# 4.6 GEOLOGY, SOILS, AND SEISMICITY

## 4.6.1 SETTING

### *INTRODUCTION*

The project area encompasses several geographic regions within California and, therefore, includes a multitude of landforms and geologic substrates. The following section provides a generalized overview of these geologic features, their mineral resource potential, and associated geologic hazards within the project area. This section addresses these issues in the context of the proposed project and provides mitigation for hazards determined to be significant.

### *TOPOGRAPHIC AND GEOLOGIC STRUCTURES*

The project area includes several diverse landscapes, which are characterized by large valleys, coastal terraces, large peninsulas, and significant mountain ranges. Given the diversity and breadth of landforms and geologic phenomena throughout the project area, and California at large, descriptions of the geologic settings in California are divided into geomorphic provinces. Portions of the project area extend over six of the eleven geomorphic provinces in California (CGS, 1997a). These provinces are referred to as the Great Valley, Coastal Ranges, Mojave Desert, the Transverse Ranges, the Peninsular Ranges, and the Colorado Desert. The following sections provide brief descriptions of these geomorphic provinces.

#### Great Valley Province

The Great Valley is an alluvial plain, about 50 miles wide and 400 miles long, between the Coast Ranges and Sierra Nevada. Portions of the project area within the Great Valley Geomorphic Province include the urbanized segments of Sacramento and Fresno counties. The Great Valley is drained by the Sacramento and San Joaquin rivers, which join and enter San Francisco Bay. Sediments that beneath the these valleys are derived from millions of years of erosion and deposition from adjacent mountains to the east and west.

#### Coast Ranges

The Coast Ranges are characterized by a series of northwest trending mountain ranges (2,000–4,000, occasionally 6,000 feet elevation above sea level) and valleys that are sub-parallel to the San Andreas Fault. Portions of the project area within the Coast Range Geomorphic Province includes the Bay Area counties of Marin, San Francisco, Alameda, Contra Costa, Santa Cruz, Santa Clara, and San Mateo. The Coast Ranges are composed of thick late Mesozoic and Cenozoic sedimentary strata. Mojave Desert

The Mojave Desert geomorphic province occupies approximately 25,000 square miles consisting of a broad interior region of isolated mountain ranges separated by expanses of desert in southern California. The astern portions of Los Angeles, San Bernardino, and Riverside counties are located within this province. An interior enclosed drainage system and numerous playas[1] characterize this geomorphic province. There are two important fault trends that control topography -- a prominent NW-SE trend and a secondary east-west trend (apparent alignment with Transverse Ranges is significant). Transverse Ranges

The Transverse Ranges are a complex series of mountain ranges and valleys distinguished by an anomalous dominant east-west trend, contrasting to the NW-SE direction of the Coast Ranges and Peninsular Ranges. This geomorphic province includes Ventura County and portions of Los Angeles, San Bernardino, and Riverside Counties and extends approximately 320 miles from Point Arguello in the west to the Little San Bernardino Mountains at the edge of the Mojave and Colorado Desert provinces in the east.

### Peninsular Ranges

The Peninsular Ranges are characterized by a series of ranges separated by longitudinal valleys, trending sub-parallel to faults associated with the San Andreas Fault System. The Peninsular Ranges extend into lower California and are bound on the east by the Colorado Desert. Portions of the project area included within the geomorphic province include urbanized areas within Riverside, Orange, Los Angeles, and San Diego counties.

### Colorado Desert (Salton Trough)

The Colorado Desert geomorphic province (also referred to as the Salton Trough) is a low-lying barren desert basin, about 245 feet below sea level in part, is dominated by the Salton Sea. The province is a depressed fault block between active branches of alluvium-covered San Andreas Fault with the southern extension of the Mojave Desert on the east. This portion of the project area includes ancient beach rims and silt deposits of extinct Lake Cahuilla and encompasses Imperial County and eastern Riverside County.

## *SOILS*

Soils within the project area are classified by distinguishing characteristics and are tropically arranged within soil associations[2]. The formation of soil depends of factors such as topographical relief, climate, biological interactions, time, and associated parent material[3] on which the soil profile is developed. Soils throughout the project area differ substantially in origin, due to the composition of associated parent material, topographical relief, and climatic regime. In general, the project area will include mainly urbanized areas within each of the fifteen counties. Urban soils tend to be covered by impervious surfaces including, roads, parking lots, sidewalks, and structures. Prior to any urban development, native soils will typically be manipulated to improve

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[1] The typically dry and nearly level lake plain that occupies the lowest portions of closed depressions. Such as those occurring on intermontane basin floors.

[2] Soil Association – A group of defined and named taxonomic soil units occurring together in an individual and characteristic pattern over a geographic region.

