COMBINED PALEONTOLOGICAL IDENTIFICATION REPORT AND PALEONTOLOGICAL EVALUATION REPORT

STATE ROUTE 60/WORLD LOGISTICS CENTER PARKWAY INTERCHANGE PROJECT

MORENO VALLEY AND UNINCORPORATED RIVERSIDE COUNTY, CALIFORNIA

DISTRICT 08

E.A. 0M590
Project ID# 0813000109
08-RIV-60
PM 20.0/22.0

Submitted to:

California Department of Transportation, District 8
464 West 4th Street, 6th Floor, MS 825
San Bernardino, California 92401

January 2019

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Approved by: _____ Date: 3-6-19

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January 2019

EXECUTIVE SUMMARY

The City of Moreno Valley (City), in cooperation with the California Department of Transportation (Caltrans) District 8, proposes the State Route 60/World Logistics Center Parkway Interchange Project (project) to reconstruct and improve the State Route 60 (SR-60)/World Logistics Center Parkway (WLC Pkwy) interchange. The project area is primarily within the City of Moreno Valley; however, the northeast quadrant of the project area is within unincorporated Riverside County but within the City's Sphere of Influence. The purpose of the project is to alleviate existing and future traffic congestion at the SR-60/WLC Pkwy interchange ramps during peak hours, to improve traffic flow along the freeway and through the interchange, to improve safety by upgrading the geometry at the current interchange, and to provide standard vertical clearance for the WLC Pkwy overcrossing.

The project will be funded with local (Measure A) and federal funds and, as such, will be required to comply with both the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). Caltrans will be the Lead Agency for CEQA, the City is a Responsible Agency under CEQA, and the Federal Highway Administration is the Lead Agency for NEPA. Federal and State regulations require that impacts to paleontological resources be considered during project design and construction; this report was prepared to comply with these regulations. Following the Caltrans Guidelines and recommendations from the Society of Vertebrate Paleontology, this report identifies and evaluates any potential paleontological resources that may be encountered during construction of this project and makes recommendations on how to mitigate impacts to those resources. The findings in this study are based on the anticipated, standard excavation and construction methods for each project alternative, the definitions of paleontological significance and sensitivity, reviews of geological and paleontological literature, a field survey, and the results of a fossil locality search through the San Bernardino County Museum.

Geologic mapping indicates the project area contains Artificial Fill; Very Young Alluvial Fan Deposits; Young Axial Channel Deposits; Young Alluvial Fan Deposits, Undivided and Units 1, 3, 5, and 7; Old Alluvial Fan Deposits; Very Old Alluvial Fan Deposits; and the San Timoteo Formation, middle member, unnamed subunit. Artificial Fill does not have the potential to contain scientifically significant paleontological resources because of its disturbed context. The Very Young Alluvial Fan Deposits are too young to produce fossils that would be considered scientifically important. Both of these geologic units are assigned no paleontological sensitivity. The upper layers of the Young Alluvial Fan Deposits, Undivided and Units 1, 3, 5, and 7, as well as Young Axial Channel Deposits are too young to contain scientifically important paleontological resources; however, the deeper layers may contain important paleontological resources. As such, these geologic units are assigned low paleontological sensitivity from the surface to depths of 10 feet (ft) and high paleontological sensitivity below a depth of 10 ft. Scientifically important fossils have been recovered in the region from the same or similar deposits as those in the Old Alluvial Fan Deposits, the Very Old Alluvial Fan Deposits, and the San Timoteo Formation, middle member, unnamed subunit. Moreover, one paleontological locality is known from the San Timoteo Formation within the project area. Therefore, these three geologic units have high paleontological sensitivity.

To reduce impacts to nonrenewable paleontological resources, this report recommends the preparation of a Paleontological Mitigation Plan for the Build Alternatives following the guidelines contained in the Caltrans Standard Environmental Reference (SER), Environmental Handbook, Volume 1, Chapter 8 on Paleontology. Please note that this document includes information used to determine the potential to encounter scientifically significant fossil remains in the geologic units found within the project areas. It is not, and should not be used as, a geological assessment.

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LIST OF ABBREVIATIONS AND ACRONYMS

Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
City	City of Moreno Valley
County	County of Riverside
EIR	Environmental Impact Report
FHWA	Federal Highway Administration
ft	feet
IS/EA	Initial Study/Environmental Assessment
kV	kilovolt
LOS	level of service
Ma	million years ago
mi	mile(s)
MND/FONSI	Mitigated Negative Declaration/Finding of No Significant Impact
NALMA	North American Land Mammal Age
NEPA	National Environmental Policy Act
PMP	Paleontological Mitigation Plan
PRC	Public Resources Code
project	State Route 60/World Logistics Center Parkway Interchange Project
SBCM	San Bernardino County Museum
SCE	Southern California Edison
SCG	Southern California Gas Company
SER	Caltrans Standard Environmental Reference
SR-60	State Route 60
SVP	Society of Vertebrate Paleontology
UCMP	University of California Museum of Paleontology
USC	United States Code
WLC Pkwy	World Logistics Center Parkway

1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

A segment of Theodore Street has been renamed to World Logistics Center Parkway (WLC Pkwy). The SR-60/Theodore Street Interchange Project will now be referred to as the SR-60/World Logistics Center Parkway Interchange Project (project).

The City of Moreno Valley (City), in cooperation with the California Department of Transportation (Caltrans), District 8, proposes to reconstruct and improve the State Route 60 (SR-60)/WLC Pkwy interchange. The majority of the project site is located in the City of Moreno Valley; however, the northeast quadrant of the site is located within unincorporated Riverside County (County) but within the City's Sphere of Influence. The purpose of the project is to alleviate existing and future traffic congestion at the SR-60/WLC Pkwy interchange ramps during peak hours, to improve traffic flow along the freeway and through the interchange, to improve safety by upgrading the geometry at the current interchange, and to provide standard vertical clearance for the WLC Pkwy overcrossing.

The project will be funded with local (Measure A) and federal funds and, as such, will be required to comply with both the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). Caltrans will be the Lead Agency for CEQA, the City is a Responsible Agency under CEQA, and the Federal Highway Administration (FHWA) is the federal Lead Agency for NEPA. The environmental review, consultation, and any other action required in accordance with the applicable federal laws for this project will be carried out by Caltrans under its assumption of responsibility pursuant to 23 United States Code (USC) 327. Therefore, preparation of the NEPA compliance documents, including the technical studies and the environmental document, will have oversight by Caltrans District 8. An Initial Study/Environmental Assessment (IS/EA) (joint CEQA/NEPA document) is being prepared and is anticipated to result in a Mitigated Negative Declaration/Finding of No Significant Impact (MND/FONSI).

1.2 PROJECT SITE AND DESCRIPTION

Although the City's General Plan Circulation Element designates WLC Pkwy as a Minor Arterial (two lanes in each direction), existing WLC Pkwy through the project limits is one travel lane in each direction, including on the overcrossing over SR-60. Existing SR-60 between Redlands Boulevard and Gilman Springs Road is two mixed-flow travel lanes in each direction. The proposed project would construct modifications to the existing SR-60/WLC Pkwy interchange from Post Mile 20.0 to Post Mile 22.0 on SR-60, a distance of approximately 2 miles (mi). Major improvements to the interchange will include: (1) reconstruction of the westbound and eastbound on- and off-ramps to SR-60, (2) replacement of the existing WLC Pkwy overcrossing with an expanded four-lane overcrossing (two through lanes in each direction) with a minimum 16.5-foot (ft) vertical clearance between the eastbound and westbound SR-60 ramps and reconstruction of WLC Pkwy between the southern limits of the project and the eastbound SR-60 ramps, and (3) construct three lanes each direction on WLC Pkwy between the eastbound SR-60 ramps and Eucalyptus Avenue west (Eucalyptus Avenue west of WLC Pkwy); construct two lanes each direction but grade for three lanes each direction on WLC Pkwy between Eucalyptus Avenue west and Eucalyptus Avenue east (Eucalyptus Avenue east of WLC Pkwy); south of Eucalyptus Avenue east WLC Pkwy would narrow to

one lane in each direction. The proposed improvements to the on- and off-ramps would extend west and east of the proposed overcrossing on SR-60 for proposed auxiliary lanes in each direction. The proposed improvements to Theodore Street/WLC Pkwy would extend north of SR-60 to Ironwood Avenue and south of SR-60 to south of Eucalyptus Avenue. Project construction is anticipated to begin in early 2022 and be completed in winter 2023, contingent upon full funding of all phases.

An existing Caltrans paved material transfer area located in the southwest quadrant of the existing SR-60/WLC Pkwy interchange, within the existing eastbound loop on-ramp, is currently used as a temporary site for the transfer of street sweeping materials. The existing paved material transfer area will be relocated to the SR-60/Gilman Springs interchange area as part of the proposed project.

Three alternatives and two design variations will be evaluated in the environmental document for the proposed project: Alternative 1 (No Build Alternative [no project]), Alternative 2 (Modified Partial Cloverleaf), Alternative 6 (Modified Partial Cloverleaf with Roundabout Intersections), Alternative 2 with Design Variation 2a and Alternative 6 with Design Variation 6a. The Design Variations for each Build Alternative are similar and would realign the Eucalyptus Avenue to join WLC Pkwy approximately 900 ft south of the existing Eucalyptus Avenue/WLC Pkwy intersection. Both Build Alternatives and Design Variations would require full right-of-way acquisitions. There would be partial right-of-way acquisitions within all four quadrants of the interchange.

