Chapter 27
Paleontological Resources

27.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)

Impact PALEO-1: Destruction of Unique or Significant Paleontological Resources as a Result of Construction of Water Conveyance Facilities

Construction of water conveyance facilities under Alternative 4 could cause the destruction of unique paleontological resources as a result of excavation for new intakes, new intake pumping plants, new forebays, pipelines and tunnels, canals to the Jones and Banks pumping plants, an operable barrier at the head of Old River, other water facility components, roads, and borrow sites.

The depth, extent, and location of excavation and other ground-disturbing activities vary greatly across the Plan Area (as shown in Table 27-14). Accordingly, this discussion considers these activities on the basis of their location and the depth of excavation.

Table 27-14. Summary of Conveyance Construction Activities and Geologic Units Sensitive for Paleontological Resources That Could Be Disturbed under Alternative 4

Alternative 4	Location	Construction/Excavation	Sensitive Units Disturbed
Three new north Delta intakes	East bank Sacramento River between Clarksburg and Walnut Grove	30 ft below existing grade; ~~330~~ 88–106 ac ~~total~~ per intake, including ~~pumping plants and~~ sedimentation basins	Riverbank and Modesto Formations
~~New intake pumping plants and sedimentation basins~~	~~Adjacent to intakes~~	~~Sedimentation basin 20–30 ft below existing grade; pumping plant 25–30 ft below existing grade; staging/storage area and construction zone prep (76–148 ac per intake structure, including sedimentation basin and pumping plant)~~	~~Riverbank and Modesto Formations~~
New pumping plants	Northeast of the Clifton Court Forebay	Pumping plant 50 ft below existing grade; staging/storage area and construction zone prep (0.74 ac for each pumping plant)	Modesto Formation eolian deposits, alluvium from Corral Hollow Drainage to Brushy Creek
Expanded Clifton Court Forebay, canals to Jones and Banks pumping plants	Just south of existing Clifton Court Forebay	~~592~~ 2,030 ac to a depth of 15–20 ft below existing grade	Modesto Formation eolian deposits, alluvium from Corral Hollow Drainage to Brushy Creek
Intermediate forebay	Glannvale Tract	~~245~~ 243 ac to a depth of ~~6~~12–~~11~~ 16 ft below existing grade	Riverbank Formation
Tunnel 1a	Single-bore ~~20~~28- to 40-ft-diameter tunnel, 46,700 ft from Intakes 2 and 3 to Intermediate Forebay	Shaft to 75 ft below existing grade; tunnel invert at 125 ft; boring using pressurized face mechanized tunneling machines, including earth pressure balance (EPB) machines and slurry tunneling machines	Riverbank and Modesto Formations
Tunnel 1b	Single-bore ~~20~~28-ft-diameter tunnel, ~~25,100~~25,200 ft from Intake 5 to Intermediate Forebay	Same as Tunnel 1a	Riverbank Formation
Tunnel 2	Dual-bore 40-ft-diameter tunnel, 159,~~000~~ 850 ft from Intermediate Forebay to Clifton Court Forebay	Same as Tunnel 1a and 1b but tunnel invert depth down to 163 ft	Riverbank and Modesto Formations

The three intakes and the intermediate forebay ~~(Figure 27-23)~~ would entail deep and extensive excavation in the northern portion of the Plan Area (Table 27-14). The three intakes ~~and the pumping plant~~ and sedimentation basin associated with each intake would be along the east bank of

the Sacramento River between Clarksburg and Walnut Grove. The intermediate forebay would be located on the west side of Glannvale Tract. No pumping plant is associated with the intermediate forebay due to the fact that water would flow via gravity to the south Delta. Ground-disturbing activities include clearing and grubbing, rough grading, excavation, pile driving, constructing foundations, and final grading. Construction of the intakes~~, pumping plants,~~ and sedimentation basins would involve excavation to a depth of between 20–35 feet over an area of 330 acres. The staging/storage area and construction zone preparation would involve 70–114 acres per intake structure. Construction for the intermediate forebay would involve excavation of approximately 245 acres to a depth of approximately 6-11 feet below existing grade.

