# 4.9 Geology and Soils

This section describes geologic, seismic, and soil conditions in the proposed Project area and analyzes environmental impacts related to these issues that could result from the Strauss Wind Energy Project (SWEP). As part of this analysis, this section analyzes whether the SWEP would result in any new significant impacts to geology and soils that were not previously identified and disclosed in the 2008 Lompoc Wind Energy Project (LWEP) EIR, or whether there would be a substantial increase in the severity of any previously identified impacts to geology and soils. The following discussion addresses existing environmental conditions of the proposed Project, identifies and analyzes environmental impacts, and recommends measures to reduce or avoid adverse impacts. In addition, laws and regulations relevant to geological and seismic hazards are described. In some cases, compliance with these existing laws and regulations would serve to reduce or avoid certain impacts that might otherwise occur with the implementation of the Project.

Baseline geologic, seismic, and soils information were collected from published and unpublished literature, GIS data, and online sources for the Project and the surrounding area. Data sources included: (1) the Final EIR for the LWEP and reports and studies related to the previous LWEP and the current SWEP; (2) geologic literature, maps, and GIS data from the U.S. Geological Survey and California Geological Survey; (3) soils data from the U.S. Department of Agriculture; and (4) other online reference materials. The study area was defined as the locations of Project components and the areas immediately adjacent to the Project components for most geologic and soils issue areas, with the following exception: the study area related to seismically induced ground shaking includes significant regional active and potentially active faults within 50 miles of the Project.

## 4.9.1 Environmental Setting

### 4.9.1.1 Regional Geology and Physiography

As discussed in Section 3.9.1.1, *Regional Geology and Physiography*, of the LWEP EIR, the proposed Project is located in the western Santa Ynez Mountains, near the western end of the Transverse Ranges geomorphic province. Please refer to Section 3.9.1.1, *Regional Geology and Physiography*, for a full description of the Regional Geology and Physiography for the Projec*t.*

### 4.9.1.2 Project Geology

As discussed, proposed Project components and associated areas of ground disturbance are located in hillside and valley terrain underlain by Quaternary landslide deposits, alluvial plain deposits, and older alluvial deposits, and Tertiary Sisquoc Shale, Monterey Shale, Tranquillon Volcanic Formation, Rincon Shale, Vaqueros Sandstone, Gaviota-Sacate Formation undivided, and Cozy Dell Shale, (Dibblee, 1988a, b, and c). Localized thin pockets of artificial fill may be present near roads and previously graded areas. Geologic units underlying the proposed Project are presented in Figure 4.9-1. The geologic units underlying the proposed Project components are discussed in Section 3.9.1.3, *Project Area Geology and Geomorphology,* of the LWEP EIR.

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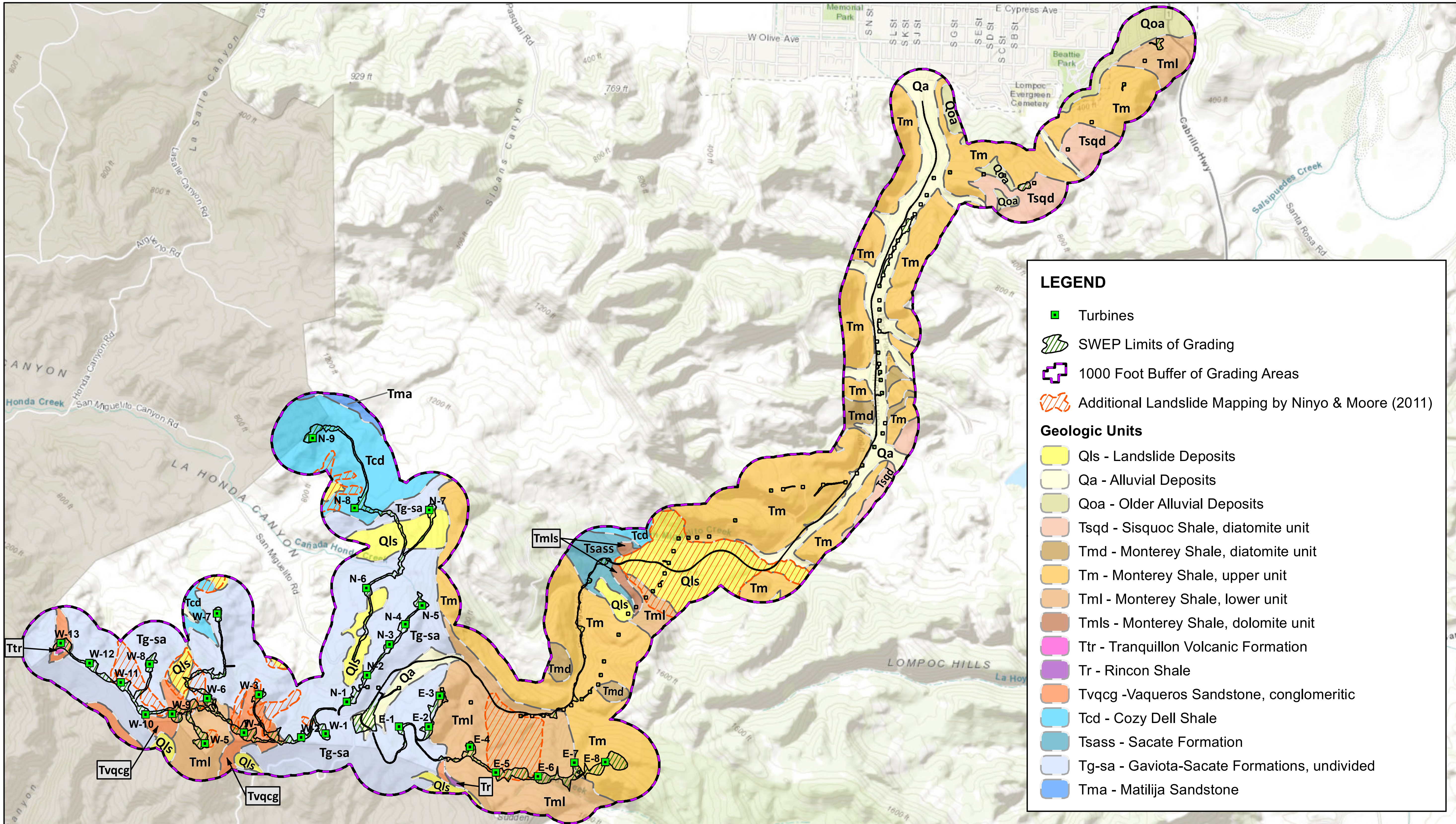


Geology Source: Modified from Dibblee 1988a, 1988b, and 1988c

**Figure 4.9-1**

**Local Geology**

Figure page 2

### 4.9.1.3 Slope Stability

The proposed Project is located in the western Santa Ynez Mountains in the White and Lompoc Hills and near the southern edge of the Lompoc Valley. The White Hills are characterized by gentle to moderate slopes and range in elevation from approximately 200 to 1000 feet. The Lompoc Hills rise about 1800 feet in the Project area above the Lompoc Valley and are characterized by moderately to steeply inclined slopes cut by numerous small valleys and drainages. Larger drainages cutting through the Lompoc Hills include La Honda Canyon, San Miguelito Creek, and La Hoya Creek. Hillslope terrain underlying and near to Project components is moderate to steep, with many areas having slopes approaching or exceeding a 20 percent grade (Wilson, 2016).

The term landslide includes a wide range of ground movements, such as rock falls, deep failure of slopes, and shallow debris flows (see Section 3.9.1.5, *Project Area Geologic Hazards*, of the LWEP EIR). Many landslides are mapped by Dibblee (Dibblee 1989 a, b, and c) in the general Project area, with several being located within the Project site. Ninyo & Moore (2011) conducted landslide mapping and slope failure analyses of the Project site as part of their LWEP 2011 geotechnical evaluation and identified several additional landslides in the Project area as well as modifying the boundaries of some of the Dibblee mapped landslides (as shown in Figure 4.9-1). The 2011 Ninyo & Moore landslide analyses identified landslides and potential slope failures areas at and near LWEP components and grading areas where additional design mitigation was recommended which included potential relocation of Project components and roads. Landslides in the Project area are mapped in Monterey Formation, Vaqueros Sandstone, Gaviota-Sacate Formation, and Cozy Dell Shale in areas of moderate to steep sloping terrain with generally unfavorable geologic structure (Ninyo & Moore, 2011; Wilson, 2016).

