5.8 Paleontological Resources

5.8.1 Introduction

The Applicant proposes to develop a solar energy project called the Ivanpah Solar Electric Generating System (Ivanpah SEGS). It will be located in southern California's Mojave Desert, near the Nevada border, to the west of Ivanpah Dry Lake. The project will be located in San Bernardino County, California, on federal land managed by the Bureau of Land Management (BLM). It will be constructed in three phases: two 100-megawatt (MW) phases (known as Ivanpah 1 and 2) and a 200-MW phase (Ivanpah 3). The phasing is planned so that Ivanpah 1 (the southernmost site) will be constructed first, followed by Ivanpah 2 (the middle site), then Ivanpah 3 (the 200-MW plant on the north), though the order of construction may change. Each 100-MW site requires about 850 acres (or 1.3 square miles); the 200-MW site is about 1,660 acres (or about 2.6 square miles). The total area required for all three phases, including the Administration/Operations and Maintenance building and substation, is approximately 3,400 acres. The Applicant has applied for a right-of-way grant for the land from BLM. Although this is a phased project, it is being analyzed as if all phases are operational.

The heliostat (or mirror) fields focus solar energy on the power tower receivers near the center of each of the heliostat arrays (the 100-MW plants have three arrays and the 200-MW plant has four arrays). In each plant, one Rankine-cycle reheat steam turbine receives live steam from the solar boilers and reheat steam from one solar reheater—located in the power block at the top of its own tower. The solar field and power generation equipment are started each morning after sunrise and insolation build-up, and shut down in the evening when insolation drops below the level required to keep the turbine online.

Ivanpah 1, 2 and 3 will be interconnected to the Southern California Edison (SCE) grid through upgrades to SCE's 115-kilovolt (kV) line passing through the site on a northeast-southwest right-of-way. These upgrades will include the construction by SCE of a new 220/115-kV breaker-and-a-half substation between the Ivanpah 1 and 2 project sites. This new substation and the 220-kV upgrades will be for the benefit of Ivanpah and other Interconnection Customers in the region. The existing 115-kV transmission line from the El Dorado substation will be replaced with a double-circuit 220-kV overhead line that will be interconnected into the new substation. Power from Ivanpah 1, 2 and 3 will be transmitted at 115 kV to the new substation. SCE plans to add three new 115-kV lines to increase capacity to the existing El Dorado-Baker-Cool Water-Dunn Siding-Mountain Pass 115-kV line heading southwest. The timing of this upgrade depends upon the development of wind projects ahead in the queue, and is not affected by the Ivanpah SEGS project.

Each phase of the project includes a small package natural gas-fired start-up boiler to provide heat for plant start-up and during temporary cloud cover. The project's natural gas system will be connected to the Kern River Gas Transmission Line, which passes less than half a mile to the north of the project site. Raw water will be drawn daily from one of two onsite wells, located east of Ivanpah 2. Each well will have sufficient capacity to supply water for all three phases. Groundwater will go through a treatment system for use as boiler make-up water and to wash the heliostats. To save water in the site's desert environment, each plant will use a dry-cooling condenser. Water consumption is, therefore, minimal (estimated at no more than 100 acre-feet/year for all three phases). Each phase includes a small onsite wastewater plant located in the power block that treats wastewater from domestic waste streams such as showers and toilets. A larger sewage package treatment plant will also be located at the Administration Building/Operations and Maintenance area, located between Ivanpah 1 and 2. Sewage sludge will be removed from the site by a sanitary service provider. No wastewater will be generated by the system, except for a small stream that will be treated and used for landscape irrigation. If necessary, a small filter/purification system will be used to provide potable water at the Administration Building.

The project site is located in the northwestern quarter of the Ivanpah Valley, which is a largely uninhabited valley in the central Mojave Desert. It would occupy the middle reaches of the alluvial fan complex (bajada) that extends to the east from the Clark Mountains that lie approximately 2 miles to the west. The toe of the bajada is approximately 1.8 miles to the east at the edge of Ivanpah Dry Lake, a playa that occupies the central and lowest portion of the valley.

Paleontological resources are fossils, the remains of prehistoric plants and animals, and are important scientific and educational resources because of their use in: (1) documenting the presence and evolutionary history of particular groups of both extinct and extant organisms, (2) reconstructing the environments in which these organisms lived, and (3) 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.

This subsection summarizes the paleontological resources and the potential impacts on paleontological resources that may result from construction of the Ivanpah SEGS. It describes the applicable laws, ordinances, regulations, and standards (LORS) and the environmental setting. It provides an analysis of the project impacts that could occur as a result of project construction and operation. It also presents protection and mitigation measures that would avoid, minimize, or compensate for adverse impacts when required. At the end of the subsection is a list of agency contracts and permits that would be required.

