8.16 Paleontological Resources

8.16.1 Introduction

Paleontological resources (fossils) are the remains or traces of prehistoric plants and animals. 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) determining the relative ages of the strata in which they occur and the geologic events that resulted in the deposition of the sediments that formed these strata. This subsection summarizes the potential environmental impacts on paleontological resources that may result from construction of the Turlock Irrigation District (TID)-owned electrical power generating facility at Turlock, the Walnut Energy Center (WEC).

8.16.2 Laws, Ordinances, Regulations and Standards

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 (California Environmental Quality Act [CEQA], Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established by the Society of Vertebrate Paleontology (SVP 1991, 1995, 1996). Design, construction, and operation of the proposed WEC, including transmission lines, pipelines, and ancillary facilities, will be conducted in accordance with all laws, ordinances, regulations, and standards (LORS) applicable to paleontological resources. Federal and state LORS applicable to paleontological resources are summarized in Table 8.16-1 and discussed briefly below, along with SVP professional standards.

TABLE 8.16-1
LORS Applicable to Paleontological Resources

LORS	Applicability	AFC Reference	Project Conformity
Antiquities Act of 1906	Protects paleontological resources on federal lands	Section 8.16.2	Yes
CEQA, Appendix G	Fossil remains may be encountered during earth-moving	Section 8.16.2	Yes
Public Resources Code, Sections 5097.5/5097.9	Would apply only if some project land were owned or acquired by the State of California	Section 8.16.2	Yes

8.16.2.1 Federal LORS

Federal protection for significant paleontological resources would apply to the WEC project only if any construction or other related project impacts occur 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 lands. In addition, the National Environmental Policy Act of 1969 (United States Code, section 4321et 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.

8.16.2.2 State LORS

The California Energy Commission (CEC) environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of the 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.) define procedures, types of activities, persons, and public agencies required to comply with CEQA. Appendix G in Section 15023 provides an Environmental Checklist of questions that a lead agency should 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:

1. Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.
2. It has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. 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, environmental impact assessments, statements, and reports must answer both these questions in the Environmental Checklist. If the answer to either question is *yes* or *possibly*, a mitigation and monitoring plan must be designed and implemented to protect significant paleontological resources.

The CEQA lead agency having jurisdiction over a project is responsible to ensure that paleontological resources are protected in compliance with CEQA and other applicable statutes. The lead agency with the responsibility to ensure that fossils are protected during

construction of the proposed WEC 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 as a misdemeanor any unauthorized disturbance or removal of a fossil site or remains on public land 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 TID project 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.

8.16.2.3 County and City LORS

Neither Stanislaus County nor the City of Turlock has mitigation requirements that specifically address potential adverse impacts to paleontological resources. However, the Stanislaus County General Plan (2002) states in the Introduction: "Air quality, water availability and other issues of resource protection are becoming increasingly significant as the population grows. Under the California Environmental Quality Act (CEQA), the County is required to give careful attention to the impacts of development on the environment."

8.16.2.4 Professional Standards

The Society of Vertebrate Paleontology (SVP), an international scientific organization of professional vertebrate 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 professional paleontologists in the nation adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically spelled out in these standard guidelines. Many federal and state regulatory agencies, including the CEC, have either formally or informally adopted the SVP standard guidelines.

8.16.3 Affected Environment

8.16.3.1 Geographic Location

The proposed WEC site is located at the western edge of the City of Turlock, Stanislaus County, California. The site is located at approximately 37°29'18" N. latitude and 120°53'48" W. longitude in the southeast quarter of the northwest quarter of Section 20, T. 5 S., R. 10 E. The City of Turlock is located in the northeastern portion of the San Joaquin Valley, just north of the geographic center of the State of California. San Joaquin Valley comprises roughly the southern two-thirds of the major north-northwest oriented structural trough called variously the Valle Grande (Clark 1929), Great Valley (Fenneman 1931), Great Central Valley (Piper et al. 1939, Davis et al. 1957), or Central Valley (Jahns 1954). The Central Valley Physiographic Province is located between the Sierra Nevada Physiographic Province on the east and the Coast Ranges Physiographic Province on the west. The general project area

is bounded on the west by the floodplain of the San Joaquin River and on the east by the gently inclined alluvial fan of the Merced River, which heads in the Sierra Nevada.

