

D.6 GEOLOGY AND SOILS

This section addresses the Proposed Project and alternatives as they would affect geology and soils. Section D.6.1 provides a description of the environmental setting, and the applicable plans, regulations, and requirements are introduced in Section D.6.2. An analysis of the Proposed Project impacts is presented in Section D.6.3, and analysis of geology and soils impacts related to the project alternatives is presented in Sections D.6.4 through D.6.6.

D.6.1 Environmental Setting for the Proposed Project

Environmental Baseline and Resources

Baseline geologic, seismic, and soils information for the Proposed Project and surrounding area were collected from literature, GIS data, and online materials. All sources used for the purposes of characterizing baseline conditions and conducting this analysis are referenced as appropriate. The literature and data review was supplemented by a brief field reconnaissance of the proposed alignment (Aspen, 2007). The literature review and field reconnaissance focused on the identification of specific geologic hazards.

Regional Overview

The Proposed Project is located in northwestern Riverside County and southeastern San Bernardino County. Elements of the Proposed Project are located in the incorporated Cities of Beaumont, Banning, Calimesa, Redlands, and Yucaipa as well as unincorporated areas of Riverside and San Bernardino Counties. Most of the Project lies within the boundary area between the northwest-southeast trending Peninsular Range and eastern block of the east-west trending Transverse Ranges geomorphic provinces of California.

Environmental Setting of the Project

Physiography and Topography

The Project route extends from the Crafton Hills and southern edge of the San Bernardino Mountains, east to the San Timoteo Badlands and western San Gorgonio Pass. The Crafton Hills are a northeast-southwest trending group of hills, with a maximum elevation of approximately 3,500 feet, which form the western boundary of the San Gorgonio Pass. The San Timoteo Badlands are a northwest-southeast trending group of hills, with a maximum elevation of approximately 2,600 feet, underlain by highly eroded bedrock which give this area a distinctive topography, known as the “The Badlands.” The western San Gorgonio Pass is a gentle southwest to southerly sloping alluvial fan, separating the San Bernardino Mountains to the north from the San Jacinto Mountains to the south. It is drained on the west by San Timoteo Creek and its tributaries and on the east by the San Gorgonio River and related tributaries.

Geology

The mountains and valleys of the Peninsular Ranges follow the more typical northwest-southeast trend seen throughout much of California. The Peninsular Ranges are generally composed of granitic rock intruded into older metamorphic rock, similar to the Sierra Nevada Mountain Range. They also generally have structural characteristics similar to the Sierra Nevada, with a steep, fault-bounded eastern face, and a more gentle western slope (SCE, 2007a). The Transverse Ranges are composed primarily of Cretaceous and Tertiary age sedimentary bedrock to the west, and Cretaceous-Jurassic age granitic and older

metamorphic rocks to the east, including the San Bernardino Mountains in the Project area. The Transverse Ranges are distinguished by their anomalous east-west trend of the mountains.

The geomorphic boundary between the Peninsular and Transverse Ranges, in the Project area, is generally formed by the various strands of the San Andreas Fault Zone, the most prominent structural feature in California. The San Andreas is considered to be the boundary between the Pacific and North American tectonic plates. It is generally a right-lateral strike-slip fault, extending 600 miles from California’s southern border, northwest to Cape Mendocino. The Project area lies within an unusual section of the San Andreas known as the “Big Bend,” where it trends more east-west, resulting in both compressional (shortening) and extensional (expansion) forces that have caused many of the structural features of the Project area. These include the uplift of the San Timoteo Badlands, Crafton Hills, and San Bernardino Mountains, as well as the inter-montane basins.

San Timoteo Formation. The Plio-Pleistocene age San Timoteo Formation (QTst) is the predominant bedrock unit with surface exposure within the area of the proposed El Casco Substation and much of the western portions of the proposed and alternate subtransmission line routes (CGS, 1966; CGS, 1986; Morton, 2004; SCE, 2007a). The formation is comprised of poorly cemented, semi-consolidated, and highly erodible sandstone, conglomerate, and fanglomerate that form topography characterized as “Badlands” in the Project area (SCE, 2007a). The middle member consists of pebbly to cobbly, moderately indurated sandstone and conglomerate, and underlies the proposed El Casco Substation. The upper member consists of moderately indurated coarse-grained sandstone and conglomerate and forms the hills on the north side and west end of San Timoteo Canyon (Morton, 2004).

Potato Sandstone. The Miocene age Potato Sandstone (Tpo) lies at the base of the southern San Bernardino Mountains north of Yucaipa (CGS, 1986; SCE, 2007a). Comprised of sandstone, it is locally interbedded with clay shale and often fails, producing large landslides.

A majority of the valley areas of the Project region are underlain by Quaternary alluvium, derived from several different bedrock and alluvial sources (SCE, 2007a). The eastern half of the main Project area is underlain by older and younger alluvial fans (Qof and Qf) eroded from the San Bernardino and San Jacinto Mountains. The surface sediments of the western half of the main Project area are comprised of Older Alluvium (Qoa) that has been cut by streams that deposited the Younger Alluvium (Qa) and stream channel gravels (Qg), forming a dendritic pattern converging on San Timoteo Creek.

Recent landslides (Qyls) have been mapped within the San Timoteo Formation along the south side of San Timoteo Creek (Morton, 2004; SCE, 2007a), as well as within the Potato Sandstone, on the slopes of the southern San Bernardino Mountains north of Yucaipa (CGS,1986; SCE, 2007a).

Tables D.6-1 through D.6-3 show summaries of the geological formations and conditions for the different features of the Proposed Project.

Table D.6-1 Milepost Geologic Conditions for Proposed and Existing Substations			
Site	Geologic Symbol ¹	Formation/Feature Name ¹	Description/Comments ¹
El Casco Substation Site	Qa, Qyls and QTst	Alluvium and San Timoteo Formation	Alluvial sand, gravel and clay from stream flood plains, and sandstone, which forms badland topography. Preliminary geology map shows landslides (Qyls) on the slopes within the north part of the site (Morton, 2004).
Banning Substation	Qf	Alluvial fan deposits	Alluvial fan sediments; moderate slope
Zanja Substation	Qoa	Older Alluvium	Alluvial sand and gravel

Notes: 1) Information in these columns is primarily derived from Table 3.6-1 of the PEA (SCE, 2007a).

Table D.6-2 Milepost Geologic Conditions for Proposed 115 kV Subtransmission Line Route			
Approximate Mile Marker ¹	Geologic Symbol ¹	Formation/Feature Name ¹	Description/Comments ¹
0.0 – 3.6	QTst and Qa	San Timoteo Formation and Alluvium	Weak, semi-consolidated sandstone, which forms badland topography, and alluvial sand, gravel, and clay from stream flood plains
3.6 – 5.5	Qa	Alluvium	Alluvial sand, gravel, and clay from stream flood plains
5.5 - 6.58	QTst	San Timoteo Formation	Sandstone, which forms badland topography
6.58	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
6.58 – 6.8	QTst	San Timoteo Formation	Sandstone, which forms badland topography
6.8 – 7.7	Qoa	Alluvium	Alluvial fan deposits dissected by steam channels
7.7 – 7.9	QTst	San Timoteo Formation	Sandstone, which forms badland topography
7.9	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
7.9 – 8.7	QTst	San Timoteo Formation	Sandstone, which forms badland topography
8.7 – 13.9	Qf & Qa	Alluvial fan deposits	Alluvial fan sediments, moderate slope and Alluvial sand, gravel and clay from stream flood plains

Notes: 1) Information in these columns is primarily derived from Table 3.6-1 of the PEA (SCE, 2007a).

Table D.6-3 Milepost Geologic Conditions for Proposed Maraschino Loop Route			
Approximate Mile Marker ¹	Geologic Symbol ¹	Formation/ Feature Name ¹	Description/Comments ¹
Loop West			
0.0 - 0.76	Qa and Qoa	Alluvium and Older Alluvium	Alluvial sand, gravel, and clay from stream flood plains; and alluvial fan deposits dissected by stream channels
0.76	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
0.76 - 0.9	Qoa	Older Alluvium	Alluvial sand and gravel
Loop South			
0.0 – 0.23	Qa and Tst	Alluvium and San Timoteo Formation	Alluvial sand, gravel, and clay from stream flood plains; and sandstone, which forms badland topography
0.23	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
0.23 – 0.8	Qa and Tst	Alluvium and San Timoteo Formation	Alluvial sand, gravel, and clay from stream flood plains; and sandstone, which forms badland topography
Mill Creek Communications Site			
	Tpo	Potato Formation	Sandstone, hard, bedded and forms steep slopes

Notes: 1) Information in these columns is primarily derived from Table 3.6-1 of the PEA (SCE, 2007a).

Faults and Seismicity

Northwestern Riverside County and southwestern San Bernardino County, like much of southern California, are crossed by numerous active and potentially active faults. Regional faults are depicted on Figure D.6-1 (all figures presented at end of section).

Figures D.6-2a and D.6-2b show locations of active and potentially active faults (representing possible seismic sources) in the region surrounding the Proposed Project. Active and potentially active faults that are significant potential seismic sources are presented in Table D.6-4. Faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 2000):

- 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 (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.

