3.7 Geology, Soils, and Paleontology

3.7.1 Introduction

This section describes effects related to geology, soils, and paleontology that would be caused by implementation of the TRTP. The following discussion addresses existing environmental conditions in the affected area, identifies and analyzes environmental impacts for a range of Project alternatives, and recommends measures to reduce or avoid adverse impacts anticipated from Project construction and operation. In addition, existing laws and regulations relevant to geology, soils, and paleontology are described. In some cases, compliance with these existing laws and regulations would serve to reduce or avoid certain impacts that might otherwise occur with the implementation of the Project.

The information and analysis that is presented in this section has been derived from the *Tehachapi Renewable Transmission Project Geology, Soils, and Paleontology Specialist Report*, prepared by Geotechnical Consultants, Inc. (2008). While this section presents the findings of the *Geology, Soils, and Paleontology Specialist Report*, please refer to that report for more detailed information on Project effects related to geology, soils, and paleontology.

Scoping Issues Addressed

During the scoping period for the EIR/EIS (August-October 2007), a series of scoping meetings were conducted with the public and government agencies, and written comments were received by agencies and the public that identified issues and concerns. The following issues related to geology, soils, and paleontology that were raised during scoping are addressed in this section:

- Natural disasters could cause towers to fall (address soil stability and/or seismic fault proximity).
- Necessity for liquefaction studies/analysis, including recent research data on local faults such as the Whittier, Puente Hills Blind Thrust, and the Elysian Park Blind Thrust.

Summary and Comparison of Alternatives

Table 3.7-1 on the following page presents some key factors related to geology, soils, and paleontology for each alternative, including a summary of the direct and indirect effects of the TRTP alternatives related to geology, soils, and paleontology. These impacts are further described in Sections 3.7.5 through 3.7.11.

3.7.2 Affected Environment

Baseline geologic, seismic, soils, and paleontological information were collected from published and unpublished literature, GIS data, and online sources for the proposed Project and the surrounding area. The literature and data review was supplemented by field reconnaissance. The literature review and field reconnaissance focused on the identification of specific geologic hazards and paleontologic resources along and adjacent to the Project ROW.

3.7.2.1 Regional Setting

The Tehachapi Renewable Transmission Project is located within the Mojave Desert and Transverse Ranges geomorphic provinces of southern California, which is characterized by a complex series of mountain ranges and valleys with dominant east-west trends. The TRTP traverses six distinct geographic

Table 3.7-1. Summary Comparison of Environmental Issues/Impacts – Geology, Soils, and Paleontology

Environmental Issues / Impacts	Alternative 1 (No Project/Action)	Alternative 2 (SCE's Proposed Project)	Alternative 3 (West Lancaster)	Alternative 4 (Chino Hills)	Alternative 5 (Partial Underground)	Alternative 6 (Max. Helicopter in ANF)	Alternative 7 (66-kV Subtransmission)
Project activities could interfere with access to known energy resources (Impact G-1)	Construction of new T/Ls of comparable length and new/ upgraded/expanded substations in lieu of the Project would have the same impacts where near active oil fields.	Construct 853 new transmission structures across 172.9 miles near 2 active oil fields.	Construct 852 new transmission structures across 173.3 miles near 2 active oil fields.	Construct 762 (4A) to 802 (4C) new transmission structures across 157 (4A) to 163 (4C) miles near 2 active oil fields.	Construct 838 new transmission structures across 172.9 miles near 2 active oil fields.	Same as Alternative 2.	Same as Alternative 2.
Erosion could be triggered or accelerated due to construction activities (Impact G-2)	Construction of new T/Ls in areas with comparable soils in lieu of the Project would have the same impacts.	Soil erosion could occur due to grading and excavation at new and modified access and spur roads, storage yards, 853 tower locations, 12 helicopter staging areas, one new substation, and expansion at five existing substations.	Construct approx. 2 miles of new access road; two additional towers and spur roads.	Despite shorter length and fewer towers compared to other alternatives, the potential for erosion is increased due to the need for access/spur roads in the Chino Hills State Park (CHSP). Approx. miles of additional roads: Alts 4A & 4B – 6.5 mi; Alts 4C & 4D – 9.5 mi.	Construction of large transition stations would disturb more soil resulting in increased potential to trigger or accelerate erosion.	Use of helicopter construction results in less grading of access and spur roads and one less helicopter staging area that would potentially need to be graded compared to Alternative 2. The overall ground disturbance during construction would be reduced by approximately 82 acres compared to Alternative 2, resulting in a decreased potential to trigger or accelerate erosion.	Construction of underground 66-kV re-routes would require additional excavation and trenching resulting in slightly more disturbance of soil resulting in incrementally increased potential to trigger or accelerate erosion.
Excavation and grading during construction activities could cause slope instability or trigger landslides (Impact G-3)	New T/Ls in hillside areas may or may not encounter areas of landslides and unstable slopes.	Slope failures could be triggered by construction related excavation and grading of access and spur roads, helicopter staging areas, and new towers through approximately 77 miles of hillside and mountain areas with known landslides and unstable slopes.	Same as Alternative 2.	Greater risk of slope instability due to increased length of alignment which would result in increased ground disturbance in the landslide-prone Puente Formation. Approx. mileage of new roads and towers in hillside area with known landslide potential:	Incrementally less than Alternative 2 because construction bypasses some towers along hillsides in the landslide prone Puente Formation.	Reduced construction and grading of access and spur roads in steep mountainous terrain (approximately 60 less acres of ground disturbance during construction than Alternative 2) resulting in a decreased potential to trigger landslides or slope instability during construction.	Same as Alternative 2.

Table 3.7-1. Summary Comparison of Environmental Issues/Impacts – Geology, Soils, and Paleontology

Environmental Issues / Impacts	Alternative 1 (No Project/Action)	Alternative 2 (SCE's Proposed Project)	Alternative 3 (West Lancaster)	Alternative 4 (Chino Hills)	Alternative 5 (Partial Underground)	Alternative 6 (Max. Helicopter in ANF)	Alternative 7 (66-kV Subtransmission)
				Alts 4A & 4B – 2.7 mi.; Alts 4C & 4D – 9.5 mi.			
Project structure damage from surface fault rupture at crossings of active faults exposing people or structures to hazards (Impact G-4)	Construction of new T/Ls may or may not cross active faults with surface rupture potential.	New T/Ls cross or parallel active faults in 9 locations.	Same as Alternative 2.	Minor decrease for Alternatives 4A and 4C due to one less fault crossing (Chino-Central Ave fault, which is not a large significantly active fault). Otherwise the same as Alternative 2. Slightly increased potential for fault rupture for Alternative 4B and 4D due to the to the location of the switching station adjacent to or on the mapped trace of the Alquist-Priolo zoned Chino Fault	Incrementally increased due to underground construction proposed across the projected trend of the active of Chino fault at eastern end of tunnel and at eastern transition station.	Same as Alternative 2.	Same as Alternative 2.
Project structure damage from seismically induced groundshaking and/or ground failure exposing people or structures to hazards (Impact G-5)	New T/Ls throughout the southern California will be exposed to seismic groundshaking; may or may not be located in areas susceptible to ground failure (liquefaction, landslides, unstable slopes).	New T/Ls, and new or expanded substations would be exposed to strong groundshaking, and local areas of low to moderate liquefaction potential, seismically induced landslides and slope failure.	Same as Alternative 2.	Slightly greater risk of earthquake-induced landslides due to the increased length of the alignment in landslide prone Puente Formation. Approx. number of additional towers placed in landslide-prone areas: Alternative 4A - 15; Alternative 4B - 23; Alts 4C & 4D - 28.	Incrementally less than Alternative 2 because construction bypasses some towers along hillsides in the landslide-prone Puente Formation, resulting in less potential for earthquake induced landslide damage.	Same as Alternative 2.	Same as Alternative 2.
Project structure damage from problematic soils exposing people or structures to hazards	Construction of new T/Ls and substations may or may not be in areas of unsuitable soil.	New T/Ls, new substation, and expanded substations are located locally in areas of unsuitable soils.	Same as Alternative 2.	Slightly less potential for damage to Project structures due to unsuitable soils because the shorter length would require	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 3.7-1. Summary Comparison of Environmental Issues/Impacts – Geology, Soils, and Paleontology

Environmental Issues / Impacts	Alternative 1 (No Project/Action)	Alternative 2 (SCE's Proposed Project)	Alternative 3 (West Lancaster)	Alternative 4 (Chino Hills)	Alternative 5 (Partial Underground)	Alternative 6 (Max. Helicopter in ANF)	Alternative 7 (66-kV Subtransmission)
(Impact G-6)				fewer towers. Approx. reduction in towers: Alternative 4A – 91; Alternative 4B – 72; Alternative 4C – 51; Alternative 4D – 62.			
Transmission line structure damage from landslides, earth flows, or debris slides, during operation (Impact G-7)	Construction of new T/Ls and substations may or may not be in hillside areas with landslides or other types of slope failures.	Approximately 360 new towers would be constructed through 77 miles of hillside and mountain areas with known landslides and unstable slopes.	Same as Alternative 2.	Greater risk of slope instability due to increased length of alignment in landslide-prone Puente Formation. Approx. number of additional towers in landslide-prone areas: Alternative 4A - 15; Alternative 4B - 23; Alts 4C & 4D - 28.	Incrementally less than Alternative 2 because construction bypasses some towers along hillsides in the landslide-prone Puente Formation.	Same as Alternative 2	Same as Alternative 2
Grading and excavation could destroy paleontologic resources (Impact G-8)	Construction of comparably-sized substations and length of T/L would have the same impacts as the Project.	Ground disturbance due to construction of new transmission structures and access and spur roads across approximately 66.4 miles of geologic units with moderate to high paleontologic sensitivity.	Same as Alternative 2.	Increased grading and excavation in geologic unit having high paleontologic sensitivity. Approximate miles of additional roads: Alternatives 4A and 4B – 6.5 miles; Alternatives 4C and 4D – 9.5 miles. Approximate reduction in towers: Alternative 4A – 91; Alternative 4B - 72; Alternative 4C - 51; Alternative 4D - 62.	Incrementally increased due to the greater ground disturbance required for tunneling and construction of the transition stations in units with moderate to high paleontologic sensitivity.	Same as Alternative 2.	Slightly increased due to the greater ground disturbance required for trenching and excavation for underground 66-kV re-routes in units with moderate paleontologic sensitivity.

Table 3.7-1. Summary Comparison of Environmental Issues/Impacts – Geology, Soils, and Paleontology

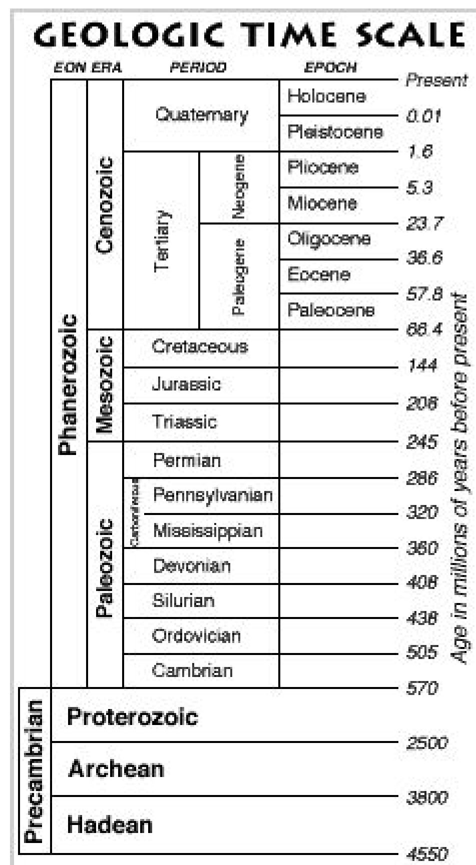
Environmental Issues / Impacts	Alternative 1 (No Project/Action)	Alternative 2 (SCE's Proposed Project)	Alternative 3 (West Lancaster)	Alternative 4 (Chino Hills)	Alternative 5 (Partial Underground)	Alternative 6 (Max. Helicopter in ANF)	Alternative 7 (66-kV Subtransmission)
Existing structures could be damaged by ground settlement along the tunnel exposing people or structures to hazards (Impact G-9)	Construction of new T/Ls may or may not include underground construction and tunneling.	Would not occur because no tunnels would be constructed.	Same as Alternative 2.	Same as Alternative 2.	Short-term (days) and long-term (years) settlement of the ground surface could occur during construction and operation of the tunnel and shafts (underground portion only).	Same as Alternative 2.	Same as Alternative 2.

areas, the Antelope Valley, the Leona Valley (the San Andreas Rift Zone), the Liebre-Sierra Pelona Mountains, the San Gabriel Mountains, San Gabriel Valley, the Montebello and Puente and Chino Hills, and the Chino Valley. The Antelope Valley consists of approximately 1200 square miles of elevated desert terrain, located along the western edge of the Mojave Desert. The Leona Valley is a small, northwest-southeast trending longitudinal valley formed by movement on multiple overlapping strands of the San Andreas Fault in the San Andreas Rift Zone, and in the Project area is bounded on the northeast by the Portal Hills and on the southwest by foothills of the Sierra Pelona. The Liebre-Sierra Pelona Mountains are a small northwest-southeast trending mountain range within the central Transverse Ranges. The San Gabriel Mountains are comprised of Precambrian to Cretaceous igneous and metamorphic rock. The San Gabriel and Chino Valleys are deep structural basins predominantly filled with semi- to unconsolidated Quaternary alluvial deposits. The Montebello Hills consist predominantly of Pliocene marine and nonmarine sedimentary rock, whereas the Puente and Chino Hills are composed of older (Miocene and Pliocene) marine sedimentary rock units.

This section presents a discussion of the regional geology, seismicity, soils, mineral resources, and paleontology in the Project area. Section 3.7.2.2 presents more specific discussions of each of these issues along the proposed route, broken up into three areas based on the general geologic character the various Project segments cross.

Geologic Setting

Exhibit 1. Geologic Time Scale



The Tehachapi Renewable Transmission Project segments cross five areas of distinctive geologic character and province, the Antelope Valley, the San Andreas Rift Zone, the Liebre-Sierra Pelona Mountains, the San Gabriel Mountains, and the Los Angeles Basin. The proposed TRTP route is underlain in various areas by sedimentary, volcanic, igneous, and metamorphic units ranging in age from Quaternary (approximately the last 1.6 million years) to Pre-Cenozoic (greater than 65 million years). Exhibit 1 (Geologic Time Scale) shows the geologic time scale indicating the breakdown of geologic time units and corresponding ages.

The proposed route crosses lacustrine deposits, alluvial plains and valleys, alluvial fans and pediments, mountain passes, and hills. In addition to data provided in the PEA, geologic maps from the California Geological Survey (CGS) Geologic Map Sheet Series (Bakersfield Sheet, 1965; Los Angeles Sheet, 1969; Long Beach Sheet, 1962; the Santa Ana Sheet, 1966; and the San Bernardino Sheet, 1986), scale 1:250,000, and 7-5 Minute Geologic Quadrangle maps (Dibblee 1989, 1996, 1997, 1998, 1999, 2001a, 2001b, 2001c, 2002a, 2002b, and 2002c), were reviewed to determine location of faults and location and type of geologic units crossed by the Project route. Approximate locations (milepost locations) of geologic units, descriptions, and general characteristics along the Project ROWs are presented in Section 3.7.2.2 by segment.

Antelope Valley. The Antelope Valley is primarily an alluviated desert plain containing bedrock hills and low mountains. Western Antelope Valley is characterized by relatively flat-lying topography and valley fill deposits. In the Project area and vicinity, the western Antelope Valley is covered primarily by alluvial deposits of Quaternary age: Holocene Alluvium and Pleistocene Older Alluvium. The Holocene alluvial deposits consist of slightly dissected alluvial fan deposits of gravel, sand and clay. The Older Alluvium is located primarily near the margins of the Antelope Valley at the flanks of Portal Ridge and consists of weakly consolidated, uplifted and moderately to severely dissected alluvial fan and terrace deposits composed primarily of sand and gravel (Dibblee, 2001c). The ridges are comprised of crystalline rocks of igneous and metamorphic composition. The west-trending Hitchbrook Fault, which diverges from the San Andreas Fault northwest of the Project area, separates Portal Ridge, with Pelona Schist on the southeast from granitic rocks on the northwest. Beyond the ridge, the Project alignment crosses into the San Andreas Rift Zone in Leona Valley (Norris and Web, 1990).

San Andreas Rift Zone. In the Project area, the San Andreas Fault lies within a linear, trough-like valley called the San Andreas Rift Zone. The Rift Zone in the Project area consists of several anastomosing fault segments (i.e. interlacing faults), which along with erosion by Amargosa Creek, has widened the zone into a valley, the Leona Valley. Holocene Alluvium, Pleistocene Older Alluvium, and the non-marine Pliocene Anaverde Formation underlie the Leona Valley. Exposed among interlacing fault strands within the San Andreas Fault Zone are several members of the Anaverde Formation: the sandstone, clay shale, and breccia members (CGS, 2003e; Dibblee, 2001c). The sandstone member is a medium-to thick-bedded, locally massive, fine to coarse-grained, locally pebbly, with local thin silty interbeds. The clay shale member is thin-bedded, sandy, silty, locally very gypsiferous clay shale with interbedded siltstone and sandstone layers. The breccia member is distinctive, reddish to dark gray, massive, pervasively sheared sedimentary breccia with angular clasts of hornblende diorite. Bedding within the Anaverde Formation strikes mostly parallel to the bounding faults, and has steep to vertical dips (CGS, 2003e).

Liebre-Sierra Pelona Mountains. The Liebre-Sierra Pelona Mountains are composed of late Mesozoic or older granitic and metamorphic rocks north of the Clearwater Fault, Paleocene (early Tertiary) San Francisquito Formation between the Clearwater and San Francisquito Faults, and Mesozoic Pelona Schist south of the San Francisquito Fault (Norris and Web, 1990). The granitic and metamorphic rocks consist of a complex mixture of biotite-rich, closely-fractured quartz diorite and gneiss with local inclusions of diorite and amphibolite. San Francisquito Formation is a layered marine clastic, lithified sedimentary rock formation comprised of thick-bedded arkosic sandstone, cobble and pebble conglomerate, and clay shale and siltstone. The Pelona Schist is primarily composed of distinctive bluish-gray schist that was metamorphosed from clastic and pryoclastic sedimentary rocks.

San Gabriel Mountains. The San Gabriel Mountains, part of the Transverse Ranges, are a 35 km-wide by 110 km-long, WNW-trending uplift bounded by the right-lateral San Andreas Fault on the north and the reverse San Fernando-Sierra Madre-Cucamonga faults on the south. The range is mainly composed of a complex of igneous and metamorphic rocks of Precambrian to early Cenozoic age. These igneous rocks include a diverse assemblage of Precambrian anorthosite-gabbro and Mesozoic granitic rocks (granodiorite, quartz monzonite, quartz diorite, gabbro) which complexly intrude various metamorphic rocks (gneiss, schist, and mylonite) of Precambrian to Mesozoic age. Sedimentary rocks (sandstone, shale, siltstone, and conglomerate) of Cenozoic age locally overlie the crystalline rocks mostly in the westernmost part of the range and occur extensively in the Santa Susana Mountains and unnamed hills to the north (McCalpin & Hart, 2002).

In the San Gabriel Mountains slopes are very steep, ridge tops are narrow, local relief ranges from several hundred to several thousand feet, rocks are dominantly intrusive or gneissic rocks, and local shearing and hydrothermal alteration zones are abundant and control local physiography. The San Gabriel Mountains rise abruptly from the San Fernando and San Gabriel Valleys (with approximate elevations of 900 to 1800 feet at the base of the range front) to an elevation of up to 10,065 feet at Mount San Antonio in the far eastern part of the range. In the range itself major canyons are incised approximately 900 to 1800 feet into a rugged topography where slopes are near the angle of repose, and ridge crests reach relatively uniform heights of 4500 to 6300 feet. Higher elevations are found only in the southeastern part of the range around Mt. San Antonio.

Los Angeles Basin. The Project crosses through the northeastern block of the Los Angeles basin, which is a northwest to southeast triangular wedge about 35 miles and is about 18 miles wide at its widest point. The northeastern block of the Los Angeles basin includes the Repetto, Puente, and San Jose Hills, the San Gabriel Valley, and the Chino basin. The Los Angeles basin developed in the Neogene (Miocene and Pliocene) as a result of regional crustal extension associated with the clockwise rotation of the Transverse Ranges during a crustal upheaval caused by a shift in the surrounding mountains. The underlying crustal weakening resulted in the formation of a large synclinal basin in which sediment from the sea and rivers accumulated, building up in thick layers. Since the early Pliocene, the basin has been deformed by numerous strike-slip, reverse, and blind-thrust faults that accommodate the oblique convergence between the Pacific and North American plates. This tectonic history has resulted in a complex physiographic and geologic structure in the Los Angeles basin (Komatitsch et. al, 2004).

The Los Angeles Basin is divided into four crustal blocks by significant northwest-trending faults. These are informally designated the southwestern, northwestern, central and northeastern blocks. Main faults involved in this division are: the Newport-Inglewood Fault Zone separating the central from the southwestern block, the Whittier Fault Zone separating the central from the northwestern block, and the east–west trending Santa Monica Fault Zone separating the northwestern from all other blocks. The TRTP alignment in the Los Angeles Basin crosses geographic features of the northeastern block, including the San Gabriel Valley, Puente Hills, Chino Hills, and Chino Basin.

Geologic Hazards

Slope Stability

Important factors that affect the slope stability of an area include the steepness of the slope, the relative strength of the underlying rock material, and the thickness and cohesion of the overlying colluvium. The steeper the slope and/or the less strong the rock, the more likely the area is susceptible to landslides. The steeper the slope and the thicker the colluvium, the more likely the area is susceptible to debris flows. Another indication of unstable slopes is the presence of old or recent landslides or debris flows.

Most of the proposed route does not cross any areas mapped as identified existing landslides; however, where the alignments cross mountainous and hilly areas they are partially underlain by landslide prone metamorphic (Pelona Schist and weathered gneiss), sheared igneous and metamorphic (along the San Gabriel fault), and sedimentary (Puente Formation) rocks that are susceptible to slope failures in areas with moderate to steep slopes and unfavorable bedding dip directions. Mapped landslides are present along and near the Project alignments where they cross these units. Unmapped landslides and areas of localized slope instability may also be encountered in the hills and mountains traversed by the proposed

Project route. Areas underlain by granitic rocks are generally only susceptible to surficial soil creep, or to rockfall in over-steepened areas.

Soils

The soils along the proposed route reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. The route crosses undeveloped desert and forest land, agricultural and rural residential land, light industrial and commercial areas, and suburban residential areas. The TRTP segment routes cross areas included in multiple National Resource Conservation Service (NRCS) soil surveys including the Kern County, Southeastern Part – CA670 (2/2006); Antelope Valley Area – CA675 (3/2004); and the Angeles National Forest Area – CA776 (12/2004). The STATSGO databases for California (1994 and 2006) were reviewed for areas not covered by more detailed surveys. More than 50 soil units/type are located along the Project alignment, and a summary of the major soil units traversed by the proposed TRTP segment routes, including the Project segments these units are mapped along, a general description, and select physical characteristics of hazard of erosion, shrink/swell potential, and corrosion potential, is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). These units are mapped along the various segments as individual soil series and as associations, families and complexes of multiple soil series. General locations and characteristics of the soil series, associations, families, and complexes along the TRTP segment routes are discussed below in Section 3.7.2.2 under the appropriate segment.

Potential soil erosion hazards vary depending on the use, conditions, and textures of the soils. For the purposes of this Project, erosion hazard potential was extracted from the Hazard of Erosion and Suitability for Roads tables from the National Resource Conservation Service (NRCS) GIS SSURGO soil databases and the GIS STATSGO databases for California (in areas not covered by more detailed surveys). Two types of potential erosion hazards are presented in this document: (1) hazard of erosion on roads and trails and (2) hazard of erosion off-road and off-trail. These two types of hazards represent the potential for soil erosion along the Project from ground disturbance due to Project construction.

Erosion hazard ratings for “Roads and Trails” apply to the potential for erosion on unsurfaced roads and trails and are ranked as follows:

- Slight – little or no erosion is likely;
- Moderate – some erosion is likely and simple erosion-control measures are needed;
- Severe – significant erosion is expected and major erosion control measures may be needed.

“Off-Road and Off-Trail” erosion hazard ratings apply to the potential for sheet or rill erosion in areas where 50 to 75 percent of the areas has been exposed by ground disturbance (i.e., grading) and are ranked as follows:

- Slight – erosion is unlikely under ordinary climate conditions;
- Moderate – some erosion is likely and erosion-control measures may be needed;
- Severe – erosion is very likely and erosion-control measures are advised; and
- Very severe – significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion control measures would generally be costly and impractical.

The properties of soil which influence erosion by rainfall and runoff are ones that affect the infiltration capacity of a soil, and those which affect the resistance of a soil to detachment and being carried away by falling or flowing water. Additionally, soils on steeper slopes would be more susceptible to erosion due to the effects of increased surface flow (runoff) on slopes where there is little time for water to infiltrate before runoff occurs.

Soils containing high percentages of fine sands and silt and that are low in density, are generally the most erodible. These soil types generally coincide with soils such as young alluvium and other surficial deposits, which likely occur in areas throughout the Project area. As the clay and organic matter content of these soils increases, the potential for erosion decreases. Clays act as a binder to soil particles, thus reducing the potential for erosion. However, while clays have a tendency to resist erosion, once eroded, they are easily transported by water. Clean, well-drained, and well-graded gravels and gravel-sand mixtures are usually the least erodible soils. Soils with high infiltration rates and permeabilities reduce the amount of runoff.

Corrosivity of soils is generally related to the following key parameters: soil resistivity; presence of chlorides and sulfates; oxygen content; and pH. Typically, the most corrosive soils are those with the lowest pH and highest concentration of chlorides and sulfates. High sulfate soils are corrosive to concrete and may prevent complete curing, reducing its strength considerably. Low pH and/or low resistivity soils could corrode buried or partially buried metal structures.

Expansive soils are characterized by their ability to undergo significant volume change (shrink and swell) due to variation in soil moisture content. Changes in soil moisture could result from a number of factors, including rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soils are typically very fine grained with a high to very high percentage of clay. Linear extensibility is the method used by the NRCS to determine the shrink-swell potential of soils. Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. The volume change is reported as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed in areas with expansive soils.

Mineral Resources

Metallic and non-metallic mineral deposits occur within the study area. Metallic mineral deposits are restricted primarily to the areas of exposed igneous and metamorphic bedrock in mountain areas. Gold, copper, and iron are the predominant metallic minerals mined in California; however, no active metallic-mineral deposits mines are located in the Project vicinity. Non-metallic mineral resources consisting of sand, clay, gravel, rock products, and petroleum are important mineral resources in California and are still activity mined in the Project vicinity (Kohler, 2002).

Both metallic and non-metallic mineral resources are located in the vicinity of the proposed Project ROW. Mineral resources in the area of Kern County near the Project ROWs consist primarily of limestone and dolomite deposits, primarily being quarried for production of cement (CGS, 1962). In Los Angeles County the principal mineral commodities in the Project area are sand, gravel, and crushed and broken stone. Metallic mineral deposits are present in both counties in varying amounts and are primarily restricted to bedrock areas in the mountainous regions; gold, copper, and tungsten were the predominant metallic minerals (ores) mined in these counties (CGS, 1987b). However, no active metallic mines are currently located in the vicinity of the Project ROWs.

GIS data from the U.S. Geological Service (USGS) Mineral Resource Data System (MRDS) for the Project area was reviewed to determine the potential for mine or quarries along the Project ROWs (USGS, 2006). To be conservative, mining locations within 1,000 feet of either side of the route were researched to allow for identification of mineral resource sites that may be within or infringing on the Project ROWs. Additionally, a 1,000-foot buffer was used because mapped locations commonly represent only one point at a mineral resource site which actually may be a much larger site. Further, the location and presence of mineral resource sites were verified using aerial photos.

Ten sites with either mineral occurrences or past or current mining activities are identified in the MRDS within 1,000 feet of the proposed TRTP route, which include six sites along Segment 6, two sites along Segment 7, and two sites along Segment 11. No mineral resource sites were identified by the MRDS along the remaining segments. The sites along Segments 6, 7, and 11 are discussed in further detail below in Section 3.7.2.2.

The geology and structure of the Los Angeles basin has resulted in numerous oil and gas fields; currently there are over 30 active oil and/or gas fields in operation and many small abandoned oil/gas fields in the Los Angeles area. A review of California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR) online maps indicates that several active and abandoned oil or gas fields are located in the vicinity of the TRTP alignments (DOGGR, 2008). The Montebello oil field is located immediately adjacent to Segment 7 and 11 near Mesa Substation. Segment 8A and Alternative 4 traverse near the Brea-Olinda and Chino-Soquel oil fields.

Seismic Hazards

Faults and Seismicity

The seismicity of southern California is dominated by the intersection of the north-northwest trending San Andreas Fault system and the east-west trending Transverse Ranges fault system. Both systems are responding to strain produced by the relative motions of the Pacific and North American Tectonic Plates. This strain is relieved by right-lateral strike-slip faulting on the San Andreas and related faults, left-lateral strike slip on the Garlock fault, and by vertical, reverse-slip or left-lateral strike-slip displacement on faults in the Transverse Ranges. The effects of this deformation include mountain building, basin development, deformation of Quaternary marine terraces, widespread regional uplift, and generation of earthquakes. Both the Transverse Ranges and northern Los Angeles County area are characterized by numerous geologically young faults. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 1999a):

- Faults that have generated earthquakes accompanied by surface rupture during historic time (approximately the last 200 years) and faults that exhibit aseismic fault creep are defined as Historically Active.
- Faults that show geologic evidence of movement within Holocene time (approximately the last 11,000 years) are defined as Active.
- Faults that show geologic evidence of movement during the Quaternary time (approximately the last 1.6 million years) are defined as Potentially Active.
- Faults that show direct geologic evidence of inactivity during all of Quaternary time or longer are classified as Inactive.

Although it is difficult to quantify the probability that an earthquake will occur on a specific fault, this classification is based on the assumption that if a fault has moved during the Holocene epoch, it is likely to produce earthquakes in the future. Blind thrust faults do not intersect the ground surface, and thus they are not classified as active or potentially active in the same manner as faults that are present at the earth's surface. Blind thrust faults are seismogenic structures and thus the activity classification of these faults is predominantly based on historic earthquakes and microseismic activity along the fault.

Since periodic earthquakes accompanied by surface displacement can be expected to continue in the study area through the lifetime of the proposed Project, the effects of strong groundshaking and fault rupture are of primary concern to safe operation of the proposed transmission line and associated facilities.

The Project area will be subject to ground shaking associated with earthquakes on faults of the San Andreas, Garlock, and Transverse Ranges fault systems. Active faults of the San Andreas system are predominantly strike-slip faults accommodating translational movement. Active reverse or thrust faults in the Transverse Ranges include blind thrust faults responsible for the 1987 Whittier Narrows Earthquake and 1994 Northridge Earthquake, and the range-front faults responsible for uplift of the Santa Susana and San Gabriel Mountains. The Transverse Ranges fault system consists primarily of blind, reverse, and thrust faults accommodating tectonic compressional stresses in the region. Blind faults have no surface expression and have been located using subsurface geologic and geophysical methods. This combination of translational and compressional stresses gives rise to diffuse seismicity across the region.

Figure 3.7-1 (Regional Active Faults and Historic Earthquakes) shows locations of active and potentially active faults (representing possible seismic sources) and earthquakes in the region surrounding the Project area. Active and potentially active faults within 50 miles of the Project alignments that are significant potential seismic sources are presented in Table 3.7-2.

Table 3.7-2. Significant Active and Potentially Active Faults in the Project Area

Name	Closest Distance to TRTP (miles)[1]	Closest Segment(s)	Estimated Max. Earthquake Magnitude[2, 3]	Fault Type and Dip Direction[3]	Slip Rate (mm/yr)[3, 4]
Anacapa-Dume	33.4	Segment 11	7.5	Reverse Left Lateral Oblique, 45° N	3.0
Big Pine	30.1	Segment 4	6.9	Left Lateral Strike Slip, 90°	0.8
Chino-Central Ave	0	Segment 8A	6.7	Right Lateral Reverse Oblique, 65° SW	1.0
Clamshell-Sawpit	0	Segment 6	6.5	Reverse, 45° NW	0.5
Cucamonga	9.6	Segment 8B	6.9	Reverse, 45° N	5.0
Elsinore - Glen Ivy Segment	8.1	Segment 8A	6.8	Right Lateral Strike Slip, 90°	5.0
Garlock	4.7	Segment 10	7.3	Left Lateral Strike Slip, 90°	6.0
Helendale	36.7	Segment 10	7.3	Right Lateral Strike Slip, 90°	0.6
Hollywood	8.7	Segment 11	6.4	Left Lateral Reverse Oblique, 70° N	1.0
Lenwood-Lockhart-Old Woman Springs	31.1	Segment 10	7.5	Right Lateral Strike Slip, 90°	0.6
Malibu Coast	29.7	Segment 11	6.7	Left Lateral Reverse Oblique, 75° N	0.3
Newport-Inglewood	12.3	Segment 11	7.1	Right Lateral Strike Slip, 90°	1.0
Northridge	12.8	Segment 11	7.0	Blind Thrust, 42° S	1.5
Oak Ridge	29.8	Segment 5	7.0	Reverse, 65° S	4.0
Palos Verdes	20.5	Segment 11	7.3	Right Lateral Strike Slip, 90°	3.0
Plieto Thrust	23.2	Segment 10	7.0	Reverse, 45° S	2.0

Table 3.7-2. Significant Active and Potentially Active Faults in the Project Area

Name	Closest Distance to TRTP (miles)[1]	Closest Segment(s)	Estimated Max. Earthquake Magnitude[2, 3]	Fault Type and Dip Direction[3]	Slip Rate (mm/yr)[3, 4]
Puente Hills Blind Thrust	0	Segments 7, 11 and 8A	7.1	Blind Thrust, 25° N	0.7
Raymond	0	Segment 11	6.5	Left Lateral Reverse Oblique, 75° N	1.5
San Andreas – Carrizo Segment	12.4	Segment 4	7.4	Right Lateral Strike Slip, 90°	34.0
San Andreas – Mojave Segment	0	Segment 5	7.4	Right Lateral Strike Slip, 90°	30.0
San Andreas – San Bernardino Segment	17.7	Segment 8A	7.5	Right Lateral Strike Slip, 90°	24.0
San Cayetano	30.3	Segment 5	7.0	Reverse, 60° N	6.0
San Gabriel	0	Segments 6 and 11	7.2	Right Lateral Strike Slip, 90°	1.0
San Jacinto	11.3	Segment 8A	6.7	Right Lateral Strike Slip, 90°	12.0
San Jose	5.2	Segment 8A	6.4	Left Lateral Reverse Oblique, 75° NW	0.5
Santa Monica	16.9	Segment 11	6.6	Left Lateral Reverse Oblique, 75° N	1.0
Santa Susana	14.7	Segment 11	6.7	Reverse, 55° N	5.0
Santa Ynez	32.3	Segment 4	7.1	Left Lateral Strike Slip, 90°	2.0
Sierra Madre	0	Segments 7 and 11	7.2	Reverse, 45° N	2.0
San Fernando	6.3	Segment 11	6.7	Reverse, 45° N	2.0
Simi-Santa Rosa	25.3	Segment 11	7.0	Left Lateral Reverse Oblique, 60° N	1.0
Upper Elysian Park Thrust	0.8	Segment 11	6.4	Blind Thrust, 50° NE	1.3
Verdugo	5.0	Segment 11	6.9	Reverse, 45° NE	0.5
White Wolf	24.1	Segment 10	7.3	Reverse Left Lateral Oblique, 60° S	2.0
Whittier	0	Segment 8A	6.8	Right Lateral Strike Slip, 90°	2.5

Notes:

1 Fault distances obtained from CGS GIS data.

2 Maximum Earthquake Magnitude – the maximum earthquake that appears capable of occurring under the presently known tectonic framework, using the Richter scale.

3 Fault parameters from the CGS Revised 2002 California Probabilistic Seismic Hazard Maps report, Appendix A - 2002 California Fault Parameters (CGS, 2002b).

4 References to fault slip rates are traditionally presented in millimeters per year.

Strong Groundshaking

An earthquake is classified by the amount of energy released, which traditionally has been quantified using the Richter scale. Recently, seismologists have begun using a Moment Magnitude (M) scale because it provides a more accurate measurement of the size of major and great earthquakes. For earthquakes of less than M 7.0, the Moment and Richter Magnitude scales are nearly identical. For earthquake magnitudes greater than M 7.0, readings on the Moment Magnitude scale are slightly greater than a corresponding Richter Magnitude.

The intensity of the seismic shaking, or strong ground motion, during an earthquake is dependent on the distance between the Project area and the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions underlying and surrounding the Project area. Earthquakes occurring on faults closest to the Project area would most likely generate the largest ground motion.

The intensity of earthquake induced ground motions can be described using peak site accelerations, represented as a fraction of the acceleration of gravity (g). GIS data based on the CGS Probabilistic Seismic Hazard Assessment (PSHA) Maps was used to estimate peak ground accelerations (PGAs) along the Project alignment. PSHA Maps depict peak ground accelerations with a 10 percent probability of exceedance in 50 years. Peak ground acceleration is the maximum acceleration experienced by a particle on the Earth's surface during the course of an earthquake, and the units of acceleration are most commonly measured in terms of fractions of g, the acceleration due to gravity (980 cm/sec^2). Peak ground accelerations along the TRTP alignment range from 0.3 to 0.8 g (CGS, 2003a), the PGA ranges for each transmission Segment and for the substation locations in Segment 9 of the proposed Project are presented in Table 3.7-3.

Table 3.7-3. Peak Ground Accelerations along Project Segments

Segment	Total Length of Segment (miles)	Range of Peak Ground Accelerations along Segment
Segment 10	16.9	0.3 – 0.4 g
Segment 4	19.6	0.3 – 0.7 g
Segment 5	14.3	0.6 - 0.8 g
Segment 11	36.2	0.4 – 0.7 g
Segment 6	26.9	0.4 – 0.7 g
Segment 7	15.8	0.4 – 0.7 g
Segment 8A	33	0.4 – 0.5 g
Segment 8B	6.8	0.4 – 0.5 g
Segment 8C	1.2	0.4 – 0.5 g
Segment 9	Substation Name Whirlwind Antelope Vincent Gould Mesa Mira Loma	Approximate PGA 0.4 g 0.6 g 0.6 g 0.6 g 0.5 g 0.4 g

A review of historic earthquake activity from 1800 to 2005 indicates that ten earthquakes that resulted in substantial damage have occurred within 50 miles (80 kilometers) of the proposed Project alignment (CGS, 2006). Included in the table is the 1857 Fort Tejon Earthquake. The location of this earthquake is uncertain due to lack of seismic instrumentation at the time and due to the widespread damage and long rupture length; however, this very large earthquake produced surface rupture on the local strands of the San Andreas Fault. A summary of each of these earthquake events is presented in Table 3.7-4.

Table 3.7-4. Significant Historic Earthquakes

Date	Approximate Closest Distance (miles) and Closest Project Segment	Earthquake Magnitude[1]	Name, Location, or Region Affected	Comments[2]
December 8, 1812	Uncertain, epicenter assumed on the San Andreas Fault near Wrightwood	7.5?	Wrightwood Earthquake	Resulted in as much as 106 miles of surface rupture near Wrightwood. Sometimes referred to as the San Juan Capistrano Earthquake because it resulted in the collapse of the Mission at San Juan Capistrano resulting in the death of 40 people.