The proposed WEC site would connect with the TID electrical grid via a 1,950-foot 115-kV transmission line and a 670-foot 69-kV transmission line. Proposed laydown areas would be located within the 69-acre site. The TID power plant site and proposed electrical transmission lines and construction laydown areas would all be located within or immediately adjacent to the boundaries of the City of Turlock. All the proposed TID facilities are within the U.S. Geological Survey (USGS) Turlock 15′ Quadrangle (1:62,500) and either the Turlock or Hatch 7.5′ Quadrangles (1:24,000).

In addition to the WEC site, electrical transmission line, and laydown areas, the project would require an approximately 3.6-mile-long natural gas supply pipeline, which would parallel Commons Road to connect with an existing PG&E pipeline at Bradbury Road. Also included as part of the project are a recycled water supply line connecting to the Turlock Waste Water Treatment Plant located approximately 1.6 miles east-southeast of the WEC site, and a 0.9 mile potable water line connecting to the City's water system at South Tegner Road, east of the WEC.

8.16.3.2 Regional Geologic Setting

The general geology of the San Joaquin Valley has been described in some detail by Hoots et al. (1954), Davis et al. (1957, 1959), Davis and Hall (1959), Arkley (1962), Hoffman (1964), Croft and Wahrhaftig (1965), Hackel (1966), Marchand (1977), Marchand and Allwardt (1981), Page (1986), Lettis (1988), and Bartow (1991), among others. The information in these and other published reports forms the basis of the following discussion. Individual publications are incorporated into this report and referenced where appropriate. For obtaining the older geological literature, the exhaustive compilation entitled "Geological Literature on the San Joaquin Valley of California" by Maher et al. (1973) was particularly helpful.

The geology in the vicinity of the proposed project facilities has been geologically mapped by numerous workers, including Wahrhaftig et al. (1993, 1:1,000,000 scale); Jennings (1977, 1:750,000 scale), Jenkins (1938, 1:500,000 scale); Schlocker (1970, 1:500,000 scale); Davis and Hall (1959, 1:250,000 scale); Rogers (1966, 1:250,000 scale); Marchand and Allwardt (1978, 1:125,000 scale), Hall (1960, 1:62,500 scale); Marchand (1976, 1:24,000 scale), and Marchand (1980, 1:24,000 scale). The site-specific geology of the WEC site, electrical transmission lines, recycled water supply line, potable water line, and natural gas supply pipeline will be considered separately below. The aspects of geology pertinent to this report are the types, distribution, and age of sediments immediately underlying these project areas and their probability of producing fossils during project construction.

The San Joaquin Valley is a great structural depression located between the tilted Sierra Nevada block on the east and the complexly folded and faulted Coast Ranges on the west. The Valley is filled with thick Mesozoic and Tertiary marine sediments covered by Quaternary alluvial sediments (Bailey 1966). Along both sides of the San Joaquin Valley are a series of individual and coalescing alluvial fans, with their apices located where streams issue from the adjacent mountain ranges. These low-relief alluvial fans form a discontinuous belt between the dissected uplands of the Sierra Nevada and the nearly flat surface of the valley bottom along the San Joaquin River. These alluvial fans are composed of undeformed

to slightly deformed sediments deposited in Quaternary time by streams that drain the adjacent uplands. Each alluvial fan consists of a mass of coarse to fine rock debris that splays outward from the mouth of its stream channel onto the valley floor as a fan-like deposit of well-sorted sand and gravel encased in a matrix of finer sediments, chiefly poorly sorted fine sand and silt deposited away from the stream channels on the alluvial plain.