[3] Parent Material is the unconsolidated ands more or less chemically weathered mineral or organic matter for which a soil is developed by pedogenic processes.

any associated limitations (e.g. poor or excessive drainage, expansiveness, reaction, shallow depth, etc.).

Soils in the project area are classified according to their pertinent and distinguishing characteristics as defined by the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service). There are no sharp demarcations between the properties of one soil individual and those of another. Rather there is a gradual transition in such properties moving from one soil individual to another. NRCS' classification system is based all the associated chemical, biological, and physical characteristics of a particular soil type. A few of these factors may include moisture retention, soil color, texture, structure, mineralogy, salt content, and depth.

The NRCS National Cooperative Soil Survey is a nationwide partnership of federal, regional, state, and local agencies and institutions that cooperatively inventory, investigate, classify, interpret, disseminate, and maintain information about the soils of the United States. The NRCS collects soil data, establishes standards for inventorying, describing and interpreting soils, and produces maps and associated databases. The project area is covered by numerous soil surveys. These surveys will be useful in determining project-specific soil interpretations as alignments are proposed.

## *STATEWIDE SOIL HAZARDS*

### Expansive Soils

Expansive soils possess a "shrink-swell" behavior. Shrink-swell is the cyclic change in volume (expansion and contraction) that occurs in fine-grained clay sediments from the process of wetting and drying. Structural damage may result over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. Typically, soils that exhibit expansive characteristics comprise the upper five feet of the surface. The effects of expansive soils could damage foundations of aboveground structures, paved roads and streets, and concrete slabs. Expansion and contraction of soils, depending on the season and the amount of surface water infiltration, could exert enough pressure on structures to result in cracking, settlement, and uplift. Because the location of expansive soils are site-specific and can generally be remedied through standard engineering practices, an assessment of expansive soil potential should be conducted as specific-alignments are proposed. This issue is discussed further in the impact analysis.

### Corrosivity

Corrosivity pertains to potential soil-induced electrochemical or chemical action that could dissolve or weaken uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and the electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on sulfate and sodium content, texture, moisture content and acidity of the soil. Since standard engineering practices will be employed during the construction of project-specific alignments and utilize corrosion resistant materials, this issue is not discussed further in this document.

### Soil Erosion

Soil erosion is also a natural on-going process that transports, erodes and displaces soil particles through a transport mechanism such as flowing water or wind. Erosion is the physical detachment and movement of soil materials through natural processes or human activities. Depending on the local landscape and climatic conditions, erosion may be very slow to very rapid. The detachment of soil particles can be initiated through the suspension of material in either hydraulic (water) or eolian (wind) setting. The project area is subject to both types of erosion depending on the time of year. The project area lies within a Mediterranean climate subject to moist winters and dry summers. Therefore, during the winter the area is more prone to erosion from water, while in the summer the area is more prone to wind erosion. The inland areas within the southern portion of the project area are characterized by a more arid climate and therefore are even more prone to wind erosion.

Rates of erosion can vary depending on the soil material and structure, placement and human activity. The erosion potential for soils in the project is variable throughout the project area. Soils containing high amounts of silt can be easily eroded while sandy soils are less susceptible. Excessive soil erosion can lead to damage of building foundations, roadways, dam embankments and increased sedimentation to drainage ways.

The effects of excessive erosion range from nuisance problems that require additional maintenance, such as increased siltation in storm drains, to extreme cases where water courses are down cut and gullies develop, which can eventually undermine adjacent structures or vegetation. Human activities that disturb soils in arid regions increase wind erosion potential. The project area includes numerous landscapes from inland desert environments, coastal bluffs, alluvial plains, to steep ridgelines. For this reason, and in conjunction with the activities proposed in Chapter 3.0 Project Description, the erosion hazard is considered a significant issue that is further addressed in the impact analysis.

## *SEISMICITY*

The project area, and California as a whole, has experienced significant seismic events within the past. The San Francisco Bay Area and southern California regions within the project area contain both active and potentially active faults and are considered regions of high seismic activity.[4] The 1997 Uniform Building Code (UBC) locates the entire Bay Area and western southern California regions within Seismic Risk Zone 4. Portions of the project area within the Central Valley are

[4] An *active* fault is defined by the State of California as a fault that has had surface displacement within Holocene time (approximately the last 10,000 years). A *potentially active* fault is defined as a fault that has shown evidence of surface displacement during the Quaternary (last 1.6 million years), unless direct geologic evidence demonstrates inactivity for all of the Holocene or longer. This definition does not, of course, mean that faults lacking evidence of surface displacement are necessarily inactive. *Sufficiently active* is also used to describe a fault if there is some evidence that Holocene displacement occurred on one or more of its segments or branches (Hart, 1997).

located in Seismic Zone 3. Areas within Zone 4 are at the highest risk from earthquakes and consequently, are expected to experience maximum magnitudes and damage in the event of an earthquake. Although both Seismic Zones 3 and 4 are susceptible to earthquake ground shaking and particular seismic design criteria are required under the UBC, minimum requirements for design in Seismic Zone 4 are typically more rigorous those required under Seismic Zone 3.

