8.8 PALEONTOLOGICAL RESOURCES

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. This section assesses the potential that earth-moving associated with construction of the proposed Russell City Energy Center (RCEC) and the Advanced Water Treatment (AWT) Plant would impact scientifically important fossil remains. Section 8.8.1 discusses the existing environmental setting. Section 8.8.2 discusses the environmental effects of construction and subsequent operation. Section 8.8.3 evaluates any cumulative impacts to paleontological resources due to other simultaneous projects. Section 8.8.4 includes any proposed mitigation measures during construction and operation. Section 8.8.5 presents applicable laws, ordinances, regulations and standards (LORS). Section 8.8.6 references agency contacts. Section 8.8.7 presents permit requirements and schedules. Section 8.8.8 contains a list of references cited.

The analysis presented in this section meets all requirements of the CEC (CEC 1999) and incorporates the Society of Vertebrate Paleontology (SVP 1995, 1996) standard measures for mitigating adverse construction-related environmental impacts on paleontological resources.

8.8.1 Affected Environment

8.8.1.1 Geographic Location and Physiographic Environment

The project area, including the RCEC and AWT plant site and the associated electrical transmission line, natural gas pipeline, water supply and wastewater return lines are located along the gently sloping southeastern shore of San Francisco Bay (Bay), which is centrally located within the Coast Ranges Physiographic Province, in west-central California. The Bay fills a north-northwest-trending structural depression in the central Coast Ranges and lies between the San Andreas Fault, to the southwest, and the Hayward Fault, to the northeast (see Section 8.4, Geology). The project area is bounded on the east by foothills of the Diablo Range, which is divided into two separate blocks, with the Berkeley Hills forming the western-most ridges. On the west and southwest, the project area is bounded by the Bay, and the sloughs and tidal channels of Alameda and Mt. Eden creeks.

The project area consists of a gently sloping alluvial fan and floodplain with an average elevation of only 10 to 15 feet above mean sea level (msl). The low alluvial fan and flood basins surrounding the Bay have frequently been referred to as the Bay plain (Robinson 1956). Technically, however, the Bay plain, as defined by Finlayson et al. (1967), is "that area surrounding San Francisco Bay which has an elevation between lower low tide and higher high tide." In other words, the Bay plain is intertidal and distinct from adjacent areas of higher relief which are not affected by tides. Some authors, however, have used the term Bay plain to include all that area that lies between the Bay tidal flats and the foothills of the Berkeley Hills.

There are two major physiographic units in the immediate project area: tidally influenced Bay plain, and the adjacent non-tidally influenced alluvial fans. The project facilities are on the Ward Creek alluvial fan. The Ward Creek alluvial fan is composed of stream-deposited sediments from Ward Creek, which exits the adjacent Berkeley Hills and flows to the bay. Additionally, the project area is just north of the margin of the Alameda Creek alluvial fan which is also referred to as the "Niles Cone" (Finlayson et al. 1967, 1968). In this section, the terms "Ward Creek alluvial fan," "Niles Cone" and "Alameda Creek alluvial fan" apply to all that area that lies between the Bay tidal flats and the foothills of the Berkeley Hills. The apex of the Ward Creek alluvial fan is at an elevation of less than 100 feet and the surface of the fan slopes gently westward at about 10 feet per mile and merges imperceptibly with the Bay plain. The distinction between the Bay plain and the alluvial fans, following Finlayson et al. (1967,1968), is easily made based on tidal influence. The north and south boundaries of the Ward Creek alluvial fan are marked by topographic lows which separate that alluvial fan from adjacent alluvial fans of Alameda Creek and San Lorenzo Creek with which it coalesces to the south and north, respectively. Small intermittent streams that empty into tidal sloughs drain the gently sloping Ward Creek alluvial fan, Niles Cone and Bay plain. The Ward Creek alluvial fan and Bay plain fill consist of medium- to fine-grained sediment, eroded primarily from sedimentary rocks in the adjacent Berkeley Hills. Poorly sorted, lenticular, alluvial sand, silt, gravel, and clay that range from Pleistocene to Recent in age underlie the Ward Creek alluvial fan and adjacent Bay plain on the east side of the Bay.

The project area is located entirely within Alameda County and primarily within the U.S. Geological Survey (USGS) Hayward and Newark Quadrangles (1:24,000).

