2.11 Paleontology

2.11.1 Regulatory Setting

Paleontology is a natural science focused on the study of ancient animal and plant life as it is preserved in the geologic record as fossils.

A number of federal statutes specifically address paleontological resources, their treatment, and funding for mitigation as a part of federally authorized projects.

16 USC 431-433 (the Antiquities Act) prohibits appropriating, excavating, injuring, or destroying any object of antiquity situated on federal land without the permission of the Secretary of the Department of Government having jurisdiction over the land. Fossils are considered "objects of antiquity" by the Bureau of Land Management, the National Park Service, the Forest Service, and other federal agencies.

16 USC 470aaa (the Paleontological Resources Preservation Act) prohibits the excavation, removal, or damage of any paleontological resources located on federal land under the jurisdiction of the Secretaries of the Interior or Agriculture without first obtaining an appropriate permit. The statute establishes criminal and civil penalties for fossil theft and vandalism on federal lands.

23 USC 1.9(a) requires that the use of federal-aid funds must be in conformity with all federal and State laws.

23 USC 305 authorizes the appropriation and use of federal highway funds for paleontological salvage as necessary by the highway department of any state, in compliance with 16 USC 431-433 and State law.

Under California law, paleontological resources are protected by CEQA.

2.11.2 Affected Environment

This section is based on the Paleontological Identification Report and Evaluation Report (PIR/PER) (October 2018).

The scope of paleontological work included a geologic map review, literature search, institutional record search, and field survey. The Area of Project Disturbance (APD) includes all areas where project activities have the potential to directly affect paleontological resources. The project site is located along SR 55 in an urban area that consists primarily of modern construction; wide, paved roadways; and vacant, graded and landscaped parcels.

2.11.2.1 Site Geology

The project site is located in the cities of Anaheim, Orange, Santa Ana, and Tustin in Orange County, California, within the Coastal Plain Region and Santa Ana Mountains of the Peninsular Ranges Geomorphic Province. The project area is mapped on the USGS Orange (1981) and Tustin (1981) California 7.5-minute topographic quadrangles on an unsectioned portion of the

Santiago de Santa Ana Land Grant. The project is approximately 7.5 miles along SR 55 and encompasses approximately 357.7 acres. Geologic mapping indicates that the project area and immediate vicinity are underlain by Miocene Puente Formation Yorba Member; Pliocene Fernando Formation Lower and Upper Members; Pleistocene old and very old alluvial fan deposits; Quaternary young alluvial fan, wash, and landslide deposits; and artificial fill.

The project area is situated in the Peninsular Ranges Geomorphic Province, a region characterized by northwest-trending fault-bounded mountain ranges, broad intervening valleys, and low-lying coastal plains. The Peninsular Ranges extend approximately 920 miles from the Los Angeles Basin to the southern tip of Baja California and vary in width from approximately 30 to 100 miles. Bedrock units in the Peninsular Ranges include Jurassic igneous rocks of the Southern California Batholith. The project area lies in both the Coastal Plain Region and the northwestern margin of the Santa Ana Mountains. The eastern Coastal Plain Region is underlain primarily by Pleistocene to Holocene non-marine sediments that were deposited from inland drainages. The Santa Ana Mountains comprise a fault block that has been uplifting since the Pleistocene along the Elsinore Fault Zone, which bounds the block's northeastern edge. These mountains tilt southwesterly toward the Coastal Plain and comprise folded Tertiary rocks and Mesozoic plutonic basement rock.

Geologic mapping indicates that the project area and immediate vicinity are underlain by Quaternary young alluvial fan, wash, and landslide deposits; Pleistocene old and very old alluvial fan deposits; Pliocene Fernando Formation Upper and Lower Members; and Miocene Puente Formation Yorba Member. Previously disturbed sediments and/or artificial fill are not mapped within the project area, although these sediments are present within the project area. Figure 2.11-1(maps 1 through 3) illustrates the geologic mapping and underlying formations associated with the project site.

Puente Formation Yorba Member (Miocene)

The Miocene Puente Formation consists of shale, siltstone, sandstone, and pebble to cobble conglomerate and has an unknown maximum thickness of more than 13,000 feet. The Puente Formation is known to be locally equivalent to the Monterey Formation. The formation is subdivided into four members, which, from oldest to youngest, include the La Vida Member, Soquel Member, Yorba Member, and Sycamore Canyon Member. The Yorba Member is mapped immediately east of the northern portion of the project area and may be present at shallow depth within the APD.

