4.6 GEOLOGY AND SOILS

This section provides an evaluation of the projects in relation to existing geologic and soils conditions within the study area. Information contained in this section is summarized from publications made available by the California Geological Survey (CGS) and site-specific geotechnical studies prepared by Landmark Consultants, Inc. (LCI), including a Preliminary Geotechnical and Geohazards Report for Mount Signal Solar Farm (LCI 2010a), a Preliminary Geotechnical and Geohazards Report for Calexico Solar Farm I (LCI 2011b), and a Preliminary Geotechnical and Geohazards Report for Calexico Solar Farm II (LCI 2011c). The preliminary reports prepared by LCI are included in Appendix G of this Environmental Impact Report (EIR).

4.6.1 Environmental Setting

The study area is located in the Colorado Desert Physiographic province of southern California. The dominant feature of the Colorado Desert province is the Salton Trough, a geologic structural depression resulting from large-scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity (LCI 2010a). Figure 4.6-1 illustrates the location of the study area in relation to regional faults and physiographic features.

The geologic conditions present within the County contribute to a wide variety of hazards that can result in loss of life, bodily injury, and property damage. Fault displacement is the principal geologic hazard affecting public safety in Imperial County. Strong ground shaking within the study area would most likely be caused by displacement along the San Andreas or San Jacinto Fault Zones and may result in secondary geologic hazards including: differential ground settlement, soil liquefaction, rock and mudslides, ground lurching, or ground displacement along the fault.

4.6.1.1 Regulatory Setting

This section identifies and summarizes Federal, State, and local laws, policies, and regulations that are applicable to the projects

Federal

Earthquake Hazards Reduction Act

In October 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. To accomplish this goal, the act established the National Earthquake Hazards Reduction Program (NEHRP). This program was substantially amended in November 1990 by the National Earthquake Hazards Reduction Program Act (NEHRPA), which refined the description of agency responsibilities, program goals, and objectives.

The mission of NEHRP includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved building codes and land use practices; risk reduction through post earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. The NEHRPA designates the Federal Emergency Management Agency as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities. Other NEHRPA agencies include the National Institute of Standards and Technology, National Science Foundation, and United States Geological Survey (USGS).

State

Alquist-Priolo Special Studies Zone Act (1972)

The Alquist-Priolo Special Studies Zone Act (AP Act) was passed into law following the destructive February 9, 1971 San Fernando earthquake. The AP Act provides a mechanism for reducing losses from surface fault rupture on a statewide basis. The intent of the AP Act is to ensure public safety by prohibiting the siting of most structures for human occupancy across traces of active faults that constitute a potential hazard to structures from surface faulting or fault creep. The State Geologist (Chief of the California Division of Mines and Geology) is required to identify "earthquake fault zones" along known active faults in California. Counties and cities must withhold development permits for human occupancy projects within these zones unless geologic studies demonstrate that there would be no issues associated with the development of a project. Based on a review of maps produced by the California Geologic Survey, no faults are mapped under the AP Act within the project study area (Hart 1997).

California Building Code

The California Building Standards Commission is responsible for coordinating, managing, adopting, and approving building codes in California. In July 2007, the Commission adopted and published the 2006 International Building Code as the 2007 California Building Code (CBC). This new code became effective on January 1, 2008, and updated all the subsequent codes under the California Code of Regulations (CCR) Title 24. The State of California provides minimum standards for building design through the 2007 CBC (CCR, Title 24). Where no other building codes apply, Chapter 29 of the 2007 CBC regulates excavation, foundations, and retaining walls. The CBC applies to building design and construction in the state and is based on the Federal Uniform Building Code (UBC) used widely throughout the country (generally adopted on a state-by-state or district-by-district basis).

The 2007 CBC replaces the previous "seismic zones" (assigned a number from 1 to 4, where 4 required the most earthquake-resistant design) with new Seismic Design Categories A through F (where F requires the most earthquake-resistant design) for structures designed for a project sites. With the shift from seismic zones to seismic design, the CBC philosophy has shifted from "life safety design" to "collapse prevention," meaning that structures are designed for prevention of collapse for the maximum level of ground shaking that could reasonably be expected to occur at a site. Chapter 16 of the CBC specifies exactly how each seismic design category is to be determined on a site-specific basis through the site-specific soil characteristics and proximity to potential seismic hazards.

