Section 3.6

3.6 GEOLOGY AND SOILS

This section describes existing conditions and the potential impacts on geology and soils from construction and operation of the Proposed Project and alternatives.

3.6.1 Existing Conditions

3.6.1.1 Physiographic Setting

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.

The Proposed Project and alternatives extend from the Crafton Hills and southern edge of the San Bernardino Mountains, 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, giving it a distinctive topography, known as the "The Badlands". The western San Gorgonio Pass is a gentle southwest to southerly sloping alluvial fan valley, 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.

3.6.1.2 Geologic Setting

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 steep, fault-bounded eastern faces, and more gentle western slopes (Norris & Webb, 1976). The Transverse Ranges are composed primarily of sedimentary bedrock to the west, and granitic and metamorphic rocks to the east, such as in the San Gabriel and San Bernardino Mountains. The Transverse Ranges are distinguished by their anomalous east-west trending mountains and valleys.

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 strikeslip 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 unusual 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 basins, and dissected streams and alluvial fans of the valley areas.

3.6.1.2.1 <u>Geologic Units</u>. The Plio-Pleistocene age San Timoteo Formation (QTsf, QTsg or Tst) is the predominant bedrock unit with surface exposure within the area of the proposed new substation and much of the western portions of the proposed and alternate subtransmission line routes (Dibblee, 2003; Dibblee, 2004). The formation is comprised of relatively poorly cemented, highly erodible sandstones, conglomerates, and fanglomerates, that often form topography characterized as "Badlands" (Riverside County General Plan, 2003). Figures 3.6-1 through 3.6-4 show the distribution of this Formation. Figure 3.6-5 is a Legend for the previous four figures.

The Miocene age Potato Formation (Tpo) underlies the southern San Bernardino Mountains north of Yucaipa (Dibblee, 2004; Matti, et al, 2003). Comprised of sandstone, it is locally interbedded with clay shale and often fails, producing significant sized landslides (Figure 3.6-6 and Legend, Figure 3.6-7).

A majority of the valley areas of the Proposed Project are underlain by Quaternary alluvium, derived from several different bedrock and alluvial sources (Dibblee, 2003; Dibblee, 2004). The eastern half of the main project area is underlain by alluvial fans (Qf and Qof) 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 the Younger Alluvium (Qa) and stream channels (Qg), forming a large dendritic pattern converging on San Timoteo Creek (Figures 3.6-1 through 3.6-5, and Figures 3.6-6 and 3.6-7).

Recent landslides have been mapped within the San Timoteo Formation along the south side of San Timoteo Creek (Morton, 2004), as well as within the Potato Formation (Tpo), on the slopes of the southern San Bernardino Mountains north of Yucaipa (Matti, et al, 2003).

Table 3.6-1 contains a summary of the geological conditions relevant to the Proposed Project.

TABLE 3.6-1
MILEPOST GEOLOGIC CONDITIONS FOR PROPOSED SUBSTATIONS AND TRANSMISSION ROUTES

Approximate Mile Marker	Geologic Symbol	Formation or Fault Name	Description of Conditions
Site 33 (Preferred Site)			
	Qa, Qyls and Tst	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 south part of the site (Morton, 2004).
Site 38 (Alternate Site)			
	Qa and Qtst	Alluvium and San Timoteo Formation	Alluvial sand, gravel and clay from stream flood plains, and sandstone, which forms badland topography
	Qg		Alluvial sand and gravel from stream channels
Banning Substation			
	Qf	Alluvial fan deposits	Alluvial fan sediments; moderate slope
Zanja Substation			
	Qoa	Older Alluvium	Alluvial fan gravel and sand
Proposed Southerly 115 kV Subtransmission Line Route			
0.0 – 3.6	Tst and Qa	San Timoteo Formation and Alluvium	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	Tst	San Timoteo Formation	Sandstone, which forms badland topography
6.58	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
6.58 – 6.8	Tst	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	Tst	San Timoteo Formation	Sandstone, which forms badland topography
7.9	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
7.9 – 8.7	Tst	San Timoteo Formation	Sandstone, which forms badland topography

TABLE 3.6-1 ***(Continued)***
MILEPOST GEOLOGIC CONDITIONS FOR PROPOSED SUBSTATIONS AND TRANSMISSION ROUTES

Approximate Mile Marker	Geologic Symbol	Formation or Fault Name	Description of Conditions
8.7 – 13.9	Qf & Qa	Alluvial fan deposits	Alluvial fan sediments, moderate slope and Alluvial sand, gravel and clay from stream flood plains
Northerly 115 kV Subtransmission Line Route Alternative			
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
5.6 - 5.85	Qoa, Qa & Qg	Alluvium	Alluvial fan sand and gravel deposits dissected by sands, gravels, and clays of steam channels and stream flood plains
5.85	Fault	Beaumont Plain Fault Zone	Riverside County Fault Zone
5.85 - 9.9	Qf	Alluvial fan deposits	Alluvial fan sediments; moderate slope
9.9 - 11.09	Qof and small channel of Qf	Alluvial fan deposits	Alluvial fan sediments, which form the Banning Bench (Mesa) area, moderate to steep slopes; closely parallels a trace of the San Gorgonio Pass Fault Zone
10.38 - 11.09	Fault	San Gorgonio Pass Fault Zone	Active Fault; California Geological Survey Alquist-Priolo Earthquake Fault Zone
11.09 - 13.6	Qf	Alluvial fan deposits	Alluvial fan sediments; moderate slope
Maraschino Loop Route			
<u>Loop West</u>			

TABLE 3.6-1 *(Continued)*
MILEPOST GEOLOGIC CONDITIONS FOR PROPOSED SUBSTATIONS AND TRANSMISSION ROUTES

Approximate Mile Marker	Geologic Symbol	Formation or Fault Name	Description of Conditions
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

Source: Dibblee Maps; Riverside County General Plan, 2003; CGS AP Earthquake Fault Zoning

3.6.1.3 Geologic Hazards

3.6.1.3.1 Faulting and Seismicity. Northwestern Riverside County and southwestern San Bernardino County, like much of southern California, are crossed by numerous active and potentially active faults (Figure 3.6-8). The faults depicted on a regional scale in Figure 3.6-8 show the interconnection of local and regional faults. Active or potentially active faults are those that have evidence of movement within the last 11,000 and 1,600,000 years, respectively, and are considered to have the greatest likelihood of rupturing in the future.

There are several active or potentially active fault zones, near or underlying the Proposed Project in Riverside County, as shown on Figure 3.6-9. 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 (San Bernardino County General Plan, 2005).

Active or potentially active faults, or fault zones, near the western project area, in San Bernardino County, include the Claremont, Crafton Hills, San Jacinto, Mill Creek, and San Andreas Fault Zones, as shown on Figures 3.6-10 and 3.6-11. The Mill Creek Fault Zone is considered to be a northern branch of the San Andreas Fault Zone in the project area.