Name	Closest Distance to Project Route (miles) ¹	Estimated Max. Earthquake Magnitude ^{1, 2}	Fault Type ¹
Beaumont Plain Fault Zone	0	NA	Potentially Active & Unknown
San Andreas Fault Zone	0.3	8.0	Active
Banning Fault Zone	1.1	7.2	Active
San Gorgonio Pass Fault	0	6.5	Active
Cherry Valley Fault	0.6	NA	Potentially Active
San Jacinto Fault Zone	1.3	7.5	Active
Crafton Hills Fault Zone	0.7	6.5	Active

Notes: 1) Information in these columns is primarily derived from Table 3.6-3 of the PEA (SCE, 2007a).
2) Maximum Earthquake Magnitude – the maximum earthquake that appears capable of occurring under the presently known tectonic framework, using the Richter scale

There are several active or potentially active fault zones, near or underlying the Proposed Project in Riverside County, as shown on Figure D.6-2a. They include the San Jacinto, Beaumont Plain, Cherry Valley, Banning, Gandy Ranch, San Gorgonio, and San Andreas Fault Zones. The two major, and most important, fault systems in the Project area are the San Jacinto and San Andreas Fault Zones, approximately 100 and 600 miles long, respectively. Historic earthquakes ranging in Richter magnitude between M6 and M8 have either been recorded or estimated for these faults (SCE, 2007a).

Active or potentially active faults, or fault zones, near the western portion of the Project area in San Bernardino County include the Crafton Hills, Mill Creek, and San Andreas Fault Zones, as shown on Figure D.6-2b. The Mill Creek Fault Zone is considered to be a northern branch of the San Andreas Fault Zone in the Project area.

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 subtransmission line and associated facilities.

Fault Rupture. Perhaps the most important single factor to be considered in the seismic design of electric subtransmission lines and underground cables crossing active faults is the amount and type of potential ground surface displacement.

Fault rupture is typically defined as the point on the ground surface where earthquake-related offsets are manifested. Although generally limited in lateral extent, fault offset can induce profound damage to human structures. Mitigation of damage through structural design is generally infeasible, so hazard

reduction efforts have concentrated on defining the location of active fault traces, and providing setbacks. Historic fault rupture has occurred on both the San Andreas and San Jacinto Fault Zones (SCE, 2007a).

Strong Ground Shaking. The seismic waves associated with the rupture along a fault plane result in surface ground acceleration or shaking. This ground shaking generally causes the majority of damage to structures and loss of life. The level of shaking is dependent on many factors, including the size of the earthquake, relative distance, orientation of structures with respect to the fault rupture plane, and nature of the underlying soils or bedrock. The U.S. Geological Survey (USGS) and California Geological Survey have generated regional maps depicting peak horizontal ground acceleration through their Probabilistic Seismic Hazards Assessment (PSHA) Program. The maps are typically expressed in terms of probability of exceeding a certain ground motion. For example, the percent probability of exceedance in 50 years maps depict an annual probability of 1 in 475 of being exceeded each year. The maps for 10 percent probability of exceedance in 50 years show ground motions that the USGS does not think will be exceeded in the next 50 years. In fact, there is a 90 percent chance that these ground motions will not be exceeded. The regional map for Riverside and San Bernardino Counties shows the entire Proposed Project area is located within the “greater than 0.7 gravity (g)” contour, which indicates that a seismic event in the area would be expected to result in strong to very strong groundshaking since it would be expected to occur with greater than 70 percent the force of gravity. Ground motions may be even greater on alluvial sediments, which cover much of the Proposed Project (SCE, 2007a).

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, 1978). Additionally, densification of the soil resulting in vertical settlement of the ground can occur. The liquefaction potentials of land occupied or traversed by the Proposed Project are depicted in Figure D.6-3. Within the Proposed Project area, the relatively flat valleys underlain by alluvium have liquefaction potentials ranging from low to moderate in Riverside County (SCE, 2007a). In the San Bernardino County portion of the Proposed Project, there is little to no liquefaction hazard to the Project sites (SCE, 2007a).

Seismically Induced Landslides. Seismically induced landslides and rock falls are considered to have a high potential to occur in the San Timoteo Badlands area (SCE, 2007a), and in the San Bernardino Mountains north of Yucaipa (SCE, 2007a).

Soils

The Proposed Project is located in a semi-arid environment with soils sensitive to human activities, however, most of the proposed subtransmission line and existing substation locations are within areas that are already developed with transmission lines or agricultural operations. Table D.6-5 describes a number of the many soil units found within and adjacent to the Proposed Project, which are shown on Figures D.6-4a through D.6-4e. A comprehensive list of all soil types identified along the Proposed Project is presented in Appendix 7.

Corrosivity of soils is generally related to several 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.

Soil Name	Soil Symbol	Description ¹	Shrink-Swell Potential ¹	Erosion Potential ^{1,2}	Corrosion Potential ¹	
					Concrete	Steel
Altamont	Aad & Aae2	clay, 5 to 25% slopes, eroded	low	low	low	low
Badland	BaG	Badland	low	NR ³	NR ³	low
Chino	Ce, Cf, Cg	silt loam, drained, strongly saline-alkali	moderate	high	low	high
Cieneba	ChF2	sandy loam, 15 to 50% slopes, eroded	low	low	moderate	Low
	CnD	Cieneba sandy loam, 9 to 15% slopes	low	low	NR ³	Moderate
Crafton	CsF2	rocky sandy loam, 25 to 50% slopes, eroded	low	low	moderate	low
Grangeville	Gr	fine sandy loam, drained, 0 to 2% slopes	low	moderate	low	high
	GIa	Grangeville fine sandy loam, drained, 5 to 15% slopes	low	moderate	low	high
Greenfield	GuD	cobbly sandy loam, 5 to 15% slopes	low	low	low	moderate
	GyC2, GyD2, GyE2	sandy loam, 2 to 25% slopes, eroded	low	moderate	low	low
Hanford	HaC	coarse sandy loam, 2 to 9% slopes (San Bernardino County)	low	moderate	low	moderate
	HaC	loamy fine sand, 0 to 8% slopes (Riverside County)	low	moderate	low	NR
	HcC, HcD2	coarse sandy loam, 2 to 15% slopes	low	moderate	low	low
	HeC2	Hanford coarse sandy loam, deep, 2 to 8% slopes, eroded	low	moderate	low	low
Monserate	MmC2, MmD2	sandy loam, 5 to 25% slopes, eroded and severely eroded	low	moderate	low	low
	MnD2, MnE3	Monserate sandy loam, shallow, 5 to 25% slopes, eroded	low	moderate	low	low
Placentia	PIB, PID	Placentia fine sandy loam, 0 to 15% slopes	moderate	moderate	low	moderate
Ramona	RaA, RaB2, RaC2, RaD3,	sandy loam, 0 to 25% slopes, eroded and severely eroded	low	moderate	low	moderate
	RdD2, RdE3	sandy loam, moderately deep, 8 to 25% slopes, eroded and severely eroded	moderate	moderate	low	moderate
	ReC2, RfC2	very fine sandy loam, 0 to 8% slopes, eroded	NR	high	low	moderate
	RmE2	sandy loam, 15 to 30% slopes, eroded	low	low	moderate	moderate
San Emigdio	SbC	gravelly sandy loam, 2 to 9% slopes	low	low	low	high
	ScA, ScC	fine sandy loam, 0 to 9% slopes	low	moderate	low	high
	SeA	fine sandy loam, 0 to 2% slopes	low	low	low	low
	SeC2, SeD2	fine sandy loam, 2 to 15% slopes, eroded	low	low	low	low
	SgA, SgC, SgD2	loam, 0 to 15% slopes	low	low	low	low
San Timoteo	SmE2, SmF2	loam, 8 to 50% slopes, eroded	low	low	low	low
Soboba	SoC	gravelly loamy sand, 0 to 9% slopes	low	low	low	moderate
	SpC	stony loamy sand, 2 to 9% slopes	low	low	moderate	moderate
	SrE	cobbly loamy sand, 2 to 25% slopes	low	low	low	low
	SsD	stony loamy sand, 2 to 15% slopes	low	low	low	low
Tujunga	TuB	loamy sand, 0 to 5% slopes	low	low	low	moderate
	TvC	gravelly loamy sand, 0 to 9% slopes (San Bernardino County)	low	low	low	moderate
	TvC	loamy sand, channeled, 0 to 8% slopes (Riverside County)	low	low	low	low
Visalia	VIC2	sandy loam, 0 to 8% slopes, eroded	low	low	moderate	low
Vista	VsD2, VsF2	coarse sandy loam, 8 to 35% slopes, eroded	low	low	moderate	low
	VtF2	rocky coarse sandy loam, 2 to 35% slopes, eroded	low	low	moderate	low

Notes: 1) Locations of these soil types are depicted on Figures D.6-4a through D.6-7e.
2) Information in these columns is primarily derived from Table 3.6-4 of the PEA (SCE, 2007a).

- 3) Erosion Hazard: 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.
- 4) NR = Not Rated

The properties of soil that influence erosion by rainfall and runoff are ones which 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. Soils containing high percentages of fine sands and silt and that may have low density are generally the most erodible. These soil types generally coincide with soils such as young alluvium and other surficial deposits, which likely occur 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.

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 rainfall, landscape irrigation, utility leakage, roof drainage, and/or perched groundwater. Expansive soils are typically very fine grained with a high to very high percentage of clay.

