D.6 Geology, Soils, and Paleontology

Section D.6.1 provides a summary of existing geological, soil, and paleontological conditions present along the alignment of Pacific Gas and Electric Company's (PG&E) proposed Jefferson-Martin 230 kV Transmission Line Project and associated geologic and seismic hazards. Descriptions of geologic and geologic hazards specific to segments of the transmission line are provided in Sections D.6.1.1 through D.6.1.4. Applicable regulations, plans, and standards are listed in Section D.6.2. Potential impacts and mitigation measures for the Proposed Project are presented in D.6.3; and alternatives are described and discussed in Sections D.6.4 through D.6.6. Mitigation monitoring, compliance, and reporting is discussed in Section D.6.7.

D.6.1 Environmental Setting for the Proposed Project

This section presents a discussion of the regional topography, geology, seismicity, soils, mineral and paleontological resources in the project area, followed in Section D.6.1.1 by a more specific discussion of each of these issues along the proposed alignment for each segment of the Proposed Project.

Baseline geologic information was collected from published and unpublished geologic, seismic, and geotechnical literature covering the Proposed Project and the surrounding area. The literature review was supplemented by a field reconnaissance of the proposed and alternative alignments. The literature review and field reconnaissance focused on the identification of specific geologic hazards and paleontologic resources.

The project alignment is located in the west-central portion of the Coast Ranges Geomorphic Province, which is characterized by a series of north-northwest trending ranges and valleys, few of which are continuous for more than 100 miles. The province extends from Santa Barbara County northward to the Oregon border (Norris and Webb, 1990) and varies in width from a few miles to 70 miles. In the project area the Coast Range is approximately 50 miles wide.

Topography

The proposed transmission line route traverses diverse topography ranging from the gently sloping floodplain of Colma Creek along the BART right-of-way (ROW) to moderate to steep slopes on San Bruno Mountain and the ridges east of the San Andreas Fault. Elevations along the proposed alignment range from about 15 feet at the Martin Substation to approximately 725 feet above mean sea level (msl) where the alignment crosses San Bruno Mountain along Guadalupe Canyon Parkway. Elevations were determined using USGS 7½-minute quadrangles from TOPO software (TOPO, 2002).

Geology

Geologic conditions anticipated to be encountered during construction of the Proposed Project are summarized in Table D.6-1. This table lists each geologic formation, a description of the formation's general rock type or lithology, the slope stability, excavation characteristics, and age of each formation along the proposed route.

Table D.6-1. General Geotechnical Characteristics of the Geologic Formations

Formation Name	Lithology	Slope Stability	Excavation Characteristics	Age
Artificial Fill	Variable, boulders to clay	Variable depending on compaction	Easy to difficult	Modern
Bay Mud	Soft saturated silt and clay	Bottom heave in excavations	Easy to difficult	Holocene
Colluvium	Sand, silt, clay, gravel, and rock debris	Variable, depending on consolidation and texture	Easy to moderate	Quaternary
Alluvium	Boulder, gravel, sand, silt, and clay	Slumps on cut slopes, unstable excavations	Easy, boulders may affect trenching	Quaternary
Stream Channels	Sand, silt, clay, and gravel	Variable, depending on consolidation and texture	Easy~~, boulders may affect trenching~~ to difficult	Quaternary
Alluvial Fans	Sand, gravel, silt, and clay	Variable, depending on consolidation and texture	Easy	Holocene
Colma Formation	Marine sandstone. Possible significant fossils.	Slumps on cut slopes, poss. Unstable excavations	Easy	Pleistocene
Santa Clara Formation	Conglomerate, sandstone, and mudstone. Possible significant fossils.	Slumps on cut slopes, poss. Unstable excavations	Easy	Pliocene and Pleistocene
Merced Formation	Marine sandstone, siltstone, and claystone. Possible significant fossils.	Slumps on cut slopes, poss. Unstable excavations	Easy	Pliocene and Pleistocene
Whiskey Hill Formation	Marine sandstone, silty claystone, and tuffaceous siltstone. Possible significant fossils.	Generally stable	Easy	Eocene
Franciscan Formation: Sandstone	Marine greywacke sandstone, and shale. No significant fossils.	Generally stable	Moderately easy to difficult	Jurassic and Cretaceous
Franciscan Formation: Greenstone	Basaltic flows, pillow lava, and breccia	Can hold vertical face	Difficult	Jurassic and Cretaceous
Franciscan Formation: Serpentine	Serpentinite	Can slump when heavily sheared	Moderately easy	Jurassic and Cretaceous
Franciscan Formation: Chert	Chert and shale	Can hold steep face, but has tendency to ravel	Difficult	Jurassic and Cretaceous
Franciscan Formation: Melange	Sheared chaotic mixture of primarily greywacke, siltstone, shale, and serpentinite	Variable depending on block-size distribution	~~Variable~~Difficult due to high variability	Jurassic and Cretaceous
Unnamed Sandstone: (San Bruno Mt.)	Marine sandstone and shale. No significant fossils.	Generally stable	Difficult; l~~L~~ocally may require heavy ripping or blasting	Jurassic and Cretaceous

Source: Brabb, et al., 1998.

The geologic units exposed at the surface along the proposed alignment consist primarily of artificial fill, alluvium, colluvium, and stream channel deposits of Holocene and Quaternary age; marine sandstone, siltstone, and claystone of Pliocene and Pleistocene age; and Cretaceous and Tertiary age sandstone, shale, chert, greenstone, and serpentinite units of the Franciscan Group, an Unnamed Sandstone on San Bruno Mountain, and the Whiskey Hill Formation (Brabb, 1998). Holocene Bay Mud is not exposed at the surface along the project alignment but is thought to underlie the artificial fill along the San Francisco Bay margin and is expected to be encountered in excavations in the project area. Excavation characteristics are very generally defined as "easy," "moderate," or "difficult" based on increasing hardness of the rock unit. Unstable or difficult ground conditions such as those often encountered in older artificial fill over Bay Mud may also create difficulties in excavation and are thus characterized as "difficult" as well. Both excavation characteristic and slope stability descriptions are general in nature and the actual ease of excavation may vary widely depending on site-specific subsurface conditions.

Artificial Fill

Artificial fill consists of loose to very well consolidated gravel, sand, silt, clay, rock fragments, organic matter, and man-made debris in various combinations. Thickness is variable and may exceed 30 meters in places. Some is compacted and quite firm, but fill made before 1965 is nearly always uncompacted and consists simply of dumped materials.

Bay Mud

Water-saturated estuarine mud, predominantly dark gray, green, and blue clay and silty clay underlying marshlands and tidal mud flats of San Francisco Bay. The mud also contains lenses of well-sorted, fine sand and silt, shelly layers (oysters), and peat. The mud interfingers with and grades into fine-grained deposits at the distal edge of alluvial fans. Mud varies in thickness from zero, at landward edge, to as much as 150 feet at the bay margin. Bay mud deposits are thought to underlie mapped artificial fill deposits at the mouth of Visitacion Valley near Martin Substation.

Stream Channel Deposits

Stream channel deposits in the project area consist of poorly to well-sorted sand, silt, silty sand, or sandy gravel with minor cobbles. Cobbles are more common in the mountainous valleys draining into San Andreas Lake and Upper and Lower Crystal Springs Reservoirs, and along San Mateo Creek. Many small stream channels are presently lined with concrete and diverted into artificially straightened channels which are lined with concrete or rip rap. This straightening is especially prevalent in the highly urbanized lower reaches of streams entering the estuary. The mapped distribution of stream channel deposits is controlled by the depiction of major creeks on the most recent United States Geologic Survey (USGS) 7.5-minute topographic maps. Only those deposits related to major creeks are mapped. In some places these deposits are under shallow water for some or all of the year, as a result of reservoir release and annual variation in rainfall.

Alluvium

Alluvium in the project area consists of unconsolidated gravel, sand, silt, and clay near streams and on the margins of San Andreas and Upper and Lower Crystal Springs Reservoirs. Alluvium may be encountered along the project alignment along the beds of former stream channels which have been straightened or diverted into underground pipes within the highly urbanized flatlands of the Colma Creek drainage. Alluvial deposits are generally less than 10 to 20 feet thick in most places.

Colluvium

Colluvium consists of loose to firm, friable, unsorted sand, silt, clay, gravel, rock debris, and organic material in varying proportions and is found along the western and northern slopes of San Bruno Mountain.

Alluvial Fan

Alluvial fan deposits are brown or tan, medium dense to dense, gravelly sand or sandy gravel that generally grades upward to sandy or silty clay. Near the distal fan edges, the deposits are typically brown, medium dense sand that fines upward to sandy or silty clay and interfinger with either alluvium or bay mud deposits.

Colma Formation

Yellowish-gray and gray, weathering to yellowish-orange and red-brown, friable to loose, fine- to medium-grained arkosic sand with subordinate amounts of gravel, silt, and clay. Total thickness in the project area is unknown, but may be as much as 200 feet. The Colma Formation may contain significant vertebrate fossils.

Santa Clara Formation

The Santa Clara Formation is characterized as gray to red-brown poorly indurated conglomerate, sandstone, and mudstone in irregular and lenticular beds. Conglomerate consists mainly of subangular to subrounded cobbles in a sandy matrix but locally includes pebbles and boulders. Cobbles and pebbles are mainly chert, greenstone, and graywacke with some schist, serpentinite, and limestone. The Proposed Project alignment passes near but does not overlie this unit; however, portions of alternative routes near the Jefferson Substation cross mapped areas of Santa Clara Formation. The Santa Clara Formation may contain significant vertebrate fossils.

Merced Formation

The Merced Formation consists of medium-gray weathering to yellowish gray and yellowish orange, medium- to very fine-grained, poorly indurated to friable sandstone, siltstone, and claystone, with some conglomerate lenses and a few friable beds of white volcanic ash. In many places sandstone is silty, clayey, or conglomeratic. Some of the conglomerate, especially where fossiliferous, is well cemented. Volcanic ash ~~is~~ occurs in beds as much as 6 feet thick and consists largely of glass shards. The Merced Formation may contain significant vertebrate fossils.

Whiskey Hill Formation

Eocene-age, light-gray to light brown coarse-grained arkosic sandstone, with light-gray to light brown silty claystone, glauconitic sandstone, and tuffaceous siltstone. Sandstone beds constitute about 30 percent of map unit. Tuffaceous and silty claystone beds are expansive. Locally, sandstone beds are well cemented with calcite. In places within this map unit, sandstone and claystone beds are chaotically disturbed. The Whiskey Hill Formation may contain significant vertebrate fossils.

Franciscan Group

The Franciscan Group consists of a complex assemblage of predominantly graywacke sandstone interbedded with lesser amounts of dark shale. Outcrops of serpentinite, submarine basalt (greenstone), limestone, chert, and metamorphic blue schist are also contained within the complex, usually bounded by faults, and often occurring in discontinuous blocks too small to depict on maps. Within the project area, the most common Franciscan unit is sheared rock, or mélange, predominantly consisting of serpentinite and shale with blocks of unsheared greywacke, chert, and greenstone. The dominant units mapped along the project alignment are described below.

Mélange (Sheared Rock). Chaotic mixture of all the Franciscan rock types, substantial portions of which have been sheared, but includes hard blocks of all other Franciscan rock types.

Sandstone. Greenish-gray to buff, fine- to coarse-grained sandstone (graywacke), with interbedded siltstone and shale. Siltstone and shale interbeds constitute less than 20 percent of this unit, but in places form sequences as much as several tens of meters thick. In many places in the project area, shearing has obscured bedding relations; rock in which shale has been sheared to gouge constitutes about 10 percent of the unit. Gouge is concentrated in zones that are commonly less than 100 feet wide but in places may be as much as 500 feet wide.

Unnamed Sandstone of San Bruno Mountain. Dark-gray to yellowish-brown graywacke interbedded with shale, in approximately equal amounts. Unit resembles some Franciscan sandstone but the bedding is better developed herein. This unit is exposed in San Bruno Mountain, where it is about 3,250 feet thick. It probably represents a large, coherent block within the Franciscan Complex.

Serpentinite. Greenish-gray to bluish-green serpentine rock. Sheared serpentinite occurs in stringers and bands throughout the project area, enclosing variably abundant blocks of unsheared rock. Blocks are commonly less than 10 feet in diameter, but range in size from one inch to 20 feet; they consist of greenish-black serpentinite, schist, rodingite, ultramafic rock, and silica-carbonate rock, nearly all of which are too small to be shown at a reasonable map scale.

Greenstone. Dark-green to red altered basaltic rocks, including flows, pillow lavas, breccias, tuff breccias, tuffs, and minor related intrusive rocks, in unknown proportions. Unit includes some Franciscan chert and limestone bodies that are too small to map. Greenstone crops out in lenticular bodies varying in thickness from a few feet to many hundreds of feet.

Chert. White, green, red, and orange chert, in places interbedded with reddish-brown shale. Chert and shale commonly are rhythmically banded in thin layers, but chert also crops out in very thick layers. In San Carlos, chert has been altered along faults to tan- to light brown-colored clay. Chert and shale crop out in lenticular bodies as much as 250 feet thick; chert bodies are commonly associated with Franciscan greenstone.

Slope Stability

Important factors that affect the slope stability of an area include the steepness of the ~~slope~~ slop,~~and~~ the relative strength of the underlying rock material, and the thickness and cohesion of the overlying colluvium. The steeper the slope and/or the less strong the rock, the more likely the area is susceptible to landslides. The steeper the slope and the thicker the colluvium, the more likely the area is susceptible to ~~and slips~~ debris flows. Such areas can be identified on maps showing the steepness of slopes (Graham and Pike, 1998) when used in combination with a geologic map. Another indication of unstable slopes is the presence of old or recent landslides or debris flows. The Landslide Folio (Wentworth, et al., 1997) shows areas where landslides and debris flow source areas exist.

Most of t~~T~~he proposed alignment and the alternatives do not cross any areas identified as an existing landslide ~~area or susceptible to landslides~~. T~~, with t~~he exceptions are ~~of a few very~~the steep areas on either side of the San Mateo Creek canyon near Crystal Springs Reservoir and along hillsides in the southern portion of the route such as the areas mapped as sheared serpentine occurring south of San Bruno Avenue. Unmapped landslides and areas of localized slope instability may be encountered in the hills traversed by the proposed and alternative alignments in the southern portion of the project area. Also, areas where debris flows source or where debris flows may cross the proposed and alternate alignments occur along the hilly regions of the southern portion of the project area.

Faults and Seismicity

The seismicity of the project area is dominated by the northwest trending San Andreas Fault system (see Figure D.6-1). The San Andreas Fault system is responding to stress produced by the relative motions of the Pacific and North American Tectonic Plates. This stress is relieved by strain, predominantly as right lateral strike slip faulting on the San Andreas and other related faults. The effects of this strain also include mountain building, basin development, deformation of Quaternary deposits, widespread regional uplift, and the generation of earthquakes (Wallace, 1990).

The Coast Ranges are characterized by numerous geologically young faults. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (Hart, 1994):

- Faults that have generated earthquakes accompanied by surface rupture during historic time (approximately the last 200 years), and faults that exhibit seismic 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**.

The most recent probability calculations by the USGS's Earthquake Hazards Program for Northern California indicate a 62% probability of at least one magnitude 6.7 or greater earthquake on one of several active faults in the San Francisco Bay Area before 2032 (Working Group on California Earthquake Probabilities, 2003). A major quake could occur on any of four major fault zones. The zone with the highest probability is the Hayward/Rogers Creek Fault Zone with a 27% chance of a quake of magnitude greater than or equal to 6.7; the San Andreas Fault Zone is ranked second with a 21% probability of a similar quake. The 62% is the combined probability for all four fault zones.

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

Strong Groundshaking

The intensity of earthquake induced ground motions can be described using peak site accelerations, represented as a fraction of the acceleration of gravity (g). The California Geological Survey's Probabilistic Seismic Hazard Assessment Maps for the San Francisco quadrangle were used to predict peak ground accelerations along the Proposed Project alignment. The Probabilistic Seismic Hazard Assessment Maps depict peak ground accelerations with a 10 percent probability of exceedance in 50 years. The results for the Proposed Project are presented in Table D.6-2.

Table D.6-2. Peak Ground Acceleration

Proposed Transmission Line Milepost	Peak Ground Acceleration
0.0 to 25.0	Greater than 0.7g
25.0 to 27.0	0.6 to 0.7g

Figure D.6-1a. San Andreas Fault and Alquist-Priolo Earthquake Zone Near Jefferson Substation
For security reasons this figure is not included in the online version of the report.

Figure D.6-1b. San Andreas Fault and Alquist-Priolo Earthquake Zone Near Proposed Transition Station

For security reasons this figure is not included in the online version of the report.

Fault Rupture

Perhaps the most important single factor to be considered in the seismic design of electric transmission lines and underground cables crossing active faults is the amount and type of potential ground surface displacement. Of the known faults in the vicinity of the project, t~~T~~he active San Andreas Fault is the most likely to rupture~~,~~; other potentially active faults crossed by the project alignment include the Late Quaternary-age Cañada trace of the San Andreas Fault and the Serra Fault. ~~, San Bruno, and t~~The pre-Quaternary Hillside ~~f~~Fault is considered no longer active~~s~~. The San Andreas Fault is a 680 (or more) mile-long active right-lateral strike-slip fault that has been responsible for many of the damaging earthquakes in California in historical times. Movement on the ~~active~~ San Andreas Fault was responsible for the 1906 San Francisco earthquake that destroyed much of San Francisco. ~~and exhibited as~~ As much as 20 feet of right lateral displacement was measured over a width of 50 to 60 feet in the southern Tomales Bay area, with offsets of 8 to 15 feet observed along single or multiple traces from Point Arena to Portola Valley (Lawson, 1908). The 1989 Loma Prieta earthquake that occurred south of the project area did not result in offset along the San Andreas Fault. Future earthquakes could occur anywhere along the length of this 680 mile-long fault, though ~~S~~only strike-slip earthquakes of magnitude 6.0 or greater are likely to ~~be associated with~~generate surface fault rupture and offset (CGS, 1996).

Active, potentially active, and ancient faults (unlikely to be active) that intersect the proposed route are summarized in Table D.6-3. Data presented in this table include estimated earthquake magnitudes and fault surface displacements. The locations of these fault crossings are described in more detail in the descriptions of each segment, below. Table D.6-4 provides summary information about significant historic earthquakes that have occurred in the project vicinity.

Regionally damaging earthquakes could also occur on other known faults in the central California area. It is also important to note that earthquake activity from unmapped subsurface faults is a distinct possibility that is currently not predictable.

