

# **APPENDIX H**

## **Paleontological Resources Technical Report**

# **Paleontological Resources Assessment for the Palen Solar Power Project, Riverside County, California**

Prepared for

**AECOM Environment**

On behalf of:

**Solar Millennium, LLC**

and

**Chevron Energy Solutions**

Prepared by

**SWCA Environmental Consultants**

Pasadena Office

July 2009

**PALEONTOLOGICAL RESOURCES ASSESSMENT FOR THE PALEN SOLAR POWER PROJECT  
RIVERSIDE COUNTY, CALIFORNIA**

**SWCA PROJECT NUMBER 15422**

**SUBMITTED TO:**

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## PROJECT SUMMARY

### PURPOSE AND SCOPE

SWCA Environmental Consultants was retained by AECOM Environment to conduct paleontological resources management services for the Palen Solar Power Project (PSPP or Project) located north of Interstate 10 (I-10) approximately 10 miles east of Desert Center in Riverside County, California. Solar Millennium, LLC and Chevron Energy Solutions (Applicants) propose to develop a nominal 500 megawatt (MW) solar thermal electric generating facility on public lands managed by the Bureau of Land Management (BLM) and includes a privately owned 40-acre parcel (under purchase option by the Applicants). The PSPP comes under the jurisdiction of both the California Energy Commission (CEC) and BLM and the two agencies are conducting a joint review of the Project. The paleontological studies documented in this report are intended to support CEC compliance with the requirements of the California Environmental Quality Act (CEQA) and BLM's compliance with the National Environmental Policy Act (NEPA); a combined CEQA/NEPA document will be prepared jointly by the two agencies.

The Project will require a double circuit 230 kV transmission line to interconnect its electrical output with the regional transmission system, but the route of this transmission has not yet been finalized. For that reason no paleontological investigation of a transmission route for the PSPP has been performed yet. When the route is finalized, the necessary paleontological investigation and impact assessment will be performed and the results reported to the regulatory agencies and other stakeholders.

The paleontological resources scope of services included (1) a comprehensive museum records search and literature review, (2) a paleontological field survey, and (3) preparation of this technical report of findings that includes recommended mitigation measures.

### DATES OF INVESTIGATION

The museum records searches were performed between May 7 and June 17, 2009. The paleontological reconnaissance survey of the proposed Project site was performed May 25 through June 19, 2009. This technical report was completed in July 2009.

### RESULTS OF THE INVESTIGATION

According to geologic mapping by Jennings (1967) and Stone and Pelka (1989), the PSPP site is underlain by Quaternary alluvial, aeolian, and lake bed deposits ranging from Pleistocene (1.8 million years old [Ma] to 10,000 years before present [BP]) to Holocene (10,000 years BP to Recent) in age. Quaternary lake bed deposits, which date to the Pleistocene and have the potential to produce significant vertebrate fossils, are present both at the surface and subsurface within the Project area. Museum collections records maintained by the Natural History Museum of Los Angeles County (LACM), the San Bernardino County Museum (SBCM), and the Colorado Desert District Stout Research Center (CDDSRC) indicate that no previously recorded fossil localities exist within the Project site boundaries, nor have any fossil localities been previously recorded within 1 mile of these boundaries. However, numerous vertebrate fossil localities have been recorded throughout the region within the same or similar sedimentary deposits that occur within the Project boundaries.

No significant fossils were discovered during the field survey; however, a total of four non-significant fossil occurrences yielding petrified wood and one non-significant fossil point yielding non-diagnostic vertebrate material were recorded. All specimens were discovered *ex situ* (removed from their original place of fossilization) as lag deposits transported an unknown distance and re-deposited on top of alluvial

sediments. For this reason, and due to the lack of diagnostic characteristics, none of the fossil resources discovered on the surface within the Project site are considered scientifically significant. For the purposes of surface clearance, the vertebrate fossils were collected and examined by vertebrate paleontologists and subsequently determined to be unidentifiable. No petrified wood was collected throughout the course of the survey.

The combined results of the museum records searches, literature review, and field survey indicate that almost the entire Project site is underlain by geologic sediments determined to have a paleontological sensitivity ranging from low to high, increasing with depth. A small portion within the area of disturbance in the far northeast corner of the Project area is underlain by geologic sediments with a high paleontological sensitivity both at the surface and at depth. Therefore, construction of the PSPP may potentially result in an adverse impact to nonrenewable fossil resources and will require implementation of paleontological resources mitigation measures to reduce such impacts to a less-than-significant level.

## **RECOMMENDATIONS**

SWCA recommends that a qualified paleontologist be retained to design and implement a paleontological resources monitoring and mitigation plan (PRMMP) for regulatory agency approval and subsequent implementation during any ground disturbances related to the proposed Project. All significant fossils recovered during construction monitoring should be prepared, stabilized, identified, and permanently curated in an approved repository or museum such as the SBCM. As was the case for the investigation reported in this document, all future paleontological field work for the PSPP would require a Paleontological Resources Use Permit issued by the Bureau of Land Management (BLM) and Field Authorization issued by the local BLM Field Office.

## **DISPOSITION OF DATA**

This report will be filed with AECOM Environment, the Applicants, the California Energy Commission, the BLM California State Office, and the SBCM. The fossil specimen discovered at 090608-JJS-01 will be transferred to the SBCM for permanent curation. A copy of the report will be retained at SWCA Environmental Consultants, along with maps, field notes, photographs, and all other records relating to the Project.

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Confidential ATTACHMENT A: Fossil Locality Map  
Confidential ATTACHMENT B: Fossil Locality Form

## INTRODUCTION

This report presents the findings of a comprehensive literature review, museum records search, and pedestrian field survey conducted for the Palen Solar Power Project (PSPP or Project) located north of Interstate 10 (I-10) approximately 10 miles east of Desert Center in Riverside County, California. Solar Millennium, LLC and Chevron Energy Solutions (the Applicants) propose to develop a nominal 500 megawatt (MW) solar thermal electric generating facility on public lands managed by the BLM and includes a privately owned 40-acre parcel (under purchase option by the Applicants). The PSPP comes under the jurisdiction of both the CEC and BLM and the two agencies are conducting a joint review of the Project. The paleontological studies documented in this report are intended to support CEC compliance with the requirements of the CEQA and BLM's compliance with the NEPA; a combined CEQA/NEPA document will be prepared jointly by the two agencies.

The Project will require a double circuit 230 kV transmission line to interconnect its output with the regional transmission system, but the route of this transmission has not yet been finalized. For that reason no paleontological investigation of a transmission route for the PSPP has been performed to date. When the route is finalized, the necessary paleontological investigation and impact assessment will be performed and the results reported to the regulatory agencies and other stakeholders.

This study was performed to evaluate the paleontological sensitivity of the Project area and vicinity, assess potential Project-related impacts on paleontological resources, and provide recommendations for the management of paleontological resources. This study was conducted in accordance with the professional guidelines established by the Society of Vertebrate Paleontology (SVP) (1995) and paleontological guidelines set for by the BLM (2008). This study also satisfies the requirements set forth by the CEC (2000, 2007).