Slope Instability. Slope instability covers a series of mass-movement phenomena such as landslides, rockfalls, mudflows, and shallow soil failure. Natural slope instability occurs either as a part of the normal weathering process, or through seismic or major storm events. Contributing factors to instability include topography, bedrock and soil types, bedrock orientation, precipitation, vegetation, and human modification of the topography. Man-made slope instability is usually attributable to the alteration of topography during development, and/or through modification of natural slope drainage or percolation.

Many of the north-facing slopes underlain by the San Timoteo Formation, on the south side of San Timoteo Creek, are mapped as landslides. In San Bernardino County, many of the slopes underlain by the Potato Formation, in the area between the branches of the San Andreas Fault Zone, are also mapped as landslides (SCE, 2007a).

Site Specific Conditions

El Casco Substation. The proposed El Casco Substation site (including the area near San Timoteo Creek where underground duct banks would be installed) is underlain by both alluvial deposits and the San Timoteo Formation. The easily eroded sandstone and claystone bedrock formed the alluvium that covers the northern portion of the site. The shallowly north-dipping San Timoteo Formation underlying the southern half of the site has been identified as a landslide (SCE, 2007a). While no identified faults intersect this site, the nearest potentially active faults are the Cherry Valley Fault Zone approximately two miles to the north and the Beaumont Plain fault about five miles to the southeast. Figure D.6-2a shows the active San Jacinto Fault Zone is located approximately 3.7 miles to the southwest of the site (SCE, 2007a). Geotechnical data (Mactec, 2007) show shallow groundwater and loose granular soils beneath the northern portion of the site, which indicate a high liquefaction and lateral spreading potential. Soils underlying the site have low potential for expansion (shrink-swell), erosion, and corrosion to steel (Table D.6-5).

Banning Substation. The Banning Substation is located in a large area of Older Alluvial Fan deposits comprised of alluvial sands and gravels derived from the San Bernardino Mountains. The site is very flat and already developed for use as a substation. No identified faults intersect the site; however, the active

San Gorgonio Pass Fault Zone is located approximately 1.5 miles to the north, as shown on Figure D.6-2a (SCE, 2007a). Liquefaction and lateral spreading potential is shown to be moderate in the Banning General Plan; however the same plan states that the depth to groundwater is 100 feet or greater, suggesting the susceptibility would be low (SCE, 2007a). Soils beneath the site have low expansion and corrosion potential, and are moderately erodible (see Table D.6-5 and Figures D.6-4a through D.6-4e).

Zanja Substation. The Zanja Substation is situated on alluvium comprised of sands and gravels. The site is fairly flat and already developed for use as a substation. There is a stream channel within 400 feet directly to the south of the site. While no identified faults intersect the site, it is situated near the South Branch of the San Andreas Fault Zone, approximately 0.3 mile southeast of the nearest mapped fault trace. The active Crafton Hills Fault lies roughly 0.7 mile to the southeast (Figure D.6-2b). The site is not located within an area designated as susceptible to liquefaction (SCE, 2007a). Soils beneath the site have a low expansion and erosion potential, but are moderately corrosive to steel (Table D.6-5 and Figures D.6-4a through D.6-4e).

Mill Creek Communications Site. The Mill Creek Communications Site lies on a ridge top underlain by the Potato Sandstone. This formation consists of bedded, hard sandstone with interbeds of clay shale. Slopes adjacent to the site range from moderate to very steep (over 30 percent). Slope instability is a noted issue due to the landslides already mapped, both in the area and on slopes adjacent to the site (SCE, 2007a). No identified faults intersect the site, but it is between the North and South Branches of the San Andreas Fault Zone (Figure D.6-2b). The South Branch is approximately one mile to the south, and the North Branch is roughly 1.3 miles to the north. The site is not located within an area designated as susceptible to liquefaction (SCE, 2007a). Soils beneath the site have low expansion and erosion potential (Table D.6-5 and Figures D.6-4a through D.6-4e).

115 kV Subtransmission Line Route. This route, within an existing subtransmission line corridor, crosses one year-round channel (San Timoteo Creek), numerous ephemeral stream channels, hillsides underlain by the San Timoteo Formation, valley and mesa areas comprised of older and younger alluvium, and alluvial fan deposits. Slopes range from very gentle to over 20 percent in the hills. Surficial deposits of alluvial sand and gravel underlie approximately the eastern half of the proposed route, while the San Timoteo Formation underlies the western half. Slope instability is a potential issue due to the numerous landslides mapped in this part of the San Timoteo Formation (SCE, 2007a). Two identified fault traces from the Beaumont Plain Fault Zone cross this route near its mid-point (Figure D.6-2a). Liquefaction potential is considered low over most of the route, with areas of moderate susceptibility where the line traverses stream channels (Mileposts 3.5 to 5.5), and as it approaches Banning Substation (Mileposts 12 to 13.9). As noted earlier, the area around Banning Substation is considered moderately susceptible to liquefaction, even though there is no shallow groundwater.

Virtually all of the soils beneath the proposed route have a low expansion potential. Approximately 40 percent of the route is underlain by soils with moderate erosion potential, with the remainder having a low potential (SCE, 2007a). Corrosivity to concrete is low over the entire route, and about 30 percent of it is underlain by soils having a moderate potential for corrosion to steel (see Table D.6-5 and Figures D.6-4a through D.6-4e).

Maraschino Loop West. The proposed Maraschino Loop West subtransmission line route is underlain by older alluvial gravels and sands. One identified fault trace from the Beaumont Plain Fault Zone crosses this route approximately 0.2 mile west of Maraschino Substation, as shown on Figure D.6-2a (SCE, 2007a). Susceptibility to liquefaction is considered low along the proposed route (SCE, 2007a). Soils underlying this route have a low expansion potential, are moderately erodible, have a low concrete corrosion potential, and a moderate corrosivity to steel (Table D.6-5 and Figures D.6-4a through D.6-4e).

Maraschino Loop South. The proposed Maraschino Loop South subtransmission line route is underlain principally by older alluvium that is locally dissected by younger alluvium associated with the San Timoteo Wash. These alluvial deposits are composed of gravel and sand. One identified fault trace from the Beaumont Plain Fault Zone appears to parallel the south trending segment of this route as shown on Figure D.6-2a (SCE, 2007a). Susceptibility to liquefaction is considered low along the proposed route (SCE, 2007a). Soils underlying this route have a low expansion potential, are moderately erodible, have a low concrete corrosion potential, and a moderate corrosivity to steel (Table D.6-5 and Figures D.6-4a through D.6-4e).

D.6.2 Applicable Regulations, Plans, and Standards

Geologic hazards and soils are governed primarily by local jurisdictions. The conservation elements and seismic safety elements of city and county general plans contain policies for the protection of geologic features and avoidance of hazards, but do not specifically address transmission line construction projects. Local grading ordinances establish detailed procedures for ground disturbing activities including slope inclination and trench backfill, compaction, and testing.

D.6.2.1 Federal

Uniform Building Code. Published by the International Conference of Building Officials, the 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.

Clean Water Act. See Section D.8 (Hydrology and Water Quality) for information about erosion control requirements associated with Storm Water Pollution Prevention Plans (SWPPPs).

D.6.2.2 State

In California, 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 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.

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 4, provisions for design should follow the requirements of Chapter 16.

The Seismic Hazards Mapping Act (the Act) of 1990 (Public Resources Code, Chapter 7.8, 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.

D.6.2.3 Local

The safety elements of General Plans for the cities and the Counties along the proposed route contain policies for the avoidance of geologic hazards and/or the protection of unique geologic features. A survey of general plans along the proposed route indicated that most municipalities require submittal of construction and operational safety plans for proposed construction in areas of identified geologic and seismic hazards for review and approval prior to issuance of permits. County and local grading ordinances establish detailed procedures for excavation and grading required for underground construction.

D.6.3 Environmental Impacts and Mitigation Measures for the Proposed Project

D.6.3.1 Significance Criteria

Geologic conditions were evaluated with respect to the impacts the Proposed Project may have on the local geology, as well as the impact that specific geologic hazards may have upon the subtransmission line and its related facilities. Impacts of the Project related to the geologic environment are characterized on the basis of CEQA statutes and guidelines and thresholds of significance developed by local agencies, government codes and ordinances, and requirements stipulated by the California Alquist-Priolo statutes. Impacts would be considered significant and require additional mitigation if:

- Construction activities would cause slope instability.
- Construction activities would accelerate erosion.
- Project structures would be damaged by corrosive soils.
- Project structures would be located on a geologic unit or soil that is or could become unstable and would result in landslides, earthflows, and/or debris flows.
- Project structures would be damaged by seismically induced groundshaking and ground failure, including liquefaction and lateral spreading.
- Project structures would be damaged by surface fault rupture at crossings of active and potentially active faults.
- Expansive, soft, loose, and/or compressible soils would damage Project structures.

D.6.3.2 Applicant-Proposed Measures

SCE has committed to implementing Applicant- Proposed Measures (APMs) presented in Table B-14 and D.6-6 to reduce geology and soils impacts associated with construction and operations of the Proposed Project. These APMs are incorporated into additional more specific mitigation measures that are recommended to ensure that all impacts would be reduced to the extent feasible (see Section D.6.9).