Excavation for the intakes and intermediate forebay would be conducted in geologic units both sensitive and nonsensitive for paleontological resources (Figure 27-2). Although most of the surficial geologic units in the area affected by excavation for the intakes and forebays 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 the area and likely is exposed at the surface and in the shallow subsurface. These Pleistocene units likely occur at a depth of less than 5 feet and would therefore be disturbed during excavation of the intakes and intermediate forebay (Figure 27-3).

Pipeline construction would involve excavation in the northern portion of the Plan Area (Figure 27-2; Table 27-10). The pipelines would extend from the intakes to the sedimentation basin and intake pumping plants and from the intake pumping plants to the intermediate forebay. Pipeline excavation would use open trenching to a minimum depth of approximately 30 feet but could be deeper, depending on local conditions. Trench widths would be approximately 220 feet. The Tunnel 2 segment as shown in Table 27-14, would be a dual-bore with finished inside diameters of 40 feet. The amount of material that would be excavated for the tunnels is shown in Table 27-14. The distance between the two bores of the tunnel would increase, as would the width of the retrieval shaft. The effects of tunneling under Alternative 4 would be greater than those under Alternative 1A due to the larger tunnel diameters~~and therefore an increased likelihood of disturbing sensitive paleontological units, but of a lesser magnitude than alternatives along the East or West alignment.~~

Excavation for the pipelines would, like that for the intakes and the intermediate forebay, occur in both sensitive and nonsensitive units. Although most of the surficial geologic units in the area affected by excavation for the pipelines are of Holocene age and not sensitive for paleontological resources, the Riverbank Formation and Modesto Formation are exposed at the surface and occur in the shallow subsurface. These Pleistocene units likely occur at a depth of 0 to 10 feet and would therefore be disturbed during excavation for pipelines.

Construction of Tunnels 1a, 1b and 2 would entail deep excavation using a tunnel-boring machine (TBM) (Table 27-10). Tunnel 1a would connect a pipeline adjacent to Intake Pumping Plant 2, a pipeline adjacent to Intake Pumping Plant 3 to the intermediate forebay on Glannvale Tract. Tunnel 1b would run between Intake Pumping Plant 5 and the intermediate forebay. Tunnel 2 would extend between the intermediate forebay and Clifton Court Forebay. The main construction or launching shafts for each tunnel would be about 60 feet in diameter. The TBM retrieval shaft would be approximately 45 feet in diameter, and 12-foot-diameter intermediate ventilation shafts would be constructed approximately every 3 miles along the tunnel route. The amount of material that would be excavated, which is the least of the tunnel or canal options, is shown in Table 27-11. The tunnels

would be excavated at a depth of approximately 100–150 feet at the tunnel invert, mainly to avoid the peaty Holocene soils. The TBMs would be mechanized soft-ground tunneling machines designed for use in soft soils with high groundwater pressure. The tunnels would be lined with precast concrete bolted-and-gasketed segments. The tunnel concrete liner would serve as permanent ground support and would be installed immediately behind the TBM, forming a continuous watertight vessel.

Shafts and tunnels would be excavated through Holocene and Pleistocene deposits (Figures 27-2 and 27-3). Shafts would be excavated through surficial Holocene deposits and then through Pleistocene deposits of the Riverbank or Modesto Formations. Tunnels would be bored wholly through Pleistocene deposits. Construction of the expanded Clifton Court Forebay would involve deep and extensive excavation directly southeast of Clifton Court Forebay (Figure 27-2). Excavation would involve approximately 592 acres to a depth of approximately 15–20 feet below existing grade, except locally at the inlet and outlet connections (Table 27-10). The invert of the incoming canal would be at -28 feet msl before discharging to the tunnel.