Table D.6-3. Active and Potentially Active Fault Crossings

Fault Name	Milepost	Activity	Maximum Capable Magnitude	Offset	Potential Fault Displacement*
San Andreas	14.7	Active	7.9	Right Lateral	Up to 20 ft
Serra	15.5	Potentially Active	Unknown	Thrust to NE	Up to ~~10~~ 3 ft
~~San Bruno~~	~~~19~~	~~Unlikely to be active~~	~~Unknown~~	~~Right Lateral~~	~~Less than 5 ft~~
Hillside	~22	Unlikely to be active	Unknown	Right Lateral	Less than ~~5~~ 1 ft

Source: USGS, 1996

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). In addition, densification of the soil resulting in vertical settlement of the ground can also occur.

Table D.6-4. Significant Historic Earthquakes Affecting the Project Vicinity

Locality, Fault Name in parentheses (if known)	Date	Magnitude[1]	Approximate Distance from Project Area[2]	
			miles	km
Loma Prieta (San Andreas)	Oct. 17, 1989	6.9	30	50
Morgan Hill (Calaveras)	April 24, 1984	6.2	50	80
Daly City (San Andreas)	March 22, 1957	5.3	< 5	< 8
Calaveras Fault	July 1, 1911	6.5	40	65
San Francisco (San Andreas)	**April 18, 1906**	**7.8**	**0**	**0**
Mare Island	March 31, 1898	6.5	30	50
Pajaro Gap	April 24, 1890	6.2	50	80
Santa Cruz Mountains	March 26, 1884	6	< 40	< 65
Los Gatos	Feb. 17, 1870	6	30	50
Hayward Fault	Oct. 21, 1868	7	15	25
Southern Santa Cruz Mtns	Oct. 8, 1865	6.5	< 40	< 65
Southern Santa Cruz Mtns	Feb. 26, 1864	6	< 40	< 65
San Jose Region (Mission?)	Nov. 26, 1858	6.2	< 40	< 65
San Francisco Peninsula	Feb. 15, 1856	5.7	< 10	< 15
San Francisco Peninsula	June, 1838 [3]	7	0	0
San Francisco Region	June 21, 1808	6[c]	--[c]	--[c]

1 Magnitude is moment magnitude (M_W) for earthquakes after 1911. For earthquakes before 1911,magnitudes are estimated from observed shaking intensity.
2 Distances are estimated from reported extent of fault rupture for earthquakes after 1911. For earthquakes before 1911, distances are estimated from location of causative fault. If causative fault is unknown, distance is estimated from area of highest reported shaking intensity.
3 Precise data is unavailable
Sources: Andrews (1992), Oppenheimer and MacGregor-Scott (1992), and Ellsworth (1990).

In order to determine liquefaction susceptibility of a region, three major factors must be analyzed. These include: (a) the density and textural characteristics of the alluvial sediments; (b) the intensity and duration of groundshaking; and (c) the depth to groundwater. Several of the surface materials beneath the proposed alignment meet the criteria for liquefaction: saturated granular sediments in the low-lying areas where intense groundshaking is likely to occur. Specifically, these conditions occur in the low-lying alluvial deposits, Bay mud deposits, artificial fill materials, especially those placed on Bay mud deposits, and stream ~~and creek and river~~ deposits including along the BART ROW and Colma Creek. Older and finer or coarser grained, indurated, and/or well-drained materials are less susceptible to liquefaction.

Subsidence/Differential Settlement

Localized subsidence may occur in unconsolidated soils during earthquake shaking as the result of a more efficient rearrangement of individual soil particles. Stream channel deposits and recent valley alluvium are generally most susceptible to earthquake-induced subsidence. Additionally, artificial fills, especially fills placed before 1965 and those placed on top of Bay mud, are highly susceptible to mobilization and densification, resulting in earthquake-induced subsidence. Failures of underground utilities tend to occur at the interface between a softer unit and a stiffer unit due to the settlement that occurs within the softer unit. The unconsolidated sediments underlying water crossings are typical examples of such conditions. Many water pipeline ruptures occurred in the Marina District of San Francisco as a result of differential settlements resulting from groundshaking during the Loma Prieta earthquake of 1989. Pipeline damage corresponded to areas of greatest surface settlement (USGS, 1992). Descriptions of damage caused to underground transmission lines as a result of subsidence or differential settlement during a ground-shaking event have not been located, but the likely scenario would include a downward displacement along the underground conduit at the boundary between geologic materials with different consolidation characteristics.

Seismic Slope Instability/Ground Cracking

Other forms of seismically induced ground failures which may affect the project area include ground cracking and seismically induced landslides. Ground cracking may result from several causes including lateral spreading due to local or widespread liquefaction or similar ground failure, from areas between fault strands experiencing localized extension or dilation, and along ridgelines or other topographic features with a freeface experiencing antinodal seismic wave effects. Seismically induced landslides may affect slopes which are unstable or marginally stable. Locally highly weathered and sheared materials along the San Andreas Fault with moderate to steep slopes, and previously existing landslides, both mapped and unmapped, are particularly susceptible to this type of ground failure.

Soils

The soils along the proposed transmission line route reflect ~~the degree of modification by man,~~ the underlying rock type, the extent of weathering of the rock, ~~and~~ the degree of slope, and the degree of modification by man. Much of the northern portion of the route goes through developed land, while the southern portion traverses mostly undeveloped land. According to the Soil Survey of San Mateo County, the major soil units are (from south to north) Fagan-Obispo, Urban land-Orthents, and Barnabe-Candlestick–Buri Buri complex (USDA, 1991). Fagan-Obispo is an upland soil present in the undeveloped areas alongside Interstate 280 (I-280) and beside the reservoirs. Urban land-Orthents is developed on the coastal terraces and hills north of where I-280 and Skyline Boulevard diverge and encompasses all the developed areas of San Bruno, Colma, and Daly City. The Barnabe-Candlestick–Buri Buri soil is developed on the sandstone uplands of San Bruno Mountain. Summary descriptions of these soil units are presented below.

Fagan-Obispo (FO). These soils range from shallow to deep, on gently rolling to steep terrain. Soils are well drained and are developed on the variable rock types of the Franciscan Complex. Fagan soil is loamy and deep, and is underlain by sandstone and shale; deep accumulations may be susceptible to landsliding or slippage. Obispo soil is clayey and shallow, and is underlain by hard, serpentine rock. Obispo soils have a tendency to shrink/swell. With respect to conditions for shallow excavation for buried utility trenches or for tower footings, Fagan soil limitations are described as moderately restrictive for shallow excavations due to the high clay content and steeper slopes. Obispo soil limitations are described as severe due to shallow bedrock and steeper slopes (USDA, 1991, Table 4). If excavated, the suitability of these soils for trench backfill would have to be determined in the field.

Urban Land–Orthents, Smoothed (UO). These soils are highly variable with respect to depth of development and steepness of slope on which they occur. The Urban land category includes generally well drained soils underlain by soft sandstone, whereas the Orthents, smoothed category comprises very shallow to very deep, well-drained, fine sandy loam over loam. Erosion hazard occurs where slopes are steep. Because of the high extent of modification of the surface soils, no engineering properties are reported for this soil type. With respect to conditions for shallow excavation for buried utility trenches or for tower footings, the qualities of Urban land-Orthents soils were not rated in the soil survey (USDA, 1991, Table 4). If excavated, the suitability of these soils for trench backfill would have to be determined in the field.

Barnabe-Candlestick–Buri Buri complex (BCB). These soils range from very shallow to moderately deep, and from moderately to very steep well-drained soils underlain by hard sandstone of the Franciscan Complex. Candlestick soil, where thick, is susceptible to shallow landslides. Specific locations of Candlestick soils are not distinguished on the maps of the soil survey. With respect to conditions for shallow excavation for buried utility trenches or for tower footings, Barnabe, Candlestick and Buri Buri soil limitations are all described as severely restrictive for shallow excavations due to shallow bedrock and steeper slopes (USDA, 1991, Table 4). If excavated, the suitability of these soils for trench backfill would have to be determined in the field.

Neither Fagan-Obispo nor Barnabe-Candlestick–Buri Buri ~~None of the~~ soils are identified by the Soil Survey as suitable for construction materials (roadfill, sand, gravel or topsoil). Urban Land-Orthents was not rated (USDA, 1991).

Mineral Resources

No major mineral resources occur along the proposed or the alternative alignments. A few crushed rock quarries are mapped near the proposed alternative alignments. One quarry is located on the east side of San Andreas Lake near the southern end of the study area. This site appears to be close to the proposed alignment on the map, but is not visible on aerial photos. The map symbol may represent an old borrow pit used during the construction of the reservoir dam. A few crushed rock quarries are located on San Bruno Mountain, but none of them appear to be close enough to any of the proposed or alternative alignments so as to create an impact or be impacted by the project.

Paleontologic Resources

A discussion of the sensitivity of paleontologic resources is provided in Section D.6.3.1. In Northern California, fossils of land-dwelling vertebrates are considered significant. ~~Two~~ Three geologic units occur along the proposed alignment that meet the criteria of moderate to high sensitivity of paleontological resources, the Merced, Whiskey Hill, ~~Formation~~ and ~~the~~ Colma f~~F~~ormations. The areas where these units occur are described in the following sections.

D.6.1.1 Jefferson Substation to Ralston Substation

Topography. The topography along the proposed route between the Jefferson and Ralston Substations is gently rolling hills that range from 350 feet to 680 feet in elevation.

Geology. The geologic units crossed by the alignment are mainly part of the Franciscan Complex. Franciscan rocks include large blocks of serpentine and sandstone. A large outcrop of serpentine is mapped from a few hundred feet north of the Jefferson Substation through Edgewood Park. Existing Towers 0/3 to 0/5 are founded in the serpentinite (serpentine rock). Towers 0/6 through 2/13 are founded in Franciscan mélange, a sheared and mixed unit containing numerous rock types. Towers 2/14 to 3/20 are located within the Tertiary Whiskey Hill formation, a softer sandstone unit that overlies the Franciscan. Towers 3/21 to 4/26 are in Franciscan mélange again, and Tower 4/27 and the Ralston Substation are located in Franciscan serpentinite.

Slope Stability. ~~Due to t~~This section of the proposed route exhibits rolling topography and ~~lack of steep~~ moderate slopes. ~~, this route has no apparent risk from slope instability.~~Though maps of landslide susceptibility indicate most of the proposed route in this portion of the project area in classified as "few landslides," some steeper slopes developed on sheared, fractured, or deeply weathered rock may pose a landslide risk. An area of "mostly landslides" is mapped on the west side of I-280 in the same area where the proposed project crosses the highway (Wentworth et al., 1997).

Faults and Seismicity. Jefferson Substation lies within an Alquist-Priolo Earthquake Hazard zone due to its proximity to the Cañada trace of ~~1906~~ the San Andreas Fault ~~trace~~ (approximately 100 feet west of the west edge of the site), but is not crossed by any mapped trace of the ~~San Andreas F~~fault. This part of the route would be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. The peak ground acceleration could be higher than 70% gravity (g) (CDMG, 2002). Groundshaking due to earthquakes on other faults would be less severe in this area.

Soils. Jefferson Substation occupies Urban Land/Orthents (UO) soil, but immediately north of the substation, the alignment crosses mainly Fagan/Obispo (FO) soil. One small patch of UO occurs at the crossing of Highway 92. Soils are thin on the ridges and thick in the valleys and swales. Soil is extremely thin in areas where it is developed over serpentine rock.

Mineral Resources. No mineral resources occur near this section of the alignment.

Paleontology. Fossils are known to occur in the Whiskey Hill formation but significant fossils are not known from the Franciscan Complex.

D.6.1.2 Ralston Substation to Carolands Substation

Topography. The topography along the proposed route between the Ralston and Carolands Substations is gently rolling hills that range from 350 feet to 700 feet in elevation.

Geology. The geologic units that would be crossed by the alignment are mainly Franciscan Complex. Tower 4/27 at the Ralston Substation starts in serpentinite that continues to Tower 6/34. From Tower 6/35 and 6/35a to Tower 6/38, the route crosses mélange; then returns to serpentinite from Tower 7/39 to 8/51 at the Carolands Substation. The substation itself may be founded in deeply weathered serpentinite or mélange (it is unclear which is present).

Slope Stability. This section of the proposed route crosses rolling topography with moderate slopes except at San Mateo Creek canyon where the canyon sides are very steep. Though maps of landslide susceptibility indicate all of the proposed route in this portion of the project area in classified as "few landslides" (Wentworth et al., 1997), some steeper slopes developed on sheared, fractured, or deeply weathered rock may pose a landslide risk. The steep canyon sides both north and south of Crystal Springs Road show evidence of slope instability. ~~Due to the rolling topography and lack of steep slopes, few landslides occur along this route. None are mapped crossing the alignment. This route has no apparent risk from slope instability.~~ During a field investigation conducted for this project, a recent shallow landslip was observed below existing Tower 6/38 on the north side of the canyon. The rock unit present on both sides of the canyon is Franciscan mélange, a sheared rock unit. New tower footings would need to be carefully placed to avoid areas of weak rock or to cause weakening of the existing slope. A steep-sided hollow occurs between Towers 6/38 and 6/39; this type of hollow could source debris flows, but the flow would bypass nearby tower footings as they will be placed on ridges and noses.

Faults and Seismicity. No mapped faults cross this alignment of the Proposed Project. However, this part of the route will be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. The peak ground acceleration could be higher than 70% g (CDMG, 2002). Groundshaking due to earthquakes on other faults would be less severe in this area.

Soils. Ralston Substation and most of the route occupies Fagan/Obispo soil. Urban Land/Orthents soil occurs where the alignment traverses developed areas.

Mineral Resources. No mineral resources occur near this section of the proposed alignment.

Paleontology. Significant fossils are not known to occur in the Franciscan Complex.

D.6.1.3 Carolands Substation to Transition Station

Topography. The topography along the proposed route between the Carolands Substation and the proposed transition station is gently rolling ridge top ranging from about 300 feet to 710 feet in elevation except for San Mateo Creek Canyon which is narrow and steep-sided with the low elevation of 160 feet.

Geology. The geologic units crossed by the alignment are mainly the types of Franciscan Complex. Transmission Tower 8/51 at the Carolands Substation is in Franciscan serpentinite or mélange which continues to Tower 8/52. From Towers 8/53 to 9/60 the route crosses serpentinite, then crosses a patch of greenstone (hard basalt) at Tower 9/61, then returns to serpentinite from Towers 9/62 to 10/66. Greenstone is again present from Towers 10/67 and 10/68. Mélange is present from Towers 10/69 to 12/80. The stretch from Tower 12/81 to 13/86 crosses either Franciscan sandstone or a Franciscan with a thin covering of Merced Formation (a softer, younger sandstone). The northernmost part of this stretch, from Tower 13/87 to the proposed Transition Station, crosses Franciscan sandstone. Depending on the final location of the transition station, it may be founded in sandstone or heavily crushed and sheared fault gouge lying within the San Andreas Fault Zone.

Slope Stability. This section of the proposed project follows the Buri Buri Ridge across moderate topography with few steep areas. Though maps of landslide susceptibility indicate all of the proposed route in this portion of the project area is classified as “few landslides” (Wentworth et al., 1997), some steeper slopes developed on sheared, fractured, or deeply weathered rock may pose a landslide risk. Areas of potential slope instability along this portion of the route would include the portion of the route that lies west of I-280 and north of MP 11.0. ~~Due to the rolling topography and lack of steep slopes, few landslides occur along this route. Very steep slopes occur on the sides of San Mateo Creek Canyon below Crystal Springs Dam. During a field investigation conducted for this project, a recent shallow landslip was observed below the existing tower on the north side of the canyon. The rock unit present on both sides of the canyon is Franciscan mélange, a sheared rock unit. New tower footings would need to be carefully placed to avoid areas of weak rock or to cause weakening of the existing slope.~~

Faults and Seismicity. The northern end of the alignment (from tower 12/80 at MP 12.6) lies within the Alquist-Priolo Zone for the San Andreas Fault ~~Zone~~. This part of the route will be subject to extreme groundshaking and possible ground rupture in the event of an earthquake on the San Andreas Fault. The peak ground acceleration could be higher than 70% g due to the proximity of the fault (CDMG, 2002). Groundshaking ~~due to~~caused by earthquakes on other faults would be less severe in the project area. A cumulative total~~Ground rupture~~ of up to 20 feet of ground rupture could occur along one or more fault traces depending on the size of ~~the~~ an earthquake on the San Andreas Fault and the location of the epicenter with respect to the Proposed Project. The expected displacement during an earthquake is right-lateral strike-slip, causing the western side of the fault to move toward the northwest with respect to the east side.

The overhead transmission line very nearly parallels the San Andreas Fault, crossing two major traces once from the east side to the west side between towers 13/89 and 14/91, and again between tower 14/96 and the Transition Station on San Bruno Avenue. Because of the orientation of the oblique fault crossing from 13/89 to 14/91, the transmission lines will likely be stretched as the fault moves. The crossing about 200 feet north of the Skyline Boulevard–San Bruno Avenue intersection is normal to the fault and crosses the main trace that broke in the 1906 earthquake. Displacement along the main trace would move tower 14/96 to the northwest, stretching the overhead line slightly. Another, minor fault trends north-south across the vacant lot lying just southwest of the Transition Station site. This fault was recently described as a shear (Reidel shear) possibly emanating from the main trace. Only vertical offset is expected along this fault based on the historical presence of a sag pond on its east side (Geomatrix, 2003). Given that the main trace of the San Andreas Fault lies between tower 14/96 and the Transition Station, the maximum likely shear displacement of 20 feet should be anticipated between the fixed points of the overhead wires.

Soils. This route would cross through more developed areas, as reflected in the soil designations. Urban UO soil occurs where the alignment traverses developed areas along neighborhoods, adjacent to the highway and through the golf course. Where the route parallels the San Andreas Reservoir, the soil is of the FO group.

Mineral Resources. No mineral resources occur near this section of the proposed alignment.

Paleontology. Fossils are known to occur in the Merced Formation, but significant fossils are not known from the Franciscan Complex.

D.6.1.4 Underground Segments

San Bruno Avenue

Topography. The topography along the proposed underground route between Skyline Boulevard and El Camino Real via San Bruno Avenue and to the BART ROW is gently sloping terrain from Buri Buri Ridge at about 480 feet to the base of the slope to about 20 feet in elevation.

Geology. The geologic units crossed by this underground segment include Franciscan sandstone (fs) from the proposed transition station part of the way down the hill. A thin covering of Merced Formation and artificial fill overlie the Franciscan soil just west of the I-280 crossing. The east side of I-280 is Colma formation with local areas of artificial fill.

Slope Stability. Due to the gently sloping topography, few landslides occur or would be expected to occur along this route.