Magnitude

Magnitude is a unit of measure used to describe the size of an earthquake. Historically, the two main methods used to determine magnitude were the Richter magnitude and the Modified Mercalli Intensity (MMI) scale. The Richter magnitude measurement method relies on instruments recording the maximum amplitude of earthquake generated seismic waves. The MMI method is a qualitative scale based on the amount of destruction to structures. The most common and familiar instrumental method is the Richter magnitude (M_L). However, a more consistent method over a greater range of magnitudes is the Seismic Moment (M_W) method, which records the energy released during an earthquake. This method measures the moment magnitude by recording many different frequencies, producing greater accuracy.

Maximum Credible Earthquake Magnitude

The Maximum Credible Earthquake (MCE) is defined as the largest earthquake that appears reasonably capable of occurring along a fault under the presently known geologic framework. This magnitude can be estimated in two ways: 1) correlating numerous fault parameters (e.g., length, displacement and area), and 2) the largest historical earthquake for a specific fault.

The local faults, their shortest distance to the Proposed Project, their maximum credible earthquake magnitude, and fault status, as specified by the Counties of Riverside and San Bernardino or the State of California, are summarized in Tables 3.6-2 and 3.6-3.

TABLE 3.6-2
LOCAL FAULTS IN THE VICINITY OF THE PROJECT

Fault Name	Max. Credible Earthquake	Fault Status
Beaumont Plain Fault Zone	NA	Active, Potentially Active & Unknown
San Andreas Fault Zone	8.0	Active
Banning Fault Zone	7.2	Active
San Gorgonio Pass Fault	6 5	Active
Cherry Valley Fault	NA	Potentially Active
San Jacinto Fault Zone	7.5	Active
Crafton Hills Fault Zone	6.5	Active

Source: Mualchin; CGS, 1999, SCEDC, 2006.
Notes: NA - not available

Ground Acceleration (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 and California Geological Survey have generated regional maps depicting peak horizontal ground acceleration through their Probabilistic Seismic Hazards Assessment (PSHA) Program. Ground acceleration is expressed as a probabilistic seismic hazard (10 percent probability of exceedance in a 50 year period) for firm ground conditions. 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. Ground motions may be even greater on alluvial sediments, which cover much of the proposed project (California Geological Survey, 2005).

Fault Rupture

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 in 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 (Southern California Earthquake Center; San Bernardino County General Plan, 2005)

Liquefaction, Landslides and Rock Falls

Liquefaction is a rapid loss of strength in water-saturated sandy soils produced by ground shaking during an earthquake. Seismic waves can increase inter-granular pore pressure and cause a rapid loss of load-bearing strength. Poorly consolidated coarse soils and a water table within approximately 30 to 60 feet of the ground surface are prerequisites for this phenomenon to occur. Manifestations of soil liquefaction include loss of load-bearing capacities, surface settlement, and deformation of the ground surface.

The relatively flat areas of the proposed project have liquefaction potentials ranging from low to moderate in Riverside County (Riverside County General Plan, 2003). In San Bernardino County, there is little to no liquefaction hazard to the project sites (San Bernardino County General Plan, 2005).

Seismically induced landslides and rock falls are considered to have a high potential in the San Timoteo Badlands area (Riverside County General Plan, 2003), and in the San Bernardino Mountains north of Yucaipa (San Bernardino General Plan, 2005).

Lateral Spreading, Dynamic Compaction, and Differential Materials Response

Lateral spreading is a type of liquefaction where sediments/materials spread laterally down slope due to temporary loss of shear strength. Lateral spreading may occur on slopes as shallow as 1 to 2 degrees, but is more frequently associated with a "free face", such as a channel or slope face.

Dynamic compaction refers to seismically-induced settlement and permanent movement of poorly consolidated materials. Strong ground motion causes particles within the material to reorganize into a more compact arrangement, which decreases the void space and causes settlement at the surface. Where the consolidation or thickness of the material varies, differential settlement can occur. The manifestation of dynamic compaction may also be related to the ability of certain fine-grained soils to deform excessively under low stresses.

Differential materials response refers to the different responses various materials display when subjected to seismic waves. Materials with different density characteristics transmit seismic energy at different wavelengths. Where materials with different densities are in contact, differential response to the seismic energy may cause distress along the contact. The combination of dynamic compaction and differential settlement, along with differential materials response, is a source of future potential hazard along cut/fill and bedrock/alluvium contacts.

Many portions of the Proposed Project will overlie poorly consolidated sediments of varying densities, which increases the possibility of soil movement effecting foundations and other improvements.

TABLE 3.6-3
LOCAL FAULTS AND DISTANCES TO PROJECT ELEMENTS

FAULT NAME	NEAREST DISTANCE TO PROJECT ELEMENT								
	Preferred Substation Site (Site 33)	Banning Substation	Zanja Substation	Mill Creek Communications Site	Southerly 115 kV T/L	Maraschino Loop West	Maraschino Loop South	Northerly 115 kV T/L	Alternative Substation Site (Site 38)
Banning Fault Zone	2.9	2.7	NA	NA	2.7	3.5	3.6	1.1	2.8
Beaumont Plain Fault Zone	4.2	4.6	NA	NA	0	0	0	0	4.4
Cherry Valley Fault	2.0	7.9	NA	NA	2.7	2.6	2.8	0.6	1.9
Crafton Hills Fault Zone	5.1	12.6	0.7	1.7	5.1	9.0	9.3	5.1	5.0
San Andreas Fault Zone (main fault)	7.0	4.0	0.3	0.9	4.0	8.7	8.7	3.3	6.6
San Andreas Fault Zone (Mill Creek splay)	10.5	3.5	2.9	1.3	4.1	12.0	12.0	9.0	9.8
San Gorgonio Pass Fault Zone	9.8	0	11.6	11.3	2.7	4.4	4.4	0	10.0
San Jacinto Fault Zone	3.6	9.3	1.3	4.0	3.5	4.1	4.2	3.8	3.8

Source: Mualchin; CGS, 1999.
Notes: NA - not available

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3.6.1.3.2 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 (Matti, et al, 2003; San Bernardino County General Plan, 2005).

3.6.1.4 Soils

Soils result from chemical, physical and biological weathering of sediments and rocks exposed at or near the earth's surface. Soil can contain both mineral and organic materials.

The Proposed Project is located in a semi-arid environment with soils sensitive to human activities. However most of the transmission line and existing substation locations are within areas already developed, either with transmission lines or agricultural operations.

Figures 3.6-13 through 3.6-18 show the soil units for the project areas as developed by the United States Department of Agriculture (USDA), Natural Resources Conservation Service. Table 3.6-5 describes the numerous soil units found within and adjacent to the Proposed Project.

3.6.1.4.1 Soil Hazards

Expansive Soils

Expansive soils, or soils that have a high shrink-swell potential, are soils that have high clay content and expand when wet and contract when dried. Wetting of the soil may occur due to the absorption of moisture from the atmosphere, rainfall, groundwater fluctuations, landscape watering, or broken water and sewer lines. When structures are placed on expansive soils, foundations may move as the soils expand and contract. The project areas have primarily a low potential risk for shrink-swell with a few soil units in the moderate category (Table 3.6-4).