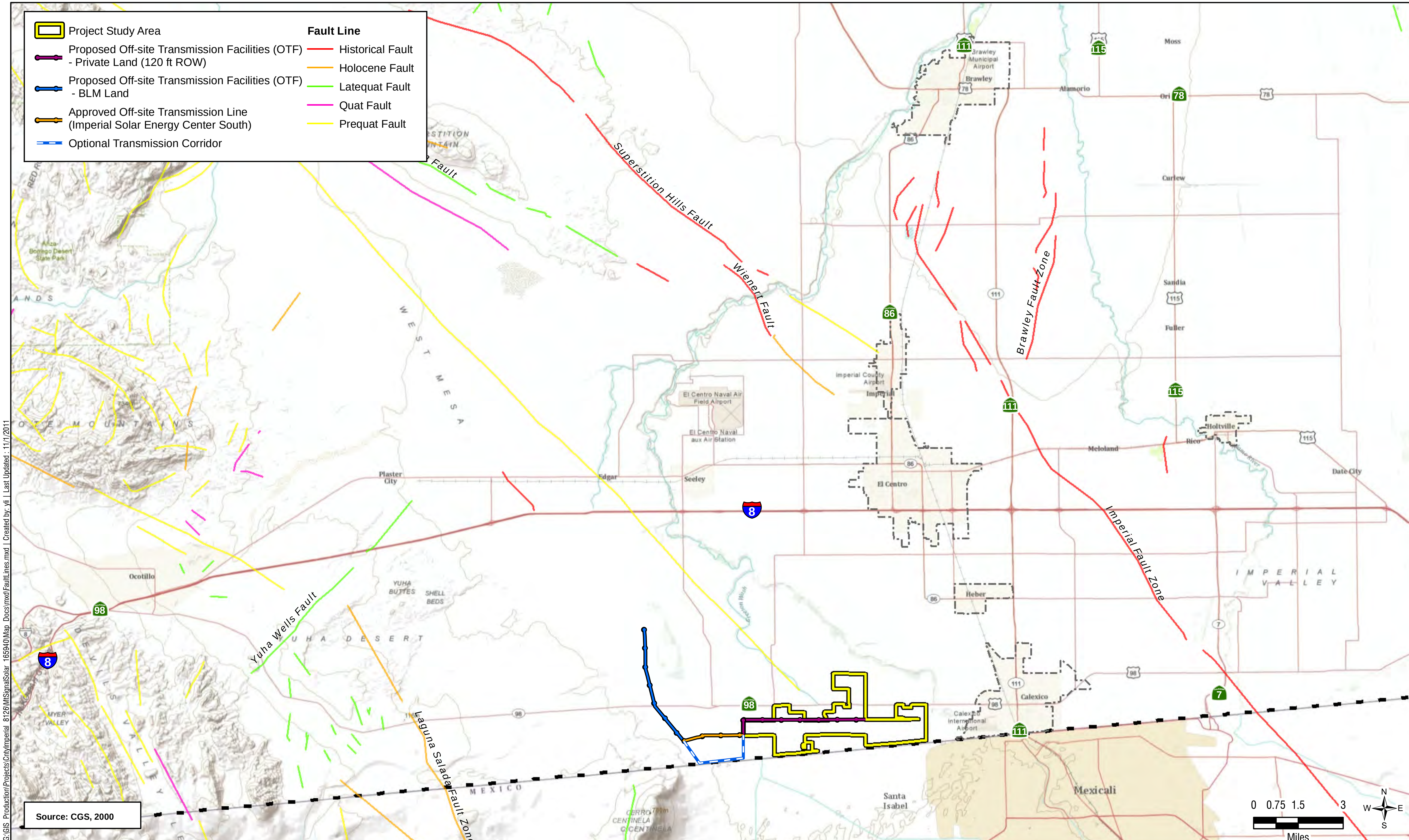
Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act aims to reduce the threat of seismic hazard to public health and safety by identifying and mitigating seismic hazards. Through the act, the California Department of Conservation, Division of Mines and Geology, is directed to delineate seismic hazard zones. State, County, and City agencies are directed to utilize such maps in land use and permitting processes. The act also requires geotechnical investigations particular to the site be conducted before permitting occurs on sites within seismic hazard zones. To date, a Seismic Hazards Map has not been prepared for areas encompassing the project study area.

Local

County of Imperial General Plan

The Seismic and Public Safety Element identifies goals and policies that will minimize the risks associated with natural and human-made hazards. The purpose of the Seismic and Public Safety Element is directly concerned with reducing the loss of life, injury, and property damage that might result from disaster or accident. Additionally, known as the Imperial Irrigation District Lifelines, the Imperial Irrigation District (IID) has formal Disaster Readiness Standard Operating Procedure for the Water Department, Power Department, and the entire District staff for response to earthquakes and other



G:\GIS_Production\Projects\Cnty\Imperial_8126\MtSignalSolar_165940\Map_Docs\mxd\FaultLines.mxd | Created by: yli | Last Updated : 11/1/2011

Regional Faults

Figure 4.6-1

Imperial County | Mount Signal Solar Farm and Calexico I and II Solar Farms | EIR

HDR ONE COMPANY | Many Solutions™

emergencies. The Water Department cooperates with the Imperial County Office of Emergency Services (OES) and lowers the level in canals after a need has been determined, and only to the extent necessary.

Table 4.6-1 analyzes the consistency of the projects with specific policies contained in the County of Imperial General Plan associated with geology, soils, and seismicity.

