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5.4 GEOLOGIC HAZARDS AND RESOURCES

5.4.1 Introduction

This Application for Certification (AFC) for the Rio Mesa Solar Electric Generating Facility (Rio Mesa SEGF or Project) has been prepared in accordance with the California Energy Commission's (CEC) Power Plant Site Certification Regulations (CEC-140-2008-001-REV1, current as of July 2008). In addition, this AFC includes elements necessary for the United States (U.S.) Bureau of Land Management (BLM) to permit the Project through the National Environmental Policy Act (NEPA). The "Applicant" for purposes of this AFC comprises Rio Mesa Solar I, LLC, Rio Mesa Solar II, LLC, and Rio Mesa Solar III, LLC, owners of the three separate solar plants and certain shared facilities being proposed. These three Delaware limited liability companies will hold equal one-third shares in the ownership of shared facilities and will separately own their respective plants. They are wholly owned by Rio Mesa Solar Holdings, LLC (a Delaware limited liability company) which is in turn wholly owned by BrightSource Energy, Inc. (BrightSource) a Delaware corporation and the ultimate parent company. The Applicant will use BrightSource's solar thermal technology for the Rio Mesa SEGF.

The proposed project site is situated on the Palo Verde Mesa in Riverside County, California, 13 miles southwest of the City of Blythe, and is located partially on private land and partially on public land administered by BLM. The project will include three solar concentrating thermal power plants and a shared common area to include shared systems. The first plant, a 250 megawatt (MW) (nominal) facility known as Rio Mesa I, will be constructed at the south end of the project and owned by Rio Mesa Solar I, LLC. The second plant, another 250 MW (nominal) facility known as Rio Mesa II, will be located in the central portion of the project site and owned by Rio Mesa Solar II, LLC. Rio Mesa III, a third 250 MW (nominal) facility, will be constructed in the northern portion of the project site and owned by Rio Mesa Solar III, LLC. These three plants will be connected via a common overhead 220 kilovolt (kV) generator tie-line (gen-tie line) to the Southern California Edison (SCE) Colorado River Substation (CRS) approximately 9.7 miles to the north.

Each plant will utilize a solar power boiler (referred to as a solar receiver steam generator or SRSG), located on top of a dedicated concrete tower, and solar field based on proprietary heliostat mirror technology developed by BrightSource. The reflecting area of an individual heliostat (which includes two mirrors) is about 19 square meters (205 square feet [sq. ft.]). The heliostat (mirror) fields will focus solar energy onto the SRSG which converts the solar energy to superheated steam. In each plant, a Rankine cycle non-reheat steam turbine receiving this superheated steam will be directly connected to a rotating generator that generates and pushes the electricity onto the transmission system steam. Each plant will generate electricity using solar energy as its primary fuel source. However, auxiliary boilers will be used to operate in parallel with the solar field during partial load conditions and occasionally in the afternoon when power is needed after the solar energy has diminished to a level that no longer will support solar generation of electricity. These auxiliary boilers will also assist with daily start-up of the power generation equipment and night time preservation.

5.4.2 Laws, Ordinances, Regulations, and Standards

The LORS that may apply to geologic resources and hazards are summarized in Table 5.4-1.

Table 5.4-1
Laws, Ordinances, Regulations and Standards (LORS)

LORS	Applicability	AFC Section Explaining Conformance
Federal		
National Environmental Policy Act (NEPA) of 1969	NEPA establishes a public, interdisciplinary framework for Federal decision-making and ensures that federal agencies take environmental factors into account when considering Federal actions.	Section 5.4.2.1
State		
Warren-Alquist State Energy Resources Conservation and Development Act, California Public Resources Code, §§ 25000, et seq.	Gives the California Energy Commission (CEC) licensing authority in lieu of state, regional, and local permits and requirements.	Section 5.4.2.2
California Environmental Quality Act (CEQA)	Requires that all agencies of the State government that regulate activities of private individuals, corporations, and public agencies, which are found to affect the quality of the environment, shall regulate such activities so that major consideration is given to preventing environmental damage.	Section 5.4.2.2
California Building Code (CBC)	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity.	Section 5.4.2.2
Alquist-Priolo Earthquake Fault Zoning Act, Title 14, Division 2, Chapter 8, Subchapter 1, Article 3, California Code of Regulations (CCR)	Identifies areas subject to surface rupture from active faults.	Sections 5.4.2.2, 5.4.4.1
The Seismic Hazards Mapping Act, Title 14, Division 2, Chapter 8, Subchapter 1, Article 10, CCR.	Identifies non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides.	Sections 5.4.2.2, 5.4.5.2
Local		
Riverside County General Plan (RCGP)	Compliance with the Public Safety Element of the RCGP.	Section 5.4.2.3
Riverside County Code §§ 15.60 et seq.	Requires permit for development in earthquake fault areas and implements the Alquist-Priolo Earthquake Fault Zoning Act.	Section 5.4.2.3
Riverside County Ordinance 457.103, § 4.J.2.7	Requires a grading permit for earthwork in excess of 50 cubic yards.	Section 5.4.2.3
Riverside County Code §§ 15.80, et seq.	Requires permits for development in flood hazard areas.	Section 5.4.2.3

Table 5.4-1
Laws, Ordinances, Regulations and Standards (LORS)

LORS	Applicability	AFC Section Explaining Conformance
Riverside County Flood Hazard Zone, Ordinance 458.13	Describes Riverside County requirements for a development permit prior to any construction or other development within areas of special flood hazards and requires that flood capacity of any altered watercourse be maintained.	Section 5.4.2.3

AFC – Application for Certification
BLM – Bureau of Land Management
CBC -- California Building Code
CEC – California Energy Commission
CEQA – California Environmental Quality Act
EFZ -- Earthquake Fault Zone
GIS – Geographic Information Systems
ICC -- International Code Conference
LORS = Laws, ordinances, regulations and standards
MRZ -- Mineral Resource Zones
NEPA – National Environmental Policy Act
PGA -- Peak Ground Acceleration

5.4.2.1 Federal LORS

National Environmental Policy Act of 1969

NEPA establishes a public, interdisciplinary framework for Federal agencies reviewing projects under their jurisdiction to consider environmental impacts. NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment.

