3.6 GEOLOGY AND SOILS

This section describes the environmental and regulatory setting for geologic and soil resources. It also describes impacts on geologic and soil resources that would result from implementation of the proposed project and mitigation for significant impacts.

3.6.1 Existing Conditions

3.6.1.1 Regulatory Setting

Federal

Clean Water Act 402/National Pollutant Discharge Elimination System

The EPA serves as the lead federal agency responsible for water quality management. The CWA of 1972 is the primary federal law that governs and authorizes water quality control activities by the EPA and the individual states.

In 1987 amendments to the CWA added Section 402p, which establishes a framework for regulating municipal and industrial stormwater discharges under the NPDES program. The EPA delegated the authority for the NPDES program in California to the State Water Resources Control Board (State Water Board), which is implemented by the State’s nine regional water quality control boards (Regional Water Boards). Under the NPDES Phase II Rule, construction activity disturbing 1 acre or more must obtain coverage under the State’s General Construction Permit. General Construction Permit applicants are required to prepare a Notice of Intent and a stormwater pollution prevention plan (SWPPP) and implement and maintain best management practices (BMPs) to avoid adverse effects on receiving water quality as a result of construction activities, including earthwork.

Institute of Electrical and Electronics Engineers - Recommended Practices for Seismic Design of Substations

The Institute of Electrical and Electronics Engineers (IEEE) 693 “Recommended Practices for Seismic Design of Substations” was developed by the Substations Committee of the IEEE Power Engineering Society, and approved by the American National Standards Institute and the IEEE-Standards Association (SA) Standards Board. This document provides seismic design recommendations for substations and equipment consisting of seismic criteria, qualification methods and levels, structural capacities, performance requirements for equipment operation, installation methods, and documentation. This recommended practice emphasizes the qualification of electrical equipment. IEEE 693 is intended to establish standard methods of providing and validating the seismic withstand capability of electrical substation equipment. It provides detailed test and analysis methods for each type of major equipment or component found in electrical substations. This recommended practice is intended to assist the substation user or operator in providing substation equipment that will have a high probability of withstanding seismic events to predefined ground acceleration levels. It establishes standard methods of verifying seismic withstand capability, which gives the substation designer the ability to select equipment from various manufacturers, knowing that the seismic withstand rating of each manufacturer's equipment is an equivalent measure. Although most damaging seismic...
activity occurs in limited areas, many additional areas could experience an earthquake with forces capable of causing great damage. This recommended practice should be used in all areas that may experience earthquakes.

State

Alquist-Priolo Earthquake Fault Zoning Act

California’s Alquist-Priolo Act (PRC 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act and renamed in 1994, is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy across the traces of active faults and strictly regulates construction in the corridors along active faults (Earthquake Fault Zones). It also defines criteria for identifying active faults, giving legal weight to terms such as “active” and establishes a process for reviewing building proposals in and adjacent to Earthquake Fault Zones.

Under the Alquist-Priolo Act, faults are zoned, and construction along or across them is strictly regulated if they are “sufficiently active” and “well-defined.” A fault is considered sufficiently active if one or more of its segments or strands shows evidence of surface displacement during the Holocene. A fault is considered well-defined if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface, using standard professional techniques, criteria, and judgment (Bryant and Hart 2007).

Seismic Hazards Mapping Act

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC 2690-2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong ground shaking, liquefaction, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act: the State is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped Seismic Hazard Zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites in Seismic Hazard Zones until appropriate site-specific geologic or geotechnical investigations have been carried out, and measures to reduce potential damage have been incorporated into the development plans. Geotechnical investigations conducted within Seismic Hazard Zones must incorporate standards specified by California Geological Survey Special Publication 117a, Guidelines for Evaluating and Mitigating Seismic Hazards (California Geological Survey 2008).

Surface Mining and Reclamation Act (1975)

The Surface Mining and Reclamation Act of 1975 (SMARA) (PRC Section 2710 et. seq.) requires the California State Mining and Geology Board map areas throughout the State that contain
regionally significant mineral resources. This mapping helps to identify and protect mineral resources in areas of the State subject to urban expansion or other irreversible land uses that could preclude mineral extraction. The SMARA acknowledges that mineral extraction is essential to California’s economy and that the reclamation of mined lands after extraction is necessary to prevent or minimize adverse effects on the environment and to protect the public health and safety. The SMARA also classifies mineral resources in the State and provides information to local governments. Local governments are responsible for designating lands that contain regionally significant mineral resources in their local General Plans and for preserving such areas from encroachment or conversion to other uses. The law has resulted in the preparation of Mineral Land Classification Maps delineating Mineral Resource Zone (MRZ) for aggregate resources (sand, gravel, and stone).

**California Building Code (2013)**

The State of California provides minimum standards for building design through the California Building Code (CBC). The CBC is promulgated under the CCR, Title 24, Part 1 through 12 (also known as the California Building Standards Code) and is administered by the California Building Standards Commission. The CBC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition. It also regulates grading activities, including drainage and erosion control.

**Local**

**City of Lancaster General Plan 2030**

The Plan for Public Health and Safety of the City of Lancaster General Plan 2030 includes specific goals, objectives, and policies to provide protection from natural hazards. Policies with respect to geology and soils that are applicable to the proposed project are listed below:

**Goal 4.0:** To provide a secure manmade environment which offers a high level of protection from natural and manmade hazards to life, health, and property.

**Objective 4.1:** Minimize the potential for loss of life, physical injury, property damage, and social disruption resulting from seismic ground shaking and other geologic events.