Table 3.7-4. Significant Historic Earthquakes

Date	Approximate Closest Distance (miles) and Closest Project Segment	Earthquake Magnitude[1]	Name, Location, or Region Affected	Comments[2]
July 11, 1855	1 mile west of Segment 11	6.0	Los Angles Region	The bells at San Gabriel Mission Church were thrown down and twenty-six buildings in Los Angeles were damaged.
January 9, 1857	Unknown, epicenter currently assumed in the San Luis Obispo area.	Estimated from 7.9 to 8.25	Fort Tejon Earthquake	One of the largest earthquakes ever reported in the US. This earthquake caused damage from Monterey to San Bernardino and caused a surface rupture of greater than 220 miles in length. Due to sparse population of the time in it only resulted in 2 deaths. Average displacement along the fault was 15 feet, with a maximum displacement of 30 feet in the Carrizo Plain area.
July 29, 1894	20 miles north of Segments 8A & 8C and 21 miles east of Segment 6	6.2	Lytle Creek region	Felt from Bakersfield to San Diego. Minor damage in the Mojave and Los Angeles areas.
March 10, 1933	19 miles south of Segment 8A	6.3	Long Beach Earthquake	This earthquake resulted in 120 deaths and more than $50 million in property damage. Many school buildings were destroyed, which led to the passage of the Field Act, which gave the State Division of Architecture authority and responsibility for approving design and supervising construction of schools. Building codes were also improved as a result of this earthquake.
July 21,1952	31 miles northwest of the northern end of Segment 4	7.3	Kern County Earthquake	Resulted in the death of 12 people and over $50 million in property damage. It was responsible for damaging hundreds of buildings in Kern County. Felt as far away as Reno and San Diego.
February 9, 1971	14.5 miles west of Segment 11	6.6	San Fernando (Sylmar) Earthquake	This earthquake caused over $500 million in damage and resulted in 65 deaths. As A result of the damage from this earthquake, building codes were strengthened and the Alquist-Priolo Special Studies Zone Act of 1972 was passed.
October 1, 1987	Less than 0.1 mile east of Segment 11	5.9	Whittier Narrows Earthquake	Resulted in eight deaths and $358 million in property damage. This earthquake occurred on a previously unknown blind thrust fault, the Puente Hills Fault.
June 28, 1991	1.6 miles east of Segment 6	5.8	Sierra Madre Earthquake	Occurred on the Clamshell-Sawpit fault and triggered numerous rockslides and landslides in the nearby mountains. Two deaths resulted from the earthquake and approximately $40 million in property damage in the San Gabriel Valley.
January 17, 1994	20 miles west of Segment 11	6.7	Northridge Earthquake	Resulted in 60 deaths and approximately $15 billion in property damage. Damage was substantial and widespread, including collapsed freeway overpasses and more than 40,000 damaged buildings in Los Angeles, Ventura, Orange, and San Bernardino Counties.

Notes:

1 Earthquake magnitudes and locations before 1932 are estimated based on reports of damage and felt effects.

2 Earthquake damage information compiled from the Southern California Data Center (SCEDC, 2007a and 2007b) and National Earthquake Information Center (NEIC, 2007) websites.

Many of these earthquakes also had numerous aftershocks, some measuring greater than M6.0, which caused further damage in the affected areas. Figure 3.7-1 (at the end of this section) shows locations of historic earthquakes in the Project area and surrounding region.

Another commonly used measure of earthquake intensity is the Modified Mercalli Scale, which is a subjective measure of the strength of an earthquake at a particular place as determined by its effects on persons, structures, and earth materials. The Modified Mercalli Scale for Earthquake Intensity is presented in Table 3.7-5, along with a range of approximate average peak accelerations associated with each intensity value.

Table 3.7-5. Modified Mercalli Scale For Earthquake Intensity

Intensity Value	Intensity Description	Average Peak Acceleration
I	Not felt except by a very few persons under especially favorable circumstances.	<0.0017 g
II	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	0.0017-0.014 g
III	Felt noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly, vibration similar to a passing truck. Duration estimated.	
IV	During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation is like a heavy truck striking building. Standing motor cars rocked noticeably.	0.014-0.039 g
V	Felt by nearly everyone, many awakened. Some dishes and windows broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles may be noticed. Pendulum clocks may stop.	0.039–0.092 g
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; and fallen plaster or damaged chimneys. Damage slight.	0.092–0.18 g
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.	0.18–0.34 g
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.	0.34–0.65 g
IX	Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.65–1.24 g
X	Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	>1.24 g
XI	Few, if any, masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	
XII	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	

Source: Bolt, 1988; Wald, 1999 (from USGS website: http://pasadena.wr.usgs.gov/shake/pubs/regress/node3.html).

Fault Rupture

Perhaps the most important single factor to be considered in the seismic design of electric transmission lines and underground cables crossing active faults is the amount and type of potential ground surface displacement. The Project alignments cross several known significant active faults, including the: San

Andreas, San Gabriel, Sierra Madre, Raymond, and Whittier faults. All of these faults have mapped Alquist-Priolo zones. Although the Project will not be subject to the regulations and guidelines related to the Alquist-Priolo Special Studies Zones Act because there will be no occupied structures constructed in the Earthquake Fault Zones as part of this Project, the presence of these mapped zones indicates substantial potential for fault rupture in the areas the Project crosses the "zones".

Fault rupture has occurred historically within the Project area. The 1857 Fort Tejon Earthquake caused rupture of the Leona Valley strands of the San Andreas Fault measuring greater than 8 feet and the 1971 Sylmar Earthquake which caused 6 feet of displacement along approximately 12 miles of surface rupture on the nearby San Fernando fault. Although future earthquakes could occur anywhere along the length of the San Andreas and Transverse Range faults, only regional strike-slip earthquakes of magnitude 6.0 or greater are likely to be associated with surface fault rupture and offset (CGS, 1996). It is also important to note that earthquake activity and resulting ground rupture from unmapped subsurface faults is a possibility that is currently not predictable.

Liquefaction

Liquefaction is the phenomenon in which saturated granular sediments temporarily lose their shear strength during periods of earthquake-induced strong groundshaking. The susceptibility of a site to liquefaction is a function of the depth, density, and water content of the granular sediments and the magnitude and frequency of earthquakes in the surrounding region. Saturated, unconsolidated silts, sands, and silty sands within 50 feet of the ground surface are most susceptible to liquefaction. Liquefaction-related phenomena include lateral spreading, ground oscillation, flow failures, loss of bearing strength, subsidence, and buoyancy effects (Youd and Perkins, 1978). In addition, densification of the soil resulting in vertical settlement of the ground can also occur.

In order to determine liquefaction susceptibility of a region, three major factors must be analyzed. These include: (a) the density and textural characteristics of the alluvial sediments; (b) the intensity and duration of groundshaking; and (c) the depth to groundwater. Portions of the TRTP ROW would meet the criteria for liquefaction in areas underlain by young alluvial deposits, including areas in the LeonaValley, and San Gabriel Valley, and in the alluvial and creek deposits of intervening drainages. Locations of these potentially liquefiable alluvial materials are described in more detail in Tables 2-6, 2-8, 2-9, and 2-10 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Older consolidated sedimentary deposits, fine or coarse grained deposits, and/or well-drained sedimentary materials are less susceptible to liquefaction. Alluvial deposits underlying the portions of Segments 10, 4, and 5 that cross the Antelope Valley areas are not expected to be liquefiable due to deep groundwater levels in these areas.

Seismic Slope Instability

Other forms of seismically-induced ground failures which may affect the Project area include ground cracking, shattered ridgetops, and seismically-induced landslides. Landslides triggered by earthquakes have been a considerable cause of earthquake damage; in southern California large earthquakes such as the 1971 San Fernando and 1994 Northridge earthquakes triggered landslides that were responsible for destroying or damaging numerous structures, blocking major transportation corridors, and damaging life-line infrastructure. Areas that are most susceptible to earthquake-induced landslides are steep slopes in poorly cemented or highly fractured rocks, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits. Areas that are underlain by landslide prone units, such as the Pelona schist and Puente Formation (located along Segments 5 and 8A, respectively), with moderate to steep slopes, and previously existing landslides, both mapped and unmapped, are particularly susceptible to this type of ground failure. Shattered ridgetop features consist of fractures, fissures, and minor slumps that are concentrated on narrow ridgelines. Studies suggest that amplification of ground motion at ridge tops is frequency dependent, potentially leading to differential motion at the top of the ridge, which produces cracks and fissures at the crest.

Paleontology

Significant California fossils are typically vertebrate fossils of late Quaternary and Tertiary age. The age of the geologic units, their terrestrial origin, and the discovery of vertebrates in late Quaternary and Tertiary-aged units in the region indicates that there is a likelihood that significant fossils may be found during excavation for new tower footings in locations along the Project route. Locations where metamorphic or crystalline rocks occur have no potential for paleontological resources (Zero sensitivity).

A paleontologic resource inventory for the Tehachapi Renewable Transmission Project was conducted for SCE by Dr. E. Bruce Lander, Dr, C. Thomas Williams, and Dr. Hugh M. Wagner (Paleo Environmental Associates, Inc. (PEAI), 2007). This report indicates that late Tertiary to late Pleistocene (Ice Age) marine vertebrates and invertebrates, land mammals, and land plants are present throughout the northern (Segments 4, 5. and 10) and southern (Segments 7, 8 and 11) parts of the Project. Although several known fossil localities are located in the western Antelope Valley, San Gabriel Valley, Chino Valley and Chino Hills, all are located more than 1,000 feet from the proposed Project. Segment 6 is located within the igneous and metamorphic rock terrane of the San Gabriel Mountains where no paleontological resources occur.

Segment 5 crosses small outcrops of the late Miocene-Pliocene lacustrine Anaverde Formation in the San Andreas Rift zone. The paleontologic resource inventory indicates that there is a high potential for scientifically highly important plant fossil remains being encountered in the Upper Member of the Anaverde Formation and this unit is considered paleontologically highly important (PEAI, 2007).

The Miocene age marine Puente Formation , which underlies a large portion of Segment 8A, contains marine microfossils (benthic foraminifers); fossilized fish scales; the fossilized remains of extinct species of marine algae, clams, crabs, fishes, sharks, and mammals (whales, desmostylids); the fossilized wood and leaves of land plants; fossilized coral remains; fragments of mollusk shells and marine vertebrate bones; and shark teeth and fish scales in the Chino Hills. The Pliocene age Fernando Formation in Chino Hills, Puente Hills, and Montebello Hills contains marine snails, clams, and brachiopods; and at least eight species of marine fishes; and baleen whales. The Fernando Formation underlies portions of the southern ends of Segments 11 and 7, and the western end of Segment 8A; see Tables 2-10, 2-11, and 2-12 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008), respectively for detailed locations of these units along these segments. The Upper Member of the Fernando Formation is considered paleontologically highly important (PEAI, 2007).

Along the San Andreas Fault at the southern margin of the western Antelope Valley, Older Alluvium includes the Harold Formation where several known fossil sites are reported northeast of Segment 5 (PEAI, 2007). These sites yielded fossilized bones and teeth representing a taxonomically diverse faunal assemblage that includes mostly extinct species of Pleistocene land mammals including a jackrabbit, a cottontail, a deermouse, the California vole, a harvest mouse, possibly the dire wolf, the American mastodon, a mammoth, possibly the western horse, and the western camel (PEAI, 2007). Older Alluvium along the western edge of Antelope Valley area (Segment 5) is considered paleontologically highly important (PEAI, 2007). Older Alluvium mantles the lower slopes of Antelopes Buttes, the San Gabriel and Tehachapi Mountains, and the Montebello, Puente, and Chino Hills. A fossil site in the Older

Alluvium of the San Gabriel Valley yielded the fossilized bones and teeth of a Pleistocene mammoth and ground sloth. The occurrence of only two recorded fossil sites near the Project area suggests that the Older Alluvium in these areas (Segments 10, 4, 5, 7, 11, and 8A) is considered to be of undetermined (but no more than moderate) paleontological importance locally (PEAI, 2007).

Holocene age Younger Alluvium underlies the floors of the western Antelope, San Gabriel, and Chino Valleys, and occurs along major drainages in the San Gabriel Mountains and the Puente and Chino Hills. At and very near the surface (e.g., less than 3 to 5 feet below present ground surface), the Younger Alluvium probably is too young to contain remains old enough to be considered fossilized. Correspondingly, there probably is only a low potential for scientifically important fossil remains being encountered by very shallow ground-disturbing activities in the Antelope, San Gabriel, and Chino Valleys where the Project area is underlain by Younger Alluvium (PEAI, 2007). The Younger Alluvium in the western Antelope Valley and San Gabriel Valley is considered to be of undetermined (but probably no more than moderate) paleontologic importance locally. The Younger Alluvium in the Puente and Chino Hills is considered to be of undetermined (but possibly high) importance locally. The Younger Alluvium in the Chino Valley (Segment 8) is considered paleontologically highly important locally due to the discovery of mammoth remains at a depth of 5 feet less than 2 miles from the Segment 8 terminus (Mira Loma Substation) (PEAI, 2007).

3.7.2.2 Alternative 2: SCE's Proposed Project

Previous Geotechnical Studies

Geotechnical investigations, including associated reports and memos, which were previously prepared for the existing Midway–Vincent No. 3 500-kV Transmission Line, were reviewed for the purpose of assessing the existing geotechnical conditions in the proposed Project area. The proposed Project would run generally parallel and/or adjacent to the existing Midway-Vincent No. 3 transmission line from S4 MP 0 to S4 MP 15.8, past the Antelope Substation, and parallel to Segment 5 from S5 MP 0 to approximately S5 MP 9.8. As such, findings of geotechnical investigations conducted for the Midway-Vincent No. 3 transmission line are directly relevant to the portions of the proposed Project which parallel this line. Geotechnical investigations prepared for the existing Antelope and Vincent Substations were also reviewed for the purpose of assessing existing geotechnical conditions in the proposed Project area. These studies (Midway-Vincent No. 3 500-kV Transmission Line, Antelope Substation, and Vincent Substation) are discussed in detail below, as they relate to the proposed Project.

Midway – Vincent No. 3 500-kV Transmission Line

- Design Report: No. 3 Midway – Vincent 500-kV Transmission Line, Tower Foundation Design Data, Report No. 232; Engineering Department, Southern California Edison, Rosemead, California, November 18, 1971.

This report summarizes the findings of a soil condition investigation conducted for the construction of the No. 3 Midway – Vincent 500-kV Transmission Line and includes soil boring data for approximately 46 soil borings along its alignment at sporadic locations adjacent to planned tower locations. These borings, depths ranging from 20 to 35 feet, are along the portion of the alignment that is parallel to Segment 4 and a portion of Segment 5, from the southern edge of the Tehachapi Mountains to the southwestern edge of the San Andreas Rift Zone. Soil materials in these borings correlate with the mapped geology. Near surface and subsurface materials encountered in the borings located in the Antelope Valley consisted primarily of alluvium of loose to dense silty sands with varying amounts of gravel and silt. Borings across Portal and Ritter Ridges revealed igneous (granitic) and metamorphic (Pelona Schist) rocks which were weathered at the surface and moderately hard at depth, with a thin layer of alluvium/colluvium on the surface in some areas. On the west side of the Leona Valley, within and along the base of the Sierra Pelona, Pelona Schist in varying stages of weathering and schist derived colluvium were encountered in the borings. Groundwater was not noted in any of the borings along this segment except for one boring within the Anaverde Creek drainage, which had perched groundwater at about 16 feet below ground surface (bgs).

Antelope Substation

- Letter Report: Antelope Substation – Pile Design Data; T.M. Leps, Chief Civil Engineer, April 25, 1952
- Memorandum: Antelope Substation, Foundation Investigation; E.E. Chandler, Assistant Civil Engineer, July 19, 1957
- Antelope Substation Boring Logs and Soil Test Results; December 1996
- Letter Report: Foundation Design Recommendations, Antelope Substation Additions, Los Angeles County, California; Engineering and Technical Services Geotechnical Group, January 9, 1997

The reports and data reviewed for the Antelope Substation indicate that the materials underlying the site consist of Recent Alluvium, composed primarily of loose to medium dense silty sand with gravel, with local gravelly, cobbly, and clayey layers. No groundwater was encountered in any of the borings conducted for these investigations; the borings were conducted to a maximum depth of 40 feet.

Vincent Substation

- Geotechnical Report: Report of Foundation Investigation, Proposed Vincent Substation, Angles Forest Highway, Vincent, California, August 28, 1963; by LeRoy Crandall & Associates.

This report indicates that materials underlying the Vincent Substation site consist of alluvial deposits, composed of medium dense to dense interbedded silty sand and sand, with local lenses of gravelly and clayey sand and sandy silt. Groundwater was not encountered in any of the borings to a total depth of 35 feet below ground surface.

Windhub Substation to Vincent Substation (Segments 10, 4, and 5)

Geology

The proposed Segment 10, 4, and 5 routes primarily traverse alluvial fans/terraces and plains of the Antelope Valley. The southern end of Segment 5 traverses the San Andreas Fault Zone, and hills, mountains, and valleys of the southern Sierra Pelona and the northern San Gabriel Mountains. Geologic units crossed by these segments of the Project are younger alluvium, older alluvium, nonmarine terrace deposits, nonmarine sandstone of the Anaverde Formation, granitic, and metamorphic. Figure 3.7-2 (Regional Geologic Map A) presents the geology along Segments 10, 4, and 5.

Geologic conditions likely to be encountered during construction of Segments 10, 4, and 5 of the proposed Tehachapi Renewable Transmission Project are summarized in below in Table 3.7-6. The table includes: the geologic symbol for the formation; the feature or formation's name; a description and comments about the geologic features and the formation's general rock type, lithology, and susceptibility to specific geologic hazards as appropriate; and general excavation characteristics of the unit related to excavation or drilling for tower and structure foundations. Locations of the geologic units and significant geologic structures along Segments 10, 4, and 5, are listed in Tables 2-6, 2-7, and 2-8, respectively, of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).Descriptions of geologic units in the

Project area are based on published geologic maps by the CGS (1964 and 1969), Dibblee (1967, 1996, 1997, 2001c), and Dibblee and Louke (1970).

Table 3.7-6. Geologic Units along Segments 10, 4, and 5 of Proposed Project Route

Geologic Symbol[1]	Formation/ Feature Name[1]	Description/Comments[1]	Excavation Characteristics[2]
Qa	Alluvium	Alluvial gravels, sand and silt	Easy
Qc	Pleistocene nonmarine	Unconsolidated alluvial gravels, sand and silt	Easy
Qoa, Qos	Older Alluvium	Sand and gravel fan deposits	Easy
Tas	Anaverde Formation	Pliocene nonmarine sandstone, claystone, shale, and conglomerate.	Easy to Moderate
psp, psq, ps	Pelona Schist	Mica schist, out-of-slope dipping foliation; landslide hazard potential	Difficult
gr	Granitic Rocks	Granitic rocks; fractured, variably weathered crystalline rock	Difficult
sy	Syenite	Granitic rocks, variable weathering profile	Difficult
lgbd	Lowe Granodiorite	Granitic rocks; fractured, variably weathered crystalline rock	Difficult
di	Dioritic Rocks	Mafic granitic rocks; fractured, variably weathered crystalline rock	Difficult
gnb	Gneiss	Banded gneiss	Difficult

Notes:
1 Information in these columns is primarily derived from Table 4.7-23 of the PEA (SCE, 2007).
2 Excavation characteristics are defined as "easy," "moderate," or "difficult" based on estimates of rock strength of the each unit. Excavation characteristic definitions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.

Slope Stability

The Project ROW through the Antelope Valley crosses flat to gently sloping terrain and is not likely to experience landslides or other slope failures. Most of the proposed Segment 10, 4, and 5 alignments do not cross any areas identified as an existing landslide, except along Segment 5 where it crosses the landslide prone Pelona Schist between S5 MP 4.4 to 7.6 and MP 7.9 to 12.5. A large landslide is mapped immediately south of Lake Elizabeth Road beneath the Project alignment between S5 MP 7.9 to 8.5 (CGS, 2003e). East of the proposed alignment the Pelona Schist is characterized by numerous, large landslides (CGS, 2003e; Dibblee, 1997). Unmapped landslides and areas of localized slope instability may also be encountered in the hills traversed by the proposed Project alignment, principally in Segment 5.

Soils

Segment 10. Five main soil units/associations are mapped along the Segment 10 Project route (Garlock, Cajon, Adelanto, Hesperia, and Hanford), listed in order of approximate first occurrence along the alignment from north to south. Each soil unit/association may occur numerous times along the Segment 10 alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). These soils are all formed in areas underlain by alluvium and colluvium on alluvial plains and fans. Locations of the soil associations along Segment 10 are listed in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail is slight and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential varies from low to moderate. The corrosive potential of soils along Segment 10 ranges from low to high for uncoated steel and from low to moderate for concrete.

Segment 4. Seven main soil units/associations are mapped along the Segment 4 Project route (Ramona, Cajon, Hesperia, Rosamond, Hanford, Greenfield, and Vista), listed in order of approximate first occurrence along the alignment from north to south. Each soil unit/association occurs numerous times along the Segment 4 alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). All of these soils, except the Vista soils, are formed in alluvium and colluvium on alluvial fans, plains, and terraces. The Vista soils are formed in material weathered from underlying and nearby granitic rocks. Locations of the soil associations along Segment 4 are listed in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail ranges from slight to very severe and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to moderate. The corrosive potential of soils along Segment 4 ranges from low to high for uncoated steel and from low to moderate for concrete.

Segment 5. Ten main soil units/associations are mapped along the Segment 5 Project route (Greenfield, Hanford, Vista, Amargosa, Godde, Wyman, Anaverde, Las Posas-Toomes, Ramona, and Las Posas), listed in order of approximate first occurrence along the alignment from north to south. Each soil unit/association occurs numerous times along the Segment 5 alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Greenfield and Hanford soils are formed in alluvium derived primarily from granitic sources, with the Greenfield soils mapped primarily along the northern end of the alignment and the Hanford mapped numerous placed along the entire alignment. Ramona soils are also formed in primarily alluvium derived primarily from granitic sources, but are only mapped along the southern end of the alignment. The remaining soil types, Vista, Amargosa, Godde, Wyman, Anaverde, Las Posas-Toomes, and Las Posas, are formed in material weathered from the underlying or nearby bedrock units consisting of miscellaneous granitic, volcanic, and schist rock types and are mapped in various locations along the southern three-fourths of the alignment. Locations of the soil associations along Segment 5 are summarized in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail ranges from slight to very severe and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to high. The corrosive potential of soils along Segment 5 ranges from low to high for uncoated steel and from low to moderate for concrete.

Seismic Hazards

Fault Rupture. Segments 10 and 4 do not cross any active faults and would not be subject to primary fault-related ground surface rupture. Segment 5, however, crosses several strands of the San Andreas Fault. All of the fault strands are within the Alquist-Priolo zone for the San Andreas Fault where the proposed Segment 5 Project route crosses the fault, as shown in Figure 3.7-3 (Segment 5 Active Fault Crossing). There is a substantial potential for surface rupture where Segment 5 crosses the State-designated Earthquake Fault Zone between MPs S5-7.4 and S5-8.6. This portion of the fault ruptured in the 1857 earthquake and had reported mean and maximum displacement along the fault of 15 and 30 feet, respectively (SCEC web site). General characteristics of the fault are presented in above in Table 3.7-2.

Groundshaking. As shown in Table 3.7-2, Segments 10, 4, and 5 are in close proximity to the Garlock Fault Zone (about 5 miles from Segment 10) and the San Andreas Fault Zone (crossed by the proposed Segment 5 route) for most of its length. Moderate to strong groundshaking from an earthquake on any of the faults in the vicinity of these segments should be expected. Very strong to severe groundshaking may be experienced near where Segment 5 crosses the San Andreas Fault Zone. The expected ranges of peak horizontal accelerations for these segments are presented in Table 3.7-3.

Liquefaction. Potential for liquefaction in the areas crossed by Segments 10, 4, and the northern portion of Segment 5 is low due to anticipated depths of groundwater in the Antelope Valley area of greater than 100 feet (CGS, 2003c). Where Segment 5 crosses the Leona Valley, it crosses potentially liquefiable alluvial deposits between S5 MP 7.6 to 7.9 (CGS, 2003d). There is little to no potential for liquefaction for most of the remaining portion of Segment 5, where it crosses the Sierra Pelona and upper Soledad basin, as these areas are primarily underlain by granitic and metamorphic rocks. However, during large storms or a wet season, sections of the proposed segments that are underlain by alluvium near to and/or crossing active river washes and streams may become susceptible to liquefaction if a strong earthquake were to occur while these sediments are saturated due to a temporary/seasonal water table rise.

Earthquake-Induced Landslides. The topography along Segments 10 and 4 is relatively flat and not likely to experience landsliding or slope failures due to earthquakes. Portions of Segment 5 that cross or are in the vicinity of the landslide prone Pelona Schist, primarily between S5 MPs 4.9 to 7.6 and S5 MPs 7.9 to 12.5, could experience earthquake induced slope failures and landslides. Additionally portions of Segment 5 that cross moderate to steep hill slopes could experience minor slope failures in areas with over-steepened slopes or weathered geologic materials.

Mineral Resources

No mineral resource sites were identified by the MRDS within 1,000 feet of the proposed route segments.

Paleontology

The proposed Project alignment in the western Antelope Valley and near the Vincent Substation is underlain mostly by Holocene Younger alluvium underlying the valley floor and Pleistocene Older Alluvium mantling the lower slopes of the Tehachapi and San Gabriel Mountains, and Antelopes Buttes, which border the valley. The Younger Alluvium is generally considered to have low sensitivity and the Older Alluvium has primarily low sensitivity, with local high sensitivity along the San Andreas Fault Zone. The late Miocene - Pliocene Anaverde Formation continental deposits occur along the southern margin of the western Antelope Valley in Leona Valley and have high to moderate sensitivity. The metamorphic Pelona Schist underlying Portal Ridge and the Sierra Pelona and the igneous rocks of the Antelope Buttes are non-fossil bearing and have zero sensitivity.

The Upper Member (Clay Shale) of the Anaverde Formation has yielded fossilized leaves representing a taxonomically diverse floral assemblage consisting of twenty-one extinct species of late Miocene land plants (PEAI, 2007). The species represented include pine, palm, poplar, willow, oak, avocado, sycamore, sumac, and California lilac. The leaves from the Anaverde Formation are scientifically important because their respective species have allowed the paleoenvironmental and paleoclimatic reconstructions of the western Antelope Valley and vicinity during the late Miocene Epoch (PEAI, 2007).

Older Alluvium along the San Andreas Fault Zone includes the Harold Formation, along Segment 5, which locally contains fossilized bones and teeth representing a taxonomically diverse faunal assemblage that includes mostly extinct species of Pleistocene land mammals. These species include a jackrabbit, a cottontail, a deermouse, the California vole, a harvest mouse, possibly the dire wolf, the American mastodon, a mammoth, possibly the western horse, and the western camel (PEAI, 2007). Based on the presence of the packrat (Neotoma Teanopus "prefuscipes") the assemblages from the Harold Formation are considered to be late Irvingtonian (early Pleistocene) and approximately 800,000 years in age (PEAI, 2007). Elsewhere in the Antelope Valley area, Older Alluvium adjacent to exposures of granitic and metamorphic (basement) rocks of the San Gabriel and Tehachapi Mountains and Antelope Buttes (Segments 10 and 4) and is probably too coarse grained to contain identifiable fossil specimens. In these areas, there probably is no more than a low potential for any identifiable and, therefore, scientifically important fossil remains being encountered locally by ground-disturbing activities, although locally finer grained facies may contain scientifically important fossil specimens (PEAI, 2007).

Vincent Substation to Mesa Substation (Segments 6, 7, and 11)

Geology

Segment 6 and the northern portion of Segment 11 traverse moderate to steep slopes of the mountains, hills, and valleys of the San Gabriel Mountains. The southern end of Segment 11 and Segment 7 primarily traverse alluvial fans, plains, and terraces of the San Gabriel Valley. Geologic units crossed by these segments of the Project are younger alluvium, older alluvium, nonmarine sandstone and conglomerate of the Fernando Formation, mixed igneous rocks, and metamorphic rocks. Figure 3.7-4 (Regional Geologic Map B) presents the geology along Segment 6, 7, and 11.

Geologic conditions likely to be encountered during construction of the transmission lines for the proposed Tehachapi Renewable Transmission Project, Segments 6, 7, and 11, are summarized below in Table 3.7-7. The table includes: name of the geologic formation or feature; the geologic symbol for the formation; the feature or formations name; a description and comments about the geologic features and the formation's general rock type, lithology, and susceptibility to specific geologic hazards as appropriate; and general excavation characteristics of the unit related to excavation or drilling of tower and structure foundations. Locations of the geologic units and significant geologic structures along Segments 6, 7, and 11 are listed in Tables 2-9, 2-10, and 2-11, respectively, of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Descriptions of geologic units in the Project area are based on published geologic maps by Dibblee (1989, 1996, 1998, 1999, 2001c. 2002a, and 2002c).

Table 3.7-7. Geologic Units along Segments 6, 7, and 11 of Proposed Project Route

Geologic Symbol[1]	Formation/ Feature Name[1]	Description/Comments[1]	Excavation Characteristics[2]
af	Artificial Fill	Artificial fill	Easy
Qls	Landslide	Landslide(s)	Moderate to Difficult
Qg	Alluvial fan/Channel alluvium	Stream channel deposits of gravel, sand and silt	Easy
Qa	Alluvium	Alluvial gravels, sand and silt	Easy
Qc	Pleistocene nonmarine	Unconsolidated alluvial gravels, sand and silt	Easy
Qoa, Qos	Older Alluvium	Sand and gravel fan deposits	Easy
Qof	Older Alluvium	Uplifted remnants of alluvial gravel	Easy
Qog	Old alluvium/Older gravels	Older alluvial gravel, sand and silt, or older fan, channel and colluvial gravels with sand and silt.	Difficult
Tfsc, Tfp	Fernando Formation	Nonmarine sandstone and conglomerate; light gray to tan, crudely bedded; claystone; and gray micaceous silty claystone or siltstone.	Easy to Moderate
gr	Granitic Rocks	Granitic rocks; fractured, variably weathered crystalline rock	Difficult
grd	Granitic Rock	Leucocratic plutonic rock; nearly white; massive.	
qd	Quartz Diorite	Plutonic rock; gray, medium-grained, incoherent where weathered	Difficult
hd	Hornblende Diorite	Mafic plutonic rock; dark gray to black	Difficult
hdg	Hornblende Diorite Gabbro	Mafic plutonic and gneissic rock, dark gray to nearly black;	Difficult

Table 3.7-7. Geologic Units along Segments 6, 7, and 11 of Proposed Project Route

Geologic Symbol[1]	Formation/ Feature Name[1]	Description/Comments[1]	Excavation Characteristics[2]
		hard, but fractured, massive to slightly gneissoid	
lgbd, lgd, lgdp, lgdh, lgdd	Lowe Granodiorite	Plutonic igneous rock, grey	Difficult
di	Dioritic Rocks	Mafic granitic rocks; fractured, variably weathered crystalline rock	Difficult
an, agb	Anorthosite Gabbro complex	Plutonic complex of plagioclase feldspar enriched rock; Light steel gray, but weathered white	Difficult
dgn	Dioritic Gneiss	Gneissic rock metamorphosed from igneous sources	Difficult
gnb	Gneissic Rock	Rock metamorphosed from sedimentary or igneous sources	Difficult

Notes:

1 Information in these columns is primarily derived from Table 4.7-23 of the PEA (SCE, 2007).

2 Excavation characteristics are defined as "easy," "moderate," or "difficult" based on estimates of rock strength of the each unit. Excavation characteristic definitions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.

Helicopter construction techniques will be use for construction of portions of Segment 6 (17 towers) and Segment 11 (16 towers). Twelve helicopter staging areas would be constructed along these segments to facilitate construction activities for these 33 towers. Each of these 12 helicopter staging areas is located within the San Gabriel Mountains proper or within the adjacent foothills/alluvial slopes, and the sites are primarily underlain by igneous and metamorphic bedrock. Geologic units expected to be encountered at the helicopter staging areas are listed below (see Table 3.7-7 for summary descriptions of these units):

- SCE#0 - Older alluvium over Lowe Granodiorite
- SCE#1 - Lowe Granodiorite
- SCE#2 – Anorthosite Gabbro Complex, primarily anorthosite and gabbro diorite
- SCE#3 - Anorthosite Gabbro Complex, primarily anothosite
- SCE#3B - Artificial fill from dredging of Big Tujunga Reservoir of unknown depth over granitic rocks
- SCE#4 and SCE#5 – Quartz Diorite
- SCE#6 - Gneiss and intrusive granitic rocks
- SCE#6B - Gneiss
- SCE#7 - Granitic rocks
- SCE#8 - Gneissic rocks
- SCE#9 – Stream channel deposits of sand, gravel, and cobbles

Slope Stability

The Project alignment along Segments 6, 7, and 11 traverses the San Gabriel Mountains and is characterized by steep to very steep terrain underlain by igneous and metamorphic bedrock before reaching the gently sloping alluvial plain of San Gabriel Valley. Small to large landslides are mapped in the steep mountain terrain along most of the mountainous portions of the proposed Segment 6, 7, and 11 alignments. Landslides underlie the proposed alignments at several locations as identified in Tables 2-9, 2-10, and 2-11 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Several landslides are mapped along Segment 6 from MP 7.4 to 26.9. One small landslide is mapped along Segment 7 at MP 0.1. Large landslide complexes in sheared granitic and metamorphic rock along the Sierra Madre fault underlie Segment 11at MP 20.5 to 21.6 (CGS, 1998c) and at MP 24.0 to 25.3 (CGS, 1998a). Unmapped landslides and areas of localized slope instability may also be encountered throughout the San

Gabriel Mountains, which are traversed by the proposed Project alignment, at the proposed helicopter staging areas, and adjacent to the proposed helicopter staging sites. Portions of Segments 7 and 11 located in the San Gabriel Valley (south of approximately S7 MP 1 and S11 MP 26) are relatively flat and would not be subject to slope stability issues.

Helicopter staging areas SCE #0, 5, and 9 are located along flat to gently sloping stream terraces along the edges of the San Gabriel Mountains and are not subject to slope stability issues. Sites SCE #4, SCE#6 and SCE#7, although located in hilly terrain of the San Gabriel Mountains, are located at preexisting, gently sloping, graded sites. Sites SCE#4 and SCE#7 are on graded gently sloping ridge/hill top sites and would likely not require additional grading for use as staging areas. Site SCE #6 is located at the existing facilities at Barton Flats, which already includes a helicopter landing area and would not require further grading for use as a helicopter staging area.

Helicopter staging areas SCE#1, 2, 3, 6B, and 8 are located on or along ridges, hilltops, and in saddles of the San Gabriel Mountains with sloping terrain which would require moderate to extensive grading (cut and fill) to create suitable, relatively flat sites for helicopter landings and staging of construction supplies and equipment. Site SCE#3B is located in Maple Canyon southeast of Big Tujunga Reservoir on terraced fill slopes created from material dredged from the reservoir. The SCE#3B helicopter staging area is located near the top of the terraced fill in the canyon with moderately sloping hills above and on either side of the site and would require moderate grading to create a suitable staging area. Although no landslides are mapped at these staging sites, small to large landslides and debris slides are mapped along the steep mountain terrain near to the staging sites indicating potential slope stability issues in the area.

Soils

Segment 6. Eighteen main soil associations/complexes are mapped along the Segment 6 Project route (Hanford, Vista, Greenfield, Pismo-Trigo-Exchequer, Pacifico, Pacifico-Preston, Olete-Kilburn-Etsel, Chilao, Pismo-Chilao-Shortcut, Trigo-Modjeska, Green Bluff-Hohmann, Trigo-Green Bluff-Supan, Caperton-Trigo, Stukel-Sur-Wintrop, Stukel-Olete, Trigo-Exchequer-Rock Outcrop, Trigo, and Vista-Trigo-Modesto; listed in order of approximate first occurrence along the segment from north to south). Each soil association/complex may occur numerous times along the Segment 6 alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). These soils are primarily either formed in alluvium or colluvium weathered from granitic or metamorphic bedrock, or formed in material weathered from the underlying bedrock (primarily granitic, metamorphic, and volcanic rocks in the Project area). Locations of the soil associations along Segment 6 are listed in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for soils along the Segment 6 alignment for off-road or off-trail is slight to very severe and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential varies primarily from low to moderate with some high potential in areas underlain by the Trigo-Modesto complex. The corrosive potential of soils along Segment 6 ranges from low to high for uncoated steel and from low to moderate for concrete.

Segment 7. Three main soil units/associations are mapped along the Segment 7 Project route (Cieneba-Exchequer-Sobrante, Urban Land-Ramona-Zamora, and Urban Land-Hanford-Sorrento), listed in order of approximate first occurrence along the alignment from north to south. Each soil unit/association may occur numerous times along the Segment 7 alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). The Cieneba-Exchequer-Sobrante soils are primarily formed in material weathered from the underlying igneous and metamorphic bedrock. The Urban Land-Ramona-Zamora and Urban Land-Hanford-Sorrento soils are formed in alluvium and colluvium on alluvial fans, plains, and terraces. Locations of the soil associations along Segment 7 are listed in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail ranges from slight to very severe and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to moderate. The corrosive potential of soils along Segment 7 ranges from low to high for uncoated steel and from low to moderate for concrete.

Segment 11. Segment 11 has numerous soil units/associations mapped along its alignment, sixteen total, with the largest number of soil types where the alignment crosses the San Gabriel Mountains. The main soil associations along the Segment 11 Project route, listed in order of approximate first occurrence along the alignment, from north to south, are: Hanford, Vista, Pismo-Trigo-Exchequer, Tollhouse-Stukel-Wrentham, Tollhouse-Knutsen-Stukel, Pismo-Chilao-Shortcut, Rock Outcrop-Chilao, Olete-Kilburn-Etsel, Trigo-Modjeska, Stukel-Sur-Winthrop, Chilao-Trigo, Trigo, Caperton-Trigo, Cienba-Exchequer-Sobrante, Urban Land-Ramona-Zamora, and Urban Land-Hanford-Sorrento. Each soil unit/association may occur numerous times along the Segment 11 alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). These soils are primarily either formed in alluvium or colluvium weathered from granitic or metamorphic bedrock, or formed in material weathered from the underlying bedrock (primarily granitic, metamorphic, and volcanic rocks in the Project area). The Hanford, Vista, Trigo-Modjeska, TrigoUrban Land-Ramona-Zamora and Urban Land-Hanford-Sorrento soils are formed in alluvium and colluvium on alluvial fans, plains, and terraces. The remaining soil types are primarily either formed in alluvium or colluvium weathered from the adjacent bedrock, or formed in material weathered from the underlying bedrock (primarily igneous, metamorphic, and volcanic rocks in the Project area). Locations of the soil associations along Segment 11 are summarized in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail ranges from slight to very severe and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to high. The corrosive potential of soils along Segment 11 ranges from low to high for uncoated steel and from low to moderate for concrete.

Helicopter Staging Areas. The soils associations located at the helicopter staging areas are the same or similar to soils located along the nearby Segments 6 and 11 routes. Soil associations mapped at the helicopter staging sites are as follows:

- SCE#0 - Hanford
- SCE#1 – Tollhouse-Stukel-Wrentham
- SCE#2 and SCE#3 –Pismo-Chilao-Shortcut
- SCE#3B – this site is mapped as underlain by Chilao soils, however because this site is on dredged fill the ‘soil characteristics’ of the material of the site is dependent on the type and grain size of the fill material.
- SCE#4 and SCE#5–Cienba-Exchequer-Sobrante

- SCE#6 and SCE#6B – Trigo-Green Bluff-Supan
- SCE#7 – Stukel-Sur-Winthrop
- SCE#8 and SCE#9 – Ramona-Zamora

These soils are primarily either formed in alluvium or colluvium weathered from granitic or metamorphic bedrock, or formed in material weathered from the underlying bedrock (primarily granitic and metamorphic, rocks in this part of the Project area). A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Hazard of erosion for soils at the helicopter staging areas for off-road or off-trail is slight to very severe; this hazard ranges from slight to severe for on roads and trails. Shrink/swell (expansive) potential of the soils varies primarily from low to high. The corrosive potential of soils for the helicopeter staging sites ranges from low to high for uncoated steel and from low to moderate for concrete.

