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Chapter 4 – ENVIRONMENTAL IMPACT ASSESSMENT

4.6 GEOLOGY, SOILS, AND SEISMICITY

Would the project:	Potentially Significant Impact	Less-Than-Significant Impact with Mitigation	Less-Than-Significant Impact	No Impact
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☑	☐
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault?[1]	☐	☐	☑	☐
ii) Strong seismic ground shaking?	☐	☐	☑	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☑	☐
iv) Landslides?	☐	☐	☑	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☑	☐
c) Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☑	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☑	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☑

[1] Refers to Divisions of Mines and Geology Special Publication #42

4.6.0 Introduction

This section describes the existing geologic and soil conditions related to the Sierra Pacific Power Company (SPPCo) 625 and 650 Line Upgrade Project (project). Potential geologic hazards, including those associated with strong seismic ground-shaking, landslides, and slope stability, and the way these conditions and potential hazards could affect the project are discussed. In addition, the project's potential to increase these hazards is also assessed. With the implementation of the applicant-proposed measures (APMs) in Section 4.6.5 Applicant-Proposed Measures, potential risks associated with geologic conditions and soil stability will be less than significant.

4.6.1 Methodology

Existing conditions for the project area were identified through review of published and non-published literature and maps. Descriptions of geologic units and existing conditions within the project area were derived from various sources including the 2007 Digital Geologic Map of the Tahoe-Donner Pass Region, Northern Sierra Nevada, California and previously prepared environmental studies for projects in the vicinity. Soils data were obtained from maps and database information from the 2008 update of the United States (U.S.) Department of Agriculture (USDA), Soil Conservation Service Soil Survey of the Tahoe Basin Area, California and Nevada. An evaluation of landslide hazards was attempted; however, because maps of landslide hazards were not available for Placer County, the potential for landslides was based on slope length, slope steepness, slope aspect, and soil type.

4.6.2 Existing Conditions

Geological Setting

The Lake Tahoe Basin is the westernmost appearance of the Basin and Range extensional terrane and was formed more than 3 million years ago. The Sierra Nevada to the west and the Carson Range to the east mark the edges of the Lake Tahoe Basin. Lake Tahoe filled as a result of ice dams and volcanic flows in the Truckee River Valley that blocked the lake's outlet, causing water levels to fluctuate during the past 2 million years (Jones and Stokes 2002).

The predominant bedrock of the region is composed of Cretaceous granodiorite of the Sierra Nevada batholith overlain by lacustrine and glacial sediments deposited in bays and canyons surrounding Lake Tahoe. A description of the geologic unit types encountered by the project components is contained within Table 4.6-1: Geology of North Lake Tahoe.

According to recent well log data, the depth to groundwater varies widely depending on location from approximately 14 feet to approximately 190 feet from the ground surface. The groundwater level has remained relatively constant with annual fluctuations of approximately 10 feet (California Department of Water Resources 2009). More information on groundwater and other hydrologic resources is provided in Section 4.8 Hydrology and Water Quality.

Table 4.6-1: Geology of North Lake Tahoe

Approximate Milepost (MP)	Geologic Unit	Unit Description
Existing 625 Line		
0–0.4	Qoa	Holocene older alluvium
0.4 to 2.8	Tmp	Miocene andesitic pyroclastic rocks
2.8 to 3.3	Tmha	Miocene hornblende andesite flows
3.3 to 3.4	Tmpa	Miocene pyroxene andesite flows
3.4 to 3.9	Tmp	Miocene andesitic pyroclastic rocks
3.9 to 4.4	Tmpa	Miocene pyroxene andesite flows
4.4 to 6.2	Tmha	Miocene hornblende andesite flows
6.2 to 7.8	Tmp	Miocene andesitic pyroclastic rocks
7.8 to 8.0	Tmpa	Miocene pyroxene andesite flows
8.0 to 8.4	Tmp	Miocene andesitic pyroclastic rocks
8.4 to 10.9	Tsbha	Bole hornblende andesite
10.9 to 12.2	Tsp	Miocene pyroclastic deposits undivided
12.2 to 14.0	QTttt	Pliocene trachydacite Tahoe City flows
14.0 to 14.7	QTttb	Pliocene olivine basalt
14.7 to 14.9	Qt	Holocene talus
14.9 to 15.1	QTttb	Pliocene olivine basalt
15.1 to 15.3	Ql	Holocene lacustrine deposits
New 625 Line		
0.0 to 0.4	Qoa	Holocene older alluvium
0.4 to 2.7	Tmp	Miocene andesitic pyroclastic rocks
2.7 to 3.1	Tmha	Miocene hornblende andesitic flows
3.1 to 3.7	Tmp	Miocene andesitic pyroclastic rocks
3.7 to 4.5	Tmpa	Miocene pyroxene andesite flows
4.5 to 6.1	Tmha	Miocene hornblende andesitic flows
6.1 to 7.9	Tmp	Miocene andesitic pyroclastic rocks
7.9 to 8.3	Tmpa	Miocene pyroxene andesite flows
8.3 to 8.4	Tmp	Miocene andesitic pyroclastic rocks
8.4 to 8.8	Tmpa	Miocene pyroxene andesite flows
8.8 to 11.6	Tsbha	Bole hornblende andesite