**Policy 4.1.1:** Manage potential seismic hazards resulting from fault rupture and strong ground motion to facilitate rapid physical and economic recovery following an earthquake through the identification and recognition of potentially hazardous conditions and implementation of effective standards for seismic design of structures.

**Policy 4.1.2:** Require development within hillside areas and areas which potentially have soils or underlying formations that might produce severe building constraints to have engineering studies performed in order to determine appropriate structural design criteria and effective construction standards.

**Geotechnical Investigations**

Local jurisdictions typically regulate construction activities through a multistage permitting process that may require a site-specific geotechnical investigation. The purpose of the
3.6-4

investigation is to provide a basis for the development of appropriate construction design. Site-specific geotechnical investigations are to be based on adequate test borings or excavations in the area where construction would occur and prepared by a civil engineer who is registered by the State.

Earth Systems Southern California (ESSC) prepared a preliminary geotechnical report for a previously anticipated development project on portions of the project site. While not comprehensive of the 1,191 acre project site, this report provides sufficient detail to describe site conditions and potential impacts related to the proposed project (Appendix E).

3.6.2 Environmental Setting

Geology and Soils

Regional Geologic Framework

The proposed project is located in an area of gently sloping alluvial fans at the northern base of the Sierra Pelona ridgeline located along the southwestern edge of the Antelope Valley. The Antelope Valley is part of the Mojave Desert geomorphic province, a broad interior region of isolated mountain ranges separated by broad desert plains. The Mojave province is wedged in a sharp angle between the Garlock Fault (southern boundary Sierra Nevada) and the San Andreas Fault, where it bends east from its northwest trend. The northern boundary of the Mojave province is separated from the prominent Basin and Range by the eastern extension of the Garlock Fault (CGS 2002). The San Andreas Fault, at its nearest point is approximately 1.5 miles southwest of the project site.

The geology of the region consists of three main rock groups: crystalline rocks of Pre-Tertiary age; volcanic and sedimentary rocks of the Tertiary age; and alluvial sedimentary rocks of the Quaternary age. The Pre-Tertiary and Tertiary rocks are hard consolidated materials from the surrounding mountains and rocky buttes that rise from the valley floor. The Antelope Valley soil profile consists of up to 4,000 feet of fine to coarse-grained alluvial fill underlain by consolidated rocks. The alluvial fill consists of fine to coarse-grained soil layers formed as a result of uplift and erosion of the surrounding mountains. Figure 3.6-1, Geologic Map, depicts the local geology, topographic contours, and significant landforms of the project area.

Project Site Topography and Geology

Geology

The northeastern portion of the project site includes gently sloping younger alluvial fan deposits (ESSC 2007). The southwestern portion of the site is at the base of Portal Ridge of the Sierra Pelona Mountains. The remaining project area is comprised of alluvial fan deposits. The limited preliminary distribution of geologic units is shown on the Geologic Map (Figure 3.6-1). The bedrock units underlying this portion of the project site consist of two groups: 1) basement rocks – early Cretaceous and older crystalline metamorphic rocks and igneous rocks; and 2) the overlying sequence of late Cretaceous and Tertiary strata.

The remainder and majority of the site is located in areas overlying younger, unconsolidated alluvial deposits. The near-surface earth materials on the project site consist primarily of sand, silt,
...of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Figure 3.6-1
Geologic Map

Legend
- Gen-tie Route 1
- Gen-tie Route 2
- Gen-tie Route 3
- Gen-tie Route 4
- Solar Array
- Switching Station
- Collector Substation
and gravel soils from alluvial deposits. Mapping by the California Geological Survey (CGS) indicates that the project site is covered by late-Pleistocene alluvial fan deposits that are unconsolidated, uplifted, and slightly dissected. Alluvial fan sediments are typically comprised of sand and gravel. These deposits are further described as having moderately developed soils with distinct soil horizons and clay accumulations.

The 2007 ESSC Geotechnical report identifies the project site lithographic units as Quartz monzonite (gr), Quaternary older alluvial fan sediments (Q2 and Q3), Quaternary old alluvial fan sediments (Q1a and Q1b), and artificial fill (af). The lithographic unit designations used in the 2007 ESSC Geotechnical Report are different from the CGS Geologic Map (Figure 3.6-1); however, map units are consistent (i.e: gr=Kgd; Q1a=Qya; Q1a-Qya; Q2=Qa; Q3=Qof). Descriptions of the units are included in Appendix E.

**Topography**

The project site lies at the base of the San Gabriel Mountain Range, specifically the Portal Ridge of the Sierra Pelona Mountains, and is characterized by a nested set of three, broad, gently sloping alluvial fan surfaces. The alluvial fan surfaces have intervening, moderately dissected drainage courses that reflect modern and ancient drainage patterns. Predominant drainage is to the north and northeast within well-defined drainage courses that exhibit distinct evidence of relatively recent erosion.

Ground elevations at the project site range from approximately 2,480 feet above mean sea level (msl) in the northeast portion of the site to approximately 2,920 feet above msl in the southwestern portion of the site. The southwestern margin is at the base of the California Aqueduct. Cut and fill slopes associated with the California Aqueduct are found on the southwestern margin. The proposed gen-tie routes have elevations relative to their respective routes, generally 3,500 feet above msl.

**Soils**

**Surface Soils**

The soils at the project site have been mapped by the U.S. Department of Agriculture, Soil Conservation Service (now called the Natural Resources Conservation Service [NRCS]) and the data has been extracted from the NRCS soil mapping web site. Field exploration conducted in 2007 as part of the ESSC geotechnical investigation included forty exploratory soil borings and thirty shallow exploratory test pits.