In the vicinity of TID's proposed power plant, an alluvial fan has been created by rock debris deposited by the Merced River and adjacent smaller streams, all of which drain off the foothills of the Sierra Nevada. Geological materials composing the alluvial fan in the vicinity of Turlock can be divided into three stratigraphic units, from oldest to youngest: weakly cemented conglomerate, sandstone, and siltstone referred to as the Middle Pleistocene Riverbank Formation exposed on the upper alluvial fan; a slightly younger and less consolidated Late Pleistocene sedimentary sequence named the Modesto Formation; and Holocene alluvium informally referred to as "Basin Deposits" laid down on the modern San Joaquin River floodplain. Each of these units has yielded fossil remains at previously recorded fossil localities within the Central Valley.

The Quaternary alluvial deposits accumulated to form the Riverbank and Modesto alluvial fans consist of medium- to fine-grained sediment eroded primarily from Jurassic to Cretaceous granitic and metamorphic rocks in the adjacent Sierra Nevada. The alluvial fan deposits grade west- and southwest-ward through gradually decreasing grain sizes from coarse pebble to cobble gravel in the Sierra Nevada foothills to clay-rich silt on the San Joaquin River floodplain. The poorly sorted and lenticular gravel, sand, and silt that compose these alluvial fans have in the past produced abundant fossils, primarily of Pleistocene-age large land mammals such as mammoths, camels, bison, and horses. These paleontological resources will be discussed further in the following paragraphs.

The limiting geologic ages of the three stratigraphic units composing the San Joaquin Valley alluvial fill are still uncertain. New excavations have the potential to yield important new information, new fossils, or other field evidence that may add to, confirm, or require modifying previous age interpretations. This new information also has the potential to provide a more complete and accurate understanding of both the geological and biological history of the area.

8.16.3.3 Resource Inventory Methods

To develop a baseline paleontological resource inventory of the area surrounding the WEC site and to assess the potential paleontological productivity of each stratigraphic unit present, the published as well as available unpublished geological and paleontological literature was searched and stratigraphic and paleontologic inventories were compiled, synthesized, and evaluated (see below). These tasks are in compliance with CEC (2000) and SVP (1991, 1995) guidelines for assessing the importance of paleontological resources in areas of potential environmental impact. To obtain information for this assessment, no subsurface exploration was conducted. However, it is highly recommended that further paleontological assessment be done in conjunction with pre-construction geotechnical surveys conducted to better define the subsurface geological features of the WEC site. These geotechnical borings could help determine both the vertical and horizontal distribution of stratigraphic units in the subsurface and further evaluate their potential for producing scientifically important paleontological resources.

8.16.3.3.1 Stratigraphic Inventory

Geologic maps and reports covering the bedrock and surficial geology of the project site and vicinity were reviewed to determine the exposed and subsurface rock units, to assess the potential paleontological productivity of each rock unit, and to delineate their respective areal distribution in the project area. In addition, available aerial photographs of the area were examined to aid in determining the areal distribution of distinctive sediment and soil types. During a survey of the area surrounding the proposed site conducted on 16 August and 28 September 2002 by Dr. Lanny H. Fisk, Ph.D. R.G., a California registered geologist and senior paleontologist with PRC, it was discovered that the stratigraphy was visible along the banks of irrigation ditches, in shallow road cuts, and in other excavations for construction projects. In addition, subsurface rocks and sediments were sometimes visible as spoils remaining around recently placed utility poles.

8.16.3.3.2 Paleontological Resource Inventory

Published and unpublished geological and paleontological literature (including previous environmental impact assessment 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 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 (UCMP) in Berkeley, California, for additional information regarding the occurrence of fossil sites and remains in and near the project site. In addition, geology/paleontology professor Dr. Abbas Kimyai, Ph.D., at California State University, Stanislaus in Turlock was consulted.

Field surveys, which included visual inspections of exposures of potentially fossiliferous strata near the project area, were conducted to document the presence of sediments suitable for containing fossil remains and the presence of any previously unrecorded fossil sites. These field surveys were conducted on 16 August and 28 September 2002 by Dr. Lanny H. Fisk, Ph.D.

