5.8 Paleontological Resources

5.8.1 Introduction

The Hidden Hills Solar Electric Generating System (HHSEGS) will be located on privately owned land in Inyo County, California, adjacent to the Nevada border. It will comprise two solar fields and associated facilities: the northern solar plant (Solar Plant 1) and the southern solar plant (Solar Plant 2). Each solar plant will generate 270 megawatts (MW) gross (250 MW net), for a total net output of 500 MW. Solar Plant 1 will occupy approximately 1,483 acres (or 2.3 square miles), and Solar Plant 2 will occupy approximately 1,510 acres (or 2.4 square miles). A 103-acre common area will be established on the southeastern corner of the site to accommodate an administration, warehouse, and maintenance complex, and an onsite switchyard. A temporary construction laydown and parking area on the west side of the site will occupy approximately 180 acres.

Each solar plant will use heliostats—elevated mirrors guided by a tracking system mounted on a pylon—to focus the sun's rays on a solar receiver steam generator (SRSG) atop a tower near the center of each solar field. The solar power tower technology for the HHSEGS project design incorporates an important technology advancement, the 750-foot-tall solar power tower. One principle advantage of the HHSEGS solar power tower design is that it results in more efficient land use and greater power generation. The new, higher, 750-foot solar power tower allows the heliostat rows to be placed closer together, with the mirrors at a steeper angle. This substantially reduces mirror shading and allows more heliostats to be placed per acre. More megawatts can be generated per acre and the design is more efficient overall.

In each solar plant, one Rankine-cycle steam turbine will receive steam from the SRSG (or solar boiler) to generate electricity. The solar field and power generation equipment will start each morning after sunrise and, unless augmented, will shut down when insolation drops below the level required to keep the turbine online. Each solar plant will include a natural-gas-fired auxiliary boiler, used to augment the solar operation when solar energy diminishes or during transient cloudy conditions, as well as a startup boiler, used during the morning startup cycle, and a nighttime preservation boiler, used to maintain system temperatures overnight. On an annual basis heat input from natural gas will be limited by fuel use and other conditions to less than 10 percent of the heat input from the sun.

To save water in the site's desert environment, each solar plant will use a dry-cooling condenser. Cooling will be provided by air-cooled condensers, supplemented by a partial dry-cooling system for auxiliary equipment cooling. Raw water will be drawn daily from onsite wells located in each power block and at the administration complex. Groundwater will be treated in an onsite treatment system for use as boiler make-up water and to wash the heliostats.

Two distinct transmission options are being considered because of a unique situation concerning Valley Electric Association (VEA). Under the first option, the project would interconnect via a 230-kilovolt (kV) transmission line to a new VEA-owned substation

(Tap Substation) at the intersection of Tecopa Road[1] and Nevada State Route (SR) 160 (the Tecopa/SR 160 Option). The other option is a 500-kV transmission line that interconnects to the electric grid at the Eldorado Substation (the Eldorado Option), in Boulder City, Nevada.

A 12- to 16-inch-diameter natural gas pipeline will be required for the project. It will exit the HHSEGS site at the California-Nevada border and travel on the Nevada side southeast along the state line, then northeast along Tecopa Road until it crosses under SR 160. From this location a 36-inch line will turn southeast and continue approximately 26 miles, following the proposed Eldorado Option transmission line corridor, to intersect with the Kern River Gas Transmission (KRGT) pipeline. A tap station will be constructed at that point to connect it to the KRGT line. The total length of the natural gas pipeline will be approximately 35.3 miles.

The transmission and natural gas pipeline alignments will be located in Nevada, primarily on federal land managed by the U.S. Bureau of Land Management (BLM), except for small segments of the transmission line (both options) in the vicinity of the Eldorado Substation, which is located within the city limits of Boulder City, Nevada. A detailed environmental impact analysis of the transmission and natural gas pipeline alignments will be prepared by BLM.

This section evaluates the potential effect on paleontological resources (fossils) from the construction and operation of the project. Section 5.8.2 discusses applicable laws, ordinances, regulations, and standards (LORS). Section 5.8.3 describes the affected environment including the resource inventory and its results. Section 5.8.4 presents the environmental analysis and impact assessment, and Section 5.8.5 considers cumulative impacts to paleontological resources. Section 5.8.6 presents applicant-proposed mitigation measures. Section 5.8.8 lists the involved agencies and any permits required. Section 5.8.9 provides the references used to prepare this section.

This section of the AFC meets all Siting Regulations of the California Energy Commission (CEC, 2000; 2007) and conforms with the recommendations of the Society of Vertebrate Paleontology (SVP, 1995; 1996) and the U.S. Bureau of Land Management (BLM, 2008) that address the assessment and mitigation of impacts on paleontological resources resulting from earth-moving activities. This paleontological resources inventory and impact assessment was conducted by the project paleontological resources specialist (PRS), Dr. W. Geoffrey Spaulding, a senior scientist with CH2M HILL.