The existing slopes in many areas of the SWEP site will be modified by significant grading; approximately 204 acres of temporary and permanent ground disturbance is planned with 968,633 cubic yards (cy) of cut, and 959,409 cy of fill. The planned grading and ground disturbance areas include turbine pads, access roads, internal collection, substation, staging area, O&M facility, transmission line, switchyard, and access roads to the pole locations of the transmission line. All grading would be subject to a final, approved grading plan to ensure adequate slope stabilization.

### 4.9.1.4 Soils

Soils within the Project area reflect the underlying rock type, the extent of weathering of the rock, the degree of slope, and the degree of human modification. The National Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) databases for Santa Barbara County, California, South Coastal Part (CA673) and Northern Santa Barbara Area, California (CA672) were reviewed to identify soil units and characteristics underlying the Project site (NRCS, 2017 and 2018). Thirty-eight soil units, representing 13 main soil associations and five miscellaneous areas are mapped as underlying the Project components. The 13 soil associations are the Botella, Crow Hill, Diablo, Gaviota, Gazos, Linne, Lopez, Los Osos, Maymen, Nacimiento, San Andreas, Santa Lucia, and Tierra. The five miscellaneous areas are landslide, gullied land, rock outcrop, pits and dumps, and sedimentary rock land; miscellaneous areas have been identified by the NRCS having little or no natural soil or soil development and are not discussed further in this section. Summaries of the significant characteristics of the major soil associations underlying the Project area and transmission line are presented in Table 4.9-1 below.

## Table 4.9-1. SWEP Soil Characteristics

| Soil Association | Project Components | Description | Susceptibility to Erosion | | Expansion Potential[3] |
|---|---|---|---|---|---|
| | | | Wind[1] | Sheet and Rill[2] | |
| Botella | O&M building, laydown yard, transmission line, water line, access roads | Clay loam[4], silty clay loam, and shaly clay loam; parent material is alluvium derived from sedimentary rocks | Low to Moderate | Moderate | Moderate |
| Crow Hill | access road | Silty clay loam; parent material is weathered from soft diatomaceous shale | Low to Moderate | Moderate | Low to Moderate |
| Diablo | turbines, transmission line, access roads and pads | Clay; parent material weathered from calcareous shale | Moderate | Moderate | Moderate to High |
| Gaviota | turbines, substation, transmission line, waterline, meteorological tower, access roads and pads | Sandy loam; parent material is weathered from sandstone | Moderate | Moderate to High | Low |
| Gazos | transmission line, access road | Clay loam; parent material is weathered from shale | Moderate | Low to Moderate | Low to Moderate |
| Linne | transmission line, switching station, access road | Clay loam; parent material weathered from mudstone | Moderate | Moderate | Low to Moderate |
| Lopez | turbines, water line, transmission line, access roads and pads | Shaly clay loam, channery[5] clay loam | Low | Low | Low |
| Los Osos | turbines, access roads and pads | Clay loam; parent material is weathered from sandstone and shale | Low to Moderate | Moderate | Moderate to High |
| Maymen | meteorological tower, access roads and pads | Stony fine sandy loam, loam; parent material weathered from shale, conglomerate, and/or sandstone | Moderate | Low to Moderate | Low |
| Nacimiento | turbine, access road and pad | Silty clay loam; parent material weathered from mudstone | Low to Moderate | Moderate | Moderate |
| San Andreas | turbines, laydown yard, O&M building, transmission line, water line, access roads and pads | Fine sandy loam; parent material weathered from soft sandstone | Moderate to High | Moderate | Low to Moderate |
| Santa Lucia | turbines, transmission line, meteorological tower, access roads and pads | Shaly clay loam, channery clay loam; parent material weathered from Monterey shale | Low | Low | Low to Moderate |
| Tierra | turbines, laydown yard, O&M building, transmission line, switching station, water line, access roads and pads | Loam, clay loam, sandy loam; parent material weathered from alluvium derived from sedimentary rock | Low to Moderate | Moderate | Low to High |

Source: NRCS, 2017 and 2018.

1. Based on soil wind erodibility groups; groups are based on the susceptibility of a soil to wind erosion.
2. Based on Erosion factor K (used by the NRCS in the Universal Soil Lose Equation), which indicates the susceptibility of a soil to sheet and rill erosion.
3. Based on the linear extensibility of soils. Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state.
4. Loam – A soil material that has appoximately equal percentages of clay, silt , and sand particles.
5. Channery – Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist.

The properties of soil that influence erosion by rainfall and runoff are ones that affect the infiltration capacity of a soil, and those that affect the resistance of a soil to detachment and being carried away by falling or flowing water. Sheet erosion occurs when water runs over a large uniform area picking up and distributing soil particles. Rill erosion occurs as concentrated surface runoff begins to remove soil along concentrated zones which numerous small, but conspicuous, water channels or tiny rivulets. Susceptibility to sheet and rill erosion from water for soils underlying Project components primarily ranges from low to moderate; however, some Project components are underlain by Gaviota association soils with sheet and rill erosion susceptibility that is moderate to high (NRCS, 2017 and 2018). Soils containing high percentages of fine sands and silt and that are low in density, are generally the most susceptible to wind erosion. As the clay and organic matter content of these soils increases, the potential for erosion decreases. Susceptibility of soils to wind erosion generally ranges from low to moderate within the Project area, although local soils within the San Andreas association may have moderate to high susceptibility to wind erosion (NRCS, 2017 and 2018). Significant ground disturbance of approximately 204 acres would occur at proposed locations of turbine pads, access roads (including along San Miquelito Road), internal collection lines, substation, staging area, O&M facility, transmission line, switchyard, and access roads to the pole locations of the transmission line as part of the Project. This ground disturbance would loosen soils making them more susceptible to erosion.

Expansive soils are characterized by their ability to undergo significant volume change (shrink and swell) due to variation in soil moisture content. Changes in soil moisture could result from a number of factors, including rainfall, landscape irrigation, utility leakage, and/or perched groundwater. Expansive soils are typically very fine grained with a high to very high percentage of clay. Soils with moderate to high shrink-swell potential would be classified as expansive soils. The expansive potential of the soils underlying the SWEP area generally ranges from low to moderate, although clayey soils with moderate to high expansion occur locally within the Diablo, Los Osos, and Tierra associations (NRCS, 2017 and 2018).

Compressible soils are fine-grained and cohesive with normally low strength that will readily consolidate and cause settlement when surcharged with fill or structure loads particularly when saturated. The 2011 Ninyo & Moore LWEP geotechnical evaluation noted that soil, colluvium, alluvium, and landslide deposits overlying the sedimentary bedrock within the Project site are generally very loose to medium dense and are considered to be potentially compressible. Collapsible soils are low density, fine-grained, predominantly granular usually containing fine sand and silt that may collapse or rapidly settle due to rearrangement of the soil particles when they become saturated under relatively low loads. The Project area consists of shallow bedrock with small valleys containing potentially collapsible unconsolidated alluvial deposits such as silt, sand, and gravel (CSB, 2008). Compressible and collapsible soil types are quite sensitive to either a rise in the groundwater table or increased surface water infiltration.

## 4.9.1.5 Subsidence

As noted in the LWEP EIR, Section 3.9.1.5, *Project Area Geologic Hazards*, subsection Subsidence, the Project area is not in an area with any reported evidence of subsidence, nor is it within or near an area undergoing localized withdrawal of groundwater, oil, or natural gas (CSB, 2008). Therefore, the potential for subsidence is considered low to negligible.