Corrosion

Corrosion potential is soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The corrosion rate of uncoated steel is dependant on soil moisture, particle size distribution, total acidity and the electrical conductivity of the soil unit. The corrosion rate of uncoated concrete is dependant primarily on sulfate content, texture, and soil acidity. Table 3.6.5 shows qualitative ratings for both concrete and steel corrosion. The soil units in the Project Area have a low to moderate capacity to corrode concrete, and a low to high capacity to corrode steel.

Soil Erosion

Erosion is the displacement of soil, rock, and other solid particles by wind, water, ice and gravity. Several characteristics of soils define their susceptibility to erosion. These include the soil erodibility factor (K factor), texture, permeability, organic matter content, and structure. The K factor is the soil erodibility factor, which represents both susceptibility of soil to erosion and the rate of runoff, as measured under the standard unit plot condition (USDA, 1971). Texture is the principal factor affecting K, but structure, organic matter and permeability also contribute. Soils high in clay have low K values, about 0.05 to 0.15, because they are resistant to detachment. Coarse textured soils, such as sandy soils, have low K values, about 0.05 to 0.2, because of low runoff even though these soils are easily detached. Medium textured soils, such as the silt loam soils, have a moderate K values, about 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having high silt content are the most erodible of all soils. They are easily detached, tend to crust, and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4. Table 3.6-4 provides the K factors for soil units rated by the National Resources Conservation Service, Soil Survey Geographic (SSURGO) Database, in 2005. Project area soils are predominantly low to moderately erodible. Local areas of soil with high erodibility are located in San Timoteo Canyon, and adjacent to State Highway 79, where it is crossed by the proposed southerly 115 kV subtransmission line route.

TABLE 3.6-4
EL CASCO SOIL UNIT DATA

		Shrink-Swell Potential		Erosion Potential (K Factor)		Corrosion Potential	
Soil Symbol	**Soil Family Name and Percent Slopes**	**Quantitative**	**Qualitative**	**Quantitative**	**Qualitative**	**Concrete**	**Steel**
AaD	Altamont clay, 5 to 15 percent slopes	2.86	low	0.2	low	low	low
AaE2	Altamont clay, 15 to 25 percent slopes, eroded	2.86	low	0.2	low	low	low
BaG	Badland	0	low	NR	NR	NR	low
BP	Borrow pit	0	low	NR	NR	NR	NR
Ce	Chino silt loam, drained	3.78	moderate	0.43	high	low	high
Cf	Chino silt loam, drained, saline-alkali	3.78	moderate	0.43	high	low	high
Cg	Chino silt loam, drained, strongly saline-alkali	3.78	moderate	0.43	high	low	high
ChDE	Ramona family-Typic Xerorthents, warm association, 2 to 30 percent slopes	3.01	moderate	0.28	moderate	NR	NR
ChF2	Cieneba sandy loam, 15 to 50 percent slopes, eroded	0.35	low	0.17	low	moderate	low
CkD2	Cieneba rocky sandy loam, 8 to 15 percent slopes, eroded	0.35	low	0.17	low	moderate	low
CkF2	Cieneba rocky sandy loam, 15 to 50 percent slopes, eroded	0.35	low	0.17	low	moderate	low
CnD	Cieneba sandy loam, 9 to 15 percent slopes	0.35	low	0.2	low	NR	moderate
Cp	Cieneba-friant sandy loams	0.35	low	0.2	low	NR	moderate
Cr	Cieneba-rock outcrop complex	0.35	low	0.2	low	low	moderate
CsF2	Crafton rocky sandy loam, 25 to 50 percent slopes, eroded	0.65	low	0.15	low	moderate	low
Dn	Trigo family-Lithic Xerorthents, warm complex, 30 to 75 percent slopes	NR	NR	NR	NR	NR	NR
DpG	Lithic Xerorthents, warm-rock outcrop complex, 50 to 100 percent slopes	0.44	low	0.1	low	NR	NR
Fc	Fallbrook rocky sandy loam, 15 to 50 percent slopes	NR	NR	NR	NR	NR	NR
FLG	Springdale family-Lithic Xerorthents association, dry, 50 to 75 percent slopes	1.12	low	0.05	low	NR	NR
FsD	Wilshire-Oak Glen, dry families association, 2 to 15 percent slopes	1.5	low	0.05	low	NR	NR
FyF2	Friant rocky fine sandy loam, 25 to 50 percent slopes, eroded	0.32	low	0.17	low	moderate	low
Gh	Gorgonio loamy sand to cobbly loamy fine sand, 0 to 8 percent slopes	NR	NR	NR	NR	NR	NR
GP	Gravel pits and Quarries	1.5	low	0.02	low	NR	NR
Gp	Grangeville sandy loam, drained, saline-alkali, 0 to 5 percent slopes	NR	NR	NR	NR	NR	NR
Gr	Grangeville fine sandy loam, 0 to 2 percent slopes	1.5	low	0.32	moderate	low	high
GrEF	Green Bluff-Brader families association, 15 to 50 percent slopes	0.65	low	0.15	low	NR	NR
Gs	Grangeville fine sandy loam, saline-alkali	1.5	low	0.32	moderate	low	high
GtA	Grangeville fine sandy loam, drained, 0 to 2 percent slopes	1.5	low	0.28	moderate	low	high
GtC	Greenfield sandy loam, 2 to 9 percent slopes	1.5	low	0.2	low	low	moderate
GtD	Grangeville fine sandy loam, drained, 5 to 15 percent slopes	1.5	low	0.28	moderate	low	high
GuD	Greenfield cobbly sandy loam, 5 to 15 percent slopes	1.5	low	0.24	low	low	moderate

