4.6 GEOLOGY AND SOILS

This section describes federal, State, and local regulations applicable to geology and soils. It also describes the existing environmental setting of the County with regard to the soils, seismicity, and geologic conditions. A discussion of geology and soil impacts is also provided, and mitigation measures are identified to address potential impacts.

4.6.1 Regulatory Setting

Federal Laws and Requirements

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 NEHRP designates the Federal Emergency Management Agency as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities. Other NEHRP agencies include the National Institute of Standards and Technology, National Science Foundation, and United States Geological Survey (USGS).

State Regulations and Policies

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 no issues would be associated with the development of a project.

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

(C.C.R.) Title 24. The State of California provides minimum standards for building design through the 2007 CBC (C.C.R., 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 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. The 2013 CBC is currently being used in the County of Imperial.

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.

Regional and Local Requirements

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 Procedures for the Water Department, Power Department, and the entire IID 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.

4.6.2 Existing Environmental Setting

Geology

Imperial County lies within the Imperial Valley, a region of the State of California that occupies lowland in southeastern California. Elevations in Imperial County range from 235 feet below sea level at the surface of the Salton Sea to 4,548 above mean sea level (amsl) at Blue Angel Peak. On average the elevation range in Imperial County is between 1,000 to 2,000 feet amsl.

Most of the central part of the Imperial Valley lies below sea level and drains northwest from Mexico to the Salton Sea. Mountain ranges within the western portion of the County include Superstition

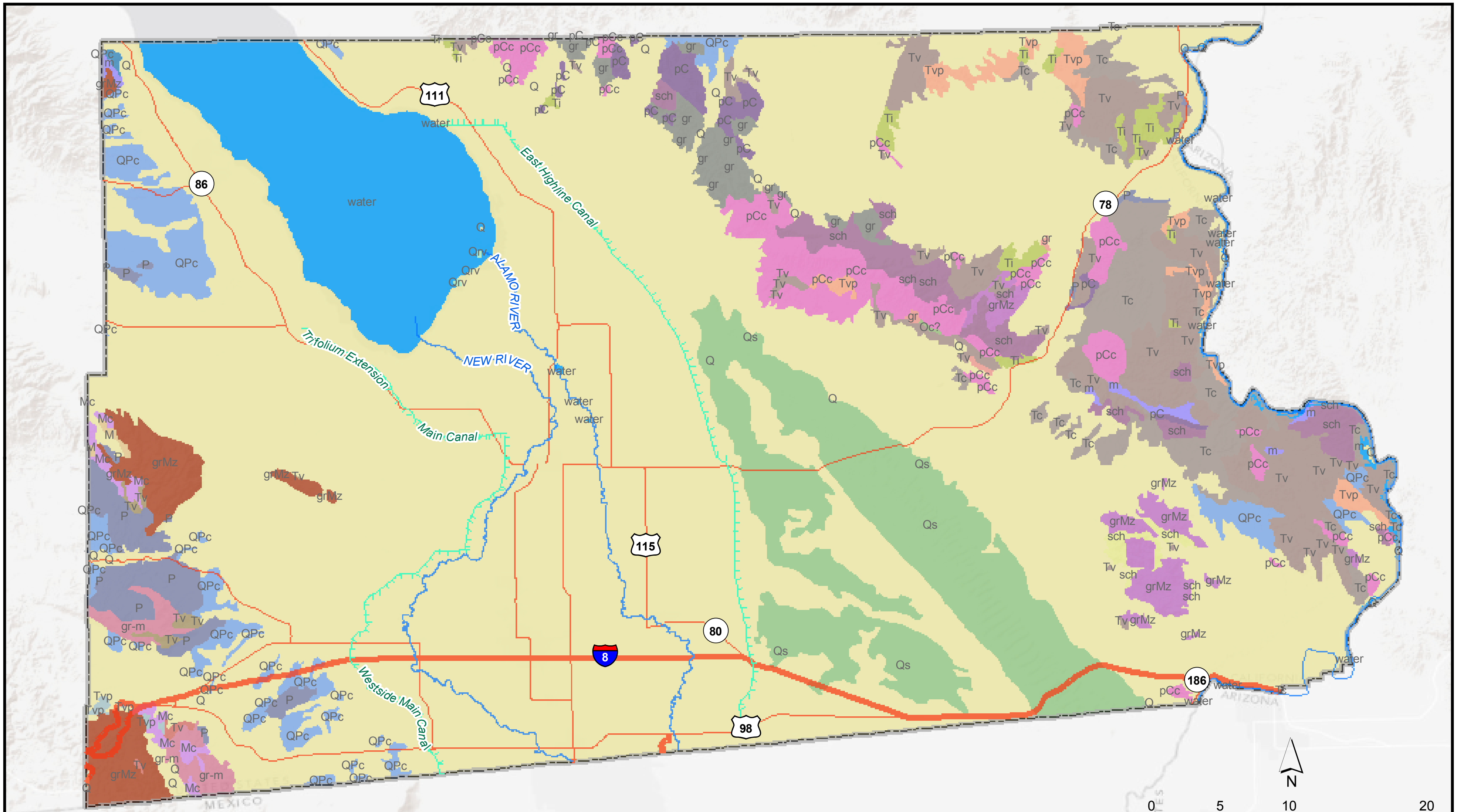
Mountain and the surrounding Superstition Hills and the Yuha Buttes. The eastern edge of the County encompasses the Algodones Sand Hills, a belt of sand dunes that expands through the County at approximately 5 miles wide and stretches 45 miles from the Mexican border to the Salton Sea. The area was once occupied by an inland sea known as Lake Cahuilla. The northeastern part of Imperial County includes several mountain ranges, including a northwest-by-southeast-trending mountain range known as the Chocolate Mountains, a low-level mountain chain that includes pre-Tertiary plutonic and metamorphic rocks. The mountain range generally reaches 2,500 feet in elevation. A smaller mountain range, the Cargo Muchacho Mountains, occurs between the San Hills and the Chocolate Mountains. Three smaller mountain chains occur north of the Chocolate Mountains: the Little Mule Mountains, the Black Hills, and the Palo Verde Mountains. Four low volcanic hills rise 100 feet above the Salton Sea lakebed along the southeast edge of the Salton Sea.