Excavation for the expanded Clifton Court Forebay and pumping plants would occur in both sensitive and nonsensitive units (Figure 27-2). Although much of the area surrounding the Clifton Court Forebay is covered in surficial units of Holocene age such as the Holocene alluvial-floodplain deposits (Qfp), which are not sensitive for paleontological resources, units sensitive for paleontological resources are also exposed at the surface and underlie the area (Figure 27-2). These units include the Holocene or Upper Pleistocene alluvium of creeks from the Corral Hollow Drainage to Brushy Creek (Qch), which is sensitive for paleontological resources. The Modesto Formation also likely occurs in the shallow subsurface of the northeast edge of Clifton Court Forebay.

A new section of canal, approximately 800 feet long and situated between Clifton Court Forebay and Union Pacific Railroad, will connect the expanded Clifton Court Forebay to the existing approach channel to the Banks Pumping Plant.

Excavation for the expanded Clifton Court Forebay and new approach to the Banks Pumping Plant would disturb these Pleistocene units. Breaching of the existing canal embankment would not disturb Pleistocene units.

An operable barrier would be constructed at the head of Old River. The operable barrier would be constructed in units of Holocene age and not sensitive for paleontological resources and, possibly, the Modesto Formation, which occurs in the shallow subsurface. The operable barrier is in the same geologic units as the canals to Jones and Banks pumping plants.

The temporary and permanent access roads required for Alternative 4 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.

Borrow material would be needed primarily for forebay embankments and levee reconstruction at intake sites, but also for access roads. The amount of material that would be needed for borrow, which is the least of the tunnel or canal options, is shown in Table 27-11. Borrow material would be excavated from targeted units described in the engineering report (California Department of Water Resources 2010). Some of these units, including the Modesto and Montezuma Formations, are sensitive for paleontological resources. Excavation of borrow material from these units could disturb paleontological resources. In addition, borrow/spoil areas are designated in the area of the

intakes, along the intermediate forebay, and along the expanded Clifton Court Forebay (Figure 27-2). As described above, units sensitive for paleontological resources in these areas include the Riverbank and Modesto Formations (potentially in the shallow subsurface) in the area of the intakes and intermediate forebay, and the alluvium of creeks from the Corral Hollow Drainage to Brushy Creek and the Modesto Formation along the expanded Clifton Court Forebay and pumping plants. Excavation of borrow material from these units could also disturb sensitive paleontological resources.

NEPA Effects: The ground-disturbing activities that occur in geologic units sensitive for paleontological resources have the potential to damage or destroy those resources. Direct or indirect destruction of significant paleontological resources as defined by the SVP (2010) would represent an adverse effect because conveyance facility construction could directly or indirectly destroy unknown paleontological resources in geologic units known to be sensitive for these resources.

The shallow excavation and grading in surficial Holocene deposits that would take place for the construction of roads could be addressed through implementation of Mitigation Measures PALEO-1b and 1d.

Mitigation Measures PALEO-1a through PALEO-1d are available to mitigate the effects of the surface-related ground disturbance activities associated with Alternative 4. However, while these measures could be applied to the excavation of the tunnel shafts, no mitigation is available for the boring activities because they would be conducted deep underground and could not be monitored. Moreover, although boring material could be examined by monitors, such work would be subsequent to boring, and the boring area could not be accessed even if fossils were encountered.

Excavation for new intakes, new intake pumping plants, new/expanded forebays, pipelines and tunnels, canals to Jones and Banks pumping plants, and other water facility components necessary for Alternative 4 would most likely destroy unique or significant paleontological resources and would constitute an adverse effect under NEPA.

***CEQA Conclusion*:** Construction of water conveyance facilities proposed under Alternative 4 could cause the destruction of unique paleontological resources. The ground-disturbing activities associated with Alternative 4 would occur in geologic units sensitive for paleontological resources and could therefore have the potential to damage or destroy those resources. Direct or indirect destruction of significant paleontological resources as defined by the SVP (2010) would constitute a significant impact under CEQA.