8.8.1.2 Regional Geologic Setting

Project facilities will encounter one major geological formation: the Late Pleistocene-Early Holocene Temescal Formation. The proposed RCEC plant site, electrical transmission line, and the natural gas and water supply and discharge pipeline routes are located on unconsolidated, Holocene-age alluvial fan deposits, equivalent to Lawson's (1914) Temescal Formation, although that formation also includes Recent Bay mud and "salt-marsh deposits" (see also Trask and Rolston 1951, Atwater et al. 1977). Older, Pleistocene-aged alluvial fan and mud deposits called Alameda Formation underlay the Temescal formation at the project site, beginning at a depth of approximately 12-15 feet (see Atwater et al. 1977).

Lawson (1914) mapped a complex of Quaternary formations along the eastern shore of San Francisco Bay including, from oldest to youngest, the Alameda Formation, San Antonio Formation, Merritt Sand, and Temescal Formation. Later geological mapping (Helley et al. 1979, Dibblee 1980, Helley and Miller 1992) depicted geological facies, mapping units which reflect depositional processes, rather than Lawson's named formations, which are lithologically and chronologically distinctive units. Many of the units mapped by Helley et al. (1979) and Helley and Miller (1992) are gradational, with alluvial fans grading westward to alluvial plains, which grade imperceptibly into Bay muds. These facies subdivisions make it difficult to compare descriptions of fossil sites, which typically refer to named stratigraphic units.

Therefore, despite the fact that many engineering geologists and hydrogeologists prefer to use informal stratigraphic units such as "older Bay mud" and "younger Bay mud", the analysis presented in this AFC uses the formally named stratigraphic units of Lawson (1914). Lawson (1914), Trask and Rolston (1951), Treasher (1963), and Atwater et al. (1977) have all assigned various names to the sediments in the vicinity of the RCEC site and AWT plant (Table 8.8-1). Both the older and younger alluvial deposits show the normal distribution of sediment on an alluvial fan, grading westward through gradually decreasing grain sizes to clay-rich mud.

Table 8.8-1. Comparison of stratigraphic nomenclature for project area sediments.

Lawson (1914)	Trask and Rolston (1951)	Treasher (1963)	Atwater, et al. (1977)
Temescal Formation (secondary alluvium)	Bay mud	Younger Bay mud	Holocene Alluvial deposits
Merritt Sand	Merritt Sand	Sand deposits	Eolian deposits (late Pleistocene and Holocene)
San Antonio Formation	Posey Formation/San Antonio Formation	Older Bay mud	Alluvial deposits (late Pleistocene and Holocene)/Estuarine deposits (late Pleistocene)
Alameda Formation	Alameda Formation	Older Bay mud	Terrestrial and Estuarine deposits, undivided (Pliocene and Pleistocene)

Table 8.8-2 correlates these formations with modern mapping units. The Temescal Formation is the equivalent of the Holocene facies units. Similarly, the Alameda Formation is equivalent to the earlier Pleistocene facies units. The sediments that underlie the proposed RCEC plant site, including the AWT plant, electric transmission line, natural gas and water supply pipeline routes, and the Eastshore Substation are Temescal Formation units mapped by Helley and Miller (1992) Dibblee (1980), and Atwater (1977). The older Alameda Formation described by Lawson (1914) and Trask and Rolston (1951) is located below the San Antonio Formation. Atwater et al. (1977) mapped this facies as Qpht, beginning at a depth of approximately 12-15 feet below the proposed RCEC site. Since Lawson's (1914) marine Merritt Sand and underlying San Antonio Formation do not crop out in the vicinity of the RCEC, they are not listed in the table below.

Table 8.8-2. Correlation of Quaternary stratigraphic units in the project area.

Lawson (1914)	Atwater, et al. (1977)	Dibblee (1980)	Helley and Miller (1992)
Temescal Formation	Alluvial deposits (Qha) Estuarine deposits (Qhe)	Surficial deposits (Qa, Qls)	Alluvial fan and fluvial deposits (Holocene) (Qhaf)
Alameda Formation	Terrestrial deposits, undivided (Qpht)	Older alluvium unconformity (Qoa)	Alluvial fan deposits (Pleistocene) (Qpaf)

Temescal Formation

Lawson (1914) included within his Late Pleistocene and Holocene-age Temescal Formation alluvial deposits younger than and overlying the marine Merritt Sand. These younger alluvial deposits developed in part from the erosion and redeposition of older alluvium, composed of fragments of the Mesozoic and Tertiary rocks of the Berkeley Hills. Stratigraphic position, lithologic components, degree of consolidation, topographic expression, attitude (flat-lying or tilted), and fossil content can be used to distinguish the younger units from the older units. According to Savage (1951), Late Pleistocene and

Holocene Temescal sediments can often be distinguished from the older Pleistocene deposits by their relatively horizontal and uniform attitude. The older San Antonio Formation sediments are slightly tilted.

