2.6 Geology, Soils, and Seismicity

Issues (and Supporting Information Sources):	*Potentially Significant Impact*	*Less Than Significant with Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
6. GEOLOGY, SOILS, AND SEISMICITY— 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?	☐	☐	☐	☒

Setting

The Proposed Project site is located approximately five miles south of the California/Oregon border near the community of Smith River, in Del Norte County, California. The Proposed Project site is located on private property owned by the Green Diamond Corporation. The property consists of relatively flat-lying terrain, which is bounded by U.S. Highway 101 on the west, Rowdy Creek on the north and northeast, and a steep, heavily vegetated ascending slope on the east and south. The existing Simonson Substation is located near the northwest portion of the property. Also located on the property are the remnants of a former lumber mill, including concrete footings and asphalt and gravel roads. The proposed Morrison Creek Substation is to be located near the southern portion of the property, approximately 1,000 feet south of the existing Simonson Substation, which would be removed from the property.

The Proposed Project site is situated in the northern portion of the California Coast Ranges Geomorphic Province. Geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. Eleven provinces are distinguished in California with each

region displaying unique, defining features based on geology, faults, topographic relief, and climate.

The Coast Ranges Geomorphic Province encompasses an area that extends approximately 600 miles from the California/Oregon border on the north, to the Transverse Ranges on the south. The northern portion of the province is bounded by the Klamath Mountain Province (South Fork Mountain thrust zone) on the east and the Pacific Ocean on the west. The province is narrowest at five miles wide near Crescent City. In general, the northern portion of the province consists of rugged mountains underlain by an assemblage of rocks known as the Franciscan Complex or Assemblage on the east, and scattered younger deposits near the coast (Norris and Webb, 1990).

Review of referenced geologic maps and data indicate the subject site is underlain by alluvium and terrace deposits (Irwin, 1997), which are expected to be underlain at depth by materials of the Franciscan Assemblage consisting of greywacke, with interbeds of shale and limestone (Norris and Webb, 1990). Due to past site development and usage (lumber mill), artificial fill materials of unknown thicknesses may be present at the Proposed Project site. During a geologic site reconnaissance conducted by a Ninyo and Moore geologist on September 12, 2007, sandy gravel- and cobble-size clasts were noted in shallow excavations at the Proposed Project site. In addition, a few scattered boulders were also observed on the existing ground surface.

Topography

The Proposed Project site is situated on a relatively flat-lying coastal terrace terrain approximately three miles east of the Pacific Ocean. Elevations at the Proposed Project site range from approximately 65- to 75-feet above Mean Sea Level (MSL). To the immediate east, a heavily vegetated ridge ascends away from the site to elevations of approximately 1,100 feet above MSL. Further to the north-northeast, the peaks of the Siskiyou and Klamath Mountains are over 9,000 feet in elevation. Drainage at the site is generally to the north, to Rowdy Creek, which then empties into the Smith River west of the Proposed Project site.

Seismicity

Based on review of referenced geologic maps and information, there are no known active faults in areas underlying, or adjacent to, the Proposed Project site. The closest known active fault is the Trinidad fault zone located approximately 60 miles south of the Proposed Project site. The closest potentially active fault to the Proposed Project site is the Big Lagoon-Bald Mountain fault zone which is projected to lie offshore approximately 20 miles southwest of the Proposed Project site. The Big Lagoon-Bald Mountain fault zone is capable of generating an earthquake magnitude of 7.5 (USGS and CGS, 2003). Review of the Geologic Map of the Smith River 7.5 foot Quadrangle (CGS, 1999a), indicated that the Del Norte fault (inferred) and the Rowdy Creek fault (inferred) are the closest mapped faults to the subject site. The Del Norte fault generally strikes north-south and is mapped on the west side of U.S. Highway 101, roughly 500 hundred feet west of the Proposed Project site. The Rowdy Creek fault, generally strikes east-west, and is mapped approximately 1,500 feet north of the Proposed Project site near the Rowdy Creek drainage. The Del Norte fault and the Rowdy Creek faults are not considered active.

Based on the geologic site reconnaissance and review of referenced geologic maps, the Proposed Project site is underlain by alluvial soils. According to the Probabilistic Seismic Hazard Assessment for California, issued by the U.S. Geological Survey/California Geological Survey (2003), the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years (or an annual probability of 1 in 475 in each year) for the subject site is 0.32g (i.e., 32 percent of the acceleration of gravity).