Approximate Milepost (MP)	Geologic Unit	Unit Description
11.6 to 12.8	Tsp	Miocene pyroclastic deposits undivided
12.8 to 14.4	QTttt	Pliocene trachydacite Tahoe City flows
14.4 to 15.1	QTttb	Pliocene olivine basalt
15.1 to 15.3	Qt	Holocene talus
15.3 to 15.5	QTttb	Pliocene olivine basalt
15.5 to 15.8	Ql	Holocene lacustrine deposits
650 Line		
0.0 to 0.6	Qa	Holocene recent alluvium
0.6 to 1.0	Qoa	Holocene older alluvium
1.0 to 1.2	Qa	Holocene recent alluvium
1.2 to 1.3	Qoa	Holocene older alluvium
1.3 to 1.9	Qa	Holocene recent alluvium
1.9 to 8.7	Tmp	Miocene andesitic pyroclastic rocks
8.7 to 9.1	Qoa	Holocene older alluvium
132/650 Line Double-Circuit		
0.0 to 0.5	Qd	Pleistocene Donner glacial deposits
0.5 to 1.0	QTao	Pleistocene Tahoe glacial outwash
1.0 to 1.2	Qttpc	Pliocene fluvial sand and gravel, lake sediments of Prosser Creek
1.2 to 1.7	Qdo	Pleistocene Donner glacial outwash
Northstar Fold		
0.0 to 0.1	Qa	Holocene recent alluvium
0.1 to 0.3	Tmp	Miocene andesitic pyroclastic rocks
0.3 to 0.4	Tma	Miocene aphyric or microporpheritic andesite lava flow
0.4 to 0.5	Tmp	Miocene andesitic pyroclastic rocks

Source: Sylvester, 2007

Existing 625 Line

The alignment for the existing 625 Line traverses a combination of older Holocene alluvium and lacustrine deposits, Pliocene trachydacite and olivine basalt flows, Miocene pyroxene and hornblende andesite volcanic flows, andesitic pyroclastic flows and undivided pyroclastic flows, and biotite-hornblende andesite intrusion.

New 625 Line

The new 625 Line crosses a combination of older and recent Holocene alluvium and lacustrine deposits, Pliocene fluvial sand and gravel deposits with lake sediments, Pliocene trachydacite and olivine basalt flows, Miocene pyroxene and hornblende andesite volcanic flows, andesitic pyroclastic flows, undivided pyroclastic flows, and biotite-hornblende andesite intrusion.

650 Line

The alignment of the 650 Line to be rebuilt encounters a combination of recent and older Holocene alluvium, Pliocene fluvial sand and gravel deposits with lake sediments, and Miocene hornblende andesite flows.

132/650 Line Double-Circuit

The alignment of the132/650 Line Double-Circuit crosses a combination of Pleistocene glacial deposits and glacial outwash.

Northstar Fold

The alignment of the Northstar Fold crosses a combination of Miocene andesitic pyroclastic rocks, andesite lava flows, and Holocene alluvium.

Faults, Seismicity, and Related Hazards

Faults and Fault Rupture

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 established policies and criteria for classifying known active earthquake fault zones in California. According to the act, known active faults are mapped and ranked by the state geologist in terms of their potential for surface rupture based on the existence or absence of a detectable fault trace and the how recent fault displacement has occurred. Per the California Public Resources Code Sections 2621 through 2630, a fault must be sufficiently active and well defined for an area to be designated as an earthquake fault zone. As a result, only faults with a high potential for ground rupture are zoned. The project is not located within or adjacent to an Alquist-Priolo Earthquake Fault Zone.

One recognized active fault—the North Tahoe-Incline Village fault—is approximately 3 miles southeast of Kings Beach (Jennings 1994). Several early Quaternary faults are located within a 30-mile radius of the project area, including the West Tahoe-Dollar Point fault zone, which crosses the 625 Line. The mapped faults are a combination of concealed and known faults, but the nature or period of movement or the direction of displacement is not known.

Seismicity and Ground Motion

The U.S. Geological Survey (USGS) and the California Division of Mining and Geology have developed probabilistic seismic hazard (PSH) maps for California (Peterson and others 1996, USGS 2008). These PSH maps depict the levels of earthquake ground motion that have a 10-percent probability of being exceeded within 50 years. The measure of earthquake ground motion depicted on the maps is peak horizontal ground acceleration, which is expressed as a proportion of the acceleration caused by gravity. The peak ground acceleration (PGA) depicted on these maps represents probabilistic estimates of the intensity of ground motion that is likely to occur as a result of reasonably foreseeable earthquake events on active faults. These maps can be used to evaluate seismic ground motion in various regions in California.

The Modified Mercalli Scale is another common measure of earthquake intensity, which is a subjective measure of earthquake strength at a particular place as determined by its effects on people, structures, and earth materials. Table 4.6-2: Mercalli Earthquake Intensity Scale presents the Modified Mercalli Scale for Earthquake Intensity, including a range of approximate average peak accelerations associated with each intensity value. According to the most current USGS PSH maps, the probability that a PGA between 0.46 gravity (g) and 0.59g will be exceeded in the project area in 50 years is 2 percent, while the probability that a PGA between 0.27g and 0.35g will be exceeded in 50 years is 10 percent. These PGAs are relatively low when compared with other seismically active areas within California (USGS 2008).