Alameda Formation

Lawson (1914) applied the name Alameda Formation to Pleistocene-age deposits of sandy clay, found immediately below the alluvial fans of the San Antonio Formation. Lawson determined this to be a Quaternary formation, generally of marine origin, that is several hundred feet thick. Parts of the Alameda formation may contain moderately firm sandy clay or silty clay up to 200 feet thick (Goldman 1969, Helley and Miller 1992). Pebbles in this formation are generally less than 1-inch in diameter and are of Franciscan origin. They also noted the presence of plant fragments at several horizons.

Fossil Content

The simple two-part subdivision of the alluvial fan deposits in the Ward Creek alluvial fan into the Temescal and San Antonio formations is supported by differences in fossil content, as well as stratigraphic superposition, topographic expression, and the presence or absence of deformation. From his survey of vertebrate faunas from the non-marine Quaternary deposits of the San Francisco Bay region, Savage (1951) concluded that only two divisions could be recognized. He named the earlier Pleistocene fauna the Irvingtonian and the later Pleistocene and Holocene fauna the Rancholabrean. As used in this report, the older San Antonio Formation is believed to be entirely Irvingtonian in age and the younger Temescal Formation is entirely Rancholabrean age.

At the project site, the Temescal Formation is underlain by undivided terrestrial deposits of Pleistocene and probably Pliocene age. The deposits unconformably overlie Mesozoic and Tertiary rocks. According to Atwater et al. (1977), these deposits correspond to the Alameda Formation as defined by Lawson (1914) and Trask and Rolston (1951).

8.8.1.3 Paleontological Resource Inventory Methods

A stratigraphic inventory and paleontological resource inventory were completed to develop a baseline paleontological resource inventory of the project site and surrounding area by rock unit, and to assess the potential paleontological productivity of each rock unit. Inventory methods included a review of published and unpublished literature and a cursory field survey. These tasks were in compliance with CEC (1999) and Society for Vertebrate Paleontology (SVP) (1995) guidelines.

Stratigraphic Inventory

Geological maps and reports covering the surficial geology of the project site and area were reviewed to determine the exposed rock units and to delineate their respective areal distributions in the project area.

Paleontological Resource Inventory

Published and unpublished geological and paleontological literature (including previous environmental impact review documents and paleontological resource impact mitigation program final reports) were reviewed to document the number and locations of previously recorded fossil sites from rock units exposed in and near the project site and surrounding area and the types of fossil remains each rock unit has produced. The literature review was supplemented by an archival search conducted at the University of California Museum of Paleontology in Berkeley, California on February 26, 2001.

Field Survey

The field reconnaissance was conducted on February 27, 2001, to document the presence of any previously unrecorded fossil sites and of strata that might contain fossil remains. The reconnaissance was limited to inspection of visible ground surface at the RCEC and AWT plant site. Ground surface visibility was nonexistent for the proposed gas pipeline, since the pipeline route runs underneath paved streets through mostly developed and urban areas. No exposures of potentially fossiliferous strata were observed in the project construction zone. A complete pedestrian survey of the entire project area of potential effect for paleontological resources was deemed unnecessary and no subsurface exploration was conducted. A more detailed survey was deemed unnecessary because the project site is located in a lowland, depositional environment consisting of Holocene alluvium located very near the early historic era bayland-bayshore saltmarsh boundary. Pleistocene deposit outcrops are unlikely in this area because of the lack of erosional features to expose older sediments beneath the Holocene sediments.

8.8.1.4 Paleontological Resource Assessment Criteria

The potential paleontological importance of the project area can be assessed by identifying the paleontological importance of exposed rock units within the project area. Since the areal distribution of a rock unit can be easily delineated on a topographic map, this method is conducive to delineating parts of the project that are of higher and lower sensitivity for paleontological resources and to delineating parts of the project that may therefore require monitoring during construction.

A paleontologically important rock unit is one that: (1) has a high potential paleontological productivity rating, and (2) is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at the project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site. However, well-developed and documented fossil-bearing formations are unlikely to yield a unique paleontological resource.