The BLM, as lead Federal agency for the Project, is responsible for preparation of an Environmental Impact Statement (EIS) in compliance with NEPA to evaluate the environmental impacts of the portions of the Rio Mesa SEGF on federal lands. The Rio Mesa Solar III plant and the Project gen-tie line are located on lands administered and managed by the BLM. NEPA compliance is required for these portions of the Project through preparation of a Draft and Final EIS. BLM is also responsible for Native American consultation, including government to government consultation.

The President's Council on Environmental Quality (CEQ) developed guidelines and procedures to assist Federal agencies with NEPA procedures so that environmental justice concerns are effectively identified and addressed. This includes guidelines for public participation, alternatives, and mitigation.

5.4.2.2 State LORS

Warren-Alquist Act

The California Public Resources Code (PRC) establishes the CEC as the decision-making authority over land use decisions and environmental determinations during the AFC process. This is in accordance with the Warren-Alquist Act, codified in §§ 25000 et seq. of the PRC. The CEC has exclusive jurisdiction over thermal power plant siting (50 MW or greater), including California Environmental Quality Act

(CEQA) implementation. The Project will demonstrate conformity with state, regional, and local laws, including land use laws.

Under the Warren-Alquist Act, the CEC's licensing process is legally equivalent to CEQA and is guided by CEQA regulations.

California Environmental Quality Act

The CEC will be the lead agency enforcing CEQA for the Project. Under California law, the CEC is responsible for reviewing the AFCs filed for projects, and also has the role of lead agency for the environmental review of these projects under CEQA (PRC, §§ 25500 et seq; PRC, §§21000 et seq.). The CEC conducts this review in accordance with the administrative adjudication provisions of the Administrative Procedure Act (5 United States Code, §§ 500 et. seq.)and its own regulations governing site certification proceedings (CCR, Title 20, §§ 1701 et seq.). These provisions require the staff to conduct an independent analysis of AFCs and prepare an independent assessment of a project's potential environmental impacts, feasible mitigation measures, and alternatives as part of this process.

The CEC considers the Staff Assessment(s), along with the environmental analysis provided by the Applicant, as well as input from interested local, regional, State, and Federal agencies, intervenors, and interested Native American tribes, in developing its final decision on whether to issue a license for a proposed project. The CEC has a certified regulatory program under CEQA that exempts the agency from having to draft an Environmental Impact Report (EIR) and, instead, requires a Final Staff Assessment (FSA), evidentiary hearings, and a decision based on the hearing record, which includes the staff's and other parties' assessments.

California Building Code

The Project is subject to the applicable sections of the California Building Code (CBC), which is administered by the California Building Standards Commission. The CEC will assign a delegate Chief Building Official (CBO) who will be responsible for implementing the CBC for the Project. The CBC provides specific and acceptable design criteria for excavations and structures for static and dynamic loading conditions. The project will comply with the seismic design and construction criteria of the 2010 CBC (ICC, 2010).

Alquist-Priolo Earthquake Fault Zoning Act

The main purpose of the Alquist-Priolo (AP) Earthquake Fault Zoning Act is to prevent the construction of buildings used for human occupancy on the surface trace of active faults. The AP Earthquake Fault Zoning Act was enacted by the State of California in 1972 to mitigate the hazard of surface faulting to structures planned for human occupancy and other critical structures. This law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The State has established regulatory zones (known as Earthquake Fault Zones [EFZs])around the surface traces of active faults and has issued "Earthquake Fault Zone Maps" to be used by government agencies in planning and reviewing new construction. In addition to residential projects, structures planned for human occupancy that are associated with industrial and commercial projects are of concern. Although the project is subject to the

AP Earthquake Fault Zoning Act, the project features are not located within a known EFZ (California Geological Survey [CGS], 2000) or within an area identified as subject to surface rupture from active faults.

Seismic Hazards Mapping Act

The purpose of the Seismic Hazards Mapping Act is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. The program and actions mandated by the Seismic Hazards Mapping Act closely resemble those of the AP Earthquake Fault Zoning Act (which addresses only surface fault-rupture hazards). The project will conform to this act by performing an analysis for potential seismic hazards at the project site.

5.4.2.3 Local LORS

Riverside County General Plan

The Public Safety Element of the RCGP, which was adopted in 2003 and subsequently updated as of 2008 (Riverside County General Plan, 2008), is intended to protect the public from the effects of natural geologic hazards. Permit requirements related to grading and buildings are discussed below.

Riverside County Ordinances

The Project is subject to Riverside County's Department of Building and Safety requirements related to building, grading and floodplain development. Compliance of construction with CBC standards is covered under engineering and construction permits for the project. The CEC will assign a delegate CBO who will be responsible for implementing these code requirements for the Project and issuing any required excavation/grading and inspection permits.

Riverside County Ordinance 15.60 et seq. requires a permit for development in earthquake fault areas and implements the Alquist-Priolo Earthquake Fault Zoning Act. The County also requires grading in excess of 50 cubic yards to be performed in accordance with an approved grading plan (Riverside County Ordinance 457.103, Section 4.J.2.7). County Ordinance Section 15.80 et seq. and Riverside County Flood Hazard Zone, Ordinance 458.13 require consideration and set forth permit requirements for development activity within a designated flood zone. Portions of the project site are within a 100-year awareness floodplain per California Department of Water Resources (shown on Figure 5.15-6 in Section 5.15, Water Resources). Based on telephone conversations, Riverside County Flood Control will treat awareness floodplains as 100-year floodplains for the purposes of development and, therefore, the Riverside County floodplain development ordinance is an applicable LORS.

