# 2.6 Geology and Soils

| *Issues (and Supporting Information Sources):* | | *Potentially Significant Impact* | *Less Than Significant with Mitigation Incorporation* | *Less Than Significant Impact* | *No Impact* |
|---|---|---|---|---|---|
| **6.** | **GEOLOGY AND SOILS — Would the project:** | | | | |
| 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? Refer to Division of Mines and Geology Special Publication 42. | ☐ | ☐ | ☒ | ☐ |
| | 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 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 wastewater disposal systems where sewers are not available for the disposal of wastewater? | ☐ | ☐ | ☐ | ☒ |

## 2.6.1 Setting

### Geology

The Proposed Project is located within the natural geologic region known as the Coast Range geomorphic province, which is distinguished by a bedrock basement[1] consisting of chaotically mixed and crumpled ancient sea floor sediments, referred to as the Franciscan Assemblage. The Coast Range extends along the Pacific Coast, from Oregon to Southern California, and exhibits northwest-trending ridges and valleys, which were formed by tectonic forces. The project area transects the Petaluma and Sonoma Valleys, which are separated by the northwest-trending ridges of the Sonoma Mountains. Bedrock directly underlying the project area is younger than the Franciscan Assemblage and includes sediments of the Petaluma Formation along the flanks of the Sonoma Mountains and volcanic rocks, referred to as the Sonoma Volcanics, which form the

1 Basement rocks are those much older parent rocks that underlie the younger sedimentary rocks of interest.

ridges and upper regions. The Petaluma Formation consists of poorly-consolidated clay, shale, silt, sand, and gravel, and some interbedded volcanic rocks (Fox et al, 1973). The Franciscan Assemblage is exposed at the surface just south of the Lakeville Substation.

The youngest geologic units underlying the project area are surficial deposits made up of unconsolidated sediments eroded from the surrounding bedrock units. These units are locally mapped as Older Alluvium and Younger Alluvium (Wagner and Bortugno, 1982). The Older Alluvium consists of alluvial deposits and underlies the Sonoma Substation site as well as portions of Segments 1, 2, and 17 of the transmission line. The Younger Alluvium consists of unconsolidated stream, channel, levee, flood plain, basin, terrace, and fan deposits ranging in size from boulder to clay. Younger Alluvium underlies the Lakeville Substation site, as well as Segments 2 and 17 of the transmission line.

## Topography

The project area originates at the Lakeville Substation at the eastern edge of Petaluma Valley and traverses the Sonoma Mountains until descending into the Sonoma Valley, where it terminates at the Sonoma Substation. Relief is fairly gentle at each end of the transmission line, while sections of the Sonoma Mountains include relatively steep to moderately steep grades. The Lakeville Substation is approximately 106 feet mean sea level (msl). The elevations on the route increase to approximately 180 feet msl at the western edge of the Sonoma Mountains and reach a maximum elevation of 712 feet msl. The route then descends the eastern flank of the mountains to 165 feet in the vicinity of Felder Creek, terminating at the Sonoma Substation at an elevation of approximately 54 feet.

## Soils

Soils within the project area form over the exposed alluvial deposits and bedrock and have been mapped as “soil associations”, which are a broad grouping of soils with common characteristics such as similar management uses or requirements like slope steepness. Five soil associations occupy the terrain crossed by the project and are described below.

### *Clear Lake-Reyes Association*

The Clear Lake-Reyes Association, located on basins and on tidal flats, is comprised of nearly-level to gently-sloping soils that are poorly drained clays to clay loams. The Lakeville Substation and the western portion of Segment 1 of the transmission line are underlain by these soils.

### *Haire-Diablo Association*

The Haire-Diablo Association, located on terraces and upland, is comprised of gently-sloping to steep soils that are well-drained to moderately well-drained sandy loams to clays. Portions of Segment 1 of the transmission line cross this association. Additionally half of the Lakeville Substation site is located on this soil association.

### Huichica-Wright-Zamora Association

The Huichica-Wright-Zamora Association, located on low bench terraces and alluvial fans, is comprised of nearly-level to moderately-sloping soils that are well-drained to excessively-drained loams to silty clay loams. The Sonoma Substation site is underlain by these soils and portions of Segments 1, 2, and 17 of the transmission line cross these soils.

