DOCKETED

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Document Title:	Section 3-7 Geology and Soils
Description:	This Section evaluates the direct, indirect and cumulative impacts the Project may have on geology and soil resources and identifies any required Applicant-Proposed Measures (APM) and any required Mitigation Measures.
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3.7 GEOLOGY AND SOILS

This section describes the existing geology, soil conditions, seismicity, and paleontological resources in the vicinity of the project site in terms of local topography, geology, soil resources and regional seismicity. This section also identifies local geologic and seismic hazards that could affect structures associated with the project. The study area relevant to geology, soils, and geologic hazards comprises the project site: the physical footprint of project construction, operation, maintenance, and decommissioning activities. The study area relevant to faulting and seismic hazards comprises the broader eastern Mojave Desert region, reflecting that the project site could be affected by ground shaking and secondary seismic hazards associated with distant faults. The study area relevant to paleontological resources also encompasses the broader Mojave Desert region, as information on the geology and paleontology in the region informs on the paleontological potential within the project site. The analysis is based on a review of existing resources, technical data, and applicable laws, regulations, plans, and policies, as well as the following technical reports prepared for the project:

- *Paleontological Resources Technical Report* prepared by SWCA Environmental Consultants (SWCA) (2024) (Appendix H)

3.7.1 Regulatory Setting

3.7.1.1 Federal

INTERNATIONAL BUILDING CODE

The 2006 International Building Code (IBC) is a model building code developed by the International Code Council that sets rules specifying the minimum acceptable level of safety for constructed objects such as buildings in the United States. As a model building code, the IBC has no legal status until it is adopted or adapted by government regulation. California has adopted the IBC. The IBC was developed to consolidate existing building codes into one uniform code that provides minimum standards to ensure the public safety, health, and welfare insofar as they are affected by building construction and to secure safety to life and property from all hazards incident to the occupancy of buildings, structures, and premises. With some exceptions, the California Building Code (CBC) discussed below is based on the IBC.

FEDERAL LAND POLICY AND MANAGEMENT ACT OF 1976 (AS AMENDED)

The Federal Land Policy and Management Act of 1976, as amended (FLPMA), establishes policy and goals to be followed in the administration of public lands by the Bureau of Land Management (BLM). The intent of FLPMA is to protect and administer public lands within the framework of a program of multiple use, sustained yield, and the maintenance of environmental quality. Particular emphasis is placed on the protection of the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resources, and archaeological values. FLPMA is also charged with the protection of life and ensuring safety from natural hazards.

DESERT RENEWABLE ENERGY CONSERVATION PLAN

In September 2016, the BLM adopted the Desert Renewable Energy Conservation Plan (DRECP) Land Use Plan Amendment (LUPA) to the California Desert Conservation Area (CDCA) Plan, Bishop Resource Management Plan, and Bakersfield Resource Management Plan. The DRECP LUPA addresses solar, wind, and geothermal energy generation and transmission projects on 10.8 million acres of BLM-administered lands in the desert regions of southern California (BLM 2016a).

The BLM DRECP LUPA establishes several land use classifications, including Development Focus Areas (DFAs), Variance Process Lands (VPLs), Recreation Management Areas, General Public Lands, and various conservation land use designations. In DFAs, renewable energy projects are incentivized and permitting is streamlined. Renewable energy projects may be implemented on VPLs, but they must first be evaluated under a variance process and then approved by the BLM to proceed through National Environmental Policy Act (NEPA) environmental review. BLM Conservation Areas include National Landscape Conservation System lands, Areas of Critical Environmental Concern (ACECs), and Wildlife Allocations. Recreation Management Areas are designated for recreation actions. This designation includes Extensive Recreation Management Areas, which entail management specifically to address recreation use and demand; and Special Recreation Management Areas, which are high-priority areas for recreation and have unique value and importance for recreation. General Public Lands are BLM-administered lands that do not have a specific land allocation or designation associated with energy development, conservation, or recreation. These lands are not needed to fulfill the DRECP biological conservation or renewable energy strategy. These areas are available to renewable energy applications but do not benefit from permit review streamlining or other incentives.

Most of the project site is on DRECP General Public Lands, and the generation-tie line (gen-tie line) route is within an ACEC.

FEDERAL EARTHQUAKE HAZARDS REDUCTION ACT

In 1977, the U.S. Congress passed the Earthquake Hazards Reduction Act, which established the National Earthquake Hazards Reduction Program to reduce the risks to life and property from future earthquakes. The agencies responsible for coordinating this program are the Federal Emergency Management Agency (FEMA), the National Institute of Standards and Technology, the National Science Foundation, and the U.S. Geological Survey (USGS). In 1990, the National Earthquake Hazards Reduction Program was amended by the National Earthquake Hazards Reduction Program Act, which refined the description of the agency responsibilities, program goals, and objectives. The four goals of this act are to 1) develop effective practices and policies for earthquake loss reduction and accelerate their implementation, 2) improve techniques to reduce seismic vulnerability of facilities and systems, 3) improve seismic hazards identification and risk-assessment methods and their use, and 4) improve the understanding of earthquakes and their effects.

PALEONTOLOGICAL RESOURCES PRESERVATION ACT

The Paleontological Resources Preservation Plan (PRPA) was signed into law as part of the Omnibus Public Lands Management Act (OPLMA) of 2009. The OPLMA-PRPA requires the Secretary of the Interior to manage and protect paleontological resources on federal land using scientific principles and expertise and requires federal agencies to develop appropriate plans for the inventory, monitoring, and scientific and educational use of paleontological resources, in accordance with applicable agency laws, regulations, and policies. Where possible, these plans should emphasize interagency coordination and collaborative efforts with non-federal partners, the scientific community, and the general public.
The OPLMA-PRPA is the authority for federal land management agencies to issue permits to collect paleontological resources as well as curate these resources in an approved repository. It provides authority for the protection of significant paleontological resources on federal lands including criminal and civil penalties for fossil theft and vandalism.

CODE OF FEDERAL REGULATIONS, TITLE 43, SECTION 8365.1−5

Under 43 Code of Federal Regulations (CFR) 8365.1–5, collecting scientific and paleontological resources, including vertebrate fossils, on public lands under the jurisdiction of the BLM is prohibited. Collecting a "reasonable amount" of common invertebrate or plant fossils for non-commercial purposes is permissible.

3.7.1.2 State

CALIFORNIA BUILDING CODE

The CBC, codified in 24 California Code of Regulations 2, was promulgated to safeguard the public health, safety, and general welfare by establishing minimum standards related to structural strength, egress facilities, and general building stability. The purpose of the CBC is to regulate and control the design, construction, quality of materials, use/occupancy, location, and maintenance of all buildings and structures within its jurisdiction.

The current CBC is the 2013 Triennial Edition, which is based on the 2012 IBC. In addition, the CBC contains necessary California amendments that are based on the American Society of Civil Engineers (ASCE) Minimum Design Standard 7-05. ASCE 7-05 provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion in building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure, or any appurtenances connected or attached to such buildings or structures, throughout California.

The earthquake design requirements of the CBC consider the occupancy category of the structure, site class, soil classifications, and various seismic coefficients, all of which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC.

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. In accordance with this act, the State Geologist established regulatory zones, called earthquake fault zones, around the surface traces of active faults and has published maps showing these zones. Within these zones, buildings for human occupancy cannot be constructed across the surface trace of active faults. Each earthquake fault zone extends approximately 200 to 500 feet on either side of the mapped fault trace because many active faults are complex and consist of more than one branch that may experience ground surface rupture. This act does not apply to the project because no active faults cross the project site (California Department of Conservation [CDOC] 2022).

SEISMIC HAZARDS MAPPING ACT

The Seismic Hazards Mapping Act was developed to protect the public from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and from other hazards caused by earthquakes. This act requires the State Geologist to delineate "zones of required investigation" (i.e., seismic hazard zones) where site investigations are required to determine the need for mitigation of potential liquefaction and/or earthquake-induced landslide ground displacements. The act requires cities, counties, and other local permitting agencies to regulate certain development projects by implementing the provisions of the act through various local building codes, permits, and ordinances. Before a development permit is granted for a site within a seismic hazard zone, a geotechnical investigation of the site must be conducted and appropriate mitigation measures incorporated into the project design, consistent with the California Geological Survey's (CGS's) Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (2008).

At the time this Environmental Impact Report was written, Seismic Hazard Zone Maps had been prepared for portions of southern California and the San Francisco Bay area; however, no seismic hazard zones had been delineated for the project site. As a result, the provisions of the Seismic Hazards Mapping Act would not apply to the project (CDOC 2021).

CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS

Occupational safety standards exist in federal and state laws to minimize worker safety risks from both physical and chemical hazards in the workplace. In California, the California Division of Occupational Safety and Health (Cal OSHA) and the federal Occupational Safety and Health Administration (OSHA) are the agencies responsible for ensuring worker safety in the workplace.

Excavation and trenching are among the most hazardous construction activities. The OSHA Excavation and Trenching standard, 29 CFR 1926.650, covers requirements for excavation and trenching operations. OSHA requires that all excavations in which employees are potentially exposed to cave-ins be protected by sloping or benching the sides of the excavation, supporting the sides of the excavation, or placing a shield between the side of the excavation and the work area. Cal OSHA would be the implementing agency for state and federal OSHA standards.

CALIFORNIA PUBLIC RESOURCES CODE 5097.5

Requirements for paleontological resource management are included in California Public Resources Code (PRC) Division 5, Chapter 1.7, Section 5097.5, which states

> no person shall knowingly and willfully excavate upon, or remove, destroy, injure or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor.

These statutes prohibit the removal, without permission, of any paleontological site or feature from land under the jurisdiction of the state or any city, county, district, authority, or public corporation, or any agency thereof. Consequently, local agencies are required to comply with PRC 5097.5 for their own activities, including construction and maintenance, as well as for permit actions (e.g., encroachment permits) undertaken by others. PRC 5097.5 also establishes the removal of paleontological resources as a misdemeanor and requires reasonable mitigation of adverse impacts to paleontological resources from developments on public (state, county, city, and district) land.

3.7.1.3 Local

SAN BERNARDINO COUNTY EMERGENCY RESPONSE PLAN

The goal of hazard mitigation is to minimize or prevent the loss of life and damage to property. According to FEMA, hazard mitigation is defined as "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards." FEMA defines a hazard as "any event or condition with the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, environmental damage, business interruption, or other loss."

The objective of San Bernardino County's *Multi-Jurisdictional Hazard Mitigation Plan* (San Bernardino County 2022) is to illustrate the strategies for minimizing or preventing hazard risks in the unincorporated area of the county and the five special districts. The plan's approach incentivizes communities to establish objectives and develop projects aimed at diminishing risk and fostering more disaster resilient communities through the analysis of potential hazards.