8.16.3.4 Resource Inventory Results

8.16.3.4.1 Stratigraphic Inventory

Regional geologic mapping of the WEC site and vicinity has been provided by Wahrhaftig et al. (1993; 1:1,000,000 scale), Jenkins (1938; 1:500,000 scale), Jennings (1977, 1:750,000 scale), Davis and Hall (1959; 1:250,000 scale), Rogers (1966; 1:250,000 scale), and Marchand and Allwardt (1978, 1:125,000 scale). Larger scale mapping of the project site has been provided by Hall (1960; 1:62,500 scale) and Marchand (1976, 1:24,000 scale). Unfortunately, in their geologic maps of the Late Cenozoic deposits of the area, geologists have not always used the formally named Riverbank and Modesto Formations of Davis and Hall (1959), nor have they consistently used the same map units. Rogers (1966) mapped the area in the vicinity of Turlock as "Recent alluvial fan deposits," but stated that in eastern Stanislaus County these sediments were probably equivalent to the Late Pleistocene Modesto Formation of Davis and Hall (1959). In western Stanislaus County, Rogers (1966) mapped Quaternary alluvial sediments overlying the Modesto Formation as "Recent Alluvium." Hall (1960) mapped the Turlock alluvial fan sediments as Quaternary "Alluvial Deposits, Undivided." In this map unit, he included the Riverbank Formation, Modesto Formation, and younger Quaternary

alluvium. Marchand (1976) mapped the entire area underlying the proposed sites of WEC and all of its linear features as the upper member of the Modesto Formation.

Piper et al. (1939) published the first detailed descriptions of Quaternary sediments in the northeastern part of the San Joaquin Valley and named the Pleistocene strata the "Victor Formation." Davis and Hall (1959) subdivided sediments equivalent to the "Victor Formation" into the older Riverbank Formation and younger Modesto Formation. Marchand and Allwardt (1981) proposed that the older "Victor Formation" be abandoned and the Riverbank and Modesto Formations be accepted as uniform stratigraphic nomenclature for Quaternary deposits in the northeastern San Joaquin Valley; their recommendations have been followed by later workers (see, for instance, Helley and Harwood 1985) and are followed in this report.

The task of subdividing alluvial fan deposits is complicated by that fact that alluvial sediments are often lithologically similar. Davis and Hall (1959) addressed this problem by stating:

> An important problem in attempting to differentiate geologic units in alluvial areas is that the sediments often are derived from a common source and are deposited in similar environments. All or nearly all of the alluvium of the east side of the San Joaquin Valley is derived from granitic and associated rocks of the Sierra Nevada, which lie to the east. Thus, the formations offer no textural or lithologic bases for subdivision. Nevertheless, the use of the topographic expression of the units in conjunction with the development of their soils makes it possible to define formations.

The three stratigraphic units (Modesto Formation, Riverbank Formation, and Quaternary alluvium) found in the area of Turlock are lithologically very similar (Davis et al. 1957, Davis and Hall 1959, Hall 1960). This similarity is completely understandable since the sediments that compose each unit have been derived from the same source rocks in the headwaters of the Merced River in the adjacent Sierra Nevada and were deposited in similar alluvial fan environments.

The primary differences recognized between the Modesto and Riverbank Formations are their age, degree of consolidation/cementation, amount of deformation (tilting and/or folding), and degree of soil development. The older Riverbank Formation has been uplifted and in some locations along the eastern margin of the San Joaquin Valley can be distinguished on that basis from the flat-lying younger Quaternary alluvium (Davis et al. 1957, Davis and Hall 1959; Hall 1960). However, at many places along the eastern San Joaquin Valley, the dips increase westward so gradually that there is no apparent separation between the alluvium of the Modesto Formation and that of the Riverbank Formation. In these areas, separation of the younger Modesto Formation from the older Riverbank Formation is more difficult. Fortunately, at those places where Modesto alluvium overlies the Riverbank, the contact between the two units is frequently marked by a red clay paleosol (Davis and Hall 1959; Hall 1960).