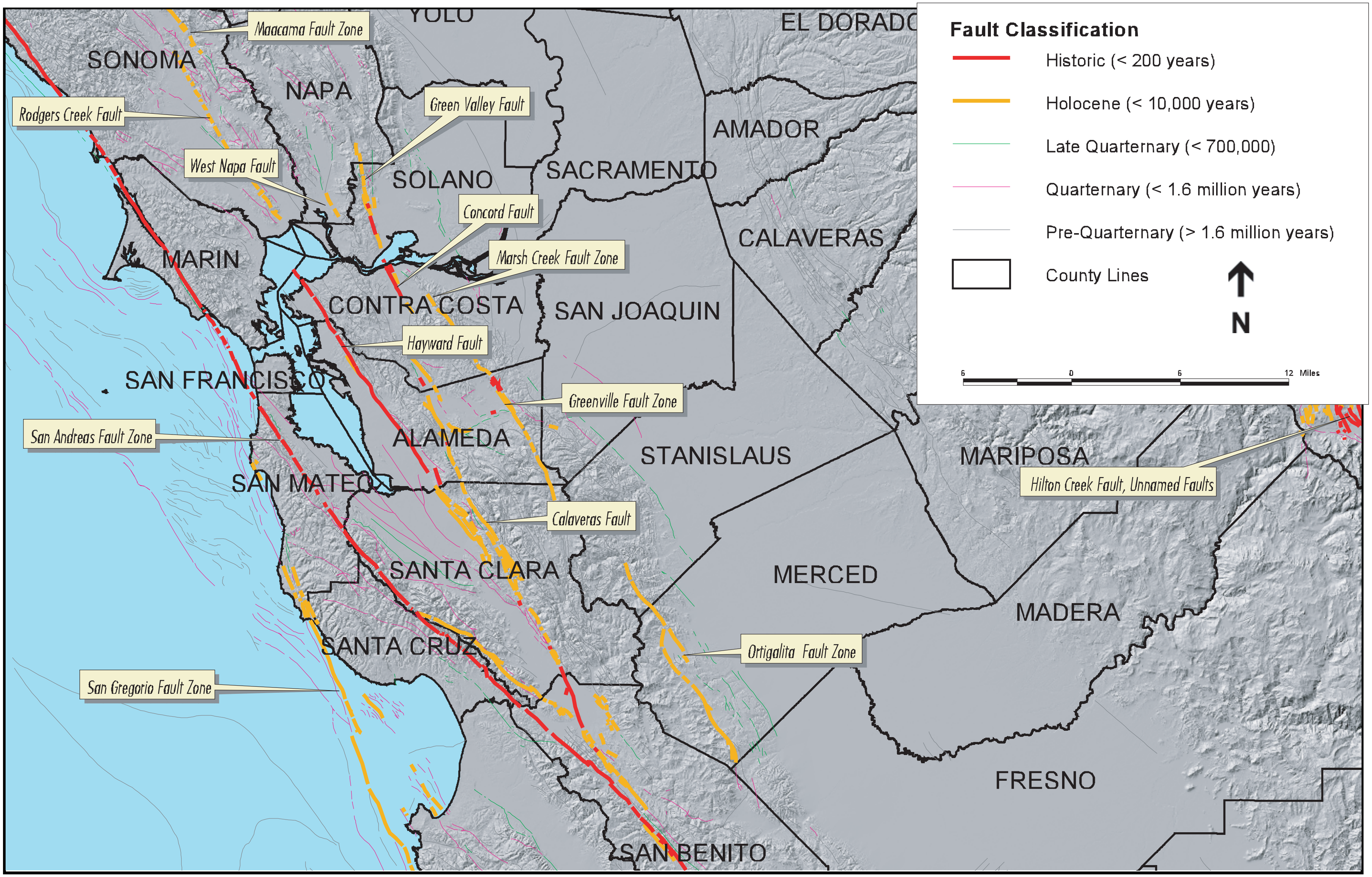
### *REGIONAL FAULTS*

A fault is a fracture in the crust of the earth along which there has been displacement of the sides relative to one another parallel to the fracture. Most faults are the result of repeated displacements over a long period of time. The project area contains numerous lateral strike slip faults[5] such as the San Andreas fault and various identified and hidden blind thrust faults[6]. These faults are illustrated in **Figures 4.6-1** and **4.6-2**. A fault trace is the surface expression of a particular fault. Buried or blind thrust faults are thought to underlay much of the project area. These “buried” faults do not exhibit readily identifiable traces on the earth’s surface and are typically at considerable depth within the underlying geologic formation. Although these faults typically do not offset surface deposits, they can generate substantial ground-shaking.

