4.6 GEOLOGY AND SOILS

This section provides an evaluation of the projects in relation to existing geologic and soils conditions within the project 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 Ferrell Solar Farm (FSF) (LCI 2013a), a Preliminary Geotechnical and Geohazards Report for Rockwood Solar Farm (RSF)(LCI 2013b), a Preliminary Geotechnical and Geohazards Report for Iris Solar Farm (ISF) (LCI 2013c), and a Preliminary Geotechnical and Geohazards Report for Lyons Solar Farm (LSF)(LCI 2013d). The preliminary reports prepared by LCI are included in Appendix G of this Environmental Impact Report (EIR).

4.6.1 Environmental Setting

The project sites are 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 2013a-d). Figure 4.6-1 illustrates the location of the project 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 project sites 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.

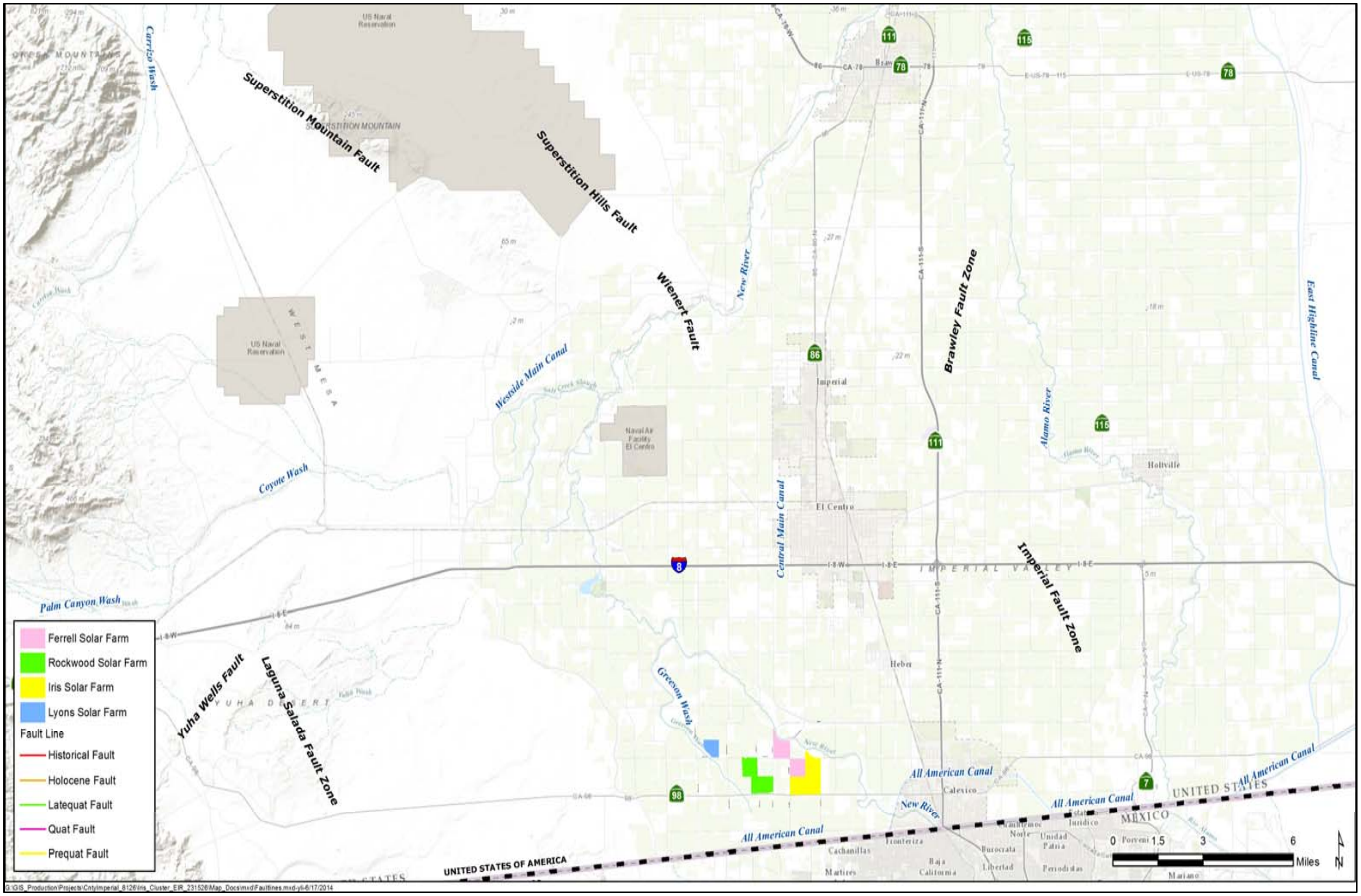
Federal

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).