Mineral Resources

Ten sites with either mineral occurrences or past or current mining activities are identified in the MRDS within 1,000 feet of the proposed TRTP route, six sites along Segment 6, two sites along Segment 7, and two sites along Segment 11. The sites consist of three metallic mineral (ore) mines, one mapped ore occurrences, two ore prospects, three sand and gravel quarries, and one crushed/broken stone quarry. The six sites along Segment 6 are all inactive and range from approximately 50 to 850 feet from the Project ROW; the sites consist of one ore occurrence, two ore prospects, and three past ore (gold) producers. The two sites along Segment 11 are also inactive, ranging from 250 to 500 feet from the Project ROW, consist of a past gravel quarry and a past crushed/broken rock quarry, both of which have been reclaimed and the sites are currently occupied by buildings and parking lots. None of these sites is listed by the CGS (CGS, 1999f) as an active mine.

The two mapped MRDS sites along Segment 7 consist of sand and gravel quarries located in the Irwindale area, ranging from 0 to 50 feet from the Project ROW and are identified as the Duarte and Irwindale Pits. The Irwindale Pit consists of three adjacent pits (commonly known as Irwindale Pits #1, #2, and #3), owned by the United Rock Products Corp, and of which two are currently in operation (CGS, 2004). The Project ROW crosses a portion of the eastern most pit; however, based on aerial photo review the towers for the existing transmission line are located outside of the existing quarry boundaries and it is assumed that any new towers would be at similar tower spacing.

Given the distance of these sites from the ROW and the ability of mining-related equipment and vehicles to cross the ROW if necessary, construction and operation of the TRTP transmission line is not expected to interfere with future access to any mineral resources. If any of the inactive mine or mineral resource sites were to be mined in the future during the Project's construction or operation, the height and spacing of the transmission lines would provide adequate clearance for vehicles and equipment to cross the ROW under the lines, if necessary.

Mineral resources in the vicinity of the helicopter staging areas consist primarily of metallic minerals (ores) such as gold and titanium and no active mines are located at or adjacent to any of the staging sites. This results in no potential for inference with access to known mineral resources from construction and use of these sites for helicopter staging activities associated with construction of towers along Segments 6 and 11.

Seismic Hazards

Fault Rupture. Segments 6, 7, and 11 cross several active faults: the San Gabriel fault, Clamshell-Sawpit fault, Sierra Madre fault, Raymond fault, and East Montebello Hills fault. All of these faults, with the exception of the East Montebello fault are part of the Transverse Ranges Southern Boundary fault system, a west-trending system of reverse, oblique-slip, and strike-slip faults that extends for ＞200 km along the southern edge of the Transverse Ranges. One additional fault crossed by the Project alignment, the southern portions of Segments 7 and 11, is the Puente Hills Blind Thrust. Although this fault underlies several miles of these segments, as shown in Figure 3.7-1, it is a buried blind thrust fault and is not expected to generate primary surface fault rupture, however minor surface cracking could be associated with an earthquake on this fault. None of the helicopter staging areas are crossed by or immediately adjacent to any active faults with the exception of Site SCE#4, which is crossed by a segment of the Sierra-Madre fault. However, because this site is temporary and will only be in use for a short duration during helicopter construction along Segment 11, the potential for an earthquake resulting in ground rupture to occur at this site during this time is remote.

The general physical characteristics of these faults are summarized below and seismic characteristics of these faults are presented above in Table 3.7-2.

- The San Gabriel Fault is approximately 87 miles long (140 kilometers) and traverses the southwestern boundary of the San Gabriel Mountains. The fault is primarily right-lateral strike-slip but transitions to oblique right reverse slip to the east, and has varying slip rates and recurrence intervals along its length, with the northwestern end being the most recently active (Holocene). In the vicinity of the proposed Project, where the San Gabriel fault is traversing the San Gabriel Mountains, it is considered less active.
- The Clamshell-Sawpit fault is an approximately 11-mile-long (18 kilometer) reverse fault along the southern edge of the San Gabriel Mountains. The Clamshell-Sawpit fault is postulated as the source of the Sierra Madre earthquake of 1991, and although it was a sizable earthquake, the depth of this quake prevented the rupture from reaching the surface (SCEDC, 2007a).
- The Sierra Madre fault is a 34-mile-long, complex reverse fault structure that extends east-west across the range front of the San Gabriel Mountains in the Project area. The zone is often divided into five main segments, with each segment also consisting of complex systems of parallel and branching fault strands. Trenching performed in Altadena area revealed evidence for two large earthquake events in the last 15,000 years with displacements on the order of 15 to 20 feet or greater and magnitude Mw 7.2 to 7.6 earthquakes (Rubin, et al, 1998).
- The Raymond fault is a 20-km-long, north dipping left-lateral strike-slip fault that extends east-northeastward through the San Gabriel Valley, northeast of downtown Los Angeles. The Raymond fault is part of east-west fault system (also including the Anacapa-Dume, Malibu Coast, Santa Monica, and Hollywood faults) that formed to accommodate the clockwise rotation of the western Transverse Ranges and forms the northern limit of the Los Angeles Basin. D Trenching studies conducted on the Raymond fault indicate that the most recent fault surface rupture occurred approximately on to two thousand years ago (ka) (Weaver and Dolan, 2000).
- The East Montebello Hills Fault is a northwest trending, north dipping right-lateral strike-slip fault with an apparent substantial reverse component that is considered to be the northern most extension of the Whittier Fault zone (Yeats, 2004). The East Montebello Hills Fault is approximately 4 miles long and generally traverses the northern edge of the Montebello Hills. Activity along this fault is considered less than that of the other portions of the Whittier fault, approximately only 0.2 mm/year, as slip/strain in this area is being distributed to the underlying blind thrusts and folds.
- The Puente Hills Blind Thrust is approximately 25 miles long, and extends in a northwest-southeast direction in the Los Angeles Basin underlying downtown Los Angeles and east to Brea in northern Orange County (see Figure 3.7-1). Geophysical research conducted on this fault indicate that it is divided into three segments and that single segment earthquakes of M6.5 could occur about every 400 to 1300 years and multiple segment earthquakes of M7.1 could have recurrence intervals of 780 to 2600 years. This fault was responsible for the

Whittier Narrows M6.0 earthquake which caused substantial damage in the Los Angeles area. (Shaw et. al., 2002).

The Segment 6 Project route crosses both the San Gabriel and Clamshell-Sawpit faults, at approximate S6 MP 18.9 and 24.5, respectively. Neither one of these faults are within the Alquist-Priolo zones where the alignment crosses them, however these faults are known seismic sources, resulting in a potential for surface rupture in the event of a large earthquake on the corresponding fault. Locations of these fault crossings along segment are shown in Figure 3.7-5 (Segment 6 Active Fault Crossings).

Segment 7 crosses five fault strands associated with the active Sierra Madre fault zone, three strands between S7 MP 1 to 1.1, and at approximately S7 MP 1.3 and 1.7. The Sierra Madre fault zone is active through this region and capable of large magnitude earthquakes with large displacements and could cause significant surface rupture in the Project area. The Segment 7 route passes approximately 650 feet south of the southern end of the Alquist-Priolo zone for the East Montebello Hills fault, with the projection of the fault crossing the route at approximately S7 MP 13.6. Because of the short length of this fault and the very low slip rate, significant primary surface fault rupture would not be expected along the projection of this fault. Locations of these fault crossings along segment are shown in Figure 3.7-6 (Segment 7 Active Fault Crossings).

Segment 11 crosses four active faults along its route between S11 MP 14 and 35, the San Gabriel fault, the Sierra Madre fault zone, the Raymond fault, and the East Montebello Hills fault. The alignment crosses the San Gabriel fault at approximately S11 MP 14.9. The Segment 11 route traverses parallel to and across the active Sierra Madre fault, crossing several fault strands associated with the zone: one strand is crossed three times between S11 MP 18.4 and 18.6, and five strands between S11 MP 24.7 to 24.4, at approximately S11 MP 24.7, 25.1, 25.2, and two strands between S11 MP 25.35 and 25.4. The alignment crosses two strands of the Alquist-Priolo zoned Raymond fault between S11 MP 28.9 and S11 MP 29.1 and crosses the Alquist-Priolo zoned East Montebello Hills fault at approximately S11 MP 34.15. The Sierra Madre fault zone and Raymond fault are capable of large magnitude earthquakes with large displacements and could cause significant surface rupture in the Project area. Locations of these fault crossings along segment are shown in Figures 3.7-7a and 3.7-7b (Segment 11 Active Fault Crossings).

Groundshaking. As shown in Table 3.7-2, Segments 6, 7, and 11 are in close proximity to numerous active faults of the Transverse Ranges, and cross several significant large active faults. Additionally, the southern portions of Segments 7 and 11 overlie and are in close proximity to the Puente Hills Blind Thrust and the Upper Elysian Park Thrust, respectively, as shown in Figure 3.7-1. These blind thrust faults are capable of producing large earthquakes and very strong groundshaking, as demonstrated by the Whittier Narrows M6.0 earthquake which occurred on the Puente Hills Blind Thrust and caused substantial damage in the Los Angeles area. Moderate to very strong groundshaking should be expected from an earthquake on any of the faults in the vicinity of Segments 6, 11, and 7, and at the nearby associated helicopter staging areas. The expected ranges of peak horizontal accelerations for these segments are presented in Table 3.7-3. Expected peak horizontal accelerations at the helicopter staging areas is similar to the nearby Project segments, Segments 6 and 11, ranging from 0.4 to 0.7g.

Liquefaction. Potential for liquefaction in the mountainous areas crossed by Segments 6 and 11 is low to nonexistent due to the presence of non-liquefiable bedrock underlying the alignments in this area. Where Segment 11 and Segment 7 cross young alluvial deposits of the San Gabriel Valley, near the Rio Hondo and San Gabriel Rivers, and in the Whittier Narrows area the underlying sediments are potentially liquefiable (CGS, 1999b, 1999c, 1999d, 1999e). Additionally, during large storms or a wet season, other sections of the proposed segments that are underlain by alluvium near to and/or crossing smaller river washes and streams may become susceptible to liquefaction if a strong earthquake were to occur while these sediments are saturated due to a temporary/seasonal water table rise.

Liquefaction potential at all of the helicopter staging areas is low to nonexistent. Ten of the helicopter staging areas have no liquefaction potential due to the presence of non-liquefiable underlying granitic and metamorphic bedrock. Site SCE#0 is underlain by older alluvium near to a stream channel, and although the area is mapped as potentially liquefiable by the CGS (2003b), potential for liquefaction is low at this site due to the expected coarse nature of the deposits and shallow depth to bedrock. Site SCE#9 is underlain by stream channel deposits of sand, gravel, and cobbles and although the area is mapped as potentially liquefiable by the CGS (1999b), the coarse nature of the deposits and shallow depth to bedrock near the mountain front reduces the potential for liquefaction at this site to low.

Earthquake-Induced Landslides. The topography along Segments 6, 7, and 11 in the San Gabriel Mountains is steep and is likely to experience landsliding or slope failures due to earthquakes. The CGS has mapped much of the mountainous and hillside terrain crossed by these Segments and the associated helicopter staging areas as having potential for earthquake-induced landslides (CGS, 1999b, 1999c, 1999d, 1999e). Historic earthquake induced ground failures are known to have occurred in the mountains of near the Project alignments due to the 1971 San Fernando Earthquake, 1991 Sierra Madre Earthquake, and the 1994 Northridge Earthquake. The steep mountain slopes could experience slope failures in areas with over-steepened slopes or with weathered and sheared bedrock.

Paleontology

In the San Gabriel Mountains the proposed Project alignment is underlain mostly by igneous and metamorphic rocks, with Quaternary alluvial rock units occurring along the major drainages, where they underlie the valley and canyon floors. Older Alluvium occurs at the base of the mountains and near the Montebello Hills (Mesa Substation). Course alluvial fans dominate Segment 7 in the Duarte area. Younger Alluvium blankets the floor of the San Gabriel Valley and underlies much of Segment 7 south of Duarte and underlies Segment 11 from east Pasadena to Rosemead. The igneous and metamorphic rocks of the San Gabriel Mountains are non-fossil bearing due to origin of the rock.

Generally the Older Alluvium and alluvial fan deposits at the base of the San Gabriel Mountains are too coarse grained to contain identifiable fossil specimens. Any such remains would have been destroyed or heavily damaged by deposition of the cobbles and boulders that comprise this rock unit (PEAI, 2007). Two fossil sites in the Older Alluvium of the San Gabriel Valley (San Dimas and West Covina) have yielded teeth of a Pleistocene mammoth and ground sloth remains (PEAI, 2007). The occurrence of only two recorded fossil site near the Project area suggests that there is an undetermined (but probably no more than a moderate) potential for additional, similar, scientifically important fossil remains being encountered locally by ground-disturbing activities in the San Gabriel Valley (PEAI, 2007).

The Younger Alluvium in the San Gabriel Valley has locally yielded late Pleistocene mammoth (Pasadena and Eagle Rock) and fossilized bones and teeth of late Pleistocene land mammals (downtown Los Angeles) (PEAI, 2007). These occurrences indicate that there is an undetermined (but probably no more than a moderate) potential for additional, similar, scientifically important fossil remains being encountered locally in Younger Alluvium in the San Gabriel Valley. The alluvial deposits along streams and valleys within the San Gabriel Mountains are unlikely to contain identifiable fossil specimens due to the high energy depositional environment that would damage the specimens.

Mesa Substation to Mira Loma Substation (Segments 8A, 8B, and 8C)

Geology

Segment 8A primarily traverses moderate to steep slopes of the Puente and Chino Hills, the western and eastern ends of Segment 8A cross alluvial deposits in the Whittier Narrows area and the Chino Basin, respectively. Segments 8B and 8C traverse alluvial fans, plains, and terraces of the Chino Basin. Geologic units crossed by these segments of the Project are younger alluvium, older alluvium, sandstone and conglomerate of the Fernando Formation, and sandstone, shale, siltstone, and conglomerate of the Puente Formation. Figure 3.7-8 (Regional Geologic Map C) presents the geology along Segment 8A, 8B, and 8C.

Geologic conditions likely to be encountered during construction of the proposed Tehachapi Renewable Transmission Project, Segments 8A, 8B, and 8C are summarized below in Table 3.7-8. The table includes: name of the geologic formation or feature; the geologic symbol for the formation; the feature or formations name; a description and comments about the geologic features and the formation's general rock type, lithology, and susceptibility to specific geologic hazards as appropriate; and general excavation characteristics of the unit related to excavation or drilling of tower and structure foundations. Locations of the geologic units and significant geologic structures along Segments 8A, 8B, and 8C are listed in Tables 2-12, 2-13, and 2-14, respectively, of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Descriptions of geologic units in the Project area are based on published geologic maps by the CGS (1997, 1998b, 1999d, 2000b, 2005), Dibblee (1999, 2001a, 2001b), Durham and Yerkes, 1964, and Yerkes (1972).

Table 3.7-8. Geologic Units along Segments 8A, 8B, and 8C of Proposed Project Route

Geologic Symbol[1]	Formation/ Feature Name[1]	Description/Comments[1]	Excavation Characteristics[2]
Qls	Landslide	Landslide(s)	Moderate to Difficult
Qa, Qye	Young Alluvium/Alluvium	Gravels, sands, and silts	Easy
Qf	Very Young Alluvium	Gravels, sands, and silts	Easy
Qg	Surficial Sediment	Stream channel deposits of gravel, sand and silt.	Easy
Qoa	Older Alluvium	Sand and gravel fan deposits	Easy
Tfp, Tfs, Tfr	Fernando Formation	Fine grained sedimentary rock from fine-medium grained sand to claystone or siltstone; gray, weathers brown.	Easy to Moderate
Tfsc	Fernando Formation	Nonmarine sandstone and conglomerate; light gray to tan, crudely bedded; conglomerate composed of pebbles and cobbles	Easy to Moderate
Tscg, Tsc	Puente Formation	Sycamore Canyon Member conglomerate sandstone unit (Tscg), and gray silty clay shale (Tsc)	Easy to Moderate
Tplv	Puente Formation	La Vida Shale Member; white, weathered; thin bedded, siliceous shale, clay shale, and siltstone	Easy to Moderate
Tps, Tpss	Puente Formation	Soquel Sandstone Member; Bedded sandstone, light gray, weather tan, medium grained could have coarser grains to pebbles	Easy to Moderate
Tpy	Puente Formation	Yorba shale member; light gray, thin bedded, semi-siliceous to clay shale, siltstone, minor sandstone; fish scales	Easy to Moderate
Tp	Puente Formation	Unassigned Member (Tp), fine-medium sedimentary unit from sand, clay to siltstone shale	Easy to Moderate

Notes:

1 Information in these columns is primarily derived from Table 4.7-23 of the PEA (SCE, 2007).

2 Excavation characteristics are defined as "easy," "moderate," or "difficult" based on estimates of rock strength of the each unit. Excavation characteristic definitions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.

Slope Stability

The Project alignment along Segment 8A traverses the northern Montebello Hills and Puente Hills where moderate to locally steep slopes are underlain by Tertiary marine and nonmarine sedimentary rock. Segments 8B and 8C cross the nearly flat Chino Valley underlain by alluvial deposits where no landslides occur. Numerous small to large landslides are mapped in the hillside areas of the Puente Hills where the Puente Formation is distinctly prone to landslides and slope failure. Mapped landslides underlie the proposed Segment 8A alignment from MP 5.6 to 23.5 at several locations as identified in Table 2-12 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). Several landslides are mapped as complexes consisting of several slides and underlie 0.3 to 0.8 mile long portions of the proposed alignment. Unmapped landslides and areas of slope instability may be encountered throughout the Puente Hills traversed by the proposed Project alignment.

Soils

Segment 8A. Segment 8A has numerous soil units/associations mapped along its alignment, thirteen in total. The main soil associations along the Segment 11 Project route, listed in order of approximate first occurrence along the alignment, from west to east, are: Urban Land-Ramona-Zamora, Urban Land-Hanford-Sorrento, Anaheim-Soper-Fontana, Gaviota-Rock Outcrop, Fontana, Chualar, Sorrento, Chino, Grangeville, Merrill, Hilmar, Tujunga, and Dehli. Each soil unit/association may occur numerous times along the Segment 8A alignment. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). The Urban Land-Ramona-Zamora, Urban Land-Hanford-Sorrento, Anaheim-Soper-Fontana, Gaviota-Rock Outcrop, Fontana, Chualar, and Sorrento soils are primarily formed on hills or sloping terrain in material weathered from the sedimentary bedrock of the Puente and Chino Hills. The Sorrento, Chino, Grangeville, Merrill, Hilmar, Tujunga, and Dehli soils are along the portion of the alignment in the Chino Basin, and are formed in alluvium and colluvium on alluvial fans, plains, and terraces derived primarily from granitic sources. Milepost locations of the soil associations along Segment 8A are summarized in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail ranges from slight to very severe and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to moderate. The corrosive potential of soils along Segment 8A ranges from low to high for uncoated steel and from low to moderate for concrete.

Segments 8B and 8C. Both of these segments are underlain by the same five main soil associations along their Project routes. The soil associations listed in order of approximate first occurrence along the alignments, from west to east, are: Chino, Grangeville, Hilmar, Tujunga, and Dehli. Each soil unit/association may occur numerous times along the Segment 8B and 8C alignments. Soil associations with only small or limited occurrences along the alignment are not discussed. A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). These soils are formed in alluvium and colluvium on alluvial fans, plains, and terraces in the Chino Basin which are derived primarily from granitic sources. Milepost locations of the soil associations along Segment 8B and Segment 8C are summarized in Appendix A of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008).

Hazard of erosion for these soils for off-road or off-trail is slight and for on roads and trails ranges from slight to moderate. Shrink/swell (expansive) potential of the soils varies from low to moderate. The corrosive potential of soils along Segment 8C ranges from low to high for uncoated steel and from low to moderate for concrete.

Seismic Hazards

Fault Rupture. Segment 8A route traverses parallel to and across the Alquist-Priolo zoned Whittier fault between S8A MP 8.9 and 10.3. Segments 8B and 8C do not cross any active faults and thus would not be subject to surface fault rupture. The Whittier fault is capable of large magnitude earthquakes with moderate to large displacements and could cause significant surface rupture in the Project area. Segment 8A also crosses the potentially active Central Avenue segment of the Chino-Central Avenue fault between S8A MP 26.8 and 26.9. Although the Segment 8A route does not cross the currently mapped trace of the active Chino segment of the Chino-Central Avenue fault, the mapped active, Alquist-Priolo zoned trace of the fault is located just less than a mile south of the alignment, trending northwest towards S8A MP 25.5. The locations of these faults relevant to Segment 8A are shown in Figure 3.7-9 (Segment 8A Fault Crossings).

The general physical characteristics of these faults are summarized below and seismic characteristics of the faults listed above are presented in above in Table 3.7-2.

- The Whittier fault is a primarily right-lateral strike-slip north dipping fault at the northern end of the Elsinore fault system and is approximately 25 miles (40 kilometers) long extending through the Chino Hills to Whittier. This fault is an active Alquist-Priolo zone fault which is considered capable of producing moderate to large earthquakes of up to magnitude M 6.8 (CGS, 2002b).
- The Chino fault is also a primarily right-lateral strike-slip fault at the northern end of the Elsinore fault system and extends approximately 13 miles (21 kilometers) from Chino Hills to Corona. A magnitude M4.1 earthquake in February, 1989, had an epicenter located southwest of the surface trace of the fault, consistent with fault plane solutions for the Chino fault (SCEC, 2001).
- The Central Avenue Fault is a potentially active strand of the Chino-Central Avenue fault zone. This fault is primarily located based the presence of groundwater barriers and vegetation lineaments and limited oil well data.

One additional fault crossed by the Segment 8A alignment is the Puente Hills Blind Thrust. Although this fault underlies many miles of this segment, as shown in Figure 3.7-1, it is a buried blind thrust fault and is not expected to generate primary surface fault rupture, however minor surface cracking could be associated with an earthquake on this fault.

Groundshaking. As shown in Table 3.7-2, Segments 8A, 8B, and 8C are in close proximity to numerous active faults of the southern Transverse Ranges and San Andreas Fault system, and cross active faults of the Elsinore Fault system (Whittier and Chino-Central Ave faults). Additionally, the eastern portion of Segment 8A overlies and is in close proximity to the Puente Hills Blind Thrust and the Upper Elysian Park Thrust, respectively, as shown in Figure 3.7-1. These blind thrust faults are capable of producing large earthquakes and very strong groundshaking, as demonstrated by the Whittier Narrows M6.0 earthquake which occurred on the Puente Hills Blind Thrust and caused substantial damage in the Los Angeles area. Moderate to very strong groundshaking should be expected from an earthquake on any of the faults in the vicinity of these segments. The expected ranges of peak horizontal accelerations for these segments are presented in Table 3.7-3.

Liquefaction. Potential for liquefaction in the Puente and Chino Hills area crossed by Segment 8A is low to nonexistent due to the presence of non-liquefiable bedrock underlying the alignment in this area. Where Segment 8A crosses young alluvial deposits in the Whittier Narrows area, the underlying sediments are potentially liquefiable (CGS, 1999d). Segments 8A, 8B, and 8C cross young alluvial sediments in the

Chino Basin, however anticipated depths to groundwater are greater than 70 feet (CBWM, 2008) resulting in a low liquefaction potential.

Earthquake-Induced Landslides. The topography along Segment 8A in the Puente and Chino Hills is locally steep and is likely to experience landsliding or slope failures due to earthquakes. Historic earthquake induced ground and slope failures are known to have occurred in the mountains and hills of southern California. Moderate to steep slopes throughout the Puente and Chino Hills could experience slope failures in areas with over-steepened slopes or with bedding planes oriented in the downslope direction.

Mineral Resources

No mineral resource sites are identified in the MRDS within 1,000 feet of the proposed TRTP Segment 8 route. Segment 8 does traverses near the Brea-Olinda oil field near Brea and Tonner Canyons north of the City of Brea, and Segment 8 about three miles north of the small Chino-Soquel oil field (DOGGR, 2008). However, the alignments do not cross through active oil well/field areas.

Paleontology

The proposed Project alignment in the Puente, Chino, and Montebello Hills traverses mostly late Tertiary marine sedimentary rock of the Puente Formation and Fernando Formation that form the hills. Quaternary Older and Younger Alluvium comprise the valley areas at San Gabriel River, Chino Valley and small stream channels within the Puente and Chino Hills.

The Miocene age Puente Formation is subdivided into four members: the La Vida Shale Member, the Soquel Sandstone Member, the Yorba Shale Member, and the Sycamore Canyon Member. Each member is known to contain scientifically important fossil assemblages and specimens (PEAI, 2007). The La Vida Shale Member has yielded the tests of marine microfossils (benthic foraminifers) of the late Miocene, lower Mohnian Stage, and fossilized fish scales; the fossilized remains of extinct species of marine algae, clams, crabs, fishes, sharks, and mammals (whales, desmostylids); and the fossilized wood and leaves of land plants (PEAI, 2007). These occurrences indicate that there is a high potential for additional, similar, scientifically important fossil remains being encountered by ground-disturbing activities where the Project area is underlain by the La Vida Shale Member. Moreover, there is a potential that some of the remains might represent new species or species previously not recorded from the member. For these reasons, the La Vida Shale Member is considered paleontologically highly important PEAI, 2007).

The Soquel Sandstone Member has yielded the tests of marine microfossil (benthic foraminifera) species of the late Miocene, upper Mohnian Stage; fossilized coral remains; fragments of mollusk shells and marine vertebrate bones; and shark teeth and fish scales in the Chino Hills (PEAI, 2007). In the Chino Hills at Laband Village, the member yielded fossilized remains representing at least fourteen species of marine and land plants and marine mollusks and vertebrates, including fishes and mammals, and additional such remains representing 19 species were recovered from the transitional zone between the Soquel Sandstone and Yorba Shale Members. Fossil localities also in the Chino Hills have yielded fossil fish and porpoise remains. These occurrences indicate that there is a high potential for similar scientifically highly important fossil remains being encountered in the Soquel Sandstone Member and there is a potential that some of the remains might represent new species or species previously not recorded from the member. For these reasons, the Soquel Sandstone Member is considered paleontologically highly important (PEAI, 2007).

The Yorba Shale Member has yielded the tests of marine microfossil (benthic foraminiferal) species of the late Miocene, upper Mohnian Stage in the Chino Hills, including the very rare, fossil remains of the paper nautilus, and 50 species of marine algae, land plants, and marine invertebrates and vertebrates at Laband Village (PEAI, 2007). The benthic foraminiferal species from Laband Village are characteristic of the late Miocene to early Pliocene lower Delmontian Stage, an age assignment that is slightly younger than previously reported for the Yorba Shale Member. These occurrences indicate that there is a high potential for additional, similar, scientifically highly important fossil remains being encountered by ground-disturbing activities where the Project area is underlain by the Yorba Shale Member and this unit is also considered paleontologically highly important (PEAI, 2007).

The Sycamore Canyon Member has yielded the tests of marine microfossil (benthic foraminiferal) species of the late Miocene to early Pliocene, upper Mohnian and lower Delmontian Stages in the Chino Hills (PEAI, 2007). Fossilized remains representing over 40 species, including marine and land plants, sea turtles, sharks, marine fishes, birds, and baleen whales, from a number of localities in this formation at the Robert O. Townsend Junior High School site in the Chino Hills. Numerous localities in the Puente Hills near Segment 8 yielded specimens representing six species of marine snails, clams, crabs, and echinoids; fossilized remains of baleen whales, sharks, fishes, porpoises, and sea lions from the Sycamore Canyon Member (PEAI, 2007). These occurrences indicate that there is a high potential for additional, similar, scientifically highly important fossil remains being encountered by ground-disturbing activities where the Project area is underlain by the Sycamore Canyon Member and this unit is considered paleontologically highly important (PEAI, 2007).

The Fernando Formation in the Puente, Chino, and Montebello Hills is subdivided into two members: the Lower or "Repetto" Member and the Upper or "Pico" Member. The Lower Member of the Fernando Formation has yielded the fossilized remains of Pliocene marine snails, clams, brachiopods, barnacles, crabs, sand dollars, heart urchins, sharks, marine fishes, and baleen whales at a fossil site in the Chino Hills and the Puente Hills (PEAI, 2007). These occurrences indicate that there is a high potential for additional, similar, scientifically highly important fossil remains being encountered by ground-disturbing activities where the Project area is underlain by the Lower Member of the Fernando Formation and this unit is considered paleontologically highly important (PEAI, 2007).

The Upper Member of the Fernando Formation has yielded fossil remains representing approximately 50 species of marine invertebrates, including snails, clams, scaphopods (tusk shells), and sand dollars, at 40 fossil sites in the Chino Hills PEAI, 2007. Whale remains were found in the Puente Hills approximately 1 mile from Segments 7 and 8 (PEAI, 2007). These occurrences indicate that there is a high potential for additional, similar, scientifically highly important fossil remains being encountered by ground-disturbing activities where the Project area is underlain by the Upper Member of the Fernando Formation and this formation is considered paleontologically highly important (PEAI, 2007).

Continental deposits at the top of the Fernando Formation have yielded the fossilized remains of a horse in Monterey Park (PEAI, 2007). In part because of the limited aerial extent of this unit, the latter occurrence indicates that there is an undetermined (but probably no more than a moderate) potential for additional, similar, scientifically highly important fossil remains being encountered locally by ground-disturbing activities in the Montebello Hills, where Segments 7, 8, and 11 and the Mesa Substation site are underlain by nonmarine unit of the Upper Member (PEAI, 2007).

In the Puente and Chino Hills, Segment 8 crosses canyons whose floors are underlain by Younger Alluvium. This rock unit yielded the fossilized remains of a late Pleistocene bison in Tonner Canyon

(PEAI, 2007). There is an undetermined (but possibly high) potential for additional, similar, scientifically highly important fossil remains being encountered locally by ground-disturbing activities in the Chino and Puente Hills (Segment 8) where the Project area is underlain by Younger Alluvium and this unit is considered to be of undetermined (but possibly high) importance locally (PEAI, 2007).

Younger Alluvium 1.5 miles east of Mira Loma Substation in the Chino Valley yielded late Pleistocene ground sloth and camel remains and depths of 11 to 15 feet below the present ground surface, and mammoth remains at a depth of 5 feet (PEAI, 2007). Numerous other localities, mostly unpublished, occur in the Chino Valley where shallow depths (about 3 feet) have yielded additional remains representing a taxonomic diversity of late Pleistocene land mammal species (PEAI, 2007). The remains Younger Alluvium in the Chino Valley are scientifically highly important because of their taxonomic diversity and because they have demonstrated that Pleistocene land mammal remains can occur at very shallow depths in areas underlain by younger alluvium. These occurrences indicate that there is a high potential for additional, similar, scientifically highly important fossil remains being encountered locally by ground-disturbing activities in the Chino Valley (Segment 8) where the Project area is underlain by Younger Alluvium and this unit is considered locally paleontologically highly important (PEAI, 2007).

Segment 9 – Substations

Whirlwind Substation

Geology

The proposed Whirlwind Substation site is entirely underlain by Quaternary alluvial fan deposits formed by streams transporting sand and gravel east from the Tehachapi Mountains.

Slope Stability

The proposed Whirlwind Substation is located on a flat to gently sloping alluvial fan, and would not be subject slope failures.

Soils

The site is underlain by the Hesperia soil association which consists primarily of fine sandy loam with calcareous layers at depth. Hazard of erosion for these soils for off-road or off-trail is slight and for on roads and trails ranges from slight to moderate. Shrink/swell (expansive) potential of the soil is low, and the corrosive potential is high for uncoated steel and low for concrete.

Mineral Resources

Although potential sand and gravel and limestone resources exist in the substation area, no active mineral resource sites were identified by the MRDS within 1,000 feet of the proposed site. This results in no potential for construction of the Whirlwind Substation to interfere with access to known mineral resources.

Seismicity

Fault Rupture. The Whirlwind Substation site is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The Whirlwind Substation is near the Garlock Fault Zone (about 10 miles northwest) and the San Andreas Fault Zone (about 11 miles southwest). Moderate to strong groundshaking from an earthquake on any of the faults in the vicinity of the Whirlwind Substation should be expected. The expected range of peak horizontal accelerations for the Whirlwind Substation is 0.4g (Table 3.7-3).

Liquefaction. Liquefaction potential at Whirlwind Substation is low due to groundwater depth greater than 100 feet in western Antelope Valley.

Earthquake-Induced Landslides. The topography at Whirlwind Substation is very gently sloping and will not experience landslides or slope failures due to earthquakes.

Paleontology

The proposed Whirlwind Substation is underlain by Holocene Younger alluvium. The Younger Alluvium is generally considered to have low sensitivity for paleontological resources.

Antelope Substation

Geology

The proposed Antelope Substation improvements site is underlain by Quaternary alluvium and alluvial fan deposits transported northeast from Portal Ridge.

Slope Stability

The proposed improvements at the Antelope Substation are located on a nearly flat alluvial plain, and would not be subject slope failures.

Soils

The Antelope Substation site is underlain by the Greenfield soil association which consists of sandy to coarse sandy loam. Hazard of erosion for these soils is slight to severe for on roads and trail use. Shrink/swell (expansive) potential of the soil is low, and the corrosive potential is low to high for uncoated steel and low for concrete.

Mineral Resources

Although potential sand and gravel resources exist in the substation area, no active mineral resource sites were identified by the MRDS within 1,000 feet of the proposed site. There is no potential for construction at the Antelope Substation to interfere with access to known mineral resources.

Seismicity

Fault Rupture. The Antelope Substation site is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The Antelope Substation is about 3.8 miles northwest of the San Andreas Fault Zone and moderate to strong groundshaking from an earthquake on this fault or any of the faults in the vicinity should be expected. The expected range of peak horizontal accelerations for the Antelope Substation is 0.6g (Table 3.7-3).

Liquefaction. Liquefaction potential at Antelope Substation is low due to groundwater depth greater than 100 feet in western Antelope Valley.

Earthquake-Induced Landslides. The topography at Antelope Substation is nearly flat and will not experience landslides or slope failures due to earthquakes.

Paleontology

The proposed Antelope Substation expansion area is underlain by Holocene Younger alluvium. The Younger Alluvium is generally considered to have low sensitivity for paleontological resources.

Vincent Substation

Geology

The proposed expansion area at the Vincent Substation is underlain by Quaternary Older Alluvium comprised of sand and gravel deposits.

Slope Stability

The Vincent Substation is located on a level graded pad that is about 10 to 20 feet above dry stream washes on the north and south sides. The Older Alluvium is generally stable at moderate slope inclinations but the poorly consolidated materials are susceptible to erosion.

Soils

The Hanford soil association underlies the Vincent Substation site. These soils consist of fine sandy to sandy loam. Hazard of erosion for these soils is moderate to severe for on roads and trail use. Shrink/swell (expansive) potential of the soil is low, and the corrosion potential is low to moderate for uncoated steel and for concrete.

Mineral Resources

Although potential sand and gravel resources exist in the substation area, no active mineral resource sites were identified by the MRDS within 1,000 feet of the proposed substation improvements. There is no potential for construction at the Antelope Substation to interfere with access to known mineral resources.

Seismicity

Fault Rupture. The Vincent Substation site is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The Vincent Substation is about 3.6 miles southwest of the San Andreas Fault Zone and moderate to very strong groundshaking from an earthquake on this fault or any of the faults in the vicinity should be expected. The expected range of peak horizontal accelerations for the Vincent Substation is 0.6g (Table 3.7-3).

Liquefaction. Liquefaction potential at Vincent Substation is low due to estimated groundwater depths greater than 50 feet in the area and the alluvium is generally medium dense to dense (Leroy Crandall, 1963).

Earthquake-Induced Landslides. The topography at Vincent Substation consists of a graded flat ridge elevated about 20 feet above wide, west-draining, flat-floored dry stream beds and will not experience landslides or slope failures due to earthquakes.

Paleontology

The proposed Vincent Substation expansion area is underlain by Quaternary Older alluvium. The Older Alluvium is generally considered to have high sensitivity for paleontological resources.

Mesa Substation

Geology

The proposed expansion area at the Mesa Substation is underlain by Older Alluvium composed of unconsolidated silt, sand and gravel, and Pleistocene Fernando Formation comprised of semi-consolidated sandstone, conglomerate, siltstone and claystone.

Slope Stability

Terrain at Mesa Substation is nearly flat to gently sloping and would not be subject slope failures.

Soils

The site is underlain by Urban Land-Ramona-Zamora soils, which are formed on alluvium and colluvium on alluvial fans, plains, and terraces. Hazard of erosion for these soils is slight to moderate for off roads and trails and moderate to severe for on roads and trails. Shrink/swell (expansive) potential of the soil is low and the corrosion potential is moderate to high for uncoated steel and moderate for concrete.

Mineral Resources

There is limited potential for sand and gravel resources at the substation area, and the Mea Substation is about 0.7-mile northwest of the active Montebello Hills oil field. There are no other active mineral resource sites identified by the MRDS within 1,000 feet of the proposed site. There is no potential for construction at the Mesa Substation to interfere with access to known mineral resources.

Seismicity

Fault Rupture. The Mesa Substation site is located only 1.7 miles southwest of the East Montebello Hills fault but is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The Mesa Substation is about 4 miles west of the Whittier fault, 2 miles southeast of the Upper Elysian Park blind thrust, and lies directly above the north-dipping thrust plane of the Puente Hills blind thrust fault. Moderate to strong groundshaking from an earthquake on any of the faults in the vicinity should be expected. The expected range of peak horizontal accelerations for the Mesa Substation is 0.5g (Table 3.7-3).

Liquefaction. Liquefaction potential at Mesa Substation is low due to estimated groundwater depths greater than 50 feet and the older alluvium and underlying Fernando Formation is medium dense to dense.

Earthquake-Induced Landslides. The topography at Mesa Substation is flat to gentle slopes and will not experience landslides or slope failures due to earthquakes.

Paleontology

The proposed Mesa Substation expansion area is underlain by older alluvium and nonmarine Fernando Formation. Both of these units are generally considered to have moderate sensitivity for paleontological resources.

Gould Substation

Geology

The proposed expansion area at the Gould Substation is underlain by artificial fill and quartz diorite.

Slope Stability

Terrain at Gould Substation consists of the nearly flat graded area at the facility and in the immediate vicinity surrounded by moderately inclined slopes. The natural slopes are underlain by quartz diorite and generally would not be subject slope failures.

Soils

The Gould Substation is underlain by the Cienba-Exchequer-Sobrante soil complex, which is formed on mafic and felsic weathered igneous rock, and are comprised of coarse sandy loam, gravelly sandy loam, gravelly loam, and loam. Hazard of erosion for these soils is severe for on roads and trail use. Shrink/swell (expansive) potential of the soil is low and the corrosion potential is low to moderate for uncoated steel and for concrete.

Mineral Resources

There are no active mineral resource sites identified by the MRDS within 1,000 feet of the proposed site. There is no potential for construction at the Gould Substation to interfere with access to known mineral resources.

Seismicity

Fault Rupture. The Gould Substation site is located 3.5 miles south of the San Gabriel fault and is within the Sierra Madre fault zone only 0.2 and 0.5 miles from two mapped traces. The Gould Substation is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The Gould Substation is near the right-lateral strike slip San Gabriel fault and the reverse dip-slip Sierra Madre fault. Both faults are capable of large earthquakes. Moderate to strong groundshaking from an earthquake on these faults or any of the faults in the vicinity should be expected. The expected range of peak horizontal accelerations for the Gould Substation is 0.6g (Table 3.7-3).

Liquefaction. There is no liquefaction potential at Gould Substation due to the underlying consolidated igneous bedrock.