## DEFINITION AND SIGNIFICANCE OF PALEONTOLOGICAL RESOURCES

Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the history of life on earth. Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years. Fossils are considered nonrenewable resources because the organisms they represent no longer exist (Murphey and Daitch, 2007). Thus, once destroyed, a fossil can never be replaced. Fossils are an important scientific and educational resource because they are used to:

- Study the phylogenetic relationships between extinct organisms, as well as their relationships to modern groups.
- Elucidate the taphonomic, behavioral, temporal, and diagenetic pathways responsible for fossil preservation, including biases in the fossil record.
- Reconstruct ancient environments, climate change, and paleoecological relationships.
- Provide a measure of relative geologic dating, which forms the basis for biochronology and biostratigraphy, and which is an independent and supporting line of evidence for isotopic dating.
- Study the geographic distribution of organisms and tectonic movements of land masses and ocean basins through time.
- Study patterns and processes of evolution, extinction, and speciation.
- Identify past and potential future human-caused effects to global environments and climates (Murphey and Daitch, 2007).

## **LAWS, ORDINANCES, REGULATIONS, AND STANDARDS**

Fossils are classified as nonrenewable scientific resources and are protected by various laws, ordinances, regulations, and standards (LORS) across the country. The SVP (1995) has established professional standards for the assessment and mitigation of adverse impacts to paleontological resources. This paleontological assessment was conducted in accordance with the LORS that are applicable to paleontological resources within the Project area. These LORS are summarized in Table 1 and the following sections.

### **FEDERAL**

Fossils are classified as nonrenewable scientific resources and are protected by various LORS across the country. Professional standards for the assessment and mitigation of adverse impacts on paleontological resources have been established by the SVP (1995, 1996). Federal protections for scientifically significant paleontological resources apply to projects if any construction or other related project impacts occur on federally owned or managed lands, involve the crossing of state lines, or are federally funded. Since the PSPP site is located virtually entirely (all but one 40-acre parcel of a 5,200-acre Right-of-Way) within federally managed land, then federal protections would apply to paleontological resources within the Project boundaries. Pertinent federal LORS are summarized below.

#### **National Environmental Policy Act**

The National Environmental Policy Act of 1969 (NEPA), as amended (Public Law [PL] 91-190, 42 United States Code [USC] 4321-4347, January 1, 1970, as amended by PL 94-52, July 3, 1975; PL 94-83, August 9, 1975; and PL 97-258 Section 4(b), September 13, 1982), recognizes the continuing responsibility of the federal government to “preserve important historic, cultural, and natural aspects of our national heritage...” (Section 101 [42 USC Section 4321]) (No. 382).

The goal of the NEPA process is to make informed, publicly supported decisions regarding environmental issues. Under NEPA, the federal government requires that:

- a) all federal agencies consider the environmental impacts of proposed actions;
- b) the public be informed of the potential environmental impacts of proposed actions; and
- c) that the public be involved in planning and analysis relevant to actions that impact the environment.

#### **Paleontological Resources Preservation Act**

In March 2009, the Paleontological Resources Preservation Act (PRPA) was enacted as a result of the passage of the Omnibus Public Lands Management Act (OPLA) of 2009, PL 111-011. PL 111-011, Title VI, *Subtitle D. Paleontological Resources Preservation* (OPLA-PRPA). The OPLA-PRPA sets forth regulations and provisions pertaining to paleontological resources on all federally administered lands. The OPLA-PRPA affirms the authority of BLM policies already in place and is consistent with paleontological guidelines outlined in the Paleontology Resources Management Manual and Handbook H-8270-1 (BLM, revised 2008). As a result of the recent enactment of the OPLA-PRPA, federal agencies will begin developing appropriate plans for the management of paleontological resources and the implementation of the OPLA-PRPA.

### **Federal Land Management and Policy Act**

The Federal Land Management and Policy Act of 1976 (FLMPA) (43 USC 1712[c], 1732[b] Section 2, Federal Land Management and Policy Act of 1962 [30 USC 611]; Subpart 3631.0 et seq., Federal Register Vol. 47, No. 159, 1982) does not refer specifically to fossils. However, “significant fossils” are understood and recognized in policy as scientific resources. Permits authorizing the collection of significant fossils for scientific purposes are issued under the authority of FLMPA.

Under FLMPA, federal agencies are charged to:

- a) manage public lands in a manner that protects the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, archaeological, and water resources, and, where appropriate, preserve and protect certain public lands in their natural condition (Section 102[a][8] [11]);
- b) periodically inventory public lands so that the data can be used to make informed land-use decisions (Section 102[a][2]); and
- c) regulate the use and development of public lands and resources through easements, licenses, and permits (Section 302[b]).

### **American Antiquities Act of 1906 1 (6 USC 431 433)**

The American Antiquities Act establishes a penalty for disturbing or excavating any historic or prehistoric ruin or monument or object of antiquity on federal lands as a maximum fine of \$500 or 90 days in jail.

### **National Historic Preservation Act of 1966**

The National Historic Preservation Act (NHPA) provides for the survey, recovery, and preservation of significant paleontological data when such data may be destroyed or lost due to a federal, federally licensed, or federally funded project (PL 89 665; 80 Stat. 915, 16 USC 470 et seq.).

### **Code of Federal Regulations Title 43**

Under the Code of Federal Regulations (CFR) Title 43, Section 8365.1-5, the collection of scientific resources, including vertebrate fossils, is prohibited without a permit. Except where prohibited, individuals are also authorized to collect some fossils for their personal use. The use of fossils found on federal lands for commercial purposes is also prohibited.

### **Department of the Interior Report—Fossils on Federal and Indian Lands**

In 2000, the Secretary of the Interior submitted a report to Congress titled “Assessment of Fossil Management on Federal and Indian Lands.” This report was prepared with the assistance of eight federal agencies, including the Bureau of Indian Affairs, the BLM, the Bureau of Reclamation, the U.S. Fish and Wildlife Service, the U.S. Forest Service (USFS), the National Park Service, the U.S. Geological Survey (USGS), and the Smithsonian Institution. The consulting agencies concluded that administrative and Congressional actions with respect to fossils should be governed by these seven basic principles:

- a) Fossils on federal land are a part of America’s heritage.
- b) Most vertebrate fossils are rare.
- c) Some invertebrate and plant fossils are rare.

- d) Penalties for fossil theft should be strengthened.
- e) Effective stewardship requires accurate information.
- f) Federal fossil collections should be preserved and available for research and public education.
- g) Federal fossil management should emphasize opportunities for public involvement.

## **STATE**

The California Energy Commission (CEC) environmental review under the Warren-Alquist Act is considered a California Environmental Quality Act (CEQA)–equivalent process under California law. The CEQA Guidelines (Title 14, California Code of Regulations Sections 15000 et seq.) define procedures, types of activities, persons, and public agencies required to comply with CEQA. Appendix G to Section 15023 includes an “Environmental Checklist” of questions that a lead agency should address if relevant to a project’s environmental impacts, including: “Will the proposed project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?” The Environmental Checklist also asks: “Does the project have potential to eliminate important examples of the major periods of California history or pre-history?” Fossils are important examples of periods of California pre-history.

Other state requirements for paleontological resources management are included in Public Resources Code sections 5097.5. This statute prohibits the removal of any paleontological site or feature from state public lands without permission of the jurisdictional agency, defines the removal of paleontological sites or features as a misdemeanor, and require reasonable mitigation of adverse impacts to paleontological resources from developments on public (state) lands. These protections would apply to the project only if the state were to obtain ownership of project lands during the term of its license.