There are five soil complexes in the project site. A soil complex is a map unit made up of two or more kinds of soil in such an intricate pattern or in so small an area that it is not practical to map them separately. The NRCS soil survey lists the following five surface soils at the project site: Greenfield Sandy Loam (48.9%), Hanford Sandy Loam (43.8%) Ramona Coarse Sandy Loam (3.6%), Vista Coarse Sandy Loam (3.3%), and Terrace Escarpments comprise less than one percent of the project site. Over 90 percent of the soils consist of deep, well-drained soils formed from mixed alluvium of granitic origin.

There are 17 soil mapping units present within the project area (Figure 3.6-2). These mapping units are individual soils or soil complexes and they are listed in Table 3.6-1. The soils are primarily
Figure 3.6-2

Soil Types within the Project Area

Legend

Soil Type

AcA  AmF2  CbA  DuD  GsA  GsC  GsC2  GsD2  HbA  HbC  HbD  HcA  HcC

Legend

Gen-tie Route 1
Gen-tie Route 2
Gen-tie Route 3
Gen-tie Route 4
Gen-tie Route 5
Gen-tie Route 6
Solar Array
Switching Station
Collector Substation

Lancaster Energy Center

0 1 Miles

Document Path: V:\1840\active\185702912_lancaster\gis\mxd\geology_soils\fig_xx_lancaster_soils.mxd
developed from weathered sedimentary bedrock and their soil depths range from 1 to more than 60 inches to unweathered bedrock. The soil depths decrease as rock outcrops and rock ridges are approached.

**Soil Expansion Potential**

Expansive soils are those whose volume contracts and expands in a “shrink-swell” pattern. Shrink-swell potential is generally related to the presence of highly plastic clayey soils found near the ground surface. Fine-grain clay sediments expand and contract as the result of changing moisture levels. As the density of soils changes, overlying materials can shift, causing structural damage to foundations and other above ground facilities.

Since the predominant soils at the project site are composed of sandy loam with very little to no fine-grained soil there is a low potential for impact due to shrink-swell potential. Additionally, the results of the limited Expansion Index Test (ASTM D 4829) indicate that the upper soils on the site are considered to have a “very low” (0-20) expansion potential (ESSC 2007).

**Table 3.6-1: Soils and Select Soil Characteristics for the Proposed Project Site**

<table>
<thead>
<tr>
<th>Soil Type Symbol</th>
<th>Soil Type</th>
<th>Drainage Class</th>
<th>Shrink-Swell Potential</th>
<th>Hydrologic Soil Group</th>
<th>Wind Erosion Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>GsA</td>
<td>Greenfield sandy loam, 0-2 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>GsC</td>
<td>Greenfield sandy loam, 2-9 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>GsC2</td>
<td>Greenfield sandy loam, 2-9 % slopes, eroded</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>GsD2</td>
<td>Greenfield sandy loam, 9-15 % slopes, eroded</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>HbA</td>
<td>Hanford coarse sandy loam, 0-2 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>HbC</td>
<td>Hanford coarse sandy loam, 2-9 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>HbD</td>
<td>Hanford coarse sandy loam, 9-15 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>HcA</td>
<td>Hanford sandy loam, 0-2 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>HfA</td>
<td>Hanford loam, 0-2 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>RcA</td>
<td>Ramona coarse sandy loam, 0-2 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>RcB</td>
<td>Ramona coarse sandy loam, 2-5 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>RcC</td>
<td>Ramona coarse sandy loam, 5-9 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>RcD</td>
<td>Ramona coarse sandy loam, 9-15 % slopes</td>
<td>Well drained</td>
<td>Low</td>
<td>C</td>
<td>3</td>
</tr>
</tbody>
</table>
Soil Erosion Potential

Erosion is the process by which rocks, soil, and other land materials are abraded or worn away from the earth’s surface. The erosive potential of soil is determined by a number of soil characteristics, including soil texture and content, surface roughness, vegetation cover, and slope grade and length. Ground-disturbance can increase erosion potential by altering natural soil characteristics, removing vegetation, and generally destabilizing an area.

Erosion from water mainly occurs in loose soils on moderate to steep slopes, particularly during high-intensity storm events. To estimate erosion potential of soils during the precipitation events, the Natural Resource Conservation Service has considered soil characteristics such as available water capacity, permeability, and associated water table and bedrock depth and categorized the soil into four hydrological soil groups (HSG), Groups A through D. Soils are classified according to the intake of water when they are thoroughly wet and receive precipitation from long-duration storms and they have had a chance to swell (U.S. Department of Agriculture [USDA] 1977). Group A soils have a high infiltration rate when thoroughly wet, consist mainly of deep and well-drained to excessively drained sands or gravelly sands, and, therefore, have a low runoff potential (less erosive). Group D soils have a very slow infiltration rate and consist chiefly of clays that have high shrink-swell potential, soils with a permanent high water table, and soils having a clay pan or clay layer at or near the surface and, therefore, have a high runoff potential (more erosive). The soil types found in the project area include class A to C which have moderately rapid to moderately slow permeability, respectively (USDA NRCS 2014).

Erosion may also occur as a result of wind. Wind erosion may be anticipated when dry, fine-grained, non-cohesive soils are exposed to high velocity wind. To estimate the erosion potential of soils by wind the NRCS has considered soil characteristics such as soil texture, organic matter content, rock content, and mineralogy, and has categorized soils into Wind Erodibility Groups (WEGs), Groups 1 to 8. Group 1 soils are dominated by sands (coarse, fine, and very fine) and are extremely erodible, while Group 8 soils are typically stony or gravelly soils and are not as susceptible to wind erosion. The soil types in the project area are all NRCS WEG Group 3 which are moderately susceptible to wind erosion (USDA NRCS 2014).