The Richter Scale is the best known scale for measuring the magnitude of an earthquake. According to the Richter Scale, the magnitude value of an earthquake is proportional to the logarithm of the amplitude of the strongest wave during an earthquake. The Richter Scale measurement of magnitude and its effects on structures is shown in Table 4.6-3: Richter Scale Magnitude and Effects. Approximately 90 earthquakes with a Richter Scale magnitude of 3.0 or larger have occurred in the Reno-Tahoe region since 1943. In 1966, a magnitude 6.0 earthquake originated in the Donner Pass area and damaged the dome of the Nevada State Capitol building in Carson City, cracked dams on the Truckee River, and was felt as far away as San Francisco, California. The largest known earthquake to strike the area was a magnitude 6.5 in 1887 (California Department of Conservation 2008).

Ground Failure Including Liquefaction

Most of the geologic units within the project area are not prone to liquefaction; however, lacustrine deposits and glacial outwash deposits located in stream channels may be prone to liquefaction during a strong earth-shaking event. Earthquake-induced liquefaction occurs when loose sands and silts that are saturated with water behave like liquids when strong ground shaking occurs. Seismic waves cause the pore pressure in the soils to build until the soil grains lose contact, therefore causing the soil to lose tensile strength and behave like a liquid. Higher pore pressure occurs as the soil attempts to compact in response to the shaking, resulting in less grain-to-grain soil contact and, therefore, loss of strength. Structures supported by a liquefying soil may sustain damage because of loss of foundation support.

Table 4.6-2: Mercalli Earthquake Intensity Scale

<table>
<tr><th>Intensity Value</th><th>Intensity Description</th><th>Peak Ground Acceleration Range</th></tr>
<tr><td>I</td><td>Not felt except by very few people under especially favorable circumstances.</td><td><0.0017g</td></tr>
<tr><td>II</td><td>Felt only by a few people at rest, especially on upper floors on buildings. Delicately suspended objects may swing.</td><td rowspan="2">0.0017 to 0.014g</td></tr>
<tr><td>III</td><td>Felt noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly, vibration similar to a passing truck. Duration estimated.</td></tr>
<tr><td>IV</td><td>During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation is like a heavy truck striking building. Standing motor cars rock noticeably.</td><td>0.014 to 0.039g</td></tr>
<tr><td>V</td><td>Felt by nearly everyone, many awakened. Some dishes and windows broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles may be noticed. Pendulum clocks may stop.</td><td>0.039 to 0.092g</td></tr>
<tr><td>VI</td><td>Felt by all, many frightened and run outdoors. Some heavy furniture moves and plaster falls or chimneys are damaged. Damage slight.</td><td>0.092 to 0.18g</td></tr>
<tr><td>VII</td><td>Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by people driving motor cars.</td><td>0.18 to 0.34g</td></tr>
<tr><td>VIII</td><td>Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. People driving motor cars disturbed.</td><td>0.34 to 0.65g</td></tr>
<tr><td>IX</td><td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.</td><td>0.65 to 1.24g</td></tr>
</table>

Intensity Value	Intensity Description	Peak Ground Acceleration Range
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	>1.24 g
XI	Few, if any, masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	
XII	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	

Sources: Bolt, 1988; Wald, 1999

Table 4.6-3: Richter Scale Magnitude and Effects

Richter Scale Magnitude	Effects
0.0 to 3.4	Detected only by seismometers
3.5 to 4.2	Just about noticeable indoors
4.3 to 4.8	Most people notice them, windows rattle
4.9 to 5.4	Everyone notices them, dishes may break, open doors swing
5.5 to 6.1	Slight damage to buildings, plaster cracks, bricks fall
6.2 to 6.9	Much damage to buildings: chimneys fall, houses move on foundations
7.0 to 7.3	Serious damage: bridges twist, walls fracture, buildings may collapse
7.4 to 7.9	Great damage, most buildings collapse
8.0 to 10.0	Total damage, surface waves seen, objects thrown in the air

Source: http://www.matter.org.uk/Schools/Content/Seismology/richterscale.html, 2009

The existing and new 625 lines cross Holocene lacustrine deposits (Ql) between approximate MP 15.1 and MP 15.3, and approximate MP15.5 and MP 15.8, respectively, and the 132/650 Line Double-Circuit encounters Pleistocene Donner Glacial deposits (Qd) from approximate MP 0.0 to MP 0.5, Pleistocene Tahoe glacial outwash (QTao) from approximate MP 0.5 to MP 1.0 and Pleistocene Donner glacial outwash (Qdo) from approximate MP 1.2 to MP 1.7. Given the right hydrologic conditions, these units might be susceptible to liquefaction during seismic events.