TABLE 4.6-1. PROJECT CONSISTENCY WITH APPLICABLE GENERAL PLAN SEISMIC AND PUBLIC SAFETY POLICIES

General Plan Policies	Consistency with General Plan	Analysis
1) Implement codified ordinances and procedures which require the review and restriction of land use due to possible natural hazards.	Yes	Division 5 of the County Land Use Ordinance has established procedures and standards for development within earthquake fault zones. Per County regulations, construction of buildings intended for human occupancy which are located across the trace of an active fault are prohibited. An exception exists when such buildings located near the fault or within a designated Special Studies Zone are demonstrated through a geotechnical analysis and report not to expose a person to undue hazard created by the construction. Since the project study area is located in a seismically active area, all proposed structures are required to be designed in accordance with the California Building Code (CBC) for near source factors derived from a Design Basis Earthquake (DBE) based on a peak ground acceleration (PGA) of 0.47 gravity (g) (LCI, 2010(a)). In addition, the only habitable structures would be the O&M buildings, which would contain 4 to 6 employees. In considering these factors in conjunction with mitigation requirements outlined in the impact analysis, the risks associated with seismic hazards would be minimized. Preliminary geotechnical reports have been prepared by LCI for the proposed projects. The preliminary geotechnical reports have been referenced in this environmental document. Additionally, design-level geotechnical investigations will be conducted to evaluate the potential for site specific hazards associated with seismic activity.
2) Monitor, evaluate, and analyze existing seismic and geological data as it pertains to Imperial County to determine future regulations and programs.		
3) Implement the geologic hazards section of the County's Codified Ordinances pursuant to the requirements of the Alquist-Priolo Geologic Hazards Zone Act.		
4) Ensure that no structure for human occupancy, other than one-story wood frame structures, shall be permitted within fifty feet of an active fault trace as designated on maps compiled by the State Geologist under the Alquist-Priolo Geologic Hazards Zone Act.		
5) The County should require suppliers of all existing utilities which cross active faults to file with the County an operation plan describing the probable effects of failures at the fault and the various emergency facilities and procedures which exist to assure that failure does not threaten public safety.		
6) Ensure that proposed highway construction which falls within an Alquist-Priolo Act Special Studies Zone shall be reviewed to ensure that grade-separated interchange structures are not located on or near an active fault.		
7) Periodically update maps of existing faults, slide areas, and other geographically unstable areas in the unincorporated area of the County.		
8) Support the safety awareness efforts of the Office of Emergency Services of Imperial County and other agencies through public information and educational activities.		
9) Continue to implement the Alquist-Priolo requirements in designated special study zones in the Imperial County Ordinance.		

Source: County of Imperial General Plan, Seismic and Public Safety Element 1993.

4.6.1.2 Existing Conditions

Geology

Topography within the study area is relatively flat and primarily characterized by a level elevation. Elevations within the boundaries of the Mount Signal Solar Farm 1 (MSSF1) site range from 15 feet below mean sea level (MSL) to 9 feet below MSL (LCI 2011a). The topography characterizing the Calexico Solar Farm 1, Phase A and B (CSF1(A) and (B)) and Calexico Solar Farm 2, Phase A and B (CSF2(A) and (B)) site locations is even more uniform with the ground surface situated at a consistent elevation of approximately 15 feet below MSL.

The project study area, including the MSSF1, CSF1(A) and (B), and CSF2(A) and (B) sites, are directly underlain by Holocene-aged[1] Cahuilla Lake sediments, which consist of interbedded lenticular and tabular silt, sand, and clay (LCI 2010a). The predominant surface soil is a silty clay material. At depth, these materials transition to late Pleistocene[2] to Holocene-aged lake deposits that are expected to be less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed Lake Cahuilla (LCI 2010a). Basement rock consisting of Mesozoic[3] granite and Paleozoic[4] metamorphic rocks are estimated to exist at depths between 15,000 to 20,000 feet below the ground surface (LCI 2010a).

Seismicity

Earthquakes are the result of an abrupt release of energy stored in the earth. This energy is generated from the forces which cause the continents to change their relative position on the earth's surface, a process called “continental drift.” The earth's outer shell is composed of a number of relatively rigid plates which move slowly over the comparatively fluid molten layer below. The boundaries between plates are where the more active geologic processes take place. Earthquakes are an incidental product of these processes. As a result, southern California is located in a considerably seismically active region as the Pacific Plate moves northward relative to the North American Plate at their boundary along the San Andreas Fault System. There are a number of faults considered to be active in southern California. The faults/fault zones within the vicinity of and surrounding the project study area include (but are not limited to) the Brawley, Wienent, Imperial, Laguna Salada, Superstition Hills Faults (Figure 4.6-1).

Ground Shaking

Ground shaking is the byproduct of an earthquake and is the energy created as rocks break and slip along a fault (Christenson 1994). The amount of ground shaking that an area may be subject to during an earthquake is related to the proximity of the area to the fault, the depth of the hypocenter (focal depth), location of the epicenter and the size (magnitude) of the earthquake. Soil type also plays a role in the intensity of shaking. Bedrock, or other dense or consolidated materials are less prone to intense ground shaking than soils formed from alluvial deposition. The project study area is within ten miles of an active fault.