SAN BERNARDINO COUNTYWIDE PLAN

The San Bernardino Countywide Plan (San Bernardino County 2024a), adopted by the Board of Supervisors in 2020, updates and expands the County's General Plan by addressing the physical, social, and economic issues facing the unincorporated portions of the county. The Countywide Plan consists of the Policy Plan, the Business Plan, and a communities plan. The Policy Plan, based on the former General Plan, consists of 11 elements: Land Use, Housing, Infrastructure and Utilities, Transportation and Mobility, Natural Resources, Renewable Energy and Conservation, Cultural Resources, Hazards, Personal and Property Protection, Economic Development, and Health and Wellness. The Business Plan consists of a policy-based governance element along with an implementation plan. The communities plan consists of 35 Community Action Guides that provide a framework for communities to create future character and independent identity through community actions.

The following policies identified in the Cultural Resources and Hazards elements of the San Bernardino Countywide Plan are relevant to this analysis (San Bernardino County 2024b).

Goal CR-2 Historic and Paleontological Resources. Historic resources (buildings, structures, or archaeological resources) and paleontological resources that are protected and preserved for their cultural importance to local communities as well as their research and educational potential.

- **Policy CR-2.3 Paleontological and archaeological resources**. We strive to protect paleontological and archaeological resources from loss or destruction by requiring that new development include appropriate mitigation to preserve the quality and integrity of these resources. We require new development to avoid paleontological and archeological resources whenever possible. If avoidance is not possible, we require the salvage and preservation of paleontological and archeological resources.

Goal HZ-1 Natural Environmental Hazards. Minimized risk of injury, loss of life, property damage, and economic and social disruption caused by natural environmental hazards and adaptation to potential changes in climate.

- **Policy HZ-1.1 New subdivisions in environmental hazard areas**. We require all lots and parcels created through new subdivisions to have sufficient buildable area outside of the following environmental hazard areas:
  1. Flood: 100-year flood zone, dam/basin inundation area
  2. Geologic: Alquist Priolo earthquake fault zone; County-identified fault zone; rockfall/debris-flow hazard area, existing and County-identified landslide area
- **Policy HZ-1.2 New development in environmental hazard areas**. We require all new development to be located outside of the environmental hazard areas listed below. For any lot or parcel that does not have sufficient buildable area outside of such hazard areas, we require

adequate mitigation, including designs that allow occupants to shelter in place and to have sufficient time to evacuate during times of extreme weather and natural disasters.

1. Flood: 100-year flood zone, dam/basin inundation area
2. Geologic: Alquist Priolo earthquake fault zone; County-identified fault zone; rockfall/debris-flow hazard area, medium or high liquefaction area (low to high and localized), existing and County-identified landslide area, moderate to high landslide susceptibility area)
3. Fire: high or very high fire hazard severity zone

- **Policy HZ-1.8 Wind erosion hazards**. We require new development in medium-high or high wind erosion hazard areas to minimize the effects of wind-blown soil through building and site design features such as fencing, surface treatment or pavement, attenuation or wind barriers, architectural features, building materials, and drought resistant landscaping.
- **Policy HZ-1.9 Hazard areas maintained as open space**. We minimize risk associated with flood, geologic, and fire hazard zones or areas by encouraging such areas to be preserved and maintained as open space.

3.7.2 Environmental Setting

3.7.2.1 Regional Setting

The project site is in the southeastern portion of the Mojave Desert geomorphic province (CGS 2002). Mojave Desert geomorphology and topography are largely controlled by fault trends and are characterized by isolated mountain ranges separated by desert plains, many draining internally and having central playas (e.g., Soda Lake). To the north and west, the boundaries of the geomorphic province are marked by major mountain ranges (e.g., the Sierra Nevada and Transverse ranges) and regional faults (e.g., the Garlock Fault and the San Andreas Fault). To the east, the geomorphic province is bounded by the Nevada and Arizona borders.

Mountains surrounding the project site are primarily composed of granitic and volcanic rocks that formed less than 65 million years ago. The surrounding mountains also include nonmarine sedimentary rocks of a similar age, older volcanic rocks (approximately 145–200 million years old), and marine sedimentary rocks that formed over 300 million years ago (Jennings et al. 1962) (Figure 3.7-1). Paleozoic strata found in the Mojave Desert are typically representative of continental margin depositional environments (Walker et al. 2002). Mesozoic rocks include marine and nonmarine sedimentary rocks, volcanics, and plutonic igneous bodies that were emplaced during the Nevadan orogeny. Cenozoic strata in the Mojave Desert are widespread and typically include both volcanic and sedimentary rock types.

Alluvial fans vary from recent (decades to millennia) to very old (tens of thousands of years), with the older deposits forming the more elevated surfaces (BLM and San Bernardino County 2015). Recent (i.e., Holocene) stream deposits originating in the Soda Mountains form wedges of alluvial sand, gravel, cobbles, and boulders as the alluvium exits mountain canyons to the valley floor. The percentage of sand and smaller-diameter gravel generally increases with distance from the mountains, as cobbles and boulders generally drop out of the water column first as the force of water flow declines in more level valley terrain. Bedrock formations in the surrounding mountains are predominantly granitic and volcanic, although older and younger sedimentary formations are present at greater distance from the project site and to the north. These bedrock formations are generally very hard and moderately to very fractured, and they form the source materials that have been transported to build the alluvial fan deposits that fill the valley (BLM and San Bernardino County 2015).

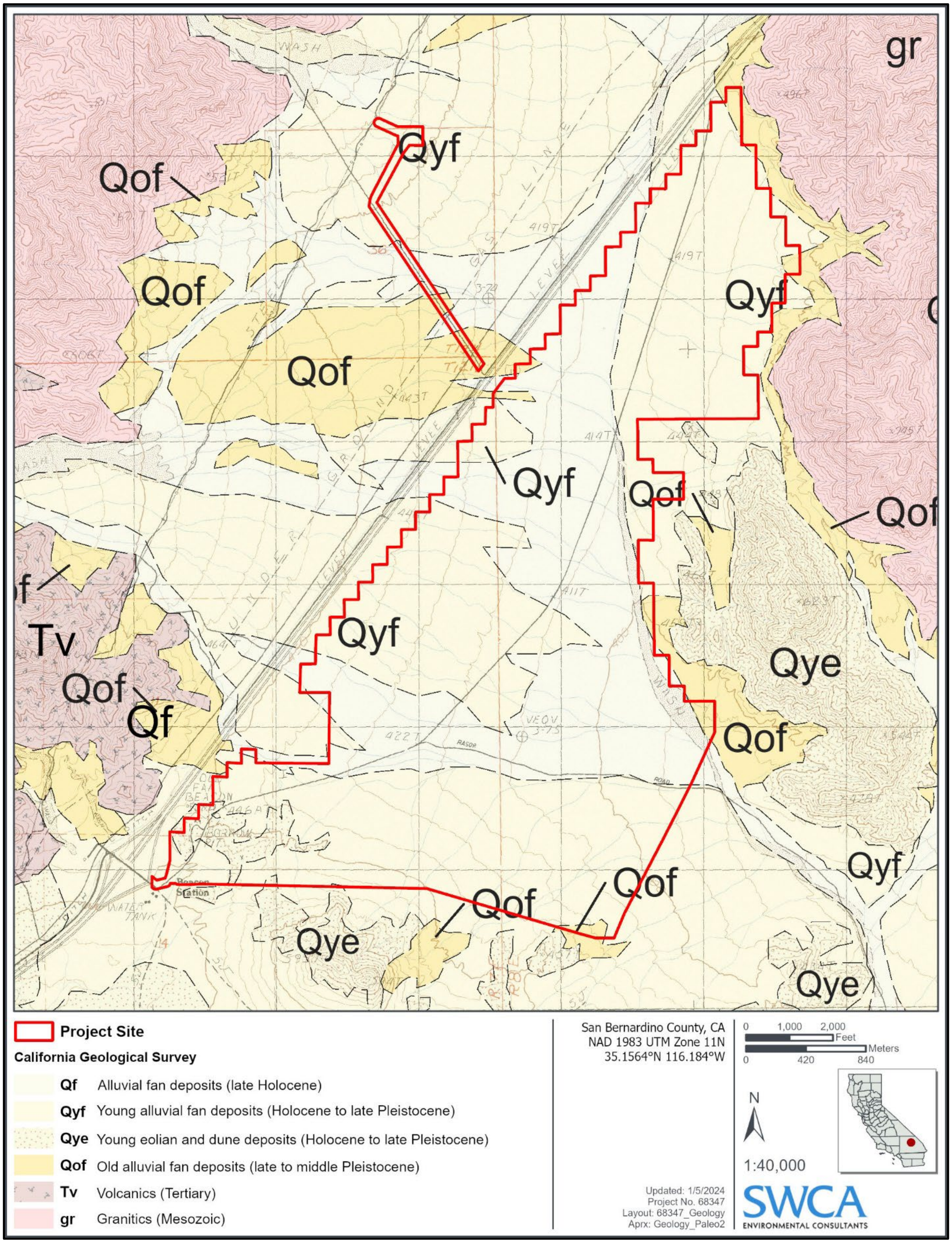

Figure 3.7-1. Geologic map of project site and vicinity.

3.7.2.2 Local Setting

TOPOGRAPHY

The project site lies within a small, intermontane desert valley occupied by alluvial fan deposits and surrounded by the Soda Mountains. The main mass of the Soda Mountains lies to the west of the project site and reaches an elevation of approximately 3,625 feet above mean sea level (amsl). Lower mountains to the south and east of the project site form a discontinuous border reaching elevations of 1,850 and 2,350 feet amsl, respectively (BLM and San Bernardino County 2015). The mountains farther to the north are within these same general elevational ranges. Elevations in the project site range from approximately 1,600 feet amsl in the southwest to 1,550 feet amsl on the north and 1,250 feet amsl on the southeast.

Terrain within the project site consists of predominantly south- to east-sloping (at 2% to 4%) alluvial deposits emanating from the Soda Mountains to the west, with minor north- and west-sloping terrain at the edges of the smaller mountains on the east. Channels and washes are deeper, and clast sizes increase up to small boulders closer to the base of the surrounding mountains. The southwestern portion of the project site, east of Interstate 15 (I-15), has an elevation of roughly 1,520 feet amsl. Surface morphology within the project site varies from older, smoothly undulating and relatively flat alluvial fan surfaces to young and active drainages incised into the alluvial fan surfaces (BLM and San Bernardino County 2015). Small shrubs and desert grasses cover approximately 35% of the site, and there is very little evidence of prior disturbance or any built environment; prior ground disturbance consists of slightly graded dirt roads and modern alluvial channels.