~~While i~~Implementation of Mitigation Measures PALEO-1a through PALEO-1d would reduce the effects of surface-related ground disturbance to a less-than-significant level, but excavation for the tunnels necessary for Alternative 4 would most likely destroy unique or significant paleontological resources in the Plan Area and would potentially cause a significant and unavoidable impact.

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

Before ground-breaking construction begins, BDCP proponents will retain a qualified paleontologist or geologist (as defined by the SVP Standard Procedures [Society of Vertebrate Paleontology 2010]) to develop a comprehensive Paleontological Resources Monitoring and

Mitigation Plan (PRMMP) for the BDCP, to help avoid directly or indirectly destroying a unique or significant paleontological resource.

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) and will require the following.

- 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 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. The PRS will be retained or designated prior to the start of ground-breaking construction. A qualified PRS is defined as a person with a M.S. or Ph.D. in paleontology, paleobiology, or geology, with strong working knowledge of local paleontology and geology, and professional expertise with paleontological procedures and techniques. The PRS may designate a paleontological monitor to be present during earth-moving activities. A paleontological monitor is defined as a person with a BS/BA in geology or paleontology and a minimum of 1 year of monitoring experience in local sedimentary rocks. Experience may be substituted for academic training on approval from the contracting agency. The PRS and paleontological monitor(s) will be notified by the Lead Agency or Resident Engineer in advance of the start of construction activity. The PRS and paleontological monitor(s) will attend any required safety training programs.
- 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 for paleontological resources.
- 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-1c and communications regarding the *stop work, evaluate and treat appropriately response* in the event of a paleontological discovery, as discussed in Mitigation Measure PALEO-1d.
- All ground-disturbing activities involving highly sensitive units will be monitored by qualified monitors. Monitoring will initially be conducted full time for grading and excavation, 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. Monitoring will also be conducted throughout drilling operations. The monitoring program for tunneling operations will be developed in conjunction with the facility design and geotechnical teams, in consideration of the tunneling method selected.
- 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) will be established.

- A repository plan will be developed that provides for appropriate curation of recovered materials, if necessary.
- Mitigation monitoring report preparation guidelines will be established that are consistent with the SVP Standard Procedures guidelines (Society of Vertebrate Paleontology 2010). The report will include, at a minimum, discussions of effects, regulatory requirements, purpose of mitigation, regional geologic context, Plan 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, quarry maps, 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.
- 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 1996 and 2010) and any specific requirements of the designated repository institution.

Implementation of this measure will ensure that unique or scientifically significant paleontological resources in the alternative footprint are systematically identified, documented, avoided or protected from damage where feasible, or recovered and curated so they remain available for scientific study.

Mitigation Measure PALEO-1b: Review 90% Design Submittal and Develop Specific Language Identifying How the Mitigation Measures Will Be Implemented along the Alignment

To help avoid directly or indirectly destroying a unique or significant paleontological resource, the BDCP proponents will have a qualified individual review the 90% design submittal to finalize the identification of construction activities involving geologic units considered highly sensitive for paleontological resources. Evaluation will consider the anticipated depth of disturbance, the selected construction technique, and the geology of the alignment. This work may be carried out in conjunction with or as part of the development of the PRMMP (Mitigation Measure PALEO-1a). The evaluation may be carried out by the PRS or an individual meeting the SVP's requirements for a qualified vertebrate paleontologist (per Society of Vertebrate Paleontology 2010) and will be conducted in collaboration with the BDCP design and geotechnical teams. If the evaluation is performed by a 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). This language will be included in the BDCP construction documents for implementation by BDCP proponents. The language will be based on the following framework.

- One onsite paleontological monitor will likely be sufficient to handle observation of most ground-disturbing activities. However, if additional paleontological monitors are needed,

the PRS will coordinate with the Resident Engineer. This communication is imperative and fundamental to the success of this PRMMP and to compliance with CEQA and NEPA.