Figure 4.6-1. Regional Faults



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 area (Hart 1997).

California Building Code

The California Building Standards Commission is responsible for coordinating, managing, adopting, and approving building codes in California. California Code of Regulations Title 24 (CCR Title 24) is reserved for state regulations that govern the design and construction of buildings, associated facilities and equipment, known as building standards. The California Health and Safety Code Section 18980 Health and Safety Code Section 18902 give CCR Title 24 the name of California Building Standards Code.

In July 2007, the Commission adopted and published the 2006 International Building Code as the 2007 California Building Code (CBC). This new code was updated on January 1, 2010, and updated all the subsequent codes under the California Code of Regulations (CCR) Title 24. The geotechnical report was based on the CBC 2010 version. . Where no other building codes apply, Part 1, Chapter 18 of the 2010 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. 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 sites.

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 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
Goal 1. Include public heath and safety considerations in land use planning.	Consistent	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 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 (operations & maintenance) buildings, which would employ up 24 full-time (up to six employees per site). 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.
Objective 1.1. Ensure that data on geological hazards is incorporated into the land use review process, and future development process.		
Objective 1.3. Regulate development adjacent to or near all mineral deposits and geothermal operations.		
Objective 1.4. Require, where possessing the authority, that avoidable seismic risks be avoided; and that measures, commensurate with risks, be taken to reduce injury, loss of life, destruction of property, and disruption of service.		
Objective 1.7. Require developers to provide information related to geologic and seismic hazards when siting a proposed project.		
Goal 2: Minimize potential hazards to public health, safety, and welfare and prevent the loss of life and damage to health and property resulting from both natural and human-related phenomena.		
Objective 2.2. Reduce risk and damage due to seismic hazards by appropriate regulation.		
Objective 2.5 Minimize injury, loss of life, and damage to property by implementing all state codes where applicable.		
Objective 2.8 Prevent and reduce death, injuries, property damage, and economic and social dislocation resulting from natural hazards including flooding, land subsidence, earthquakes, other geologic phenomena, levee or dam failure, urban and wildland fires and building collapse by appropriate planning and emergency measures.		

Source: County of Imperial General Plan, Seismic & Public Safety Element as amended through 2008

4.6.1.2 Existing Conditions

Geology

Topography within each of the project sites is relatively flat and primarily characterized by a level elevation. Elevations within the boundaries of the range from the highest elevation of 5 to 7 feet below mean sea level (BMSL) for the ISF, 8 to 10 BMSL for the FSF, 10 to 15 BMSL for the RSF, to 20 to 25 feet BMSL for the LSF (GS Lyon 2013).

The project area is directly underlain by lacustrine deposits, which consist of interbedded lenticular and tabular silt, sand, and clay. The predominant surface soil is a silty clay loams and sandy loams for the project area along the New River (FSF and ISF). At depth, these materials transition from late Pleistocene[1]- to Holocene[2]-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 2013a-d). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. 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 2013a-d).

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.

The project area is located in a seismically active region, with potential for strong ground shaking associated with earthquakes. The faults/fault zones within the vicinity of (15 miles) and surrounding the project sites include (but are not limited to) the Brawley Fault Zone, Imperial Fault Zone, Laguna Salada Fault Zone, Superstition Hills Fault, Superstition Mountain Fault, Wienert Fault, and the Yuha Wells Fault (Figure 4.6-1). According to the Preliminary Geotechnical and Geohazards Report, the nearest mapped earthquake fault zone is an unnamed fault located approximately 3 miles west of the LSF. This unnamed fault was recently identified and zoned after the April 4, 2010 magnitude 7.2 M_w El Mayor-Cucaph earthquake.