Earthquake-Induced Landslides. The moderately inclined slopes immediately surrounding Gould Substation are composed of thin colluvium over quartz diorite bedrock resulting in a low to moderate potential for earthquake-triggered landslides or slope failures. However, nearby steep slopes and locally sheared bedrock in the San Gabriel Mountains are likely to experience landslides or slope failures due to earthquakes.

Paleontology

The proposed Gould Substation expansion area is underlain by igneous rock with no potential for paleontological resources.

Mira Loma Substation

Geology

The proposed Mira Loma Substation improvements site is underlain by Quaternary alluvium deposited on a very broad alluvial plain.

Slope Stability

The Mira Loma Substation is located on a flat plain with no potential for landslides or slope failures.

Soils

Soil at the Mira Loma Substation belong to the Delhi soil series, are very deep soils formed in wind-modified alluvial deposits, and are comprised of sand, fine sand, loamy fine sand, or loamy sand. Hazard of erosion for these soils is slight to moderate for on roads and trail use. Shrink/swell (expansive) potential of the soil is low and the corrosion potential is low to moderate for uncoated steel and for concrete.

Mineral Resources

Although potential sand and gravel resources exist in the substation area, no active mineral resource sites were identified by the MRDS within 1,000 feet of the proposed site. There is no potential for construction at the Mira Loma Substation to interfere with access to known mineral resources.

Seismicity

Fault Rupture. The Mira Loma Substation site is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The Mira Loma Substation is about 7 miles east of Central Avenue fault and 11.3 miles southwest of the San Jacinto fault. Moderate to strong groundshaking from an earthquake on any of the faults in the vicinity should be expected. The expected range of peak horizontal accelerations for the Mira Loma Substation is 0.4g (Table 3.7-3).

Liquefaction. Liquefaction potential at Mira Loma Substation is low due to estimated groundwater depths greater than 50 feet.

Earthquake-Induced Landslides. The topography at Mira Loma Substation is almost level and will not experience landslides or slope failures due to earthquakes.

Paleontology

Younger Alluvium 1.5 miles east of Mira Loma Substation yielded late Pleistocene ground sloth and camel remains at depths of 11 to 15 feet below the present ground surface, and mammoth remains at a depth of 5 feet (PEAI, 2007). Numerous other localities, mostly unpublished, occur in the Chino Valley where shallow depths (about 3 feet) have yielded additional remains representing a taxonomic diversity of late Pleistocene land mammal species (PEAI, 2007). The remains in Younger Alluvium in the Chino Valley are scientifically highly important because of their taxonomic diversity and because they have demonstrated that Pleistocene land mammal remains can occur at very shallow depths in areas underlain by younger alluvium and these units are generally considered to have moderate sensitivity for paleontological resources.

3.7.2.3 Alternative 3: West Lancaster Alternative

Alternative 3 is identical to the proposed Project, except for one deviation. It would re-route the new 500-kV T/L in Segment 4 along 115th Street West rather than 110th Street West. This Alternative would deviate from the proposed route at approximately S4 MP 14.9,where the new 500-kV T/L would turn south down 115th Street West for approximately 2.9 miles and turn east for approximately 0.5 mile, rejoining the proposed route at S4 MP 17.9. This re-route traverses through undeveloped land with scattered residential use along West Avenue I and J and would increase the overall distance of Segment 4 by approximately 0.4 mile.

Geology

The minor reroute of the West Lancaster Alternative traverses Younger Alluvium like the equivalent portion of Segment 4 of the proposed Project.

Slope Stability

The proposed Alternative 3 alignment is located on a nearly flat alluvial plain and would not be subject to slope failures.

Soils

Soils units encountered along Alternative 3 are the same as for the proposed Project, and thus have the same characteristics.

Mineral Resources

There are no known quarries along the minor reroute of Alternative 3 alignment, although the alluvial deposits contain sand and gravel resources. The mineral resources along the remainder of the Alternative 3 alignment are identical to the proposed Project.

Seismic Hazards

Fault Rupture. The proposed Alternative 3 reroute is not crossed by any active faults and therefore would not be subject to surface fault rupture.

Groundshaking. The proposed Alternative 3 reroute does not pass across or nearer to major faults and the level of groundshaking would be identical to the proposed Project.

Liquefaction. Liquefaction potential along the Alternative 3 reroute is low due to groundwater depth greater than 100 feet in western Antelope Valley. The liquefaction hazard along the remainder of Alternative 3 is identical to the proposed Project.

Earthquake-Induced Landslides. The minor reroute of the West Lancaster Alternative traverses relatively level to gently sloping alluvial plains like the equivalent portion of Segment 4 of the proposed Project and has no potential for earthquake-induced slope failure. The remainder of Alternative 3 is identical to the proposed Project and has low to high potential to encounter areas of known or potential landslides and unstable slopes (as described in Section 3.7.2.2).

Paleontology

The minor reroute of the West Lancaster Alternative traverses Younger Alluvium like the proposed Project. The Younger Alluvium to shallow depths of three to five feet is probably too young to contain remains old enough to be considered fossilized. Correspondingly, there probably is only a low potential for scientifically important fossil remains being encountered (PEAI, 2007) along the reroute portion of Alternative 3. The remainder of Alternative 3 is identical to the proposed Project and has low to high potential to encounter scientifically important fossil remains.

3.7.2.4 Alternative 4: Chino Hills Route Alternatives

Alternative 4 consist of four route options (designated Route A, Route B, Route C, and Route D) passing through and around Chino Hills State Park. Alternative 4 is identical to the proposed Project, except for the eastern end of the alignment where it deviates from Segment 8. Therefore the environmental setting is identical except where it deviates from the proposed Project alignment, therefore only the setting for the portion of Alternative 4 that deviates from the proposed Project is discussed below. Environmental setting of the proposed Project is discussed in Section 3.7.2.2.

Geology

Where Alternative 4 deviates from the proposed Project route, it is entirely underlain by the Puente Formation (Soquel and Yorba members).

Slope Stability

All of the Alternative 4 route options (Route A, Route B, Route C, and Route D) pass through moderate to steep terrain with mapped landslides, potentially unstable slopes, and narrow alluvium-filled valleys. Alternative 4 would reduce the total length of the Project and not pass through Chino Valley. Within Chino Hills (eastern Puente Hills) each of the four route options traverses Miocene age Puente Formation which is prone to landslides. Alternative 4 diverges from the proposed Project 0.5 miles east of Tonner Canyon, at approximately MP S8A-19.2, where additional landslides are mapped and continue along the proposed Project alignment to the east in the Puente Hills. Unmapped landslides and areas of slope instability may be encountered throughout the Alternative 4 alignment in the eastern Puente Hills. Alternative 4 has similar impacts for potential landslides and unstable slopes as the comparable portion of Segment 8A as they both cross hillside areas underlain by the landslide prone Puente Formation. However, all of the Alternative 4 routes cross a slightly longer length through the Puente Formation than the proposed Project (ranging from 6.2 to 12.4 miles versus 5.9 miles for the comparable portion of Segment 8A), resulting in a slightly increased potential for impacts from landslides and unstable slopes along Alternative 4 compared to the proposed Project.

Soils

All of the Alternative 4 routes are underlain by one soil association, the Anaheim-Soper-Fontana association. This soil association is formed in material weathered from sandstone, shale, and conglomerate on moderate to steep hills. Hazard of erosion for these soils is moderate to very severe for off road or trail and severe for on roads and trails. Shrink/swell (expansive) potential of the soil is low to moderate and the corrosion potential is moderate to high for uncoated steel and low to moderate for concrete.

Mineral Resources

There are no known mines or quarries along the Alternative 4 alignment. The Alternative 4, Route D alignment traverses adjacent and east of the Chino-Soquel oil field boundary, but does not cross the active field. The Alternative 4, Route C Raptor Ridge Reroute of the existing 500-kV and 220-kV transmission lines would pass approximately 1800 feet south and southeast of the Chino-Soquel oil field, but is not near any mapped active or inactive oil wells. The proposed switching station for Alternative 4 Route B and Route D is located only about 800 feet north of the inactive Mahala oil field but is not in the vicinity of any mapped inactive oil wells.

Seismic Hazards

Fault Rupture. Neither Route A nor Route C of Alternative 4 cross active or potentially active faults, resulting in no potential for surface fault rupture along these routes. However, both the eastern ends of Routes B and D and their associated new switching station would cross the Alquist-Priolo zoned Chino Fault, as shown in Figure 3.7-1, which results a potential for damage from surface fault rupture.

Groundshaking. Moderate to strong ground shaking of 0.4 to 0.6g is anticipated in the eastern Puente and Chino Hills. The closest active faults to the Alternative 4 routes are the Whittier and Chino fault. The Whittier fault approximately parallels the Alternative 4 alignments 2 miles to the southwest, and the Chino fault is located approximately 3 and 1.5 miles east of the eastern end of Alternative 4 Routes A and C, respectively, and crosses the eastern end of Alternative 4 Routes B and C.

Liquefaction. The Alternative 4 routes are all underlain by Puente Formation bedrock, which is not susceptible to liquefaction.

Earthquake-Induced Landslides. The topography along Alternative 4 in the Chino Hills is locally steep and is likely to experience landsliding or slope failures due to earthquakes. Historic earthquake induced ground and slope failures are known to occur in the mountains and hills of southern California. Moderate to steep slopes throughout the Chino Hills could experience slope failures in areas with over-steepened slopes or with bedding planes oriented in the downslope direction.

Paleontology

Alternative 4 would reduce the total length of the Project and not pass through Chino Valley. Within Chino Hills each of the four route options traverses Miocene age Yorba and Soquel Members of the Puente Formation; Routes B and D extend east into areas underlain by the late Miocene – early Pliocene age Sycamore Canyon Member of the Puente Formation. Alternative 4 joins the proposed Project 0.5 miles east of Tonner Canyon where the Soquel Member of the Puente Formation forms the hillsides. Alternative 4 crosses through the same units with the same paleontologic sensitivity as the equivalent portion of Segment 8A, therefore the same types of paleontologic resources may be found along the Alternative 4 alignment as these geologic units have several known fossil locations that have yielded scientifically important fossil remains. However, each of the Alternative 4 route options is within the paleontologic-rich Puente Formation (high sensitivity) and is longer than the comparable portion of the proposed Project within these same formations (0.3 to 6.5 miles longer). Despite these longer lengths of alignment in Puente Formation, the shorter overall lengths results in the following: Alternative 4 would eliminate approximately 3.6 to 9.2 miles of paleontologically sensitive Puente Formation and alluvium along Segment 8A, and 6.8 and 6.4 miles of paleontologically sensitive alluvium along Segments 8B and 8C, respectively.

3.7.2.5 Alternative 5: Partial Underground Alternative

This alternative would utilize underground construction in place of the proposed overhead line construction following the same routes as the proposed Project. The transmission line route for Alternative 5 would be the same as the proposed Project, with the exception that the line would be installed underground in a tunnel for approximately four miles through Chino Hills along Segment 8A. Under this alternative, the proposed transmission line would shift from overhead to underground at approximately MP 21.9 of Segment 8A and would continue underground through the City of Chino Hills to approximately MP 25.8 of Segment 8A, where the underground line would shift back to overhead. New underground facilities would replace the proposed aboveground facilities along the four miles through the Chino Hills, and transition stations would be required at each end of the underground segment to transfer the transmission lines from overheard to underground and vice versa. The geologic, seismic, and paleontologic setting along Alternative 5 would be identical to the proposed Project; therefore refer to Section 3.7.2.2 for discussions of setting along the proposed Project alignment.

3.7.2.6 Alternative 6: Maximum Helicopter Construction in the ANF Alternative

Alternative 6 is identical to the proposed Project (Alternative 2), except along Segment 6 and Segment 11 where helicopter construction would be used to the maximum extent feasible in the ANF portion of the route. This alternative would include construction of 11 helicopter staging areas in the ANF, several of which would require extensive grading (cut and fill). As a result of helicopter construction, some access and most spur roads would not be created and/or upgraded for ground access to towers along these portions of Segment 6 and Segment 11. However, many unpaved access roads would still require some upgrading and or regrading for access by construction personnel. This alternative would result in approximately 69 fewer acres of temporary ground disturbance in the ANF, 82 fewer acres of temporary ground disturbance total, and approximately 47 fewer acres of permanent ground disturbance than Alternative 2. Despite the increased use of helicopter construction techniques for the ANF portions of Segment 6 and Segment 11, the transmission line route traversed by Alternative 6 would be identical to that of Alternative 2 and thus the geologic, seismic, and paleontologic setting along the Alternative 6 transmission line route would be identical to the proposed Project (Alternative 2); therefore please refer to Section 3.7.2.2 for discussions of setting along the proposed Project alignment.

However, most of the helicopter staging areas to be used for Alternative 6 would be at locations not included or analyzed in any of the other alternatives and the geologic, seismic, and paleontologic settings for these sites are discussed below. Although four of the helicopter staging areas are located at approximately the same locations as those identified for Alternative 2, they are discussed below to include a full setting description for the helicopter staging areas. The sites that are the same in both alternatives are as follows:

- Alternative 6 Site #7 = Alternative 2 Site SCE#6B,
- Alternative 6 Site #8 = Alternative Site SCE#3B,
- Alternative 6 Site #9 = Alternative 2 Site SCE#7, and
- Altenative 6 Site #11 = Alternative 2 Site SCE#8.

Geology

Each of the 11 helicopter staging areas is located in the San Gabriel Mountains. The sites are primarily underlain by igneous and metamorphic bedrock. Geologic units expected to be encountered at the helicopter staging areas are listed below (see Table 3.7-7 for summary descriptions of these units):

- Older alluvium over Hornblende Diorite Gabbro – Site #1
- Older alluvium over Lowe Granodiorite – Sites #2 and #3
- Anorthosite gabbro, primarily hornblende gabbro – Site #4
- Landslide and anorthosite gabbro complex – Site #5
- Lowe Granodiorite and gneiss – Site #6
- Gneiss – Site 7 (same as Alternative 2 Site SCE#6B)
- Artificial fill from dredging of Big Tujunga Reservoir of unknown depth over granitic rocks – Site #8 (same as Alternative 2 Site SCE#3B)

- Granitic rocks – Site 9 (same as Alternative 2 Site SCE#7)
- Granitic rocks – primarily quartz monzonite – Site #10
- Gneiss – Site 11 (same as Alternative 2 Site SCE#8)

Slope Stability

Sites SCE#1,# 2, and #3 are located along flat to gently sloping stream terraces along the northern edge of the San Gabriel Mountains and are not subject to slope stability issues. Site 7, although located in hilly terrain of the San Gabriel Mountains, is located at preexisting, gently sloping, graded facilities at Barton Flats, which already includes a helicopter landing area, and would not require further grading for use as a helicopter staging area. Site SCE#8 is located in Maple Canyon southeast of Big Tujunga Reservoir on terraced fill slopes created from material dredged from the reservoir. The Site SCE#8 helicopter staging area is located near the top of the terraced fill in the canyon with moderately sloping hills above and on either side of the site and would likely require moderate grading to create a suitable staging area.

The remaining five helicopter staging areas (Sites SCE#4, #5, #6, #9, and #10) are located on or along ridges, hilltops, and in saddles of the San Gabriel Mountains with sloping terrain which would require moderate to extensive grading (cut and fill) to create suitable, relatively flat sites for helicopter landings and staging of construction supplies and equipment. Small to large landslides and debris slides are mapped along the steep mountain terrain adjacent to the staging sites in the Project vicinity. Helicopter staging Site SCE#5 is located on a mapped landslide near the top of the landslide. Although many of the helicopter staging areas may be subject to construction triggered landslides, the need for fewer access roads in the steep terrain would result in less grading in steep, potentially landslide prone terrain than Alternative 2, thereby reducing the overall potential for construction triggered landslides as compared to the proposed Project.

Soils

The Alternative 6 helicopter staging areas are underlain by similar soil associations as the nearby Segment 6 and Segment 11 transmission line corridors. Soil associations mapped at the helicopter staging areas are as follows:

- Sites #1 and 2 - Hanford
- Site #3 – Pismo-Trigo-Exchequer
- Site #4 – Pismo-Chilao-Shortcut
- Site #5 – Vista
- Site #6 – Trigo-Modjeska
- Site #7 – Trigo-Green Bluff-Supan
- Site #8 – This site is mapped as underlain by Chilao soils, however because this site is on dredged fill the 'soil characteristics' of the material of the site is dependent on the type and grain size of the fill material.
- Site #9 – Stukel-Winthrop
- Site #10 – Rock Outcrop-Chilao
- Site #11 – Ramona-Zamora

These soils are primarily either formed in alluvium or colluvium weathered from granitic or metamorphic bedrock, or formed in material weathered from the underlying bedrock (primarily granitic and metamorphic, rocks in this part of the Project area). A summary of the basic characteristics of these soils is presented in Table 2-1 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008). These soils are primarily either formed in alluvium or colluvium weathered from granitic or metamorphic bedrock, or formed in material weathered from the underlying metamorphic and igneous bedrock. The hazard of erosion for these soils for off-road or off-trail ranges from slight to very severe. The hazard of erosion for these soils on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to moderate. The corrosive potential of soils at the staging sites ranges from low to high for uncoated steel and from low to moderate for concrete.

Mineral Resources

Mineral resources in the vicinity of the helicopter staging areas consist primarily of metallic minerals (ores) such as gold and titanium and no active mines are located at or adjacent to any of the staging sites. This results in no change in potential for inference with access to known mineral resources along the ANF portion of Alternative 6 compared to the equivalent portion of Alternative 2.

Seismic Hazards

Fault Rupture. None of the helicopter staging areas is crossed by active or potentially active faults, resulting in no potential for surface fault rupture at these sites. This results in no change in potential for fault rupture along the ANF portion of Alternative 6 compared to the equivalent portion of Alternative 2.

Groundshaking. Moderate to strong ground shaking of 0.4g to 0.7g is anticipated in the San Gabriel Mountains near the helicopter staging areas.

Liquefaction. Although Sites 1, 2, and 3 are underlain by older alluvium near to stream channels, the potential for liquefaction is low at these sites due to the expected coarse nature of the deposits and shallow depth to bedrock. Liquefaction potential is low to nonexistent at the remaining staging sites due to the presence of the non-liquefiable underlying granitic and metamorphic bedrock at these helicopter staging areas.

Earthquake-Induced Landslides. The topography at and near the helicopter staging areas is locally steep and is likely to experience landsliding or slope failures due to earthquakes. Historic earthquake induced ground and slope failures have occurred in the San Gabriel Mountains due to large regional earthquakes. The steep mountain slopes could experience slope failures in areas with over-steepened slopes or with weathered and sheared bedrock.

Paleontology

In the San Gabriel Mountains the helicopter staging areas are underlain mostly by non-fossiliferous igneous and metamorphic rocks. At Sites 1, 2, and 3, which are underlain by alluvial deposits along streams and valleys of the San Gabriel Mountains, the deposits are unlikely to contain identifiable fossil specimens due to the high energy depositional environment that would have destroyed or damaged any fossil specimens (PEAI, 2007).

3.7.2.7 Alternative 7 : 66-kV Subtransmission Alternative

Alternative 7 is identical to the proposed Project (Alternative 2), except along Segments 7 and 8A where three 66-kV subtransmission line elements would be undergrounded or relocated. The three 66-kV subtransmission line elements include the following: (1) Undergrounding the 66-kV subtransmission line in Segment 7 through the River Commons or Duck Farm Project (between Valley Boulevard – S7 MP 8.9 and S7 MP 9.9); (2) Re-routing and undergrounding the 66-kV subtransmission line around the Whittier Narrows Recreation area in Segment 7 (S7 MP 11.4 to 12.025); and (3) Re-routing the 66-kV subtransmission line around the Whittier Narrows Recreation Area in Segment 8A between the San Gabriel Junction (S8A MP 2.2) and S8A MP 3.8. Other than the minor 66-kV re-routes and underground construction described above for the three elements of Alternative 7, this alternative would be identical to the proposed Project (Alternative 2) as discussed in Sections 2.2.3 through 2.2.9. All substation and information technology facilities would also be identical to the proposed Project as discussed in Sections 2.2.10 and 2.2.11, respectively. Therefore, with the exception of the minor differences in alignment for the three 66-kV re-routes, the transmission line route traversed by Alternative 7 would be identical to that of Alternative 2 and thus the geologic, seismic, and paleontologic setting along the Alternative 7 transmission line route would be identical to the proposed Project (Alternative 2); therefore refer to Section 3.7.2.2 for discussions of setting along the proposed Project alignment. The geologic setting along the three 66-kV re-routes has slight differences than that of the proposed Project and is discussed below.

Geology

The geology of the 66-kV re-routes is nearly identical to the corresponding nearby portion of the proposed Project alignment. Geologic units expected to be encountered along the 66-kV re-route alignments are listed below (see Table 3.7-7 for summary descriptions of these units) (Dibblee, 1999):

- Duck Farm 66-kV Underground – entirely underlain by channel deposits (Qg)
- Whittier Narrows 66-kV Underground Re-Route – underlain by alluvium (Qa) and channel deposits (Qg)
- Whittier Narrows 66-kV Overhead Re-Route – underlain by Fernando Formation for the first half-mile and then by alluvium (Qa) and channel deposits (Qg)

Slope Stability

The Duck Farm and Whittier Narrows Underground re-routes are both located on flat alluvial channel and valley topography and would not be subject to slope stability issues. The western end of the Whittier Narrows Overhead re-route is located along the moderate to gently sloping eastern slopes of the Montebello Hills, and although the moderately sloping areas may be subject to minor landslides or debris slides, the area is developed and graded for roads and oil field work areas and is unlikely to experience significant slope stability issues. The remaining portion of the Whittier Narrows Overhead re-route crosses flat alluvial channel and valley topography and would not be subject to slope stability issues.

Soils

The 66-kV re-route alignments are underlain by similar soils as the nearby Segments 7 and 8A transmission line corridors, primarily the Urban Land-Hanford-Sorrento soil association. These soils are mainly formed either in alluvium or colluvium weathered from the underlying sedimentary formations, or in alluvium and colluvium on alluvial fans, plains, and terraces. Hazard of erosion for these soils for off-road or off-trail is slight and for on roads and trails ranges from slight to severe. Shrink/swell (expansive) potential of the soils varies from low to moderate. The corrosive potential of soils along the 66-kV re-routes ranges from low to high for uncoated steel and from low to moderate for concrete.

Mineral Resources

Mineral resources in the vicinity of the 66-kV re-routes consist primarily of aggregate resources near the San Gabriel River and oil and gas near the Montebello Hills. No active sand or gravel quarries are located in the vicinity of the re-routes, however a portion of the Whittier Narrows 66-kV Overhead Re-Route crosses the northern edge of the Montebello oil field. Although this alignment crosses the edge of the oil field, it does not cross through any active oil well fields and construction within the existing ROW in this area is not expected to impact access to this resource. This results in no change in potential for inference with access to known mineral resources along Alternative 7 as compared to Alternative 2.

Seismic Hazards

Fault Rupture. None of the 66-kV re-routes are crossed by active or potentially active faults, resulting in no potential for surface fault rupture along these alignments. This results in no change in potential for fault rupture along Alternative 7 as compared to Alternative 2.

Groundshaking. Moderate to strong ground shaking of 0.4g to 0.5g is anticipated in the San Gabriel Valley, Montebello Hills, and Whittier Narrows areas along and near the 66-kV re-route alignments. This is the same range anticipated for the associated portions of Segments 7 and 8A, and thus results in no change in potential for damage from strong groundshaking.

Liquefaction. Where the re-route alignments cross young alluvial and channel deposits of the San Gabriel Valley, near the Rio Hondo and San Gabriel Rivers, and in the Whittier Narrows area, the underlying sediments are potentially liquefiable (CGS, 1999d). Liquefaction potential is low to nonexistent along the portion of the Whittier Narrows 66-kV Overhead re-route in the Montebello Hills (the western end) due to the presence of the non-liquefiable underlying consolidated sedimentary bedrock (Fernando Formation).

Earthquake-Induced Landslides. Only the portion of the Whittier Narrows 66-kV Overhead re-route located within the gently to moderately sloping hills of the Montebello Hills is likely to experience landsliding or slope failures due to earthquakes. The remaining portion of this alignment and the other re-routes are located on flat topography and would not be subject to earthquake-induced landslides or other slope failures.

Paleontology

Where the 66-kV re-routes cross the Younger Alluvium in the San Gabriel Valley, which has locally yielded fossils of late Pleistocene mammoth (Pasadena and Eagle Rock) and land mammals (downtown Los Angeles), there is an undetermined (but probably no more than a moderate) potential for additional, similar, scientifically important fossil remains to be encountered locally by ground-disturbing activities in Younger Alluvium in the San Gabriel Valley (PEAI, 2007). In the area where the Whittier Narrows 66-kV Overhead re-route crosses the Montebello Hills, the alignment crosses the Fernando Formation, which has yielded the fossilized remains of Pliocene marine fossils at a fossil site in the Chino Hills and the Puente Hills (PEAI, 2007). This indicates that there is a high potential for additional, similar, scientifically highly important fossil remains being encountered by ground-disturbing activities where the Project area is underlain by the Fernando Formation (PEAI, 2007). These units are also crossed by the corresponding portions of Segments 7 and 8A, however the small increase in ground disturbance for the underground re-routes would result in a slight increase in potential to encounter significant fossil remains for this alternative.

3.7.3 Applicable Laws, Regulations, and Standards

3.7.3.1 Federal

Geology and Mineral Resources

Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations"

The Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations" was developed by the Substations Committee of the IEEE Power Engineering Society, and approved by the American National Standards Institute and the IEEE-SA Standards Board. This document provides seismic design recommendations for substations and equipment consisting of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation. This recommended practice emphasizes the qualification of electrical equipment.

IEEE 693 is intended to establish standard methods of providing and validating the seismic withstand capability of electrical substation equipment. It provides detailed test and analysis methods for each type of major equipment or component found in electrical substations. This recommended practice is intended to assist the substation user or operator in providing substation equipment that will have a high probability of withstanding seismic events to predefined ground acceleration levels. It establishes standard methods of verifying seismic withstand capability, which gives the substation designer the ability to select equipment from various manufacturers, knowing that the seismic withstand rating of each manufacturer's equipment is an equivalent measure. Although most damaging seismic activity occurs in limited areas, many additional areas could experience an earthquake with forces capable of causing great damage. This recommended practice should be used in all areas that may experience earthquakes.

Environmental Protection Agency – Clean Water Act

Stormwater runoff from construction activities can have a significant impact on water quality. As stormwater flows over a construction site, it picks up pollutants like sediment, debris, and chemicals. Polluted stormwater runoff can harm or kill fish and other wildlife. Sedimentation can destroy aquatic habitat and high volumes of runoff can cause stream bank erosion. Under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) Stormwater program requires operators of construction sites one acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge stormwater under an NPDES construction stormwater permit and the development and implementation of stormwater pollution prevention plans (SWPPP) is the focus of NPDES stormwater permits for regulated construction activities.

Most states are authorized to implement the Stormwater NPDES permitting program. EPA remains the permitting authority in a few states, territories, and on most land in Indian Country. For construction (and other land disturbing activities) in areas where EPA is the permitting authority, operators must meet the requirements of the EPA Construction General Permit (CGP). In California, Stormwater NPDES permits on non-tribal and non-federal land are overseen by the State of California EPA (CalEPA).

A SWPPP must include a site description, including a map that identifies sources of storm water discharges on the site, anticipated drainage patterns after major grading, areas where major structural and nonstructural measures will be employed, surface waters, including wetlands, and locations of discharge points to surface waters. The SWPPP also describes measures that will be employed, including at least protection of existing vegetation wherever possible, plus stabilization of disturbed areas of site as quickly as practicable, but no more than 14 days after construction activity has ceased.

Uniform Building Code

Published by the International Conference of Building Officials, the Uniform Building Code (UBC) provides complete regulations covering all major aspects of building design and construction relating to fire and life safety and structural safety. This is the code adopted by most western states. The provisions of the 1997 Uniform Building Code, Volume 1, contain the administrative, fire and life-safety, and field inspection provisions, including all nonstructural provisions and those structural provisions necessary for field inspections. Volume 2 contains provisions for structural engineering design, including those design provisions formerly in the UBC Standards. Volume 3 contains the remaining material, testing and installation standards previously published in the UBC Standards.

Paleontology

USDA Forest Service

The Forest Service issues permits authorizing both Project-related identification and mitigation efforts in addition to research-related investigations based on the provisions of the Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1701 1782) and the Antiquities Act of 1906. Regulations promulgated under 36 CFR 261 state that each Regional Forester has jurisdiction over “Protection of objects or places of historical, archaeological, geological or paleontological interest” (36 CFR 261.70(a)(5)), and that the following are prohibited: “Excavating, damaging, or removing any vertebrate fossil or removing any paleontological resource for commercial purposes without a special use permit” (36 CFR 261.9 (g)). FSM Chapter 2880 - Geologic Resources, Hazards, and Services contains policies and regulations related to paleontologic resource management and preservation. Forest Service policy makes the salvage of known paleontological resources a standard condition of their Special Use Permits. Treatment standards are specific to each forest and rely heavily upon implementation of a mitigation plan developed under the auspices of professional paleontologists at regional museums and universities.

3.7.3.2 State

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 (formerly the Special Studies Zoning Act) regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture. While this Act does not specifically regulate overhead transmission lines, it does help define areas where fault rupture is most likely to occur. This Act groups faults into categories of active, potentially active, and inactive. Historic and Holocene age faults are considered active, late Quaternary and Quaternary age faults are considered potentially active, and pre-Quaternary age faults are considered inactive. These classifications are qualified by the conditions that a fault must be shown to be “sufficiently active” and “well defined” by detailed site-specific geologic explorations in order to determine whether building setbacks should be established.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act (the Act) of 1990 (Public Resources Code, Chapter7.8, Division 2) directs the California Department of Conservation, Division of Mines and Geology [now called California Geological Survey (CGS)] to delineate Seismic Hazard Zones. The purpose of the Act is to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards. Cities, counties, and state agencies are directed to use seismic hazard zone maps developed by CGS in their land-use planning and permitting processes. The Act requires that site-specific geotechnical investigations be performed prior to permitting most urban development projects within seismic hazard zones.

California Building Code

The California Building Code (CBC, 2001) is based on the 1997 Uniform Building Code, with the addition of more extensive structural seismic provisions. Chapter 16 of the CBC contains definitions of seismic sources and the procedure used to calculate seismic forces on structures. As the proposed Project route lies within UBC Seismic Zone 34, provisions for design should follow the requirements of Chapter 16. Chapter 33 of the CBC contains requirements relevant to the construction of underground transmission lines.

3.7.3.3 Local

Elements of the General Plans for Kern, Los Angeles and San Bernardino Counties contain policies for the avoidance of geologic hazards and/or the protection of unique geologic features, as well as for the preservation of paleontologic resources.

Kern County

The Safety Element (Chapter 4) of the Kern County General Plan (2004) provides policies and measures to minimize injuries and loss of life and reduce property damage from seismic and geologic hazards. The main policy relevant to the Project is "The County shall encourage extra precautions be taken for the design of major lifeline installations, such as highways, utilities, and petrochemical pipelines". Proper design of the Project facilities, including all APMs and mitigation measures outlined in this document, would comply with this policy and would be consistent with the Safety Element.

The Land Use, Open Space, and Conservation Element (Chapter 1) of the Kern County General Plan (2004) provides the following policy related to preservation of paleontologic resources: the County will promote the preservation of cultural and historic resources which provide ties with the past and constitute a heritage value to residents and visitors. Measures to minimize impacts in the plan include preservation of paleontologic resources in areas with known paleontologic resources, where feasible. The Project would be consistent with general plan policy for protection of paleontologic resources through implementation of the APMs and the mitigation measures outlined in this document.

Los Angeles County

The Safety Element of the Los Angeles County General Plan (1990) provides goals and policies to reduce impacts from seismic and geologic hazards and provide a safer environment. The two main policies relevant to the Project are: minimize injury and loss of life, damage, and social, cultural, and economic impacts caused by earthquake hazards; and protect public safety and minimize the social and economic impacts from geologic hazards. Proper design of the Project facilities, including all APMs and mitigation measures outlined in this document, would meet these goals and would be consistent with the Safety Element.

The Conservation, Open Space, and Recreation Element (1986) of the Los Angeles County General Plan provides the following goal related to preservation of paleontologic resources: to preserve and protect sites of historical, archeological, scenic, and scientific value. The Project would be consistent with general plan policy for protection of paleontologic resources through implementation of the APMs and the mitigation measures outlined in this document.

Antelope Valley Areawide General Plan. The Antelope Valley Areawide General Plan (1986) is a component of the Los Angeles County General Plan and provides policies related to public planning in the Antelope Valley area, including policies related to seismic and geologic hazards. These policies generally include enforcing standards and criteria to reduce impacts from seismic and geologic hazards, advocating detailed site evaluations and improved seismic design and construction standards for critical linear system facilities, and programs and practices for dealing with erosion, settlement, and other soil-related hazards. The Project would be consistent with these policies through implementation of the Project APMs and the mitigation measures outlined in this document.

San Bernardino County

The Natural Hazards section of the San Bernardino County General Plan (2002) provides for mitigation of geologic hazards through a combination of engineering, construction, land use and development standards. The Plan addresses the geologic hazards present within the county, including fault rupture, ground shaking, liquefaction, seismically-generated subsidence, seiche and dam inundation, landslides/mudslides, non-seismic subsidence, erosion and volcanic activity. The county has prepared Hazard Overlay Maps to address fault rupture, liquefaction hazards and landslide hazards. Special consideration, including possible engineering/geologic evaluation, is required for development of sites designated on the maps.

The Natural Resources section of the San Bernardino County General Plan (2002) provides for recognizing and protecting mineral resources through permitting. The Plan requires buffer zones between resources and other land uses, and existing mining access routes generally have priority over proposed alterations.

3.7.4 Impact Analysis Approach

3.7.4.1 Criteria for Determining Impact Significance

To satisfy CEQA requirements, conclusions are made regarding the significance of each identified impact that would result from the proposed Project and alternatives. Appropriate criteria have been identified and utilized to make these significance conclusions. The following significance criteria for geology, soils, and paleontology were derived from previous environmental impact assessments and from the CEQA Guidelines (Appendix G, Environmental Checklist Form, Section IX). An impact would be considered significant and require additional mitigation if Project construction or if maintenance of Project facilities during Project operations would result in any of the following criteria being met.

Geology and Soils

- Criterion GEO1: Results in disturbance or otherwise adverse effects on unique geologic features or geologic features of unusual scientific value for study or interpretation.
- Criterion GEO2: Results in known mineral and/or energy resources being rendered inaccessible.
- Criterion GEO3: Results in triggering or acceleration of geologic processes, such as landslides, substantial soil erosion, or loss of topsoil during construction.
- Criterion GEO4: Expose people or structures to potential risk of loss or injury where there is high potential for earthquake-related ground rupture in the vicinity of major fault crossings.

- Criterion GEO5: Expose people or structures to potential risk of loss or injury where there is high potential for seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking.
- Criterion GEO6: Expose people or structures to potential risk of loss or injury where corrosive soils or other unsuitable soils are present.
- Criterion GEO7: Results in damage to Project structures where there is potential for future slope failures on existing unstable slopes.

Paleontology

- Criterion GEO8: Results in the destruction of scientifically important paleontological resources.

Determination of the "significance" of a fossil can only occur after a fossil has been found and identified by a qualified paleontologist. Until then, the actual significance is unknown. The most useful designation for paleontological resources in an EIR document is the "sensitivity" of a particular geologic unit. Sensitivity refers to the likelihood of finding significant fossils within a geologic unit. Categories of "sensitivity" are defined in Section 3.7.2.1. Fossils are considered to be scientifically significant if they meet or potentially meet any one or more of the following criteria:

- Taxonomy – fossils that are scientifically judged to be important for representing rare or unknown taxa, such as defining a new species
- Evolution – fossils that are scientifically judged to represent important stages or links in evolutionary relationships, or fill gaps or enhance under-represented intervals in the stratigraphic record
- Biostratigraphy – fossils that are scientifically judged to be important for determining or constraining relative geologic (stratigraphic) age, or for use in regional to interregional stratigraphic correlation problems
- Paleoecology – fossils that are scientifically judged to be important for reconstructing ancient organism community structure and interpretation of ancient sedimentary environments
- Taphonomy – fossils that are scientifically judged to be exceptionally well or unusually or uniquely preserved, or are relatively rare in the stratigraphy.

Significance conclusions for individual impacts are not required for compliance with NEPA. Therefore, conclusions presented in the following analysis regarding the significance of identified impacts are provided for the purposes of CEQA only.

3.7.4.2 Applicant-Proposed Measures (APMs)

APMs were identified by SCE in the PEA. Table 3.7-9 presents the APMs that are relevant to geology, soils, and paleontology. APMs are a commitment by the Applicant (SCE) and are considered part of the proposed Project. Therefore, the following discussions of impact analysis assume that all APMs will be implemented as defined in the table. Additional mitigation measures are recommended in this section if it is determined that APMs do not fully mitigate the impacts for which they are presented.

Table 3.7-9. Applicant-Proposed Measures – Geology, Soils, and Paleontology

APM GEO-1	Seismic Design. For new substation construction, specific requirements for seismic design would be followed based on the Institute of Electrical and Electronic Engineers' 693 "Recommended Practices for Seismic Design of Substation." Other Project elements would be designed and constructed in accordance with the appropriate industry standards, and good engineering and construction practices and methods, as applicable.
APM GEO-2	Perform Geotechnical Studies. Prior to final design of substation facilities and T/L tower foundations, a geotechnical study would be performed to identify site-specific geologic conditions and potential geologic hazards in enough detail to support good engineering practice. The geotechnical study would be performed by professional civil or geotechnical engineers and engineering geologists licensed in the State of California and would provide design and construction recommendations, as appropriate, to reduce potential impacts from geologic hazards or soil conditions.