Subsurface Conditions

As noted in the introduction to this section, the project area soil depths to unweathered bedrock range from 1 to more than 60 inches.
**Soil Corrosion Potential**

The NRCS mapping indicates that all the soils on the project site are rated low for concrete corrosion. The ratings for steel corrosion range from high in the Greenfield Series, moderate in the Hanford Series, and low in the Ramona and Vista Series. Laboratory testing was conducted on five near surface soil samples as part of the preliminary geotechnical report. The results of the preliminary tests indicate that Type II Portland Cement can be used in the concrete for the proposed project. The project plan is for using steel I-beams. Some protective measures may be necessary in project design to prevent corrosion of these beams.

**Naturally Occurring Asbestos**

Naturally occurring asbestos does not form in the sedimentary deposits found across most of the project site, and geologic mapping indicates that none would be expected to be present on the project site.

**Seismicity and Faults**

The term seismicity describes the effects of seismic waves that are radiated from an earthquake as it ruptures. While most of the energy released during an earthquake results in the permanent displacement of the ground, as much as 10 percent of the energy may dissipate immediately in the form of seismic waves. Seismic hazards are earthquake fault ground rupture and ground shaking (primary hazards) and liquefaction and earthquake-induced slope failure (secondary hazards).

Faults form in rocks when stresses overcome the internal strength of the rock, resulting in a fracture. Large faults develop in response to large, regional stresses operating over a long time, such as those stresses caused by the relative displacement between tectonic plates. According to the elastic rebound theory, these stresses cause strain to build up in the earth’s crust until enough strain has built up to exceed the strength along a fault and cause a brittle failure. The slip between the two stuck plates or coherent blocks generates an earthquake. Following an earthquake, strain will build once again until the occurrence of another earthquake. The magnitude of slip is related to the maximum allowable strain that can be built up along a particular fault segment. The greatest buildup in strain that is due to the largest relative motion between tectonic plates or fault blocks over the longest period of time will generally produce the largest earthquakes.

Faults are mapped to determine earthquake hazards since they occur where earthquakes tend to recur. A historic plane of weakness is more likely to fail under stress and strain than a previously unbroken block of crust. Therefore, faults area prime indicator of past seismic activity, and faults with recent activity are presumed to be the best candidates for future earthquakes. However, since slip is not always accommodated by faults that intersect the surface along traces, and since the orientation of stresses and strain in the crust can shift, predicting the location of future earthquakes is complicated. Earthquakes sometimes occur in areas with previously undetected faults or along faults previously thought inactive.

**Surface Rupture and Faulting**

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) is to regulate
development near active faults to mitigate the hazard of surface rupture. Faults in an Alquist-
Priolo Earthquake Fault Zone are typically active faults. As defined under the Alquist-Priolo Act,
an active fault is one that has had surface displacement within the Holocene epoch (the last
11,000 years); a potentially active fault is one that has had surface displacement during
Quaternary time (the last 1.6 million years); and an inactive fault is one that has had surface
placement prior to the Quaternary period.

The site is located in an active seismic area designated as Seismic Zone 4 by the 2001 edition of
the CBC. Major historic earthquakes felt in the vicinity of the project site have usually originated
from faults located outside the area. Table 3.6-2 lists significant earthquakes felt in the Lancaster
area and the estimated intensity of the ground shaking at the site based on the Modified
Mercalli Scale. A description of the Modified Mercalli Scale is included as Table 3.6-3.

The project site is not identified as being located in an Alquist-Priolo Fault Zone (Bryant and Hart
2007). There is no evidence of recent (i.e., Holocene) faulting on the project site and no active
faults are mapped near the project site (CGS 2010; International Conference of Building Officials
1998; USGS 2010) (also see Appendix E). However, the site is located in a seismically active area
and the potential for strong ground motion at the site is considered significant.

The active San Andreas Fault is located approximately 1.5 miles from the project site, parallel
with the southwest boundary. In addition to the San Andreas Fault, principal faults that could
produce damaging earthquakes in the area are the Sierra Madre-San Fernando, Garlock, Sierra
Nevada (Owens Valley) and the White Wolf faults.

The distance to the site and the magnitude of major earthquakes in the area since 1850 are
summarized in Table 3.6-2.

Table 3.6-2: Major Earthquakes and Distance From Project Site

<table>
<thead>
<tr>
<th>Earthquake (Fault)</th>
<th>Approx. Distance to Epicenter (miles)</th>
<th>Earthquake Magnitude*</th>
<th>Estimated Intensity at Site **</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fort Tejon (San Andreas)</td>
<td>96</td>
<td>8.0</td>
<td>VII</td>
<td>1857</td>
</tr>
<tr>
<td>Owens Valley (Sierra Nevada)</td>
<td>142</td>
<td>7.6</td>
<td>VI</td>
<td>1872</td>
</tr>
<tr>
<td>Arvin-Tehachapi (White Wolf)</td>
<td>47</td>
<td>7.5</td>
<td>VII</td>
<td>1952</td>
</tr>
<tr>
<td>San Fernando (San Fernando)</td>
<td>18</td>
<td>6.6</td>
<td>VI</td>
<td>1971</td>
</tr>
<tr>
<td>Whittier</td>
<td>43</td>
<td>5.9</td>
<td>IV</td>
<td>1987</td>
</tr>
<tr>
<td>Landers</td>
<td>111</td>
<td>7.3</td>
<td>V</td>
<td>1992</td>
</tr>
<tr>
<td>Northridge</td>
<td>33</td>
<td>6.7</td>
<td>V</td>
<td>1994</td>
</tr>
<tr>
<td>Hector Mine</td>
<td>115</td>
<td>7.1</td>
<td>V</td>
<td>1999</td>
</tr>
</tbody>
</table>