The mountains of Imperial County consist mainly of metamorphic and igneous rocks of pre- Cambrian to Tertiary age, and sediments in the intervening valleys are generally weakly consolidated to unconsolidated sediments of late Cenozoic age (Figure 4.6-1).

Imperial County can generally be divided into three geomorphic provinces: the Peninsular Range, the Salton Trough, and the Mojave Desert. Each of these provinces is a geologic feature with a distinct physiographic unit with a geologic history. The Salton Trough is the most significant of the three provinces, as it underlies a majority of Imperial County. Variously described as the Salton Sink, Cahuilla Basin, and Salton Basin, it is basically a northwestern landward continuation of the Gulf of California rift, which was formed by gradual settling in association with uplift of the surrounding mountains during the Miocene, Pliocene, and Pleistocene epochs. Much of the land surface within this province is below sea level, and the Trough trends from the southeast to the northwest. It is bounded on the northeast and east by the Chocolate and Cargo Muchacho mountains and on the southwest and west by the Jacumba, Coyote, Fish Creek, and Santa Rosa mountains.

An ancient shoreline nearly surrounds the Salton Trough. The shoreline has a major break roughly 14 miles wide at the southeast end. This breach has been the entrance point for large amounts of Colorado River water and for upstream sedimentary materials that were occasionally diverted from their historically normal flows south into the Gulf of California. An unexposed succession of Tertiary- and Quaternary-age sedimentary rocks lies below the alluvial and lake bottom sediment. These sediments have basement depths ranging from 15,400 to 11,000 feet at the east and west margins to over 20,000 feet in the central portions of the Salton Trough province.

The Salton Trough has experienced continual in-filling with both marine and nonmarine sediments since its formation in the Miocene epoch (30 million years before present). The specific stratigraphy incorporates Middle and/or Lower Pliocene marine, undivided Pliocene nonmarine, and Quaternary nonmarine terrace deposits. The Middle and/or Lower Pliocene marine deposits consist of light-gray claystone containing some arkosic sandstones, calcareous oyster-shell reefs, and fossiliferous calcareous sandstone. The undivided Pliocene nonmarine formations consist of interbedded arkosic sandstones and reddish clays. The Quaternary nonmarine terrace deposits are believed to be Pleistocene in age (see Figure 4.6-1).



Legend

Unit Age, Map Label

- Cretaceous(?) to Oligocene(?), Oc?
- Early Proterozoic to Cretaceous, m
- Early Proterozoic to Late Cretaceous, gr-m
- Early Proterozoic to Miocene, pC
- Early Proterozoic to Miocene, pCc
- Holocene, Qrv
- Holocene, water
- Jurassic(?) to Cretaceous(?), gr
- Jurassic(?), sch
- Late Cretaceous to Eocene, sch
- Middle Jurassic to Late Cretaceous, grMz
- Miocene to Pleistocene, P
- Miocene to Pleistocene, QPc
- Oligocene to Miocene, gr
- Oligocene to Pleistocene, Mc
- Oligocene to Pliocene, M
- Paleocene to Pliocene, Tc
- Paleozoic to Mesozoic, ls
- Permian to Tertiary; most Mesozoic, grMz
- Pliocene to Holocene, Q
- Quaternary, Qs
- Tertiary (12-19 Ma), Tv
- Tertiary (12-19 Ma), Tvp
- Tertiary (14-18 Ma), Tv
- Tertiary (8-28 Ma), Tv
- Tertiary (8-28 Ma), Tvp
- Tertiary, Ti

Figure 4.6-1
Imperial County Renewable Energy and Transmission Element Update PEIR
Geology of Imperial County

Name: 20674 EIR Fig 4.6-1 Geology.Mxd
Date Saved: 11/20/2014, Author: msimmons

The Imperial Formation is a geologic area that occurs within Imperial County and is exposed in the southeast Coyote Mountains on three major facies. Facies A includes shoreline deposits associated with alluvial fans. Facies B includes supratidal gypsum to low-tide terraces. Facies C includes siltstones and clays, indicating a filling of the Salton Trough by fine clastic material from the Colorado River (see Figure 4.6-1).

