5.8 Paleontological Resources

5.8.1 Introduction

This section evaluates the potential effect to paleontological resources (fossils) from the construction and operation of the Carlsbad Energy Center Project (CECP). The project will be sited within the boundaries of the current Encina Power Station property (see Figure 5.8-1). The site would occupy the present locations of fuel oil tanks Nos. 5, 6, and 7 (Figure 5.8-1). These three tanks are being demolished as part of the current operations of the Encina Power Station.

This section considers the potential for sediments containing significant fossil remains to be within the area of potential effect from earth moving associated with construction of the CECP. Operation of the CECP will not involve further ground disturbing activities, and therefore no impacts to paleontological resources would occur during the operational phase of this project.

The project site is located on a small isthmus that projects northward into Agua Hedionda lagoon. To the northwest, north, and east the isthmus is bordered by Agua Hedionda. To the west and southwest it is bordered by the Pacific Ocean (Figure 5.8-1). In the case of the CECP, the offsite laterals do not extend onto other areas that have geology and paleontological potential that differ from the CECP site. They include connection to existing potable water, sewer, and natural gas lines, each about 1,100 feet long, and a new reclaimed water line, about 3,700 feet long, all between Agua Hedionda and the ocean (Figure 5.8-1).

This section of the AFC meets all requirements of the California Energy Commission (CEC) (2000, 2007) and conforms with the recommendations of the Society of Vertebrate Paleontology (SVP, 1991; 1995; 1996) that address mitigating impacts to paleontological resources resulting from earth moving activities. This paleontological resources inventory and impact assessment was conducted by W. Geoffrey Spaulding, Ph.D. a senior paleontologist with CH2M HILL. Dr. Spaulding has advanced degrees in geology with emphases in paleobiology, and is a recognized expert on the glacial-age environments of the American West. He previously has completed paleontological resource surveys and prepared paleontological resource impact assessments in support of energy generation and other large construction projects in southern California, including a number of projects in San Diego County.

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 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 this 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 along San Diego County's prominent shoreline, which in many areas consists of cliffs of fossiliferous marine sedimentary rock.

Paleontological resources are non-renewable scientific resources and are protected by several federal and state statutes (California Office of Historic Preservation 1983; see also Marshall 1976, Fisk and Spencer 1994), most notably by the 1906 Federal Antiquities Act and other subsequent federal legislation and policies, and by State of California's environmental regulations (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts to paleontological resources have been established by the Society of Vertebrate Paleontology (1991, 1995, 1996). Design, construction, and operation of the CECP will be conducted in accordance with all laws, ordinances, regulations, and standards (LORS) applicable to paleontological resources in the context of this project. Federal, state, and local LORS applicable to paleontological resources are summarized in Table 5.8-1 and discussed briefly below, along with professional standards for paleontological resources assessment and impact mitigation.

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

LORS	Applicability	AFC Reference	Project Conformity
Antiquities Act of 1906	Not applicable – No federal land involved, or federal entitlement required	—	—
CEQA, Appendix G	Applicable – Fossil remains may be encountered by earth-moving activities	Sections 5.8.3, 5.8.4, and 5.8.6	Yes
Public Resources Code, Sections 5097.5/5097.9	Not applicable – Applies to state-owned land	—	—
San Diego County General Plan, Part X "Conservation Element"	Not applicable – County jurisdiction does not extend to this project's land.	—	—
San Diego County (2007) Guidelines for Determining Significance	Not applicable – County jurisdiction does not extend to this project	—	—
City of Carlsbad Cultural Resources Guidelines	Applicable – Cultural Resources Guidelines call for the assessment and mitigation of impacts to paleontological resources.	Sections 5.8.3, 5.8.4, and 5.8.6	Yes

AFC = Application for Certification

5.8.2.1 Federal LORS

Federal protection for significant paleontological resources would apply to CECP only if any construction or other related project impacts occur on federally owned or managed lands, or if a federal entitlement or other permit were required. Federal legislative protection for paleontological resources stems 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 addition, the National Environmental Policy Act of 1969 (United States

Code, section 4321 et seq.; 40 Code of Federal Regulations, section 1502.25), as amended, requires analysis of potential environmental impacts to important historic, cultural, and natural aspects of our national heritage.

5.8.2.2 State LORS

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of the California Environmental Quality Act (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 CEQA lead agency having jurisdiction over a project is responsible to insure that paleontological resources are protected in compliance with CEQA and other applicable statutes. The lead agency with the responsibility to insure that fossils are protected during

construction of the proposed CECP 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 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 statute would apply to the CECP only if any construction or other related project impacts occur on state owned or managed lands or if the state or a state agency were to obtain ownership of project lands during the term of the project license.

5.8.2.3 Local LORS

The City of Carlsbad (1990) Planning Department Cultural Resources Guidelines requires an evaluation of potential impacts to paleontological resources as part of its environmental review process pursuant to CEQA. Its Cultural Resource Guidelines identify a significant impact when, among other things, a planned action may affect an important site. A site is considered important when… "It is an archaeological, paleontological, botanical, geological, topographical, ecological, or geographical site which has the potential of yielding information of scientific value".

5.8.2.4 Professional Standards

The Society of Vertebrate Paleontology, an international organization of professional paleontologists, has established standard guidelines (SVP, 1991; 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 curation. Most practicing paleontologists in the nation adhere to the SVP's guidelines, and extend those to address other types of fossils of scientific significance, such as invertebrate fossils and paleobotanical specimens. Many federal and state regulatory agencies, including the CEC, have informally adopted the SVP standard guidelines.