*Moment Magnitude
**Modified Mercalli Scale
Source: ESSC 2007
Ground-Shaking Hazard

The project site is located in a region of California characterized by strong ground shaking as a result of regional earthquakes (International Conference of Building Officials 1998). The severity of ground shaking depends on several variables including earthquake magnitude, distance to the epicenter, local geology, thickness of rock strata, seismic wave-propagation properties of unconsolidated materials, groundwater conditions, and topographic setting. Ground shaking hazards are most pronounced in areas near faults or with unconsolidated alluvium.

Based on observations of damage from recent earthquakes in California (e.g., San Fernando 1971, Whittier-Narrows 1987, Landers 1992, Northridge 1994), ground shaking is responsible for 70 to 100 percent of all earthquake damage. The most common type of damage from ground shaking is structural damage to buildings, which can range from cosmetic stucco cracks to total collapse. The overall level of structural damage from a nearby large earthquake would likely be moderate to heavy, depending on the characteristics of the earthquake, the type of ground, and the condition of the building. Besides damage to buildings, strong ground shaking can cause severe damage from falling objects or broken utility lines. Fire and explosions are also hazards associated with strong ground shaking.

While Richter magnitude provides a useful measure of comparison between earthquakes, the moment magnitude is more widely used for scientific comparison since it accounts for the actual slip that generated the earthquake. Actual damage is due to the propagation of seismic or ground waves as a result of initial failure, and the intensity of shaking is as much related to earthquake magnitude as it is to the condition of underlying materials. Loose materials tend to amplify ground waves, while hard rock can quickly attenuate them, causing little damage to overlying structures. For this reason, the Modified Mercalli Intensity (MMI) Scale provides a useful qualitative assessment of ground shaking. The MMI Scale is a 12 point scale of earthquake intensity based on local effects experienced by people, structures, and earth materials. Each succeeding step on the scale describes a progressively greater amount of damage at a given point of observation. The MMI Scale is shown in Table 3.6-3, along with relative ground velocity and acceleration.

Table 3.6-3: Modified Mercalli Intensity Scale

<table>
<thead>
<tr>
<th>Richter Magnitude</th>
<th>Modified Mercalli Intensity</th>
<th>Effects</th>
<th>Average Peak Ground Velocity</th>
<th>Average Peak Acceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1–0.9</td>
<td>I</td>
<td>Not felt. Marginal and long-period effects of large earthquakes</td>
<td>―</td>
<td>―</td>
</tr>
<tr>
<td>1.0–2.9</td>
<td>II</td>
<td>Felt by only a few persons at rest, especially on upper floors of building. Delicately suspended objects may swing.</td>
<td>―</td>
<td>―</td>
</tr>
<tr>
<td>Richter Magnitude</td>
<td>Modified Mercalli Intensity</td>
<td>Effects</td>
<td>Average Peak Ground Velocity</td>
<td>Average Peak Acceleration</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>3.0–3.9</td>
<td>III</td>
<td>Felt quite noticeable indoors, especially on upper floors of building, but many people do not recognize it as an earthquake. Standing cars may rock slightly. Vibration similar to a passing truck. Duration can be estimated.</td>
<td>—</td>
<td>0.0035–0.007 g</td>
</tr>
<tr>
<td>4.0–4.5</td>
<td>IV</td>
<td>During the day, felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensations like heavy truck striking building. Standing cars rocked noticeably.</td>
<td>1–3</td>
<td>0.015–0.035 g</td>
</tr>
<tr>
<td>4.6–4.9</td>
<td>V</td>
<td>Felt by nearly everyone, many awakened. Some dishes, windows, broken; cracked plaster in a few places; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.</td>
<td>3–7</td>
<td>0.035–0.07 g</td>
</tr>
<tr>
<td>5.0–5.5</td>
<td>VI</td>
<td>Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of falling plaster and damaged chimneys. Damage slight.</td>
<td>7–20</td>
<td>0.07–0.15 g</td>
</tr>
<tr>
<td>5.6–6.4</td>
<td>VII</td>
<td>Everyone runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well built, ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving cars.</td>
<td>20–60</td>
<td>0.15–0.35 g</td>
</tr>
<tr>
<td>Richter Magnitude</td>
<td>Modified Mercalli Intensity</td>
<td>Effects</td>
<td>Average Peak Ground Velocity</td>
<td>Average Peak Acceleration</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>6.5–6.9</td>
<td>VIII</td>
<td>Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monument walls, and heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving in cars disturbed.</td>
<td>60–200</td>
<td>0.35–0.7 g</td>
</tr>
<tr>
<td>7.0–7.4</td>
<td>IX</td>
<td>Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.</td>
<td>200–500</td>
<td>0.7–1.2 g</td>
</tr>
<tr>
<td>7.5–7.9</td>
<td>X</td>
<td>Some well-built structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Railway lines bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed, slopped over banks.</td>
<td>200–500</td>
<td>&gt;1.2 g</td>
</tr>
<tr>
<td>8.0–8.4</td>
<td>XI</td>
<td>Few, if any, masonry structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
From Table 3.6-2, it appears that the past maximum intensity of historic earthquakes felt in the Lancaster area due to regional faults has been on the order of VIII on the MMI Scale. According to this scale, a 7.9+ earthquake occurring on the local San Andreas Fault would have a VIII intensity rating. Intense ground shaking lasting at least 60 seconds is anticipated. Aftershocks with magnitudes up to 7.0 are expected (ESSC 2007).