## 4.9.1.6 Seismicity and Faulting

Santa Barbara County is located in a geologically complex and seismically active region which includes both the east-west Transverse Ranges and the north-south trending Coast Ranges. The seismicity of the Project area is dominated by the intersection of the north-northwest trending San Andreas and Coast Ranges faults, and the east-west trending Transverse Ranges fault system. Both systems are responding to strain produced by the relative motions of the Pacific and North American Tectonic Plates. This strain is relieved by right-lateral strike-slip faulting on the San Andreas and related faults, and by vertical, reverse-slip or left-lateral strike-slip displacement on faults in the Transverse Ranges. The effects of this strain and deformation includes mountain building, basin development, deformation of Quaternary marine terraces, widespread regional uplift, and generation of earthquakes. Both the Transverse Ranges and Coast Ranges areas are characterized by numerous geologically young faults. These faults can be classified as historically active, active, potentially active, or inactive, based on the following criteria (CGS, 1999):

- Faults that have generated earthquakes accompanied by surface rupture during historic time (approximately the last 200 years) and faults that exhibit aseismic fault creep are defined as Historically Active.
- Faults that show geologic evidence of movement within Holocene time (approximately the last 11,000 years) are defined as Active.
- Faults that show geologic evidence of movement during the Quaternary time (approximately the last 1.6 million years) are defined as Potentially Active.
- Faults that show direct geologic evidence of inactivity during all of Quaternary time or longer are classified as Inactive.

Although it is difficult to quantify the probability that an earthquake will occur on a specific fault, this classification is based on the assumption that if a fault has moved during the Holocene epoch, it is likely to produce earthquakes in the future. Blind thrust faults which do not intersect the ground surface are not classified as active or potentially active in the same manner as faults that are present at the earth's surface. Activity classification of blind thrust faults is predominantly based on geologic data from deep oil wells, geophysical profiles, historic earthquakes, and microseismic activity along the fault.

Active regional faults capable of producing significant ground shaking at the Project site are strike-slip faults associated with the San Andreas Fault System, offshore Santa Barbara Channel faults, and reverse and blind thrust faults associated with the compressional folding and faulting of the Coast and Transverse Ranges. Periodic earthquakes accompanied by surface displacement can be expected to continue in the study area through the lifetime of the proposed Project. Active faults and potentially active faults that represent a significant seismic threat to the proposed Project are listed in Table 4.9-2. Data presented in this table include estimated earthquake magnitudes, and type of fault. Figure 4.9-2 shows locations of significant active and potentially active faults and historic earthquakes in the Project area and surrounding region.

**Table 4.9-2. Significant Active and Potentially Active Faults within 50 miles of SWEP**

| Fault Name | Closest Distance to Project (miles)[1] | Estimated Maximum Earthquake Magnitude[2] | Fault Type and Dip Direction[1] |
|---|---|---|---|
| Lions Head | 5.8 | 6.8 | Reverse, 75°NE |
| Casmalia | 9.9 | 6.7 | Reverse-Right Lateral Oblique, 75°SW |
| Los Alamos – West Baseline | 10.8 | 6.9 | Thrust, 30°S |
| Santa Ynez – (West or Connected) | 11.1 | 7.0-7.4[3] | Reverse Left Lateral Oblique, 70°S |
| Red Mountain | 15.9 | 7.4 | Reverse, 56°N |
| San Luis Range (South Margin) | 18.4 | 7.2 | Thrust, 45°N |
| Hosgri | 22.0 | 7.3 | Right Lateral Strike Slip, 80°E |
| Pitas Point (Lower, West) | 32.1 | 7.3 | Thrust, 13°N |
| Pitas Point (Upper or Connected) | 32.9 | 6.9-7.3 | Thrust, 42°N |
| North Channel | 33.1 | 6.8 | Thrust, 26°N |
| Los Osos | 33.6 | 7.0 | Thrust, 45°SW |
| Mission Ridge-Arroyo Parida-Santa Ana | 33.7 | 6.9 | Reverse, 70°S |
| Santa Rosa Island | 38.0 | 6.9 | Right Lateral Strike Slip, 90° |
| Santa Cruz Island | 44.5 | 7.2 | Right Lateral Strike Slip, 90° |
| Santa Ynez (East) | 46.5 | 7.2 | Reverse Left Lateral Oblique, 70°S |
| Rinconada | 46.9 | 7.5 | Right Lateral Strike Slip, 90° |
| Pitas Point (Lower)-Montalvo | 48.4 | 7.3 | Thrust, 16°N |
| San Andreas | 55[4] | 7.2-8.0 | Right Lateral Strike Slip, 90° |

Notes:

1. Fault distances and parameters obtained from USGS Earthquake Hazards Program, 2008 National Seismic Hazard Maps - Source Parameters website (USGS, 2018) and CGS Quaternary Fault and Fold Database of the United States, (USGS & CGS, 2006).
2. Maximum Earthquake Magnitude – the maximum earthquake that appears capable of occurring under the presently known tectonic framework, magnitude listed is "Ellsworth-B" magnitude from the USGS Earthquake Hazards Program, 2008 National Seismic Hazard Maps - Source Parameters website (USGS, 2018), unless otherwise noted.
3. Range of magnitudes represents varying rupture scenarios of one or more segments along a fault.
4. San Andreas Fault is included in the table even though it is greater than 50 miles from the site due to its potential for very large significant earthquakes generating strong ground shaking.

No active faults or Alquist-Priolo zoned faults cross or are in the immediate vicinity of the proposed Project. The nearest significant active fault to the SWEP area is the San Andreas fault zone, located approximately 55 miles east-northeast of the Project area. Other active faults located in within the Project region are portions of the Red Mountain fault zone, Pitas Point fault zone, Mission Ridge-Arroyo Parida-Santa Ana fault zone, Hosgri fault zone, and Santa Cruz Island fault.

The closest mapped fault to the SWEP is the Santa Ynez River fault zone, which trends in an east-west direction across the base of the Lompoc Hills. It has two named strands in the Project vicinity, the Santa Ynez River fault and the Honda fault, which are located approximately 0.2 and 0.5 mile north of the SWEP transmission line, respectively (USGS & CGS, 2006). The Santa Ynez River fault zone is a buried late Quaternary fault zone that is not well mapped or defined, is not considered a significant seismic hazard by the USGS and is not included in their seismic hazard analyses (USGS, 2018). The Santa Barbara Seismic Safety and Safety Element (SSSE) does not map this fault zone on their hazard maps and is not discussed in the SSSE (CSB, 2015).