Table D.6-6. Applicant-Proposed Measures – Geology and Soils

APM	Description
APM GEO-1	<p>A geotechnical investigation of slope stability and geologic conditions, coupled with engineering design, would delineate the extent of potential landslide hazards and develop recommendations to support appropriate design measures to mitigate these hazards. Landslide mitigation may include one or more of the measures listed below.</p> <ul style="list-style-type: none"> • Over-excavation of adverse bedding and landslide failure surfaces, and placement of a large stabilizing buttress fill. • Over-excavation of adverse bedding and landslide failure surfaces to remove potential slope stability hazards. • Other appropriate design measures, or combinations of design measures.
APM GEO-2	<p>A geotechnical investigation of site soils and geologic conditions, coupled with engineering design, would identify the hazards and develop recommendations to support appropriate seismic designs to mitigate the effects of ground shaking. Specific requirements for seismic design would be based on the IEEE 693 "Recommended Practices for Seismic Design of Substations", and/or CBC Seismic Design criteria for sites within seismic Zone IV.</p>
APM GEO-3	<p>Where appropriate, subsurface trenching along active fault traces would be required to ensure tower foundations are not placed on, or immediately adjacent to, these features. In addition, tower locations would be selected to accommodate anticipated fault offset, and minimize excessive tension in lines should a fault movement occur.</p>

Source: SCE, 2007a

D.6.3.3 Proposed Project Impact Analysis

The geology and soils impacts of the Proposed Project are discussed below under subheadings corresponding to each of the significance criteria presented in the preceding section. The analysis describes the impacts of the Proposed Project related to geologic, seismic, and soils hazards and, for each criterion, determines whether implementation of the Proposed Project would result in significant impacts.

Impact GEO-1: Construction activities would cause slope instability (Class II).

Destabilization of natural or constructed slopes could occur as a result of construction activities due to excavation and/or grading operations. The proposed 115 kV subtransmission route crosses terrain that ranges from flat to 25 percent slopes. The proposed El Casco Substation site and much of the subtransmission line route are underlain by the San Timoteo Formation, which has been subject to numerous landslides (SCE, 2007a). Preparation of the proposed El Casco Substation site would include excavation that intercepts landslide failure surface, thus increasing the possibility of slope failures. Therefore, proposed cut slopes could result in slope failures during construction. Unmapped landslides and areas of localized slope instability may also be encountered along other portions of the subtransmission line that cross the hills and slopes between the proposed El Casco Substation and MP-4.

Excavation operations associated with tower foundation construction and grading operations for temporary and permanent access roads and construction activities in areas of hilly or sloping terrain could result in increased slope instability, landslides, soil creep, or debris flows during construction. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions (APM GEO-1) prior to final design of substation facilities and subtransmission line tower foundations, this impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-1 (Protect Against Slope Instability), which adds specific requirements to the planned geotechnical

investigations prior to final Project design, would reduce Impact GEO-1 to a less-than-significant level (Class II).

Construction-induced slope instability is not anticipated to occur at the Mill Creek Communications Site, Zanja Substation, Banning Substation, or the Maraschino Loops since construction would occur on flat land and/or would not require excavation or grading at these locations.

Fiber optic cable for the new fiber optic system would be installed on existing poles and within existing underground conduit. Installation of fiber optic cable would not require any ground disturbing activities and no impacts would occur.

Mitigation Measure for Impact GEO-1

GEO-1 Protect Against Slope Instability. Appropriate support and protection measures shall be implemented to maintain the stability of excavations and protect surrounding structures and utilities to limit ground deformation. Design-level geotechnical investigations shall be performed to evaluate subsurface conditions, identify potential hazards, and provide information for development of excavation plans and procedures. Based on the results of the geotechnical investigations, appropriate support and protection measures shall be designed and implemented to maintain the stability of slopes adjacent to newly graded or re-graded access roads and work areas during and after construction. These measures shall include, but are not limited to, retaining walls, visqueen, removal of unstable materials, and avoidance of highly unstable areas. SCE shall document compliance with this measure prior to the start of construction by submitting a report to the CPUC for review and approval. The report shall document the investigations and detail the specific support and protection measures that will be implemented.

Impact GEO-2: Construction activities would accelerate erosion (Class II).

Excavation and grading for tower and substation foundations, work areas, and access roads could loosen soil or remove stabilizing vegetation and expose areas of loose soil. These areas, if not properly stabilized during construction, could be subject to increased soil loss and erosion by wind and stormwater runoff. Newly constructed and compacted engineered slopes can also undergo substantial erosion through dispersed sheet flow runoff. More concentrated runoff can result in the formation of small erosional channels and larger gullies, each compromising the integrity of the slope and resulting in significant soil loss. The Maraschino Loop West and South, as well as approximately 40 percent of the proposed 115 kV subtransmission line route, are underlain by soils with a moderate potential for erosion.

SCE has committed to perform subtransmission line and substation construction activities in accordance with the soil erosion/water quality protection measures specified in the Construction Storm Water Pollution Prevention Plan (SWPPP). In accordance with Section 402 of the federal Clean Water Act (CWA) and the State Water Resources Control Board (SWRCB), any construction project that disturbs one acre or more of ground surface must prepare a Construction SWPPP. The SWPPP would be prepared once the Proposed Project is approved and after the necessary facilities are sited and designed, in order to ensure site-specific conditions are effectively addressed. All SWPPPs must include Best Management Practices (BMPs) for erosion and sediment control, as well as for construction waste handling and disposal. This impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-2 (Minimize Soil Erosion) ensures that potential impacts from erosion

related to grading and use of access roads and work areas in areas of moderate to severe erosion potential during construction would be reduced to a less-than-significant level (Class II).

Fiber optic cable for the new fiber optic system would be installed on existing poles and within existing underground conduit. Installation of fiber optic cable would not require any ground disturbing activities and no impacts would occur.

Mitigation Measure for Impact GEO-2

GEO-2 Minimize Soil Erosion. The Construction SWPPP for the Project shall include BMPs designed to minimize soil erosion along access roads and at work areas. Appropriate BMPs may include construction of water bars, grading road surfaces to direct flow away from natural slopes, use of soil stabilizers, and consistent maintenance of roads and culverts to maintain appropriate flow paths. Silt fences and straw bales installed during construction shall be removed to restore natural drainage during the cleanup and restoration phase of the Proposed Project. Where access roads cross streams or drainages, they shall be built at or close to right angles to the streambeds and washes and culverts or rock crossings shall be used to cross streambeds and washes. Design of appropriate BMPs should be conducted by or under the direction of a qualified geologist or engineer.

Impact GEO-3: Project structures would be damaged by corrosive soils (Class II).

Soils with moderate to high potential for corrosion exist along the proposed route, as presented in Table D.6-5. Corrosive soils could have a detrimental effect on concrete and metals. Depending on the degree of corrosivity of subsurface soils, concrete, reinforcing steel in concrete structures, and bare-metal structures exposed to these soils could deteriorate, eventually leading to structural failures. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions (APM GEO-1) prior to final design of substation facilities and subtransmission line tower foundations, this impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-3 (Geotechnical Studies for Corrosive Soils), which adds specific requirements to the planned geotechnical investigations to be completed prior to final Project design, would reduce Impact GEO-3 to a less-than-significant level (Class II).

Fiber optic cable for the new fiber optic system would be installed on existing poles and within existing underground conduit and would not be affected by corrosive soils.

Mitigation Measure for Impact GEO-3

GEO-3 Geotechnical Studies for Corrosive Soils. In areas underlain by potentially corrosive soils, the design-level geotechnical studies performed by SCE shall identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates, and soil parameters, such as pH and electrical resistivity. 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.

Impact GEO-4: Project structures would be damaged by unstable soils, landslides, earthflows, and/or debris flows (Class II).

The El Casco Substation site, the Mill Creek Communications site, and portions of the proposed 115 kV subtransmission route are located on or cross sloping areas that are underlain by geologic formations prone to landslides (San Timoteo Formation and Potato Sandstone). These same areas also traverse existing landslides or are situated near existing landslides. 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. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions (APM GEO-1), prior to final design of substation facilities and subtransmission line tower foundations, this impact would be significant without mitigation. However, with implementation of Mitigation Measure GEO-4 (Geotechnical Surveys for Landslides), which adds specific requirements to the planned geotechnical investigations to be completed prior to final Project design, Impact GEO-4 would be reduced to a less-than-significant level (Class II).

The fiber optic system would be installed on and within existing infrastructure adjacent to other utility cable and would not present a new risk of damage or injury to people or structures as result of unstable soils, landslides, earthflows, or debris flows.

Mitigation Measure for Impact GEO-4

GEO-4 Geotechnical Surveys for Landslides. The design-level geologic/geotechnical investigation performed by SCE shall include detailed surveys to evaluate the potential for unstable slopes, landslides, earth flows, and debris flows along the approved subtransmission line route and in the vicinity of other Project facilities. Based on these surveys, approved Project facilities shall be located away from known landslides, very steep hillsides, debris-flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain. Where these landslide hazard areas cannot be avoided, appropriate engineering design and construction measures shall be incorporated into the Project designs to minimize potential for damage to Project facilities.

Impact GEO-5: Project structures would be damaged by seismically induced groundshaking and ground failure, including liquefaction and lateral spreading (Class II).