During the construction phase of the proposed project, removal of the existing overcrossing and construction of the new overcrossing and ramps would interfere with access to the SR-60 at WLC Pkwy. The WLC Pkwy overcrossing is being evaluated for closure during construction of the proposed project. Therefore, if not done prior to this project, Eucalyptus Avenue would be extended and improved approximately 5,100 ft between WLC Pkwy and Redlands Boulevard to provide a detour route to SR-60. The improvements to Eucalyptus Avenue will be constructed early in the construction schedule, prior to the closure of the WLC Pkwy overcrossing. North of the freeway, access to SR-60 during construction would be provided via Ironwood Avenue and Redlands Boulevard. South of the freeway, access to SR-60 would be provided via Alessandro Boulevard and Gilman Springs Road and via Eucalyptus Avenue and Redlands Boulevard. Additional intersection improvements are proposed along the detour routes to facilitate vehicle movement. As a result, widening is proposed at the Redlands Boulevard/Ironwood Avenue, WLC Pkwy/Alessandro Boulevard, and Alessandro Boulevard/Gilman Springs Road intersections. Consequently, signal modifications are proposed at the Redlands Boulevard/Ironwood Avenue and Redlands Boulevard/Eucalyptus Avenue intersections. A new signal would be installed at the Gilman Springs Road/Alessandro Boulevard intersection due to the high through movements on Gilman Springs Road conflicting with left turns to and from Alessandro Boulevard. The improvements required for the detour routes also include utility adjustments and/or relocations at Redlands Boulevard/Ironwood Avenue, WLC Pkwy/Alessandro Boulevard, and Alessandro Boulevard/Gilman Springs Road.

Project construction would also involve the import of soils to the project site from a Borrow Site. One borrow site, the City Stockpile, is located at the northwest corner of the intersection of Alessandro Boulevard/Nason Street, approximately 2.3 mi from the western boundary of the project site. Approximately 50,000 cubic yards of import material will be imported to the project from the

City Stockpile borrow site. The City Stockpile will be environmentally cleared with this project. Additional fill material beyond the 50,000 cubic yards will be necessary for the project and will come from another site(s) to be determined during future phases of the project.

The regional location of the proposed project and the project vicinity are shown on Figure 1.1. The project site is depicted on the *Sunnymead, California* and *El Casco, California* 7.5-minute series United States Geological Survey (USGS) topographic maps within several Sections (Sec) in two Townships (T) and two Ranges (R). Specifically, the project area is found in T 2 South (S), R 3 West (W), Sec 35 and 36; T 3 S, R 3 W, Sec 1, 2, 9, and 12; T 3 S, R 2 W, Sec 6, 7, 8, and 9, San Bernardino Baseline and Meridian. The footprint of disturbance is shown on Figure 1.2.

1.3 PURPOSE AND NEED

1.3.1 Project Purpose

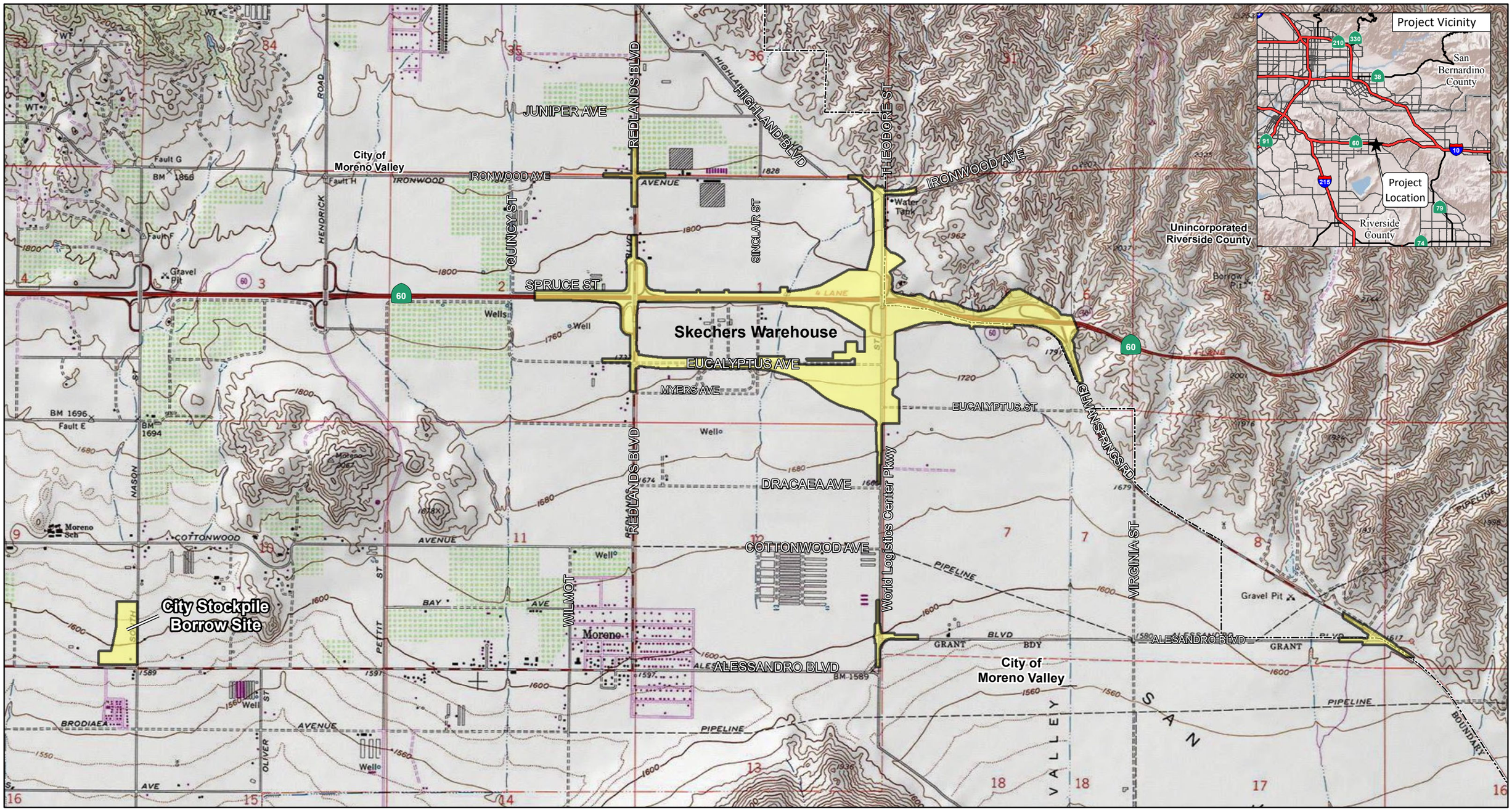
The purpose of the proposed project is to:

1. Provide increased interchange capacity, reduce congestion, and improve traffic operations to support the forecast travel demand for the 2045 design year;
2. Improve existing and projected interchange geometric deficiencies; and
3. Accommodate a multimodal facility that has harmony with the community and preserves the values of the area.

1.3.2 Project Need

The proposed project is needed for the following reasons:

1. According to the demographics and growth forecast prepared for the 2016 Southern California Association of Governments (SCAG) Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS), between 2012 and 2040, Riverside County's population is expected to increase by 41 percent, job growth is anticipated to increase by 90 percent, and households are anticipated to increase by 51 percent. For Moreno Valley specifically, between 2012-2040, population is anticipated to increase by 30 percent, households jobs are anticipated to increase by 165 percent, and households are anticipated to increase by 41 percent. Without improvements, in the year 2045, the eastbound and westbound on-and off- ramps are anticipated to operate at unacceptable levels of service (LOS) (LOS E in the a.m. peak hour and F in the p.m. peak hour, respectively) and the ramp intersections with WLC Pkwy are anticipated to operate at LOS F for both the a.m. and p.m. peak hours. The westbound mainline segment on SR-60 between WLC Pkwy and Redlands Boulevard is anticipated to operate at LOS E during the a.m. peak hour. The Theodore Street intersections with Ironwood Avenue, and the WLC Pkwy intersections with the SR-60 westbound and eastbound ramps, and Eucalyptus Avenue are forecast to operate at LOS F in the p.m. peak hour.