Table 3.7-9. Applicant-Proposed Measures – Geology, Soils, and Paleontology	
APM GEO-3	Construction SWPPP. T/L and substation construction activities would be performed in accordance with the soil erosion/water quality protection measures to be specified in the Construction Storm Water Pollution Prevention Plan (SWPPP) for the TRTP.
APM HYD-1	Construction SWPPP. A Construction SWPPP would be developed for the Project. Notices of Intent (NOIs) would be filed with the SWRCB and/or the RWQCBs, and a Waste Discharge Identification Number (WDID) would be obtained prior to construction. The SWPPP would be stored at the construction site for reference or inspection review. In addition, grading permit applications would be submitted, as applicable, to local jurisdictions. Implementation of the SWPPP would help stabilize graded areas and waterways, and reduce erosion and sedimentation. The plan would designate BMPs that would be adhered to during construction activities. Erosion minimizing efforts such as straw wattles, water bars, covers, silt fences, and sensitive area access restrictions (for example, flagging) would be installed before clearing and grading begins. Mulching, seeding, or other suitable stabilization measures would be used to protect exposed areas during construction activities. During construction activities, measures would be in place to ensure that contaminates are not discharged from the construction sites. The SWPPP would define areas where hazardous materials would be stored, where trash would be placed, where rolling equipment would be parked, fueled and serviced, and where construction materials such as reinforcing bars and structural steel members would be stored. Erosion control during grading of the construction sites and during subsequent construction would be in place and monitored as specified by the SWPPP. A silting basin(s) would be established, as necessary, to capture silt and other materials, which might otherwise be carried from the site by rainwater surface runoff.
APM HYD-8	Operation Storm Water Management Plan. The post-construction (Operation) Storm Water Management Plan (SWMP) for Vincent Substation would be updated. The SWMP identifies potential pollutants based on the activities that take place at the site, and discusses the appropriate Best Management Practices that should be used to prevent pollutants from entering the storm water and non-storm water runoff from the site. The SWMP also includes requirements for periodic site training for employees and inspections by onsite personnel.
APM PALEO-1	Retention of Paleontologist. Prior to construction, a certified paleontologist would be retained by SCE to supervise monitoring of construction excavations and to produce a PRMP for the proposed Project. Paleontological monitoring would include inspection of exposed rock units and microscopic examination of matrix to determine if fossils are present. The monitor would have authority to temporarily divert grading away from exposed fossils in order to recover the fossil specimens. More specific guidelines for paleontological resource monitoring can be found in the PRMP.
APM PALEO-2	Conduct a Pre-construction Paleontological Field Survey. The paleontologist and/or his designated representative will conduct a pre-construction field survey of the Project area underlain by Tertiary rock units and older alluvium. Results of the field inventory and associated recommendations would be incorporated into the PRMP.
APM PALEO-3	Prepare and Implement a Paleontological Resource Management Plan (PRMP). This plan would be prepared and implemented under the direction of a qualified paleontologist and would address and incorporate the following APMs:
APM PALEO-4	Environmental Training. Training would be provided to construction supervisors and crew with environmental awareness training regarding the protection of paleontological resources and procedures to be implemented in the event fossil remains are encountered by ground-disturbing activities.
APM PALEO-5	Construction Monitoring. Ground-disturbing activities would be monitored on a part-time or full-time basis by a paleontological construction monitor only in those parts of the Project area where these activities will disturb previously undisturbed strata in rock units of moderate and high sensitivity. Quaternary Alluvium, colluvium, and Quaternary Landslide Deposits have a low paleontological sensitivity level and would be spot-checked on a periodic basis to insure that older underlying sediments are not being penetrated. Monitoring would not be implemented in areas underlain by younger alluvium unless these activities have reached a depth 5 feet below the present ground surface and fine grained strata are present. Ground-disturbing activities in areas underlain by rock units of low sensitivity would be monitored on a quarter-time basis or spot checked if fine grained strata are present.
APM PALEO-6	Recovery and Testing. If fossils are encountered during construction, construction activities would be temporarily diverted from the discovery and the monitor would notify all concerned parties and collect matrix for testing and processing as directed by the Project Paleontologist. In order to expedite removal of fossil-bearing matrix, the monitor may request heavy machinery to assist in moving large quantities of matrix out of the path of construction to designated stockpile areas. Construction would resume at the discovery location once the all necessary matrix was stockpiled, as determined by the paleontological monitor. Testing of stockpiles would consist of screen washing small samples to determine if important fossils are present. If such fossils were present, the additional matrix from the stockpiles would be water screened to ensure recovery of a scientifically significant sample. Samples collected would be limited to a maximum of 6,000 pounds per locality.

Table 3.7-9. Applicant-Proposed Measures – Geology, Soils, and Paleontology	
APM PALEO-7	Prepare Monthly Progress Reports. The Project Paleontologist would document interim results of the construction monitoring program with monthly progress reports. As well, at each fossil locality, field data forms would record the locality, stratigraphic columns would be measured, and appropriate scientific samples submitted for analysis.
APM PALEO-8	Analysis and Prepare Final Paleontological Resource Recovery Report. The Project Paleontologist would direct identification, laboratory processing, cataloguing, analysis, and documentation of the fossil collections. When appropriate, and in consultation with SCE, splits of rock or sediment samples would be submitted to commercial laboratories for microfossil, pollen, or radiometric dating analysis. After analysis, the collections would be prepared for curation (see APM PALEO-9, below). A final technical report would be prepared to summarize construction monitoring and present the results of the fossil recovery program. The report would be prepared in accordance with SCE, Society of Vertebrate Paleontology guidelines, and lead agency requirements. The final report would be submitted to SCE, the lead agency, and the curation repository (see below).
APM PALEO-9	Curation. Prior to construction, SCE would enter into a formal agreement with a recognized museum repository and would curate the fossil collections, appropriate field and laboratory documentation, and the final Paleontological Resource Recovery Report in a timely manner following construction.

3.7.4.3 Impact Assessment Methodology

The geology, soils and paleontology impacts of the proposed Project are discussed below under subheadings corresponding to each of the significance criterion presented in the preceding section. The analysis describes the impacts of the proposed Project related to geologic and seismic hazards and mineral and paleontologic resources for each criterion, and determines whether implementation of the proposed Project would result in significant impacts by evaluating effects of construction and operation of the proposed Project against the affected environment described above in Section 3.7.2.

For the purposes of satisfying CEQA requirements, the significance of each impact is also identified according to the following classifications: Class I: Significant impact; cannot be mitigated to a level that is less than significant; Class II: Significant impact; can be mitigated to a level that is less than significant; Class III: Adverse impact; less than significant; and Class IV: Beneficial impact. Sections 3.7.5 through 3.7.11, below, provide a detailed discussion of the impacts identified for the proposed Project and alternatives.

3.7.5 Alternative 1: No Project/Action

Selection of the No Project/Action Alternative would mean that the Tehachapi Renewable Transmission Project, as proposed, would not be implemented. As such, the environmental impacts associated with the Project, as described in Section 3.7.6, would not occur. However, in the absence of the proposed Project or an alternative to the Project, the purposes and need for the power transmission capabilities that would be met by the proposed Project (or an alternative) would not be achieved. As a result, it is possible that another, similar transmission line project would be constructed in the future to meet the power transmission needs of developing wind farms in the Tehachapi Wind Resource Area. Such a project would likely introduce similar impacts to Geology, Soils, and Paleontology that would be introduced through the proposed TRTP or an alternative.

Environmental conditions in the Project Area are expected to naturally change or evolve over time and therefore, independently of the proposed Project or an alternative to the Project (including the No Project/Action Alternative), the regional setting and baseline conditions in the Project Area which are discussed in Section 3.7.2.1 (Regional Setting) would not remain static. If the No Project/Action Alternative is implemented, geologic and soil conditions as well as paleontologic resources preserved in the natural formation within the Project Area will remain unchanged over a short geologic time period, and will be independent of the potential impacts associated with the proposed TRTP.

Because the potential impacts of the proposed Project would not occur under the No Project/Action Alternative, the significance criteria described in Section 3.7.4.1 (Impact Analysis Approach) are not used for analysis of the No Project/Action Alternative. The continued development of lands within the Counties of Kern, Los Angeles, and San Bernardino will result in the continued potential for development in areas with geologic risk factors such as hillside areas with potential slope stability issues. However, new developments will be subject to existing and new building codes that restrict development in geologically unstable areas. In addition, areas with previously unknown geologic hazards and unsuitable soil will likely be discovered during planning, followed by the required analysis, implementation of the required design and construction standards, or avoidance of these areas.

3.7.6 Alternative 2: SCE's Proposed Project

3.7.6.1 Direct and Indirect Effects Analysis

The geologic, seismic, and paleontologic impacts of the proposed Project are discussed below under subheadings corresponding to each of the significance criterion presented in the preceding section. The analysis describes the impacts of the proposed Project related to geologic and seismic hazards, mineral resources, and paleontology and, for each criterion, determines whether implementation of the proposed Project would result in significant impacts.

The geologic, seismic, and paleontologic impacts of the proposed Project are discussed below under subheadings corresponding to each of the significance criterion presented in the preceding section. The analysis describes the impacts of the proposed Project related to geologic and seismic hazards, mineral resources, and paleontology and, for each criterion, determines whether implementation of the proposed Project would result in significant impacts.

Unique geologic features (Criterion GEO1)

No unique geologic features or geologic features of unusual scientific value for study or interpretation would be disturbed or otherwise adversely affected by the proposed Project Segments. No impact would occur.

Known mineral and/or energy resources (Criterion GEO2)

Although known sand and gravel resources, limestone and dolomite, and stone quarries are located within the general Project area, only Segment 7 is located within or adjacent to areas of active production of these resources. The Segment 7 alignment traverses adjacent to and across several active gravel quarries in the Irwindale area; the Irwindale Pit consists of three adjacent pits (commonly known as Irwindale Pits #1, #2, and #3), owned by the United Rock Products Corp, and of which two are currently in operation (CGS, 2004). The Project ROW crosses a portion of the easternmost pit; however the towers for the existing transmission line are located outside of the existing quarry boundaries and it is assumed that any new towers would be at similar tower spacing. Given the distance of these sites from the ROW and the ability of mining-related equipment and vehicles to cross the ROW if necessary, construction and operation of the TRTP transmission line is not expected to interfere with future access to any metallic or non-metallic mineral resources.

Impact G-1: Project activities could interfere with access to known energy resources.

The Segment 7, 11, and 8A ROWs cross the Montebello oil and gas field and the Segment 8A ROW also crosses the northern edge of the Brea-Olinda oil and gas field. These alignments do not traverse through the active well fields; however they do pass adjacent to several active well fields and traverse along and cross access roads for the fields. Because these alignments do not cross within the active well fields, operation of the Project in the existing ROWs is not expected to interfere in access to or operation of these existing oil fields. However, construction activities for the segments, which would include construction vehicle traffic such as excavators and haulers for fill and spoils, cranes and trucks for transportation and construction of towers and transmission lines, and traveling and working along oil field access roads, could interfere with ongoing operation with the oil fields. Implementation of Mitigation Measure G-1 (Coordination with oil field operations) is recommended.

Mitigation Measure for Impact G-1

G-1 **Coordination with oil field operations.** Operations and management personnel for the oil fields shall be consulted regarding access requirements, and SCE and its contractors shall coordinate construction activities across and along necessary oil field access roads in a manner to limit interference with oil field operations. A plan to avoid or minimize interference with oil field operations shall be prepared in conjunction with oil field operators prior to construction. SCE shall document compliance with this measure by submitting the plan to the CPUC for review 30 days prior to the start of construction in the affected Project segments.

CEQA Significance Conclusion

Construction traffic and work areas for the proposed Project (Segments 7, 11, and 8A) along oil field access roads could interfere with daily operation of the oil field, including but not limited to impeding access to oil field structures and facilities by temporarily blocking access roads during construction. Implementation of Mitigation Measure G-1 (Coordination with oil field operations) would reduce potential impacts to less than significant (Class II) by requiring coordination with the oil field operators to identify and minimize potential areas of interference.

Triggering or acceleration of geologic processes, such as landslides, soil erosion, or loss of topsoil, during construction (Criterion GEO3)

Impact G-2: Erosion could be triggered or accelerated due to construction activities.

Soils along all of the proposed segments (Segments 4, 5, 6, 7, 8, 9, 10, and 11) of the proposed Project alignment have potential hazards of erosion for off-road/off-trail ranging from slight to very severe and on-road/on-trail ranging from slight to severe. Excavation and grading for tower, substation, and switching station foundations, staging and work areas, access roads, and spur roads would loosen soil and trigger or accelerate erosion. Implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits) which is fully described in Section 3.8.6.1 (Hydrology and Water Quality), is also relevant to issues related to soil erosion and is recommended.

CEQA Significance Conclusion

The proposed Project would result in significant impacts if erosion were triggered or accelerated by Project construction. Soil loosened by Project construction could migrate by wind or water to nearby waterways potentially causing damage to aquatic habitat, or could add to particulate air pollution if picked up by the wind or disturbed by vehicles. Erosion could cause rutting and loss of topsoil. SCE's APM

GEO-3 and APM HYD-1 (Construction SWPPP, see Table 3.7-9) would partially reduce the amount of erosion that would result from construction by developing and implementing a Project-specific SWPPP as required in accordance with the Clean Water Act. Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits) would require that pre-construction plans be developed to identify and properly implement any necessary BMPs to control erosion and/or sedimentation, and for the identification and mitigation of any disturbances to drainages and/or riparian areas. Implementation of this measure would ensure impacts from soil erosion due to Project construction would be less than significant (Class II).

Impact G-3: Excavation and grading during construction activities could cause slope instability or trigger landslides.

Portions of Segments 5, 6, 11, and 8A traverse moderate to steep mountains and hills underlain by landslide prone sedimentary and metamorphic rocks (primarily Pelona Schist, gneisses, and Puente Formation). The alignments also cross numerous mapped landslides (see Tables 2-8, 2-9, 2-11, and 2-12 of the *Geology, Soils, and Paleontology Specialist Report* (GTC, 2008)). Destabilization of the natural or constructed slopes could occur as a result of construction activities due to excavation and/or grading operations. Excavation operations associated with tower foundation construction and grading operations for temporary and permanent access roads and work areas could result in slope instability, resulting in landslides, soil creep, or debris flows. Implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) is recommended.

Mitigation Measure for Impact G-3

G-3 **Conduct geological surveys for landslides and protect against slope instability.** Design-level geotechnical investigations performed by SCE shall include geological surveys for landslides that will allow identification of specific areas with the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in other areas of ground disturbance, such as access and spur roads. The geotechnical investigations shall evaluate subsurface conditions, identify potential hazards, and provide information for development of excavation plans and procedures. If the results of the geotechnical survey indicate the presence of unstable slopes at or adjacent to Project structures, appropriate support and protection measures shall be designed and implemented to maintain the stability of slopes adjacent to newly graded or re-graded access and spur roads, work areas, and Project structures during and after construction, and to minimize potential for damage to Project facilities. These design measures shall include, but are not limited to, retaining walls, visqueen, removal of unstable materials, and avoidance of highly unstable areas. Appropriate construction methods and procedures, in accordance with State and federal health and safety codes, shall be followed to protect the safety of workers and the public during drilling and excavation operations. SCE shall document compliance with this measure by submitting a report to the CPUC and FS (for NFS lands) for review at least 30 days prior to the start of construction. The report shall document the investigations and detail the specific support and protection measures that will be implemented.

CEQA Significance Conclusion

The proposed Project would result in significant impacts if unidentified unstable slopes or areas of potentially unstable slopes were disturbed or undercut by construction activities resulting in slope failures. Slope failures could cause damage to the environment, to Project or other nearby structures, and could cause injury or death to workers and/or the public, a significant impact. Prior to final design of substation facilities and transmission line tower foundations, SCE plans to perform geotechnical studies to identify site-specific geologic conditions (APM GEO-2). However, this measure does not identify items to be completed as part of the geotechnical study to identify areas of unstable slopes. Implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) adds specific requirements to the planned geotechnical investigations to be completed prior to final Project design, ensuring that slope instability impacts would be reduced to less than significant (Class II). Implementation of Mitigation Measure G-3 is required along the hill and mountain portions of Segments 5, 6, 11, and 8A to delineate potential areas of unstable slopes near and within work areas and minimize the potential from construction triggered slope failures by avoidance or implementation of slope stabilizing design measures.

Exposure to potential risk of loss or injury due to earthquake-related ground rupture (Criterion GEO4)

Impact G-4: Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards.

Project facilities would be subject to hazards of surface fault rupture at crossings of the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), Whittier (Segment 8A), and Chino-Central Ave (Segment 8A) faults. Implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) is recommended. Additionally, portions of the Segment 11 and Segment 8A routes that cross and then run parallel to and within the Sierra Madre and Whittier fault zones, respectively, are at substantial risk of damage to multiple structures should an earthquake and ground rupture occur along these portions of the respective faults. Implementation of Mitigation Measure G-4b is recommended for Segments 11 and 8A where they cross and run parallel to and within the Sierra Madre and Whittier fault zones, respectively, is also recommended.

Mitigation Measures for Impact G-4

G-4a **Minimize Project structures within active fault zones.** Prior to final Project design SCE shall perform a fault evaluation study to confirm the location of mapped traces of active and potentially active faults crossed by the Project route or other Project structures. For crossings of active faults, the Project design shall be planned so as not to locate towers or other Project structures on the traces of active faults; and in addition, Project components shall be placed as far as feasible outside the areas of mapped fault traces. Compliance with this measure shall be documented to the CPUC and FS in a report submitted for review at least 60 days prior to the start of construction.

G-4b **Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines.** Operation and maintenance plans shall be prepared that outline measures to be implemented in the event of damage to transmission facilities due to fault rupture. These plans shall include contingencies for potential fault-rupture scenarios that could result in damage to transmission lines and facilities that cross and run parallel to and within the Sierra Madre and Whittier fault zones, including, but not limited to, plans for facilitating temporary bypasses (of potentially several weeks to months, depending on the severity of fault rupture damage) of portions of the transmission lines damaged as a result of fault surface rupture. Compliance with this measure shall be documented to the CPUC and FS in a report submitted for review at least 60 days prior to the start of construction.

CEQA Significance Conclusion

Fault crossings, where multiple feet of displacement are expected along active faults, are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the conductor lines to absorb offset. Collapse of Project structures could result in power outages, damage to nearby roads of structures, and injury or death to people, a significant impact. SCE has committed to designing Project elements according to appropriate industry standards and in accordance with good engineering practices (APM GEO-1); prior to final design of substation facilities and transmission line tower foundations SCE would perform geotechnical studies to identify site-specific geologic conditions (APM GEO-2). However, APM GEO-1 and APM GEO-2 do not specify that fault studies will be performed to prevent placement of towers on active fault traces, nor do they address issues related to potential fault rupture damage to transmission line facilities where it is not feasible to locate towers outside of active fault zones. Mitigation Measures G-4a (Minimize Project structures within active fault zones) and G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines) reduce impacts associated with overhead active fault crossings to less-than-significant levels (Class II). Proper placement of towers relative to active faults would allow the conductor to distribute fault displacements over a comparatively long span and towers would be less likely to collapse in the event of an earthquake if not placed directly on an active fault trace. Appropriate planning and readily available repair equipment and parts would decrease repair time in the event fault surface rupture does cause damage to structures.

Exposure to potential risk of loss or injury due to seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking (Criterion GEO5)

Impact G-5: Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards.

Moderate to severe groundshaking should be expected in the event of an earthquake on the faults in the Project area and from other major faults in the region, with estimated PGAs ranging from 0.3 to 0.8 g (see Table 3.7-3). It is likely that the Project facilities would be subjected to at least one moderate or larger earthquake occurring close enough to produce local strong to severe groundshaking along portions of Segments 4, 5, 6, 7, 9, and 11. Local strong to severe groundshaking with vertical and horizontal ground accelerations that could exceed standard design stresses could result in damage or collapse of Project structures. Collapse of Project structures could result in power outages, damage to nearby roads of structures, and injury or death to nearby people, a significant impact.

Severe to strong groundshaking could result in liquefaction-related phenomena along sections of the proposed Project segments (portions of Segments 5, 7, 11, 8A, 8B, and 8C) that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, Chino Basin, and in active river washes and streams where lenses and pockets of loose seasonally saturated sand may be present. This could result in damage to Project structures should a large earthquake occur during the periods when these soils are saturated, a significant impact. Seismically induced slope failures such as landslides could occur in the event of a large earthquake along portions of the Project. Portions of Segments 5, 6, 11, and 8A are located along hillsides or ridgelines in geologic units of moderate to steep slopes, which are particularly susceptible to this type of ground failure. Some of these areas, which include the Pelona Schist, weathered gneissic bedrock, and Puente Formation, have a high possibility of seismic-induced ground failure in the form of landsliding or ground-cracking resulting in damage to or collapse of Project structures. Implementation of Mitigation Measures G-3 (Conduct geological surveys for landslides and protect against slope instability), G-5a (Reduce effects of groundshaking), and G-5b (Conduct geotechnical investigations for liquefaction) are recommended.

Mitigation Measures for Impact G-5

G-5a **Reduce effects of groundshaking.** The design-level geotechnical investigations performed by SCE shall include site-specific seismic analyses to evaluate the peak ground accelerations for design of Project components. Based on these findings, Project structure designs shall be modified/strengthened, as deemed appropriate by the Project engineer, if the anticipated seismic forces (high calculated peak vertical and horizontal ground accelerations due to severe groundshaking) are found to be greater than standard design load stresses on Project structures. Study results and proposed design modifications shall be provided to the CPUC and FS for review at least 60 days before final Project design.

G-5b **Conduct geotechnical investigations for liquefaction.** Because seismically induced liquefaction-related ground failure has the potential to damage or destroy Project components, the design-level geotechnical investigations to be performed by SCE shall include investigations designed to assess the potential for liquefaction to affect the approved Project and all associated facilities, specifically at tower locations in areas with potential liquefaction-related impacts (portions of Segments 5, 7, 11, 8A, 8B, and 8C underlain by alluvium with the potential for shallow groundwater). Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the Project designs as deemed appropriate by the Project engineer. Design measures that would mitigate liquefaction-related impacts could include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in cables to allow ground deformations without damage to structures. Study results and proposed solutions to mitigate liquefaction shall be provided to the CPUC and FS for review at least 60 days before final Project design.

CEQA Significance Conclusion

Prior to final design of substation facilities and transmission line tower foundations, SCE plans to perform geotechnical studies to identify site-specific geologic conditions (APM GEO-2). In addition, as part of the Project SCE plans to design new substations in accordance with seismic design requirements based on the IEEE 693 “Recommended Practices for Seismic Design of Substation”and design other Project elements according to appropriate industry standards and in accordance with good engineering practices (APM GEO-1). However, these measures do not identify specific items to be completed as part of the geotechnical study to identify areas of severe groundshaking, potential seismically induced landslides, or potential liquefacton. Implementation of Mitigation Measures G-3 (Conduct geological surveys for landslides and protect against slope instability), G-5a (Reduce effects of groundshaking), and G-5b (Conduct geotechnical investigations for liquefaction) include these specific requirements to the planned geotechnical investigations to be completed prior to final Project design. These specific requirements would ensure that potentially significant impacts for seismically induced groundshaking and potential of seismically-related ground failure along the Project route are reduced to less-than-significant levels (Class II).

Exposure to potential risk of loss or injury where corrosive soils or other unsuitable soils are present (Criterion GEO6)

Impact G-6: Project structures could be damaged by problematic soils exposing people or structures to hazards.

Soils along the proposed Project Segments have a potential to corrode steel and concrete ranging from low to high. In areas where corrosive subsurface exist along the proposed route, the corrosive soils could have a detrimental effect on concrete and metals. Depending on the degree of corrosivity of subsurface soils, concrete and reinforcing steel in concrete structures and bare-metal structures exposed to these soils could deteriorate, eventually leading to structural failures. Expansion potential for the soils along the Project alignment ranges from low to high. Expansive soils can also cause problems to structures. Soils that exhibit shrink-swell behavior are clay-rich and react to changes in moisture content by expanding or contracting. Some of the natural soil types identified along the Project have moderate to high clay contents and many have moderate to high shrink-swell potential. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to structures and equipment. In addition, potential impacts associated with loose sands or other compressible soils include excessive settlement, low foundation-bearing capacity, and limitation of year-round access to Project facilities. Implementation of Mitigation Measure G-6 (Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design) is recommended.

Mitigation Measure for Impact G-6

G-6 **Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design.** The design-level geotechnical studies to be performed by SCEshall identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates. Appropriate design measures for protection of reinforcement, concrete, and metal-structural components against corrosion shall be utilized, such as use of corrosion-resistant materials and coatings, increased thickness of Project components exposed to potentially corrosive conditions, and use of passive and/or active cathodic protection systems. The geotechnical studies shall also identify areas with potentially expansive or collapsible soils and include appropriate design features, including excavation of potentially expansive or collapsible soils during construction and replacement with engineered backfill, ground-treatment processes, and redirection of surface water and drainage away from expansive foundation soils. Studies shall conform to industry standards of care and American Society for Testing and Materials (ASTM) standards for field and laboratory testing. Study results and proposed solutions shall be provided to the CPUC and FS, as appropriate, for review at least 60 days before final Project design.

CEQA Significance Conclusion

Application of APM GEO-2 (Perform Geotechnical Studies, see Table 3.7-9) would partially reduce the adverse effects of problematic soils by conducting a geotechnical study for the Project. However, this APM is lacking in detail and is inadequate to ensure that unsuitable soils would be properly identified and mitigated. Unidentified expansive and corrosive soils could damage Project structures and facilities potentially resulting in collapse of Project structures, which could result in power outages, damage to nearby roads or structures, and injury or death to nearby people, a significant impact. Accordingly, implementation of Mitigation Measure G-6 (Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design) provides additional detail to ensure that impacts associated with problematic soils are reduced to less-than-significant levels (Class II).

Damage to Project structures due to slope failure (Criterion GEO7)

Impact G-7: Transmission line structures could be damaged by landslides, earth flows, or debris slides, during operation.

Slope instability including landslides, earth flows, and debris flows has the potential to undermine foundations, cause distortion and distress to overlying structures, and displace or destroy Project components. The southern part of Segment 5, Segment 6, the north end of Segment 7, Segment 8A, and the north half of Segment 11, are located in hill and mountain areas with steep slopes, mapped landslides, or geologic materials prone to landslide. Locating transmission line structures within landslides or on unstable slopes would result in result in damage to Project structures. Slope failures could cause collapse of Project structures resulting in power outages, damage to nearby roads or structures, and injury or death to nearby people. Implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) is recommended.

CEQA Significance Conclusion

SCE's APM GEO-2 (Perform Geotechnical Studies, see Table 3.7-9) would partially reduce impacts related to landslide hazards during operations of the Project. However this measure does not specify that surveys for unstable slope would be conducted as part of the planned geotechnical studies. Unidentified unstable slopes or areas of potentially unstable slopes along or nearby and upslope of Project components could fail during the lifetime of the proposed Project resulting in damage to these facilities. To ensure that landslide impacts to Project structures during operation would be reduced to less-than-significant levels (Class II), implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) is required prior to construction for the hill and mountain areas. This will aid in proper identification of areas of potential slope instability allowing for avoidance or stabilization of these areas, reducing potential for damage to structures during Project operation.

Destruction of unique paleontological resources (Criterion GEO8)

Impact G-8: Grading and excavation could destroy paleontologic resources.

Grading activities for new access and spur roads, and excavation for tower and substation building foundations could encounter potentially fossil-bearing deposits throughout nearly all of the proposed Project segments underlain by Quaternary alluvial deposits (Segments 4, 5, 7, 8, 9, 10, and 11) and Tertiary sedimentary rock in the Montebello, Puente, and Chino Hills (Segment 8). Construction activities could destroy the fossils contained in the earth materials and the opportunity to properly retrieve, study, catalog, and archive them would be lost.

CEQA Significance Conclusion

The Applicant will implement APMs PALEO-1 through PALEO-9 which would reduce the potential to destroy scientifically important fossils and would provide for the systematic collection, analysis, and documentation of any such discoveries. SCE's APM PALEO-1 (Retention of Paleontologist), APM PALEO-2 (Conduct Pre-construction survey), and APM PALEO-3 (Prepare and implement a Paleontological Resource Management Plan [PRMP]) would be completed prior to construction to allow a certified paleontologist to plan for and supervise the pre-construction planning and field surveys. SCE's APM PALEO-4 (Environmental training), APM PALEO-5 (Construction monitoring), APM PALEO-6 (Recovery and testing), and APM PALEO-7 (Prepare monthly progress reports) would occur during construction. These activities would train construction supervisors and crews to be aware of paleontologic resources and provide procedures to follow in the event fossils are encountered during excavation. In addition the construction-related paleontology APMs would require a paleontologic monitor, under the supervision of the Project certified paleontologist, to monitor ground-disturbing activities on a part-time or full-time basis in areas with rock units of moderate to high sensitivity. At the conclusion of construction, SCE's APM PALEO-8 (Analysis and prepare final Paleontologic Resource Recovery Report) and APM PALEO-9 (Curation) would provide for documenting and preserving all of the paleontologic resources discovered during construction. The final report and fossil collections would be placed in a museum repository identified before the start of construction in the PRMP.

These measures would reduce the potential for paleontological resources to be destroyed to a less than significant level by ensuring any resources encountered would be identified, documented, and preserved. Impacts would be less than significant (Class III).

3.7.6.2 Cumulative Effects Analysis

This section addresses potential cumulative effects that would occur as a result of implementation of the proposed Tehachapi Renewable Transmission Project.

Geographic Extent

The geographic scope for considering cumulative impacts to geology, soils, and paleontology is the proposed Project corridor itself (including proposed substations). This is because geologic conditions, soils, and paleontologic resources occur at specific locales and are unaffected by activities not acting on them directly and any impacts of the proposed Project would be site-specific.

Existing Cumulative Conditions

Past and ongoing development throughout the proposed Project area has resulted in substantial alterations to the natural landscape. Past, existing, and future projects could contribute to the cumulative effects of geology, soils, and paleontologic resources creating any of the following conditions: triggering or acceleration of erosion or slope failures; loss of mineral resources, and damage or loss to paleontologic resources. These conditions would be limited to the areas within and adjacent to the boundaries of individual projects. In order to be cumulatively considerable, such conditions would have to occur at the same time and in the same location as the same or similar conditions of the proposed Project. Seismic impacts (groundshaking, earthquake-induced ground failure, and fault rupture) from the numerous local and regional faults comprise an impact of the geologic environment on individual projects and would not introduce cumulatively considerable impacts.

The actual number and type of resources that might be adversely affected by the cumulative scenario projects is unknowable without a comprehensive inventory of the area within the geographic scope of the cumulative analysis. Development of such an inventory is beyond the reasonable scope of this analysis. Typically, cultural and paleontological resources are identified as part of the permitting process for individual undertakings, and often are discovered only during ground disturbing activities. Applicable laws and regulations, as discussed in Section 3.7.3, afford specific protections to discovered resources.

Reasonably Foreseeable Future Projects and Changes

Foreseeable future projects identified for this analysis include major energy and transmission projects, transportation projects, and numerous commercial and residential development projects throughout the jurisdictions traversed by the proposed Project. In addition, projects within NFS lands were also identified. The list was reviewed to identify cumulative projects that would be located close to the proposed Project such that a geologic impact would affect both projects simultaneously. Cumulative geologic impacts could occur where future projects cross or closely parallel the proposed Project. Numerous small to large residential projects are planned along some of the proposed Project segments, including known fault zones (Leona Valley). Finally, projects within NFS lands related to fire fuel management and reduction and road management projects were considered. The passenger rail projects (California High Speed Train, Orangeline Maglev Project, and Metro Gold Line Extension) could experience cumulative impacts if earthquake shaking resulted in collapse of transmission line towers and closure or damage of the rail lines, trains, or stations. ANF projects to reduce fuel for brush fires and improve roads would not have cumulative impacts related to geologic hazards. Consequently, reasonably foreseeable cumulative projects with potential cumulative impacts related to geologic hazards is limited to parallel and crossing transmission lines, crossing of passenger rail lines, and local commercial/residential developments.

Cumulative Impact Analysis

Impacts of the proposed Project would be cumulatively considerable if they would have the potential to combine with similar impacts of other past, present, or reasonably foreseeable projects. Table 3.7-10, below, identifies which impacts of the proposed Project would be cumulatively considerable and of those, what the cumulative significance of each impact would be. Impacts that are not found to be cumulatively considerable would not have an incremental effect on the cumulative scenario. Impact classes for cumulative impacts are as follows:

- **No Impact:** Project would have no impacts or would otherwise not be cumulatively considerable.
- **Class III:** Project impacts would combine with impacts of other projects but cumulative effect is not significant.
- **Class II:** Project impacts would combine with impacts of other projects to create a cumulative effect, but the application of feasible mitigation measures would reduce the incremental effect of the Project to less than significant.
- **Class I:** Project impacts would combine with impacts of other projects to create a cumulative effect that is significant and unavoidable.

Table 3.7-10. Cumulative Impacts for Geology, Soils, and Paleontology– Alternative 2

Impact	Cumulatively Considerable?	Cumulative Significance
G-1: Project activities could interfere with access to known energy resources.	No	No Impact
G-2: Erosion could be triggered or accelerated due to construction activities.	No	No Impact
G-3: Excavation and grading during construction activities could cause slope instability or trigger landslides.	No	No Impact
G-4: Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards.	Yes	Class III
G-5: Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards.	Yes	Class III
G-6: Project structures could be damaged by problematic soils exposing people or structures to hazards.	Yes	Class III
G-7: Transmission line structures could be damaged by landslides, earth flows, or debris slides, during operation.	Yes	Class III
G-8: Grading and excavation could destroy paleontologic resources.	Yes	Class III

It has been determined that three impacts associated with the proposed Project, as identified in Section 3.7.6.1, would not be cumulatively considerable and therefore would not contribute to cumulative impacts. These impacts include: Impact G-1 (Project activities could interfere with access to known energy resources), Impact G-2 (Erosion could be triggered or accelerated due to construction activities), and Impact G-3 (Excavation and grading during construction activities could cause slope instability or trigger landslides) as described below.

Impact G-1 (Project activities could interfere with access to known energy resources) could occur if Project-related construction interfered with operation of the oil field that the Project traverses. As described in Section 3.7.6.1 (Direct and Indirect Effects Analysis), this impact would be less than significant for the proposed Project. The potential for this impact to combine with similar effects of other projects would only occur if other projects were implemented in the same area at the same time as the proposed Project. However, construction of the proposed Project would preclude other projects from being implemented concurrently in the same location. Furthermore, Mitigation Measure G-1 (Coordination with oil field operations) would be implemented to prevent interference with oil field operations. Therefore, proposed Project impacts would not have the potential to combine with similar effects from other projects and would not be cumulatively considerable.

Impact G-2 (Erosion could be triggered or accelerated due to construction activities) could occur during construction-related excavation and grading in areas underlain by soils with high erosion potential. As described in Section 3.7.6.1 (Direct and Indirect Effects Analysis), this impact would be less than significant for the proposed Project. The potential for this impact to combine with similar effects of other projects would only occur if other projects were implemented in the same area at the same time as the proposed Project. However, construction of the proposed Project would preclude other projects from being implemented concurrently in the same location. Furthermore Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits) would be implemented to reduce or prevent erosion impacts during construction. Therefore proposed Project impacts would not have the potential to combine with similar effects from other projects and would not be cumulatively considerable.

Impact G-3 (Excavation or grading during construction activities could cause slope instability or trigger landslides) could occur if Project-related excavation and grading were to trigger slope failures. As described in Section 3.7.6.1 (Direct and Indirect Effects Analysis), this impact would be less than significant for the proposed Project. The potential for this impact to combine with similar effects of other projects would only occur if other projects were implemented on the same slopes at the same time as the proposed Project. However, construction of the proposed Project would preclude other projects from being implemented concurrently in the same location. Furthermore Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) would be implemented to minimize the potential for construction triggered slope failures. Therefore proposed Project impacts would not have the potential to combine with similar effects from other projects and would not be cumulatively considerable.

The potential for cumulatively considerable geology, soils, and paleontology impacts of the proposed Project to combine with similar impacts of other projects within the geographic scope of the cumulative analysis are described below.

- **Project structures could be damaged by surface fault rupture at crossings of active faults (Impact G-4).** As discussed in Section 3.7.6.1 (Direct and Indirect Effects Analysis), this impact could result in collapse of proposed Project structures in the event of surface fault rupture at crossings of active faults. Collapse of

Project structures could result in power outages, damage to nearby roads or structures, and injury or death to nearby people. Past and future projects located in close proximity to Project structures would be exposed to the same conditions and therefore the same impacts. Collapse of Project structures and adjacent structures would combine to result in a significant impact where such structures are in close proximity to other structures or people, such as other parallel and crossing transmission lines and substations, and residential and commercial developments located adjacent to the Project route along Segments 5, 7, 8 and the southern portion of Segment 11. However, implementation of Mitigation Measure G-4a, which requires Project structures be placed outside of active fault zones, and Mitigation Measure G-4b, which requires contingency plans be prepared to prepare the necessity to bypass or work around potential fault-rupture damage where numerous tower structures are located within active fault zones, would minimize the proposed Project's contribution to this cumulative impact. Due to similar policies regarding construction within active fault zones that have been imposed on past projects and that will likely be imposed on reasonably foreseeable projects, this cumulative impact would be less than significant (Class III).

- **Project structures could be damaged by seismically induced groundshaking and/or ground failure (Impact G-5).** Large earthquakes on regional faults could result in strong to very strong seismically induced groundshaking, liquefaction, and earthquake induced slope failures, as discussed in Section 3.7.6.1. This impact could result in collapse of proposed Project structures which could result in power outages, damage to nearby roads or structures, and injury or death to nearby people. Past and future projects located in close proximity to Project structures would be exposed to the same conditions and therefore the same impacts. Collapse of Project structures and adjacent structures would combine to result in a significant impact where such structures are in close proximity to other structures or people, such as other parallel and crossing transmission lines and substations, and residential and commercial developments located adjacent to the Project route along Segments 5, 7, 8 and the southern portion of Segment 11. However, implementation of Mitigation Measure G-5a, which requires site-specific seismic analyses to evaluate the peak ground accelerations for design or modification of Project components to avoid damage from seismic groundshaking, Mitigation Measure G-5b, which requires design-level geotechnical investigations designed to assess the potential for liquefaction and design of Project features to avoid damage liquefaction, and Mitigation Measure G-3, which requires identification of existing and potential unstable slopes to minimize the potential slope failures, would minimize the proposed Project's contribution to this cumulative impact. Due to similar policies regarding construction within areas of potentially substantial seismic shaking and seismically induced ground failures that have been imposed on past projects and that will likely be imposed on reasonably foreseeable projects, this cumulative impact would be less than significant (Class III).
- **Project structures could be damaged by problematic soils exposing people or structures to hazards (Impact G-6).** Unidentified expansive and corrosive soils could damage Project structures and facilities potentially resulting in collapse of such structures, which could result in power outages, damage to nearby roads or structures, and injury or death to nearby people, as described in Section 3.7.6.1 (Direct and Indirect Effects Analysis). Past and future projects located in close proximity to Project structures on the same soil types would be exposed to the same conditions and therefore the same impacts. Collapse of Project structures and adjacent structures would combine to result in a significant impact where such structures are in close proximity to other structures or people, such as other parallel and crossing transmission lines and substations, and residential and commercial developments located adjacent to the Project route along Segments 5, 7, 8 and the southern portion of Segment 11. However, implementation of Mitigation Measure G-6, which would require studies to identify the presence of unsuitable soils and designing of Project features to avoid damage from problematic soils, would minimize the proposed Project's contribution to this cumulative impact. Due to similar policies regarding construction within areas of potentially unsuitable and damaging soils that have been imposed on past projects and that will likely be imposed on reasonably foreseeable projects, this cumulative impact would be less than significant (Class III).
- **Project structures could be damaged by landslides, earthflows, debris flows and/or rock fall (Impact G-7).** As discussed in Section 3.7.6.1, this impact could result in collapse of proposed Project structures in the event of landslides, earthflows, debris flows and/or rock fall. Collapse of Project structures could result in power outages, damage to nearby roads or structures, and injury or death to nearby people. Past and future projects located in close proximity to Project structures would be exposed to the same conditions and therefore the same impacts. Collapse of Project structures and adjacent structures would combine to result in a significant impact where such structures are in close proximity to other structures or people, such as other

parallel and crossing transmission lines and substations, and residential and commercial developments located adjacent to the Project route along Segments 5, 7, 8 and the southern portion of Segment 11. However, implementation of Mitigation Measure G-3, which requires identification of existing and potential unstable slopes to minimize the potential slope failures, would minimize the proposed Project's contribution to this cumulative impact. Due to similar policies regarding construction within areas of unstable and potentially unstable slopes that have been imposed on past projects and that will likely be imposed on reasonably foreseeable projects, this cumulative impact would be less than significant (Class III).

- **Grading and excavation could destroy paleontologic resources (Impact G-8).** Unknown, unrecorded paleontological resources may be found at nearly any development site. As they are discovered, sites are recorded and information retrieved. If the nature of the resource requires it, the resource is protected. When discovered, paleontological resources are treated in accordance with applicable federal and State laws and regulations as well as the mitigation measures and permit requirements applicable to a project. It is not known what paleontological resources, if any, would be affected by development of all present and future projects along and near the proposed Project; however, given the density of past development in these areas and the large number of reasonably foreseeable projects in the area, it is reasonable to assume that paleontologic resources exist and would be expected to be uncovered in at least several of these sites. As with the proposed Project, Applicant-Proposed Measures (APMs PALEO-1 through PALEO-9) shall be employed during construction to reduce the potential that any scientifically important fossils would be destroyed and would provide for the systematic collection, analysis, and documentation of any such discoveries. Should resources be discovered during construction of current and future projects, they would be subject to legal requirements designed to protect them, thereby reducing the effect of impacts. Therefore proposed Project impacts, when combined with impacts from past, present and reasonably foreseeable projects would not be significant (Class III) and no additional mitigation measures are necessary.

