5.8 Paleontological Resources

The purpose of this section is to address the requirements of the CEC for an assessment of potential impact to paleontological resources (fossils) from the construction and operation of the proposed CPV Vaca Station (CPVVS) in Solano County, central California. Section 5.3.1 describes the paleontological resources environment that might be affected by the CPVVS. Section 5.3.2 discusses the environmental consequences of construction and operation of the proposed project. Section 5.3.3 determines whether there will be any cumulative effects from the project. Section 5.3.4 presents mitigation measures that will be implemented to avoid construction impacts. Section 5.3.5 discusses the laws, ordinances, regulations, and standards (LORS) applicable to the protection of cultural resources. Section 5.3.6 lists the agencies involved and agency contacts, and Section 5.3.7 discusses permits. Section 5.3.8 lists reference materials used in preparing this section.

This section of the AFC considers the potential for sediments containing significant fossil remains to be within the area of potential effect from earth moving associated with construction of the CPVVS project area. Offsite laterals for natural gas and electrical transmission extend the impact zone beyond the CPVVS to different areas, but their geology and, therefore, their paleontological potential do not differ substantially. CPVVS operation will not involve further ground-disturbing activities, and therefore no impacts to paleontological resources would occur during the operational phase of this project.

This section of the AFC meets all requirements of the CEC (2000, 2007) and conforms to the recommendations of the Society of Vertebrate Paleontology (SVP, 1991, 1995 regarding the assessment of and mitigating of impacts to paleontological resources resulting from earth-moving activities. Subsequent to presenting the results of paleontological research and the sensitivity assessment of the CPVVS, measures will be described to mitigate adverse impacts to paleontological resources from excavations at the project site.

This section of the AFC summarizes the potential environmental impacts on paleontological resources that may result from construction of the CPVVS. This paleontological resources inventory and impact assessment was conducted by Dr. Geoffrey Spaulding, a senior paleontologist with CH2M HILL. Dr. Spaulding has advanced degrees in geology with emphasis in paleobiology, and is a recognized expert on the glacial-age environments of the American West. He previously has completed paleontological resource surveys and prepared paleontological resource impact assessments in support of energy-generation and other large construction projects throughout California and adjacent states.

Paleontological resources (fossils) are the remains or traces of prehistoric plants and animals. They may range from the actual bones and shells of ancient organisms, to mineral replacements of a once-living organism, to impressions of plants or animals in soft sediments later transformed to rock. They range in size and abundance from many thousands per cubic centimeter for microfossils such as pollen, diatoms, and radiolaria, to rare large-mammal bones exceeding a meter in length. Fossils are important scientific and educational resources because of their use in (1) documenting the presence and evolutionary history of particular groups of now-extinct organisms, (2) reconstructing the environments in which these organisms lived, and (3) determining the relative ages of strata in which they occur and the geologic events that resulted in the deposition of the sediments that formed these strata. In

Solano County, the fossils of marine organisms and those of terrestrial animals and plants are important in the paleontological record (Solano County, 2006a).

5.8.1 Affected Environment

5.8.1.1 Physiographic Setting

Fenneman (1931) described the major physiographic features of this area as the north-south trending Coast Ranges to the west of the CPVVS, and the Great Valley paralleling them to the east. The hydrographically defined regions of the Great Valley are the Tulare Basin far to the south, the San Joaquin Valley north of that, and the Sacramento Valley, which begins north of the Sacramento–San Joaquin Delta region that lies about 10 miles southeast of the project area. Being close to the San Andreas Fault Zone, the area is tectonically active. The Montezuma Hills lie approximately 8 miles south of the CPVVS. They represent an area of active deformation and a recently upwarped crustal segment (Weber, 2005), with Quaternary sediments exposed by erosion on its flanks.