The simple, two-part subdivision of the Pleistocene alluvial sediments appears to be defensible not only on the bases of stratigraphic superposition, degree of

consolidation/cementation, topographic expression, presence or absence of deformation, and degree of soil development, but also on the basis of fossil content. From his survey of vertebrate faunas from the non-marine Quaternary deposits of the greater San Francisco Bay region, Savage (1951) concluded that only two divisions could be recognized. He named the earlier Pleistocene fauna the Irvingtonian North American Land Mammal Age and the later Pleistocene and early Holocene fauna the Rancholabrean North American Land Mammal Age. As used in this report, the older Riverbank Formation is believed to be primarily, if not entirely, Irvingtonian in age and the younger Modesto Formation alluvium is probably entirely Rancholabrean in age.

8.16.3.4.2 Site Geology

As mapped by Davis and Hall (1959), Hall (1960), Rogers (1966), and Marchand (1976), the proposed site for WEC and the right-of-ways (ROWs) for the electrical transmission lines, reclaimed water supply line, domestic water line, and the natural gas supply pipeline are all located on Late Pleistocene alluvium of the Modesto Formation. In the vicinity of Turlock, the Modesto Formation is approximately 10 feet thick (Davis and Hall 1959, Hall 1960, Arkley 1962), meaning that Riverbank Formation sediments are unlikely to be impacted except possibly by the very deepest excavations. Thus, project construction will probably not impact the Riverbank Formation. The unnamed Holocene alluvial sediments are not present at the proposed sites of the TID power plant, nor along the ROWs of any of the project linear facilities. Thus, construction of WEC will impact only sediments of the Modesto Formation.

8.16.3.4.3 Modesto Formation

The Pleistocene-age Modesto Formation was first named by Davis and Hall (1959), who designated a type section along the south bluff of the Tuolumne River at the south edge of the City of Modesto. The Modesto Formation is composed of interbedded and poorly sorted, brownish sandstone and siltstone with lesser amounts of pebble to cobble conglomerate. In places these materials are fairly well cemented with both calcareous and hematite cements, but in other nearby locations they are only slightly cemented. These beds are primarily fluvial deposits and are believed to represent the depositional cycle between two major glacial stages in the Sierra Nevada (Davis and Hall 1959, Hall 1960, Marchand and Allwardt 1981).

The alluvial sediments composing the Modesto Formation are lithologically indistinct from either the underlying Riverbank Formation or the overlying unnamed Quaternary alluvium known as "Basin Deposits." Modesto sediments can be distinguished from the older Riverbank sediments based on the degree of cementation and therefore topographic expression, amount of deformation, and age. In addition, a distinctive red paleosol caps the Riverbank Formation. The Riverbank Formation is believed to be Middle Pleistocene in age, while the Modesto Formation is probably Late Pleistocene in age. Strata comprising the Riverbank Formation have been deformed by frequent tectonic activity and can often be recognized from the overlying Modesto Formation by their non-flat-lying attitude. Because of its greater cementation, the older stratigraphic unit often also has a distinct topographic expression in outcrop.

8.16.3.4.4 Paleontological Resource Inventory

An inventory of the paleontological resources of each rock unit exposed in or near the proposed project site, including the electrical transmission lines and three new pipelines, is presented below; and the paleontological importance of these resources is assessed. The

literature review and UCMP archival search conducted for this inventory documented no previously recorded fossil sites within the very limited footprint of either proposed project sites, nor within the narrow linear corridors of the electrical transmission lines, recycled water supply line, and natural gas supply pipeline. However, a number of fossil sites were documented as occurring in sediments of the Modesto Formation near these proposed facilities. In addition, fossil remains were found at several previously unrecorded fossil sites during the field survey of the proposed project site and vicinity conducted for this inventory.