5.8.3 Affected Environment

5.8.3.1 Physiographic Setting

The proposed CECP site lies on the south shore of Agua Hedionda Lagoon, the tidal estuary of Agua Hedionda Creek, on a relatively narrow spit of land immediately west of the I-5 corridor and immediately east of the shoreline of the Pacific Ocean, within the City of Carlsbad, San Diego County, California. As noted previously, all construction associated with this project will be restricted to the project site, which is currently devoted to industrial uses.

Fenneman (1931) originally termed this region the Lower Californian Physiographic Province and described its salient large-scale features as the north-south trending Peninsular Range to the east, the eroded granitic upland flanking it to the west, and a terraced coastal plain 18 to

26 miles wide bordering the Pacific Ocean. This area is now often referred to as the Peninsular Ranges Province, an area that characterized by the north-south trending Peninsular Ranges that extend into Mexico, physiographically distinct from the great rift occupied by the Salton Trough and Gulf of California immediately east of the ranges.

Approaching the north coast of San Diego County from the ocean, however, the mountains in the distance are often obscured and the most prominent topographic feature seen is the slightly elevated and deeply dissected coastal plain, formed by a series of broad mesas rising immediately behind the shoreline. The plain ascends to the east as a series of beach terraces or ridges as much as 3 miles wide (La Joie et al., 1991; Kennedy and Tan, 2005) with each representing a separate period of high sea level in the geologically recent past. Their height, often hundreds of feet above current sea level, reflects the relative age of their tectonic uplift; the higher the terrace, the older the surface. Superimposed upon the effects of uplift are quasi-cyclic variations in sea-level that reflect the glacial-interglacial climatic cycle, and that have been pronounced during the Middle and Late Pleistocene (Kennedy and Tan, 2005). For example, sea level rose more than 350 feet at the close of the last glacial age, between about 20,000 and 6,000 years ago (Bloom, 1983).

5.8.3.2 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the project area and surrounding lands, and to assess the potential paleontological productivity of the stratigraphic units that may be present, published as well as available unpublished geological and paleontological literature was reviewed. Sources included geological maps, satellite and aerial photography, technical and scientific reports, and assessments of existing conditions in relevant environmental documents. These tasks were conducted in compliance with CEC (2000, 2007) and Society of Vertebrate Paleontology (SVP, 1991; 1995) guidelines for assessing the importance of paleontological resources in areas potentially impacted by construction-related excavations.

Of particular utility are the paleontological site records search for the CECP conducted by the San Diego Natural History Museum (SDNHM) completed July 6, 2007 (Confidential Appendix 5.8A), a records search performed by the Los Angeles County Museum of Natural History (LACM) for the City of Carlsbad Desalination Project immediately adjacent to the CECP (McCloud, 2003; Figure 5.8-1), and the recent geological map of the area prepared by Kennedy and Tan (2005). A geotechnical investigation of the adjacent RSDP provided information on the subsurface of the area that is assumed to be generally applicable to the stratigraphy of the CECP site as well (Magorien, 2006). This was confirmed by a reconnaissance level paleontological survey conducted by the project paleontological resources specialist (PRS), Dr. Geoffrey Spaulding, on August 6, 2007. This field review included the CECP site, the area that encompasses the reclaimed water line route, and the subdued coastal bluff to the west of Coast Highway 1.

5.8.3.3 Resource Inventory Results

The history of sedimentation along the coastal San Diego region during the Cenozoic (the last 64 million years) has been governed by local tectonism as well as fluctuations in the global sea level. At times when the relative position of the land surface was below sea level, deposition of fossil bearing marine sediments occurred. Erosion occurred at other times

when the land surface was above sea level, and these periods are usually represented by gaps in the rock stratigraphic record, and less often by terrestrial sediments. The fossil-bearing rock units of coastal San Diego County date back to the Oligocene Epoch and represent major portions of the Tertiary and Quaternary geological records. Most of the exposed rock units near the coast were deposited in marine or estuarine environments, and are mantled with much thinner, and much younger stratigraphic sequences representing beach and near-shore terrestrial environments. They comprise ridges that are beveled very nearly flat on their tops into a series of marine terraces. These terraces are progressively older, higher, and more dissected with increasing distance from the shore.

5.8.3.3.1 Geological Units in the Vicinity

As a result of paleogeographic variations, as well as post-depositional variations in local geologic history, the stratigraphic units that are present vary from place to place along the coast. Those units that are present in southern San Diego County are not all present in North County. Not withstanding that variability, time-equivalent stratigraphic units may be found at different localities along the coast, representing different depositional basins in this tectonically and topographically complex region (e.g., the late Oligocene Sespe and Otay Formations of the Ventura and south San Diego areas, respectively).

Table 5.8-2 lists the geologic units that occur in North County San Diego and within about 3 miles of the CECP. This distance was chosen because it adequately encompasses the range of different rock unit present locally, and assists in understanding the geological context of the results of the paleontological records review.

TABLE 5.8-2
Geologic Units within about 3 miles of the CECP site

Map Symbol	Epoch and Name	Paleontological Potential	Mapped at or in Immediate Vicinity of CECP*
MzU	Undivided Mesozoic metamorphic rocks	Low to none	No
Tsa	Middle Eocene Santiago Formation	High	Yes
Td	Middle Eocene Del Mar Formation	High	No
Tt	Middle Eocene Torrey Sandstone	High	No
-	Early to Middle Pleistocene Bay Point Formation	High	No
Qvop	Very old Quaternary paralic deposits	Moderate	No
Qop	Old Quaternary paralic deposits	Moderate	Yes
Qoa	Middle to late Pleistocene alluvial flood plain deposits of arroyo floors	Moderate	No
Qya	Late Pleistocene & Holocene alluvial floodplain and beach deposits	Low	No
Qa	Recent alluvium	Low	No
Qaf	Artificial fill and previously disturbed sediment	None	Yes

* Kennedy and Tan (2005)

For the purpose of this assessment paleontological potential is the probability that a given rock unit will yield scientifically significant fossils based on its geologic history as well as the available fossil record.