The probability of earthquake occurrences and their associated peak ground accelerations for the study area has been estimated (LCI 2011). A probabilistic seismic hazard assessment is typically expressed in terms of probability of exceeding a certain ground motion. The peak ground accelerations (PGA) estimate for the design basis earthquake (DBE), defined as having a 10% probability of being exceeded in 50 years, was estimated at 0.47 g. The PGA estimate for the maximum creditable earthquake (MCE),

---

[1] The Holocene is a geological epoch which began at the end of the Pleistocene (around 11,700 years ago) and continues to the present.

[2] The Pleistocene is the epoch from 2,588,000 to 11,700 years before present. The end of the Pleistocene corresponds with the end of the last glacial period.

[3] The Mesozoic epoch extends from 251 to 65.5 million years before present.

[4] The Paleozoic epoch extends from 542 to 251 million years before present.

which is defined as having a 2% probably of being exceeded in 50 years, is estimated at 0.68 g. (LCI 2010a).

Surface Rupture

Surface rupture occurs when movement along a fault results in actual cracking or breaking of the ground along a fault during an earthquake. However, it is important to note that not all earthquakes result in surface rupture. Surface rupture almost always follows preexisting fault traces, which are zones of weakness. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. Fault creep is the slow rupture of the earth's crust. Sudden displacements are more damaging to structures because they are accompanied by shaking. No faults mapped under the Alquist-Priolo (AP) Act are within the project study area (Hart 1997). Therefore, surface rupture due to faulting within the project study area is not expected to occur and hazards related to rupture along a known earthquake fault are considered unlikely (LCI 2010a).

Liquefaction

Liquefaction occurs when granular soil below the water table is subjected to vibratory motions, such as those produced by earthquakes. With strong ground shaking, an increase in pore water pressure develops as the soil tends to reduce in volume. If the increase in pore water pressure is sufficient to reduce the vertical effective stress (suspending the soil particles in water), the soil strength decreases and the soil behaves as a liquid (similar to quicksand). Liquefaction can produce excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations. Four conditions are generally required for liquefaction to occur: (1) the soil must be saturated (relatively shallow groundwater); (2) the soil must be loosely packed (low to medium relative density); (3) the soil must be relatively cohesionless (not clayey); and (4) groundshaking of sufficient intensity must occur to function as a trigger of mechanism. Some of these conditions exist to some degree at one or more locations in the project study area and, therefore, the risk of liquefaction occurring during a seismic event is considered moderate and is discussed further in the impact analysis (LCI 2010a).

Landslides

A landslide refers to a slow to very rapid descent of rock or debris caused by natural factors such as the pull of gravity, fractured or weak bedrock, heavy rainfall, erosion and earthquakes. The project study area is located on relatively flat topography with a low range in elevation. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during site visits conducted by LCI (LCI 2010a).

Hydrocollapse

Hydrocollapse occurs when soils collapse as a result of being saturated with water. The project study area is dominantly underlain by clays that are not expected to collapse with the addition of water to the site and, therefore, the risk of hydro-collapse is considered very low (LCI 2010a).

Total and Differential Settlement

Settlement can occur both uniformly and differentially (i.e., where adjoining areas settle at different rates). Typically, areas underlain by artificial fills, unconsolidated alluvial sediments, and slope wash, and areas with improperly engineered construction fills are susceptible to this type of settlement. Settlement of the ground surface can be accelerated and accentuated by earthquakes. During an earthquake, settlement can occur as a result of the relatively rapid compaction and settling of subsurface materials (particularly loose, non-compacted, and variable sandy sediments) due to the rearrangement of soil particles during prolonged ground shaking. Given the extensive agricultural use within the project study area, transitions between compacted and non-compacted surfaces could present implications for utility infrastructure in the project study area and is discussed further in the impact analysis.

Regional Subsidence

Subsidence refers to the downward shifting motion relative to geologic units. Regional subsidence has not been documented in the area west of Calexico; therefore the risk of regional subsidence is considered low (LCI 2010a).

Volcanic Hazards

The project study area is located over 400 miles from Mono Lake/Long Valley volcanic areas. Therefore, the risk to the project study area from volcanic hazards is extremely low. For this reason, this issue is not discussed further in this EIR.

Soil Resources

Figure 4.6-2 identifies the soil resources within the project study area. As shown in Figure 4.6-2, there are predominantly six soil types that comprise the MSSF1, CSF1(A) and (B), and CSF2(A) and (B) site locations. The six predominant soil types within the boundaries of the project study area are described below (NRCS 2008):

Glenbar silty clay loam, 0 to 3 percent slopes: The Glenbar series consists of very deep well drained soils that formed in stratified stream alluvium. These soils occur on flood plains and alluvial fans. These soils are well drained, runoff is medium to slow, and permeability is moderately slow.

Holtville silty clay, 0 to 3 percent slopes: The Holtville Series consists of very deep, well drained soils formed in mixed and stratified alluvium. Holtville soils occur on flood plains and basins. These soils are well drained, runoff is low, and permeability is slow.