5.8.2 Laws, Ordinances, Regulations, and Standards

Paleontological resources are non-renewable scientific and educational resources and are protected by several federal and state statutes (California Office of Historic Preservation, 1983; see also Marshall, 1976; Gastaldo, 1999), most notably by the 1906 Federal Antiquities Act and by the State of California's environmental regulations (California Environmental Quality Act [CEQA], Section 15064.5). Professional guidelines for the assessment and mitigation of impacts to paleontological resources have been disseminated by the Society of Vertebrate Paleontology (SVP, 1995, 1996). Construction of the proposed Ivanpah SEGS project will be conducted in accordance with all LORS applicable to paleontological resources. Federal, State, and County LORS applicable to paleontological resources are summarized in Table 5.8-1 and discussed briefly below, along with SVP guidelines.

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

LORS	Requirements/Applicability	Administering Agency	AFC Section Explaining Conformance
Antiquities Act of 1906	Protects paleontological resources on federal lands; requires inventory, assessment of effects, and mitigation if appropriate.	Bureau of Land Management	Section 5.8.2.1
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	California Energy Commission	Section 5.8.2.2
CEQA, Appendix G(j)	Requires that impacts to paleontological resources be assessed and mitigated on all discretionary projects, public and private	California Energy Commission	Section 5.8.2.2
San Bernardino County General Plan	Emphasizes the conservation of resources having the potential to provide information important in history and prehistory	County of San Bernardino	Section 5.8.2.3

5.8.2.1 Federal LORS

Because the Ivanpah SEGS project is to be located entirely on federally managed land, protection of significant paleontological resources under the Antiquities Act does apply. Federal legislative protection for paleontological resources stems primarily from the Antiquities Act of 1906 (PL 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal lands. In response, federal land management agencies such as the BLM have guidelines for the assessment of paleontological resources and evaluation of impacts that may result from proposed management actions, such as the letting of a land lease for development purposes. Section 5.8.3 et seq. describes the assessment of paleontological resources that may be affected by this project, and measures to avoid impacts to those resources and, therefore, compliance with this federal legislation.

5.8.2.2 State LORS

The California Energy Commission (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 potential 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 Section 5020.1 [b]). Guidelines for the Implementation of CEQA (Public Resources Code Sections 15000 et seq.) define 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 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:

1. [It] contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.
2. It has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. [It] is directly associated with a scientifically recognized important prehistoric or historic event."

Making accommodation for the type of antiquity involved, this definition of "unique archaeological resources" 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?" Fossils are important examples of the major periods of California prehistory. To be in compliance with CEQA, environmental impact assessments, statements, and reports 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 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 lead agency with the responsibility to ensure that fossils are protected during construction of the proposed Ivanpah SEGS project 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.

Other state requirements for paleontological resource management are in California Public Resources Code Chapter 1.7, Section 5097.5 (Stats. 1965, c. 1136, p. 2792), entitled Archaeological, Paleontological, and Historical Sites. This statute defines any unauthorized disturbance or removal of a fossil site or fossil remains on public land as a misdemeanor and specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources. This state statute would not apply to the proposed Ivanpah SEGS project because construction or other related project impacts would occur only on federally managed lands.

5.8.2.3 Local LORS

California Planning and Zoning Law requires each county and city jurisdiction to adopt a comprehensive, long-term General Plan for its development. The General Plan is a policy document designed to give long range guidance to those making decisions affecting the future character of the planning area. It represents the official statement of the community's physical development as well as its environmental goals. The General Plan also acts to clarify and articulate the relationship and intentions of local government to the rights and expectations of the general public, property owners, and prospective investors. Through its general plan, the local jurisdiction can inform these groups of its goals, policies, and development standards; thereby communicating what must be done to meet the objectives of the general plan.

The *Conservation Background Report* of the *San Bernardino County General Plan* (County of San Bernardino, 2006) notes that the protection or mitigation of fossil resources serves several purposes. These include the preservation and recovery of important biological and environmental data, geological information including timelines for geological strata, and specimens that can serve as unique educational tools. The cultural resources section of the "San Bernardino County Initial Study Environmental Checklist Form" specifically asks if a given project would directly or indirectly destroy a unique paleontological resource.

5.8.2.4 Professional Standards

To assist in the compliance with applicable laws, the SVP, an international scientific organization of professional vertebrate paleontologists, has disseminated guidelines (SVP, 1995; 1996) that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys; monitoring and mitigation; data and fossil recovery; sampling procedures; and specimen preparation, identification, analysis, and museum curation. The SVP's guidelines are a commonly used standard against which paleontological monitoring and mitigation programs are evaluated. Briefly, SVP guidelines recommend that each project have literature and museum archival reviews, a field survey, and, if there is a high potential for disturbing significant fossils during project construction, a mitigation plan that includes monitoring by a qualified paleontological monitor, salvage of fossils if encountered, preparation and identification of salvaged fossils, and placement of curated fossil specimens into a permanent, retrievable museum collection (such as the San Bernardino County Museum or the Stout Research Center of the Anza-Borrego Desert State Park).

5.8.3 Affected Environment

The project area is in the northwestern Ivanpah Valley (see Figure 5.8-1) which, like many other rift valleys in the region (e.g., Death Valley, Panamint Valley) is much longer north-south (in excess of 20 miles) than it is wide east-west (about 10 miles).