## **LOCAL**

Paleontological resources are addressed in the Multipurpose Open Space Element of the County of Riverside General Plan (adopted October 7, 2003). The following policies provide direction for paleontological resources:

OS 19.8 “Whenever existing information indicated that a site proposed for development may contain biological, paleontological, or other scientific resources, a report shall be filed stating the extent and potential significance of the resources that may exist within the proposed development and appropriate measures through which the impacts of development may be mitigated.”

OS 19.9 “This policy requires that when existing information indicates that a site proposed for development may contain paleontological resources, a paleontologist shall monitor grading activities, with the authority to halt grading to collect uncovered paleontological resources, curate any resources collected with an appropriate repository, and file a report with the Planning Department documenting any paleontological resources that are found during the course of site grading.”

OS 19.10 “Transmit significant development applications subject to CEQA to the San Bernardino County Museum for review, comment, and/or preparation of recommended conditions of approval with regard to paleontological resources.”

**Table 1. Summary of Paleontological LORS Applicable to the Project**

Jurisdiction	Pertinent Paleontological LORS
Federal	NEPA
	OPLA-PRPA
	FLMPA
	American Antiquities Act of 1906
	National Historic Preservation Act of 1966
	Code of Federal Regulations Title 43
	Department of Interior—Fossils on Federal and Indian Lands
State	CEQA
County	Riverside County General Plan

**PROFESSIONAL STANDARDS**

The SVP has established standard guidelines (SVP, 1995) that outline professional protocols and practices for the conducting of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation. Most practicing professional vertebrate paleontologists adhere closely to the SVP’s assessment, mitigation, and monitoring requirements as specifically provided in its standard guidelines. Typically, state regulatory agencies with paleontological LORS accept and use the professional standards set forth by the SVP.

As defined by the SVP (1995:26), significant nonrenewable paleontological resources are defined as:

...Fossils and fossiliferous deposits here restricted to vertebrate fossils and their taphonomic and associated environmental indicators. This definition excludes invertebrate or paleobotanical fossils except when present within a given vertebrate assemblage. Certain invertebrate and plant fossils may be defined as significant by a project paleontologist, local paleontologist, specialists, or special interest groups, or by lead agencies or local governments.

As defined by the SVP (1995:26), significant fossiliferous deposits are defined as:

A rock unit or formation which contains significant nonrenewable paleontologic resources, here defined as comprising one or more identifiable vertebrate fossils, large or small, and any associated invertebrate and plant fossils, traces and other data that provide taphonomic, taxonomic, phylogenetic, ecologic, and stratigraphic information (ichnites and trace fossils generated by vertebrate animals, e.g., trackways, or nests and middens which provide datable material and climatic information). Paleontologic resources are considered to be older than recorded history and/or older than 5,000 years, BP [before present].

Based on the significance definitions of the SVP (1995), all identifiable vertebrate fossils are considered to have significant scientific value. This position is held because vertebrate fossils are relatively uncommon, and only rarely will a fossil locality yield a statistically significant number of specimens of the same genus. Therefore, every vertebrate fossil found has the potential to provide significant new information on the taxon it represents, its paleoenvironment, and/or its distribution. Furthermore, all geologic units in which vertebrate fossils have previously been found are considered to have high sensitivity. Identifiable plant and invertebrate fossils are considered significant if found in association

with vertebrate fossils or if defined as significant by project paleontologists, specialists, or local government agencies.

A geologic unit known to contain significant fossils is considered to be “sensitive” to adverse impacts if there is a high probability that earth-moving or ground-disturbing activities in that rock unit will either disturb or destroy fossil remains directly or indirectly. This definition of sensitivity differs fundamentally from that for archaeological resources as follows:

It is extremely important to distinguish between archaeological and paleontological (fossil) resource sites when defining the sensitivity of rock units. The boundaries of archaeological sites define the areal extent of the resource. Paleontologic sites, however, indicate that the containing sedimentary rock unit or formation is fossiliferous. The limits of the entire rock formation, both areal and stratigraphic, therefore define the scope of the paleontologic potential in each case. [SVP, 1995]

Many archaeological sites contain features that are visually detectable on the surface. In contrast, fossils are contained within surficial sediments or bedrock and are therefore not observable or detectable unless exposed by erosion or human activity. Monitoring by experienced paleontologists greatly increases the probability that fossils will be discovered during ground-disturbing activities and that, if these remains are significant, successful mitigation and salvage efforts may be undertaken in order to prevent adverse impacts to these resources.

## **BUREAU OF LAND MANAGEMENT**

The BLM manages fossils for their scientific, educational, and (where appropriate) recreational values. Scientifically significant fossils, such as vertebrates and noteworthy occurrences of invertebrates and plants, may be collected by qualified individuals who have obtained Paleontological Resources Use permits from the BLM. All fossils collected under these permits must be stored and preserved in approved repositories where they can be studied or displayed. Potential adverse impacts on significant fossils are assessed and mitigated to prevent damage or lessen negative effects on the resources. The BLM inventories and monitors paleontological resources on a case-by-case basis under the guidance of Handbook H-8270-1 (2008). When notice of a proposed land use is received, the pertinent Field Office determines whether significant resources may be impacted and whether a field survey and subsequent work are necessary.

Four objectives have been identified by the BLM for the management of paleontological resources on the lands it administers. These include (1) locating, evaluating, managing, and protecting paleontological resources; (2) facilitating appropriate scientific, educational, and recreational uses of paleontological resources; (3) ensuring that proposed land uses do not inadvertently damage or destroy important paleontological resources; and (4) fostering public awareness of the nation’s rich paleontological heritage. The BLM considers vertebrate fossils to be scientifically significant, whereas invertebrate and plant fossils may be deemed scientifically significant on a case-by-case basis. Fossilized wood is considered a mineral resource, and may be collected or purchased under the Material Sales Act of 1947 (as amended), but cannot be obtained under the General Mining Law of 1872.

## **RESOURCE ASSESSMENT GUIDELINES**

Paleontological resources are limited, nonrenewable resources of scientific, cultural, and educational value and are afforded protection under federal (NEPA), state (CEQA), and local (County of Riverside) laws and regulations. This study satisfies project requirements in accordance with CEQA (13 PRC, 2100

et seq.) and Public Resources Code Section 5097.5 (Stats 1965, c 1136, p. 2792). This analysis also complies with guidelines and significance criteria specified by the SVP (1995) and requirements set forth by the CEC in Appendix B, Information Requirements for an Application of the CEC’s Power Plant Site Certification Regulations (CEC, 2000). The study also is consistent with BLM policies and paleontological guidelines outlined in the Paleontology Resources Management Manual and Handbook H-8270-1 (BLM, revised 2008)

### **Paleontological Sensitivity**

Paleontological sensitivity is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined by rock type, past history of the geologic unit in producing significant fossils, and fossil localities recorded from that unit. Paleontological sensitivity is derived from the known fossil data collected from the entire geologic unit, not just from a specific survey. In its “Standard Guidelines for the Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources,” the SVP (1995:23) defines three categories of paleontological sensitivity (potential) for sedimentary rock units: high, low, and undetermined:

- **High Potential.** Rock units from which vertebrate or significant invertebrate fossils or suites of plant fossils have been recovered and are considered to have a high potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations that contain significant nonrenewable paleontologic resources anywhere within their geographical extent and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical, and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas that contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas that may contain new vertebrate deposits, traces, or trackways are also classified as significant.
- **Low Potential.** Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections.
- **Undetermined Potential.** Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials.

