Appendix E
Paleontological Resources Assessment

ESA

626 Wilshire Boulevard
Suite 1100
Los Angeles, CA 90017
213.599.4300 phone
213.599.4301 fax

esassoc.com

memorandum

date September 22, 2020

to May Duong
Project Management
Orange County Public Works
601 North Ross Street
Santa Ana, CA 92703

from Monica Strauss and Russell Shapiro
Environmental Science Associates

subject Paleontological Resources Assessment for the Peters Canyon Bikeway Extension Project, Cities of Orange and Tustin, California

Orange County Public Works (OCPW) proposes to construct a Class I bike lane along a 1.15-mile stretch of Jamboree Road from Canyon View to Pioneer Road, and a Class II bike lane along a 1.55-mile stretch of Pioneer Road within the cities of Tustin and Orange, Orange County. The proposed project would connect the existing Peters Canyon Trail to Orange County's larger bikeway network and would include: the construction of a Class I multi-use bikeway and sidewalk along the west side of Jamboree Road; striping of 8-foot-wide buffered Class II bike lanes on both sides of Pioneer Road; installation of bike path wayfinding signage; and construction of retaining walls with V-ditches, tree removal, landscaping, drainage systems and decorative fence installations, utility relocation, and sidewalk removal along the west side of Jamboree Road.

An Initial Study Mitigated Negative Declaration (ISMND) is being prepared for the proposed project pursuant to the statutes of the California Environmental Quality Act (CEQA). OCPW is the lead agency under CEQA. The proposed project is also eligible for Bicycle Improvement Corridor Program (BCIP) funding and is therefore subject to review and approval by California Department of Transportation (Caltrans), District 12 as the lead agency under the National Environmental Policy Act (NEPA). The environmental review, consultation, and any other actions required by applicable federal environmental laws for this project are being, or have been, carried out by Caltrans pursuant to 23 U.S.C. 327 and the Memorandum of Understanding dated December 23, 2016, and executed by the Federal Highway Administration (FHWA) and Caltrans.

This paleontological resources assessment was conducted to identify unique geological features and paleontological resources that could be impacted by proposed project activities and to assess the proposed project area's paleontological sensitivity. This assessment is based on a paleontological resources records search conducted by the Natural History Museum of Los Angeles County (LACM), as well as a review of geologic maps, relevant published, and available geotechnical data.

Project Location

The proposed project is located in the cities of Tustin and Orange, within east-central Orange County (**Figure 1**). Specifically, the proposed project is located in unsectioned portions of Township 4 and 5 South, Range 8 and 9 West on the Orange, CA 7.5-minute topographic quadrangle (**Figure 2**). The proposed project is located along a 1.15-mile stretch of Jamboree Road from Canyon View to Pioneer Road, and a 1.55-mile stretch on Pioneer Road from Jamboree Road to Pioneer Way.