The Puente Formation was deposited when the ocean still covered much of Southern California. Rapid uplift of landward sediments due to the geologically rapid convergence of the Pacific and Farallon plates caused the production of large amounts of terrestrially derived sediments. At that time, submarine canyons along the coast shed two main "megasequences" of turbidites (comparable to oceanic landslides) off the continental shelf and into the ocean basin, where they were interbedded with slower accumulating silts and clays.

The Yorba Member is late Miocene in age (~10 to 7.5 million years old), and generally consists of white to gray colored siltstone and sandstone with some gray-white to brick-red diatomaceous mudstone.

Figure 2.11-1. Project Geologic Map (1 of 3)

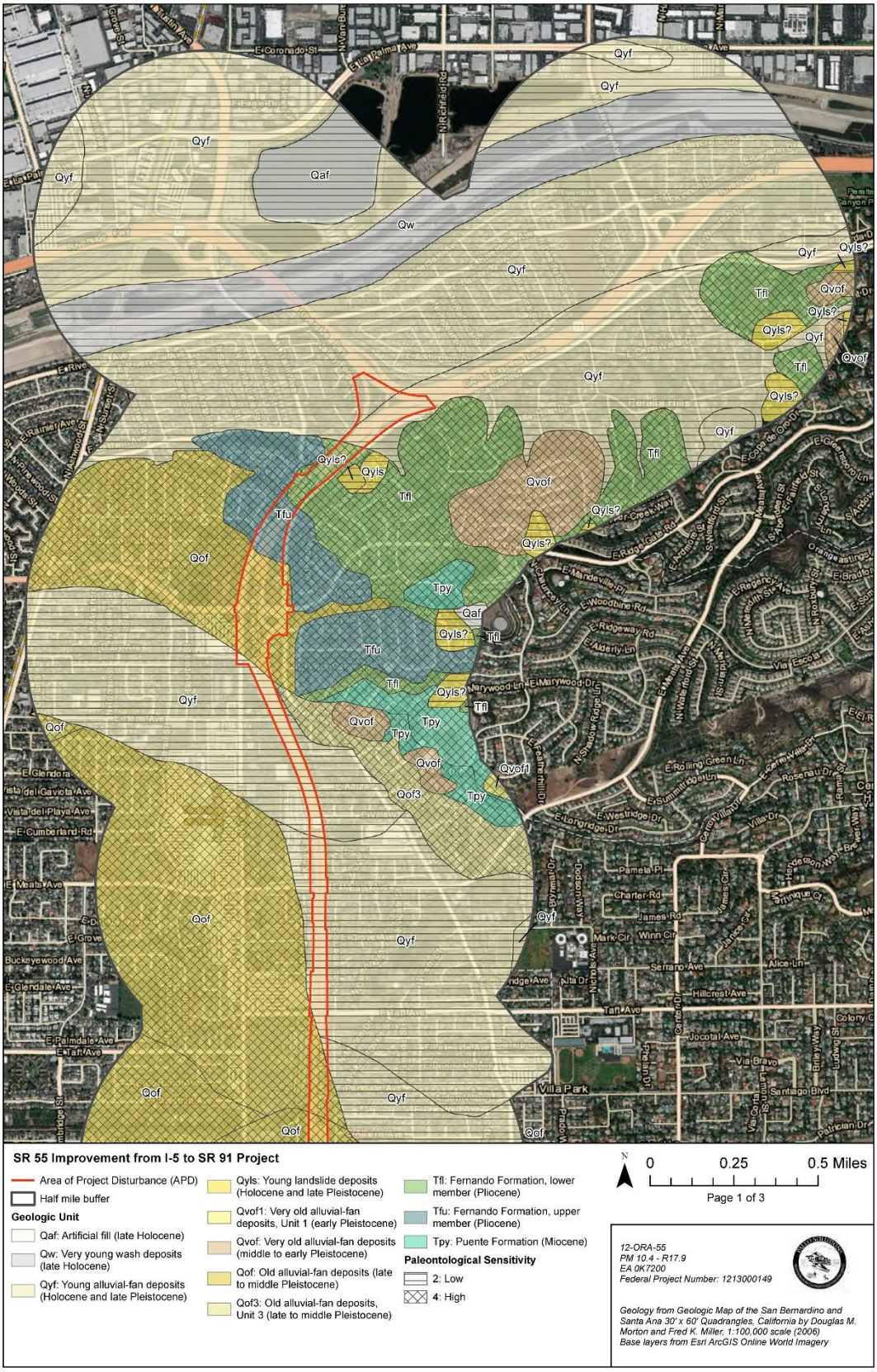


Figure 2.11-1. Project Geologic Map (2 of 3)