Rock units in Imperial County can be described as Precambrian. Rocks that are described as Precambrian in age are placed into two groups, the Chuckwalla complex and the Orocopia Schist. The rocks in the Chuckwalla complex include quartz biotite gneiss and various foliated hybrid granitic rocks and granophyres which range in composition from gabbro to granite. Rocks in the Orocopia Schist include weatherized mica-covered surfaces. The rock units are sericite-albite schist, quartz sericite schist, phyllite, and quartzite. Marble occurs in the schist in the Orocopia Mountains. Rock types or geological material known to occur within Imperial County include: Alluvium, Andesite, Basalt, Conglomerate, Dune Sand, Gneiss, Granodiorite, Limestone, Mica schist, Plutonic rock, Rhyolite, Sandstone, Schist, and Tonalite (Figure 4.6-2).

<u>Seismicity</u>

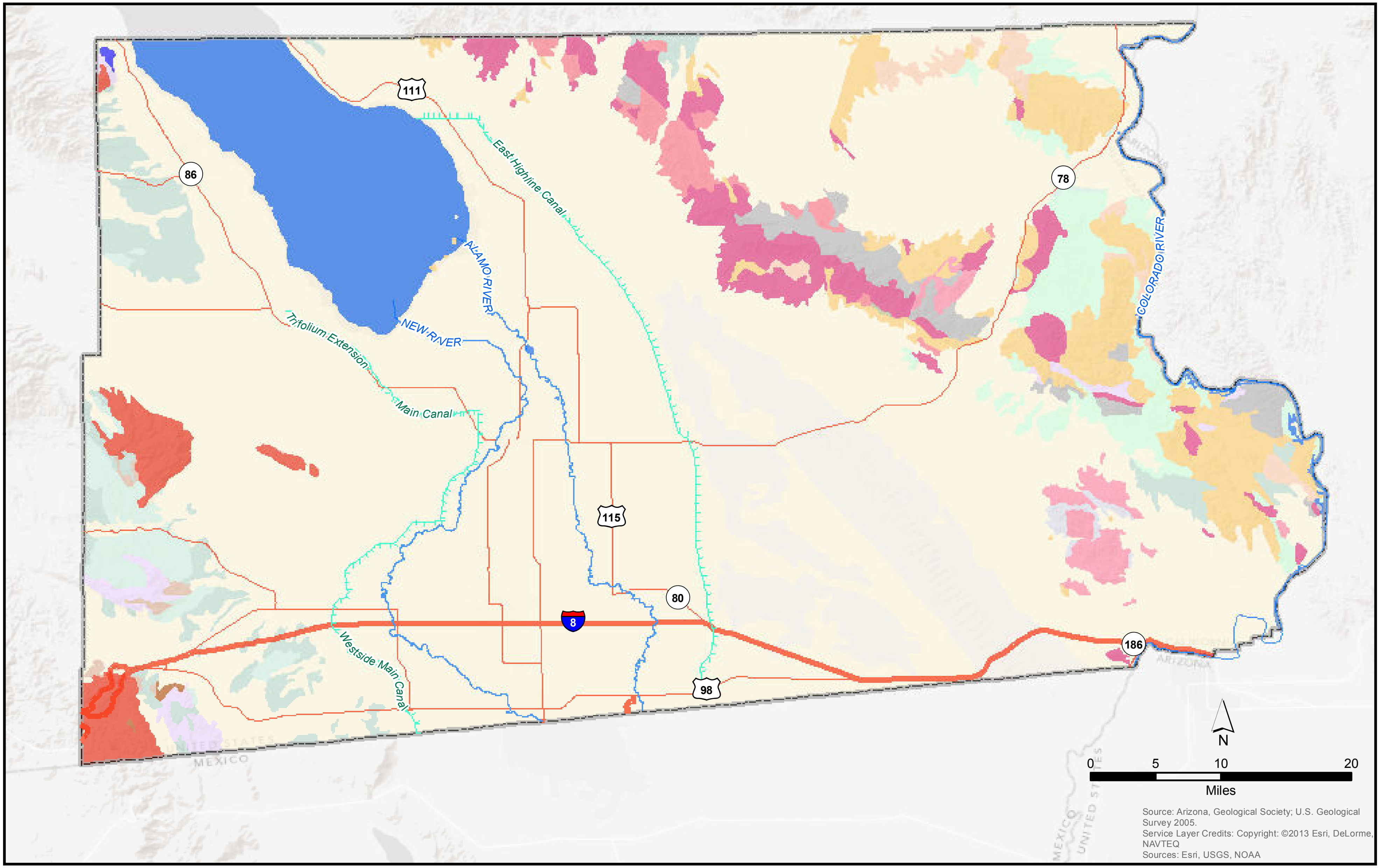
Similar to most areas of southern California, Imperial County is seismically active. Numerous active faults traverse the Salton Trough and the County. Figure 4.6-3 shows the known active and potentially active faults and epicenters of earthquakes that occurred within the last 100 years in the County. The most notable fault in the County is the San Andreas, extending northward from Mexico through the Imperial Valley and on into northern California. Other major, active faults are in the San Jacinto and Elsinore fault zones in the southwest and northwest portions of the County. These northwest-trending fault zones are extensive and are a major factor in determining the configurations of the land. In addition to these major active fault zones, a number of minor inactive faults are located within the County. These include (but are not limited to) the Brawley, Wienent, Imperial, Laguna Salada, and Superstition Hills faults.