### Yolo-Cortina-Pleasanton Association

The Yolo-Cortina-Pleasanton Association, located on flood plains, alluvial fans, and low terraces, is comprised of nearly-level to moderately-sloping soils that are well-drained to excessively-drained very gravelly sandy loams to clay loams. These soils are located in the central portion of Segment 17 of the transmission line.

### Goulding-Toomes-Guenoc Association

The Goulding-Toomes-Guenoc Association, located on uplands of the Sonoma Mountains, is comprised of well-drained, gently-sloping to very steep clay loams to loams. The east-central portion of Segment 1 of the transmission line is underlain by these soils.

## Seismicity

The seismic environment in Northern California and the San Francisco Bay Area is characterized by the San Andreas fault system, which formed due to major forces occurring at the boundary of shifting tectonic plates. This fault system, and its northwest-trending folds and faults, control much of the geologic structure within the northern Coast Ranges. The major faults in the region include the San Andreas, Hayward, Rodgers Creek, Maacama, Calaveras, and Green Valley faults. The USGS Working Group on California Earthquake Probabilities estimated there is a 21 percent chance of the San Andreas fault experiencing an earthquake of M 6.7 or greater in the next 30 years (USGS, 2003).

The 80-mile Rodgers Creek fault, like the San Andreas fault, is a “strike-slip” fault and bisects the project site between Pole 41 and Pole 43. [2] The Rodgers Creek fault is considered by the State of California as “active” because it has experienced displacement during the last 10,000 years.[3] The most recent significant earthquake on the Rodgers Creek fault occurred on 1 October 1969. On this date, two earthquakes of magnitude 5.6 and 5.7 occurred in an 83-minute period and caused serious damage to buildings in Santa Rosa. The last major earthquake (estimated Richter magnitude 6.7) was generated in 1898 with an epicenter near Mare Island at the north margin of San Pablo Bay. The USGS estimates the probability of a large earthquake (magnitude 6.7 or greater) on the Rodgers Creek fault zone (when considered as an extension of the Hayward fault zone) during the period 2002 to 2032 to be 27 percent, the highest probability for all San Francisco Bay fault zones (USGS, 2003). The expected ground shaking generated by a seismic

2 Strike-Slip faults are those that displace laterally; movement of a strike slip fault is parallel with the direction of the fault trace.

3 Active faults pose a potential hazard either directly, due to sudden permanent ground deformations (fault rupture and related deformation), or indirectly, due to strong ground shaking. The existing Lakeville and Sonoma Substation sites are not within identified Alquist-Priolo Earthquake Hazards Zones (described below) that would require investigations to assess the potential for surface-fault rupture (Hart, 1997).

event on the Rodgers Creek fault is anticipated to cause significant damage and interruption of service for transportation (e.g., highways, railroads, and marine facilities) and lifeline (e.g., water supply, communications, and petroleum pipelines) facilities throughout Sonoma County. Other faults in the region of the project include the potentially active Tolay fault located west of the Lakeville substation, as well as others east and north of the project, which include Carneros, West Napa, and Bennett Valley faults (Fox et al, 1973).

## Geologic Hazards

### *Expansive Soils*

Expansive soils possess a “shrink-swell” behavior. Shrink-swell is the cyclic change in volume (expansion and contraction) that occurs in fine-grained clay sediments from the process of wetting and drying. Structural damage may occur over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. Expansive soils with high clay contents were identified in the project area (USDA, 1972).

### *Soil Erosion*

Erosion is the wearing away of soil and rock by processes such as wind and precipitation runoff. Soils containing high amounts of silt or clay can be easily erodible, while sandy soils are less susceptible. Excessive soil erosion can eventually lead to damage of building foundations and roadways. Typically, soil erosion potential is reduced once the soil is graded and covered with gravel, concrete, structures, or asphalt.