**Estimates of Earthquake Shaking**

In the project area the primary seismic threat from earthquakes is groundshaking, which can also include the secondary (indirect) threat of fire by damaging or destroying natural gas or electrical utility lines. The intensity of ground shaking depends on several factors, including the magnitude of the earthquake, distance from the earthquake epicenter (point of the earth directly above the focus of the earthquake), and underlying soil conditions.

According to the California Department of Conservation, California Geologic Survey (CGS), Seismic Hazard Evaluation of the Del Sur Quadrangle, portions of the project site could be subject to intense shaking associated with a large earthquake along the San Andreas Fault. The project site could be subjected to ground accelerations between 0.50g and 0.70g.

**Liquefaction and Associated Hazards**

Ground failure includes liquefaction and the liquefaction-induced phenomena of lateral spreading and lurching.

Liquefaction is a process by which sediments below the water table temporarily lose strength during an earthquake and behave as a viscous liquid rather than a solid. Liquefaction is restricted to certain geologic and hydrologic environments, primarily recently deposited sand and silt in areas with high groundwater levels. The process of liquefaction involves seismic waves passing through saturated granular layers, distorting the granular structure, and causing the particles to collapse. This causes the granular layer to behave temporarily as a viscous liquid, resulting in liquefaction.

Liquefaction can cause the soil beneath a structure to lose strength, which may result in the loss of foundation-bearing capacity. This loss of strength commonly causes the structure to settle or tip. Loss of bearing strength can also cause light buildings with basements, buried tanks, and foundation piles to rise buoyantly through the liquefied soil.
Lateral spreading is lateral ground movement, with some vertical component, caused by liquefaction. In effect, the soil rides on top of the liquefied layer. Lateral spreading can occur on relatively flat sites with slopes less than 2 percent, under certain circumstances, and can cause ground cracking and settlement.

Lurching is the movement of the ground surface toward an open face when the soil liquefies. An open face could be a graded slope, stream bank, canal face, gully, or other similar feature.

Poorly consolidated, water-saturated fine sands and silts having low plasticity and located within 40 feet of the ground surface are typically considered to be the most susceptible to liquefaction. Soils and sediments that are not water saturated and that consist of coarser or finer materials are generally less susceptible to liquefaction. Geologic age also influences the potential for liquefaction. Sediments deposited within the most recent millennia are generally more susceptible to liquefaction than older Holocene sediments; Pleistocene sediments are even more resistant; and pre-Pleistocene sediments are generally immune to liquefaction (CGS 2008).

Figure 3.6-3 shows areas of the USGS Del Sur, CA Quadrangle subject to liquefaction. These areas include three narrow lenses near the southwest corner of the project site. Based on the limited site exploration, the shallow alluvial soils encountered at the site consist of sands that are in a medium dense to dense state. Static groundwater depths from the boring performed for the geotechnical investigation are greater than 50 feet. Where groundwater levels are greater than 50 feet deep, it is generally thought that surface damage from deeper liquefaction will not occur. Based on the relatively dense nature of the soils and the depth to groundwater, the potential for liquefaction, dynamic compaction, or seismically induced settlement or bearing loss is considered low even with a high ground shaking hazard.

**Static and Seismically Induced Slope Failures**

Landslides and other forms of slope failure form in response to the long-term geologic cycle of uplift, mass wasting, and disturbance of slopes. Mass wasting refers to a variety of erosional processes from gradual downhill soil creep to mudslides, debris flows, landslides and rock fall. These processes are commonly triggered by intense precipitation, which varies according to climactic shifts. Various forms of mass wasting are grouped together as landslides, which are generally used to describe the downhill movement of rock and soil.

Geologists classify landslides into types that reflect differences in the type of material and movement. The four most common types of landslides are translational, rotational, earth flow, and rock fall. Debris flows are another common type of landslide similar to earth flows, except that the soil and rock particles are coarser. Mudslide is a term that appears in nontechnical literature to describe a variety of shallow, rapidly moving earth flows.

The preliminary geotechnical investigation and field reconnaissance did not identify any slope failure concerns (Appendix E). No areas of landslide hazards were identified in the CGS Seismic Hazard Zone Report for the Del Sur 7.5 Minute Quadrangle. No other indications of slope instability such as seeps or springs were observed.
3.6.3 Environmental Impacts

This section analyzes the proposed project’s potential to result in significant impacts related to geology and soils. When an impact was determined to be significant, mitigation measures were identified that would reduce or avoid that impact.

Methodology for Analysis

Impacts related to geology, soils, and seismicity were assessed based on the preliminary geotechnical report prepared for the project site (Appendix E) and other available data (maps, soil surveys, etc.).

This analysis focuses on the proposed project’s potential to increase the risk of personal injury, loss of life, and damage to property as a result of existing geologic conditions within the project site. Seismic and geologic hazards are determined to be significant under CEQA if their related effects pose a substantial risk of damage to structures or pose a substantial human health threat. The criteria used to evaluate significance do not require the elimination of the potential for structural damage from the site’s geologic and seismic conditions. Rather, the criteria require evaluation of whether site conditions can be overcome through engineering design solutions that reduce the substantial risk to people and structures to an acceptable level. The evaluation considers whether conformance with existing codes and standards, and application of accepted, proven construction engineering practices, would reduce the substantial risk to structures or to people.

