Chapter 28
Paleontological Resources

This chapter describes the environmental setting and study area for paleontological resources; analyzes impacts that could result from construction, operation, and maintenance of the project; and provides mitigation measures to reduce the effects of potentially significant impacts. This chapter also analyzes the impacts that could result from implementation of compensatory mitigation required for the project, describes any additional mitigation necessary to reduce those impacts, and analyzes the impacts that could result from other mitigation measures associated with other resource chapters in this Draft Environmental Impact Report (Draft EIR).

28.0 Summary Comparison of Alternatives

Table 28-0 provides a summary comparison of important impacts on paleontological resources by alternative. The table presents the CEQA findings after all mitigation is applied. If applicable, the table also presents quantitative results after all mitigation is applied. This table provides information on the magnitude of the most pertinent impacts on paleontological resources that are expected to result from implementation of the alternatives. Important impacts to consider include the large amount of excavation that would occur in geologic units sensitive (i.e., have high or undetermined sensitivity) for paleontological resources. Impacts from surface excavation would be reduced to less than significant with implementation of Mitigation Measures PALEO-1a: *Prepare and Implement a Monitoring and Mitigation Plan for Paleontological Resources,* and PALEO-1b: *Educate Construction Personnel in Recognizing Fossil Material*. The impacts of tunneling and ground improvement, however, cannot be mitigated and would, therefore, cause a significant and unavoidable impact for all project alternatives. Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, 4c, and 5 vary in magnitude of excavation required, primarily for tunneling and ground improvement. Alternative 2b would require the least and Alternative 4a would require the greatest amount of excavation and ground improvement.

Table ES-2 in the Executive Summary provides a summary of all impacts disclosed in this chapter.

1 **Table 28-0. Comparison of Impacts on Paleontological Resources by Alternative**

	Alternative								
Chapter 28 – Paleontological Resources	1	2a	2b	2c	3	4a	4b	4c	5
Impact PALEO-1: Cause Destruction of a Unique Paleontological Resource as a Result of Surface Ground Disturbance	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Impact PALEO-2: Cause Destruction of a Unique Paleontological Resource as a Result of Tunnel Construction and Ground Improvement	SU	SU	SU	SU	SU	SU	SU	SU	SU

2 LTS = less than significant; SU = significant and unavoidable.

28.1 Environmental Setting

This section describes the environmental setting for paleontological resources in the study area.

For the purposes of this chapter, the paleontological resources study area (see Figure 28-1) refers to all areas that could involve excavation, construction, or other ground disturbance to construct the conveyance facilities and appurtenant features, such as tunnels, intakes, forebay, tunnel access shafts, levees, and new and improved roads for all the alternatives combined. The paleontological resources study area, which is the same as for geological resources, also includes a 0.5-mile buffer beyond the footprints of these areas, with the exception of power transmission lines, metering areas, and park-and-ride sites, which have a one-eighth-mile buffer. This buffer area allows for an assessment of the broader geologic context, such as the stratigraphic relationship between geologic units.

Paleontological resources, typically called fossils, are the remains, traces, imprints, or life history artifacts (e.g., nests) of prehistoric plants and animals found in ancient sediments, which may be either unconsolidated or lithified (i.e., either poorly or well cemented). Fossils are considered nonrenewable scientific and educational resources. Fossils include the bones and teeth of animals, the casts and molds of ancient burrows and animal tracks, and very small remains such as the bones of birds and rodents. They also include plant remains such as logs, prehistoric leaf litter, and seeds. Recovered specimens in the study area vicinity range from the shells of marine invertebrates to the bones and teeth of extinct Pleistocene megafauna, such as mammoths and giant ground sloths that are less than 200,000 years old (Figure 28-1).

No unique geologic features, such as those designated by the National Natural Landmarks Program, are known in the study area (National Park Service 2021) and are therefore not discussed further.

28.1.1 Study Area

This section addresses paleontological resources and the potential effects of the project alternatives on paleontological resources in the study area. Information sources for this section include geological, geomorphic, and sedimentological studies, and data from the University of California Museum of Paleontology (UCMP) paleontological database collected for the Delta and its surrounding areas.

The probability of encountering fossils (paleontological sensitivity) depends on the type of geology at an excavation site; the information below is related to geological resources to the extent necessary to assess the presence of fossils. The geological units present in the study area are discussed in Chapter 10, *Geology and Seismicity*. Figures from Chapter 10 that are helpful to understanding the information presented in this chapter include Figure 10-1, a map showing the geomorphic provinces of California; Figure 10-2, a geologic timescale; and Figure 10-3, a geologic map of the study area and vicinity. Figure 28-1 is a geologic map of the study area and vicinity that shows the paleontological sensitivity of geologic units exposed at the surface.

28.1.1.1 Paleontological Sensitivity of Potentially Affected Units

Paleontological sensitivity is a qualitative assessment that takes into account the paleontological potential of the stratigraphic units present, the local geology and geomorphology, and any other local factors that may be germane to fossil preservation and potential yield. According to the Society of Vertebrate Paleontology (SVP) (2010:2), standard guidelines for sensitivity are (1) the potential for a geological unit to yield abundant or significant vertebrate fossils or to yield a few significant fossils, large or small, vertebrate, invertebrate, or paleobotanical remains; and (2) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecological, or stratigraphic data (Table 28-1).

Table 28-1. Paleontological Sensitivity Ratings

Potential	Definition
High	Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. Paleontological potential consists of both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, plant, or trace fossils and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data.
Undetermined	Rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment are considered to have undetermined potential. Further study is necessary to determine if these rock units have high or low potential to contain significant paleontological resources.
Low	Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus only preserve fossils in rare circumstances and the presence of fossils is the exception not the rule.
No	Some rock units have no potential to contain significant paleontological resources, for instance high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require neither protection nor impact mitigation measures relative to paleontological resources.

Source: Society of Vertebrate Paleontology 2010:1–2.

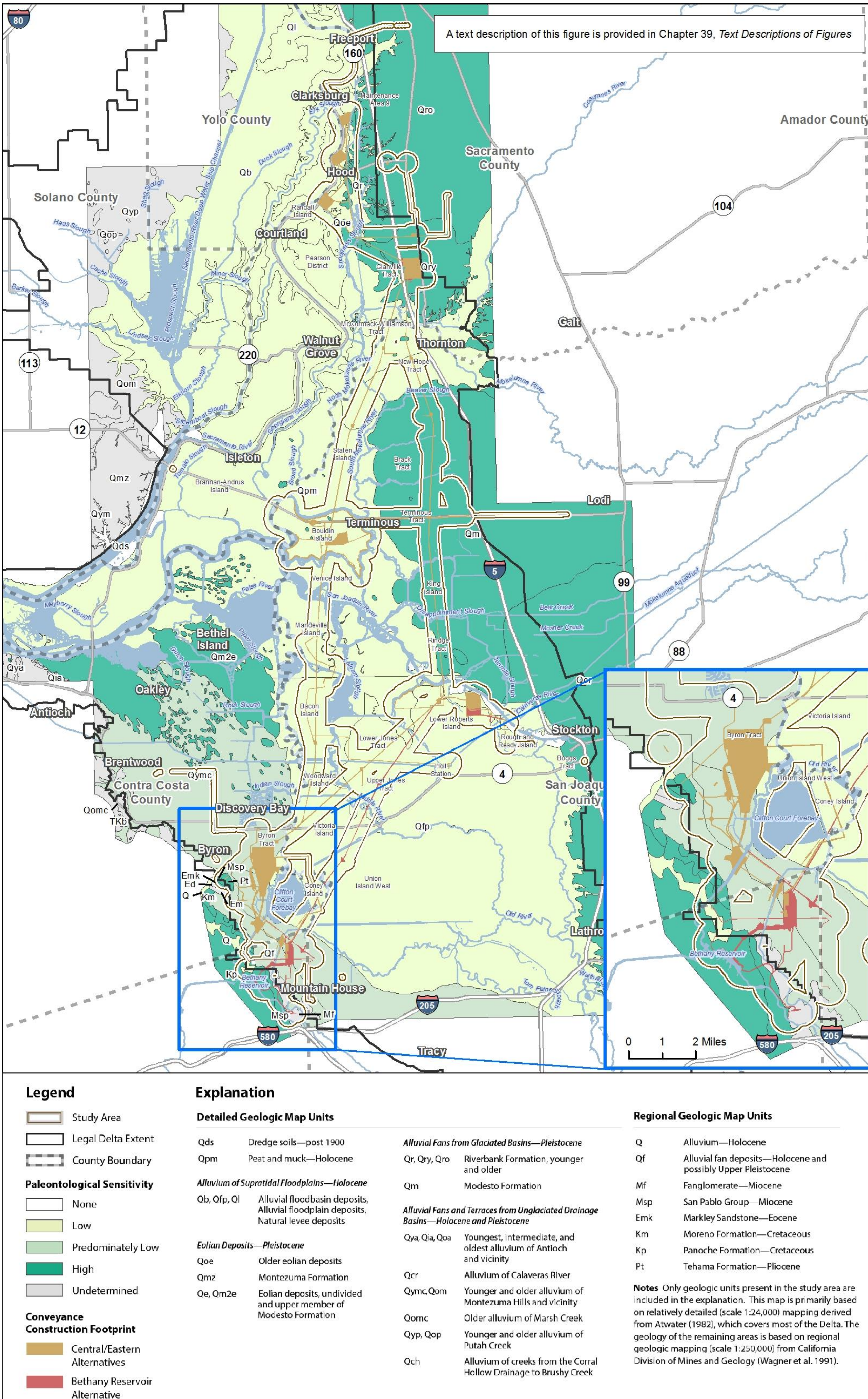

Figure 28-1. Paleontologically Sensitivity of Geologic Units Exposed at the Surface

SVP (2010:11) defines *significant paleontological resources* (i.e., scientifically important resources) as:

> fossils and fossiliferous deposits, here defined as consisting of identifiable vertebrate fossils, large or small, uncommon invertebrate, plant, and trace fossils, and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information. Paleontological resources are considered to be older than recorded human history and/or older than middle Holocene (i.e., older than about 5,000 radiocarbon years).

This analysis focuses on vertebrate paleontological resources because of their rarity and scientific importance. See Section 28.3.2, *Thresholds of Significance*, for more information on the use of vertebrate fossils in this analysis and the usage of *unique*.

Table 28-2 and the following sections describe the paleontological sensitivity of the geologic units found in the study area.

Table 28-2. Summary of Paleontological Sensitivity of Geologic Units in the Study Area

Geologic Unit Map Symbol	Geologic Unit	Depositional Environment	Age	UCMP Vertebrate Fossil Records in Counties of the Study Area	Paleontological Sensitivity
Qds	Hydraulic-dredge spoils	Hydraulic-dredge spoils	post-1900	None	None
Qpm	Peat and mud of tidal wetlands and waterways	Peat and mud of tidal wetlands and waterways	Holocene	None	Low
Qfp	Alluvial flood plain deposits undivided	Alluvium of supratidal floodplains	Holocene	None	Low
Ql	Natural levee deposits	Alluvium of supratidal floodplains	Holocene	None	Low
Qb	Flood basin deposits	Alluvium of supratidal floodplains	Holocene	None	Low
Q	Alluvium	Drainages	Holocene	None	Low
Qymc	Younger Alluvium of Marsh Creek	Alluvial fans and terraces from unglaciated drainage basins	Holocene to Upper Pleistocene	None known [b]	Predominately low [a]
Qch	Alluvium—Corral Hollow Drainage to Brushy Creek	Alluvial fans and terraces from unglaciated drainage basins	Holocene to Upper Pleistocene	None known [b]	Predominately low [a]
Qf	Alluvial fan deposits	Alluvial fans	Holocene and possibly Upper Pleistocene	None known [b]	Predominately low [a]
Qcr	Alluvium of Calaveras River	Alluvial fans and terraces from unglaciated drainage basins	Holocene to Upper Pleistocene	See Riverbank Formation	See Riverbank Formation

Geologic Unit Map Symbol	Geologic Unit	Depositional Environment	Age	UCMP Vertebrate Fossil Records in Counties of the Study Area	Paleontological Sensitivity
Qm2e	Eolian Deposits of Upper Modesto Formation	Eolian deposits	Upper Pleistocene	Unknown [c]	Undetermined
Qoe	Older Eolian Deposits	Eolian deposits	Upper Pleistocene	Unknown [c]	High
Qm	Modesto Formation	Alluvial fans from glaciated basins	Pleistocene	8 (Sacramento County)	High
Qr, Qry, Qro	Riverbank Formation undivided, younger, and older	Alluvial fans from glaciated basins	Upper Pleistocene	120 (Sacramento County)	High
Qtl [d]	Turlock Lake Formation	Alluvial fan	Pleistocene	None	High
Pt	Tehama Formation	Nonmarine	Pliocene	70 (Yolo County)	High
Mf	Fanglomerate	Alluvial fans	Miocene	None	Undetermined
Msp	San Pablo Group	Marine	Miocene	45 (Alameda, Contra Costa, and San Joaquin Counties)	High
Emk	Markley Sandstone	Marine	Eocene	4 (Contra Costa County)	High
Km	Moreno Formation	Marine	Cretaceous	None (but 80 in other counties, mainly in Fresno, Merced, and Stanislaus Counties)	High
Kp	Panoche Formation	Marine	Cretaceous	1 (Contra Costa County)	High

Source: University of California Museum of Paleontology 2021.