### *Settlement*

Settlement is the depression of the bearing soil when a load, such as that of a structure or new fill material, is placed upon it. If not properly engineered, loose, soft, soils comprised of sand, silt, and clay have the potential to settle after a building or other load is placed on the surface. Settlement of the ground surface can be accelerated and accentuated by earthquakes. During an earthquake, settlement can occur as a result of the relatively rapid compaction and settling of subsurface materials (particularly loose, uncompacted, and variable sandy sediments) due to the rearrangement of soil particles during prolonged ground shaking.

## Seismic Hazards

### *Surface Fault Rupture*

Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake’s seismic waves. The magnitude, sense, and nature of fault rupture can vary for different faults or even along different strands of the same fault. Ground rupture is considered more likely along active faults, including the Rodgers Creek Fault Zone which runs through the project area.

### *Ground Shaking*

Strong ground shaking from a major earthquake could affect Sonoma County during the next 30 years. Earthquakes on a nearby active fault are expected to produce a range of ground shaking intensities at the project site. Ground shaking may affect areas hundreds of miles distant from the earthquake's epicenter. Historic earthquakes have caused strong ground shaking and damage in the San Francisco Bay Area, the most recent being the M 6.9 Loma Prieta earthquake in October 1989. This earthquake caused strong ground shaking for about 20 seconds and resulted in varying degrees of structural damage throughout the Bay Area. The epicenter was approximately 50 miles southeast of the project site and therefore significant damage was not observed in Sonoma County.

Earthquake ground motion is commonly described using the motion parameters of acceleration and velocity in addition to the duration of the shaking. A common measure of ground motion is the peak ground acceleration (PGA). The PGA for a given component of motion is the largest value of horizontal acceleration obtained from a seismograph. PGA is expressed as the percentage of the acceleration due to gravity (g), which is approximately 980 centimeters per second squared.[4] For comparison purposes, the maximum peak acceleration recorded during the 1989 Loma Prieta earthquake on the San Francisco Peninsula was 0.64 g at the epicenter near Santa Cruz. The highest value measured in the East Bay was 0.29 g, recorded at the Oakland Wharf near the Naval Supply Center. However, an earthquake on the nearby Rodgers Creek Fault would likely produce far more severe ground shaking at the project site than was observed during the Loma Prieta earthquake. The modeled shaking scenario in Sonoma for the 1989 Loma Prieta earthquake was considered light; however the modeled shaking scenario for a future earthquake on the Rodgers Creek Fault could produce a M 7.0 event. An earthquake of this magnitude could cause very strong to very violent ground shaking at the project site (ABAG, 2003).

### *Liquefaction*

Liquefaction is a phenomenon whereby unconsolidated and/or near saturated soils lose cohesion and are converted to a fluid state as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in the temporary fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations. Liquefaction can occur in areas characterized by water-saturated, cohesionless, granular materials at depths less than 40 feet (ABAG, 2003). Hazard maps produced by the Association of Bay Area Governments (ABAG) depict liquefaction and lateral spreading hazards for the entire Bay Area in the event of a significant seismic event. According to these maps, the project site is in an area expected to have a very low to moderate potential to experience liquefaction (ABAG, 2005).

## 2.6.2 Regulatory Context

### *Alquist-Priolo Earthquake Fault Zoning Act*

The Alquist-Priolo Earthquake Fault Zoning Act (formerly the Alquist-Priolo Special Studies Zones Act), signed into law in December 1972, requires the delineation of zones along active faults in California. The purpose of the Alquist-Priolo Act is to regulate development on or near

4 In terms of automobile accelerations, one "g" of acceleration is a rate of increase in speed equivalent to a car traveling 328 feet from rest in 4.5 seconds.

fault traces to reduce the hazard of fault rupture and to prohibit the location of most structures for human occupancy across these traces. Cities and counties must regulate certain development projects within the zones, which includes withholding permits until geologic investigations demonstrate that development sites are not threatened by future surface displacement (Hart and Bryant, 1997). Surface fault rupture is not necessarily restricted to the area within a Fault Rupture Hazard Zone, as designated under the Alquist-Priolo Act.