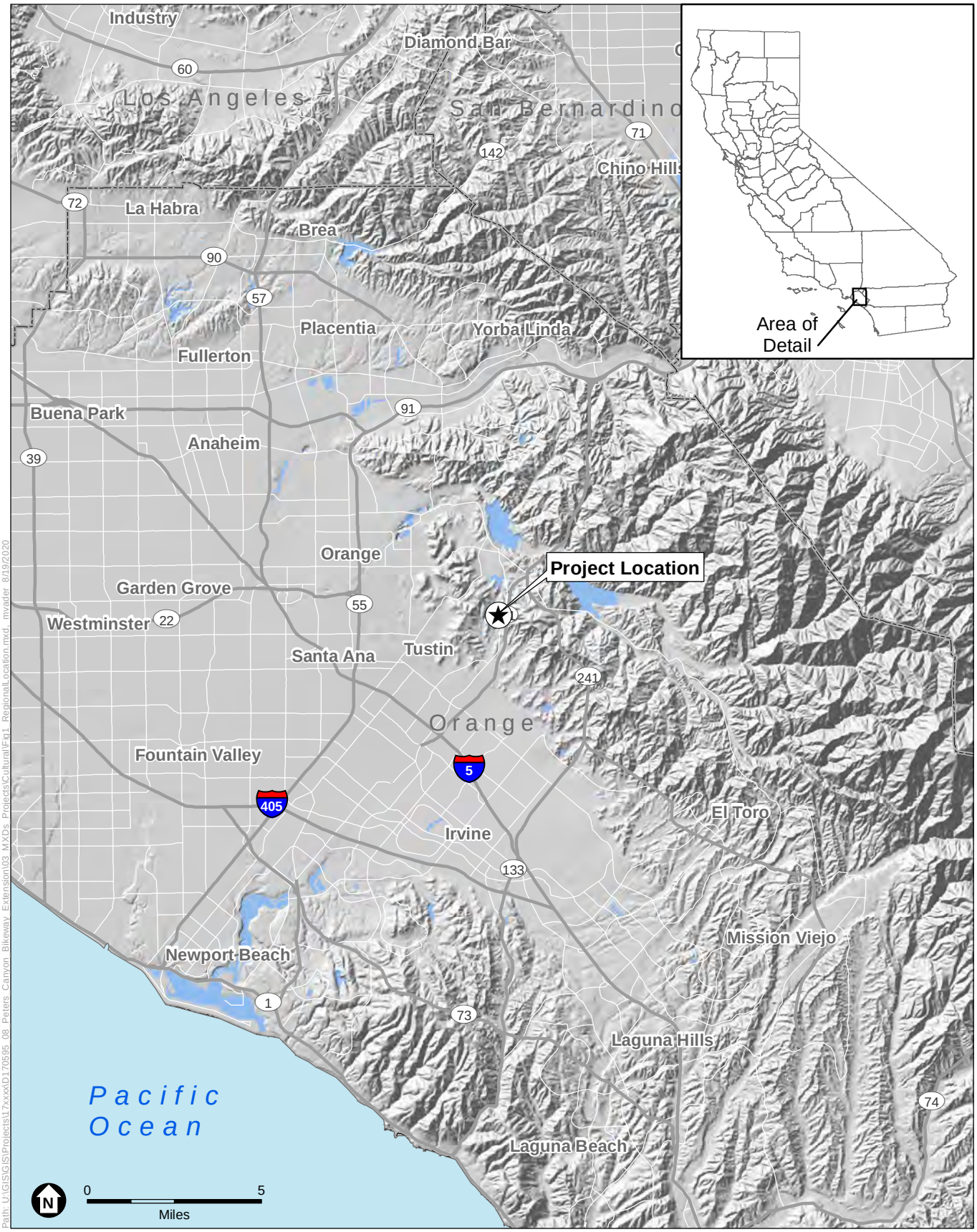
Project Description

OCPW proposes to construct a Class I bike lane along Jamboree Road from Canyon View to Pioneer Road, and Class II bike lanes along Pioneer Road from Jamboree Road to Pioneer Way within the cities of Tustin and Orange, Orange County. The project proposes construction of a bike and pedestrian path that will connect the Peters Canyon Trail to existing bikeways at the intersections of Jamboree Road with Canyon View Avenue and Pioneer Road with Pioneer Way in the cities of Orange and Tustin. The project is located on Jamboree Road (between Canyon View Avenue and Pioneer Road) and proposes the construction of a Class I multi-use/combined bikeway along the west side (approximately 1.5 miles long).

Project features along Jamboree Road include:

- installation of bike path and bike lanes way finding signage;
- construction of an approximately 3 to 8-foot high retaining wall and/or grading to a maximum depth of 15 feet;
- relocation of utilities (water meters, high voltage electrical cabinets, pull boxes, valves boxes, fire hydrants, etc.);
- removal of mature trees to accommodate the proposed bike path width;
- replacement of existing irrigation system and landscape;
- and, installation of decorative fence along the west side of Jamboree Road.

In addition, the project includes intersection improvements at Jamboree Road and Pioneer Road to connect the existing Class II bike lane on the south side of the intersection to the proposed Class I bike lane along Jamboree Road. A striped 8-foot wide buffered Class II bike lane (approximately 1.55 miles) would be designated on both sides of Pioneer Road to Pioneer Way. No additional improvements are proposed along Pioneer Road.