Landslides

Landslides occur when earthquakes, heavy precipitation, or other natural or human-induced activities cause soil and/or rock to rapidly move downslope. Long, steep hillsides and mountain terrain that becomes saturated from snowmelt or heavy rainfall are particularly susceptible to landslides given the right soil conditions. In general, poorly consolidated sediments (such as recently uplifted or exposed marine sediments, river floodplain deposits, or glacial deposits), loose volcanic deposits, or deeply weathered bedrock are prone to landslides. The project area is primarily underlain by volcanic rock and alluvium that generally has a moderate potential for landslides. Areas with large boulders and weathered bedrock will increase slope instability and the potential for landslides.

Topsoil

Soils are created through physical and chemical weathering of rocks that are exposed at or near the earth’s surface. Soil is formed through a complex combination of physical, chemical and biological processes. Soil surveys by the USDA, Natural Resources Conservation Service (NRCS) in the project area classify soils by distinct soil types and are compiled into reports and soil survey maps. The A horizon (topsoil) for the soils in the project area are typically very shallow and unproductive for agricultural use. Soils in the project area are shown in Figure 4.6-1: Soils of North Lake Tahoe and are presented in Table 4.6-4: Soil Units of North Lake Tahoe.

Erosion

Soil erosion is the wearing away of the land surface by physical forces, such as rainfall, flowing water, wind, or anthropogenic agents, that abrade or remove soil. There is only one soil unit, the Aldi-Kyburz complex (ARE), along the 650 Line from approximate MP 1.9 to MP 2.1 that is classified as having a high erosion potential. However, the erosion potential may also be high in areas with steep slopes, particularly with a south facing aspect. Erosion hazards for the soils encountered in the project area are presented in Table 4.6-4: Soil Units of North Lake Tahoe.

Subsidence

Subsidence is a settling or sinking of the ground surface due to the subsurface movement of earth materials. The main causes of subsidence are aquifer compaction from groundwater withdrawal, underground mining, sinkholes from the dissolution of soluble rock, or natural compaction of lithologic material often associated with buried faults in alluvial basins. The area under the existing and proposed transmission lines, and the general region as a whole, has no significant groundwater producing aquifers, there are no current or abandoned underground mines, and the dominant geologic materials are not prone to dissolution. The alluvium and colluvium in alpine regions is not typical of material prone to subsidence.

Expansive or Collapsible Soils

Expansive soils contain shrink-swell clays, such as smectite clays, that are capable of absorbing water. As these clays absorb water, they increase in volume. These changes in volume are capable of exerting enough force on buildings and other structures to damage foundations and basement walls. Damage from expansive soils also occurs when the soils dry out and contract, causing subsidence and earth fissuring.

According to the Swelling Clays Map of the Coterminous United States, the project area generally falls within an area that is underlain by soils with little to no clays with swelling potential (USGS 1989). Only one soil unit in the project area, the Kingbeach unit, has a high shrink-swell potential. The Kings Beach Substation, approximately 0.4 mile of the new and existing 625 lines, and 0.5 mile of the 650 Line cross this soil unit in the Kings Beach area, as shown in Table 4.6-4: Soil Units of North Lake Tahoe.

4.6.3 Impacts

Significance Criteria

Impacts to geology and soils will be considered significant if the project:

- Exposes people or structures to potential substantial adverse effects involving strong seismic ground shaking, fault rupture, liquefaction, or landslides
- Results in substantial soil erosion or the loss of topsoil