An individual vertebrate fossil specimen may be considered unique or significant if it meets the following criteria: 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 its species. For example, identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare. The value or importance of different fossil groups varies, depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions such as part of a research project. Marine invertebrates are generally common, well developed, and well documented. They would generally not be considered a unique paleontological resource.

The following tasks were completed to establish the paleontological importance of each rock unit exposed at or near the project site:

- The potential paleontological productivity of each rock unit exposed at the project site was assessed, based on the density of fossil remains previously documented within the rock unit.

- The potential for a rock unit exposed at the project site to contain a unique paleontological resource was considered.

8.8.1.5 Resource Inventory Results

Stratigraphic Inventory

This section begins with an overview of past efforts to map the surficial geology of the project region and attempts to correlate the various geologic units. This is followed by a description of the geologic units that outcrop in the immediate project vicinity.

Regional surficial geologic mapping of the project site and vicinity (1:125,000 or 1:500,000 scale) is provided by Goldman (1969), Finlayson et al. (1967), and Helley and Lajoie (1979). Atwater et al. (1977) created three separate 1:250,000 cross-sectional maps across the San Francisco Bay. Larger scale mapping of the project site (1:24,000 or 1:62,500 scale) is provided by Lawson (1914), Robinson (1956), Helley et al. (1979), Dibblee (1980), and Helley and Miller (1992).

Paleontological Resource Inventory and Assessment by Rock Unit

Mammalian fossils have been the most helpful in determining the relative age of the alluvial fan and Bay plain sedimentary deposits (Louderback 1951, Savage 1951). The mammalian inhabitants of the late Pleistocene and Holocene alluvial fan and floodplain included horses, mastodons, camels, ground sloths, and pronghorns.

Surveys of Late Cenozoic land mammal fossils have been provided by Hay (1927), Stirton (1939), Savage (1951), and Jefferson (1991b). On the basis of his survey of vertebrate fauna from the non-marine Late Cenozoic deposits of the San Francisco Bay region, Savage (1951) concluded that only two divisions of Pleistocene time could be recognized in the San Francisco Bay region. He named the earlier Pleistocene fauna the Irvingtonian and the later Pleistocene and Holocene fauna the Rancholabrean. The age of the later Pleistocene, Rancholabrean fauna was based on the presence of bison and on the presence of many mammalian species which are inhabitants of the same area today. In addition to bison, larger land mammals identified as part of the Rancholabrean fauna include mammoths, mastodons, camels, horses, and ground sloths.

No known vertebrate fossils or other paleontological resources are within the project Area of Potential Effect (APE). However, Pleistocene and Holocene vertebrate fossils have been reported from the general vicinity of the proposed RCEC plant site and related facilities, and the project area may therefore be considered an area of potential sensitivity for paleontological resources. A table providing the details of fossil remains, and a map showing the locations of these fossil sites, are provided in Appendix 8.8 (filed under a request for confidentiality).

Temescal Formation

Remains of land mammals have been found at a number of localities in younger alluvial deposits referable to the Temescal Formation (Hay 1927, Louderback 1951, Savage 1951; Jefferson 1991b). Jefferson (1991a,b) compiled a database of California Late Pleistocene (Rancholabrean North American Land Mammal Age) vertebrate fossils from published records, technical reports, unpublished manuscripts, information from colleagues, and inspection of museum paleontological collections at over 40 public and private institutions. He lists more than 50 individual sites in Alameda County that have yielded Rancholabrean vertebrate fossils, including several localities near the RCEC project area, studied by the University of California Museum of Paleontology (UCMP) in Berkeley, California. These fossils would presumably all be referable to the Temescal Formation, as used in this AFC section. In addition to UCMP localities, Jefferson (1991a, b) lists fossils localities from the Yale Peabody Museum, Chicago Field Museum of Natural History, and the U. S. National Museum.

The most common fossils reported from Rancholabrean-age alluvial sediments in the East Bay area are the remains of mammoths, bison, and horses. Helley and LaJoie (1979) and Atwater et al. (1977) noted that the Estuarine deposits (part of the Temescal Formation) locally also contain fresh water invertebrate fossils (gastropods and pelecypods). Helley and LaJoie (1979) note that alluvial deposits (also part of the Temescal Formation) locally contain aboriginal artifacts and skeletal remains. The age of these deposits apparently extends from latest Pleistocene to the Holocene. Lawson (1914) referred to the Temescal Formation as entirely Holocene in age, but Louderback (1951) believed that the bulk of this younger alluvium was Pleistocene in age. Based on the presence of fossil bison, Savage (1951) referred the younger alluvium to the Rancholabrean North American Land Mammal Age, which spans the boundary between Late Pleistocene and Early Holocene.