These permit requirements will be implemented by the CEC pursuant to the Warren Alquist Act. Additional discussion of grading and floodplain development permit requirements is provided in Section 5.11 Soils.

5.4.3 Affected Environment

This section discusses the existing geologic environment of the Rio Mesa SEGF. The geologic setting, seismicity, and geologic hazards for the project area are discussed.

5.4.3.1 Regional Geology

The project area is located in southeastern California along the western flank of the Colorado River floodplain. According to Note 36 from the California Geological Survey (CGS), which outlines California's Geomorphic Provinces, the general area is within the Mojave Desert Physiographic Province (CGS, 2002). The Mojave Desert Physiographic Province is described as a high desert, whereas the project area is in an area that would be described as a low desert, which is more typical of the characteristics of the Colorado Desert Physiographic Province (Norris and Webb, 1990). For this reason, there is some debate about which physiographic province the project area fits.

In general, the region consists of desert mountain ranges surrounded by extensive alluvial fans and plains. However, the Colorado River has played a major role in reworking the landforms in its path and plays an intricate part in the local geology as outlined below.

5.4.3.2 Local Geology

In 1967, Jennings mapped the Needles 30' by 60' quadrangle at a scale of 1:100,000. Until recently, this was the most detailed geologic map that encompassed the entire project area. In 2006, the United States Geological Survey (USGS) produced an in-depth geologic study with a geologic map at a scale of 1:24,000 that covered the western Blythe area and extended south into the northern portion of the project area (USGS, 2006). Expansion of this data southward to encompass the entire project site was performed in March of 2010 by Jay Rehor of URS Corporation (URS, 2011b). This additional mapping effort was initially done using GIS and aerial photographic analysis, and was followed up with verification field mapping. A map showing the geology of the project area is presented in Figure 5.4-1.

The project area is primarily situated on the Palo Verde Mesa. The Palo Verde Mesa is bounded to the south and west by the volcanic and plutonic rocks that form the Mule Mountains, to the north by an extension of the Chuckwalla Valley that separates the Mule and McCoy Mountains, and to the east by the broad floodplain of the Colorado River. The rock outcrops of the Mule Mountains are heavily eroded and mantled by a series of Quaternary-age alluvial fans. Alternatively, the Colorado River floodplain is composed of more recent alluvial material deposited by the river. Between these two areas lies the Palo Verde Mesa, which is primarily composed of inset Pleistocene terraces of the Colorado River (URS, 2011b).

The project area can be divided into two dominant structural sections. One section consists of the Mule Mountains and associated coalescing alluvial fans (western area) gradually sloping down to the east. These alluvial fans have varying degrees of desert pavement development on the surface. The second dominant structural section is formed by several inset alluvial terraces which form the Palo Verde Mesa (central area), and the modern Colorado River floodplain (eastern area). These alluvial terraces were formed by successive aggradations and degradations of the Colorado River (URS, 2011b).

Ninyo & Moore performed a Preliminary Geotechnical Evaluation for the Project (Ninyo & Moore, 2011), which is presented in Appendix 5.4A. Subsurface investigations included borings, Cone Penetration Tests (CPTs), and test pits through much of the main project area. The explorations encountered primarily silty fine sands with gravel and coarse sands. The materials ranged in density from loose to very dense; however, the majority of the subsurface investigations reported medium dense to dense silty sands. None of the subsurface investigations encountered groundwater. The depth to groundwater is anticipated to be approximately equivalent to the surface of the nearby Hodges Drain located east of the project site. Other findings from the investigation are discussed in Section 5.4.4.

5.4.3.3 Seismic Setting

The project area is located in seismically active Southern California, a region that has experienced numerous earthquakes in the past. According to the AP Earthquake Fault Zone Maps (CGS, 2000), there are no EFZs within the project area. In addition, no active fault zones are present within 20 miles of the Project. The majority of fault activity in the region is to the west of the project area. The nearest active fault (showing movement in the last 11,000 years) is the San Andreas Fault, located approximately 55 miles to the southwest. Inactive faults exist in the mountains that border the western edge of the project area but none are mapped within its boundaries. The nearest fault to have shown activity in the Quaternary period is the Blythe Graben located approximately 20 miles north of the project area. The tectonic significance and age of this fault is unknown. Figure 5.4-2 shows the regional active faults and epicenters in relation to the project area.

The project area is subject to an estimated peak ground acceleration (PGA) between approximately 0.10 percent of gravity (g) and 0.12g with a 10 percent probability of being exceeded in 50 years, and a PGA between 0.12g and 0.16g with a 2 percent probability of being exceeded in 50 years (Ninyo & Moore, 2011).

5.4.3.4 Geologic Resources of Recreational, Commercial, or Scientific Value

This subsection presents a discussion of the presence of geologic resources of recreational, commercial, or scientific value within two miles of the limits of the project site and linear elements.

The mineral commodities near the project site include metallic and non-metallic mineral deposits. The primary metallic mineral deposit is gold, which is restricted mostly to the Mule Mountains. The primary non-metallic deposits near the project site are aggregate (e.g., sand, gravel) and agate (e.g., semiprecious gem stones) (USGS, 2011). The Palo Verde Valley area has an aggregate production area of less than 0.5 million tons per year, as delineated by the 2006 Aggregate Availability Map (California Department of Conservation, SMGB, 2008).