LEGEND

Project Location

FIGURE 1.1

SR-60/World Logistics Center Parkway Interchange Project

Regional and Project Location

08-RIV-60 PM 20.0/22.0

EA No. 0M590

Project No. 0813000109

0 1000 2000

FEET

SOURCE: USGS 7.5' Quad -Sunnymead (1980); El Casco (1979), CA; MBI (11/2018)

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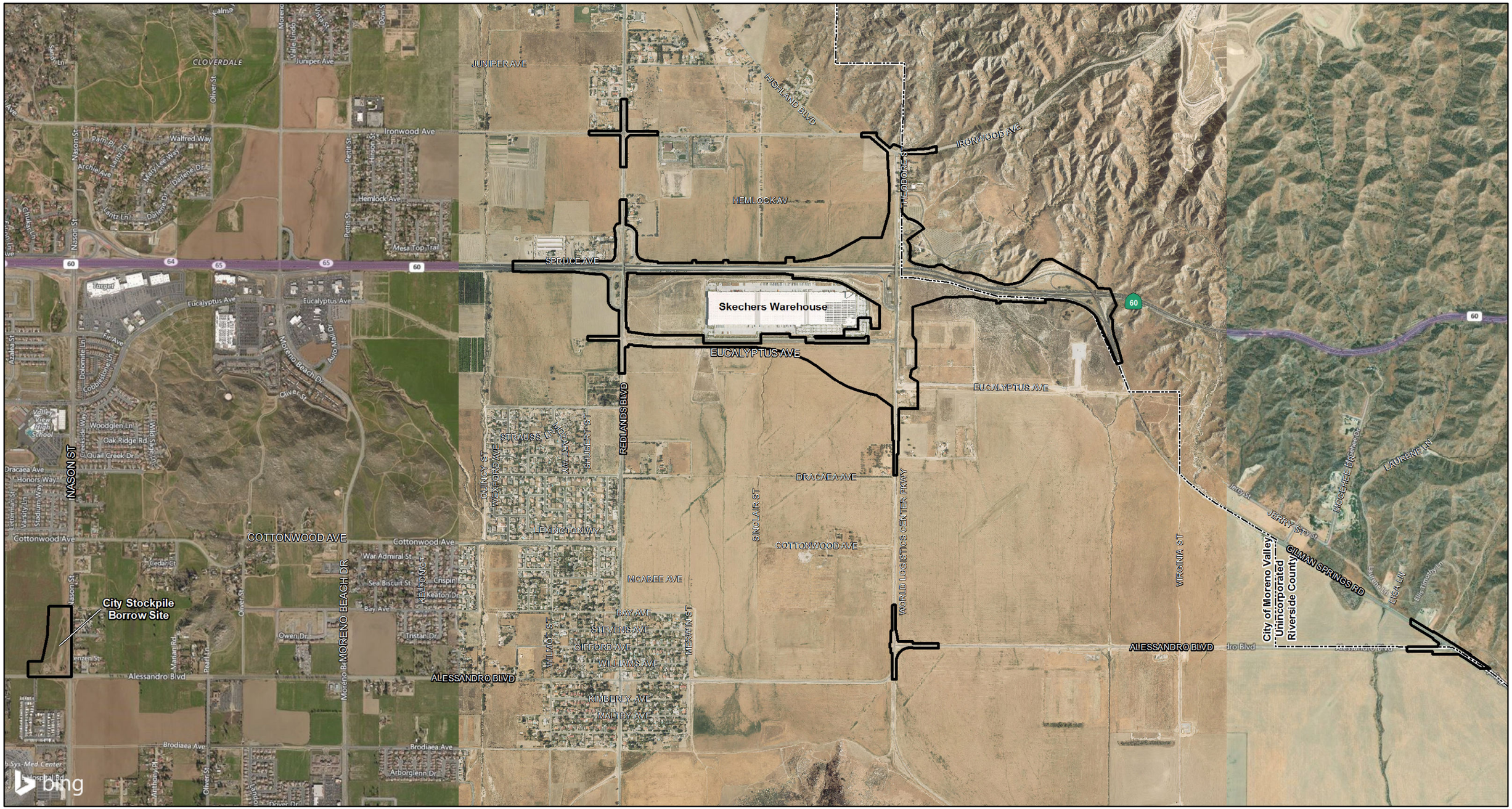

LEGEND

Project Location

FIGURE 1.2

SR-60/World Logistics Center Parkway
Interchange Project

Footprint of Disturbance

08-RIV-60 PM 20.0/22.0
EA No. 0M590
Project No. 0813000109

0 900 1800
FEET

SOURCE: MBI (11/2018); ESRI (07/2012)

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2. The overpass bridge at the interchange was hit in January 2015 and a costly emergency repair project was required, so there is a need to bring vertical clearance up to current standards. In addition, the WLC Pkwy overcrossing is geometrically deficient and needs additional capacity to accommodate projected future travel volumes.

3. This project will fulfill the need to accommodate the movement of people using multiple modes of transportation by community-based design taking into consideration the natural environment, social environment, transportation behavior, cultural characteristics and economic environment.

1.4 PROJECT ALTERNATIVES

In addition to the No Build Alternative (Alternative 1), two Build Alternatives (Alternatives 2 and 6) and Design Variations (Design Variations 2a and 6a) are under consideration. Alternatives 1, 2, 6 and the Design Variations are described in further detail below.

1.4.1 Alternative 1 (No Build)

The No Build Alternative assumes that no improvements will be made to the freeway mainline or to the existing SR-60/WLC Pkwy interchange. Without the planned improvements proposed as part of the project, the LOS at the on- and off-ramps and traffic operations at the interchange would continue to worsen over time. Alternative 1 was determined to not meet or satisfy the project purpose and need.

1.4.2 Common Design Features for Both Build Alternatives

As described further in Sections 1.3.3 and 1.3.4, Alternatives 2 and 6 both propose to modify the SR-60/WLC Pkwy interchange and share several common design features. These common design features are discussed below by type of improvement.

Interchange On- and Off-Ramp Improvements. The proposed interchange is located approximately 1 mi east of the SR-60/Redlands Boulevard interchange and 0.7 mi west of the SR-60/Gilman Springs Road interchange. The new on- and off- ramps and the new bridge overcrossing would provide a direct and continuous alignment for WLC Pkwy traffic crossing SR-60. In accordance with the Caltrans District 8 Ramp Meter Design Manual, all interchange on-ramps would be two-lane and/or three-lane metered ramps, with sufficient right-of-way to accommodate vehicle storage, ramp meter equipment, and California Highway Patrol enforcement areas. Additionally, all on- ramps would provide high-occupancy vehicle (HOV) preferential lanes. **Roadway Improvements.** Roadway improvements associated with the proposed project include the following:Widening of WLC Pkwy through the proposed project limits

- Improvements along WLC Pkwy to include a parkway, sidewalk, and multi-use trail
- Improvement of Eucalyptus Avenue to a four-lane cross-section between Redlands Boulevard and WLC Pkwy; and
- Addition of one auxiliary lane in each direction between the Redlands Boulevard and Gilman Springs Road interchanges with SR-60.

The WLC Pkwy improvements listed above would have a design speed of 45 miles per hour (mph). Aside from the improvements listed above, no additional future widening on WLC Pkwy is planned within the interchange limits. The proposed overcrossing would be designed to the ultimate width.

Nonvehicular and Pedestrian Access Improvements. The proposed project includes construction of a number of nonvehicular and pedestrian access improvements. These include an 8 ft wide sidewalk on the east side of WLC Pkwy along the limits of the WLC Pkwy improvements, a 6 ft wide sidewalk on the west side of WLC Pkwy between the southern project limits and Eucalyptus Avenue, and a 6 ft wide sidewalk on both sides of Eucalyptus Avenue from WLC Pkwy to Redlands Boulevard. Additionally, an 11 ft wide multi-use trail would be constructed on the east side of WLC Pkwy between Eucalyptus Avenue and Ironwood Avenue.

The proposed project would also accommodate a future 11 ft wide multi-use trail on the north side of Eucalyptus Avenue between Redlands Boulevard and WLC Pkwy. A grade-separated trail and pedestrian crossing over the eastbound SR-60 direct on-ramp would potentially be provided with the proposed project based on available funding.

Utility and Right-of-Way Requirements. The proposed project would require relocation or protection in place of several utility facilities. To prevent impacts to utility facilities and services during construction, the following utilities have been contacted regarding the proposed project: Eastern Municipal Water District (EMWD), Metropolitan Water District of Southern California (MWD), Western Municipal Water District (WMWD), Riverside County Flood Control and Water Conservation District (RCFCWCD), Riverside County Waste Management, Moreno Valley Electric Utility, Time Warner Cable, Charter Communications, Southern California Edison (SCE), Southern California Gas Company (SCG), Questar Southern Trails Pipeline Company, Sunesys, Verizon, and AT&T. The existing SCE overhead 115-kilovolt (kV) transmission line and 12 kV distribution line that are currently adjacent to the west side of WLC Pkwy would be relocated to the east side of WLC Pkwy between the westbound ramps intersection and the southern limits of the proposed project. North of the westbound ramps intersection, the SCE utility lines will cross WLC Pkwy and be relocated to the parkway on the west side of WLC Pkwy. In order to accommodate future utilities, the proposed overcrossing would incorporate conduits for Moreno Valley Electric Utility, SCE and other utility companies as requested.

Build Alternatives 2 and 6 and Design Variation 2a would each require a total of six full acquisitions: one full acquisition in the northwest quadrant and five full acquisitions in the southwest quadrant. Design Variation 6a will require the same amount of acquisitions with an additional full acquisition in the southeast quadrant of the interchange. There would be partial right-of-way acquisitions within all four quadrants of the interchange. The full acquisition for Design Variation 6a in the southeast quadrant of the interchange would require one residential displacement.

Additional Considerations. Geotechnical investigations would be required during final design of the WLC Pkwy overcrossing and the interchange improvements.

Highway planting would potentially be provided and coordinated with Caltrans and the City.

Infiltration basins will be proposed in the undeveloped areas between the on-/off-ramps and SR-60. A system of bioswales and infiltration basins will be installed to make up for the low infiltration rates.

1.4.3 Alternative 2 (Modified Partial Cloverleaf)

Alternative 2 proposes to reconstruct the SR-60/WLC Pkwy interchange in a modified partial cloverleaf configuration. Improvements under Alternative 2 would include the construction of a new westbound direct on-ramp and a new westbound loop off-ramp in the northwest quadrant of the interchange, in a cloverleaf configuration. A new eastbound direct off-ramp, a new eastbound loop on-ramp, and a new eastbound direct on-ramp would be constructed in the southwest and southeast quadrants, in a partial cloverleaf configuration.