5.8.2 Laws, Ordinances, Regulations, and Standards

Paleontological resources (fossils) are the remains or traces of prehistoric plants and animals. They may range from the actual bones and shells of ancient organisms, to mineral replacements of a once-living organism, to simple impressions of plants or animals in soft sediments later transformed to rock. They range in size and abundance from many thousands per cubic centimeter for microfossils such as pollen, diatoms, and radiolaria, to very rare large-mammal bones exceeding a meter in length. Fossils are important scientific and educational resources because of their use in (1) documenting the presence and evolutionary history of particular groups of now-extinct organisms, (2) reconstructing the

[1] The road is also called Tecopa Highway and Old Spanish Trail Highway. The names are generally used interchangeably.

environments in which these organisms lived, and (3) in determining the relative ages of the strata in which they occur and the geologic events that resulted in the deposition of the sediments that formed these strata. In the project area, the fossils of marine organisms as well as those of terrestrial animals and plants are important in the paleontological record. They have helped define the age and sequences of deposition and uplift in the Great Basin, where fossiliferous marine and terrestrial sedimentary rock provide important data on the development and tectonics of California's complex geology.

Paleontological resources are non-renewable scientific and educational resources that are protected by several federal and state statutes, most notably by the 1906 Federal Antiquities Act, and the California Environmental Quality Act (CEQA) (Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established by the SVP (1995, 1996) and BLM (2008). LORS applicable to paleontological resources are summarized in Table 5.8-1, and discussed briefly below.

TABLE 5.8-1
Laws, Ordinances, Regulations, and Standards Applicable to Paleontological Resources

LORS	Requirements/Applicability	Administering Agency	AFC Section Explaining Conformance
Federal			
Antiquities Act of 1906	Protects paleontological resources on federal lands; requires inventory, assessment of effects, and mitigation if appropriate. Applicable –Federal land involved and federal entitlement required for utility corridor	Federal lead agency	Section 5.8.2.1
National Environmental Policy Act of 1969	Applicable – Federal land involved and federal-agency environmental review required for utility corridor	Federal lead agency	Section 5.8.2.1
Omnibus Public Land Management Act of 2009	Applicable –Federal land involved along utility corridor	Federal lead agency	Section 5.8.2.1
State			
CEQA, Appendix G	Requires that impacts on paleontological resources be assessed and mitigated on all discretionary projects, public and private. Applicable – Fossil remains may be encountered by earth-moving activities	California Energy Commission	Section 5.8.2.2
Public Resources Code, Sections 5097.5/5097.9	Designates unauthorized removal or disturbance of fossil remains or fossil site on publicly owned lands in the State of California as a misdemeanor. Not applicable – Applies to state-owned land	California Energy Commission	Section 5.8.2.2
Local			
Inyo County General Plan	Paleontological resources are not specifically addressed	Inyo County	Section 5.8.2.3

5.8.2.1 Federal LORS

Several federal regulations have been passed that protect paleontological resources, either explicitly (such as the recent Omnibus Public Land Management Act of 2009) or implicitly (for example by invoking "important historic or scientific resources," as found in the Antiquities Act of 1906 and the National Environmental Policy Act of 1969). These regulations apply to paleontological resources on federally managed land, or to those that might be encountered during the course of a project that requires a federal entitlement. The utility corridor required for this project is primarily on land managed by BLM, and federal regulations are therefore applicable to this project.

5.8.2.2 State LORS

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of CEQA (Public Resources Code Sections 21000 et seq.). CEQA requires that public agencies and private interests identify the environmental consequences of their proposed projects on any object or site of significance to the scientific annals of California (Division I, California Public Resources Code: 5020.1 [b]). *Guidelines for the Implementation of CEQA* (Public Resources Code Sections 15000 et seq.) defines procedures, types of activities, persons, and public agencies required to comply with CEQA. Appendix G in Section 15023 provides an Environmental Checklist of questions that a lead agency should normally address if relevant to a project's environmental impacts. One of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section V, part c) is the following: "Would the project directly or indirectly destroy a unique paleontological resource or site…?"

Although CEQA does not define what is "a unique paleontological resource or site", Section 21083.2 defines "unique archaeological resources" as "…any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

- Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information
- Has a special and particular quality such as being the oldest of its type or the best available example of its type.
- Is directly associated with a scientifically recognized import prehistoric or historic event."

With only slight modification, this definition is equally applicable to recognizing "a unique paleontological resource or site." Additional guidance is provided in CEQA Section 15064.5 (a)(3)(D), which indicates "generally, a resource shall be considered historically significant if it has yielded, or may be likely to yield, information important in prehistory or history."

Section XVII, part a, of the CEQA Environmental Checklist asks a second question equally applicable to paleontological resources: "Does the project have the potential to … eliminate important examples of the major periods of California history or pre-history?" To be in compliance with CEQA, impact assessments must answer both these questions in the

Environmental Checklist. If the answer to either question is "yes" or "possibly", a mitigation and monitoring plan must be designed and implemented to protect significant paleontological resources. The answer to these questions is "possibly" if not "yes", and therefore CEQA does apply to this project (Table 5.8-1).

The CEQA lead agency having jurisdiction over a project is responsible to ensure that paleontological resources are protected in compliance with CEQA and other applicable statutes. The CEQA lead agency with the responsibility to ensure that fossils are protected during construction of the HHSEGS on land in California is the CEC. California Public Resources Code Section 21081.6, entitled Mitigation Monitoring Compliance and Reporting, requires that the CEQA lead agency demonstrate project compliance with mitigation measures developed during the environmental impact review process.

No Nevada state statutes address the preservation or protection of paleontological resources beyond those establishing certain reserves for fossil preservation, such as the Berlin Ichthyosaur State Park in central Nevada. No such reserves occur in the vicinity of the project.

5.8.2.3 Local LORS

Neither the Inyo County General Plan, nor the comprehensive plans for Nye and Clark counties address paleontological resources specifically. Nevertheless, all place emphasis on the preservation of historic and prehistoric resources and values.