UCMP = University of California Museum of Paleontology.

[a] Although much of the unit is too young to contain vertebrate fossils, the lower, older layers may have the potential to contain fossils. However, few fossils from the Holocene are recorded in California (except in association with caves) and no vertebrate fossils from the Holocene are recorded in the study area or vicinity (University of California Museum of Paleontology 2021).

[b] Atwater named these units based on *drainage* of origin and relative age, and this naming system is not widely used. Therefore, fossils could be recorded for this unit under a different name, such as the Modesto Formation.

[c] It is unknown whether the UCMP records for the Modesto Formation apply to these eolian deposits, which may not be sufficiently consolidated for fossil preservation.

[d] The Turlock Lake Formation is not exposed at the surface in the study area and is therefore not shown on Figure 28-1. It underlies the Riverbank Formation in the northern portion of the study area (Maier et al. 2013).

Hydraulic-Dredge Spoils

Hydraulic-dredge spoils, which are post-1900, occur in the eastern portion of the study area along the San Joaquin River (Atwater 1982:map sheets 16, 17). Intact fossil material is not expected in hydraulic dredge spoils because this type of deposit is made up of disturbed sediment. If fragmentary remains were encountered, they would lack scientific significance because they would not be in stratigraphic context, which means the age and geologic setting of the fossil would be uncertain; without this information, the fossil's scientific utility would be compromised. Therefore, hydraulic-dredge spoils have no paleontological sensitivity.

Peat and Mud of Tidal Wetlands and Waterways

Peat and mud sediments of tidal wetlands and waterways are widespread in the central portion of the study area (Atwater 1982:map sheets 10, 11, 15, 16). These deposits are typically Holocene (less than 10,000 years Before Present) in age, and, because of their young age, they are unlikely to contain megafossils. Muds and peats provide a rich source of microfossils for paleoenvironmental studies, but microfossils exist in the uncounted trillions throughout deposits of estuarine mud and peat and are therefore not rare. Because these deposits are recent in age and seldom yield megafossils, estuarine sediments, including peat, are assigned low paleontological sensitivity. No vertebrate fossils are recorded from these peat and mud sediments (University of California Museum of Paleontology 2021). Underlying these sediments are older Pleistocene sediments.

Alluvium

Alluvium of supratidal floodplains, named by Atwater (1982:map sheets 1, 18, 19), are widespread in the northern and southeastern portions of the study area. These Holocene deposits are made up of alluvium originating in the western Sierra Nevada and washed down by the Sacramento and San Joaquin Rivers and their tributaries and deposited above the limit of high tides in a variety of fluvial environments. They are made up of undivided alluvial floodplain deposits, natural levee deposits, and flood basin deposits (Atwater 1982:8). These formed as part of an anastomosing (multichannel, low energy but dynamic) river system, made up of a network of channels, both active and abandoned; islands; and wetlands. In this environment, clay-rich sediment was deposited in flood basins between natural levees (Florsheim and Mount 2003:305–306). The relatively fine-grained sedimentary composition of these units and their deposition in slowing, low energy fluvial environments may indicate conditions suitable for fossil preservation. Although much of the alluvium is too young to contain vertebrate fossils, the lower, older layers may have the potential to contain fossils. The paleontological sensitivity of these deposits therefore is predominately low but may have potentially high sensitivity in stratigraphically lower older localities. However, few fossils from the Holocene are recorded in California (except in association with caves or oil seeps), and no vertebrate fossils from the Holocene are recorded in the study area or vicinity (University of California Museum of Paleontology 2021).

The alluvial fan deposits mapped by Wagner et al. (1991) occur in drainages on the southwestern edge of the study area. These deposits are Holocene in age and made up of unconsolidated stream and basin deposits and are considered too young to contain fossils. The paleontological sensitivity of these deposits is therefore low.

Alluvial Fans

Alluvial fans and terraces from unglaciated drainage basins deposits, named by Atwater (1982:4–5), are present in the southern and eastern most portions of the study area and occur where streams emerged from upland areas and flowed onto more gently sloping valley floors or plains (Atwater 1982:4–5). The units that make up these deposits are the alluviums of Marsh Creek, Corral Hollow Drainage to Brushy Creek, and Calaveras River. These units are older than the supratidal floodplain alluvium, and, similar to the supratidal deposits, the Marsh Creek and Corral Hollow Drainage to Brushy Creek alluviums have some potential to contain vertebrate fossils. Atwater named these units based on *drainage* of origin and relative age, and this naming is not widely used. On the Wagner et al. (1991) regional map, these units correlate with the Quaternary fan deposits, except for the Calaveras River alluvium, which notably is mapped as the Modesto Formation (see discussion in

Alluvial Fans from Glaciated Basins). Though there may be some areas with high sensitivity, the paleontological sensitivity of the Marsh Creek and Corral Hollow Drainage to Brushy Creek alluviums is overall generally low. Few fossils from the Holocene are recorded in California (except in association with caves), however, and no vertebrate fossils from the Holocene are recorded in the study area or vicinity (University of California Museum of Paleontology 2021). The paleontological sensitivity of the Calaveras River alluvium is high, based on its correlation with the Modesto Formation.

The alluvial fan deposits mapped by Wagner et al. (1991) are assumed to correlate with the alluvium of Corral Hollow Drainage to Brushy Creek described by Atwater (1982:5) because of their colocation and descriptions. The paleontological sensitivity of these fan deposits is, therefore, generally low.

Eolian Deposits

The eolian deposits occur in scattered pockets throughout the study area. These Pleistocene windblown dune deposits are largely related to the Modesto Formation and form a mantle of varying thicknesses over older materials. Most of the deposits are thought to be associated with the latest Pleistocene to early Holocene periods of low sea level, during which large volumes of fluvial (i.e., pertaining to a river or stream) and glacially derived sediment from the Sierra were blown into the dunes (Atwater 1982:7–8). Although it is not clear whether the conditions necessary for fossil preservation are present in these deposits, because of their association with the Modesto Formation (see discussion in Alluvial Fans from Glaciated Basins), these deposits are assigned a paleontological sensitivity of high.

Alluvial Fans from Glaciated Basins

The alluvial fans from glaciated basins in the study area are made up of the Modesto and Riverbank Formations of Pleistocene age. These deposits occur extensively throughout the study area and underlie many of the younger deposits, such as the peat and mud deposits, eolian deposits, and younger alluvial deposits. California's Pleistocene sedimentary units—especially those that, like the Riverbank and Modesto Formations, record deposition in continental settings—are typically considered highly sensitive for paleontological resources because of the large number of recorded fossil finds in such units throughout the state.

Modesto Formation

The broad alluvial fans of the Modesto Formation extend from the foothills of the Sierra Nevada to the western edge of the Central Valley, where they are overlain by Holocene alluvial, eolian deposits, and peat and mud deposits (Wagner et al. 1991). In the study area, the Modesto Formation occurs over much of the eastern extent. Examples of vertebrate fossils recorded in the Modesto Formation in counties in the study area include unspecified mammals and reptiles. Farther to the south, mammoth (*Mammuthus*), bison (*Bison*), camel (*Camelops*), and ground sloth (*Megalonyx*) fossils have also been found and recorded (University of California Museum of Paleontology 2021). Because of these vertebrate records, the Modesto Formation is considered highly sensitive for paleontological resources.

Riverbank Formation

The Riverbank Formation also forms broad alluvial fans across the Central Valley but is older than Modesto Formation and exposed on the eastern edge of the valley. It underlies much of the extent of the younger Modesto Formation (Wagner et al. 1991; Helley and Harwood 1985:1). The Pleistocene age of the Riverbank Formation is well represented by fossils recovered from excavations at the Arco Arena site in 1989 and more than a dozen other localities. Fossil finds in the Riverbank Formation in the counties of the study area (specifically Sacramento County) include mammoth, bison, camel, horse (*Equus*), ground sloth, dire wolf (*Canis*), coyote, a variety of rodents (e.g., *Neotoma*, *Thomomys*), rabbit (*Lepus*), birds (e.g., *Tadorna, Aythya*), toad (*Scaphiopus*), and bony fish (*Osteichthyes*) (University of California Museum of Paleontology 2021). Because of these vertebrate records, the Riverbank Formation is considered highly sensitive for paleontological resources.

Turlock Lake Formation

The Turlock Lake Formation is made up of fluvial and alluvial deposits that represent eroded alluvial fans derived primarily from the plutonic rocks of the Sierra Nevada to the east (Helley and Harwood 1985:11, 12). It is not exposed at the surface in the study area but is present in the relatively shallow subsurface in the northern portion of the study area, which is at the thinning margin of the overlying Modesto and Riverbank Formations (Maier et al. 2013). It is well known for the vertebrate fossils that have been recovered from this unit in the Central Valley. The Irvingtonian (approximately 780,000 years old) Fairmead Landfill locality in Madera County contains significant vertebrate fossils from this formation, including remains of horse, ground sloth, saber-toothed cat, Armbruster's wolf, scimitar-toothed cat, *Tetrameryx irvingtonensis* Stirton (ancestor to modern pronghorn), deer, camel, mammoth, rodents, *Capromeryx* (pronghorn-like ungulates), coyote, turtle, and tortoise (Dundas et al. 1996:1, 54). Because of these vertebrate records, the Turlock Lake Formation is considered highly sensitive for paleontological resources.

Older Units on Southwestern Edge of Study Area

Tehama Formation

There are 175 vertebrate fossils records from the Tehama Formation, including a large number of horses (e.g., *Equus simplicidens*, *Nannippus*, and *Pliohippus*) and bony fish, as well as rodents (e.g., *Reithrodontomys*, *Peromyscus*, and *Neotoma*) and deer (*Odocoileus*) (University of California Museum of Paleontology 2021). The 71 records known from counties in the study area are mainly of early horse and fish fossils. The paleontological sensitivity for this unit is therefore considered high.

Miocene Fanglomerate

Although there are no records of fossils in the UCMP database for the Miocene fanglomerate, including its members the Oro Lomo Formation and the Carbona Formation, the alluvial depositional environment and the age of the unit indicate that fossils could be preserved in the unit. The paleontological sensitivity for this unit is therefore considered undetermined.

San Pablo Group

The San Pablo Group contains a number of vertebrate fossils, as well as a rich diversity of plant fossils. The UCMP database contains 45 records of vertebrate fossils from the Briones and Neroly Formations. These fossils include bony fish, cartilaginous fish (*Chondrichthyes*), reptiles, birds, a genus of three-toed horse (Nannippus), dwarf pronghorn (*Capromeryx*), and desmostylia

(*Desmostylus*), a group of marine mammals known only from the Late Oligocene and Miocene who are thought to have been herbivores and most closely related to elephants and sea-cows (University of California Museum of Paleontology 2021). Given the presence of vertebrate fossils, the paleontological sensitivity for this unit is considered high.

Markley Sandstone

The Markley Sandstone contains the Eocene fossils of bony fish (*Osteichthyes*). There are four records of fossils from the unit in Contra Costa County (University of California Museum of Paleontology 2021). Although fish fossils may not be considered unique because of their abundance and widespread distribution, there is potential for the presence of scientifically significant resources. The paleontological sensitivity for this unit is therefore considered high.

Moreno and Panoche Formations

The Moreno and Panoche Formations are both Cretaceous units known to contain vertebrate fossils. Although there are no records of fossils from the Moreno Formation in the counties of the study area, there are more than 80 records of vertebrate fossils from this unit (mainly in Fresno, Merced, and Stanislaus Counties), including bony fish, cartilaginous fish, and marine reptiles such as plotosaurus (*Plotosaurus*) and morenosaurus (*Morenosaurus*). One record of a reptile is known from the Panoche Formation (University of California Museum of Paleontology 2021). Given the presence of vertebrate fossils, the paleontological sensitivity for this unit is considered high.

Borrow Material

On-site borrow pits have been identified at several locations, such as the intakes, the Twin Cities Complex, Lower Roberts Island, and the Southern Complex. Maximum excavation depths at these locations are anticipated to be approximately 10 feet at the Twin Cities Complex for all alignments and between 5 and 10 feet at Lower Roberts Island, depending on the alternative (Delta Conveyance Design and Construction Authority 2022a:4, 2022b:4). Geologic units with a high potential to contain paleontological resources that could be affected by excavation for borrow in these locations include the Modesto Formation and the Riverbank Formation (Figure 28-1). These units are briefly described, and a paleontological sensitivity assigned, in Table 28-2.

