than significant level.

GEO-1 **Geotechnical Design Considerations.** The recommendations in the 2009 *Preliminary Foundation Investigation* conducted by Pacific Materials Laboratory of Santa Barbara (Appendix E) related to soil engineering must be incorporated into the proposed project grading and building plans. These recommendations are summarized here:

- *Site grading, compaction, fill and drainage.*
- *Foundation/footing, slab design, soil bearing value and waterproofing methods for sub-grade interior spaces.*
- *Retaining wall design, soil pressure, waterproofing, and backfill.*
- *Pavement soil foundation, application, dimensions, waterproofing and maintenance.*
- *Swimming pool wall and deck concrete design and reinforcement standards.*
- *Adjacent load effect on footings at varying elevations.*
- *Angular distortion, settlement and soil bearing values.*

Plan Requirements and Timing. Grading and building plans must be submitted for review and approval by the Planning and Environmental Review Director or designee before issuance of grading and building permits.

Monitoring. The Project Geotechnical Engineer must observe all excavations before placement of compacted soil, gravel backfill, or rebar and concrete.

Significance After Mitigation. Implementation of Mitigation Measure GEO-1 would reduce potential impacts due to liquefaction resulting in volumetric compression, or settling, of soils on the site to a less than significant level.

Impact GEO-2 **On-site construction and grading activity may temporarily increase soil erosion on the project site. Temporary impacts related to soil erosion would be Class III, *less than significant*.**

The proposed project would involve construction of 176 attached residential units and associated landscaping and hardscape. Site preparation would involve excavation of approximately 5,700 cubic

yards of material (soil and rock) and placement of approximately 8,500 cubic yards of fill material, for a net import of 2,800 cubic yards of material. Excavation and grading could result in erosion of soils and sedimentation. During grading and soil storage, there is the potential for soil migration offsite via wind entrainment and/or water erosion.

Impacts would be minimized during all phases of project construction through compliance with the Construction General Permit (this permit is described in Section 4.8, *Hydrology and Water Quality*). To comply with this permit, the permittee would be required to prepare and implement a Stormwater Management Plan (SWMP), which must include erosion and sediment control BMPs that would meet or exceed measures required by the Construction General Permit, as well as BMPs that control other potential construction-related pollutants. Erosion control BMPs are designed to prevent erosion, whereas sediment controls are designed to trap sediment once it has been mobilized. Examples of BMPs that may be implemented during construction include the use of geotextiles and mats, temporary drains and swales, silt fences and sediments traps. Erosion control practices may include the use of drainage controls such as down drains, detention ponds, filter berms, or infiltration pits; removal of any sediment tracked offsite within the same day that it is tracked; containment of polluted runoff onsite; use of plastic covering to minimize erosion from exposed areas; and restrictions on the washing of construction equipment.

An SWMP would be developed for the project as required by, and in compliance with, the Construction General Permit and City regulations, including grading regulations. The Construction General Permit requires the SWMP to include a menu of BMPs to be selected and implemented based on the phase of construction and the weather conditions to effectively control erosion and sediment using the Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology (BAT/BCT). As development implementation of an SWMP is a standard requirement that would apply to this project, erosion impacts from construction would be less than significant.

Mitigation Measures. No mitigation is required.

Residual Impacts. Impacts would be less than significant without mitigation.

c. Cumulative Impacts. The proposed project, in conjunction with other cumulative projects proposed in and around Goleta, would expose additional people and property to seismic and geologic hazards that are present in the region. The magnitude of geologic hazards for individual projects would depend upon the location, type, and size of development and the specific hazards associated with individual sites. Any specific geologic hazards associated with each individual site would be limited to that site without affecting other areas. In addition, existing regulations, including compliance with CBC requirements, would reduce seismic and geologic hazards to acceptable levels. Seismic and geologic hazards would be addressed on a case-by-case basis and would not result in cumulatively considerable impacts. Cumulative geologic hazard impacts would be less than significant and the project's contribution would not be cumulatively considerable.