The closest vertebrate fossil to the RCEC is UCMP vertebrate fossil locality V-5258, located near Interstate 880 Freeway in the city of Hayward, approximately 2.75 miles north of the RCEC site. This site has yielded a bison fossil—a Rancholabrean land mammal. In addition, UCMP vertebrate fossil localities V-5928 and –6304, located approximately 3 miles northeast of the proposed RCEC site at near Mission Boulevard in Hayward, have produced horse fossils from Late Pleistocene gravels, which have been identified as Rancholabrean fauna referable to the Temescal Formation. Other Rancholabrean mammal remains found in Temescal Formations on the east side of San Francisco Bay include UCMP sites V-6420, -4045, -1051, -1052, -3613, -7073, -6533, -6644, -6227, -67194, and –2841. These sites have yielded fossil remains of mammoth, bison, camel, bear, horse, sea otter, tapir, merycoidodon, and ground sloth (precise locations found in Appendix Figure 8.8-1, filed separately under a request for confidentiality). In addition, Atwater et al. (1977) reported the presence of estuarine pelecypods, foraminifers, and seeds of the marsh plant *Salicornia* sp. from boreholes in San Francisco Bay, within three miles of the project site.

The occurrence of previously recorded fossil sites near the project site suggests that there is a potential for uncovering additional similar fossil remains during earth-moving activities related to construction of those areas of the project underlain by sediments of the Temescal Formation.

Alameda Formation

When naming the Alameda Formation, Lawson (1914) noted that this unit contained "marine shells". Trask and Rolston (1951) noted the presence of "plant fragments" in several horizons, particularly in the upper portions of the Alameda Formation. Atwater et al. (1977) reported sparse mollusks, foraminifers, ostracodes, and diatoms from boreholes in San Francisco Bay.

The Alameda Formation underlies the proposed RCEC site and is associated facilities at a depth of approximately 12-15 feet. Although no fossils have been reported from the site itself, marine fossils have been reported from boreholes in San Francisco Bay within 2 miles of the site. The presence of a number of previously recorded marine fossil sites near the project site suggests that there is a potential for uncovering additional similar fossil remains during earth-moving activities related to the RCEC construction if the excavation depth were to exceed approximately 10 feet. However, any identifiable fossil remains that may be recovered from the Alameda formation during project construction are not likely to be scientifically important because they have already been identified and dated by Atwater et al. (1977) and because coring anywhere in the vicinity would recover similar materials.

8.8.2 Environmental Consequences

The potential environmental effects from construction and operation of the RCEC and AWT plant on paleontological resources are presented in the following subsections.

8.8.2.1 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. Areas where fossils have been previously found are deemed to have a high sensitivity and a high potential to produce fossils. In areas of high sensitivity, full-time monitoring is typically recommended during any project ground disturbance. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past, typically are deemed to have low sensitivity and monitoring is usually not needed during project construction. Areas 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 cuts, and possibly sub-surface testing, a qualified paleontologist can determine whether the area should be categorized as having high, low, or undermined sensitivity. In keeping with the significance criteria of the SVP (1995), all vertebrate fossils are categorized as being of potential significant scientific value.

Appendix G of California Environmental Quality Act (CEQA) addresses significance criteria with respect to paleontological resources (Public Resources Code Sections 21000 et seq.). Appendix G(V)(c) asks if the project will "directly or indirectly destroy a unique paleontological resource or site or unique geologic feature."

Using both the criteria of the SVP (1995) and CEQA, outlined above, the significance of the potential adverse impacts of earth moving on the paleontological resources of each stratigraphic unit exposed in the project site construction zone was assessed. This assessment reflects the paleontological importance and impact sensitivity of the stratigraphic unit.

8.8.2.2 Construction

Potential impacts on paleontological resources resulting from the proposed RCEC and AWT plant can be divided into construction-related impacts and impacts related to plant operation. This section presents the potential adverse impacts on the paleontological resources resulting from construction of each portion of the project.

RCEC Plant Site

Construction-related impacts to paleontological resources primarily involve ground disturbance (excavations and drainage diversion measures).