### *California Building Code*

The California Building Code (CBC) is another name for the body of regulations found in the California Code of Regulations (CCR), Title 24, Part 2, which is a portion of the California Building Standards Code (CBSC, 2001). Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. The purpose of the CBC is to provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. Published by the International Conference of Building Officials, the Uniform Building Code is a widely adopted model building code in the United States. The CBC incorporates by reference the Uniform Building Code (UBC) with necessary California amendments. These amendments include significant building design criteria that have been tailored for California earthquake conditions (CBSC, 2001).

The project area is located within Zone 4, one of the four seismic zones designated in the United States. Zone 4 is expected to experience the greatest effects from earthquake ground shaking and therefore has the most stringent requirements for seismic design. The national model code standards adopted into Title 24 apply to all occupancies in California except for modifications adopted by state agencies and local governing bodies.

### *Sonoma County*

The Sonoma County General Plan contains the following goals, objectives, and policies that would applicable to the Proposed Project:

- Goal PS-1: Prevent unnecessary exposure of people and property to risks of damage or injury from earthquakes, landslides and other geologic hazards.
- Objective PS-1.1: Continue to utilize available data on geologic hazards and associated risks.
- Objective PS-1.2: Regulate new development to reduce the risks of damage and injury from known geologic hazards to acceptable levels.
- Policy PS-1a: Continue to utilize all available data on geologic hazards and related risks from the appropriate agencies.

- Policy PS-1b: Continue to utilize studies of geologic hazards prepared during the development review process.

- Policy PS-1e: Prepare a “geologic hazard area” combining district. Consider establishing limits on permissible uses and including standards for permitted development.

- Policy PS-1f: Require and review geologic reports prior to decisions on any project which would subject property or persons to significant risks from the geologic hazards shown on Figures PS-1a through PS-1i (pages 257 through 273 General Plan) and related file maps and source documents. Geologic reports shall describe the hazards and include mitigation measures to reduce risks to acceptable levels. Where appropriate, require an engineer’s or geologist’s certification that risks have been mitigated to an acceptable level and, if indicated, obtain indemnification or insurance form the engineer, geologist, or developer to minimize County exposure to liability.

- Policy PS-1i: Require dynamic analysis of structural response to earthquake forces prior to County approval of building permits for structures whose irregularity or other factors prevent reasonable load determination and distribution by static analysis. (Sonoma County PRMD, 1989)

### *City of Sonoma*

The City of Sonoma General Plan contains the following goals, objectives, and policies that would be applicable to the Proposed Project:

- Goal PSE-1: Minimize risks to life and property posed by seismic and other geologic hazards.

- Policy 2: The City shall continue to require, as conditions of project approval, the incorporation of measures which eliminate or reduce to acceptable levels identified risks associated with relevant geologic hazards.

- Policy 4: All proposed critical and high priority facilities (including hospitals, convalescent homes, schools and community buildings) must be constructed in accordance with the latest adopted seismic and building codes. (City of Sonoma, 1995)

## 2.6.3 Geology and Soils Impacts and Mitigation Measures

**a.i) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault: *less than significant impact.***

The Rodgers Creek fault bisects the Proposed Project between Pole 41 and Pole 43. The official map of the Alquist-Priolo Special Studies Zones for this area shows two fault traces of the Rodgers Creek Fault mapped at the project line crossing (CGS, 1983). As demonstrated during major historical earthquakes on the San Andreas Fault, surface fault rupture and significant ground distortion may occur within a zone extending several hundred feet on either side of the main fault trace.

PG&E engineers calculated that based on the maximum anticipated slip movement across the fault and the orientation of the fault across the transmission line, the approximate maximum fault displacement between Poles 41 and 43 could range from 3.6 to 6.5 feet across the 1,275 foot span (PG&E PEA, 2004). The fault displacement occurring between the poles could cause a reduction of slack and increased tension in the conductors. For suspension tubular steel poles (TSP), fault displacement would cause the insulator strings to be pulled at an angle to the TSP adjacent the fault crossing. For dead-end TSPs, the steel poles would deflect (bend) elastically.

PG&E considered the anticipated displacement in the design and placement of Poles 41, 42, and 43. The transmission line at this location is designed with a flexible capacity by ~~lengthening the insulator strings~~ installing load-limiters to allow for any increased tension on the line caused by fault rupture and displacement.