Thirteen mineral resource sites within a two mile buffer of the Project site were identified by the USGS Mineral Resource Data System (USGS, 2011). Of these 13 sites, 10 are gold, one is uranium, one is agate, and one is sand and gravel. Two sites (gold), designated “Punch” and “Senate”, are located within the project area, and one site, named “American Flag Mine” (gold) is within the gen-tie line right-of-way (ROW) (Figure 5.4-1). The Punch and Senate development status is designated as “occurrence” (e.g., grade and tonnage is unknown, no production has taken place and little/no activity has occurred since discovery, no economic significance.) The American Flag Mine is a “past producer” and has been closed.

The other 10 sites within the two mile buffer are not producers or are past producers. The identified mineral resource sites are not considered active.

Mineral Resource Zones (MRZs) are delineated in the area by the California Department of Conservation Division of Mines and Geology (CDMG, 1994). The majority of the project area is designated as MRZ-4. These are areas of no known mineral occurrences where geologic information does not rule out either the presence or absence of significant mineral resources. However, a portion of the Mule Mountains near the northwest corner of the main project site is designated MRZ-3a. MRZ-3a areas contain known mineral occurrences of undetermined mineral resource significance. Further exploration work within these areas could result in the reclassification of specific localities into more significant categories. The mineral occurrences in this zone are identified within the mountainous terrain; however, the designated MRZ-3a area extends into the surrounding alluvial material and onto the northeast corner of the project site.

There are no known oil or gas reserves identified to be present in the project vicinity (California Department of Conservation Division of Oil Gas and Geothermal Resources, 2011).

5.4.4 Environmental Analysis

5.4.4.1 Geologic Hazards

The following subsections discuss the potential for geologic hazards to impact the Project. The evaluation is based on a literature search and a review of project-related documents, including the Preliminary Geotechnical Evaluation performed for the Project (Ninyo & Moore, 2011). Ground shaking presents the most significant geologic hazard to the Project and linear features, as discussed below.

5.4.4.1.1 Seismic Ground Shaking

During an earthquake, seismic waves are produced that emanate in all directions from the fault rupture. Seismic waves can produce strong ground shaking that is typically strongest near the fault and attenuates as the waves move away from the source. The severity of ground shaking is controlled by the interaction of magnitude, distance, and the type, thickness, and condition of underlying geologic materials. Areas underlain by unconsolidated, recent alluvium or fill may amplify the strength and duration of strong ground motion. The nearest active faults to the project area are shown in Figure 5.4-2.

Based on the seismic setting, the Project is likely to experience strong seismic shaking within the lifetime of the Project.

5.4.4.1.2 Ground Rupture

As discussed in Section 5.4.3.3, the site is not located within an area delineated by the AP Earthquake Fault Zone Act. Based on the referenced sources reviewed, no faults have been mapped transecting the proposed project site or linear elements. The potential for ground rupture to impact the Project is considered low.

5.4.4.1.3 Liquefaction and Seismic Settlement

During strong ground-shaking, loose, saturated, cohesionless soils can experience a temporary loss of shear strength. This phenomenon is known as liquefaction. Liquefaction is dependent on grain size distribution, relative density of the soils, degree of saturation, and intensity and duration of the earthquake. Potential hazards associated with liquefaction are seismically induced settlement and lateral spreading. Large scale GIS based natural hazard mapping performed by Earth Consultants International (ECI) in 2000 delineates the Colorado River Valley area to have a liquefaction susceptibility as high (ECI, 2000). However, based on recent groundwater data collected that shows groundwater to be greater than 150 feet deep on the mesa, the susceptibility is low (Ninyo & Moore, 2011). According to Ninyo & Moore (2011), the majority of the subsurface soil on the Palo Verde Mesa and in the alluvium to the east, is medium dense to dense silty sands. Furthermore, shallow groundwater conditions are not expected along the proposed linear elements. Due to the geologic setting of the project area, the site is considered to have a low potential for liquefaction.

Settlement of dry sands can occur during a seismic shaking event, potentially resulting in settlement of the ground surface and supported structures. One of the most important parameters affecting the settlement of dry sands is the relative density of the soil (Silver & Seed, 1971). Subsurface evaluations (Ninyo & Moore, 2011) indicated subsurface materials are generally medium dense to very dense. However, in some locations loose sands extended to depths up to 10 feet below the ground surface. The active alluvial channels that transect the project area, as well as the areas underlain by eolian sands (see Section 5.4.4.1.8), may be relatively loose at or near the ground surface. Foundation design will consider the potential presence of loose sands.

5.4.4.1.4 Slope Stability

Slope instability depends on slope inclination, underlying geology, surface soil strength, and pore pressures in the soil. Significant excavating, grading, or fill work during construction could also introduce temporary slope stability hazards.

Slope stability hazards are not expected to be a concern across the majority of the project area where topographic relief is minimal (ECI, 2000). Further, significant earthwork consisting of large cuts and fills is not planned for the Project. However, areas where the alluvial washes have incised relatively steep walls in the existing Palo Verde Mesa, as well as the eastern edge of the Palo Verde Mesa where it rises above the Colorado River Basin, have a higher potential for slope instability as a result of natural erosion. Site-specific slope stability evaluations will be required for development adjacent to these slopes, if impacted by the Project.

5.4.4.1.5 Subsidence

Subsidence can be caused by natural phenomena during tectonic movement, consolidation, hydro-compaction (see Section 5.4.4.1.6), liquefaction and seismic settlement (as described in Section 5.4.4.1.3), or rapid sedimentation. Subsidence can also result from human activities, such as withdrawal of water and/or hydrocarbons in the subsurface soils. As of 2000, no documented subsidence has been noted in the area of the project site (ECI, 2000). Based on the geologic setting, the potential for widespread subsidence is considered low inasmuch as there is no significant fluid withdrawal in the project area.

5.4.4.1.6 Collapsible Soils

The Preliminary Geotechnical Evaluation (Ninyo & Moore, 2011) identified relatively loose near-surface soil, as well as slightly gypsiferous (potentially water soluble) soils, that could experience settlement when loaded, especially under saturated conditions (hydrocompaction). It was recommended that further design-level geotechnical evaluation be conducted to assess further evaluate the presence of these materials relative to specific foundations and identify mitigation recommendations.