The proposed RCEC site is situated on "Holocene Alluvial deposits" (Qha) equivalent to the Temescal Formation. The planned site filling and grading is not expected to result in significant adverse impacts to paleontological resources, as the ground surface in this area has already been greatly disturbed by construction of the existing metal painting company and radio towers. Neither are the supporting facilities, such as temporary construction offices, laydown areas, and parking areas, expected to have a significant adverse impact on resources, as they also are located on ground previously disturbed and will involve no significant ground disturbance.

The deepest excavation for power plant facilities will be approximately 18 feet below the existing ground surface (cooling tower pump bay). Other excavations will range in depth from 6 to 12 feet below the finished grade. The deep excavations at the power plant site will encounter sediments of the Temescal Formation, which are known to contain Rancholabrean-age vertebrate fossils in the general project vicinity. These excavations also have the potential to disturb sediments of the underlying Alameda Formation which may contain marine fossils. Thus, these deep excavations could cause impacts to paleontological resources in both stratigraphic units. However, only vertebrate fossils would be considered potentially significant because of their general rarity. Marine pelecypods, diatoms, and marine micro- and macrofauna would not be considered significant because Atwater et al. (1977) have already identified and dated these materials and because similar materials could be recovered by coring anywhere along the East Bay front. Implementation of the proposed mitigation measures will ensure that potentially significant paleontological resources are not affected.

Electric Transmission Line and Eastshore Substation Expansion—The electrical transmission lines will be located in a developed area; however, replacement of the existing lattice transmission towers with tubular steel towers will involve ground-disturbing activities in sediments of the Temescal Formation, which are known to contain Rancholabrean-age vertebrate fossils in the general project vicinity. Thus, these excavations could encounter to paleontological resources.

Natural Gas Pipeline—Installation of gas pipelines will occur in developed areas on previously disturbed ground; therefore, no significant adverse impacts to paleontological resources are expected.

Wastewater Return Pipeline—Installation of gas pipelines will occur in developed areas on previously disturbed ground; therefore, no significant adverse impacts to paleontological resources are expected.

AWT Plant

Impacts resulting from construction of the AWT plant will be similar to those from construction of the RCEC plant site. However, implementation of the proposed mitigation measures will ensure that potentially significant paleontological resources are not affected.

Construction Laydown and Worker Parking Areas

These areas occur on developed lands on previously disturbed ground; therefore, no significant adverse impacts to paleontological resources are expected.

8.8.2.3 Operation

No impacts on paleontological resources are expected to occur from the continuing operation of the RCEC AWT plant, or any of the related facilities because project operation will not involve significant ground disturbance.

8.8.3 Cumulative Impacts

If paleontological resources were encountered during the ground disturbance, the potential cumulative effect on paleontological resources would be low, as long as the mitigation measures proposed in Section 8.8.4 are implemented to recover the resources. When properly implemented, these mitigation measures would effectively recover the scientific value of significant fossils encountered during construction.

Thus, the proposed project will not cause or contribute to significant cumulative impacts to paleontological resources.

8.8.4 Proposed Mitigation Measures

This section describes measures proposed to reduce or mitigate potential project-related adverse impacts to significant paleontological resources.

- **Paleontological Mitigation Plan**—The paleontological resource mitigation program will include the preparation of a mitigation and monitoring plan for construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; preconstruction coordination; and reporting.
- **Paleontological Monitoring**—Prior to construction, Calpine/Bechtel will retain a qualified paleontologist to design and implement a mitigation program during project-related earth-moving activities for deep excavation at the power plant site, for deep boring for electrical transmission towers, and for construction of the water and natural gas pipelines. The paleontologist will conduct a limited field survey of exposures of sensitive stratigraphic units in areas that will be disturbed by earth moving.
- **Construction Personnel Education**—Prior to start of construction, construction personnel involved with earth-moving activities will be informed of the possibility of encountering fossils, and trained in identification of fossils and proper notification procedures. This worker training will be prepared and presented by the project paleontologist. The previously-trained construction personnel will monitor earth-moving construction activities where this activity will disturb previously undisturbed sediment. Monitoring will not take place in areas where the ground has been previously disturbed, in areas underlain by artificial fill, or in areas where exposed sediment will be buried but not otherwise disturbed.

Implementation of these mitigation measures will reduce the potentially significant adverse environmental impact of project earth-moving activities on paleontological resources to an insignificant level. These measures will allow for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data that otherwise might have been destroyed by construction and unauthorized fossil collecting.