5.8.3.1 Geographic & Physiographic Setting

The project site and laterals lie within a valley occupying the southwestern portion of the Basin and Range physiographic province (Fenneman, 1931). This valley is also part of the hydrographically defined Great Basin, being internally drained and having no outlet to the Colorado River and Pacific Ocean beyond. Even though the Colorado lies only about 30 miles to the east its drainage is separated from the Ivanpah Valley by intervening mountain ranges, in this case the Lucy Grey and southern McCullough ranges that form the eastern boundary of the Ivanpah Valley. The Mescal and Ivanpah ranges lie to the west of the valley, while the Clark Mountain Range forms its northwestern border and, along with the southern Spring Range, its northern border. Finally, the New York Mountains and Mid-Hills form the southern boundary of this valley.

The Basin and Range is characterized by mountains and intervening valleys that generally are longer than they are wide. This elongation of mountain ranges and intervening valleys in a north-south direction is the surficial manifestation of the extensional tectonics affecting the western margin of the continent (Wernicke, 1990). Extension, or stretching, of the crust of the western portion of the North American plate is being caused by its entrainment by the North Pacific plate as it moves in a generally northwesterly direction. Through complex interaction along a series of transform faults in California, this motion is translated into a principally west-directed stretching. Consequently, most mountain ranges in this region are great north-south blocks of crust that, once separated from the surrounding crust by extension, have rotated downward to the west. The westerly rotation of these elongated mountain blocks has buried their western edges many thousands of feet in valley fill and younger sediment, while their eastern margins are elevated correspondingly to great heights. Mountains with peaks above 7,000 feet on the edge of the Ivanpah Valley include Clark Mountain, New York Mountain, and McCullough Mountain.

Because Ivanpah Valley possesses a large drainage basin surrounded by relatively high mountains, it may have received sufficient runoff to support a pluvial lake during the Pleistocene. Under present climatic conditions the bottom of the valley is occupied by a large playa, or dry lake bed, that is about 11.5 miles long, and about 2 miles wide. The lowest portion of the project site, the northeastern corner of Ivanpah 1, is about 1.6 miles west of the west edge of the playa (Figure 5.8-1). It lies at about 2,765 feet above mean sea level (amsl), and therefore, the project site is at least 150 feet above the playa floor (2,605 feet amsl), and in most places higher. Lacustrine sediment dating to previous high-stands of this ancient lake is likely present at depth in proximity to the playa, but its lateral distribution in the valley would have been limited by the maximum depth of the ancient lake. The ancient lake in the Ivanpah Valley is unlikely to have been more than a few tens of feet deep (see Mifflin and Wheat [1979] for a discussion of the modest depths of playa lakes that do not possess a large river system flowing into them). About 7 miles farther south on the western margin of the playa, near the Nipton Road, a gravel pit 0.5 mile east of the playa edge and only 70 feet above the current playa surface shows no evidence of lacustrine sediment (Figure 5.8-1). Even though it has been excavated to a depth exceeding 20 feet the only sediment revealed is a sandy gravelly alluvium.

5.8.3.2 Geologic Setting

The project site itself lies on the bajada that flanks the east side of Clark Mountain. The alluvial fans extending east from the mountains to the valley bottom and that form this bajada consist chiefly of sand through cobble to boulder size debris, with progressively smaller grain size as the distance from the mountains increases. The alluvium at the project site is polymineralic and composed of an array of sedimentary, metamorphic, and igneous rock types. Within the project site there is no bedrock. However, there are bedrock outcrops in the form of a set of hills immediately to the northeast of Ivanpah 2, and a more limited bedrock ridge just west of Ivanpah 3 (Figure 5.8-1). Both the ridge and the small set of hills represent “inselbergs,” a geomorphic term for the highest projections of mountains that are otherwise completely buried in the cascade of alluvium from the surrounding high mountains.

To the extent that the literature search was able to determine, the bedrock of this set of hills and the small ridge has not been subject to geological mapping. The set of hills, northeast of Ivanpah 2, provide exposures of fine grained quartzite and metamorphic rock of probable Lower Cambrian and/or Late Proterozoic age, respectively. The quartzite resembles the Zabriskie Quartzite, a regionally common Lower Cambrian rock unit. The ridge immediately to the west of the west boundary of Ivanpah 3, named Ridge 1059 for its highest point (1,059 meters amsl) noted on the 7.5′ topographic sheet for the area (USGS, 1985), is the only example of Paleozoic carbonate rock in the project vicinity. It is a dark blue-grey primarily coarsely bedded limestone with rare thin, stringers of banded light-grey quartzite that develops a red-brown desert varnish after long exposure. The limestone is variably but extensively burrow mottled, with the rock of some strata appearing to be more than 50 percent replaced by lighter gray, sandy burrow infilling. The strata comprising this ridge dip steeply (approximately 62 degrees) to the southwest and only about 150 feet of the geologic section is exposed by this ridge. The rock resembles the Bonanza King Formation of Middle to Upper Cambrian age (about 490 to 510 million years), a geological unit that is widespread and well-known in the Mojave Desert of Nevada and adjacent California (e.g. Martin et al., 2002).