Faults and Seismicity. ~~This proposed segment crosses the San Andreas Fault at the Skyline-San Bruno intersection.~~ The proposed transition station would be located within an Alquist-Priolo Earthquake Hazard zone and ~~between several~~west of the main mapped traces of the San Andreas F~~f~~ault. Because of the proximity of the transition station to the San Andreas Fault, the peak ground acceleration along the western end of the underground route could be higher than 70% g (CDMG, 2002). Groundshaking due to earthquakes on other faults would be less severe in this area of the project. Recent site-specific studies performed for PG&E indicate the main trace and a probable Reidel shear fault (a secondary fault of the main San Andreas) both lie west of the proposed transition station site. Another probable secondary fault may occur just east of the transition station site; this fault is inferred from the presence of a historical sag pond that used to lie about 200 feet due north of the transition station (Geomatrix, 2003). While this secondary fault is considered Quaternary in age, and therefore potentially active, the estimated oblique fault displacement is probably 1 foot or less. This secondary fault would be crossed by the underground 230 kV transmission line near or just east of the boundary of the transition station site. Ground deformation associated with slip on the secondary fault east of the transition station site could consist of warping, tilting, and/or settlement.

About ~~a mile~~450 feet east of the transition station site and down the hill, ~~just west of I-280,~~ the alignment crosses a lineament corresponding to a depositional contact between the Franciscan Complex on the southwest and the sedimentary strata of the Merced Formation on the northeast. This contact is interpreted as ~~the Serra Fault~~an area where movement on the nearby Serra Fault results in tension cracks caused by flexural slip (Geomatrix, 2003). The underground alignment could be subject to local extension on the order of 1-foot or less across this zone. The underground alignment crosses the Serra Fault about 1 mile east of and down the hill from the transition station. The Serra Fault~~, a fault that~~ is not classified as an Alquist-Priolo fault, but shows evidence of movement in the Late Quaternary (making it a potentially active fault). The Serra is a thrust fault with the west side riding over the east side with an oblique sense of motion. Potential displacement along this fault is believed to generally occur as triggered slip during an earthquake on the San Andreas Fault (Burgmann and others, 1997), and could be as high as 3 feet. Movement on the Serra Fault would cause compression of the underground transmission line where it crosses the fault.~~The peak ground acceleration along the route could be higher than 70% g (CDMG, 2002). Groundshaking due to earthquakes on other faults would be less severe in this area of the project.~~

Soils. This route crosses developed areas designated as having UO soil along neighborhoods and within the roads.

Mineral Resources. No mineral resources occur near this section of the proposed alignment.

Paleontology. Fossils are known to occur in both the Merced and Colma formations which may be encountered while trenching in the hill slope and lower hill slope portions of the proposed underground route. Fossils are known to occur in the Franciscan sandstone, but they are generally not deemed significant.

BART ROW

Topography. The topography along the proposed underground route in the BART ROW is nearly flat terrain ranging from 20 feet to 70 feet in elevation. The proposed alignment follows the BART ROW up the broad river valley that was made by Colma Creek.

Geology. The entire segment is in clean fill recently installed over the new BART extension. The BART tunnel is built into Colma Formation and recent alluvium.

Slope Stability. The segment crosses areas mapped as surficial deposits and is mostly flat. There is no risk of landslides or slope instability.

Faults and Seismicity. No faults cross the alignment of the proposed underground segment in the BART ROW. However, this part of the route will be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. The peak ground acceleration could be as high as 60 to 70% g or higher in places (CDMG, 2002). Groundshaking due to earthquakes on other faults would be less severe in this area.

Soils. This portion of the underground route crosses developed areas designated as having UO soil.

Mineral Resources. No mineral resources occur near this section of the proposed underground alignment.

Paleontology. Fossils are known to occur in the Colma Formation; however, because the underground segment would be placed within disturbed BART ROW, no fossils would be encountered.

Colma to Martin Substation

Topography. The topography along this portion of the proposed underground segment varies from 65 feet in elevation in the area of Lawndale Boulevard ~~McLellan Drive~~ and 15 feet in elevation at Martin Substation to 715 feet in elevation at the top of San Bruno Mountain.

Geology. The western portion of this segment to Guadalupe Canyon Parkway is entirely within Colma Formation as mapped, but because the Colma Formation may be thin along the hillside, the trench could be excavated into Franciscan sandstone below Colma Formation. Guadalupe Canyon Parkway is mapped as lying within Franciscan sandstone, but because the trench follows the roadway, excavations may only encounter disturbed material and fill. The final portion of this segment, near and at the Martin Substation, is through artificial fill.

Slope Stability. All route segments cross areas mapped as covered by thin surficial deposits (soil) with few landslides. San Bruno Mountain is composed of sturdy sandstone that is not susceptible to landsliding except in over-steepened areas. The route over San Bruno Mountain would follow Guadalupe Canyon Parkway and would not traverse any over-steepened areas.

Faults and Seismicity. No active or potentially active faults cross the alignment of this proposed underground segment. However, this part of the route will be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. The peak ground acceleration could be as high as 60 to 70% g in the vicinity of Colma and South San Francisco; 50 to 60% g on San Bruno Mountain and at the Martin Substation (CDMG, 2002). Groundshaking due to earthquakes on other more distant faults would be less severe in this area.

Soils. Soils along the majority of this segment, including near the south and north ends of the Guadalupe Canyon Parkway, are UO soils. The top of San Bruno Mountain is mapped as having Barnabe-Candlestick–Buri Buri (BCB) soil complex. The BCB soils are variously thin and thick depending on the local topography and depth of weathered sandstone bedrock.

Mineral Resources. Crushed rock quarries are present on San Bruno Mountain, though they are not within the ROW of the Guadalupe Canyon Parkway.

Paleontology. The western portion of this segment (Colma) is entirely within Colma Formation, which is known to contain fossils, but because the line would be installed within roadway ROWs where sediments are already disturbed, it would be less likely that undisturbed sediments would be encountered. However, if the trench were to penetrate undisturbed Colma Formation, there would be a slight chance of significant fossils being disturbed. The eastern segment, along the roadbed of Guadalupe Canyon Parkway, is not likely to contain undisturbed bedrock. However, if the trench penetrates undisturbed rock, there is a slight chance of disturbing fossils in the sandstone of San Bruno Mountain, though fossils in the Cretaceous-age marine sandstone are not likely to be significant.

D.6.2 Applicable Regulations, Plans, and Standards

Geologic resources and geotechnical hazards 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 pipeline construction, including trench backfill, compaction, and testing.

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 pipelines, 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. Chapter 33 of the CBC contains requirements relevant to the construction of underground transmission lines. CCR Title 24, Section 3301.2 and 3301.3 *et seq.* contain the provisions requiring protection of the adjacent property during excavations and requires 10 days written notice and access to the excavation be given to the adjacent property owners. Relevant owners would include BART along which a large portion of the proposed underground segment is located.

Local. The safety elements of General Plans for the cities and the County along the proposed alignment contain policies for the avoidance of geologic hazards and/or the protection of unique geologic features. A survey of General Plans along the proposed alignment 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

A wide range of potential impacts, including loss of mineral and paleontological resources, slope instability including landslides, debris flows and slope creep, and seismic hazards including surface fault rupture, strong groundshaking, liquefaction, and seismically induced landslides, was considered in this analysis. Each of these potential geologic, soils, and paleontologic impacts is discussed in the following sections.

D.6.3.1 Definition and Use of Significance Criteria

Geology

Geologic conditions were evaluated with respect to the impacts the project may have on the local geology, as well as the impact that specific geologic hazards may have upon the ~~pipeline~~ transmission line and its related facilities. The significance of these impacts was determined on the basis of National Environmental Policy Act (NEPA) and CEQA statutes, guidelines and appendices, thresholds of significance developed by local agencies, government codes and ordinances, and requirements stipulated by California Alquist-Priolo statutes. Significance criteria and methods of analysis were also based on standards set or expected by agencies for the evaluation of geologic hazards.

Impact assessment was developed based on geologic and geotechnical engineering evaluation of the project. The assumptions and justification for site specific assessments are explained in the text.

Impacts of the project on the geologic environment would be considered significant if:

- Unique geologic features or geologic features of unusual scientific value for study or interpretation would be disturbed or otherwise adversely affected by the transmission line alignment and consequent construction activities
- Known mineral and/or energy resources would be rendered inaccessible by transmission line construction
- Geologic processes, such as landslides, could be triggered or accelerated by construction or disturbance of landforms
- Substantial alteration of topography would be required or could occur beyond that which would result from natural erosion and deposition.

Impacts of the following geologic hazards on the project would also be considered significant:

- High potential for ground rupture due to presence of an active earthquake fault at the transmission line route with attendant potential for damage to the transmission line or other project structures
- High potential for earthquake-induced groundshaking to cause liquefaction, settlement, lateral spreading and/or surface cracking along the route and probable attendant damage to the transmission line or other project structures
- Potential for landslides, earthflows, and debris flows.
- Potential for failure of construction excavations and project facilities due to the presence of loose saturated sand or soft clay.
- Potential for ground deformation and settlement as a result of loading of soft, loose and/or compressible soils causing damage to project structures and other improvements.
- Potential for exposure of workers and public to naturally occurring asbestos fibers

Soils

Major topics considered for assessing the project soil impacts included the erosion potential, agricultural productivity, and the corrosive effects of the soil on the transmission line duct encasement.

The impact of the project on soils is considered significant if:

- Erosion could be triggered or accelerated so that successful revegetation would be impaired and/or siltation would cause significant impacts on water quality or aquatic habitats
- Erosion of native soils or poorly compacted backfill could increase to a rate that would expose the transmission line casing or undermine structural supports (see Section D.7, Hydrology and Water Resources).
- The productivity of prime agricultural land would be reduced by disruption, mixing, displacement, or compaction of soils
- Agricultural soils would be converted to non-agricultural use

The impact of natural soils on the transmission line project would be considered significant if:

- Corrosive soils would damage the transmission line casing
- Expansive soils would damage aboveground structures.

Paleontology

Determination of the "significance" of a fossil can only occur after a fossil has been found and identified by a qualified paleontologist. Until then, the actual significance is unknown. The most useful designation for paleontological resources in an EIR document is the "sensitivity" of a particular geologic unit. Sensitivity refers to the likelihood of finding significant fossils within a geologic unit. In Northern California, fossils of land-dwelling vertebrates are considered significant. Such fossils are found in fluvial and lake deposits.

The following levels of sensitivity recognize the important relationship between fossils and the geologic formations within which they are preserved.

- **High Sensitivity.** High sensitivity is assigned to geologic formations known to contain paleontological localities with rare, well-preserved, and/or critical fossil materials for stratigraphic or paleoenvironmental interpretation, and fossils providing important information about the paleobiology and evolutionary history (phylogeny) of animal and plant groups. Generally speaking, highly sensitive formations are known to produce vertebrate fossil remains or are considered to have the potential to produce such remains.
- **Moderate Sensitivity.** Moderate sensitivity is assigned to geologic formations known to contain paleontological localities with moderately preserved, common elsewhere, or stratigraphically long-ranging fossil material. The moderate sensitivity category is also applied to geologic formations that are judged to have a strong, but unproven potential for producing important fossil remains (e.g., Pre-Holocene sedimentary rock units representing low to moderate energy, of marine to non-marine depositional settings).
- **Low Sensitivity.** Low sensitivity is assigned to geologic formations that, based on their relative youthful age and/or high-energy depositional history, are judged unlikely to produce important fossil remains. Typically, low sensitivity formations may produce invertebrate fossil remains in low abundance.
- **Marginal Sensitivity.** Marginal sensitivity is assigned to geologic formations that are composed either of pyroclastic volcanic rocks or metasedimentary rocks, but which nevertheless have a limited probability for producing fossil remains from certain sedimentary lithologies at localized outcrops.
- **Zero Sensitivity.** Zero sensitivity is assigned to geologic formations that are entirely plutonic (volcanic rocks formed beneath the earth's surface) in origin and therefore have no potential for producing fossil remains.

D.6.3.2 Applicant Proposed Measures

PG&E has committed to implementation of the Applicant Proposed Measures (APMs) presented in Table D.6-5 to reduce potential impacts. The CPUC will ensure that these APMs are implemented by monitoring their implementation concurrent with monitoring of adopted mitigation measures.

D.6.3.3 230 kV/60 kV Overhead Transmission Line

This segment of the proposed route lies parallel to the San Andreas Fault and within 1 mile of the main active fault trace. The northern end of the segment crosses over the surface trace of the 1906 rupture in two places. In the event of an earthquake along the San Andreas Fault adjacent to the project, this entire segment would be subject to severe groundshaking and near-field effects such as amplified ground motions in particular areas. In addition, the transmission towers in the vicinity of the fault crossings would be subject to the hazard of surface fault rupture, potentially causing damage or failure of tower structures. While much of the route crosses areas of bedrock with very little soil cover, some areas of potential slope instability and landslides may be encountered on the steep slopes of San Mateo Creek canyon as well as along other hilly portions of the route.

Jefferson Substation to Ralston Substation

During the review and field check of the geologic conditions along the overhead alignment, no evidence was found of especially problematic soil conditions. However, the Proponent's Environmental Assessment (PEA) describes the possible presence of soft or loose soils, and compressible soils; therefore, Impacts G-1 and G-2 are identified below. In addition, Impacts G-7 (slope instability) and G-11 (corrosive soils) and associated Mitigation Measures G-7a (geotechnical surveys for landslides) and G-11a (implement standard engineering methods for corrosive soils) are applicable to this portion of the overhead route segment (see Ralston Substation to Carolands Substation below for Impact G-7 discussion and Section D.6.3.5 for Impact G-11 discussion). Other impacts are also defined.

Table D.6-5. Applicant Proposed Measures – Geology, Soils, and Paleontology

APM No.	Measure
10.1	If fossils are encountered during construction, a qualified paleontologist will be contacted to examine the find and to determine its significance. If the find is deemed to have scientific value, the paleontologist and PG&E will devise a plan to either avoid impacts or to continue construction without disturbing the integrity of the find (e.g., by carefully excavating the material containing the resources). APM 10.1 is superseded by Mitigation Measure G-3a (see Impact G-3 discussion in Section D.6.3.3).
10.2	**Overhead Transmission Lines.** For overhead transmission lines, site-specific geotechnical investigations will be performed at proposed tower locations to evaluate the potential for fault surface rupture. Where significant potential for fault surface rupture exists, tower locations will be adjusted as possible. Incorporation of standard engineering practices as part of the Project will ensure that people or structures are not exposed to fault rupture hazards. **Underground Transmission Lines.** Site-specific geotechnical investigations will be performed at locations where underground portions of the proposed transmission line cross mapped fault zones and intersect individual fault traces. Where significant potential for fault surface rupture is identified, appropriate engineering measures, such as installing breakaway connections and strategically locating splice boxes outside of the fault zone, will be implemented to protect sensitive equipment and limit the extent of potential repairs. Appropriate operation and maintenance measures will be implemented to prepare for potential fault-rupture scenarios and facilitate timely repair of facilities, if necessary. Preparation measures may include storage and maintenance of spare parts and equipment that may be needed to repair or temporarily bypass portions of the transmission line damaged as a result of fault surface rupture. Spare parts and equipment will be stored at the transition station or nearby PG&E facilities. **Overhead-Underground Transition Station.** A geotechnical investigation will be performed at the proposed overhead-underground transition station location to identify primary and subsidiary traces of the San Andreas Fault. Critical transition station facilities, including transmission-line support structures, the overhead-underground transition structure, and the control building, will not be sited over active or potentially active traces of the fault. To the extent feasible, station structures will be designed to accommodate anticipated displacement and distortion of the ground surface during a major earthquake along the San Andreas Fault Zone. As with design of underground transmission lines, transition station facilities will be designed for ductility and strength using reinforced components and flexible connections. Overhead transmission-line spans will be designed to accommodate potential fault displacement between support structures.

Source: PG&E, 2002.

Impact G-1: Soft or Loose Soils Along Alignment May Affect Tower Foundations and Footings, Excavation Stability, and Access to Construction Areas

Loose or saturated sands and soft clays present along the proposed alignment may pose difficulties in excavating for pole or tower foundations, in trenching during construction of underground facilities, and in access to project sites during construction. Mitigation Measure G-1a described below is recommended to reduce potential impacts associated with soft or loose soils to less than significant levels (Class II).

Mitigation Measure for Impact G-1

G-1a **Perform Geotechnical Studies**. The Applicant shall perform design-level geotechnical studies to identify areas of soft or loose soils along the alignment where they may affect tower footing excavation stability and/or access roads. Where soft or loose soils are found, Best Management Practices (BMPs) shall be followed for avoidance, improvement, or replacement of affected soil areas. BMPs shall be identified and provided to the CPUC and SFPUC for review and approval at least 60 days before construction.

Impact G-2: Excavation, Grading, or Fill Placement During Construction Activities Could Cause Slope Instability

Destabilization of natural or constructed slopes could occur as a result of construction activities due to excavation, grading, or fill operations. Excavation operations associated with pole foundation construction could result in unstable excavation slopes, caving, and displacement of the adjacent ground surface. This potential hazard would be mitigated to less than significant levels (Class II) through the implementation of Mitigation Measure G-2a, described below.

Mitigation Measure for Impact G-2

G-2a **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. Appropriate construction methods and procedures, in accordance with State and federal health and safety codes, shall be followed to protect the safety of workers and the public during trenching and excavation operations. PG&E 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 G-3: Paleontologic Resources May Be Destroyed by Construction Activities

~~Some~~ Several fossil-bearing geologic formations are located in the project area. Fossils are particularly common in the Merced formation, and a little less common in the Colma and Whiskey Hill formations. PG&E has recommended APM 10.1, which requires the construction contractor to contact a qualified paleontologist to assess the significance of a resource if fossils are encountered during construction. To strengthen the intent of APM 10.1, and to ensure that impacts to paleontological resources are mitigated to less than significant levels (Class II), Mitigation Measure G-3a is recommended. Measure G-3a supersedes APM 10.1.

Mitigation Measure for Impact G-3

G-3a **Consult a Paleontologist**. Prior to construction, a qualified paleontologist shall be consulted regarding the likelihood of encountering significant fossils along specific segments of the approved~~proposed~~ alignment. The definition of a "qualified paleontologist" is provided by the Society of Vertebrate Paleontologists (SVP, 1999). If the paleontologist determines fossils may be present, a paleontologic monitor shall be present at each excavation that penetrates ~~potentially fossiliferous~~ undisturbed native soil or rock (not fill or Franciscan rock) that has been identified by the paleontologist as moderately to highly sensitive. Sampling and collecting shall follow

SVP (1999) guidelines. Typical samples for microfossils shall be collected and ~~A~~any significant megafossils that are found shall be prepared for curation by the paleontologist and donated to a public museum such as the Museum of Paleontology at the University of California at Berkeley. PG&E shall document compliance with this measure prior to the start of construction by submitting to the CPUC for review and approval a preliminary paleontological report by the paleontologist containing the following elements: (1) ~~documenting~~ the locations where project construction is likely ~~ihood of~~to encounter~~ing~~ significant fossils; and (2) a plan outlining the proposed monitoring and fossil recovery/salvage methods. ~~shall be provided to the CPUC for review and approval.~~ Within ninety (90) days of completion of the excavation phase of the project, the paleontologist shall prepare a final paleontological report summarizing the monitoring and the findings; this report shall be provided to the CPUC for review and approval. The report shall include a list of fossils found (if any), the general locations of found fossils (precise locations should be kept confidential), the name of the curating institute where the fossils have been delivered, and a statement that the loss of non-renewable resources has been mitigated.