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 probability of earthquake occurrences and their associated peak ground accelerations for the project sites was estimated in the Preliminary Geotechnical and Geohazards Report (LCI 2013). A probabilistic seismic hazard assessment is typically expressed in terms of probability of exceeding a certain ground

[1] 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.
[2] The Holocene epoch extends from 11,700 years to present.
[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.

motion. The 2014 CBC general ground motion parameters are based on the Maximum Credible Earthquake (MCE) for a ground motion with a 2 percent probability of occurrence in 50 years. The site soils have been classified as Site Class D (stiff soil profile). Design earthquake ground motions are defined as the earthquake ground motions that are two-thirds of the corresponding MCE ground motions. The PGA value of 0.38g to 0.40g (force of gravity) was determined for liquefaction and seismic settlement analysis in accordance with 2010 CBC Section 1803.5.12 and CGS Note 49 (PGA = S_{DS}/2,5). The parameter S_{DS} is derived from the maximum considered earthquake spectral response acceleration for short periods.

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 traverse the project sites (LCI 2013a-d). Ground failures (lateral spreading) were noted along the embankments of the All American Canal after the April 4, 2010 magnitude 7.2 M_W El Mayor-Cucapah earthquake. However, surface rupture due to faulting within the project sites is not expected to occur and hazards related to rupture along a known earthquake fault are considered unlikely (LCI 2013a-d).

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. All of these conditions may exist to some degree within the project area. .

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 sites are 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 2013a-d).

Hydrocollapse

Hydrocollapse occurs when soils collapse as a result of being saturated with water. The project sites are 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 2013a-d).

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 sites, transitions between compacted and non-compacted surfaces could present implications for utility infrastructure in the project sites 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 2013a-d).

Volcanic Hazards

The project area is located 37 miles south of Salton Buttes, a lava dome located within the Salton Sea Geothermal Field (USGS Volcano Hazards Program). The geothermal system is fueled by heat emanating from zones of partially molten rock deep below the earth's surface. Eruptions occurring about 400,000 years ago were followed by a long lull in volcanic activity until about 18,000 years ago, and the most recent activity 9,000 years ago. According to the USGS, the available data are insufficient to establish a pattern of volcanic activity to determine the likelihood of eruption. The high heat flow from the area and the relatively young age of the Salton Buttes would indicate a potential for future eruptions.

Soil Resources

Figure 4.6-2 identifies the soil resources within the project sites. As shown in Figure 4.6-2, there are predominantly seven soil types that comprise the FSF, RSF, ISF, and LSF. The seven predominant soil types within the boundaries of the project area are described below (NRCS 2008):

Badland, (102) No slope listed: This steep to very steep miscellaneous area consists of barren land on unconsolidated, stratified alluvium, and is dissected by drainage ways.

Holtville silty clay (109 and 110), 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 (114), 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.