GEOLOGY

The geology of the Mojave Desert is complex, and rocks found in the Mojave Desert represent nearly all divisions of geologic time, from Precambrian basement rocks to modern alluvium. Geologic units within the project site consist primarily of alluvium (sedimentary deposits derived from weathering, erosion, and transport) on the flanks of the Soda Mountains and in the central valley and washes (see Figure 3.7-1). Small areas of bedrock are present in the southern and southwestern extremes of the site.

According to geologic mapping by Bedrossian et al. (2012), the surface of the project site contains late Holocene alluvial fan deposits (Qf), Holocene to late Pleistocene young alluvial fan deposits (Qyf), Holocene to late Pleistocene young eolian and dune deposits (Qye), and late to middle Pleistocene (11,700–774,000 years ago) old alluvial fan deposits (Qof) (Table 3.7-1; see Figure 3.7-1). In general, geologic units mapped at the surface near the project site (e.g., within a 0.5-mile buffer) can be a good indicator of the geologic units that may be present in the subsurface, provided that structural deformation has not altered or displaced the vertical or lateral continuity of the units and that the geologic units are in their original geochronological order (relatively young deposits overlying relatively old deposits based on the principles of stratigraphy). Neogene (Tertiary) formations of volcanic origin (Tv), and Mesozoic and older granitic and other intrusive crystalline rocks of all ages (gr) are also mapped along the uplifted hills east and west of the project site (Bedrossian et al. 2012) and may be present at substantial depth within the project site.

Table 3.7-1. Surface Geology and Paleontological Resource Potential of Geologic Units within Approximately 0.5 Mile of the Project Site

Geologic Unit and Map Abbreviation	Typical Fossils	Age	Provisional PFYC Ranking
Alluvial Fan Deposits (Qf)	None	Late Holocene	Class 2 – Low
Young Alluvial Fan Deposits (Qyf)	Vertebrates, invertebrates, plants, trace fossils	Holocene to late Pleistocene	Class 2 – Low overlying Class 3 – Moderate
Young Eolian and Dune Deposits (Qye)	None	Holocene to late Pleistocene	Class 1 – Very Low
Old Alluvial Fan Deposits (Qof)	Vertebrates, invertebrates, plants, trace fossils	Late to middle Pleistocene	Class 2 – Low overlying Class 3 – Moderate
Tertiary Age Formations of Volcanic Origin (Tv)	None	Tertiary	Class 1 – Very Low
Granitic and Other Intrusive Crystalline Rocks of All Ages (gr)	None	Mesozoic to Precambrian	Class 1 – Very Low

Sources: Bedrossian et al. (2012); SWCA (2024) (Appendix H).

PFYC = Potential Fossil Yield Classification system

SOILS

Data from the Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) dataset was reviewed to identify soils on the subject property (NRCS 2023a). The STATSGO data were used because the map units are larger and define broader areas. These soil maps are compiled by generalizing more detailed soil survey mapping. They are normally used where more detailed soil survey maps are not available or not feasible for the scale of the project.

As shown in Figure 3.7-2, the project site is mapped as Rillito–Gunsight, Rositas–Carrizo, and rock outcrop soil complexes (NRCS 2023a). Soil type descriptions (NRCS 2023b) are provided in Table 3.7-2.

Table 3.7-2. Descriptions of Soil Types on the Project Site

Soil Name	Description
Carrizo	The Carrizo series consists of very deep, excessively drained soils formed in mixed igneous alluvium. It is gravelly sand and has negligible to low runoff and high hydraulic conductivity. Carrizo soils are on numerous landforms on floodplains, fan piedmonts, and bolson floors. Slopes range from 0 to 15 percent.
Rositas	The Rositas series consists of very deep, somewhat excessively drained soils formed in sandy eolian material. It is fine sand and has negligible to low runoff and rapid permeability. Rositas soils are on dunes and sand sheets. Slope ranges from 0 to 30 percent with hummocky or dune micro relief.
Gunsight	The Gunsight series consists of very deep, somewhat excessively drained, strongly calcareous soils that formed in alluvium from mixed sources. It is gravelly loam with very low to high runoff and moderate or moderately rapid permeability. Gunsight soils are on fan terraces or stream terraces and have slopes of 0 to 60 percent.
Rillito	The Rillito series consists of very deep, somewhat excessively drained soils that formed in mixed alluvium. It is gravelly sandy loam and has slow or medium runoff with moderate permeability. Rillito soils are on fan terraces or stream terraces. Slopes are predominantly 0 to 5 percent but range to 40 percent.
Rock outcrop	Miscellaneous soil unit.

Source: NRCS (2023b).

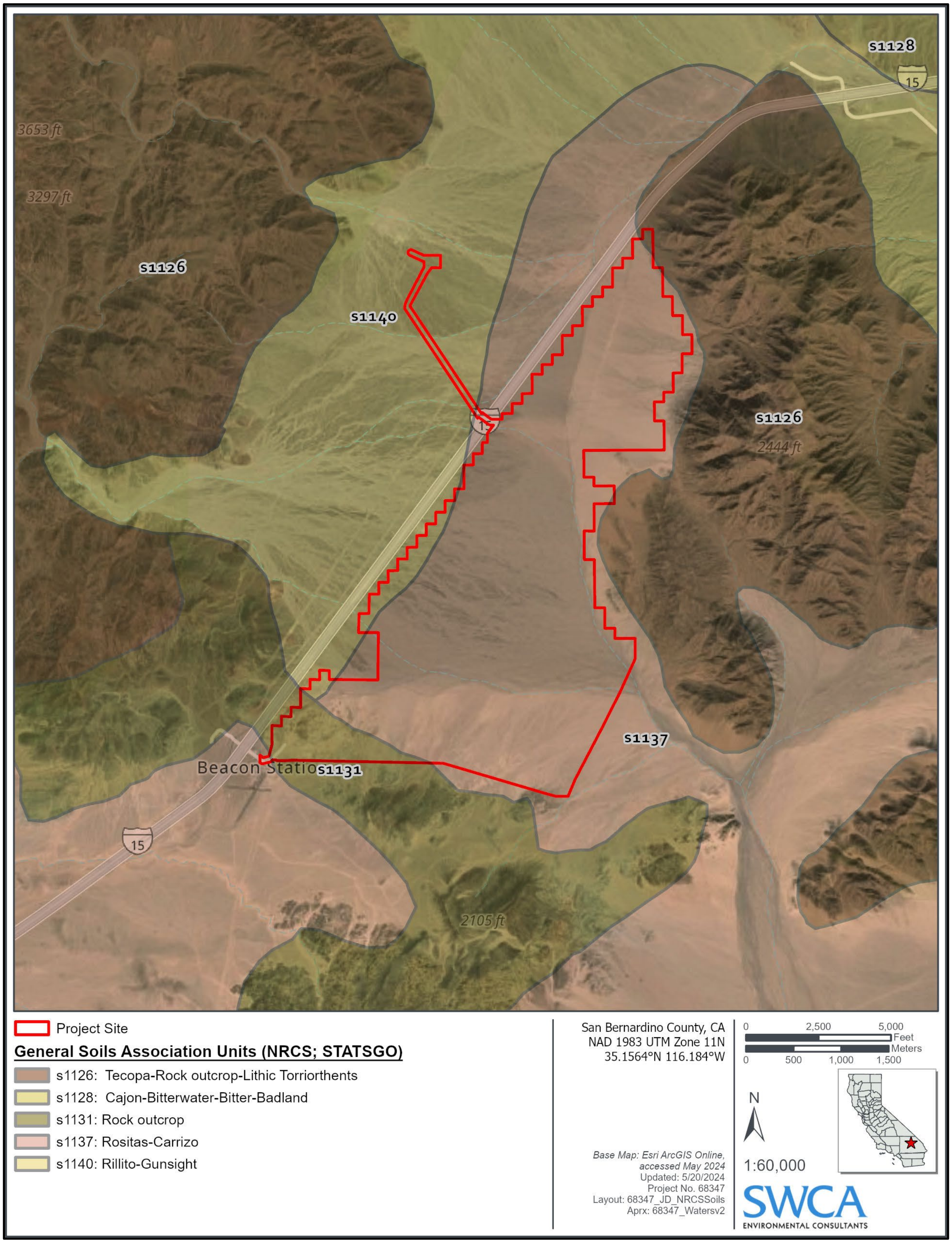

Figure 3.7-2. Soil types on the project site and vicinity.

DESERT PAVEMENT

Desert pavement is a feature of desert surfaces and is generally composed of a closely fitted, single layer of rock fragments over fine sand or silt. The single layer of rock fragments traps dust particles over time, which settle and adhere to each other. Desert pavements could be formed via geological processes such as gradual removal of sand, dust, and other fine-grained material, or by the shrink/swell properties of the clay underneath the pavement; when clay absorbs precipitation it expands, and when it dries it cracks along weak planes. The project site consists of rocky alluvial slopes and desert pavement separated by washes.

3.7.2.3 Geologic Hazards

LANDSLIDES

Slope failures, commonly referred to as landslides, include many phenomena of downslope displacement and movement of material, triggered by either static (i.e., gravity) or dynamic (i.e., earthquake) forces. Slope stability depends on several interacting variables, including bedrock geology, geologic structure, the amount of groundwater present, climate, topography, slope geometry, and human activity. Contributing factors to slope movement may decrease the resistance in the slope materials or increase the stresses on the slope, or both. Landslides can occur on slopes of 15% or less, but the probability of slope failure is greater on steeper slopes that exhibit previous landslide features such as scarps, slanted vegetation, and transverse ridges. Landslides typically occur within slide-prone geologic units that contain excessive amounts of water or are located on steep slopes, or where planes of weakness are parallel to the slope angle. The predominantly flat, alluvial nature of the project site generally precludes risk of or susceptibility to landslides. No landslide hazards are identified for the project site or within 20 miles (CDOC 2023; San Bernardino County 2007).

SOILS

Problematic soil conditions such as erosion, corrosion, and expansion (linear extensibility or shrink-swell) are potential geologic hazards for engineering components of the project and are discussed in detail below.

Soil Erosion

Erosion of soil or rock can be driven by the shearing action of water and wind. Water erosion can occur by rill and gully development driven by overland flow or by lateral erosion of a stream channel. For example, active alluvial fans are typically very dynamic with respect to lateral changes in the main channels and are prone to relatively high rates of vertical and lateral scour. Active alluvial fans also typically are characterized by a continual sediment supply deposited over the fan surface. Soil erosion can eventually lead to damage of building foundations and roadways, loss of topsoil, or substantial changes in drainage patterns or water quality. At the project site, areas that are susceptible to increased erosion are generally those that would be disturbed and exposed during the construction phase.