SOURCE: ESRI

Peters Canyon Bikeway Extension Project

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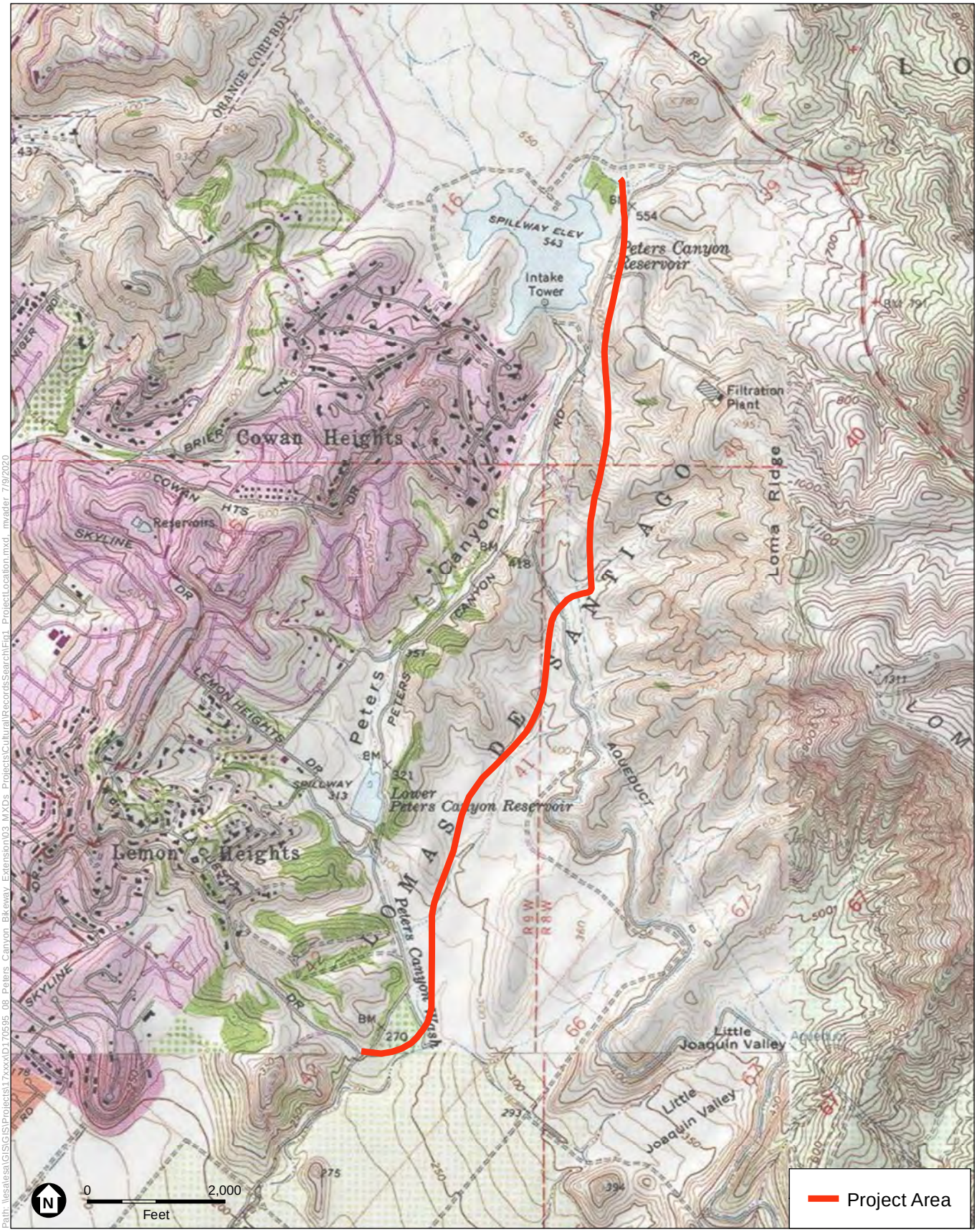
Figure 1
Regional Location



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TOPO QUAD: Orange, Tustin, and Black Star Canyon, CA 7.5-minute

Peters Canyon Bikeway Extension Project

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Figure 2
Project Location

Methods

This assessment includes a paleontological resources records search conducted by the LACM, as well as a review of geologic maps, and relevant published literature to identify unique geologic features and paleontological resources that may be impacted by proposed project ground disturbance and to assess the paleontological sensitivity of the proposed project area. The LACM records search results are included in **Appendix A**.