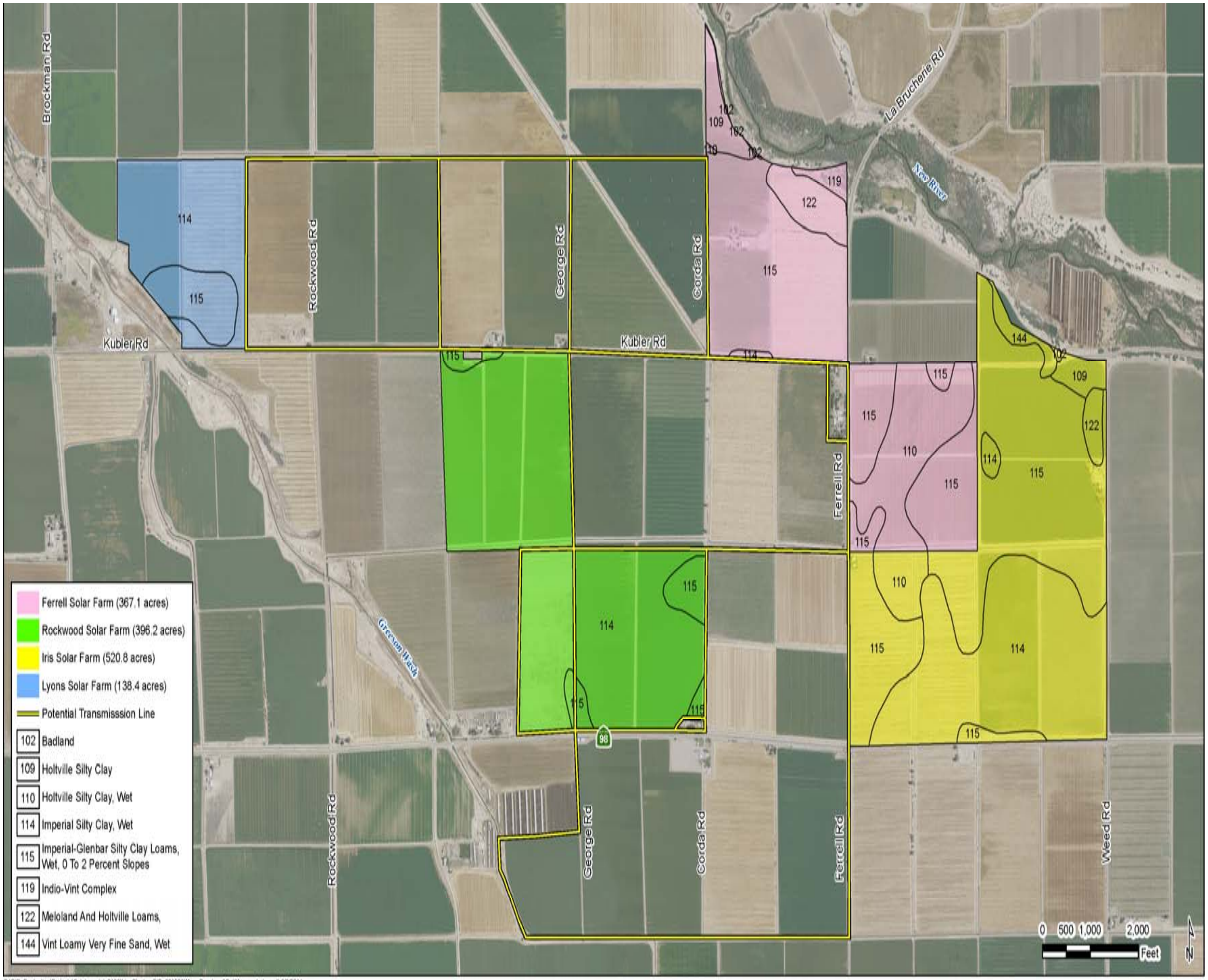
Imperial-Glenbar (115), silty clay loam, 0 to 2 percent slopes: The Imperial series is derived from clayey alluvium mixed sources and/or clayey lacustrine deposits derived from mixed sources. These soils are well drained, runoff is slow, and permeability is slow.

Indio Vint Complex (119), loamy fine sand, 0 to 3 percent slopes: These nearly level soils are on flood plains and alluvial basin floors. The unit averages about 35 percent Indio lam and 30 percent Vint loamy fine sand. The remaining 35 percent is Rositas, Meloland, and Holtville soils.

Meloland and Holtville loams (122), 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 very fine sand (144), 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.

Figure 4.6-2. Soils Map



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 area that have a severe shrink-swell potential for small buildings and roadways (see 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, these types of soils can be corrosive and damage underground utilities including pipelines and cables, or weaken roadway structures. Soils within project area are classified as moderately corrosive to concrete and steel (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 impacts related to geologic and soil conditions, the methodology employed for the evaluation, an impact evaluation, and mitigation requirements, if necessary.

4.6.2.1 Thresholds of Significance

Based on CEQA Guidelines Appendix G, project impacts related to geologic and soil conditions are considered significant if any of the following occur:

- 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 sites. 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 discussed above, four separate Geotechnical and Geologic Hazards Reports have been prepared which covers the FSF, RSF, ISF, and LSF. 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 3.0-6 through 3.0-9.

4.6.2.3 Impact Analysis

IMPACT 4.6-1 *Possible Risks to People and Structures Caused by Strong Seismic Ground Shaking.*

The project 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.

Iris Cluster (FSF, RSF, ISF, and LSF) and Transmission Line

The project area is located within a seismically active area and 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 to the project sites include: the Brawley Fault Zone (11.3 miles), Imperial Fault Zone (8.6 miles), Laguna Salada Fault Zone 11.3 miles), Superstition Hills Fault (9.9 miles), Superstition Mountain Fault (13.2 miles), Wienert Fault (8.5 miles), and the Yuha Wells Fault (13.5 miles) (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 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 0.38 to 0.40 g (LCI 2013a-d), ground motions within the project 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 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 a **significant impact**, as proposed structures, such as the O&M buildings and transmission lines could be damaged.

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 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. The potential impact to liquefaction is considered a **significant impact**.