5.8.2.4 Professional Standards

The SVP, an international scientific organization of professional paleontologists, has established guidelines that outline acceptable professional practices in the conduct of paleontological resource assessments, monitoring, data recovery, specimen preparation, analysis, and curation (SVP, 1995). Most practicing professional paleontologists adhere to the SVP guidelines, with appropriate accommodations for the last 16 years of research and management experience. More recently, paleontological resources guidelines were promulgated by the U.S. Department of the Interior *BLM Instructional Memorandum No. 2008-009* (BLM, 2008), and these incorporate advancements that are being followed by many professional paleontologists conducting paleontological studies on federal lands and elsewhere.

5.8.3 Affected Environment

5.8.3.1 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the HHSEGS, and to assess the potential paleontological productivity of the stratigraphic units that are present, published as well as available unpublished geological and paleontological literature was reviewed. Sources included geological maps, satellite and aerial photography, and technical and scientific reports. Review of the literature on the geology of the project area was augmented by previous field experience in southern Nevada and adjacent California. For the HHSEGS, updated paleontological resources records reviews were conducted for the project using the on-line database maintained by the University of California Museum of Paleontology at Berkeley (UCMP). Targeted records reviews were conducted independently by the San

Bernardino County Museum (SBCM) (Appendixes 5.8A, 5.8B). The SBCM is the principal paleontological records repository for southern Nevada and adjacent California. Its principal paleontologists have more than 20 years' experience in this region.

In January 2011, Dr. Geof Spaulding conducted the initial reconnaissance of the paleontological sensitivity of the project site in conjunction with the monitoring of geotechnical testing. No fossil material was found. One potential fossil was identified, but was later determined to be a badly eroded modern long-bone fragment. A records review for the HHSEGS project area and a field survey of the HHSEGS project area, all on privately owned land in California, were conducted over 5 days in May 2011. The purpose of this field survey was to identify the paleontological potential of the Pleistocene sediments underlying the project area considered to be potential lacustrine (lake) sediments based on previous site reconnaissance. This field survey was also to note the location of and collect any paleontological resources at the surface of the project site. The survey was consistent with guidelines in BLM *Instructional Memorandum 2008-009* (BLM, 2008) which requires field surveys of all areas of projects underlain by geologic units of high, moderate, or unknown paleontological potential. The potential lacustrine, or basin fill sediments possessed unknown paleontological sensitivity.

5.8.3.2 Regional Physiographic Setting

The HHHSEGS lies in the Basin and Range physiographic province originally described by Fenneman (1931). This region received its name because it is typified by numerous (more than 100) linear mountain ranges, most oriented north-south, separated by intervening basins. The region extends south from southeastern Oregon between the Sierra Nevada and the Wasatch Range of Utah, and then east from the Peninsular Range of southern California to the Guadalupe Mountains of West Texas. A portion of this region, lying primarily in Nevada and western Utah, is called the Great Basin because all waterways drain internally to dry basins. No streams lying within the Great Basin reach the Pacific Ocean or the Gulf of California.

HHSEGS lies in the Pahrump Valley, the internally drained basin lying immediately west of the Spring Mountains in Clark and Nye counties, Nevada, and Inyo County, California. For much of the Paleozoic, about 550 to 240 million years ago, the region lay off the western margin of the North American plate, frequently in relatively shallow marine environments. Sediments laid down in these seas, primarily limestone mud but also sandstone, dolomite, and limited shales, now comprise the marine sedimentary rocks boldly exposed by uplift in most of the surrounding mountains, such as the Spring Mountains to the east of the HHSEGS site. These Paleozoic marine rocks are separated by a hiatus from Early Mesozoic (Triassic to Jurassic) estuarine and continental sediments, which are exposed primarily in the Spring Mountains and farther east. A period of crustal compression followed in the Late Mesozoic, the most remarkable result of which is the Keystone Thrust in the Spring Mountains. Here a large crustal slab of Paleozoic rock is thrust *over* a layer of much younger Jurassic sandstone, each crustal slab being many thousands of feet thick (Burchfiel et al., 1974). Compression was followed by crustal extension beginning during the Middle Tertiary (Miocene), about 22 million years ago. Normal and strike-slip faulting, as well as associated volcanic activity, transformed the landscape to the basin-and-range type topography typical of the Mojave region today. Beginning late during this Basin and Range Orogeny, and continuing into the Quaternary (the last 2 million years), uplift of the Sierra Nevada, as well as Transverse and Peninsular Ranges of California, led to a strengthened rain shadow and progressive desertification as precipitation declined in the interior (Winograd et al., 1985).

Progressive desertification during the Quaternary led to the development of the current, biogeographically defined Mojave Desert. However, it is important to note in the context of this study that warm-desert environments typical of the present have been the exception rather than the rule, over at least the last 0.7 million years (the Middle and Late Pleistocene, and the succeeding Holocene). Interglaciations like the current Holocene (the last 10,000 years) last for relatively brief periods of time while intervening glaciations last for more than 50,000 years. During each of these glacial ages, global climate and vegetation changed radically. Instead of warm-desert flora, during the last ice age the northern Mojave region was occupied by steppe shrubs and coniferous woodland (Spaulding, 1985; 1990). This is important in considering paleontological resources because, at the same time, recharge to local aquifers and runoff into the valleys greatly increased, as well as consequent discharge from now largely extinct artesian spring systems (cf., Smith and Street-Perrott, 1983; Enzel et al., 2003; Quade et al., 1995). These valley bottom riparian habitats attracted extinct Pleistocene megafauna, and their remains can be common in some (but not all) ancient lake and spring sediments (e.g., Jefferson, 2003).