Paleontological sensitivity is defined as the potential for a geologic formation to produce scientifically significant fossils. This is determined by rock type, past history of the geologic unit in producing significant fossils, and fossil localities recorded from that unit. Paleontological sensitivity is derived from the known fossil data collected from the entire geologic unit, not just from a specific survey. In its "Standard Guidelines for the Assessment and Mitigation of Adverse Impacts to Non-renewable Paleontologic Resources," the Society of Vertebrate Paleontology (SVP, 2010) defines four categories of paleontological sensitivity (potential) for rock units: 1) High Potential, 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; 2) Low Potential, rock units that are 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; 3) Undetermined Potential, rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment; and 4) No Potential, rock units like high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites) that will not preserve fossil resources.

Results

Physical Setting

The proposed project area is located along the western border of the Santa Ana Mountains, which form the northern boundary of the Peninsular Ranges (Sylvester and O'Black Gans, 2016). Four main phases define the geological history of the Peninsular Ranges (Morton and Miller, 2006). The oldest rocks are a suite of primarily marine sediments deposited along the flanks of island arcs or the edge of the North American continent. These deposits were tectonically amalgamated to the continental border during the Jurassic Period (201.3 to 145 million years ago), concurrent with the development of a major subduction zone. During the second phase (Jurassic to Cretaceous periods [201.3 to 65.5 million years ago]), large volumes of intrusive igneous rocks, such as granodiorite, were intruded into the country rock above the subduction zone. Some volcanic rocks were preserved as well as marine sediments washing off the volcanic arc to the west. Subduction ceased during the end of the Paleogene (66 to 23.03 million years ago) with the collision of a spreading ridge with the trench, leading to the development of a transform plate tectonic boundary. As this new boundary grew north in the Miocene (23.03 to 5.333 million years ago), small mountains formed from uplift and small basins dropped along the boundary, leading to deposition of marine sediments mixed with terrestrial deposits. In the third phase, basins formed, filled, and shifted position as the faults grew through the area. Major mountains were uplifted in the Neogene (23.03 to 2.58 million years ago) along these faults such as the Santa Ana Mountains and the Transverse Ranges to the north. The final phase encompasses the sediments eroding off these mountains to form extensive alluvial fans along the mountain fronts and river and lake deposition in the lowland.

Against this backdrop, the proposed project area is dominated by sedimentary rocks of the third phase, which include a mix of marine and terrestrial sediments associated with basin development during growth of the

transform margin. Portions of the proposed project also overlap alluvial fans of the fourth phase (Morton and Miller, 2006).

Geologic Setting

Geologic mapping by Morton and Miller (2006) and Tan (1995) indicate there are five geologic units mapped at the surface within the immediately adjacent to (within 200 feet of) the project area including: the Sespe Formation, the Vaqueros Formation, the Santiago Formation, the Puente Formation, the Modeno Volcanics, and young alluvial deposits. These geologic units are summarized in **Table 1** and depicted in **Figure 3**.