Impact G-4: Naturally Occurring Asbestos Fibers May Be Encountered and Become Airborne Through Construction Activities

The Proposed Project alignment traverses mapped areas of Franciscan serpentinite rock which is known to contain naturally occurring chrysotile asbestos minerals in varying abundance. Serpentinite rock is also a constituent of Franciscan mélange. Though all serpentinite rocks may not contain sufficient quantities of asbestos to create a hazardous condition, excavation and grading activities could potentially cause the airborne transport of chrysotile asbestos fibers. Mitigation Measure A-3a (see Air Quality, Section D.10.3.1), which requires the preparation of an Asbestos Dust Mitigation Plan per the requirements of Title 17 of the California Code of Regulations, would reduce potential impacts associated with naturally occurring asbestos to levels that are less than significant (Class II).

Mitigation Measure for Impact G-4

Implementation of Air Quality Mitigation Measure A-3a would ensure that impacts associated with naturally occurring asbestos fibers becoming airborne would be reduced to less than significant levels.

Impact G-5: Strong Groundshaking from Local and Regional Seismic Sources

This portion of the proposed route would not cross any active trace of the San Andreas Fault, though it lies very close. Severe groundshaking should be expected in the event of an earthquake on the fault in this area. The alignment is also subject to groundshaking from any of several major, active faults in the region. While the shaking would be less severe from an earthquake that originates farther from the alignment, the effects, particularly on the ridgelines, could be damaging 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. Estimated horizontal peak ground acceleration (PGA) experienced by project facilities would range upwards from approximately 0.6 g for a maximum capable earthquake on the San Andreas Fault. To reduce potential impacts to less than significant levels (Class II), Mitigation Measure G-5a is recommended, which requires incorporation of standard engineering practices as part of the project, to ensure that people or structures are not exposed to hazards associated with strong seismic groundshaking.

Mitigation Measure for Impact G-5

G-5a **Reduce Effects of Groundshaking.** The Applicant shall perform design-level geotechnical investigations including 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 ~~past~~ types of damage that 230 kV equipment at substations ~~equipment damage~~have been subjected to in the past. These design guidelines shall be implemented during construction of substation modifications and transition station construction. Substation and transition station control buildings shall be designed in accordance with the Uniform Building Code for sites in Seismic Zone 4 with near-field factors. Compliance with this measure shall be documented to the CPUC at least 60 days before construction by submittal of reports describing the potential peak ground accelerations expected for design level earthquake and a description of how the design will accommodate this anticipated motion.

Impact G-6: Seismically Induced Ground Failures Including Liquefaction, Lateral Spreading, Seismic Slope Instability, and Ground-Cracking

Seismically induced ground failure includes liquefaction, lateral spreading, seismic slope instability (landslide) and ground-cracking. 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. Slope instability and ground-cracking can occur anywhere, but is generally concentrated on hilltops, ridgelines, or very close to an active trace of the fault.

As much of the this portion of the overhead segment is located along hillsides or ridgelines, the possibility of seismic-induced ground failure in the form of ~~slope instability~~landsliding or ground-cracking is high. Some of the underground portions of alternatives cross areas of artificial fill over Bay Mud where the likelihood of coseismic ground failure is also high. Mitigation Measure G-6a below would reduce potentially significant impacts for all potential instances of ground failure along the project to less than significant levels (Class II).

Mitigation Measure for Impact G-6

G-6a **Geotechnical Investigations for Liquefaction and Slope Instability**. Since seismically induced ground failure has the potential to damage or destroy project components, the Applicant shall perform design-level geotechnical investigations to assess the potential for liquefaction, lateral spreading, seismic slope instability, and ground-cracking 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 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. PG&E shall submit a report of the required investigations to the CPUC for review and approval at least 60 days before construction.

Ralston Substation to Carolands Substation

This portion of the overhead line route would cross the steep-sided San Mateo Creek Canyon. No evidence of especially problematic soil conditions, ~~slope instability,~~ fault rupture, or paleontologic resources has been identified along this portion of the route. Slope instability could occur along the steep sides of San Mateo Creek Canyon, and anywhere along the route where the rock is thoroughly fractured or sheared and lies on a moderate to steep slope. The following previously identified Class II impacts and mitigation measures may affect this portion of the overhead segment: Impact G-1 (soft or loose soils) would be mitigated by Mitigation Measure G-1a; Impact G-2 (slope instability) would be mitigated by Mitigation Measure G-2a; Impact G-3 (destruction of paleontologic resources) would be mitigated by Mitigation Measure G-3a; Impact G-4 (naturally occurring asbestos fibers) would be mitigated by Mitigation Measure A-3a; Impact G-5 (strong groundshaking) would be mitigated by Mitigation Measure G-5a; and Impact G-6 (seismically induced ground failures) would be mitigated by Mitigation Measure G-6a. Impact G-11 (corrosive soils) and associated Mitigation Measure G-11a (implement standard engineering methods for corrosive soils) is applicable to this portion of the overhead route segment (see Section D.6.3.5 for Impact G-11 discussion). In addition, Impact G-7 is applicable to this portion of the overhead route segment.

Impact G-7: Slope Instability Including Landslides, Earth Flows, and Debris Flows

Slope instability including landslides, earth flows, and debris flows has the potential to undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. The area where landslides would be most likely to occur is the steep sides of San Mateo Creek Canyon where towers are proposed fairly close to the steep canyon sides. Impacts associated with slope instability would be mitigated to less than significant levels (Class II) with implementation of standard practices and Mitigation Measure G-7a, below.

Mitigation Measure for Impact G-7

G-7a **Geotechnical Surveys for Landslides.** The Applicant shall perform design-level geotechnical surveys to evaluate the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in the vicinity of other project facilities. Based on these surveys, approved project facilities shall be located away from very steep hillsides, debris-flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain. A report documenting these surveys shall be submitted to the CPUC for review and approval at least 60 days before construction.

Carolands Substation to Transition Station

~~This portion of the overhead line route would cross the steep-sided San Mateo Creek Canyon.~~ The following previously identified Class II impacts and mitigation measures may affect this portion of the overhead segment: Impact G-1 (soft or loose soils) would be mitigated by Mitigation Measure G-1a; Impact G-2 (slope instability) would be mitigated by Mitigation Measure G-2a; Impact G-3 (destruction of paleontologic resources) would be mitigated by Mitigation Measure G-3a; Impact G-4 (naturally occurring asbestos fibers) would be mitigated by Mitigation Measure A-3a; Impact G-5 (strong groundshaking) would be mitigated by Mitigation Measure G-5a; ~~and~~ Impact G-6 (seismically induced ground failures) would be mitigated by Mitigation Measure G-6a; and Impact G-7 (landslides) would be mitigated by Mitigation Measure G-7a. Impact G-11 (corrosive soils) and associated Mitigation Measure G-11a (implement standard engineering methods for corrosive soils) is applicable to this portion of the overhead route segment (see Section D.6.3.5 for Impact G-11 discussion).

In addition, the following impact is applicable to this portion of the overhead line.

Impact G-8: Surface Fault Rupture at Crossings of Active and Potentially Active Fault Traces

Project facilities would be subject to hazards of surface fault rupture at crossings of active traces of the San Andreas Fault between MP 14.1 and 14.9 along the proposed route. Hazards would not be as great where the proposed alignment crosses traces of potentially active faults, such as Serra Fault along San Bruno Avenue~~, the Cañada Trace of San Andreas Fault, or the unnamed fault trace near the Jefferson Substation~~. Fault crossings where multiple feet of displacement are expected along active faults are best crossed as overhead lines with towers placed well outside the fault zone to allow for the flex in the cables to absorb offset. APM 10.2 requires geotechnical investigations for surface rupture potential to be conducted for proposed tower locations and to adjust tower locations if possible where surface rupture potential exist. In addition to APM 10.2, Mitigation Measure G-8a is recommended for overhead crossings to minimize the length of transmission line within fault zones. Impacts associated with overhead active fault crossings can be mitigated to less than significant levels (Class II) because they are able to distribute fault displacements over a comparatively long span.

Mitigation Measure for Impact G-8

G-8a **Minimize Project Structures Within Active Fault Zone.** Any crossing of an active fault ~~crossing~~ (overhead or underground) shall be made as close to perpendicular to the fault as possible to make the segment cross the shortest distance within an active fault zone. For crossings of active faults with overhead transmission lines, the towers shall be placed as far as feasible outside the area of mapped fault traces.

For underground crossings of active or potentially active fault traces, the cable vaults on either side of the fault shall be oversized, leaving as much slack as possible in the cables (ideally enough slack to allow for 20 feet of offset for the San Andreas Fault). If 20 feet of offset cannot be accommodated, the underground cable should be installed in the shortest feasible segments, with splice vaults located as close as possible outside of the fault zone in order to minimize the area where post-earthquake repairs may be required. Adequate supplies of spare cable sections shall be maintained by PG&E for rapid repair after an earthquake-caused failure.

For aboveground installations such as transition stations, PG&E shall follow standard design codes for facilities in seismic zones. Compliance with this measure shall be documented to the CPUC in a report submitted for review and approval at least 60 days prior to the start of construction.

D.6.3.4 Transition Station

The proposed transition station would be located 200 feet east of~~at~~ the intersection of San Bruno and Skyline Boulevard on a Caltrans-owned vacant parcel. In addition to roadwork and grading, the station would have an 8-foot-high masonry wall, enclosing the equipment, a control building and an underground vault. The control building would be enclosed by another masonry wall, approximately 10 feet by 10 feet by 13 feet. The outside dimensions of the underground vault would be about 24 feet by 10 feet by 10 feet. The site was once a gasoline filling station which was abandoned and removed in 1985. The site overlies fractured sandstone of the Franciscan Complex and is currently underlain by clean fill.

The proposed transition station site is located ~~immediately adjacent~~between 100 to 250 feet east of~~ to two~~ the main active trace~~s~~ of the San Andreas Fault as identified in a site-specific report prepared for PG&E by Geomatrix (2003). The Geomatrix report also indicates that no active or potentially active faults traverse the site. A secondary fault occurs on the west side of the site, and another inferred secondary fault occurs on the east side of the site. The secondary faults are considered to be potentially active, though the estimated maximum oblique net slip across either of the faults is less than one foot (Geomatrix, 2003). APM 10.2 requires that to the extent feasible, the station structures be designed to accommodate anticipated displacement and distortion associated with fault rupture which are not anticipated to be greater than one foot at the site. Though it is likely that future ruptures on the San Andreas Fault will follow the most active trace, over 100 feet away from the transition station, it is possible that a new splay or trace could develop. The possibility of fault rupture at the transition station site should not be ruled out altogether. ~~However, because of the possible large offsets of up to 20 feet (the west side of the fault would move north relative to the east side) that could occur along these active traces, structures and equipment associated with the proposed transition station would unavoidably be susceptible to impacts from surface fault rupture (Impact G-8).~~ Fault rupture impacts (Impact G-8) to the proposed transition station would be mitigable to less than significant levels with implementation of Mitigation Measure G-8a ~~and not mitigable to a level that is less than significant~~ (Class II).

Potentially significant impacts that are mitigable to less than significant levels (Class II) at the transition station include Impact G-5 (strong groundshaking), mitigated with Mitigation Measure G-5a, and Impact G-6 (seismically induced ground failures), mitigated with implementation of Mitigation Measure G-6a. Impact G-11 (corrosive soils) and associated Mitigation Measure G-11a (implement standard engineering methods for corrosive soils) is applicable to the proposed transition station site (see Section D.6.3.5 for Impact G-11 discussion).

D.6.3.5 230 kV Underground Transmission Line

San Bruno Avenue

This portion of the proposed underground route traverses areas where Merced and Colma formations are present. Impact G-3 (destruction of non-renewable paleontologic resources) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-3a. In addition, Impact G-5 (strong groundshaking from local and regional seismic sources) and Impact G-6 (seismically induced ground failures) would be mitigated to less than significant levels with implementation of Mitigation Measures G-5a and G-6a, respectively.

Two zones of potential fault rupture are recognized along this portion of the route (Impact G-8). ~~Two~~A ~~separate~~ secondary fault~~s~~ of the San Andreas Fault Zone lies just east of the proposed transition station, approximately under Glenview Drive, and crosses the beginning of the underground route. The actual presence of this fault is not established, but its existence is inferred based on geomorphic features and other fault relationships at the site (Geomatrix, 2003). This fault is interpreted to be a structure that allows mostly vertical offset as a means of reducing stress during an earthquake on the San Andreas Fault, and as such is not expected to generate more than 1 foot of oblique offset. ~~exist along this portion of the proposed underground route: traces of the active San Andreas Fault along the first 0.2 mile portion of the underground segment (i.e., from MP 14.7 to 14.9)~~ The next fault-like feature occurs about 450 feet east of the transition station site. It is interpreted to be a geologic contact between the Franciscan Complex and the marine sediments of the Merced Formation that shows evidence of movement (shears and slickensides) where the contact is exposed. The recent Geomatrix report interprets the sheared contact as a location where sympathetic movement of no more than 1 foot along the contact resulted in the past from movement on the Serra Fault (Geomatrix, 2003). The potentially active Serra Fault occurs about 4400 feet east from the proposed transition station along San Bruno Avenue. ~~and the potentially active Serra Fault along San Bruno Avenue.~~ The Serra Fault is described as one of the faults of the Foothills thrust belt, a set of thrust and reverse faults lying east of, and subparallel to the San Andreas Fault. Some movement on these faults was observed following the 1989 Loma Prieta earthquake (Burgmann and others, 1997). A common interpretation of these faults is that they accommodate a portion of the compression across the San Andreas Fault. If so, the Serra Fault would never have offset as large as the San Andreas Fault because compression makes for only a fraction of the stress across this part of the tectonic boundary. A single-event offset of less than 3 feet on the Serra Fault could be possible. ~~Potentially significant impacts to the proposed underground line between the transition station and the BART ROW include possible fault rupture caused by movement along active traces of the San Andreas Fault and the potentially active Serra Fault.~~ APM 10.2 requires preparation of geotechnical investigations at locations where underground portions of the proposed transmission line cross mapped fault zones for fault surface rupture and requires engineering measures, such as installing breakaway connections and strategically locating splice boxes outside of the fault zone. ~~However,~~ Impact G-8 (fault rupture at crossings of active and potentially active fault traces) would be mitigable to less than significant ~~and unavoidable~~ at the potentially active ~~San Andreas~~Serra Fault ~~trace~~ crossing~~s~~ ~~near~~ east of the transition station (Class II) as well as at the secondary fault crossing just east of the transition station ~~and would be mitigated to less than significant levels (Class II)~~ with implementation of Mitigation Measure G-8a. Corrosive soils may be present along the route. This impact (Impact G-11) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-11a (see Colma to Martin Substation impact discussion below). ~~at the Serra Fault crossing. Although the San Andreas Fault trace crossings would be significant and unmitigable impacts, Mitigation Measure G-8a is recommended to reduce impacts to the maximum extent feasible.~~

BART ROW

Because the entire route that follows the BART ROW would be placed within the clean, engineered fill over the BART tunnel, it is unlikely that any geologic~~, soil,~~ or paleontologic issues would be encountered except for seismically induced groundshaking. Impact G-5 (strong groundshaking from local and regional seismic sources) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a. Corrosive soils may be present along the route. This impact (Impact G-11) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-11a (see Colma to Martin Substation impact discussion below).

Colma to Martin Substation

The following previously identified Class II impacts and mitigation measures would also be applicable to this segment of the proposed underground line: Impact G-3 (destruction of non-renewable paleontologic resources) would be mitigated with Mitigation Measure G-3a; impact G-5 (strong groundshaking from local and regional seismic sources) would be mitigated with Mitigation Measure G-5a); impact G-6 (seismically induced ground failures) would be mitigated with implementation of Mitigation Measure G-6a. In addition, the following impacts (G-9 through G-11) and mitigation measures (where applicable) apply to this underground segment of the proposed route.

Impact G-9: Expansive, Soft, Loose and/or Compressible Soils

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. Several of the natural soil types identified within this portion of the project area have moderate to high clay contents and many have moderate to high shrink-swell potential. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to structures and equipment.

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. Application of standard design and construction practices and i~~I~~mplementation of Mitigation Measure G-9a, below, would reduce potential impacts to less than significant levels (Class II).

Mitigation Measure for Impact G-9

G-9a Implement Standard Engineering Methods for Problematic Soils. The Applicant 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.

Impact G-10: Project May Impact Access to Mineral Resources

The only economically viable mineral resources located along or adjacent to the Proposed Project alignment are on the west side of San Bruno Mountain. The project alignment in this area lies exclusively within paved roadways, and are therefore excluded from mapped resource sectors. Project construction would not block access to existing quarry operations, therefore potential impacts to mineral resources are considered to be less than significant (Class III) and mitigation measures are not required.

Impact G-11: Corrosive Soils

Corrosive subsurface soils may exist in places along proposed route, and is especially likely along Bayshore Boulevard where Bay Mud is present beneath the fill. Corrosive soils could have a detrimental effect on concrete and metals. Depending on the degree of corrosivity of subsurface soils, concrete and reinforcing steel in concrete structures and bare-metal structures exposed to these soils could deteriorate, eventually leading to structural failures. Implementation of standard design and construction practices and Mitigation Measure G-11a would reduce potential impacts from corrosive soils to less than significant levels (Class II).

Mitigation Measure for Impact G-11

G-11a Implement Standard Engineering Methods for Corrosive Soils. The Applicant shall perform design-level geotechnical studies to identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates. Appropriate design measures for protection of reinforcement, concrete, and metal-structural components against corrosion shall be utilized, such as use of corrosion-resistant materials and coatings, increased thickness of project components exposed to potentially corrosive conditions, and use of passive and/or active cathodic protection systems. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days before construction.