Mitigation to Reduce the Project's Contribution to Significant Cumulative Effects

Mitigation measures introduced for the proposed Project in Section 3.7.6.1 (Direct and Indirect Effects Analysis) would help to reduce the proposed Project's incremental contribution to cumulative impacts. However, no additional mitigation measures have been identified that would reduce cumulative impacts to a less-than-significant level for geologic, soils, and paleontologic resources.

3.7.7 Alternative 3: West Lancaster Alternative

The following section describes geology, soils, and paleontology impacts of Alternative 3 (West Lancaster Alternative), as determined by the significance criteria listed in Section 3.7.4. Mitigation measures are introduced where necessary in order to reduce significant impacts to less-than-significant levels. As described in Section 2.3, this alternative would deviate from the proposed route along Segment 4, at approximately S4 MP 14.9, where the new 500-kV transmission line would turn south down 115th Street West for approximately 2.9 miles and turn east for approximately 0.5 mile, rejoining the proposed route at S4 MP 17.9. This re-route would increase the overall distance of Segment 4 by approximately 0.4 mile, but it would not have the potential to encounter or avoid any sources of contamination or hazards that would be affected or traversed by the proposed Project and would not introduce any new source of contamination or hazards to Project-related impacts.

3.7.7.1 Direct and Indirect Effects Analysis

The significance criteria used to identify geology, soils, and paleontology impacts are introduced in Section 3.7.4.1 (Criteria for Determining Impact Significance). Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, the short re-route has a nearly identical setting as Alternative 2 (the proposed Project), and thus impacts associated with Alternative 3 would be the same as impacts associated with the criteria for the proposed Project. Impacts associated with Alternative 3 are presented below under the applicable significance criterion.

Unique geologic features (Criterion GEO1)

No unique geologic features or geologic features of unusual scientific value for study or interpretation would be disturbed or otherwise adversely affected by Alternative 3. No impact would occur.

Known mineral and/or energy resources (Criterion GEO2)

Impacts associated with Criterion GEO2 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, as with the equivalent portion of Segment 4 there are no known mineral resource sites along the re-route and therefore the impacts related to Criterion GEO2 would be the same as for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-1 (Project activities could interfere with access to known energy resources) would be the same as for the proposed Project. Therefore where the portions of Alternative 3 equivalent to Segments 7, 11, and 8 would cross the Montebello oil and gas field and where the Segment 8 equivalent would cross the northern edge of the Brea-Olinda oil and gas field, there is a potential for Project construction activities to interfere with oil field operations. Impact G-1, as described in Section 3.7.6.1, for Alternative 3 would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Triggering or acceleration of geologic processes, such as landslides, soil erosion, or loss of topsoil, during construction (Criterion GEO3)

Impacts associated with Criterion GEO3 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, the geologic materials, soils, and very gentle slopes would be identical to those of the proposed Project and there would be no substantial increase in the potential for erosion triggered or accelerated due to construction activities. These impacts and their associated mitigation measures that fall under Criterion GEO3 are summarized in the following paragraphs. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are the same as the proposed Project.

Impact G-2 (Erosion could be triggered or accelerated due to construction activities) would be the same under Alternative 3 as it would be for the proposed Project (please see Section 3.7.6.1). The rerouted portion of Alternative 3 is only minimally longer than the proposed Project route and is located on the same soil types with the same potential for erosion. The remaining portion of Alternative 3 is identical to Alternative 2 and the potential of erosion triggered or accelerated due to construction activities is the same as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits). With implementation of this mitigation measure, as described in Section 3.7.6.1, Impact G-2 of Alternative 3 would be less than significant (Class II).

Impact G-3 (Excavation and grading during construction activities could cause slope instability or trigger landslides) would be the same for Alternative 3 as it would be for the proposed Project (see Section 3.7.6.1). The rerouted portion of Alternative 3 is located in flat-lying terrain and there is no potential for slope failure. The remaining portion of Alternative 3 is identical to Alternative 2 and the potential of slope failure or triggered landslides due to construction activities is the same as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). With implementation of this mitigation measure, as described in Section 3.7.6.1, Impact G-3 of Alternative 3 would be less than significant (Class II).

Exposure to potential risk of loss or injury due to earthquake-related ground rupture (Criterion GEO4)

Impacts associated with Criterion GEO4 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, as with the equivalent portion of Segment 4 there are no fault crossings along the re-route and therefore the impacts related to Criterion GEO4 would be the same as for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-4 (Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards) would be the same for Alternative 3 as it would be for the proposed Project (see Section 3.7.6.1). The rerouted portion of Alternative 3 does not cross any active faults and therefore there is no potential for fault rupture along the reroute. The remaining portion of Alternative 3 is identical to Alternative 2 and the potential of surface fault rupture is the same as presented in Section 3.7.6.1. Therefore the portions of Alternative 3 equivalent to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), Whittier (Segment 8A), and Chino-Central Ave (Segment 8A) faults would require implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) and G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines) to reduce potential impacts to less than significant (Class II).

Exposure to potential risk of loss or injury due to seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking (Criterion GEO5)

Impacts associated with Criterion GEO5 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. The minimally longer length of the reroute for this alternative compared to the proposed Project would result in incrementally increased opportunity for damage to Project structures from seismically induced groundshaking along the reroute. Therefore the impacts related to Criterion GEO5 would be the same as for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-5 (Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards) would be the same under Alternative 3 as it would be for the proposed Project (see Section 3.7.6.1). Potential earthquake-related groundshaking along the Alternative 3 reroute is the same as that for the equivalent portion of Segment 4. Local strong to severe groundshaking may occur along the Alternative 3 alignment equivalent to portions of Segments 4, 5, 6, 7, 9, and 11 and would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking). The potential for liquefaction and earthquake induced slope failures along Alternative 3 are identical to the proposed Project (see Section 3.7.6.1). Therefore, the portions of Alternative 3 equivalent to the portions of Segments 5, 7, 11, 8A, 8B, and 8C that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams where lenses and pockets of loose seasonally saturated sand may be present would require implementation of Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction). Portions of Alternative 3 equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 3 to less than significant (Class II).

Exposure to potential risk of loss or injury where corrosive soils or other unsuitable soils are present (Criterion GEO6)

Impacts associated with Criterion GEO6 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, the soils underlying the alignment would be identical to those of the proposed Project and there would be no change in the potential for damage to Project structures due to unsuitable soils. These impacts and their associated mitigation measures that fall under Criterion GEO6 are summarized in the following paragraphs. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are the same as the proposed Project.

Impact G-6 (Project structures could be damaged by problematic soils exposing people or structures to hazards) would be the same for Alternative 3 as the alignment crosses the same soil types as the proposed Project alignment. Soils along the alignment have a potential to corrode steel and concrete ranging from low to high and expansion potential ranging from low to high. Corrosive and/or expansive soils can cause damage to structure foundations, potentially resulting in collapse of the structure, a significant impact (see Section 3.7.6.1). Therefore, Alternative 3 would require implementation of Mitigation Measure G-6 (Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Damage to Project structures due to slope failure (Criterion GEO7)

Impacts associated with Criterion GEO7 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, there is no potential for slope failure along the flat-lying terrain of the re-route. Therefore, there would be no substantial increase in the potential for slope failures to occur.

Impact G-7 (Transmission line structures could be damaged by landslides, earth flow, or debris flows, during operation) would be the same for Alternative 3 as it would be for the proposed Project (see Section 3.7.6.1). The rerouted portion of Alternative 3 is located in flat-lying terrain and there is no potential for slope failure. The remaining portion of Alternative 3 is identical to Alternative 2 and the potential for failure of existing unstable slope or landslides during operation is the same as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). With implementation of this mitigation measure, as described in Section 3.7.6.1, Impact G-7 of Alternative 3 would be less than significant (Class II).

Destruction of unique paleontological resources (Criterion GEO8)

Impacts associated with Criterion GEO8 for Alternative 3 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 4 of the proposed transmission line, the geologic materials would be identical to those of the proposed Project and there would be no substantial increase in the potential for Impact G-8 (Grading and excavation could destroy paleontologic resources) to occur. Additionally, APM PALEO-1 through APM PALEO-9

(Paleontologic resource planning, construction monitoring and recovery, and final report and museum curation) would be included as part of the Project in order to reduce the likelihood of destroying unique paleontologic resources. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 3 would be less than significant (Class III). Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are the same as the proposed Project.

3.7.7.2 Cumulative Effects Analysis

This section addresses potential cumulative effects that would occur as a result of implementation of the Alternative 3 route. This alternative consists of re-routing the new 500-kV T/L in Segment 4 along 115th Street West rather than 110th Street West. This alternative was developed to avoid the existing residences. The remainder of this alternative route (which totals approximately 150 miles) would be identical to that of the proposed Project and would, therefore, result in substantially similar or identical impacts as the proposed Project. The rerouted portion of the Alternative 3 route generally parallels the proposed Project route for approximately 3 miles, at a 0.5 mile distance from the proposed Project route. As a result, this alternative traverses the same geologic materials as the portion of the proposed Project route it is proposed to replace, would require the same types of construction activities to build, and would result in the same operational capacity as the proposed Project.

Based on the substantial similarity of Alternative 3 to the proposed Project, this alternative's contribution to cumulative impacts would be identical to that of the proposed Project. See Section 3.7.6.2 for a detailed discussion of cumulative effects.

Geographic Extent

The geographic extent for the analysis of cumulative impacts related to geology, soils, and paleontology is limited to the Project site and the immediate vicinity surrounding Project substations, laydown areas, and the transmission line ROWs occupied by the proposed alignment. These geographic limits are appropriate to consider the potential cumulative impacts as the geologic materials and terrain on the Project site and directly adjacent to the Project site are the most significant factors to evaluate the potential for geologic hazards, unsuitable soil and paleontologic resources at a project site. Impacts would have the potential to occur during construction and operation and would be limited to the areas where concurrent construction is occurring. The geographic extent for Alternative 3 is identical to that of the proposed Project, as presented in Section 3.7.6.2.

Existing Cumulative Conditions

The existing cumulative conditions of Alternative 3 are identical to the proposed Project as discussed in Section 3.7.6.2.

Reasonably Foreseeable Future Projects and Changes

Reasonably foreseeable future projects and changes to the cumulative scenario for Alternative 3 would be exactly the same as Alternative 2, described in Section 3.7.6.2.

Cumulative Impact Analysis

As discussed for the proposed Project in Section 3.7.6.2, Impacts G-1 through G-3 of Alternative 3 would not have the potential to combine with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2. Impacts G-4 through G-8 for Alternative 3 would combine but not be cumulatively significant (Class III) with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2.

Mitigation to Reduce the Project's Contribution to Significant Cumulative Effects

Mitigation measures introduced for the proposed Project in Section 3.7.6.1 (Direct and Indirect Effects Analysis) would help to reduce Alternative 3's incremental contribution to cumulative impacts. However, there are no impacts or significant cumulative effects of Alternative 3 related to geology, soils, and paleontology and no additional mitigation is required.

3.7.8 Alternative 4: Chino Hills Route Alternatives

3.7.8.1 Direct and Indirect Effects Analysis

The significance criteria used to identify geology, soils, paleontology are introduced in Section 3.7.4.1 (Criteria for Determining Impact Significance). Impacts associated with Alternative 4 are presented below under the applicable significance criterion. As described in Section 3.7.2.4 (Affected Environment: Alternative 4), this alternative would follow the same route as the proposed Project with the exception that it would diverge from the proposed Project route along Segment 8A at S8A MP 19.2. Therefore, any impacts of the proposed Project that would occur between S8A MP 19.2 and 35.2 (16 miles) through Chino Hills, Chino, and Ontario would not occur under Alternative 4. In addition, impacts associated with Segments 8B and 8C of the proposed Project also would not occur under Alternative 4. Where the proposed route for Alternative 4 diverges from the proposed Project route at S8A MP 19.2, it would turn to the southeast, crossing through part of Orange County, San Bernardino County, and the CHSP. Therefore, Alternative 4 would introduce the potential to result in Geology, Soils, and Paleontology impacts in these areas which would not be affected by the proposed Project.

As described in Section 2.4, this alternative includes four separate routing options: Route A, Route B, Route C, and Route D. For the purposes of this impact analysis, the routing options for Alternative 4 are discussed in comparison to each other throughout the following section. As described, the alignment of Alternative 4 would be the same as the proposed Project north of S8A MP 19.2; as such, please see Section 3.7.6.1 for a summary of geology, soils, and paleontology impacts that could potentially affect resources along this portion of the Alternative 4 route which is identical to the proposed Project route.

Unique geologic features (Criterion GEO1)

No unique geologic features or geologic features of unusual scientific value for study or interpretation would be disturbed or otherwise adversely affected by Alternative 4. No impact would occur.

Known mineral and/or energy resources (Criterion GEO2)

Impacts associated with Criterion GEO2 for Alternative 4 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a re-route of part of Segment 8 of the proposed transmission line, as with the equivalent portion of Segment 8 the reroute and all associated facilities and access roads do- not cross any active energy resource sites and therefore the impacts related to Criterion GEO2 would be the same as for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-1 (Project activities would interfere with access to known energy resources) would be the same as for the proposed Project. Therefore where the portions of Alternative 4 equivalent to proposed Project Segments 7, 11, and 8 would cross the Montebello oil and gas field and where the Segment 8 equivalent would cross the northern edge of the Brea-Olinda oil and gas field, there is a potential for Project construction activities to interfere with oil field operations.

Route A. This impact would be exactly the same for Alternative 4, Route A, as it would be for the proposed Project (please see Section 3.7.6.1). Impact G-1, as described in Section 3.7.6.1, for Alternative 4, Route A, would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Route B. The Route B option would be exactly the same as Route A with regards to Impact G-1. Impact G-1, as described in Section 3.7.6.1, for Alternative 4, Route B, would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Route C. The Route C option would be exactly the same as Route A with regards to Impact G-1. Impact G-1, as described in Section 3.7.6.1, for Alternative 4, Route C, would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Route D. The Route D option would be exactly the same as Route A with regards to Impact G-1. Impact G-1, as described in Section 3.7.6.1, for Alternative 4, Route D, would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Triggering or acceleration of geologic processes, such as landslides, soil erosion, or loss of topsoil, during construction (Criterion GEO3)

Impacts associated with Criterion GEO3 for Alternative 4 would be similar to impacts associated with this criterion for the proposed Project. The shorter length of all four routes of this alternative compared to the proposed Project would result in incrementally decreased opportunity to cause construction triggered erosion. However, the increased length of the Alternative 4 routes through the Puente Formation than the proposed Project (ranging from 6.2 to 12.4 miles versus 5.9 miles for the comparable portion of Segment 8A), and the grading of all-weather access roads for the associated switching station for Alternative 4 result in a slightly increased potential to trigger or accelerate landslides during Project construction. The impacts and their associated mitigation measures that fall under Criterion GEO3 are summarized in the following paragraphs. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are similar to the proposed Project.

Impact G-2 (Erosion could be triggered or accelerated due to construction activities) would be similar under Alternative 4 as it would be for the proposed Project (please see Section 3.7.6.1). The rerouted portion of Alternative 4 is located in an undeveloped area with moderate to steep slopes and soil with severe to very severe erosion potential. Therefore, there is substantial potential for erosion caused by construction of transmission structures, unpaved access roads, and all-weather (e.g., paved) switching station access roads. The remaining portion of Alternative 4 is identical to the equivalent portions of Alternative 2 and the potential of erosion triggered or accelerated due to construction activities is similar, although incrementally decreased due to the shorter alignment length as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits). With implementation of this measure, as described in Section 3.7.6.1, Impact G-2 of Alternative 4 would be less than significant (Class II).

Route A. Despite the additional ground disturbance required for the switching station site and the several mile long associated permanent all-weather access road to the switching station, the approximately 16 mile shorter transmission line route (compared to the proposed Project) would still result in incrementally reduced ground disturbance and erosion for this alignment. Impact G-2 would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits), as described in detail in Section 3.7.6.1, for Alternative 4, Route A, to reduce potential impacts to less than significant (Class II).

Route B. Erosion impacts of Route B would be incrementally greater than the impacts of Route A due to the longer alignment (approximately 3.5 miles longer than Route A), grading for the switching station, and the associated permanent all-weather access road to the site off Butterfield Ranch Road. Impact G-2 would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits), as described in detail in Section 3.7.6.1, for Alternative 4, Route B, to reduce potential impacts to less than significant (Class II).

Route C. New and rerouted transmission lines for Route C would include the removal of about 7.0 miles of transmission line/structures and grading for a several mile long permanent all-weather access road to the new switching station resulting in an incremental increase in erosion impacts. Impact G-2 would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits), as described in detail in Section 3.7.6.1, for Alternative 4, Route C, to reduce potential impacts to less than significant (Class II).

Route D. Grading for the Route D switching station, the associated all-weather access road to the site off Butterfield Ranch Road, and the approximately 3.7 miles greater length compared to Route A, results in incrementally greater construction-related erosion impacts. Impact G-2 would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits), as described in detail in Section 3.7.6.1, for Alternative 4, Route D, to reduce potential impacts to less than significant (Class II).

Impact G-3 (Excavation and grading during construction activities could cause slope instability or trigger landslides) would be similar for Alternative 4 as it would be for the proposed Project (see Section 3.7.6.1). All route options of Alternative 4 are located in hillside areas with mapped landslides and substantial potential for slope failure similar to the equivalent portion of Alternative 2 that traverses the Puente Formation about two to three miles north. The Alternative 4 routes would traverse a slightly greater length of landslide prone Puente Formation than the proposed Project (ranging from 6.2 to 12.4 miles versus 5.9 miles for the comparable portion of Segment 8A), resulting in a slightly increased potential for impacts from landslides and unstable slopes along Alternative 4 compared to the proposed Project (Alternative 2). The remaining portion of Alternative 4 is identical to Alternative 2 and the potential of slope failure or triggered landslides due to construction activities is the same as presented in Section 3.7.6.1.

Route A. Route A would be only 0.3 miles longer than the proposed Project within hillside areas with slope stability issues resulting in slightly greater potential to cause slope instability or trigger landslides. Additionally the Route A alignment would require the construction of a several mile long permanent all-weather access road along ridgelines and in canyons underlain by the landslide prone Puente Formation which further increases the potential for construction triggered slope instability. Impact G-3 of Alternative 4, Route A, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Route B. Construction-triggered slope instability impacts of Route B would be incrementally greater than Route A due to the longer alignment (approximately 3.5 miles longer than Route A), grading for the Route D switching station, and the associated all-weather access road to the site off Butterfield Ranch Road. Impact G-3 of Alternative 4, Route B, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Route C. The total length of Route C would be approximately 6 miles longer than Route A resulting in an incremental increase in potential to cause construction-triggered slope instability. Additionally the Route C alignment would require the construction of a several mile long permanent all-weather access road along ridgelines and in canyons underlain by the landslide prone Puente Formation which further increases the potential for construction triggered slope instability. Removal of about 7.0 miles of transmission line/structures with nominal ground disturbance and site restoration is not anticipated to result in an increase in slope instability or trigger landslides. Impact G-3 of Alternative 4, Route C, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Route D. Route D of Alternative 4 is about.4 miles longer than Route A resulting in incrementally greater potential for construction-related slope instability impacts. Additional construction-related slope stability impacts could result from the grading for the Route D switching station and the associated all-weather access road to the site off Butterfield Ranch Road, which are both underlain by the landslide prone Puente Formation. Impact G-3 of Alternative 4, Route D, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Exposure to potential risk of loss or injury due to earthquake-related ground rupture (Criterion GEO4)

Impacts associated with Criterion GEO4 for Alternative 4 would be the same as impacts associated with this criterion for the proposed Project. Although this alternative introduces a new shorter route for the portion of the Project alignment, eliminating the portion of the alignment equivalent to the end of Segment 8, it does add one new fault crossing for two of Alternative 4 route options (Routes B and D), The Chino fault. This alignment, however does avoid the Chino-Central Ave fault crossing. Therefore the impacts related to Criterion GEO4 would be similar as for the proposed Project, as presented in Section 3.7.6.1, with the same number of fault crossings, but crossing a different strand of the Chino-Central Avenue fault. The impact and associated mitigation measures that fall under Criterion GEO4 are summarized in the following paragraph.

Impact G-4 (Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards) would generally be the same for Alternative 4 as it would be for the proposed Project (see Section 3.7.6.1). The rerouted portion of Alternative 4, Routes A and C do not cross any active faults and therefore there is no potential for fault rupture along these reroutes. However, both the eastern ends of Routes B and D and their associated new switching station would cross the

Alquist-Priolo zoned Chino Fault, resulting in a potential for damage to project facilities from surface fault rupture. The remaining portion of Alternative 4 (west of S8A-19.2) is identical to Alternative 2 and the potential of surface fault rupture is the same as presented in Section 3.7.6.1, with the exception that Alternative 4 does not cross the Chino-Central Ave fault crossing.

Route A. This impact would be exactly the same for Alternative 4, Route A, as it would be for the proposed Project (please see Section 3.7.6.1), with the exception of having one less fault crossing (does not cross the Chino-Central Ave fault). Therefore the portions of Alternative 4, Route A, equivalent to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), and Whittier (Segment 8A) faults would require implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) and G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines), described in detail in Section 3.7.6.1, to reduce potential impacts to less than significant (Class II).

Route B. The Route B option would be similar to Route A with regards to Impact G-4, with the exception that the eastern end of the Route B alignment and its associated switching station cross and are mapped on the Alquist-Priolo zoned Chino fault. Therefore, in addition to the portions of Alternative 4, Route B, equivalent to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), and Whittier (Segment 8A) faults, the rerouted portion of Alternative 4, Route B where it crosses and lies on the Chino fault would require implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) and G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines), described in detail in Section 3.7.6.1, to reduce potential impacts to less than significant (Class II).

Route C. The Route C option would be exactly the same as Route A with regards to Impact G-4. Therefore the portions of Alternative 4, Route C, equivalent to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), and Whittier (Segment 8A) faults would require implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) and G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines), described in detail in Section 3.7.6.1, to reduce potential impacts to less than significant (Class II).

Route D. The Route D option would be similar to Route A with regards to Impact G-4, with the exception that eastern end of the Route D alignment and its associated switching station cross and are mapped on the Alquist-Priolo zoned Chino fault. Therefore in addition to the portions of Alternative 4, Route D, equivalent to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), and Whittier (Segment 8A) faults, the rerouted portion of Alternative 4, Route D where it crosses and lies on the Chino fault would require implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) and G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines), described in detail in Section 3.7.6.1, to reduce potential impacts to less than significant (Class II).

Exposure to potential risk of loss or injury due to seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking (Criterion GEO5)

Impacts associated with Criterion GEO5 for Alternative 4 would be the same as impacts associated with this criterion for the proposed Project. The shorter length of all four routes of this alternative compared to the proposed Project would only result in incrementally decreased opportunity for damage to Project structures from seismically induced groundshaking and ground failures. Therefore the impacts related to Criterion GEO5 would be the same as for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-5 (Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards) would be the same under Alternative 4 as it would be for the proposed Project (please see Section 3.7.6.1). All the route options under Alternative 4 traverse areas with PGAs ranging from 0.4 to 0.6g, the same as the proposed Project; therefore earthquake induced moderate to strong groundshaking equivalent to that along the corresponding portion of 8A should be expected along these alignments. The potential for landslides and unstable slopes along Alternative 4 are similar, but incrementally increased due to the increased length with the landslide prone Puente Formation, to the eastern Puente Hills portion of Segment 8A of the proposed Project (see Section 3.7.6.1). The potential for liquefaction-related phenomena are the same along Alternative 4 as for the proposed Project. These impacts could cause collapse of Project structures that could result in power outages, damage to nearby roads of structures, and injury or death to nearby people, a significant impact.

Route A. This impact would be the same for Alternative 4, Route A, regarding groundshaking and liquefaction as it would be for the proposed Project (please see Section 3.7.6.1). However, the increased length (approximately 0.3 mile longer) of transmission line within hillside areas with slope stability issues results in a slightly greater potential for earthquake induced slope failure. This impact would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking); Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction) along the portions of Alternative 4, Route A, equivalent to the portions of Segments 5, 7, 11, and 8A that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams; and Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) along portions of Alternative 4, Route A, equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures. Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 4, Route A, to less than significant (Class II).

Route B. The Route B option would be exactly the same as Route A with regards to Impact G-5, except the potential for earthquake induced slope failures along Route B would be incrementally greater than Route A due to the 3.5 mile longer alignment. This impact would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking); Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction) along the portions of Alternative 4, Route B, equivalent to the portions of Segments 5, 7, 11, and 8A that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams; and Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) along portions of Alternative 4, Route B, equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures. Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 4, Route B, to less than significant (Class II).

Route C. The Route C option would be exactly the same as Route A with regards to Impact G-5, except Route C would consist of a new transmission line alignment and reroutes that total approximately 6 miles more of transmission line than Route A, resulting in an incremental increase in potential for earthquake induced slope failures. This impact would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking); Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction) along the portions of Alternative 4, Route C, equivalent to the portions of Segments 5, 7, 11, and 8A that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams; and Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) along portions of Alternative 4, Route A, equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures. Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 4, Route A, to less than significant (Class II).

Route D. The Route D option would be exactly the same as Route A with regards to Impact G-5, except Route D of Alternative 4 is about 4 miles longer than Route A resulting in an incrementally increased potential for earthquake induced slope failures. This impact would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking); Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction) along the portions of Alternative 4, Route D, equivalent to the portions of Segments 5, 7, 11, and 8A that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams; and Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) along portions of Alternative 4, Route D, equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures. Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 4, Route D, to less than significant (Class II).

Damage to Project structures due to slope failure (Criterion GEO7)

Impacts associated with Criterion GEO7 for Alternative 4 would be similar to impacts associated with this criterion for the proposed Project. The four route options of Alternative 4 traverse hillside areas of the eastern Puente Hills composed of slightly consolidated Tertiary age marine sedimentary rocks prone to landslides and slope failure. Numerous mapped and suspected landslides and locally unstable slopes occur in the area of Alternative 4, with slope conditions similar to the comparable portion of the proposed Project.

Impact G-7 (Transmission line structures could be damaged by landslides, earth flow, or debris flows, during operation) would be similar for Alternative 4 as it would be for the proposed Project (see Section 3.7.6.1). Alternative 4 is underlain by the same geologic units and is located in identical terrain as the proposed Project, which includes the eastern Puente Hills where there is substantial potential for slope failure. The Alternative 4 routes would traverse a slightly greater length of landslide prone Puente Formation (ranging from 0.3 to 3.3 miles longer) than the equivalent portion of the proposed Project (Segment 8A), resulting in a slightly increased potential for impacts due to slope failures. The remaining portion of Alternative 4 is identical to Alternative 2 and the potential for failure of existing unstable slope or landslides during operation of the Project is the same as presented in Section 3.7.6.1.

Route A. Route A would be approximately 0.3 miles longer than the proposed Project within the hillside areas underlain by the landslide prone Puente Formation resulting in incrementally greater potential of slope instability or landslides to impact transmission structures during the life of the Project. Impact G-7 of Alternative 4, Route A, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce the impact to a level of less than significant (Class II).

Route B. Future slope instability or landslide impacts to transmission line structures of Route B would be incrementally greater than Route A due to the 3.5 mile longer alignment. Impact G-7 of Alternative 4, Route B, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce the impact to a level of less than significant (Class II).

Route C. Route C would consist of a new transmission line alignment and reroutes that total approximately 6 miles more of transmission line alignment than Route A and removal of about 7.0 miles of transmission line/structures resulting in a very small incremental increase in potential for future impacts from slope failure on transmission line structures. Impact G-7 of Alternative 4, Route C, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce the impact to a level of less than significant (Class II).

Route D. Route D of Alternative 4 is about 4 miles longer than Route A resulting in incrementally greater potential for future landslides and slope failure impacts to transmission line structures. Impact G-7 of Alternative 4, Route A, would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability), as described in Section 3.7.6.1, to reduce the impact to a level of less than significant (Class II).

Destruction of unique paleontological resources (Criterion GEO8)

Impacts associated with Criterion GEO8 for Alternative 4 would be similar to impacts associated with this criterion for the proposed Project. The shorter length of all four routes of this alternative compared to the proposed Project would result in incrementally decreased opportunity to encounter and destroy paleontologic resources as a whole. However, each of the Alternative 4 route options is within the paleontologic-rich Puente Formation (high sensitivity) and is longer than the comparable portion of the proposed Project within these same formations (0.3 to 6.5 miles longer). Alternative 4 would eliminate approximately 3.6 to 9.2 miles of paleontologically sensitive Puente Formation and alluvium along Segment 8A, and 6.8 and 6.4 miles of paleontologically sensitive alluvium along Segments 8B and 8C, respectively.

Route A. Although the transmission line of Route A within the highly sensitive Puente Formation is about 0.3 miles longer than the equivalent portion of Segment 8A (S8A MP 19.2 to 25.1) and Route A would require grading for a several mile long all-weather paved access road to the switching station through the highly sensitive Puente Formation, the Route A transmission alignment would overall be approximately 16 miles shorter (primarily in paleontologically sensitive units) than the proposed Project. This would result in reduced ground disturbance and potential to encounter paleontologic resources. Although construction could still disturb unique paleontologic resources, as with the proposed Project, application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant, resulting in no change in the potential for Impact G-8 (Grading and excavation could destroy paleontologic resources) to occur. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 4, Route A, would be less than significant (Class III).

Route B. Paleontologic impacts of Route B would be incrementally greater than the impacts of Route A due to the 3.5 mile longer alignment and grading for the switching station and associated all-weather access road within the paleontologically sensitive Puente Formation. Although construction could still disturb unique paleontologic resources, as with the proposed Project, application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant, resulting in no change in the potential for Impact G-8 (Grading and excavation could destroy paleontologic resources) to occur. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 4, Route B, would be less than significant (Class III).

Route C. The new 500-kV transmission line alignment and the 500-kV and 220-kV reroute for Route C would be approximately 6 miles longer than Route A and would require grading for a several mile long all-weather (e.g., paved) access road to the switching station through the highly sensitive Puente Formation, which results in an incremental increase in potential for paleontologic impacts. The removal of about 7.0 miles of transmission line/structures would not impact paleontologic resources. Although construction could still disturb unique paleontologic resources, as with the proposed Project, application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant, resulting in no change in the potential for Impact G-8 (Grading and excavation could destroy paleontologic resources) to occur. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 4, Route C, would be less than significant (Class III).

Route D. Route D of Alternative 4 is approximately 4 miles longer than Route A and would require grading for the switching station and associated all-weather access road, which results in an incrementally greater potential for paleontologic impacts. Although construction could still disturb unique paleontologic resources, as with the proposed Project, application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant, resulting in no change in the potential for Impact G-8 (Grading and excavation could destroy paleontologic resources) to occur. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 4, Route A, would be less than significant (Class III).

3.7.8.2 Cumulative Effects Analysis

This section addresses potential cumulative effects that would occur as a result of implementation of Alternative 4. The Alternative 4 routes deviate from the proposed Project beginning about two miles east of State Route 57 (approximately S8A MP 19.2), where the existing Mira Loma-Walnut/Olinda 220-kV double-circuit T/L and the existing un-energized Mesa-Chino T/L (both in the same corridor as that of Segment 8A) separate from one another. The remainder of this alternative route would be identical to that of the proposed Project and would, therefore, result in substantially similar or identical impacts as the proposed Project. The rerouted portion of the Alternative 4 route generally parallels the proposed Project route for approximately 4 to 6 miles, at a distance of approximately 3 miles south of the proposed Project route. As a result, this alternative traverses the same or similar land uses as the portion of the proposed Project route it is proposed to replace, would require the same types of construction activities to build, and would result in the same operational capacity as the proposed Project.

Based on the substantial similarity of the Alternative 4 route to the proposed Project, this alternative's contribution to cumulative impacts would be similar or identical to that of the proposed Project. However, when compared to the proposed Project, each alternative's contribution to certain cumulative impacts may be incrementally increased or decreased as a result of the rerouted portion of the alternative. Such increases or decreases would result from:

- The nature of the alternative (e.g., underground or overhead);
- The location of the alternative with respect to land uses and specific resources; or
- The location of past, present, or reasonably foreseeable projects with which impacts of the alternative route would have the potential to combine (i.e., the other projects are located such that their impacts would or would not combine with impacts of the alternative, as compared to the proposed Project).

Geographic Extent

The geographic extent for the analysis of cumulative impacts related to geology, soils, and paleontology is limited to the Project site and the immediate vicinity surrounding Project substations, laydown areas, and the transmission line ROWs occupied by the proposed alignment. These geographic limits are appropriate to consider the potential cumulative impacts as the geologic materials and terrain at the Project site and directly adjacent to the Project site are the most significant factors to evaluate the potential for geologic hazards, unsuitable soil and paleontologic resources at a project site. Impacts would have the potential to occur during construction and operation and would be limited to the areas where concurrent construction is occurring. The geographic extent for Alternative 4 is identical to that of the proposed Project, as presented in Section 3.7.6.2.

Existing Cumulative Conditions

The existing cumulative conditions of Alternative 4 are identical to the proposed Project as discussed in Section 3.7.6.2.

Reasonably Foreseeable Future Projects and Changes

Reasonably foreseeable future projects and changes to the cumulative scenario for Alternative 4 would be exactly the same as Alternative 2, described in Section 3.7.6.2.

Cumulative Impact Analysis

As discussed for the proposed Project in Section 3.7.6.2, Impacts G-1 through G-3 of Alternative 4 would not have the potential to combine with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2. Impacts G-4 through G-8 for Alternative 4, Routes A through D would combine but not be cumulatively significant (Class III) with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2

Mitigation to Reduce the Project's Contribution to Significant Cumulative Effects

Mitigation measures introduced for Alternative 2 in Section 3.7.6.1 (Direct and Indirect Effects Analysis) would help to reduce Alternative 4's incremental contribution to cumulative impacts. However, there are no impacts or significant cumulative effects of Alternative 4, Routes A through D, related to geology, soils, and paleontology and no additional mitigation is required.

3.7.9 Alternative 5: Partial Underground Alternative

3.7.9.1 Direct and Indirect Effects Analysis

The significance criteria used to identify geology, soils, and paleontology impacts are introduced in Section 3.7.4.1 (Criteria for Determining Impact Significance). Impacts associated with this alternative are presented below under the applicable significance criterion.

As summarized below, the impacts and mitigation measures for Alternative 5 would be the same as those for Alternative 2. Although a portion of Alternative 5 would be installed underground, from approximately MP S8A-21.9 through the City of Chino Hills to approximately MP S8A-25.8, the route of this alternative would be identical to that of Alternative 2 and would therefore be within the same geologic materials and terrain. However, the construction of underground transmission lines would require more extensive amounts of ground disturbance and increased duration of construction activities required than for the equivalent aboveground portions of Alternative 2. Therefore, the potential for some geology, soils, and paleontology impacts to occur would be incrementally increased compared to Alternative 2.

Unique geologic features (Criterion GEO1)

No unique geologic features or geologic features of unusual scientific value for study or interpretation would be disturbed or otherwise adversely affected by Alternative 5. No impact would occur.

Known mineral and/or energy resources (Criterion GEO2)

Impacts associated with Criterion GEO2 for Alternative 5 would be the same as impacts associated with this criterion for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-1 (Project activities could interfere with access to known energy resources) would be the same as for Alternative 2. Therefore, where the portions of Alternative 5 equivalent to Segments 7, 11, and 8 would cross the Montebello oil field and where the Segment 8 equivalent would cross the northern edge of the Brea-Olinda oil field, there is a potential for Project construction activities to interfere with oil field operations. Impact G-1, as described in Section 3.7.6.1, for Alternative 5 would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Triggering or acceleration of geologic processes, such as landslides, soil erosion, or loss of topsoil, during construction (Criterion GEO3)

Impacts associated with Criterion GEO3 for Alternative 5 would be similar to the impacts associated with this criterion for Alternative 2. The underground portion of the alignment would require excavation and grading of transition stations at either side of the underground portion (approximately 1.8 acres each), that would equal more ground disturbance than that required for the towers that would be replaced by construction of the underground portion of Alternative 5, resulting in incrementally greater ground disturbance compared to Alternative 2 and would result in increased opportunity to cause construction triggered erosion. Construction of the tunnel and transition stations would incrementally decrease the potential of construction triggered landslides due to the decreased number of construction sites along potentially unstable slopes underlain by landslide prone Puente Formation. These impacts and their associated mitigation measures that fall under Criterion GEO3 are summarized in the following paragraphs. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are similar but have greater potential for significant impact than Alternative 2.

Impact G-2 (Erosion could be triggered or accelerated due to construction activities) would be greater under Alternative 5 than it would be for Alternative 2 (please see Section 3.7.6.1). The proposed underground portion of Alternative 5 and the associated transition stations are located along moderate to gentle hillside areas on the eastern slopes of the Chino Hills on soils with severe to very severe erosion potential. Alternative 5 would require the excavation and grading of large transition stations at either side of the underground portion (approximately 1.8 acres each), resulting in a slightly greater potential for erosion along Alternative 5 due to the smaller amount of ground disturbance that would be required for construction of the towers for the equivalent section of Alternative 2. Therefore, there is substantial potential for erosion caused by construction. The remaining portion of Alternative 5 is identical to Alternative 2 and the potential of erosion triggered or accelerated due to construction activities is the same as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits). With implementation of this measure, as described in Section 3.7.6.1, Impact G-2 of Alternative 5 would be less than significant (Class II).

Impact G-3 (Excavation and grading during construction activities could cause slope instability or trigger landslides) for Alternative 5 would be incrementally less than it would be for Alternative 2 (see Section 3.7.6.1). Although Alternative 5 is located in hillside areas with mapped landslides and substantial potential for slope failure identical to the equivalent portion of Alternative 2, the tunneling required to complete the underground installation of transmission lines for Alternative 5 would bypass slopes underlain by potentially unstable Puente Formation where tower foundations would otherwise be constructed, thus decreasing the potential that Project excavation would result in slope instability or landslides along the underground portion of the alignment. The remaining portion of Alternative 5 is identical to Alternative 2 and the potential of slope failure or triggered landslides due to construction activities is the same as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). With implementation of this measure, as described in Section 3.7.6.1, Impact G-3 of Alternative 5 would be less than significant (Class II).

Exposure to potential risk of loss or injury due to earthquake-related ground rupture (Criterion GEO4)

Impacts associated with Criterion GEO4 for Alternative 5 would be the same as impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-4 (Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards) would be similar for Alternative 5 as it would be for Alternative 2 (see Section 3.7.6.1). The trend to the active Chino fault, see Figure 3.7-10, potentially places the fault within or adjacent to the planned location for the eastern transition station for the underground portion of Alternative 5, which results in a potential for damage at these facilities due to surface fault rupture. The remainder of the Alternative 5 alignment would be identical to Alternative 2 and have the same fault rupture impacts. Therefore, at the eastern transition station and along the portions of Alternative 5 corresponding to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), Whittier (Segment 8A), and Chino-Central Ave (Segment 8A) faults, implementation of Mitigation Measures G-4a (Minimize Project structures within active fault zones) would be required to reduce potential impacts to less than significant (Class II).

Additionally, the portions of the Alternative 5, equivalent to the Segments 11 and 8A where the routes cross and then run parallel to and within the Sierra Madre and Whittier fault zones, respectively, are at substantial risk of damage to multiple structures should an earthquake and ground rupture occur along these portions of the respective faults. Implementation of Mitigation Measure G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines) is recommended for Segments 11 and 8A where they cross and run parallel to and within the Sierra Madre and Whittier fault zones, respectively, is also recommended to reduce potential impacts to less than significant (Class II).

Exposure to potential risk of loss or injury due to seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking (Criterion GEO5)

Impacts associated with Criterion GEO5 for Alternative 5 would be the same as impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, except for the underground portion of Alternative 5. The impact and associated mitigation measure that is the same as Alternative 2 and that falls under Criterion GEO5 is summarized in the following paragraph. Construction of the underground portion of Alternative 5 would introduce one new impact related to the deep excavations for the transition stations and tunneling for the underground transmission line, Impact G-9 (Existing structures could be damaged by ground settlement along the tunnel exposing people or structures to hazards).