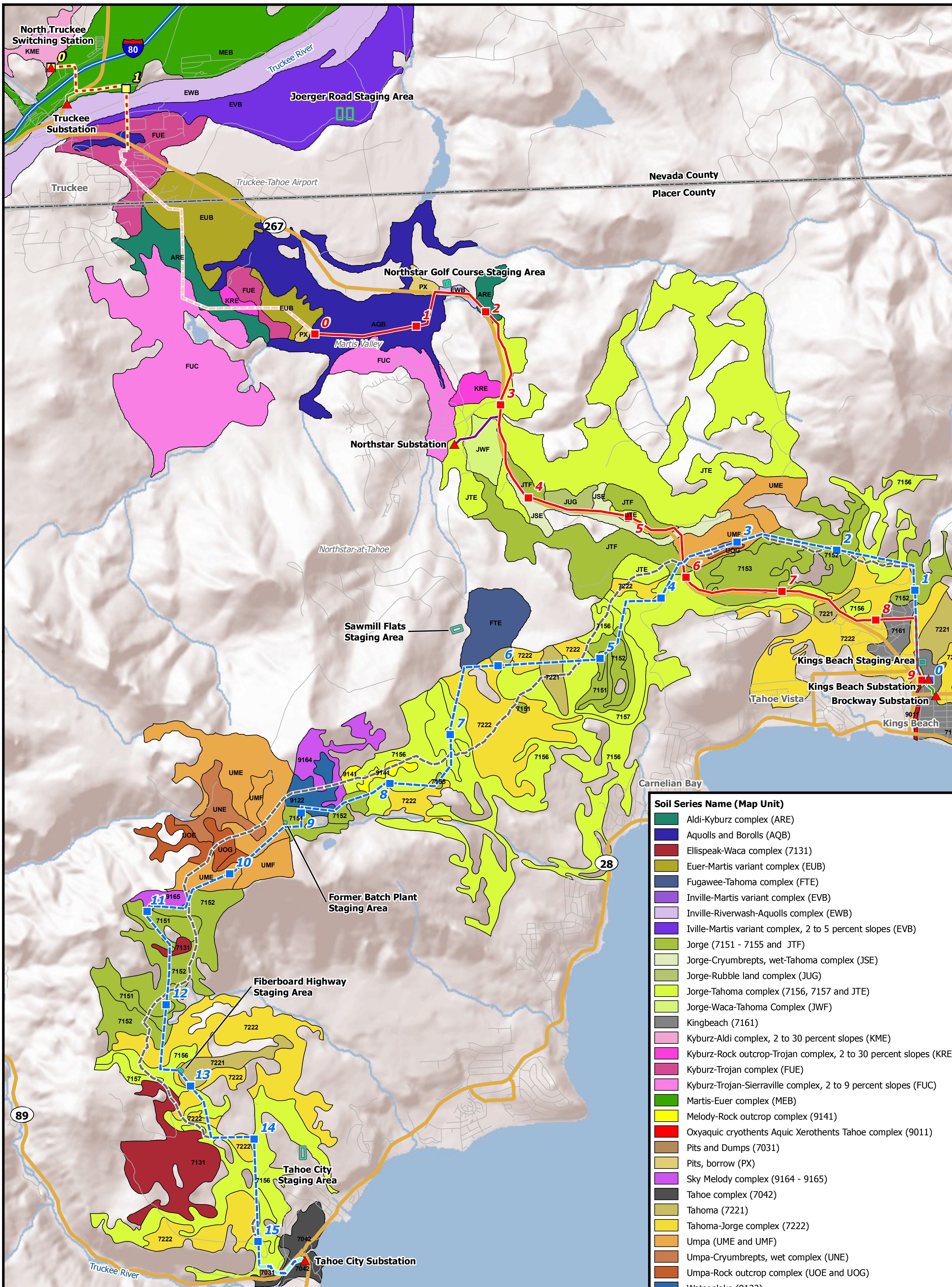

Figure 4.6-1: Soils Map **625 and 650 Line Upgrade Project**

- New 625 Line
- Existing 625 Line
- 625/629 Double-Circuit
- 650 Line to be Rebuilt
- 650 Line Previously Upgraded
- 132/650 Double-Circuit to be Rebuilt
- 650 Line to be Removed
- Northstar Fold
- Substation/Switching Station
- Milepost (Color Coded by Line)
- Staging Area

Sierra Pacific

INSIGNIA ENVIRONMENTAL

N W E S

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Table 4.6-4: Soil Units of North Lake Tahoe

Approximate MP	Map Unit Name	Soil Name	Shrink-Swell Potential	Erosion Hazard	Soil Drainage	Soil Permeability (lowest permeability)
Existing 625 Line						
0.0 to 0.1, 0.3 to 0.4, 0.8 to 0.9, 15.0 to 15.1	7161	Kingbeach	High	Low	Moderately Well Drained	Impermeable
0.1 to 0.2	9011	Oxyaquic cryothents Aquic Xerothents Tahoe complex	Low	Low	Excessively Drained	Moderate
0.2 to 0.3, 0.4 to 0.8, 1.8 to 1.9, 4.3 to 4.5, 5.0 to 5.1, 6.0 to 6.7, 11.8 to 12.0, 12.6 to 12.7, 13.3 to 13.5, 14.4 to 14.5	7222	Tahoma–Jorge complex	Low	Low	Well Drained	Slow
0.9 to 1.3, 1.4 to 1.6, 2.0 to 2.5, 2.6 to 2.8, 10.2 to 10.3, 10.5 to 11.1, 11.2 to 11.8	7152	Jorge	Low	Low	Well Drained	Moderate
1.3 to 1.4, 1.6 to 1.8, 4.5 to 4.6, 4.7 to 5.0, 5.1 to 5.4, 5.7 to 6.0, 6.9 to 7.4, 7.8 to 7.9, 12.0 to 12.2,	7156	Tahoma–Jorge complex	Low	Low	Well Drained	Slow

Approximate MP	Map Unit Name	Soil Name	Shrink-Swell Potential	Erosion Hazard	Soil Drainage	Soil Permeability (lowest permeability)
12.7 to 12.9, 13.0 to 13.3, 13.5 to 14.4, 14.5 to 15.0						
1.9 to 2.0, 2.5 to 2.6	7153	Jorge	Low	Low	Well Drained	Moderate
2.8 to 3.1 3.4 to 3.7	UMF	Umpa	N/D	N/D[2]	Well Drained	Moderately Rapid
3.1 to 3.4, 9.3 to 9.5	UOG	Umpa–Rock outcrop complex	N/D	N/D	Well Drained	Moderately Rapid
3.7 to 3.9	JTF	Jorge	Low	Low	Well Drained	Moderate
3.9 to 4.3	JTE	Jorge–Tahoma complex	N/D	N/D	Well Drained	Moderate
4.6 to 4.7, 6.7 to 6.9, 12.2 to 12.4, 12.9 to 13.0	7157	Jorge–Tahoma complex	Low	Low	Well Drained	Slow
5.4 to 5.7	7221	Tahoma	Low	Low	Well Drained	Slow
7.4 to 7.8, 7.9 to 8.0	9141	Melody–Rock outcrop complex	Low	Low	Well Drained	Moderate
8.0 to 8.3	9164	Sky Melody complex	Low	Low	Well Drained	Very Slow
8.3 to 8.6	9122	Watsonlake	Low	Low	Well Drained	Slow
8.6 to 9.0, 9.1 to 9.3, 9.7 to 10.1	UME	Umpa	N/D	N/D	Well Drained	Moderately Rapid
9.0 to 9.1	UNE	Umpa–Cryumbrepts, wet complex	N/D	N/D	Well Drained	Moderately Rapid
9.5 to 9.7	UOE	Umpa–Rock outcrop complex	N/D	N/D	Well Drained	Moderately Rapid

[2] This information is not defined, or is unavailable.