D.6.3.6 Substations, Switchyard, and Taps

Jefferson Substation

Jefferson Substation is located east of I-280 and is accessed by Cañada Road. Work necessary to accommodate the Proposed Project includes the relocation and addition of transmission poles and equipment. Rearrangement of new and existing equipment within the substation would require modification to the existing fence line and perimeter road within the existing substation boundaries. The active Cañada trace of the San Andreas Fault lies 400 to 600 feet southwest of the substation, and the main trace of the San Andreas Fault lies approximately 3,500 feet southwest. ~~re are no fault crossings at the substation;~~ T~~t~~he primary rock type is Franciscan sandstone.

Because the site is located at the top of a slope and a new tubular steel pole will be installed on the slope, there is a potential for slope instability to occur during excavation for the pole foundation (Impact G-2). Potential impact from slope instability would be mitigated to less than significant levels with implementation of Mitigation Measure G-2a and application of standard engineering design practices. Other sources of potential slope instability could result from seismic shaking and liquefaction (Impact G-5 and G-6) or from landslides or debris flows (Impact G-7). These potential impacts would be mitigated to less than significant levels with implementation of Mitigation Measures G-5a, G-6a and G-7a, respectively. Soils at the substation have moderate to high shrink-swell potential. Potentially significant impacts associated with shrink-swell potential soils (Impact G-9) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-9a and application of standard engineering design practices. ~~The substation modifications would be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. Potentially significant impacts associated with strong groundshaking (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a.~~

Ralston Substation

Ralston Substation is northeast of the I-280 and State Route 92 (SR 92). Existing lattice steel structures would be replaced by four new dead-end structures. Outside the substation fence, two new H-frame structures would be added to bring the line under the 230 kV circuit. A new lattice steel tower (Tower 5/27) would replace the existing lattice steel and wood pole tap structures. The station ground and conduit system would be modified and expanded within the existing substation footprint. There are no fault crossings at the substation; the primary rock type is Franciscan serpentinite beneath any fill that has previously been brought in for the substation. The site is nearly level.

Soils have moderate to high shrink-swell potential. Potentially significant impacts associated with soils with shrink-swell potential (Impact G-9) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-9a. Impacts associated with excavations within asbestos-containing serpentine rock (Impact G-4) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure A-3a. The substation modifications would be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. Potentially significant impacts associated with strong groundshaking (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a.

Hillsdale Junction Switchyard

The Hillsdale Junction Switchyard is located at MP 6.4, east of I-280. Bus and breaker modification would occur within the existing substation fence line. A new, single-circuit tubular steel pole (no tower number) would be installed outside and to the west of the existing switchyard footprint, north of new Tower 6/35. Hillsdale Junction is situated at the top of the ridge just south of the steep-sided San Mateo Canyon. There are no fault crossings at the substation and the primary rock type is Franciscan sheared rock (mélange) beneath any fill that has previously been brought in for the switchyard.

Soils have moderate to high shrink-swell potential. Potentially significant impacts associated with soils with shrink-swell potential (Impact G-9) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-9a. Impacts associated with excavations within asbestos-containing serpentine rock (Impact G-4) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure A-3a. The substation modifications would be subject to extreme groundshaking in the event of an earthquake on the San Andreas Fault. Potentially significant impacts associated with strong groundshaking (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a. Excavation slope stability (Impact G-2) and landslide (Impact G-7) impacts would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measures G-2a and G-7a. Because the Hillsdale Junction switchyard lies near a west-facing slope, and the new tubular steel pole would be placed on the slope, the project components may be subject to risk of damage caused by seismically induced slope instability (Impact G-6a); impacts can be mitigated to less than significant with implementation of Mitigation Measure G-6a.

Carolands Substation

The Carolands Substation is located at MP 8.8, east of Skyline Road. There are no fault crossings at the substation and the primary rock type is Franciscan sheared rock (mélange) beneath any fill that has previously been brought in for the substation. The site is level.

Soils have moderate to high shrink-swell potential. Potentially significant impacts associated with soils with shrink-swell potential (Impact G-9) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-9a. Impacts associated with excavations within asbestos-containing serpentine rock (Impact G-4) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure A-3a. Potentially significant impacts associated with strong groundshaking (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and application of standard engineering design practices.

Martin Substation

The Martin Substation is located to the southwest of the intersection of Bayshore Boulevard and Geneva Avenue. Relocation of fence, roadway, existing wood poles, and tubular steel poles near the southern perimeter of the substation is proposed to expand the existing yard. There are no fault crossings at the substation and the primary rock type is Quaternary-age alluvial fan deposits beneath any fill that has previously brought in for the substation. The site is level.

Soils at Martin Substation may be susceptible to ground failure during a major earthquake and have indeterminate shrink-swell potential. Impacts associated with seismic induced ground failure (Impact G-6) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-6a, and impacts associated with shrink-swell hazard (Impact G-9) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-9a. In addition, corrosive soils may be present beneath the fill at the substation. This impact (Impact G-11) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-11a. Potentially significant impacts associated with strong groundshaking (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and application of standard engineering design practices.

San Mateo and Monta Vista Substations

Monta Vista Substation. All upgrades would occur within the existing, enclosed control room. No changes would be visible from outside. Because the work would occur within an existing building, there are no geologic, soils, or paleontologic issues for proposed modifications to the Monta Vista Substation.

San Mateo. Modifications include requirement of a series reactor in the area presently used by the Substation Construction Field Office. The trailer office would be relocated onsite within the existing fence line and disturbed area. Because construction would occur within an existing substation without modifying the footprint, there are no geologic, soils, or paleontologic issues associated with the proposed modifications at the San Mateo Substation.

Tap Locations (Crystal Springs, Millbrae, San Andreas, San Bruno, Watershed)

The proposed San Bruno Tap at approximately MP 14.4 that would be on Tower 14/93B would be located within the San Andreas Fault Zone and on or nearly on a trace of the fault. Impacts to San Bruno Tap associated with potentially active fault rupture (Impact G-8) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-8a. Potentially significant impacts associated with strong groundshaking (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and application of standard engineering design practices.

The remaining taps (Watershed, Crystal Springs, Millbrae, and San Andreas) have no geological or soil impacts other than strong groundshaking (Impact G-5) which would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a and application of standard engineering design practices.

D.6.4 Southern Area Alternatives

D.6.4.1 PG&E Route Option 1B – Underground

Environmental Setting

This all-underground alternative would follow a route similar to the proposed overhead transmission line route. In general, this route lies west of, and downhill from the overhead route until just south of the Carolands Substation when the alternative route would turn east for a short span. It would then closely follow the proposed route until Trousdale Drive where it again would turn east to follow Trousdale downhill. At the intersection with El Camino Real, this alternative turns north to follow El Camino Real until the intersection with San Bruno Avenue. Topography is essentially the same as for the proposed route.

The geology of the section between Jefferson Substation and Trousdale Drive is nearly identical to that of the proposed overhead route. The Trousdale Drive portion crosses Franciscan sheared rock and patches of Merced Formation where not covered by artificial fill. Towards the base of the hill, the alignment crosses Colma Formation. Between Trousdale and San Bruno Avenue, the route follows El Camino Real with very little change in elevation and nearly entirely in Colma Formation. Most of the trench excavation would encounter the disturbed surface layer beneath paved roads; rock or undisturbed soil may be present toward the base of the trench. ~~There are no mapped or potential slope stability problems along this portion of the alternative.~~Due to the hilly terrain and presence of weak and unstable bedrock material (i.e., weathered serpentine, fault gouge, sheared rock) along portions of the alignment, unmapped landslides and unstable slopes may exist on natural slopes as well as on engineered roadway cut slopes and earthfill embankments.

This alternative would cross several fault traces with late Quaternary movement. Like the Proposed Project, the south end of the underground alignment that follows Cañada Road would lie within an Alquist-Priolo (AP) Earthquake Hazard Zone of the San Andreas Fault. At about MP 1.0 or 1.1, the alignment crosses the Cañada trace, an older trace of the San Andreas Fault that apparently did not show offset during the 1906 earthquake, though it exhibits the type of geomorphic expression that caused the California Geological Survey to classify it as an active trace. At about MP 2.0, the alignment passes ~~out~~ east of the AP zone. At about MP 5.3, the alignment follows Ralston Road for a short while before turning onto Highway 35 (Skyline Boulevard). Near the intersection of those two roads, the alignment re-enters the AP zone and gets to within 400 feet of a trace of the 1906 earthquake. The Trousdale Drive portion would cross several ~~fault~~ traces of the Serra Fault Zone interpreted as late as Quaternary in age. ~~While these~~These faults ~~are~~ should be~~not~~ considered ~~active they may be~~ potentially active. Seismic groundshaking would be as intense for this alternative as for the proposed route.

The only sensitive soils are located in the southern part of the route, near Jefferson Substation where the underground alternative follows Cañada Road, bypassing the sensitive Obispo soils developed over serpentine rock in Edgewood Park. North of the substation the route follows roads along the east side of the reservoirs, thus avoiding undisturbed soils. There are no mineral resources along this alternative route. Potentially significant fossils are known to exist in the Merced and Colma formations in this area.

Environmental Impacts and Mitigation Measures

Soft or loose soils along the alignment may affect excavation stability, and access to construction areas (Impact G-1). Mitigation Measure G-1a would reduce impacts to less than significant levels (Class II). Excavation, grading or fill placement during construction activities could cause slope instability (Impact G-2). Mitigation Measure G-2a would reduce impacts to less than significant levels (Class II). Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through Whiskey Hill Formation, Merced Formation, or Colma Formation. Potential impacts associated with paleontological resources (Impact G-3) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-3a. Naturally occurring asbestos fibers may be encountered and become airborne through construction activities when trenching through serpentine bedrock, serpentine soils, or sheared rock that includes serpentine. This impact (Impact G-4) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure A-3a. This route is susceptible to seismically induced ground failures including liquefaction, lateral spreading, seismic slope instability, and ground-cracking especially on ridgetops, and adjacent to the reservoirs. This impact (Impact G-6) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-6a. Portions of the route may be susceptible to landslides or debris flows (Impact G-7). These potential impacts would be mitigated to less than significant levels with implementation of Mitigation Measure G-7a. Expansive, soft, loose and/or compressible soils may be present beneath the engineered soil of the roadbed and/or median. The impact associated with these soils (Impact G-9) would be mitigated to less than significant with implementation of Mitigation Measure G-9a. Corrosive soils may be present along the route. This impact (Impact G-11) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-11a.

Project facilities along the Proposed alignment would be subject to surface fault rupture at crossings of active Cañada trace of the San Andreas Fault and the potentially active traces of the ~~San Andreas Fault. Because this fault trace is considered potentially active rather than active,~~ Serra Fault along Trousdale Drive (Impact G-8). Because of the relatively fresh geomorphic expression along the Cañada trace, fault offset could be a considerable component of the maximum 20 feet of offset expected for a major earthquake along the San Andreas Fault, even though it was not described as having moved during the 1906 earthquake. For purposes of this study, a maximum offset of between 2 and 10 feet is assumed. The best method of crossing the fault would be via overhead lines that could accommodate offset during an earthquake, however, this proposed alternate route is all underground in Cañada Road. The fault would be crossed twice: once about 1,500 feet northwest of Jefferson Substation, and again about 5,000 feet northwest of the substation. The route lies very nearly on the mapped trace, and the crossings are at a low angle — the least desirable way to cross a fault with anticipated significant offset. This type of crossing will result in the first crossing (from east to west) to stretch the cable by as much as 10 feet. The second crossing (from west to east) would compress the cable. Impact G-8, fault rupture ~~would~~ could not be mitigated to less than significant levels (Class ~~II~~I) without ~~implementation of Mitigation Measure G-8a~~an overhead fault crossing. However, Mitigation Measure G-8a, which includes engineering technique requirements for underground crossings, is recommended to reduce impacts to the extent feasible. Project facilities would be subject to strong groundshaking from local and regional seismic sources. This impact (Impact G-5) would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a.

Six options were considered in the Draft EIR for crossing the Crystal Springs Dam (see Section 4.2.1 of Appendix 1), including one overhead crossing. In its comments on the Draft EIR, PG&E suggested consideration of an additional overhead crossing of San Mateo Creek as an option to avoid a crossing at Crystal Springs Dam. The option (illustrated in Appendix 1, Figure Ap.1-2c) would require a bore from Skyline Boulevard to the vicinity of Hillsdale Junction Substation, where a new transition tower would be installed. A bore in this area could be difficult as a result of subsurface conditions. From the transition tower, the overhead line would follow the proposed overhead route crossing San Mateo Creek to Tower 6/38. A transition tower would be located below Tower 6/38 adjacent to Crystal Springs Road. From this transition tower the underground line would be installed in Crystal Springs Road for approximately 1,000 feet to Skyline Boulevard where it would rejoin the originally defined Route Option 1B.

Comparison to Proposed Route Segment

Route Option 1B is entirely underground, except where it crosses the Crystal Springs Dam, depending on which dam crossing method is selected. The impact of the project on the environment and the impact of the environment on the project is very much greater than for an overhead transmission line. Instead of isolated work at tower footings for an overhead line, soil and rock along the entire length of the route is disturbed. The Route Option 1B Alternative crosses the ~~potentially~~ active Cañada trace of the San Andreas Fault underground. This trace is less likely to rupture than one of the traces that ruptured in 1906, though rupture and offset of between 2 to 10 feet at this trace ~~is~~are possible and should be taken into consideration given that reliability of electric service is one of the major objectives of this project.

Any route that is mostly underground will encounter areas of difficult excavation as it passes through a developed area. Difficult to extremely difficult excavation is likely to be encountered when excavating within existing roadways, particularly in urban areas, where the route crosses existing underground utilities. Additionally, difficult excavation conditions may be found where the route crosses roadway cuts and goes along hillsides and ridges where shallow bedrock may be encountered. Such conditions may be found all along the southern portion of Route Option 1B. Some areas of excavation may encounter artificial fill along Trousdale Drive and El Camino. Artificial fill could contain highly variable materials, including large construction debris, refuse, and other deleterious materials, that are difficult to remove and to dispose of. Any option to cross Crystal Springs Dam or San Mateo Creek that involves a bore would not would not be considered a preferred method of crossing.

~~There is no area ofdifficult excavation along this route, and there are no impacts that cannot be mitigated to less than significant. This route avoids crossing the active traces of the San Andreas Fault.~~

D.6.4.2 Partial Underground Alternative

Environmental Setting

The Partial Underground Alternative follows a similar route as the Proposed route, but portions of the southern part of the alternative route would be underground. The northern half of this route is identical as the proposed route, so the comparison of the two routes is only for the southern part, south of the proposed transition station at San Bruno Avenue and Skyline Boulevard. The topography associated with this alternative is the same as that of the proposed route, as are the geologic units, slope stability, and soils. The overhead portion ~~in the first 2 miles~~ of the alternative crosses the active Cañada trace of the San Andreas Fault in the first 2 miles of the route. Much of the route lies very close to the San Andreas Fault and would be subjected to extreme groundshaking in the event of an earthquake on the San Andreas Fault. No mineral resources occur near this section of the alignment. Significant fossils have been found in the Whiskey Hill, Merced, and Colma formations; these formations are present along this alternative route.

Environmental Impacts and Mitigation Measures

Soft ~~or~~, loose, or corrosive soils along ~~alignment~~roadway embankments and native materials along the alignment may affect tower footings, excavation stability of the trench, and access to construction areas (Impacts G-1, G-9, and G-11). Mitigation Measures G-1a, G-9a, and G-11a would reduce impacts to less than significant levels (Class II). Excavation, grading or fill placement during construction activities could cause slope instability (Impact G-2). This would most likely occur at the San Mateo Creek Canyon crossing, but is also applicable to the underground portions of the route. Mitigation Measure G-2a would reduce impacts to less than significant levels (Class II). Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through Whiskey Hill Formation, Merced Formation, and/or Colma Formation (Impact G-3). Mitigation Measure G-3a would reduce impacts to less than significant levels (Class II). Naturally occurring asbestos fibers may be encountered and become airborne through construction activities when trenching through serpentine bedrock, serpentine soils, or sheared rock that includes serpentine (Impact G-4). Mitigation Measure A-3a would reduce impacts to less than significant levels (Class II).

Project facilities would be subject to strong groundshaking from local and regional seismic sources (Impact G-5). Mitigation Measure G-5a would reduce impacts to less than significant levels (Class II). Landslides and debris flows could impact the Partial Underground Alternative (Impact G-7), primarily along the southern part of the route. Mitigation Measure G-7a would reduce impacts to less than significant levels (Class II). Project facilities along the alternative ~~proposed~~ alignment would be subject to surface fault rupture at crossings of ~~potentially~~ active fault traces (Cañada trace of the San Andreas Fault at about MP 1.0 to 2.0, and the San Andreas Fault near the San Bruno Avenue Transition Station) (Impact G-8). Because the Cañada trace ~~is considered potentially active rather than active~~would be crossed by an overhead line, Mitigation Measure G-8a would reduce this impact to less than significant levels (Class II). The route is susceptible to seismically induced ground failures including liquefaction, lateral spreading, seismic slope instability, and ground-cracking especially on ridgetops, and adjacent to the reservoirs (Impact G-6). Mitigation Measure G-6a would reduce impacts to less than significant levels (Class II).

Two new mitigation measures presented in this Final EIR would require transition tower locations to be moved. Biology Mitigation Measure B-2b would require that the transition tower originally located at Tower 6/37 to be moved to approximately 100 feet north of existing Tower 6/36 location. Visual Resources Mitigation Measure V-24a would require that Tower 7/39 to be relocated approximately 100 feet north of its proposed location. Implementation of Mitigation Measure B-2b would result in slightly less underground construction work than the originally identified alternative.

Comparison to Proposed Route Segment

The overhead portion of the Partial Underground R~~r~~oute crosses the Cañada trace of the San Andreas Fault; the proposed route avoids this fault crossing. This fault trace is less likely to rupture than one of the traces that ruptured in 1906, though ~~it~~ rupture is possible and should be taken into consideration given that reliability is one of the major objectives of this project. An overhead crossing of the Cañada trace (as would be done with this alternative) is a superior method of crossing this fault compared to an underground crossing. ~~There is~~The same ~~no~~ ~~area~~ impacts ~~of difficult excavation~~ occur along this route as occur along the proposed route.~~, and there are no impacts that cannot be mitigated to less than significant.~~ This alternative would include ~~additional~~ more underground line construction ~~compared to~~than the Proposed Project, ~~which would~~ resulting in ~~more~~ increased impacts from and to geology, soils, and paleontologic resources.~~y potential impacts~~. The crossing of the San Mateo Creek canyon is by the same method, and would generate the same impacts for both the proposed route and the Partial Underground Route.