Of the ten geologic units identified in the vicinity of the CECP (Table 5.8-2), only three occur at or in the immediate vicinity of the site (Kennedy and Tan, 2005): the Santiago Formation, its mantle of "old Quaternary surficial" (or paralic) deposits, and floodplain/beach deposits of Late Pleistocene and Holocene age.

5.8.3.4 Sediments Present at the Project Site

The geological units present in the project area that have the potential to yield fossils are a middle Tertiary marine sedimentary unit, and the overlying Quaternary terrace or paralic deposits (Table 5.8-2). In addition, artificial fill and previously disturbed sediment covers most of the project area to varying depths.

5.8.3.4.1 Santiago Formation

The entire project area is underlain at depth by Tertiary near-shore marine sediments assigned by Kennedy and Tan (2005) to the middle Eocene (about 38- to 48-million-years old) Santiago Formation. Exploratory borings in the vicinity of the RSDP show that the top of the Santiago Formation lies as deep as about 34 feet above mean sea level (amsl) to the east, and as shallow as about 23 feet amsl to the west closer to the ocean shore. Borings, as well as sediment exposed along the bluff bordering Agua Hedionda Lagoon, show that the Santiago Formation at this locality consists mainly of well indurated sandstone strata with interbedded layers and lenses of siltstone, claystone, and shale (Magorien, 2006). Greenish to light-yellowish-brown, fine- to medium-grained silty sandstone, and sandy claystone predominate, displaying varying amounts of secondary manganese and iron-staining on joint surfaces. The greenish lagoonal claystone and siltstone is often fossiliferous (Kennedy and Tan, 2005). Exposures of the top 5 to 10 feet of this unit along South Carlsbad State Beach, about 1,800 feet to the southwest of the CECP are weathered to a white color.

One fossil site has been recorded by the SDNHM in sediment mapped as the Santiago Formation within one mile of the CECP. Its location is shown on Confidential Figure 5.8A-1, filed separately under a request for confidentiality. Both the SDNHM (Appendix 5.8A) and the LACM (McCloud, 2003) report numerous fossil sites in the Santiago Formation father inland where there has been extensive recent development, in the vicinity of El Camino Real 1.5 to 2.5 miles to the east of the CECP. Fossils from these localities have included turtles (Testudinidae; Trionychidae), crocodile (Crocodilia), birds (Aves), and an array of land mammals demonstrating the importance of near-shore and terrestrial facies of this sedimentary unit. These land mammals include the extinct giant herbivorous brontothere (Brontotheriidae) and primitive rhinoceros (*Amynodon intermedius*), as well as moderate size herbivores such as the oreodont (*Leptoreodon leptolophus;* Merycoidodontidae) and camels (*Protylopus stocki*, *P. petersoni*). Microvertebrates include insectivores (*Proterixoides, Sespedectes*) and rodents (*Microparamys, Griphomys,* and *Eohaplomys*). Colbert (2006) describes a new genus of Eocene tapiroid, *Hesperaletes*, with fossil specimens from the Santaigo Formation. Marine facies of the Santiago Formation have yielded the fossils of bivalve and gastropod mollusks, sand dollars, and both bony and cartilaginous fish (Osteichthyes, Chondrichthyes). In Oceanside, less than 5 miles north and northeast of the CECP, fossil sites in the Santiago Formation include several where decapod crustaceans are unusually well represented. These include a very large species of ghost shrimp (*Callianassa* sp.). Swimmer crabs (Portunidae) are also common as well as at least one new species of mantis shrimp (Stomatopoda) (SDNHM, 2001). Santiago Formation sites have also yielded important vertebrate records such as that of the artiodactyl *Protoreodon walshi*

(Agriochoeridae) and *Tapocyon robustus*, a member of an extinct family of carnivores, the Miacidae.

5.8.3.4.2 Old Quaternary Paralic or Terrace Deposits

"Paralic" refers to a package of sediments that represent the continuum of coastal environments from surf zone to beach, estuarine, lagoon, and tidal marsh habitats; essentially the sedimentary expression of the range of habitats that exists on the actual continental margin. In the past these have been more commonly called terrace deposits since in this area they often mantle the relatively flat wave-cut terraces, and are usually thought to immediately postdate their incision. Thus, paralic deposits overlying beveled terrace surfaces, as they do in the vicinity of the project, almost always represent the regressive phases of an episode of higher sea level, describing a trend from near-shore marine to continental deposits with decreasing depth and age.

Paralic sediment forms a blanket-like deposit across much of the project area, except where deeper excavations have removed it. Prior investigations to the immediate south and west at the RSDP site indicate that the sediment overlying the surface of the Santiago Formation attains a maximum thickness of about 22 to 28 feet. These deposits are discontinuously exposed along the heavily vegetated natural slope bordering Agua Hedionda Lagoon, as well as along the face of the slope leading down to the beach ca. 1,800 feet to the southwest of the CECP. The uppermost portions are well exposed by the cut slopes on either side of the North County Transportation District Railroad tracks. Geotechnical borings for the RSDP demonstrated the presence of two units; a 9-11 foot thick upper unit consisting of yellowish-brown to brown silty sand. The deeper unit immediately above the terrace surface consists of mottled olive yellow to brown poorly graded, fine- to medium-grained sand with silt (Magorien, 2006). As exposed above the beach, the lower unit appears to be of near-shore marine sands, while the upper unit may represent terrestrial sediment.