The capacity of soils to resist erosion by rainfall and runoff is a function of soil infiltration capacity and resistance to detachment and transport by falling or flowing water. Soils with high infiltration rates and permeability reduce the amount of runoff (and therefore the erosion potential). Soils that contain high percentages of fine sands and silt and that are low in density are generally the most erodible by water and wind. The majority of the alluvial formations throughout the project site are sand- and gravel-rich and excessively drained to well-drained, thus reducing erosion potential (BLM and San Bernardino County 2015). Alluvial units with desert pavement are less prone to erosion if left undisturbed. Intermediate-age alluvial fans are covered with variously developed desert pavement. In general, the highly ephemeral nature of seasonal runoff leads to erosion generally being concentrated along active and, to a lesser degree, young alluvial fans and washes. Roughness of the desert soil surface, soil moisture content, mechanical stability of soil aggregates (clumps of soil), and stability of soil crusts also affect the potential for soil loss resulting from wind.

The potential for the project to result in an increase in soil erosion is further discussed in Section 3.3, Air Quality, and Section 3.19, Utilities and Service Systems.

Corrosive Soils

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete or uncoated steel. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The steel in installations that span different soil types or cross soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer. The risk of corrosion is expressed as low, moderate, or high.

Project site soils were tested for pH, soluble sulfate content, soluble chloride content, and electrical resistivity (BLM and San Bernardino County 2015). Testing results showed that most of the project site soils have high corrosion potential for uncoated steel and low corrosion potential for concrete.

Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume change (shrink and swell) due to variation in soil moisture content. Changes in soil moisture could result from several factors, including rainfall, landscape irrigation, utility leakage, and perched groundwater. Expansive soils are typically very fine-grained with a high to very high percentage of clay. Soils with moderate to high shrink-swell potential would be classified as expansive soils. Soils on the project site and surrounding area are relatively coarse-grained and lack a significant clay fraction or thick accumulations of organic material.

Expansive soils exhibit a shrink-swell behavior, also referred to as linear extensibility. Shrink-swell is the cyclic change in volume (expansion and contraction) that occurs in fine-grained clay sediments during the processes of wetting and drying. Changes to soil moisture could stem from several factors, including rainfall, irrigation, and/or shallow depth to groundwater. Structural damage may occur over a long period, usually as a result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. For the project site, no expansive soils were identified and based on the nature of alluvial deposition, no expansive soils are expected (BLM and San Bernardino County 2015).

Subsidence and Settlement

Subsidence of the land surface is a general process that can be attributed to natural phenomena such as tectonic deformation, consolidation, hydro-compaction, collapse of underground cavities, oxidation of organic-rich soils, or rapid sedimentation. Human activities, such as the withdrawal of groundwater, can also cause subsidence. Naturally occurring subsidence most frequently takes place in tectonically active areas such as volcanic regions and fault zones. Subsidence due to groundwater withdrawal is possible due to substantial groundwater pumping in the region. Records of subsidence, however, are not known from the vicinity of the project site, most likely because sandy and gravelly soils are less susceptible to subsidence (BLM and San Bernardino County 2015). Based on a geophysical investigation of the project site, groundwater is estimated to be 180 to 350 feet below ground surface (bgs). Therefore, even with groundwater withdrawal from the valley, it is very unlikely that subsidence would occur (BLM and San Bernardino County 2015).

REGIONAL FAULTING AND SEISMIC HAZARDS

Surface Fault Rupture

Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude, sense, and nature of fault rupture can vary for different faults or even along different strands of the same fault. A factor considered in the seismic design of project structures is the location of active faults that may cross a portion of the facility; ground movement and surface rupture offset can be several feet vertically and horizontally, which could cause damage that would severely disrupt operations.

The project site is in a broad region of active and potentially active faults and fault zones that bound the Mojave Desert province. The closest active faults or fault zones to the project site are (in order of increasing distance) the Red Pass Lake Fault, the Eastern California Shear Zone, the Garlock Fault, and the San Andreas Fault Zone (USGS 2024). The Red Pass Lake Fault is 2.2 miles west of the project site on the southwestern flank of the Soda Mountains; the fault does not project toward the project site. Several Quaternary-age potentially active faults near the area (the nearest being the Baker Fault north and east of the project site) trend northwest-southeast, and others have a variety of trends. Although no mapped faults occur within or immediately adjacent to the project site, there is a short Quaternary fault west of and parallel to the main Baker Fault that projects toward the far eastern edge of the project site. Although it has not been mapped in this area, one or more faults may exist beneath the sediments filling the valley. However, there is no indication from the latest fault activity maps that this fault segment poses a surface rupture risk (BLM and San Bernardino County 2015; USGS 2024).

Seismic Ground Shaking

The USGS provides a uniform estimate of earthquake-induced ground motion intensity for the United States based on an up-to-date assessment of potential earthquake faults and other sources. One of the benchmarks used by the USGS is the peak ground acceleration (PGA) that has a 2% probability of being exceeded in 50 years. This probability level would allow structures to be designed for ground motions that have a 98% chance of not occurring in the next 50 years, making buildings safer than if they were simply designed for the most likely events. The approximate range of PGA with a 2% probability of occurrence during a 50-year period is 0.30 unit of gravity (g) to 0.40 g for the central and southern portions of the project site (including the proposed location of the operation and maintenance area buildings) and 0.20 g to 0.40 g for the northern edge of the project site. The maximum expected earthquake for the Red Pass Lake Fault could produce higher PGA levels, possibly near 0.50 g, for the entire project site and surrounding area due to its proximity and to the possibility it is a thrust fault that dips beneath the area (BLM and San Bernardino County 2015). Overall, this information suggests that strong ground shaking would be within the highest levels experienced in the Landers earthquake area in 1992 (0.45 g) and the Hector Mine earthquake in 1999 (0.42 g), both in the Mojave Desert region south-southwest of the project site (BLM and San Bernardino County 2015).

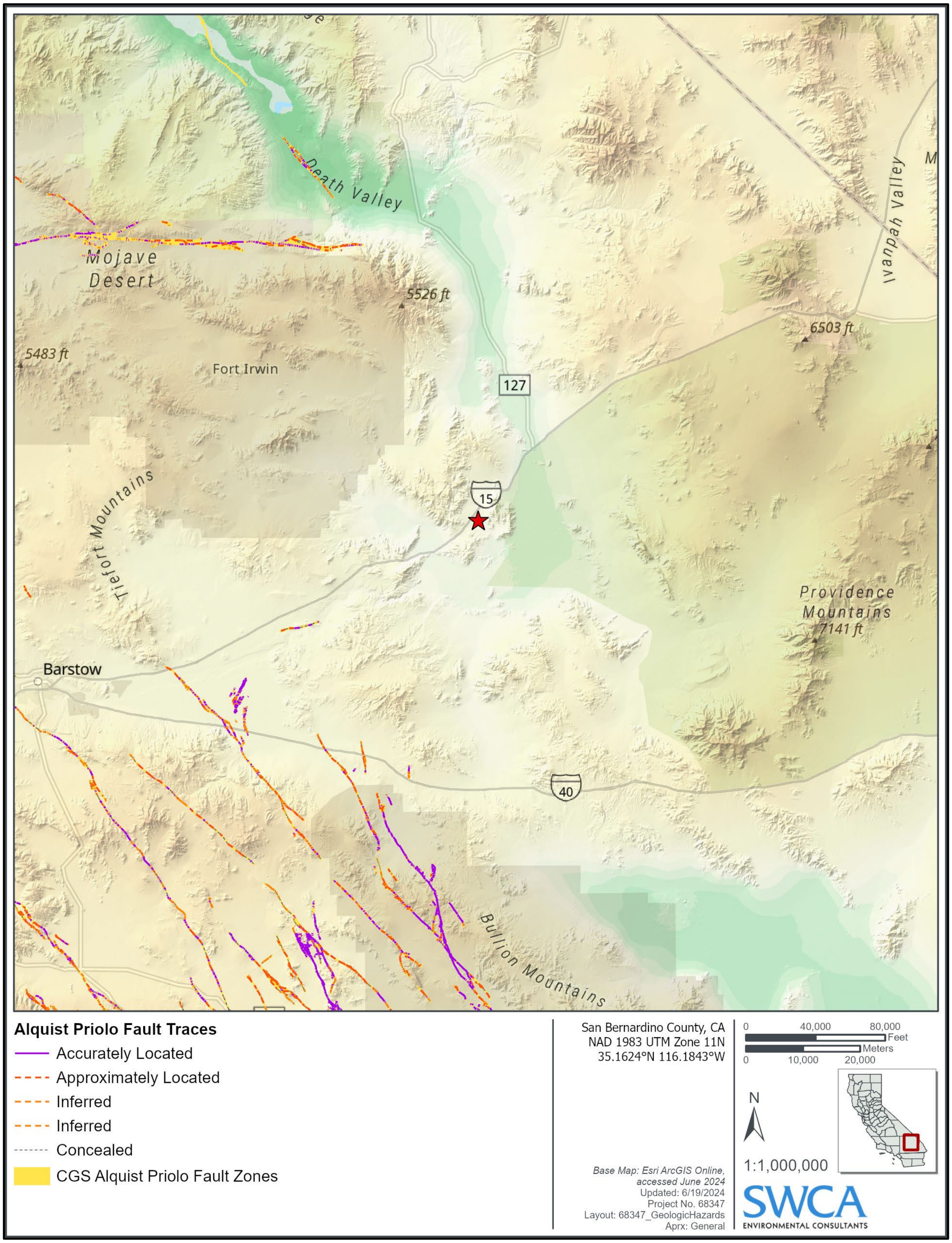

Figure 3.7-3. Alquist-Priolo earthquake fault traces.

Liquefaction

Saturated, unconsolidated silts, sands, and silty sands within 50 feet of the ground surface are most susceptible to liquefaction, which can include loss of bearing strength, lateral spreading, subsidence, and buoyancy effects caused when these sediments temporarily lose their shear strength during strong ground shaking. Susceptibility to liquefaction is a function of the sediment density, water content, depth, and the PGA. The potential for liquefaction within the project site is very low for the following reasons (BLM and San Bernardino County 2015):

1. Permanent groundwater depth is much greater than 50 feet (probably 180 to 350 feet deep).
2. Geologic material types are dense and contain a high percentage of gravel, cobbles, and boulders (intermediate and older alluvial fans).
3. Some geologic units have calcium carbonate cementation (some intermediate-age alluvial fans).