<u>Surface Rupture</u>

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.

<u>Landslides</u>

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 majority of lands within the County are located on relatively flat topography and are not prone to seismically-induced landslides. Areas of moderate landslide activity are located in the western portions of Imperial County and include the Jacumba, Coyote, Fish Creek, and Santa Rosa mountains.



Legend

Rock Units

- Andesite
- Basalt
- Conglomerate
- Dacite
- Gneiss
- Granitoid
- Lake Or Marine Deposit (Non-Glacial)
- Marble
- Mica Schist
- Mudstone
- Plutonic Rock (Phaneritic)
- Quartz Diorite
- Quartz Monzonite
- Rhyolite
- Sandstone
- Schist
- Sedimentary Breccia
- Terrace
- Water

Figure 4.6-2

Imperial County Renewable Energy and Transmission Element Update PEIR
Rock Units within Imperial County

Name: 20674 EIR Fig 4.6-2 Geo Rock Units.Mxd
Date Saved: 11/20/2014, Author: msimmons

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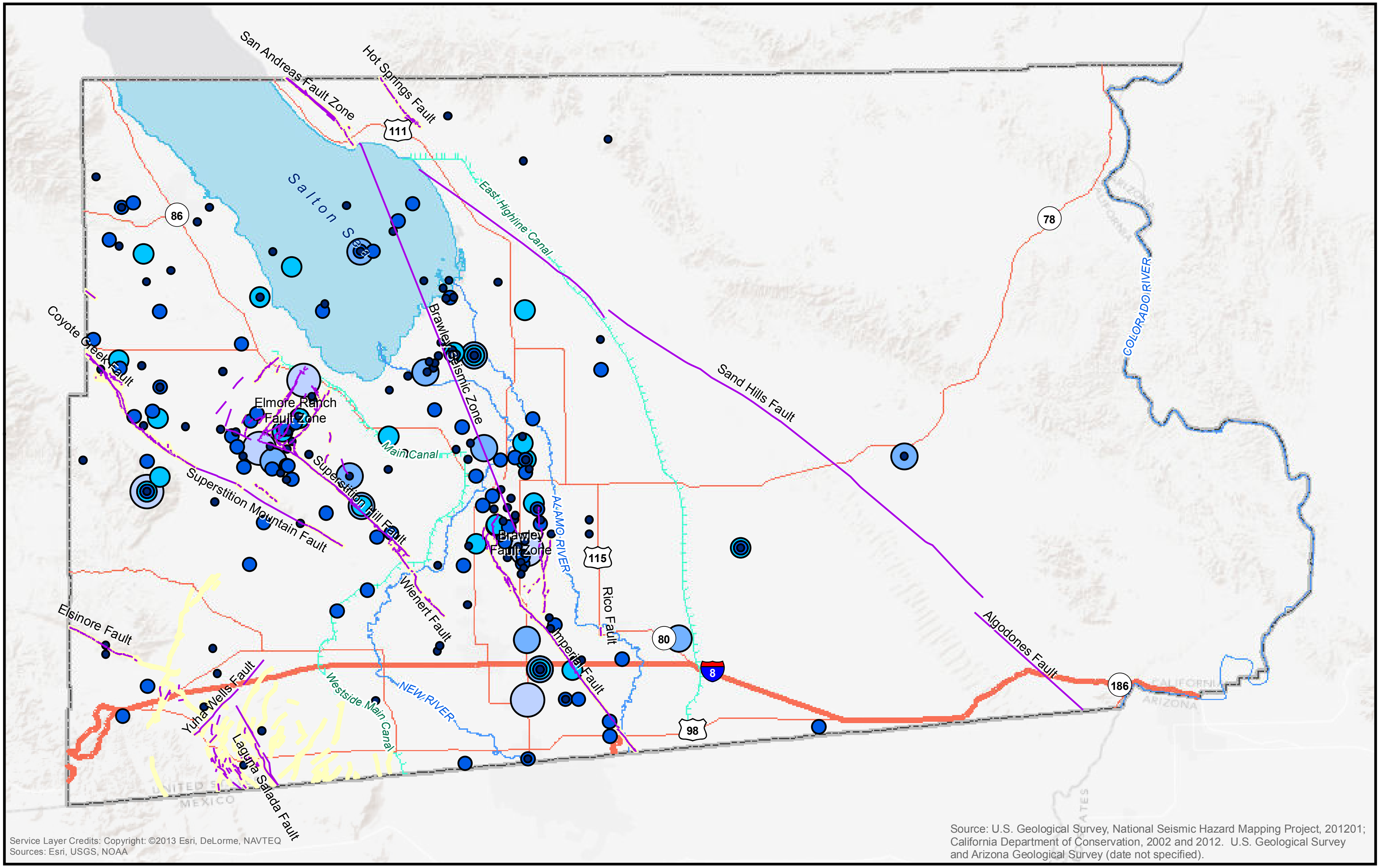