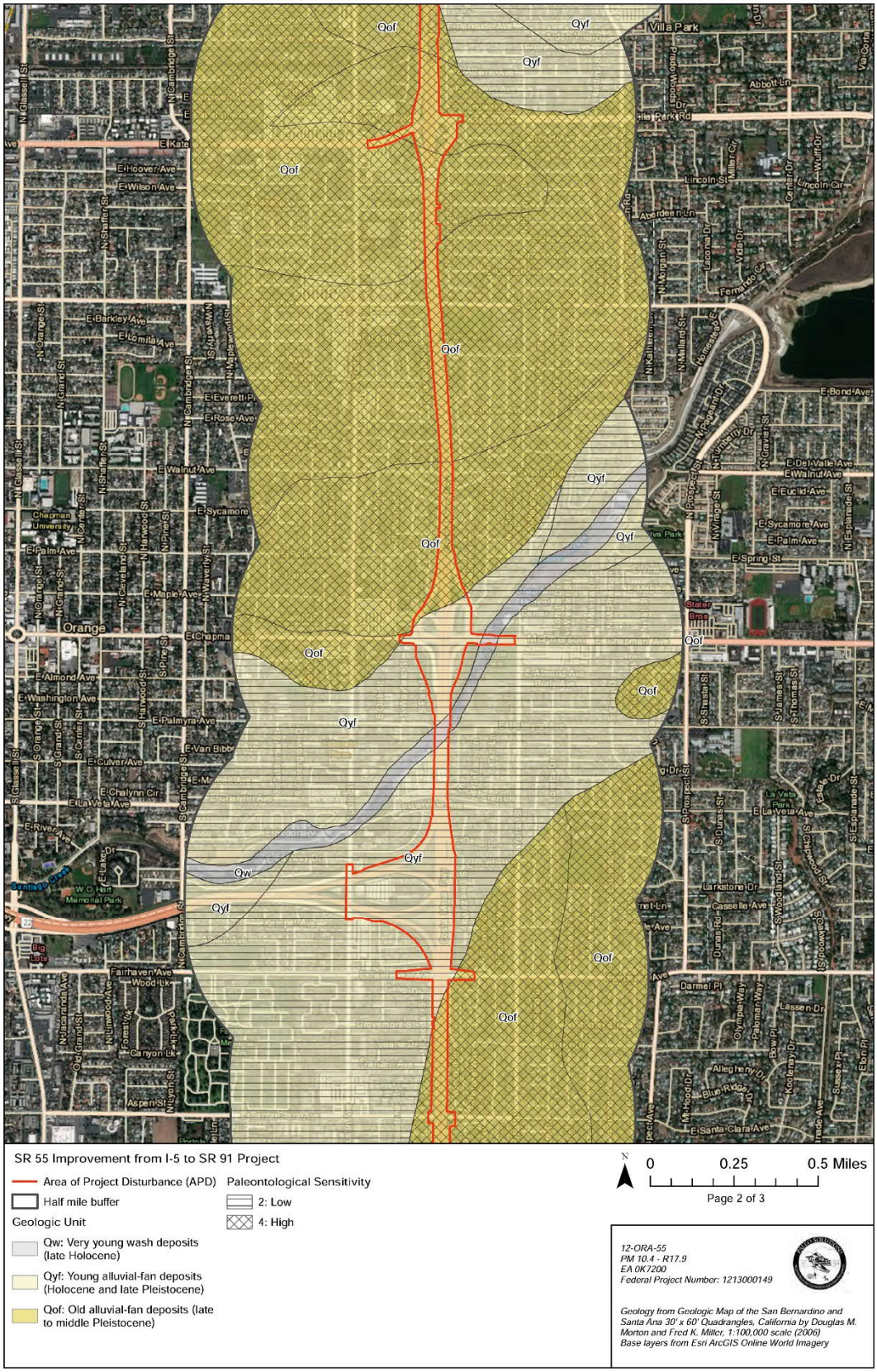