La Joie et al. (1991, Figure 31) map two "relict beach ridges" in the immediate project vicinity, one at about the location of the current I-5 right-of-way, and the other immediately west of the NCTD right-of-way (Figure 5.8-1). A third, more discontinuous beach ridge is mapped as occurring immediately in-board of the current shoreline. This latter is presumably the youngest and is also the least well-exposed here. It may be equivalent to the "latest-most Pleistocene… marine terrace surface and associated non-marine soil deposits" observed by Magorien (2006, p. 11) on the margin of Aqua Hedionda. However, given that sea level did not return to near its current elevation until well into the middle Holocene (e.g. Bloom, 1983), it is possible that this youngest feature is post-Pleistocene in age and reflects some post-Pleistocene uplift.

The CECP area occupies the marine terrace that has been named the Nestor terrace, and its formation is securely dated to the last interglaciation, approximately 118 to 120 thousand years ago (ka) (La Joie et al., 1991). Kennedy and Tan (2005) have mapped the surface deposits of this part of the Nestor terrace as undifferentiated ("$Qop_{6/7}$") Late to Middle Pleistocene paralic deposits. Unit Qop_7 is defined by them (Kennedy and Tan, 2005) as mantling the 30 to 36 feet amsl Bird Rock terrace, and Qop_6 mantles the 72 to 75 feet amsl Nestor terrace. As noted above the Nestor surface dates to about 120 ka, while the Bird Rock surface is assigned a middle Wisconsin interstadial age of about 45 ka. It is possible that the two subsurface units described by Magorien (2006) and visible on the current beach bluff

are the chronostratigraphic equivalents of these surfaces, with the lower and older dating to the last interglaciation.

By their very nature, paralic deposits are quite heterogenous in contrast to most older Tertiary strata which generally display less spatial variation in lithology and paleontological potential. Fine grained facies of paralic deposits, especially those deposited in logoonal, estuarine, or fluvial environments can be expected to yield paleontological materials based on the records review from the SDNHM, as well as at least one recent, well publicized finds (North County Times, 2007). Pleistocene fauna from Quaternary paralic or terrace deposits include both mammoth (*Mammuthus*) and mastodon (*Mammut americanum*), the extinct North American camel (*Camelops hesternus*) and horse (*Equus* spp.), as well as a diverse invertebrate and vertebrate fauna from the marine facies.

5.8.3.4.3 Artificial Fill and Previously Disturbed Sediment

Construction of the Encina Power Station, the NCTD railroad, and other facilities and infrastructure within the boundaries of the CECP, and in the immediate vicinity, has left varying depths of fill in the area. On the northern-most part of the project area, fill exceeding a depth of 4 feet was observed during the field reconnaissance. In contrast, in most other areas fill and previously disturbed sediment appears to be less than a foot or two in thickness. This shallow depth of fill is also found in the geotechnical investigations for the adjacent RSDP (Magorien, 2006).

Artificial fill and previously disturbed sediment would not have fossils in stratigraphic context. Most fossils would be destroyed by the mechanical equipment used in excavation, mixing, and spreading. Therefore, this sediment has no paleontological potential.

5.8.3.5 Paleontological Sensitivity of the Project Site

Paleontological sensitivity is the 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 be germane. According to SVP (1995) standard guidelines and San Diego County (2007) specific guidelines, sensitivity comprises both (1) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical, and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data.

In the San Diego area sensitivity ratings have been standardized (San Diego County, 2007), and they are applied here because the same suite of Tertiary marine and Quaternary deposits lies beneath the CECP (Table 5.8-3).

TABLE 5.8-3
Paleontological Sensitivity Ratings Employed

	Definition
High	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	Stratigraphic units that have yielded fossils that are but 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	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.
Marginal and Zero	Stratigraphic units with marginal potential include pyroclastic flows and soils that might preserve traces or casts of plants or animals. Most igneous rocks, however, 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. Manmade fill is also considered to possess zero (no) paleontological potential.

Source: adopted from San Diego County, 2007

As noted above, within one mile of the project area there is a limited suite of geological units present. Their paleontological sensitivity and relationship to the project is described summarized below.

5.8.3.5.1 Middle Tertiary Sediments

Lying at depths exceeding approximately 25 feet in the vicinity of the CECP, the "bedrock" of the project area is mapped as the Santiago Formation of middle Eocene age. The records review indicates that the one paleontological site that occurs within one mile of the CECP (Confidential Figure 5.8A-1), in what has been mapped as the Santiago Formation, may instead be of late Oligocene age and relate to an entirely different fossiliferous Tertiary sedimentary formation.

Based on the fact that Middle Tertiary units in this area have yielded scientifically significant fossils in the past (e.g. Woodburne, 2004), and that additional fossils may provide scientifically significant records that would assist in understand not only the paleobiology of this area but also its geological history, the middle Tertiary sediments mapped as the Santiago Formation beneath the CECP possess "high" paleontological sensitivity.

5.8.3.5.2 Quaternary Terrace Deposits

The paralic sediments comprising the mantle of the terrace cut onto the top of the Santiago Formation can be expected to have facies with both high and low paleontological potential. Fine-grained facies deposited in a shallow marine, estuarine, or fluvial environment have moderate to high paleontological sensitivity. Coarse-grained facies representing energetic environments, or soil zones where chemical alternation can be intense, can be expected to

have low potential. These terrace deposits nevertheless have yielded scientifically significant fossils in the Carlsbad area.

Although no fossils records are known from the Quaternary sediments that lie immediately beneath surface in the CECP area, similar sediments of somewhat greater age have yielded scientifically significant fossil records in the Carlsbad area (Confidential Figure 5.8A-1; Confidential Appendix 5.8A). The locally unproven but strong potential for this unit to yield fossils (Table 5.8-3) is basis to assign this unit a "moderate" sensitivity rating.