It should be noted that highly metamorphosed rocks and granitic rock units do not generally yield fossils and therefore have low potential to yield significant nonrenewable fossiliferous resources.

In general terms, for geologic units with high potential, full-time monitoring typically is recommended during any project-related ground disturbance. For geologic units with low potential, protection or salvage efforts typically are not required. For geologic units with undetermined potential, field surveys by a qualified paleontologist are usually recommended to specifically determine the paleontologic potential of the rock units present within the study area.

## **PROJECT LOCATION AND DESCRIPTION**

Solar Millennium LLC and Chevron Energy Solutions (the Applicants) are proposing to construct a nominal 500 MW solar thermal electric power generating facility, referred to as the Palen Solar Power Project (PSPP or Project). The PSPP would be located in the southern California inland desert, about 10 miles east of

Desert Center, in Riverside County (Figure 1). The Applicants seek to lease 5,200 acres of federal land administered by the BLM, on which the proposed facilities would occupy approximately 2,974 acres. The Project would utilize solar parabolic trough technology to generate electricity. With this technology, arrays of parabolic mirrors collect heat energy from the sun and refocus the radiation on a receiver tube located at the focal point of the parabola. A heat transfer fluid (HTF) is heated to high temperature (750 °F) as it circulates through the receiver tubes. The heated HTF is then piped through a series of heat exchangers where it releases its stored heat to generate high pressure steam. The steam is then fed to a traditional steam turbine generator where electricity is produced.

The Project's nominal output of 500 MW would be, produced by two adjacent, identical and independent 250 MW units. The two power generating facilities would share a main office building, a main warehouse/maintenance building, a parking lot, onsite access roads, a bioremediation area for HTF-contaminated soil, and a central internal switchyard. Each unit would have its own solar field, comprised of piping loops arranged in parallel groups, and its own power block, centrally located within the solar field. Each power block will have its own HTF pumping and freeze protection system, solar steam generator; steam turbine generator; an air-cooled condenser for cooling, transmission lines and related electrical system; and auxiliary equipment, e.g., water treatment system, emergency generators. From the onsite switchyard, a common new double circuit 230 kV transmission line will interconnect with Southern California Edison's (SCE) Devers-Palo Verde transmission line at the planned Red Bluff substation whose location has not been finalized but is expected to be in the general vicinity of Desert Center west of the PSPP site.

The Project would use a gas-fired boiler for quick startup and for HTF freeze protection, but not for power generation. The fuel will be LPG (propane), which will be stored in onsite tanks supplied via regular truck deliveries. Thermal power plants require cooling which historically has involved large quantities of cooling water. The PSPP will utilize an air cooled condenser (ACC) commonly referred to as "dry cooling", thereby dramatically reducing the amount of water needed by the facility. Water would be used principally for solar mirror washing , ancillary equipment heat rejection, feed water makeup, dust suppression, firewater supply, and onsite domestic use. Total consumption for both units is estimated at approximately 300 acre-feet annually supplied by onsite wells

Project construction is scheduled to begin in late 2010. Commercial operation is expected to begin in with the first unit by mid-2013 followed by commercial operation of the second unit by year end 2013.

## **PROJECT PERSONNEL**

SWCA paleontologists Jessica DeBusk, B.S., Justin Strauss, M.S., Stephanie Lukowski, M.S., Benjamin Borkan, B.S. (in progress), and Peter Kloess, B.S., conducted fieldwork. Ms. DeBusk requested the museum records searches, managed field staff, and authored this technical report. David Daitch, Ph.D. and Georgia Knauss, M.S. examined the fossil specimens for identification. GIS Specialists Chad Flynn and John Covert produced graphics. Technical Editor Michelle Treviño edited and formatted this report. Cara Corsetti, M.S., Qualified Paleontologist and SWCA Paleontology Program Director, served as Principal Investigator.

## **METHODS**

Due to the nature of the fossil record, paleontologists cannot know either the quality or the quantity of fossils present in a given geologic unit prior to natural erosion or human-caused exposure. Therefore, in the absence of surface fossils, it is necessary to assess the sensitivity of rock units based on their known

potential to produce scientifically significant fossils elsewhere within the same geologic unit (both within and outside of the study area) or a unit representative of the same depositional environment.

### **MUSEUM RECORDS SEARCH**

For this project, museum records searches were performed by the Vertebrate Paleontology Section of the Natural History Museum of Los Angeles County (LACM), the Department of Earth Sciences at the San Bernardino County Museum (SBCM), and the Colorado Desert District Stout Research Center (CDDSRC). Museum collections records were searched to determine whether there are any known fossil localities in or near the project site, to identify the geologic units present in the Project area, and to determine the paleontological sensitivity ratings of those geologic units to assess potential impacts to nonrenewable paleontological resources. Published and unpublished literature and geologic maps were reviewed, and mitigation measures specific to this project were developed in accordance with the SVP's professional standards and guidelines (1995).

Geologic units were assigned a paleontological sensitivity rating based on the museum records search and literature review. For the area underlying the project area, geologic maps and paleontological sensitivity maps were created.

### **FIELD SURVEY**

A pedestrian reconnaissance survey of the Project area was performed between May 25 and June 19, 2009. The purpose of the fieldwork was to inspect the study area for surface fossils and exposures of potentially fossil-bearing geologic units and to determine areas in which fossil-bearing geologic units could be exposed during project-related ground disturbances. For the purposes of this analysis, only the areas of disturbance, including a 200-foot buffer, were surveyed for paleontological resources (Figure 1). Note that the associated linear facilities to the south of the Project site, including a natural gas line and access roads, are no longer a part of the PSPP; however, these areas are included in this technical report because they were defined as within the Project's area of disturbance at the time the paleontological resources field work was accomplished. The survey data for the area that is no longer part of the Project is not included in the Project impact analysis. However, the survey data is included in this report to add to the body of scientific knowledge.