Alternative 2 would also remove the existing two-lane (one lane in each direction) WLC Pkwy overcrossing and replace it with a new four-lane (two lanes in each direction) overcrossing. The proposed overcrossing would accommodate turn lanes: in the northbound and southbound direction.

Additional improvements as part of Alternative 2 include the installation of signals at both the proposed eastbound and westbound ramp intersections, as well as at the intersection of Eucalyptus Avenue/WLC Pkwy. Bike lanes would be provided on both sides of WLC Pkwy and Eucalyptus Avenue throughout the project limits.

Design Variation 2a – (Alternative 2 with Design Variation)

Design Variation 2a will have the same features as Alternative 2 with the exception of the location of the Eucalyptus Avenue/WLC Pkwy intersection. The Design Variation will consist of moving the current Eucalyptus Avenue/WLC Pkwy intersection approximately 900’ south from its current location. The shift will cause a partial realignment of Eucalyptus Avenue from approximately 2,600’ west of WLC Pkwy to connect with the west side of WLC Pkwy.

1.4.4 Alternative 6 (Modified Partial Cloverleaf with Roundabout Intersections)

Alternative 6 proposes to reconstruct the SR-60/WLC Pkwy interchange in a modified partial cloverleaf configuration. Improvements under Alternative 6 would include the construction of a new westbound direct on-ramp and a new westbound loop off-ramp in the northwest quadrant, in a partial cloverleaf configuration. New eastbound direct off- and on-ramps would be constructed in the southwest and southeast quadrants, respectively, in a partial cloverleaf configuration.

Similar to Alternative 2, Alternative 6 would also remove the existing two-lane (one lane in each direction) WLC Pkwy overcrossing and replace it with a new four-lane (two through lanes in each direction) overcrossing. Additional improvements included as part of Alternative 6 include the installation of roundabouts at both the proposed eastbound and westbound ramp intersections, as well as at Eucalyptus Avenue/WLC Pkwy. On WLC Pkwy north of the Eucalyptus Avenue intersection and on Eucalyptus Avenue, bike lanes are provided on both sides within the width of the proposed shoulders. Bicyclists would have the option to merge with vehicular traffic to navigate through the

roundabout or exit the travel lane prior to each roundabout and cross the roundabout with pedestrian traffic.

Design Variation 6a – (Alternative 6 with Design Variation)

Design Variation 6a will have the same features as Alternative 6 with the exception of the location of the Eucalyptus Avenue/WLC Pkwy intersection. The Design Variation will consist of moving the current Eucalyptus Avenue/WLC Pkwy intersection approximately 900' south from its current location. The shift will cause a partial realignment of Eucalyptus Avenue from approximately 2600' west of WLC Pkwy to connect to the west side of WLC Pkwy. Construction of the roundabout at WLC Pkwy and Eucalyptus Avenue east would result in one residential displacement in the southeast quadrant of WLC Pkwy and Eucalyptus Avenue east.

2.0 REGULATORY ENVIRONMENT

The following discussion of applicable laws has been excerpted and reordered from the Caltrans online Standard Environmental Reference (SER), Environmental Handbook, Volume 1, Chapter 8 on Paleontology (Caltrans, 2017). This project is subject to federal and State legislation regarding paleontological resources.

2.1 FEDERAL LAWS AND REGULATIONS

A project must comply with one or more federal regulations concerning paleontological resources if: (1) the project involves land under the jurisdiction of a federal agency, (2) a federal agency has oversight on the project, and/or (3) a permit, license, authorization, or funding from a federal agency is required to complete the project. Because this project is not on federal land, the majority of federal regulations concerning paleontological resources do not apply. However, this project has federal funding and oversight by the FHWA, a federal agency; therefore, the following federal regulations apply to this project.

National Environmental Policy Act of 1969 (42 United States Code 4321-4375): NEPA established a national policy for the protection, promotion, enhancement, and understanding of the environment and created the Council on Environmental Quality. As part of this act, Section 101(b)(4) (42 USC 4331) seeks to "…preserve important historic, cultural, and natural aspects of our natural heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice." NEPA requires that the environmental effects of a proposed federal project or action be evaluated, and regulations for implementing this evaluation are found in 40 Code of Federal Regulations (CFR) 1500-1508. Because a federal agency, the FHWA, has oversight on this project, compliance with NEPA regulations is required for the project as a whole. The applicability of NEPA to paleontological resources depends on whether Section 101(b)(4) is interpreted to include fossils. However, compliance with CEQA regulations and Caltrans guidelines regarding paleontological resources will meet the requirements of NEPA regardless of whether paleontological resources are deemed to be covered under this act.

Archaeological and Paleontological Salvage (23 USC 305): As part of the Federal-Aid Highway Act of 1956 (23 USC et seq.), this federal law authorizes the appropriation and use of federal funds for paleontological salvage as necessary by the highway department of any state, in compliance with 16 USC 431-433. According to 23 CFR 1.9(a), the use of federal aid funds must be in conformity with federal and State laws. Under this statute, mitigation of impacts to paleontological resources during development of this project may be an eligible federal project cost, provided the necessary documentation is submitted to the FHWA.

2.2 STATE REGULATIONS

Under State law, paleontological resources are protected by both CEQA and Public Resources Code (PRC) Section 5097.5.

2.2.1 California Environmental Quality Act (PRC 21000 et seq.)

The purpose of CEQA is to provide a statewide policy of environmental protection. As part of this protection, State and local agencies are required to analyze, disclose, and, when feasible, mitigate the environmental impacts of, or find alternatives to, proposed projects.

The State CEQA Guidelines (California Code of Regulations 15000 et seq.) provide regulations for the implementation of CEQA and include more specific direction on the process of documenting, analyzing, disclosing, and mitigating the environmental impacts of a project. To assist in this process, Appendix G of the State *CEQA Guidelines* provides a sample checklist form that may be used to identify and explain the degree of impact a project will have on a variety of environmental aspects, including paleontological resources (Section V(c)).

As stated in Section 15002(b)(1-3) of the State *CEQA Guidelines*, CEQA applies to governmental action, including activities that are undertaken by, financed by, or require approval from a governmental agency. Because this project is undertaken by governmental agencies, CEQA regulations apply.

2.2.2 California Public Resources Code, Section 5097.5

This law protects historic, archaeological, and paleontological resources on public lands within California and establishes criminal and civil penalties for violations.

Specifically, PRC Section 5097.5 states:

> (a) No person shall knowingly and willfully excavate upon, or remove, destroy, injure or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor.
>
> (b) As used in this section, "public lands" means lands owned by, or under the jurisdiction of, the state, or any city, county, district, authority, or public corporation, or any agency thereof.

Because this project involves public lands as defined in Section 5097.5(b), Caltrans and the local project proponent are required to comply with this regulation.

2.3 LOCAL REGULATIONS

Caltrans is not required to comply with local laws and ordinances; however, it will endeavor to do so to the extent possible. The General Plans for both the Riverside County and the City of Moreno Valley include elements related to paleontological resources within their jurisdictions. These elements provide additional guidance on assessment and treatment measures for projects subject to CEQA compliance. Project staff should periodically coordinate with local entities to update their

knowledge of local requirements. Protection of paleontological resources following Caltrans guidelines will likely meet and/or exceed paleontological protection guidelines of the County of Riverside (County) and the City; however, they are included here to provide a complete review.

2.3.1 County of Riverside

The County General Plan (County of Riverside, 2015) sets forth the goals, policies, and programs the County uses to manage future growth and land uses. Chapter 5 of the Multipurpose Open Space Element of the General Plan contains the policies designed to protect paleontological resources within unincorporated areas of the County. The following policies contained in the General Plan of the County are designed to protect paleontological resources in those areas of Riverside County.

OS 19.8: Whenever existing information indicates that a site proposed for development may contain biological, paleontological, or other scientific resources, a report shall be filed stating the extent and potential significance of the resources that may exist within the proposed development and appropriate measures through which the impacts of development may be mitigated.

OS 19.9: This policy requires that when existing information indicates that a site proposed for development may contain paleontological resources, a paleontologist shall monitor site grading activities, with the authority to halt grading to collect uncovered paleontological resources, curate any resources collected with an appropriate repository, and file a report with the Planning Department documenting any paleontological resources that are found during the course of site grading.

OS 19.10: Transmit significant development applications subject to CEQA to the San Bernardino County Museum (SBCM) for review, comment, and/or preparation of recommended conditions of approval with regard to paleontological resources.

2.3.2 City of Moreno Valley

The protection and preservation of paleontological resources within the city limits of Moreno Valley are addressed in the Moreno Valley General Plan (City of Moreno Valley, 2006a) and the Final Program Environmental Impact Report (EIR) (City of Moreno Valley, 2006b) prepared for the adoption and implementation of the General Plan.

The Moreno Valley General Plan, Chapter 9 Goals and Objectives, Section 9.7.3, Conservation Element Program 7-6, states:

> In areas where archaeological or paleontological resources are known or reasonably expected to exist, based upon the citywide survey conducted by the [University of California, Riverside] Archaeological Research Unit, incorporate recommendations and determinations of that report to reduce potential impacts to levels of insignificance.

Section 5.10, Cultural Resources, of the Final Program EIR includes the following mitigation measure to reduce those potential impacts to paleontological resources:

> **Mitigation Measure C1.** Prior to the approval of a project, the City will assess potential impacts to significant historic, archaeological, and paleontological resources, including impacts to human remains, pursuant to Section 15064.5 of the [CEQA] Guidelines. If significant impacts are identified, the City will require the project to be modified to avoid the impacts, or require measures to mitigate the impacts. Mitigation may involve monitoring, resource recovery, documentation, or other measures.