5.4.4.1.7 Expansive Soils

Expansive soils are clay-rich soils that have the ability to shrink and swell with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement beneath foundations. Based on the preliminary geotechnical evaluation by Ninyo & Moore (2011), the soils in the project area are primarily composed of coarser grained material, such as sands and silty sands, with minor amounts of gravel. A minor clay layer was noted to exist within the project site as observed during field mapping in March of 2011 (URS, 2011b). In general, the potential for expansive soils in the main project area is low.

Subsurface data is not available in the within the gen-tie line corridor. However, this area is mapped with similar geology as the main project area and is likely to have similar non-expansive soil characteristics. Similarly, geotechnical data is not available for the linear elements that extend eastward into the Colorado River Plain. There is considered to be some potential for finer grained-materials with expansive properties along these linear elements. Further geotechnical studies and the engineering design for the Project will consider the potential for expansive soil. Expansive soils, if present, can be mitigated by removing the soil and backfilling with non-expansive soil, instituting chemical stabilization of the soil, or designing foundations to resist uplift of the expansive soil.

5.4.4.1.8 Eolian Processes

Sandstorms are common in the region, and windblown sands can be a significant erosional and depositional force that may damage structures. Large scale GIS data suggests that the general area has a moderate wind erosion susceptibility (ECI, 2000); however, recent mapping has shown that the existing deposits of windblown sand are small and localized within the project area, indicating these processes are limited (URS, 2011b). More significant windblown sand is locally mapped near the northern end of the gen-tie line. More detailed mapping of these features may be warranted prior to final design. The potential for eolian processes to impact the project site is considered to be low.

5.4.4.1.9 Tsunami/Seiche

Tsunamis are waves typically generated offshore or within large, open bodies of water during a subaqueous fault rupture or a subaqueous landslide event. Seiches are waves generated within a large, closed body of water, also caused by subaqueous fault rupture or a subaqueous landslide event. Due to lack of proximity of the project site to large bodies of water, there is a no potential for the project site to be impacted by a tsunami or seiche.

5.4.4.2 Other Soil Conditions

Layers of caliche ("hardpan") were encountered in a number of the subsurface investigations performed by Ninyo & Moore (2011). Caliche is a naturally occurring cemented soil with rock-like characteristics. The lithification or hardening of the soil is considered to be a product of secondary cementation primarily by calcium carbonate. The presence of caliche can impede earthwork and drilling operations, and rock excavation techniques may need to be employed.

5.4.4.3 Geologic Conditions and Topography

Construction of the proposed solar site is expected to require minor grading and excavation, thereby altering the terrain of the site. Impacts on the geologic conditions involve minor changes in drainage, cuts, and fills. Since the majority of the Project site has a fairly gentle slope, minor site grading is not expected to adversely impact the geologic environment. However, where steeper slopes do exist, grading would have a more significant impact.

5.4.4.4 Corrosion Potential

Foundation materials such as concrete and steel that come in contact with subsurface soils are subject to the chemical properties of the soils themselves. Corrosion of the foundation materials due to chemical reactions with the substrate can limit the efficacy of the foundation to support the load for which it was designed. The Preliminary Geotechnical Evaluation (Ninyo & Moore, 2011) identified some soils that are potentially corrosive to steel and concrete. The report also presents design recommendations to reduce the effects of corrosion.

5.4.4.5 Geologic Resources of Recreational, Commercial, and Scientific Value

The Project will not result in a loss of availability of a known significant mineral resource that would be of value to the region and the residents of the state. As discussed in Section 5.4.3.4, a MRZ-3a extends onto the northwest corner of the project area. However, the portion of the zone within the site contains alluvial deposits, while the identified mineral occurrences are in the Mule Mountains. It is unlikely that any similar mineral occurrences are present in the alluvial terrain on the site. Further, the Palo Verde Valley Area Plan of the RCGP (Riverside County, 2003) indicates there is no significant mineral resource within the project area. The Project is anticipated to have less than significant impact to geological resources.

5.4.5 Cumulative Effects

Potential cumulative impacts to geologic hazards and resources from construction and/or operation of the proposed Project are not expected. The Project will have a less than significant effect on geologic hazards and resources in the immediate vicinity of the project site. Projects that could result in a cumulative impact would also be required to comply with applicable federal, state, and local LORS. The proposed Project is unlikely, therefore, to result in cumulative impacts to geologic hazards and resources in combination with other closely related past, present, and reasonably foreseeable future projects.

5.4.6 Mitigation Measures

As discussed previously, the Project is not expected to have a significant impact on geologic resources in the area. Design and construction of the project features in accordance with appropriate LORS and a design level geotechnical report, as described below, will limit the impact of geologic hazards on the Project to an acceptable level.

5.4.6.1 Seismic Ground Shaking

The project elements will be designed and constructed to withstand earthquake shaking in accordance with current LORS. Structures and equipment will be designed to meet seismic requirements of the 2010 CBC. A design-level geotechnical investigation will provide seismic design criteria for the Project.

5.4.6.2 Geologic Hazards

A design level geotechnical investigation will be performed to further evaluate the potential for liquefaction and associated effects, subsidence and settlement, slope stability, expansive soils, and eolian processes. The geotechnical report will present appropriate mitigation recommendations that will limit the impact of these and other geologic hazards to an acceptable level.

5.4.6.3 Topography and Grading

The design level geotechnical investigation will present detailed recommendations for earthwork design, which will used to develop the final grading plan for the Project. Design and implementation of the grading plan in accordance with appropriate LORS will limit the impact on the geologic surroundings to an acceptable level.