Over the past 100 years, several earthquakes of magnitude 5.0 or larger have been reported on the active San Andreas, San Jacinto, Elsinore, Garlock, and Newport-Inglewood fault systems, all of which traverse the Southern California region. The northern extent of the San Andreas fault in northern California has also experienced a high level of seismicity. Within the northern California portion of the project area, the San Andreas and Hayward faults are the two principally active fault system that have experienced movement in the last 150 years. Other principal fault systems within the Bay Area region of the project include the Rodgers Creek-Healdsburg fault, the Calaveras fault, San Gregorio-Hosgri Fault Zone, and the Concord-Green Valley fault. Major seismic events along the faults include the 1906 San Francisco earthquake, the 1868 Hayward earthquake, and the 1989 Loma Prieta earthquake. In Southern California, the last earthquake exceeding Richter magnitude 8.0 occurred in 1857. Much more frequent are smaller temblors like the moderate 1971 San Fernando and 1994 Northridge earthquakes; both of these magnitude 6.7 quakes were very damaging. Very recently, a magnitude 7 earthquake affected the region in the Mojave Desert, east of the Los Angeles/San Diego area. **Figure 4.6-1** and **Figure 4.6-2** illustrates the locations of the Quaternary or younger faults in the Southern and Northern California portions of the project area. **Table 4.6-1** provides the slip rate, maximum moment magnitude, recency of faulting for active faults in the vicinity of the project area, and counties in which the fault passes through.

[5] A fault in which the movement is essentially horizontal.

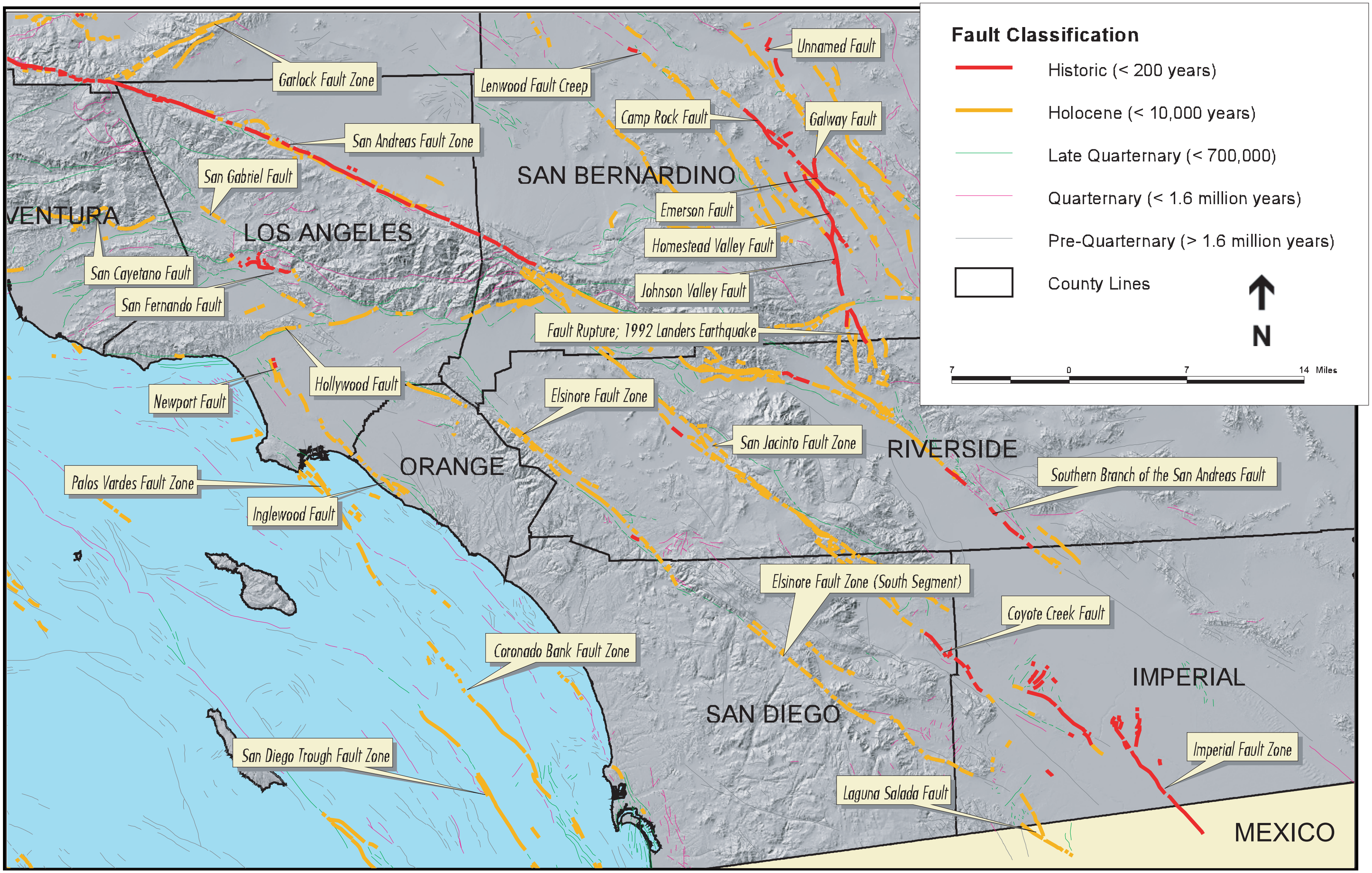
[6] A reverse fault, whereby the hanging wall has moved up relative to the footwall.