TABLE 3.6-4 *(Continued)*
EL CASCO SOIL UNIT DATA

		Shrink-Swell Potential		Erosion Potential (K Factor)		Corrosion Potential	
Soil Symbol	**Soil Family Name and Percent Slopes**	**Quantitative**	**Qualitative**	**Quantitative**	**Qualitative**	**Concrete**	**Steel**
GyC2	Greenfield sandy loam, 2 to 8 percent slopes, eroded	1.5	low	0.32	moderate	low	low
GyD2	Greenfield sandy loam, 8 to 15 percent slopes, eroded	1.5	low	0.32	moderate	low	low
GyE2	Greenfield sandy loam, 15 to 25 percent slopes, eroded	1.5	low	0.32	moderate	low	low
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes (San Bernardino County)	1.5	low	0.32	moderate	low	moderate
HaC	Hanford loamy fine sand, 0 to 8 percent slopes (Riverside County)	1.5	low	0.28	moderate	low	NR
HbA	Hanford sandy loam, 0 to 2 percent slopes	1.5	low	0.32	moderate	low	moderate
HcC	Hanford coarse sandy loam, 2 to 8 percent slopes	1.5	low	0.28	moderate	low	low
HcD2	Hanford coarse sandy loam, 8 to 15 percent slopes, eroded	1.5	low	0.28	moderate	low	low
HdD2	Hanford cobbly coarse sandy loam, 2 to 15 percent slopes, eroded	1.5	low	0.1	low	low	low
HeC2	Hanford coarse sandy loam, deep, 2 to 8 percent slopes, eroded	1.5	low	0.28	moderate	low	low
HfD	Hanford sandy loam, 2 to 15 percent slopes	1.5	low	0.28	moderate	low	low
LrG	Lithic Xerorthents-Rock outcrop complex, 50 to 100 percent slopes	0.45	low	0.1	low	NR	NR
MeD	Metz loamy sand, channeled, 0 to 15 percent slopes	1.5	low	0.17	low	low	low
MfA	Metz loamy fine sand, 0 to 2 percent slopes	1.5	low	0.17	low	low	low
MlD	Metz gravelly sandy loam, 2 to 15 percent slopes	1.5	low	0.1	low	low	low
MmC2	Monserate sandy loam, 5 to 8 percent slopes, eroded	1.67	low	0.28	moderate	low	low
MmD2	Monserate sandy loam, 8 to 15 percent slopes, eroded	1.67	low	0.28	moderate	low	low
MmE3	Monserate sandy loam, 15 to 25 percent slopes, severely eroded	1.91	low	0.28	moderate	low	low
MnD2	Monserate sandy loam, shallow, 5 to 15 percent slopes, eroded	0.93	low	0.28	moderate	low	low
MnE3	Monserate sandy loam, shallow, 15 to 25 percent slopes, severely eroded	0.93	low	0.28	moderate	low	low
PaC2	Pachappa fine sandy loam, 2 to 8 percent slopes, eroded	2.5	low	0.24	low	low	low
PlB	Placentia fine sandy loam, 0 to 5 percent slopes	4.5	moderate	0.32	moderate	low	moderate
PlD	Placentia fine sandy loam, 5 to 15 percent slopes	4.5	moderate	0.32	moderate	low	moderate
Ps	Psamments and fluvents, frequently flooded	1.5	low	0.17	low	low	moderate
RaA	Ramona sandy loam, 0 to 2 percent slopes	1.5	low	0.28	moderate	low	moderate
RaB2	Ramona sandy loam, 2 to 5 percent slopes, eroded	1.5	low	0.28	moderate	low	moderate
RaB3	Ramona sandy loam, 0 to 5 percent slopes, severely eroded	1.5	low	0.28	moderate	low	moderate
RaC2	Ramona sandy loam, 5 to 8 percent slopes, eroded	1.5	low	0.28	moderate	low	moderate
RaC3	Ramona sandy loam, 5 to 8 percent slopes, severely eroded	1.5	low	0.28	moderate	low	moderate
RaD2	Ramona sandy loam, 8 to 15 percent slopes, eroded	1.5	low	0.28	moderate	low	moderate
RaD3	Ramona sandy loam, 8 to 15 percent slopes, severely eroded	1.5	low	0.28	moderate	low	moderate

TABLE 3.6-4 *(Continued)*
EL CASCO SOIL UNIT DATA

		Shrink-Swell Potential		Erosion Potential (K Factor)		Corrosion Potential	
Soil Symbol	**Soil Family Name and Percent Slopes**	**Quantitative**	**Qualitative**	**Quantitative**	**Qualitative**	**Concrete**	**Steel**
RaE3	Ramona sandy loam, 15 to 25 percent slopes, severely eroded	1.5	low	0.28	moderate	low	moderate
RdD2	Ramona sandy loam, moderately deep, 8 to 15 percent slopes, eroded	4	moderate	0.28	moderate	low	moderate
RdE3	Ramona sandy loam, moderately deep, 15 to 25 percent slopes, severely eroded	4.1	moderate	0.28	moderate	low	moderate
ReC2	Ramona very fine sandy loam, 0 to 8 percent slopes, eroded	NR	NR	0.49	high	low	moderate
RfC2	Ramona very fine sandy loam, moderately deep, 0 to 8 percent slopes, eroded	NR	NR	0.32	moderate	low	moderate
RmC	Ramona sandy loam, 2 to 9 percent slopes	1.95	low	0.2	low	low	moderate
RmD	Ramona sandy loam, 9 to 15 percent slopes	1.95	low	0.2	low	low	moderate
RmE2	Ramona sandy loam, 15 to 30 percent slopes, eroded	1.95	low	0.2	low	moderate	moderate
RsC	Riverwash	0	low	0.05	low	NR	NR
RtF	Rockland	0	low	NR	NR	NR	NR
RuF	Rough broken land	0	low	NR	NR	NR	NR
Rw	Riverwash	0	low	NR	NR	NR	NR
SbC	San Emigdio gravelly sandy loam, 2 to 9 percent slopes	1.5	low	0.2	low	low	high
ScA	San Emigdio fine sandy loam, 0 to 2 percent slopes	1.5	low	0.32	moderate	low	high
ScC	San Emigdio fine sandy loam, 2 to 9 percent slopes	1.5	low	0.32	moderate	low	high
SdD	San Emigdio sandy loam, channeled, 2 to 15 percent slopes	1.5	low	0.24	low	low	low
SeA	San Emigdio fine sandy loam, 0 to 2 percent slopes	1.5	low	0.24	low	low	low
SeC2	San Emigdio fine sandy loam, 2 to 8 percent slopes, eroded	1.5	low	0.24	low	low	low
SeD2	San Emigdio fine sandy loam, 8 to 15 percent slopes, eroded	1.5	low	0.24	low	low	low
SgA	San Emigdio loam, 0 to 2 percent slopes	1.5	low	0.24	low	low	low
SgC	San Emigdio loam, 2 to 8 percent slopes	1.5	low	0.24	low	low	low
SgD2	San Emigdio loam, 8 to 15 percent slopes, eroded	1.5	low	0.24	low	low	low
ShF	Saugus sandy loam, 30 to 50 percent slopes	1	low	0.24	low	low	low
SmE2	San Timoteo loam, 8 to 25 percent slopes, eroded	0.55	low	0.24	low	low	low
SmF2	San Timoteo loam, 25 to 50 percent slopes, eroded	0.55	low	0.24	low	low	low
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	1.5	low	0.15	low	low	moderate
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	1.5	low	0.15	low	moderate	moderate
SrE	Soboba cobbly loamy sand, 2 to 25 percent slopes	1.5	low	0.1	low	low	low
SsD	Soboba stony loamy sand, 2 to 15 percent slopes	1.5	low	0.1	low	low	low
TeG	Terrace escarpments	0	low	NR	NR	NR	low
TuB	Tujunga loamy sand, 0 to 5 percent slopes	1.5	low	0.2 & 0.17	low	low	moderate