Impact G-5 (Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards) would be the same under Alternative 5 as it would be for Alternative 2 (see Section 3.7.6.1). The potential for strong to severe groundshaking, liquefaction, and earthquake induced slope failures along Alternative 5 are identical to Alternative 2 (see Section 3.7.6.1). Local strong to severe groundshaking may occur along the Alternative 5 alignment that corresponds to portions of Segments 4, 5, 6, 7, 9, and 11 and would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking). Portions of Alternative 5 equivalent to the portions of Segments 5, 7, 11, 8A, 8B, and 8C that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams would require implementation of Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction). Portions of Alternative 5 equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 5 to less than significant (Class II).

Impact G-9: Existing structures could be damaged by ground settlement along the tunnel exposing people or structures to hazards.

Short term (days) and long term (years) settlement of the ground surface could occur during construction and operation of the tunnel and shafts of Alternative 5. There is potential for tunneling activities to encounter unstable geologic units or cause geologic units to become unstable and cause local subsidence and settlement of the overlying ground surface and result in damage to structures adjacent to the alignment. Tunneling through the unconsolidated alluvium from approximately MP S8A-24.5 to 25.5 could encounter flowing or running sands although the use of an earth-pressure balance tunnel boring machine (EPB TBM) or slurry-pressure balance machine (SPB TBM) to create a pressurized-face will effectively control rapid or excessive inflows. Similarly, excavation of the large eastern access shaft in saturated unconsolidated alluvium could encounter soft sediment or flowing sands. The access shaft excavation will be advanced as the permanent shoring is set and grouted to prevent entry of groundwater. This approach would effectively control inflows and limit the amount of ground settlement around the perimeter of the shaft. Excavation of the tunnel and shafts in the Tertiary age bedrock of eastern Chino Hills (MP S8A-21.9 to 24.5) is not anticipated to cause ground settlement and the use of a conventional (non-pressure balance) TBM may be adequate.

Subsidence caused by dewatering during construction would not occur as dewatering is not expected due to the use of a pressure-face TBM. Dewatering is also not anticipated at the shafts, which would use water-tight boxes.

Post-construction or operational settlement, including seismically-induced, could occur locally due to a loss of soil strength resulting from the tunneling process. Advancement of the TBM in full-pressure mode will not result in loss of soil strength above or around the tunnel. The project specifications will require that the contractor conduct the tunneling process under pressure at all times to prevent soil loss and the development of narrow chimneys that may migrate to the surface. Maintaining the soil properties will not increase the potential for seismically-induced settlements which existed before tunneling. Although settlement of the ground surface is estimated to be low due to the construction method (EPB or SPB TBM), an analysis of the settlement will be completed during final design.

Mitigation Measure for Impact G-9

G-9 Conduct geotechnical analysis of settlement potential during design and implement a Subsidence Monitoring Program during construction to protect against ground settlement. The potential for ground subsidence to occur during tunneling should be identified during design, and will identify Project-specific trigger levels that would require corrective action should subsidence occur. The settlement analysis would evaluate conditions along the tunnel alignment and at and adjacent to the proposed access shafts. Development and implementation of a Subsidence Monitoring Program is standard practice during construction of large diameter tunnels and access shafts in urban areas. As determined to be necessary, SCE or the tunnel contractor shall implement a subsidence monitoring program during shaft excavation and tunneling to detect subsidence, including measurements of groundwater levels, surface and subsurface settlement, ground movement and displacement, and movement in existing infrastructure as needed. SCE or the contractor will implement corrective actions, such as additional advance grouting or increased tunnel support, if measured displacement reaches the specified trigger levels. In addition, the Project specifications will require that the contractor conduct the tunneling process under pressure at all times to prevent soil loss and the development of narrow chimneys that may migrate to the surface. The results of the geotechnical analysis of settlement, Subsidence Monitoring Plan, and the relevant construction specifications shall be provided to the CPUC for review and approval at least 60 days prior to the start of construction (shaft excavation).

CEQA Significance Conclusion

During final design of the transition station facilities, access shafts, ventilation shafts, and tunnel of the Partial Underground Alternative, SCE shall conduct geotechnical analyses of the settlement potential, develop tunnel specifications, and develop and implement a Subsidence Monitoring Program to limit the amount of ground settlement. Implementation of Mitigation Measure G-9 (Conduct geotechnical analysis of settlement potential and implement Subsidence Monitoring Program), adds specific requirements to the planned geotechnical investigations to be completed prior to final Project design, such as implementing standard design procedures, selection of the most effective TBM method, and preparation of a Subsidence

Monitoring Program. These specific requirements would ensure that potentially significant impacts from ground settlement along the Alternative 5 route are reduced to less-than-significant levels (Class II).

Exposure to potential risk of loss or injury where corrosive soils or other unsuitable soils are present (Criterion GEO6)

Impacts associated with Criterion GEO6 for Alternative 5 would be identical to those associated with this criterion for Alternative 2, as described in Section 3.7.6.1, and there would be no change in the potential for damage to Project structures due to unsuitable soils. This impact and its associated mitigation measure that falls under Criterion GEO6 are summarized in the following paragraphs.

Impact G-6 (Project structures could be damaged by problematic soils exposing people or structures to hazards) would be the same for Alternative 5 as the alignment crosses the same soil types as the Alternative 2 alignment. Soils along the alignment have a potential to corrode steel and concrete ranging from low to high and expansion potential ranging from low to high. Corrosive and/or expansive soils can cause damage to structure foundations, potentially resulting in collapse of the structure, a significant impact (see Section 3.7.6.1). Therefore Alternative 5 would require implementation of Mitigation Measure G-6 (Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Damage to Project structures due to slope failure (Criterion GEO7)

Impacts associated with Criterion GEO7 for Alternative 5 would be incrementally less than it would be for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-7 (Transmission line structures could be damaged by landslides, earth flow, or debris flows, during operation) would be the incrementally less than it would be for Alternative 2 (see Section 3.7.6.1). Although Alternative 5 is located in hillside areas with mapped landslides and substantial potential for slope failure identical to the equivalent portion of Alternative 2, the tunneling required to complete the underground installation of transmission lines for Alternative 5 would bypass slopes underlain by potentially unstable Puente Formation where tower foundations would otherwise be constructed, thus decreasing the potential that slope instability or landslides could damage Project facilities along the underground portion of the alignment The remaining portion of Alternative 5 is identical to Alternative 2 and the potential for failure of existing unstable slope or landslides during operation of the Project is the same as presented in Section 3.7.6.1, and would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). With implementation of this measure, as described in Section 3.7.6.1, Impact G-7 of Alternative 5 would be less than significant (Class II).

Destruction of unique paleontological resources (Criterion GEO8)

Impacts associated with Criterion GEO8 for Alternative 5 would be greater than the impacts associated with this criterion for Alternative 2. The underground construction would result in greater ground disturbance with the paleontologically sensitive Puente Formation as compared to Alternative 2 and would result in increased opportunity to destroy scientifically important paleontologic resources. Impact G-8 (Grading and excavation could destroy paleontologic resources) would be greater under Alternative 5 than it would be for Alternative 2 (please see Section 3.7.6.1) due to the greater amount of ground disturbance. Although construction could disturb unique paleontologic resources, as with Alternative 2 application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant, resulting in no change in the potential for Impact G-8 to occur. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 5 would be less than significant (Class III).

3.7.9.2 Cumulative Effects Analysis

This section addresses potential cumulative effects that would occur as a result of implementation of Alternative 5. This alternative would utilize underground construction in place of the proposed overhead line construction following generally the same routes as the proposed Project. New underground facilities would replace existing aboveground facilities, and transition stations would be required at each end of an underground segment to transfer the transmission lines from overheard to underground and vice versa.

This alternative was developed to provide less visual impact in residential areas. The remainder of this alternative route (which totals approximately 159 miles) would be identical to that of the proposed Project and would, therefore, result in substantially similar or identical impacts as the proposed Project. As a result, this alternative traverses the same or similar land uses as the portion of the proposed Project route it is proposed to replace, would require the same types of construction activities to build (in addition to utilizing underground construction techniques), and would result in the same operational capacity as the proposed Project.

Based on the substantial similarity of Alternative 5 to the proposed Project, this alternative's contribution to cumulative impacts would be similar or identical to that of the proposed Project. However, when compared to the proposed Project, each alternative's contribution to certain cumulative impacts may be incrementally increased or decreased as a result of the change in construction (underground versus overhead). Such increases or decreases would result from:

- The nature of the alternative (e.g., underground or overhead);
- The location of the alternative with respect to land uses and specific resources; or
- The location of past, present, or reasonably foreseeable projects with which impacts of the alternative route would have the potential to combine (i.e., the other projects are located such that their impacts would or would not combine with impacts of the alternative, as compared to the proposed Project).

Geographic Extent

The geographic extent for the analysis of cumulative impacts related to geology, soils, and paleontology is limited to the Project site and the immediate vicinity surrounding Project substations, laydown areas, and the transmission line ROWs occupied by the proposed alignment. These geographic limits are appropriate to consider the potential cumulative impacts as the geologic materials and terrain at the Project site and directly adjacent to the Project site are the most significant factors to evaluate the potential for geologic hazards, unsuitable soil and paleontologic resources at a project site. Impacts would have the potential to occur during construction and operation and would be limited to the areas where concurrent construction is occurring. The geographic extent for Alternative 5 is identical to that of the proposed Project, as presented in Section 3.7.6.2.

Existing Cumulative Conditions

The existing cumulative conditions of Alternative 5 are identical to the proposed Project as discussed in Section 3.7.6.2.

Reasonably Foreseeable Future Projects and Changes

Reasonably foreseeable future projects and changes to the cumulative scenario for Alternative 5 would be exactly the same as Alternative 2, described in Section 3.7.6.2.

Cumulative Impact Analysis

As discussed for the proposed Project in Section 3.7.6.2, Impacts G-1 through G-3 of Alternative 5 would not have the potential to combine with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2. Impacts G-4 through G-9 for Alternative 5 would combine but not be cumulatively significant (Class III) with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2.

Mitigation to Reduce the Project's Contribution to Significant Cumulative Effects

Mitigation measures introduced for the proposed Project in Section 3.7.6.1 (Direct and Indirect Effects Analysis) would help to reduce Alternative 5's incremental contribution to cumulative impacts. However, there are no impacts or significant cumulative effects of Alternative 5 related to geology, soils, and paleontology and no additional mitigation is required.

3.7.10 Alternative 6: Maximum Helicopter Construction in the ANF Alternative

3.7.10.1 Direct and Indirect Effects Analysis

The significance criteria used to identify geology, soils, and paleontology impacts are introduced in Section 3.7.4.1 (Criteria for Determining Impact Significance). Impacts associated with this alternative are presented below under the applicable significance criterion.

As summarized below, the impacts and mitigation measures for Alternative 6 would be substantially the same as those for Alternative 2, with minor differences in the potential impacts to occur due to the differing amounts of ground disturbance required for each alternative. Although Alternative 6 would be installed along Segment 6 and Segment 11 in the ANF using maximum helicopter construction, the route of the transmission line and tower locations for Alternative 6 would be identical to those of Alternative 2 and would therefore be within the same geologic materials and terrain. However, the increased use of helicopter construction would require construction of 11 helicopter staging areas and would reduce the number of access and spur roads that would need to be created or graded resulting in slightly less ground disturbance than required for the equivalent portions of Alternative 2. Therefore, the potential for some geology, soils, and paleontology impacts to occur would be incrementally decreased compared to Alternative 2.

Unique geologic features (Criterion GEO1)

No unique geologic features or geologic features of unusual scientific value for study or interpretation exist at any of the helicopter stating areas or along the transmission line route, and therefore none would be disturbed or otherwise adversely affected by Alternative 6. No impact would occur.

Known mineral and/or energy resources (Criterion GEO2)

Impacts associated with Criterion GEO2 for Alternative 6 would be the same as impacts associated with this criterion for the proposed Project, as presented in Section 3.7.6.1, and summarized below.

Impact G-1 (Project activities could interfere with access to known energy resources) would be the same as that identified for Alternative 2. Therefore, where the portions of Alternative 6 equivalent to Segments 7, 8, and 11 would cross the Montebello oil field and where the Segment 8 equivalent would cross the northern edge of the Brea-Olinda oil field, there is a potential for Project construction activities to interfere with oil field operations. Impact G-1, as described in Section 3.7.6.1, for Alternative 6 would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Triggering or acceleration of geologic processes, such as landslides, soil erosion, or loss of topsoil, during construction (Criterion GEO3)

Impacts associated with Criterion GEO3 for Alternative 6 would be less than the impacts associated with this criterion for Alternative 2. Although this alternative would require ground disturbance and grading for 10 helicopter staging areas through the ANF, the associated decrease in grading required for fewer access and spur roads would result in slightly less ground disturbance compared to Alternative 2. This would result in incrementally decreased opportunity to cause construction triggered erosion and landslides. These impacts and their associated mitigation measures that fall under Criterion GEO3 are summarized in the following paragraphs. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are similar but have less potential for significant impact than Alternative 2.

Impact G-2 (Erosion could be triggered or accelerated due to construction activities) would be slightly less under Alternative 6 than it would be for Alternative 2 (please see Section 3.7.6.1). The maximum helicopter construction along Segment 6 and Segment 11 through the ANF would require construction of 10 helicopter staging areas but would reduce the number of access and spur roads that would need to be created or upgraded, which would require less overall ground disturbance in soils that have a hazard of erosion ranging from slight to severe. Therefore, there is incrementally less potential for erosion caused by construction in the ANF portion of Segment 6 and Segment 11 under Alternative 6. The remaining portion of Alternative 6 is identical to Alternative 2 and the potential of erosion triggered or accelerated due to construction activities is the same as presented in Section 3.7.6.1. Construction of Alternative 6 would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits). With implementation of this measure, as described in Section 3.7.6.1, Impact G-2 of Alternative 6 would be less than significant (Class II).

Impact G-3 (Excavation and grading during construction activities could cause slope instability or trigger landslides) for Alternative 6 would be incrementally less than it would be for Alternative 2 (see Section 3.7.6.1). The maximum helicopter construction along Segment 6 and Segment 11 through the ANF would require construction of 10 helicopter staging areas but would reduce the number of access and spur roads that would need to be created or upgraded, which would require less overall ground disturbance in steep mountainous terrain, which would decrease the potential for construction related slope instability or landslides. The remaining portion of Alternative 6 is identical to Alternative 2 and the potential of slope failure or triggered landslides due to construction activities is the same as presented in Section 3.7.6.1. Construction of Alternative 6 would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) along the transmission line corridors, and at all sites or access roads that would require grading. With implementation of this measure, as described in Section 3.7.6.1, Impact G-3 of Alternative 6 would be less than significant (Class II).

Exposure to potential risk of loss or injury due to earthquake-related ground rupture (Criterion GEO4)

Impacts associated with Criterion GEO4 for Alternative 6 would be the same as impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-4 (Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards) would be the same for Alternative 6 as it would be for Alternative 2 (see Section 3.7.6.1). Therefore, the portions of Alternative 6 corresponding to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), Whittier (Segment 8A), and Chino-Central Ave (Segment 8A) faults would require implementation of Mitigation Measure G-4a (Minimize Project structures within active fault zones). Additionally, portions of Alternative 6 equivalent to portions of Segment 11 and Segment 8A that cross and then run parallel to and within the Sierra Madre and Whittier fault zones, respectively, are at substantial risk of damage to multiple structures should an earthquake and ground rupture occur along these portions of the respective faults. Implementation of Mitigation Measure G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines) is recommended for Segments 11 and 8A where they cross and run parallel to and within the Sierra Madre and Whittier fault zones, respectively. Implementation of these mitigation measures is recommended to reduce potential impacts to less than significant (Class II).

Exposure to potential risk of loss or injury due to seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking (Criterion GEO5)

Impacts associated with Criterion GEO5 for Alternative 6 would be the same as impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-5 (Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards) would be the same under Alternative 6 as it would be for Alternative 2 (see Section 3.7.6.1). The potential for strong to severe groundshaking, liquefaction, and earthquake induced slope failures along Alternative 6 is identical to Alternative 2 (see Section 3.7.6.1). Local strong to severe groundshaking may occur along the Alternative 6 alignment that corresponds to portions of Segments 4, 5, 6, 7, 9, and 11 and would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking). Portions of Alternative 6 equivalent to the portions of Segments 5, 7, 11, 8A, 8B, and 8C that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams would require implementation of Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction). Portions of Alternative 6 equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 6 to less than significant (Class II).

Exposure to potential risk of loss or injury where corrosive soils or other unsuitable soils are present (Criterion GEO6)

Impacts associated with Criterion GEO6 for Alternative 6 would be identical to those associated with this criterion for Alternative 2, as described in Section 3.7.6.1, and there would be no change in the potential for damage to Project structures due to unsuitable soils. This impact and its associated mitigation measure are summarized in the following paragraphs.

Impact G-6 (Project structures could be damaged by problematic soils exposing people or structures to hazards) would be the same for Alternative 6 as the alignment crosses the same soil types as the Alternative 2 alignment. Soils along the alignment have a potential to corrode steel and concrete ranging from low to high and expansion potential ranging from low to high. Corrosive and/or expansive soils can cause damage to structure foundations, potentially resulting in collapse of the structure, a significant impact (see Section 3.7.6.1). Therefore Alternative 6 would require implementation of Mitigation Measure G-6 (Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Damage to Project structures due to slope failure (Criterion GEO7)

Impacts associated with Criterion GEO7 for Alternative 6 would be the same as the impacts associated with this criterion for the proposed Project (Alternative 2). Although the maximum helicopter construction along Segment 6 and Segment 11 through the ANF would require construction of 10 helicopter staging areas and would reduce the number of access and spur roads that would need to be created or upgraded in the steep mountainous terrain, the permanent transmission line structures would be the same as Alternative 2, which would result in no change to the potential for slope instability or landslides to damage Project structures during operation of the Project. Therefore the potential impact to transmission line facilities for Alternative 6 is the same as that presented in Section 3.7.6.1 for Alternative 2. This impact and its associated mitigation measure that falls under Criterion GEO3 are summarized in the following paragraph. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are the same as Alternative 2.

Impact G-7 (Transmission line structures could be damaged by landslides, earth flow, or debris flows, during operation) would be the same for Alternative 6 as it would be for Alternative 2 (see Section 3.7.6.1). The transmission line portion of Alternative 6 is identical to Alternative 2 and the potential for failure of existing unstable slope or landslides during operation of the Project is the same as presented in Section 3.7.6.1. Alternative 6 would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) in hillside and mountainous areas. With implementation of this measure, as described in Section 3.7.6.1, Impact G-7 of Alternative 6 would be less than significant (Class II).

Destruction of unique paleontological resources (Criterion GEO8)

Impacts associated with Criterion GEO8 for Alternative 6 would be the same as the impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-8 (Grading and excavation could destroy paleontologic resources) would be the same under Alternative 6 as it would be for Alternative 2 (please see Section 3.7.6.1). Although construction of the ANF portions of Segment 6 and Segment 11 would result in less ground disturbance, the areas of decreased ground disturbance would be located primarily within non-fossiliferous igneous and metamorphic rock, which would result in no change in potential impact to paleontologic resources compared to Alternative 2. The other portions of Alternative 6 have the same potential to disturb paleontologic resources as the corresponding portions of Alternative 2 (see Section 3.7.6.1). Although construction could disturb unique paleontologic resources, as with Alternative 2, application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 6 would be less than significant (Class III).

3.7.10.2 Cumulative Effects Analysis

This section addresses potential cumulative effects that would occur as a result of implementation of Alternative 6. This alternative would require construction of 10 helicopter staging areas near to the transmission line routes. As a result of the increased helicopter construction, implementation of Alternative 6 would reduce the number of access and spur roads that would need to be created or upgraded, but would still follow the same transmission route as the proposed Project. As a result, this alternative would traverse the same geologic materials as the portion of the proposed Project route it is proposed to replace, would require similar types of construction activities to build, (although use of helicopter construction would be increased), and would result in the same operational capacity as the proposed Project.

Based on the substantial similarity of Alternative 6 to the proposed Project, this alternative's contribution to cumulative impacts would be similar or identical to that of the proposed Project. However, when compared to the proposed Project, each alternative's contribution to certain cumulative impacts may be incrementally increased or decreased as a result of the change in construction (underground versus overhead). Such increases or decreases would result from:

- The nature of the alternative (e.g., underground or overhead);
- The location of the alternative with respect to land uses and specific resources; or
- The location of past, present, or reasonably foreseeable projects with which impacts of the alternative route would have the potential to combine (i.e., the other projects are located such that their impacts would or would not combine with impacts of the alternative, as compared to the proposed Project).

Geographic Extent

The geographic extent for the analysis of cumulative impacts related to geology, soils, and paleontology is limited to the Project site and the immediate vicinity surrounding Project substations, laydown areas, staging sites, and the transmission line ROWs occupied by the proposed alignment. These geographic limits are appropriate to consider the potential cumulative impacts as the geologic materials and terrain at the Project site and directly adjacent to the Project site are the most significant factors to evaluate the potential for geologic hazards, unsuitable soil and paleontologic resources at a project site. Impacts would have the potential to occur during construction and operation and would be limited to the areas where concurrent construction is occurring. The geographic extent for Alternative 6 is identical to that of the proposed Project, as presented in Section 3.7.6.2.

Existing Cumulative Conditions

The existing cumulative conditions of Alternative 6 are identical to the proposed Project as discussed in Section 3.7.6.2.

Reasonably Foreseeable Future Projects and Changes

Reasonably foreseeable future projects and changes to the cumulative scenario for Alternative 6 would be exactly the same as Alternative 2, described in Section 3.7.6.2.

Cumulative Impact Analysis

As discussed for the proposed Project in Section 3.7.6.2, Impacts G-1 through G-3 of Alternative 6 would not have the potential to combine with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2. Impacts G-4 through G-8 for Alternative 6 would combine but not be cumulatively significant (Class III) with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2.

Mitigation to Reduce the Project's Contribution to Significant Cumulative Effects

Mitigation measures introduced for the proposed Project in Section 3.7.6.1 (Direct and Indirect Effects Analysis) would help to reduce the incremental contribution of Alternative 6 to cumulative impacts. However, there are no impacts or significant cumulative effects of Alternative 6 related to Geology, Soils, and Paleontology and no additional mitigation is required.

3.7.11 Alternative 7: 66-kV Subtransmission Alternative

3.7.11.1 Direct and Indirect Effects Analysis

The significance criteria used to identify geology, soils, and paleontology impacts are introduced in Section 4.1 (Criteria for Determining Impact Significance). Impacts associated with this alternative are presented below under the applicable significance criterion.

As summarized below, the impacts and mitigation measures for Alternative 7 would be the same as those for Alternative 2. Although Alternative 7 would include minor re-routes of three 66-kV subtransmission line elements along portions of Segment 7 and Segment 8A, these re-routes are so close to the Alternative 2 route that the geologic materials, terrain, and seismic setting for this alternative would be identical to that of Alternative 2. However, the underground construction for the 1.625 miles of 66-kV subtransmission line would incrementally increase the amount of ground disturbance than that required for the equivalent portions of Alternative 2. Therefore, the potential for some geology, soils, and paleontology impacts to occur would be incrementally increased compared to Alternative 2.

Unique geologic features (Criterion GEO1)

No unique geologic features or geologic features of unusual scientific value for study or interpretation would be disturbed or otherwise adversely affected by Alternative 7. No impact would occur.

Known mineral and/or energy resources (Criterion GEO2)

Impacts associated with Criterion GEO2 for Alternative 7 would be the same as impacts associated with this criterion for the proposed Project, as presented in Section 3.7.6.1 and summarized below.

Impact G-1 (Project activities could interfere with access to known energy resources) would be the same as that identified for Alternative 2. Therefore, where the portions of the Alternative 7 equivalent to Segments 7, 11, and 8 would cross the Montebello oil field and where the Segment 8 equivalent would cross the northern edge of the Brea-Olinda oil field, there is a potential for Project construction activities to interfere with oil field operations. Impact G-1, as described in Section 3.7.6.1, for Alternative 7 would require implementation of Mitigation Measure G-1 (Coordination with oil field operations) to reduce potential impacts to less than significant (Class II).

Triggering or acceleration of geologic processes, such as landslides, soil erosion, or loss of topsoil, during construction (Criterion GEO3)

Impacts associated with Criterion GEO3 for Alternative 7 would be slightly increased compared to those identified for this criterion for Alternative 2. This alternative would require ground disturbance for construction of the underground portions of the 66-kV re-routes, including excavation for trenches and vaults, and for construction of several new poles for portions of the Whittier Narrows 66-kV Overhead Re-Route. This would result in an incrementally increased potential to result in construction triggered erosion. No increase in the potential to cause construction triggered landslides would occur with this alternative due to the primarily flat terrain in areas where additional ground disturbance would occur. These impacts and their associated mitigation measures that fall under Criterion GEO3 are summarized in the following paragraphs. Please see Section 3.7.6.1 (Direct and Indirect Effects Analysis) for a detailed description of these impacts, as they are similar but have less potential for significant impact than Alternative 2.

Impact G-2 (Erosion could be triggered or accelerated due to construction activities) would be slightly increased under Alternative 7 than it would be for Alternative 2 (please see Section 3.7.6.1). This alternative would require ground disturbance for construction of the two underground 66-kV re-routes, including excavation for trenches and vaults, and for construction of several new poles for portions of the Whittier Narrows 66-kV Overhead re-route in areas with soils that have hazard of erosion ranging from slight to severe. This would result in incrementally increased opportunity to cause construction triggered erosion. Therefore, there is incrementally more potential for erosion caused by construction of the 66-kV re-routes under Alternative 7. The remaining portion of Alternative 7 is identical to Alternative 2 and the potential of erosion triggered or accelerated due to construction activities is the same as presented in Section 3.7.6.1. Construction of Alternative 7 would require implementation of Mitigation Measure H-1a (Implement an Erosion Control Plan and demonstrate compliance with water quality permits). With implementation of this measure, as described in Section 3.7.6.1, Impact G-2 of Alternative 7 would be less than significant (Class II).

Impact G-3 (Excavation and grading during construction activities could cause slope instability or trigger landslides) for Alternative 7 would be the same as it would be for Alternative 2 (see Section 3.7.6.1). Ground disturbance required for the 66-kV re-routes of Alternative 7 would occur in flat terrain and would therefore not change the potential for construction triggered landslides to occur, thus Alternative 7 is identical to Alternative 2 in respect to the potential of slope failure or triggered landslides due to construction activities. Construction of Alternative 7 would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) along the transmission line corridors, and all at all sites or access roads that would require grading. With implementation of this measure, as described in Section 3.7.6.1, Impact G-3 of Alternative 7 would be less than significant (Class II).

Exposure to potential risk of loss or injury due to earthquake-related ground rupture (Criterion GEO4)

Impacts associated with Criterion GEO4 for Alternative 7 would be the same as impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

The re-routed and underground portions of Alternative 7 are located the same distance from active faults as the equivalent portions of Alternative 2. Therefore, Impact G-4 (Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards) would be the same for Alternative 7 as it would be for Alternative 2 (see Section 3.7.6.1). Therefore, implementation of Mitigation Measure G-4a (Minimize Project structures within active fault zones) would be required for the portions of Alternative 7 corresponding to Segments 5, 6, 7, 11, and 8A where it crosses the active San Andreas (Segment 5), San Gabriel, (Segments 6 and 11), Clamshell-Sawpit (Segment 6), Sierra Madre (Segments 7 and 11), Raymond (Segment 11), East Montebello Hills (Segment 11), Whittier (Segment 8A), and Chino-Central Ave (Segment 8A) faults. Additionally, portions of Alternative 7 equivalent to portions of Segment 11 and Segment 8A that cross and then run parallel to and within the Sierra Madre and Whittier fault zones, respectively, are at substantial risk of damage to multiple structures should an earthquake and ground rupture occur along these portions of the respective faults. Implementation of Mitigation Measure G-4b (Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines) is recommended for Segment 11 and Segment 8A where they cross and run parallel to and within the Sierra Madre and Whittier fault zones, respectively. Implementation of these mitigation measures would reduce potential impacts to less than significant (Class II).

Exposure to potential risk of loss or injury due to seismically induced ground shaking, landslides, liquefaction, settlement, lateral spreading, and/or surface cracking (Criterion GEO5)

Impacts associated with Criterion GEO5 for Alternative 7 would be the same as impacts associated with this criterion for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-5 (Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards) would be the same under Alternative 7 as it would be for Alternative 2 (see Section 3.7.6.1). The potential for strong to severe groundshaking, liquefaction, and earthquake induced slope failures along Alternative 7 is identical to that of Alternative 2 (see Section 3.7.6.1). Local strong to severe groundshaking may occur along the Alternative 7 alignment along Segments 4, 5, 6, 7, 9, and 11 and would require implementation of Mitigation Measure G-5a (Reduce effects of groundshaking). Portions of Alternative 7 equivalent to the portions of Segments 5, 7, 11, 8A, 8B, and 8C that cross young alluvial deposits in the Leona Valley, San Gabriel Valley, and active river washes and streams would require implementation of Mitigation Measure G-5b (Conduct geotechnical investigations for liquefaction). Portions of Alternative 7 equivalent to Segments 5, 6, 11, and 8A where they are located along hillsides or ridgelines in geologic units of moderate to steep slopes that are susceptible to slope failures would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability). Implementation of these measures, as described in Section 3.7.6.1, would reduce Impact G-5 of Alternative 7 to less than significant (Class II).

Exposure to potential risk of loss or injury where corrosive soils or other unsuitable soils are present (Criterion GEO6)

Impacts associated with Criterion GEO6 for Alternative 7 would be identical to those associated with this criterion for Alternative 2, as described in Section 3.7.6.1, and there would be no change in the potential for damage to Project structures due to unsuitable soils. This impact and its associated mitigation measure that falls under Criterion GEO6 are summarized below.

Impact G-6 (Project structures could be damaged by problematic soils exposing people or structures to hazards) would be the same for Alternative 7 as it would be for Alternative 2 because this alignment would cross the same soil types as the Alternative 2 alignment. Soils along the alignment have a potential to corrode steel and concrete ranging from low to high and expansion potential ranging from low to high. Corrosive and/or expansive soils can cause damage to structure foundations, potentially resulting in collapse of the structure, which would be a significant impact (see Section 3.7.6.1). Therefore Alternative 7 would require implementation of Mitigation Measure G-6 (Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design), as described in Section 3.7.6.1, to reduce impacts to less than significant (Class II).

Damage to Project structures due to slope failure (Criterion GEO7)

Impacts associated with Criterion GEO7 for Alternative 7 would be the same as impacts associated with this criterion for the proposed Project (Alternative 2). New structures and facilities constructed for the 66-kV re-routes would be located in flat terrain and would not be subject to slope stability issues. Therefore the potential impact to transmission line facilities is the same as that identified for Alternative 2, as presented in Section 3.7.6.1, and summarized below.

Impact G-7 (Transmission line structures could be damaged by landslides, earth flow, or debris flows, during operation) would be the same for Alternative 7 as it would be for Alternative 2 (see Section 3.7.6.1). With the exception of the minor 66-kV re-routes, Alternative 7 is identical to Alternative 2 and the potential for failure of existing unstable slopes or landslides during operation of the Project is the same as presented in Section 3.7.6.1. Therefore, Alternative 7 would require implementation of Mitigation Measure G-3 (Conduct geological surveys for landslides and protect against slope instability) in hillside and mountainous areas. With implementation of this measure, as described in Section 3.7.6.1, Impact G-7 of Alternative 7 would be less than significant (Class II).

Destruction of unique paleontological resources (Criterion GEO8)

Impacts associated with Criterion GEO8 for Alternative 7 would be similar to the impacts associated with this criterion for Alternative 2, as described in Section 3.7.6.1, and summarized below.

Impact G-8 (Grading and excavation could destroy paleontologic resources) would be slightly increased under Alternative 7 compared to Alternative 2 (please see Section 3.7.6.1). Due to the slight increase in ground disturbance associated with excavation of trenches and vaults for the two underground 66-kV re-routes of Alternative 7, this alternative would result in a corresponding increase in the potential for disturbing paleontologic resources during construction compared to Alternative 2. The other portions of Alternative 7 would have the same potential to disturb paleontologic resources as the corresponding portions of Alternative 2 (see Section 3.7.6.1). Although construction could disturb unique paleontologic resources, as with Alternative 2, application of SCE's planned APMs would reduce the potential for destruction of these resources to less than significant, resulting in no change in the potential for Impact G-8 to occur. With implementation of these APMs, as described in Section 3.7.6.1, Impact G-8 of Alternative 7 would be less than significant (Class III).

3.7.11.2 Cumulative Effects Analysis

This section addresses potential cumulative effects that would occur as a result of implementation of Alternative 7. The re-routed portions of Alternative 7 diverge only slightly from the proposed Project alignments and therefore have the same geologic and seismic settings as the corresponding portions of the proposed Project. The remainder of this alternative route would be identical to that of the proposed

Project and would, therefore, result in substantially similar or identical impacts as the proposed Project. As a result, this alternative would traverse the same geologic materials as the portion of the proposed Project route it is proposed to replace, would require similar types of construction activities to build, and would result in the same operational capacity as the proposed Project.

Based on the substantial similarity of Alternative 7 to the proposed Project, this alternative's contribution to cumulative impacts would be similar or identical to that of the proposed Project. However, when compared to the proposed Project, each alternative's contribution to certain cumulative impacts may be incrementally increased or decreased as a result of the change in construction (underground versus overhead). Such increases or decreases would result from:

- The nature of the alternative (e.g., underground or overhead);
- The location of the alternative with respect to land uses and specific resources; or
- The location of past, present, or reasonably foreseeable projects with which impacts of the alternative route would have the potential to combine (i.e., the other projects are located such that their impacts would or would not combine with impacts of the alternative, as compared to the proposed Project).

Geographic Extent

The geographic extent for the analysis of cumulative impacts related to geology, soils, and paleontology is limited to the Project site and the immediate vicinity surrounding Project substations, laydown areas, staging sites, and the transmission line ROWs occupied by the proposed alignment. These geographic limits are appropriate to consider the potential cumulative impacts as the geologic materials and terrain at the Project site and directly adjacent to the Project site are the most significant factors to evaluate the potential for geologic hazards, unsuitable soil and paleontologic resources at a project site. Impacts would have the potential to occur during construction and operation and would be limited to the areas where concurrent construction is occurring. The geographic extent for Alternative 7 is identical to the proposed Project, as presented in Section 3.7.6.2.

Existing Cumulative Conditions

The existing cumulative conditions of Alternative 7 are identical to the proposed Project as discussed in Section 3.7.6.2.

Reasonably Foreseeable Future Projects and Changes

Reasonably foreseeable future projects and changes to the cumulative scenario for Alternative 7 would be exactly the same as Alternative 2, described in Section 3.7.6.2.

Cumulative Impact Analysis

As discussed for the proposed Project in Section 3.7.6.2, Impacts G-1 through G-3 of Alternative 7 would not have the potential to combine with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2. Impacts G-4 through G-8 for Alternative 7 would combine but not be cumulatively significant (Class III) with impacts of other past, present and reasonably foreseeable projects for the same reasons discussed in Section 3.7.6.2.

Mitigation to Reduce the Project's Contribution to Significant Cumulative Effects

Mitigation measures introduced for the proposed Project in Section 3.7.6.1 (Direct and Indirect Effects Analysis) would help to reduce Alternative 7's incremental contribution to cumulative impacts. However, there are no impacts or significant cumulative effects of Alternative 7 related to Geology, Soils, and Paleontology and no additional mitigation is required.

3.7.12 Impact Significance Summary

Table 3.7-11 summarizes the direct and indirect environmental impacts of the proposed Project (Alternative 2) and the other alternatives related to geology, soils, and paleontology. The direct and indirect effects of the Project and alternatives have been fully described in Sections 3.7.6 through 3.7.11 above. Alternative 1 (No Project/No Action) impacts are fully described in Section 3.7.5; however, since no potential future project information is available an impact significance level for Alternative 1 is not included in the table below.

Table 3.7-11. Summary of Impacts and Mitigation Measures – Geology, Soils, and Paleontology

Impact	Impact Significance								
	Alt. 1+	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	NFS Lands*	Mitigation Measures
G-1: Project activities could interfere with access to known energy resources.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	No	G-1: Coordination with oil field operations.
G-2: Erosion could be triggered or accelerated due to construction activities.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	Yes	H-1a: Implement an Erosion Control Plan and demonstrate compliance with water quality permits
G-3: Excavation and grading during construction activities could cause slope instability or trigger landslides.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	Yes	G-3: Conduct geological surveys for landslides and protect against slope instability.
G-4: Project structures could be damaged by surface fault rupture at crossings of active faults exposing people or structures to hazards.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	Yes	G-4a: Minimize Project structures within active fault zones. G-4b: Prepare fault rupture contingency plans to minimize repair time for damaged transmission lines.
G-5: Project structures could be damaged by seismically induced groundshaking and/or ground failure exposing people or structures to hazards.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	Yes	G-5a: Reduce effects of groundshaking. G-5b: Conduct geotechnical investigations for liquefaction. G-3. (See Impact G-3)
G-6: Project structures could be damaged by problematic soils exposing people or structures to hazards.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	Yes	G-6: Conduct geotechnical studies to assess soil characteristics and aid in appropriate foundation design.
G-7: Transmission line structures could be damaged by landslides, earth flows, or debris slides, during operation.	N/A	Class II	Class II	Class II	Class II	Class II	Class II	Yes	G-3 (See Impact G-3)
G-8: Grading and excavation could destroy paleontologic resources.	N/A	Class III	Class III	Class III	Class III	Class III	Class III	No	None recommended.