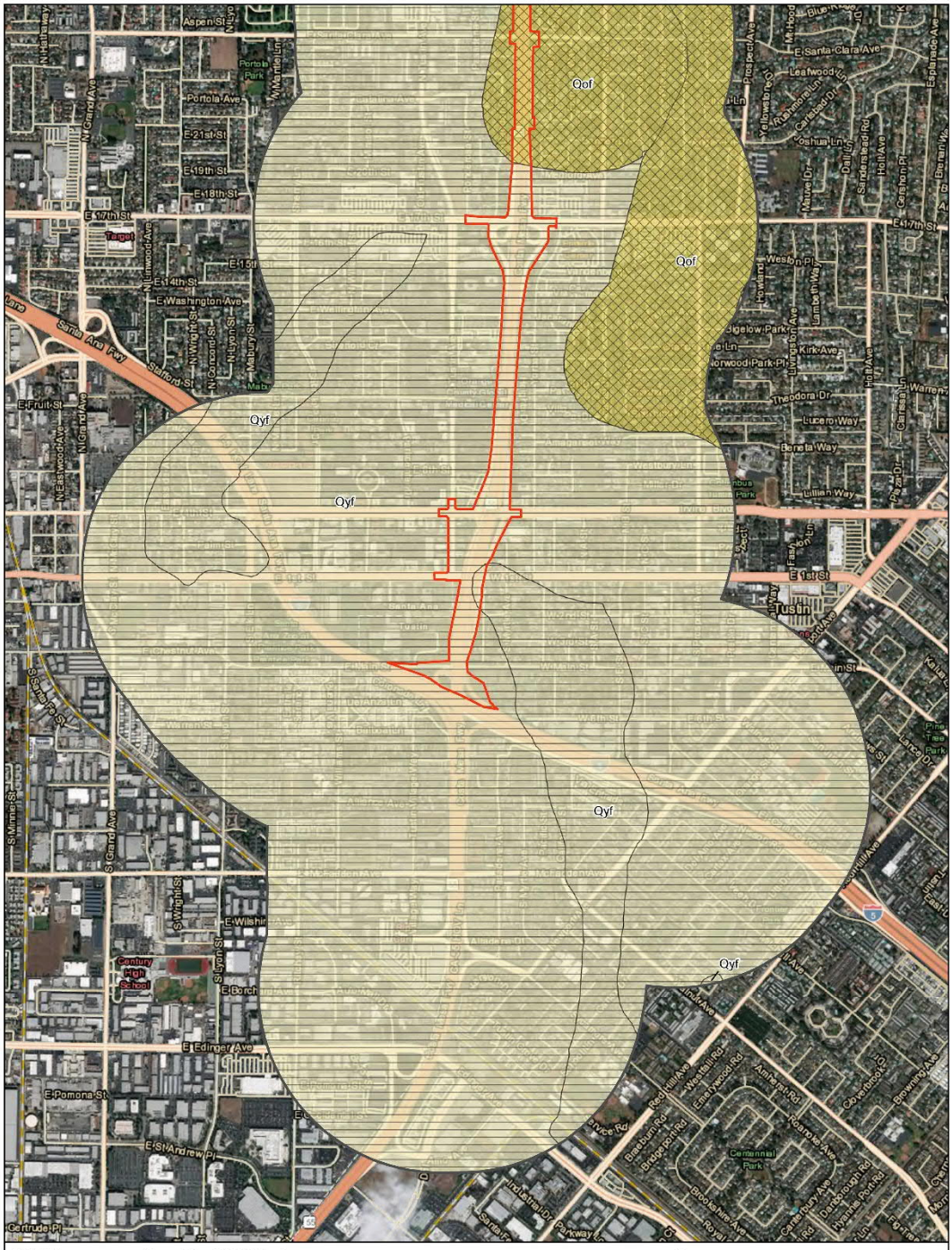