Off-site borrow would come from existing, permanent, permitted facilities.

28.2 Applicable Laws, Regulations, and Programs

The applicable laws, regulations, and programs considered in the assessment of project impacts on paleontological resources are indicated in Section 28.3.1, *Methods for Analysis*, or the impact analysis, as appropriate. Applicable laws, regulations, and programs associated with state and federal agencies that have a review or potential approval responsibility have also been considered in the development of CEQA impact thresholds or are otherwise considered in the assessment of environmental impacts. A listing of some of the agencies and their respective potential review and approval responsibilities, in addition to those under CEQA, is provided in Chapter 1, *Introduction*, Table 1-1. A listing of some of the federal agencies and their respective potential review, approval, and other responsibilities, in addition to those under NEPA, is provided in Chapter 1, Table 1-2.

28.3 Environmental Impacts

This section describes the direct and cumulative environmental impacts associated with paleontological resources that would result from project construction, operation, maintenance of the project, and compensatory mitigation. It describes the methods used to determine the impacts of the project and lists the thresholds used to conclude whether an impact would be significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant impacts are provided. Indirect impacts are discussed in Chapter 31, *Growth Inducement*.

28.3.1 Methods for Analysis

SVP's *Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources* provides standard guidelines that are widely followed (Society of Vertebrate Paleontology 2010:1–11). These guidelines reflect the accepted standard of care for paleontological resources. The SVP guidelines identify two key phases in the process for protecting paleontological resources from project impacts.

- Assess the likelihood that the project's area of potential effect contains significant paleontological resources that could be impacted, damaged, or destroyed as a result of the project.
- Formulate and implement measures to mitigate potential impacts.

An important strength of SVP's approach to assessing potential impacts on paleontological resources is that the SVP guidelines provide some standardization in evaluating a study area's paleontological sensitivity. Table 28-3 defines the SVP's sensitivity categories for paleontological resources and summarizes SVP's recommended treatments to mitigate impacts on geologic units with high or undetermined sensitivity.

Table 28-3. Society of Vertebrate Paleontology's Recommended Treatment for Paleontological Resources

Sensitivity Category	Mitigation Treatment
High or Undetermined	• An intensive field survey and surface salvage prior to earth moving, if applicable. • Monitoring by a qualified paleontological resource monitor of excavations. • Salvage of unearthed fossil remains and/or traces (e.g., tracks, trails, burrows). • Screen washing to recover small specimens, if applicable. • Preliminary survey and surface salvage before construction begins. • Preparation of salvaged fossils to a point of being ready for curation (i.e., removal of enclosing matrix, stabilization and repair of specimens, and construction of reinforced support cradles where appropriate). • Identification, cataloging, curation, and provision for repository storage of prepared fossil specimens. • A final report of the finds and their significance.
Low or no	Rock units with low or no potential typically will not require impact mitigation measures to protect fossils.

Source: Society of Vertebrate Paleontology 2010:3–4.

28.3.1.1 Process and Methods of Review for Paleontological Resources

The primary source of information used in developing this section is the paleontological database at the UCMP (2021). Effects on paleontological resources were analyzed qualitatively on a large-scale level, based on professional judgment and the SVP guidelines (Society of Vertebrate Paleontology 2010:1–11) (Table 28-3).

28.3.1.2 Evaluation of Construction Activities

The impacts of construction activities were evaluated by determining the geologic units that would be disturbed by construction of Delta Conveyance Project facilities, both at the surface and at depth, and evaluating the paleontological sensitivity of those units. Paleontological sensitivity determinations were based first on review of records in the paleontological database at the UCMP. If a geologic unit in the study area was not listed in the database, the depositional and lithologic (i.e., physical characteristics, such as grain size and degree of consolidation) characteristics were considered to determine the potential for the preservation of fossils.

Table 28-4 provides the excavation quantities associated with the major excavation activities for each alternative and preliminary information on on-site borrow quantities. Excavation values represent excavation below ground surface and do not include overlying spoils, which are previously disturbed and therefore not included in the analysis. Further information about on-site borrow is provided in Table 28-5. Off-site borrow is not analyzed because off-site borrow would come from existing, permanent, permitted facilities and were therefore already analyzed and permitted.

Table 28-6 shows the locations where ground improvement would occur in sediments prone to liquefaction (Chapter 10, *Geology and Seismicity*). Ground improvement would consist of a combination of ground-disturbing activities, such as excavation of unsuitable soils and replacement with compacted suitable fill material and deep soil mixing, an in-situ technique to mix amendments, such as cement grout, into the foundation to improve stability. However, the term *ground improvement* in this analysis applies only to deep soil mixing and other subsurface improvements because excavation of unsuitable soils regarding paleontological resources would be treated in the same way as other surface excavation. Ground improvement would generally occur in sandy Holocene sediments because these sediments are young and tend to be poorly consolidated, whereas the older Pleistocene units have higher densities and are not prone to liquefaction. However, as described in the Liquefaction and Ground Improvement Analysis (Final Draft) Technical Memorandum (Delta Conveyance Design and Construction Authority 2022d:6–16), the depth of ground improvements may be as much as 70 feet in some locations and extend into the Modesto and Riverbank Formations. Although, with further geotechnical refinement it may be determined that ground improvement may be limited to the Holocene units, this analysis assumes the Modesto and Riverbank Formations, which are sensitive for paleontological resources, would be affected by ground improvement. Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c would require the same ground improvements at the Southern Forebay embankments and the South Delta Pumping Plant, so relative comparisons of these alternatives is based on the number of intakes and shafts.

Areas where the ground has already been disturbed, such as agricultural fields and developed areas, were not considered sensitive for paleontological resources because any fossils that might be found in these areas would have been removed from their stratigraphic context and important scientific information would have already been lost. Therefore, excavation in disturbed areas, to the depth of the disturbance, was not considered to have an impact on paleontological resources.

Table 28-4. Major Excavation by Project Feature and Alternative

Alternative	On-Site Borrow (CCY)	Intakes	Intakes Total Area of Disturbance (acres) [a]	Total Intakes Excavation (CCY)	Main Tunnel Length (miles) [c]/ Diameter (feet)	Dual Tunnel Length (miles)/ Diameter (feet)	Single Jones Tunnel Length (miles)/ Diameter (feet)	Total Shaft Excavation (CCY)	Total Tunnel Excavation (million LCY) [b, d]	Southern Complex Total Area of Disturbance (acres)	Total Southern Complex Excavation (CCY) [b]	Bethany Complex Total Area of Disturbance (acres)	Total Bethany Complex Excavation (CCY)
1	945,783	B/C	481	2,957,763	39/39	1.7/41	N/A	526,805	13.9	1,621	5,909,548	N/A	N/A
2a [b]	989,051	A/B/C	647	4,246,341	42/44	1.7/44	22/1.5	570,384	18.4	1,750	7,384,474	N/A	N/A
2b	929,292	C	239	1,412,850	37/28	1.7/41	N/A	452,211	7.5	1,621	5,870,662	N/A	N/A
2c	938,363	B/C	462	2,560,090	39/34	1.7/41	N/A	482,296	10.7	1,621	5,888,562	N/A	N/A
3	863,141	B/C	481	2,957,765	42/39	1.7/41	N/A	562,311	14.8	1,652	5,971,610	N/A	N/A
4a [b]	915,809	A/B/C	647	4,246,341	44/44	1.7/44	22/1.5	611,125	19.5	1,805	7,463,529	N/A	N/A
4b	822,578	C	239	1,412,850	40/28	1.7/41	N/A	474,814	7.9	1,621	5,903,386	N/A	N/A
4c	842,442	B/C	462	2,560,090	42/34	1.7/41	N/A	512,148	11.3	1,639	5,934,792	N/A	N/A
5	1,004,936	B/C	481	2,957,767	45/39	N/A	N/A	598,003	14.4	N/A	N/A	390	2,445,930

Note: Excavation represents excavation below ground surface and does not include overlying spoils, which are previously disturbed and therefore not included in the analysis.

N/A = not applicable; LCY = loose cubic yards, which is the volume of bulk soil material placed or piled; CCY = compact cubic yards, which is the volume after the material has been compacted by construction equipment.

[a] The entire construction area would not be disturbed, depth of excavation would vary across the area, and much of the excavation would be relatively shallow.

[b] Alternatives 2a and 4a include an additional single Jones Tunnel that would be 1.5 miles long and have an outside diameter of 22 feet. This excavation amount is included in the Total Tunnel Excavation volume.

[c] For Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c, the main tunnel extends from the intakes to the Southern Complex, and for Alternative 5, the main tunnel extends from the intakes to the Bethany Reservoir Pumping Plant and Surge Basin.

[d] Wet excavated volume, which is the volume of bulk material, including conditioners, placed or piled after excavation and before it is dried.

Table 28-5. Borrow Volume by Formation

Alternative	Alignment	Total Borrow Volume [a, b]	Riverbank Formation [c] (Twin Cities)	Holocene Deposits (Lower Roberts)
1	Central	945,783	945,783	Does not Apply
2a	Central	989,051	989,051	Does not Apply
2b	Central	929,292	929,292	Does not Apply
2c	Central	938,363	938,363	Does not Apply
3	Eastern	863,141	559,196	303,945
4a	Eastern	915,809	604,430	311,379
4b	Eastern	822,578	531,325	291,253
4c	Eastern	842,442	546,315	296,127
5	Bethany	1,004,936	609,193	395,743

[a] All volumes in compact cubic yards (CCY).
[b] Volumes do not include topsoil.
[c] Formation Reference: Atwater 1982:6–8.

Table 28-6. Ground Improvement Locations

Location	Geologic Units Affected
Intakes A, B, and C	Holocene sediments overlying the Riverbank and Modesto Formations
Tunnel shafts (all alignments, all shafts except at Twin Cities Complex and at the Bethany Reservoir Surge Basin reception shaft)	Holocene sediments overlying the Modesto and/or Riverbank Formations
Southern Forebay embankments (central and eastern alignments)	Holocene sediments and Modesto Formation sands overlying the Modesto Formation, alluvium of Corral Hollow Drainage to Brushy Creek, Younger Alluvium of Marsh Creek
South Delta Pumping Plant (central and eastern alignments)	Modesto Formation and alluvium of Corral Hollow Drainage to Brushy Creek

28.3.1.3 Evaluation of Operations and Maintenance

The impacts of operation and maintenance activities were evaluated by determining which activities would cause ongoing ground disturbance and if those ground-disturbing activities would occur in geologic units sensitive (i.e., with high or undetermined sensitivity) for paleontological resources.

28.3.2 Thresholds of Significance

This impacts analysis assumes that a project alternative would have a significant impact under CEQA if implementation would result in the following condition:

- Destroy a unique paleontological resource.

Although CEQA does not define “unique paleontological resource,” the California Public Resources Code (5097.5) specifies vertebrate fossils in its protection of paleontological sites, and the presence of vertebrate fossils is used by agencies such as the U.S. Department of Interior Bureau of Land Management (Potential Fossil Yield Classification System) and the California Department of Transportation to determine the scientific importance and paleontological sensitivity of geologic units. According to the California Department of Transportation Standard Environmental Reference (California Department of Transportation 2014:10):

> Terrestrial vertebrate fossils are often assigned greater significance than other fossils because they are rarer than other types of fossils. This is primarily due to the fact that the best conditions for fossil preservation include little or no disturbance after death and quick burial in oxygen depleted, fine-grained, sediments. While these conditions often exist in marine settings, they are relatively rare in terrestrial settings (e.g., as a result of pyroclastic flows and flashflood events). This has ramifications on the amount of scientific study needed to adequately characterize an individual species and therefore affects how relative sensitivities are assigned to formations and rock units.

In addition, all vertebrate fossils contribute to our understanding of evolution and changes in ecosystems and determining the "uniqueness" of a vertebrate fossil often requires examination in the laboratory (Scott and Springer 2003:5–7). Therefore, given the rarity of vertebrate fossils and their scientific importance, all terrestrial vertebrate fossils are considered unique for the purposes of this analysis, even though there may be numerous vertebrate fossils of the same kind already in collections. Geologic units sensitive for paleontological resources (i.e., with a high or undetermined sensitivity rating, as shown in Table 28-1) were considered to have potential to contain unique paleontological resources.

Effects on paleontological resources were analyzed qualitatively, and the analysis focused on (1) identifying activities with the potential to destroy paleontological resources if any are present on the work site and (2) developing a strategy to implement mitigation requiring paleontological sensitivity assessment and appropriate treatment developed on a site-specific basis for those activities identified as likely to result in destruction of paleontological resources.