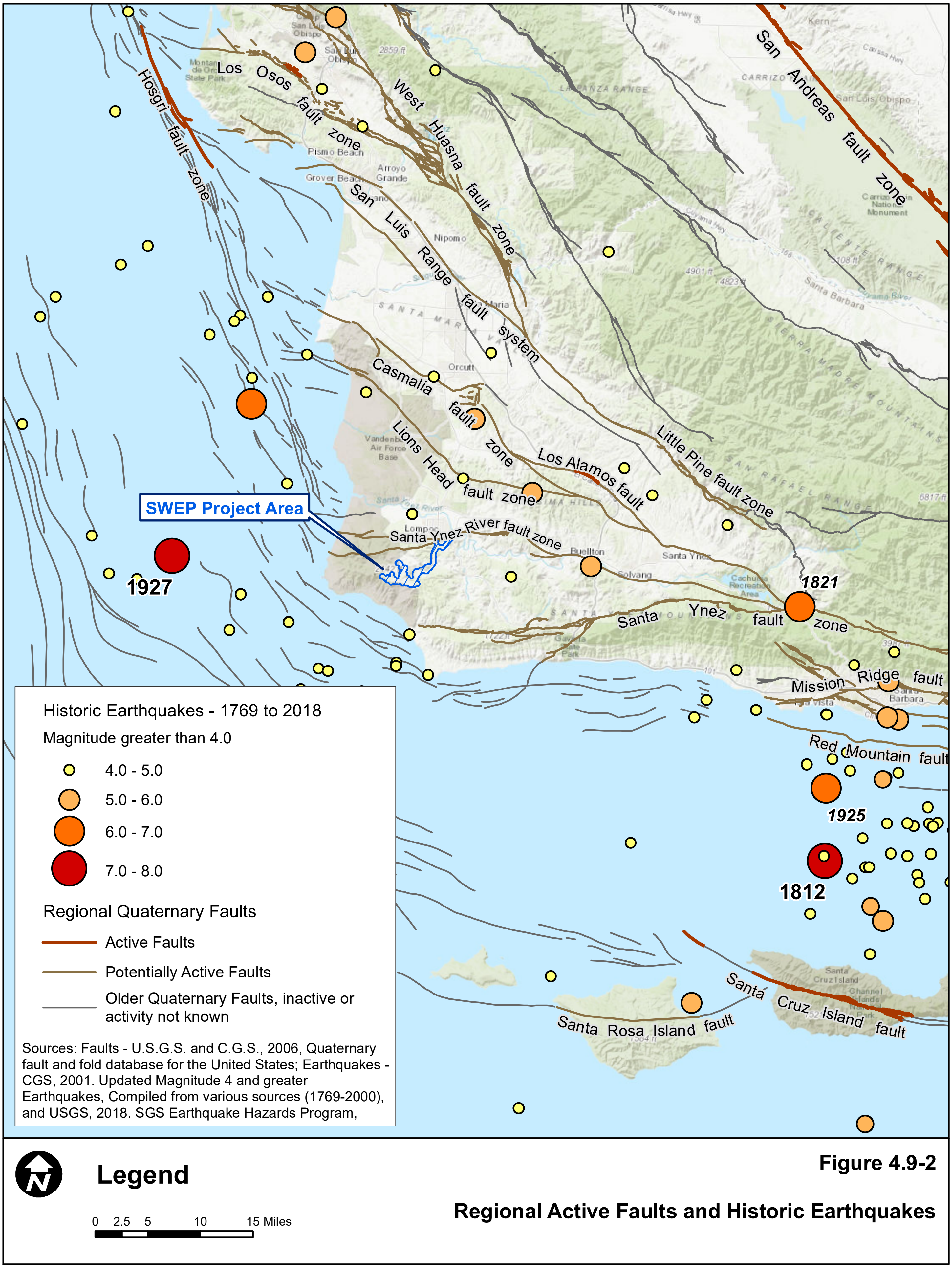


**Figure 4.9-2**

**Regional Active Faults and Historic Earthquakes**

Faults located close to the Project are all potentially active faults (as defined by the CGS) and include the Lion Head fault zone, the Casmalia fault zone, the Los Alamos-Baseline fault zone, and the Santa Ynez fault zone.

- **Lion Head fault zone.** The Lion Head fault zone, a northeast dipping thrust fault, is located 5.8 miles north of the SWEP area that trends in a west to northwest direction through the Purisima and Casmalia Hills.
- **Casmalia fault zone.** The potentially active Casmalia fault zone is located approximately 9.9 miles northeast of the SWEP. The Casmalia fault zone is comprised of several reverse faults with a component of right lateral slip that generally dip steeply to the southwest and trend in northwest direction.
- **Los Alamos-Baseline fault zone.** The Los Alamos-Baseline fault is located approximately 10.8 miles northeast of the SWEP site. The Los Alamos-Baseline fault zone is a south dipping thrust fault that trends in a northwest direction between the Casmalia and Santa Ynez fault zones. An approximately 5-kilometer (3.1 mile) section of the fault near Highway 101, about 13.2 miles northeast of the northern end of the SWEP transmission line, is mapped as active and is Alquist-Priolo zoned.
- **Santa Ynez fault zone.** The western section of the Santa Ynez fault zone is located approximately 11.1 miles southeast of the SWEP site. The Santa Ynez fault zone is a major east-west trending feature separating the San Rafael Mountains on the north side of the fault from the Sant Ynez Mountains on the south side. The fault zone is a high angle reverse fault with considerable left lateral slip that consists of several segments with local subparallel fault traces. A small approximately 0.5-mile-long section of the eastern Santa Ynez fault zone, located approximately 33 miles east of the SWEP, is mapped as active.

While numerous earthquakes of up to magnitude (M) 4.0 commonly occur throughout the region, larger earthquakes are somewhat rare. Only 12 earthquakes of M5.0 or greater have occurred within 50 miles of the Project area, with four of those greater than M6.0 and two greater than M7.1 (USGS, 2018a). The largest earthquake to occur near the Project area was the offshore 1927 M7.1 Lompoc Earthquake, which caused little damage due to the sparse population onshore near the earthquake at the time. The most damaging earthquake in the Project area was the 1925 M6.8 Santa Barbara Earthquake, which is mapped as having occurred offshore in the Santa Barbara Basin, north of Santa Cruz Island. This earthquake caused property damage estimated at $8 million and killed 13 people. Most of the damage occurred in Santa Barbara and nearby towns along the coast. Moderate damage occurred at many points north of the Santa Ynez Mountains, in the Santa Ynez and Santa Maria River valleys. North of Santa Barbara, the earth dam of the Sheffield Reservoir was destroyed, but the water released caused little damage (SCEDC, 2018).

## Fault Rupture

Fault rupture is the surface displacement that occurs when movement on a fault deep within the earth breaks through to the surface. Fault rupture and displacement almost always follows preexisting faults, which are zones of weakness; however, not all earthquakes result in surface rupture (i.e., earthquakes that occur on blind thrusts do not result in surface fault rupture). Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. In addition to damage caused by ground shaking from an earthquake, fault rupture is damaging to buildings and other structures due to the differential displacement and deformation of the ground surface that occurs from the fault offset leading to damage or collapse of structures across this zone. In California, Alquist-Priolo Earthquake Fault Zones have been defined by the California Geological Survey along active faults with the potential for surface rupture. However, not all active faults have been zoned, as the criteria specifies that a fault must be shown to be “sufficiently active” and “well defined” by detailed site-specific geologic explorations in order to determine whether an Alquist-Priolo Earthquake Hazard Zone can be established with associated building setbacks. Many known active faults are not sufficiently “well defined” at the surface to qualify to be Alquist-Priolo zoned but could still cause significant surface fault rupturing.

No known active or potentially active faults cross the SWEP site (Figure 4.6-6). The Santa Ynez River fault zone is in close proximity to the northern end of the Project; however, this fault does not cross any proposed Project components and is not considered a significant seismic source (USGS, 2018). Additionally, this fault is not included on the County of Santa Barbara SSSE Seismic-Tectonic Map (CSB, 2015). The closest Alquist-Priolo zoned fault to the Project is a small section of the Los Alamos Fault, located approximately 13.2 miles northeast of the Project site. Therefore, fault rupture within the Project site is unlikely.

## Strong Ground Shaking

An earthquake is classified by the amount of energy released, which traditionally has been quantified using the Richter scale. Recently, seismologists have begun using a Moment Magnitude (M) scale because it provides a more accurate measurement of the size of major and great earthquakes. For earthquakes of less than M7.0, the Moment and Richter Magnitude scales are nearly identical. For earthquake magnitudes greater than M7.0, readings on the Moment Magnitude scale are slightly greater than a corresponding Richter Magnitude.

The intensity of the seismic shaking, or strong ground motion, during an earthquake is dependent on the distance between the Project area and the epicenter of the earthquake, the magnitude of the earthquake, and the geologic conditions underlying and surrounding the Project area. Earthquakes occurring on faults closest to the Project area would most likely generate the largest ground motion.

The intensity of earthquake-induced ground motions can be described using peak site accelerations (PGAs), represented as a fraction of the acceleration of gravity (g). Peak ground acceleration is the maximum acceleration experienced by a particle on the Earth’s surface during the course of an earthquake, and the units of acceleration are most commonly measured in terms of fractions of g, the acceleration due to gravity (980 cm/sec2). The CGS Probabilistic Seismic Hazards Ground Motion Interpolator website was used to estimate PGAs at the proposed Project site. The interpolator uses data from the 2008 Probabilistic Seismic Hazard Assessment Maps (PSHA) to interpolate peak ground accelerations with a 2 percent probability of exceedance in 50 years (return interval of 2,475 years for a maximum considered earthquake) and with a 10 percent probability of exceedance in 50 years (a return interval of 475 years for the maximum considered earthquake) (CGS, 2018). PGAs at the proposed Project site for 2 percent probability of exceedance in 50 years is approximately 0.48 g and approximately 0.27 g for a 10 percent probability of exceedance in 50 years, which correspond to moderate ground shaking.

## Liquefaction

Liquefaction is the phenomenon in which saturated granular sediments temporarily lose their shear strength during periods of earthquake-induced strong ground shaking. The susceptibility of a site to liquefaction is a function of the depth, density, and water content of the granular sediments and the magnitude and frequency of earthquakes in the surrounding region. Saturated, unconsolidated silts, sands, and silty sands within 50 feet of the ground surface are most susceptible to liquefaction. Liquefaction-related phenomena include lateral spreading, ground oscillation, flow failures, loss of bearing strength, subsidence, and buoyancy effects (Youd and Perkins, 1978). In addition, densification of the soil resulting in vertical settlement of the ground can also occur.