Legend

USGS Quaternary Faluts

Alquist-Priolo Earthquake Fault Zoning

Earthquake Epicenter (from year 1900 to 2000)

4.0 - 4.2

4.2 - 4.7

4.7 - 5.2

5.2 - 6.0

6.0 - 7.0

N

0 5 10 20

Miles

Figure 4.6-3

Imperial County Renewable Energy and Transmission Element Update PEIR
Regional Faults and Seismicity

Name: 20674 EIR Fig 4.6-3 Seismic Hazards.Mxd
Date Saved: 11/20/2014, Author: msimmons

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Subsidence

Subsidence is the gradual, local settling or sinking of the earth's surface with little or no horizontal motion. Subsidence is usually the result of gas, oil, or water extraction, hydro-compaction, or peat oxidation and not the result of a landslide or slope failure. Subsidence due to groundwater withdrawal can occur in unconsolidated to semiconsolidated sediments containing confined or semiconfined sand and gravel aquifers inter-bedded with clay sediments. The potential for subsidence is dependent on the depths of and amount of water likely to be extracted from the aquifer. On the valley floor where these conditions exist, the potential for subsidence is considered to be moderate to low, based on the current hydrological conditions.

Liquefaction

Liquefaction of soils can be caused by strong vibratory motion in response to earthquakes. Both research and historical data indicate that loose, granular soils are susceptible to liquefaction, while cohesive clays are not adversely affected by vibratory motion. Liquefaction is generally known to occur only in saturated or near-saturated granular soils at depths shallower than approximately 50 feet.

The unconsolidated sediments of the Salton Trough, especially in saturated areas such as irrigated lands, are subject to failure during earthquakes, thus, causing the potential for liquefaction. The majority of soil types within Imperial Valley are generally considered liquefiable due to their physical characteristics and saturated conditions. The Glenbar clay loam and the Torriorthents-Rock outcrop soil complexes, usually found in the eastern and western portions of the County, are not subject to liquefaction primarily due to the density of underlying sediments and volcanic base.

Soils

The soils of Imperial County are variable and complex and are formed by stratified alluvial deposits. The upper soil layers have been worked through the hydrologic action from periodic flooding of the New and Alamo rivers and other various washes from the East and West mesas. Wind erosion has also helped work the surface soils.

Approximately 48 soil mapping units are located within Imperial County (Table 4.6-1). These map units cover areas as small as 462 acres to as large as 203,659 acres. Each detailed soil map unit consists of one or more general soil series that occur in association with each other. These include Aco, Antho, Carrizo, Carsitas, Chuckawalla, Cibola, Coachella, Fluvaquents, Gadsden, Gilman, Glenbar, Holtville, Imperial, Indio, Kofa, Lagunita, Laposa, Laveen, Mecca, Meloland, Niland, Orita, Ripley, Rositas, Salorthids, Superstition, Torriorthents, and Vint. For a detailed description of the characteristics of each soil type, refer to the Soil Survey of Imperial County (SCS 1981).

Parent material includes Glenbar, Holtville, and Imperial soils. Indio, Vint, Meloland, and Rositas are derived from windblown and channel silts. Rositas and Carsitas were formed in beach deposits. A desert plain which forms the west terrace of the Colorado River delta known as the Imperial East Mesa is nearly flat with an almost 1-percent elevation change. Sand and gravelly fan materials are the parent materials of Carsitas and Rositas soils.

The clay material deposited in riverine environments during the formation of the Colorado River delta terrace is the source of the Holtville and Imperial soils. Niland soils occur in clayey lakebed. Several large gullies have formed from runoff water leading into the Salton Sea. The Antho, Laveen, Niland, and

Superstition soils were formed from fan sediment. Fine-textured basin deposits provide the source material for Glenbar, Holtville, and Imperial soils.