An older Tertiary sedimentary deposit is indicated by a thin (10 to 20 feet) stratum of calcareous fanglomerate[1] or metaconglomerate capping the top of Ridge 1059. The cap is composed of large and highly angular clasts composed of the same limestone as the ridge, well cemented in a dark carbonate matrix. From the perspective of historical geology, this limited exposure of old fanglomerate is a remnant of sediments capping the ridge prior to the final tectonic event(s) that led to its uplift above the current alluvial fan surface.

Quaternary (Pleistocene and Holocene) sediments exposed in the project area are the alluvial fan deposits comprising the bajada issuing from the Clark Mountains outcropping only about 2 miles to the west. The alluvial deposits range in age from those that have been active during the late Holocene (last 3,000 to 4,000 years) to those that support well-developed soils and have been stable since the Middle Pleistocene, or for at least the last 125,000 years. Most of these older surfaces stand in higher topographic relief and are found primarily on the upper bajada to the west of Ivanpah 1 and 2. Apparently, as a consequence of the relative active uplift in the area, most surfaces are mapped as being composed of "younger" alluvium of Late Pleistocene to Holocene age, with only a few surfaces being of "intermediate" or Middle to Late Pleistocene age by (Schmidt and McMackin, 2006). Holocene eolian and sheet wash sediments typically occupy the washes incising the surface of these alluvial fan units. As noted above, no evidence of beach or playa (lacustrine sediments) are present in or near (within 2 miles) of the project area due to its relative elevation above the dry lake bed.

[1] When a series of conglomerates accumulates into an alluvial fan, in rapidly eroding (e.g., desert) environments, the resulting rock unit is often called a fanglomerate. Although unaltered other than being consolidated to the point of lithification, the degree of metamorphic alteration of the deposit qualifies it as a weakly developed metaconglomerate.

5.8.4 Resource Inventory

5.8.4.1 Resource Inventory Methods

A records search and literature review was conducted for this project by the San Bernardino County Museum (SBCM), the regional repository for paleontological records in this area. It is included as Appendix 5.8A (Scott, 2006). Online records repositories operated by *Palaeos* and the University of California Museum of Paleontology at Berkeley were also consulted. These latter online resources provided no records of paleontological sites in the project vicinity. The nearest paleontological localities recorded by the SBCM are to the southeast near the western border of Ivanpah Lake, about 2 miles from the project area. The faunal remains are unremarkable, consisting of smaller vertebrates still present in the area today (desert tortoise [*Gopherus* sp.], kangaroo rat [*Dipodomys* sp.). However, records of hackberry and tufa deposits near the lake edge are indicative of a former wetter environment that may have been responsible for the deposition of fossiliferous sediment. Nevertheless, and as discussed above, it is doubtful that lacustrine habitat ever extended to the immediate vicinity of the project site.

Subsequent to the receipt of the results of the records search, an initial paleontological field reconnaissance of the entire project area was conducted by Dr. Geoffrey Spaulding. Dr. Spaulding is project paleontologist and has more than 30 years of field experience in the Mojave Desert of California and adjacent Nevada. This reconnaissance led to the determination that the only paleontologically sensitive area in the project vicinity is Ridge 1059, which was subsequently subject to a field inventory by Dr. Spaulding.

5.8.4.2 Results: Geology and Stratigraphy

The results of the paleontological records review and field survey are synthesized below. The available geological literature is sparse for this area, and detailed geologic mapping is limited to that of the surficial alluvial deposits (Schmidt and McMackin, 2006), at least in the vicinity of the project site. Further, a database review revealed that there were no records of paleontological sites in the project area, although this is unsurprising considering its remoteness. Field survey was, therefore, the primary means used to determine the nature of the geology and the paleontological sensitivity of the sediments and rock units in the vicinity of the project.

5.8.4.2.1 Rocks and Sediment Lacking or Unlikely To Yield Fossils.

Quartzite & Other Metamorphic Rocks. The set of hills located immediately northeast of the boundary of Ivanpah 2 (Figure 5.8-1) consists of metamorphic rocks and fine-grained quartzite unlikely to yield fossil remains (the quartzite units), or entirely devoid of fossils (the higher-grade metamorphic rocks present here).

Tertiary Fanglomerate. The limited exposure of Tertiary fanglomerate or metaconglomerate overlying the Paleozoic carbonate bedrock along the crest of Ridge 1059 closely resembles outcrops of the Horse Spring Formation in adjacent Clark County, Nevada (Longwell et al., 1965). Its setting is also similar. It is an older, well-indurated alluvium entrained by and upthrust along with its underlying bedrock. Although finer grained valley fill deposits of Tertiary age are known to yield fossils in the southern Great Basin, these coarse-grained fanglomerates are not know to yield fossil remains of any sort.