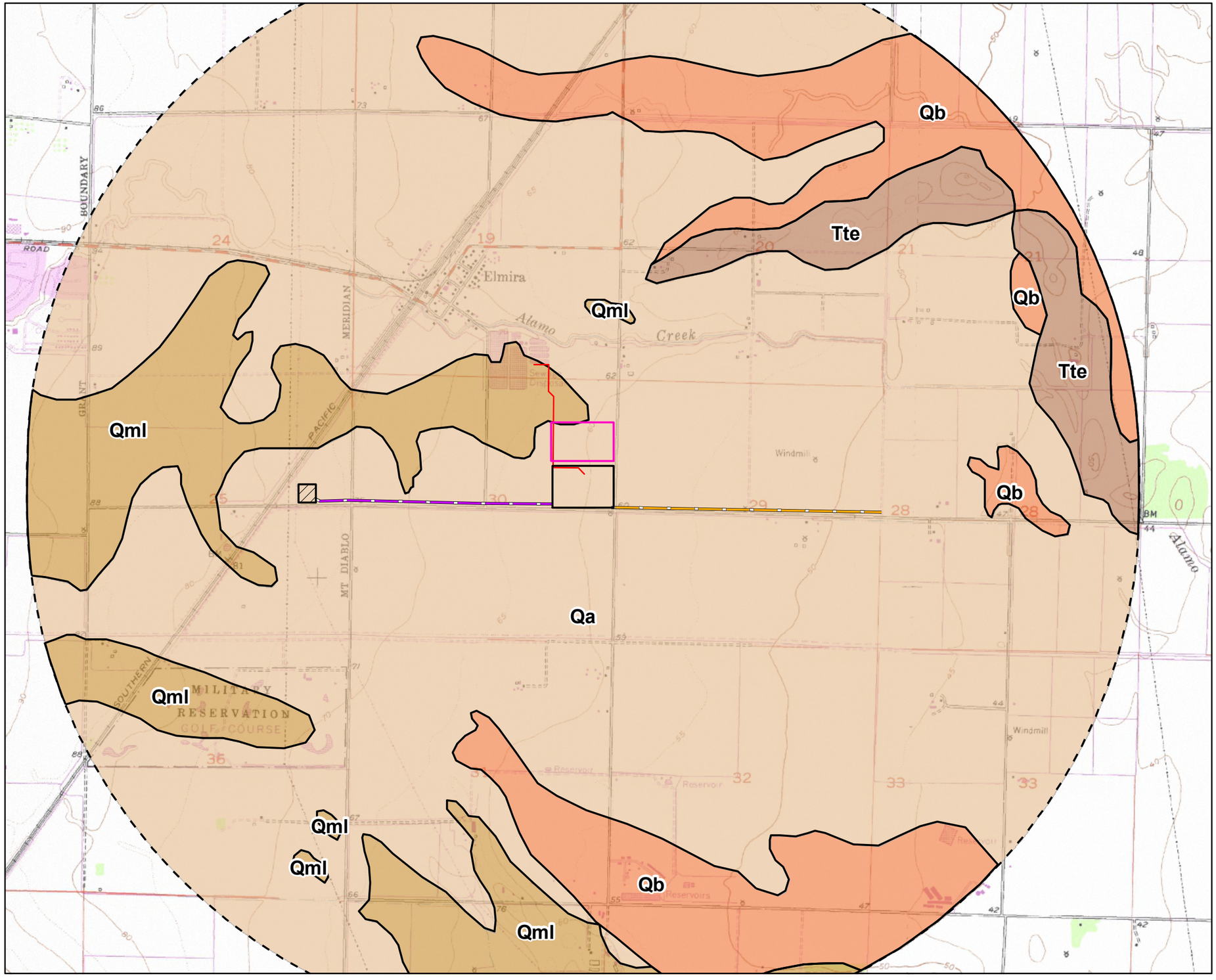
The proposed CPVVS site lies on the alluvial plain that extends southeast and east from the Vaca and English Hills, foothills of the Coast Ranges, which lie only about 2.6 miles west-northwest of the project area. These north-south trending hills are the easternmost outcrops of the monoclinal ridges that compose what geologists have named the Great Valley Complex of Cretaceous and Paleogene marine sediments. Physiographically, the ridges mark the western margin of the Sacramento Valley and the beginning of the Coast Ranges (Graymer et al., 2002; Helley and Harwood, 1985).

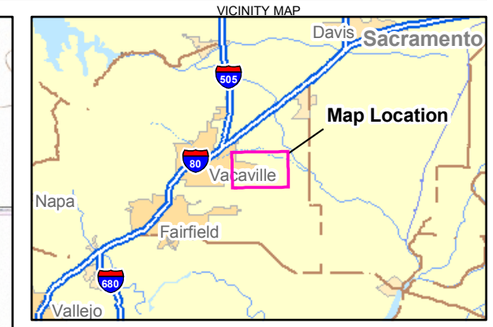
The project site is about 0.5 mile south of Alamo Creek, an east-flowing tributary to Ulatis Creek. Ulatis Creek in turn drains southeast to Cache Slough, on the northwestern margin of the great estuarine complex that comprises the Sacramento–San Joaquin River Delta. The head of Cache Slough is about 13.5 miles southeast of the project site; in turn the slough flows into the Sacramento River, which runs first south and then west to skirt the Montezuma Hills, finally entering Suisun Bay about 23 miles downstream. The project laterals, which extend approximately 1 mile east of the proposed CPVVS generation plant site, do not encounter topography or subsurface geology substantively different from the proposed plant site (Figure 5.8-1).