Imperial silty clay, 0 to 2 percent slopes: The Imperial series is derived from clayey alluvium mixed sources and/or clayey lacustrine deposits derived from mixed sources. These soils are moderately well drained, runoff is slow or very slow, and permeability is very slow.

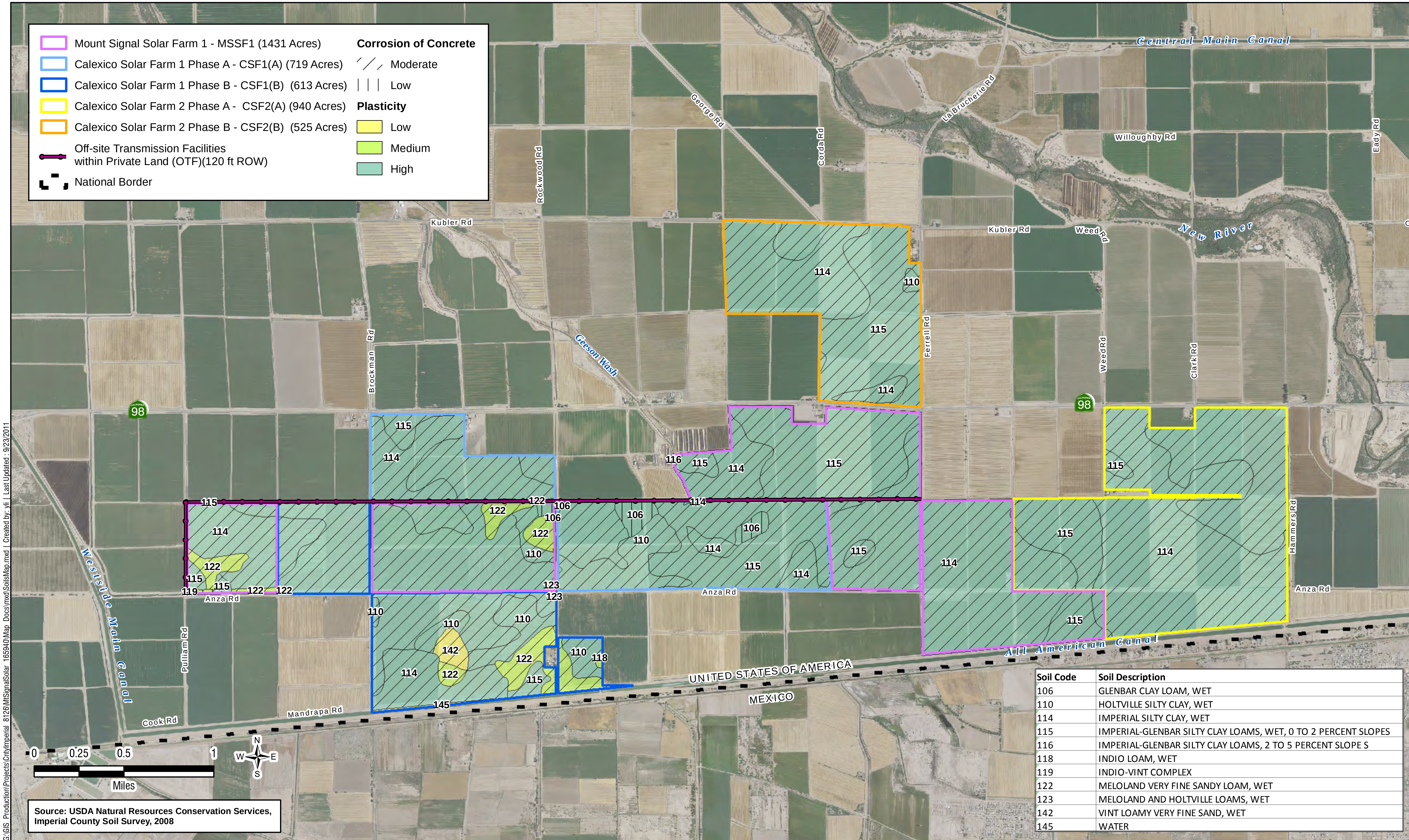
Imperial-Glenbar silty clay loam, 0 to 2 percent slopes: The Imperial series is derived from clayey alluvium mixed sources and/or clayey lacustrine deposits derived from mixed sources. These soils are well drained, runoff is slow, and permeability is slow.

Meloland very fine sandy loam, 0 to 1 percent slopes: The Meloland soils are naturally well drained, but commonly have perched water tables under irrigation. Surface runoff is low or medium, and permeability is slow. Tile drains have been used extensively to improve drainage and remove salts in irrigated soils.

Vint loamy fine sand, 0 to 3 percent slopes: The Vint series consists of very deep, soils formed in stratified stream alluvium. Vint soils occur on flood plains. Vint soils are somewhat excessively drained, runoff is very slow, and permeability is moderately rapid.

Soil-Related Hazards

The physical properties of the soil base can greatly influence improvements constructed upon them. As an example, expansive soils are largely comprised of clays, which greatly increase in volume when water is absorbed and shrink when dried. This movement may result in the cracking of foundations for aboveground, paved roads, and concrete slabs. Clayey and silty clay soils occur throughout the project study area, including the MSSF1 site and have a high expansion potential (see Figure 4.6-2).