Approximate MP	Map Unit Name	Soil Name	Shrink-Swell Potential	Erosion Hazard	Soil Drainage	Soil Permeability (lowest permeability)
10.1 to 10.2	9165	Sky–Melody complex	Low	Low	Well Drained	Very Slow
10.3 to 10.5, 11.1 to 11.2	7151	Tahoe complex	Low	Low	Poorly Drained	Moderate
12.4 to 12.6	7131	Ellispeak–Waca complex	Low	Low	Well Drained	Rapid
15.1 to 15.3	7042	Tahoe complex	Low	Low	Poorly Drained	Moderate
New 625 Line						
0.0 to 0.1, 0.3 to 0.4, 0.8 to 0.9, 15.4 to 15.5	7161	Kingbeach	High	Low	Moderately Well Drained	Impermeable
0.1 to 0.2	9011	Oxyaquic cryothents Aquic Xerothents Tahoe complex	Low	Low	Excessively Drained	Moderate
0.2 to 0.3, 0.4 to 0.8, 5.6 to 5.9, 6.1 to 6.7, 12.4 to 12.6, 13.7 to 14.0	7222	Tahoma–Jorge complex	Low	Low	Well Drained	Slow
0.9 to 1.3, 1.4 to 1.6, 2.0 to 2.7, 4.7 to 5.0, 8.3 to 8.7, 10.4 to 10.8, 11.4 to 11.5, 11.6 to 12.1, 12.3 to 12.4	7152	Jorge	Low	Low	Well Drained	Moderate

Approximate MP	Map Unit Name	Soil Name	Shrink-Swell Potential	Erosion Hazard	Soil Drainage	Soil Permeability (lowest permeability)
1.3 to 1.4, 1.6 to 1.8, 3.8 to 4.5, 5.1 to 5.4, 6.7 to 7.1, 7.3 to 7.5, 7.6 to 8.3, 12.6 to 12.8, 13.1 to 13.7, 14.0 to 14.9, 15.0 to 15.4	7156	Jorge–Tahoma complex	Low	Low	Well Drained	Slow
1.8 to 2.0, 4.6 to 4.7	7153	Jorge	Low	Low	Well Drained	Moderate
2.7 to 3.0, 3.2 to 3.6, 9.8 to 9.9	UMF	Umpa	N/D	N/D	Well Drained	Moderately Rapid
3.0 to 3.2	UOG	Umpa–Rock outcrop complex	N/D	N/D	Well Drained	Moderately Rapid
3.6 to 3.8	JTF	Jorge	Low	Low	Well Drained	Moderate
4.5 to 4.6, 7.1 to 7.3, 14.9 to 15.0	7157	Jorge–Tahoma complex	Low	Low	Well Drained	Slow
5.0 to 5.1, 9.0 to 9.3, 11.0 to 11.4, 12.1 to 12.3	7151	Tahoe complex	Low	Low	Poorly Drained	Moderate
5.4 to 5.6, 5.9 to 6.1, 12.8 to 13.1	7221	Tahoma	Low	Low	Well Drained	Slow
7.5 to 7.6	7155	Jorge	Low	Low	Well Drained	Slow
8.7 to 9.0	9122	Watsonlake	Low	Low	Well Drained	Slow

Approximate MP	Map Unit Name	Soil Name	Shrink-Swell Potential	Erosion Hazard	Soil Drainage	Soil Permeability (lowest permeability)
9.3 to 9.7, 9.9 to 10.4	UME	Umpa	N/D	N/D	Well Drained	Moderately Rapid
9.7 to 9.8	UOE	Umpa–Rock outcrop complex	N/D	N/D	Well Drained	Moderately Rapid
10.8 to 11.0	9165	Sky–Melody complex	Low	Low	Well Drained	Very Slow
11.5 to 11.6	7131	Ellispeak–Waca complex	Low	Low	Well Drained	Rapid
15.5 to 15.8	7042	Tahoe complex	Low	Low	Poorly Drained	Moderate
650 Line						
0.0 to 1.4	AQB	Aquolls and Borolls	N/D	N/D	Poorly drained	N/D
1.4 to 1.5	PX	Pits, borrow	N/D	N/D	N/D	N/D
1.5 to 1.9	EWB	Inville–Riverwash–Aquolls complex	Low	N/D	Well Drained	Moderate/ Moderately Rapid
1.9 to 2.1	ARE	Aldi–Kyburz complex	N/D	High	N/D	Moderately Slow
2.1 to 3.7, 4.8 to 5.2	JTE	Jorge–Tahoma complex	N/D	N/D	Well Drained	Moderate
3.7 to 4.0, 4.6 to 4.8, 5.5 to 5.6	JSE	Jorge–Cryumbrepts, wet–Tahoma complex	N/D	N/D	Well Drained	Moderate
4.0 to 4.2, 5.2 to 5.5, 5.9 to 6.0	JTF	Jorge	Low	Low	Well Drained	Moderate
4.2 to 4.6	JUG	Jorge–Rubble land complex	N/D	N/D	Well Drained	Moderate
5.6 to 5.9	UMF	Umpa	N/D	N/D	Well Drained	Moderately Rapid
6.0 to 6.2, 7.0 to 7.5	7156	Jorge–Tahoma complex	Low	Low	Well Drained	Slow
6.2 to 6.4, 6.8 to 7.0	7152	Jorge	Low	Low	Well Drained	Moderate