5.8.3.5.3 Artificial Fill and Previously Disturbed Sediment

This material has no potential to yield scientifically important materials, and therefore possesses no paleontological sensitivity (Table 5.8-3)

5.8.4 Environmental Analysis

The environmental impacts on paleontological resources from both construction and operation of the CECP 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 to paleontological resources, the SVP (1995) notes that 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, or (9) 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. For marine sediments, invertebrate fossils, including marine microfossils, are scientifically important for the same reasons that land mammal and/or land plant fossils are valuable in terrestrial deposits. 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 County (San Diego County, 2007) and the sensitivity ratings provided in Section 5.8.3.4, the significance of potentially adverse 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 or moderate sensitivity would be considered significant.

5.8.4.2 Paleontological Resource Impact Assessment

The significance of potential adverse impacts of project-related activities on the paleontological resources of each stratigraphic unit anticipated to be present at the project site is presented in this section. This assessment includes the entirety of the CECP area.

- **Artificial Fill and Previously Disturbed Sediment –** Construction-related excavations within artificial fill will not result in any adverse impacts to paleontological resources. Reworked and disturbed fossil material may be present in the artificial fill and previously disturbed sediment, but lack of stratigraphic context and likely mechanical damage would compromise all scientific values. This would apply to all excavations within 2 feet of current ground surface.
- **Quaternary Terrace Deposits –** Excavations including drilling and trenching extending to depths below 2 feet are likely to affect Quaternary-age paralic deposits. This unit has moderate paleontological sensitivity; fine-grained facies could yield significant fossil resources. Uncontrolled excavation affecting identifiable and *in situ* fossils potentially present at depth in this unit would be an adverse impact.
- **Middle Tertiary Sediments –** Uncontrolled excavations of this geological unit would result in adverse effects to sensitive paleontological resources. Significant fossil finds have been made in this unit, and additional specimens could contribute important information on the chronostratigraphy and paleobiology of this region.

Impacts to paleontological resources would occur from subsurface excavations associated with construction of the CECP and its linear interconnections. No impacts to paleontological resources are expected to occur from the operation of the CECP.

5.8.5 Cumulative Effects

Widespread recent development in San Diego County has resulted in proportionately extensive impacts to paleontological resources, and this is anticipated to continue (San Diego County, 2007). The extensive nature of these cumulative impacts is due to this extensive development combined with the widespread presence of a number of fossiliferous sedimentary units in the area (San Diego County, 2007). However, mitigation measures typically implemented pursuant to State, County, and City statutes (See Section 5.8.2) serve to mitigate these impacts through the recovery of the scientific and educational potential of the affected paleontological resources. The widespread application of paleontological monitoring and mitigation measures in San Diego County (San Diego County, 2007; SDNHM, 2006a) therefore mitigate the cumulative as well as direct impacts of continued development.

The potential contribution to cumulative impacts to paleontological resources from project-related ground disturbance would be appreciable, given the probability of encountering these resources, in the absence of mitigation. Thus, the proposed project would contribute measurably to cumulative negative impacts to paleontological resources in the absence of mitigation. With the mitigation described below, however, the contribution of the CECP to cumulative negative impacts to paleontological resources would be negligible. Moreover, the application of controlled scientific recovery methods to discovered paleontological resources is typically thought of constituting a beneficial impact to the extent that new scientific specimens and knowledge are generated. In an area such as San Diego County where there measures are typically applied, then cumulative beneficial impacts accrue (e.g. SDNHM, 2006b) to which this project may also contribute.

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 affirmative based on the data and considerations provided above. Because construction of the CECP may have potential adverse impacts on significant paleontological resources, mitigation measures are necessary.

This section describes Applicant-proposed mitigation measures that would be implemented to reduce potential adverse impacts to significant paleontological resources resulting from project construction. These proposed paleontological resource impact mitigation measures would 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 for the CECP are in compliance with CEC environmental guidelines (CEC, 2000; 2007) and with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP, 1991; 1995; 1996).

5.8.6.1 Paleontological Resources Monitoring and Mitigation Program

A Paleontological Resources Monitoring and Mitigation Program (PRMMP) will be developed for review and approval by the CEC prior to implementation. The PRMMP will include: construction monitoring and coordination; emergency discovery procedures; sampling and data recovery, if needed; 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 should construction activities be restricted to previously disturbed fill, and to adjust monitoring protocols based on updated evaluations of sensitivity subsequent to initial excavations.

5.8.6.1.1 Paleontological Monitoring

Prior to construction, a qualified paleontologist will be retained as project PRS to design and implement a monitoring program during project-related earth-moving activities. Prior to construction, the paleontologist will review excavation plans to determine whether 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. Monitoring will not be conducted in areas where the ground will not be disturbed.

5.8.6.1.2 Construction Personnel Education

Prior to working on the site for the first time, all personnel involved in earth-moving activities will be provided with Paleontological Resources Awareness Training. This training would ideally be provided as a module in their worker environmental awareness training. They will be informed that fossils may be encountered, provided with information on the appearance of fossils, the role of paleontological monitors, and on proper notification procedures. This worker training will be prepared and initially presented by a qualified

paleontologist. Subsequent training may be conducted using recorded and hard copy training materials.

Implementation of these mitigation measures would 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.

5.8.6.2 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 CECP.

5.8.7 Proposed Conditions of Certification

While the potential impacts to paleontological resources at the CECP site are less than significant, the following conditions of certification are proposed for the CECP by the Applicant to ensure impacts remain below a level of significance.

5.8.7.1 PAL-1—Paleontological Resources Specialist

At least 90 days prior to ground-breaking, the Applicant shall provide the CPM with a resume detailing the qualifications of its PRS and Paleontological Resource Monitors (PRMs) for review and approval. If the approved PRS or one of the PRMs is replaced prior to completion of project mitigation and report, the Applicant shall obtain CPM approval of the replacement.