Section 5.10, Cultural Resources, of the Final Program EIR also discusses the geologic units within the city limits and contains a paleontological sensitivity map of the City (City of Moreno Valley, 2006b). Based on that map, most of the project area is in an area of low paleontological sensitivity. However, the boundary between areas of low and high paleontological sensitivity runs northwest to southeast along the edge of The Badlands and crosses part of the eastern end of the project area. This boundary follows Highland Boulevard, down WLC Pkwy to SR-60 and Gilman Springs Road. Therefore, portions of the project north and east of these roads are in the area of high paleontological sensitivity shown on the paleontological sensitivity map in the Final Program EIR.

3.0 SIGNIFICANCE

3.1 DEFINITION OF SIGNIFICANCE

If a paleontological resource, such as a rock unit or formation with the potential to contain fossils, cannot be avoided during construction, the significance of the resource must be assessed before mitigation measures are proposed. The scientific significance or importance of a paleontological resource is based on various attributes of that resource, and in the interest of thoroughness, definitions of significance from Caltrans, the Society of Vertebrate Paleontology (SVP), and one additional source are included below.

3.1.1 California Department of Transportation

According to Caltrans (2017), there are two generally recognized types of paleontological significance:

National: A National Natural Landmark-eligible paleontological resource is an area of national significance (as defined under 36 CFR 62) that contains an outstanding example of fossil evidence of the development of life on earth. This is the only codified definition of paleontological significance.

Scientific: Definitions of a scientifically significant paleontological resource can vary by jurisdictional agency and paleontological practitioner.

Generally, scientifically significant paleontological resources are identified sites or geological deposits containing individual fossils or assemblages of fossils that are unique or unusual, are diagnostically or stratigraphically important, and add to the existing body of knowledge in specific areas stratigraphically, taxonomically, or regionally. Particularly important are fossils found in situ (undisturbed) in primary context (e.g., fossils that have not been subjected to disturbance subsequent to their burial and fossilization). As such, they aid in stratigraphic correlation, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, paleoclimatology, the relationships between aquatic and terrestrial species, and evolution in general. Discovery of in situ fossil-bearing deposits is rare for many species, especially vertebrates. Terrestrial vertebrate fossils are often assigned greater significance than other fossils because they are rarer than other types of fossils. This is primarily due to the fact that the best conditions for fossil preservation include little or no disturbance after death and quick burial in oxygen-depleted, fine-grained sediments. While these conditions often exist in marine settings, they are relatively rare in terrestrial settings. This has ramifications with regard to the amount of scientific study needed to characterize an individual species adequately and, therefore, affects how relative sensitivities are assigned to formations and rock units.

3.1.2 Society of Vertebrate Paleontology

The SVP provides the following definitions of significance (SVP, 2010):

> **Significant Paleontological Resources** are fossils and fossiliferous deposits, here defined as consisting of identifiable vertebrate fossils, large or small, uncommon invertebrate, plans, and trace fossils, and other data that provide taphonomic,

taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information. Paleontological resources are considered to be older than recorded human history and/or older than middle Holocene (i.e., older than about 4,200 years [Cohen et al., 2018]).

3.1.3 Other

Eisentraut and Cooper (2002) developed a useful set of criteria for judging whether fossils are scientifically significant. Using their method, fossils can be judged scientifically significant if they meet any of the criteria within the following categories.

Taxonomy: Assemblages that contain rare or unknown taxa, such as defining new (previously unknown to science) species, or representing a species that is the first or has very limited occurrence within the area or formation.

Evolution: Fossils that represent important stages or links in evolutionary relationships or that fill gaps or enhance underrepresented intervals in the stratigraphic record.

Biostratigraphy: Fossils that are important for determining or confining relative geologic (stratigraphic) ages or for use in defining regional to interregional stratigraphic associations. These fossils are often known as biostratigraphic markers and represent plants or animals that existed for only a short and restricted period in the geologic past.

Paleoecology: Fossils that are important for reconstructing ancient organism community structure and interpretation of ancient sedimentary environments. Depending on which fossils are found, much can be learned about the ancient environment, from water depth, temperature, and salinity to what the substrate was like (muddy, sandy, or rocky), and even whether the area was in a high-energy location (e.g., a beach) or a low-energy location (e.g., a bay). Even terrestrial animals can contain information about the ancient environment. For example, an abundance of grazing animals such as horse, bison, and mammoth suggest more of a grassland environment, while an abundance of browsing animals such as deer, mastodon, and camel suggest more of a brushy environment. Preserved parts of plants can also lend insight into what was growing in the area at a particular time. In addition, by studying the ratios of different species to each other's population densities, relationships between predator and prey can be determined.

There is a complex but vital interrelationship among evolution, biostratigraphy, and paleoecology: biostratigraphy (the record of fossil succession and progression) is the expression of evolution (change in populations of organisms through time), which in turn is driven by natural selection pressures exerted by changing environments (paleoecology).

Taphonomy: Fossils that are exceptionally well or unusually/uniquely preserved or that are relatively rare in the fossil record. This could include preservation of soft tissues such as hair, skin, or feathers from animals or the leaves/stems of plants that are not commonly fossilized.

3.2 SUMMARY OF SIGNIFICANCE

All vertebrate fossils that can be related to a stratigraphic context are considered scientifically significant, nonrenewable paleontological resources. Invertebrate and plant fossils, as well as other environmental indicators associated with vertebrate fossils, are considered scientifically significant. Certain invertebrate and plant fossils that are regionally rare or uncommon, or that help to define stratigraphy, age, or taxonomic relationships, are considered scientifically significant.

4.0 SENSITIVITY

4.1 DEFINITION OF SENSITIVITY

Sensitivity is often stated as "potential" because decisions about how to manage paleontological resources must be based on "potential." The actual situation cannot be known until grading and excavation for the project is underway. Caltrans and the SVP each have a ranking system to describe paleontological sensitivity, as described in the following sections.

4.1.1 California Department of Transportation

In accordance with the Caltrans SER guidelines for paleontology (Caltrans, 2017), the sensitivity of rock units and formations that may contain paleontological resources is assessed on the basis of high, low, or no potential for paleontological resources as follows

High Potential: Rock units that, based on previous studies, contain or are likely to contain significant vertebrate, significant invertebrate, or significant plant fossils. These units include, but are not limited to, sedimentary formations that contain significant nonrenewable paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. These units may also include some volcanic and low-grade metamorphic rock units. Fossiliferous deposits with very limited geographic extent or an uncommon origin (e.g., tar pits and caves) are given special consideration and ranked as highly sensitive. High sensitivity includes the potential for containing (1) abundant vertebrate fossils; (2) a few significant fossils (large or small vertebrate, invertebrate, or plant fossils) that may provide new and significant taxonomic, phylogenetic, ecologic, and/or stratigraphic data; (3) areas that may contain datable organic remains older than Recent, including *Neotoma* middens; and/or (4) areas that may contain unique new vertebrate deposits, traces, and/or trackways. Areas with a high potential for containing significant paleontological resources require monitoring and mitigation during grading and excavation.

Low Potential: This category includes sedimentary rock units that (1) are potentially fossiliferous, but have not yielded significant fossils in the past; (2) have not yet yielded fossils but possess a potential to contain fossil remains; or (3) contain common and/or widespread invertebrate fossils if the taxonomy, phylogeny, and ecology of the species contained in the rock are well understood. Sedimentary rocks expected to contain vertebrate fossils are not placed in this category because vertebrates are generally rare and found in more localized stratum. Rock units designated as low potential generally do not require monitoring and mitigation during grading and excavation. However, as excavation for construction gets underway, it is possible that new and unanticipated paleontological resources might be encountered. If this occurs, a Construction Change Order (CCO) must be prepared to have a qualified Principal Paleontologist evaluate the resource. If the resource is determined to be significant, monitoring and mitigation are required during grading and excavation from that time on.

No Potential: Rock units of intrusive igneous origin, most extrusive igneous rocks, and moderately to highly metamorphosed rocks are classified as having no potential to contain significant paleontological resources. For projects encountering only these types of rock units, paleontological

resources can generally be eliminated as a concern when the Preliminary Environmental Analysis Report (PEAR) is prepared and no further action taken.

4.1.2 Society of Vertebrate Paleontology

According to the SVP (2010), Paleontological Potential is the potential for the presence of significant nonrenewable paleontological resources. All sedimentary rocks, some volcanic rocks, and some metamorphic rocks have potential to contain significant nonrenewable paleontological resources, and review of available literature may further refine the potential of each rock unit, formation, or facies. The SVP has four categories of potential or sensitivity: high, low, none, and undetermined. If a geographic area or geological unit is classified as having undetermined potential for paleontological resources, studies must be undertaken to determine whether that rock unit has a sensitivity of either high, low, or none. These categories are described in more detail below.

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. Rocks units classified as having high potential for producing paleontological resources include, but are not limited to: sedimentary formations and some volcaniclastic formations (e.g., ashes or tephras), some low-grade metamorphic rocks that contain significant paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils (e.g., middle Holocene and older, fine-grained fluvial sandstones, argillaceous and carbonate-rich paleosols, cross-bedded point bar sandstones, and fine-grained marine sandstones). Paleontological potential consists of both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, plant, or trace fossils; and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data. Rock units that contain potentially datable organic remains older than the late Holocene, including deposits associated with animal nests or middens, and rock units that may contain new vertebrate deposits, traces, or trackways are also classified as having high potential.