Figure 2.11-1. Project Geologic Map (3 of 3)



This unit is up to 3,000 feet thick at its center and is thought to consist of basin slope and basin plain facies. Fossils found in the Yorba Member include benthic and pelagic, and upper Mohnian-aged foraminifera, which indicate ocean depths of greater than 2,000 feet, and numerous fish taxa. Deep marine fish are also present in this unit that are today found only in water below 3,300 feet, below the photic zone. Species include anglerfish (Lophiiformes), deep-sea smelts (*Bathyalgidae*), hatchetfish (*Argyropelecus* sp.), and lanternfish (*Myctophidae*).

Numerous vertebrate fish fossil localities are recorded from the Puente Formation Yorba Member in Chino Hills, San Bernardino County. Recorded specimens include herring family (Clupeidae), extinct herring (*Etringus* sp., *Xyne grex* sp.), bristlemouth (*Cyclothone* sp.), lantern fish family (Myctophidae), ray-finned fish (*Teleostei* sp.), extinct bony fish (*Ganolytes cameo* sp.), extinct croaker (*Lompoquia* sp.), alder (*Alnus* sp.), deep-sea smelt (*Bathylagus* sp.), bonito (cf. *Sarda* sp.), jack fish (*Pseudoseriola* sp.), pipefish (*Sygnathus* sp.), and extinct viperfish (*Chauliodus eximius*). Additional Puente Formation localities were recorded during construction of the Tehachapi Renewable Transmission Project in Chino Hills and include fossilized plant, fish, and mammal. Specimens recorded include plane or sweetgum tree (Platanus or Liquidambar), algae (Algae), legume seed pod (Fabaceae cf. *Cersis*), sumac (Anacardiaceae), ray-finned fish (*Teleostei* sp.), lanternfish (Myctophidae), extinct bony fish (*Ganolytes cameo*), bristlemouth fish (*Cyclothone* sp.), spiny ray-finned fish (*Acanthomorpha* sp.), extinct bony fish (*Eclipes* sp.), drumfish (*Sciaenidae* sp.), extinct drumfish (Lompoquia), hammerhead shark (*Sphyrna* sp.), mammal (Mammalia), and whale (Cetacean). Recorded from the South Pointe Project located in Diamond Bar, Los Angeles County, are specimens of herring (cf. *Etringus scintillans*, Clupeidae), ray-finned fish (Scombridae, Teleostei), extinct bony fish (*Eclipes* sp., *Ganolytes cameo*), bony fish (Osteichthyes), and a rare eel specimen (Anguilliformes). The SR 57/60 Confluence Project, also located in Diamond Bar, produced specimens of plant and bony fish (Osteichthyes). The Puente Formation has a high paleontological potential based on Caltrans guidelines (Caltrans 2016a).

Fernando Formation Lower and Upper Members (Pliocene)

The Pliocene to Pleistocene Fernando Formation has an unknown maximum thickness and a complex nomenclatural history. The unit may be referred to in literature either by the Fernando Formation or by the individual members of the formation including, from oldest to youngest, the Repetto Claystone, the Pico Member, and the Saugus Member, as well as specific facies that have not been formally named. Two members of the Fernando Formation, including the Upper Member and Lower Member, are mapped in the northern portion of the project area. The Upper Member consists of sandstone, pebbly-sandstone, and sandy conglomerate. The Lower Member consists of siltstone, sandstone, and conglomerate.

Marine vertebrate fossils recovered from the Fernando Formation include fossil fish (e.g., great white shark, herring, hake, lanternfish, swordfish, mackerel, flounder) and whale specimens. Additional marine specimens of pinnipeds and dolphins, as well as mollusks and brachiopods, have also been published from the Fernando Formation. Terrestrial vertebrates include ground sloth, mastodon, mammoth, horse, camel, pronghorn antelope, and turkey. The Fernando Formation has high paleontological potential based on Caltrans guidelines (Caltrans 2016a).

Very Old Alluvial Fan Deposits – Pleistocene

Very old alluvial fan deposits were deposited during the early to middle Pleistocene (approximately 2.5 million years ago to 781,000 years ago). These sediments consist of reddish-brown colored, well-indurated, mostly well-dissected, moderately sorted alluvial fan deposits with mostly sand and gravel. Very old alluvial fan deposits are mapped at just east of the project area in the northern extent.