The resume shall demonstrate to the satisfaction of the CPM the appropriate paleontological education and experience to accomplish the required paleontological resource tasks.

As determined by the CPM, the PRS shall meet the minimum qualifications for a paleontologist. The experience of the PRS shall include the following:

1. Institutional affiliations or appropriate credentials and college degrees;
2. Ability to recognize and recover fossils in the field;
3. Geological and biostratigraphic expertise;
4. Proficiency in identifying vertebrate and invertebrate fossils;

5. Publications in scientific journals; and
6. At least three years of paleontological resource mitigation and field experience in California, and at least one year of experience leading paleontological resource mitigation and field activities.

Under direction of the PRS the project owner shall obtain qualified PRMs to monitor as necessary on the project. PRMs shall have the equivalent of the following qualifications:

1. BS or BA degree in geology or paleontology, or biology and one year experience monitoring in California; or
2. AS or AA in geology, paleontology, or biology and four years experience monitoring in California; or
3. Enrollment in upper division classes pursuing a degree in the fields of geology or paleontology and two years of monitoring experience in California; or
4. Enrollment in a graduate program pursuing a degree in paleobiology or paleontology, and a BS or BA degree in geology or paleontology.

Verification:

1. At least 60 days prior to the start of ground disturbance, the CPM shall provide confirmation that the PRS's resume is adequate (or not), and the Applicant will respond within one week with a statement of availability of its designated PRS for onsite work.
2. At least 20 days prior to ground disturbance, the PRS or Applicant shall provide a letter with resumes naming anticipated monitors for the project and stating that the identified monitors meet the minimum qualifications for paleontological resource monitoring required by the condition. If additional monitors are obtained during the project, the PRS shall provide additional letters and resumes to the CPM for approval. The letter shall be provided to the CPM no later than one week prior to the monitor beginning onsite duties.
3. Prior to the termination or release of a PRS, the Applicant shall submit the resume of the proposed new PRS to the CPM for review and approval.

5.8.7.2 PAL-2—Maps and Drawings

The Applicant shall provide to the PRS and the CPM maps and drawings showing the footprints of the power plant and all linear facilities. Maps shall identify all areas of the project where ground disturbance is anticipated. If the PRS requests enlargements or strip maps for linear facility routes, the Applicant shall provide copies to the PRS and CPM. The site grading plan and the plan and profile drawings for the utility lines would normally be acceptable for this purpose. The plan drawings should show the location, depth, and extent of all ground disturbances and can be 1 inch = 40 feet to 1 inch = 100 feet range. If the footprint of the power plant or linear facility changes, the Applicant shall provide maps and drawings reflecting these changes to the PRS and CPM.

If construction of the project will proceed in phases, maps, and drawings may be submitted prior to the start of each phase. A letter identifying the proposed schedule of each project phase shall be provided to the PRS and CPM. Prior to work commencing on affected phases,

the project owner shall notify the PRS and CPM of any construction phase scheduling changes.

At a minimum, the PRS shall consult weekly with the project superintendent or construction field manager to confirm area(s) to be worked during the next week, until ground disturbance is completed.

Verification:

1. At least 30 days prior to the start of ground disturbance, the Applicant shall provide the maps and drawings.
2. If there are changes to the footprint of the project, revised maps and drawings shall be provided at least 15 days prior to the start of ground disturbance.
3. If there are changes to the scheduling of the construction phases, the Applicant shall submit a letter to the CPM within 5 days of identifying the changes.

5.8.7.3 PAL-3—Paleontological Resources Monitoring and Mitigation Plan

At least 60 days prior to ground-breaking, the PRS shall prepare, and the Applicant shall submit to the CPM for review and approval, a PRMMP to identify general and specific measures to minimize potential impacts to significant paleontological resources. Approval and subsequent implementation of the PRMMP by the CPM shall occur prior to any ground disturbance. The PRMMP shall function as the formal guide for monitoring, collecting, and sampling activities and may be modified by the PRS with CPM approval.

This document shall be used as a basis for discussion in the event that onsite decisions or changes are proposed. Copies of the PRMMP shall reside with the PRS, each monitor, the project owner's onsite manager, and the CPM.

The PRMMP shall be developed in accordance with the guidelines of the Society of the Vertebrate Paleontologists (SVP, 1995) and shall include, but not be limited to, the following:

1. Stipulations that the performance and sequence of project-related tasks, such as any literature searches, pre-construction surveys, worker environmental training, fieldwork, flagging or staking; construction monitoring; mapping and data recovery; fossil preparation and recovery; identification and inventory; preparation of final reports; and transmittal of materials for curation shall be performed according to the PRMMP procedures;
2. Identification of the person(s) expected to assist with each of the tasks identified within the PRMMP and all conditions for certification;
3. A thorough discussion of the anticipated geologic units expected to be encountered, the location and depth of the units relative to the project when known, and the known sensitivity of those units based on the occurrence of fossils either in that unit or in correlative units;
4. An explanation of why, how, and how much sampling is expected to take place and in what units. Include descriptions of different sampling procedures that shall be used for fine-grained and coarse-grained beds;

5. A discussion of the locations of where the monitoring of project construction activities is deemed necessary, and a proposed schedule for the monitoring;
6. A discussion of the procedures to be followed in the event of a significant fossil discovery, including notifications;
7. A discussion of equipment and supplies necessary for recovery of fossil materials and any specialized equipment needed to prepare, remove, load, transport, and analyze large-sized fossils or extensive fossil deposits;
8. Procedures for inventory, preparation, and delivery for curation into a retrievable storage collection in a public repository or museum, which meets the Society of Vertebrate Paleontologists standards and requirements for the curation of paleontological resources; and
9. Identification of the institution(s) that will be approached to receive any data and fossil materials that may be recovered, requirements or specifications for materials delivered for curation and how they will be met, and the name and phone number of the contact person at the institution(s); and,
10. A copy of the paleontological conditions of certification.