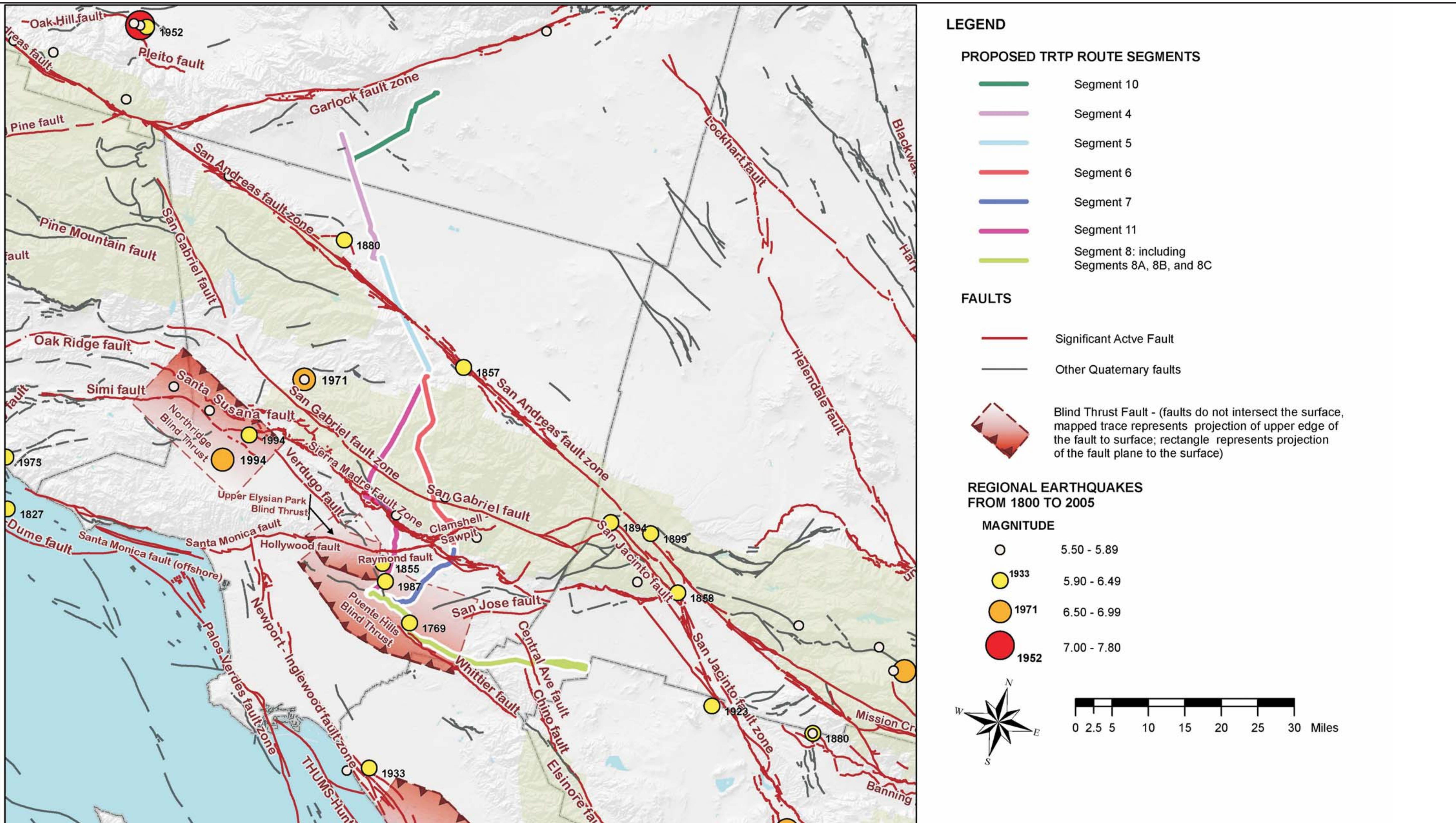
Table 3.7-11. Summary of Impacts and Mitigation Measures – Geology, Soils, and Paleontology

Impact	Impact Significance								
	Alt. 1+	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	NFS Lands*	Mitigation Measures
G-9: Existing structures could be damaged by ground settlement along the tunnel exposing people or structures to hazards.	N/A	N/A	N/A	N/A	Class II	N/A	N/A	No	G-9: Conduct geotechnical analysis of settlement potential during design and implement a Subsidence Monitoring Program during construction to protect against ground settlement.

N/A = Not Available

* Indicates whether this impact is applicable to the portion of the Project on National Forest System lands.

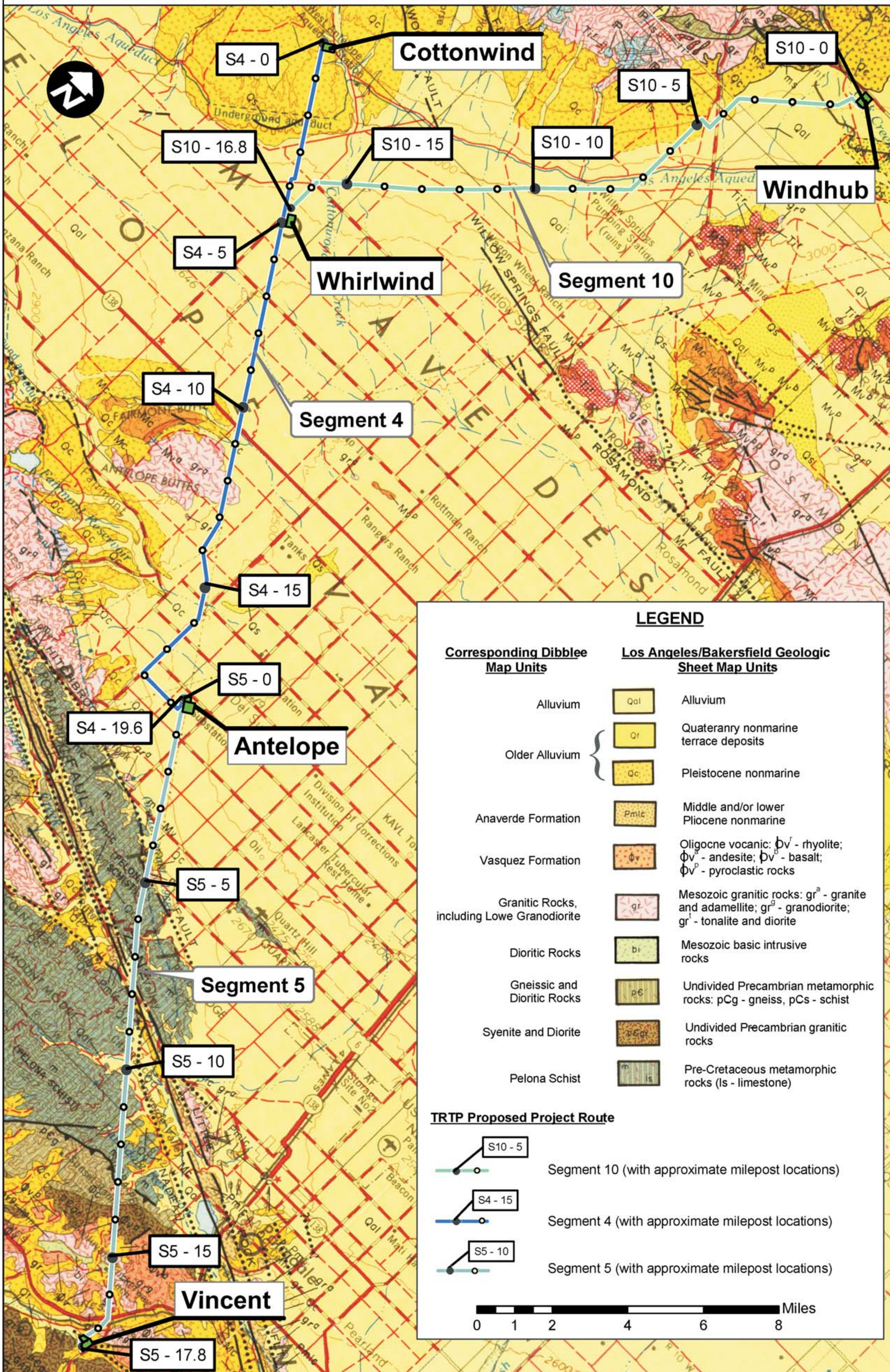
+ Potential projects would likely traverse the same geographic regions as either the proposed Project or Alternatives 3 through 7, and subsequently introduce similar types of impacts.



Source: GTC, 2008.

Figure 3.7-1

Regional Active Faults and Historic Earthquakes



Source: GTC, 2008.

Figure 3.7-2
Regional Geology Map A

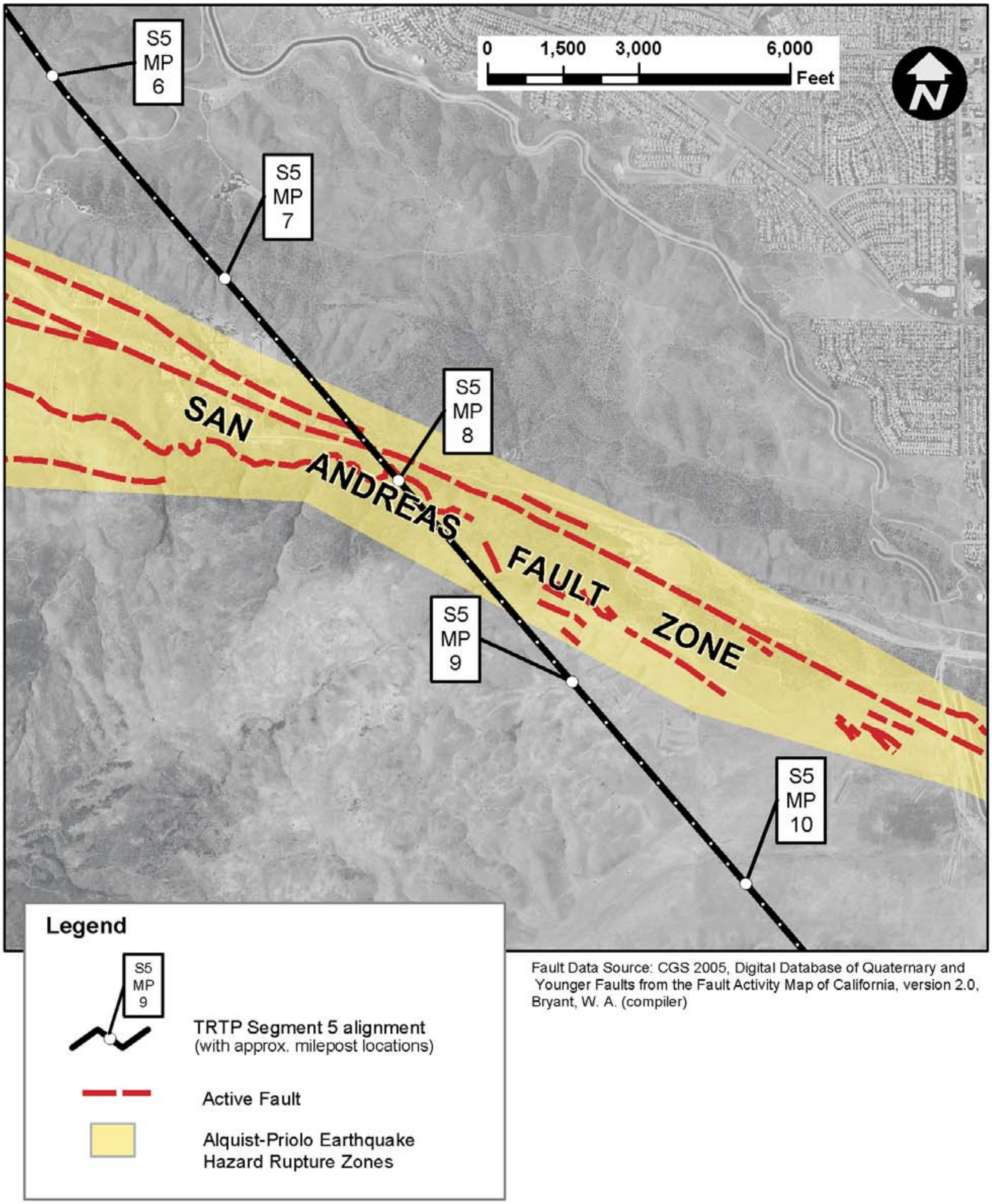


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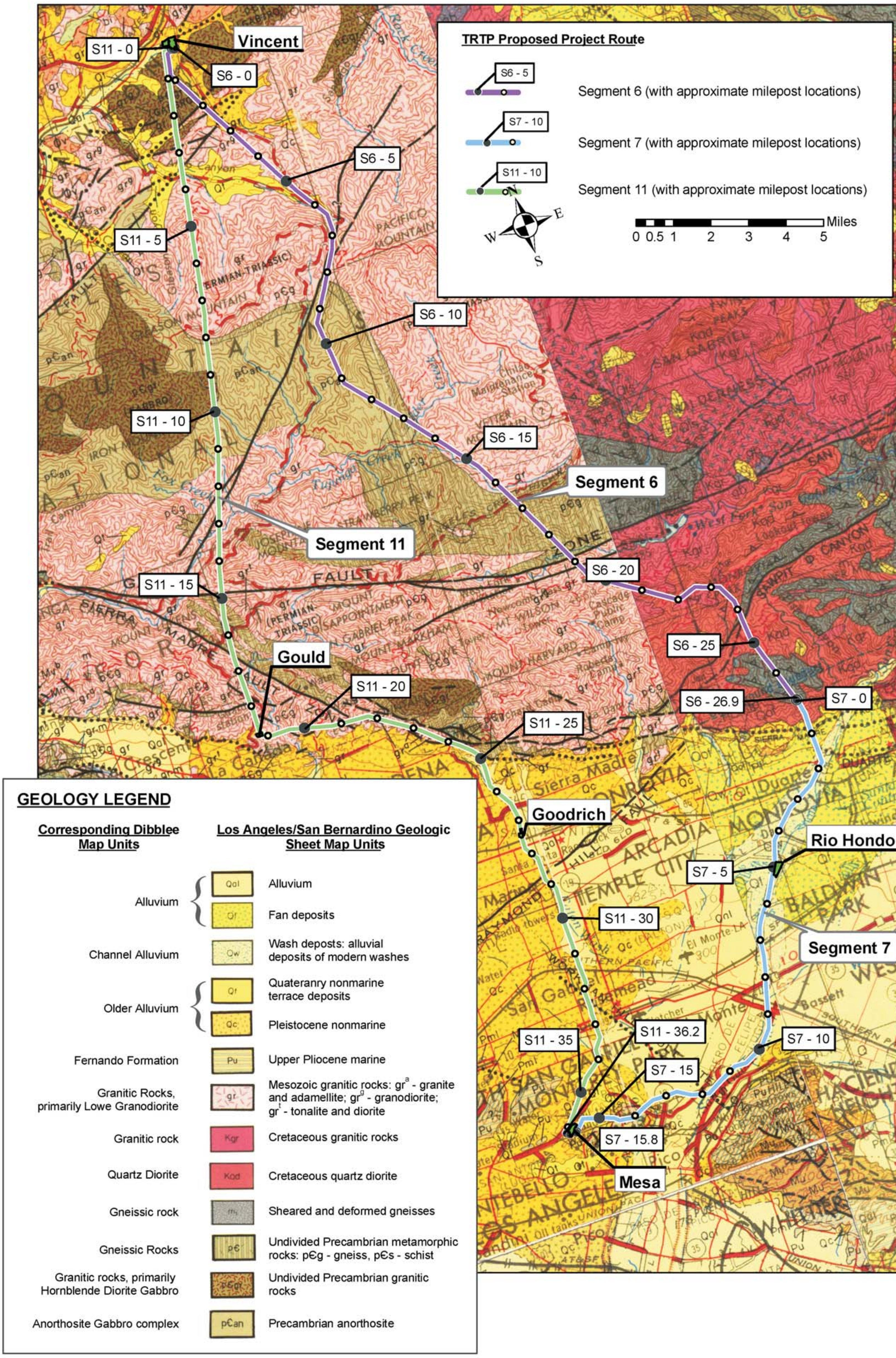
Figure 3.7-3
Segment 5 Active Fault Crossing



Source: GTC, 2008.

Figure 3.7-4
Regional Geology Map B

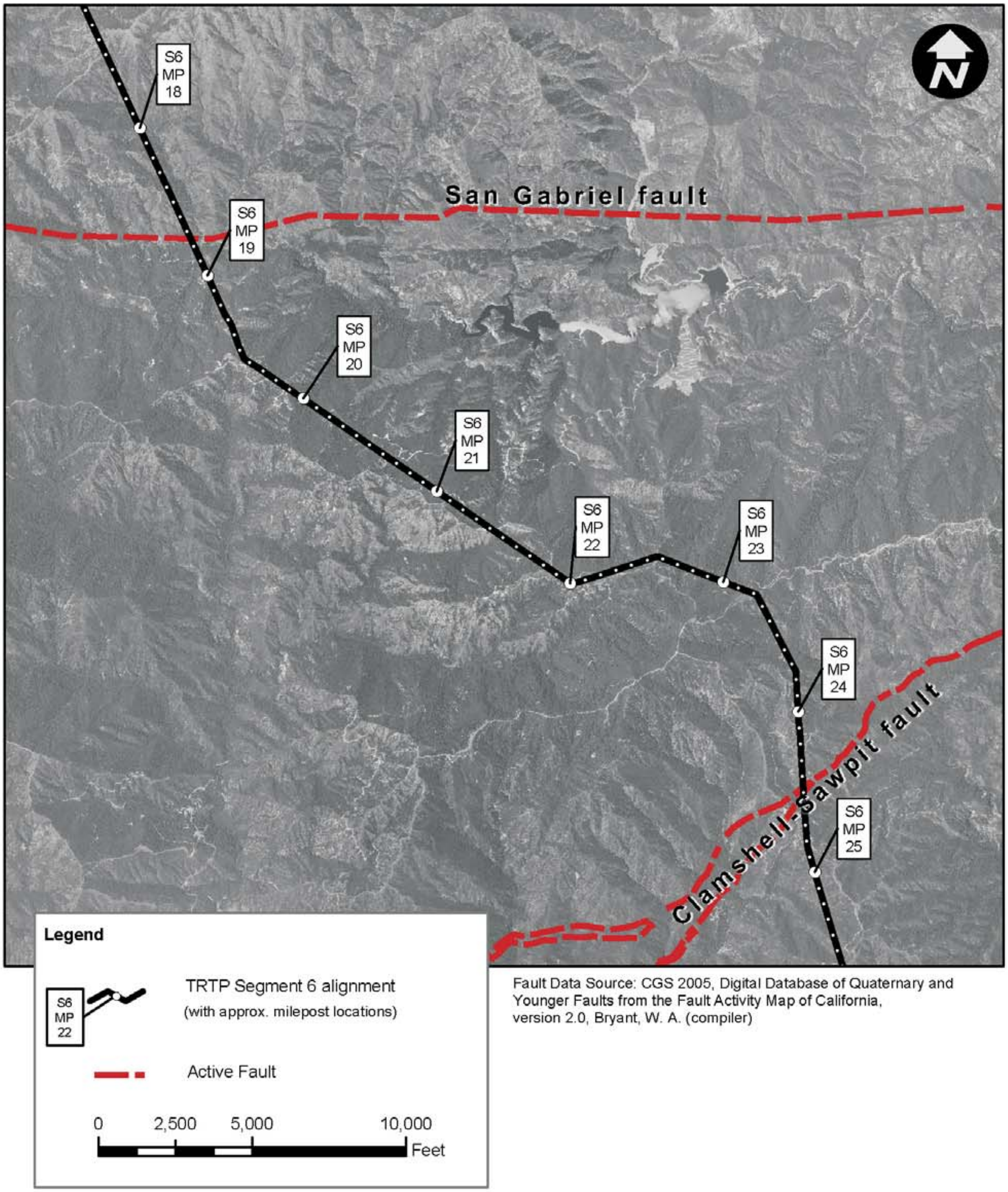


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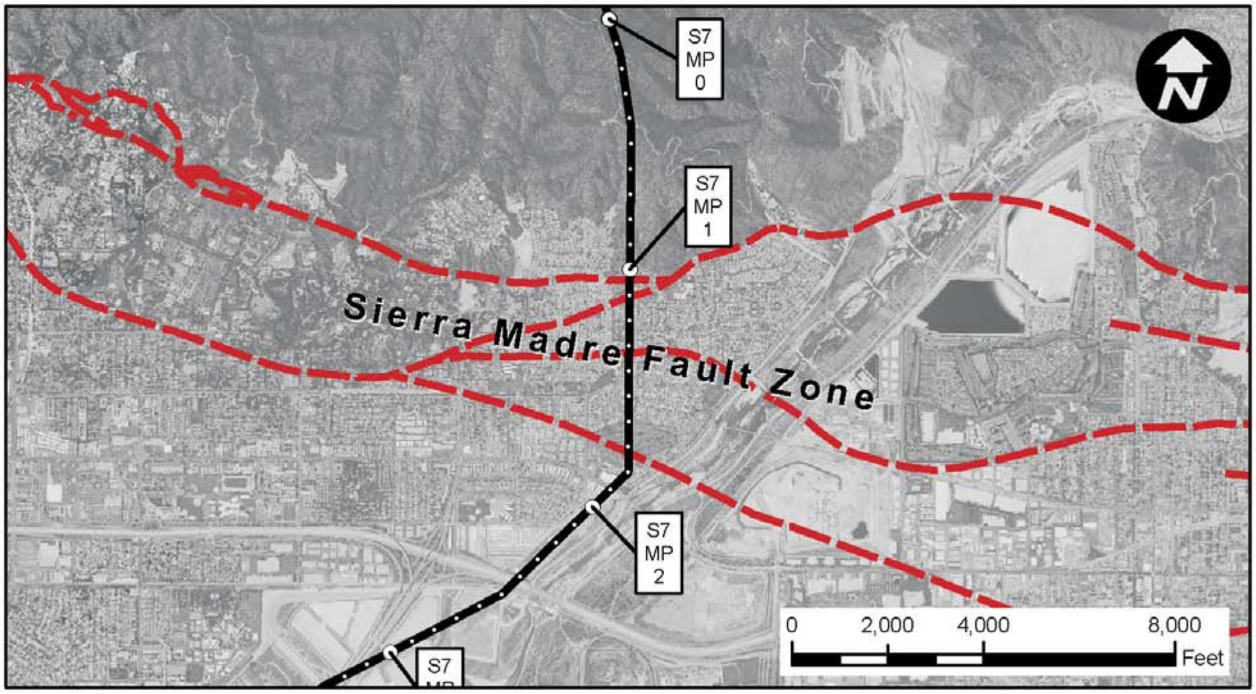
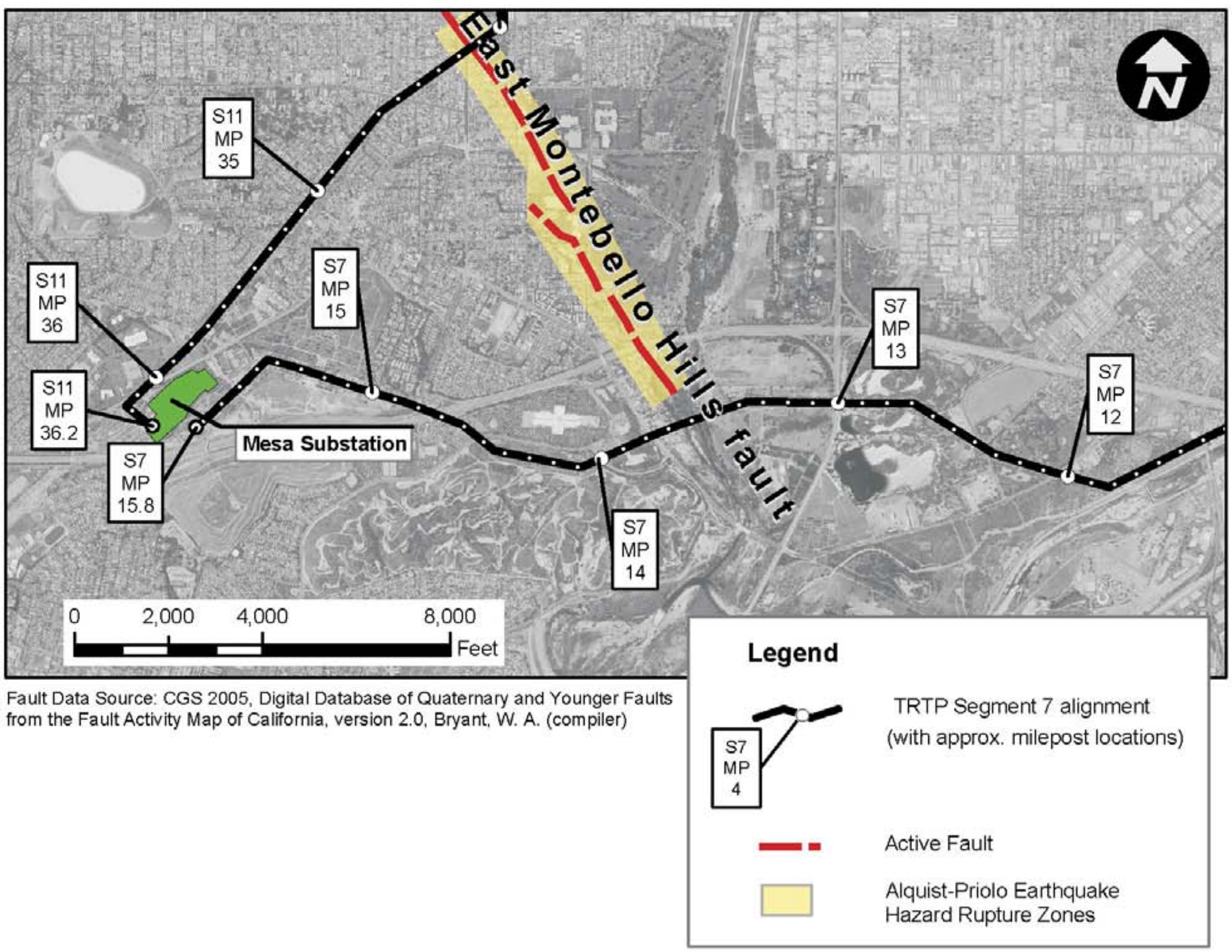
Figure 3.7-5

Segment 6 Active Fault Crossings





Fault Data Source: CGS 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0, Bryant, W. A. (compiler)

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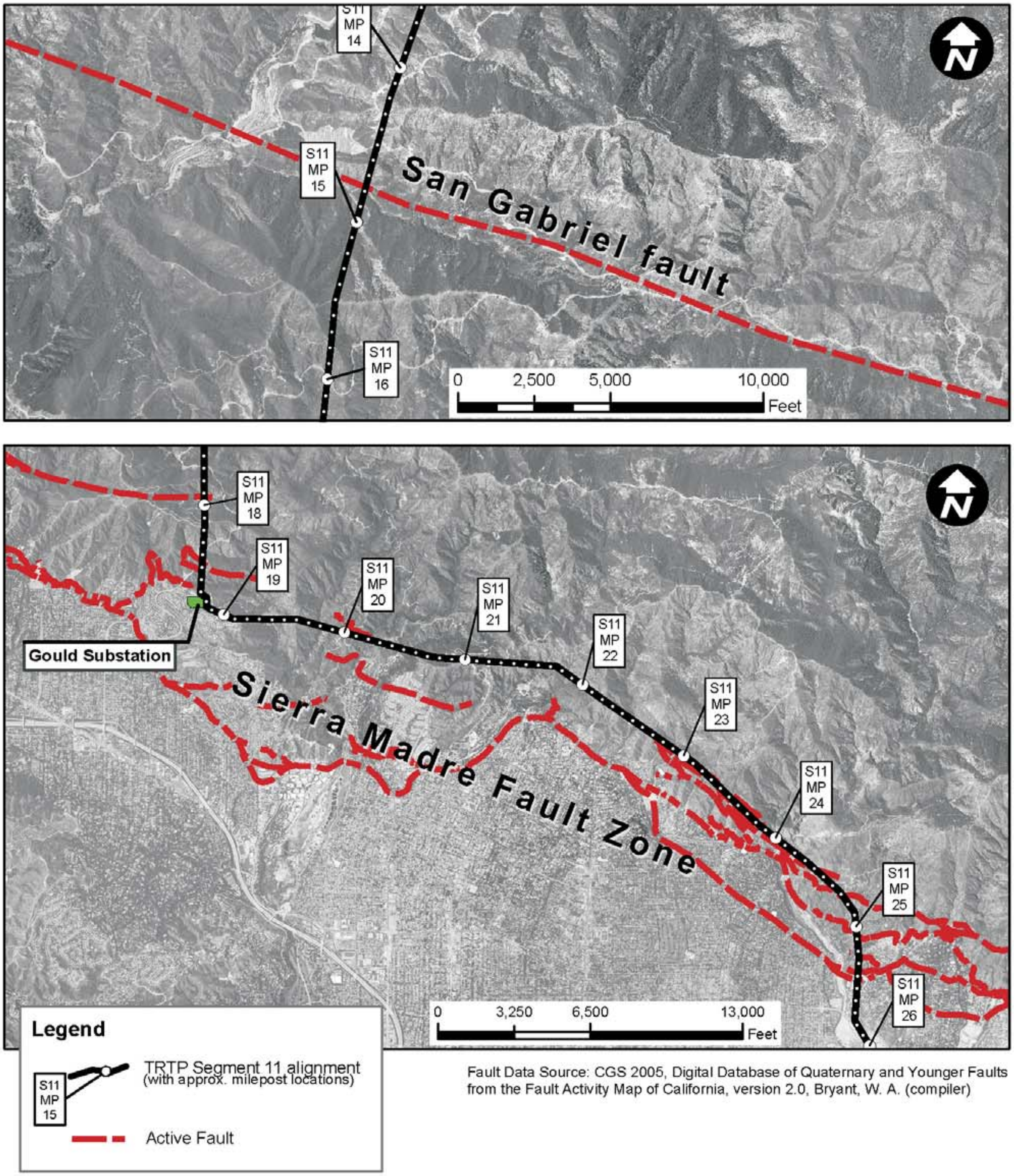
Figure 3.7-6

**Segment 7
Active Fault Crossings**



Fault Data Source: CGS 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0, Bryant, W. A. (compiler)

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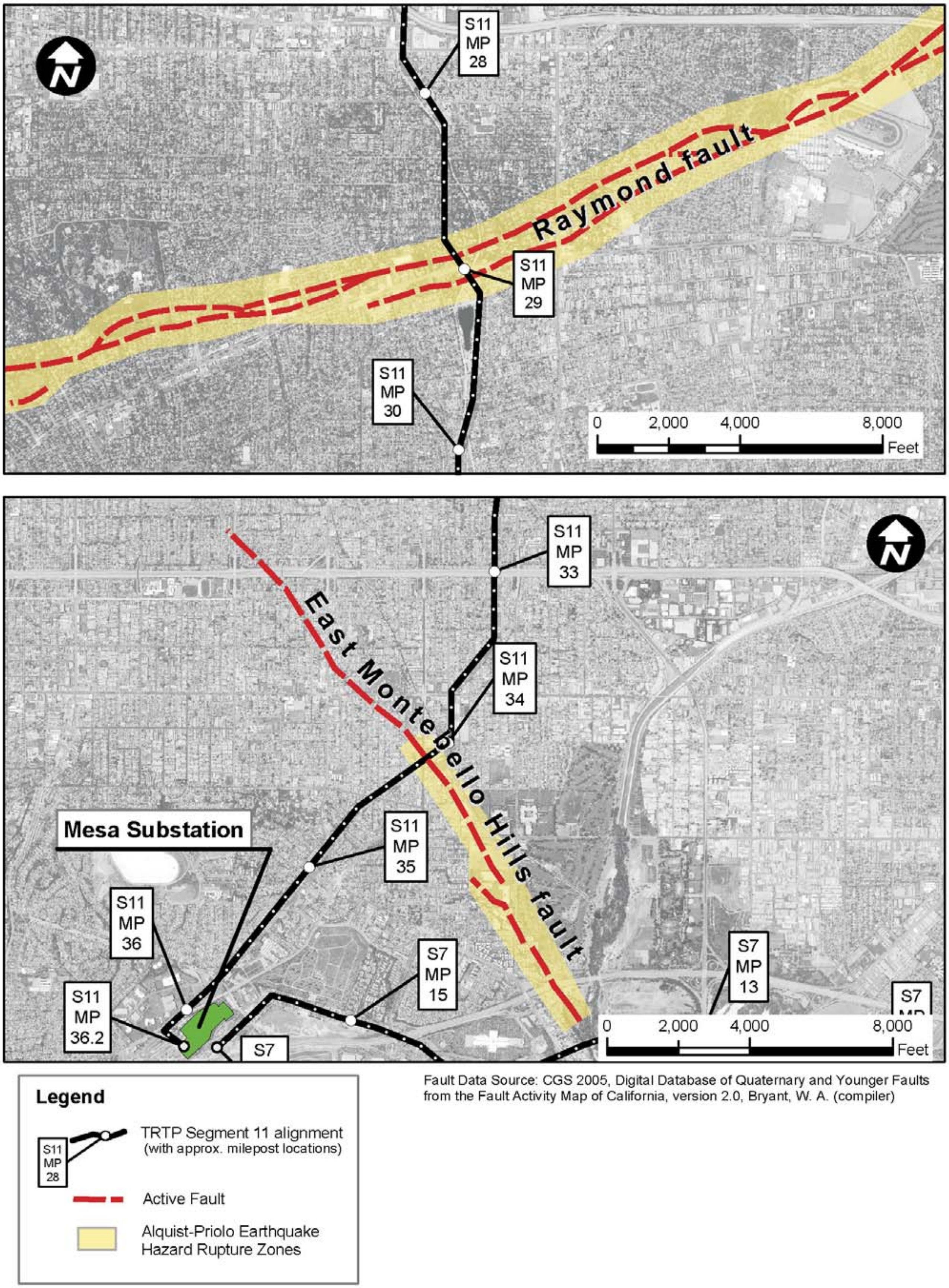
Figure 3.7-7a

Segment 11
Active Fault Crossings



Fault Data Source: CGS 2005, Digital Database of Quaternary and Younger Faults from the Fault Activity Map of California, version 2.0, Bryant, W. A. (compiler)

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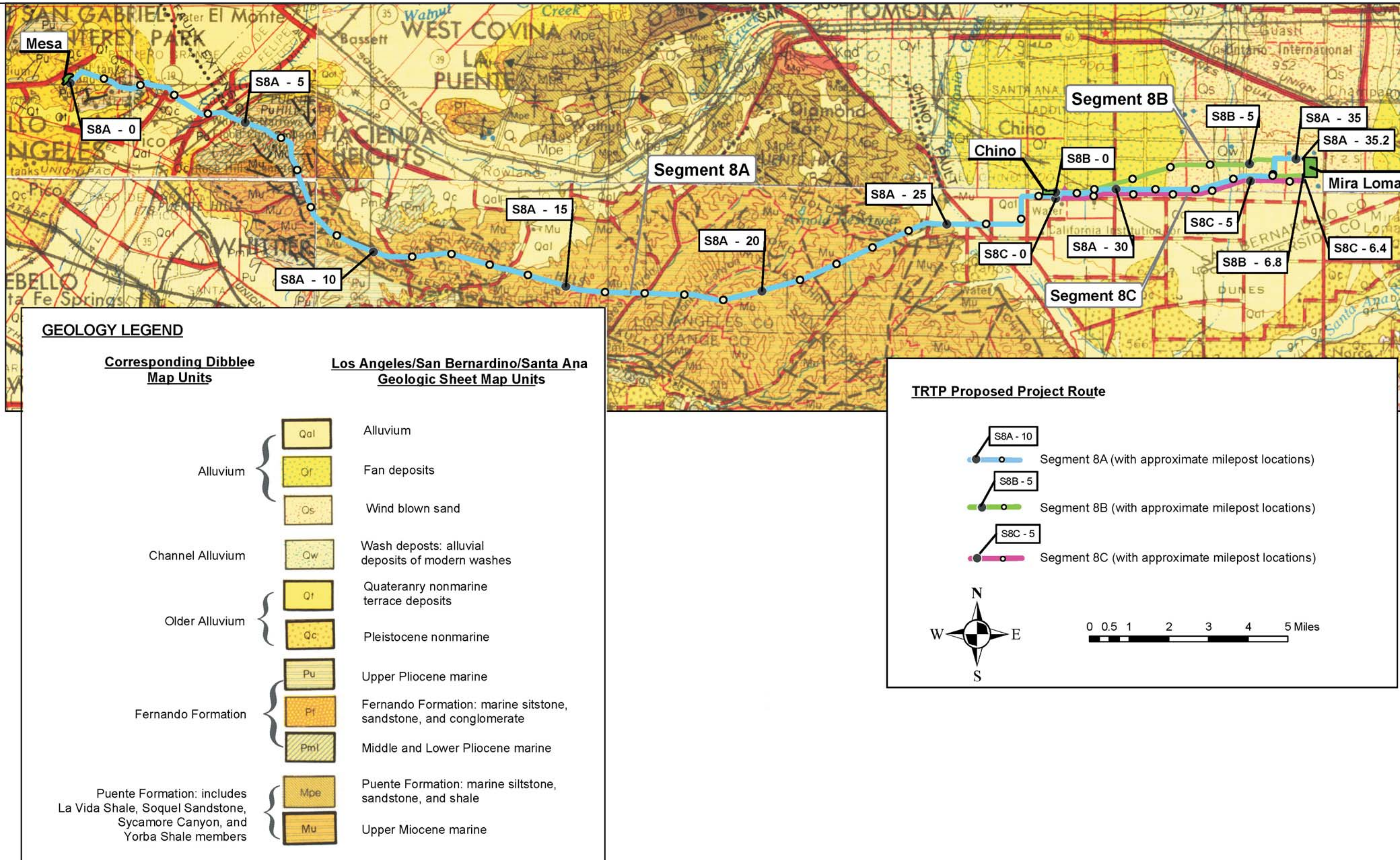
Figure 3.7-7b
Segment 11
Active Fault Crossings



Source: GTC, 2008.

Figure 3.7-8

Regional Geology Map C

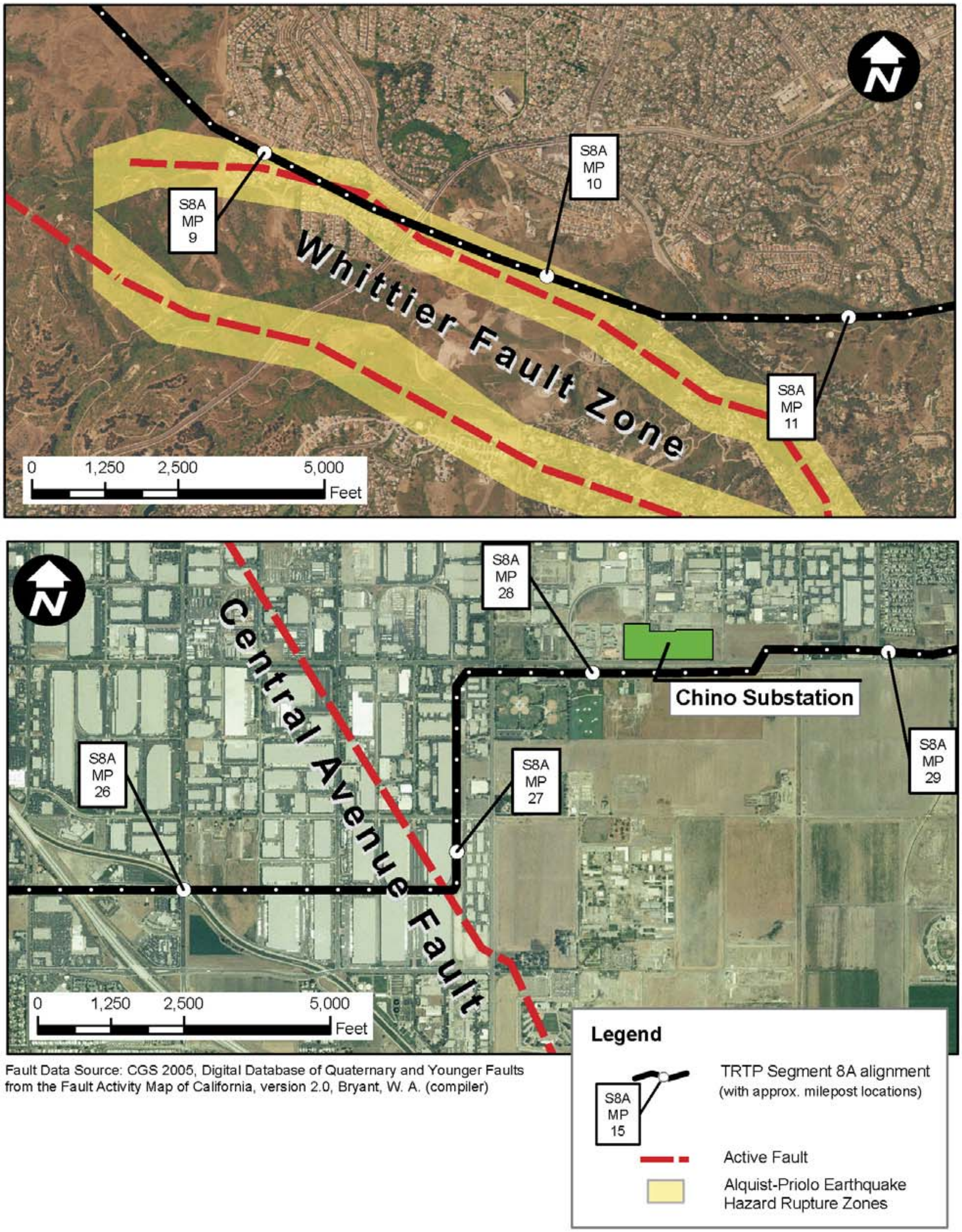


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Figure 3.7-9

Segment 8A Active Fault Crossings