In order to determine liquefaction susceptibility of a region, three major factors must be analyzed. These include: (a) the density and textural characteristics of the alluvial sediments; (b) the intensity and duration of ground shaking; and (c) the depth to groundwater.

Most of the Project area is underlain by relatively dense sedimentary bedrock formations that would not be susceptible to liquefaction (Ninyo & Moore, 2011 and 2017). Liquefaction GIS data from the County of Santa Barbara, based on the County's SSSE, maps most of the Project area as having low liquefaction hazard; however, areas along the proposed transmission line underlain by unconsolidated alluvial deposits are mapped as having a moderate potential for liquefaction (CSB, 2015a). Groundwater was encountered in some of the borings conducted for the LWEP in the proposed WTG areas at varying depths ranging from 1 to 87 feet below ground surface. Shallow groundwater was encountered within the alluvial deposits underlying the LWEP O&M Building site. The liquefaction analyses conducted by Ninyo & Moore (2011) indicated that the upper 13 feet of loose saturated material at the LWEP O&M Building is susceptible to liquefaction and may experience up to 2 inches of post-earthquake settlement. The proposed Project O&M Building is located northwest of the LWEP O&M Building location and is underlain by Gaviota-Sacate Formation, a dense bedrock formation with no potential for liquefaction.

### Seismically Induced Landslides

Other forms of seismically induced ground failures which may affect the Project area include ground cracking, and seismically induced landslides. Landslides triggered by earthquakes have been a significant cause of earthquake damage. In southern California, large earthquakes such as the 1971 San Fernando and 1994 Northridge earthquakes triggered landslides that were responsible for destroying or damaging numerous structures, blocking major transportation corridors, and damaging life-line infrastructure. Areas that are most susceptible to earthquake-induced landslides are steep slopes in poorly cemented or highly fractured rocks, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits. As noted above, the Project area is located within an area of moderate to steep slopes with existing landslides mapped throughout much of the area.

## 4.9.2 Regulatory Setting

## 4.9.2.1 Federal

No federal regulations were identified in the LWEP EIR and no new federal regulations have been enacted that would apply to the proposed Project.

## 4.9.2.2 State

The following two State of California regulations have not changed since the publishing of the LWEP Final EIR in 2008 and are summarized below, more detailed description of these regulations can be found in the LWEP Final EIR, Section 3.9.2.1

**Alquist-Priolo Earthquake Fault Zoning Act of 1972.** The Alquist-Priolo Earthquake Fault Zoning Act of 1972, Public Resources Code (PRC) Sections 2621–2630 (formerly the Special Studies Zoning Act) regulates development and construction of buildings intended for human occupancy to avoid the hazard of surface fault rupture.

**California Seismic Hazards Mapping Act of 1990**. The Seismic Hazards Mapping Act (the Act) of 1990 (PRC, Chapter7.8, Division 2, Sections 2690–2699.) directs the California Department of Conservation, California Geological Survey (CGS) [formerly the Division of Mines and Geology (CDMG)] to delineate Seismic Hazard Zones to reduce the threat to public health and safety and to minimize the loss of life and property by identifying and mitigating seismic hazards such as liquefaction, earthquake-induced landslides, or other earthquake induced ground displacements.

### California Building Standards Code

The 2016 California Code of Regulations (CCR), also known as Title 24, California Building Standards Codes, provides a minimum standard for building design through the California Building Code (CBC), which is based on the (IBC) but has been modified for California conditions. Chapter 16 of the CBC contains specific requirements for seismic safety. Chapter 18 of the CBC regulates excavation, foundations, and retaining walls. Chapter 33 of the CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching, as specified in the State of California Division of Occupational Safety and Health (commonly called Cal/OSHA) regulations (Title 8 of the CCR) and in Section A33 of the CBC.

## 4.9.2.3 Local

### Santa Barbara County

**Water Resources Division – Project Clean Water.** New and redevelopment projects in Santa Barbara County must be designed to prevent water quality impacts from occurring, not just during construction, but throughout the life of the project. The Water Resources Division – Project Clean Water Project provides review, monitoring, and enforcement of construction applications and permits with the goal of preventing water quality impacts. The County regulates discharges from construction activities through permits such as Grading Permits and Land Use Permits. The County's discretionary permit review process provides additional authority for regulating discharges associated with construction activity. Monitoring and enforcement authority are provided through the County Zoning Ordinance and implementation of Comprehensive Plan policy. As part of this enforcement, the Water Resources Division reviews and oversees SWPPP's (or Erosion and sediment Control Plans) developed as required by project grading permits.

**County of Santa Barbara Code of Ordinances.** The County of Santa Barbara County Code of Ordinances includes building codes in Chapter 10, Building Regulations, and grading requirements in Chapter 14, Grading Code. The Building Regulations are based on the 2016 CBC, with modifications specific to the County of Santa Barbara. The Building Regulations include regulations specific to Geologic Hazards and Special Problem Areas. The Grading Code sets forth regulations, conditions and provisions to protect and preserve property and public welfare by regulating and controlling the design, construction, quality of materials, location and maintenance of grading, drainage, erosion and sediment control, where required within the County of Santa Barbara.

**Santa Barbara County Comprehensive Plan.** The Santa Barbara County Seismic Safety and Safety Element (CSB, 2015) is part of the Santa Barbara Comprehensive Plan, and divides geologic hazards in the County into three general levels of impact, critical, sometimes critical, and less critical.

- Critical - ground rupture from fault movement, tsunamis and seiches, and liquefaction
- Sometimes Critical – ground shaking, high groundwater, subsidence (normally correctable with engineering), slope stability and landslides, and soil creep
- Less Critical - expansive soils and compressible - collapsible soils

The Santa Barbara Seismic Safety and Safety Element also presents the following Geologic and Seismic Policy Goal:

- Protect the community to the extent feasible from risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche and dam failure; slope instability leading to mudslides and landslides; subsidence, liquefaction and other seismic hazards pursuant to Government Code §65302(g)(1), Chapter 7.8 (commencing with Section 2690) of Division 2 of the Public Resources Code, and other geologic hazards known to the legislative body.

This policy goal includes six Geologic and Seismic Protection Policies and associated Implementation Measures. These Protection Policies direct the County to minimize geologic, soil and seismic hazards by implementing State and County Building Codes, enforcing development, grading, and land use codes, and enforcing the State Alquist-Priolo Earthquake Fault Zoning and Seismic Hazard Mapping Acts.

**Environmental Health Services.** The County of Santa Barbara Public Health Department, Environmental Health Services (EHS) oversees the Local Agency Management Program (LAMP), which addresses issues related to Onsite Wastewater Treatment Systems (OWTS) (septic systems). Santa Barbara County's Local Agency Management Program includes permit, inspection, and reporting elements. A permit issued by EHS is required for the construction of new OWTS as well as the repair, modification, or abandonment of existing systems. Inspection and approval of all work by EHS is required prior to backfilling any components or putting the system into service.

## 4.9.3 Significance Thresholds

Impacts are considered potentially significant if a proposed project activity could result in substantially increased erosion, landslides, soil creep, mudslides, and unstable slopes (Appendix G(q), CEQA Guidelines). In addition, impacts are considered significant when people or structures would be exposed to major geologic hazards upon implementation of the project (Appendix G(r), CEQA Guidelines).

Additionally, impacts related to geology have the potential to be significant if the proposed Project involves any of the following characteristics, as outlined in the County of Santa Barbara Geologic Constraints Guidelines (CSB, 2018):

- The Project site or any part of the Project is located on land having substantial geologic constraints, as determined by the Planning and Development Department or the Public Works Department. Areas constrained by geology include parcels located near active or potentially active faults and property underlain by rock types associated with compressible/collapsible soils or susceptible to landslides or severe erosion. Special Problem Areas designated by the Board of Supervisors have been established based on geologic constraints, flood hazards and other physical limitations to development.

- The Project results in potentially hazardous geologic conditions such as the construction of cut slopes exceeding a grade of 1.5 horizontal to one vertical.
- The Project proposes construction of a cut slope over 15 feet in height as measured from the lowest finished grade.
- The Project is located on slopes exceeding 20 percent grade.