No portion of the project area is located on an active fault or within a designated AP Zone and, therefore, the potential for ground rupture to occur within the project sites and off-site transmission area is unlikely. Ground failures (lateral spreading) were noted along the embankments of the All American Canal after the April 4, 2010 magnitude 7.2 M_W El Mayor-Cucapah earthquake. However, surface rupture due to faulting within the project area is not expected to occur and hazards related to rupture along a known earthquake fault are considered unlikely (LCI 2013a-d). Similarly, in the context of the flat topography within the project 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 the FSF, RSF, ISF, LSF, and transmission line.

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 and liquefaction 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 projects could be located on a geologic unit or soil that is unstable, or that could become unstable as a result of the projects.

Iris Cluster (FSF, RSF, ISF, and LSF) and Transmission Line

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, and the potential for volcanic hazards. 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 impacts** and require mitigation. Upon implementation Mitigation Measure 4.6-1 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.

The surrounding area has an identified lava dome, Salton Buttes, located 37 miles north of the project area. The surrounding area has a geothermal system that Imperial Irrigation District capitalizes on, by owning and operating several thermal generation facilities within their service territory. According to USGS, the most recent activity occurred 9,000 years ago. There is insufficient data to determine the likelihood of an eruption in the area; however, the high heat flow from the area and relatively young age of the Salton Buttes would indicate a potential for future eruptions. Given the nature of the uncertainty of an eruption and the distance from the lava dome to the projects, it is unlikely the projects would be impacted by a large volcanic eruption. Therefore, impacts related to volcanic hazards are considered **less than significant**.

Mitigation Measure(s)

No additional mitigation measures beyond Mitigation Measure 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.*

Iris Cluster (FSF, RSF, ISF, and LSF) and Transmission Line

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

The projects are not expected to result in substantial soil erosion or the loss of topsoil over the long-term given the existing agricultural uses. In addition, ground cover will be planted between the arrays for the life-span of the solar facility is operations. Under existing conditions, lands within the project 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 (or CPV) 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 percent of each of the four project sites. Additionally, harvesting activities remove much of the crop residue off-site, thereby exposing the soil surface to increased erosion potential. Upon implementation of 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 projects' long-term impact in terms of soil erosion and loss of topsoil would be **less than significant**. In addition, the implementation of Mitigation Measure 4.9-1 in Chapter 4.9, Hydrology/Water Quality, the potential **significant impact** associated with erosion from construction activities would be reduced to a **less than significant** level with the preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP), including Best Management Practices (BMPs) to reduce erosion from the construction site.

Mitigation Measure(s)

No additional mitigation measures beyond Mitigation Measure 4.9-1 are required.
Significance After Mitigation

With implementation of Mitigation Measure 4.9-1 in Chapter 4.9, Hydrology/Water Quality, potential impacts from erosion during construction activities would be reduced to a **less than significant** level with the preparation of a SWPPP and implementation of BMPs to reduce erosion from the construction site.

IMPACT 4.6-4 *Exposure to Potential Hazards from Problematic Soils.*

The projects could encounter expansive or corrosive soils thereby subjecting related structures to potential risk of failure.

Iris Cluster (FSF, RSF, ISF, and LSF) and Transmission Line

As provided in the environmental setting, soil materials within the project sites and off-site transmission area generally contain a high percentage 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 a **significant impact** as structures could be damage by these types of soils.

Mitigation Measure(s)

The following mitigation measure is required for the FSF, RSF, ISF, LSF, and transmission line.

4.6-4 **Implement Corrosion Protection Measures.** As determined appropriate by a licensed geotechnical or civil engineer, the project 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.

Iris Cluster (FSF, RSF, ISF, and LSF) and Transmission Line

As described in the setting discussion, the predominant soil types found within the project area consist of silty clays and clays that have a very low to low percolation rates 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. According to the County Conditional Use Permit applications for each of the projects, each project site will have its own on-site leach field. In the event that O&M buildings are shared, the leach field will be located at the site of the shared O&M building. 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 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**.

Mitigation Measure(s)

The following mitigation measure is required for the FSF, RSF, ISF, and LSF.

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 project 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 Anti-Degradation Policy.

Significance After Mitigation

With implementation of the mitigation measure listed above, potential impacts related to infiltration of wastewater into the soil column and water quality degradation would be reduced to a **less than significant** level through compliance with County performance standards.

4.6.3 Decommissioning/ Restoration and Residual Impacts

Decommissioning/Restoration

Decommissioning and 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 geologic or soil impacts associated with the restoration activities would be anticipated, and therefore, **no impact** is identified.

Residual

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, and 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. Based on these circumstances, the projects would not result in residual significant and unmitigable impacts related to geology and soil resources.