- Whenever possible, sedimentary rocks exposed during trenching and other deep excavation work will be inspected. Ideally, this monitoring will involve inspection of fresh bedrock exposures. However, observation of some work may not be possible for safety reasons and inspection from these operations will be restricted to spoils. In this case, the monitor will inspect spoils as they are stockpiled and remove any matrix blocks containing paleontological resources. Construction personnel, namely the Resident Engineer/Lead, must communicate depths of excavated materials and their approximate location to the field monitor.
- Recording of stratigraphic data will be an ongoing aspect of excavation monitoring, to provide context for any eventual fossil discoveries. Outcrops exposed in active cuts and finished slopes will be examined and geologic features recorded on grading plans and in field notes. The goal of this work is to delimit the nature of fossiliferous unconsolidated sedimentary deposits within the Plan Area, determine their areal distribution and depositional contacts, and record any evidence of structural deformation. Standard geologic and stratigraphic data collected include lithologic descriptions (e.g., color, sorting, texture, structures, and grain size), stratigraphic relationships (e.g., bedding type, thickness, and contacts), and topographic position. Stratigraphic sections will be routinely measured, areas containing exposures of fossiliferous sedimentary rocks will be documented, and fossil localities will be recorded on measured stratigraphic sections.
- If fossils are discovered, the following procedures will be followed. The monitor or PRS will inform the Resident Engineer who will determine the appropriate course of action. For all excavations except those relating to the tunnels, mitigation shall consist of one of the following: diverting, directing, or temporarily halting ground-disturbing activities in the area of discovery to allow for preliminary evaluation of potentially significant paleontological resources and to determine whether additional mitigation (i.e., collection, curation or other preservation) is required. Where excavations relate to construction of the tunnels, such measures will be infeasible because the fossils will most likely have been destroyed by the tunnel boring machines before they could have been identified.

The significance of the discovered resources will be determined by the PRS in consultation with appropriate contractor representatives. Because of the infrequency of fossil preservation, fossils are considered to be nonrenewable resources. Because of their rarity, and because of the scientific information they provide, fossils can be highly significant records of ancient life. Given this, fossils can be considered to be of significant scientific interest if one or more of the following criteria apply.

- Provide data on the evolutionary relationships and developmental trends among organisms, both living and extinct.
- Provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein.
- Provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas.
- Demonstrate unusual or spectacular circumstances in the history of life.

- Are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

They can include fossil remains of large to very small aquatic and terrestrial vertebrates (including animal trackways), remains of plants and animals previously not represented in certain portions of the stratigraphy, and fossils that might aid stratigraphic correlations, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, paleoclimatology, and the relationships of aquatic and terrestrial species.

- Recovery methods will vary to some degree depending on the types of fossils discovered (e.g., invertebrate macrofossils, invertebrate microfossils, vertebrate macrofossils, vertebrate microfossils, or plant fossils). Many fossil specimens discovered during excavation monitoring are readily visible to the naked eye and large enough to be easily recognized and removed. Upon discovery of such macrofossils, the paleontological monitor will temporarily flag the discovery site for avoidance and evaluation, as described above. Actual recovery of unearthed macrofossils can involve several techniques, including immediate collection, hand quarrying, plaster-jacketing, and/or large-scale quarrying. The PRS and the contracting agency representative will evaluate the discovery and take action to protect or remove the resource within the shortest period of time possible.
- Many significant vertebrate fossils (e.g., small mammal, bird, reptile, amphibian, or fish remains) often are too small to be readily visible in the field, but are nonetheless significant and worthy of attention. The potential discovery of microvertebrate sites is anticipated and can include sites that produce remains of large vertebrate fossils from fine-grained deposits, sites with an obvious concentration of small vertebrate fossil remains, and sites that based on lithology alone (e.g., paleosols) appear to have a potential for producing small vertebrate fossil remains. Microvertebrate sites will be sampled by collecting bulk quantities of sedimentary matrix. An adequate sample comprises approximately 12 cubic meters (6,000 lbs or 2,500 kg) of matrix for each formation, or as determined by the PRS (Society of Vertebrate Paleontology 2010). The uniqueness of the recovered fossils may dictate salvage of larger amounts. However, conditions in the field may make it impossible to recover such large samples. To avoid construction delays, bulk matrix samples will be transported to an offsite location for processing.
- The discovery of fossil plants is possible in the Plan Area. Paleobotanical specimens typically occur in fine-grained, laminated strata (e.g., shale) and will require special recovery techniques. Large blocks (>2 feet) of sedimentary rock are hand quarried from the temporary outcrop and then split along bedding plains to reveal compressed fossil plant material (e.g., leaves, stems, and flowers). Individual slabs are then wrapped in newsprint to minimize destructive desiccation of the fossils. Specimens that are delaminating or flaking badly may need to be coated with special consolidants.
- Oriented matrix samples may be collected for paleomagnetic analysis. Such sampling will likely only be necessary in instances where long, continuous sections of stratified rocks are producing fossils from several different stratigraphic horizons or where vertebrate fossils are being collected in stratigraphic sections lacking in biochronologically useful microfossils. Likewise, it may be necessary to collect stratigraphically positioned samples of fine matrices pollen analysis or aid in addressing questions of geologic age, depositional environment, or paleoecology.