It is plausible that seasonal, perched groundwater may exist at depths less than 50 feet; however, the grain size and density of the alluvium should still preclude liquefaction (BLM and San Bernardino County 2015). In addition, the San Bernardino County Geologic Hazard Overlay Map – Baker CIDIC shows no liquefaction areas on or near the project site (San Bernardino County 2007).

Tsunami

The project site is situated in an inland desert area and is not susceptible to tsunami inundation (CDOC 2024). Furthermore, there are no water bodies (e.g., lake, reservoir, and canals) in the project vicinity that are capable of generating a seiche.

3.7.2.4 Paleontological Resources

BUREAU OF LAND MANAGEMENT POTENTIAL FOSSIL YIELD CLASSIFICATION SYSTEM

Paleontological resources are fossilized remains, traces, or imprints of organisms, preserved in or on the Earth's crust, that provide information about the history of life on Earth. Examples of paleontological resources may include bones, teeth, shells, traces, impressions, leaves, and wood. They are considered nonrenewable resources because the organisms they represent no longer exist, and such resources, if destroyed, cannot be replaced. Paleontological resources are important scientific and educational resources that paleontologists and other scientists use in many different studies, such as to understand evolution, extinction, and speciation patterns; to reconstruct ancient environments and paleobiogeographic relationships; and to provide relative geological dates through biochronology and biostratigraphy. Paleontological resources that may not have paleontological significance (i.e., are not considered scientifically important) are those that lack provenance or context, that lack physical integrity because of decay or natural erosion, or that are overly redundant or are otherwise not useful for research (Murphey et al. 2019).

In general, the BLM's management objectives include locating, evaluating, managing, and protecting paleontological resources (BLM 1998). To aid in these objectives, the BLM developed the Potential Fossil Yield Classification (PFYC) system to provide baseline guidance for the agency and specialists to determine the presence of and potential for paleontological resources across its jurisdiction and guide the appropriate corresponding management considerations (BLM 2022a). Using this system, the BLM has assigned a PFYC ranking (PFYC 1 to PFYC 5) to each geologic unit (formation, member, or other distinguishable units) at the most detailed, mappable level available based on the taxonomic diversity and abundance of previously recorded scientifically significant paleontological resources associated with the unit and the potential for future discoveries, with a higher-class number indicating higher potential. Additional rankings are provided for geologic units of unknown potential (PFYC U), water (PFYC W), and ice (PFYC I). Paleontological resource management concerns and mitigation efforts are related to that potential and PFYC classification. A complete discussion of the background and context for the PFYC system is provided in BLM *Instructional Memorandum (IM) 2016-124* (BLM 2016b), which was updated in BLM *Permanent IM No. 2022-009* (BLM 2022a). Descriptions of paleontological sensitivity class rankings, drawn directly from the BLM guidelines (BLM 2022a), are provided in Table 3.7-3. Figure 3.7-4 shows the PFYC rankings for the project site and vicinity.

Table 3.7-3. Potential Fossil Yield Classification Rankings and Management Concerns

PFYC	Description	Management Concerns
Class 1 – Very Low	Geological units that are not likely to contain recognizable paleontological resources, such as igneous, metamorphic, or Precambrian-age rocks.	Negligible or not applicable
Class 2 – Low	Sedimentary geological units that are not likely to contain paleontological resources, such as those younger than 10,000 years, recent eolian deposits, and those that have undergone physical or chemical changes.	Generally low
Class 3 – Moderate	Sedimentary units with variable fossil content and significance.	Moderate
Class 4 – High	Geological units with high occurrence of paleontological resources but with variable occurrence and predictability. Contained paleontological resources may be at risk from human disturbance.	Moderate to high
Class 5 – Very High	Geological units that consistently and predictably produce paleontological resources of significant scientific value that may be at risk from human disturbance.	High to very high
Class U – Unknown	Geologic units that cannot receive an informed PFYC assignment due to the unit being poorly studied.	Moderate to high until a provisional ranking is assigned
Class W – Water	Most surface water bodies do not contain paleontological resources, but shorelines should be considered for uncovered paleontological resources. Reservoirs, karst area sinkholes, cenotes, and dredged river systems may contain paleontological resources.	Low
Class I – Ice	Includes any area that is mapped as ice or snow. Receding glaciers, including exposed lateral and terminal moraines, should be considered for their potential to reveal recently exposed paleontological resources. Other considerations include melting snow fields that may contain paleontological resources with possible soft-tissue preservation.	Low to moderate

Source: BLM (2022b).

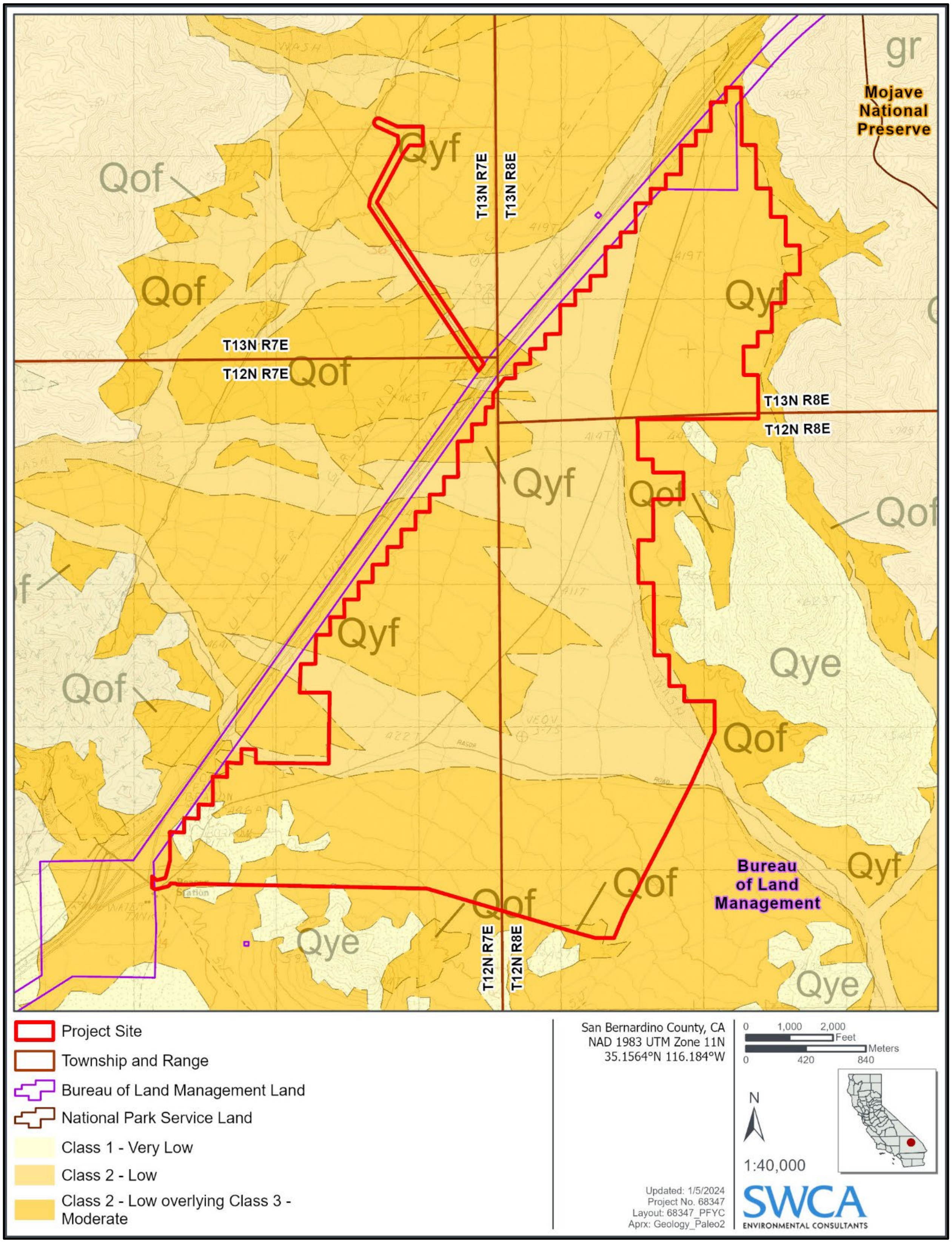

Figure 3.7-4. Potential Fossil Yield Classification map of project site and vicinity.

EXISTING DATA ANALYSIS

The *Paleontological Resources Technical Report* (SWCA 2024; see Appendix H) presents an analysis of available existing data pertinent to paleontological resources. This analysis includes a review of geologic maps, geotechnical information, scientific literature, results of museum records searches, and a pedestrian reconnaissance survey. The geologic mapping used in this analysis is from Bedrossian and others (2012) compiled from several quadrangles at scales of 1:100,000, and geotechnical investigation data are from Diaz Yourman & Associates (2010). Museum records search requests for fossil localities within a 1-mile buffer of the project site or within the vicinity of the project site were submitted to the Natural History Museum of Los Angeles (NHMLA) and the San Bernardino County Museum (SBCM) on April 26, 2023. The results of the museum records searches indicate that neither the NHMLA nor the SBCM possess records of paleontological resources from within the project site; however, several fossil localities have been recorded in the vicinity of the project site from Pleistocene alluvial, fluvial, and lacustrine deposits. The desktop review was supplemented by a review of the BLM's PFYC data (BLM 2016b, 2022). The desktop information and PFYC were used to determine areas subject to a pedestrian reconnaissance survey and to assign provisional PFYC rankings to geologic units within the project site.

PEDESTRIAN FIELD SURVEY AND RESULTS

During the 2010 paleontological surveys conducted for the *Proposed Plan Amendment/ Final Environmental Impact Statement/Environmental Impact Report for the Soda Mountain Solar Project*, four fossil localities were documented immediately outside of the project site and included nonsignificant burrow and root casts, as well as unidentifiable fossil bone fragments, indicating that fossil material may be present in the general vicinity (BLM and San Bernardino County 2015). Additionally, although geologic units classified by the BLM as low potential (PFYC Class 2) are mapped at the surface throughout most of the project site, geologic units of unknown potential (PFYC Class U) are mapped by the BLM along the project site's periphery and may extend into the project site as unmapped deposits or may be present in the subsurface (BLM 2022b). Therefore, to supplement the results of the existing data analysis and to conform to the BLM's guidelines (2008a, 2022a), a pedestrian reconnaissance survey of the project site was conducted on July 5 and 6, 2023.