5.8.1.2 Resource Inventory Methods

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

A paleontological records search for the CPVVS was conducted May 2, 2008 using the online utilities offered by the University of California Museum of Paleontology at Berkeley (UCMP) and the Paleobiology Database. Keywords included geographically relevant designators and the names of geological formations known to occur in the area. In addition, internet searches





LEGEND

- Utility Corridor to WWTP
- Natural Gas Pipeline Route
- Electrical Transmission Line Route
- Construction Laydown Area
- Project Site
- New Substation
- Two Mile Buffer

Geology Type

- Geologic Contact (approximate)
- Qa - Quaternary Alluvium
- Qb - Quaternary Basin Deposit
- Qml - Quaternary Modesto Formation, Lower Member
- Tte - Tehama Formation

Notes:

1. Area of interest subject to change.
2. Source: Geologic map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierra Foothills, Califorina. by E.J. Helley and D.S. Harwood, 1985. USGS MF-1790
3. No paleontological sites are recorded within one mile of the project site, or within the map coverage shown here

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 1,000 2,000
Feet

FIGURE 5.8-1
GEOLOGY WITHIN TWO MILES OF SITE
CPV VACA STATION
VACAVILLE, CA

CH2MHILL

SAC\\ZION\SACGIS\PROJ\VACAVILLE_AFC_370668\MAPFILES\GEOLOGYTYPE_PALEO.MXD MHASKELL 8/21/2008 09:47:55

using Google™ were used to identify relevant paleontological and geological literature. Of particular utility for this study are geological maps by Helley and Harwood (1985), Graymer et al. (2002), and Solano County's (2006b) background report for the *2008 Draft General Plan* (Solano County, 2008) that provides paleontological sensitivity assessments of most recognized geological formations in the county. A reconnaissance-level paleontological survey was conducted by the project paleontological resources specialist (PRS), Dr. Geoffrey Spaulding, on May 12, 2008. This field review included the CPVVS site and the area that encompasses the rights-of-way for the gas transmission pipeline and the electrical lines extending approximately 1 mile west of the CPVVS site. No comprehensive paleontological survey was conducted because ground visibility was near zero due to vegetation, and the soils that were exposed consisted of previously disturbed agricultural sediments and roadbed material. These were inspected carefully during the reconnaissance, and no evidence of paleontological materials was noted.

5.8.1.3 Resource Inventory Results

The history of sedimentation in the Sacramento Valley during the Cenozoic (the last 65 million years) has been governed by local tectonism and by fluctuations in global sea level and changes in the drainages of the valley and the delta region. The fossil-bearing rock units of the western margin of the Sacramento Valley represent two distinctly different times and environments. Rocks of the Great Valley Complex date to the late Mesozoic and early Cenozoic, and represent marine conditions. In the project area these include the Late Cretaceous Guinda Formation, unnamed shale and sandstone of the Paleocene, and the Eocene Markley Formation. Much younger, continental environments are represented by the Pliocene Tehama Formation, and overlying Quaternary alluvial and basin deposits.

The records search and literature review revealed no known paleontological sites within 1 mile of the project site, or within the area depicted in Figure 5.8-1.

5.8.1.4 Geological Units in the Project Vicinity

Table 5.8-1 lists the geologic units that occur within about 3 miles of the CPVVS. This distance was chosen because it adequately encompasses the range of rock units locally present, and assists in understanding the geological context of the results of the paleontological records review.

Of the eight geological units identified in the CPVVS's vicinity (Table 5.8-1), only four occur at or in the immediate vicinity of the site based on the most recent geological mapping by Graymer et al. (2002): (1) the Tehama Formation, (2) a mantle of older Pleistocene alluvium that includes the lower member of the Modesto Formation as mapped by Helley and Harwood (1985), (3) younger alluvium of Holocene age (including Quaternary basin deposits of Helley and Harwood [1985]), and (4) artificial fill and previously disturbed sediment. This later category includes roadbeds, the "plow zone" of agricultural fields, and the prepared pads of agricultural processing facilities.