D.6.5 Northern Area Alternatives

D.6.5.1 West of Skyline Transition Station Alternative

Environmental Setting of the Alternative Transition Station

This transition station would be located near the top of Buri Buri Ridge in a relatively flat area. The location lies a few feet west of ~~an~~ the active trace of the San Andreas Fault. The bedrock beneath the site is likely fault gouge within the mapped sheared rock of the Franciscan Complex. The Alquist-Priolo fault map shows two traces under Skyline Boulevard adjacent to the proposed alternative.~~;~~ Geomatrix determined that just one ~~both~~ trace~~s~~ w~~ere~~as broken in the 1906 earthquake (Geomatrix, 2003). The report also identified a 70-foot wide slip zone in which 3 feet of right slip occurred during the 1906 earthquake. The slip zone appears to cross the footprint of the West of Skyline Transition Station. Extreme groundshaking with near field effects as well as potential fault rupture should be anticipated at this location. No problematic soils occur at this location; neither are mineral nor paleontologic resources an issue.

Environmental Impacts and Mitigation Measures for the Alternative Transition Station

Project facilities at the West of Skyline Transition Station would be subject to surface fault rupture of an adjacent zone of distributed slip associated with the~~two~~ active ~~traces of the~~ San Andreas Fault (Impact G-8). ~~No measures could mitigate the anticipated fault rupture impacts so the impact would be~~

~~significant (Class I).~~Implementation of Mitigation Measure G-8a would reduce potentially significant impacts to less than significant levels (Class II). Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-5a. Other impacts at this site are similar to those at the Proposed transition station site; they include problematic soils (G-1, G-9, and G-11), and seismic ground failure (G-6). The site is on level, well-drained ground, and no other impacts are likely.

Comparison to Proposed Transition Station

This alternative transition station would ~~be~~ lie directly on an active ~~traces~~slip zone of the San Andreas Fault. Because of the possible ~~large~~ offsets of up to ~~20~~ several feet over a slip zone 70-feet wide,~~(the west side of the fault will move north relative to the east side),~~ the station could be damaged. The proposed transition station on the east side of Skyline Boulevard lies well east of the active trace and is not crossed by any identified secondary fault trace or zone of distributed slip. With the alternative transition station placed west of Skyline, the underground portion of the transmission line will cross the main active trace of the San Andreas Fault on its way to the Martin Substation. Because the San Andreas Fault could rupture with as much as 20 feet of offset, it is unlikely that underground cable leaving the transition station could accommodate that amount of deformation. The Proposed transition station will allow an overhead crossing of the San Andreas Fault (best method) and start the underground portion of the transmission line well away from the main trace of the fault. ~~it is unlikely that underground cable leaving the transition station could accommodate that amount of deformation. Although significant (Class I) impacts are also identified under the proposed transition station, the proposed transition station site is not located directly on an active fault trace.~~

West of Skyline Transition Station with Proposed Underground Route

Environmental Setting

This portion of the route connects the West of Skyline alternative transition station with the proposed route on San Bruno Avenue. The route traverses the top of Buri Buri Ridge, crossing beneath Skyline Boulevard and over ~~two~~ the active trace~~s~~ of the San Andreas Fault, to join with the proposed route just as it descends the hill. The bedrock is likely fault gouge within the ~~mapped~~ sheared rock of the Franciscan Complex. The Alquist-Priolo fault map shows two traces under Skyline Boulevard~~;~~. A recent site-specific fault report in the area determined that the main trace crosses Skyline Boulevard obliquely from left to right. A zone of distributed slip occurs on the west side of Skyline Boulevard; this zone experienced about 3 feet of slip over a width of 70 feet during the 1906 earthquake (Geomatrix, 2003).~~both traces were broken in the 1906 earthquake.~~ Extreme groundshaking with near field effects as well as potential fault rupture with offsets of as much as 20 feet along the main San Andreas Fault trace should be anticipated at this location. No problematic soils occur at this location; neither are mineral nor paleontologic resources an issue.

Environmental Impacts and Mitigation Measures

The underground transmission line from the West of Skyline Transition Station across Skyline Boulevard to the proposed alignment would be subject to surface fault rupture at crossings of active ~~fault~~ trace~~s (two active traces o~~ of the San Andreas Fault, (Impact G-8). ~~No~~ It is unlikely that measures could mitigate the anticipated fault rupture impacts, so impacts would be significant (Class I). Although impact of the San Andreas Fault crossings could not be mitigated to levels less than significant, Mitigation Measure G-8a, which includes engineering technique requirements for underground crossings, is recommended to reduce impacts to the maximum extent feasible.

Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a. Other impacts at this site are similar to those at the Proposed transition station site.

Comparison to Proposed Route Segment

All impacts are similar for this comparison except for that of fault rupture. The use of the West of Skyline Transition Station with the proposed route would cause the transmission line to cross the ~~entire~~ main trace of the San Andreas Fault Zone underground. An overhead crossing of an active fault, as ~~with~~ accommodated by the Proposed Project, has substantially less likelihood of transmission facility damage. Because of the possible large offsets of up to 20 feet (the west side of the fault will move north relative to the east side), it is unlikely underground cable and duct bank could accommodate that amount of deformation and remain operational.

West of Skyline Transition Station with Sneath Lane Underground Route

Environmental Setting

From the West of Skyline alternative transition station, this route would continue north along Skyline Boulevard to Sneath Lane. The route would follow the top of the ridge, crossing beneath Skyline Boulevard and over ~~one~~ the active trace of the San Andreas Fault, to follow Sneath Lane as it descends the hill. It ends at the BART ROW. The bedrock in the segment nearest Skyline Boulevard is likely fault gouge and sheared rock of the Franciscan Complex along the Skyline Boulevard portion — similar to the Proposed transition station. Artificial fill is mapped at the intersection of Skyline Boulevard with Sneath Lane and for a block or two south. The upper half of Sneath Lane crosses Merced Formation, the lower half crosses Colma Formation; both formations may contain significant fossils.

The Skyline Boulevard portion of this underground route segment would follow the mapped active trace of the San Andreas Fault for approximately 0.7 miles. ~~No problematic soils occur at this location; neither are m~~Mineral resources are not an issue. The presence of fault gouge in the subsurface could generate poor soils for trenching.

Environmental Impacts and Mitigation Measures

The buried transmission line along the ~~proposed~~ West of Skyline Transition Station to the Sneath Lane underground route~~alignment~~ would be subject to ~~surface~~ fault rupture along the entire portion ~~at crossings and at locations~~ where the transmission line is placed parallel and above active ~~and potentially~~the active fault traces ~~(one or two active traces~~ of the San Andreas Fault. This alternative route would also cross ~~and~~ a potentially active trace about 0.3 miles down the hill on Sneath Lane; (Impact G-8)**.** Not only would the route be subject to extreme groundshaking with near field effects, but there are also multiple locations along this alternative route where potential fault rupture with offsets of as much as 20 feet is possible. While no measures could mitigate the significant anticipated fault rupture impacts (Class I) associated with crossings of the active San Andreas traces, Mitigation Measure G-8a, which includes engineering technique requirements for underground crossings, is recommended to reduce impacts associated with the potentially active fault crossing to less than significant levels (Class II). Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a. Other impacts at this site are similar to those at the Proposed transition station site.

Comparison to Proposed Route Segment

This route lies on top of ~~an~~ the active trace of the San Andreas Fault for almost 0.75 miles. Because of the possible large offsets of up to 20 feet (the west side of the fault will move north relative to the east side), it is unlikely underground cable could accommodate that amount of deformation. Also, because so much of the cable would be within the fault zone, repairs may be necessary to multiple parts of the cable, delaying ~~power~~ service restoration after a damaging earthquake. The proposed route out of the transition station would cross ~~a very short segment of the fault zone~~only a secondary fault of the San Andreas Fault Zone (<1-foot offset) and the potentially active Serra Fault (<3-feet offset). The West of Skyline Transition Station to the Sneath Lane underground route also potentially impacts paleontologic resources; the equivalent portion of the proposed route does not.

West of Skyline Transition Station with Westborough Boulevard Underground

Environmental Setting

From the alternative transition station, this route would continue north along Skyline Boulevard until Westborough Boulevard. The route tracks along the top of the ridge, beneath Skyline Boulevard and ~~above~~ over two active traces of the San Andreas Fault for about 2.1 miles. Skyline then turns to the west, away from the fault, but still lies within the Alquist-Priolo Fault Hazard Zone. At the intersection with Westborough, the route turns east, taking the underground cable across the active fault trace again at about 0.3 miles east of the intersection. ~~and~~ The route then descends the hill to join the BART ROW at the base of the hill. About 0.5 miles east of the Westborough/Skyline intersection, the route crosses a large mapped landslide (Wentworth, et al., 1997). As mapped, the alternative underground route would cross nearly 2500 feet of landslide. Along the Skyline Boulevard portion that overlies the fault, bedrock is likely fault gouge and sheared rock of the Franciscan Complex. Where Skyline turns to the west, the bedrock is mapped as Franciscan greenstone, a difficult rock to excavate. ~~About 0.3 miles east of the Westborough/Skyline intersection, the route crosses the active trace of the San Andreas Fault at right angles. More than one trace may be present here, with a potentially active trace about 0.4 miles from the Westborough/Skyline intersection.~~ East of the San Andreas Fault, the bedrock is Merced Formation until about 0.5 miles east of I-280. The route then crosses Colma Formation. Merced and Colma formations both may contain significant fossils.

The Skyline Boulevard portion of this alternative segment follows the mapped trace of the active San Andreas Fault for approximately 2.1 miles. Not only would the route be subject to extreme groundshaking with near field effects, but there is also the potential for fault rupture with offsets of as much as 20 feet along this route. Where the underground cable would be parallel to the fault, it would be stretched; where it would cross at right angles it would be sheared. ~~No problematic s~~Soil conditions are similar to other locations along the ridge portion of the proposed route. ~~occur at this location; neither are m~~ No mineral resources occur in this area.

Environmental Impacts and Mitigation Measures

Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through Merced Formation or Colma Formation (Impact G-3). This impact would be mitigated to less than significant levels (Class II) with implementation of Mitigation Measure G-3a. The buried transmission line along the proposed alignment would be subject to surface fault rupture at crossings and at locations where the transmission line is placed parallel and above active and potentially active fault traces (one or two active traces of the San Andreas Fault and potentially active traces about 0.3 to 0.4 miles east on Westborough Boulevard; Impact G-8). No measures could mitigate the significant

(Class I) fault rupture impacts associated with crossings of the active San Andreas traces. However, Mitigation Measure G-8a, which includes engineering technique requirements for underground crossings, is recommended to reduce impacts to the extent feasible. Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a. Seismic reactivation of the existing landslide located between Callan and Gellert Boulevards along Westborough could impact the project, as could reactivation of the landslide due to non-seismic triggering (Impact G-7). Mitigation Measure G-7a would likely mitigate the impact to less than significant, though there could be a chance that under unusual circumstances, extensive reactivation of the existing slide could create significant deformation of the soil and the underground cable. Other impacts at this site are similar to those at the proposed transition station site; they include coseismic ground failure (G-6), expansive or compressible soils (G-9), and corrosive soils, (G-11).

Comparison to Proposed Route Segment

This route lies on top of an active trace of the San Andreas Fault for more than 2 miles, then crosses the fault at a right angle. Because of the possible large offsets of up to 20 feet, it is unlikely underground cable could accommodate that amount of deformation. Also, because so much of the cable would be within the fault zone, repairs may be necessary to multiple parts of the cable, delaying power restoration after a damaging earthquake. The proposed transition station and route would cross through a relatively short segment of the fault zone.

D.6.5.2 Sneath Lane Transition Station Alternative

Environmental Setting of the Alternative Transition Station

This transition station location would be near the top of Buri Buri Ridge in a relatively flat area approximately 0.6 miles northwest of the West of Skyline Transition Station described in Section D.6.5.1. The Sneath Lane Transition Station location would~~appears to~~ lie approximately 300 to 400 feet west of the active trace of the San Andreas Fault. ~~which is mapped on the east side of Skyline Boulevard~~ The State of California Special Studies Zones map for the Montara Mountain Quadrangle fault map shows one trace of the fault that was broken in the 1906 earthquake crossing Sneath Lane at approximately Earl Avenue. The alternative transition station site is within the Alquist-Priolo Earthquake Hazard zone associated with the San Andreas Fault. The bedrock is likely fault gouge developed within greenstone (metabasalt) of the Franciscan Complex, though the actual site has a thin cover of artificial fill. ~~The A-P fault map shows one trace under Skyline Boulevard adjacent to the proposed alternativethat was broken in the 1906 earthquake; this places the site within the Alquist-Priolo Earthquake Hazard zone.~~ Extreme groundshaking with near field effects as well as potential fault rupture should be anticipated at this location. ~~No problematic soils occur at this location; neither are mineral or paleontologic resources an issue.~~

Environmental Impacts and Mitigation Measures for the Alternative Transition Station

The Sneath Lane Transition Station site would not be located directly on a fault trace. However, it would lie approximately 300 to 400 feet west of the active trace of the San Andreas Fault and is within the Alquist-Priolo Earthquake Hazard zone. ~~The project facilities at this station site would be subject to surface fault rupture at a crossing of an active fault trace of the San Andreas Fault (Impact G-8). No mitigation could reduce the anticipated fault rupture impacts and resultant damage to less than significant; the impact remains significant (Class I).~~ APM 10.2, which was designed for the proposed transition station site also applies to the Sneath Lane Transition Station site. APM 10.2 requires that to the extent feasible, the station structures be designed to accommodate anticipated displacement and distortion associated with fault rupture. Though it is likely that future ruptures on the San Andreas Fault will follow the most active trace, over 300 feet away from the alternative transition station, it is possible that a new splay or trace could develop. The possibility of fault rupture at this alternative transition station site should not be ruled out altogether. Fault rupture impacts (Impact G-8) would be mitigable to less than significant levels with implementation of Mitigation Measure G-8a (Class II).

Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a. All other impacts are nearly identical to those identified for the proposed transition station.

Comparison to Proposed Transition Station

This alternative transition station would be ~~immediately adjacent to~~ located approximately 200 feet farther from an active trace of the San Andreas Fault compared to the proposed transitions station site.~~,~~ ~~similar to the proposed transition station~~. Therefore, there is a slightly higher probability that a fault rupture would occur at the proposed site compared to this alternative transition station site.

Sneath Lane Transition Station with Proposed Underground Route

Environmental Setting

This route would follow the top of Buri Buri Ridge along a relatively flat stretch of Skyline Boulevard for approximately 0.5 mile between the Sneath Lane Transition Station location and the Skyline/San Bruno Avenue intersection. The proposed route appears to lie either on or within several feet of the active trace of the San Andreas Fault as mapped on the A-P fault map (CDMG, 2000). The bedrock is likely fault gouge developed within sheared rock of the Franciscan Complex, though the actual site has a thin cover of artificial fill. The site lies entirely within an Alquist-Priolo Earthquake Hazard zone. Extreme ground-shaking with near field effects as well as potential fault rupture should be anticipated at this location. No problematic soils occur at this location; neither are mineral or paleontologic resources an issue.

Environmental Impacts and Mitigation Measures

The buried transmission line along this alternative alignment would be subject to surface fault rupture along the entire length until it joins the proposed route, because it would be parallel to and above an active trace of the San Andreas Fault (Impact G-8)**.** No measures could mitigate the anticipated fault rupture impacts and resultant damage to less than significant; impacts would remain significant (Class I). Although this impact cannot be mitigated to less than significant levels, Mitigation Measure G-8a, which includes engineering technique requirements for underground crossings, is recommended to reduce impacts to the extent feasible.

Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a.

Comparison to Proposed Route Segment

This route would lie on top of the San Andreas Fault for 0.5 mile, and would connect to a transition station also within the fault zone. Because of the possible large offsets of up to 20 feet (the west side of the fault will move north relative to the east side), it is unlikely underground cable could accommodate that amount of deformation. Also, because so much of the cable would be within the fault zone, repairs may be necessary to multiple parts of the cable, delaying power restoration after a damaging earthquake. The proposed underground route would be nearly entirely outside of the fault zone, though the transition station would still be at risk due to its location within the fault zone.

Sneath Lane Transition Station with Sneath Lane Underground Route

Environmental Setting

The beginning of this route would connect to the alternative transition station at Sneath Lane then continue across Skyline Boulevard and over the San Andreas Fault, to follow Sneath Lane as it descends the hill, ending at the BART ROW. The State of California Special Studies Zones map for the Montara Mountain Quadrangle fault map shows one trace of the fault that was broken in the 1906 earthquake crossing Sneath Lane at approximately Earl Avenue. The bedrock is likely fault gouge and sheared rock of the Franciscan Complex along the Skyline Boulevard crossing. Artificial fill is mapped at the intersection with Sneath Lane and for a block or two east. The upper half of Sneath Lane crosses Merced Formation, the lower half crosses Colma Formation; both of which may contain significant fossils.

The first 0.1 miles of this alternative segment would cross the mapped active trace of the San Andreas Fault at a right angle. No problematic soils occur at this location; neither are mineral resources an issue.

Environmental Impacts and Mitigation Measures

The buried transmission line along this alternative alignment would be subject to surface fault rupture at the crossing of the active fault trace of the San Andreas Fault beneath ~~Skyline Boulevard~~Sneath Lane as well as a potentially active trace about 0.3 miles down the hill on Sneath Lane (Impact G-8). Not only would the route be subject to extreme groundshaking with near field effects, but the potential fault offset could be as much as 20 feet. The underground cable would likely be sheared during an earthquake. No measures could mitigate the significant (Class I) fault rupture impacts associated with crossing the active San Andreas trace, but Mitigation Measure G-8a, which includes engineering technique requirements for underground crossings, is recommended to reduce impacts to the extent feasible.

Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a.

Comparison to Proposed Route Segment

This route would cross the entire San Andreas Fault Zone underground. Because of the possible large offsets of up to 20 feet (the west side of the fault will move north relative to the east side), it is unlikely underground cable could accommodate that amount of deformation, and would break. The proposed route would have only a short portion within the fault zone.

Sneath Lane Transition Station with Westborough Boulevard Underground

Environmental Setting

This route would begin at the Sneath Lane Transition Station, then continue north along Skyline Boulevard ~~until~~ to Westborough Boulevard. The route tracks along the top of the ridge, beneath Skyline Boulevard, and above an active trace of the San Andreas Fault for about 1.5 miles. Skyline then turns to the west, away from the fault. At the intersection with Westborough, the route would turn east and descends the hill to join the BART ROW at the base of the hill. Along the Skyline Boulevard portion that overlies the fault, bedrock is likely fault gouge and sheared rock of the Franciscan Complex. Where Skyline turns to the west, the bedrock is mapped as Franciscan greenstone, a ~~difficult~~ very hard rock to excavate. About 0.3 miles east of the Westborough/Skyline intersection, the route crosses the active trace of the San Andreas Fault at right angles. More than one trace may be present here, with a potentially active trace about 0.4 miles from the Westborough/Skyline intersection. East of the San Andreas Fault, the bedrock is Merced Formation until about 0.5 mile east of I-280; the route then crosses Colma Formation. Merced and Colma formations both may contain significant fossils. This alternative route crosses a large mapped landslide on Westborough Boulevard between Callan and Gellert Boulevards.