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.

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 and when drainage improvements have been installed to drain water away from structures.

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. Given the geologic setting of the area and the nature of the Proposed Project, the Proposed Project is not likely to be affected by settlement.

Landslides

A landslide is the sliding of a mass of loosened rock and/or soil down a hillside or slope. Based on the review of background information and the geologic field reconnaissance, some landslides have been mapped on the steep mountain slopes north-northeast of the subject site. However, there are no landslides mapped on or in the immediate vicinity of the Proposed Project site (CGS, 1999b).

Volcanic Eruptions

Volcanic eruptions have occurred throughout California geologic history, particularly in the last 1.6 million years. Volcanic eruptions are associated with earthquakes and eruptions are usually preceded by earthquake swarms. The most recent eruption in California was the violent eruption at Lassen Peak in 1917. Future volcanic eruptions within California are likely; however, location and timing of future eruptions are uncertain. It is generally considered that future eruptions would likely take place in large central vent volcanoes such as Mount Shasta and Lassen Peak where more recent activity has been recorded.

Seismic Hazards

Surface Fault Rupture

Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to movement on a fault plane. 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. As discussed, the Del Norte and Rowdy Creek faults, mapped near the Proposed Project site, are not considered active. Because there are no known active faults underlying, or adjacent to the Proposed Project site, the likelihood of surface fault rupture is low and would not be a design consideration.

Ground Shaking

Ground shaking in the Proposed Project study area could occur due to earthquakes on the regions active faults. However, ground motion attenuates with distance from the causative fault. There are no active or potentially active earthquake faults identified within Del Norte County (Del Norte County, 2003), though some (Bald Mountain – Big Lagoon) are located offshore. Accordingly, potential ground shaking at the Proposed Project site can be expected to have low to moderate intensities.

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 50 feet below the ground surface.

Tsunami

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. Based on the elevation and the relative inland location of the Proposed Project site, the potential for damage due to tsunami is not a design consideration.

Regulatory Context

State

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 main purpose of the Alquist-Priolo Act is to prevent the construction of buildings to be used for human occupancy on the surface trace of active faults. The Act only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards such as ground shaking and liquefaction. 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 ground surface displacement (Hart and Bryant, 1997). Although, surface fault rupture is not necessarily restricted to the area within a Fault Rupture Hazard Zone, as designated under the Alquist-Priolo Act, it is considered unlikely outside of these zones.

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. 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.

The Proposed Project site is located within Zone 3, 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. Zone 3 still has a relatively high level of potential seismic activity, particularly when compared to much of the rest of the country, but is somewhat less than Zone 4. 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.

Local

Del Norte County General Plan

The Del Norte County General Plan Land Use Element contains the following policy that could be applicable to the Proposed Project:

> *Policy 2.A.3:* To the extent practicable, the County shall discourage the location of "critical facilities or uses" from being located in areas subject to natural hazards as identified in this Element, For purposes of the General Plan, "critical facilities or uses" are defined as facilities or uses that would be used to respond to the needs of the County in the event of natural or manmade hazardous event (i.e., hospitals, fire stations, utility installations, communication centers) or uses with high occupancies, such as schools.

The objective of the Seismic Hazards Element which applies to the Proposed Project is "to minimize loss of life, injury, and property damage due to seismic hazards." Applicable policies are listed below:

> *Policy 2.B.2.* The County shall utilize the most current seismic design criteria in the construction of new public buildings. Buildings meant to accommodate activities and equipment related to public safety, especially police, fire, and communications services, should be constructed to standards that, as much as technically possible, would ensure continued operational and availability of services after the maximum credible earthquake.

> *Policy 2.B.7.* Since no active or potentially active earthquakes faults have been identified within Del Norte County, the provisions for the Alquist-Priolo Special Studies Zone are not applicable.

Additionally, the objective of the Geologic Hazards Element which applies to the Proposed Project is "to minimize loss of life, injury, and property damage due to geologic hazards."

> *Policy 2.C.4.* The County shall require that a geologic investigation be made by a registered geologist, engineering geologist, or Registered Civil Engineer for all proposals in landslide potential areas, coastal or river bluffs, and development on slopes greater than 10 percent including road construction. These investigations should assess the stability of the site under both normal and seismic conditions as well as recommended mitigation measures. If it is found that the hazards cannot be mitigated within acceptable risk levels appropriate with the intended land uses, the proposal should be denied.