TABLE 5.8-1
Geologic Units within about 3 miles of the CPVVS Site

Epoch and Name[a]	Presence/Absence of Paleontologically Significant Fossils[b]	Mapped at or Within 1 Mile of CPVVS
Late Cretaceous siliceous shale	None noted	No
Late Cretaceous Guinda Formation	Present	No
Paleocene shale, sandstone	Present	No
Eocene Markley Formation	Present	No
Plio-Pleistocene Tehama Formation	Present	Yes
Pleistocene alluvium[b]	Present	Yes[b]
Holocene alluvium[b]	Absent	Yes[b]
Artificial fill and previously disturbed sediment[c]	Absent	No, but assumed to be present

[a]Graymer et al. (2002) except where noted
[b]Solano County (2006a)
[c]This study

5.8.1.5 Sediments Present or Within One Mile of the Project Site

The geological units in the project area that have the potential to yield fossils are the Tehama Formation, a late Tertiary (Pliocene) continental sedimentary unit, and overlying Quaternary (Pleistocene and Holocene) alluvium (Table 5.8-2). In addition, artificial fill and previously disturbed sediment mantles the project area to varying depths.

5.8.1.5.1 Tehama Formation

The Tehama Formation is older valley fill of the Sacramento Valley. It consists of a 100- to 600-foot thick sequence of poorly sorted massive sandy silt, sand, and silty gravel of chiefly fluvial origin (Wahrhaftig and Birman, 1965). It is generally found exposed on the flanks of the valley, elevated above the current grade of streams issuing from the North Coast Ranges. The Tehama Formation rests unconformably on sediment of the Great Valley Complex in this area, and its stratigraphic relationships across the Sacramento Valley reflect the beginning of a major period of uplift in the North Coast Range. The vigorous fluvial sedimentation recorded in the sediments of the Tehama Formation reflect this active tectonic uplift (Lettis and Unruh, 1991). Consisting of sandstone, siltstone, and conglomerate as well as volcaniclastic rocks, the age of the Tehama Formation is well controlled by the Nomlaki Tuff near its base. This volcanic ash originated in an eruption near present-day Lassen Peak, and has yielded potassium-argon (K-Ar) dates of about 3.4 million years ago. This age is generally accepted as representing the approximate beginning of late Cenozoic volcanism in the southern Cascade Range (Sarna-Wojcicki et al., 1991), which, along with the beginning of rapid uplift of the North Coast Ranges at the same time, is a milestone in the recent geological history of the Pacific Rim of North America. Deposition of the Tehama Formation on the western margin of the Sacramento Valley abruptly ceased in the early Pleistocene, about 1.25 million years ago (Lettis and Unruh, 1991).

5.8.1.5.2 Pleistocene Alluvium

These sediments are poorly sorted and moderately to poorly bedded sands, silts, and gravels deposited in alluvial fan, valley fill, terrace, or basin environments. Except where mature soil zones are present, the sediments are generally unconsolidated to poorly consolidated.

Pleistocene alluvium includes both younger, late Pleistocene alluvium assigned to the Modesto Formation by Helley and Harwood (1985), and sediments assigned to the older Riverbank Formation on the basis of their deeper and their topographic position. Older alluvial sediments generally are isolated and present in topographically elevated situations, while younger late Pleistocene and Holocene alluvium and basin sediments accumulate in topographic lows.

5.8.1.5.3 Holocene Alluvium

Holocene sediments are younger than about 11 thousand years ago, and therefore are typified by weakly developed soils that frequently display an incipient CCa (caliche carbonate) horizon. Otherwise, these sediments can be very similar to older Pleistocene alluvium. They are typified by moderately to poorly bedded sands, silts, and gravels deposited in alluvial fan and valley fill or basin environments. Frequently, it is not possible to determine in a stratigraphic section the exact location of the Pleistocene-Holocene boundary and, as a consequence, it should be assumed that some Holocene sediments may contain facies of late Pleistocene age.

5.8.1.5.4 Artificial Fill and Previously Disturbed Sediment

Construction on nearby roads as well as agricultural activities, especially mechanical cultivation within and near the boundaries of the CPVVS, have left varying depths of fill or disturbed soil in the area. In the absence of detailed subsurface mapping, it is assumed that fill or previously disturbed sediment extends 3 feet below the surface. Artificial fill and previously disturbed sediment would not have fossils in stratigraphic context. Most fossils would be destroyed by the mechanical equipment used in excavation, mixing, and spreading. Therefore, this sediment has no paleontological potential and is not considered further in this assessment.

5.8.1.6 Paleontological Sensitivity of the Project Site

Paleontological sensitivity is a qualitative assessment made by a professional paleontologist taking into account the paleontological potential of the stratigraphic units present, the local geology and geomorphology, and any other local factors that may be germane. Paleontological potential is the probability that a given rock unit will yield scientifically significant fossils based on its geologic history and physical properties, as well as the available fossil record from that unit. According to SVP (1995) standard guidelines, paleontological sensitivity consists of (1) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical, and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data (Table 5.8-2).