Taxonomically diverse and locally abundant Pleistocene animals and plants have been collected from older alluvial deposits throughout southern California and include mammoth (Mammuthus), mastodon (*Mammut*), camel (Camelidae), horse (Equidae), bison (*Bison*), giant ground sloth (Megatherium), peccary (Tayassuidae), cheetah (Acinonyx), lion (Panthera), saber tooth cat (*Smilodon*), capybara (*Hydrochoerus*), dire wolf (*Canis dirus*), and numerous taxa of smaller mammals (Rodentia). Pleistocene very old alluvial fan deposits have a high paleontological potential based on Caltrans guidelines (Caltrans 2016a).

Old Alluvial Fan Deposits – Pleistocene

Old alluvial fan deposits were deposited during the middle to late Pleistocene (approximately 781,000 years ago to 10,000 years ago). These sediments consist of reddish-brown colored, well-indurated, commonly dissected sand and gravel alluvial fan deposits. Old alluvial fan deposits are mapped in the north, central, and southern parts of the project area. Pleistocene old alluvial fan deposits yield the same paleontological resources as Pleistocene very old alluvial fan deposits. Pleistocene old alluvial fan deposits have a high paleontological potential based on Caltrans guidelines (Caltrans 2016a).

Quaternary Young Sedimentary Deposits – Pleistocene to Holocene

Young sedimentary deposits are Pleistocene to Holocene and include alluvial fan deposits, wash deposits, and landslide deposits. Alluvial fan and wash deposits include surficial sediments consisting of poorly consolidated alluvial gravel, sand, silt, and clay that were deposited in canyon and mountain drainage systems as well as in the lowest lying inland area. These sediments may be variable in color, though they are often tan to brown. These deposits are considered too young (less than 11,000 years old) to contain scientifically significant in-situ fossils. These sediments, however, may shallowly overlie older more fossiliferous sedimentary units. Young landslide deposits comprise abruptly displaced sections of land. Fossils contained within these deposits may lack stratigraphic context due to displacement from the original deposition, reducing scientific significance of the fossils. Young alluvial fan deposits are mapped in broad portions of the northern and southern project areas as well as portions of the central project area. Young wash deposits are mapped in relatively thin east-west trending sections to the north of the project area, and within the central portion of the project area. Young landslide deposits are mapped in several relatively small areas adjacent to the northern project area. Young alluvial fan, wash, and landslide deposits have low paleontological potential based on Caltrans guidelines (Caltrans 2016a).

Artificial Fill (Not Mapped) – Recent

Artificial fill comprises recent deposits of previously disturbed sediments displaced by construction operations and are found in areas where recent construction has taken place. Color is highly variable, and sediments are mottled in appearance. These sediments are mapped in a single section north of the project area but were observed during the field survey to cover the majority of the project area surface. Although these materials may contain fossil resources, they have been removed from their original locations and, therefore, lack significance. Artificial fill has low paleontological potential based on Caltrans guidelines (Caltrans 2016a).

Literature Review and Records Search

The literature reviewed included published and unpublished scientific papers. A paleontological record search was conducted on November 14, 2017, at the Natural History Museum of Los Angeles County (LACM) (October 2018); and no localities were identified within the project area. However, several fossil localities are adjacent to the project area that have been recorded from the same sedimentary deposits that occur within the project area at the surface and at depth. Additional record searches of online databases were completed. Localities LACM 1067, 1729, 2019, 3408, 3802, 3977, 3978, 3980, and 3986, which are located southwest of the project area east of Upper Newport Bay, collectively produced ghost shark (Chimaera, Chimaeroidei), thresher shark (*Alopias superciliosus*), giant white shark (*Carcharocles*), white shark (*Carcharodon carcharias, Carcharodon sulcidens*), bonito shark (*Isurus oxyrinchus*), spiny dogfish (*Squalus acanthias*), hake (*Merluccius productus*), codling (Moridae), queenfish (*Seriphus*), sculpins (Cottidae), rockfish (*Sebastes*), auklet (*Mancalla californiensis*), turkey (*Meleagris*), shearwater (*Puffinus felthami*), sea lion (Otariidae). Locality LACM 1652 is located northwest of the project area and northwest of the Santa Ana River and produced fossil sheep (*Ovis*). Locality LACM 4943 is located northwest of the project area and east of the Santa Ana River and produced fossil horse (*Equus*). Locality LACM 7867 is located southeast of the project area in Orange County Park and produced fossil pocket gopher (*Thomomys*).