8.8.5 Applicable Laws, Ordinances, Regulations, and Standards (LORS)

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal and state statutes, most notably by the 1906 Federal Antiquities Act and other subsequent federal legislation and policies and by the state of California's environmental regulations (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established for vertebrate fossils by the SVP (1995, 1996). Design, construction, and operation of the RCEC and AWT plant, including transmission lines, pipelines, and ancillary facilities, will be conducted in accordance with all LORS applicable to paleontological resources. Federal and state LORS applicable to paleontological resources are summarized in Table 8.8-3 and discussed briefly below, along with SVP professional standards.

8.8.5.1 Federal

Federal protection for significant paleontological resources would apply to the RCEC if any construction or other related project impacts were to take place on federally owned or managed lands. 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 land. The project currently does not cross such lands. Federal requirements would apply if a Federal agency were to obtain ownership of project lands during the term of the project license.

Table 8.8-3. Applicable LORS regarding paleontological resources.

LORS	Applicability	AFC Reference	Project Conformity
Antiquities Act of 1906	Protects paleontological resources from vandalism and unauthorized collecting on federal lands (currently no federal land)	Section 8.8.5	yes
CEQA, Appendix G	Fossil remains may be encountered by earth-moving activities	Section 8.8.4, Section 8.8.5	yes
Public Resources Code, Sections 5097.5/5097.9	Would apply only if some project land acquired by state (currently no state land)	Section 8.8.5	yes

8.8.5.2 State

The CEC environmental review process under the Warren-Alquist Act has been certified to be functionally equivalent to that of CEQA (Public Resources Code Sections 15000 et seq.) with respect to paleontological resources. CEQA's Appendix G (Public Resources Code Sections 21000 et seq.) lists among its significant effects when a project will "disrupt or adversely affect...a paleontological site except as part of a scientific study."

Other state requirements for paleontological resource management are in Public Resources Code Chapter 1.7, Section 5097.5, *Archaeological, Paleontological, and Historical Sites*. This statute specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources. It would apply to the RCEC only if the state or a state agency were to obtain ownership of project lands during the term of the project license.

8.8.5.3 County

Alameda County does not have LORS that specifically address potential adverse impacts to paleontological resources.

8.8.5.4 Professional Standards

The Society of Vertebrate Paleontology (SVP 1995, 1996), a national scientific organization of professional vertebrate paleontologists, has established standard guidelines that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, specimen preparation, analysis, and curation. Most practicing professional paleontologists in the nation adhere to the SVP's assessment, mitigation, and monitoring requirements, as specifically spelled out in its standard guidelines.

8.8.6 Involved Agencies and Agency Contacts

The CEC will be the lead agency for the protection of paleontological resources for this project.

8.8.7 Permits Required and Schedule

No state or county agency requires a paleontological collecting permit to recover fossil remains discovered by construction-related earth moving on either state or private land in the project site.

8.8.8 References

Atwater, T. 1970. Implication of plate tectonics for the Cenozoic tectonic evolution of western North America. *Bulletin of the Geological Society of America* 81:3513-3536.

Atwater, B.F., Hedel, C.W., and Helley, E.J. 1977. Late Quaternary depositional history, Holocene sea-level changes, and vertical crustal movement, southern San Francisco Bay, California. USGS Professional Paper 1014.

California Energy Commission. 1997. Paleontologic resources. In: *Regulations pertaining to the rules of practice and procedure and power plant site certification.*

Dibblee, T.W., Jr. 1980. Preliminary geologic map of the Hayward quadrangle, Alameda and Contra Costa counties, California. 1 map sheet, scale 1:24,000.

Finlayson, D. J., Hansen, W. R., and Ford, R. S. 1967. Evaluation of groundwater resources, South Bay, Appendix A, Geology. California Department of Water Resources Bulletin 118.

Finlayson, D. J., Hammersmith, E., and Hansen, W. R. 1968. Evaluation of ground water resources, South Bay, Volume 1, Fremont study area. California Department of Water Resources Bulletin 118-1.

Goldman, H. B. 1967. *Geology of San Francisco Bay.* San Francisco Bay Conservation and Development Commission, San Francisco, CA.

Goldman, H.B. 1969. *Geologic and engineering aspects of San Francisco Bay fill.* California Division of Mines and Geology, Special Report 97.

Hall, C. A., Jr. 1958. Geology and paleontology of the Pleasanton area, Alameda and Contra Costa Counties, California. University of California *Publications in Geological Sciences*, volume 34, 1:1-90.

Hay, O.P. 1927. *The Pleistocene of the western region of North America and its vertebrated animals.* Carnegie Institute Washington, Publication 322B.