An abundance of Pleistocene and Holocene vertebrate fossils have been reported from sediments referable to the Modesto Formation in the vicinity of the proposed TID power plant site. Surveys of Quaternary land mammal fossils have been made by Stirton (1939, 1951), Hay (1927), Savage (1951), Lundelius et al. (1983), and Jefferson (1991b), and surveys of Quaternary birds, reptiles, and amphibians have been made by Miller and DeMay (1953) and Jefferson (1991a). Mammalian fossils have been the most helpful in determining the relative age of alluvial fan sedimentary deposits (Louderback 1939, Savage 1951). Fossils from the Modesto Formation are Late Pleistocene or Rancholabrean in age. The mammals collected from this unit include mammoths, bison, horses, camels, ground sloths, and rodents (Jefferson 1991b, UCMP records). The age of these Late Pleistocene Rancholabrean faunas is based on the presence of bison and on the presence of many mammalian species, which are inhabitants of the same area today.

8.16.3.4.5 Modesto Formation

The Modesto Formation has yielded fossil remains at numerous sites in the San Joaquin Valley. These remains include petrified wood; shells of clams; and the bones and/or teeth of bony fishes, amphibians, reptiles, birds, and a diversity of extinct land mammals, including moles, rodents, rabbits, ground sloths, mammoths, horses, camels, and bison (Davis et al. 1957, Davis and Hall 1959, Hall 1960, Jefferson 1991b, UCMP records). In addition to these previously reported occurrences, during the field surveys of prospective fossiliferous sediments on 16 August and 28 September 2002, ichnofossils (burrow and root casts/molds) in a paleosol (fossil soil) in the Modesto Formation at several sites within one mile of the sites proposed for WEC were discovered (see Figure 8.16-1, filed confidentially under separate cover).

A number of previously recorded fossil sites in the Modesto Formation are reported as occurring near the proposed WEC site, many of these fossil sites having been uncovered by earth moving associated with previous construction projects (Reiche 1950; Jefferson 1991a and 1991b; UCMP records). Fossils have been reported from Pleistocene Rancholabrean sediments during construction of the California Aqueduct, Hetch Hetchy Aqueduct, Wagner Aqueduct, Hilmar High School, Modesto Landfill, Modesto Irrigation District Woodland Generation Station 2, and various other large earth-moving construction projects. Similar discoveries to those made during excavations for these other construction projects could be made during excavations for the proposed WEC project, which will be constructed in the same stratigraphic unit deposited at the same time on the same or similar alluvial fan.

Jefferson (1991a and 1991b) 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 listed 14 individual sites in Stanislaus County and 9 in adjacent Merced County that

have yielded Rancholabrean vertebrate fossils. Most, if not all, of these fossil sites were from alluvial sediments considered to be Late Pleistocene presumably referable to the Modesto Formation. Rancholabrean localities in Stanislaus County have produced fossils of extinct mammoths, mastodon, ground sloth, bison, camel, horse, deer, and other large and small land mammals. All were collected from the Modesto Formation. Several UCMP localities are located in the vicinity of the proposed WEC, including UCMP sites in and near the City of Turlock known as "Turlock unnumbered Pleistocene" and UCMP locality V-69194 known as the "Hilmar High School Site" located approximately 6 miles due south of Turlock. The Hilmar High School Site produced fossil remains of Pleistocene vertebrate land mammals from a caliche layer similar to that exposed in the vicinity of the proposed sites for WEC.

In summary, sediments referable to the Modesto Formation have produced numerous significant vertebrate fossils in the past. Several previously recorded fossil localities are found near the proposed project site. In addition, during the field survey for this report several sites were discovered which contained ichnofossils in a paleosol within one mile of the proposed WEC site. Because the Modesto Formation has in the past produced significant fossils, using SVP criteria (SVP 1995) the entire stratigraphic unit is judged to be highly sensitive to impacts from construction. Additional identifiable fossil remains recovered from the Modesto Formation during WEC project construction could be scientifically important and significant.