Quaternary Alluvium. As noted above, the great majority of the surface and subsurface of the Ivanpah SEGS project area consists of alluvium comprising the east bajada of Clark Mountains. This coarse, poorly sorted sediment rarely yields fossils, particularly on the upper portions of the bajada closer to the mountain front, as is the case with most of the Ivanpah SEGS area. The lack of paleontological sensitivity of this, and most alluvial deposits, is due to the fact that it is deposited subaerially (at or near the surface) as a result of high-energy depositional events, and although sedimentation of the fans is considered rapid from a geological perspective, in any one area it has not been sufficiently rapid to bury organic material to great depth before decomposition. Therefore, organic preservation is quite rare in these deposits, particularly in arid regions (for general discussions of lack of preserved organic material in geological contexts in desert environments see Wormington and Ellis, 1967; Betancourt et al., 1990; Bull, 1991). The only common exceptions to the rule that alluvium is of low paleontological sensitivity, are alluvial deposits that interdigitate with lacustrine or fluvial facies. These generally more fine-grained alluvial facies to do not occur in the vicinity of the project site; the closest favorable habitats being 2 to 3 miles to the east of Ivanpah 1 near the edge of the Ivanpah Dry Lake.

5.8.4.2.2 Potentially Fossiliferous Sediments & Fossil Deposits

Paleozoic Carbonate Rocks. Although the analyses and comparative studies needed to confidently assign the limestone of Ridge 1059 to a specific geological unit is beyond the scope of this study, it is clearly one of the Paleozoic carbonate units common in this part of the Basin and Range, and it possesses the attributes of the Bonanza King Formation. A thorough walk-over of the ridge and examination of the exposed strata in cross section as well as some in plan view, failed to reveal the presence of fossils. This is consistent with the Bonanza King in that while some Paleozoic carbonate sequences will have abundant invertebrate fossil faunas, this is often not the case for the Bonanza King Formation. Nevertheless, there are abundant burrows (ichnofossils) in the limestone attesting to the fact that at the time of deposition this sediment did host an invertebrate fauna. More intensive sampling and treatment of samples from Ridge 1059 in the laboratory can be expected to yield a suite of microfossils useful in determining the age and affinity of this rock unit, and therefore, useful in addressing geological and paleontological research questions (e.g., Montañez and Osleger, 1996)

Late Quaternary Packrat Middens. A common feature of limestone exposures in the region is that they often contain rock shelters and small caves that developed by groundwater solution of the rock before it was uplifted well above the water table. These cavities can be particularly common near the contacts between two strata of differing permeability to groundwater flow. At Ridge 1059 this appears to be the case because most rock shelters and small caves noted on this ridge are at the geological contact between the carbonate bedrock and the capping Tertiary fanglomerate. The shelters and caves that do not possess fissures or cracks in their ceiling and that, therefore, have an effective bedrock roof, can contain organic remains that are literally tens of thousands of years old, mummified as a consequence of the dry desert climate and shelter from the rare rainfall that occurs here (Betancourt et al., 1990). These are often indurated packrat middens, and those from limestone rock shelters elsewhere in the Mojave Desert have yielded rich paleobotanical and paleoecological records spanning the last 50,000 years (e.g., Spaulding, 1990). Several ancient packrat middens were located in the rock shelters and small caves of Ridge 1059.

5.8.4.3 Results: Paleontological Resources.

The paleontological resources records review conducted for this project at the San Bernardino County Museum as well as with current online tools (Appendix 5.8A) did not reveal previously recorded fossil sites within the footprint of the project site or its laterals, or within one mile of those. The closest known previously recorded fossil sites occur as close as 2 miles near the margin of Ivanpah Dry Lake. Although the faunal remains reported are not indicative of a paleontologically significant deposit, lake margin habitats have produced important paleontological remains in other intermountain basins (e.g., Waters, 1989). Regardless, due to the steep slope of the bajada upon which the project site is located, the closest lacustrine habitats suitable for fossil preservation would still have been more than a half-mile from the boundary of the project area. A paleolake in the Ivanpah Basin would have to have been more than 150 feet deep to reach the eastern edge of the project area, and available geological evidence (Section 5.8.3.1) suggests that any lake in the area did not attain a depth exceeding 70 feet. Therefore, no lacustrine sediments are expected in the project area, either near the surface or at depth below the surface.

5.8.4.3.1 Paleontological Sensitivity of Proterozoic and Paleozoic Rocks

The probable Proterozoic and Paleozoic rocks in the study area comprise the set of hills northeast of Ivanpah 2, and Ridge 1059 west of, and partially encompassed by, the western boundary of Ivanpah 3. Of these, the limestone of Ridge 1059 is of moderate sensitivity because of its potential to yield micropaleontological and geochronological information that would assist in answering some fundamental questions about the geological history of this area (e.g., Montañez and Osleger, 1996). There is no indication that the quartzite or metamorphic rock suite represented by the set of hills northeast of Ivanpah 2 is fossiliferous, and therefore, it is considered to possess low paleontological sensitivity.

5.8.4.3.2 Paleontological Sensitivity of Tertiary and Quaternary Sediments.

The different-age alluvial units recognized in the project area (Schmidt and McMackin, 2006) range in age from Early Pleistocene to Holocene. There is no record of these specific geologic units having yielded fossils, nor have alluvial deposits similar to these in other parts of the Mojave Desert yielded fossils. This applies to the older Tertiary fanglomerate or metaconglomerate capping Ridge 1059, as well as to the younger Quaternary alluvium underlying the majority of the Ivanpah SEGS project site. Therefore, they possess low paleontological sensitivity[2].