SOURCE: Jennings Fault Activity Map, 1994 and 2001;
modified by Environmental Science Associates, 2002



**Figure 4.6-1**
Regional Fault Locations in
Northern California

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SOURCE: Jennings Fault Activity Map, 1994 and 2001;
modified by Environmental Science Associates, 2002

**Figure 4.6-2**
Regional Fault Locations in
Southern California

## TABLE 4.6-1
## MAJOR ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE PROJECT AREA

| Fault Zone | Counties | Recency of Faulting[a] | Slip Rate[b] (mm/year) | Maximum Moment Magnitude[c] |
|---|---|---|---|---|
| **Southern California** | | | | |
| San Andreas | Los Angeles, San Bernardino, Riverside, Ventura, Imperial | Historic | 34.00 | 6.8 to 7.9 |
| San Jacinto | San Bernardino, Riverside, and Imperial | Holocene, Late Quaternary | | 6.6 to 7.2 |
| Elsinore | Imperial | Holocene | 2.50-5.00 | 6.8 to 7.1 |
| Garlock | San Bernardino | Historic, Holocene | 6.00 | 6.5 to 7.1 |
| Sierra Madre | Los Angeles | Holocene, Late Quaternary | 3.00 | 6.7 to 7.0 |
| Santa Susana | Los Angeles, Ventura | Historic, Late Quaternary | 5.00 | 6.6 |
| Newport-Inglewood | Los Angeles, Orange | Late Quaternary | 1.00 | 6.9 |
| Oak Ridge | Los Angeles | Holocene, Late Quaternary | 4.00 | 6.9 |
| **Northern California** | | | | |
| San Andreas (Peninsula and Golden Gate Segments) | Santa Clara, San Mateo, Marin | Historic | 17.0 | 7.3 |
| Hayward | Alameda, Contra Costa | Historic | 9.0 | 6.9 |
| Calaveras | Santa Clara, Alameda | Historic | 15.0 | 6.8 |
| Concord-Green Valley | Solano, Napa | Historic | 6.0 | 6.9 |
| Dunnigan Hills | Yolo | Holocene | N/A | N/A |
| Healdsburg-Rodgers Creek | Sonoma | Holocene | 9.0 | 7.0 |
| Marsh-Greenville | Contra Costa | Historic | 2.0 | 6.9 |
| Ortigalita | Merced, Stanislaus | Holocene | 1.0 | 6.9 |
| West Napa | Napa | Holocene | 1.0 | 6.5 |

a Recency of faulting from Jennings, 1994. Historic: displacement during historic time (within last 200 years), including areas of known fault creep; Holocene: evidence of displacement during the last 10,000 years; Quaternary: evidence of displacement during the last 1.6 million years; Pre-Quaternary: no recognized displacement during the last 1.6 million years (but not necessarily inactive). Multiple periods are listed when different branches have shown displacement for different geologic periods.

b Slip Rate = Long-term average total of fault movement including earthquake movement, slip, expressed in millimeters.

c The Maximum Moment Magnitude is an estimate of the size of a *characteristic* earthquake capable of occurring on a particular fault. Moment magnitude is related to the physical size of a fault rupture and movement across a fault. Richter magnitude scale reflects the maximum amplitude of a particular type of seismic wave. Moment magnitude provides a physically meaningful measure of the size of a faulting event (CDMG, 1997b). Richter magnitude estimations can be generally higher than moment magnitude estimations. Ranges are provided for certain fault zones due to different magnitudes calculated for different branches of the fault zone.

NA = Not applicable and/or not available.