Although the current wording for the Significance Thresholds for Geology and Soils differs slightly than that used for the LWEP, the geology and soils thresholds as related to CEQA Appendix G and Santa Barbara significance criteria remain unchanged.

As the Project is not located within a County of Santa Barbara designated Special Problem Area, this impact with not be discussed further.

Implementation of mitigation measures may reduce impacts related to these thresholds to a less-than-significant level. These measures would include minor Project redesign and engineering steps recommended by licensed geologists and engineers subsequent to detailed investigation of the site. In some cases, compliance with existing laws and regulations would serve to reduce or avoid certain impacts that might otherwise occur with the implementation of the Project.

## 4.9.4 Environmental Impacts and Mitigation Measures

Table 4.9-3 below lists the impacts and mitigation measures identified for geology and soils in the Geology and Soils section (Section 3.9) of the LWEP Final EIR. These same impacts are addressed in this section for the SWEP. The right-hand column of the table below indicates whether the LWEP impacts or mitigation measures have been modified for the SWEP.

**Table 4.9-3. LWEP Impacts and Mitigation Measures – Geology and Soils**

| Impact No. | LWEP Impact Statements | LWEP Mitigation Measures | SWEP Changes |
|---|---|---|---|
| GEO-1 | Fault Rupture. Risk of damage to structures by fault rupture is very low. | None | Updated Impact Discussion. |
| GEO-2 | Ground Shaking and Liquefaction. A major earthquake could result in ground shaking and liquefaction. | GEO-1: Seismicity | Updated Impact Discussion.<br>Revised/Updated Mitigation. |
| GEO-3 | Landslides. Construction activities could increase the potential for landslides and or reactivate existing landslides. | GEO-2: Grading and Drainage Plan | Updated Impact Discussion.<br>Revised/Updated Mitigation. |
| GEO-4 | Soil Erosion. Construction could accelerate or increase the potential for erosion from water and wind. | GEO-2: Grading and Drainage Plan | Updated Impact Discussion.<br>Revised/Updated Mitigation. |
| GEO-5 | Expansive Soils. Structures would be designed to appropriate engineering standards and would not be susceptible to significant damage produced by expansive soils. | GEO-1: Seismicity<br>GEO-3: Expansive Soils | Updated Impact Discussion.<br>Revised/Updated Mitigation. |

| Impact No. | LWEP Impact Statements | LWEP Mitigation Measures | SWEP Changes |
|---|---|---|---|
| GEO-6 | Sewage Effluent Disposal. Testing has determined that leach lines would be a suitable method of sewage effluent disposal. | None | Updated Impact Discussion. |
| GEO-7 | Compressible and Collapsible Soil, Subsidence. Compressible soil and subsidence potential is considered low. Collapsible soil may be present within alluvial valleys and could cause settlement damage to structures and roadways. | GEO-1: Seismicity<br>GEO-4: Project Support Facilities | Updated Impact Discussion.<br>Revised/Updated Mitigation. |

The impacts of the proposed SWEP related to geology and soils are discussed below.

## GEO-1 **Fault Rupture.** There could be a risk of damage to structures by fault rupture.

The impact for damage to proposed SWEP structures from fault rupture is unchanged (very low) from the LWEP as the proposed Project still does not cross any active or potentially active faults. The Santa Ynez River fault is mapped in close proximity to the northern end of the Project, but this fault is not considered a significant seismic source and does not cross any proposed Project components. Therefore, the impact from the Project is not significant (Class III) and no mitigation is necessary.

## GEO-2 **Ground Shaking and Liquefaction.** A major earthquake could result in ground shaking, liquefaction, or seismically induced landslides resulting in damage to structures or exposure of people to injury or death.

The LWEP impact regarding seismic shaking and related damage focused only on shaking effects and liquefaction, noting that a major earthquake could occur before the LWEP would be decommissioned, resulting in ground shaking and liquefaction. The LWEP EIR stated that the LWEP would comply with recommendations developed based on Project-specific seismic analyses, which could include such measures as constructing deep foundations, deep soil densification, and geopiers. The LWEP EIR concluded that, because the appropriate studies would be conducted and the LWEP would be required to be designed to appropriate engineering standards (Uniform Building Code Seismic Zone 4 standards), impacts from ground shaking and liquefaction would be adverse, but not significant (Class III). In addition, the LWEP EIR concluded that this impact would be further reduced by implementation of Mitigation Measure (MM) GEO-1 (Seismicity).

For the SWEP, impacts related to seismic shaking are essentially unchanged; however, impacts related to liquefaction are reduced due to the relocation of the proposed Project O&M Building to an area underlain by a non-liquefiable unit and the LWEP Final EIR did not address potential impacts related to seismically induced landslides. The SWEP site is susceptible to ground shaking in the event of a large local or regional earthquake, and it is likely that proposed Project components would be subjected to at least one moderate or larger earthquake occurring close enough to produce ground shaking and related effects that could cause damage to Project components. Strong ground shaking could cause shearing, differential settlement, or heave of structures at the ground surface resulting in the weakening or collapse of proposed structures. Liquefaction related to the strong ground shaking could occur in areas underlain by unconsolidated alluvial deposits with shallow groundwater; however, no significant Project structures, such as WTGs or buildings, are located within areas of potential liquefaction. Minor damage to transmission line poles located within unconsolidated alluvial materials due to settlement or to buried pipelines or utilities due to buoyancy and uplift. The hillslopes in the Project area are underlain by landslide prone formations and numerous existing landslides are mapped in the area and seismically induced landslides could cause damage to proposed structures.

Project structures such as the O&M Building that would be occupied by onsite workers, would be required to be designed and constructed according to the CBC and County of Santa Barbara Building Regulations reducing the potential for damage due to seismic ground shaking. The Applicant indicates the transmission line, substation, and switchyard would be constructed consistent with recommended practices and procedures of the IEEE, standards for overhead line construction consistent with CPUC General Order 95, and other applicable rules and standards. The switchyard and substation surface would be covered with a layer of rock. This rock layer would act as a fire barrier. In addition, spatial separation of transformers and other equipment would be provided for in the design to prevent fire propagation. The substation would meet or exceed Institute of Electrical and Electronics Engineers (IEEE)-979 Substation Fire Protection.

As discussed in Section 2.5.1, the WTG foundations would have one of three designs, depending on soil conditions, geotechnical constraints, and other factors: P&H foundation, rock anchor-type foundation, or modified spread footing. The P&H foundation is expected to be the preferred foundation for the proposed Project based on the site characteristics. While the potential for seismically induced ground shaking in the Project area during Project operation is unavoidable, proper design according to accepted standards and practices, and local, State, and federal regulations reduces the potential for damage, injury, or death due to seismic shaking to a less-than-significant level for most structures within the SWEP. Impacts related to damage from seismic ground shaking, liquefaction, or seismically induced landslides for Project components would be reduced to a less-than-significant level (Class II) with implementation of revised MM GEO-1 (Seismic Design) and revised MM GEO-2 (Grading and Drainage Plan).

## Mitigation Measures

**MM GEO-1** **Seismic Design.** Project facilities shall be designed using the appropriate seismic design criteria from the CBC and County of Santa Barbara Building Regulations based on seismic design parameters provided by the Project-specific Geotechnical/Seismic Evaluation report. Substation and switchyard components shall be designed based on IEEE 693 recommended seismic design practices and other applicable IEEE standards. The transmission line shall be designed consistent with recommended practices and procedures of the IEEE, standards for overhead line construction consistent with CPUC General Order 95, and other applicable rules and standards. The wind turbines design shall incorporate seismic design guidelines from IEC Standard 61400-1 (or equivalent wind turbine seismic design guidelines).

**Plan Requirements.** The Applicant shall submit plans for buildings and structures indicating compliance with standards to the satisfaction of the County.

**Timing.** Prior to zoning clearance for construction.

**Monitoring.** County building inspectors will inspect the site prior to occupancy clearance (for the O&M facility) and prior to operation of the WTGs and power line.