Moderate to strong groundshaking would be experienced along all portions of the Project route in the event of an earthquake on the faults in the Project area. The regional map for Riverside and San Bernardino Counties shows the entire Proposed Project area is located within the “greater than 0.7 gravity (g)” contour, which indicates that a seismic event in the area would be expected to result in strong to very strong groundshaking. Ground motions may be even greater on alluvial sediments, which cover much of the Proposed Project area (SCE, 2007a). Although appropriate tower design, which accounts for lateral wind loads and conductor loads, will likely exceed any creditable seismic loading, strong to severe seismically induced groundshaking could cause damage to Project structures. It is likely that the Project facilities would be subjected to at least one moderate or larger earthquake occurring close enough to produce strong groundshaking in the Project area. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions prior to final design of substation facilities and subtransmission line tower foundations (APM GEO-2), this impact would be significant without mitigation. To reduce Impact GEO-5 to a less-than-significant level, Mitigation

Measure GEO-5a (Reduce Effects of Groundshaking) shall be implemented prior to final Project design to ensure that people or structures are not exposed to hazards associated with strong seismic groundshaking. Mitigation Measure GEO-5a adds specific requirements to the geotechnical investigations planned in APM GEO-2 and design requirements to ensure that impacts from Impact GEO-5 is reduced to a less-than-significant level (Class II).

Liquefaction occurs in low-lying areas where saturated noncohesive sediments are found. Lateral spreading occurs along waterfronts or canals where non-cohesive soils could move out along a free-face. The soils beneath the El Casco Substation and Banning Substation sites have moderate potential for liquefaction, as do portions of the subtransmission line route between MP-3.5 to MP-5.5 and between MP-12 to MP-13.9, and both Maraschino Loop routes. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions in regard to geologic hazards (APM GEO-2), this impact would be significant without mitigation. However, with implementation of Mitigation Measure GEO-5b (Protect Against Liquefaction and Lateral Spreading), which adds specific requirements to the planned geotechnical investigations prior to final Project design, impacts related to liquefaction and lateral spreading would be reduced to a less-than-significant level (Class II).

Mitigation Measures for Impact GEO-5

GEO-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. The Applicant shall follow the Institute of Electrical and Electronics Engineers (IEEE) 693 “Recommended Practices for Seismic Design of Substations,” which has specific requirements to mitigate the types of damage that equipment at substations have had in the past from such seismic activity. These design guidelines shall be implemented during construction of substation modifications. Substation control buildings shall be designed in accordance with the 2001 California Building Code for sites in Seismic Zone 4 with near-field factors.

GEO-5b Protect Against Liquefaction and Lateral Spreading. Since seismically induced ground failure has the potential to damage or destroy Project components, SCE shall perform design-level geotechnical investigations to assess the potential for liquefaction and lateral spreading hazards to affect the approved Project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the Project designs. Appropriate measures include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in underground cables to allow ground deformations without damage to structures. SCE shall submit a report of the required investigations to the CPUC for review and approval at least 60 days before construction.

Impact GEO-6: Project structures would be damaged by surface fault rupture at crossings of active and potentially active faults (Class II).

The proposed 115 kV subtransmission line route crosses two traces of the Beaumont Plain Fault Zone at MP-6.58 and MP-7.9. The proposed Maraschino Loop West and Maraschino Loop South cross a trace of the same fault zone at MP-0.76 and MP-0.23, respectively, as shown in Figures D.6-2a and D.6-2b. This fault is considered active but is not within a mapped Alquist-Priolo zone. A portion of the fiber optic cable route would be located within the Alquist-Priolo fault zone of the San Andreas Fault just

east of the Zanja Substation. This portion of the route would also cross the Crafton Hills Fault. Both faults are considered active.

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 enough slack in the cables to absorb offset. This impact would be significant without mitigation. Although SCE has committed to APMs GEO-2 and GEO-3 that would require a geotechnical study to investigate seismic hazards and subsurface trenching along active fault traces, respectively, this impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-6 (Minimize Project Structures within Active Fault Zones) prior to final Project design for the active fault crossings identified above to minimize the length of subtransmission line and fiber optic cable within fault zones would reduce potential impacts associated with active fault crossings to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-6

GEO-6 Minimize Project Structures within Active Fault Zones. Perform a geologic study to confirm location of active and potentially mapped traces of the Beaumont Plain, San Andreas, and Crafton Hills faults where crossed by the Project alignment. Tower locations shall be adjusted as necessary to avoid placing tower footings on or across mapped fault traces. Towers on either side of a fault shall be designed to provide a significant amount of slack to allow for potential fault movement and ground surface displacement.

Impact GEO-7: Expansive, soft, loose and/or compressible soils would damage Project structures (Class II).

Problematic soils can cause construction and maintenance hazards. Expansive-soil, or shrink-swell behavior is a condition in which clay-rich soils react to changes in moisture content by expanding or contracting. Most of the soils beneath the proposed subtransmission line route and substation sites have low potential for expansion (shrink-swell); however, three soils types found along the subtransmission line route have moderate potential for expansion. These soil types include Chino silt, Placentia sandy loam, and Ramona sandy loam. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to structures and equipment. Potential operation impacts from loose sands, soft clays, and other potentially compressible soils include excessive settlement, low foundation-bearing capacity, and limitation of year-round access to Project facilities. Implementation of APM GEO-1, application of standard design and construction practices, and Mitigation Measure GEO-7 (Implement Standard Engineering Methods for Problematic Soils) would reduce potential impacts to less-than-significant levels (Class II).

Mitigation Measure for Impact GEO-7

GEO-7 Implement Standard Engineering Methods for Problematic Soils. SCE shall perform design-level geotechnical studies to identify areas with potentially problematic soils and develop appropriate design features, including excavation of potentially problematic soils during construction and replacement with engineered backfill, ground-treatment processes, redirection of surface water, and drainage away from expansive foundation soils. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days prior to commencement of construction.

D.6.4 CPUC’s Northerly Route Alternative Option 3

CPUC’s Northerly Route Alternative Option 3 (also referred to as Route Alternative Option 3) is located within the same general region as the Proposed Project and crosses the same types of geologic formations and soil types as described above for the Proposed Project in Section D.6.1. The subtransmission portion of this alternative is composed of the El Casco-Maraschino line, the Banning-Maraschino line (this line would only include construction along a 0.7-mile segment extending south out of Banning Substation), and the El Casco-Banning line (which includes the El Casco-Zanja line). The El Casco-Maraschino line follows the same route from El Casco Substation to Maraschino Substation as the western portion of the Proposed Project route, which is described above in Section D.6.1. Therefore discussion of the environmental setting for this alternative will focus primarily on the El Casco-Banning portion of the alternative route except where otherwise noted.

D.6.4.1 CPUC’s Northerly Route Alternative Option 3 – Environmental Setting

The westernmost end of the El Casco-Banning line, near the proposed El Casco substation, is underlain by recent alluvial sand, gravels, and clays associated with the San Timoteo Creek. The line then traverses slopes comprised of the San Timoteo Formation for approximately one mile. The remainder of the line crosses principally older alluvium and alluvial fan deposits, interspersed with younger alluvium. These surficial deposits are composed of sand and gravel. Slope instability is a potential issue along the portion of the route underlain by the San Timoteo Formation due to the steeper slopes, mapped landslides, and the nature of the bedrock unit (SCE, 2007a). As shown on Figure D.6-5, the El Casco-Banning line crosses four traces of the Beaumont Plain Fault Zone and the El Casco-Maraschino line crosses one trace of this fault (SCE, 2007a). Additionally, this route would cross the San Gorgonio Pass Fault Zone at approximately MP 12.1. This portion of the San Gorgonio Pass Fault is a mapped Alquist-Priolo Fault Zone (SCE, 2007a). As shown on Figure D.6-6, liquefaction susceptibility is documented as low from Milepost 0 to approximately Milepost 11 (SCE, 2007a), and moderately susceptible from Milepost 11 to Banning Substation (SCE, 2007a). The portion of the route that is documented as moderately susceptible to liquefaction is also documented to have no shallow groundwater, with levels varying from fifty, to over five hundred feet deep (SCE, 2007a). Table D.6-7 contains summaries of the geologic conditions for Option 3.

Table D.6-7 Milepost Geologic Conditions for the El Casco-Banning Subtransmission Route

Approximate Mile Marker ¹	Geologic Symbol ¹	Formation/ Feature Name ¹	Description/Comments ¹
0.0 - 0.7	Qa & Qg	Alluvium	Alluvial sand, gravel and clay from stream flood plains and stream channels
0.7 - 1.6	QTst	San Timoteo Formation	Sandstone, which forms badland topography
1.6 - 4.3	Qoa & Qa	Alluvium	Alluvial fan sand and gravel deposits dissected by sand, gravel, and clay of steam channel flood plains
4.3	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
4.3 - 5.0 6	Qoa, Qa & Qg	Alluvium	Alluvial fan sand and gravel deposits dissected by sands, gravels, and clays of steam channels and stream flood plains
5.06	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
5.06 - 5.6	Qoa, Qa & Qg	Alluvium	Alluvial fan sand and gravel deposits dissected by sands, gravels, and clays of steam channels and stream flood plains
5.6	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone

Table D.6-7 Milepost Geologic Conditions for the El Casco-Banning Subtransmission Route

Approximate Mile Marker ¹	Geologic Symbol ¹	Formation/ Feature Name ¹	Description/Comments ¹
5.6 - 5.85	Ooa, Qa & Qg	Alluvium	Alluvial fan sand and gravel deposits dissected by sands, gravels, and clays of stream channels and stream flood plains
5.85	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
5.85 - 9.2	Qf	Alluvial fan deposits	Alluvial fan sediments; moderate slope
9.2 - 9.7	QTsf	San Timoteo Formation	Sandstone; fine to coarse grained, locally pebbly with granitic pebbles and some cobbles. Includes interbeds of green and red claystone.
9.7 - 10.7	Qof	Alluvial Gravel	Alluvial gravel and sand at high fans of Banning Bench.
10.7-11.5	QTsf	San Timoteo Formation	Sandstone; fine to coarse grained, locally pebbly with granitic pebbles and some cobbles. Includes interbeds of green and red claystone.
11.5 - 12.1	Tcf	Coachella Conglomerate	Fanglomerate, massive to crudely bedded of unsorted detritus of plutonic and gneissic rocks derived from San Bernardino Mountains.
12.1	Fault	San Gorgonio Pass Fault Zone	Active Fault; California Geological Survey Alquist-Priolo Earthquake Fault Zone
12.2 - Banning Substation	Qf	Alluvial fan deposits	Alluvial fan sediments; moderate slope

Notes: Information in these columns is primarily derived from Table C.5-1 of the PEA (SCE, 2006). Project mile measurements were estimated.