Verification: At least thirty (30) days prior to ground disturbance, the Applicant shall provide a copy of the PRMMP to the CPM. The PRMMP shall include an affidavit of authorship by the PRS, and acceptance of the project applicant evidenced by a signature.

5.8.7.4 PAL-4—Employee Awareness Training Program

Prior to ground disturbance and for the duration of construction, the Applicant and the PRS shall prepare and conduct CPM-approved training for all project managers, construction supervisors and workers who operate ground disturbing equipment or tools. Workers to be involved in ground disturbing activities in sensitive units shall not operate equipment prior to receiving worker training. The training program may be combined with other training programs prepared for cultural and biological resources, hazardous materials, or any other areas of interest or concern.

The Paleontological Resources Module of the Worker Environmental Awareness Program (WEAP) shall address the potential to encounter paleontological resources in the field, the sensitivity and importance of these resources, and the legal obligations to preserve and protect such resources. Training shall be provided for each new employee involved with ground disturbing activities. The in-person training shall before a new-hire begins work. Video-taped training modules are acceptable as long as they are reviewed and approved by the PRS. Provisions will be made to provide the WEAP training to workers not fluent in English.

The Paleontological Resources training shall include:

1. A discussion of applicable laws and penalties under the law designed to protect fossil resources;

2. The PRS shall provide good quality photographs or physical examples of fossils that may be expected in the area, and general descriptions of the stratigraphic units which may contain fossils;
3. Information that the PRS or PRM has the authority to halt or redirect construction in the event of, and in proximity to a discovery, or unanticipated impact to a paleontological resource;
4. Instruction that, should they encounter known or suspected fossils, employees are to halt or redirect work in the vicinity of a find and to contact their supervisor and the PRS or PRM;
5. An informational brochure that identifies reporting procedures in the event of a discovery;
6. A Certification of Completion of WEAP form signed by each worker indicating that they have received the training; and
7. A sticker that shall be placed on hard hats indicating that environmental training has been completed.

Verification:

1. At least 30 days prior to ground disturbance, the Applicant shall submit the proposed WEAP including the brochure with the set of reporting procedures the workers are to follow.
2. At least 30 days prior to ground disturbance, the Applicant shall submit the script and final video to the CPM for approval if the project owner is planning on using a video for interim training.
3. If an alternate paleontological trainer is requested by the Applicant, the resume and qualifications of the trainer shall be submitted to the CPM for review and approval. Alternate trainers shall not conduct training prior to CPM authorization.
4. The Applicant shall provide in the Monthly Compliance Report the WEAP copies of the Certification of Completion forms with the names of those trained and the trainer for each training offered that month. The Monthly Compliance Report shall also include a running total of all persons who have completed the training to date.

5.8.7.5 PAL-5—Monitoring and Discoveries

The PRS and PRM(s) shall monitor consistent with the PRMMP, all construction related grading, excavation, trenching, and auguring in areas where potentially fossil bearing materials have been identified. In the event that the PRS determines full time monitoring is not necessary in locations that were identified as potentially fossil-bearing in the PRMMP, the PRS shall notify and seek the concurrence of the CPM.

The PRS and PRM(s) shall have the authority to halt or redirect construction if paleontological resources are encountered. The project owner shall ensure that there is no interference with monitoring activities unless directed by the PRS. Monitoring activities shall be conducted as follows:

1. Any change of monitoring different from the accepted schedule presented in the PRMMP shall be proposed in a letter from the PRS and the project owner to the CPM prior to the change in monitoring. The letter shall include the justification for the change in monitoring and submitted to the CPM for review and approval.
2. PRM(s) shall keep a daily log of monitoring of paleontological resource activities. The PRS may informally discuss paleontological resource monitoring and mitigation activities with the CPM at any time.
3. The PRS shall immediately notify the project owner and the CPM of any incidents of non-compliance with any paleontological resources conditions of certification. The PRS shall recommend corrective action to resolve the issues or achieve compliance with the conditions of certification.
4. For any significant paleontological resources encountered, either the project owner or the PRS shall notify the CPM immediately (no later than the following morning after the find, or Monday morning in the case of a weekend) of any halt of construction activities.

Verification: The PRS shall prepare a summary of the monitoring and other paleontological activities that will be placed in the Monthly Compliance Reports. The summary will include the name(s) of PRS or monitor(s) active during the month; general descriptions of training and construction activities and general locations of excavations, grading, etc. A section of the report will include the geologic units or subunits encountered; descriptions of sampling within each unit; and a list of fossils identified in the field. A final section of the report will address any issues or concerns about the project relating to paleontologic monitoring including any incidents of non-compliance and any changes to the monitoring plan that have been approved by the CPM. If no monitoring took place during the month, the PRS shall include a justification in summary as to why monitoring was not conducted.

5.8.7.6 PAL-6—Treatment of Discovered Resources

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

Verification: The Applicant shall maintain in their compliance file copies of signed contracts or agreements with the designated PRS and other qualified research specialists. The project owner shall maintain these files for a period of three years after completion and approval of the CPM-approved Paleontological Resources Report (PRR). The Applicant shall be responsible to pay curation fees for fossils collected and curated as a result of paleontological monitoring and mitigation.

5.8.7.7 PAL-7—Final Report

The Applicant shall ensure preparation of a PRR by the designated PRS. The PRR shall be prepared following completion of the ground disturbing activities. The PRR shall include an analysis of the recovered fossil materials and related information and submitted to the CPM for review and approval. The report shall include, but not be limited to, a description and inventory of recovered fossil materials; diagrams and photos showing the stratigraphic

context and the location of paleontological resources encountered; results of initial analysis; and a statement by the PRS that project impacts to paleontological resources have been mitigated.