Low Potential: Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have a low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus, fossils will only be preserved in rare circumstances; the presence of fossils is the exception, not the rule (e.g., basalt flows or Recent colluvium). Rock units with low potential typically will not require measures to protect fossils.

No Potential: Some rock units have no potential to contain significant paleontological resources (e.g., high-grade metamorphic rocks [such as gneisses and schists] and plutonic igneous rocks [such as granites and diorites]). Rock units with no potential require no protection measures relative to paleontological resources.

Undetermined Potential: Rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment are considered to have undetermined potential. Further study is necessary to determine whether these rock units have

high, low, or no potential to contain significant paleontological resources. A field survey by a qualified professional to specifically determine the paleontological resource potential of these rock units is required before a Paleontological Resource Impact Mitigation Program (PRIMP) can be developed. In cases where no subsurface data are available, paleontological potential can sometimes be determined by strategically located excavations into subsurface stratigraphy.

4.2 SUMMARY OF SENSITIVITY

A formation or rock unit has paleontological sensitivity or the potential to contain significant paleontological resources if it previously has produced, or has lithologies conducive to the preservation of, vertebrate fossils and associated or regionally uncommon invertebrate or plant fossils. All sedimentary rocks, certain extrusive volcanic rocks, and mildly metamorphosed rocks are considered to have potential for paleontological resources.

5.0 METHODS

5.1 LITERATURE REVIEW

Geologic maps of the area were examined and relevant geological and paleontological literature were reviewed to determine which geologic units are present in the project area and whether fossils have been recovered from those or similar geologic units elsewhere in the region. As geologic formations and units may extend over large geographic areas and contain similar lithologies and fossils, the literature review includes areas well beyond the project area. The results of this literature review include an overview of the geology of the project area and a discussion of the paleontological sensitivity (or potential) of the geologic units within the project area.

5.2 FOSSIL LOCALITY SEARCH

In September 2013, a fossil locality search was completed by Eric Scott, Curator of Paleontology at the SBCM. This fossil locality search included a 1 mi buffer around the project area. The purpose of a locality search is to establish the status and extent of previously recorded paleontological resources in and adjacent to the study area. The locality search results from Mr. Scott are summarized in Section 6.2, and a copy of the letter from the SBCM is provided in Appendix A.

5.3 FIELD SURVEY

The purpose of a field survey is to note the sediments and to identify any unrecorded paleontological resources exposed on the surface of a project area. In this way, impacts to existing, unrecorded paleontological material may be mitigated prior to the beginning of ground-disturbing activities and portions of the project area that are more likely to contain paleontological resources may be identified. Pedestrian surveys of the project area were conducted by Riordan Goodwin and Veronica Sorce on February 4, March 19, March 20, and May 7, 2015, and November 15, 2018. These surveys were conducted by opportunistically walking most areas of the project area or visually inspecting the project area from a distance. Because much of the project area is within active freeway and street rights-of-way, access was not safely available in all areas. Nonnative surfaces such as graded pads, graded/landscaped areas associated with prior development, and freeway shoulders and ramps were not surveyed. Special attention was given to areas that had exposed ground surfaces, cut slopes, and rodent borrow backdirt. The results of the field survey are summarized in Section 6.3.

5.4 PERSONNEL

5.4.1 Sarah Rieboldt, Ph.D.

Dr. Sarah Rieboldt, Associate and Senior Paleontologist at LSA, prepared this Paleontological Identification Report/Paleontological Evaluation Report. Dr. Rieboldt received her Ph.D. in Paleontology from the University of California, Berkeley, and has extensive experience surveying for and collecting paleontological resources; salvaging large fossil specimens; collecting bulk sediment samples; identifying, preparing, and curating fossil material; and writing paleontological assessment reports and final mitigation monitoring reports at the conclusion of construction projects. She has conducted paleontological and geological fieldwork in California, Nevada, Utah, Wyoming, Colorado,

Texas, and Alabama, and has 8 years of experience working with natural history collections in several museums (the Field Museum of Natural History, the University of California Museum of Paleontology, and the University of Colorado Museum of Natural History). She has worked as a geologist and paleontological consultant on many different projects, including carbon sequestration and astrobiology research programs funded by the United States Department of Energy and the National Aeronautics and Space Administration, respectively, as well as on projects for the State of California Department of Parks and Recreation, Caltrans, and various private developers in California, Nevada, and Utah. Dr. Rieboldt's résumé is provided in Appendix B.

5.4.2 Riordan Goodwin

Riordan Goodwin, LSA Senior Cultural Resources Manager, conducted the paleontological field inspection for this project. He has more than 20 years of paleontological as well as archaeological experience in Southern and Central California and has served as Field Supervisor/Coordinator, Lead Monitor, and/or Monitor on numerous paleontological projects. Mr. Goodwin also serves as the laboratory manager in LSA's Riverside office. Since joining LSA, Mr. Goodwin has personally conducted and contributed to numerous projects at the CEQA and NEPA levels and for projects varying in size from less than 1 acre to tracts as large as 20,000 acres, as well as extensive transportation improvements. Surveys have included implementation of global positioning system (GPS) mapping, locality descriptions, and/or recordation. Mr. Riordan conducted the reconnaissance survey for this project.

5.4.3 Veronica Sorce

Veronica Sorce is a cultural and paleontological technician at LSA. She has been with LSA for 2.5 years and has been working actively in the field and in the laboratory for the past 6 years in Illinois, the Bahamas, and California. Ms. Sorce has spent most of the past 2.5 years monitoring for paleontological and archaeological resources on construction projects. Ms. Sorce's professional archaeological experience includes conducting Phase I surveys, Phase II testing, and Phase III data recovery, as well as construction monitoring. She also has experience in completing records searches and documenting sites (profiles and plan mapping, photography, sketch drawing, site forms, soil analysis and recording, and site recording), and laboratory analysis. Ms. Sorce conducted the reconnaissance survey for this project.

6.0 RESULTS

6.1 GEOLOGIC SETTING OF THE AREA

The project area is in the Peninsular Ranges Geomorphic Province, a 900 mi long northwest-southeast trending structural block that extends from the Transverse Ranges in the north to the tip of Baja California in the south and includes the Los Angeles Basin (California Geological Survey, 2002; Norris and Webb, 1976). The total width of this province is 225 mi, extending from the Colorado Desert in the east, across the continental shelf, to the southern Channel Islands (Santa Barbara, San Nicolas, Santa Catalina, and San Clemente) in the west (Sharp, 1976). This province is characterized by a series of mountain ranges and valleys that trend in a northwest–southeast direction roughly parallel to the San Andreas Fault (Norris and Webb, 1976; Sharp, 1976). It contains extensive pre-Cenozoic (more than 66 million years ago [Ma]) igneous and metamorphic rock covered by limited exposures of Cenozoic (less than 66 Ma) sedimentary deposits (Norris and Webb, 1976).