- All fossil discoveries will include the collection of stratigraphic data to delimit the nature of the fossil-bearing sedimentary rock unit, determine its areal distribution and depositional contacts, record any evidence of structural deformation, generate lithologic descriptions of fossil-bearing strata, determine stratigraphic relationships (bedding type, thickness, and contacts), and topographic position, measure stratigraphic sections, and describe taphonomic details.

Implementation of this measure will ensure that mitigation procedures are followed so that unique or scientifically significant paleontological resources in the alternative footprint are systematically identified, documented, avoided or protected from damage where feasible, or recovered and curated so they remain available for scientific study.

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

In order to reduce the likelihood of directly or indirectly destroying a unique or significant paleontological resource, BDCP proponents will require that all construction personnel receive training provided by a qualified paleontologist experienced in teaching non-specialists, to ensure that 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 ensure that unique or scientifically significant paleontological resources have a high likelihood of being identified during construction so they can be avoided or treated appropriately.

Mitigation Measure PALEO-1d: Collect and Preserve Substantial Potentially Unique or Significant Fossil Remains When Encountered

To help avoid directly or indirectly destroying a unique or significant paleontological resource, the BDCP proponents will ensure that if substantial potentially unique or significant fossil remains (particularly vertebrate 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. A newly discovered resource may need to be fenced off to protect it from inadvertent intrusions by machinery or protect the location from vandalism. If extensive recovery and jacketing is needed, the area will be fenced off with temporary fencing and a 3- to 5-meter (10- to 15-foot) buffer will be included in the fenced area around the locality. If specific construction activities preclude placement of a buffer of this width, the monitor will stake a mutually agreeable buffer prior to fencing. The PRS will evaluate the resource and prepare a mitigation plan in accordance with SVP guidelines (2010). The mitigation plan may include a field survey, construction monitoring, sampling and data recovery procedures, museum storage coordination for any specimen recovered, and a report of findings. Recommendations determined by BDCP

proponents to be necessary and feasible will be implemented before construction can resume at the site where the paleontological resources were discovered.

Except for the fossils destroyed by tunnel boring machines, implementation of this measure will ensure that unique or scientifically significant paleontological resources identified during construction are protected from damage or treated and documented appropriately to preserve their scientific value.

Impact PALEO-2: Destruction of Unique or Significant Paleontological Resources Associated with the Implementation of ~~Other Conservation Measures~~CM2–CM21

Ground-disturbing activities associated with other conservation measures (CM2 and CM4–CM10) have the potential to affect paleontological resources. These activities are evaluated below by conservation measure. Conservation measures to address reduction of other stressors (CM11–CM~~22~~21) would have no effect on paleontological resources because they would not entail ground-disturbing activities.