Hazelwood, R. M. 1976. Contour map and interpretive cross sections showing depth and configuration of bedrock surfaces, South San Francisco Bay Region, California. U.S. Geological Survey Miscellaneous Field Studies Map, MF-796, 2 map sheets, scale 1:62,500.

Helley, E. J., Lajoie, K. R., Spangle, W. E., and Blair, M. L. 1979. *Flatland deposits of the San Francisco Bay region, California—their geology and engineering properties, and their importance to comprehensive planning.* U.S. Geological Survey Professional Paper 943.

Helley, E. J., and D. M. Miller. 1992. Geologic map of the Newark 7.5 minute quadrangle, Alameda County, California. U.S. Geological Survey Open-File Report 92-312.

Jefferson, G. T. 1991a. A catalogue of late Quaternary vertebrates from California, part one, nonmarine lower vertebrate and avian taxa. *Natural History Museum of Los Angeles County Technical Reports* 5.

Jefferson, G. T. 1991b. A catalogue of late Quaternary vertebrates from California, part two, mammals. *Natural History Museum of Los Angeles County Technical Reports* 7.

Lawson, A. C. 1895. Sketch of the geology of the San Francisco peninsula. In: *U. S. Geological Survey 15th Annual Report*, pp. 401-476.

Lawson, A. C. 1914. San Francisco folio. U.S. Geological Survey Atlas 193.

Louderback, G. D. 1939. San Francisco Bay sediments. In: *6th Pacific Science Congress Proceedings.* volume 2, pp. 783-793.

Louderback, G. D. 1951. *Geologic history of San Francisco Bay*. California Division of Mines Bulletin 154, pp. 75-94.

Nichols, D. R., and Wright, N. A. 1971. Preliminary map of historic margins of marshland, San Francisco Bay, California. San Francisco Bay Region Environment and Resources Planning Study, Basic Data Contribution 9, one map sheet, scale 1:250,000.

Robinson, G. D. 1956. Geology of the Hayward Quadrangle, California. U. S. Geological Survey Map GQ 88, one map sheet with text on reverse, scale 1:24,000.

Savage, D. E. 1951. Late Cenozoic vertebrates of the San Francisco Bay region. *University of California Publications Bulletin of the Department of Geological Sciences*, volume 28, 10:215-314.

Snetsinger, K.G. 1976. Rock types of the Franciscan Formation, Coyote Hills, Alameda County, California. *California Geology* 43:174-177.

Society of Vertebrate Paleontology. 1995. Assessment and mitigation of adverse impacts to nonrenewable paleontologic resources—standard guidelines. *Society of Vertebrate Paleontology News Bulletin*, volume 163, pp. 22-27.

Society of Vertebrate Paleontology. 1996. Conditions of receivership for paleontologic salvage collections [final draft]. *Society of Vertebrate Paleontology News Bulletin*, volume 166, pp. 31-32.

Stirton, R. A.. 1939. Cenozoic mammal remains from the San Francisco Bay region. *University of California Department of Geological Sciences Bulletin*, volume 24, number 13, pp. 339-410.

Trask, P.D., and Rolston, J.W. 1951. Engineering geology of San Francisco Bay, California. *Geological Society of America Bulletin*, volume 62, 8:1079-1110.

U. S. Army Corps of Engineers. 1963. *Comprehensive survey of San Francisco Bay and tributaries, California—geology, soils and construction materials.* Appendix E to the Technical Report on San Francisco Bay Barriers.

Wahrhaftig, C., and Sloan, D., (eds). 1989. Geology of San Francisco and vicinity. In: *28th International Geological Congress Field Trip Guidebook* T105.

Wahrhaftig, C., Radbruch, D. H., and Case, J. E. 1963. *The Berkeley Hills and Livermore Valley, Alameda and Contra Costa Counties, California: Guidebook to field trips in Alameda and Contra Costa Counties, California*, pp. 1-27. Presented at the 49th Annual Meeting of the Cordilleran Section Geological Society of America, Berkeley, CA.

Welch, L. E. 1981. *Soil survey of Alameda County, California, western part.* U.S. Department of Agriculture Soil Conservation Service in cooperation with the University of California Agricultural Experiment Station.

Webster, D. A. 1973. Map showing areas bordering the southern part of San Francisco Bay, where a high water table may adversely affect land use. U.S. Geological Survey Miscellaneous Field Studies Map MF-530.