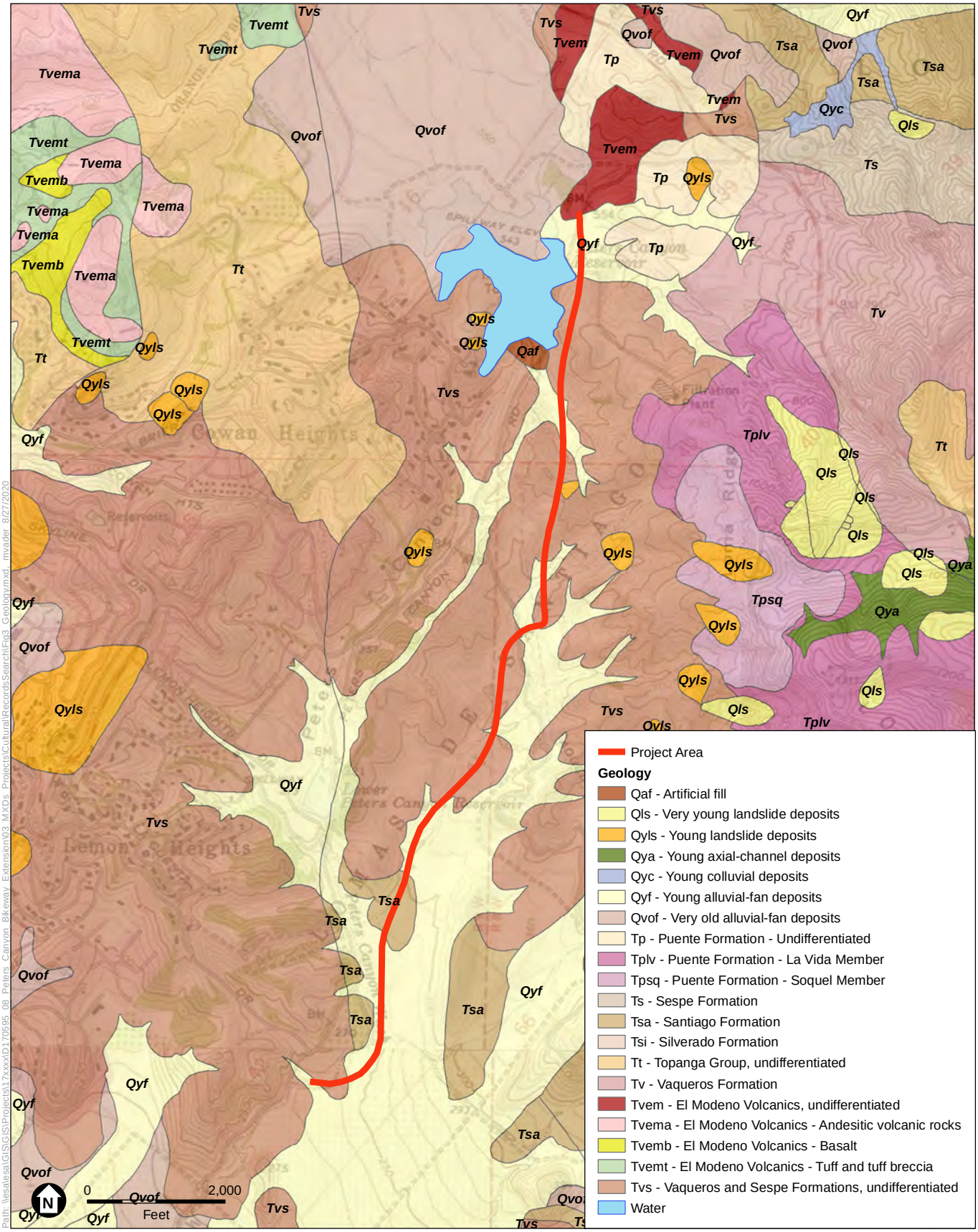
TABLE 1 SUMMARY OF GEOLOGIC UNITS WITHIN AND IMMEDIATELY ADJACENT TO PROJECT

Geologic Unit	Map Unit Symbol	Age	Description	Distance from Project	Paleo Sensitivity
Young Alluvial Fan	Qyfsa	Holocene to late Pleistocene (129,000 years ago to present	Unconsolidated to moderately consolidated silt, sand, pebbly cobbly sand, and boulders.	Overlaps	Low at surface increasing with depth
Puente Formation	Tp	Late Miocene (11.63 to 5.333 million years ago)	Marine sandstone, siltstone, and shale.	Within 100 feet	High
El Modeno Vocanics	Tvem	Middle Miocene (15.97 to 11.608 million years ago).	Andesite, tuff, tuff- breccia, and basalt	Within 200 feet	Low
Vaqueros and Sespe (undifferentiated0	Tvs	Late Eocene to Early Miocene (37.8 to 15.97 million years ago	Interbedded marine (Vaqueros) and non-marine (Sespe) sandstone and conglomerate.	Overlaps	High
Santiago Formation	Tsa	Middle Eocene (47.8 million to 38 million years ago)	Basal conglomerate overlain by sandstone and siltstone; upper unit transitions from marine to non-marine	Overlaps	High

LACM Records Search

The LACM records search indicates no fossil localities have been identified within the project area; however, a number of vertebrate fossil localities are known from similar geologic units in the project's vicinity (McLeod, 2020). Localities LACM 3983-3985, located northeast and north of the project's northern terminus, respectively, produced marine fossils from the Vaqueros Formation, including an eagle ray, *Myliobatis*, bonito shark, *Isurus planus*, four-legged marine mammal, *Desmostylus,* and toothed whales, Odontoceti. However, McLeod (2020) notes that it is possible these localities came from the 'Topanga Formation' (*sensu lato*), not the Vaqueros. The Topanga Group (sensu stricto) is mapped approximately 0.50 miles west of the project. Additional desmostylid fossils were collected from LACM 6624 and 6666, located near the Santiago Dam approximately 2.25 miles northeast of the project's northern terminus and in Little Joaquin Valley approximately 0.50 miles east of the project's southern terminus, respectively.