> *Policy 2.C.5.* The County shall require that any construction contemplated on filled areas be preceded by an analysis of the fill and its capabilities or limitations.

Geology, Soils, and Seismicity 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.*

There are no known active faults underlying, or adjacent to, the Proposed Project site. The closest active fault to the Proposed Project site is more than 60 miles away. Moreover, no Alquist-Priolo Earthquake Fault Zones have been mapped in the vicinity; therefore, the potential impact of fault rupture to impact 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.*

Ground shaking on the Proposed Project site could occur due to earthquakes on the regions faults. However, the closest active fault to the Proposed Project site is more than 60 miles away. Ground shaking due to seismic events is expected to have low to moderate intensities. According to the Probabilistic Assessment of California, the Proposed Project site has a 10 percent probability of exceeding a peak ground acceleration value of 0.32g in 50 years (or a 1 in 475 chance annually). Given the relatively low calculated peak ground acceleration and the use of current building code standards, the potential for seismic ground shaking to impact the Proposed Project would be less than significant.

Proposed Morrison Creek Substation

Substation improvements would be designed in accordance with the most current CBC and the seismic design criteria developed for Seismic Zone 3. Use of standard seismic engineering design criteria, and accepted construction methods would ensure that impacts associated with strong ground shaking at the proposed Morrison Creek Substation would be less than significant.

Proposed Transmission Tap Line

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. In fact, the required separation distance to reduce wires touching in strong winds is also considered sufficient to accommodate movement associated with ground shaking. Therefore, existing design criteria for wind loads are adequate to protect wire contact during ground shaking and thus, this impact is less than significant.

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.*

Based on background information and the geologic field reconnaissance the Proposed Project would not be expected to be adversely impacted by seismic-related ground failure, such as liquefaction. Liquefaction hazards are evaluated as a standard practice in design-level geotechnical investigations, and typically mitigated through standard geotechnical measures such as soil treatment or engineered fill replacement. Incorporation of recommended measures, if necessary, into Proposed Project design specifications would ensure that the potential impact due to seismic-related ground failure is 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.*

Background data and the geologic field reconnaissance did not indicate the presence of landslides underlying, or adjacent to, the Proposed Project site. Some landslides have been mapped east of the Proposed Project site; however, these are located sufficiently far enough away from the Proposed Project site to have a potential impact. In addition, standard engineering construction practices, incorporation of recommendations made in design-level geotechnical investigations, and avoidance of potentially sensitive slopes, if present, would avoid or reduce potential impacts of landslides. Accordingly, the potential impact to the Proposed Project due to landslides and shallow soil failures would be less than significant.

b) Soil erosion or the loss of topsoil: *Less than significant.*

Surface soil erosion and loss of topsoil could occur from soil disturbances associated with grading, preparation work and staging areas, pole installation, and the construction and use of access roads. In cases such as this (i.e., constructed-related impacts), increased runoff or entrainment of sediment in runoff is just as much a concern as soil erosion. It is *both* processes (surface runoff and disturbed soils) that must be managed, and the principle concern for the Proposed Project for this issue relates more to water quality impacts than to the effect of losing topsoil as discussed in Section 2.8, *Hydrology and Water Quality*. In general, the Best Management Practices (BMPs) that would be incorporated to protect water quality would adequately prevent soil erosion and loss of topsoil; therefore, the potential impact is less than significant.

c) 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.*

Destabilization of natural or constructed slopes could occur as a result of construction activities. Excavation, grading, and fill operations associated with construction of the Morrison Creek Substation, 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, the project area has relatively gentle slopes. In addition, standard engineering design features and construction procedures would be implemented to maintain stable slopes and excavations during construction, and therefore, impacts associated with destabilized slopes would be less than significant.

d) Located on expansive soil, creating substantial risks to life or property: *Less than significant.*

Shrink-swell or expansive soil behavior is a condition in which soil reacts to changes in moisture content by expanding or contracting. Expansive soils can cause structural damage particularly when concrete structures are in direct contact with the soils.

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 any of these standard engineering methods would ensure that impacts associated with expansive soils would remain less than significant.

e) 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: ***No impact.***

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

References – Geology, Soils and Seismicity

California Geological Survey (CGS), 1999a, *Geologic Map, Smith River 7.5' Quadrangle, Open-File Report 83-19*, Scale 1:24,000, Dated January 27.

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