CM2 (Yolo Bypass Fisheries Enhancement)

- Construct four experimental ramps at the Fremont Weir.
- Construct up to three sets of up to three fish ladders.
- Construct fish screens on small Yolo Bypass diversions.
- Construct new or replacement operable check-structures at Tule Canal/Toe Drain.
- Replace the Lisbon Weir with a fish-passable gate structure.
- Realign Putah Creek.
- Modify a section of the Fremont Weir.
- Construct and operate nonphysical or physical barriers in the Sacramento River.
- Construct associated support facilities (operations buildings, parking lots, access facilities such as roads and bridges) necessary to provide safe access for maintenance and monitoring.
- Construct and test flood-neutral fish barriers.

Of these ground-disturbing activities, only the realignment of Putah Creek has the potential to disturb sensitive paleontological resources. If this realignment includes excavating a new channel, Pleistocene deposits associated with the older alluvium of Putah Creek could be disturbed. The other CM2 activities would occur in basin deposits of Holocene origin, which have low potential sensitivity for paleontological resources, based on age.

CM4 (approximately 65,000 acres of restored freshwater and brackish tidal habitat within the BDCP Restoration Opportunity Areas)

Ground-disturbing activities associated with CM4 range from relatively shallow, localized excavation to deep or extensive excavation. Two types of activities involve deeper excavation.

- Modify existing land elevations through grading and filling or subsidence reversal.
- Relocate existing roads and utilities to support construction and postconstruction activities at the restoration site or services to adjacent lands protected by levees.

Sensitive Pleistocene deposits occur at the surface or in the shallow subsurface in all the Restoration Opportunity Areas (ROAs), except the South Delta ROA (Figures 27-2 and 3-1). Shallow, localized excavation in areas where sensitive units occur at the surface could disturb paleontological resources in these units. Deeper or extensive excavation could disturb sensitive units in all of the ROAs.

CM5 (approximately 10,000 acres of seasonally inundated floodplain habitat within the north, east, and/or south Delta)

Ground-disturbing activities associated with CM5 include clearing and grubbing, demolition of existing structures, setting back levees and removing existing levees, removal of riprap to allow for channel meander between setback levees, grading to restore drainage patterns and increase inundation frequency and duration, and establishment of riparian habitat. Most of these activities would involve shallow excavation or excavation in disturbed materials (levees), but grading to restore drainage patterns could involve deeper excavation. This floodplain-related excavation could occur in the northern, eastern, or southern sections of the Delta, but the most promising areas for paleontological resources are expected along the San Joaquin River in Conservation Zone 7. This area includes sensitive Modesto Formation and Corral Hollow/Brushy Creek drainage units at or near the surface (Figures 27-2 and 3-1); sensitive paleontological resources could be disturbed in this area.

CM6 (20 linear miles of channel margin habitat enhancement in the Delta)

Ground-disturbing activities associated with CM6 include clearing and grubbing, demolition of existing structures, modification of levees or setting back levees, removing riprap where levees are set back, and modifying channel geometry in unconfined channel reaches or along channels where levees are set back. Most of these activities would involve shallow excavation or excavation in disturbed materials (levees), but modifying channel geometry could involve deeper excavation. Sensitive Pleistocene deposits may be encountered at shallow depths along the San Joaquin River in Conservation Zone 7 (Figures 27-2 and 3-1), should there be channel geometry modification in this area.

CM7 (approximately 5,000 acres of restored valley/foothill riparian habitat)

Ground-disturbing activities associated with CM7 include clearing and grubbing, and demolition of existing structures. Earthwork activities for development of the riparian habitat areas would be minimal and focused on removal of riprap and minor landform modifications to restore water circulation. These activities are shallow and unlikely to disturb paleontological resources.