5.4.6.4 Corrosion Potential

A design-level geotechnical investigation will be performed to further evaluate the corrosion potential of the soils in the project area and present appropriate mitigation recommendations. The materials used for foundation design will be selected to match the corrosive potential of the surrounding soils.

5.4.7 Involved Agencies and Agency Contacts

Compliance of building construction with CBC standards is covered under engineering and construction permits for the Project. There are no other permit requirements that specifically address geologic resources and hazards. Applicable agencies and agency contacts for grading and floodplain development permits are shown in Table 5.4-2.

Table 5.4-2
Agency Contacts

Issue	Agency	Contact
Application for Certification	California Energy Commission	Pierre Martinez California Energy Commission 1516 Ninth Street Sacramento, CA 95814 PMartine@energy.state.ca.us
Right-of-Way Grant and CDCA Plan Amendment	Bureau of Land Management	Cedric Perry Bureau of Land Management 22835 Calle San Juan de Los Lagos Moreno Valley, CA 92553-9046 (951) 697-5200 cperry@blm.gov
Grading Permit–Large scale (non-residential) *	Riverside County Planning Department *	Larry Ross 4080 Lemon Street Riverside, CA 92502-1629 951-955-1852 Email: lross@co.riverside.ca.us
Building Permit-Construction Activities *	Riverside County Transportation and Land Management Agency *	Chandra Thomas 4080 Lemon Street Riverside, CA 92502-1629 951-955-5996
Riverside County Floodplain Development Permit	Riverside County Planning Department	Scott Arnold 4080 Lemon Street Riverside, CA 92502-1629 (951) 955-1852

Note:
* These permits will be issued by the CEC's delegate CBO. However, the CBO may communicate with the County regarding the permits and Riverside County Code Enforcement is responsible for inspections and ensuring compliance with building standards.

Acronyms/Abbreviations:
CDCA = California Desert Conservation Area

5.4.8 Permits Required and Permit Schedule

As discussed previously, compliance of building construction with CBC standards is covered under engineering and construction permits for the Project. The agencies responsible for permits related to grading and floodplain development, and the associated schedules, are listed in Table 5.4-3.

Table 5.4-3
Permits and Permit Schedule

Permit	Agency	Schedule
Grading Permit–Large scale (non-residential)	CBC's delegate CBO	Grading plan and permit applications will be submitted in accordance with the requirements as set forth in the CEC Final Decision and project assigned CBO. Subject to the CED one year permit process.
Building Permit-Construction Activities	CBC's delegate CBO	Building permit applications will be submitted in accordance with the requirements as set forth in the CEC Final Decision and project assigned CBO.
Riverside County Floodplain Development Permit	Scott Arnold Riverside County Planning Department 4080 Lemon Street Riverside, CA 92502-1629 (951) 955-1852	Floodplain development permit application will be submitted six weeks prior to the start of construction.

Notes:
CBC = California Building Code
CBO = Chief Building Official
CEC = California Energy Commission

5.4.9 References

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United States Geological Survey (USGS), 2006. Geologic Map of the West Half of the Blythe 30' by 60' Quadrangle, Riverside County, California and La Paz County, Arizona. Compiled by Paul Stone.

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URS Corporation (URS), 2011b. Geoarchaeological Sensitivity Analysis – Rio Mesa Solar Generating Electric Facility Project, URS Project No. 27651004, May 13.

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Adequacy Issue: Adequate ____ Inadequate ____

DATA ADEQUACY WORKSHEET

Revision No. 0 Date ____

Technical Area: **Geological Hazards** Project: ____ Technical Staff: ____

Project Manager: ____ Docket: ____ Technical Senior: ____

SITING REGULATIONS	INFORMATION	AFC PAGE NUMBER AND SECTION NUMBER	ADEQUATE YES OR NO	INFORMATION REQUIRED TO MAKE AFC CONFORM WITH REGULATIONS
Appendix B (g) (1)	...provide a discussion of the existing site conditions, the expected direct, indirect and cumulative impacts due to the construction, operation and maintenance of the project, the measures proposed to mitigate adverse environmental impacts of the project, the effectiveness of the proposed measures, and any monitoring plans proposed to verify the effectiveness of the mitigation.	Sections 5.4.3, 5.4.4, 5.4.5, 5.4.6		
Appendix B (g) (17) (A)	A summary of the geology, seismicity, and geologic resources of the project site and related facilities, including linear facilities.	Section 5.4.3		
Appendix B (g) (17) (B)	A map at a scale of 1:24,000 and description of all recognized stratigraphic units, geologic structures, and geomorphic features within two (2) miles of the project site and along proposed facilities. Include an analysis of the likelihood of ground rupture, seismic shaking, mass wasting and slope stability, liquefaction, subsidence, tsunami runup, and expansion or collapse of soil structures at the plant site. Describe known geologic hazards along or crossing linear facilities.	Map: see Figure 5.4-1 (Note: scale adjusted to accommodate the large scale of the project area and the 2 mile buffer) Analysis: Section 5.4.4		
Appendix B (g) (17) (C)	A map and description of geologic resources of recreational, commercial, or scientific value which may be affected by the project. Include a discussion of the techniques used to identify and evaluate these resources.	Map see Figure 5.4-1 Descriptions see Section 5.4.3 page 5.4-5 and Section 5.4.4 page 5.5-9		