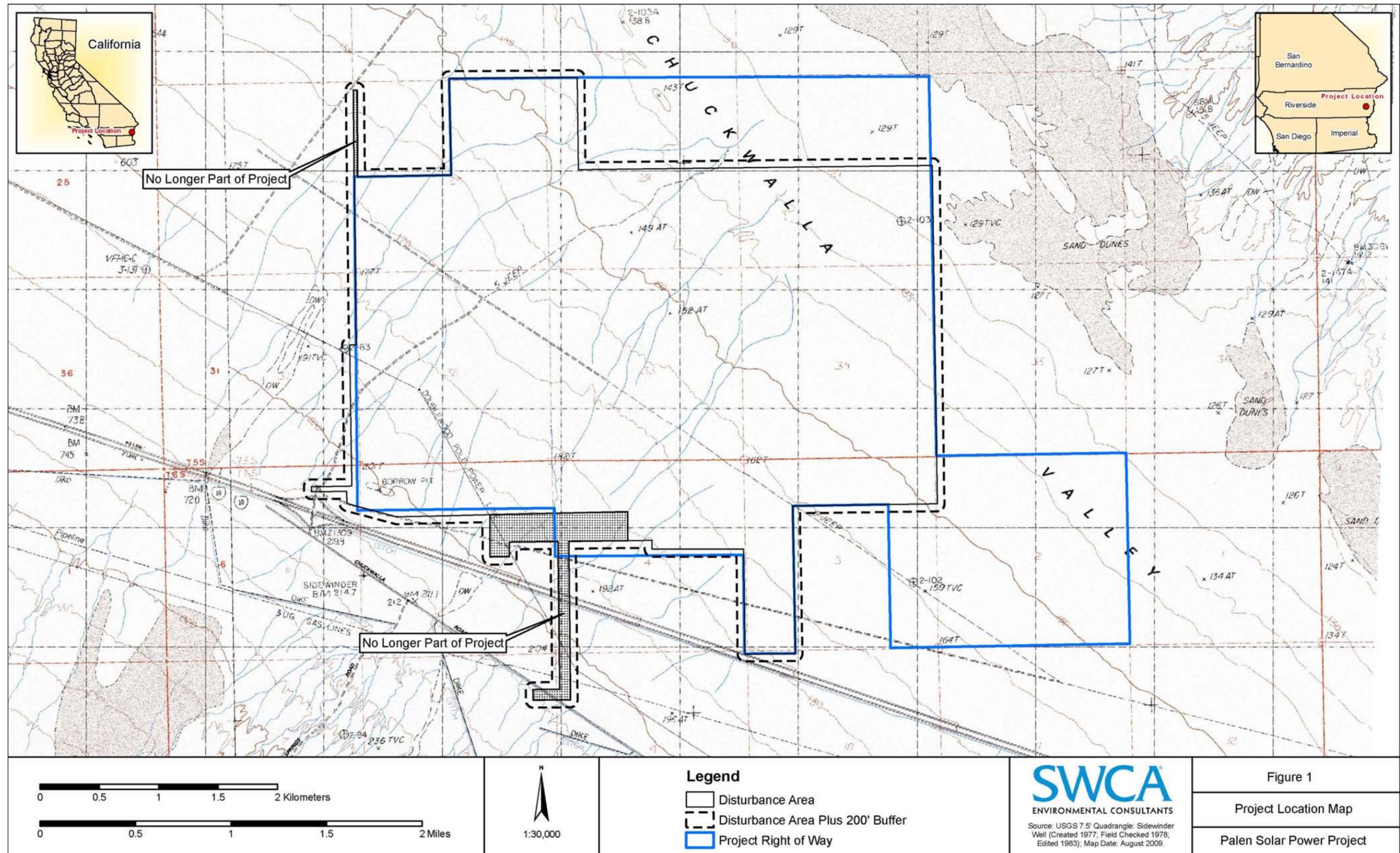


Figure 1. Project Location

## **GEOLOGY AND PALEONTOLOGY**

### **GEOLOGIC SETTING**

California is naturally divided into the following 12 geomorphic provinces, each distinguished from one another by having unique topographic features and geologic formations: (1) the Sierra Nevada, (2) the Klamath Mountains, (3) the Cascade Range, (4) the Modoc Plateau, (5) the Basin and Range, (6) the Mojave Desert, (7) the Colorado Desert, (8) the Peninsular Ranges, (9) the Transverse Ranges, (10) the Coast Ranges, (11) the Great Valley, and (12) the Offshore area. The PSPP site is located in the northeast corner of the Colorado Desert geomorphic province. The Colorado Desert is bounded to the east by the Colorado River, to the south by the international border, and to the west by the Peninsular Ranges. Norris and Webb (1976) define the northern border as the southern edge of the eastern Transverse Ranges and the San Bernardino–Riverside county line.

The PSPP site is located within Chuckwalla Valley, situated between the Chuckwalla Mountains to the south and the Palen and Coxcomb Mountains to the north (Jennings, 1967). Alluvial divides reaching up to 1,500 feet above mean sea level (msl) serve as boundaries between the mountain ranges to the north and west of the valley (Brown, 1923). The valley is dominated by up to 1,200 feet of sand, gravel, and clay derived from the surrounding highlands (Brown, 1923) and contains numerous dry lake beds that are separated by sand dunes (Norris and Webb, 1976). The surrounding mountains reach 2,000 to 4,000 feet above msl and the lowest point of the valley is Ford Dry Lake, located southeast of the project area at an elevation of around 360 feet above msl (Brown, 1923). These lake beds, alluvial sediments, and sand dunes underlie the PSPP project site and are depicted in Figure 2 and discussed in more detail in the following sections.

### **SITE-SPECIFIC GEOLOGY AND PALEONTOLOGY**

According to geologic mapping by Jennings (1967) and Stone and Pelka (1989), the PSPP site is underlain by Quaternary alluvial, aeolian, and lake bed deposits ranging from Pleistocene (1.8 million years old [Ma] to 10,000 years before present [BP]) to Holocene (10,000 years BP to Recent) in age (Figure 2). Quaternary lake bed deposits, which date to the Pleistocene and have the potential to produce significant vertebrate fossils, are present both at the surface and subsurface within the project area. These units, and their paleontological resource potential, are depicted in Figures 2 and 3 and discussed in more detail in the following sections.

#### **Quaternary Lake Bed Deposits (Ql)**

Surficial exposures of Quaternary lake bed deposits occur in the northeastern portion of the PSPP site and may also be found at the subsurface underlying both aeolian deposits and younger alluvium (Figure 2). Quaternary lake bed deposits, mapped by Jennings (1967) as “Ql,” are locally weakly consolidated to slightly dissected and in part overlain by modern playa deposits consisting of partly gypsiferous silt and clay (Stone and Pelka, 1989). Jennings (1967) and Stone et al. (1985) date these sediments to the Holocene and the latest Pleistocene. These Quaternary lacustrine sediments were likely deposited as a result of an expanded ancient Palen Lake (now Palen Dry Lake) located very close to the northeastern corner of the Project site (McLeod, 2009). Quaternary lake beds and similar deposits nearby and elsewhere in the Mojave Desert have produced numerous fossil vertebrate localities (McLeod, 2009; Scott, 2009; Jefferson, 1989, 1991; Reynolds, 1989). Therefore, these sediments are determined to have a high paleontological sensitivity.