Observations from previous earthquakes, such as the 1994 Northridge earthquake, indicate that fault rupture causes limited damage to overhead transmission lines (Gamble, 2005). Although surface fault rupture is not necessarily limited to the Alquist-Priolo zone, the poles would be located sufficiently far enough away to avoid significant damage as well as being designed to accommodate a substantial fault displacement. Therefore, the potential impact of fault rupture to the Proposed Project would be less than significant.

**a.ii) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking: *less than significant impact.***

### *Transmission Line*

It is likely that the project area will experience a significant earthquake that will produce strong ground shaking. The greatest potential source for strong seismic ground shaking in the general project area is the active Rodgers Creek fault, which has historically produced moderately large earthquakes (USGS, 2003). The project area would experience moderate to very strong shaking intensity in the event of a magnitude 7 earthquake along the Rodgers Creek segment of the Hayward-Rodgers Creek Fault System (ABAG, 2003). Very strong ground shaking would be expected to occur east of the Lakeville Substation to the Sonoma Substation. This would include Segments 1, 2, and 17 of the transmission line. The Lakeville Substation site would likely experience comparatively less ground shaking intensity.

Strong ground shaking could cause wires to swing and contact each other causing short-circuiting. However, observations from past earthquakes have shown that overhead transmission lines can accommodate strong ground shaking (Gamble, 2005). In fact, the required separation distance to reduce wires touching in wind is sufficient to accommodate movement associated with ground shaking (Gamble, 2005). Although ground shaking could cause wires to swing, existing design criteria for wind loads are adequate to preclude wires contacting and thus, this impact is less than significant.

The Project also involves transitioning the new transmission line from overhead to an underground line along Leveroni Road. In general, underground transmission lines can accommodate significant ground shaking events and would not require any further mitigation measures beyond current design criteria.

### *Substations*

Seismic waves attenuate with distance from their source so estimated bedrock accelerations are highest for portions of the project near the fault zone and decrease with distance from the fault. Local soil conditions may amplify or dampen seismic waves as they travel from underlying bedrock to the ground surface. In addition to the Rodgers Creek and Tolay faults, other active or potentially active faults within the project area also present significant potential for strong ground shaking within the region. A major earthquake along the Rodgers Creek Fault could damage the Lakeville Substation causing facility closure and possibly service disruption for a period up to two days (CDMG, 1994).

Some types of substation equipment are susceptible to damage from earthquake shaking. PG&E has reviewed historical substation damage to determine the vulnerabilities of each specific type of equipment. The review included immediate visits to substations following past earthquakes. PG&E personnel inspected substation damage in Los Angeles and Japan shortly after the Northridge and Kobe earthquakes. Damage has been found to vary dramatically with voltage. Damage was noted as extensive at 500 kV substations, significant at 230 kV substations, and minor at substations of 115 kV and below. The types of equipment most susceptible to damage from strong seismic ground shaking are transformer radiators and bushings, circuit breakers, circuit switchers, and disconnect switches (PG&E PEA, 2004).

The Institute of Electrical and Electronics Engineers (IEEE) Standard 693-1997 *Recommended Practices for Seismic Design of Substations*, has specific requirements to mitigate possible substation equipment damage. These design guidelines would be implemented during construction of substation improvements. Substation equipment would be purchased using the seismic qualification requirements in IEEE 693. When these requirements are followed, PG&E expects very little structural damage from horizontal ground accelerations approaching 1.0 g. Maximum ground accelerations throughout the project area have been calculated between 0.5 g and 0.58g (Abrahamson, Silva, 1997; Idriss, 1997, *in* PG&E PEA, 2004). Substation improvements would be designed in accordance with the UBC and the seismic design criteria developed for the UBC Seismic Zone 4. Use of site-specific seismic data, standard seismic engineering design criteria, and accepted construction methods for the Bay Area region would ensure that impacts associated with strong ground shaking at the substations would remain less than significant.