**MM GEO-2** **Grading and Drainage Plan.** The Applicant shall prepare a final Grading and Drainage Plan, designed to minimize erosion and landslides, which includes the following measures:

a. Avoidance of identified landslides and areas of unstable slopes, as feasible.

b. If slope instability impacts cannot be avoided, submit detailed plans of the placement of structures and/or excavation/grading measures (with limits of cut and fill and slope restoration method) as related to stabilization of slopes prior to construction for review and approval.

c. Where fill is placed upon a natural or excavated slope steeper than about 5:1 (20 percent), construct a base key at the toe of the fill and bench the fill into the existing slopes. Embed the base key at least 2 feet into competent inorganic soils; then bench the fill horizontally into the existing slope at least 2 feet normal to the slope as the fill is brought up in layers.

d. Construct cut slopes no steeper than 1.5:1 unless topographic constraints prevent this possibility; then, incorporate special design features to prevent slope failure.

e. Construct fill slopes no steeper than 2:1 unless topographic constraints prevent this possibility; then, incorporate special design features to prevent slope failure.

f. Design grading on slopes steeper than 3:1 to minimize surface water runoff.

g. Use diversion structures and spot grading to reduce siltation into adjacent streams during grading and construction activities.

h. Limit grading during construction to the dry season (April 15 to November 1) to the extent practicable. If grading needs to be done outside of the dry season, Applicant will coordinate grading work with the County and will follow all applicable guidelines.

i. Keep soil damp during grading activities to reduce the effects of dust generation.

j. Stockpile excess topsoil on site and segregate it from other soils to facilitate future land restoration

k. Any disturbed area that is not covered with base or paving within 14 days of its disturbance shall be stabilized through use of soil coating mulch, dust palliatives, compaction, reseeding, or other approved methods.

l. Install erosion control structures where appropriate, including temporary erosion control structures, such as trench plugs and water bars, on moderately steep slopes.

m. Restore soil elevation/topography consistent with the approved grading and erosion control plans.

n. Reseed all exposed graded surfaces with deep-rooted, native, drought-tolerant ground cover to minimize erosion. Geotextile binding fabrics shall be used if necessary to hold slope soils until vegetation is established.

o. Strip areas to receive fill of vegetation, organic topsoil, debris, and other unsuitable material. Place engineered fill in layers not exceeding 12 inches in loose thickness, properly moistened and compacted, and tested for 90 percent compaction.

p. Designate a place for temporary storage of construction equipment at least 100 feet from any water bodies.

q. Project grading and earthwork shall be observed and tested by a geotechnical engineer or his representative to verify compliance with these mitigation measures.

**Plan Requirements.** A Grading and Drainage Plan shall be prepared. The plan shall be designed to address erosion and sediment control throughout Project construction. Plan requirements shall be noted on all grading and building plans. The Applicant shall notify the County prior to commencement of grading.

**Timing.** The Grading and Drainage Plan shall be submitted for review and approval by the County, including County Flood Control, prior to zoning clearance. Erosion and sediment control measures shall be in place throughout grading and development of the site until all disturbed areas are permanently stabilized. Graded surfaces shall be reseeded within 60 days of grading completion, with the exception of surfaces graded for the placement of structures. These surfaces shall be reseeded if construction of structures does not commence within 60 days of grading completion.

**Monitoring.** P&D staff shall perform site inspections throughout the construction.

## GEO-3 **Landslides.** Construction activities could increase the potential for landslides and/or reactivate existing landslides.

The impacts for the SWEP related to increasing the potential for landslides and/or reactivating existing landslides is unchanged from LWEP. Construction activities such as vegetation removal and grading could destabilize the soil and weaken geologic units, increasing the potential for construction triggered landslides which could cause damage to proposed Project components. Additionally, proposed grading of roads and pads could alter existing drainage, resulting in saturation of adjacent areas causing or reactivating existing landslides in the Project area that could cause damage to proposed Project components. The LWEP EIR indicated that existing landslides affecting proposed corridors and structures in the Project area would be evaluated as part of a geotechnical study and that locating roads and structures at or near existing landslides and potentially unstable areas would be avoided where feasible. Several proposed SWEP WTGs and portions of some of the proposed access roads and other areas of grading are located within or adjacent to mapped landslides; the Ninyo & Moore 2017 geotechnical report recommended that if it is not feasible to relocate proposed Project components that are within or immediately adjacent to landslide deposits, that slope movement should be included in the design of WTG foundations and/or mitigation of the slope failures and/or remedial grading should be conducted. Compliance with geotechnical design recommendations and implementation of revised MM GEO-2 (Grading and Drainage Plan) would reduce the potential impact related to landslides and slope stability to a less-than-significant level (Class II).

### Mitigation Measure

**MM GEO-2** **Grading and Drainage Plan.** Described under Impact GEO-2 above.

## GEO-4 **Soil Erosion.** Construction could accelerate or increase the potential for erosion from water and wind.

The LWEP EIR concluded that construction-related ground disturbance consisting of clearing and grading, cut-and-fill activities, and potential soil compaction during construction could increase the potential for erosion. Road construction could also increase water runoff rates, resulting in accelerated soil erosion. The movement of equipment and materials during construction could destabilize the soil surface and increase erosion potential from water and wind. The most likely time for erosion to occur is after initial disturbance and before reestablishment of vegetative cover or placement of structures. In the LWEP EIR, the impact was classified as adverse but not significant due to the required preparation of a SWPPP with included BMPs and implementation of MM GEO-2. However, the LWEP EIR did not analyze potential erosion related to construction of the transmission line or to grading and improvements along San Miquelito Road or other existing access roads.

The SWEP would have similar potential for erosion from water and wind as the LWEP; however, it would be distributed differently. While most of the soils underlying the proposed Project have low to moderate potential for erosion, some of the soils underlying the Project site have moderate to high susceptibility to wind erosion and moderate to high susceptibility to sheet and rill erosion by water (Table 4.9-1). The SWEP disturbs less total acreage than the LWEP (approximately 150 acres versus 236 acres); however, the proposed SWEP would have a much larger volume of cut and fill (approximately 1.9 million cubic yards total for SWEP versus 401,000 cubic yards, which was analyzed in the LWEP EIR). The proposed Project includes approximately 3.2 acres of ground disturbance along San Miquelito Road, and approximately 14.3 acres of ground disturbance along transmission line access roads that were not analyzed in the LWEP EIR. The grading activities along San Miquelito Road (cut along the south and east side of the road and fill along the north and west sides of the road) consists primarily of widening existing shoulders along the road and would take place primarily along an approximately 1.3-mile length of the road just north of the wind farm area. Four residences or accessory structures would be located between approximately 130 and 170 feet from the grading activities along this road.

As with the LWEP, the SWEP would disturb an area of greater than one acre and a Project-specific Storm Water Pollution Prevention Plan (SWPPP) would be required, which would include Best Management Practices (BMPs). Implementation of erosion and sedimentation control BMPs and procedures included in the Project SWPPP would reduce erosion rates during and after construction to essentially natural rates. As per Santa Barbara County Grading Code, a grading plan would be required for the proposed Project that would include drainage, erosion, and sediment control design. MM GEO-2 provides some additional site-specific detail related to Project-specific grading and drainage. Implementation of the required SWPPP BMPs and revised MM GEO-2 (Grading and Drainage Plan) would reduce the impact to a less-than-significant level (Class II).

### Mitigation Measure

**MM GEO-2** **Grading and Drainage Plan.** Described under Impact GEO-2 above.

## GEO-5 **Expansive Soils.** Project Structures could be damaged by expansive soils.

Potential SWEP impacts related to expansive soils would be similar as compared to the LWEP. The LWEP EIR indicates that based on a geotechnical study, buildings and structures would have been designed to required engineering standards and would not have been susceptible to significant damage from shrinking and swelling forces produced by expansive soils. However, the LWEP EIR applied MM GEO-3 (Expansive Soils) to further reduce any impacts from expansive soils.

Ninyo & Moore noted that expansive soils are present at the Project site resulting from the weathering of the underlying formation materials and that expansive soils should not be used below proposed structure foundations and/or in the upper surface of proposed access roads (Ninyo & Moore 2017). Soils with moderate to high expansion potential (NRCS 2017 and 2018) are located underlying proposed SWEP components, which could cause damage to WTG foundations, substation, switchyard, and O&M facility. Expansive soils undergo shrink and swell with moisture changes that can cause damage such as cracking to Project components such as slabs, building foundations, and concrete flatwork. MM GEO-3 (Expansive Soils) provides requirements for soil analyses and engineered measures to mitigate potential impacts from expansive soils. Compliance with required design standards and implementation of MM GEO-3 would reduce potential impacts from expansive soils to a less-than-significant level (Class II).