The purpose of the reconnaissance survey was to 1) confirm the geologic mapping by Bedrossian et al. (2012); 2) assess the status of previously recorded paleontological localities noted in the results of the museum records searches, if any; 3) inspect exposures of previously undisturbed sediments or bedrock outcrops within the project site, if any, to assess their potential to preserve paleontological resources and to evaluate the appropriateness of the BLM's (2022b) PFYC mapping; and 4) record newly identified or previously unrecorded paleontological localities that may be present within the project site, if any. The reconnaissance survey included both pedestrian reconnaissance surveying of most areas identified as unknown potential (PFYC Class U) by the BLM (2022b), and a combined pedestrian and visual reconnaissance survey for areas noted as low potential (PFYC Class 2) by the BLM (2022b). Areas subject to pedestrian reconnaissance survey included walking in transects across the site, inspecting outcrops in dissected channels and survey washes. Areas not subject to pedestrian reconnaissance survey were instead subject to a visual reconnaissance that included windshield drive-by survey to confirm geologic mapping, overview site reconnaissance during pedestrian or windshield survey, and overview site reconnaissance from elevated vantage points looking across the project site.

No previously recorded fossil localities are present within the project site, although fossils are known to occur within stratigraphically correlative units elsewhere in the Mojave Desert. During the field survey, no fossils were documented within the project site, but four fossil localities were documented outside the boundaries of the project (BLM and San Bernardino County 2015). These fossils included unidentifiable bone fragments and poorly preserved burrow and root casts, none of which meet the BLM's significance criteria (BLM and San Bernardino County 2015).

3.7.3 Impact Analysis

3.7.3.1 Thresholds of Significance

The determinations of significance of project impacts are based on applicable policies, regulations, goals, and guidelines defined by the California Environmental Quality Act. Specifically, the project would be considered to have a significant effect on geology, soils, and paleontological resources if the effects exceed the significance criteria described below:

1. Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:
   i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42.
   ii. Strong seismic ground shaking.
   iii. Seismic-related ground failure, including liquefaction.
   iv. Landslides.
2. Result in substantial soil erosion or the loss of topsoil.
3. 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.
4. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property.
5. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater.
6. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature.

Each of these thresholds is discussed under Section 3.7.3.3, Impact Assessment, below.

3.7.3.2 Applicant-Proposed Measures

The applicant has identified and committed to implement the following applicant-proposed measures (APMs) as part of the proposed project to avoid or substantially lessen potentially significant impacts to geology and soils, to the extent feasible. The APMs, where applicable, are discussed in Section 3.7.3.3, Impact Assessment, below.

APM AIR-4: The applicant shall stabilize graded site surfaces upon completion of grading when subsequent development is delayed or expected to be delayed more than 14 days, except when such a delay is due to precipitation that dampens the disturbed surface sufficiently to eliminate visible fugitive dust emissions.

APM GEO-1: After construction completion, the BLM shall monitor disturbed areas where clearing, grubbing, and cut-and-fill shall be compacted once construction is complete for greater resistance to wind erosion.

APM GEO-2: During construction, facilities will be built in accordance with San Bernardino County and California State Building Code requirements applicable to "Seismic Zone 3." No human-occupied structures will be placed across the trace of a documented active fault. No human-occupied structure will be placed within 50 feet of the trace of an active fault or within a seismic special studies zone without a fault evaluation report, satisfactory to the State Geologist, demonstrating that no undue hazard would be created by the construction or placement of the structure.

APM GEO-3: Roads shall be constructed at grade to maintain existing drainage patterns during storm events. Unpaved access roads shall be constructed of compacted native soils. Rock or gravel may be added to unpaved roads for stabilization to prevent rutting or erosion.

APM GEO-4: The project stormwater pollution prevention plan or best management practices (BMP) plan required by Lahontan Regional Water Quality Control Board (RWQCB) for compliance with its General Permit R6T-2003-0004 and prepared consistent with its Project Guidelines for Erosion Control (Board Order No R6T-2003-0-04 Attachment G; Lahontan RWQCB 2003) shall be prepared and submitted to the BLM and County for review by a watershed specialist, hydrologist, and/or engineer from each lead agency before implementation. Reports shall be submitted 30 days prior to ground-disturbing activities. Erosion control and drainage plans for new and existing roads to be utilized for the project shall be aimed at maintaining to the greatest extent feasible existing soil quality and integrity. In developing the plan, the applicant or its contractor shall consult with the BLM and the County to determine the appropriate soil quality objective(s) to be met following construction (for temporary construction disturbances) and following decommissioning (for total site restoration). As part of the erosion control and drainage plans, the applicant and/or its contractor shall implement an appropriate combination of BMPs in order to meet or exceed the applicable soil quality objective(s) (e.g., maintain or enhance soil quality and function).

All measures and facilities for controlling runoff and erosion shall be in place prior to ground-disturbing activities. Desert tortoise fencing shall be installed consistent with APM BIO-28**,** which requires approved design to ensure a minimum impact to existing washes and to limit any substantial increase of erosion or sediment transport. Any desert tortoise fencing that creates substantial excess soil shall have straw wattles or other measures installed to prevent soil transport.

All erosion control facilities shall be monitored immediately following a qualified storm event. A major rainfall event is defined as one for which flow is visibly detectable within the fenced drainage. All repairs shall be completed prior to the commencement of ground disturbing activity. Any erosion control facilities that are damaged by rainfall shall be repaired within 72 hours of any damage and shall be monitored after any precipitation. Clearance reports and inspection logs shall be submitted to the BLM and the County. Substantial damage to erosion control facilities shall be reported to the BLM and the County and per the above, no ground disturbing activity shall restart until the facilities are repaired.

APM GEO-5: Prior to construction of project facilities, a qualified California-licensed geotechnical engineer shall prepare and submit to BLM a final geotechnical investigation that provides design requirements for foundations, retaining walls/shoring, and excavation, compliant with the applicable seismic design standards in the CBC. The scope of the geotechnical report shall include the solar array fields, collection line routes, substation and switchyard site, and the operation and maintenance buildings sites. The geotechnical investigation shall expand upon the preliminary investigations as necessary and identify and evaluate the presence of expansive, compressible, liquefiable, or mechanically unstable soils and, if present, shall make recommendations for site preparation or design necessary to avoid or reduce adverse structural impacts. Structural foundations shall not be founded on engineered fill, nor on native soil, unless it is demonstrated that the soils would be adequate to support the foundation. A California-licensed geotechnical engineer shall be retained by the applicant to be present on the project site during excavation, grading, and general site preparation activities to monitor the implementation of the recommendations specified in the geotechnical investigation. When/if needed, the geotechnical engineer shall provide structure-specific geologic and geotechnical recommendations that shall be documented in a report approved by the permitting agency.

APM GEO-6: Grading and other methods of ground disturbance in areas covered by desert pavement shall be avoided or minimized. If avoidance of these areas is not possible, the desert pavement surface shall be protected from damage or disturbance from construction vehicles by use of temporary mats on the surface. A Desert Pavement Identification, Avoidance, and Protection Plan shall be prepared and submitted to the BLM for review and approval at least 60 days prior to start of construction which shall include, at a minimum:

1. A preconstruction survey using accepted methodology to identify areas covered by desert pavement;
2. Identification of areas covered by desert pavement that can feasibly be avoided and methods for avoidance, such as through placement of project structures during final design, flagging and/or fencing areas of desert pavement for avoidance, and/or other measures;
3. Identification of areas covered by desert pavement that cannot feasibly be avoided and methods for protection, including at a minimum the use of temporary mats on the surface. Other methods may include restrictions on vehicle weight in addition to the use of mats.

APM GEO-7: A Project Paleontologist listed as a Principal Investigator on a current California BLM Permit for Paleontological Investigations who meets or exceeds the standards of the BLM will be retained to oversee the execution of all paleontological mitigation measures. The Project Paleontologist shall obtain a curatorial arrangement with a qualified repository prior to construction in the event of significant paleontological resource discoveries during construction.

APM GEO-8: The Project Paleontologist shall develop Worker Environmental Awareness Program training to educate the project personnel on the legal requirements for preserving fossil resources, the recognition of the types of paleontological resources that could be encountered within the requested right-of-way boundary, and the procedures to be followed in the event of a fossil discovery. This training program shall be given by the Project Paleontologist or their designee to the crew before ground-disturbing work commences and shall include handouts to be given to new workers as needed.

APM GEO-9: The Project Paleontologist will develop a comprehensive paleontological resources monitoring and mitigation plan (PRMMP) that incorporates the latest project description, engineering plans, and project site. The PRMMP will consider the results of previous paleontological resources assessments, including but not limited to the results of the geologic map review, geotechnical investigation, scientific literature review, museum records searches, reconnaissance surveys, and the accepted provisional paleontological sensitivity classification. The PRMMP will specify locations and depth thresholds that require paleontological monitoring during ground-disturbing activities. The PRMMP will discuss paleontological monitoring of ground-disturbing activities in previously undisturbed sediments identified as having moderate or higher sensitivity, whether present at the surface or anticipated to be present at depth in the subsurface. Geologic units of low and very low paleontological sensitivity, as well as all previously disturbed sediments, regardless of depth, should not be subject to paleontological monitoring unless anticipated to be underlain by previously undisturbed geologic units of relatively higher paleontological sensitivity that could be impacted by earthwork activities at depth. Appropriate mitigation methods may include full-time paleontological monitoring, screening of sediment samples for small fossils, or additional field surveys in the event of changes to the project site boundaries.

Monitoring will be conducted by a BLM-approved paleontological monitor working under the supervision of a BLM-permitted Field Agent or BLM-permitted Principal Investigator (i.e., the Project Paleontologist) in the field, with the overall implementation of the PRMMP overseen by a BLM-permitted Principal Investigator. If field observations of surface or subsurface geologic conditions during construction activities would indicate a differing paleontological sensitivity ranking than that previously assigned, the Project Paleontologist may consult with the BLM, the California Department of Fish and Wildlife (CDFW), other relevant overseeing agencies, and Soda Mountain Solar, LLC, to recommend adjustments to the level of monitoring in response to subsurface conditions. Full-time (or on-site) monitoring can be reduced to part-time inspections (or spot checks) or ceased entirely if this is determined adequate by the Project Paleontologist and approved by all parties. This change can be done verbally and then documented via email or another written format to the BLM, CDFW, other relevant overseeing agencies, and Soda Mountain Solar, LLC. The paleontological monitor will have authority to temporarily divert activity away from exposed fossils to evaluate the significance of the find and, should the Project Paleontologist or Field Agent determine that the fossils are potentially significant, professionally and efficiently recover the fossil specimens for laboratory evaluation, and collect associated data following the procedures and guidelines of the BLM (2008a) and in accordance with the requirements stipulated in the California BLM Permit for Paleontological Investigations and Fieldwork Authorization permit(s). Nonsignificant fossils will be documented and recorded in the field but not collected. Any potentially significant fossil that is collected for further evaluation will be returned to the discovery site or retained for educational purposes if after laboratory analysis it is determined to be a nonsignificant resource. The disposal of the fossil will depend on the requirements of the agency administering the land on which the fossil was discovered. Paleontological monitors will record pertinent geologic and geographic data from any fossil localities.