TABLE 3.6-4 *(Continued)*
EL CASCO SOIL UNIT DATA

		Shrink-Swell Potential		Erosion Potential (K Factor)		Corrosion Potential	
Soil Symbol	**Soil Family Name and Percent Slopes**	**Quantitative**	**Qualitative**	**Quantitative**	**Qualitative**	**Concrete**	**Steel**
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes (San Bernardino County)	1.5	low	0.1	low	low	moderate
TvC	Tujunga loamy sand, channeled, 0 to 8 percent slopes (Riverside County)	1.5	low	0.17	low	low	low
TwC	Tujunga gravelly loamy sand, 0 to 8 percent slopes	1.5		0.17	low	low	low
VlC2	Visalia sandy loam, 0 to 8 percent slopes, eroded	1.5		0.24	low	moderate	low
VsD2	Vista coarse sandy loam, 8 to 15 percent slopes, eroded	0.6		0.24	low	moderate	low
VsF2	Vista coarse sandy loam, 15 to 35 percent slopes, eroded	0.6		0.24	low	moderate	low
VtF2	Vista rocky coarse sandy loam, 2 to 35 percent slopes, eroded	0.6		0.24	low	moderate	low
W	Water	0					

Notes:
NR = Not Rated.

3.6.1.5 Site-Specific Conditions

3.6.1.5.1 El Casco Substation (Site 33). Site 33 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 (Figure 3.6-1). The San Timoteo Formation underlying the southern half of the site has been identified as a landslide (Morton, 2004). While no identified faults intersect this site, the nearest potentially active fault is the Cherry Valley Fault Zone, approximately two miles to the north. Figure 3.6-9 shows the active San Jacinto Fault Zone is located approximately 3.7 miles to the southwest (CGS, 1999). Preliminary geotechnical data (SCE, 2007) indicates shallow groundwater and granular soils beneath the site, which may indicate a moderate liquefaction and lateral spreading potential.

Soils underlying the site have low potential for expansion (shrink-swell), erosion, and corrosion to steel (Table 3.6-5).

3.6.1.5.2 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 (Figure 3.6-4). 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 3.6-9 (CGS, 1999). 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 (City of Banning General Plan, undated).

Soils beneath the site have low expansion and corrosion potential, and are moderately erodible (Table 3.6-5).

3.6.1.5.3 Zanja Substation. The Zanja Substation is situated on alluvium comprised of fan sands and gravels (Figure 3.6-6). 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 miles southeast of the nearest mapped fault trace. The active Crafton Hills Fault lies roughly 0.7 miles to the southeast (Figure 3.6-11). The site is not located within an area designated as susceptible to liquefaction (County of San Bernardino General Plan, 2005).

Soils beneath the site have a low expansion and erosion potential, but are moderately corrosive to steel (Table 3.6-5).

3.6.1.5.4 **Mill Creek Communications Site.** The Mill Creek Communications Site lies on a ridge top underlain by the Potato Formation. This formation consists of bedded, hard sandstone with interbeds of clay shale (Figure 3.6-7). 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 (Morton, 2004; San Bernardino County General Plan, 2005). No identified faults intersect the site, but it is between the North and South Branches of the San Andreas Fault Zone (Figure 3.6-11). 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 (County of San Bernardino General Plan, 2005).

Soils beneath the site have low expansion and erosion potential (Table 3.6-5).

3.6.1.5.5 **Southerly 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, slopes of the San Timoteo Formation, older and younger alluvium, and alluvial fan deposits (Figures 3.6-1, 3.6-3 and 3.6-4). 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 (Morton, 2004). Two identified faults traces from the Beaumont Plain Fault Zone cross this route near its mid-point (Figure 3.6-9). Liquefaction potential is considered low over most of the route, with moderate areas of susceptibility where the line traverses stream channels (Milepost 3.5 to 5.5), and as it approaches Banning Substation (Milepost 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 forty percent of the route is underlain by soils with moderate erosion potential, with the remainder having a low potential. Corrosivity to concrete is low over the entire route, and about thirty percent of it is underlain by soils having a moderate potential for corrosion to steel (Table 3.6-5).

3.6.1.5.6 **Maraschino Loop West.** The proposed Maraschino Loop West subtransmission line route is underlain by older alluvial gravels and sands (Figure 3.6-3). One identified fault trace from the Beaumont Plain Fault Zone crosses this route approximately 0.2 miles west of Maraschino Substation (Figure 3.6-9; Riverside County General Plan, 2003). Susceptibility to liquefaction is considered low along the proposed route (Riverside County General Plan, 2003).

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 3.6-5).

3.6.1.5.7 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 (Figure 3.6-3). One identified fault trace from the Beaumont Plain Fault Zone appears to parallel the south trending segment of this route (Figure 3.6-9; Riverside County General Plan, 2003). Susceptibility to liquefaction is considered low along the proposed route (Riverside County General Plan, 2003).

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 3.6-5).

3.6.1.5.8 Northerly 115 kV Subtransmission Line Route Alternative. The northerly 115 kV subtransmission line route parallels an existing power line corridor. The westernmost end of the line, near the proposed 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 a 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 (Figures 3.6-1, 3.6-2, and 3.6-4). Slope instability is a potential issue along the route underlain by the San Timoteo Formation due to the steeper slopes, mapped landslides and the nature of the bedrock unit (Riverside County General Plan, 2003; Morton, 2004). Four identified fault traces from the Beaumont Plain Fault Zone cross this route (Riverside County General Plan, 2003), and the San Gorgonio Pass Fault Zone (CGS, 1999) parallels the line west of Banning (Figure 3.6-9). Liquefaction susceptibility is documented as low from Milepost 0 to about Milepost 11(Riverside County General Plan, 2003; City of Banning General Plan, undated), and moderately susceptible from Milepost 11 to Banning Substation (City of Banning General Plan, undated). 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 (City of Banning General Plan, undated).

Soils underlying this route have a low expansion potential, with the exception of the first 0.7 miles, which are moderately expansive. Soil erosion potential is high for the first 0.7 miles. The remainder of the route is about evenly split between low to moderate erosion potential (Table 3.6-5).

3.6.1.5.9 Site 38 (Alternate Site). Site 38 is located immediately adjacent to the north of San Timoteo Creek. It slopes gently towards its center from the hill of the San Timoteo Formation along the northern boundary. Slopes range from very gentle to over 20 percent in the hill. Surficial deposits consist of alluvial gravel, sand, and clay (Figure 3.6-1). Slope instability is a potential issue due to the landslide potential of the San Timoteo Formation (Riverside County General Plan, 2003; Morton, 2004). No identified faults transverse the site. The nearest potentially active fault is the Cherry Valley Fault Zone, approximately two miles to the north (Riverside County General Plan, 2003). The active San Jacinto Fault Zone is located approximately 3.8 miles to the southwest (Figure 3.6-9; CGS, 1999). The site-specific geotechnical investigation indicated a moderate susceptibility to liquefaction and lateral spreading during an earthquake (SCE, 2006).

Soils underlying the site have a low expansive potential (SCE, 2006). Soil erodibility is moderate to high (Table 3.6-5). Soils are moderately to highly corrosive to steel, and minimally corrosive to concrete (SCE, 2006).