As noted in Table 5.8-1, within 3 miles of the project area is a limited suite of geological units. Their paleontological sensitivity and relationship to the project is summarized under the following discussions. In Solano County, guidance documents provide the paleontological sensitivity ratings for certain rock units (Solano County, 2006a), and these are generally adopted here since they are consistent with the findings of the literature review and record search conducted for this project.

TABLE 5.8-2
Paleontological Sensitivity Ratings Employed in this Assessment

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

Source: Adapted from SVP, 1995

5.8.1.6.1 Tehama Formation

The records search conducted using the UCMP database yielded a total of 46 fossil localities within the Tehama Formation, chiefly from Yolo, Tehama, and Glenn counties. All except 3 of these localities have yielded the remains of vertebrates. The Paleobiology Database yielded no records for the Tehama Formation. Only 1 fossil locality is recorded from the Tehama Formation in Solano County, and that is more than 3 miles from the project area. This likely reflects the lack of paleontological research on the Tehama within Solano County, rather than an anomalous (compared to elsewhere) lack of fossils. The diverse fossil assemblage from the Plio-Pleistocene Tehama Formation documents faunal and environmental conditions in California not long before the beginning of the great environmental changes that ushered in the ice ages of the Pleistocene. Recent discovery of the remains of a giant tortoise (*Geochelone*) from the Tehama Formation farther north in the Sacramento Valley near Red Bluff (Sierra College, 2007) adds to a faunal list that already includes several records of the giant tortoise, as well as ancestral mastodon (*Pliomastodon*), extinct horse (*Equus simplicidens*), native North American camel (Camelidae), giant ground sloth (Megalonichidae), and the extinct hyena-like dog *Borophagus diversidens*. These findings are consistent with that of Solano County (2006a), which determines that the Tehama Formation possesses high paleontological sensitivity.

5.8.1.6.2 Pleistocene Alluvium

The paleontological records search using the UCMP database provided 12 records of Pleistocene vertebrates from Solano County. Most of these sites are located in the bluffs and arroyo cuts that lie immediately north of the Sacramento River on the south flank of the Montezuma Hills. None are from the area within 3 miles of the project site.

Although no fossils records are known from the Pleistocene sediments in the CPVVS area, it is evident that similar sediments frequently have yielded scientifically significant fossil records elsewhere in the Sacramento Valley. These include units that have been assigned to the Modesto and Riverbank formations as well as generically classified as Quaternary or Pleistocene age alluvium. Hansen and Begg (1970) report a variety of Rancholabrean fossils collected *in situ* from two gravel quarries near Sacramento. These fossils include extinct bison and camel (*Bison antiquus*, *Camelops hesternus*), dire wolf (*Canis dirus*), the big-tongued ground sloth (*Paramylodon harlani*), and remains of Douglas fir, sycamore, and willow trees. Dundas and Cunningham (1993) recovered the bones of ground sloth and Columbian mammoth (*Mammuthus columbi*) from the sediments of Putah Creek west of Davis, on the border of Solano and Yolo Counties.

Hilton et al. (2000) collected a variety of fossils including big-tongued ground sloth, extinct bison, extinct horse (*Equus* sp.) and camel, as well as mammoth (*Mammuthus* sp.) and plant fossils during excavations for Arco Arena north of Sacramento. These fossils were found in excavations about 13 to 30 feet below the ground surface. Although they were attributed to the Riverbank formation at the time, the presence of *Bison* in this record indicates a Rancholabrean age and therefore their fossil assemblage more likely relates to the Modesto Formation. Therefore, the locally unproven but regionally high paleontological potential of Pleistocene alluvium is basis to consider this unit as possessing high paleontological sensitivity (Solano County, 2006a).

5.8.1.6.3 Holocene Alluvium

The UCMP database yields records of 8 recent (i.e., Holocene) fossil localities in Solano County; all are invertebrate collections. This material has only low potential to yield scientifically important materials, and therefore possesses low paleontological sensitivity. This is consistent with Solano County's (2006a) assessment that the fossils of extant, modern taxa from Holocene sediment are generally not considered paleontologically significant. However, in many cases in the field it is not clear where the stratigraphic boundary lies between latest Pleistocene and Holocene alluvium. This is particularly true where Holocene alluvium (Qa) and basin deposits (Qb) are mapped at the surface (e.g. Figure 5.8-1), but their depth is unknown.