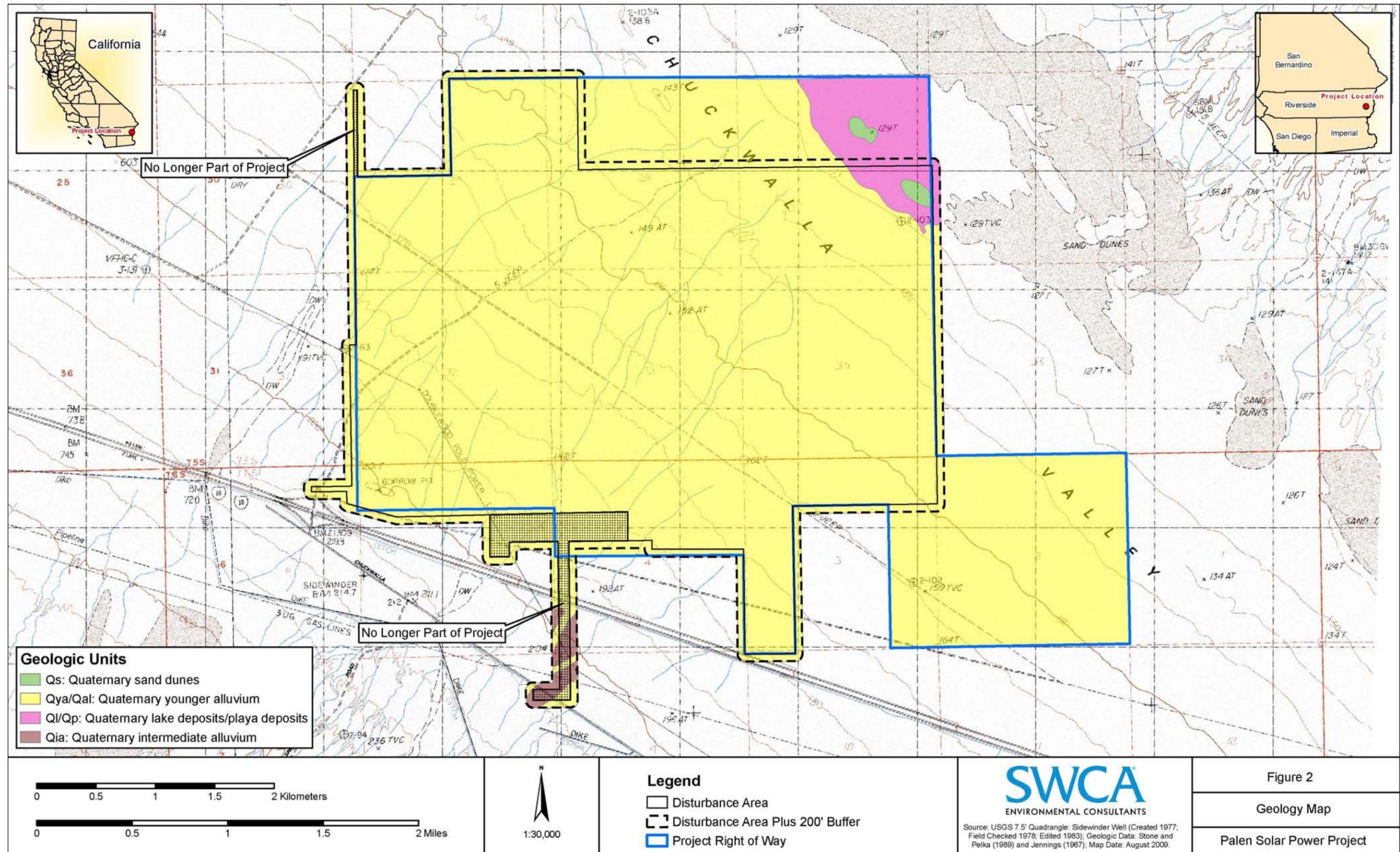


Figure 2. Geologic Map

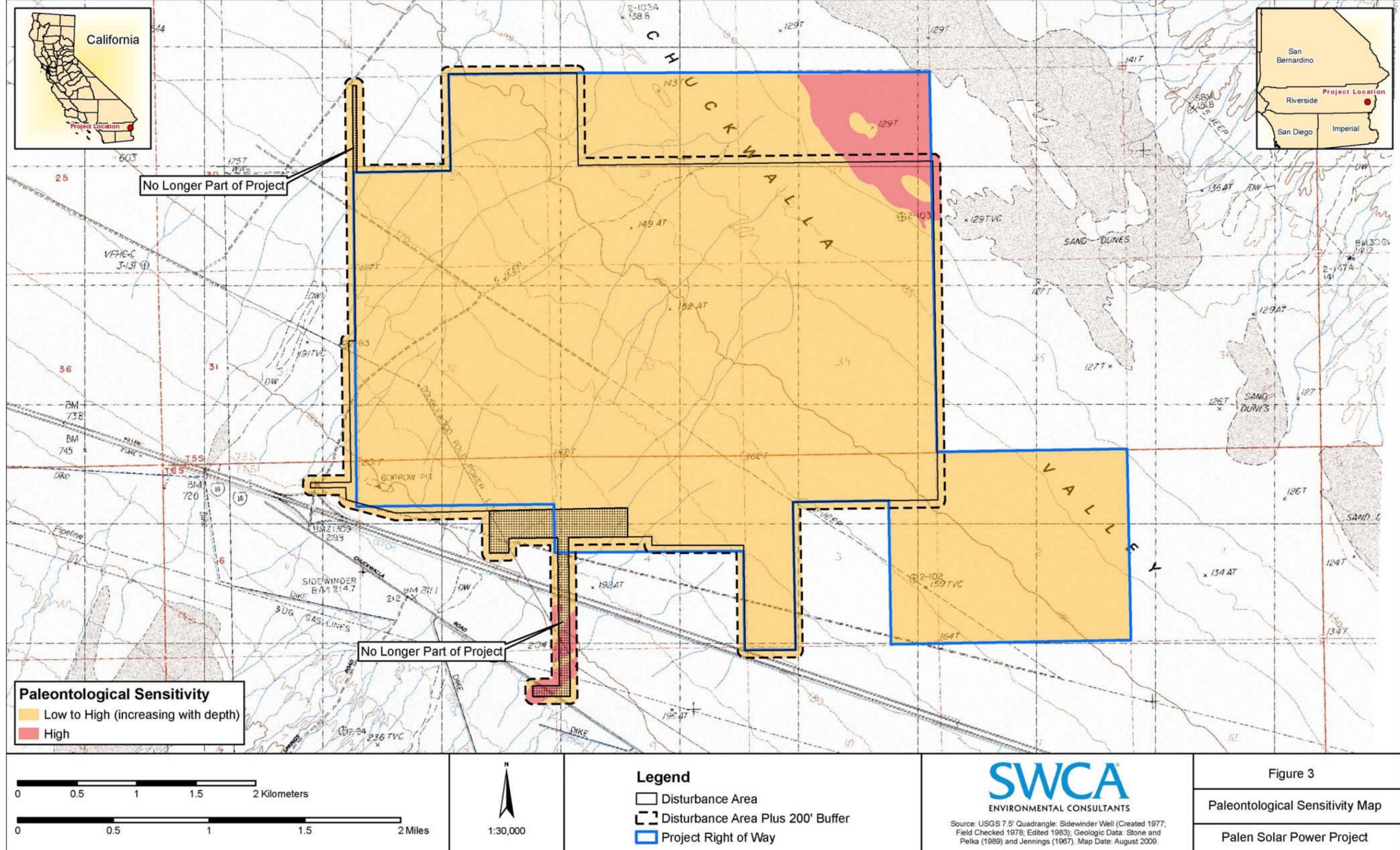


Figure 3. Paleontological Sensitivity

### **Quaternary Intermediate Alluvium (Qia)**

According to geologic mapping by Stone and Pelka (1989), the formerly proposed PSPP gas line route traversed Quaternary intermediate alluvium, mapped as “Qia.” These deposits, estimated in age to be between 2,000 and 200,000 years BP, consist variously of alluvial gravel, sand, and silt and are situated on top of inactive older fan surfaces. Pleistocene-aged alluvium has proven to yield scientifically significant vertebrate fossils both within the region and throughout southern California (Scott, 2009; McLeod, 2009); thus, this unit is determined to have a high paleontological sensitivity.