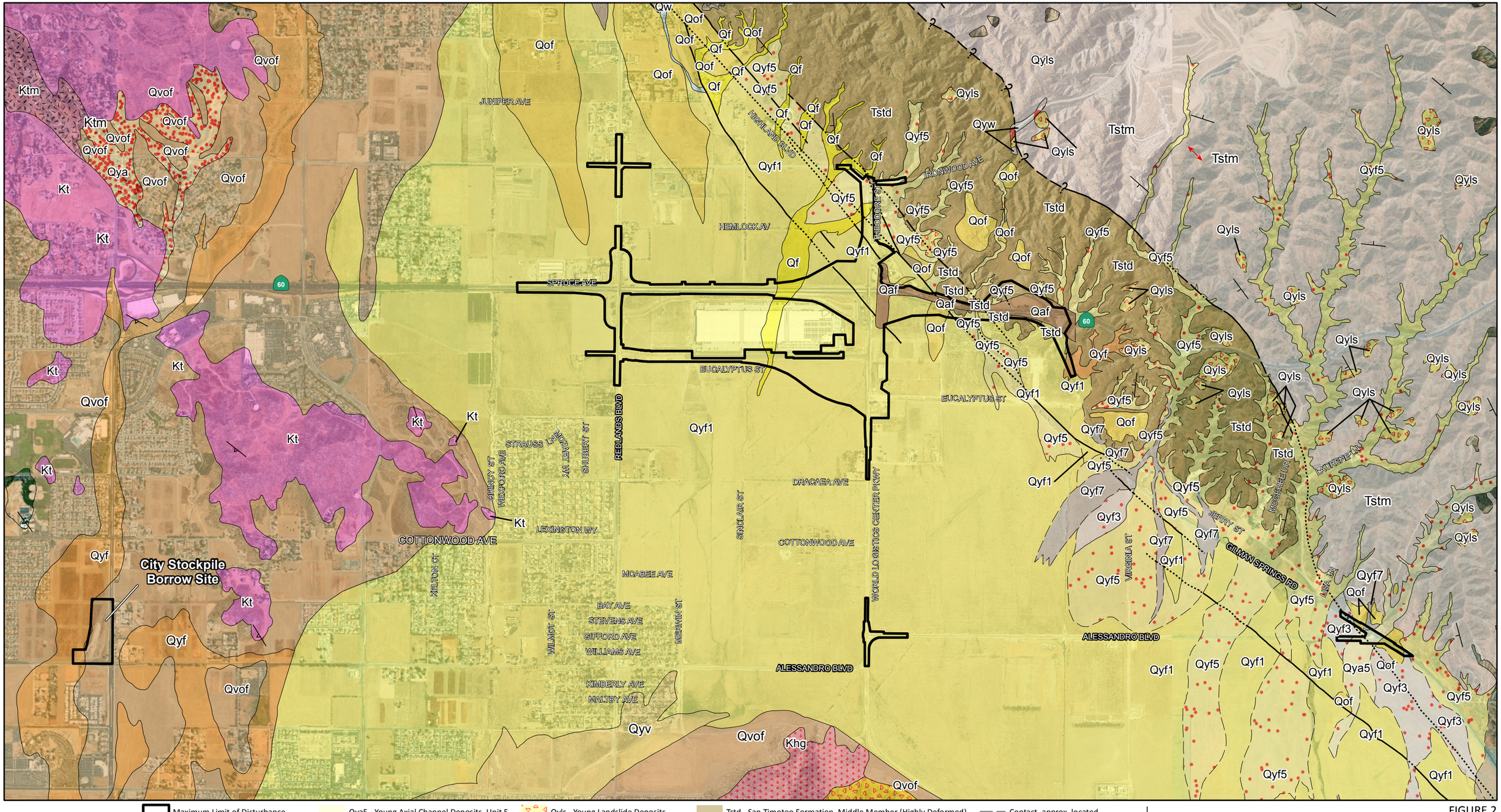
6.2 STRATIGRAPHY OF THE PROJECT AREA

Geologic maps prepared by Morton and Matti (2001) and Morton and Miller (2006) indicate that the project area contains the following geologic units: Artificial Fill; Very Young Alluvial Fan Deposits; Young Axial Channel Deposits; Young Alluvial Fan Deposits, Undivided, and Units 1, 3, 5, and 7; Old Alluvial Fan Deposits, Very Old Alluvial Fan Deposits, and the San Timoteo Formation, middle member, unnamed subunit. All of these geologic units are described briefly below, and their distribution in the project area is shown on Figure 6-1. Table 6.A summarizes the ages for each geologic unit and denotes the map symbols used to abbreviate the geologic units shown on Figure 6-1. The time intervals for the geologic periods and ages used herein are based on the *International Chronostratigraphic Chart* prepared by Cohen et al. (2018). Each of these geologic units is described in the following sections. Please note that this document includes information used to determine the potential to encounter scientifically significant fossil remains in the geologic units found within the project areas. It is not, and should not be used as, a geological assessment.

Table 6.A: Geologic Units Within the SR-60/WLC Pkwy Interchange Project Area

Geologic Formation/Unit	Map Symbol	Age (Years Ago)	Geologic Epoch
Artificial Fill	Qaf	less than 100	Recent
Very Young Alluvial Fan Deposits	Qf	less than 11,700	late Holocene
Young Axial Channel Deposits	Qya	less than 126,000	Holocene to late Pleistocene
Young Alluvial Fan Deposits	Qyf, Qyf1, Qyf3, Qyf5, and Qyf7	less than 126,000	Holocene to late Pleistocene
Old Alluvial Fan Deposits	Qof	11,700 to 781,000	late to middle Pleistocene
Very Old Alluvial Fan Deposits	Qvof	126,000 to 2.588 million	middle to early Pleistocene
San Timoteo Formation, Middle Member, Unnamed Subunit	Tstd	2.588 million to 5.333 million	Pliocene

Source: Morton and Miller (2006)
SR-60 = State Route 60
WLC Pkwy = World Logistics Center Parkway



Maximum Limit of Disturbance

Geology

- Qaf - Artificial Fill
- Qf - Very Young Alluvial Fan Deposits
- Qw - Very Young Wash Deposits
- Qya - Young Axial Channel Deposit
- Qya5 - Young Axial Channel Deposits, Unit 5
- Qyf - Young Alluvial Fan Deposits
- Qyf1 - Young Alluvial Fan Deposits, Unit 1
- Qyf3 - Young Alluvial Fan Deposits, Unit 3
- Qyf5 - Young Alluvial Fan Deposits, Unit 5
- Qyf7 - Young Alluvial Fan Deposits, Unit 7
- Qyls - Young Landslide Deposits
- Qyv - Young Alluvial Valley Deposits
- Qyw - Young Alluvial Wash Deposits
- Qof - Old Alluvial Fan Deposits
- Qols - Old Landslide
- Qvof - Very Old Alluvial Fan Deposits
- Tstd - San Timoteo Formation, Middle Member (Highly Deformed)
- Tstm - San Timoteo Formation, Middle Member
- Khg - Heterogeneous Granitic Rocks
- Kt - Tonalite
- Ktm - Tonalite and Mafic Rocks, Undifferentiated

- Contact, approx. located
- Contact, certain
- Fault, approx. located
- Fault, approx. located, queried
- Fault, certain
- Fault, concealed
- Bedding
- Igneous Foliation
- Anticline

0 900 1800

FEET

SOURCE: MBI (11/2018); ESRI (07/2012); Morton and Miller (2006); Morton and Matti (2001)

I:\RBF1301\GIS_Mod\MXD\Paleo\Geology.mxd (12/13/2018)

FIGURE 2

SR-60/World Logistics Center Parkway Interchange Project

Geology Map

08-RIV-60 PM 20.0/22.0
EA No. 0M590
Project No. 0813000109

6.2.1 Artificial Fill (Qaf)

Morton and Matti (2001) and Morton and Miller (2006) mapped an area of Artificial Fill in the eastern end of the project area, roughly along SR-60 from the WLC Pkwy interchange to the Gilman Springs interchange. Additional portions of the project area within the existing road right-of-way may also have used Artificial Fill during their construction, although those portions are too small to be mapped. Artificial Fill consists of sediments that have been removed from one location and transported to another by humans. The transportation distance can range from a few feet to dozens of miles. Composition is dependent on the source.

6.2.2 Very Young Alluvial Fan Deposits (Qf)

The Very Young Alluvial Fan Deposits are late Holocene in age (less than 4,200 years ago) and consist mainly of unconsolidated pebbly and gravelly sand (Morton and Matti, 2001; Morton and Miller, 2006). Cobble-sized clasts are also present and become more abundant closer to the head of the fan (Morton and Matti, 2001; Morton and Miller, 2006). These sediments were deposited by flooding streams and debris flows coming down from higher elevations and generally form a fan or lobe shape at the base of hills and mountains. They are mapped in the northeastern and central portions of the project area.

6.2.3 Young Axial Channel Deposits (Qya)

The Young Axial Channel Deposits are Holocene to late Pleistocene in age (less than 126,000 years ago) and consist mainly of thin- to thick-bedded very fine to medium sand that varies from white and light gray to very pale brown (Morton and Miller, 2006). These deposits are usually close to an active stream channel and are often found in narrow canyons.

6.2.4 Young Alluvial Fan Deposits (Qyf, Qyf1, Qyf3, Qyf5, and Qyf7)

The Young Alluvial Fan Deposits consist of slightly consolidated to cemented sand, gravel, and cobbles that are predominantly gray in color (Morton and Matti, 2001; Morton and Miller, 2006). These sediments were eroded from higher elevations in the San Timoteo Badlands, carried by flooding streams and debris flows down the canyons, and deposited in a fan or lobe shape at the base of the hills. They show slight to moderate dissection by more recent washes and gullies (Morton and Matti, 2001; Morton and Miller, 2006). The number indicates the unit's age relative to the other units: Unit 1 (Qyf1) is from the early Holocene to late Pleistocene (8,200 to 126,000 years ago), Unit 3 (Qyf3) is from the middle Holocene (4,200 to 8,200 years ago), Unit 5 (Qyf5) is from the late Holocene (less than 4,200 years ago), and Unit 7 (Qyf7) is from the late Holocene to late Pleistocene (less than 126,000 years ago). When the relative age is undetermined, the unit is termed Young Alluvial Fan Deposits, Undivided (Qyf), and is dated to the Holocene to late Pleistocene (less than 126,000 years ago). These deposits of one unit or another underlie most of the project area.

6.2.5 Old Alluvial Fan Deposits (Qof)

Similar to the Young Alluvial Fan Deposits described above, the Old Alluvial Fan Deposits were deposited by flooding streams and debris flows coming down from higher elevations; however, these deposits consist of reddish-brown gravel, sand, and silt, and are moderately consolidated and older, ranging in age from the late to middle Pleistocene (approximately 11,700 to 781,000 years

ago) (Morton and Matti, 2001; Morton and Miller, 2006). Some surfaces show increased soil development and are dissected by erosional gulleys (Morton and Matti, 2001; Morton and Miller, 2006). These deposits are found on the south side of the San Timoteo Badlands and are mapped at the surface in northern and eastern portions of the project area. They also may be encountered elsewhere in the project area in the subsurface below younger deposits.

6.2.6 Very Old Alluvial Fan Deposits (Qvof)

Similar to the other Alluvial Fan Deposits described above, the Very Old Alluvial Fan Deposits consist of orangish-brown to reddish-brown gravel, sand, and silt deposited by flooding streams and debris flows coming down from higher elevations (Morton and Miller, 2006). Morton and Miller (2006) state that the common grain size is medium- to coarse-grained sand and that this unit can be sparsely to highly conglomeritic clasts composed of rocks of the Pelona Schist. These deposits are moderately to well consolidated and range in age from the middle to early Pleistocene (approximately 126,000 years ago to 2.588 Ma) (Morton and Matti, 2001; Morton and Miller, 2006). Most surfaces show some soil development and are dissected by erosional gulleys (Morton and Matti, 2001; Morton and Miller, 2006). These deposits are west of the San Timoteo Badlands and are mapped at the surface at the location of the proposed borrow pit in the northwest corner of Alessandro Boulevard and Nason Street. They also may be encountered elsewhere in the project area in the subsurface below younger deposits.