8.16.4 Environmental Consequences

The potential environmental impacts on paleontological resources from both construction and operation of WEC project are presented in the following subsections.

8.16.4.1 Paleontological Resource Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. The paleontological importance or sensitivity of a stratigraphic unit reflects (1) its potential paleontological productivity (and thus sensitivity) and (2) the scientific significance of the fossils it has produced. Thus, the potential paleontological productivity of a stratigraphic unit exposed in a project area is based on the abundance of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near that project site. The underlying assumption of this assessment method is that exposures of a stratigraphic unit are most likely to yield fossil remains in quantity (and quality) similar to those previously recorded from that unit in and near the project site.

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

including plant microfossils, are usually considered of lesser importance because they are more common and less helpful in age determination, they are actually more sensitive indicators of their environment and, thus, as sedentary organisms, more valuable 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.

The following tasks were completed to establish the paleontological importance and sensitivity of each stratigraphic unit exposed in or near the project site:

- The potential paleontological productivity of each rock unit was assessed, based on the abundance of fossil remains and/or previously recorded and newly documented fossil sites it contains in and/or near the project site.
- The scientific importance of fossil remains recorded from a stratigraphic unit exposed in the project site was assessed.
- The paleontological importance of a rock unit was assessed, based on its documented and/or potential fossil content in the project site and surrounding area.

This method of paleontological resource assessment is the most appropriate because discrete levels of paleontological importance can be delineated on a topographic or geologic map.

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

Using the criteria of the SVP (1995) above, the significance of the potential adverse impacts of earth moving on the paleontological resources was assessed for each stratigraphic unit exposed in and near the sites proposed for construction of WEC. This assessment reflects the paleontological importance/impact sensitivity of the stratigraphic unit, which, in turn,

reflects the potential for fossil remains and fossil sites being encountered during earth moving. However, it should be noted that any impact on a fossil site or a fossil-bearing rock unit during construction would be considered highly significant, regardless of the previously determined paleontologic importance of the rock unit in which the site or fossiliferous layer occurs. For example, grading in an area underlain by a rock unit with low sensitivity would have only a low potential to disturb fossil remains (i.e., the rock unit would have low sensitivity to adverse impacts). However, the loss of any fossil remains from that rock unit would be a highly significant impact.

8.16.4.2 Paleontological Resource Impact Assessment

The significance of potential adverse impacts of project-related earth moving on the paleontological resources of each stratigraphic unit exposed in the project site or along the electrical transmission and pipeline ROWs is presented in this section.

8.16.4.2.1 Modesto Formation

The Modesto Formation has yielded vertebrate fossil remains at numerous previously recorded fossil sites, including some less than one mile from the proposed WEC site. Therefore, adverse impacts on the paleontological resources of this rock unit resulting from earth moving at the project site would be highly significant because of the high potential for the loss of scientifically important fossil remains, unrecorded fossil sites, and associated specimen data and corresponding geologic and geographic site data where the project site is underlain by sediments of this formation.

8.16.4.2.2 Summary of Paleontological Resource Inventory and Assessment

The potential adverse impacts on the paleontological resources resulting from construction of the TID power plant project are summarized in this section. Potential impacts on paleontological resources resulting from construction WEC can be divided into construction-related impacts and impacts related to plant operation. Construction-related impacts on paleontological resources primarily involve terrain modification (excavations and drainage diversion measures). No impacts on paleontological resources are expected to occur from the continuing operation of WEC or any of its related facilities.

Paleontological resources, including an undetermined number of fossil remains and unrecorded fossil sites; associated specimen data and corresponding geologic and geographic site data; and the fossil-bearing strata, could be adversely affected by the project (i.e., would be sensitive to both direct and indirect environmental impacts resulting from ground disturbance and earth moving associated with construction of WEC). Direct impacts would result from grading of the power plant site; trenching for pipelines; auguring for concrete pilings and the foundations for electrical towers or poles; and any other earth-moving activity that disturbed or buried previously undisturbed fossiliferous sediments, making those sediments and their paleontological resources unavailable for future scientific investigation. Although earth moving associated with construction of the project site would be a comparatively short-term activity, the loss of fossil remains, unrecorded fossil sites, associated specimen data and corresponding geologic and geographic site data, and the fossil-bearing strata would be a potentially long-term environmental impact.