CM8 (approximately 2,000 acres of restored grassland and 8,000 acres of protected or enhanced grassland within BDCP Conservation Zones 1, 8, and/or 11)

Ground-disturbing activities associated with CM8 entail little or no ground disturbance. Any grading for this restoration would be at shallow depths and would not be likely to affect paleontological resources.

CM3 and CM9 (approximately 67 acres of restored vernal pool complex and 600 acres of protected vernal pool complex within Conservation Zones 1, 8, and/or 11)

Ground-disturbing activities associated with CM9 entail some land disturbance, such as minor grading to improve connectivity between complexes. Any grading for this restoration would be at shallow depths and would not be likely to affect paleontological resources.

CM10 (approximately 1,200 acres of restored nontidal marsh within Conservation Zones 2 and 4 and/or 5)

Ground-disturbing activities associated with CM10 entail grading to establish an elevation gradient to support open water perennial aquatic habitat intermixed with shallower marsh habitat. The Pleistocene Riverbank and Modesto Formations are exposed throughout Conservation Zone 4 and may occur in the older alluvium of Putah Creek in Conservation Zone 2. Where sensitive Pleistocene deposits are exposed at the surface or are overlain by a shallow veneer of Holocene deposits in these two conservation zones (Figures 27-2 and 3-1), paleontological resources could be disturbed as grading is undertaken for CM10.

NEPA Effects: Although excavation associated with these conservation measures under Alternative 4 would be shallow, CM2, CM4–CM6, and CM10 require deeper or more extensive excavation. Units sensitive for paleontological resources, such as the Riverbank and Modesto Formations, occur at the surface in several conservation zones and at shallow depth in other zones. If fossils are present in the Plan Area, they could be damaged during excavation for these conservation measures. The greater the extent of excavation, the greater the potential effect, although even localized excavation could damage or destroy paleontological resources. Direct or indirect destruction of vertebrate or otherwise scientifically significant paleontological resources as defined by the SVP (2010) would be an adverse effect.

Mitigation Measures PALEO-1b and PALEO-1d are available to mitigate all shallow ground-disturbing conservation measures. Mitigation Measures PALEO-1a through PALEO-1d would address all deeper ground-disturbing conservation measures.

CEQA Conclusion: Ground-disturbing activities associated with other conservation measures (CM2 and CM4–CM10) could affect paleontological resources. Although most excavation associated with these conservation measures under Alternative 4 would be fairly shallow, CM2, CM4–CM6, and CM10 require deeper or more extensive excavation. Units sensitive for paleontological resources, such as the Riverbank and Modesto Formations, occur at the surface in several conservation zones and occur at shallow depth in other zones. If fossils are present in the Plan Area, they could be damaged during excavation associated with these conservation measures. The greater the extent of excavation, the greater the potential impact, although even localized excavation could damage or destroy paleontological resources. Direct or indirect destruction of significant paleontological resources as defined by the SVP (2010) would constitute a significant impact.

Implementation of Mitigation Measures PALEO-1b and PALEO-1d for all shallow ground-disturbing conservation measures and Mitigation Measures PALEO-1a through PALEO-1d for all deeper ground-disturbing conservation measures ensure that unique or significant paleontological resources in the alternative footprint are systematically identified, documented, avoided or protected from damage where feasible, or recovered and curated so they remain available for scientific study and would reduce these impacts to a less-than-significant level.

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

Please see Mitigation Measure PALEO-1a under Impact PALEO-1 in the discussion of Alternative 4.

Mitigation Measure PALEO-1b: Review 90% Design Submittal and Develop Specific Language Identifying How the Mitigation Measures Will Be Implemented along the Alignment

Please see Mitigation Measure PALEO-1b under Impact PALEO-1 in the discussion of Alternative 4.

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

Please see Mitigation Measure PALEO-1c under Impact PALEO-1 in the discussion of Alternative 4.

Mitigation Measure PALEO-1d: Collect and Preserve Substantial Potentially Unique or Significant Fossil Remains When Encountered

Please see Mitigation Measure PALEO-1d under Impact PALEO-1 in the discussion of Alternative 4.