5.8.3.3 Geological Setting of the HHSEGS

The HHSEGS project area has the general shape of a right triangle with the legs of the triangle running north-south and east-west, and the hypotenuse lying parallel to the California-Nevada border. Important to this discussion, the Stateline Fault System (SFS; Scheirer et al., 2010) runs approximately parallel to the border, on the Nevada side. Visible scarps associated with the SFS comprise three successively higher-elevation, subparallel lineaments, about 0.25 mile, 1.6, and 1.8 miles northeast of the border (Figure 5.8-1). Lundstrom et al. (2002) also map a subparallel, concealed fault about 0.65 mile west of the state line in California within the HHSEGS boundary, but no associated geomorphic feature, such as a scarp, can be readily discerned.

To the east of the SFS scarps lies the west bajada, or alluvial fan complex, of the Spring Mountains, and to their west is the axial basin of the Pahrump Valley (termed the Pahrump Basin for purposes of this discussion). This basin marks the position of the graben, or down-warped segment of crust, that lies to the west of the SFS, and it presumably has been accumulating sediment for at least the Pleistocene (the last approximately 2 million years; Lundstrom et al., 2002; Scheirer et al., 2010). The scarps just over the state line in Nevada mark the presence of what Lundstrom et al. (2002) map as chiefly low-angle normal faults. These faults channel artesian water to the surface where springs still discharged historically at a few localities (e.g., Stump Spring, Mound Spring). But, during Pleistocene glaciations, these fault lineaments hosted vastly enlarged spring discharge systems with associated pools, wet meadows, and streams (Quade et al., 1995). These would have been heavily vegetated areas and prime watering spots for large Pleistocene animals in what was otherwise a glacial-age shrub steppe (Spaulding, 1990). The extent to which these wetlands extended west into the Pahrump Basin, and onto what is now the HHSEGS project area, is an important question given the paleontological sensitivity of paleospring sediments.

5.8.3.4 Paleontological Inventory

Certain rock and unconsolidated sedimentary units have yielded no fossil records, and by their very nature are not expected to yield fossils. The paleontological potential of Neogene and Quaternary alluvium can be interpreted as being higher than it actually is (e.g. Appendix 5.8A). Nevertheless, if the unique depositional circumstances associated with artesian springs, lakes, and rivers are accounted for, it appears clear that alluvial fans in the desert interior are of low paleontological potential (Appendix 5.8B).

5.8.3.4.1 Results Records Review and Literature Search

In the records review conducted of the HHSEGS area (excluding the utility corridor) by the SBCM in April 2011 (Appendix 5.8A), SBCM staff concluded that the Pleistocene sediment at the project site had high paleontological sensitivity. This was based on vertebrate fossil finds (one mammoth tooth and one unidentifiable mammal tooth) approximately 3 miles east of the southeastern corner of the project area. These finds were, however, from paleospring deposits associated with fault scarps of the SFS; a setting that does not occur in the HHSEGS area (Quade et al., 1995; Lundstrom et al. 2003).

Quaternary Lacustrine and Groundwater Discharge Deposits

During the Pliocene to Middle Pleistocene (about 5 million years ago to as recently as about 160,000 years ago) long-lived perennial lakes were present in the Amargosa River drainage (Menges, 2008) to the west and northwest of Pahrump Valley. Given the massive Spring Mountains immediately to the east and the large orographic effect it could have had on precipitation and run-off (see Mifflin and Wheat, 1979), lakes conceivably could have occurred in the Pahrump Valley as well. These lakes, and the increased runoff and discharge that maintained them, represent conditions prior to the final desertification of the Mojave Desert. The mountains to the west that create the intense rain shadow of this region (the southern Sierra Nevada and the Transverse Ranges) did not experience their final phase of uplift until the last million years or so (Winograd et al., 1985). The distinctive lake sediments laid down during that time are best exposed about 20 miles farther west in the Tecopa Basin (Hillhouse, 1987).

During Pleistocene "pluvial" periods, enhanced recharge to the aquifer resulted in a higher water table and increased groundwater discharge along basin-margin faults like the scarps associated with the SFS (Quade et al., 1995). Pond and marsh environments, and well-vegetated "phreatophyte flats" were common and, the older the paleospring deposit, the greater the extent of the spring-fed environments. Quade et al. (1995) describe a chronosequence of spring discharge deposits of ever-decreasing extent, from Middle Pleistocene Unit B to a Late Pleistocene Unit D and finally, a terminal Pleistocene to early Holocene Unit E (see also Haynes, 1967). Vertebrate fossils are most commonly encountered in Units B and D, where pond sediments are most extensive, but fossils from Unit E would be from near the time of the mass extinction of the Pleistocene megafauna, and therefore of critical scientific interest (Mawby, 1967; de Narvaez, 1995).