3.6.2 Significance Criteria

Impacts to geology and soils are considered potentially significant if the project:

- Exposes people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides
- Results in substantial soil erosion or the loss of topsoil
- Is located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse
- Is located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property
- Has soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of wastewater

3.6.2.1 Alquist-Priolo Earthquake Fault Zoning Act

The intent of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 is to minimize the chance for structures used for human occupancy to be built over active faults by requiring a geological investigation for new development within designated active earthquake fault zones. This Act includes definitions for "active faults" and "potentially active faults," as well as for other specific terms applied to fault evaluations. For purposes of implementing the Act, it is assumed that the area within 50 feet of an active fault is underlain by active branches of the fault, until proven otherwise by an appropriate geologic investigation.

3.6.2.2 Seismic Hazards Mapping Act

The state Department of Conservation, California Geological Survey (CGS), provides guidance with regard to seismic hazards. Under the CGS Seismic Hazards Mapping Act (SHMA), seismic hazard zones are to be identified and mapped to assist local governments in planning and developing purposes. The intent of this publication is to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other types of ground failure, and other hazards caused by earthquakes. CGS Special Publications 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, provides guidance for evaluation and mitigation of earthquake-related hazards for projects within designated zones of required investigations.

3.6.2.3 Design Standards

Building codes provide specific standards for design of buildings and structures. The Uniform Building Code (UBC) defines "expansive soil" in Table 18-1-B. The California Building Code (CBC) is modeled after the UBC. The CBC provides minimum seismic design requirements for structures. The Institute of Electrical and Electronics Engineers, Inc. (IEEE) provides recommended seismic design practices for electrical equipment in IEEE 693-2005.

3.6.2.4 Riverside County General Plan

The Riverside County General Plan Safety Element includes faults designated under both the Alquist-Priolo (AP) Earthquake Zone Act, as well as their own County Fault Zones. These AP and County faults are shown on Figure 3.6-9.

3.6.3 Proposed Project Impacts

3.6.3.1 Construction Impacts

3.6.3.1.1 El Casco Substation (Site 33). The following impacts are potentially significant for Site 33:

- Landslides

Landslides have been mapped on the slopes located on the southern part of the Preferred Site. Landslide debris, adverse rock bedding planes, and two landslide failure planes are present underlying the proposed substation site (SCE, 2007). These slope stability hazards were identified in soil borings during a preliminary geotechnical investigation. Site preparation would include excavation that intercepts the upper landslide failure surface, thus increasing the possibility of slope failures. Therefore, proposed cut slopes could result in slope failures during construction. Construction impacts associated with landslides would be less than significant with implementation of mitigation measure GEO-1.

The following geologic and soil hazards are not considered significant for the proposed El Casco Substation location (Site 33):

- Fault rupture
- Seismic ground shaking
- Soil erosion, expansive soils, and soils incapable of supporting a septic system

There are no known active or potentially active faults on or near the site. The nearest active fault is the Cherry Valley Fault Zone (Riverside County designated fault zone; Figure 3.6-9), approximately 2 miles to the northeast.

Site 33 is located within the CBC Seismic Zone IV. SCE substation design standards meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

Soils beneath the site are classified as having a low erosion potential. Geotechnical studies of similar soils from Site 38 indicate they are non-expansive (SCE, 2006). Therefore, there would be no impact related to soil erosion.

In summary, impacts to geology and soils due to the construction of the El Casco Substation would be less than significant with the implementation of mitigation measures.

3.6.3.1.2 <u>Banning Substation</u>. There are no potentially significant impacts for the proposed construction at Banning Substation:

The following geologic and soil hazards are not considered significant for the existing Banning Substation location:

- Fault rupture

- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system
- Landslides

There are no known active or potentially active faults on or adjacent to the site. The nearest active fault is the San Gorgonio Pass Fault Zone, approximately 1.5 miles to the north (CGS, 1999).

Banning Substation is located within the CBC Seismic Zone IV. SCE would design equipment to meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

Although the site is located in an area designated as moderately susceptible to liquefaction (City of Banning General Plan, 2004), implementation of foundation design recommendations would reduce the impact to less than significant during construction (mitigation measure GEO-2).

There would be no impacts related to soil erosion, or loss of topsoil, since construction is proposed within the existing substation.

In summary, impacts to geology and soils due to the construction at Banning Substation would be less than significant with the implementation of mitigation measures.

3.6.3.1.3 Zanja Substation. There are no potentially significant impacts for the proposed construction at Zanja Substation:

The following geologic and soil hazards are not considered significant for the existing Zanja Substation location:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

- Landslides

There are no known active or potentially active faults on or near the site. The nearest active fault is the South Branch of the San Andreas Fault Zone, approximately 0.3 miles to the northwest (CGS, 1999).

Zanja Substation is located within the CBC Seismic Zone IV. SCE would design equipment to meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

The site is not located within an area designated as susceptible to liquefaction (County of San Bernardino General Plan, 2005).

There would be no impacts related to soil erosion, or loss of topsoil, since construction is proposed within the existing substation.

In summary, impacts to geology and soils due to the construction at Zanja Substation would be less than significant with the implementation of mitigation measures.

3.6.3.1.4 **<u>Mill Creek Communications Site</u>.** There are no potentially significant impacts for the proposed construction at Mill Creek Communications Site:

The following geologic and soil hazards are not considered significant for the existing Mill Creek Communications Site:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Seismically induced landslides
- Landslides
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

There are no known active or potentially active faults on or near the site. The nearest active fault is the South Branch of the San Andreas Fault Zone, approximately 0.9 miles to the southwest (CGS, 1999).

Mill Creek Communications Site is located within the CBC Seismic Zone IV. SCE would design equipment to meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

The site is located on a ridge-top underlain by landslide-susceptible geologic units, between two branches of the San Andreas Fault Zone. It is considered to have a moderate to high general landslide susceptibility (County of San Bernardino General Plan, 2005). However, the planned construction of a microwave tower and prefabricated support building would be within an existing communications site. Therefore, this impact would not be significant.

There would be no impacts related to soil erosion, or loss of topsoil associated with operations within the existing communications site. Geotechnical studies for foundation design would determine whether expansive soils are present, and provide recommendations for mitigation (mitigation measure GEO-2). There would be no impacts related to a septic system, since existing facilities would be utilized.

The site is not located within an area designated as susceptible to liquefaction (County of San Bernardino General Plan, 2005).

There would be no impacts related to soil erosion, or loss of topsoil, since construction is proposed within the existing communications site.

In summary, impacts to geology and soils due to the construction of a communications tower at the Mill Creek Communications Site would be less than significant with the implementation of mitigation measures.