SOURCES: Jennings, C. W., 1994, Fault Activity Map of California (with Appendix), California Division of Mines and Geology, Geologic Data Map No. 6; Peterson, M. D., Bryant, W. A., Cramer, C. H., 1996, Probabilistic Seismic Hazard Assessment for the State of California by the California Department of Conservation, Division of Mines and Geology, Open File Report 96-08, USGS Open-File Report 96-706.

## *STATEWIDE SEISMIC HAZARDS*

Movements on the previously identified faults and fault systems (see **Table 4.6-1**) could potentially experience displacement in future, thereby resulting in earthquakes throughout much of the project area. Future earthquakes can originate where energy along a fault has built up and has not yet been released in earthquakes. Studies supported by the National Earthquake Hazards Reduction Program enable scientists to evaluate the hazard level in different areas. In Southern California, scientists estimate that the probability of a magnitude 7.0 or greater earthquake by the year 2024 approaches 80 to 90 percent. The four major hazards generally associated with earthquakes are ground shaking, fault surface rupture (ground displacement), liquefaction ground failures, and settlement. (WGCEP 1995).

## *STATEWIDE GEOLOGIC HAZARDS*

The northern and southern portions of the project area have similar soil types, seismic regimes, and geology. The geology in both can vary from upland areas underlain by bedrock to alluvial flatlands. Because of this varied geology, geologic hazards that could affect the proposed project include slope instability (landsliding), settlement, and volcanism.

### Settlement

Loose, soft soil material comprised of sand, silt and clay, if not properly engineered, has the potential to settle after a building is placed on the surface. Settlement of the loose soils generally occurs slowly but over time can amount to more than most structures can tolerate. Building settlement could lead to structural damage such as cracked foundations, misaligned or cracked walls and windows. Settlement problems are site-specific and can generally be remedied through standard engineering applications. This issue is further discussed in the impact analysis.

### Landslides

Generally, a slope can fail when its ability to resist movement decreases and the stresses on a slope increase. The material in the slope and external processes such as climate, topography slope geometry, and human activity can render a slope unstable and eventually initiate slope movements and failures. Factors that decrease resistance to movement in a slope includes pore water pressure, material changes, and structure. Changes in slope material such as improperly engineered fill slopes can alter water movement and lead to chemical and physical changes within the slope. This impact is discussed further in the impact analysis.

### Volcanism

The three most prominent volcanic features in California are Mount Shasta, Mammoth Lakes, and Mount Lassen. The most recent eruption in California was the violent eruption at Lassen Peak (1914-1917) (Jennings, 1994). Mount Shasta has also been extensively studied and some 14 eruptions in the last 10,000 years have been identified and dated (Jennings, 1994). The last eruption of Mount Shasta occurred about 200 years ago. It is reasonable to expect future volcanic eruptions in California, however the location and timing is uncertain. With the relatively distant proximity of volcanic features from the project area, the risk associated with volcanic hazards is considered low. For this reason, this issue is no longer discussed in the document.

### *MINERAL RESOURCES*

The California Division of Mines and Geology (CDMG) has classified lands within the San Joaquin Valley region into Mineral Resource Zones (MRZs) based on guidelines adopted by the California State Mining and Geology Board, as mandated by the Surface Mining and Reclamation Act (SMARA) of 1975 (Stinson et al., 1983). The CDMG classified lands within the project area according to the presence or absence of significant sand, gravel, or stone deposits that are suitable as sources of aggregate. Areas classified as MRZ-1 are areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little or no likelihood exists for their presence. MRZ-2 areas are those where adequate information indicates that significant deposits are present. Areas classified as MRZ-3 contain mineral deposits, but their significance cannot be evaluated from available data. Areas are classified as MRZ-4 where available information is inadequate for assignment to any other MRZ category.

Mineral resource extraction occurs in various portions of California, but is generally limited to non-urban areas. Each county's General Plan is required to identify significant mineral resource areas and apply appropriate land use designations to ensure their future availability. Most of the comprehensive mineral resource mapping in California has been completed for urban areas where there is a high probability that converted land uses would be incompatible with mining. As previously indicated, the project area includes mainly urbanized regions of California and will be limited to existing rights-of-way. Consequently, significant caches of mineral resources will not likely be affected by the proposed project. For this reason, this issue is not discussed further in the document.

## 4.6.2 REGULATIONS, APPROVALS, AND PERMITS APPLICABLE TO GEOLOGY, SOILS, AND SEISMICITY

### *STATE REGULATIONS*

#### California Building Code

The *California Building Code* is another name for the body of regulations known as the California Code of Regulations (CCR), Title 24, Part 2, which is a portion of the California Building Standards Code (CBSC, 1995). Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable (Bolt, 1988). Published by the International Conference of Building Officials, the Uniform Building Code (UBC) is a widely adopted model building code in the United States. The California Building Code incorporates by reference the Uniform Building Code with necessary California amendments. About one-third of the text within the California Building Code has been tailored for California earthquake conditions. Although widely accepted and implemented throughout the United States, local, city and county jurisdictions can adopt the UBC either in whole or in part.