Two factors are considered when evaluating a proposed project's potential to destroy paleontological resources. First, most vertebrate fossils are rare and are therefore considered important paleontological resources. Second, unlike archaeological sites, which are narrowly defined, paleontological sites are defined by the entire extent (both areal and stratigraphic) of a unit or formation. In other words, once a unit is identified as containing vertebrate fossils or other rare fossils, the entire geologic unit is a considered sensitive for paleontological resources (Society of Vertebrate Paleontology 2010:2).

This impact analysis assumes that a project alternative would have a significant impact under CEQA on paleontological resources if the alternative would destroy a unique paleontological resource. For all project alternatives, operation and maintenance activities are not expected to affect paleontological resources. Operation activities would not affect paleontological resources because these activities would involve existing waterways and structures, which would not cause ground disturbance. Maintenance of project facilities would not affect paleontological resources because these activities would primarily involve maintenance of tunnels, shafts, gates, sedimentation basins, lagoons, and equipment and minor vegetation control and would not involve ground-disturbing activities or substantially increase erosion. Therefore, paleontological resources would not be destroyed or affected as a result of operation or maintenance of any of the project alternatives.

28.3.2.1 Evaluation of Mitigation Impacts

CEQA also requires an evaluation of potential impacts caused by the implementation of mitigation measures. Following the CEQA conclusion for each impact, the chapter analyzes potential impacts associated with implementing both the Compensatory Mitigation Plan and the other mitigation measures required to address with potential impacts caused by the project. Mitigation impacts are considered in combination with project impacts in determining the overall significance of the project. Additional information regarding the analysis of mitigation measure impacts is provided in Chapter 4, *Framework for the Environmental Analysis*.

28.3.3 Impacts and Mitigation Approaches

28.3.3.1 No Project Alternative

As described in Chapter 3, *Description of the Proposed Project and Alternatives,* CEQA Guidelines Section 15126.6 directs that an EIR evaluate a specific alternative of “no project” along with its impact. The No Project Alternative in this Draft EIR represents the circumstances under which the project (or project alternative) does not proceed and considers predictable actions, such as projects, plans, and programs, that would be predicted to occur in the foreseeable future if the Delta Conveyance Project is not constructed and operated. This description of the environmental conditions under the No Project Alternative first considers how paleontological resources could change over time and then discusses how other predictable actions could affect paleontological resources.

Future Paleontological Resources Conditions

For paleontological resources, future conditions are not anticipated to substantially change compared to existing conditions because future conditions are not expected to affect paleontological resources if the project (or project alternatives) does not proceed. Sea level rise, changes in hydrologic conditions and water quality, and continued seismic risk would not affect paleontological resources because they are buried resources. A levee break caused by a seismic event could cause erosion, but it is not expected this erosion would be deep enough to affect paleontological resources.

Predictable Actions by Others

A description of actions included as part of the No Project Alternative is provided in Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*. As described in Chapter 4, *Framework for the Environmental Analysis,* the No Project Alternative analyses focus on identifying the additional water-supply-related actions public water agencies may opt to follow if the Delta Conveyance Project does not occur.

Public water agencies participating in the Delta Conveyance Project have been grouped into four geographic regions. The water agencies within each geographic region would likely pursue a similar suite of water supply projects under the No Project Alternative (see Appendix 3C).

Many of these projects, such as construction of desalination plants or water recycling facilities, would involve construction of facilities which would require ground-disturbing activities by individual public water agencies to ensure local water supply reliability for its constituents.

Construction of water supply reliability projects would result in ground-disturbing activities that could destroy unique paleontological resources. Table 28-7 provides examples of geologic units sensitive for paleontological resources that could be affect by the projects.

Table 28-7. Examples of Sensitive Geologic Units That Could be Affected under the No Project Alternative

Region	Examples of Geologic Units with Potential to Contain Sensitive Paleontological Resources That Could Be Affected	Examples of Fossils Known to Occur in These Units [a]
Northern Coastal	Orinda and Briones Formations and Irvington Gravels	Horses, cat, camel, rhinoceros, elephant, *Desmostylus* (marine mammal somewhat like a sea cow), birds, bony and cartilaginous fishes, *Tetrameryx* (relative of the pronghorn), and tortoise
Northern Inland	Briones, Santa Clara, Modesto, and Riverbank Formations	Horses, elephant, camel, tortoise, bison, horse, bony fish, ground sloths, bison, mammoth, rodents, coyote, badger, and fox
Southern Coastal	Monterey, Santa Margarita, Caliente, and Sespe Formations	*Desmostylus,* toothed whales, bony and cartilaginous fishes, bird, oreodonts, horses (many species), rodents, camel, other artiodactyls, and canid
Southern Inland	Bopesta, Ricardo, Tulare, San Joaquin, and Barstow Formations	Horses (many species), oredont, camel, deer, other artiodactlys, barbourofelis (felid), mustelid, canids, rabbit, bird, mastodon, beaver, and peccary

Source: University of California Museum of Paleontology 2021.

Desalination projects would most likely be pursued in the northern and southern coastal regions. The southern coastal regions would likely pursue larger and more desalination projects than the northern coastal region in order to replace the water yield that otherwise would have been received through the Delta Conveyance Project. These projects would be sited near the coast. Groundwater recovery (brackish water desalination) would involve similar types of ground disturbance but could occur across the northern inland, southern coastal, southern inland regions and in both coastal and inland areas, such as the San Joaquin Valley. Grading and excavation at the desalination and groundwater recovery plant sites would be necessary for construction of foundations, and trenching would occur for installation of water delivery pipelines and utilities. Examples of geologic units sensitive for paleontological resources that could be affected by these types of projects are shown on Table 28-7. Ground-disturbing activities in these types of units could unearth, expose, or destroy vertebrate fossils. These types of water supply projects are more likely to affect paleontological resources due to the size of the area needed to accommodate construction activities and permanent facilities. However, these facilities would most likely be constructed in an already developed area zoned for commercial or industrial uses.

The northern and southern coastal regions are also most likely to explore constructing groundwater management projects. The southern coastal region would pursue more or larger capacity projects than the northern coastal region under the No Project Alternative if water suppliers in those regions were to pursue desalinization as part of their efforts to meet demands in the absence of the Delta Conveyance Project. Groundwater management projects would occur in association with an underlying aquifer but could occur in a variety of locations and therefore affected a variety of geologic units. Construction activities for each project could require excavation for the construction of the recharge basins, and pipelines and drilling for the construction of recovery wells (with completion intervals between approximately 200 and 900 feet below ground surface). Construction activities would include excavation and backfill and construction of basins, pipelines, pump stations, and the turnout. Grading activities associated with the construction of recharge basins would involve earthmoving, excavation, and grading. Pipelines would likely be constructed using typical open trench construction methods. In some cases where siphons would be installed, jack and bore methods could be used to tunnel under and avoid disruption of surface features. Examples of geologic units sensitive for paleontological resources that could be affected by these types of projects are shown on Table 28-7. Excavation of varying depths could be required, and these construction activities have the potential to occur in geologic units sensitive for paleontological resources or affect unique geologic features.

Water recycling projects could be pursued in all four regions. The southern coastal region would pursue the greatest number of wastewater treatment/water reclamation plants, followed by the northern coastal region, followed by the northern inland region if water suppliers in those regions were to pursue recycling as part of their efforts to meet demands in the absence of the Delta Conveyance Project. The southern inland region would pursue the greatest number or size of water recycling projects to replace the anticipated water yield that it would have otherwise received through the Delta Conveyance Project. Typically, these projects would be located at or near existing water treatment facilities. Construction techniques for water recycling projects would vary depending on the type of project (e.g., for landscape irrigation, groundwater recharge, dust control, industrial processes) but could require earth moving activities, grading, excavation, and trenching. Because construction would involve ground-disturbing activities, such actions could occur in geologic units sensitive for paleontological resources and thereby unearth, expose, or disturb vertebrate fossils. In the southern inland region where a greater number of projects would be needed as a substitute for the Delta Conveyance Project, the potential for impact would also be greatly increased. Examples of geologic units sensitive for paleontological resources that could be affected by these types of projects are shown on Table 28-7.

Water efficiency projects involving ground disturbance could be pursued in all four regions and involve a wide variety of project types, such as flow measurement or automation in a local water delivery system, lining of canals, use of buried perforated pipes to water fields, and additional detection and repair of commercial and residential leaking pipes. These projects could occur anywhere in the regions, and most would involve little ground disturbance or would occur in previously disturbed areas.

As detailed above, all project types across all regions would involve relatively typical construction techniques (i.e., no large-scale tunnels) and would be required to conform with the requirements of CEQA and/or state and local regulations protecting paleontological resources. As such, mitigation measures would be developed to protect these resources, such as requiring paleontological monitoring in areas known to have geologic units sensitive for paleontological resources and requiring stop-work measures in the event unexpected fossils are encountered.

These projects are examples of water reliability projects that could occur if the project was not approved and project objectives were not met. While it cannot be anticipated what ultimate suite of projects would be chosen by each of the regions, it would likely be a mix of various types of projects reasonably feasible within that region, as outlined in Chapter 3, *Description of the Proposed Project* *and Alternatives,* and Appendix 3C, *Defining Existing Conditions, No Project Alternative, and Cumulative Impact Conditions*. Under the No Project Alternative, declining surface water supply reliability, paired with decreasing groundwater, may result in water supplies that are not able to meet demand in some areas (see Section 6.4.2.1 for more information).

28.3.3.2 Impacts of the Project Alternatives on Paleontological Resources

Impact PALEO-1: Cause Destruction of a Unique Paleontological Resource as a Result of Surface Ground Disturbance

Alternatives 1, 2a, 2b, and 2c

<u>*Project Construction*</u>

Construction of water conveyance facilities under Alternatives 1, 2a, 2b, and 2c could cause the destruction of unique paleontological resources as a result of surface ground disturbance from excavation.

Excavation for intakes, tunnel shafts and shaft pads, other water facility components, roads, and on-site borrow could cause the destruction of unique paleontological resources if excavation for these project features occurs in geologic units highly sensitive for paleontological resources. Figure 10-3 (Chapter 10, *Geology and Seismicity*, Section 10.1.1.2, *Local Geology*) shows the location of the alternatives in relation to geologic units; Table 28-2 and Figure 28-1 show the paleontological sensitivity of these units. Table 28-8 provides the extent of ground-disturbing activities for the intakes, tunnel shafts and shaft pads, as well as the Southern Complex and the geologic units sensitive for paleontological resources that would be disturbed under Alternatives 1, 2a, 2b, and 2c. Table 28-4 provides the volume of material that would be excavated as a result of these activities.

The depth, extent, and location of major excavation and other ground-disturbing activities vary greatly across the study area. Accordingly, this discussion considers these activities on the basis of their location and the depth of excavation.

Table 28-8. Summary of Conveyance Construction Activities and Geologic Units Sensitive for Paleontological Resources That Could Be Disturbed along the Central Alignment (Alternatives 1, 2a, 2b, and 2c)

Feature [a]	Construction for Alternative 1 [a]	Construction for Alternative 2a [a]	Construction for Alternative 2b [a]	Construction for Alternative 2c [a]	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed [b]	Approximate Depth to Sensitive Geologic Unit (up to 120 feet below ground surface) [c]
North Delta intakes	481 acres	647 acres	239 acres	462 acres	Riverbank Formation and underlying Turlock Lake Formation	• 10 to 60 feet to Riverbank Formation
Twin Cities Double Launch Shaft Site	479 acres	546 acres	322 acres	392 acres	Modesto and Riverbank Formations	• 0 feet to Modesto Formation • 40 feet to Riverbank Formation
Tunnel maintenance shaft on New Hope Tract	11 acres	11 acres	11 acres	11 acres	Modesto and Riverbank Formations	• 0 feet to Modesto Formation • 40 feet to Riverbank Formation
Tunnel maintenance shaft on Staten Island	12 acres	12 acres	12 acres	12 acres	Modesto and Riverbank Formations	• Not assessed
Tunnel reception shaft and tunnel launch shaft on Bouldin Island	615 acres	657 acres	540 acres	585 acres	Modesto and Riverbank Formations	• 20 feet to Modesto Formation • 80 feet to Riverbank Formation
Tunnel maintenance shaft on Mandeville Island	14 acres	14 acres	14 acres	14 acres	Modesto Formation	• Not assessed
Tunnel reception shaft on Bacon Island	15 acres	15 acres	15 acres	15 acres	Modesto Formation	• 40 feet to Modesto Formation
Southern Complex on Byron Tract (Southern Forebay Inlet Structure tunnel launch shaft, Byron Tract Working Shaft, South Delta Pumping Plant, Southern Forebay, Southern Forebay Outlet Structure and dual tunnel launch shafts)	1,457 acres	1,457 acres	1,457 acres	1,457 acres	Modesto Formation	• 40 feet to Modesto Formation

Feature [a]	Construction for Alternative 1 [a]	Construction for Alternative 2a [a]	Construction for Alternative 2b [a]	Construction for Alternative 2c [a]	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed [b]	Approximate Depth to Sensitive Geologic Unit (up to 120 feet below ground surface) [c]
Southern Complex West of Byron Highway (South Delta Outlet and Control Structure and California Aqueduct Control Structure)	164 acres	293 acres	164 acres	164 acres	Modesto Formation	• 50 feet to Modesto Formation

N/A = not applicable.