Adequacy Issue: Adequate ____ Inadequate ____

DATA ADEQUACY WORKSHEET

Revision No. 0 Date ____

Technical Area: **Geological Hazards**

Project: ____

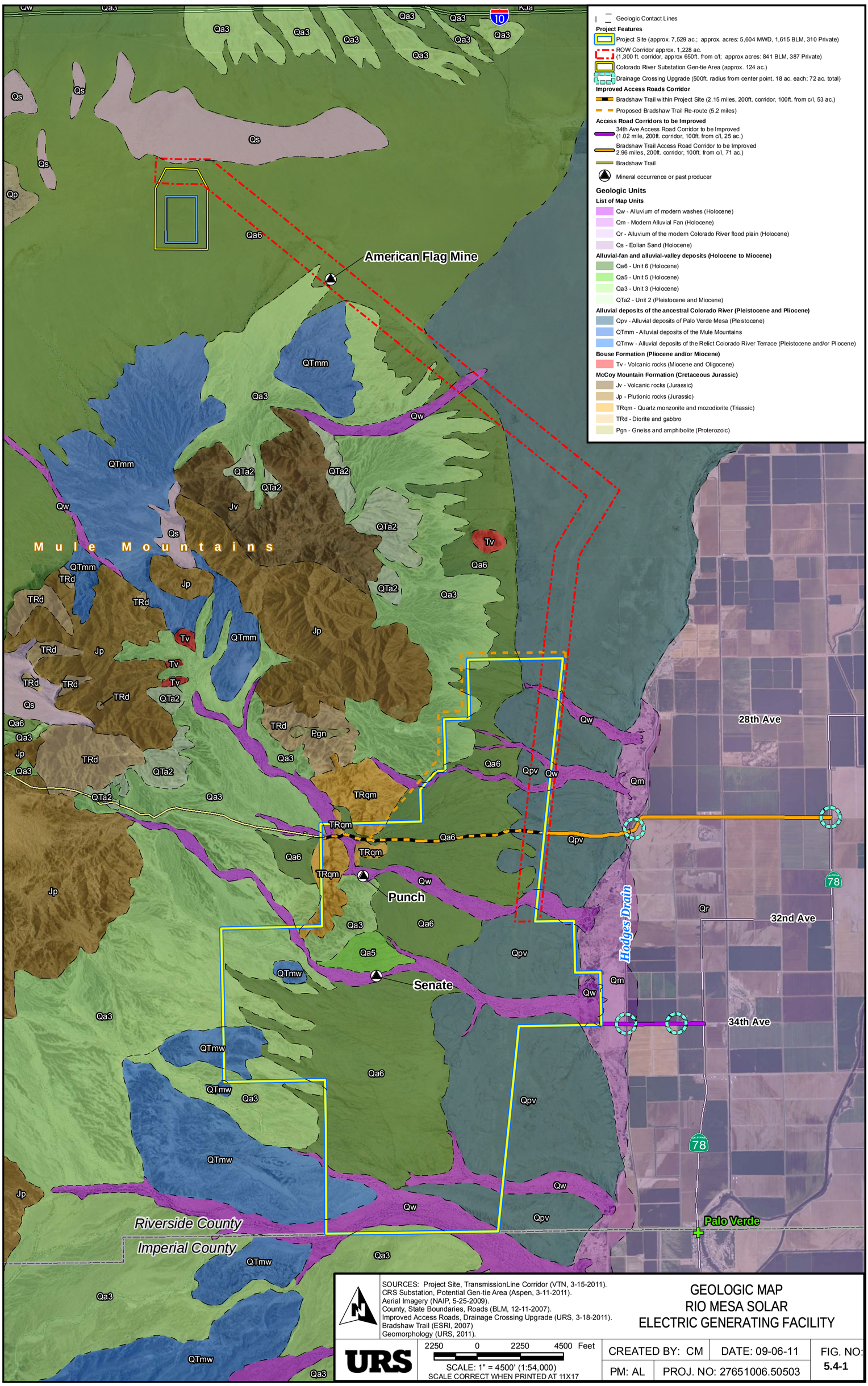
Technical Staff: ____

Project Manager: ____

Docket: ____

Technical Senior: ____

SITING REGULATIONS	INFORMATION	AFC PAGE NUMBER AND SECTION NUMBER	ADEQUATE YES OR NO	INFORMATION REQUIRED TO MAKE AFC CONFORM WITH REGULATIONS
Appendix B (i) (1) (A)	Tables which identify laws, regulations, ordinances, standards, adopted local, regional, state, and federal land use plans, leases, and permits applicable to the proposed project, and a discussion of the applicability of, and conformance with each. The table or matrix shall explicitly reference pages in the application wherein conformance, with each law or standard during both construction and operation of the facility is discussed; and	Table 5.4-1 (Section 5.4.2)		
Appendix B (i) (1) (B)	Tables which identify each agency with jurisdiction to issue applicable permits, leases, and approvals or to enforce identified laws, regulations, standards, and adopted local, regional, state and federal land use plans, and agencies which would have permit approval or enforcement authority, but for the exclusive authority of the commission to certify sites and related facilities.	Section 5.4.7, Table 5.4-2		
Appendix B (i) (2)	The name, title, phone number, address (required), and email address (if known), of an official who was contacted within each agency, and also provide the name of the official who will serve as a contact person for Commission staff.	Section 5.4.7, Table 5.4-2		
Appendix B (i) (3)	A schedule indicating when permits outside the authority of the commission will be obtained and the steps the applicant has taken or plans to take to obtain such permits.	Section 5.4.8, Table 5.4-3		



SOURCES: Project Site, TransmissionLine Corridor (VTN, 3-15-2011).
CRS Substation, Potential Gen-tie Area (Aspen, 3-11-2011).
Aerial Imagery (NAIP, 5-25-2009).
County, State Boundaries, Roads (BLM, 12-11-2007).
Improved Access Roads, Drainage Crossing Upgrade (URS, 3-18-2011).
Bradshaw Trail (ESRI, 2007)
Geomorphology (URS, 2011).