The Skyline Boulevard portion of this alternative segment follows the mapped trace of the San Andreas Fault for approximately 1.5 miles. Where the underground cable is parallel to the fault, it would be stretched; where it crosses at right angles it would be sheared. ~~No problematic soils occur at this location; neither are m~~Mineral resources are not an issue.

Environmental Impacts and Mitigation Measures

Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through the Merced Formation and Colma Formation (Impact G-3). Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). Renewed motion on the large landslide could deform and damage the underground cable (Impact G-7). All these impacts would be mitigated to less than significant by applying their corresponding mitigation measures.

~~This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-3a.~~ The buried transmission line along the proposed alignment would be subject to surface fault rupture at crossings and at locations where the transmission line would be placed parallel and above active and potentially active fault traces (one or two active traces of the San Andreas Fault under Skyline Boulevard and potentially active traces about 0.3 to 0.4 miles east on Westborough Boulevard; Impact G-8). Not only would the route be subject to extreme groundshaking with near field effects, but it would also be susceptible to multiple potential fault rupture locations where offsets may be as much as 20 feet. No measures could mitigate the significant (Class I) fault rupture impacts associated with crossings of the active San Andreas traces, but Mitigation Measure G-8a is recommended to reduce impacts to the extent feasible.

Comparison to Proposed Route Segment

This transmission line route would lie on top of the San Andreas Fault for 1.5 miles, then cross the fault at a right angle. Because of the possible large offsets of up to 20 feet, it is unlikely underground cable could accommodate that amount of deformation. Also, because so much of the cable would be within the fault zone, repairs may be necessary to multiple parts of the cable, delaying power restoration after a damaging earthquake. The proposed route ~~would have a comparatively short segment within~~crosses the fault zone with overhead lines, going underground well east of the main trace. The proposed route does not cross any mapped landslides; the Westborough Boulevard alternative crosses a large mapped landslide. Stabilizing a landslide or performing frequent repairs on the underground cable would be costly.

D.6.5.3 Glenview Drive Transition Tower Alternative

The Glenview Drive Transition Tower would allow an overhead crossing of Skyline Boulevard approximately 0.5 miles south of San Bruno Avenue, with a transition tower east of Skyline and the underground route following Glenview Drive north to San Bruno Avenue where the proposed route is located. This site could also be used with the Sneath Lane underground route or the Westborough Drive underground route.

Environmental Setting

The location of this alternative transition tower site lies approximately 60 to 70 feet east from the mapped active trace of the San Andreas Fault, which is approximately 30 to 40 feet closer to the trace than the proposed transition station location. The geologic and topographic setting is otherwise essentially the same as for the proposed transition station. This location would put the transition tower about 70 feet east of the southern extension of a secondary fault identified in the Geomatrix fault report (as described in Section D.6.3.4 of the EIR) (Geomatrix, 2003). The underlying rock is fractured Franciscan sandstone (graywacke) and lies within the Alquist-Priolo Earthquake Hazard Zone boundary for the San Andreas Fault. The surface materials are likely disturbed due to surrounding construction.

Environmental Impacts and Mitigation Measures

Difficult excavation could be experienced if hard blocks of greenstone or peridotite (crystalline precursor to serpentinite) are encountered during drilling. The area is slightly sloping and no landslides are mapped near the site south of San Bruno Avenue; however, local areas of slope instability may occur (Impact G-7). Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). Other potential impacts at this location could include release of asbestos fibers if the excavation is through serpentinite materials (common in sheared Franciscan rock) (Impact G-4). Also, there is a possibility of encountering corrosive soils (Impact G-11). All these impacts can be mitigated to less than significant with their corresponding mitigation measures (see Section D.6.3).

Comparison to Proposed Transition Station

This alternative is considered less desirable than the proposed transition station because it places the transition tower structure approximately 30 to 40 feet closer to the active fault where local ground cracking could damage the transition tower as well as the connection to the underground cable that would follow Glenview Drive north before turning east or west on San Bruno Avenue. Also, the underground portion of the route would be subject to extreme groundshaking and potential fault rupture where it crosses the secondary fault that nearly parallels Glenview Drive. The secondary fault may not generate much slip (probably less than one foot per earthquake), but could disrupt several hundred feet of the route. However, this transition tower, because it would be located east of the mapped active trace of the San Andreas Fault, would be preferred over the West of Skyline or Sneath Lane Transition Station locations.

D.6.5.4 Trousdale Drive Transition Tower Alternatives

There are two alternative transition tower locations west of the end of Trousdale Drive: one would connect the Partial Underground Alternative with the Route Option 1B, and the other would connect the Proposed Project with Route Option 1B. Both alternative transition tower locations lie within Watershed Lands near the existing ROW.

Environmental Setting

The connection for the Proposed Project would be at Tower 11/70; the tower location would be about 800 feet east of the Alquist-Priolo Earthquake Hazard Zone boundary for the San Andreas Fault. The site is mapped as sheared Franciscan rock. No mapped fault traces cross the vicinity. The area is moderately hilly and local areas of slope instability may occur. For the Partial Underground Alternative transition tower, the site is about 0.25 miles further west (closer to the San Andreas Fault zone).

Environmental Impacts and Mitigation Measures

Difficult excavation could be experienced if hard blocks of greenstone or peridotite (crystalline precursor to serpentinite) are encountered during drilling. Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). Other potential impacts at this location could include release of asbestos fibers if the excavation is through serpentinitic materials (common in sheared Franciscan rock) (Impact G-4). Also, there is a possibility of encountering corrosive soils (Impact G-11). All these impacts can be mitigated to less than significant with their corresponding mitigation measures.

Comparison to Proposed Transition Station

These alternatives are considered superior to the proposed transition station because they would create a route that bypasses the northern crossing of the San Andreas Fault near the proposed transition station unless it is connected to an underground route that goes north and then crosses the fault.

D.6.5.5 Golf Course Drive Transition Station Alternative

The Golf Course Drive Transition Station would allow implementation of two scenarios. First, the Route Option 1B alternative in which the 230 kV line would be installed underground in Cañada Road and Skyline Boulevard could transition to overhead at this location. From there, it would connect with the Partial Underground Alternative or the Proposed Project, continuing north to one of the four transition station options near San Bruno Avenue. This would eliminate the use of the portion of Route Option 1B route north of Hayne Road (including Trousdale Drive and El Camino Real).

The second option for the use of the Golf Course Drive Transition Station would be to allow an underground crossing of the 230 kV line below the I-280 in the Partial Underground Alternative. In the original definition of the Partial Underground Alternative, both the 60 and 230 kV lines would be underground from the transition tower north of San Mateo Creek (Tower 7/39) to another transition tower south of Carolands Substation (Tower 8/50). A 60/230 kV transition tower at the 8/50 location would create a significant visual impact, as defined in Section D.3.4.2. However, the Golf Course Drive Transition Station would allow the 230 kV line to turn west when the line reaches Hayne Road and cross below the I-280 freeway, so there would be a need only for a single-circuit 60 kV transition tower at the 8/50 location so the visual impact would be substantially reduced. The 60 kV line would then enter Carolands Substation and cross the I-280 freeway overhead from Tower 8/50 to the west.

Environmental Setting

The location for this alternative transition station is very close to the southbound off ramp of I-280. It appears to be situated on a thin layer of Merced Formation overlying either Franciscan greenstone (altered basalt) or sheared Franciscan rock about 800 feet east of the Alquist-Priolo Earthquake Hazard Zone boundary for the San Andreas Fault. No mapped fault traces cross the vicinity. The area is fairly flat and no landslides are mapped near the site. The surface materials are likely to be disturbed due to the nearby construction of the highway to the east and the Park & Ride facility adjacent and to the south of the proposed alternative transition tower site.

Environmental Impacts and Mitigation Measures

A transition station would most likely be constructed at this site to minimize visibility so excavation difficulties would not be expected. Project facilities would be subject to extreme groundshaking from local and regional seismic sources (Impact G-5). Other potential impacts at this location could include: (1) loss of paleontologic resources if undisturbed Merced Formation blankets the site (Impact G-3), (2) release of asbestos fibers if the excavation drills through serpentinitic materials (common in sheared Franciscan rock) (Impact G-4), and (3) landslides or debris slides that are possible in this hilly area (Impact G-7). Also, there is a possibility of encountering corrosive soils (Impact G-11). All these impacts can be mitigated to less than significant with their corresponding mitigation measures.

D.6.5.6 Cherry Avenue Alternative

Environmental Setting

The entire route overlies Colma Formation along the lower flanks of the Buri Buri Ridge at approximately the same elevation. Though the route is within existing roads, excavations may penetrate undisturbed rock or soil in the lower parts of the trench. Colma Formation is known to yield significant fossils in some locations. No issues with ~~slope stability or~~ fault crossings are known. Soils may be soft, loose, expansive or corrosive along this alternative segment. No mineral resources occur near this alternative segment. As with all route segments, severe groundshaking should be expected in the event of a nearby earthquake.

Environmental Impacts and Mitigation Measures

Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through the Colma Formation (Impact G-3). This impact would be mitigated to less than significant levels with Mitigation Measure G-3a. Project facilities would be subject to strong groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a. Expansive, soft, loose and/or compressible soils may be present beneath the engineered soil of the roadbed and/or median. The impacts associated with these soils (Impacts G-1 and G-9) would be mitigated to less than significant with implementation of Mitigation ~~Measure~~ Measures G-1a and G-9a. Excavations in Colma deposits may encounter less cohesive areas causing trench walls to become unstable (Impact G-2). This impact would be mitigated by Mitigation Measure G-2a. Corrosive soils (Impact G-11) could be encountered along this route. Corrosive soils would be mitigated with Mitigation Measure G-11a.

Comparison to Proposed Route Segment

This alternative would have essentially the same impacts as the equivalent portion of the proposed route along the BART ROW.

D.6.5.7 PG&E's Route Option 4B – East Market Street

Environmental Setting

The topography along the route is subdued, with a slight increase in elevation at the approach to Guadalupe Canyon Parkway. The entire route lies on Colma Formation, though because the line would be placed within streets, the immediate subsurface would be fill. The East Market Street portion of this alternative overlies an ancient drainage channel leading from Guadalupe Canyon. This area may be slightly more susceptible to exaggerated seismically induced groundshaking due to a thicker sequence of unconsolidated sediments. There are no issues with ~~slope stability,~~ faults~~, or soils~~. No mineral resources occur near this section of the alignment. Significant fossils could occur in the Colma Formation.

Environmental Impacts and Mitigation Measures

Soft, loose, compressible, or corrosive soils could be encountered (Impacts G-1, G-9 and G-11). Excavation could induce construction-related slope instability (Impact G-2). Liquefaction or other seismically induced ground failure could occur in saturated soils (Impact G-6). Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through the Colma Formation (Impact G-3). ~~This impact would be mitigated to less than significant levels with Mitigation Measure G-3a.~~ Project facilities would be subject to strong groundshaking from local and regional seismic sources (Impact G-5). ~~This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a.~~All these impacts would be mitigated by their corresponding mitigation measures.

Comparison to Proposed Route Segment

This alternative is nearly identical to the correlative Proposed Project segment (Hoffman and Orange streets)~~.~~, ~~Hoffman Street portion of the alternative route~~ with the exception that the Market Street portion may be slightly more susceptible to exaggerated groundshaking during an earthquake due to its proximity to the old stream channel that came out of the mouth of Guadalupe Canyon.

D.6.5.8 Junipero Serra Alternative

Environmental Setting

This alternative includes the Westborough Boulevard segment as described previously in Section D.6.5.1. Please refer to the that section for information on the Westborough Boulevard segment of this alternative.

The topography associated with this alternative route is moderate from the connection with the Westborough segment as it follows ~~north on~~ Junipero Serra to the north. Once turning east onto Serramonte, the route crosses the low point of Colma Valley (at Mission Road) then climbs slightly onto the west flank of San Bruno Mountain. The route crosses mostly Merced Formation until the turn onto Serramonte when the route crosses into Colma Formation. ~~Some p~~Local patches of artificial fill are mapped along the Junipero Serra portion. Issues affecting the whole alternative (from the West of

Skyline Transition Station, down Westborough Boulevard, along Junipero Serra, then to Serramonte and ending at Hillside Boulevard, include (1) tracking the a~~A~~ctive trace~~s~~ of the San Andreas Fault along Skyline Boulevard and crossing at right angles the ~~one potentially~~ active ~~fault~~ trace near the top of West~~chester~~borough Boulevard, (2) ~~– exist along this route~~crossing a large mapped landslide on Westborough Boulevard between Callan and Gellert Boulevards, (3)~~.–~~ certain locations along the route may be susceptible to expansive or loose soils, (4) significant fossils are known from both the Colma and Merced formations, and (5) the part of the route closest to Mission Road may be susceptible to exaggerated groundshaking or possibly liquefaction in the event of an earthquake. No issues with ~~slope stability or~~ mineral resources are noted. ~~Certain locations along the route may be susceptible to expansive or loose soils. Significant fossils are known from both the Colma and Merced formations. The part of the route closest to Mission Road may be susceptible to exaggerated groundshaking or possibly liquefaction in the event of an earthquake.~~

Environmental Impacts and Mitigation Measures

Soft, loose, compressible, or corrosive soils could be encountered (Impacts G-1, G-9 and G-11). Excavation could induce construction-related slope instability (Impact G-2). Non-renewable paleontologic resources may be destroyed by construction activities where the alignment crosses through the Merced or Colma Formation (Impact G-3). Project facilities would be subject to strong groundshaking from local and regional seismic sources (Impact G-5). Seismically induced ground failures (primarily liquefaction) along the floor of Colma Valley could occur during an moderate to severe earthquake (Impact G-6). All these impacts would be mitigated by their corresponding mitigation measures.

~~This impact would be mitigated to less than significant levels with Mitigation Measure G-3a.~~ The buried transmission line along this alignment would be subject to surface fault rupture where the transmission line would cross the active San Andreas Trace along Skyline Boulevard and where it would be placed parallel and above potentially active fault traces about 0.3 to 0.4 miles east on Westborough Boulevard (Impact G-8). No measures could mitigate the significant (Class I) fault rupture impacts associated with crossings of the active San Andreas traces, but Mitigation Measure G-8a is recommended to reduce impacts to the extent feasible. A landslide is present along Westborough Boulevard (Impact G-7). Not all landslides can be crossed in such a way as to preclude damage to an underground electrical transmission line; this landslide may or may not be mitigable by trenching below the slide surface (Mitigation Measure (G-7a).

Comparison to Proposed Route Segment

This underground route ~~would~~ cross~~es~~ ~~longer sections of~~ the active San Andreas Fault traces compared to no active fault crossings associated with the underground portion of the proposed route segment. Underground crossings are the least desirable method of crossing an active fault. In addition, this alternative crosses a large landslide on Westborough Boulevard.

D.6.5.9 Modified Existing 230 kV Underground ROW

This alternative route would begin at San Bruno Avenue and Huntington Avenue, then follow a mostly northerly route along streets (Shaw Road, Produce Avenue, and Gateway Boulevard) and paved parking lots to Sierra Point. There, the route goes under the railroad, and follows Bayshore Boulevard to the ~~the~~ Martin Substation. Because of existing infrastructure and creeks, this route would need to make several waterway crossings as well as a railroad undercrossing using boring or directional~~ly~~ drilling. Towards the northern end, the route would follow~~s~~ Bayshore Boulevard before joining the proposed route at the corner of Guadalupe Canyon Parkway and Bayshore.

Environmental Setting

The beginning of the Modified Underground Existing 230 kV Collocation Alternative crosses Colma Formation from the BART ROW east for a short stretch. From just before Shaw Road, and then north, this portion of the ~~alternative~~ Modified Underground Existing 230 kV ROW Alternative between the northern boundary of San Bruno and the center of South San Francisco would cross a large area of old, unconsolidated fill that presumably has been placed over Bay Mud. Colma Formation is present again along the alignment in the low hill that separates South San Francisco from Brisbane (Point San Bruno). Once west of the railroad tracks, t~~T~~he alignment hugs the base of San Bruno Mountain at the southeast side. Here~~;~~ it crosses alternating Franciscan Sandstone, colluvium, and artificial fill as it makes its final approach to the Martin Substation. There is one mapped landslide on the side of San Bruno Mountain adjacent to the alternative ~~corridor~~route. Two water crossings occur along the Modified Underground Existing 230 kV Alternative: a southern arm of Colma Creek just north of Tanforan Road and Colma Creek just south of Produce Avenue. Horizontal drilling or jack and bore methods will be applied to make the crossings. Soils along this route are very problematic for the following reasons: much of the soil is old, unconsolidated, uncontrolled fill; the areas around and under water crossings are under the water table and will require dewatering during construction and perhaps continually; there are numerous areas where soil contamination has been documented;

This alternative alignment would cross the inactive Hillside Fault as the alignment crosses the topographic high point between South San Francisco and Brisbane (Sierra Point). ~~This fault is not considered active.~~ Seismic groundshaking on this alternative would likely be ~~similar~~ higher in intensity to that of the proposed route because the alignment crosses thick sequences of unconsolidated and saturated mud and fill. These conditions cause the equivalent ground motion to generate exaggerated surface movement compared to ground motion in stiff soils or rock. Very strong ground motion may be experienced in the areas underlain by artificial fill (South San Francisco and near Martin Substation).

Utility trenches placed in soils that either are or have a component of Bay Mud are likely to be corrosive (USDA, 1991). As most of the rest of the route lies within already-disturbed street and urban corridors, the local soil conditions would be highly variable and dependent on past activities. Potentially significant fossils are known from the ~~Merced and~~ Colma ~~f~~Formation~~s~~ in this area.

Route Options A through F. These route options are variations of the South San Francisco and southern Brisbane segment of the Modified Underground Existing 230 kV Collocation Alternative. The entire low-lying area is covered by old, poorly placed, non-engineered fill that can pose a number of potential problems. As the route gets closer to the Bay, the depth of artificial fill increases. Options A, B and C move the route eastward, toward thicker fill. Option E, while potentially avoiding a closed landfill, also moves the route into thicker fill. Option D also moves the route towards the Bay, but could be taking advantage of the fill beneath the Railroad ROW (if it is of good quality). Route Option F is a modification of Route Option D to avoid use of the ramp from Van Waters and Rodgers Road onto Bayshore Boulevard.