[a] The acres and volumes of ground disturbance presented in this table are greater than the actual acres and volumes because the entire construction area would not be disturbed, depth of excavation would vary across the area, and much of the excavation would be relatively shallow. In addition, the acreages include excavation in all geologic units, including the Holocene deposits, which are not sensitive for paleontological resources. The RTM storage areas are also included in these overall construction acreages but would not affect paleontological resources.

[b] In much of the project area, these units are overlain by Holocene deposits, which are not sensitive for paleontological resources.

[c] As part of the seismic site response analysis (Delta Conveyance Design and Construction Authority 2022c: Table 1 in Attachment 1), data on the depth to the top of the Modesto and Riverbank Formations were collected at select shaft locations.

Under Alternatives 1, 2a, 2b, and 2c, construction of the intakes and associated sedimentation basins would entail excavation to a depth of approximately 20 feet below ground surface in the northern portion of the project area (Figure 28-1, Table 28-8). Ground-disturbing activities would include rough grading, excavating of the sedimentation basins and intakes, pile driving, and final grading. Geologic units sensitive (i.e., with high or undetermined sensitivity) for paleontological resources that would be disturbed during construction are the Modesto, Riverbank, and Turlock Lake Formations (Table 28-8). Although most of the surficial geologic units in the area affected by excavation for the intakes and sedimentation basins are of Holocene age and not sensitive for paleontological resources, the Riverbank Formation, which is of Pleistocene age and sensitive for paleontological resources, is exposed at the surface in some locations or underlies the Holocene units in the shallow subsurface. The Modesto Formation, another Pleistocene-age unit that is sensitive for paleontological resources, also occurs in isolated locations in the area and maybe present in the shallow subsurface. Excavation for the intakes for Alternatives 1, 2a, 2b, and 2c would occur in the same geologic units, but Alternative 2a, which has three intakes, would involve the greatest amount of excavation; Alternatives 1 and 2c, which have two intakes, would require somewhat less excavation (Table 28-4); and Alternative 2b, which has one intake, would involve the least excavation.

Ten shaft sites would be excavated for the launch, maintenance, and retrieval/reception of the tunnel boring machines (TBMs). This excavation would occur in two geologic units sensitive for paleontological resources: the Modesto and Riverbank Formations. The shafts would be excavated from the surface. Table 28-8 shows the location of the shafts. Although the surficial geology at most tunnel shaft locations would not be sensitive for paleontological resources, such as the peat and muck in the central portion of the study area, all tunnel shafts would be excavated in the subsurface through geologic units sensitive for paleontological resources, primarily the Modesto Formation and/or the Riverbank Formation. Other than slight differences in shaft diameter, excavation for the tunnel shafts would be similar under Alternatives 1, 2b, and 2c, and Alternative 2a would include three additional shafts, one at Intake A, one at the Jones Control Structure, and one at the Jones Outlet Structure.

Major construction in the Southern Complex would include excavation of the Byron Tract Working Shaft and construction of the tunnel terminus, South Delta Pumping Plant, Southern Forebay, Southern Forebay Outlet Structure double launch shaft, and South Delta Outlet and Control Structure and Dual Reception Shafts. Alternative 2a would also include the Jones Control Structure, Jones Outlet Structure, and Delta-Mendota Control Structure. This major construction would occur in both sensitive and nonsensitive units (Figure 28-1; Table 28-8). Although much of the area is covered in surficial units of Holocene age, such as the Holocene alluvial-floodplain deposits, which are not sensitive for paleontological resources, units sensitive for paleontological resources are also exposed at the surface and underlie the area (Figure 28-1). The units sensitive for paleontological resources that would be disturbed during construction of the Southern Complex the Pleistocene Modesto Formation. Excavation for the Southern Complex would be the similar under Alternatives 1, 2a, 2b, and 2c (Table 28-8).

The temporary and permanent access roads required for Alternatives 1, 2a, 2b, and 2c would involve shallow excavation and grading, primarily along existing farm roads or across lands disturbed by agricultural activity. Road modifications for the new intake haul road would not require excavation deeper than 5 feet and would be located on lands that have been previously cultivated and disturbed several feet below the ground surface. Byron Highway improvements would not require excavation more than 2 feet deep. It is unlikely that this shallow ground disturbance would affect unique paleontological resources.

On-site borrow material would be needed primarily for shaft pads, levees, and levee improvements. Sources of on-site borrow material would be from construction excavation locations, such as shafts, or near-source borrow locations. For example, soil excavated at the Twin Cities Complex would be used for the on-site ring levee and shaft pad at Twin Cities Complex, and the shaft pads and/or levee repairs on New Hope Tract, Staten Island, and Bouldin Island for central alignment alternatives. The Riverbank Formation, which is sensitive for paleontological resources, would be used for borrow. The alluvium of Corral Hollow Drainage to Brushy Creek would also be used for borrow, but it generally has a low sensitivity for paleontological resources. Excavation for borrow would be similar under Alternatives 1, 2b, and 2c and greatest for Alternative 2a (Table 28-5). Alternative 2a would require the greatest volume of borrow from the Riverbank Formation, which is sensitive for paleontological resources.

Under Alternatives 1, 2a, 2b, and 2c, field investigations prior to the start of construction would involve a variety of ground-disturbing activities. Soil borings would use drill bits 4 to 8 inches in diameter and could extend to depths of as much as 200 feet, cone penetration test would use rods 1 to 2 inches in diameter, groundwater testing and monitoring wells would be approximately 24 inches in diameter, utility potholing would be between 5 to 10 feet in depth, and test trenches would be approximately 30 feet long, 3 feet wide, and 10 feet deep. Up to five test trenches (up to approximately 1,000 feet long, 3 feet wide, and 20 feet deep) would be excavated along a line running from the southeast of Byron Tract to the southeast of the Clifton Court Forebay to further investigate the nature and location of the West Tracy Fault. Other than the soil borings and test trenches related to the West Tracy Fault, most investigations would occur in young surficial sediments and would disturb a small area, and therefore would be unlikely to destroy paleontological resources. Although the soil borings would be deep, the diameter of the bore is small and the bore holes would therefore be unlikely to destroy unique paleontological resources. The trenches related to the West Tracy Fault would be in geologic units with a low to high sensitivity for paleontological resources and therefore could destroy paleontological resources.

Operations and Maintenance

For Alternatives 1, 2a, 2b, and 2c, operation and maintenance of project facilities would not involve ground-disturbing activities or substantially increase erosion (Chapter 3, *Description of the Proposed Project and Alternatives)*. Therefore, unique paleontological resources would not be destroyed or affected as a result of operation or maintenance of any of these alternatives.

Alternatives 3, 4a, 4b, and 4c

Project Construction

Similar to Alternatives 1, 2a, 2b, and 2c, construction of water conveyance facilities under Alternatives 3, 4a, 4b, and 4c could cause the destruction of unique paleontological resources as a result of surface ground disturbance from excavation.

Excavation for intakes, tunnel shafts and shaft pads, other water facility components, and on-site borrow could cause the destruction of unique paleontological resources if excavation for these project features occurs in geologic units highly sensitive for paleontological resources. Figure 10-3 (Chapter 10, *Geology and Seismicity*, Section 10.1.1.2, *Local Geology*) shows the location of the alternative alignments in relation to geologic units, and Table 28-2 and Figure 28-1 show the paleontological sensitivity of these units. Table 28-9 provides the extent of ground-disturbing activities for the intakes, the shafts, and the Southern Complex and the geologic units sensitive for paleontological resources that would be disturbed. Table 28-4 provides the volume of material that would be excavated as a result of these activities.

Construction of tunnel shafts and shaft pads under Alternatives 3, 4a, 4b, and 4c would be the same as Alternatives 1, 2a, 2b, and 2c except that 11 shaft sites would be excavated on the main tunnel for the launch, maintenance, and retrieval/reception of the TBMs and these shafts would occur in the eastern alignment. Table 28-9 shows their locations. This excavation would occur in the same two geologic units sensitive for paleontological resources as Alternatives 1, 2a, 2b, and 2c (i.e., the Modesto and Riverbank Formations), but in the eastern alignment these units are not overlain at some locations (Figures 10-3 and 28-1) by the Holocene peat and muck deposits and, therefore, construction could potentially remove more Pleistocene paleontological resources. Other than slight differences in shaft diameter, excavation for the tunnel shafts would be similar for Alternatives 3, 4a, 4b, and 4c, except that Alternative 4b would have one fewer shaft, and Alternative 4a would include additional shafts at the intake, the Jones Control Structure, and the Jones Outlet Structure. Excavation for tunnel shafts for Alternatives 3, 4a, 4b, and 4c would be similar to Alternatives 1, 2a, 2b, and 2c, respectively, but somewhat more excavation would occur because of the longer tunnel alignment (Tables 28-7 and 28-8).

Major construction in the Southern Complex under Alternatives 3, 4a, 4b, and 4c would be the same as Alternatives 1, 2a, 2b, and 2c (Figure 28-1; Tables 28-4 and 28-8).

The construction methods for and geologic units affected by temporary and permanent access roads required for Alternatives 3, 4a, 4b, and 4c would be the same as for Alternatives 1, 2a, 2b, and 2c.

As with Alternatives 1, 2a, 2b, and 2c, borrow material would be needed primarily for shaft pads, levees, and levee improvements under Alternatives 3, 4a, 4b, and 4c. Borrow material would be excavated from on-site or near-source locations. For example, soil excavated at the Twin Cities Complex would be used for shaft pads on New Hope Tract, Canal Ranch Tract, Terminous Tract, and King Island. Soils excavated at the Lower Roberts Island launch shaft site would be used for the shaft pads on Lower Roberts Island and Upper Jones Tract and to backfill borrow areas on Lower Roberts Island. The Riverbank Formation, which is sensitive for paleontological resources, would be used for borrow. The alluvium of Corral Hollow Drainage to Brushy Creek would also be used for borrow, but it generally has a low sensitivity for paleontological resources. Excavation for borrow would be less than under Alternatives 1, 2a, 2b, 2c, and 5 and would affect a smaller volume of the Riverbank Formation (Table 28-5).

Field investigation impacts would be the same under all project alternatives.

Table 28-9. Summary of Conveyance Construction Activities and Geologic Units Sensitive for Paleontological Resources That Could Be Disturbed along the Eastern Alignments (Alternatives 3, 4a, 4b, and 4c)

Feature [a]	Construction for Alternative 3 [a]	Construction for Alternative 4a [a]	Construction for Alternative 4b [a]	Construction for Alternative 4c [a]	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed [b]	Approximate Depth to Sensitive Geologic Unit (up to 120 feet below ground surface) [c]
North Delta intakes	481 acres	647 acres	239 acres	462 acres	Riverbank and Modesto Formations and underlying Turlock Lake Formation	• 10 to 60 feet to Riverbank Formation
Twin Cities Double Launch Shaft Site	479 acres	546 acres	322 acres	392 acres	Riverbank Formation	• 0 feet to Modesto Formation • 50 feet to Riverbank Formation
Tunnel maintenance shaft on New Hope Tract (eastern alignment)	11 acres	11 acres	11 acres	11 acres	Riverbank and Modesto Formations	• 0 feet to Modesto Formation • 40 feet to Riverbank Formation
Tunnel maintenance shaft on Canal Ranch Tract	11 acres	11 acres	11 acres	11 acres	Riverbank and Modesto Formations	• 0 feet to Modesto Formation • 40 feet to Riverbank Formation
Tunnel reception shaft on Terminous Tract	13 acres	13 acres	13 acres	13 acres	Riverbank and Modesto Formations	• Not assessed
Tunnel maintenance shaft on King Island	12 acres	12 acres	12 acres	12 acres	Riverbank and Modesto Formations	• 0 feet to Modesto Formation • 80 feet to Riverbank Formation
Tunnel reception/ launch shaft on Lower Roberts Island	407 acres	445 acres	327 acres	376 acres	Riverbank and Modesto Formations	• 20 feet to Modesto Formation • 100 feet to Riverbank Formation
Tunnel maintenance shaft on Upper Jones Tract	13 acres	13 acres	13 acres	13 acres	Modesto Formation	• Not assessed
Southern Complex on Byron Tract (Southern Forebay Inlet Structure tunnel launch shaft, Byron Tract Working Shaft, South Delta Pumping Plant, Southern Forebay, Southern Forebay Outlet Structure and dual tunnel launch shafts)	1,488 acres	1,512 acres	1,457 acres	1,475 acres	Modesto Formation	• 40 feet to Modesto Formation

Feature [a]	Construction for Alternative 3 [a]	Construction for Alternative 4a [a]	Construction for Alternative 4b [a]	Construction for Alternative 4c [a]	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed [b]	Approximate Depth to Sensitive Geologic Unit (up to 120 feet below ground surface) [c]
Southern Complex West of Byron Highway (South Delta Outlet and Control Structure and California Aqueduct Control Structure)[e]	164 acres	293 acres	164 acres	164 acres	Modesto Formation	• 40 feet to Modesto Formation

[a] The acres and volumes of ground disturbance presented in this table are greater than the actual acres and volumes because the entire construction area would not be disturbed, depth of excavation would vary across the area, and much of the excavation would be relatively shallow. In addition, the acreages include excavation in all geologic units, including the Holocene deposits, which are not sensitive for paleontological resources. The RTM storage areas are also included in these overall construction acreages but would not affect paleontological resources.