### **Quaternary Windblown Sand/Sand Dunes (Qs)**

The northeast portion of the project site is underlain by active sand dunes and sand sheets, “Qs,” of Recent age (Jennings, 1967; Stone and Pelka, 1989). The sand derives from the surrounding mountains, and dune formation has likely resulted from winds originating from the northwest based on their accumulation in the southeast area of the valley floor (Brown, 1923). Whereas the uppermost active sand dune deposits are not likely to contain fossilized remains, underlying older sand dune deposits may contain scientifically significant vertebrate specimens (McLeod, 2009). Therefore, sand dune deposits within the Project area are assigned a paleontological sensitivity ranging from low to high, increasing with depth.

### **Quaternary Younger Alluvium (Qya, Qal)**

Much of Chuckwalla Valley is underlain by Quaternary younger alluvium, mapped as “Qal” by Jennings (1967) and “Qya” by Stone and Pelka (1989). Quaternary younger alluvium is generally reported as Holocene in age (10,000 years BP to Recent) but is locally dated as 2,000 years to 0 years BP in age (Stone and Pelka, 1989). These sediments, underlying about half of the surficial deposits within the project area, are composed of alluvial silt, sand, and gravel derived from the surrounding mountains. Although these Holocene-aged sediments often contain the remains of modern organisms, they are too young to contain significant paleontological resources. However, paleontologically sensitive Quaternary lake beds or Quaternary intermediate age or older alluvium may occur at a relatively shallow but unknown depth. Therefore, Quaternary alluvium within the Project area is assigned a paleontological sensitivity ranging from low to high, increasing with depth.

**Table 2. Geologic Units Within the Palen Solar Power Project Area**

Age	Geologic Unit	Map Abbreviation*	Typical Fossil Types	Paleontological Resource Potential (Sensitivity)
Holocene to Latest Pleistocene	Dune sands	Qs	None	Low (increases with depth)
	Younger alluvium	Qya, Qal	None	Low (increases with depth)
Pleistocene	Intermediate-age alluvium	Qia	Terrestrial Vertebrates	High
	Lake deposits	Ql	Terrestrial Vertebrates	High

Sources: Jennings (1967) and Stone and Pelka (1989)

## ANALYSIS AND RESULTS

### MUSEUM RECORDS SEARCH

A review of museum collections records at the LACM, SBCM, and CDDSRC confirmed that no fossil localities have been previously recorded within the area that will be disturbed by PSPP construction and operation (and within which all Project facilities will be located), or within a 1-mile radius of the disturbance area. However, at least three vertebrate fossil localities have been previously recorded southwest of the Project area within the same or similar sediments (McLeod, 2009; Scott, 2009; Jefferson, 2009). LACM 5977, located east-southeast of the PSPP site north of I-10 and on the southwest side of Ford Dry Lake, yielded fossilized remains of *Perognathus* (pocket mouse). LACM (CIT) 208 and LACM 3414, located north-northwest of the proposed PSPP project site between Eagle and Coxcomb Mountains, yielded fossilized remains of *Gopherus* (tortoise), *Equus* (horse), *Camelops* (camel) and *Tanupolama stevensi* (llama). The depth at which these localities were discovered was not reported by the LACM; however, the SBCM indicates that significant vertebrate fossil remains have often been discovered in this region from similar Pleistocene deposits at a depth of approximately 5 feet or more below the ground surface (Scott, 2009).

**Table 3. Previously Recorded Fossil Localities in the Vicinity of the Project**

Geological Formation	Museum Locality Number and Approximate Location*	Taxon	Common Name
Quaternary Alluvium	LACM 5977; east-southeast of the proposed project area north of I-10 and on the southwest side of Ford Dry Lake	<i>Perognathus</i>	Pocket mouse
Quaternary Alluvium (Pinto Formation)	LACM (CIT) 208 and LACM 3414; north-northwest of the proposed project area between the Eagle Mountains and the Coxcomb Mountains	<i>Gopherus</i>	Tortoise
		<i>Equus</i>	Horse
		<i>Camelops</i>	camel
		<i>Tanupolama stevensi</i>	camel

\*LACM = Natural History Museum of Los Angeles County

### FIELD SURVEY

A comprehensive field survey of the Project disturbance area and 200-foot buffer was performed between May 25 and June 19, 2009. The entire Project area was relatively flat and scarcely to moderately vegetated (Photograph 1). A transect survey of the entire study area was conducted using 25- to 50-meter intervals, with close examination of exposed cross-sections (Photograph 2) and drainages (Photograph 3). The interval width used in any given area was determined based on the expected abundance of fossil materials in each area, based upon the recommendations of the museum records searches performed prior to the field survey, inspection of geologic and aerial maps, and visual observations made in the process of surveying. Both a handheld Garmin Global Positioning System (GPS) unit and a Trimble GeoXT GPS unit were used to ensure complete coverage of the project area.

Upon discovery of any fossil materials, the exact location of each fossil was recorded on the Trimble unit and a variety of information was recorded for each specimen, including notes on the material on which it was found and a brief description of the specimen. A set of photographs were also taken at each fossil locality, including a photograph facing north, east, south, and west at the point at which the fossil was

found, a view of the location at which the fossil was found from a short distance away, and two or more photographs of the specimen itself were taken. If warranted, the fossil was then collected by hand, wrapped in tissue paper, and placed within a plastic bag with a field label.

Within the PSPP site and associated linear alignments, the paleontological field survey recorded four non-significant fossil occurrences yielding petrified wood and one non-significant fossil point yielding non-diagnostic vertebrate material (Attachment A). All specimens were discovered *ex situ* (removed from their original place of fossilization) as lag deposits transported and unknown distance and re-deposited on top of alluvial sediments. For this reason, and due to the lack of diagnostic characteristics, none of the fossil resources discovered within the project site are considered significant. For the purposes of surface clearance, the vertebrate fossil specimen was collected and examined by a qualified vertebrate paleontologist to confirm that it was not identifiable (Attachment B). No petrified wood was collected throughout the course of the survey, but all occurrences were photo documented (Photograph 4).

**Table 4. Newly Recorded Fossil Occurrences Within the PSPP Boundaries**

Geologic Formation*	SWCA Field Number**	Taxa and Description	Significance
Quaternary younger alluvium	090608-JJS-02	Mammal jaw fragment?	Non-significant
	F3-090619-01	Petrified wood	Non-significant
	F3-090619-02	Petrified wood	Non-significant
	F3-090619-03	Petrified wood	Non-significant
Quaternary intermediate alluvium	F3-090619-04	Petrified wood	Non-significant

\*Float

\*\*Field numbers F3-090619-01-F3090619-04 were discovered outside of the current PSPP boundaries in the formerly proposed gas line and access road alignments.