5.8.2 Environmental Analysis

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

5.8.2.1 Paleontological Resource Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) notes that an individual fossil specimen is considered scientifically important and significant if it is: (1) identifiable, (2) complete, (3) well preserved, (4) age-diagnostic, (5) useful in paleoenvironmental reconstruction, (6) a type or topotypic specimen, (7) a member of a rare species, (8) a species that is part of a diverse assemblage, or (9) a skeletal element different from, or a specimen more complete than, those now available for that species. For example, identifiable land mammal fossils are considered scientifically important because of their potential use in determining the age and providing input to paleoenvironmental reconstructions for the sediments in which they occur. Moreover,

vertebrate remains are comparatively rare in the fossil record. Fossil plants are also important in this regard and, as sedentary organisms, are actually more sensitive indicators of their paleoenvironment and, thus, more important than mobile mammals for paleoenvironmental reconstructions. For marine sediments, invertebrate fossils, including marine microfossils, are scientifically important for the same reasons that land mammal and/or land plant fossils are valuable in terrestrial deposits. The value or importance of different fossil groups varies depending on the age and depositional environment of the stratigraphic unit that contains the fossils, their abundance in the record, and their degree of preservation.

Using the criteria of the SVP (1995) and the County (Solano County, 2006a, 2008) and the sensitivity ratings provided in Section 5.8.2.3, the significance of potentially adverse impacts of earth moving on the paleontological resources was assessed. Any unmitigated impact on a fossil site or a fossil-bearing rock unit of high or moderate sensitivity would be considered significant.

5.8.2.2 Paleontological Resource Impact Assessment

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

- **Artificial fill and previously disturbed sediment**—Construction-related excavations within artificial fill and disturbed sediment, including agricultural soils, will not result in any adverse impacts to paleontological resources. Reworked and disturbed fossil material may be present in artificial fill and previously disturbed sediment, but lack of stratigraphic context and likely mechanical damage would compromise all scientific values. This would apply to all excavations within 3 feet of current ground surface.
- **Pleistocene and Holocene alluvial deposits**—Excavations including drilling and trenching extending to depths below 3 feet are likely to affect Quaternary-age (Pleistocene plus the Holocene) alluvial sediments. While Holocene sediment has low paleontological sensitivity, Pleistocene alluvium has high paleontological sensitivity and fine-grained facies could yield significant fossil resources. Uncontrolled excavation affecting identifiable and *in situ* fossils potentially present at depth in this unit would be an adverse impact.
- **Sediments of the Tehama Formation**—This geological formation possesses high paleontological sensitivity and its uncontrolled excavation would result in adverse effects to sensitive paleontological resources. Significant fossil finds have been made in this unit, and additional specimens could contribute important information on the chronostratigraphy and paleobiology of this region.

Impacts to paleontological resources would occur from subsurface excavations associated with construction of the CPVVS and its offsite laterals. No impacts to paleontological resources are expected from the operation of the CPVVS.

5.8.3 Cumulative Effects

Widespread recent development in Solano County has resulted in proportionately extensive impacts to paleontological resources, and this is anticipated to continue (Solano County, 2008). The extensive nature of these cumulative effects is only partially due to extensive development. It is also attributable to the widespread presence of a number of fossiliferous sedimentary units (Solano County, 2006a). Although, when applicable, measures are implemented pursuant to State statutes to realize the scientific and educational potential of these affected resources, as noted in Section 5.8.6.3. The *2008 Draft General Plan* for Solano County contains no goals, policies, or implementation programs that address impacts to paleontological resources. Because no local plan codifies mitigation of impacts to this resource, notwithstanding commitments in the DEIR for the *2008 General Plan* (Solano County, 2008), cumulative effects to paleontological resources resulting from continued development in Solano County can be expected to be substantial and adverse.

The potential contribution to cumulative effects to paleontological resources from project-related ground disturbance would be appreciable, given the probability of encountering these resources. Thus, the proposed CPVVS project would contribute measurably to cumulative effects to paleontological resources in the absence of mitigation. With the mitigation described below, however, the CPVVS's contribution to cumulative effects to paleontological resources would not be significant.

5.8.4 Mitigation Measures

Guidelines for the Implementation of CEQA (Public Resources Code Sections 15000 *et seq.*) include among the questions to be answered in the Environmental Checklist (Section 15023, Appendix G) the following: "*Would the project directly or indirectly destroy a unique paleontological resource or site*?" and "*Does the project have the potential to . . . eliminate important examples of the major periods of California . . . pre-history*?" These questions are answered in the affirmative based on the data and considerations provided above. Because construction of the CPVVS may have potential adverse impacts on significant paleontological resources, mitigation measures are necessary.

This section describes Applicant-proposed mitigation measures that would be implemented to reduce potential adverse impacts to significant paleontological resources resulting from project construction. These proposed paleontological resource impact mitigation measures would reduce to an insignificant level the direct, indirect, and cumulative adverse environmental impacts on paleontological resources that might result from project construction. The mitigation measures proposed below for the CPVVS are in compliance with CEC environmental guidelines (CEC 2000, 2007) and with SVP standard guidelines for mitigating adverse construction-related impacts on paleontological resources (SVP, 1991, 1995, 1996).