The acreages include excavation in all geologic units, including the Holocene deposits, which are not sensitive for paleontological resources.

[b] In much of the project area, these units are overlain by Holocene deposits, which are not sensitive for paleontological resources.

[c] As part of the seismic site response analysis (Delta Conveyance Design and Construction Authority 2022c:Table 1 in Attachment 1), data on the depth to the top of the Modesto and Riverbank Formations was collected at select shaft locations.

Operations and Maintenance

Operation and maintenance impacts would be the same as described above for Alternatives 1, 2a, 2b, and 2c.

Alternative 5

Project Construction

Similar to the other project alternatives, construction of water conveyance facilities under Alternative 5 could cause the destruction of unique paleontological resources (i.e., with high or undetermined sensitivity) as a result of surface ground disturbance from excavation.

Excavation for intakes, shaft pads, aqueduct, other water facility components, and borrow could cause the destruction of unique paleontological resources if excavation for these project features occurs in geologic units highly sensitive for paleontological resources. Figure 10-3 (Chapter 10, *Geology and Seismicity*, Section 10.1.1.2, *Local Geology*) shows the location of the alternative alignments in relation to geologic units, and Table 28-2 and Figure 28-1 show the paleontological sensitivity of these units. Table 28-10 provides the extent of ground-disturbing activities for the intakes, shaft pads, and Bethany Complex and the geologic units sensitive for paleontological resources that would be disturbed. Table 28-4 provides the volume of material that would be excavated as a result of these activities.

Table 28-10. Summary of Conveyance Construction Activities and Geologic Units Sensitive for Paleontological Resources That Could Be Disturbed along the Bethany Alignment (Alternative 5)

Feature [a]	Construction for Alternative 5	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed	Approximate Depth to Sensitive Geologic Unit (up to 120 feet below ground surface) [b]
North Delta intakes	481 acres	Riverbank and Modesto Formations and underlying Turlock Lake Formation	• 10 to 60 feet to Riverbank Formation
Twin Cities Double Launch Shaft Site	586 acres	Riverbank Formation	• 0 feet to Modesto Formation • 50 feet to Riverbank Formation
Tunnel maintenance shaft on New Hope Tract (eastern alignment)	11 acres	Riverbank and Modesto Formations	• 0 feet to Modesto Formation • 40 feet to Riverbank Formation
Tunnel maintenance shaft on Canal Ranch Tract	11 acres	Riverbank and Modesto Formations	• 0 feet to Modesto Formation • 40 feet to Riverbank Formation
Tunnel reception shaft on Terminous Tract	13 acres	Riverbank and Modesto Formations	• Not assessed
Tunnel maintenance shaft on King Island	12 acres	Riverbank and Modesto Formations	• 0 feet to Modesto Formation • 80 feet to Riverbank Formation
Tunnel Double launch shaft on Lower Roberts Island	610 acres	Riverbank and Modesto Formations	• 20 feet to Modesto Formation • 100 feet to Riverbank Formation

Feature [a]	Construction for Alternative 5	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed	Approximate Depth to Sensitive Geologic Unit (up to 120 feet below ground surface) [b]
Tunnel maintenance shaft on Upper Jones Tract	11 acres	Modesto Formation	• Not assessed
Tunnel maintenance shaft on Union Island	14 acres	Modesto Formation	• Not assessed
Bethany Reservoir Pumping Plant and Surge Basin	228 acres	None	• Not assessed
Bethany Reservoir Aqueduct pipelines, including shafts at discharge structure	138 acres	Panoche Formation, Miocene fanglomerate, and San Pablo Group	• Not assessed
Bethany Reservoir Aqueduct tunnels	Four tunnels (trenched) with outside diameter of approximately 20 feet. Tunneling under Jones Pumping Plant discharge pipelines 14,370 cubic yards and tunneling under conservation easement 220,000 cubic yards and 45 to 180 feet deep.	Quaternary fan deposits, Panoche Formation, Miocene fanglomerate, and San Pablo Group	• Not assessed
Bethany Reservoir Discharge Structure	15 acres	Panoche Formation and possibly Miocene fanglomerate and San Pablo Group	• Not assessed

Source: Delta Conveyance Design and Construction Authority 2022c.

[a] The acres and volumes of ground disturbance presented in this table are greater than the actual acres and volumes because the entire construction area would not be disturbed, depth of excavation would vary across the area, and much of the excavation would be relatively shallow. In addition, the acreages include excavation in all geologic units, including the Holocene deposits, which are not sensitive for paleontological resources.

[b] As part of the seismic site response analysis (Delta Conveyance Design and Construction Authority 2022c:Table 1 in Attachment 1), data on the depth to the top of the Modesto and Riverbank Formations were collected at select shaft locations.

Impacts related to intakes and tunnel shafts and shaft pads would be the same as Alternative 3 because the design of this project alternative is the same between the intakes and Lower Roberts Island. There would a slight difference in location of the shaft on Upper Jones Tract, but the same geologic units would be affected, and the shafts in the southern portion of the alignment, below the Upper Jones Tract, would be in the same geologic units as Alternative 3.

Less excavation would occur in the vicinity of Byron Highway than for the other alternatives because rather than construction of the Southern Complex, Alternative 5 would construct an underground pumping plant and surge basin at a different location south of Clifton Court Forebay and immediately east of the Jones pumping plant. This construction would involve the same geologic units as Alternatives 1 through 4c, including the Holocene or Upper Pleistocene alluvium of creeks from the Corral Hollow Drainage to Brushy Creek and the Pleistocene Modesto Formation.

An aqueduct system with multiple pipelines would be constructed from the pumping plant to the discharge structure at Bethany Reservoir. This construction would involve trenching for two short tunnel reaches and excavating for the discharge structure. The construction would occur in the southernmost part of the study area and would affect both the valley geologic units (i.e., the Holocene or Upper Pleistocene alluvium of creeks from the Corral Hollow Drainage to Brushy Creek, Quaternary fan deposits, and Pleistocene Modesto Formation), and the foothill geologic units (i.e., the Cretaceous Panoche Formation and the Miocene fanglomerate and San Pablo Group). The Panoche Formation and San Pablo Group are both sensitive for paleontological resources, and the sensitivity of the fanglomerate is unknown.

The construction methods for and geologic units affected by temporary and permanent access roads required for Alternative 5 would be similar to those for Alternative 3 because they would involve shallow excavation and grading, primarily along existing farm roads or across lands disturbed by agricultural activity. It is unlikely that this shallow ground disturbance would affect significant paleontological resources. The new access road to the Bethany Reservoir Pumping Plant, however, could involve more extensive roadwork, which in some cases, would occur in areas where sensitive geologic units could be present in the shallow subsurface. This includes the road cut near Bethany Reservoir along Mountain House Road, which would occur in the Panoche Formation and could result in greater impacts on paleontological resources.

Borrow material would be needed primarily for shaft pads and levees. Overall, Alternative 5 would require more borrow than Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c but would require less borrow from the Riverbank Formation, which is sensitive for paleontological resources, than Alternative 1, 2a, 2b, 2c, and 4a (Table 28-5).

Field investigation impacts would be similar under all project alternatives; however, the number and locations of investigations would be different for each alignment.

Operations and Maintenance

Operation and maintenance impacts for Alternative 5 would be the same as described above for Alternatives 1, 2a, 2b, and 2c.

CEQA Conclusion—All Project Alternatives

Construction of water conveyance facilities proposed under all project alternatives could cause the destruction of unique paleontological resources because extensive ground disturbance would occur in geologic units with high or undetermined sensitivity for paleontological resources. Both the eastern and central alignments would involve excavation in the same geologic units. The major surface ground-disturbing activities associated with Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c (i.e., excavating the intakes, sedimentation basins, shaft tunnels and pads, and Southern Forebay and constructing a pumping plant) would occur over a large area, involve large quantities of ground disturbance, and occur in geologic units sensitive for paleontological resources. These activities could have the potential to destroy those resources. The impacts of Alternative 5 would be similar to Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c because the same geologic units (i.e., the Modesto, Riverbank, and Turlock Lake Formations) would be affected for most project activities and a similar amount of excavation would be required, though additional geologic units (i.e., Panoche Formation, Miocene fanglomerate, and San Pablo Group) with potential to contain fossils would be affected by Alternative 5 in the area of Bethany Reservoir. All project alternatives could destroy unique paleontological resources, with varying degrees of magnitude.

The impacts on paleontological resources would be similar for Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, 4c, and 5 because surface excavation that could destroy unique paleontological resources (e.g., for intakes, sedimentation basins) would be similar, but Alternative 4a would involve the largest amount of excavation at the Southern Complex and the greatest surface excavation overall, and Alternative 5 would involve the least amount of surface excavation. The potential for destruction of unique paleontological resources, as defined in Section 28.3.2, *Thresholds of Significance*, in those portions of the study area affected by project construction would constitute a significant impact under CEQA because excavation for project facilities would occur in locations known to be sensitive for paleontological resources and localized project excavation would be considerable. Implementation of Mitigation Measures PALEO-1a: *Prepare and Implement a Monitoring and Mitigation Plan for Paleontological Resources*, and PALEO-1b: *Educate Construction Personnel in Recognizing Fossil Material* would reduce the impacts to a less-than-significant level by ensuring that a qualified professional paleontologist would develop a monitoring and mitigation plan and determine which activities would occur in units sensitive for paleontological resources; educating construction personnel in recognizing paleontological resources; and having qualified monitors in place to monitor for paleontological resources and temporarily stop construction (per the PRMMP) should paleontological resources be discovered. For excavation at the tunnel shafts where *in situ* monitoring cannot occur, the shaft spoils would be monitored. The level of impact for all alignment alternatives would be similar but would vary in magnitude based on the amount of excavation that would occur (Table 28-4). In summary, the impacts of surface-related ground disturbance would be less than significant with mitigation.

Mitigation Measure PALEO-1a: Prepare and Implement a Monitoring and Mitigation Plan for Paleontological Resources

1. Before ground-breaking construction begins, DWR will retain a qualified professional paleontologist (as defined by the SVP Standard Procedures [Society of Vertebrate Paleontology 2010:10]) to develop a comprehensive Paleontological Resources Monitoring and Mitigation Plan (PRMMP) for the project, to help avoid destroying unique paleontological resources.