Verification: Within ninety (90) days after completion of ground disturbing activities that, in the opinion of the PRS, have the potential to affect paleontologically sensitive sediments, the Applicant shall submit the Paleontological Resources Report under confidential cover.

5.8.8 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 light of San Diego County (2007) emphasis on paleontological resources significance and documentation, copies of the final paleontological resources documentation of no effect should be provided to the contacts listed in Table 5.8-4.

TABLE 5.8-4
Agency Contacts for Paleontological Resources

Issue	Agency	Contact
Paleontological Resources Documentation	County of San Diego 5201 Ruffin Road Suite B San Diego, CA 92123	Gary Pryor Director of Planning and Land Use (858) 694-2960 gary.pryor@sdcounty,ca.gov
Paleontological Resources Documentation	San Diego Natural History Museum 1788 El Prado Balboa Park San Diego, CA 92101	Dr. Thomas Deméré Department of PaleoServices (619) 255-0232 paleoservices@sdnhm.org
Qualifications of PRS; Paleontological Resources Documentation	City of Carlsbad 1635 Faraday Avenue Carlsbad, CA 92008-7314	Christer Westman Planning Department (760) 602-4600 http://www.carlsbadca.gov/contact us

5.8.9 Permits Required and Permit Schedule

No state, county, or city agency requires a paleontological collecting permit to allow for the recovery of fossil remains discovered as a result of construction-related earth moving on this project site.

5.8.10 References

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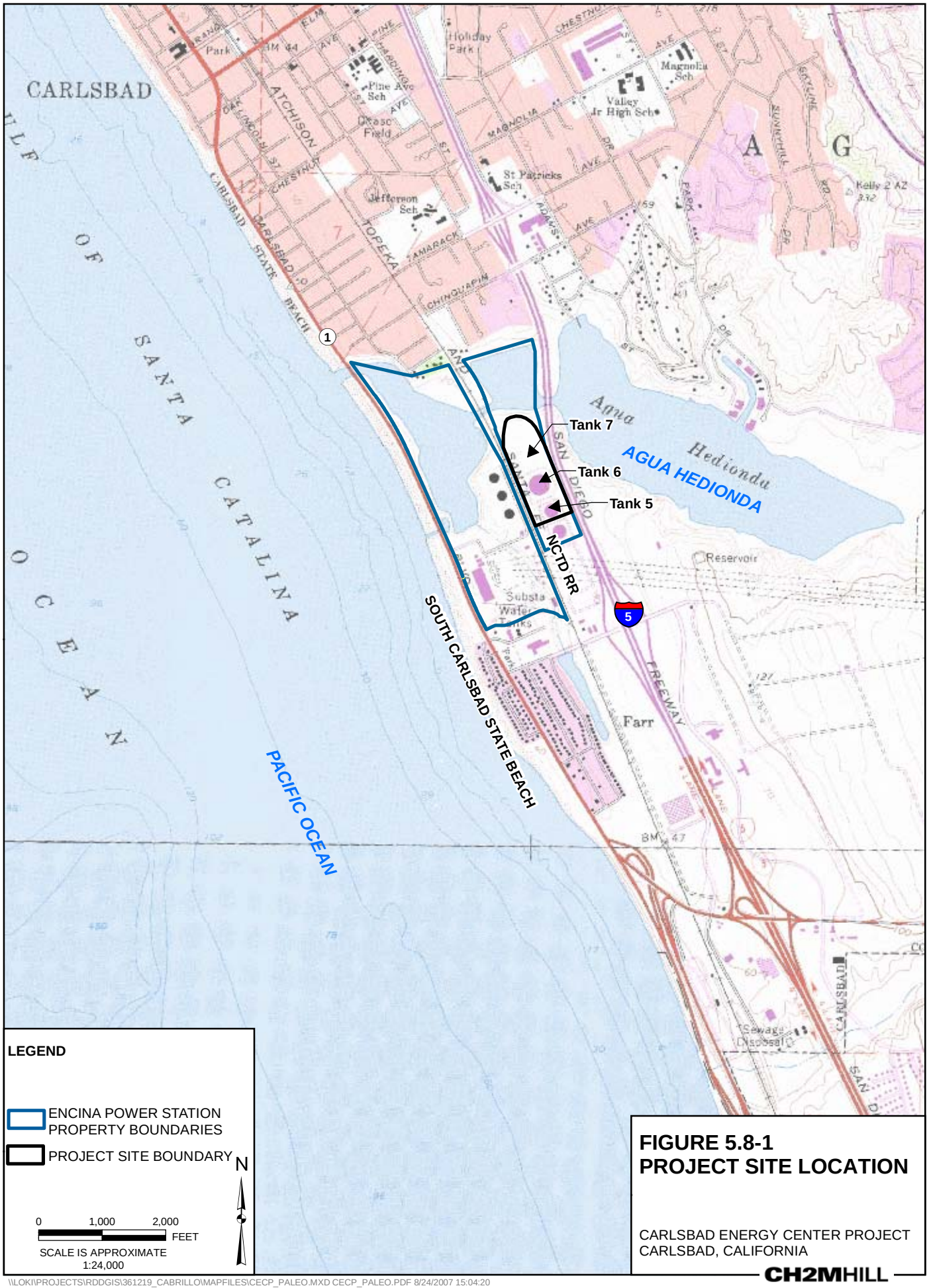

FIGURE 5.8-1
PROJECT SITE LOCATION

CARLSBAD ENERGY CENTER PROJECT
CARLSBAD, CALIFORNIA

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