Soil Code	Soil Description
106	GLENBAR CLAY LOAM, WET
110	HOLTVILLE SILTY CLAY, WET
114	IMPERIAL SILTY CLAY, WET
115	IMPERIAL-GLENBAR SILTY CLAY LOAMS, WET, 0 TO 2 PERCENT SLOPES
116	IMPERIAL-GLENBAR SILTY CLAY LOAMS, 2 TO 5 PERCENT SLOPE S
118	INDIO LOAM, WET
119	INDIO-VINT COMPLEX
122	MELOLAND VERY FINE SANDY LOAM, WET
123	MELOLAND AND HOLTVILLE LOAMS, WET
142	VINT LOAMY VERY FINE SAND, WET
145	WATER

G:\GIS_Production\Projects\CntyImperial_8126\MtSignalSolar_165940\Map_Docs\mxd\SoilsMap.mxd | Created by: yli | Last Updated : 9/23/2011

Soils Map

Figure 4.6-2

These clayey materials are generally comprised within one or more soil horizons within the upper five feet of the soil profile. Similarly, corrosive soils can damage underground utilities including pipelines and cables, and can weaken roadway structures. Soils within project study area are classified as moderately corrosive to concrete and steel (see Figure 4.6-2) (NRCS 2008). These hazards are discussed further in the impact analysis.

4.6.2 Impacts and Mitigation Measures

This section presents the significance criteria used for considering project-related land used compatibility impacts and consistency with applicable planning documents, the methodology employed for the evaluation, and mitigation requirements, if necessary.

4.6.2.1 Thresholds of Significance

Based on California Environmental Quality Act (CEQA) Guidelines Appendix G and the professional judgment of the County's staff and environmental consultants, the project would result in a significant impact on the environment if it would:

- Expose people or structures to potential substantive 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 the latest UBC, creating substantial risks to life or property; or
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water.

4.6.2.2 Methodology

This analysis evaluates the potential for the projects, as described in Chapter 3, Project Description, to interact with local geologic and soil conditions in the project study area. Based on the extent of these interactions, this analysis considers whether these conditions would result in an exceedance of one or more of the applied significance criteria as identified above.

As indicated in the environmental setting, three separate Geotechnical and Geologic Hazards Reports have been prepared which cover the MSSF1, CSF1(A) and (B), and CSF2(A) and (B) site locations. These reports are included as Appendix G of this EIR. The analysis prepared for this EIR also relied on NRCS soil survey data ("Web Soil Survey"), and published geologic literature and maps. The information obtained from these sources was reviewed and summarized to present the existing conditions and to identify potential environmental impacts, based on the significance criteria presented in this section.

Impacts associated with geology and soils that could result from project construction and operational activities were evaluated qualitatively based on site conditions; expected construction practices; materials, locations, and duration of project construction and related activities; and a field visit. Conceptual site plans for the projects were also used to evaluate potential impacts. These conceptual exhibits are provided in Figures 3.0-4 through 3.0-6 and 3.0-9 through 3.0-13.

4.6.2.3 Impact Analysis

IMPACT 4.6-1	**Possible Risks to People and Structures Caused by Strong Seismic Ground Shaking.** The project study area is located in an area of moderate to high seismic activity and, therefore, project-related structures could be subject to damage from seismic ground shaking and related secondary geologic hazards.

PP, MSSF1, CSF1(A), CSF1(B), CSF2(A), CSF2(B), OTF

The project study area would likely experience at least one major earthquake (greater than moment magnitude 6 on the Richter scale) within the next 30 years, which is within the expected useful life of the projects. The closest mapped active faults in the region include: the Laguna Salada fault, located approximately 15 miles west of the project sites; the Cerro Prieto, located approximately 10 miles south of the projects; the Imperial Fault zone, located approximately 12 miles east of the project study area; and the Superstition Hills fault zone located approximately 10 miles north of the project study area (see Figure 4.6-1). In the event of an earthquake along one of these fault sources, seismic hazards related to ground motion could occur in susceptible areas within the project study area. The intensity of such an event would depend on the causative fault and the distance to the epicenter, the moment magnitude, and the duration of shaking. Given the estimated PGA of 0.47 to 0.68 g (LCI 2010a), ground motions within the project study area could cause moderate structural damage to older structures, but damage would be less in newly constructed structures.

Even with the integration of building standards, ground shaking within the project study area could cause some structural damage to the facility structures or, at least, cause unsecured objects to fall. During a stronger seismic event, ground shaking could expose employees to injury from structural damage or collapse of electrical distribution facilities. Given the potentially hazardous nature of the project facilities (e.g. danger from electrocution), the potential impact of ground motion during an earthquake is considered **significant** as proposed structures could be damaged, such as the O&M buildings.