Thresholds of Significance

According to the CEQA Guidelines’ Appendix G Environmental Checklist, the following questions were analyzed and evaluated to determine whether impacts to geology and soils were significant. Would the proposed project:

- 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? Refer to Division of Mines and Geology Special Publication 42.
  - Strong seismic ground shaking?
  - Seismic-related ground failure, including liquefaction?
  - Landslides?

- Result in substantial soil erosion or the loss of topsoil?

- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?

- 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?

The following question was determined to have no impact during the Notice of Preparation Scoping. This issue is summarized in Section 4, Effects Found Not To Be Significant, and is not discussed further in this section.

- 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?

### 3.6.3.1 Project Impact Analysis and Mitigation Measures

#### Earthquakes

**Impact GEO-1**  
The project would not 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.

#### Impact Analysis

The project site is not identified as being located in an Alquist-Priolo Fault Zone (Bryant and Hart 2007), and the International Conference of Building Officials (ICBO) recognizes no seismic sources in the immediate project area (International Conference of Building Officials 1998). There is no evidence of recent (i.e., Holocene) faulting within the project site and no active faults are mapped at or near the project site (CGS 2010; USGS 2010) (also see Appendix E). The San Andreas Fault is located about 1.5 miles from the project site; however, based on the aforementioned references the project site itself is not subject to surface rupture hazard and there would be no significant impact.

In addition to the low hazard of surface fault rupture, this impact is considered less than significant because the applicant is required to implement IEEE, International Building Code (IBC), and California Building Standards Code (CBSC) standards into the project design for applicable features to minimize the potential fault rupture hazards on associated project features. Structures must and will be designed to meet the regulations and standards associated with the IEEE, IBC, and the CBSC. Although the proposed project would be located in an area that may experience strong groundshaking due to large local or regional earthquakes, the proposed project would be designed as required by CPUC General Order 131-D (Planning and construction of Facilities for the Generation of Electricity and Certain Electric Transmission Facilities), and the gen-tie line and associated structures would be designed as required by California Public Utilities Commission (CPUC) General Order 128 (Rules for Construction of Underground Electric Supply and Communication Systems). Current standard design practices for substation and similar facilities also would include design recommendations in the Institute of
Electrical and Electronic Engineers guidelines IEEE 693 (Recommended Practices for Seismic Design of Substations). Design of these new facilities and structures to the above referenced guidelines and standards would reduce the impact of any potential damage from groundshaking to these features to a less than significant level. This will ensure that impacts will be less than significant.

The ground-shaking hazard in the project area is high and a large earthquake on a nearby fault could cause substantial ground shaking at the project site, potentially resulting in an increased risk of structural loss, injury, or death. However, implementation of the proposed project would not change the intensity of the ground shaking that would occur in the project area during a seismic event. Personnel present during construction and operation of the proposed project would not be exposed to substantially increased seismic hazards as a result of the proposed project beyond those that generally exist in the entire region.

As part of the design process described above, the applicant is required to implement IEEE, IBC, and CBSC standards into the project design for applicable features to minimize the potential ground-shaking hazards on associated project features. Additionally, the number of onsite employees using any buildings would be very low thereby minimizing exposure. These factors would ensure that impacts would be less than significant.

Liquefaction and related hazards such as lateral spreading and differential settlement have the potential to compromise the structural integrity of proposed new facilities and cause injury to construction workers and residents. However, based on the 2007 geotechnical study conducted at the project site, the geologic age of the earth materials, average relative density of the subsurface material, groundwater conditions, and anticipated ground-shaking hazard for the project site, the potential for liquefaction, dynamic compaction, or seismically induced settlement or bearing loss is considered low. Please refer to Impact GEO-3 for a further discussion of unstable geologic conditions onsite. Furthermore, as part of the design process described above, the applicant is required to implement IEEE, IBC, and CBSC standards into the project design for applicable features to minimize the potential liquefaction hazards on associated project features. This would ensure that impacts would be less than significant.

Due to the absence of permanently elevated groundwater table, the relatively low seismicity and the relatively shallow depth to rock, the potential for seismically induced slope instability is considered negligible even though there is a high ground-shaking hazard. This impact is considered less than significant.

In brief, due to the absence of permanently elevated groundwater table, the relatively shallow depth to rock, and the lack of onsite surface faults, the potential for seismically induced damage due to liquefaction, surface ruptures, and settlement is considered negligible. For the abovementioned reasons mitigation (other than conformance to IEEE, IBC, and CBSC standards) for these potential hazards is not necessary in the geographic vicinity of the proposed project. Finally, the soils of the project site are classified as Site Class C in accordance with Table 1613.5.2 of the 2010 California Building Standards Code for Seismic Design purposes, as recommended by the geotechnical consultants (Appendix E).

**Level of Significance Before Mitigation**
Less Than Significant Impact.

**Mitigation Measures**

No mitigation is necessary.

**Level of Significance After Mitigation**

Less Than Significant Impact.

**Soil Erosion or Topsoil Loss**

| Impact GEO-2 | The proposed project would not result in substantial soil erosion or the loss of topsoil. |

**Impact Analysis**

Implementation of the proposed project would result in short-term, construction-related and operational activities. The preliminary stages of construction, especially site grading and excavation, would leave loose soil exposed to the erosive forces of rainfall and high winds. Minimal grading would be performed on the project site because the current topography is suitable for the placement of solar panels with minimal site preparation or improvements for roadway and access points. Existing vegetation would be mowed and grubbed in minimal areas, and the soil surface would be smoothed and compacted to prepare the roadway surface. Excavation would be required for activities such as trenching for gen-tie lines, underground wiring and cables and preparing equipment pads for the switching stations. All excavations are anticipated to be relatively shallow.