2. The PRMMP will be consistent with the SVP Standard Procedures (Society of Vertebrate Paleontology 2010) and the SVP Conditions of Receivership (Society of Vertebrate Paleontology 1996:1,2) and will require the following:

    a. **Paleontological qualifications:** A paleontological resources specialist (PRS) will be designated or retained for construction activities. The PRS will have paleontological resources management qualifications consistent with the description of a qualified professional paleontologist in the SVP Standard Procedures (Society of Vertebrate Paleontology 2010). The PRS will be responsible for implementing all aspects of the PRMMP, managing any additional paleontological monitors needed for construction activities, and serving as a qualified resource in the event of unanticipated paleontological finds. The PRS may, but need not necessarily, be the same individual who prepared the PRMMP.

    b. **Preconstruction surveys:** Preconstruction surveys (with salvage and/or protection in place, as appropriate) will be conducted in areas where construction activities would result in surface disturbance of geologic units identified as highly sensitive or undetermined for paleontological resources. The PRS will be responsible for determining where and when paleontological resources monitoring would be required prior to breaking ground.

c. **Coordination procedures and communications protocols:** Preconstruction and construction-period coordination procedures and communications protocols will be established, including procedures to alert all construction personnel involved with earthmoving activities about the possibility of encountering fossils as set forth in Mitigation Measure PALEO-1b and communications regarding the *stop work, evaluate and treat appropriately response* in the event of a paleontological discovery, as described in "e" below.

d. **Monitoring:** All ground-disturbing activities involving highly sensitive units will be monitored by qualified monitors (as defined by the SVP Standard Procedures [Society of Vertebrate Paleontology 2010:10]). Monitoring will initially be conducted full time for grading and excavation in those areas identified by the PRS as having potential to damage paleontological resources, but the PRMMP may provide for monitoring frequency in any given location to be reduced once 50% of the ground-disturbing activity in that location has been completed, if the reduction is appropriate based on the implementing PRS's professional judgment in consideration of actual site conditions. The PRS will have the authority to stop work if paleontological resources are discovered and as described in "e" below.

e. **Stop work, evaluate, and treat appropriately when a unique or significant fossil is encountered:** DWR will require that if potentially unique or significant fossil remains are discovered during ground-disturbing activities, the construction crew will be directed to immediately cease work in the vicinity of the find and notify the PRS, consistent with the PRMMP described under Mitigation Measure PALEO-1a.

f. **Sampling and data recovery procedures:** Sampling and data recovery procedures that are consistent with the SVP Standard Procedures (Society of Vertebrate Paleontology 2010) and the SVP Conditions of Receivership (Society of Vertebrate Paleontology 1996:1,2) will be established.

g. **Repository plan and curation:** A repository plan will be developed that provides for appropriate curation of recovered materials, if necessary. Procedures for preparing, identifying, and analyzing fossil specimens and data recovered will be established, consistent with the SVP Conditions of Receivership (Society of Vertebrate Paleontology 2010) and any specific requirements of the designated repository institution.

h. **Reporting:** Mitigation monitoring report preparation guidelines will be established that are consistent with the SVP Standard Procedures guidelines (Society of Vertebrate Paleontology 2010) and approved by DWR. The report will include, at a minimum, discussions of effects, regulatory requirements, purpose of mitigation, regional geologic context, project area stratigraphy, stratigraphic and geographic distribution of paleontological resources, field and laboratory methods and procedures, fossil recovery, and paleontological significance. The report will also include geological cross sections and stratigraphic sections depicting fossil discovery localities and excavated rock units; maps showing the activity location and vicinity, as well as geology and location of discovered fossil localities; appropriate illustrations depicting monitoring conditions, field context of collecting localities, and laboratory activities; and appendices including an itemized listing of catalogued fossil specimens, complete descriptions of all fossil collecting localities, an explanation of report acronyms and terms, and a signed curation agreement with an approved paleontological repository.

i. **90% design submittal for project elements requiring excavation:** DWR will have a qualified individual review the 90% design submittals to finalize the identification of construction activities involving geologic units considered highly sensitive for paleontological resources for the purpose of determining monitoring location and schedule. Evaluation will consider the anticipated depth of disturbance, the selected construction technique, and the geology of the alignment. The evaluation may be carried out by the PRS or an individual meeting the SVP's requirements for a qualified professional paleontologist (per Society of Vertebrate Paleontology 2010) and will be conducted in collaboration with the design and geotechnical teams. If the evaluation is performed by a professional paleontologist, it will be reviewed and verified by a California-licensed professional geologist. The purpose of this evaluation will be to develop specific language identifying how the mitigation measures will be applied to the various phases of construction along the alignment (e.g., which areas would require monitors).

Implementation of this measure will require that unique or significant paleontological resources identified during surface excavation are protected from destruction or treated and documented appropriately to preserve their scientific value. Unique paleontological resources will be systematically identified, documented, avoided, or protect from destruction, where feasible, or recovered and curated so they remain available for scientific study.

Mitigation Measure PALEO-1b: Educate Construction Personnel in Recognizing Fossil Material

1. DWR will require that all construction personnel receive training provided by a qualified professional paleontologist experienced in teaching non-specialists, so they can recognize fossil materials in the event any are discovered during construction. Training will include information on the possibility of encountering fossils during construction, the types of fossils likely to be seen and how to recognize them, and proper procedures in the event fossils are encountered. All field management and supervisory personnel and construction workers involved with ground-disturbing activities will be required to take this training prior to beginning work. Training materials will include an informational brochure that provides contacts and summarizes procedures in the event paleontological resources are encountered.

Implementation of this measure will help ensure that unique or significant paleontological resources have a better likelihood of being identified during construction so they can be temporarily avoided or immediately treated, as appropriate.

Mitigation Impacts

Compensatory Mitigation

Although the Compensatory Mitigation Plan described in Appendix 3F, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*, does not act as mitigation for impacts on paleontological resources from project construction or operations, its implementation could result in impacts on these paleontological resources.

Most of the compensatory mitigation efforts would require developing temporary facilities, such as staging areas, access haul roads, work areas, and borrow sites. These facilities could involve clearing and grubbing, excavation, and other grading activities that entail surface disturbance. Construction of compensatory mitigation at Bouldin Island and the I-5 ponds could cause the destruction of unique paleontological resources (i.e., with high or undetermined sensitivity) as a result of this surface excavation. This work would occur in a Holocene unit too young to contain fossils. The earthwork at the I-5 ponds would be extensive and occur in the Riverbank Formation, which is sensitive for paleontological resources. Earthwork at the I-5 ponds would entail up to approximately 1.2 million cubic yards of on-site cut and on-site fill. These activities could have the potential to destroy those resources if present. Implementation of Mitigation Measures PALEO-1a: *Prepare and Implement a Monitoring and Mitigation Plan for Paleontological Resources,* and PALEO-1b: *Educate Construction Personnel in Recognizing Fossil Material* would reduce the impacts by requiring a qualified professional paleontologist to develop a monitoring and mitigation plan and determine which activities would occur in units sensitive for paleontological resources; educating construction personnel in recognizing paleontological resources; and having qualified monitors in place to monitor for paleontological resources and stop construction should paleontological resources be discovered. Therefore, the project alternatives combined with compensatory mitigation implemented at Bouldin Island and the I-5 ponds would not change the overall impact conclusion of less than significant with mitigation.

As described in Appendix 3F, compensatory mitigation would also involve surface excavation at undetermined tidal wetland or channel margin restoration sites within the North Delta Arc. It cannot be known at this time whether paleontological resources would be affected by ground-disturbing activities at these sites. If geologic units with high or unknown sensitivity for paleontological resources would be affected by excavation at the undetermined tidal wetland or channel margin restoration sites, Mitigation Measures PALEO-1a: *Prepare and Implement a Monitoring and Mitigation Plan for Paleontological Resources*, and PALEO-1b: *Educate Construction Personnel in Recognizing Fossil Material* would be implemented. Therefore, the project alternatives combined with compensatory mitigation would not change the overall impact conclusion of less than significant with mitigation.

<u>*Other Mitigation Measures*</u>

Some mitigation measures would involve surface excavation, using heavy equipment, such as graders, excavators, dozers, and haul trucks, that could have the potential to destroy unique paleontological resources. The mitigation measures with potential to result in destruction of paleontological resources as a result of excavation in geologic units that could have a high or undetermined sensitivity for paleontological resources are Mitigation Measures BIO-2c: *Electrical Power Line Support Placement*, AG-2: *Replacement or Relocation of Affected Infrastructure Supporting Agricultural Properties*, AES-1c: *Implement Best Management Practices to Implement Project Landscaping Plan,* CUL-1: *Prepare and Implement a Built-Environment Treatment Plan in Consultation with Interested Parties*, and AQ-9: *Develop and Implement a GHG Reduction Plan to Reduce GHG Emissions from Construction and Net CVP Operational Pumping to Net Zero*. Destruction of unique paleontological resources caused by surface excavation related to implementing mitigation measures would be similar to the project alternatives' construction effects in certain construction areas and would contribute to impacts of the project alternatives caused by destruction of paleontological resources. Implementation of Mitigation Measures PALEO-1a: *Prepare and Implement a Monitoring and Mitigation Plan for Paleontological Resources*, and PALEO-1b: *Educate*

Construction Personnel in Recognizing Fossil Material would reduce these impacts. Therefore, implementation of other mitigation measures is unlikely to result in the destruction of unique paleontological resources caused by disturbances, and the impact on paleontological resources would not be substantial.

Impacts caused by destruction of unique paleontological resources during construction of compensatory mitigation and implementation of other mitigation measures, combined with project alternatives, would remain less than significant for surface-related ground disturbance.

Impact PALEO-2: Cause Destruction of a Unique Paleontological Resource as a Result of Tunnel Construction and Ground Improvement

Table 28-11 summarizes the extent of ground-disturbing activities for the tunnels and the geologic units sensitive for paleontological resources that would be disturbed for all project alternatives (Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, 4c, and 5). Table 28-6 shows the locations where ground improvement (i.e., in-situ techniques to mix amendments, such as cement, into the foundation) would occur. Figure 10-3 (Chapter 10, *Geology and Seismicity,* Section 10.1.1.2, *Local Geology*) shows the location of the tunnel alignments by alternative in relation to geologic units, and Table 28-2 and Figure 28-1 show the paleontological sensitivity of these units.

Table 28-11. Summary of Tunnel Construction Activities and Geologic Units Sensitive for Paleontological Resources That Could Be Disturbed along All Alternatives (Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, 4c, and 5)

Alternative	Main Tunnel and Dual Tunnels on Southern Complex [a]	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed	Jones Tunnel	Geologic Units with High or Undetermined Sensitivity That Would Be Disturbed
1	13.9 million LCY	Riverbank and Modesto Formations (main tunnel) and Modesto Formation (dual tunnels)	N/A	N/A
2a	18.4 million LCY	Same as Alternative 1	112,227 CCY	Modesto Formation
2b	7.5 million LCY	Same as Alternative 1	N/A	N/A
2c	10.7 million LCY	Same as Alternative 1	N/A	N/A
3	14.8 million LCY	Same as Alternative 1	N/A	N/A
4a	19.5 million LCY	Same as Alternative 1	112,227 CCY	Modesto Formation
4b	7.9 million LCY	Same as Alternative 1	N/A	N/A
4c	11.3 million LCY	Same as Alternative 1	N/A	N/A
5	14.4 million LCY (main tunnel only)	N/A	N/A	N/A

N/A = not applicable; LCY = loose cubic yards, which is the volume of bulk soil material placed or piled; CCY = compact cubic yards, which is the volume after the material has been compacted by construction equipment.

[a] Wet excavated volume, which is the volume of bulk material, including conditioners, placed or piled after excavation and before it is dried.

Alternatives 1, 2a, 2b, and 2c

Project Construction

Construction of water conveyance facilities under Alternatives 1, 2a, 2b, and 2c could cause the destruction of unique paleontological resources as a result of excavation tunnel construction. The main tunnel under Alternatives 1, 2a, 2b, and 2c would extend for 37 to 41 miles to the new pumping plant in the south Delta. TBMs would be used to excavate the tunnels and would bore primarily through the Modesto and Riverbank Formations, which are both sensitive for paleontological resources. The boring process would generate reusable tunnel material (RTM), and any macrofossils encountered by the TBM would be destroyed by the boring process. Table 28-4 shows the amount of excavation that would be required for construction of the tunnel for each alternative. The greatest amount of excavation would occur under Alternative 2a, which has the largest-diameter tunnel and includes the Jones Tunnel (i.e., the additional single tunnel from Jones Control Structure to Jones Outlet Structure that would be 1.5 miles long and have an outside diameter of 22 feet; Alternative 2a only), followed by Alternative 1, Alternative 2c, and Alternative 2b. Alternative 2b would involve the least excavation of all project alternatives.

Alternatives 1, 2a, 2b, and 2c would require ground improvements at some locations (Table 28-6) where liquefiable soils are present. Liquefiable soils are generally poorly consolidated sandy Holocene soils and, therefore, have a low sensitivity for paleontological resources. However, as described in the Liquefaction and Ground Improvement Analysis (Final Draft) Technical Memorandum (Delta Conveyance Design and Construction Authority 2022d:6–16), the depth of ground improvements may extend into the Modesto and Riverbank Formations. Although with further geotechnical refinement it may be determined that ground improvement may be limited to the Holocene units, this analysis assumes the Modesto and Riverbank Formations, which are sensitive for paleontological resources, would be affected by ground improvement. During ground improvement, in-situ techniques would be used to mix amendments, such as cement, into the ground underlying the intakes, most tunnel shafts, Southern Forebay embankments, and South Delta Pumping Plant. If paleontological resources are present, these resources would be damaged or destroyed by the process because the activity cannot be viewed or stopped by a paleontological monitor. Based on the number of intakes and shafts, Alternative 2a would require the greatest amount of ground improvement, followed by Alternatives 1 and 2c; Alternative 2b would require the least amount of ground improvement.