Field Survey

The field survey for the entire project corridor was conducted on December 20, 2017. The paleontological field survey was performed in order to inspect the project area for the presence of surface fossils and evaluate the project area for the likelihood of subsurface fossil occurrences. The survey was completed after a review of aerial photographs indicated the survey sections were within areas of exposed sediment. The pedestrian survey included thorough inspection of potentially fossiliferous bedrock exposures and surficial deposits occurring within the project area. Sediment exposures as well as the surrounding areas were photographed and documented. Reference points were acquired using a Trimble Global Positioning System (GPS) unit. Sediment lithologies were recorded and analyzed and used to better interpret the project's paleontological sensitivity, and thus better understand the project's potential impact.

Although the intent was to survey the entire APD, approximately 99 percent of the APD could not be surveyed for paleontological resources because it is a paved roadway. The survey focus included inspecting areas of the alignment that contain native sediment outcrops of geologic units with high sensitivities. Areas of the alignment that are developed and/or mapped as low paleontological sensitivity were quickly traversed to confirm geologic mapping. The project site is situated in a highly developed area characterized by dense infrastructure and terrain that

comprises low to moderate relief hills and relatively flat and low-lying broad valleys. The hills are constrained to the northern portion of the project area where Pliocene Fernando Formation and Miocene Puente Formation are located. The central and southern portions of the project area, which comprise Pleistocene old alluvial fan deposits and Quaternary young alluvial fan and wash deposits, are entirely flat and yielded no native sediment exposures. The majority of the alignment has been previously disturbed by construction and landscaping and includes infrastructures such as paved roads, including the SR 55, SR 22, SR 91, and I-5 freeways; transmission lines; and commercial and residential buildings. Vegetation density ranges from low in more developed areas to moderate and high along road shoulders, freeway embankments, and hillsides.

Due to the high level of previous disturbance and overall low relief terrain, sediment exposures were sparse and mostly constrained to the moderate relief hillsides and slopes located in the northern project area. Only one native bedrock outcrop, consisting of Fernando Formation, was observed along an approximately 100-foot-thick east-facing slope. The outcrop was relatively small compared to the slope, encompassing a surface area of approximately 50 square feet; and sediments were highly weathered and crumbly. The sediments consisted of moderately to well lithified, blue-gray, olive green, to orange-brown colored, well sorted siltstone and silty fine- to medium-grained sandstone. Sediments were mostly massive with some planar banding of the orange oxidized material. Similar sediments were observed in several additional areas within the northern project area, although they only occurred as weathered and previously disturbed surficial sediments with no in situ structure. Additional surficial sediments observed in the northern area consisted of previously disturbed younger alluvial fan deposits and artificial fill, which were generally poorly consolidated, medium to dark brown colored, moderately sorted silt with some fine- to medium-grained sand and subrounded pebble to small cobble-sized plutonic clasts. Additionally, artificial sediments often contained imported pebble-sized gravel. No undisturbed native sediments were observed in areas mapped as Puente Formation or old alluvial fan deposits. Furthermore, only previously disturbed surficial sediments were observed in the central and southern portions of the project area.

No paleontological resources were observed or collected during the survey. However, sediments conducive to fossil preservation, including those of the Pliocene Fernando Formation, were observed. The fine-grained material characteristic of these sediments is favorable for harboring recognizable and intact scientifically significant vertebrate fossils.

2.11.3 Environmental Consequences

2.11.3.1 Temporary Impacts

Build Alternative

The Build Alternative would require ground-disturbance activities and modifications to the existing freeway corridor and associated ramps which could result in direct impacts to paleontological resources. Although construction activities are considered temporary and short-term, the impacts to paleontological resources are considered permanent impacts. Section 2.11.3.2, Permanent Impacts, describes these impacts and includes Project Features to address potential direct and indirect impacts to paleontological resources associated with ground-disturbance activities during construction.