Table 4.6-1: Soil Mapping Units in Imperial County

Soil Map Unit Name	Acres	Percent
Antfao loamy fine sand	4,134	0.4
Antho-Superstition Complex	8,416	0.9
Bad Land	4,390	0.4
Carsitas gravelly sand, 0 to 5 percent slopes	7,011	0.7
Fluvaquents, saline	12,262	1.2
Glenbar clay loam	2,951	0.3
Glenbar day loam, wet	4,239	0.4
Glenbar complex	12,894	1.3
Holtville loam	2,804	0.3
Holtville silty clay	3,628	0.4
Holtville silty day, wet	70,547	7.1
Holtville-Imperial silty clay loams	2,242	0.2
Imperial silty clay	1,405	0.1
Imperial silty day, saline	5,679	0.6
Imperial silty clay, wet	123,401	12.5
Imperial-Glenbar silty clay loams, wet, 0 to 2 percent slopes	203,659	20.6
Imperial-Glenbar silty clay loams, 2 to 5 percent slopes	2,162	0.2
Indio loam	9,169	0.9
Indio loam, wet	13,625	1.4
Indio-Vint complex	29,643	3.0
Laveen loam	2,322	0.2
Meloland fine sand	10,748	1.1
Meloland very fine sandy loam, wet	41,734	4.2
Meloland and Holtville loams, wet	11,483	1.2
Niland gravelly sand	7,884	0.8
Niland gravelly sand, wet	9,820	1.0
Niland fine sand	2,846	0.3
Niland loamy fine sand	2,088	0.2
Niland-Imperial complex, wet	6,974	0.7
Pits	1,400	0.1

Table 4.6-1: Soil Mapping Units in Imperial County

Soil Map Unit Name	Acres	Percent
Rositas sand, 0 to 2 percent slopes	22,608	2.3
Rositas sand, 2 to 5 percent slopes	1,590	0.2
Rositas fine sand, 0 to 2 percent slopes	77,301	7.8
Rositas fine sand, 2 to 9 percent slopes	40,748	4.1
Rositas fine sand, 9 to 30 percent slopes	19,401	2.0
Rositas fine sand, wet, 0 to 2 percent slopes	22,626	2.3
Rositas loamy fine sand, 0 to 2 percent slopes	90,896	9.2
Rositas silt loam, 0 to 2 percent slopes	3,737	0.4
Rositas-Superstition loamy fine sands	11,373	1.2
Superstition loamy fine sand	12,887	1.3
Tomorthents-Rock outcrop complex, 5 to 6 percent slopes	462	*
Torriorthents and Orthids, 5 to 30 percent slopes	900	0.1
Vint loamy very fine sand, wet	31,545	3.2
Vint fine sandy sand, wet	13,066	1.3
Vint and Indio very fine sandy loams, wet	15,462	1.6
Vint and Indio very fine sandy loams, water	3,288	0.3

* Less than 0.1%
Source: Soil Survey of Imperial County, California, Imperial Valley Area (SCS 1981).

A large portion of Imperial County includes fine-textured lakebed sediments. On the surface, the Salton Trough province exhibits at least three geomorphic areas: ancient lakebed sediments, alluvial channels, and dune sands. The central portion of this province, consisting of the Imperial and Coachella valleys (or the Salton Sink), is covered by clay and silt deposits from prehistoric lakestands. Shoreline deposits circumscribe the central lakebed deposits and consist predominantly of unconsolidated sand and gravel, grading into the previously mentioned silts and clays. Lake Cahuilla beds are generally believed to be less than 100 feet thick and may have received their heaviest rate of deposition during the Wisconsin or early postglacial age.

Dissected, flat-lying alluvium is present on both mesa-like areas east and west of the central portion of the Salton Trough province. Consisting of poorly consolidated silts, sands, and gravels, these more recent alluviums typically form thin veneers of desert pavement between dry washes. Also, no topsoils or well-defined horizons are present in these areas.

<u>Expansive Soils</u>

Expansive soils are primarily composed of clay particles. Clay increases in volume when water is absorbed and shrinks when dry. Expansive soils can damage building foundations, concrete flatwork, and asphaltic concrete pavements as a result of swelling forces that reduce soil strength. In general, much of the near surface soils in the agricultural area of the Salton Trough consist of silty clays and clays which are moderately to highly expansive.

Soil Corrosivity

Soils in the Project Area have characteristics which make them corrosive to metals. A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (direct current [DC]) from the metal into the soil. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage. Soil pH values ranged from 7.6 to 8, which are considered mildly to moderately alkaline. The soluble salt content of the samples ranges from low to very high. Chloride and sulfate salts are the predominant constituents.

Mineral Resources

Imperial County contains diverse mineral resources. Those with the highest economic value include gold, gypsum, sand, gravel, lime, clay, and stone. Geologic factors restrict mining operations to the relatively few locations where mineral deposits are feasible for extraction. The majority of the mining areas are located in the eastern portion of Imperial County.