5.8.4.3.3 Paleontological Sensitivity of Late Quaternary Packrat Middens.

Although packrat or woodrat (*Neotoma* spp.) dens occur throughout the area, only those found in bedrock cavities can be expected to possess sufficient age to make them valuable to paleontological research, chiefly in the context of paleobotanical and paleoecological investigations. In the arid Mojave Desert these deposits can be preserved for tens of millennia (Spaulding, 1990), and they can yield tens of thousands of ideally preserved plant fragments as well as microvertebrate bones and insect exoskeleta (Betancourt et al., 1990). Early Holocene and Late Pleistocene middens, those older than about 8,000 years, typically contain the remains of plants that grow only in wetter habitats today.

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[2] Paleontologists hesitate to assign a "no sensitivity" rating to any sedimentary unit on the principal that if it is sedimentary, it may somewhere contain a significant paleontological record. That convention is followed here.

A four rock shelter sites in Ridge 1059 were found to contain middens that fit the criteria for sufficient age to be scientifically significant, and therefore, represent deposits possessing high paleontological sensitivity. At least one is extensive, representing organic deposits of 2 feet depth in some areas, and with lateral continuity of more than 10 feet. They have thick, convoluted weathering rinds and their interiors possess a distinctive red-brown color associated with midden deposits older than about 6,000 years in this region (Spaulding et al., 1990). One midden that was found beneath a large overhang at an undisclosed location on Ridge 1059 contains the remains of the following plants:

twigs-	*Juniperus* sp. (juniper or cedar)
leaf-	*Forsellesia nevadensis* (greasebush)
twig, fruit-	*Symphoricarpos longiflorus* (snowberry)
epidermis-	*Sphaeralcea* sp. (globemallow)

Of these plant species, only the globemallow occurs nearby in the modern desert scrub vegetation at the site. The other species, like the juniper, are typical of woodland that now occurs only at higher elevations. Colder and wetter conditions during the last glacial age, or pluvial, woodland occurred at this site. This is consistent with the established Late Pleistocene paleoecological record for the central Mojave Desert (Koehler et al., 2004). This deposit, and at least three other middens in different shelters developed in Ridge 1059, possesses high paleontological sensitivity. Packrat middens are nondescript dark masses usually found in the recesses of poorly lit caves and rock shelters, and escape the attention of most people. Consisting primarily of crystallized packrat urine and fecal pellets, they have little intrinsic appeal to vandals or "treasure hunters." Their paleontological significance nevertheless is high.

5.8.5 Environmental Analysis

The following subsections discuss potential effects on paleontological resources from construction and operation of the Ivanpah SEGS project.

5.8.5.1 Paleontological Resource Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. This assessment also includes the sensitivity category of moderate to address those circumstances where scientific potential is present, but an extensive fossil record is unlikely (such as the limestone of Ridge 1059).

The paleontological importance or sensitivity of a stratigraphic unit reflects: (1) its potential paleontological productivity (and thus sensitivity), and 2) the scientific significance of the fossils it has produced. The potential paleontological productivity of a stratigraphic unit exposed in a project area is based on the abundance of fossil specimens and/or previously recorded fossil sites in exposures of that unit in or near that project site. The underlying assumption of this assessment method is that exposures of a stratigraphic unit are most likely to yield fossil remains in quantity (and quality) similar to those previously recorded from that unit.

An individual fossil specimen is considered scientifically important and significant if it is: (1) identifiable, (2) complete, (3) well preserved, (4) age diagnostic, (5) useful in paleoenvironmental reconstruction, (6) a type or topotypic specimen, (7) a member of a rare species, (8) a species that is part of a diverse assemblage, and/or 9) a skeletal element different from, or a specimen more complete than, those now available for that species (SVP, 1995). For example, identifiable land mammal fossils are considered scientifically important because of their potential use in providing age determinations and paleoenvironmental reconstructions for the sediments in which they occur. Moreover, vertebrate remains are comparatively rare in the fossil record. Although fossil plants are less frequently considered to be significant fossils, as sessile (attached in place) organisms they are actually more sensitive indicators of their environment and, thus, more valuable than mobile mammals for paleoenvironmental reconstructions.

Under SVP (1995) standard guidelines, stratigraphic units in which fossils have been previously found are deemed to have a high sensitivity and a high potential to produce additional fossils. In areas of high sensitivity, full-time monitoring by a professionally trained paleontologist is recommended during any project ground disturbance. Stratigraphic units that are not sedimentary in origin or that have not been known to produce fossils in the past are deemed to have low or undetermined sensitivity and monitoring is usually not recommended nor needed during project construction in these units. Stratigraphic units that have not had any previous paleontological resource surveys or fossil finds are deemed undetermined until surveys and mapping are done to determine their sensitivity. After reconnaissance surveys, observation of exposed strata, and possibly subsurface testing, a qualified paleontologist can usually determine whether the stratigraphic unit should be categorized as having high, low, or undetermined sensitivity; that is, whether there is a high, low, or undetermined potential to encounter fossil resources during construction. In keeping with the significance criteria of the SVP (1995), all vertebrate fossils are categorized as being of significant scientific value and all stratigraphic units in which vertebrate fossils have previously been found have high sensitivity. According to SVP (1995) standard guidelines, 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, paleoecologic, or stratigraphic data.