The water table decline caused by postglacial desertification led to the failure of most of these spring systems by approximately 8,000 years ago. As their mantle of vegetation died off, the spring discharge areas were left as badlands of white to buff-colored, carbonate-rich silts. Because discharge environments are quite variable across relatively short distances, the facies changes of paleospring deposits can be abrupt and frequent. The typically laterally discontinuous suite of sediments ranges from green clays and lithic carbonate tufa, to feeder (conduit) sands and gravels, to buff and brown carbonate-rich silt representing the sediments of "phreatophyte flats" (including dense saltbush scrub; Haynes 1967; Quade et al., 1995). Portions of the ROW cross Late Pleistocene groundwater discharge deposits. These potentially fossiliferous deposits are mapped as Unit D and Unit E by dePolo et al. (1999), and correlated with the same units in the Tule Springs area of Las Vegas Valley (Haynes, 1967; Quade et al., 1995). Older Unit D (as mapped by dePolo et al., 1999) sediments typically display more extensive fossiliferous paludal and stream facies, while latest Pleistocene and early Holocene Unit E sediments often display sedimentary facies of more arid habitats. Not coincidentally, Unit D tends to be more fossiliferous than Unit E (Mawby, 1967; de Narvaez, 1995).

Both lacustrine sediments and paleospring deposits can be fossiliferous. Examples of the former include the fossil beds of Lake Manix (Jefferson, 2003) and more limited fossil occurrences in the beds of Lake Tecopa (Hillhouse, 1987). Groundwater discharge, or paleospring deposits in the northern Mojave Desert have yielded important Rancholabrean vertebrate fossil records, including those from Tule Springs in the Las Vegas Valley (Mawby, 1967; Scott and Cox, 2008). The faunal elements most often encountered represent primarily the grazing members of the extinct Pleistocene megafauna including mammoth (*Mammuthus columbi*), camel (*Camelops hesternus*), at least two species of horse (*Equus* spp.), and giant llama (*Hemiauchenia* sp.) (Mawby, 1967; Scott and Cox, 2008; de Narvaez, 1995).

5.8.3.4.2 Results of Field Survey

An initial reconnaissance by the project PRS of the HHSEGS area (Figure 5.8-1) was followed by a day of monitoring the excavation of geotechnical test pits in the project area. Ten test pits were excavated by backhoe to a depth of 10 feet. In addition to checking for fossil material during excavation, the objective of monitoring these excavations was to identify sediment at depth that might possess high paleontological sensitivity. Initial reconnaissance suggested that paleolake or paleospring sediments might be widespread

During initial reconnaissance and subsequent field investigation, it was noted that a blanket of younger, alluvial silty sand appears to mantle an older, more indurated, carbonate-rich, light-colored silty clay to clayey sand. As noted above, the younger overburden of sandy alluvium appears equivalent to the late Holocene Unit G of Haynes (1967). Areas mantled by Unit G generally support creosote bush (*Larrea tridentata*) scrub. The older, fine-grained substratum lying beneath Unit G appears to extend over much of the project area, and farther west within the HHSEGS site it is not obscured by overlying sandy alluvium. In areas lacking the alluvial overburden, the vegetation growing directly on this lower stratum is sparse and dominated by saltbush species (*Atriplex* spp.). Mapping of the project area's surficial geology has been completed for the area north of Avenue B, which is in the northern portion of the HHSEGS site (see Figure 8.5-1; Lundstrom et al., 2002) and several surficial alluvial units are recognized. The fine-grained sediments in the project area that lie at greater depth, however, do not appear to be late Holocene. Instead they display strong soil development at depth, and are likely of Pleistocene age.

The information from geotechnical testing is consistent with the idea that a relatively young mantle of sandy alluvium is present over part of the project area. Test pits excavated from nearer the state line and the alluvial fans extending through the SFS reveal primarily sandy strata that appear fluvial /alluvial in origin. Reworked eolian sand appears to be the primary component of this alluvium, with small-gravel lenses common. Because drainage is from the northeast, it is thicker near the state line than it is down-gradient to the southwest and west. Conversely, test pits away from the toes of these fans are dominated by clay, or possess significant clay strata.

The stratigraphy of the geotechnical test pits appears consistent with a model of recent (post-Pleistocene and likely late Holocene), sandy alluvium encroaching from the east (Unit G) and covering an older surface, which may be of Pleistocene age. Carbonate horizons and nodular carbonate are common in the older, deeper fine-grained strata. These clays are strongly affected by pedogenesis (chemical and physical changes caused by weathering), which is consistent with the inferred (potentially much) greater age of this lower unit. It is possible that older (Middle Pleistocene) phreatophyte-flat / basin-fill silts could be pedogenically altered to the clays observed in the test pits.

No carbonate ledges or other carbonate deposits that could clearly be assigned to groundwater tufa were encountered. In many cases, carbonate nodules and carbonate pseudomorphs could be attributed to calcite nucleation in saturated soils near the capillary fringe.

No paleontological resources were encountered during the excavation of the geotechnical test pits. Gastropod shells, bone fragments, relatively well-sorted gravel lenses, and carbonized wood are indicators of paleospring deposits, but none were encountered. The absence of any faunal material may be due to intense weathering of this older stratum. The long-bone fragment found during the earlier reconnaissance appeared heavily eroded by chemical weathering.

The HHSEGS site is located on privately owned land. A paleontological resources pedestrian survey was conducted on the site over 5 days in May 2011. It focused on areas of high albedo (white and near-white; Figure 5.8-1) which comprise exposures of the older, fine-grained and carbonate-rich basin fill discussed above. No paleontological resources were found. A number of modern, bleached bone fragments were located but these proved upon testing to be recent. No mineralized bone was located, and while tufa nodules were common as lag concentrate in some area, and at least one tufa ledge was noted, no direct evidence of ground water discharge was located.