4.6.3 Significance Criteria

The thresholds for significance of impacts for the analysis are based on the environmental checklist in Appendix G of the State California Environmental Quality Act (CEQA) Guidelines. Consistent with the CEQA Guidelines and the professional judgment of the County's staff and environmental consultants, the proposed Project could result in a significant impact on the environment if it would:

- Expose people or structures to potential substantial adverse effects, including 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 and seiche/tsunami
  - 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 offsite landslides, lateral spreading, subsidence, liquefaction, or collapse

- Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial risk to life or property

- 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

4.6.4 Impacts and Mitigation

GEO-1: Expose people or structures to potential substantial adverse effects, including risk of loss, injury due to seismic activity

Imperial County is located in the seismically active region of southern California. As shown in Figure 4.6-3, several fault zones delineated on the Alquist-Priolo Earthquake Fault Zoning Map underlie the renewable energy overlay zones developed for the proposed Project. The San Andreas Fault Zone traverses portions of the overlay zone east of the Salton Sea, while portions of the San Jacinto Fault Zone traverse portions of the overlay zone west of the Salton Sea. Additionally, numerous smaller faults identified in Figure 4.6-3 underlie various locations within the proposed overlay zone. Consequently, development of future renewable energy facilities under the proposed Project may be subject to fault rupture, strong seismic ground shaking, or seismic-related ground failure during an earthquake. 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 overlay zones. 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. While implementation of the proposed Project would not include development of habitable structures, future renewable energy facilities developed under the proposed Project may be constructed near fault sources and could be damaged by strong seismic shaking. Thus, impacts associated with strong seismic shaking are considered potentially significant.

Mitigation Measures

GEO-1: Prepare Geotechnical Report(s) for the Projects and Implement Required Measures. Facility design for all project components of future renewable energy facilities developed under the proposed Project 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
- 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 each project applicant. Design of future renewable energy facilities would need to be consistent with applicable CBC Seismic Design Categories based on site-specific soil characteristics and proximity to potential seismic hazards.

Significance After Mitigation

Implementation of mitigation measure GEO-1 would reduce impacts associated with seismic activity to a level less than significant.

GEO-2: Result in substantial soil erosion or the loss of topsoil

Construction and operation of future renewable energy facilities under the proposed Project would result in short- and long-term impacts to soils within the overlay zones. Impacts would result from the clearing of vegetation, excavation, salvage, stockpiling, and redistribution of soils during construction and reclamation activities associated with solar arrays, wind turbine and well pad sites, access roads, and other proposed Project facilities.

Blading or excavation to achieve desired grades could result in steepening slopes of exposed soils in cut and fill areas, mixing of topsoil and subsoil materials, and the breakdown of soil aggregates into loose particles. Soil structural aggregates would also be broken down by compaction from vehicular traffic. Removal and stockpiling of topsoil for revegetation purposes could reduce the natural fertility of the soil and cause a loss of soil profiles by mixing soil horizons and subsequent breakdown in soil structure.

The removal of vegetation due to future renewable energy facilities developed under the proposed Project would increase the potential for channelized runoff and accelerated erosion to occur, with a corresponding increase in rill and gully erosion where disturbance occurs on steeper slopes. Erosion would be particularly evident if future project-related activities are conducted during periods of high precipitation. The increased erosion of soils could potentially lead to increased loss of vegetative cover and increased sedimentation in ephemeral or intermittent drainages. The actual amount of additional sedimentation that could reach nearby drainages would depend on the effectiveness of reclamation and erosion control measures as well as natural factors including the water available for overland flow; the texture of the eroded material, the amount and kind of ground cover; the shape, gradient, and length of the slope; and surface roughness (Barfield et al. 1981). Wind erosion could also increase with removal of vegetation and exposure of soils. Therefore, development of future renewable energy facilities under the proposed Project would have the potential to result in substantial soil erosion or the loss of topsoil and may result in a significant impact.

Mitigation Measures

GEO-2: Develop and Implement a Storm Water Pollution Prevention Plan (SWPPP). Future renewable energy facilities developed under the proposed Project would require a detailed SWPPP to be developed and implemented to minimize erosion during construction in compliance with the National Pollutant Discharge Elimination System (NPDES) General Construction Permit. The SWPPP would be required to include the following:

- A detailed description of all Best Management Practices (BMPs) that will be employed
- An outline of the areas on site that will be disturbed during construction of the project
- An outline of all areas that will be stabilized by temporary or long-term erosion control measures
- A proposed schedule for the implementation of erosion control measures

In addition, all surface water and drainage features within 1,000 feet of construction activities shall be identified. Construction activities within 100 feet of these resources shall implement the BMPs detailed in the SWPPP prepared for each project.

Significance After Mitigation

Implementation of mitigation measure GEO-2 would reduce impacts related to erosion and soil loss to a level less than significant.

GEO-3: Be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project

As described in Section 4.6-2 above, the primary concerns related to soils that are unstable or that could become unstable are from liquefaction, settlement, and differential settlement. According to the Soil Survey of Imperial County, the proposed Project overlay zones contain some soils that are prone to liquefaction under certain conditions. Where soils are comprised of lean, stiff, clays, liquefaction is not considered to be a problem; however, liquefaction is known to occur in saturated or near saturated granular soils at depths shallower than 50 feet. Sandy zones underlying the lacustrine clays down to 50 feet in depth may liquefy given the Design Basis Earthquake (i.e., the earthquake which a structure is required to safely withstand with repairable damage).