### ~~*Mitigation Measure 2.1-1*~~

~~Mitigation Measure 2.1-1 involves transferring the transmission line from overhead to an underground line. In general, underground transmission lines can accommodate significant ground shaking events and would not require any further mitigation measures beyond current design criteria.~~

**a.iii) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction:** ***less than significant impact.***

If seismic-induced ground failure, such as liquefaction occurred in areas underlying the project site, it could distress, displace, and/or destroy project components. Similar to all transmission line projects PG&E completes, it conducted a geologic reconnaissance and study of the Proposed Project alignment to determine geologic conditions and potential geologic hazards. The project area has a low to moderate potential for liquefaction hazards (ABAG, 2005). The Lakeville Substation was listed as having a low potential and the Sonoma Substation a very low potential for liquefaction. Areas along the transmission line varied from very low to moderate. The moderate areas were generally along Leveroni Road.

Lateral spreading is related to liquefaction in areas of free slopes. Such free slope areas are confined to stream banks in the project area and are generally spanned by the existing and proposed transmission line. The potential for lateral spreading to affect project facilities is very low given the relatively low potential for liquefaction.

The steeper areas of the project area where the transmission line traverses the Sonoma Mountains are susceptible to seismic induced landslide, earth flow, and debris flow as a result of strong seismic ground shaking. Ground cracking is typically a problem only on narrow-crested, steep-sided ridges, similar to some of those traversed by Segment 1 along the crest of the Sonoma Mountains. However, because the transmission line poles are placed in deep foundations, the potential is low for slope failure to adversely impact the structural integrity of the pole.

Geologic and geotechnical reconnaissance completed by PG&E for the proposed project as well as the use of standard engineering design criteria would ensure that impacts associated with seismically-induced ground failure would remain less than significant.

**a.iv) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving landslides: *less than significant impact.***

Slope instability, including landslides, earth flows, and debris flows, have the potential to undermine foundations, cause distortion and distress to overlying structures, and displace or destroy project components. A design-level geotechnical survey would be performed to evaluate the potential for slope instability including landslides, earth flows, and debris flows along the proposed transmission line route and in the vicinity of the substations. The Proposed Project would allow for the transmission line to span large unstable areas. In cases of shallow sliding, slope creep, or raveling, specially-designed deep foundations may be used to anchor the overlying structure to underlying competent material. As appropriate, stabilization of unstable slopes would be performed by excavating and removing unstable material, regrading unstable slopes to improve surface drainage and limit infiltration, installing subsurface drainage systems, and/or constructing improvements to mechanically restrain slope movement. Facilities would be located away from very steep hillsides, debris flow source areas, the mouths of steep side-hill drainages, and the mouths of canyons that drain steep terrain. Incorporation of engineering recommendations completed during the design phase of this project, and the use of standard engineering design criteria and practices would ensure that impacts associated with slope instability would remain less than significant.

**b) Result in substantial soil erosion or the loss of topsoil: *less than significant impact.***

### *Proposed Project*

Surface soil erosion and loss of topsoil could occur from soil disturbance associated with pole installation, grading staging areas, undergrounding of the new transmission line along Leveroni Road from about Fifth Street West to the Sonoma Substation, and the construction and use of new access roads. The extent of the soil erosion and topsoil loss expected for the Proposed Project is minor because the specific construction activities would occur in localized areas (pole sites, staging areas, and short lengths of access roads) and amount to only a limited area of soil disturbance. Compared to a large development grading project, the Proposed Project involves work in many small, disconnected areas, which allows PG&E to manage erosion within a limited footprint and more effectively reduce soil loss. PG&E would adopt erosion control strategies outlined in the Erosion Control and Restoration Plan (ECRP) (PG&E PEA, 2004), which it prepared specifically to address areas disturbed during the Proposed Project. The goals of the ECRP are to: 1) control soil erosion and reduce sedimentation; 2) minimize adverse impacts from erosion and sedimentation to sensitive biological resources, including special-status plants and animals, streams and other high-value wetlands and native vegetation; 3) minimize impacts from erosion and sedimentation to non-native grasslands and pasturelands; 4) control locally established weed species to pre-project levels and prevent the establishment of new weed species; 5) promote the natural re-establishment of native vegetation and non-native grasslands; and 6) restore pasturelands to pre-project productivity. Considering the localized work areas, the limited soil disturbance, and adherence to the ECRP, impacts associated with erosion and topsoil loss would remain less than significant.