APM GEO-10: In the event of a fossil discovery, whether by the permitted and approved paleontological field staff or a member of the construction crew, all work will cease in a 50-foot radius of the find while the Project Paleontologist or Field Agent assesses the significance of the fossil and documents its discovery. Should the Project Paleontologist or Field Agent determine that the fossil locality is potentially significant, it will be salvaged following the procedures and guidelines of the BLM (BLM 2008a) and in accordance with the requirements stipulated in the California BLM Permit for Paleontological Investigations and Fieldwork Authorization permit(s). Nonsignificant fossils will be documented and recorded in the field but not collected. Potentially significant fossils that were collected in the field that were determined to be nonsignificant after laboratory analysis will be returned to the site or retained for educational purposes (depending on the requirements of the overseeing agency administering the land on which the fossil was discovered). Significant fossils will be prepared to the point of morphological identification and/or taxonomic identification to facilitate the requirements of the curation in an accredited repository pre-approved by the BLM, CDFW, and/or another overseeing agency.

APM GEO-11: Upon conclusion of ground-disturbing activities, the Project Paleontologist will prepare a final report detailing the methods and results of implementing the PRMMP, including full documentation of scientifically significant fossils found, significance assessment of those fossils, repository details for significant fossils, and any recommendations for future work within the project site. If paleontological resources are curated, the final monitoring report and any associated data pertinent to the curated specimen(s) should be submitted to the designated repository. A copy of the final monitoring report should be filed with the BLM, CDFW, and/or another overseeing agency.

3.7.3.3 Impact Assessment

Impact GEO-1: Would the project directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42. (Less than Significant)

Southern California as a region, including the project site, is subject to the effects of seismic activity due to active faults that traverse the region. Active faults are defined as those that have experienced surface displacement within Holocene time (approximately the last 11,000 years) or are in a State-designated Alquist-Priolo earthquake fault zone, or both. The type and magnitude of seismic hazards affecting the site depend on the distance to causative faults and on the intensity and magnitude of the seismic event.

The California Geological Survey Seismic Hazards Program does not map any Alquist-Priolo earthquake fault zones, or other substantial known faults, that pass through the project site (CDOC 2022). Although there are no mapped faults in the project site, it is possible that one or more faults exist beneath the sediments filling the valley. On the eastern edge of the project site, there is a short Quaternary fault west of and parallel to the Baker Fault. However, there is no indication from the latest fault activity maps that this fault segment poses a surface rupture risk (BLM and San Bernardino County 2015; USGS 2024). Operational activities involve periodic maintenance and inspections, and the likelihood of a newly discovered fault rupturing at a facility site while people are present is low.

All solar facilities, the gen-tie line, and associated structures would not be placed on or near a known active or potentially active fault zone. Implementation of APM GEO-2 would ensure that the project would lessen exposure of people or structures to adverse fault rupture effects, and impacts would be **less than significant.**

ii. Strong seismic ground shaking. (Less than Significant)

As discussed above under Item i, the potential exists for large magnitude earthquakes to result in seismically induced ground shaking within the project site and surrounding area. The intensity of such an event would depend on the fault and the distance to the epicenter, the moment magnitude, the duration of shaking, and the nature of the geologic materials in or on which the project components would be constructed. Intense ground shaking and high ground accelerations could affect the proposed facilities (e.g., solar panel arrays and support structures, substation and switchyard facilities, operation and maintenance facilities, and water supply lines). The primary and secondary effects of ground shaking could damage structural foundations and cause failure of concrete. During construction, damage to these features could cause temporary short-term delays in construction. During operations, damage to these features could cause temporary service disruption.

Modern standard engineering and construction practices include design criteria to mitigate potential damage from an earthquake. Based on preliminary geologic and geotechnical investigations, the applicant has incorporated recommended design measures and criteria to minimize risks associated with geologic and seismic hazards. These investigations and subsequent design measures relate to earthwork, foundation design, resistance to lateral loads, utility trenches, pavement thickness, and soil corrosion potential, and further design-level geotechnical analysis and review will occur as part of final project design.
In addition, the administration building and other occupied parts of the facility site would be designed to withstand strong ground motion (BLM and San Bernardino County 2015).

Compliance with applicable building codes and implementation of APM GEO-2 would ensure that soil and ground instabilities would not have substantial adverse impacts on facilities or on-site workers. This would include the effects of seismic ground shaking. Building codes include requirements to design structures according to their SDC, as determined by the CBC, which provides specific building standards based on the level and intensity of expected ground motions, and the occupancy category of the structure. Because building codes and geotechnical seismic design parameters are primarily intended to avoid building collapse or substantial structural damage, a strong earthquake could still cause short-term damage to or toppling of unsecured equipment, which could result in injuries to workers. This would include the effects of seismic ground shaking. However, potential worker injuries would be anticipated to be minor, and facility damage would not be expected to be severe and could be later inspected and repaired or corrected. Implementation of APM GEO-2 and other recommended design criteria, i.e., incorporation of preliminary design recommendations (BLM and San Bernardino County 2015), and compliance with applicable construction and design requirements in the CBC and County codes would result in the effects of seismic ground shaking on facilities and workers being minor. Therefore, impacts would be **less than significant.**

iii. Seismic-related ground failure, including liquefaction. (Less than Significant)

Liquefaction is a loss of strength in soil when a stress, such as that caused by an earthquake, is applied to susceptible soils, such as loose, saturated sands and silts. These susceptible soils were not encountered during the preliminary geotechnical analysis, as groundwater within the project site is generally deeper than 150 bgs. Further, no designated or identified liquefaction, lateral spreading, or other ground failure zones have been identified across, or near, the project site (BLM and San Bernardino County 2015). Due to the lack of shallow groundwater and liquefaction-prone sediments, seismic-related ground failures are not expected in the project site. In addition, the San Bernardino County Geologic Hazard Overlay Map - Baker CIDIC (San Bernardino County 2007) shows no liquefaction areas on or near the project site.

The solar facilities, gen-tie line, access roads, and associated structures would be designed in compliance with state and local regulations and standards and established engineering procedures. In addition, the project’s construction, operation, and decommissioning would not directly or indirectly cause substantial adverse effects, including the risk of loss, injury, or death involving seismic-related ground failure, including liquefaction. As a result, impacts would be **less than significant**.

iv. Landslides? (Less than Significant)

Non-seismically induced landslides can be caused by water from rainfall, septic systems, landscaping, or other origins that infiltrate slops with unstable material. Boulder-strewn hillsides can pose a boulder-rolling hazard from blasting or a gradual loosening of their contact with the surface. The predominantly flat, alluvial nature of the project site generally precludes any risk of or susceptibility to landslides. Additionally, no landslide hazards are identified on or near the project site on the San Bernardino County Geologic Hazards Overlay Map - Baker CIDIC (San Bernardino County 2007). Therefore, impacts associated with landslides are considered **less than significant**.

Impact GEO-2: Would the project result in substantial soil erosion or the loss of topsoil? (Less than Significant with Mitigation Incorporated)

The occurrence of severe erosion is a function of the strength and competence of the earth materials and the presence of water, wind, and/or slope (gravity) that can dislodge and transport these materials. Most alluvial earth materials within the project site are moved by water in and near the desert washes, resulting in well-defined drainages with steep side slopes (BLM and San Bernardino County 2015).

CONSTRUCTION

Construction activities that could affect soil resources include excavation, grading, and soil compaction to prepare the site for installation of project components such as the solar panels and support structures, operation and maintenance facilities, new roads, and surface runoff controls. Ground-disturbing activities would have the potential to result in erosion, transport, and deposition of soil and/or surface sediments, particularly where desert pavement (a protective layer of pebble- to cobble-size material) or biological soil crusts are present. Disturbance of these protective ground covers could increase wind erosion rates by exposing the underlying layer of finer-grained material. Without protective measures, disturbance of desert pavement or biological soil crusts, or both, could cause a noticeable and possibly substantial increase in wind erosion rates during construction.

Fluvial erosion (i.e., from water) is only likely during storm events, whereas wind erosion would not necessarily be dependent upon seasonality or storm occurrence. Further, soil compaction and vegetation clearing may increase soil erosion through decreased infiltration rates and dislodging soil particles and can result in the loss of the soil pore spaces and oxygen necessary to support native plant growth. Construction activities also would result in soil compaction within linear corridors associated with new and realigned roads.

Without measures to avoid or minimize damage to soil function (e.g., due to soil compaction and rilling) during construction and operation of the project, and without plans to properly decommission disturbed areas (i.e., restoration and revegetation), soils within the project site could experience long-term, adverse impacts in specific areas through degradation of soil function and increased susceptibility to erosion. The sandy and gravelly soils throughout the project site are generally highly permeable and thus have a low susceptibility to erosion, particularly for the coarser soil types. However, certain areas where the soils contain a relatively high proportion of fine sands and silts could be particularly vulnerable to either fluvial or eolian erosion.

To reduce the potentially significant impact to soil erosion during project construction, the applicant would incorporate APM AIR-4, APM GEO-1, APM GEO-3, APM GEO-4 to avoid or substantially reduce the project’s adverse impacts on soil resources. To ensure that APMs are reviewed and approved by BLM personnel and that proper BLM standards and guidance are used when developing erosion control and drainage plans, the applicant shall implement and APM GEO-6 to ensure that disturbance of desert pavement is minimized. Implementation of the APMs and mitigation measures would avoid or substantially reduce adverse impacts to soil resource and impacts would be **less than significant with mitigation incorporated.**

OPERATION AND MAINTENANCE

Following facility construction and installation, operation and maintenance activities would have minimal additional soil impacts. Maintenance activities would include inspecting, repairing, and maintaining the arrays and tracking systems and the supervisory control and data acquisition (SCADA) system; washing panels; and troubleshooting the collector lines and repairing damaged cables, which may necessitate some trenching. Additional maintenance would be required to maintain the administrative buildings, fencing and signage, roadways, and other ancillary facilities at the site. All these activities would take place within previously disturbed areas and would not require additional disturbances outside of the construction footprint analyzed for the construction phase. Without mitigation, operation and maintenance of the project would have localized adverse impacts on soil resources. Implementation of APM AIR-4, APM GEO-1, APM GEO-3, and APM GEO-4 would ensure that adverse impacts to soil resources are avoided or substantially reduced.