According to McLeod (2020), there are no known localities in the Santiago Formation in Orange County; however, the Santiago Formation has yielded fossils from several localities in San Diego County. LACM 5347 in San Onofre Canyon, approximately 28 miles south-southeast of the project, produced fossil specimens of the insectivore *Sespedectes*. Several vertebrate fossil localities around Carlsbad (LACM 3881, 3883-3884, 3979, 4022, 5346-5347, 6926 and 68102), located approximately 45 miles south-southeast of the project, produced a composite fauna of primarily mammals. Locality LACM 68102 produced specimens of protoceratid artiodactyl, *Leptoreodon leptolophus,* and the camels, *Protylopus petersoni* and *Protylopus stocki.*



SOURCE: USGS; Orange, Tustin, and Black Star Canyon Topoquads, CA 7.5-minute

Peters Canyon Bikeway Extension Project

Figure 3
Geology

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Literature Review

A review of relevant literature pertaining to paleontological resources indicates most of the geologic units present within and immediately adjacent to the project are known to host significant fossil resources. Locally, the Santiago Formation has yielded significant concentrations of terrestrial mammals during a paleontological monitoring for the housing development in San Clemente approximately 25 miles south-southeast of the project (Santos and Parham, 2016). Elsewhere in southern California, the Santiago Formation has yielded diverse terrestrial mammals of Eocene age.

Whistler and Lander (2003) provide an extensive list of significant fossil assemblages from the 'undifferentiated' Sespe and Vaqueros formations of the northwest Santa Ana Mountains, located east of the project. Their list includes marine vertebrates such as sharks, rays, and turtles as well as terrestrial mammals such as marsupials, insectivores, rabbits, and rodents. It is important to note that six of their localities are within 5 miles of the project and two of the localities are within 0.5 miles of the project.

The Puente Formation in the broad Los Angeles region is a highly fossiliferous Miocene marine unit (Valpey, 1975). Although it is well known for fish such as anglerfish (Pietsch and Lavenberg, 1980; Carnevale et al., 2008), the formation has also yielded invertebrates such as crustaceans (Feldmann, 2003). It is unknown if there are fossiliferous localities near the project as the Puente Formation was not included in the LACM records search. However, a well-known locality known as "Chalk Bluff" from the nearby Puente Hills is located approximately 16 miles northwest of the project (Cooper, 1973, Huddleston and Takeuchi. 2006).

Paleontological Sensitivity Analysis

The literature and geologic mapping review, as well as the LACM records search results, were used to assign paleontological sensitivity to the geologic units within and adjacent to the Project area, following the guidelines of the SVP (2010):

- **Young Alluvial Fan (Qya) –** Alluvial fan deposits within Peters Canyon are not known to contain significant fossils. Based on the mapped age, Holocene to late Pleistocene, shallow excavations are not likely to impact fossil resources. However, deeper excavations may encounter older alluvium that contain fossils. Therefore, this unit is assigned a **Low-to-High Potential** to contain paleontological resources, increasing with depth.

- **Puente Formation (Tp) –** The Puente Formation is composed of a sequence of sandstone, siltstone, and shale, deposited in a marine setting. While not labeled on the Morton or Miller (2006) map, it is clear from the Tan (1995) map, which was used as a data source, that the formation underlies the northernmost part of the project area. The Puente Formation has produced vertebrate fossils throughout Los Angeles—most notably in the nearby Puente Hills. Based on the published record, the Puente Formation is assigned a **High Potential** to contain paleontological resources.

- **El Modeno Volcanics (Tvem) –** In the northern Santa Ana Mountains, the series of volcanic rocks attributed to the El Modeno Formation are mapped as an undifferentiated sequence of andesite, tuff, tuff-breccia, and basalt. While fossils may be recovered from tuff deposits, there is no known record from the Santa Ana Mountains and other volcanic units are not likely to host fossils. Therefor this formation is assigned a **Low Potential** to contain paleontological resources.

- **Vaqueros and Sespe Formations (undifferentiated) (Tvs) –** In the project area, the marine Vaqueros Formation interbeds with the non-marine Sespe Formation on a bed-by-bed scale. Both formations are richly fossiliferous, producing important and diverse fossils from within 0.5 to 5 miles of the project area. Therefore, this formation is assigned a **High Potential** to contain paleontological resources.