Based on the underlying geology, generally consisting of cohesive soil materials (e.g., plastic silts and clays which bond together), the potential for liquefaction to occur during the expected peak ground acceleration is considered low. However, given the proximity of several active faults and the presence of a shallow (or perched) groundwater table, additional geotechnical investigation would be required to confirm the liquefaction hazards within the project study area. Without additional geotechnical investigation, the potential for ground-related failures, such as ground lurching, differential settlement or lateral spreading, during a seismic event remain an inherent, significant risk to the projects. However, provided prudent geotechnical engineering recommendations are followed during site preparation in conjunction with the implementation of the prescribed mitigation, these effects would be reduced to a level **less than significant**.

The project study area is not located on an active fault or within a designated AP Zone and, therefore, the potential for ground rupture to occur within the project study area is unlikely. Similarly, in the context of the flat topography within the project study area, the potential for earthquake induced landslides to occur at the site is unlikely. For these reasons, **no significant impact** has been identified associated with these geologic issues.

Mitigation Measure(s)

The following mitigation measure is required for PP, MSSF1, CSF1(A), CSF1(B), CSF2(A), CSF2(B), and OTF.

4.6-1 Prepare Geotechnical Report(s) for the Projects and Implement Required Measures. Facility design for all project components shall comply with the site-specific design recommendations as provided by a licensed geotechnical or civil engineer to be retained by the project applicant. The final geotechnical and/or civil engineering report shall address and make recommendations on the following:

- Site preparation;
- Soil bearing capacity;
- Appropriate sources and types of fill;
- Potential need for soil amendments;
- Road, pavement, and parking areas;
- Structural foundations, including retaining-wall design;
- Grading practices;
- Soil corrosion of concrete and steel;
- Erosion/winterization;
- Seismic ground shaking;
- Liquefaction; and
- Expansive/unstable soils.

In addition to the recommendations for the conditions listed above, the geotechnical investigation shall include subsurface testing of soil and groundwater conditions, and shall determine appropriate foundation designs that are consistent with the version of the CBC that is applicable at the time building and grading permits are applied for. All recommendations contained in the final geotechnical engineering report shall be implemented by the project applicant.

Significance After Mitigation

With the implementation of the above mitigation measure, potential impacts from strong seismic ground-shaking would be reduced to a less than significant level through the implementation of recommendations made by a licensed geotechnical engineer in compliance with the CBC prepared as part of a formal geotechnical investigation.

IMPACT 4.6-2	**Unstable Geologic Conditions.** The project could be located on a geologic unit or soil that is unstable, or that could become unstable as a result of the project.

PP, MSSF1, CSF1(A), CSF1(B), CSF2(A), CSF2(B), OTF

Based on the discussions provided for geologic hazards within the setting description, the primary concerns related to local geologic conditions is related to settlement and differential settlement. Settlement could potentially occur from the placement of new static loads with possibly half of the settlement taking place during construction or shortly thereafter. Differential settlement could occur between foundation blocks or slabs due to variability in underlying soil conditions. Total and differential settlement could therefore damage proposed foundations, structures, and utilities. Additionally, although unlikely, regional subsidence could cause potential damage to structures designed with minimal tolerance for settlement. Therefore, these direct and indirect impacts are considered significant and require mitigation with implementation of Mitigation Measure 4.6-1. With implementation of the mitigation measures listed above, geologic hazards in terms of total and differential settlement would be reduced to a **less than significant** level, because a licensed geotechnical or soils engineer would investigate the site-specific soil conditions and design the facilities to withstand settlement in accordance with the CBC.

Mitigation Measure(s)

No additional mitigation measures beyond 4.6-1 are required.

IMPACT 4.6-3	**Construction-Related Erosion.** Construction activities during project implementation would involve grading and movement of earth in soils subject to wind and water erosion as well as topsoil loss.

PP, MSSF1, CSF1(A), CSF1(B), CSF2(A), CSF2(B), OTF

During the site grading and construction phases, large areas of bare soil would be exposed to erosive forces by water for long periods of time. Bare soils are much more likely to erode from precipitation than vegetated areas because these areas can not disperse, infiltrate, and retain water as they could with vegetation present. Construction activities involving soil disturbance, excavation, cutting/filling, stockpiling, and grading activities could result in increased erosion and sedimentation to surface waters. If precautions are not taken to contain contaminants, construction could produce sediment-laden stormwater runoff (nonpoint source pollution), a major contributor to the degradation of water quality. Construction related erosion impacts could be significant in the absence of mitigation.

Mitigation Measure(s)

No additional mitigation measures beyond 4.6-1 are required.

Over the long-term and when compared to the environmental baseline, the projects are not expected to result in substantial soil erosion or the loss of topsoil given the existing agricultural use of the subject properties and the use of a ground cover while the solar facility is in operation. Under existing conditions, lands within the project study area are actively used for irrigated agriculture and are worked for planting and harvesting of crops. Under the projects, these lands would be covered with a combination of PV solar arrays and a cover crop or soil stabilizer used in between the solar arrays. This management approach would be less intense as compared to the baseline condition, and would effectively cover over 90% of project study area. Additionally, harvesting activities remove much of the crop residue off-site, thereby exposing the soil surface to increased erosion potential. Under the projects, the quantity of groundcover would likely experience a net increase, since no crop residue would be exported off-site.