Soils underlying this route have a low expansion potential, with the exception of the first 0.7 mile, which are moderately expansive. Soil erosion potential is high for the first 0.7 mile. The remainder of the route is about evenly split between low and moderate erosion potential, as shown in Table D.6-8 and Figures D.6-7a through D.6-7c.

Table D.6-8. Major Soils Along the El Casco-Banning Subtransmission Route¹

Soil Symbol	Description ²	Shrink-Swell Potential ¹	Erosion Potential ^{2,3}	Corrosion Potential ¹	
				Concrete	Steel
Ce	Chino silt loam, drained	moderate	high	low	high
Cg	Chino silt loam, drained strongly saline-alkali	moderate	high	low	high
GyC2	Greenfield sandy loam, 2 to 8% slopes, eroded	low	moderate	low	low
GyE2	Greenfield sandy loam, 15 to 25% slopes, eroded	low	moderate	low	low
HcC	Hanford coarse sandy loam, 2 to 8% slopes	low	moderate	low	low
HcD2	Hanford coarse sandy loam, 8 to 15% slopes	low	moderate	low	low
RaB2	Ramona sandy loam, 2 to 5% slopes, eroded	low	moderate	low	moderate
RaC2	Ramona sandy loam, 5 to 8% slopes, eroded	low	moderate	low	moderate
RaD3	Ramona sandy loam, 8 to 15% slopes, eroded	low	moderate	low	moderate
RaE3	Ramona sandy loam, 15 to 25% slopes, severely eroded	low	moderate	low	moderate
ReC2	Ramona very fine sandy loam, 0 to 8% slopes, eroded	NR	high	low	moderate
SmE2	San Timoteo loam, 8 to 25% slopes, eroded	low	low	low	low
TeG	Terrace escarpments	low	NR	NR	low

Notes: 1) Locations of these soil types are depicted on Figures D.6-7a through D.6-7c.

2) Information in these columns is primarily derived from Table 3.6-4 of the PEA (SCE, 2007a).

3) Erosion Hazard: 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.

4) NR = Not Rated

D.6.4.2 CPUC's Northerly Route Alternative Option 3 – Environmental Impacts and Mitigation Measures

The geology and soils impacts of Route Alternative Option 3 are discussed below under subheadings corresponding to each of the significance criteria presented above in Section D.6.3.1. The analysis describes the impacts of Route Alternative Option 3 related to geologic, seismic, and soils hazards and, for each criterion, determines whether implementation of this alternative would result in significant impacts.

Impact GEO-1: Construction activities would cause slope instability (Class II).

Similar to the Proposed Project, Route Alternative Option 3 crosses terrain that ranges from flat to 25 percent slopes. Excavation operations associated with tower foundation construction and grading operations for temporary and permanent access roads and construction activities in areas of hilly or sloping terrain could result in increased slope instability, landslides, soil creep, or debris flows during construction. Although SCE would implement APM GEO-1 (Perform geotechnical studies to identify site-specific geologic conditions), this impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-1 (Protect Against Slope Instability), which adds specific requirements to the planned geotechnical investigations prior to final Project design, would reduce Impact GEO-1 to a less-than-significant level (Class II).

Construction-induced slope instability is not anticipated to occur at the Mill Creek Communications Site, Zanja Substation, Banning Substation, or the Maraschino Loops since construction would occur on flat land and/or would not require excavation or grading at these locations. Fiber optic cable for the new fiber optic system would be installed on existing poles and within existing underground conduit. Installation of fiber optic cable would not require any ground disturbing activities and no impacts would occur.

Mitigation Measure for Impact GEO-1

GEO-1 Protect Against Slope Instability

Impact GEO-2: Construction activities would accelerate erosion (Class II).

This alternative traverses the same types of soils as the Proposed Project and therefore has the same potential for accelerating erosion as construction of the Proposed Project. This impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-2 (Minimize Soil Erosion) ensures that potential impacts from erosion related to grading and use of access roads and work areas in areas of moderate to severe erosion potential during construction would be reduced to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-2

GEO-2 Minimize Soil Erosion

Impact GEO-3: Project structures would be damaged by corrosive soils (Class II).

Similar to the Proposed Project, soils with moderate to high potential for corrosion exist along the Route Alternative Option 3 route, as presented in Table D.6-8. Therefore impacts of this alternative would be the same as those described above for the Proposed Project. Although SCE plans to perform

geotechnical studies to identify site-specific geologic conditions (APM GEO-1) prior to final design of substation facilities and subtransmission line tower foundations, this impact would be significant without mitigation. Implementation of Mitigation Measure GEO-3 (Geotechnical Studies for Corrosive Soils), would reduce Impact GEO-3 to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-3

GEO-3 Geotechnical Studies for Corrosive Soils

Impact GEO-4: Project structures would be damaged by unstable soils, landslides, earthflows, and/or debris flows (Class II).

The El Casco Substation site, the Mill Creek Communications site, and portions of the proposed El-Casco-Maraschino and El Casco-Banning subtransmission routes are located on, or cross, sloping areas that are underlain by geologic formations prone to landslides (San Timoteo Formation and Potato Sandstone). These same areas also traverse existing landslides or are situated near existing landslides. Therefore, this alternative would have the same susceptibility as the Proposed Project for slope instability, including landslides, earth flows, and debris flows. The geologic formations present in these areas have the potential to undermine foundations, cause distortion and distress to overlying structures, and displace or destroy Project components. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions (APM GEO-1) prior to final design of substation facilities and subtransmission line tower foundations, this impact would be significant without mitigation. However, with implementation of Mitigation Measure GEO-4 (Geotechnical Surveys for Landslides), which adds specific requirements to the planned geotechnical investigations to be completed prior to final Project design, Impact GEO-4 would be reduced to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-4

GEO-4 Geotechnical Surveys for Landslides

Impact GEO-5: Project structures would be damaged by seismically induced groundshaking and ground failure, including liquefaction and lateral spreading (Class II).

Moderate to strong groundshaking would be experienced along the all portions of this alternative route in the event of an earthquake on the faults in the Project area. The regional map for Riverside and San Bernardino Counties shows the entire Project area is located within the “greater than 0.7 gravity (g)” contour, which indicates that a seismic event in the area would be expected to result in strong to very strong groundshaking. Impacts would be similar to those described for the Proposed Project; however, since this alternative crosses two more active fault traces than the Proposed Project it is incrementally more susceptible to groundshaking. Ground motions may be even greater on alluvial sediments, which cover much of the alternative route (SCE, 2007a). Although appropriate tower design will likely exceed any creditable seismic loading, strong to severe seismically induced groundshaking could cause damage to Project structures. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions prior to final design of substation facilities and subtransmission line tower foundations (APM GEO-2), this impact would be significant without mitigation. To reduce Impact GEO-5 to a less-than-significant level, Mitigation Measure GEO-5a (Reduce Effects of Groundshaking) shall be implemented prior to final Project design to ensure that people or structures are not exposed to hazards associated with strong seismic groundshaking. Mitigation Measure GEO-5a adds specific

requirements to the geotechnical investigations planned in APM GEO-2 and design requirements to ensure that impacts from Impact GEO-5 is reduced to a less-than-significant level (Class II).

The soils beneath the El Casco Substation and Banning Substation sites have moderate potential for liquefaction, as do portions of the subtransmission line route between MP-11 to Banning Substation. Although SCE plans to perform geotechnical studies to identify site-specific geologic conditions with regard to geologic hazards (APM GEO-2), this impact would be significant without mitigation. However, with implementation of Mitigation Measure GEO-5b (Protect Against Liquefaction and Lateral Spreading), which adds specific requirements to the planned geotechnical investigations prior to final Project design, impacts related to liquefaction and lateral spreading would be reduced to a less-than-significant level (Class II).

Mitigation Measures for Impact GEO-5

GEO-5a Reduce Effects of Groundshaking

GEO-5b Protect Against Liquefaction and Lateral Spreading

Impact GEO-6: Project structures would be damaged by surface fault rupture at crossings of active and potentially active faults (Class II).

This alternative route crosses five traces of the Beaumont Plain Fault Zone, as shown in Figure D.6-5. This fault is considered active but is not within a mapped Alquist-Priolo zone. The El-Casco Banning Line also crosses the San Gorgonio Pass Fault Zone at approximately MP 12.1. This portion of the San Gorgonio Pass Fault is a mapped Alquist-Priolo Fault Zone (SCE, 2007a). A portion of the fiber optic cable route would be located within the Alquist-Priolo fault zone of the San Andreas Fault just east of the Zanja Substation. This portion of the route would also cross the Crafton Hills Fault. Both faults are considered active.