3.6.3.1.5 <u>Southerly 115 kV Subtransmission Line Route</u>. There are no potentially significant impacts for the construction of the southerly 115 kV subtransmission line.
The following geologic and soil hazards are not considered significant for the southerly 115 kV subtransmission line route:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Seismically induced landslides
- Landslides

- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

Although the proposed subtransmission line crosses two traces of the Beaumont Plain Fault Zone, at Mileposts 6.58 and 7.9, pre-construction trenching studies would ensure tower footings are not placed along fault traces. Subtransmission line design would also account for possible line extension associated with fault rupture.

The southerly route is located within the CBC Seismic Zone IV. However, SCE designs overhead electric lines to meet or exceed GO 95 wind loading criteria. SCE's design standards incorporate lateral wind loading requirements that exceed seismic loading forces. Consequently, impacts from potential seismic ground shaking would be less than significant.

The easternmost five miles of the subtransmission line is considered to have a moderate susceptibility to liquefaction (Riverside General Plan, 2003). Implementation of foundation design recommendations would reduce the impact to less than significant during construction (mitigation measure GEO-2).

The westernmost 6.5 miles of the proposed subtransmission line is underlain by a geologic unit that is susceptible to both seismically-induced landslides, as well as landslides due to other causes. The proposed tower construction will be at existing sites, and no new access roads are planned. This would reduce slope stability impacts to insignificant during construction.

The proposed southerly 115 kV subtransmission line route would be constructed along an existing line. Therefore, there would be no significant grading, or construction of new access roads. Soils underlying the proposed route generally have a low expansion factor. Septic systems are not required for subtransmission line construction.

In summary, impacts to geology and soils due to the construction of the southerly 115 kV subtransmission line route would be less than significant with the implementation of mitigation measures.

3.6.3.1.6 Maraschino Loop West. There are no potentially significant impacts for the proposed construction of the subtransmission line:

The following geologic and soil hazards are not considered significant for the Maraschino Loop West:

- Fault rupture
- Seismic ground shaking

- Seismically induced liquefaction and lateral spreading
- Seismically induced landslides
- Landslides
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

The proposed subtransmission line crosses a trace of the Beaumont Plain Fault Zone, at Milepost 0.76. Pre-construction trenching studies will ensure tower footings are not placed along fault traces (mitigation measure GEO-3).

The Maraschino Loop West is located within the CBC Seismic Zone IV. However, SCE designs overhead electric lines to meet or exceed GO 95 wind loading criteria. SCE's design standards incorporate lateral wind loading requirements that exceed seismic loading forces. Consequently, impacts from potential seismic ground shaking would be less than significant.

The proposed line is considered to have a moderate susceptibility to liquefaction (Riverside General Plan, 2003). Implementation of foundation design recommendations would reduce the impact to less than significant during construction.

Landslides or other slope stability issues are not a factor since the line traverses generally flat terrain.

Soils underlying the proposed route generally have a low expansion factor. Septic systems are not required for subtransmission line construction.

The proposed subtransmission line route would be constructed along an existing line. Therefore, there would be no significant grading, or construction of new access roads.

In summary, geologic and soils impacts to construction of the Maraschino Loop West would be less than significant with the implementation of mitigation measures.

3.6.3.1.7 <u>Maraschino Loop South</u>. There are no potentially significant impacts for the proposed construction of the subtransmission line.

Fault rupture is a potentially significant impact since the proposed subtransmission line crosses a trace of the Beaumont Plain Fault Zone at Milepost

The Maraschino Loop South is located within the CBC Seismic Zone IV. However, SCE designs overhead electric lines to meet or exceed GO 95 wind loading criteria. SCE's design standards incorporate lateral wind loading requirements that exceed seismic loading forces. Consequently, impacts from potential seismic ground shaking would be less than significant.

The proposed line is considered to have a moderate susceptibility to liquefaction (Riverside General Plan, 2003).

The following geologic and soil hazards are not considered significant for the Maraschino Loop South:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Seismically induced landslides
- Landslides
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

The proposed subtransmission line crosses a trace of the Beaumont Plain Fault Zone, at Milepost 0.23, and roughly parallels the line for approximately 0.1 miles on either side of the crossing. Pre-construction trenching studies will ensure tower footings are not placed along fault traces.

The proposed line is considered to have a moderate susceptibility to liquefaction (Riverside General Plan, 2003). Implementation of foundation design recommendations would reduce the impact to less than significant during construction.

Landslides or other slope stability issues are not a factor since the line traverses generally flat terrain.

The proposed subtransmission line route would be constructed along an existing line. Therefore, there would be no significant grading, or construction of new access roads. Soils underlying the proposed route generally have a low expansion factor. Septic systems are not required for subtransmission line construction.

Soils underlying the proposed route generally have a low expansion factor. Septic systems are not required for subtransmission line construction.

In summary, geologic and soils impacts to construction of the Maraschino Loop South would be less than significant with the implementation of mitigation measures.

3.6.3.1.8 <u>Fiber Optic System</u>. There are no potentially significant impacts for the proposed construction of the fiber optic system.

The proposed fiber optic circuits would primarily be installed on existing poles and in existing underground conduits. While the fiber optic route would cross a number of faults along its length, SCE designs overhead lines to meet or exceed GO 95 wind loading criteria. SCE's design standards incorporate lateral wind loading requirements that exceed seismic loading forces. Any impacts to underground conduits resulting from seismic ground shaking would be addressed as appropriate. Consequently, impacts from potential seismic ground shaking would be less than significant.

The following geologic and soil hazards are not considered significant for the fiber optic system:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Seismically induced landslides
- Landslides
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

The proposed fiber optic system would be installed primarily on existing, generally accessible poles. Therefore, there would be no significant grading, or construction of new access roads. Soils underlying the proposed route generally have a low expansion factor. Septic systems are not required for fiber optic line construction.

In summary, geologic and soils impacts to construction of the fiber optic line would be less than significant.

3.6.3.2 <u>Operational Impacts</u>

3.6.3.2.1 <u>El Casco Substation</u>. The following impacts are potentially significant for the proposed El Casco Substation location (Site 33):

- Seismically induced landslides
- Liquefaction
- Lateral spreading
- Differential Settlement

Seismically induced landslides are a potentially significant impact to the site. The existing landslide on the slopes within the southern part of the proposed site would likely be susceptible to seismically induced failure. Proposed design measures would be incorporated into the project to address slope instability as described in the Project Description. Details of these measures cannot be determined until additional detailed future geotechnical evaluations are conducted. Operational impacts associated with landslides would be less than significant with implementation of mitigation measure GEO-1.

Liquefaction, lateral spreading and differential settlement are potentially adverse impacts to the site. A preliminary geotechnical investigation identified moderate susceptibility to liquefaction and lateral spreading. In addition, substantial differential settlement across the northern portion of the site was identified. Design measures described in the Project Description would reduce these potential geotechnical hazards to a less than significant level.

The following geologic and soil hazards are not considered significant the proposed El Casco Substation location (Site 33):

- Fault rupture
- Seismic ground shaking
- Soil erosion, expansive soils, and soils incapable of supporting a septic system

As noted previously, there are no known active or potentially active faults on or near the site.