The proposed WEC site is located on unconsolidated, Late Pleistocene alluvial deposits of the Modesto Formation overlying at depth Middle Pleistocene sediments of the Riverbank

Formation. Because of its depth greater than 10 feet below the surface, paleontological resources of the Riverbank Formation are not expected to be impacted by construction of WEC or any of its related facilities.

Site grading is not expected to result in significant adverse impacts to paleontological resources, as the ground surface in the area is relatively flat and has already been disturbed by farming. Nor are the supporting facilities, such as temporary construction offices, proposed laydown area(s), and parking areas, expected to have a significant adverse impact on paleontological resources, as they also would be located on ground previously disturbed and will involve no significant new ground disturbance. However, deeper excavations at the plant site for foundations for the electrical generators and excavations for electrical transmission line and burial of the reclaimed water supply line, domestic water line, and natural gas pipeline would disturb potentially fossiliferous sediments of the Modesto Formation that contain Rancholabrean-age vertebrate fossils elsewhere. Thus, project-related ground disturbance and excavations could potentially have adverse impacts on highly significant paleontological resources.

8.16.5 Cumulative Impacts

If paleontological resources were encountered during project-related ground disturbance, the potential cumulative effect on paleontological resources would be low, as long as the mitigation measures proposed in Subsection 8.16.6 are fully implemented to recover the resources. When properly implemented, these mitigation measures would effectively recover the value to science of significant fossils discovered during project construction. Thus, the proposed project would not cause or contribute to significant cumulative adverse impacts to paleontological resources.

8.16.6 Mitigation Measures

8.16.6.1 Environmental Checklist

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 have been answered in the affirmative above. Because construction of the WEC project may have potential adverse impacts on significant paleontological resources, mitigation measures are necessary.

8.16.6.2 Proposed Mitigation Measures

This subsection describes TID-proposed mitigation measures that would be implemented to reduce potential adverse impacts on 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 WEC project are in compliance with CEC environmental guidelines (CEC 2000) and with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP 1991, 1995, 1996).

1. **Paleontological Monitoring.** Prior to construction, a qualified paleontologist will be retained to both design and implement a monitoring and mitigation program during project-related earth-moving activities at the power plant site, for deep boring for concrete piles and electrical transmission towers, and for construction of the recycled water supply line, domestic water line, and natural gas supply pipeline. Prior to construction, the paleontologist will conduct a limited field survey of exposures of sensitive stratigraphic units that 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 be buried, but not otherwise disturbed.

2. **Paleontological Monitoring and Mitigation Program**. The paleontological resource monitoring and mitigation program will include construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; preconstruction coordination; and reporting.

3. **Construction Personnel Education**. Prior to start of construction, all personnel involved in earth-moving activities will be informed that fossils may be encountered, on the appearance of fossils, and on proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist or in the form of a video.

Implementation of these mitigation measures would reduce the potentially significant adverse environmental impact of project-related ground disturbance and earth moving on paleontological resources to an insignificant level by allowing for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data. These data might otherwise be lost to earth moving and unauthorized fossil collecting.

With a well-designed and well-implemented paleontological resource monitoring and mitigation plan, project construction could actually result in beneficial impacts on paleontological resources through the possible recovery of fossil remains that would not have been exposed without project construction and, therefore, would not have been available for study. 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 Turlock area.

8.16.6.3 Significant Unavoidable Adverse Impacts

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

8.16.7 Involved Agencies and Agency Contacts

There are no state or local agencies having specific jurisdiction over paleontological resources.

8.16.8 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 either public or private land.

8.16.9 References

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