5.8.4.1 Paleontological Resources Monitoring and Mitigation Program

A Paleontological Resources Monitoring and Mitigation Program (PRMMP) will be developed for review and approval by the CEC prior to implementation. The PRMMP will include these provisions: construction monitoring and coordination; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimens and data recovered; preconstruction coordination; and reporting. Reporting

requirements will include monthly monitoring reports and a final report. Monitoring procedures will include measures to suspend monitoring should construction activities be restricted to previously disturbed fill, and to adjust monitoring protocols based on updated evaluations of sensitivity subsequent to initial excavations.

5.8.4.2 Paleontological Monitoring

Prior to construction/demolition, a qualified paleontologist will be retained as project PRS to design and implement a monitoring program during project-related earth-moving activities. Prior to construction, the paleontologist will review excavation plans to determine whether sensitive stratigraphic units will be disturbed by project-related earth movement. Earth-moving construction activities will be monitored where these activities will potentially disturb previously undisturbed sediment. Monitoring will not be conducted in areas where the ground will not be disturbed, nor will it be conducted in areas where only sediment of low paleontological sensitivity is affected.

5.8.4.3 Construction Personnel Education

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

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

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

5.8.4.4 Significant Unavoidable Adverse Impacts

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

5.8.5 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 (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts to paleontological resources have been established by the SVP (1991, 1995, 1996). Design, construction, and operation of the CPVVS will be conducted in accordance with all laws, ordinances, regulations, and statutes (LORS) applicable to paleontological resources in the context of this project. Federal, state, and local LORS applicable to paleontological resources are presented in Table 5.8-3 and discussed briefly below, along with professional standards for paleontological resources assessment and impact mitigation.

TABLE 5.8-3
Laws, Ordinances, Regulations, and Standards for Paleontological Resources

LORS	Requirements/Applicability	Administering Agency	AFC Section Explaining Conformance
Federal			
Antiquities Act of 1906	Protects paleontological resources on federal lands; requires inventory, assessment of effects, and mitigation if appropriate. **Not applicable**—No federal land involved, or federal entitlement required	Federal lead agency	Section 5.8.2.1
State			
CEQA, Appendix G	Requires that impacts to paleontological resources be assessed and mitigated on all discretionary projects, public and private. **Applicable**—Paleontological resources are listed as environmental components subject to CEQA review.	California Energy Commission	Section 5.8.2.2
Public Resources Code, Sections 5097.5/5097.9	Designates unauthorized removal or disturbance of fossil remains or fossil site on publicly owned lands in the State of California as a misdemeanor. **Not applicable**—Applies only to state-owned land, and none are affected by this project	California Energy Commission	Section 5.8.2.2
Local			
Solano County 1980 General Plan	**Not applicable**—The Resources Conservation and Open Space Element dated 1972 does not address paleontological resources	Solano County	Section 5.8.2.3
Solano County Draft 2008 General Plan	**Applicable**—The DEIR for the 2008 General Plan notes that all projects subject to a CEQA evaluation shall include a site-specific analysis of paleontological resources, and mitigation through recovery should a fossil locality be encountered.	Solano County	Section 5.8.2.3

5.8.5.1 Federal LORS

Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (PL 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal lands. In addition, the National Environmental Policy Act of 1969 (United States Code, section 4321 et seq.; 40 Code of Federal Regulations, section 1502.25), as amended, requires analysis of potential environmental impacts to important historic, cultural, and natural aspects of our national heritage. Federal protection for significant paleontological resources would apply to the CPVVS project only if construction or other project impacts affects federally owned or managed lands, if a federal entitlement or other permit is required for project implementation, or if federal funds were to be used for project construction. Since none of these cases apply, no federal LORS are applicable to potential impacts to paleontological resources resulting from the CPVVS project.

5.8.5.2 State LORS

5.8.5.2.1 CEQA

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of the California Environmental Quality Act (CEQA; Public Resources Code Sections 21000 et seq.). CEQA requires that public agencies and private interests identify the environmental analysis 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 "a unique paleontological resource or site," Section 21083.2 defines "unique archaeological resources" as "…any archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

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

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 that "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 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 comply with CEQA, impact assessments must answer both these questions in the Environmental Checklist. If the answer to either question is *yes* or *possibly*, a mitigation and monitoring plan must be designed and implemented to protect significant paleontological resources.

The CEQA lead agency having jurisdiction over a project is responsible to 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 CPVVS 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.