> **No paleontological resources, or records of previous fossil finds, were found within one mile of the HHSEGS. Therefore, no map of recorded paleontological resources is provided.**

5.8.3.5 Paleontological Sensitivity of the Project Area

Paleontological sensitivity is a qualitative assessment made by a professional paleontologist taking into account the paleontological potential of the stratigraphic units present, the local geology and geomorphology, and any other local factors that may inform on the probability of encountering fossils and the nature of those fossils. According to SVP (1995) standard guidelines sensitivity comprises (1) the potential for a geological unit to yield abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or paleobotanical remains, and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecological, or stratigraphic data (Table 5.8-2). The BLM’s (2008) recommended potential fossil yield classification system offers a more fine-grained system of evaluating the likelihood that a given geological unit may yield fossils. This system is described in detail, and also summarized in Table 5.8-2.

TABLE 5.8-2
Paleontological Sensitivity Ratings Employed and Equivalent Potential Fossil Yield Classifications Consistent with BLM Guidelines

Sensitivity (PFYC)	Definition
High and Very High (PFYC 4, 5)	Assigned to geological formations known to contain paleontological resources that include rare, well-preserved, and/or fossil materials important to on-going paleoclimatic, paleobiological and/or evolutionary studies. They have the potential to produce, or have produced vertebrate remains that are the particular research focus of many paleontologists, and can represent important educational resources as well.
Moderate and Unknown (PFYC 3a, 3b)	Stratigraphic units that have yielded fossils that are moderately well-preserved, are common elsewhere, and/or that are stratigraphically long-ranging would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.
Low (PFYC 2)	Sediment that is relatively recent, or that represents a high-energy subaerial depositional environment where fossils are unlikely to be preserved. A low abundance of invertebrate fossil remains, or reworked marine shell from other units, can occur but the paleontological sensitivity would remain low due to their lack of potential to serve as significant scientific or educational purposes.
Very Low and Zero (PFYC 1)	Stratigraphic units with very low potential include pyroclastic flows and sediments heavily altered by pedogenesis. Most igneous rocks have zero paleontological potential. Other stratigraphic units deposited subaerially in a high energy environment (such as alluvium) may also be assigned a marginal or zero sensitivity rating (see Appendix 5.8B). Manmade fill is also considered to possess zero (no) paleontological potential.

PFYC = Potential Fossil Yield Classifications
Source: BLM, 2008

The sensitivity ratings applied to the sediments with paleontological potential affected by this project are summarized below:

5.8.3.5.1 Quaternary Lacustrine and Groundwater Discharge Deposits

As noted, both lacustrine sediments and paleospring deposits can be fossiliferous. Therefore these deposits possess high paleontological sensitivity. However, there is both lateral and horizontal variability in the fossil yield potential of these sediments. They are assigned a PFYC of 4 because of that, and because they are also covered by a mantle of alluvium or eolian sand in most areas (Appendix 5.8B; BLM, 2008).

Widespread "phreatophyte flat deposits" which are associated with shallow groundwater but lie at some distance from the sources of discharge closer to fault lineaments, possess a PFYC of 3a (moderate potential). They yield fossils less frequently than either lacustrine sediments or the palludal and riparian facies of paleospring deposits, but their proximity and depositional context confers some paleontological potential.

5.8.3.5.2 Rocks and Sediments with Low to No Paleontological Potential

Neogene and Quaternary alluvium, including the alluvium comprising the vast bajadas does not yield paleontological materials (Appendix 5.8B) is nevertheless sedimentary and classified PFYC 2 following BLM (2008) guidelines (BLM, 2008). This includes the Unit G alluvial sands and gravels of the HHSEGS project area, and the underlying fine-grained alluvium mapped in the project area by Lundstrom et al. (2002).

5.8.4 Environmental Analysis

The environmental impacts on paleontological resources from both construction and operation of the HHSEGS are presented in the following sections.

5.8.4.1 Paleontological Resource Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts on paleontological resources, the SVP (1995) notes that an individual fossil specimen can be scientifically important and significant if it is: (1) identifiable, (2) complete, (3) well preserved, (4) age-diagnostic, (5) useful in paleoenvironmental reconstruction, (6) a member of a rare species, or (7) a skeletal element different from, or a specimen more complete than, those now available for that species. For example, identifiable land mammal fossils are considered scientifically important because of their potential use in determining the age and providing input to paleoenvironmental reconstructions for the sediments in which they occur. Moreover, vertebrate remains are comparatively rare in the fossil record. Fossil plants are also important in this regard and, as sedentary organisms, are actually more sensitive indicators of their paleoenvironment and, thus, more important than mobile mammals for paleoenvironmental reconstructions. The value or importance of different fossil groups varies depending on the age and depositional environment of the stratigraphic unit that contains the fossils, their abundance in the record, and their degree of preservation.

Using the criteria of the SVP (1995) and the BLM (2008), the sensitivity ratings provided above, the significance of potential impacts of earth moving on the paleontological resources was assessed. Any unmitigated impact on a fossil site or a fossil-bearing rock unit of high, moderate or unknown sensitivity would be considered significant.

5.8.4.2 Paleontological Resource Impact Assessment

Impacts on paleontological resources occur from ground-disturbing activities, particularly construction-related excavations such as trenching and other deep excavations. Blading, grading, and other largely surface disturbances that do not extend more than a foot or two below the surface do not impact paleontological resources, unless the sedimentary unit affected possesses very high (PFYC 5) paleontological sensitivity.