### Mitigation Measures

**MM GEO-3** **Expansive Soils.** Soil analyses shall be completed for expansion potential. Once Project design has been developed and the criteria for the facility performance have been established, the soils engineer shall review the mitigation measures and modify them as appropriate. If further measures are considered necessary to mitigate problems posed by expansive soils, the following alternatives shall be considered:

a. Over-excavation of expansive soils and replacement with non-expansive fill.

b. Support of structures on drilled shaft foundations.

c. Lime treatment of expansive subgrades.

**Plan Requirements.** Soil analyses and performance criteria shall be completed and submitted to the County for review and approval.

**Timing.** Soil analyses and performance criteria shall be completed and submitted to the County for review and approval prior to the zoning clearance.

**Monitoring.** County building inspectors will inspect the site to ensure that construction complies with the appropriate performance standards.

## GEO-6 **Sewage Effluent Disposal.** Soils could be found incapable for use of septic or alternative wastewater disposal.

Percolation testing conducted at the site of the LWEP O&M facility determined that a leach system (septic) would be a suitable method of sewage effluent disposal. The percolation testing report provided recommendations for a suitable leach system and noted that based on the Uniform Plumbing Code, a sufficient area must be set aside for future expansion of the system by 100 percent and that a dual system would be required.

The proposed Project O&M facility is in a different location than the LWEP O&M facility and based on the existing conditions at the O&M site, the Applicant plans on using a leach line septic system. Percolation test results show that the O&M facility site vicinity is characterized by native soils with permeability ranging from 42 to 100 minutes per inch. Groundwater levels are expected to fluctuate with rainfall. Local perched ground water was observed by boring to be at a depth of 9 feet after a period of heavy rain. Design sewage flow generated by the O&M facility is estimated at 250 gallons per day, which is conservative since the California plumbing code estimate roughly 20 gallons per person per day for a typical office. Five to seven employees are expected to occupy the O&M facility, which would make actual use approximately 100 to 140 gallons per day.

The proposed system is a conventional in-ground septic system, including a septic tank to remove solids and grease, a 4-inch pipeline at 3 percent slope to a distribution box, and two leach lines, sized to accommodate the design flows for the field soils. An in-ground septic disposal system requires, depending upon the permeability of the soil, a minimum separation requirement between the bottom of the leach trenches and the groundwater table; groundwater levels in the alluvium near the proposed Project O&M site are relatively shallow, encountered at approximately 20 feet below ground surface and rising to about 8 feet below ground surface (ESP, 2017).

The septic system design will depend on final engineering calculations. At this time, it is estimated that a 1,000-gallon septic tank with roughly 200 feet of leaching lines (two lines each 100 feet long) would be adequate to dispose of the generated wastes. A leach trench depth of approximately 42 inches would have adequate (more than five feet) separation from the wet weather groundwater location. This impact would not be significant (Class III) with compliance with County of Santa Barbara Onsite Sewage Treatment System: New System Permit requirements and the Uniform Plumbing Code. No mitigation is necessary.

## GEO-7 **Compressible and Collapsible Soil, Subsidence.** Subsidence or compressible or collapsible soils could cause settlement damage to structures and roadways.

Compressible soil and subsidence potential within the Project area is considered low. Collapsible soil may be present within alluvial valleys of the Project area, and the LWEP EIR found that it could cause settlement damage to structures and roadways. SWEP impacts related to subsidence and collapsible soils are considered to be unchanged from the LWEP; however, the impact from compressible soils is increased for the SWEP based geotechnical evaluations conducted at the site. The Ninyo & Moore geotechnical evaluations (2011 and 2017) concluded that soil, colluvium, alluvium, and landslide deposits in the Project area are potentially compressible. Differential settlement due to compressible or collapsible soils could cause damage to proposed Project components, such as tilting of structures and/or fracturing of shallow foundations or slabs. Implementation of revised MM GEO-4 (Foundation Support) would reduce the potential impacts due to collapsible or compressible soil to a less-than-significant level (Class II).

### Mitigation Measure

**MM GEO-4** **Foundation Support.** Foundations for Project components, such as the O&M Building and substation, and for other Project support facilities, such as bridge foundations, shall be sited on cut pads that have been engineered and treated, if necessary, to provide relatively uniform foundation support and reduce differential settlement. Soil treatment could include soil removal and recompaction, prewetting, and potentially, deep foundation or deep soil densification techniques. Alternatively, structure foundations shall be designed to tolerate potential differential settlement.

**Plan Requirements.** Building plans including foundation design, shall be submitted to the County for review and approval.

**Timing.** The final building plans, including foundation design elements, and requirements for engineered site preparation shall be approved prior to zoning clearance.

**Monitoring.** County building inspectors will inspect the site to ensure that construction complies with the appropriate standards.

## 4.9.5 Cumulative Effects

### Geographic Extent/Context

Geologic and soils impacts (such as slope instability and soil erosion) are typically site specific. The impacts of each past, present, and reasonably foreseeable project would be specific to the respective site and its users and would not be in common with or contribute to (or shared with, in an additive sense) the impacts on other sites. In addition, development of each site would be subject to site development and construction guidelines and standards (local, State, and federal) that are designed to protect public safety. In order to be cumulatively considerable, adverse geologic conditions would have to occur at the same time and in the same location as the same or similar conditions of the proposed Project.

### Impact Categories

Seismic impacts (such as fault rupture, ground shaking, and liquefaction) from the numerous local and regional faults comprise an impact of the geologic environment on individual projects and would not introduce cumulatively considerable impacts. Impacts from unsuitable soils (expansive, collapsible, or compressible) would also represent an impact of the environment on individual projects and would not be cumulatively considerable. As the cumulative projects listed in Section 3.3 (Table 3-1) are located over three miles from the SWEP, potential soil impacts from each of these projects would not be located within the proposed Project site. The proposed Project would not combine with the effects of other projects to create a cumulative geologic and soils impact.

## 4.9.6 Residual Impacts

As summarized in Section 4.9.4, Impacts GEO-1 and GEO-6 would be less than significant. With implementation of proposed mitigation measures, residual effects from Impacts GEO-2, GEO-3, GEO-4, GEO-5, and GEO-7 would be less than significant.

## 4.9.7 Impact and Mitigation Summary

Table 4.9-4 below provides a summary of the SWEP's impacts related to geology and soils. The table also indicates the mitigation measures proposed to reduce each significant impact.

**Table 4.9-4. SWEP Impact and Mitigation Summary – Geology and Soils**

| Impact No. | Impact Statement | Mitigation Measures | Significance Conclusion |
|---|---|---|---|
| GEO-1 | **Fault Rupture.** There could be a risk of damage to structures by fault rupture. | None required. | Class III |
| GEO-2 | **Ground Shaking and Liquefaction.** A major earthquake could result in ground shaking, liquefaction, or seismically induced landslides resulting in damage to structures or exposure of people to injury or death. | GEO-1: Seismic Design<br>GEO-2: Grading and Drainage Plan | Class II |
| GEO-3 | **Landslides.** Construction activities could increase the potential for landslides and/or reactivate existing landslides. | GEO-2: Grading and Drainage Plan | Class II |

| Impact No. | Impact Statement | Mitigation Measures | Significance Conclusion |
|---|---|---|---|
| GEO-4 | **Soil Erosion.** Construction could accelerate or increase the potential for erosion from water and wind. | GEO-2: Grading and Drainage Plan | Class II |
| GEO-5 | **Expansive Soils.** Project Structures could be damaged by expansive soils. | GEO-3: Expansive Soils | Class II |
| GEO-6 | **Sewage Effluent Disposal.** Soils could be found incapable for use of septic or alternative wastewater disposal. | None required. | Class III |
| GEO-7 | **Compressible and Collapsible Soil, Subsidence.** Subsidence or compressible or collapsible soils could cause settlement damage to structures and roadways. | GEO-4: Foundation Support | Class II |

**Class I.** Significant unavoidable adverse impact.
**Class II.** Significant environmental impacts that can be feasibly mitigated or avoided.
**Class III.** Adverse impacts found not to be significant.
**Class IV.** Impacts beneficial to the environment.

## 4.9.8 References

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