Further, the project applicant would be required to implement on-site erosion control measures in accordance with County standards, which require the preparation, review and approval of a grading plan by the County Engineer. Given these considerations and the fact that the encountered soil types have a low to moderate erosion potential, the project's long term impact in terms of soil erosion and loss of topsoil would be **less than significant**. With implementation of Mitigation Measure 4.9-1 in Chapter 4.9, Hydrology/Water Quality, erosion from construction activities related to the off-site water facilities would be reduced to a **less than significant** level because a Storm Water Pollution Prevention Plan (SWPPP) would be prepared and Best Management Practices (BMPs) would be implemented to reduce erosion from the construction site.

IMPACT 4.6-4	**Exposure to Potential Hazards from Problematic Soils.** The project could encounter expansive or corrosive soils thereby subjecting related structures to potential risk of failure.

PP, MSSF1, CSF1(A), CSF1(B), CSF2(A), CSF2(B), OTF

As provided in the environmental setting, soil materials within the project study area generally contain a high proportion of clay, which may exhibit a moderate to high potential for shrink-swell. Unless properly mitigated, shrink-swell soils could exert additional pressure on buried structures and electrical connections producing shrinkage cracks that could allow water infiltration and compromise the integrity of backfill material. These conditions could be worsened if structural facilities are constructed directly on expansive soil materials. Likewise, corrosive soil materials could lead to deterioration of structural concrete footings. These impacts would be **significant** as structures could be damage by these types of soils.

Mitigation Measure(s)

The following mitigation measure is required for PP, CSF1(A), CSF1(B), CSF2(A), CSF2(B), and OTF.

4.6-4 Implement Corrosion Protection Measures. As determined appropriate by a licensed geotechnical or civil engineer, the Applicant shall ensure that all underground metallic fittings, appurtenances, and piping include a cathodic protection system to protect these facilities from corrosion.

Significance After Mitigation

With implementation of the mitigation measure listed above, soil-related hazards in terms of expansive and corrosive soils would be reduced to a less than significant level because a licensed geotechnical or soils engineer would investigate the site-specific soil conditions and design the facilities to withstand expansive soil pressures and soil corrosivity.

IMPACT 4.6-5	On-site Wastewater Treatment and Disposal. The on-site wastewater treatment system could violate water quality standards, waste discharge requirements, or otherwise degrade surface and groundwater quality.

PP, MSSF1, CSF1(A), CSF1(B), CSF2(A), CSF2(B)

As described in the setting discussion, the six predominant soil types found within the project study area consist of silty clays and clays that have a very low to low infiltration rate and thus, are considered poor in supporting on-site septic systems and leach fields for wastewater disposal. The project applicant is proposing the use of a standard on-site septic tank and leach field for the treatment and disposal of on-site generated sanitary wastewater. This would occur only at the O&M buildings. As described in Chapter 3, the wastewater system would be designed to meet standard construction requirements and operations and maintenance guidelines required by Imperial County laws, ordinances, regulations and standards to ensure that soils are capable of supporting the use of septic tanks.

Notwithstanding these design requirements, potential equipment failures or wastewater loading rates in excess of the design capacity of the treatment and disposal system could lead to water quality degradation. Additionally, the local soil survey notes that a shallow groundwater table is present throughout the project study area, which could render infiltration of wastewater into the soil column temporarily infeasible at certain times of the year. This would be a **significant** impact.

OTF

This project component would not require the installation of an on-site wastewater treatment and disposal system. For this reason, **no significant impact** is identified.

Mitigation Measure(s)

The following mitigation measure is required for CSF1(A), CSF1(B), CSF2(A), and CSF2(B).

4.6-5 Demonstrate Compliance with On-site Wastewater Treatment and Disposal Requirements. The project's wastewater treatment and disposal system(s) shall demonstrate compliance with the Imperial County performance standards as outlined in Title 9, Division 10, Chapters 4 and 12 of the Imperial County Code. Prior to construction, and again prior to operation, the applicant will obtain all necessary permits and/or approvals from the Imperial County Public Works Department. The project applicant shall demonstrate that the system adequately meets County requirements, which have been designed to protect beneficial uses and ensure that applicable water quality standards are not violated. This shall include documentation that the system will not conflict with the Regional Water Quality Control Board's (RWQCB) Anti-Degradation Policy.

4.6.3 Residual Impacts

With implementation of Mitigation Measures 4.6-1, 4.9-1, and 4.6-4, impacts related to strong seismic ground-shaking, construction-related erosion, soil hazards related to settlement and corrosion, would be reduced to less than significant levels. With the implementation of Mitigation Measure 4.6-5, impacts resulting from new on-site wastewater treatment and disposal systems would be reduced to a less than significant level. Restoration of the sites at the end of their use as solar fields would involve the removal of structures and the reintroduction of agricultural operations. No geology or soils impact associated with the restoration activities would be anticipated. Based on these circumstances, the projects would not result in residual significant and unmitigable impacts related to geology and soil resources.