No Build Alternative

Under the No Build Alternative, none of the proposed improvements would be constructed. The No Build Alternative would maintain the existing conditions; therefore, the No Build Alternative would not result in direct or indirect temporary adverse impacts related to paleontological resources as a result of construction activities.

2.11.3.2 Permanent Impacts

Build Alternative

Excavations (including drilling) into areas containing native Miocene, Pliocene, and Pleistocene sediments may result in significant direct impacts to paleontological resources. Surface grading or shallow excavations that are entirely within Quaternary young alluvial fan, wash, and landslide deposits; and artificial fill in the project area are unlikely to impact significant fossil vertebrate remains. However, older deposits are likely present at depth beneath Quaternary young sedimentary deposits and previously disturbed or artificial fill.

Due to the flat terrain of the central and southern project areas and limited exposures of subsurface native sediments on the entire project area, the depth of native Miocene, Pliocene, and Pleistocene sediments beneath the ground surface could not be determined during the field survey. Only one exposure of in situ Pliocene Fernando Formation was observed during the survey. Depending on the depth and location of earthmoving activities, project construction has the potential to result in significant adverse direct impacts to paleontological resources within the project area. There is potential for direct impacts both at the surface and at depth in areas of native high sensitivity deposits and at depth in areas of low sensitivity surface deposits. Indirect or secondary impacts on paleontological resources are not anticipated to occur.

Implementation of Project Feature PF-PAL-1 would address potential direct impacts to paleontological resources associated with ground-disturbance activities during construction and reduce them to less than significant.

PF-PAL-1 If unanticipated paleontological resources are discovered, all work within 60 feet of the discovery must cease and the construction Resident Engineer will be notified. Work cannot continue near the discovery until authorized.

No Build Alternative

Under the No Build Alternative, none of the proposed improvements would be constructed. The No Build Alternative would maintain the existing conditions; therefore, the No Build Alternative would not directly result in permanent adverse impacts to paleontological resources as a result of post-construction activities. No indirect or secondary impacts on paleontological resources would result from implementation of the No Build Alternative.

2.11.4 Avoidance, Minimization, and/or Mitigation Measures

In addition to implementation of project feature PF-PAL-1, the project will incorporate mitigation measures PALEO-1 and PALEO-2, as outlined below, to help mitigate, avoid and/or minimize potential direct impacts to paleontological resources.

PALEO-1 Prior to construction, or initiated at the 65 percent Plans, Specification and Estimate (PS&E) design phase per Caltrans process, a Paleontological Mitigation Plan (PMP) will be prepared. It should provide recommended monitoring areas based on proposed construction activities and locations in sensitive geologic formations, depth of excavation, and results of geotechnical studies completed in the Area of Project Disturbance (APD) and immediate vicinity; a description of a worker training program; detailed procedures for monitoring, fossil recovery, laboratory analysis, and museum curation; notification procedures in the event of a fossil discovery by a paleontological monitor or other project personnel; and a potential cost estimate for mitigation. A curation agreement with a qualified repository with a curator on staff and retrievable storage will be required if paleontological specimens requiring preservation are identified.

PALEO-2 Construction monitoring should initially be implemented for excavations occurring in areas of sediments with paleontological high sensitivity, with the exception of pile-driving activities and drilling using an auger bit that is less than 3 feet in diameter. Excavations in areas of low sensitivity sediments should be periodically spot checked when impacted depths exceed 5 feet to check for the presence of underlying older, high sensitivity deposits unless the depth to underlying sensitive sediments can be determined more precisely during the geotechnical review conducted during preparation of the PMP. If it is determined that only Quaternary young alluvial fan deposits (low paleontological potential [Caltrans 2016a]), Quaternary young wash deposits (low paleontological potential [Caltrans 2016a]), Quaternary young landslide deposits (low paleontological potential [Caltrans 2016a]), or artificial fill (low paleontological potential [Caltrans 2016a]) is impacted, monitoring and spot checking should be reduced or halted at the direction of the Principal Paleontologist. Quaternary young alluvial fan, wash, and landslide sediments and artificial fill should not be monitored. However, any potential fossils in these sediments that are unearthed during construction should be evaluated by the Principal Paleontologist as described in the PMP.

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