The geology of the HHSEGS project area is dominated by late Holocene sandy alluvium, principally in the eastern portion of the project site, which in turn overlies fine-grained, carbonate-rich sediments. Monitoring of geotechnical test pit excavations, pedestrian survey of areas where this sediment is exposed at the surface, and repeated reconnaissance of the most promising areas by the project PRS has failed to identify any paleontological materials. The alluvium of the project area therefore possesses low paleontological sensitivity (PFYC 2).

Construction-related excavations and piling installment in the HHSEGS project area will not result in adverse impacts on paleontological resources.

No impacts to paleontological resources will occur from the HHSEGS operation because operation activities will not include excavations.

5.8.5 Cumulative Effects

Prior to 2007, widespread development in the nearby region resulted in proportionate impacts on paleontological resources. These impacts were not extensive because fossiliferous sediments are not widespread in the region, and since that time, development and consequent impacts on paleontological resources have decreased. Outside of relatively limited areas such as in the vicinity of Tule Springs in North Las Vegas, and the impacts to the paleospring deposits in the vicinity of Pahrump, impacts to paleontological resources have been limited in this region.

The relative contribution to cumulative impacts on paleontological resources from project-related ground disturbance will be limited, because impacts to paleontological resources themselves have been limited in this region. Thus, the proposed project is not expected to contribute measurably to cumulative negative impacts on paleontological resources in the absence of mitigation. With the mitigation described below, however, the impacts of the project development construction will be cumulatively negligible. Moreover, if any paleontological finds are made, the application of controlled scientific recovery methods to discovered paleontological resources will constitute a beneficial impact to the extent that new scientific specimens and knowledge are generated.

5.8.6 Mitigation Measures

Guidelines for the Implementation of CEQA (Public Resources Code Sections 15000 *et seq.*) include among the questions to be answered in the Environmental Checklist (Section 15023, Appendix G) the following: "*Would the project directly or indirectly destroy a unique paleontological resource or site*?" and "*Does the project have the potential to…eliminate important examples of the major periods of California…pre-history*?" These questions are answered in the negative for construction of HHSEGS, based on the data and considerations provided above. Because construction of the HHSEGS does not have appreciable potential to adversely affect significant paleontological resources, mitigation measures beyond worker education for facility construction are not necessary.

This section describes Applicant-proposed mitigation measures that should be implemented to reduce potential adverse impacts to significant paleontological resources resulting from project construction. These proposed paleontological resource impact mitigation measures will reduce, to an insignificant level, the direct, indirect, and cumulative adverse environmental impacts on paleontological resources that might result from project construction. The mitigation measures proposed below are in compliance with CEC environmental guidelines (CEC 2000, 2007), BLM guidelines (BLM, 2008), and with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP, 1995, 1996).

5.8.6.1 Construction Personnel Education

Prior to working on the site or utility corridor for the first time, all personnel involved in earth-moving activities will be provided with Paleontological Resources Awareness Training. This training would ideally be a module of the project-specific worker environmental awareness training. Workers and supervisory personnel will be informed that, while fossils are unlikely to be encountered at the HHSEGS site, they are nevertheless of scientific importance and should be reported immediately if indeed they are encountered.

The training will further provide information on the appearance of fossils, their importance in understanding the prehistory of the region, the role of paleontological monitors, and proper notification procedures.

5.8.6.2 Paleontological Resources Monitoring and Mitigation Program

A Paleontological Resources Monitoring and Mitigation Program (PRMMP) will be developed for review and approval prior to implementation. The PRMMP will include: construction monitoring and coordination; emergency discovery procedures; procedures for sampling and data recovery, if needed; appropriate levels of analysis of specimens; museum storage coordination for any specimens and data recovered; preconstruction coordination; and reporting. Reporting requirements will include monthly monitoring reports as well as a final report. Monitoring procedures will include measures to suspend monitoring if construction activities are restricted to previously disturbed fill, and to adjust monitoring protocols based on updated evaluations of sensitivity subsequent to initial excavations.

5.8.6.2.1 Paleontological Monitoring

Prior to construction, a qualified paleontologist will be retained as project PRS to design and implement a monitoring program during project-related construction activities. Prior to construction, the paleontologist will review excavation plans to determine where sensitive stratigraphic units will be disturbed by project-related earth movement.

Earth-moving construction activities will be monitored where these activities will potentially disturb previously undisturbed sediment of high or unknown paleontological sensitivity. The HHSEGS project area is underlain by sediment that has only low paleontological potential. However, due to the proximity of paleospring deposits immediately to the east, and the possibility that the Pahrump Basin may have held a perennial lake prior to the Late Pleistocene, spot monitoring of excavations exceeding depths of 10 feet will be recommended.

Monitoring will not be conducted in areas where the ground will not be disturbed, nor will it be conducted in areas where only fill, or sediment of low to moderate paleontological sensitivity is affected.

5.8.6.3 Impacts After Mitigation

Implementation of these mitigation measures will reduce the potential impact from project-related ground disturbance on paleontological resources to an insignificant level by allowing for the recovery of fossil remains and associated specimen data, and corresponding geologic and paleoenvironmental data, that otherwise might be lost to earth moving or to unauthorized fossil collecting. These scientific and associated educational values constitute the chief significance of the resource, and their recovery therefore mitigates the impacts to that resource.