- **Santiago Formation (Tsa) –** The Santiago Formation has produced important vertebrate fossils throughout southern California. Yet, as noted in the records search (McLeod, 2020), the Santiago is poorly studied in Orange County. However, a number of well-known fossil localities have been identified within San Diego County from Santiago Formation. Therefore, this formation is assigned a **High Potential** to contain paleontological resources.

Summary and Recommendations

As a result of this study, three of the five geologic units mapped at surface within and immediately adjacent to the project area have high paleontological sensitivity (Puente Formation [Tp], Undifferentiated Vaqueros and Sespe formations [Tvs], and Santiago Formation [Tsa]), one has low-to high paleontological sensitivity increasing with depth (Young Alluvial Fan [Qya]), and one has low paleontological sensitivity (El Modeno Volcanics [Tvem]). Given the project area's potential to contain paleontological resources, grading activities associated with Class I bike lane construction have the potential to encounter fossiliferous sediments. Therefore, the following recommendations would mitigate potential impacts to unique paleontological resources or unique geological features, should they be encountered during project implementation.

1. Prior to the start of construction activities, OCPW should retain a Qualified Paleontologist that meets the standards of the Society for Vertebrate Paleontology (2010) to carry out all mitigation measures related to paleontological resources.

2. Prior to start of any ground disturbing activities, the qualified paleontologist should conduct pre-construction worker paleontological resources sensitivity training. The Qualified Paleontologist should contribute to any construction worker cultural resources sensitivity training either in person or via a training module. The training should include information on what types of paleontological resources could be encountered during excavations, what to do in case an unanticipated discovery is made by a worker, and laws protecting paleontological resources. All construction personnel should be informed of the possibility of encountering fossils and instructed to immediately inform the construction foreman or supervisor if any bones or other potential fossils are unexpectedly unearthed in an area where a paleontological monitor is not present. OCPW will ensure that construction personnel are made available for and attend the training and retain documentation demonstrating attendance.

3. Paleontological resources monitoring should be performed by a qualified paleontological monitor (meeting the standards of the SVP, 2010) working under the direction of the qualified paleontologist. Paleontological resources monitoring will be conducted for all ground disturbing activities of previously undisturbed sediments of the Puente, Santiago, Vaqueros, and Sespe formations, as well as all excavations exceeding 15 feet deep within Young Alluvial Fan deposits as depicted in Figure 3 of this memorandum. The El Modelo Volcanics have low potential to contain paleontological resources and would not require monitoring. Monitoring will consist of visually inspecting fresh exposures of rock for larger fossil remains and, where appropriate, collecting wet or dry screened standard sediment samples

(up to 4.0 cubic yards) of promising horizons for smaller fossil remains (SVP, 2010). Per the Society for Vertebrate Paleontology standards (2010), once 50 percent of excavations or other ground disturbing activities are complete within geologic units assigned high paleontological sensitivity and no fossils are identified, monitoring can be reduced to part-time inspections or ceased entirely if determined adequate by the qualified paleontologist in consultation with OCPW. Monitoring activities will be documented in a Paleontological Resources Monitoring Report to be prepared by the Qualified Paleontologist at the completion of construction and should be provided to OCPW within six (6) months of project completion. If fossil resources are identified during monitoring, the report will also be filed with the Natural History Museum of Los Angeles County.

4. If a paleontological resource is discovered during construction, all project-related ground disturbing activities within a 100-foot buffer around of the find shall be temporarily diverted to facilitate evaluation of the discovery and OCPW will be immediately notified of the find. Work will be allowed to continue outside of the buffer area. At the qualified paleontologist's discretion and to reduce any construction delay, the grading and excavation contractor should assist in removing rock samples for initial processing and evaluation of the find. All significant fossils will be collected by the paleontological monitor and/or the qualified paleontologist. Collected fossils will be prepared to the point of identification and catalogued before they are submitted to their final repository. Any fossils collected will be curated at a public, non-profit institution with a research interest in the materials, such as the Natural History Museum of Los Angeles County, if such an institution agrees to accept the fossils. If no institution accepts the fossil collection, they should be donated to a local school in the area for educational purposes. Accompanying notes, maps, and photographs should also be filed at the repository and/or school.

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