Fault crossings along active faults where multiple feet of displacement are expected are best accomplished as overhead lines with towers placed well outside the fault zone to allow for enough slack in the cables to absorb offset. Although SCE has committed to APMs GEO-2 and GEO-3 that would require a geotechnical study to investigate seismic hazards and subsurface trenching along active fault traces, respectively, this impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-6 (Minimize Project Structures within Active Fault Zones) prior to final Project design to minimize the length of subtransmission line and fiber optic cable within fault zones for the active fault crossings identified above would reduce potential impacts associated with active fault crossings to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-6

GEO-6 Minimize Project Structures within Active Fault Zones

Impact GEO-7: Expansive, soft, loose, and/or compressible soils would damage Project structures (Class II).

Problematic soils can cause construction and maintenance hazards. Expansive soil, or shrink-swell behavior is a condition in which clay-rich soils react to changes in moisture content by expanding or contracting. Most of the soils beneath this alternative line route and the substation sites have low potential for expansion (shrink-swell); however, two soils types found along the subtransmission line route, Chino silt

and Ramona sandy loam, have moderate potential for expansion. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to structures and equipment. Potential operation impacts from loose sands, soft clays, and other potentially compressible soils include excessive settlement, low foundation-bearing capacity, and limitation of year-round access to Project facilities. Implementation of APM GEO-1, application of standard design and construction practices, and Mitigation Measure GEO-7 (Implement Standard Engineering Methods for Problematic Soils) would reduce potential impacts to less-than-significant levels (Class II).

Mitigation Measure for Impact GEO-7

GEO-7 Implement Standard Engineering Methods for Problematic Soils

D.6.5 Partial Underground Alternative

The Partial Underground Alternative is identical to the Proposed Project except under this alternative, a one-mile segment of the 115 kV subtransmission line, from approximately MP 9.0 to MP 10.0, would be installed underground.

D.6.5.1 Partial Underground Alternative – Environmental Setting

This alternative follows the same route and crosses the same faults, geologic formations, and soil types as the Proposed Project, therefore the environmental setting for this alternative is identical to that of the Proposed Project and is described above in Section D.6.1.

D.6.5.2 Partial Underground Alternative – Environmental Impacts and Mitigation Measures

This alternative would have identical Geology and Soils impacts as identified for the Proposed Project at the substation sites, the Mill Creek Communication site, and the Fiber Optic System and would require the same mitigation recommended for the Proposed Project. This alternative would also result in identical impacts as the Proposed Project along the subtransmission line route. Installing a one-mile segment of the subtransmission line underground would not avoid or reduce impacts to geology and soils, however it may result in increased potential for certain geology and soils impacts. Therefore, the impact analysis presented below will focus specifically on activities related to installation of the underground segment of the line.

Impact GEO-1: Construction activities would cause slope instability (Class II).

Impacts for this alternative would be identical to those described for the Proposed Project and would be reduced to a level of less than significant (Class II) with implementation of Mitigation Measure GEO-1 (Protect Against Slope Instability), which adds specific requirements to the geotechnical investigations that would be implemented under APM GEO-1.

Mitigation Measure for Impact GEO-1

GEO-1 Protect Against Slope Instability

Impact GEO-2: Construction activities would accelerate erosion (Class II).

Excavation and grading activities associated with the underground portion of this alternative would be substantially more intensive than those of the Proposed Project and would have an incrementally higher

potential for accelerating erosion along this portion of the route. Similar to the Proposed Project this impact would be significant without mitigation. However, implementation of Mitigation Measure GEO-2 (Minimize Soil Erosion) ensures that potential impacts from erosion related to grading and use of access roads and work areas in areas of moderate to severe erosion potential during construction would be reduced to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-2

GEO-2 Minimize Soil Erosion

Impact GEO-3: Project structures would be damaged by corrosive soils (Class II).

Impacts for this alternative would be identical to those described for the Proposed Project and would be reduced to a level of less than significant (Class II) with implementation of Mitigation Measure GEO-3 (Geotechnical Studies for Corrosive Soils), which adds specific requirements to the geotechnical investigations that would be implemented under APM GEO-1.

Mitigation Measure for Impact GEO-3

GEO-3 Geotechnical Studies for Corrosive Soils. (See Section D.6.3.3 for full description.)

Impact GEO-4: Project structures would be damaged by unstable soils, landslides, earthflows, and/or debris flows (Class II).

Impacts for this alternative would be identical to those described for the Proposed Project and would be reduced to a level of less than significant (Class II) with implementation of Mitigation Measure GEO-4 (Geotechnical Surveys for Landslides), which adds specific requirements to the geotechnical investigations that would be implemented under APM GEO-1.

Mitigation Measure for Impact GEO-4

GEO-4 Geotechnical Surveys for Landslides

Impact GEO-5: Project structures would be damaged by seismically induced groundshaking and ground failure, including liquefaction and lateral spreading (Class II).

Although the underground portion of this alternative does not cross any known active fault traces, impacts for this alternative would be identical to those described for the Proposed Project and would be reduced to a level of less than significant (Class II) with implementation of Mitigation Measures GEO-5a (Reduce Effects of Groundshaking) and GEO-5b (Protect Against Liquefaction and Lateral Spreading), which adds specific requirements to the geotechnical investigations that would be implemented under APM GEO-2.

Mitigation Measures for Impact GEO-5

GEO-5a Reduce Effects of Groundshaking

GEO-5b Protect Against Liquefaction and Lateral Spreading

Impact GEO-6: Project structures would be damaged by surface fault rupture at crossings of active and potentially active faults (Class II).

The underground portion of this alternative does not cross any active fault traces. However the above ground portion of this route would cross the same faults as Proposed Project. Therefore impacts of this alternative would be identical to those described for the Proposed Project and would be significant without mitigation. However, implementation of Mitigation Measure GEO-6 (Minimize Project Structures within Active Fault Zones) prior to final Project design for the active fault crossings identified above to minimize the length of subtransmission line and fiber optic cable within fault zones would reduce potential impacts associated with active fault crossings to a less-than-significant level (Class II).

Mitigation Measure for Impact GEO-6

GEO-6 Minimize Project Structures within Active Fault Zones

Impact GEO-7: Expansive, soft, loose and/or compressible soils would damage Project structures (Class II).

Impacts for this alternative would be identical to those described for the Proposed Project and would be reduced to a level of less than significant (Class II) with implementation of Mitigation Measure GEO-7 (Implement Standard Engineering Methods for Problematic Soils), which adds specific requirements to the geotechnical investigations that would be implemented under APM GEO-1.

Mitigation Measure for Impact GEO-7

GEO-7 Implement Standard Engineering Methods for Problematic Soils

D.6.6 No Project Alternative

Under the No Project Alternative the Proposed Project would not be built and none of the impacts described above would occur. However, without the Proposed Project, overload of the existing capacities would occur at five distribution stations that are currently served by the Vista and Devers 115 kV Systems. To address the overload conditions in the Maraschino service area, SCE would add a third transformer and two 12 kV distribution lines (each about nine miles in length).

D.6.6.1 Environmental Impacts of the No Project Alternative

If the No Project Alternative is selected, the environmental impacts identified above would not occur. However, without the Proposed Project, overload of existing capacities would occur at five distribution substations that are currently served by the Vista and Devers 115 kV Systems (Crafton Hills, Maraschino, Mentone, Zanja, and Banning, Substations). To address the overload conditions in the Maraschino Substation service area, SCE would add a third transformer and two 12 kV distribution lines (each approximately 9 miles in length) at Maraschino Substation.

Although it is currently unknown where the 12 kV distribution lines would be constructed, it can be reasonably assumed that construction of these lines would result in similar impacts as the Proposed Project. Any construction activities that require grading and excavation would have the potential to result in similar impacts related to soils (inducing slope instability, accelerating erosion, damage from corrosive, loose, compressible or unstable soils) and project structures would be susceptible to seismic-

related impacts such as groundshaking, liquefaction, and surface fault ruptures. These impacts would require mitigation similar to the Proposed Project depending on the results of site-specific geotechnical investigations to characterize site-specific soils and seismic conditions.

D.6.7 Mitigation Monitoring, Compliance, and Reporting Table

Table D.6-9 on the following page presents the mitigation monitoring recommendations for Geology and Soils. These measures along with Applicant Proposed Measures GEO-1 through GEO-3 would be applicable to construction on the proposed route and all alternative route segments.