Approximate MP	Map Unit Name	Soil Name	Shrink-Swell Potential	Erosion Hazard	Soil Drainage	Soil Permeability (lowest permeability)
6.4 to 6.8	7153	Jorge	Low	Low	Well Drained	Moderate
7.5 to 7.6	7221	Tahoma	Low	Low	Well Drained	Slow
7.6 to 8.1, 8.4 to 8.7, 8.8 to 8.9	7222	Tahoma–Jorge complex	Low	Low	Well Drained	Slow
8.1 to 8.4, 8.7 to 8.8, 9.0 to 9.1	7161	Kingbeach	High	Low	Moderately Well Drained	Impermeable
8.9 to 9.0	9011	Oxyaquic cryothents Aquic Xerothents Tahoe complex	Low	Low	Excessively Drained	Moderate
132/650 Line Double-Circuit						
0.0 to 1.0	MEB	Martis–Euer complex	N/D	N/D	Well Drained	Moderately Slow
1.0 to 1.2	EWB	Inville–Riverwash–Aquolls complex	Low	N/D	Well Drained	Moderate/ Moderately Rapid
1.2 to 1.3	EVB	Inville–Martis variant complex	N/D	N/D	Well Drained	Moderately High/ High
1.3 to 1.4, 1.6 to 1.7	FUE	Kyburz–Trojan complex	N/D	N/D	Well Drained	Moderately High
1.4 to 1.6	AQB	Aquolls and Borolls	N/D	N/D	Poorly drained	N/D
Northstar Fold						
0.0 to 0.2, 0.4 to 0.5	JTE	Jorge–Tahoma complex	N/D	N/D	Well Drained	Moderate
0.2 to 0.4	JWF	Jorge–Waca–Tahoma Complex	N/D	N/D	Well Drained	Moderately High/ High

Source: NRCS, 2008

- Is located on a geologic unit or soil that is unstable, or that will become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse
- Is located on expansive soil, as defined in Table 18-1-B of the UBC (1994), creating substantial risks to life or property
- Is located on soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater

Question 4.6a – Human Safety and Structure Integrity

Construction – Less-than-Significant Impact

The project area is not located within or adjacent to an Alquist-Priolo Earthquake Fault Zone. Should a seismic event occur in the project area, most of the geologic units crossed by the project components are not prone to liquefaction. However, lacustrine deposits and glacial outwash deposits located in stream channels may be prone to liquefaction during a strong earth shaking event. The existing and new 625 lines and the 132/650 Line Double-Circuit cross 0.2 mile, 0.3 mile, and 1.5 miles, respectively, of geologic units that, given the right hydrologic conditions, might be susceptible to liquefaction during seismic events. However, as described in APM-GEO-01, a Geotechnical Report will be prepared and used to develop the final design of all project components to ensure that geologic hazards are adequately addressed in the design and construction of the project. In addition, the majority of the project components cross geologic units which are not prone to high shrink-swell potential. Expansive soils are discussed further in response to Question 4.6d.

The potential for landslides and rock fall in steeper portions of the project area exists, and construction of the project could result in the destabilization of natural or constructed slopes, both on site and in adjacent areas. Excavation, chemical cracking, grading, and cut and fill activities associated with establishing spur roads to pole sites could alter existing slope profiles, making them unstable as a result of over–excavation of slope material, steepening of the slope, or increased loading. A geotechnical survey of pole installation sites will be conducted prior to construction, as described in APM-GEO-01 in Section 4.6.5 Applicant-Proposed Measures, to identify and evaluate potential impacts to slope stability that might result in landslides or rock fall. As a result, the impact will be less than significant.

The project area may be subject to relatively strong seismic shaking due to earthquakes. However, the transmission lines and substations will be engineered to withstand strong ground movement and moderate ground deformation. The IEEE 693 “Recommended Practices for Seismic Design of Substations” has specific requirements to mitigate substation equipment damage. When these requirements are followed, very little structural damage from horizontal ground accelerations approaching 1.0g is anticipated. Incorporation of these standard engineering practices will ensure that people or structures will not be exposed to hazards associated with strong seismic ground shaking. Given that transmission lines have existed in this area during seismic events and no reports of liquefaction, landslides, or other seismic hazards have been encountered, it is unlikely that these issues will pose a significant risk to the project. Therefore, the impact will be less than significant.