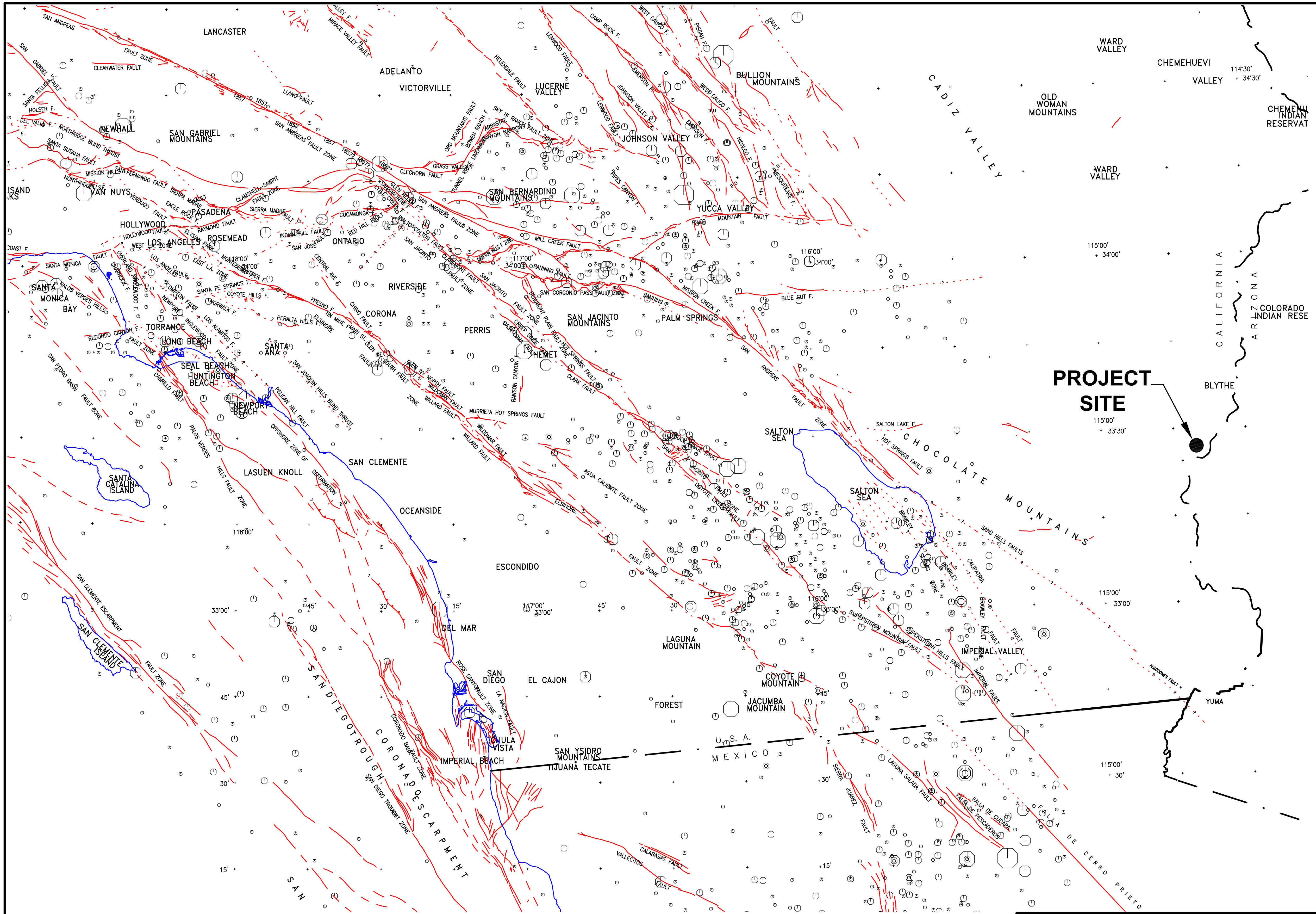
URS

2250 0 2250 4500 Feet
SCALE: 1" = 4500' (1:54,000)
SCALE CORRECT WHEN PRINTED AT 11X17

GEOLOGIC MAP
RIO MESA SOLAR
ELECTRIC GENERATING FACILITY

CREATED BY: CM	DATE: 09-06-11	FIG. NO:
PM: AL	PROJ. NO: 27651006.50503	5.4-1

Path: G:\gis\projects\1577\27651002\map_docs\mxd\AFC\Geol\Geology.mxd, Colin_Mattison, 9/6/2011, 7:40:31 PM



LEGEND:

REPORTED EARTHQUAKE MAGNITUDES.

- 4.0 TO 4.9
- 5.0 TO 5.9
- 6.0 TO 6.9
- 7.0 AND GREATER

SOUTH OF LATITUDE 35°N, EPICENTER AND MAGNITUDE DATA ARE FROM THE CALIFORNIA GEOLOGICAL SURVEY (2000) EARTHQUAKE CATALOG FOR THE PERIOD FROM 1769 TO 2000. ONLY EARTHQUAKES OF MAGNITUDE 4.0 AND LARGER ARE SHOWN. AFTERSHOCKS ARE NOT INCLUDED.

? ? ?

APPROXIMATE LOCATION OF HOLOCENE AND PLEISTOCENE FAULTS, DOTTED WHERE CONCEALED, QUERIED WHERE CONJECTURAL. FAULT LOCATIONS BASED ON: ZIONY AND JONES, 1989; CDMG GEOLOGIC MAP SERIES OF CALIFORNIA, 1977–1986 (1:250,000 SCALE); CDMG GEOLOGIC MAP SERIES, CALIFORNIA CONTINENTAL MARGIN, 1987 (1:250,000 SCALE); HAUKSSON, 1990; SHAW AND SHEARER, 1999; WRIGHT, 1991; GRANT ET AL. 1999.

REGIONAL FAULT AND EPICENTER MAP
RIO MESA SOLAR
ELECTRIC GENERATING FACILITY

URS

10 0 10 20 Miles
SCALE: 1"= 20 miles

CHECKED BY: DR	DATE: 08–09–11	FIG. NO:
PM: AL	PROJ. NO: 27651006.50503	**5.4-2**