Environmental Impacts and Mitigation Measures

~~Paleontologic resources may be destroyed by construction activities where the alignment crosses through the Colma Formation (Impact G-3). This impact would be mitigated to less than significant levels with Mitigation Measure G-3a.~~

Poor soil and excavation conditions may be encountered where the route crosses areas of artificial fill over Bay Mud (Impacts G-1, G-2, G-9 and G-11), especially along the margins of the Bay. All Bay Mud and fill containing a component of Bay Mud is corrosive. Most of the part of the route east of the

BART ROW occurs in material that is either all or partly composed of Bay Mud. Some of the materials potentially encountered in the artificial fill include old construction debris that may consist of concrete, bricks, steel, wood, etc., if significantly harder or softer material than the average fill is encountered during horizontal drilling under a waterway, road or railroad, it could shut down drilling. Multiple attempts to complete a horizontal bore could become costly. Extremely difficult excavation associated with Impacts G-1, G-2, and G-9 is likely to be encountered for the Modified Existing 230 kV Underground Alternative as follows:

- Excavations within existing roadways, particularly in urban areas, will likely encounter existing underground utilities. Numerous problems area associated with excavation around existing utilities. A high concentration of utilities is expected along Trousdale Drive, El Camino Real, San Bruno Avenue, Produce Avenue, Airport Boulevard, Gateway Boulevard, and Bayshore Boulevard.
- Difficult excavation conditions may be found in roadway cuts and along hillsides where shallow bedrock may be encountered (Bayshore Boulevard north of the Sierra Point area).
- Excavation through artificial fill along the Bay margin could encounter highly variable materials, including large construction debris, refuse, and other deleterious materials and contaminated soils. Areas of artificial fill occur along the route east of El Camino Real, through the city of South San Francisco, and to the Martin Substation.
- Excavation in this area could also encounter buried structures such as box culverts, bridge footings, and other structures supported on deep pile foundations.

These impact would likely be mitigated to less than significant with Mitigation Measures G-1a, G-2a, G-9a, and G-11a, but there may be instances where local re-routes may be required.

Paleontologic resources may be destroyed by construction activities where the alignment crosses through the Colma Formation (Impact G-3). This impact would be mitigated to less than significant levels with Mitigation Measure G-3a.

~~Impacts associated with the Hillside Fault crossing (Impact G-8) would be less than significant (Class III) and would not require mitigation.~~ Project facilities would be subject to strong groundshaking from local and regional seismic sources (Impact G-5). This impact would be mitigated to less than significant levels (Class II) with Mitigation Measure G-5a. Seismically induced ground failures including liquefaction, lateral spreading, seismic slope instability, and ground-cracking especially in areas adjacent to waterways could occur during an moderate to severe earthquake (Impact G-6). Because of the thickness, composition, and saturation of much of the fill material along alternative route east of the railroad, t~~T~~his impact may be much greater than for a route through stiffer, better-drained land — this impact may not ~~would~~ be completely mitigable with implementation of Mitigation Measure G-6a~~)~~. A landslide mapped adjacent to the alternate route where it crosses the foot of San Bruno Mountain could impact the transmission line (Impact G-7); Mitigation Measure G-7a would mitigate to less than significant (Class II). Impacts associated with the inactive Hillside Fault crossing (Impact G-8) would be less than significant (Class III) and would not require mitigation.

Impacts of Route Options A through E. The same impacts apply for these route options as for the Modified Underground Existing 230 kV Collocation Alternative segment: Poor soil and excavation conditions may be encountered where the route crosses areas of artificial fill over Bay Mud (Impacts G-1, G-2, G-9 and G-11. Refer to Section D.6.5.6 for a full discussion of the materials potentially encountered in the artificial fill. Project facilities would be subject to strong groundshaking from local and regional seismic sources (Impact G-5). All these impacts can be mitigated to less than significant with their corresponding mitigation measures. Seismically induced ground failures including liquefaction, lateral spreading, seismic slope instability, and ground-cracking especially in areas adjacent to waterways could occur during a moderate to severe earthquake (Impact G-6). Because of the thickness, composition, and saturation of much of the fill material along the route east of the railroad, Impact G-6 may be much greater for Route Options A, B, C, and E than for a route through stiffer, better-drained land. However, this impact would be mitigable to less than significant levels with implementation of Mitigation Measure G-6a (Class II).

Comparison to Proposed Route Segment

The Modified Underground 230 kV Alternative would begin where the proposed route at the San Bruno Avenue meets the BART ROW crossing. Both the proposed route and the Modified Underground Existing 230 kV Alternative follow an underground route for an equivalent distance to the Martin Substation; therefore there is no difference in terms of overhead vs. underground impacts. The Modified 230 kV Underground Alternative route has more potential impact from adverse ground conditions than the proposed route in terms of seismic susceptibility. Because the alternative route lies on thick sequences of saturated, unconsolidated materials, large areas of the route (perhaps 60% between the BART ROW crossing and the Martin substation) crosses areas identified as having very high liquefaction potential (Knudsen, et al., 1997) compared to less than 5% of the proposed route crossing areas of very high liquefaction potential. The proposed route crosses areas mapped as high liquefaction potential (about 15% of route), but this is over the BART extension which has new, stabilized fill. ~~There is no area of difficult excavation along this route, and there are no impacts that cannot be mitigated to less than significant levels. This alternative would include one crossing of the Hillside Fault, which is unlikely to be active, compared to no fault crossings associated with the BART ROW or Colma to Martin Substation segments of the proposed underground route.~~ Hazards associated with trenching through the Sierra Point landfill are addressed in Section D.8, Public Health and Safety.

In terms of geology and soils, all the Route Options for the Modified Underground Existing 230 kV Collocation Alternative are considered equivalent to slightly worse than the Modified Underground Existing 230 kV Collocation Alternative segment. Options A, B, C, and E all move the underground route closer to the margin of the Bay and into thicker artificial fill. Option D may be superior if it would be excavated into good quality fill along the Railroad ROW. If the fill is not of good quality, then this Option could be inferior to the original route. This review was not able to assess the site-specific conditions of these minor modifications, and understands that several of the route modifications were made to avoid known environmental hazards and potential land use impacts.

D.6.6 Environmental Impacts of the No Project Alternative

The No Project Alternative scenario would result in the installation of new generation in the CCSF, and in improvements to existing utility systems. The utility system improvements would create only minor impacts to the geology and soil in the region. The impacts would occur in the areas where upgrades of existing systems take place, especially when earthwork is required (such as new foundations, footings or trenches). However, potential new generation facilities would require analysis of geologic and seismic impacts, requiring consideration of appropriate soils and foundations, and specific facility design to minimize damage in earthquakes or strong groundshaking.

D.6.7 Mitigation Monitoring, Compliance, and Reporting Table

Table D.6-6 presents the mitigation monitoring, compliance, and reporting information for Geology, Soils, and Paleontology.

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

IMPACT G-1	**Soft or Loose Soils (Class II)**
MITIGATION MEASURE	**G-1a: Perform Geotechnical Studies**. The Applicant shall perform design-level geotechnical studies to identify areas of soft or loose soils along the alignment where they may affect tower footing excavation stability and/or access roads. Where soft or loose soils are found, Best Management Practices (BMPs) shall be followed for avoidance, improvement, or replacement of affected soil areas. BMPs shall be identified and provided to the CPUC and SFPUC for review and approval at least 60 days before construction.
Location	Areas having soils that are loosely compacted such as old, non-engineered fill along the margins of the Bay and in patches on hillsides
Monitoring / Reporting Action	CPUC approved engineer shall review and approve construction plans
Effectiveness Criteria	Plan/ remediation prevents failure of tower footings to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site
IMPACT G-2	**Construction-Caused Slope Instability (Class II)**
MITIGATION MEASURE	**G-2a: 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. Appropriate construction methods and procedures, in accordance with State and federal health and safety codes, shall be followed to protect the safety of workers and the public during trenching and excavation operations. PG&E 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.
Location	Areas where surface units are not coherent enough to support themselves during excavation
Monitoring / Reporting Action	CPUC approved engineer shall review and approve construction plans, including the report that will document the investigations and provide the support and protection measures.
Effectiveness Criteria	Plan/ remediation prevents collapse of excavations and risk or injury to workers to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site
IMPACT G-3	**Paleontologic Resources (Class II)**
MITIGATION MEASURE	**G-3a: Consult a Paleontologist**. Prior to construction, a qualified paleontologist shall be consulted regarding the likelihood of encountering significant fossils along specific segments of the approved ~~the proposed~~ alignment. The definition of a "qualified paleontologist" is provided by the Society of Vertebrate Paleontologists (SVP, 1999). If the paleontologist determines fossils may be present, a paleontologic monitor shall be present at each excavation that penetrates ~~potentially fossiliferous~~ undisturbed native soil or rock (not fill or Franciscan rock) that has been identified by the paleontologist as moderately to highly sensitive. Sampling and collecting shall follow SVP (1999) guidelines. Typical samples for microfossils shall be collected and ~~A~~any significant megafossils that are found shall be prepared for curation by the paleontologist and donated to a public museum such as the Museum of Paleontology at the University of California at Berkeley. PG&E shall document compliance with this measure prior to the start of construction by submitting to the CPUC for review and approval a preliminary paleontological report by the paleontologist

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	containing the following elements: (1)~~documenting~~ the locations where project construction is likely~~ihood of~~ to encounter~~ing~~ significant fossils; and (2) a plan outlining the proposed monitoring and fossil recovery/salvage methods. ~~shall be provided to the CPUC for review and approval.~~ Within ninety (90) days of completion of the excavation phase of the project, the paleontologist shall prepare a final paleontological report summarizing the monitoring and the findings; this report shall be provided to the CPUC for review and approval. The report shall include a list of fossils found (if any), the general locations of found fossils (precise locations should be kept confidential), the name of the curating institute where the fossils have been delivered, and a statement that the loss of non-renewable resources has been mitigated. **APM 10.1:** If fossils are encountered during construction, a qualified paleontologist will be contacted to examine the find and to determine its significance. If the find is deemed to have scientific value, the paleontologist and PG&E will devise a plan to either avoid impacts or to continue construction without disturbing the integrity of the find (e.g., by carefully excavating the material containing the resources). **[This APM has been superseded by Mitigation Measure G-3a, above.]**
Location	Areas where Whiskey Hill Fm, Colma Fm, or Merced Fm are present at the surface or in the undisturbed subsurface
Monitoring / Reporting Action	~~Applicant shall provide~~Review a monthly report to the CPUC compliance manager from the Applicant informing him/her of the status of the paleontologic monitoring. ~~Applicant shall deliver a copy of~~Review and approve the final paleontologic report that lists the fossils found and their significance ~~to the CPUC compliance manager~~. ~~Applicant shall provide~~Verify proof of the donation of fossils to a museum.
Effectiveness Criteria	No significant paleontologic resources are destroyed and those that are found are deposited in a curating museum for the benefit of the citizens of the State
Responsible Agency	CPUC, local planning agencies
Timing	Initial survey occurs prior to construction. Monitoring occurs during construction in sensitive units. Fossil preparation will occur after project completion.
IMPACT G-5	**Groundshaking (Class II)**
MITIGATION MEASURE	**G-5a: Reduce Effects of Groundshaking.** The Applicant shall perform design-level geotechnical investigations including 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 ~~past~~ types of damage that 230 kV equipment at substation~~s equipment damage~~ have been subjected to in the past. These design guidelines shall be implemented during construction of substation modifications and transition station construction. Substation and transition station control buildings shall be designed in accordance with the Uniform Building Code for sites in Seismic Zone 4 with near-field factors. Compliance with this measure shall be documented to the CPUC at least 60 days before construction by submittal of reports describing the potential peak ground accelerations expected for design level earthquake and a description of how the design will accommodate this anticipated motion.
Location	The entire project area, but especially where the project lies within a mapped Alquist-Priolo Earthquake Hazard Zone
Monitoring / Reporting Action	CPUC approved engineer shall review and approve construction plans.
Effectiveness Criteria	Plan/ remediation prevents damage to project facilities during a groundshaking event to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site.

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IMPACT G-6	**Ground Failure, Liquefaction (Class II)**
MITIGATION MEASURE	**G-6a: Geotechnical Investigations for Liquefaction and Slope Instability**. Since seismically induced ground failure has the potential to damage or destroy project components, the Applicant shall perform design-level geotechnical investigations to assess the potential for liquefaction, lateral spreading, seismic slope instability, and ground-cracking 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 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. PG&E shall submit a report of the required investigations to the CPUC for review and approval at least 60 days before construction.
Location	Areas having high potential for liquefaction, especially along lower Colma Creek and anywhere groundwater is shallow. Other areas to investigate would include the flatlands along the Modified Existing 230 kV Underground ROW alternative.
Monitoring / Reporting Action	CPUC approved engineer shall review and approve construction plans
Effectiveness Criteria	Plan/ remediation prevents liquefaction/differential settling to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site.
IMPACT G-7	**Landslides, Earth Flows and Debris Flows (Class II)**
MITIGATION MEASURE	**G-7a: Geotechnical Surveys for Landslides.** The Applicant shall perform design-level geotechnical surveys to evaluate the potential for unstable slopes, landslides, earth flows, and debris flows along the approved transmission line route and in the vicinity of other project facilities. Based on these surveys, approved project facilities shall be located away from very steep hillsides, debris-flow source areas, the mouths of steep sidehill drainages, and the mouths of canyons that drain steep terrain. A report documenting these surveys shall be submitted to the CPUC at least 60 days before construction.
Location	Areas of steep slopes and incompetent rock, colluvium or soil such as the sides of San Mateo Creek Canyon and the flanks of San Bruno Mountain
Monitoring / Reporting Action	CPUC approved engineer shall review and approve construction plans
Effectiveness Criteria	Plan/ remediation prevents damage to project facilities during a groundshaking event to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site
IMPACT G-8	**Fault Rupture (Class I for underground crossings of active fault traces; Class II for transition stations, overhead crossings, and underground crossings of potentially active fault traces)**
MITIGATION MEASURE	**G-8a: Minimize Project Structures Within Active Fault Zone.** Any crossing of an active fault ~~crossing~~ (overhead or underground) shall be made as close to perpendicular to the fault as possible to make the segment cross the shortest distance within an active fault zone. For crossings of active faults with overhead transmission lines, the towers shall be placed as far as feasible outside the area of mapped fault traces. For underground crossings of active or potentially active fault traces, the cable vaults on either side of the fault shall be oversized, leaving as much slack as possible in the cables (ideally enough slack to allow for 20 feet of offset for the San Andreas Fault). If 20 feet of offset cannot be accommodated, the underground cable should be installed in the shortest feasible segments, with splice vaults located as close as possible outside of the

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	fault zone in order to minimize the area where post-earthquake repairs may be required. Adequate supplies of spare cable sections shall be maintained by PG&E for rapid repair after an earthquake-caused failure. For aboveground installations such as transition stations, PG&E shall follow standard design codes for facilities in seismic zones. Compliance with this measure shall be documented to the CPUC in a report submitted for review and approval at least 60 days prior to the start of construction. **APM 10.2: Overhead Transmission Lines.** For overhead transmission lines, site-specific geotechnical investigations will be performed at proposed tower locations to evaluate the potential for fault surface rupture. Where significant potential for fault surface rupture exists, tower locations will be adjusted as possible. Incorporation of standard engineering practices as part of the Project will ensure that people or structures are not exposed to fault rupture hazards. **Underground Transmission Lines.** Site-specific geotechnical investigations will be performed at locations where underground portions of the proposed transmission line cross mapped fault zones and intersect individual fault traces. Where significant potential for fault surface rupture is identified, appropriate engineering measures, such as installing break-away connections and strategically locating splice boxes outside of the fault zone, will be implemented to protect sensitive equipment and limit the extent of potential repairs. Appropriate operation and maintenance measures will be implemented to prepare for potential fault-rupture scenarios and facilitate timely repair of facilities, if necessary. Preparation measures may include storage and maintenance of spare parts and equipment that may be needed to repair or temporarily bypass portions of the transmission line damaged as a result of fault surface rupture. Spare parts and equipment will be stored at the transition station or nearby PG&E facilities. **Overhead-Underground Transition Station.** A geotechnical investigation will be performed at the proposed overhead-underground transition station location to identify primary and subsidiary traces of the San Andreas Fault. Critical transition station facilities, including transmission-line support structures, the overhead-underground transition structure, and the control building, will not be sited over active or potentially active traces of the fault. To the extent feasible, station structures will be designed to accommodate anticipated displacement and distortion of the ground surface during a major earthquake along the San Andreas Fault Zone. As with design of underground transmission lines, transition station facilities will be designed for ductility and strength using reinforced components and flexible connections. Overhead transmission-line spans will be designed to accommodate potential fault displacement between support structures.
Location	At crossings of the San Andreas Fault both at the Cañada Trace near Jefferson Substation and at any crossing of Skyline Boulevard north of Millbrae Avenue. This mitigation measure and APM also applies to any crossing of a potentially active fault trace.
Monitoring / Reporting Action	CPUC approved engineer shall review and approve construction plans
Effectiveness Criteria	Plan/ remediation prevents damage to project facilities during a groundshaking event to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	During planning stages of fault crossings.
IMPACT G-9	**Expansive, Soft, Loose and/or Compressible Soils (Class II)**
MITIGATION MEASURE	**G-9a: Implement Standard Engineering Methods for Problematic Soils**. The Applicant 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.

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Location	Areas having soils with moderate to high shrink-swell potential, soft or loose soils
Monitoring / Reporting Action	CPUC approved engineer shall review and approve geotechnical report, grading plans, and foundation designs
Effectiveness Criteria	Plan/ remediation prevents differential settling to the extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site.
IMPACT G-11	**Corrosive Soils (Class II)**
MITIGATION MEASURE	**G-11a: Implement Standard Engineering Methods for Corrosive Soils.** The Applicant shall perform design-level geotechnical studies to identify the presence, if any, of potentially detrimental soil chemicals, such as chlorides and sulfates. Appropriate design measures for protection of reinforcement, concrete, and metal-structural components against corrosion shall be utilized, such as use of corrosion-resistant materials and coatings, increased thickness of project components exposed to potentially corrosive conditions, and use of passive and/or active cathodic protection systems. Study results and proposed solutions shall be provided to the CPUC for review and approval at least 60 days before construction
Location	Areas having high potential for corrosive soils such as areas where Bay Mud either underlies fill or where Bay Mud is a component of the fill
Monitoring / Reporting Action	CPUC approved engineer shall review test results and approve geotechnical report, grading plans, and foundation designs
Effectiveness Criteria	Plan/ remediation prevents corrosion of foundations and trench facilities to extent feasible
Responsible Agency	CPUC, local planning agencies
Timing	Prior to construction. Could be staged to stay ahead of construction at particular site.