Excavation and grading on the project site would be limited to preparation of the structure pads, below-grade utility trenching and compaction of internal roads. The percentage of excavation and grading area represents a small portion of the overall site, thereby retaining the existing topsoil.

Grading, excavation, removal of vegetation cover, and loading activities associated with construction could temporarily increase erosion, runoff, and sedimentation. Construction activities also could result in soil compaction and wind erosion effects that could adversely affect soils at the construction sites and staging areas. Implementation of Mitigation Measure HYD-1 would reduce the potentially significant impact of temporary, short-term construction-related erosion.

**Wind Erosion**

Due to the proposed project’s location within the Antelope Valley, the project site could generate dust emissions, particularly when disturbed. Numerous factors existing in the region contribute to this condition including high winds, arid conditions, sparse vegetation, and surface soils characteristics. The soils on the project site are classified as NRCS WEG 3. Although the proposed project would minimize on site grading, the installation of proposed facilities, including roads, fencing, and solar arrays, could result in erosion and soil loss if not properly mitigated.
Wind erosion caused by the proposed project is an issue addressed in the air quality analysis due to the potential for wind erosion to cause increases in fugitive dust emissions (PM10 and PM2.5). As described in Section 3.3, Air Quality and Greenhouse Gases, potential increases in fugitive dust emissions would be controlled by the fugitive dust control plan during construction and operation activities, watering of graded areas, vehicle speed limits, and minimization of the disturbance to the extent feasible. The analysis provided in Section 3.3, Air Quality and Greenhouse Gases, is applicable to the issue of soil loss via wind erosion, and the BMP proposed in that section is effective at reducing potential impacts from wind erosion.

**Water Erosion**

The generally flat topography of the site and the low average annual precipitation for the area would reduce the likelihood of substantial water erosion and loss of topsoil. Daily operations and routine maintenance are not anticipated to increase erosion, since the level of activity at the project site would be very low. Therefore, operational impacts would be less than significant.

The above discussion of Impact GEO-2 applies to project construction. As discussed in Section 3.8, Hydrology and Water Quality, project use, maintenance, and rainstorm events over the course of project operation would not have the potential to cause soil erosion events (see Impact HYD-3).

**Level of Significance Before Mitigation**

Less Than Significant Impact.

**Mitigation Measures**

Mitigation measures for Impact GEO-2 are covered in other sections of this Draft EIR pertaining to air quality and hydrology. These include AQ-1 through 4 and HYD-1.

**Level of Significance After Mitigation**

Less Than Significant Impact.

**Unstable Geologic Location**

| Impact GEO-3 | The proposed project would not be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse. |

**Impact Analysis**

Severe ground shaking can cause loose, saturated, subsurface materials to liquefy. Earthquakes are the cause of most documented cases of liquefaction. The potential for liquefaction at the project site is considered to be low due to the absence of shallow groundwater (<40 feet) and the medium-dense to dense soils.
The CGS Seismic Hazards Zone Map for the Del Sur Quadrangle indicates there are potential liquefaction zones associated with the historic washes at three areas along the southwestern border of the project site (Figure 3.6-3 Liquefaction Zones). These liquefaction zones are less than 2.6% of the project area and fall within the historic washes. The project design calls for a minimum setback of 7 feet from the edge of existing drainages to the edge of access roads where feasible. Additionally, due to the absence of permanently elevated groundwater table and the density of the soils, the potential for seismically induced slope instability is considered less than significant with mitigation. Although liquefaction zones have been mapped in the project area, the proposed development should not result in increased risk of or exposure to liquefaction or other seismic-related ground failures, based on information from the on-site geotechnical study. California statutes require that cities and counties use mapped liquefaction zones as part of their construction permitting process; following City permitting requirements will be necessary in design and construction of the proposed project. As a result, the proposed project will have a less than significant impact.

**Level of Significance Before Mitigation**

Potentially Significant Impact.

**Mitigation Measures**

**MM GEO-1:** For those parts of the proposed project to be located in mapped liquefaction zones, design and construct project in compliance with applicable local permitting requirements for construction within liquefaction zones.

**Level of Significance After Mitigation**

Less Than Significant Impact.

**Expansive Soil**

**Impact GEO-4** The project would not 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.

**Impact Analysis**

Soil complexes found on the project site have only low shrink-swell potential and do not include expansive soils. The impact is considered less than significant.

**Level of Significance Before Mitigation**

Less Than Significant Impact.

**Mitigation Measures**

No mitigation is necessary.

**Level of Significance After Mitigation**
Less Than Significant Impact.

3.6.4 Cumulative Impacts

Construction in a seismically active region puts people and structures at risk from a range of earthquake-related effects, such as surface fault rupture, strong ground shaking, and landslides. However, as discussed in this section, various mechanisms are in place to reduce seismic-related risks from construction including seismic design standards promulgated by applicable building codes and ordinances which have been adopted by the City of Lancaster. Proposed project activities would not exceed acceptable risk of upset and therefore would not contribute considerably to the existing cumulative impact related to seismic hazards.

The proposed project would have minor cumulative effects with respect to soil erosion. Construction of the project under the action alternatives would include erosion control measures to reduce potential erosion effects. These controls would result in less than significant effect from soil erosion that would not contribute to cumulative regional effects.