### ~~*Mitigation Measure 2.1-1*~~

~~As discussed above, the ERCP would include measures to reduce potential erosion from soil activities associated with the undergrounding of the transmission line beneath Leveroni Road from about Fifth Street West to the Sonoma Substation that would be required under Mitigation Measure 2.1-1. Implementation of the erosion control plan would ensure that impacts associated with soil erosion and topsoil loss would remain less than significant.~~

**c) Be located on 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: *less than significant impact.***

Destabilization of natural or constructed slopes could occur as a result of construction activities. Excavation, grading, and fill operations associated with providing access to proposed pole locations and other project facilities could alter existing slope profiles making them unstable as a result of over-excavation of slope material, steepening of the slope, or increased loading. However, as discussed above, PG&E would implement standard engineering design features and construction procedures to maintain stable slopes and excavations during construction, and therefore, impacts associated with stabilized slopes would be less than significant.

Temporary construction slopes and existing natural or constructed slopes impacted by construction operations would be evaluated for stability. In developing grading plans and construction procedures for access roads and transmission poles, PG&E would analyze the stability of both temporary and permanent cut, fill, and otherwise impacted slopes. Site-specific construction slopes and grading designs would limit the potential for slope instability, maintain adequate drainage of improved areas, and minimize the potential for erosion and flooding during construction. During construction, slopes affected by construction operations would be monitored and maintained in a stable condition. Construction activities likely to result in slope or excavation instability would be suspended during and immediately following periods of heavy precipitation when slopes are more susceptible to failure. As standard practice, temporary construction grading slopes would be evaluated by PG&E engineers during the construction phase of the project and therefore, impacts associated with failure of these slopes would remain less than significant.

For construction requiring excavations, such as concrete pier foundations, standard and appropriate support and protection measures would be implemented to maintain the stability of excavations and to protect surrounding structures and utilities. Where excavations are located adjacent to structures, utilities, or other features that may be adversely impacted by potential ground movements, bracing, underpinning, or other methods of temporary support for the affected facilities would be designed and implemented as part of the project. Excavation stability would be evaluated and addressed using standard and accepted engineering and construction practices with adherence with trench and excavation safety laws and therefore, impacts related to excavation stability would remain less than significant.

Saturated, loose sands and soft clays may pose difficulties in access for construction and in excavating pole foundations. Soft or loose soils could also cause instability of excavations during construction of foundations. However, geologic reconnaissance conducted by PG&E during the design stages of this project evaluated the potential for, and effects of, soft or loose soils where necessary. Where potential soil strength issues exist, appropriate measures would be implemented by PG&E engineers to avoid, accommodate, replace, or improve soft or loose soils encountered during construction. Such measures, typical of common construction practice, may include: locating construction facilities and operations away from areas of soft and loose soil; over-excavating soft or loose soils and replacing them with engineered backfill materials; increasing the density and strength of soft or loose soils through mechanical vibration and/or compaction; and treating soft or loose soils in-place with binding or cementing agents. PG&E would employ standard shoring construction methods for trenches and other excavations would be designed. Where necessary, construction activities would be scheduled for the dry season to allow safe and reliable truck and equipment access. As a result, potential construction impacts from soft or loose soils would be less than significant.

**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: *less than significant impact.***

Shrink-swell or expansive soil behavior is a condition in which soil reacts to changes in moisture content by expanding or contracting. Many of the natural soil types identified within the project area have high clay contents and most have moderate to high shrink-swell potential. Expansive soils may cause differential and cyclical foundation movements that can cause damage and/or distress to overlying 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. Appropriate design features to address expansive soils may include excavation of potentially problematic soils during construction and replacement with engineered backfill, ground-treatment processes, direction of surface water and drainage away from foundation soils, and the use of deep foundations such as piers or piles. Implementation of these standard engineering methods would ensure that impacts associated with expansive soils remain less than significant.

**e) Have 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: *less than significant impact.***

The Proposed Project does not include any components that would include the construction of any septic tank or other wastewater disposal system into project area soils. Therefore, there would be no potential impact to soils in the project area from wastewater disposal.

## References – Geology and Soils

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