Operations and Maintenance

For Alternatives 1, 2a, 2b, and 2c, operation and maintenance of the tunnels would not involve ground-disturbing activities, substantially increase erosion, or require ground improvement (Chapter 3, *Description of the Proposed Project and Alternatives*). Therefore, unique paleontological resources would not be destroyed or affected by tunnelling or ground improvements during operation or maintenance of any of these alternatives.

Alternatives 3, 4a, 4b, and 4c

Project Construction

Similar to Alternatives 1, 2a, 2b, and 2c, construction of the tunnels under Alternatives 3, 4a, 4b, and 4c could cause the destruction of unique paleontological. Construction of the main tunnel under Alternatives 3, 4a, 4b, and 4c, which would extend from 40 to 48 miles to the new South Delta

Pumping Plant (depending on how many intakes), would use the same construction method and would occur, for the most part, in the same geologic units (i.e., the Modesto and Riverbank Formations) as Alternatives 1, 2a, 2b, and 2c (Figure 28-1). However, because of the longer tunnel length, more excavation would be required. The impacts of this tunneling would be similar to Alternatives 1, 2a, 2b, and 2c, but the quantity of material excavated would generally be greater (Tables 28-8 and 28-9). The greatest amount of excavation for all alternatives would occur under Alternative 4a, which has the largest-diameter tunnel, longest length, and includes the Jones Tunnel (i.e., the additional single tunnel from Jones Control Structure to Jones Outlet Structure that would be 1.5 miles long and have an outside diameter of 22 feet; Alternative 4a only), followed by Alternative 2a. Alternative 3 excavation would be similar to, but somewhat greater than, Alternative 1; Alternative 4c excavation would be similar to, but somewhat greater than, Alternative 2c; and Alternative 4b excavation would be similar to, but somewhat greater than, Alternative 2b.

For ground improvement, based on the number of intakes and shafts, Alternative 4a would require the greatest amount of ground improvement, followed by Alternatives 3 and 4c; Alternative 4b would require the least amount of ground improvement. More ground improvement would be required under Alternatives 3, 4a, 4b, and 4c than Alternatives 1, 2a, 2b, and 2c because Alternatives 3, 4a, 4b, and 4c each would require one more shaft than Alternatives 1, 2a, 2b, and 2c, respectively. Therefore, more ground improvement would be required overall.

Operations and Maintenance

Operation and maintenance impacts for Alternatives 3, 4a, 4b, and 4c would be the same as described for Alternatives 1, 2a, 2b, and 2c.

Alternative 5

Project Construction

Similar to the other project alternatives, construction of the tunnels under Alternative 5 could cause the destruction of unique paleontological resources (i.e., with high or undetermined sensitivity).

Impacts related to tunneling would also be similar to Alternative 3 because the same geologic units would be disturbed, though Alternative 5 would involve somewhat less excavation because, although the main tunnel would be longer, the 1.7-mile-long dual tunnels would not be built under Alternative 5.

Ground improvement impacts related to intakes and shafts under Alternative 5 would be similar to Alternative 3 because the same number of intakes and shafts would be included. However, Alternative 5 would not include the Southern Forebay embankments or the South Delta Pumping Plant and therefore the ground improvement would be considerably less. In addition, no ground improvement is anticipated to be necessary at the Bethany Complex.

Operations and Maintenance

Operation and maintenance impacts for Alternative 5 would be the same as described above for Alternatives 1, 2a, 2b, and 2c.

CEQA Conclusion—All Project Alternatives

Construction of water conveyance facilities proposed under all project alternatives could cause the destruction of unique paleontological resources because tunneling would occur in geologic units with high sensitivity for paleontological resources: the Modesto and Riverbank Formations. Both the eastern and central alignments would involve tunneling in the same geologic units. All project alternatives could destroy unique paleontological resources, with varying degrees of magnitude (Table 28-11).

Alternative 4a would involve the greatest amount of tunnel excavation in units with high potential to contain paleontological resources because it would have the largest diameter and longest tunnel of all alternatives and would also include the Jones Tunnel, whereas Alternative 2b, which has the smallest diameter and shortest tunnel, would involve the least amount of tunnel excavation of all alternatives (Table 28-4). Excavation using the TBM for the tunnels could destroy unique paleontological resources because tunneling would involve large-scale ground disturbance that would not be accessible to monitors and would occur in geologic units sensitive for paleontological resources. This tunneling would occur at depths greater than 100 feet and therefore the geologic units affected would not be accessible to paleontologists and any fossils would not be available for scientific study. It cannot, however, be known whether paleontological resources would be present because paleontological resources are not distributed evenly throughout a geologic unit. Nevertheless, given the volume of material excavated by tunneling (Table 28-4) that would occur in the Modesto and Riverbank Formations, which are both sensitive for paleontological resources, and the consistency of the RTM generated by the TBM (i.e., too fine to contain macrofossils), tunneling could result in a significant impact. No mitigation is available to address this impact. The impacts of tunneling would therefore be significant and unavoidable.

Alternative 4a would require the greatest amount of ground improvement and therefore would have the potential to destroy the most paleontological resources, whereas Alternative 5, unlike all other alternatives, would involve no ground improvement at the Southern Forebay embankments or the South Delta Pumping, and would also not require ground improvement at the Bethany Complex. Therefore, Alternative 5 would have the least amount of ground improvement of all alternatives. Ground improvement would consist of in-situ mixing of amendments, such as cement grout, into the subsurface to improve stability. If this improvement occurs in the Modesto or Riverbank Formations and paleontological resources are present, ground improvement would damage or destroy these resources because the activity cannot be viewed or stopped by a paleontological monitor. No mitigation is available to address this impact. The impacts of ground improvement would therefore be significant and unavoidable.

Mitigation Impacts

Compensatory Mitigation

Compensatory mitigation would not involve tunneling or ground improvement; therefore, there would be no additional impact.

Other Mitigation Measures

Other mitigation measures would not involve tunneling or ground improvement; therefore, there would be no additional impact.

28.3.4 Cumulative Analysis

The geographic scope of the analysis for paleontological resources is the project area as defined in Chapter 1, *Introduction* (Figure 1-4). This geographic limit was established to encompass the footprints of all construction and conservation-related ground-disturbing activity associated with the project. The geographic scope of the paleontological resources cumulative analysis is centered on large-scale ground-disturbing projects in the Delta region. The analysis focuses on projects and programs within the project area and the broader Delta region that involve substantial ground-disturbing activities. The principal programs and projects considered in the analysis are listed in Table 28-12.

Table 28-12. Cumulative Impacts on Paleontological Resources from Plans, Policies, and Programs

Program/Project	Agency	Status	Description of Program/ Project	Impacts on Paleontological Resources
Delta Dredged Sediment Long-Term Management Strategy	USACE	Ongoing	Maintaining and improving channel function, levee rehabilitation, and ecosystem restoration.	Sediments disturbed by dredging would likely be too young to contain fossils.
West Sacramento Levee Improvements Program	West Sacramento Area Flood Control Agency and USACE	Final EIR/EIS certified on March 10, 2011	Improvements to levees protecting West Sacramento to meet local and federal flood protection criteria.	Construction of levees could disturb the Riverbank Formation, which underlies Holocene basin deposits.
American River Watershed Common Features Water Resources Development Act of 2016 Project Sacramento River East Levee Contract 3	USACE	Final Supplemental EIR/EIS October 1, 2021	Levee improvements consisting of an approximately 10,580 cumulative feet (2 miles) of cut off wall along the Sacramento River's east levee	Cutoff walls would be installed primarily in Holocene deposits, and disturbance of the Modesto and Riverbank Formations would be limited to a small area. Impact would be less than significant.
Dutch Slough Tidal Marsh Restoration Project	DWR	Ongoing	Wetland and upland habitat restoration in area used for agriculture.	Excavation would be required to create channels and habitat. No impacts were found related to paleontological resources.
2019 NMFS and USFWS BiOps	DWR	Ongoing	Restore 8,000 acres of tidal marsh	Excavation would be required to create tidal marsh. No impacts were found related to paleontological resources.

Program/Project	Agency	Status	Description of Program/ Project	Impacts on Paleontological Resources
CALFED Levee System Integrity Program	DWR, CDFW, USACE	Planning phase	Reuse of dredge material. Levee maintenance and levee improvement	Depending on locations of improvements, construction could result in impacts on paleontological resources.
Delta Flood Protection Fund	DWR	Ongoing	Maintenance and rehabilitation of non-project levees in the Delta	Depending on location of improvements, construction could result in impacts on paleontological resources.
Mayberry Farms Subsidence Reversal and Carbon Sequestration Project	DWR	Completed (ongoing maintenance)	Wetland restoration and enhancement to reverse subsidence	Sediments disturbed by excavation would likely be too young to contain fossils.
Sherman Island Setback Levee-Mayberry Slough	DWR	Completed	Construction of four sections of setback levees to increase levee stability	Sediments disturbed by excavation would likely be too young to contain fossils.
Sherman Island – Whale's Belly Wetlands	DWR	Ongoing	Wetland restoration and enhancement and levee construction to reverse subsidence provide 30,000 acres of habitat	Sediments disturbed by excavation would likely be too young to contain fossils.
Twitchell Island - San Joaquin River Setback Levee	DWR	Planning phase	Levee stabilization and habitat restoration	Sediments disturbed by excavation would likely be too young to contain fossils.
Central Valley Joint Venture Program	Central Valley Joint Venture	Ongoing	Restoration of 19,170 acres of seasonal wetland, enhancement of 2,118 acres of seasonal wetland annually, restoration of 1,208 acres of semi-permanent wetland	Geologic units sensitive for paleontological resources are present in the project area and could be affected by excavation for restoration.
Lower Putah Creek Realignment	CDFW	Planning phase	Restoration of 300‑700 acres of tidal freshwater wetlands and creation of 5 miles of a new fish channel	Sediments disturbed by excavation would likely be too young to contain fossils. Mitigation measure available should paleontological resources be encountered.

BiOps = Biological Opinions; CDFW = California Department of Fish and Wildlife; DWR = California Department of Water Resources; EIR = environmental impact report; EIS = environmental impact statement; NMFS = National Marine Fisheries Service; USACE= U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service.

28.3.4.1 Cumulative Impacts of the No Project Alternative

The projects that would happen if the Delta Conveyance Project is not approved and built under the No Project Alternative and the cumulative projects would require ground-disturbing construction to either construct new facilities or implement restoration and habitat enhancement goals. SWP/CVP operations would require repair, maintenance, or protection of infrastructure such as levees, and may also include actions for water quality management, habitat and species protection, and flood management. These continuing actions could occur throughout the study area and could result in effects on unique paleontological resources, depending on the type of construction needed for repairs or adjustments to potential irrigation water and drainage needed for water quality and flood management. In addition, many planning documents that govern portions of the Delta include buildout footprints that allow development of land that is likely to contain paleontological resources. If the development requires excavation into undisturbed sediments (i.e., excavation deeper than previous disturbance, such as occurred for farming), unique paleontological resources could be destroyed. Because of the ground-disturbing activities associated with the cumulative set of plans and projects, the suite of all ongoing projects and programs in the Delta could both singly and collectively result in significant impact on unique paleontological resources. However, these projects would involve relatively typical construction techniques (i.e., no large-scale tunnels or deep soil mixing) and would be required to conform with the requirements of CEQA and/or state and local regulations protecting paleontological resources, and mitigation measures would be developed to protect these resources. Therefore, the impacts of these projects would be less than significant.

28.3.4.2 Cumulative Impacts of the Project Alternatives

All project alternatives involve surface excavation for both water conveyance construction and compensatory mitigation. Excavation into sensitive geologic units (i.e., with high or undetermined sensitivity) in combination with other past, present, and probable future projects and programs that require similar surface excavation in the study area could result in a cumulatively significant impact on paleontological resources.

All project alternatives involve surface excavation, ground improvements, and tunneling, which could cause a significant impact. With implementation of Mitigation Measures PALEO-1a through PALEO-1b, the impacts of surface excavation would have a less than significant. Surface excavation would be limited spatially to the project footprint and would not combine with other projects to cause a cumulative impact. In addition, surface excavation can be mitigated by implementing mitigation measures. Therefore, surface excavation and ground improvements combined with other past, present, and probable future projects and programs in the study area would not result in a cumulatively considerable impact. Although tunnel boring could have a significant and unavoidable impact on unique paleontological resources, no other large-scale tunneling projects in the Delta region are part of the cumulative analysis and therefore the project would not combine with other tunnel projects. Ground improvement could also have a significant and unavoidable impact on paleontological resources, but ground improvement is limited to the project footprint and is primarily used in Holocene deposits, which are not sensitive for paleontological resources. Combined with other past, present, and probable future projects and programs in the study area, the impacts of the project alternatives would be cumulatively less than significant.