DECOMMISSIONING AND RECLAMATION

As part of the decommissioning phase, the applicant would prepare and implement a site restoration plan addressing removal of structures, including solar photovoltaic blocks, and roads in conformance with BLM requirements. As part of this plan, the surface of the site would be restored to conform to approximate pre-project land uses, and the vegetation would be allowed to return to its natural condition without intervention. The site restoration plan also would address stabilization and revegetation of disturbed areas in conformance with BLM requirements.

Decommissioning of the project would have short-term, localized adverse impacts on soil resources while facilities are decommissioned, prior to site restoration. These impacts would be similar to, though less intense than, the construction-related impacts discussed above. To reduce the potentially significant impact to soil erosion during decommissioning, the applicant would incorporate APM AIR-4, APM GEO-1, and APM GEO-3 to avoid or substantially reduce the project's adverse impacts on soil resources. To ensure that APMs are reviewed and approved by BLM personnel and that proper BLM standards and guidance are used when developing erosion control and drainage plans, the applicant shall implement APM GEO-4 and APM GEO-6 to ensure that disturbance of desert pavement is minimized. Areas disturbed by the project would be returned to preconstruction conditions through minor grading and revegetation. Adverse impacts to soil resources during project site decommissioning and reclamation would thus be avoided or substantially reduced.

Impact GEO-3: Would the project 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? (Less than Significant)

As previously discussed, the solar facility site and gen-tie line are in an area that has a low landslide hazard due to the predominantly flat, alluvial nature of the project site and a low liquefaction/lateral spreading potential due to groundwater depths in excess of 50 feet. The San Bernardino County Geologic Hazards Overlay Map – Baker CIDIC (San Bernardino County 2007) does not identify landslide hazards or liquefaction areas on or near the project site. Additionally, because the groundwater depths are estimated to be 180 to 350 feet bgs, it is very unlikely that any subsidence would occur due to groundwater withdrawal from the valley.

Given the geologic setting, the project site is unlikely to become unstable and collapse as a result of these geologic hazards. According to an initial examination of available geologic and soil information, the project site is unlikely to be underlain or otherwise affected by unstable soil conditions. However, adverse soil conditions, if present, would be a threat only to project facilities and not to the public at large. Therefore, impacts would be **less than significant**.

Impact GEO-4: Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property? (Less than Significant)

Soils on the project site and surrounding area are relatively coarse-grained and lack a significant clay fraction or thick accumulations of organic material. No expansive soils were identified by the geotechnical investigation and based on the nature of alluvial deposition, no expansive soils are expected (BLM and San Bernardino County 2015). As a result, the project would not create substantial risks to life or property associated with expansive soils. During the building permit application process, the BLM will verify that the type of construction proposed is consistent with the soils present on the proposed project site and that the recommendations found in the geotechnical report have been incorporated into the site design as required by APM GEO-5. Based on on-site conditions and development requirements outlined in the CBC, as well as the recommendations in the geotechnical report, impacts associated with expansive soils are considered **less than significant**.

Impact GEO-5: Would the project have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater? (Less than Significant)

Construction of the proposed project would require an average of 200 temporary workers daily on-site with an anticipated 300 temporary employees during peak construction activities. Decommissioning will require a similar number of temporary employees. Aboveground portable sanitary waste facilities would be used for these activities. Waste liquids would be removed by qualified waste disposal contractors and disposed of in accordance with all applicable regulations and codes. Concurrently, a septic system would be designed and constructed adjacent to the project buildings to support operation and maintenance employees' sanitary needs. A septic system would be constructed adjacent to the permanent project buildings to serve the sanitary wastewater treatment needs.

Soils suitable for septic and wastewater disposal systems are generally well-drained so that water can percolate through the soils efficiently. Most of the soils within the project site and surrounding area are classified as well-drained to excessively well-drained (i.e., permeable) (NRCS 2023b).

In addition, groundwater occurs at a depth of approximately 180 to 350 feet bgs. These conditions are conducive to the construction and operation of a septic system. Percolation testing and design of the septic system would be conducted to meet San Bernardino County Department of Environmental Health septic system requirements. Additionally, to ensure soils at the operation and maintenance buildings site are adequate for septic tank installation and operation, the applicant would need to conduct proper geotechnical and engineering geology studies to investigate and evaluate the soil and geologic formations and assess soil permeability and percolation characteristics. Thus, implementation of APM GEO-4 and APM GEO-5 would ensure that adverse impacts related to the capacity of soils to support septic tanks would be avoided or substantially reduced, and impacts would be considered **less than significant**.

Impact GEO-6: Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature? (Less than Significant)

The project would have direct impacts on paleontological resources if it resulted in breakage or crushing of or disturbance to fossils that have eroded onto the surface or are buried in subsurface rocks and sediments. Indirect effects could result from increased access to paleontological resources by construction personnel and recreational users of public lands as the result of project-related construction, leading to vandalism and unauthorized collection (theft) of resources.

The project site is underlain by geologic units with low to moderate potential to contain paleontological resources (PFYC 1 to 3). Ground disturbances in geologic units that have very low to low paleontological sensitivity (PFYC 1 and 2) are unlikely to result in impacts to scientifically significant paleontological resources. These geologic units include late Holocene alluvial fan deposits (Qf) (PFYC 2), Holocene to late Pleistocene young eolian and dune deposits (Qye) (PFYC 1), Tertiary (Neogene) age formations of volcanic origin (Tv) (PFYC 1), and Mesozoic and older granitic and other intrusive crystalline rocks of all ages (gr) (PFYC 1).

Ground-disturbing activities in Holocene to late Pleistocene young alluvial fan deposits (Qyf) and late to middle Pleistocene old alluvial fan deposits (Qof), both of which have low to moderate paleontological potential, increasing with depth (PFYC 2 to PFYC 3, increasing with depth) may impact potentially significant paleontological resources at depth. Based on field observations and the depths at which fossils have been recovered in similar sediments elsewhere in the Mojave Desert, these older, moderate potential

(PFYC 3) sediments may be present at depths as shallow as 4.5 feet bgs. Therefore, ground-disturbing activities that impact previously undisturbed sediments greater than 4.5 feet bgs in areas mapped as Qyf or Qof may result in impacts to scientifically significant paleontological resources.

APM GEO-7 through APM GEO-11 require retention of a BLM-permitted Principal Investigator (Project Paleontologist) to develop and implement a PRMMP; paleontological resource worker awareness training; adherence with unanticipated discovery protocols; paleontological monitoring in sensitive sediments; the collection, preparation, documentation, and curation of scientifically significant paleontological resources; and preparation of a final monitoring report. With the implementation of these APMs, impacts on paleontological resources would be **less than significant.**

3.7.4 Mitigation Measures

No mitigation measures are required.

3.7.5 Cumulative Impacts

Impact C-GEO-1: Would the impacts of the proposed project, in combination with other past, present, and reasonably foreseeable future projects, contribute to a cumulative impact related to geology and soils? (Less than Significant)

Loss of soil through erosion, land subsidence due to groundwater withdrawals, and soil instability caused by construction and operation of a project are impacts that can cumulatively affect soil and geologic resources in combination with other past, present, and reasonably foreseeable future actions in a given area. These potential cumulative impacts would apply to the construction, operation, maintenance, and decommissioning phases of the proposed project. All other geology and soils issues (such as strong seismic ground shaking, seismically induced ground failure, collapsible soils, and expansive soils) relate to local, site-specific soil conditions, ground response to earthquakes, and the potential for adverse soil conditions to damage the project’s structural components. The presence of other projects in the cumulative scenario would have no effect on either the severity or the probability of geotechnical challenges associated with seismicity and/or the character of underlying soils. Such issues are site-specific and unaffected by the presence of other projects in the cumulative scenario. Therefore, only potential soil erosion, land subsidence and paleontological resources are analyzed in this discussion.

3.7.5.1 Land Subsidence and Soil Erosion

Projects located in the same watershed as the proposed project could contribute to cumulative soil erosion or land subsidence impacts. The greatest potential for cumulative impacts with respect to soil erosion would occur if either the construction or decommissioning phases of the cumulative projects were to happen concurrently with the project. However, the operation and maintenance phase of the cumulative projects is included in this analysis because minor alterations in topography and the addition of impervious surfaces could combine to cause or contribute to cumulative impacts. For land subsidence, applicable potential cumulative projects include all projects that would draw groundwater from the same aquifer. The scope of impacts would include all phases of the project because some level of groundwater typically is needed for construction and decommissioning activities (e.g., dust suppression) and operation and maintenance needs (e.g., panel washing and water service for operation and maintenance buildings). In the Cumulative Impact Analysis, discussed in Chapter 3, Environmental Impacts Analysis, a 50-mile radius was evaluated (see Table 3-1 and Figure 3-1 for the list of existing and reasonably foreseeable projects in the region). The I-15 Mojave Wildlife Crossings Restoration project would be within 1 mile of the boundary of the project site and could therefore combine with the proposed project and result in a cumulative considerable impact. Several other utility-scale solar development projects are proposed within 50 miles of the proposed project. There are not any cumulative projects that would be constructed in the same watershed and add impervious surfaces that could combine to cause or contribute to cumulative impacts to geology and soils.

Land subsidence could occur either at the project site or a neighboring project site if the amount of groundwater use associated with these projects results in a lowering of the groundwater levels sufficient to result in ground subsidence. As discussed in Section 3.10, Hydrology and Water Quality, a groundwater model was completed to support the analysis for groundwater supply and drawdown. Water basins that could be affected by the proposed project or an action alternative were identified in this report. The only cumulative projects that cross these basins is the I-15 Mojave Wildlife Crossings Restoration Project, which does not propose to disturb geology and soils on the project site. The amount of groundwater drawdown therefore would be determined solely by the proposed project, which is not expected to cause subsidence during construction or operation. Therefore, the project's cumulative contribution to subsidence would be considered **less than significant.**

3.7.5.2 Paleontological Resources

Cumulative effects on paleontological resources involve the loss of non-renewable scientifically important fossils and associated data and the incremental loss to science and society of these resources over time. Energy development projects, as well as commercial and residential development projects, have resulted in cumulative conditions affecting paleontological resources elsewhere in the Mojave Desert. However, the implementation of paleontological mitigation measures during surface-disturbing actions has resulted in the salvage and permanent preservation of large numbers of scientifically significant paleontological resources that would otherwise have been destroyed. This has greatly reduced the cumulative effects of such projects on paleontological resources and has resulted in the beneficial cumulative effect of making these fossils available for scientific research and education by placing them in museum collections. Therefore, the project's cumulative contribution to paleontological resource impacts would be considered **less than significant.**

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