Site 33 is located within the CBC Seismic Zone IV. SCE substation design standards meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

Soils beneath the site are classified as having a low erosion potential. Geotechnical studies of similar soils at the nearby substation site indicate they are non-expansive (SCE, 2006). There would be no impact related to soils being incapable of supporting a septic system, since the substation is planned to be unmanned and would be provided with maintained portable toilets.

In summary, geologic and soils impacts to operation of the El Casco Substation would be less than significant.

3.6.3.2.2 Banning Substation. There are no potentially significant impacts related to operation of the proposed improvements at Banning Substation.
The following geologic and soil hazards are not considered significant at the existing Banning Substation location:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Slope instability
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

As noted previously, there are no known active or potentially active faults on or adjacent to the site.

Banning Substation is located within the CBC Seismic Zone IV. SCE would design equipment to meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

Although the site is located in an area designated as moderately susceptible to liquefaction (City of Banning General Plan, 2004), implementation of foundation design recommendations would reduce the impact to less than significant during operation.

There would be no impacts related to soil erosion, or loss of topsoil, since operation of the improvements would be within the existing substation. Geotechnical studies for foundation design would determine whether expansive soils are present, and provide recommendations for mitigation. There would be no impacts related to a septic system because existing facilities would be utilized.

In summary, geologic and soils impacts to the operation of Banning Substation would be less than significant with the implementation of mitigation measures.

3.6.3.2.2 Zanja Substation. There are no significant impacts related to operation of the proposed improvements at Zanja Substation.

The following geologic and soil hazards are not considered significant at the existing Zanja Substation location:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

As noted previously, there are no known active or potentially active faults on or near the site.

Zanja Substation is located within the CBC Seismic Zone IV. SCE would design equipment to meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

The site is not located within an area designated as susceptible to liquefaction (County of San Bernardino General Plan, 2005).

There would be no impacts related to soil erosion, or loss of topsoil, since improvements will be operated within the existing substation. Geotechnical studies for foundation design would determine whether expansive soils are present, and provide recommendations for mitigation. There would be no impacts related to a septic system because existing facilities would be utilized.

In summary, geologic and soils impacts to the operation of Zanja Substation would be less than significant.

3.6.3.2.4 Mill Creek Communications Site. There would be no geologic and soils impacts to operation of the communications tower at the Mill Creek Communications Site.

3.6.3.2.5 Southerly 115 kV Subtransmission Line Route. There would be no geologic and soils impacts to operation of the southerly 115 kV subtransmission line.

3.6.3.2.6 Maraschino Loop West. There are no potentially significant impacts for the operation of the proposed Maraschino Loop West.

3.6.3.2.7 Maraschino Loop South. There are no potentially significant impacts for the operation of the proposed Maraschino Loop South.

3.6.3.2.8 Fiber Optic System. Communications circuits may cross delineated geologic hazard areas, such as active faults, unstable slopes or liquefaction areas. In the event of a major earthquake, these hazards may result in severed communications circuits.

The proposed substation site is subject to potential liquefaction and lateral spreading hazards. Although soils underlying the substation site would be improved to remediate these hazards for the substation, communications circuits passing beneath San Timoteo Creek within the 12 kV distribution line conduits would remain subject to both potential liquefaction and lateral spreading hazards. These hazards could result in severed communications circuits during a major earthquake.

Since the fiber optic communications circuits and the microwave system create a redundant telecommunications system, potential damage to the telecommunications system from geologic hazards would be less than significant.

In summary, geologic and soils impacts to operation of the fiber optic system would be less than significant.

3.6.3.3 Applicant Proposed Mitigation Measures

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.

- 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.

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.

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.

3.6.4 Alternatives

3.6.4.1 Northerly 115 kV Subtransmission Line Route Alternative.

The following geologic and soil hazards are not considered significant for the Northerly 115 kV Subtransmission Line Route Alternative:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Seismically induced landslides
- Landslides
- Soil erosion, loss of topsoil, and expansive soils, and soils incapable of supporting a septic system

Although the proposed subtransmission line crosses four traces of the Beaumont Plain Fault Zone, at Mileposts 4.33, 5.06, 5.6, and 5.85, pre-construction trenching studies (mitigation measure GEO-3) would ensure tower footings are not placed along fault traces. Transmission line design will also account for possible line extension associated with fault rupture.

The northerly route is located within the CBC Seismic Zone IV. However, SCE designs overhead electric lines to meet or exceed GO 95 wind loading criteria. SCE's design standards incorporate lateral wind loading requirements that exceed seismic loading forces. Consequently, impacts from potential seismic ground shaking would be less than significant.

The easternmost three miles of the subtransmission line is considered to have a moderate susceptibility to liquefaction (Riverside General Plan, 2003). Implementation of foundation design recommendations would reduce the impact to less than significant during construction (mitigation measure GEO-2).

Approximately one mile of the alternative subtransmission line (Milepost 0.7 to 1.6) line is underlain by a geologic unit that is susceptible to both seismically-induced landslides, as well as landslides due to other causes. The proposed tower construction will be at existing sites, and no new access roads are planned. This would reduce slope stability impacts to insignificant during construction (mitigation measure GEO-1).

The alternative 115 kV subtransmission line route would be constructed along an existing line. Therefore, there would be no significant grading, or construction of new access roads. Soils underlying the proposed route generally have a low expansion factor. Septic systems are not required for subtransmission line construction or operation.

In summary, impacts to geology and soils due to the construction and operation of the alternative 115 kV subtransmission line route would be less than significant with the implementation of mitigation measures.

3.6.4.2 Site 38 (Alternate Site)

The following geologic and soil hazards are not considered significant for Site 38:

- Fault rupture
- Seismic ground shaking
- Seismically induced liquefaction and lateral spreading
- Landslides
- Soil erosion, loss of topsoil, expansive soils, and soils incapable of supporting a septic system

There are no known active or potentially active faults on or near the site. The nearest active fault is the Cherry Valley Fault Zone (Riverside County designated fault zone; Figure 3.6-9), approximately 1.9 miles to the northeast.

Site 38 is located within the CBC Seismic Zone IV. SCE substation design standards meet or exceed CBC criteria and IEEE 693 recommendations. Consequently, impacts from potential seismic ground shaking would be less than significant.

The geotechnical investigation has documented moderate susceptibility to both liquefaction and lateral spreading (SCE, 2006). Implementation of foundation design recommendations would reduce the impact to less than significant during construction (mitigation measure GEO-2).

The majority of the Alternate Site is underlain by soils with a high erosion potential (SSURGO, 2005). These impacts would be reduced to below significant levels with the implementation of mitigation measure GEO-2. Geotechnical studies at the substation site indicate that site soils are non-expansive (SCE, 2006). There would be no impact related to soils being incapable of supporting a septic system, since the substation is planned to be unmanned and would be provided with maintained portable toilets.

In summary, impacts to geology and soils due to the construction and operation of the substation at the Site 38 site alternative would be less than significant with the implementation of mitigation measures.