Operation and Maintenance – No Impact

As a result of the project, the transmission lines will be constructed with more robust steel poles, and will be more capable of withstanding seismic events and associated hazards. In addition, the operation and maintenance of the project facilities will not change significantly from the activities already occurring at the existing facilities. Therefore, there will be no impact.

Question 4.6b – Soil Erosion or Topsoil Loss

Construction – Less–than–Significant Impact

Installing and removing transmission line structures, constructing and/or upgrading substations and switching stations, upgrading and establishing access roads, and vegetation clearing and grading will result in soil disturbance and loss of vegetation, which has the potential to cause a temporary increase in soil erosion loss of topsoil. While the A horizon (topsoil) in alpine forests is typically very shallow and unproductive, all attempts will be made to salvage and store topsoil during construction to aid in the revegetation of disturbed areas, as described in APM-BIO-21 in Section 4.4.4 Applicant-Proposed Measures. In addition, the project will be constructed in accordance with the conditions in the project's Storm Water Pollution Prevention Plan (SWPPP). The SWPPP will detail the best management practices that will be implemented to minimize erosion, topsoil loss, stabilize areas of ground disturbance, reduce sediment transfer, and control stormwater flow from the project site. Therefore, the impact will be less than significant.

Operation and Maintenance – No Impact

Operation and maintenance of the project components will not typically involve ground–disturbing activities and will not change from what is already occurring along the existing transmission lines. Additionally, existing access roads will be used for routine operation and maintenance activities and the practices will not differ substantially from those employed to maintain the existing lines. Therefore, there will be no impact.

Question 4.6c – Geologic Unit Instability

Construction – Less–than–Significant Impact

The removal of wooden poles and installation of steel structures will not have an impact on the stability of the granodiorite bedrock that underlies the project area. However, destabilization of natural or constructed slopes could occur as a result of excavation, grading, and cut and fill activities to establish access and spur roads and create level work sites. While these activities could increase instability in the project area, most of the geologic units crossed by the project components are not prone to liquefaction or lateral spreading. Approximately 2 miles of the project components cross geologic units that, given the right hydrologic conditions, might be susceptible to liquefaction during seismic events. However, implementation of APM-GEO-01—which requires a registered professional geologist or engineer to conduct a geotechnical analysis and prepare a Geotechnical Report to be used to develop the final project design—will ensure impacts from landslide, lateral spreading, subsidence, and liquefaction are less than significant.

As discussed in the existing conditions, landslides have the potential to occur throughout the project area. To ensure that the project does not increase the potential for landslides nor be adversely affected by them, an engineer, qualified in landslide hazard evaluations, will further assess the potential for landslides and slope failure along the transmission line route as part of the geotechnical evaluation that will be conducted in accordance with APM-GEO-01 in Section 4.6.5 Applicant-Proposed Measures. Chemical cracking, grading, and construction on slopes will be conducted to limit the potential for slope instability, maintain adequate drainage of improved areas, and minimize the potential for soil erosion during construction. Therefore, the impact associated with geologic unit and soil instability will be less than significant.

Operation and Maintenance – No Impact

Normal operation and maintenance of the transmission lines, substations, or access roads does not typically involve activities such as grading and excavation, which would affect geologic stability. If proper geotechnical assessments are conducted as previously described, and design procedures are followed during construction, the operation and maintenance of the transmission line will have no impact on the geologic stability in the area. In addition, operation and maintenance activities will not change from what is already occurring for the existing facilities. Therefore, no impact will occur.

Question 4.6d – Expansive Soils – *Less–than–Significant Impact*

The project is located within an area that is underlain by soils with little to no shrink–swell potential. Approximately 1.3 miles of project components—including transmission poles and the Kings Beach Substation—located in the Kings Beach area will cross soil units with a high shrink–swell potential. However, all transmission poles will be embedded at a depth equal to 10 percent of the total pole height plus 2 additional feet. Approximately 7 to 10 feet of each pole will be located below grade. Thus the poles will be stabilized and soil movement is less likely to cause an adverse impact. While the footprint of the Kings Beach Switching Station will increase slightly to rebuild the facility into the Kings Beach Substation, all of the work will take place within the larger confines of the existing Kings Beach Diesel Generation Station. Additionally, the implementation of APM-GEO-01—which requires a registered professional geologist or engineer to conduct a geotechnical analysis and prepare a Geotechnical Report to be used to develop the final design of the project—will ensure that the impact to structures as a result of expansive soils will be less than significant.

Question 4.6e – Septic Tanks and Waste Disposal Systems – *No Impact*

The project will not involve the installation of a septic tank or alternative wastewater disposal system; therefore, no impact will occur.

4.6.4 Applicant-Proposed Measures

The following measure will be implemented to ensure that all project impacts to geology, soils, and seismicity remain less than significant:

- APM-GEO-01: A registered professional geologist or engineer will conduct a geotechnical analysis and prepare a Geotechnical Report that will be used to develop the final design of all project components to ensure that the potential for landslides, slope instability, seismic events, and all applicable codes and seismic standards are adequately addressed in the design and construction of the project. The final design will be reviewed and approved by a Professional Engineer registered in the State of California prior to construction.

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