Using the criteria of the SVP (1995), the significance of the potential adverse impacts of earth moving on the paleontological resources of each stratigraphic unit exposed in and near the project site was assessed, including the offsite laterals. The paleontological sensitivity of the stratigraphic unit in turn reflects the potential for fossil remains and fossil sites being encountered during earth moving. However, it should be noted that any impact on a fossil site or a fossil-bearing rock unit during construction would be considered significant, regardless of the previously determined paleontological importance of the rock unit in which the site or fossiliferous layer occurs. For example, grading in an area underlain by a rock unit with low sensitivity would have only a low potential to disturb fossil remains (i. e., the rock unit would have low sensitivity to adverse impacts). However, the loss of any fossil remains from that rock unit would be a significant impact.

5.8.5.2 Paleontological Resource Impact Assessment

No direct impacts to non-renewable paleontological resources would occur from construction or operation of the proposed Ivanpah SEGS or associated gas pipeline. Impacts to paleontological resources would not occur from construction-related excavations or other activities that would disturb low sensitivity Quaternary alluvium, which underlies the project site. Quaternary alluvium does not yield fossils other than the occasional Paleozoic invertebrate in a clast of carbonate rock from the surrounding mountains. Such remains are out of stratigraphic context and of minimal scientific significance.

The only area of moderate to high paleontological sensitivity in the project vicinity is the Ridge 1059 area, and because the configuration of the Ivanpah SEGS project area which avoids the ridge, no direct impacts will occur to the potentially fossiliferous limestone of ridge itself, or to the Quaternary-age packrat middens within shelters in the ridge. Indirect impacts are unlikely from this project, since the nature of the paleontological resources on the ridge would not attract the attention of the casual collector or vandal. Macrofossils are rare or absent in the limestone itself, and the ancient packrat middens are non-descript, obscurely placed, and of a composition that would not attract the casual collector or vandal.

5.8.5.3 Project Conformity

Development and implementation of these monitoring and mitigation measures will maintain conformity with the LORS identified in Section 8.5.2.

5.8.5.4 Significant Unavoidable Adverse Impacts

There are no impacts to sensitive paleontological resources resulting from construction or operation of the Ivanpah SEGS facility because all sensitive resources are avoided. Therefore, the proposed project would not cause significant unavoidable adverse impacts as defined by CEQA.

5.8.6 Cumulative Effects

A cumulative effect refers to a proposed project's incremental effect together with other closely related past, present, and reasonably foreseeable future projects whose impacts may compound or increase the incremental effect of the proposed project (Pub. Resources Code § 21083; Cal. Code Regs., Title 14, §§ 15064(h), 15065(c), 15130, and 15355). Cumulative projects are described in Section 5.6.7 and include the Desert Xpress Rail Line, improvements to Interstate 15, Las Vegas Valley Water District Pipeline, Southern Nevada Supplemental Airport (Ivanpah Valley Airport), and Table Mountain Wind Generating Facility. Although environmental analyses for most of these projects have not been completed at the time of preparation of this Application for Certification, standard mitigation measures exist to reduce impacts to paleontological resources to a less-than-significant level, and it is anticipated that impacts to paleontological resources from the cumulative projects, if any, would be mitigated to a less than significant level. The project is unlikely, therefore, to have impacts that would combine cumulatively with other closely related past, present, and reasonably foreseeable future projects.

5.8.7 Mitigation Measures

The Guidelines for the Implementation of CEQA (Public Resources Code Sections 15000 et seq.) include as one of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section XIV, Part a) the following: "Would the project directly or indirectly destroy a unique paleontological resource or site…?" Because no impacts to significant paleontological resources will result from construction or operation of the Ivanpah SEGS facility, mitigation measures are not necessary.

Excavations are highly unlikely to encounter fossil remains in the Quaternary alluvium that underlies the fossil site, but should such occur, mitigation measures will be developed that would be implemented to reduce potential adverse impacts to significant paleontological resources. These proposed paleontological resource mitigation measures would reduce to an insignificant level the direct, indirect, and cumulative adverse impacts to paleontological resources that would result from project construction. They would include the development of a paleontological resource monitoring and mitigation plan to include paleontological monitoring, discovery assessment and treatment procedures, and construction personnel education.

5.8.8 Involved Agencies and Agency Contacts

There are no state or local agencies having specific jurisdiction over paleontological resources. However, in San Bernardino County, the Division of Geological Sciences of the San Bernardino County Museum maintains an active paleontological resources mitigation program, and acts on behalf of the County on issues dealing with paleontological resources mitigation and management. The CEQA lead agency having specific responsibility to ensure that paleontological resources are protected in compliance with CEQA and other applicable statutes during construction of the Ivanpah SEGS facility 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. At the federal level, the Ivanpah SEGS project area is on land managed by the BLM and it is required to assure that its land management actions comply with the *Federal Land Policy Management Act* and the *National Environmental Policy Act*, including assessing impacts to scientifically important resources such as paleontological resources. For this area, the BLM contact for paleontological resources is the Needles Resource Area Archaeologist is provided in Table 5.8-2.