Table D.6-9. Mitigation Monitoring Program – Geology and Soils

Impact	Mitigation Measure	Location	Monitoring / Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
<p>GEO-1: Construction activities would cause slope instability (Class II).</p>	<p>GEO-1: Protect Against Slope Instability. Appropriate support and protection measures shall be implemented to maintain the stability of excavations and protect surrounding structures and utilities to limit ground deformation. Design-level geotechnical investigations shall be performed to evaluate subsurface conditions, identify potential hazards, and provide information for development of excavation plans and procedures. Based on the results of the geotechnical investigations, appropriate support and protection measures shall be designed and implemented to maintain the stability of slopes adjacent to newly graded or re-graded access roads and work areas during and after construction. These measures shall include, but are not limited to, retaining walls, visqueen, removal of unstable materials, and avoidance of highly unstable areas. SCE shall document compliance with this measure prior to the start of construction by submitting a report to the CPUC for review and approval. The report shall document the investigations and detail the specific support and protection measures that will be implemented.</p>	<p>Areas where surface units are not coherent enough to support themselves during excavation</p>	<p>CPUC-approved engineer shall review and approve construction plans, including the report that will document the investigations and provide the support and protection measures</p>	<p>Plan/ remediation prevents collapse of excavations and risk or injury to workers to the extent feasible</p>	<p>CPUC, local planning agencies</p>	<p>Prior to construction. Could be staged to stay ahead of construction at particular site</p>
	<p>APM GEO-1: A geotechnical investigation of slope stability and geologic conditions, coupled with engineering design, would delineate the extent of potential landslide hazards and develop recommendations to support appropriate design measures to mitigate these hazards. Landslide mitigation may include one or more of the measures listed below.</p> <ul style="list-style-type: none"> • Over-excavation of adverse bedding and landslide failure surfaces, and placement of a large stabilizing buttress fill. • Over-excavation of adverse bedding and landslide failure surfaces to remove potential slope stability hazards. • Other appropriate design measures, or combinations of design measures. 					

Table D.6-9. Mitigation Monitoring Program – Geology and Soils

Impact	Mitigation Measure	Location	Monitoring / Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
GEO-2: Construction activities would accelerate erosion (Class II).	GEO-2: Minimize Soil Erosion. The Construction SWPPP for the Project shall include Best Management Practices (BMPs) designed to minimize soil erosion along access roads and at work areas. Appropriate BMPs may include construction of water bars, grading road surfaces to direct flow away from natural slopes, use of soil stabilizers, and consistent maintenance of roads and culverts to maintain appropriate flow paths. Silt fences and straw bales installed during construction shall be removed to restore natural drainage during the cleanup and restoration phase of the Proposed Project. Where access roads cross streams or drainages, they shall be built at or close to right angles to the streambeds and washes and culverts or rock crossings shall be used to cross streambeds and washes. Design of appropriate BMPs should be conducted by or under the direction of a qualified geologist or engineer.	Entire Project alignment	Review and approve final construction plans demonstrating compliance with this measure. Onsite monitor to verify effective use of screening fencing and compliance with additional requirements of this measure.	Ground-level clutter from equipment, materials, and vehicles will be effectively screened from views in areas of high public visibility.	CPUC	Prior to and during construction.
GEO-3: Project structures would be damaged by problematic soils (Class II).	GEO-3: Geotechnical Studies for Corrosive Soils. In areas underlain by potentially corrosive soils, the design-level geotechnical studies performed by SCE shall identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates, and soil parameters, such as pH and electrical resistivity. 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.	In areas identified as having corrosive soils	CPUC-approved engineer shall review test results and approve geotechnical report, grading plans, and foundation designs	Plan/ remediation prevents corrosion of foundations and trench facilities to extent feasible	CPUC, local planning agencies	Prior to construction. Could be staged to stay ahead of construction at particular site
	APM GEO-1: Perform geotechnical investigation of slope stability and geologic conditions (see Impact GEO-1, above for full description).					

Table D.6-9. Mitigation Monitoring Program – Geology and Soils						
Impact	Mitigation Measure	Location	Monitoring / Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
GEO-4: Project structures would be damaged by unstable soils, landslides, earthflows, and/or debris flows (Class II).	<p>GEO-4: Geotechnical Surveys for Landslides. The design-level geologic/geotechnical investigation performed by SCE shall include detailed surveys to evaluate the potential for unstable slopes, landslides, earth flows, and debris flows along the approved subtransmission line route and in the vicinity of other Project facilities. Based on these surveys, approved Project facilities shall be located away from known landslides, very steep hillsides, debris-flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain. Where these landslide hazard areas cannot be avoided, appropriate engineering design and construction measures shall be incorporated into the Project designs to minimize potential for damage to Project facilities.</p>	Areas of steep slopes and incompetent rock, colluvium, or soil such as portions of the Proposed Project underlain by the San Timoteo Formation	CPUC-approved engineer shall review and approve construction plans.	Plan/ remediation prevents damage to Proposed Project facilities during a groundshaking event to the extent feasible	CPUC, local planning agencies	Prior to construction. Could be staged to stay ahead of construction at particular site
	<p>APM GEO-1: Perform geotechnical investigation of slope stability and geologic conditions (see Impact GEO-1, above for full description).</p>					
GEO-5: Project structures would be damaged by seismically induced groundshaking and ground failure, including liquefaction and lateral spreading (Class II).	<p>GEO 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. The Applicant shall follow the Institute of Electrical and Electronics Engineers (IEEE) 693 "Recommended Practices for Seismic Design of Substations" which has specific requirements to mitigate the types of damage that equipment at substations have had in the past from such seismic activity. These design guidelines shall be implemented during construction of substation modifications. Substation control buildings shall be designed in accordance with the 2001 California Building Code for sites in Seismic Zone 4 with near-field factors.</p> <p>GEO-5b Protect Against Liquefaction and Lateral Spreading. Since seismically induced ground failure has the potential to damage or destroy Proposed Project components, SCE shall</p>	Areas having moderate potential for liquefaction, especially along the sub-transmission line route between MP-3.5 and MP 5.5 and between MP-12 and MP-13.9, and both Maraschino Loop routes	CPUC-approved engineer shall review and approve construction plans.	Plan/ remediation prevents liquefaction/differential settling to the extent feasible	CPUC, local planning agencies	Prior to construction. Could be staged to stay ahead of construction at particular site

Table D.6-9. Mitigation Monitoring Program – Geology and Soils

Impact	Mitigation Measure	Location	Monitoring / Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
	<p>perform design-level geotechnical investigations to assess the potential for liquefaction and lateral spreading hazards to affect the approved Proposed Project and all associated facilities. Where these hazards are found to exist, appropriate engineering design and construction measures shall be incorporated into the Proposed Project designs. Appropriate measures could include construction of pile foundations, ground improvement of liquefiable zones, installation of flexible bus connections, and incorporation of slack in underground cables to allow ground deformations without damage to structures. SCE shall submit a report of the required investigations to the CPUC for review and approval at least 60 days before construction.</p>					
		<p>The entire Project area, but especially along the subtransmission line route at MP-6.58 and MP-7.9. and both Maraschino Loop routes</p>	<p>CPUC-approved engineer shall review and approve construction plans</p>	<p>Plan/ remediation prevents damage to Proposed Project facilities during a groundshaking event to the extent feasible</p>	<p>CPUC, local planning agencies</p>	<p>Prior to construction. Could be staged to stay ahead of construction at particular site</p>
	<p>APM GEO-2: A geotechnical investigation of site soils and geologic conditions, coupled with engineering design, would identify the hazards and develop recommendations to support appropriate seismic designs to mitigate the effects of ground shaking. Specific requirements for seismic design would be based on the IEEE 693 "Recommended Practices for Seismic Design of Substations", and/or CBC Seismic Design criteria for sites within seismic Zone IV.</p>					

Table D.6-9. Mitigation Monitoring Program – Geology and Soils						
Impact	Mitigation Measure	Location	Monitoring / Reporting Action	Effectiveness Criteria	Responsible Agency	Timing
GEO-6: Project structures would be damaged by surface fault rupture at crossings of active and potentially active faults (Class II).	GEO-6: Minimize Project Structures within Active Fault Zones. Perform a geologic/geotechnical study to confirm location of active and potentially mapped traces of the Beaumont Plain, San Andreas, and Crafton Hills faults where crossed by the Project alignment. Tower locations shall be adjusted as necessary to avoid placing tower footings on or across mapped fault traces. Towers on either side of a fault shall be designed to provide a significant amount of slack to allow for potential fault movement and ground surface displacement.	At crossings of the Beaumont Plain Fault Zone, the San Andreas Fault, and the Crafton Hills Fault.	CPUC-approved engineer shall review and approve construction plans	Plan/ remediation prevents damage to Proposed Project facilities during a groundshaking event to the extent feasible	CPUC, local planning agencies	During planning stages of fault crossings
	<p>APM GEO-2: Perform geotechnical investigation of geologic conditions and seismic hazards (see Impact GEO-5, above for full description).</p> <p>APM GEO-3: Where appropriate, subsurface trenching along active fault traces would be required to ensure tower foundations are not placed on, or immediately adjacent to, these features. In addition, tower locations would be selected to accommodate anticipated fault offset, and minimize excessive tension in lines should a fault movement occur.</p>					
GEO-7: Expansive, Soft, Loose and/or Compressible Soils would damage Proposed Project structures (Class II).	GEO-7: Implement Standard Engineering Methods for Problematic Soils. SCE shall perform design-level geotechnical studies to identify areas with potentially problematic soils and develop appropriate design features, including excavation of potentially problematic soils during construction and replacement with engineered backfill, ground-treatment processes, redirection of surface water and drainage away from expansive foundation soils. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days before construction.	Areas having soils with moderate to high shrink-swell potential, soft or loose soils	CPUC-approved engineer shall review and approve geotechnical report, grading plans, and foundation designs	Plan/ remediation prevents differential settling to the extent feasible	CPUC, local planning agencies	Prior to construction. Could be staged to stay ahead of construction at particular site
	APM GEO-1: Perform geotechnical investigation of slope stability and geologic conditions (see Impact GEO-1, above for full description).					

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[Click here for Figure D.6-2a](#)

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