**Photograph 1. View of typical ground visibility within northeastern portion of the PSPP site, looking northeast.**



**Photograph 2. View of playa exposure, northeastern portion of the project area.**



**Photograph 3. View of alluvial deposits along drainage.**



**Photograph 4. Fossil occurrence F3-090619-04.**

## CONCLUSIONS

The destruction of fossils as a result of human-caused ground disturbance has a significant cumulative impact, as it makes biological records of ancient life permanently unavailable for study by scientists. Implementation of proper mitigation measures can, however, reduce the impacts to the paleontological resources to below the level of significance. Construction of the PSPP has the potential to result in the destruction of sub-surface paleontological resources via breakage and crushing related to ground-disturbing activities during grading for the proposed facilities (e.g., solar field, power block, ancillary facilities, drainage channels, and access road). Project ground disturbance and terrain modification, expected to disturb 4,500,000 cubic yards of sediments, has the potential to adversely affect an unknown quantity of fossils that may occur on or underneath the surface in areas containing paleontologically sensitive geologic units. Although no significant paleontological resources were identified within the Project area during the course of the field survey, the majority of the PSPP site is underlain by geologic sediments determined to have a paleontological sensitivity ranging from low to high, increasing with depth. The far northeastern corner of the project is underlain by geologic sediments determined to have a high paleontological sensitivity at the surface as well as at depth (Figure 3).

As discussed immediately below (Recommended Mitigation Measures), all Project ground disturbances in Quaternary lake bed deposits will be monitored on a full-time basis because of their high paleontological sensitivity. All ground disturbances in Quaternary younger alluvium and in windblown sand/sand dune deposits (at or less than 5 feet in depth) will be spot-checked by paleontological monitors; ground disturbances in these areas that are more than 5 feet in depth will be monitored on a full-time basis because of their high sensitivity. No ground disturbances are expected to occur within Quaternary intermediate-age alluvium because the formerly proposed gas line is no longer a part of the Project.

Using information from published geologic maps and the results of the paleontology study of the PSPP site, the locations of the paleontologically sensitive geologic units underlying the proposed Project area were identified and are depicted in Figure 3.

## RECOMMENDED MITIGATION MEASURES

Ground-disturbing activities within the PSPP site may result in adverse impacts to significant paleontological resources unless proper mitigation measures are implemented. Implementation of proper mitigation measures can, however, reduce the impacts to the paleontological resources to below the level of significance.

The following mitigation measures have been developed to reduce the potential adverse impacts on paleontological resources to a less-than-significant level. The measures are based on the SVP standard guidelines (1995) and meet the requirements of CEQA. These mitigation measures have been used throughout California and have been demonstrated to be successful in protecting paleontological resources while allowing timely completion of construction projects in paleontologically sensitive areas.

### PRE-CONSTRUCTION PHASE

**A.** Prior to the start of any project related construction (defined as construction-related vegetation clearing, ground disturbance and preparation, and site excavation activities), the project owner shall ensure that the designed paleontological resource specialist approved by the Compliance Project Manager (CPM) is available for field activities and prepared to implement the conditions of certification. The designated paleontological resource specialist shall be responsible for implementing all the paleontological conditions of certification and for using qualified personnel to assist in this work.

**B.** Prior to the start of construction, a Paleontological Resource Monitoring and Mitigation Plan (PRMMP) drafted by the designated paleontological resource specialist shall be submitted to the CPM for approval. The plan shall identify general and specific measures to minimize potential impacts to sensitive paleontological resources. The project paleontological resource specialist shall implement the Paleontological Resource Monitoring and Mitigation Plan as needed.

The Paleontological Resource Monitoring and Mitigation plan shall include, but not be limited to, the following elements and measures:

- A discussion of the sequence of project-related tasks, such as any pre-construction surveys, fieldwork, flagging or staking; construction monitoring; mapping and data recovery; fossil preparation and recovery; identification and inventory; preparation of final reports; and transmittal of materials for curation;
- Identification of the person(s) expected to assist with each of the tasks identified within this condition, and a discussion of the mitigation team leadership and organizational structure, and the interrelationship of tasks and responsibilities;
- Where monitoring of project construction activities is deemed necessary, the extent of the areas where monitoring is to occur and a schedule for the monitoring;
- An explanation that the designated Paleontological Resource Specialist shall have the authority to halt or redirect construction in the immediate vicinity of a vertebrate fossil find until the significance of the find can be determined;
- A discussion of the equipment and supplies necessary for the recovery of fossil materials and any specialized equipment needed to prepare, remove, load, transport, and analyze large-sized fossils or extensive fossil deposits;
- Inventory, preparation and delivery for curation into a retrievable storage collection in a public repository or museum, which meets the Society of Vertebrate Paleontology standards and requirements for the curation of paleontological resources; and
- Identification of the institution that has agreed to receive any data and fossil materials recovered during project-related monitoring and mitigation work, discussion of any requirements of specifications for materials delivered for curation and how they will be met, and the name and phone number of the contact person at the institution.

**C.** Prior to the start of construction, the Paleontological Resource Specialist shall prepare a staff training program for review and approval by the CPM. Prior to and throughout the project and as needed, the paleontological resource specialist shall conduct training for the project owner, project managers, construction supervisors, equipment operators and all new employees in accordance with the CPM-approved training plan. Contractor briefings will also be videotaped and used for education for new employees.

The paleontological training program shall address the potential to encounter paleontological resources in the field, the sensitivity and importance of these resources, and the legal obligations to preserve and protect such resources. The training program shall also include the set of reporting procedures that workers are to follow if paleontological resources are encountered during project activities. The training program shall be presented by the designated Paleontological Resource Specialist and may be combined with other training programs prepared for cultural and biological resources, hazardous materials, or any other areas of interests or concerns.

## **CONSTRUCTION PHASE**

**D.** The designated paleontological resource specialist or paleontological monitor(s) shall be present at all times he or she deems appropriate to monitor construction-related grading, excavation, trenching, and/or augering in areas with a significant potential for fossil-bearing sediments to occur. All ground-disturbing activities at depths greater than 5 feet shall be monitored on a full-time basis because of their high paleontological sensitivity (see Figure 3). All ground disturbances at depths less than 5 feet will be “spot-checked” by paleontological monitors. The frequency of the spot checks shall be determined by the Paleontological Resource Specialist and will be based on factors such as the extent of ground disturbance and the location of those disturbances in relation to paleontologically sensitive sediments. Paleontological monitoring will include inspection of exposed rock units and collection of matrix to be testing for the presence of microscopic fossils. Paleontological monitors will have authority to temporarily divert excavations or drilling away from exposed fossils in order to efficiently and professionally recover the fossil specimens and collect associated data.

## **POST-CONSTRUCTION PHASE**

**E.** The project owner, through the designated paleontological resource specialist, shall ensure recovery, preparation for analysis, analysis, identification and inventory, the preparation for curation, and the delivery for curation of all significant paleontological resource materials encountered and collected during the monitoring, data recovery, mapping, and mitigation activities related to the project.

**F.** The project owner shall ensure preparation of a Paleontological Resources Report by the designated paleontological resource specialist. The Paleontological Resources Report shall be completed following the analysis of the recovered fossil materials and related information. The project owner shall submit the paleontological report to the CPM for approval. The report shall include, but not be limited to, a description and inventory list of recovered fossil materials; a map showing the location of paleontological resources found in the field; determinations of sensitivity and significance; and a statement by the paleontological resource specialist that project impacts to paleontological resources have been mitigated.

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**Confidential ATTACHMENT A:  
Fossil Locality Map**

**Confidential ATTACHMENT B:  
Fossil Locality Form**

**Confidential Documents to be submitted under separate cover**