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 associated with future renewable energy facilities. Additionally, although unlikely, regional subsidence could cause potential damage to structures designed with minimal tolerance for settlement. These factors related to unstable soils would potentially result in significant impacts.

Mitigation Measures

Mitigation measure GEO-1 would also be implemented to address impacts related to unstable soils. Mitigation measure GEO-1 would address geologic hazards in terms of liquefaction and total and differential settlement associated with future renewable energy projects by requiring a licensed geotechnical or soils engineer to investigate site-specific soil conditions and site facilities in a manner that avoids areas prone to liquefaction. Mitigation measure GEO-1 would also require the design of future renewable energy facilities to withstand settlement in accordance with the CBC.

Significance After Mitigation

Implementation of mitigation measure GEO-1 would reduce impacts related to unstable soils to a level less than significant.

GEO-4: Be located on expansive soil, as defined in the latest Uniform Building Code, creating substantial risk to life or property.

As described in Section 4.6-2, many soil types within the County 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 to produce shrinkage cracks that could allow water infiltration and compromise the integrity of backfill material. These conditions could be worsened if structural facilities for future renewable energy facilities are constructed directly on expansive soil materials. Likewise, corrosive soil materials could lead to deterioration of future structural concrete footings. Future structures could be damaged by these types of soils, which may result in a significant impact. Implementation of GEO-1 above and GEO-4 below would reduce this impact to less than significant.

Mitigation Measures

Implementation of mitigation measures GEO-1 and GEO-2 would also mitigate for impacts associated with expansive soils. The geotechnical evaluation required under GEO-1 and SWPPP required under GEO-2 would also analyze potential impacts and require appropriate project design and mitigation measures to address impacts related to expansive soils for future renewable energy facilities.

GEO-4: Implement Corrosion Protection Measures*.* As determined appropriate by a licensed geotechnical or civil engineer, each project proponent shall ensure that all underground metallic fittings, appurtenances, and piping located in corrosive soils include a cathodic protection system to protect these facilities from corrosion for future renewable energy facilities developed under the proposed Project.

Significance After Mitigation

Implementation of mitigation measures GEO-1, GEO-2, and GEO-4 would mitigate impacts associated with expansive and corrosive soils to a level less than significant.

GEO-5: 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.

The majority of the Renewable Energy Overlay Zones developed for the proposed Project are rural and not served by municipal wastewater. Rural residences in these areas of the County use septic systems for sanitary waste. Temporary septic systems or holding tanks and portable toilets would be used during the construction phase of future renewable energy facilities to provide needed sanitary facilities for workers on site; however, during operations, some of these future renewable energy facilities may choose to collect wastewater from sinks and toilets located in buildings and convey the waste stream to an onsite sanitary waste septic system. Alternatively, some future renewable energy facilities may be designed to direct sanitary waste streams to an underground tank for storage. The Renewable Energy Overlay Zones are underlain by a variety of soil types, many of which have moderate absorptive capabilities and provide moderate infiltration and drainage but can be used effectively for septic leach systems with the proper design. Septic systems for future renewable energy facilities would be engineered based on onsite soil characteristics and designed and installed in compliance with County Environmental Health Department standards. If a leach field is proposed, it would also be engineered based on future onsite soil characteristics and designed and installed in compliance with County Environmental Health Department standards. If the County prefers that a leach field not be used, an underground tank could also be installed according to County specifications. Whichever system is used, 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 or alternative wastewater systems.

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, areas where a shallow groundwater table is present could render infiltration of wastewater into the soil column temporarily infeasible at certain times of the year. These factors related to soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal system would potentially result in significant impacts.

Mitigation Measures

GEO-5: Demonstrate Compliance with Onsite Wastewater Treatment and Disposal Requirements. Wastewater treatment and disposal system(s) associated with future renewable energy facilities shall demonstrate compliance with the Imperial County performance standards as outlined in Title 9, Division 10, Chapters 4 and 12 of the Imperial County *Land Use Ordinance*. Prior to construction, and again prior to operation, each future project proponent would be required to obtain all necessary permits and/or approvals from Imperial County. Each future project proponent would be required to 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 would not conflict with the Regional Water Quality Control Board's (RWQCB) Anti-Degradation Policy.

Significance After Mitigation

Implementation of mitigation measure GEO-5 would reduce impacts associated with soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems to a level less than significant.

4.6.5 Cumulative Impacts

Development of future renewable energy facilities under the proposed Project would not result in cumulative impacts related to geology and soils. Geologic and soil conditions are site-specific and are generally unaffected by activities that are not directly or immediately adjacent to site. Therefore, impacts related to geology and soils would be cumulatively less than significant.