### Alquist-Priolo Special Study Zones

The Alquist-Priolo Earthquake Fault Zoning Act of 1971 requires that special geologic studies be conducted to locate and assess any active fault traces in and around known active fault areas prior to development of 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 Alquist-Priolo Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. This Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. Surface rupture is the most easily avoided seismic hazard.

### Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. The purpose of the Act is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. The program and actions mandated by the Seismic Hazards Mapping Act closely resemble those of the Alquist-Priolo Earthquake Fault Zoning Act.

### *COUNTY AND CITY CONTROLS*

### General Plans and Seismic Safety Element

Cities and county governments typically develop as part of the General Plans, safety and seismic elements that identify goals, objectives, and implementing actions to minimize the loss of life, property damage and disruption of goods and services from man-made and natural disasters including floods, fires, non-seismic geologic hazards and earthquakes. General Plans can provide policies and develop ordinances to ensure acceptable protection of people and structures from risks associated with these hazards. Ordinances can include those addressing unreinforced masonry construction, erosion or grading.

## 4.6.3 IMPACT ANALYSIS

### *APPROACH TO ANALYSIS*

The impact assessment used a qualitative analysis to address project-related impacts in relation to geologic hazards, affects on soil resources, and the primary and secondary effects of earthquakes. Geologic and seismic hazards that, because subsequent activities could expose people to injury and infrastructure to damage were considered in terms of an adverse impact to public safety. Loss of soil resources from erosion and sedimentation potentially caused by proposed activities were considered in terms of depletion or as having other adverse effects on soil resources. The proposed project elements were evaluated in terms of the level of significance and whether the impacts were considered not significant, less than significant or significant.

## *IMPACT MECHANISMS*

Geology, seismicity, and soil impact mechanisms include damage to subsequent activities by seismic events, static soil movement and erosion. Groundshaking from seismic events can cause secondary hazards such as surface fault rupture, liquefaction and settlement of soils. Settlement can also occur in improperly placed artificial fills and compressible soils when subject to static loads. Initiation of shallow landslides and accelerated erosion can be caused by soil disturbance during the installation of the cable and other system facilities. This analysis addresses impacts that are reasonably foreseeable according to the geographic scope and context of the proposed project.

## *SIGNIFICANCE CRITERIA*

The CEQA Guidelines establish that a significant impact would be expected to occur if the project would:

- 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. Refer to CDMG Special Publication 42.

  ii) Strong seismic ground shaking.

  iii) Seismic-related ground failure, including liquefaction.

  iv) Landslides.

- Result in substantial soil erosion or the loss of topsoil.

- Be located on strata 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, as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property.

- Sediments being discharged at the surface of the site contain materials that would result in significant toxicity or bioaccumulation of contaminants, inhibit revegetation, or result in contaminated vegetation; or

- Result in the loss of availability of a known mineral resource classified MRZ-2 by the State Geologist that would be of value to the region and the residents of the state.

## *IMPACT STATEMENTS AND MITIGATION MEASURES*

**Impact GEO-1: The project area is traversed by numerous active and potentially active faults. Displacement along any one of these faults could result in significant structural damage to proposed facilities and structures. Ground-shaking associated with the displacement of one of these faults could potentially expose project-related structures to seismic-related hazards, including localized fault rupture, liquefaction, and other related ground failures. With the implementation of standard engineering practices, this impact is considered less than significant. (Less than Significant)**

As provided, in Chapter 3.0 of the Project Description, the project would involve the installation of fiber optic cable and association facilities. As stated in Section 3.2 of the Project Description, Sempra Communications would utilize several different methods for the installation of fiber optic cable. These methods to be employed include open trenching, plow and trenching, directional borings, or aerial installation and are described in detail under Section 3.2 of the Project Description. The project may also involve the construction of periodic above-ground facilities referred to as regenerator or OP-AMP stations to reconstruct or boost optical signals over long distances.