TABLE 5.8-2
Agency Contacts for Ivanpah SEGS Paleontological Resources

Issue	Agency	Contact
Preservation of Paleontological Resources	Bureau of Land Management	Mr. John Murray District Archaeologist Needles Field Office CA-690 Bureau of Land Management 1303 South Highway 95 Needles, CA 92363-4228 (760) 326-7014 email: John_R_Murray@ca.blm.gov

5.8.9 Permits Required and Permit Schedule

No state or local agency requires a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earth moving on private or public lands, except for federal lands. Removal of paleontological resources from federal lands requires a Paleontological Resource Use Permit from BLM. Because federal lands are involved in this project, a Fieldwork Authorization was also required for the field survey. The paleontological resources field survey for this assessment was carried out under BLM Fieldwork Authorization CA-690-07-08PALE. Because no paleontological resources will be affected by project construction or operation, no further permits pertaining to this resource will be required.

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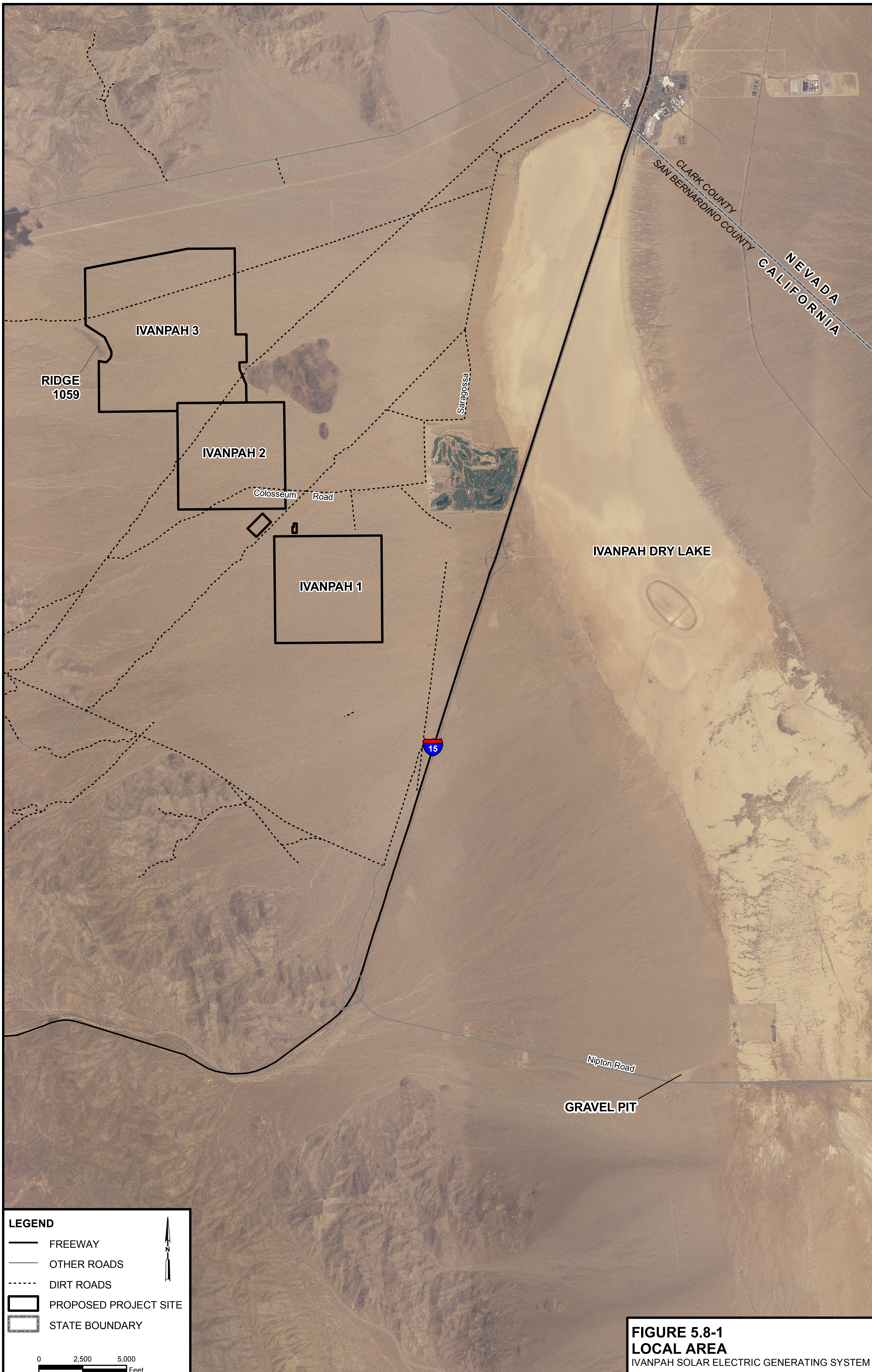

FIGURE 5.8-1
LOCAL AREA
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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