With a well designed and implemented PRMMP, project construction could potentially result in beneficial impacts to paleontological resources through the recovery of fossil remains that would otherwise not have been exposed and, therefore, would not have been available for study. This consideration is particularly applicable to this area with its complex geological history as well as a paucity of fossil sites on this particular terrace surface compared to those farther inland. The recovery of fossil remains as part of project construction could help answer important questions regarding the geographic distribution, stratigraphic position, and age of fossiliferous sediments in the area.

5.8.6.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts on paleontological resources are anticipated as a result of the construction and/or operation of the HHSEGS.

5.8.7 Involved Agencies and Agency Contacts

There are no agencies having blanket jurisdiction over paleontological resources. The CEC has jurisdiction over paleontological resources for this project in the state of California. The Inyo County General Plan (Inyo County, n.d.) places emphasis on the preservation of historic and cultural resources, including archaeological resources, but does not specifically address paleontological resources.

The BLM's NEPA review responsibility for this project includes HHSEGS as well as the utility corridor based on the principal of "connected actions." Documentation of any paleontological finds will be provided not only to the BLM, but also to the SBCM which is the regional repository of paleontological site records for this portion of southern California and adjacent southern Nevada.

5.8.8 Permits Required and Permit Schedule

No state or county requirements exist for a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earth moving on this project. Any paleontologist supervising such work on the HHSEGS site would, however, have professional credentials reviewed and approved by the CEC.

CEC review and approval of PRS credentials will take place before construction kick-off at the HHSEGS. PRS credentials are normally required by the CEC at least 90 days prior to construction kick-off.

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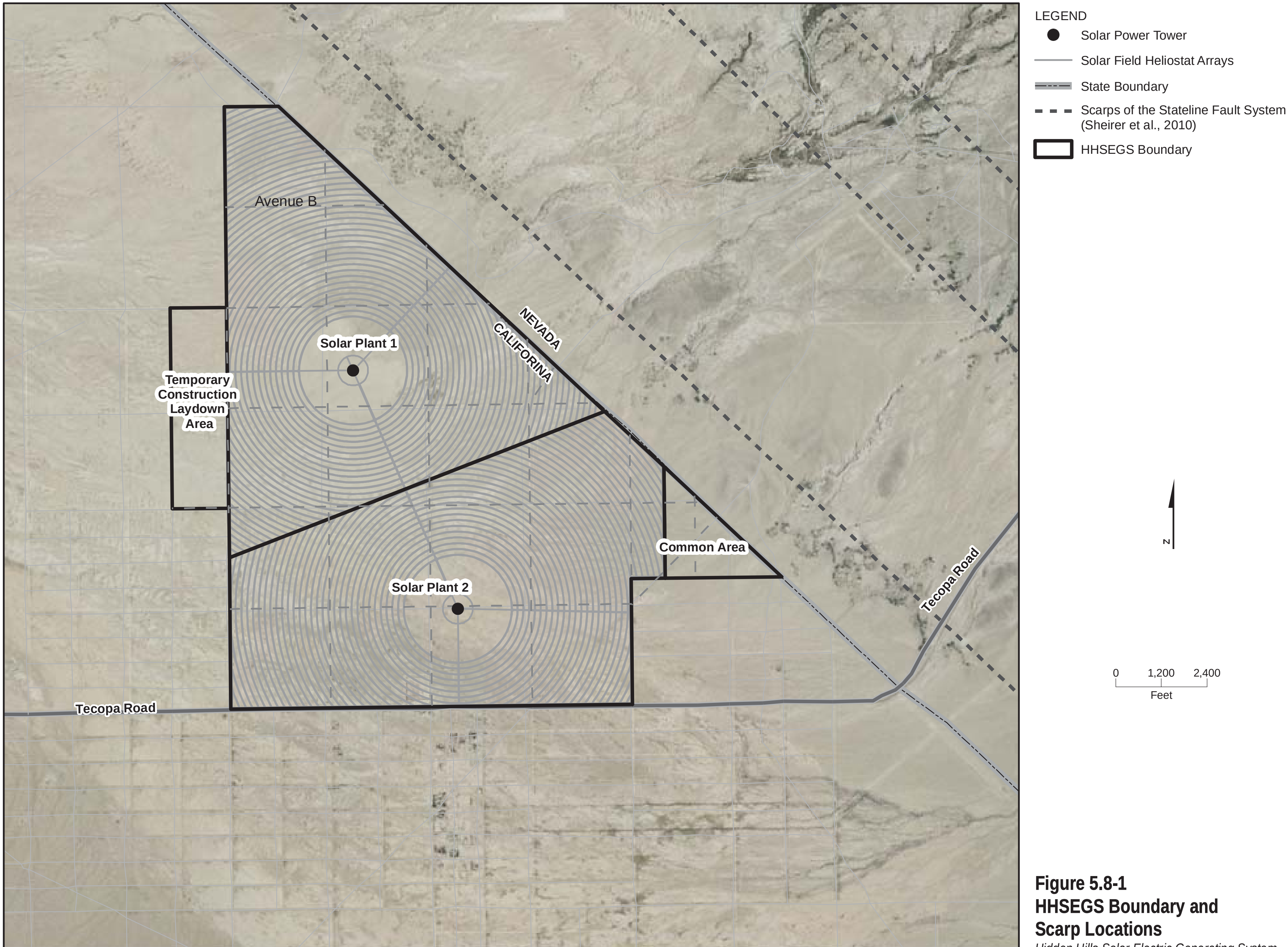

Figure 5.8-1
HHSEGS Boundary and Scarp Locations
Hidden Hills Solar Electric Generating System