Based on these considerations, it is evident that the CEQA process as implemented by the CEC under the Warren-Alquist Act does apply to paleontological resources that may be affected by the CPVVS project.

5.8.5.2.2 California Public Resources Code

Additional state requirements for paleontological resource management are stated in California Public Resources Code Chapter 1.7, Section 5097.5 (Stats. 1965, c. 1136, p. 2792), entitled Archaeological, Paleontological, and Historical Sites. This statute defines any unauthorized disturbance or removal of a fossil site or remains on state-owned public land as a misdemeanor and specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to preserve or record paleontological resources. This statute would apply to the CPVVS project only if any construction or other related project impacts occur on state-owned or state-managed lands or if the state or a state agency were to obtain ownership of project lands during the term of the project license.

5.8.5.2.3 Local LORS

The Solano County (1980) *General Plan* includes a Resource Conservation and Open Space Element dated 1972. Neither the current *General Plan* nor its Resource Conservation Element addresses paleontological resources. However, Solano County is currently updating its general plan and as part of this process has issued a *Draft Environmental Impact Report Solano County 2008 Draft General Plan* (DEIR) for public comment (Solano County, 2008). Components of the *2008 Draft General Plan* relevant to paleontological resources include the *Cultural and Paleontological Resources Background Report* (Solano County, 2006b).

Despite the contents of the *Cultural and Paleontological Resources Background Report* (Solano County, 2006b), the *2008 Draft General Plan* contains no goals, policies, or implementation programs that address paleontological resources. Nevertheless, in its impact analysis the DEIR (Solano County, 2008, pp. 4.10-39 – 4.10-40) notes that the following:

> "Development within Solano County in accordance with the 2008 Draft General Plan under the Preferred Plan [*or* the Maximum Development Scenario] may result in the destruction of paleontological resources. This

> impact would be **potentially significant**." (italics and brackets added for emphasis)

To reduce potentially significant impacts to paleontological resources to a less-than-significant level, the DEIR states that the County will implement the following measures:

> "(a) Actions that do not meet the CEQA definition of a "project" and therefore do not require an environmental analysis under the CEQA process shall not be required to perform a paleontological resources analysis.
>
> (b) All projects in Solano County that are subject to a CEQA evaluation shall include a site-specific analysis of paleontological resources. At a minimum, the site-specific analysis shall include a review of the types of the geologic formation(s) present at the project site and a determination of the likelihood that those formation(s) would contain a "unique paleontological resource" as stated in Title 14, California Code of Regulations, Appendix G (the CEQA checklist). If the site-specific analysis determines that a project may have an adverse effect on a "unique paleontological resource," the County shall require that project specific mitigation measures be implemented to address the following:
>
> - cessation of work in the vicinity of the find and notification of the County Planning Department and the lead agency for the project;
> - retention by the project applicant of a qualified paleontologist to evaluate the resource and prepare a proposed mitigation plan, which may include some or all of the following elements: a field survey, construction monitoring, sampling and data recovery procedures, museum storage coordination for any specimen recovered, and a report of findings; and
> - implementation of recommendations made by the paleontologist, where the lead agency for the project determines that said recommendations are necessary and feasible."

The City of Vacaville has no requirements regarding paleontological resources and does not address paleontological resources in its planning documents.

5.8.5.2.4 Professional Standards

The Society of Vertebrate Paleontology (SVP), an international organization of professional paleontologists, has established standard guidelines (SVP 1991, 1995, 1996) that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys; monitoring and mitigation; data and fossil recovery; sampling procedures; and specimen preparation, identification, analysis, and curation. Most practicing paleontologists in the nation adhere to the SVP's guidelines, and extend those to address other types of fossils of scientific significance, such as invertebrate fossils and paleobotanical specimens. Many federal and state regulatory agencies, including the CEC, have informally adopted the SVP standard guidelines.

5.8.6 Agencies and Agency Contacts

There are no agencies having blanket jurisdiction over paleontological resources. The CEC has jurisdiction over paleontological resources for this project. Although Solano County (2006a, 2008) acknowledges the occurrence of paleontological resources within its jurisdiction, and that these resources are afforded protection by CEQA, there is no priority placed on paleontological resources documentation or significance evaluation beyond that stated in the *2008 Draft General Plan* DEIR. Nevertheless, copies of the final paleontological resources documentation should be provided to the contact listed in Table 5.8-4.

TABLE 5.8-4
Agency Contacts for Paleontological Resources

Issue	Agency	Contact
Paleontological Resources Documentation	Solano County Department of Resource Management 675 Texas Street Suite 5500 Fairfield, CA 94533	Jim Louie (707) 784-6765

5.8.7 Permits and Permit Schedule

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

5.8.8 References

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