The project area will likely experience at least one major earthquake (greater than moment magnitude 7) within the next 30 years. The intensity of such an event will depend on the causative fault and the distance to the epicenter, the moment magnitude and the duration of shaking. Damage due to ground-shaking could disturb or cause breakage to one or more of the previously identified project facilities. The resulting damage to these facilities could result in a temporary disruption of communications on the affected networks, thereby potentially indirectly affecting communications between public service entities and/or emergency service providers. Likewise, if damage from seismically-induced ground failure were to occur, it could temporarily disrupt telecommunications infrastructure and result in periods of interrupted service while the system is inspected and repaired. The impact severity of seismically-induced ground failures would be reduced because the cable system would be placed primarily within existing roadways, on existing electrical towers, and railroad easements that contain engineered fills and are designed to withstand adverse effects of seismically-induced ground failures. Where subsequent activities cross identified Alquist-Priolo Fault Rupture Zones, the infrastructure design will incorporate elements that allow the cable or associated facilities to compensate for surface offsets such as flexible joints in cable segments.

Geotechnical studies conducted as part of the final design phase for subsequent activities would determine susceptibility to geologic and seismic hazards in areas of the proposed activities and

OP-AMP station buildings. Design and construction of these structures would be in accordance with geotechnical recommendations that incorporate applicable UBC standards required by the appropriate local building department. The prefabricated OP-AMP station structures will not be inhabited and are certified by the manufacturer to meet necessary seismic design standards. Therefore, any damage will not affect humans or the environment. Ground-shaking is considered a less than significant impact because the proposed project would not result in an increased exposure of individuals to the adverse effects of ground-shaking or increase the severity of the ground-shaking in the project area. For these reasons, this impact is considered less than significant.

**Mitigation Measure:** No mitigation is required.

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**Impact GEO-2: Construction operations and periodic repair operations could result in temporary accelerated erosion and sedimentation from soil disturbance and vegetation removal. (Potentially Significant)**

Although erosion is a natural process, accelerated erosion is often caused by human activities. Soils in the project area, many of which are already disturbed, vary widely with respect to their erosion hazard. Ground disturbing activities, including the removal of vegetation, can cause increased runoff rates and concentrated flows, which may result in accelerated erosion and concomitant loss in soil productivity. The eroded material, or sediment, could degrade the quality of receiving waters.

With implementation of Best Management Practices (BMPs) prepared for the project SWPPP, outlined in Section 4.8, Hydrology and Water Quality, and in Section 4.4, Biology, construction impacts to water quality would not be expected to degrade water quality in drainages within the project area, or cause adverse levels of soil erosion.

**Mitigation Measure GEO-2a:** Implement **Mitigation Measures HYD.1a and BIO.8**

**Significance after Mitigation:** Less than significant.

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**Impact GEO-3: The project area could be subjected to geologic hazards including differential settlement, expansive soils, and slope failure. (Less than Significant)**

Soil settlement presents a hazard in areas with variable thickness of previous and new fills, as well as natural variations in the thickness and compressibility of the soils. Static or seismically-induced settlement of soils could damage project-related facilities over the life of the project. Settlement would typically be expected to adversely affect above-ground structures rather than the fiber cable. Structures impose additional weight on the soil and can induce settlement. The impact of settlement is considered less than significant because proper engineering and construction techniques will eliminate this hazard and because any damage that does occur will not have an adverse physical effect on humans or the environment.

Expansive soils will potentially be encountered within finer-textured alluvial deposits along future project-specific alignments. Expansive soils, as defined in Table 18- 1-B of the UBC soils are clay-rich surficial materials that shrink and swell as a result of dehydration of clay materials during periods of wetting and drying. Buried fiber optic cable is generally not impacted by expansive soils, if proper engineering techniques are used. However, expansive soils along underground telecommunications infrastructure could result in distress to above-ground structures, foundations, and sensitive equipment. With the implementation of standard engineering practices, this impact is considered less than significant.

The susceptibility of land (slope) failure is dependent on the slope and underlying geology, as well as the amount of rainfall, excavation or seismic activities. Areas most susceptible to landsliding are characterized by steep slopes and include most existing landforms that exhibit substantial evidence of down-slope creep of surface materials. Typically, applicable geotechnical engineering remedies were previously incorporated into the roadway and railroad design to reduce the likelihood of soil failure. However, in a few areas the installation may potentially require excavation into steep slopes, some of which are subject to mass movement (i.e., landsliding, debris flows). The areas of existing and potential instability will be avoided to the extent practicable. Geotechnical analysis would be conducted in areas where the subsequent activities must pass through a potentially unstable area. Geotechnical recommendations may include cable rerouting or methods to stabilize the cable facilities in areas with unstable slopes. Geotechnical studies during the final design phase would determine susceptibility to slope instability in areas of proposed OP-AMP station construction. Design and construction of OP-AMP stations would be in accordance with geotechnical recommendations that incorporate UBC standards required by the local building departments for construction. The proposed project itself would not increase the potential for slope failures and would not result in exposing people, property or the environment to additional slope stability hazards. Therefore, this impact is considered less than significant.

**Mitigation Measure:** No mitigation is required.

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