6.2.7 San Timoteo Formation, Middle Member, Unnamed Subunit (Tstd)

The San Timoteo Formation consists of non-marine sandstone, conglomeratic sandstone, and conglomerate deposited during the Pliocene and Pleistocene (Morton and Matti, 2001). The middle member of this formation was deposited during the Pliocene (3.6 to 5.333 Ma) and is predominantly composed of light gray, medium- to coarse-grained sandstone with some pebbly and cobbly conglomerates (Morton and Matti, 2001; Morton and Miller, 2006). The conglomerate beds may be up to 30 ft thick and are more abundant in the upper part of the unit (Morton and Matti, 2001; Morton and Miller, 2006). There are also several reddish-brown beds, some of which are oxidized sandstone, while others are rich in clay and may be paleosols (Morton and Matti, 2001; Morton and Miller, 2006). Mapped within the project area is an unnamed subunit of this member (Tstd) that consists of highly deformed sandstone, pebbly sandstone, and conglomerate (Morton and Miller, 2006).

6.3 FOSSIL LOCALITY SEARCH

The fossil locality search identified one fossil locality within the boundaries of the proposed project from the San Timoteo Formation, SBCM 5.3.9, which refers to a University of California Museum of Paleontology (UCMP) locality (UCMP 3258) that yielded remains of the extinct horse (*Equus* [*Plesippus*] *francescana*). This locality is near the existing intersection of SR-60 and Gilman Springs Road. Because much of this area is mapped as Artificial Fill by Morton and Matti (2001) and Morton and Miller (2006), the locality may have been removed or covered.

In addition, the SBCM identified 14 localities in the San Timoteo Formation within 1 mi of the project area. These localities have produced specimens of gastropods, bivalves, and terrestrial vertebrates, including the pocket gopher (*Thomomys*) and kangaroo rat (*Dipodomys*). The SBCM also indicates

that to the north and the northeast of the project area, numerous localities are known from the San Timoteo Formation.

The SBCM maintains that the San Timoteo Formation is extremely fossiliferous and has a high potential to yield scientifically significant paleontological resources. The SBCM also indicates that the Pleistocene older fan deposits (i.e., Old Alluvial Fan Deposits) have the potential to contain important fossils and, therefore, are considered to have high paleontological sensitivity. The other geologic units that the SBCM identified within the project area, including Holocene fan deposits (i.e., Very Young Alluvial Fan Deposits and Young Alluvial Fan Deposits) and Holocene landslide debris (which are, in fact, outside the project area), were not assigned specific paleontological sensitivities by the SBCM.

6.4 FIELD SURVEY

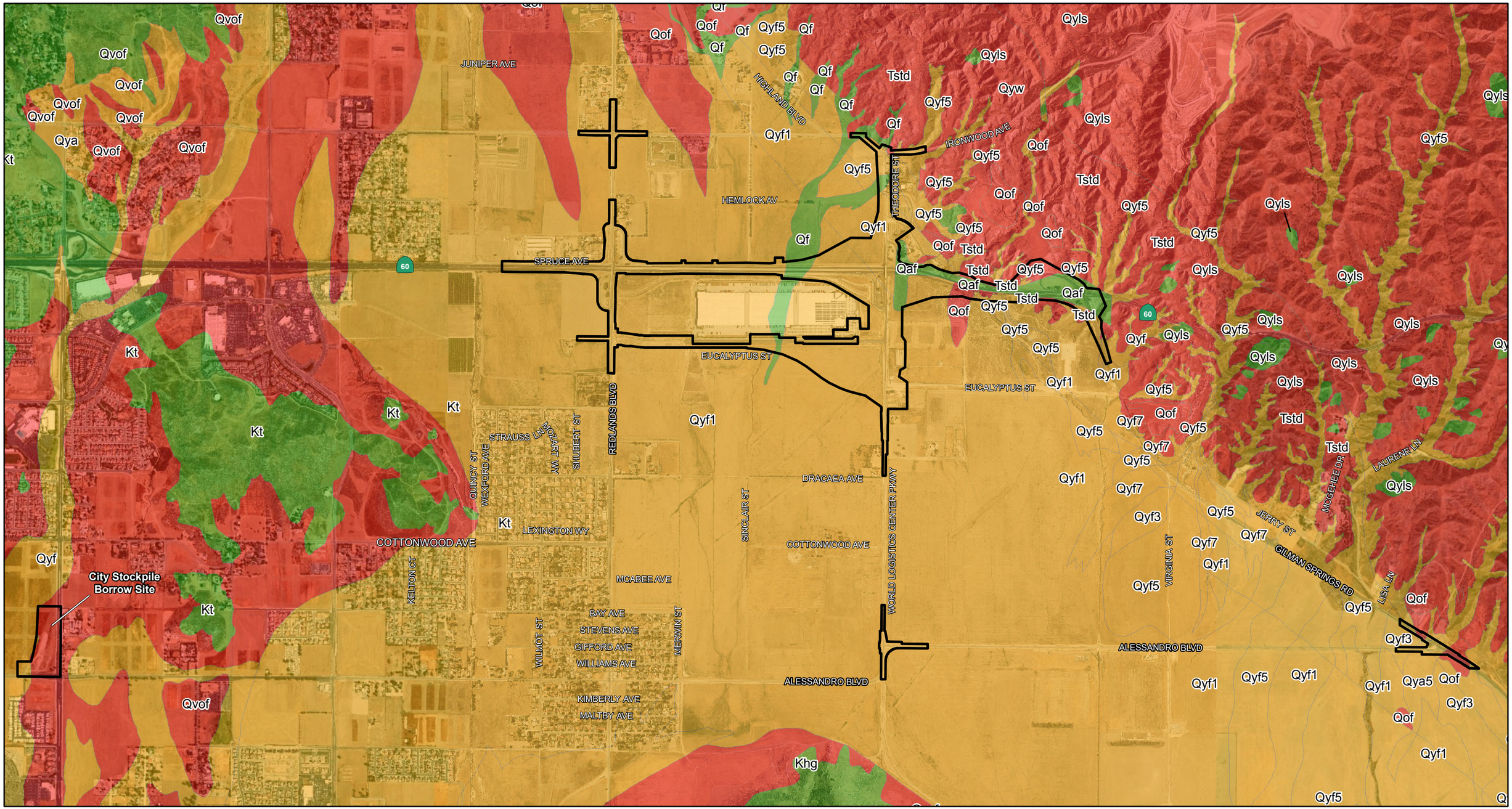
Visibility varied from excellent to poor, averaging 50 percent with substantial obstruction of the surface by vegetation, roadway, and other development. The majority of the project area was severely disturbed by road construction and commercial and residential development, as well as agricultural activities. Modern roadside refuse was noted throughout the project area. Special attention was given to the area near the existing intersection of SR-60 and Gilman Springs Road, as this is the location of the previously recorded fossil locality, SBCM 5.3.9 (UCMP 3258),. No evidence of the fossil locality was observed. As previously stated, much of this area is mapped as Artificial Fill by Morton and Matti (2001) and Morton and Miller (2006); therefore, it is likely that the locality has been removed or covered. No paleontological resources were observed during the field surveys.

6.5 PALEONTOLOGICAL SENSITIVITIES

The paleontological resource sensitivity rating describes the potential to encounter scientifically significant fossil remains in a given geologic unit. The paleontological sensitivities (or potential) of deposits within the project area are summarized in Table 6.B and described in more detail below. They are also illustrated on Figure 6-2. These sensitivity (or potential) ratings follow the guidelines of Caltrans (2017) and the SVP (2010) and are based on various aspects of these deposits, including their age, composition, depositional environment, and any scientifically significant fossil remains they have produced in other areas. As shown on Figure 6-2, geologic units and formations with the same paleontological sensitivity are combined and presented as sensitivity polygons. Therefore, formations and units of different ages and depositional environments, such as the Old Alluvial Fan Deposits that are in contact with the San Timoteo Formation, middle member, unnamed subunit will be represented on Figure 6-2 in a single polygon of high sensitivity.

6.5.1 Artificial Fill (Qaf)

Artificial Fill can contain fossils, but these fossils have been removed from their original locations and are thus out of context. They are not considered to be important for scientific study. Therefore, Artificial Fill has no paleontological sensitivity. However, these deposits vary in thickness and may overlie deposits in other geologic units or formations that can contain scientifically significant fossils.



Maximum Limit of Disturbance

Paleontological Sensitivity

- No
- Low 0-10, High below 10
- High

0 900 1800
FEET

SOURCE: MBI (11/2018); ESRI (07/2012); Morton and Miller (2006); Morton and Matti (2001)

I:\RBF1301\GIS_Mod\MXD\Paleo\PaleoSens.mxd (12/13/2018)

FIGURE 3

SR-60/World Logistics Center Parkway Interchange Project

Paleontological Sensitivity Map

08-RIV-60 PM 20.0/22.0
EA No. 0M590
Project No. 0813000109

Table 6.B: Paleontological Sensitivity of Geologic Units within the SR-60/WLC Pkwy Interchange Project Area

Geologic Unit	Paleontological Sensitivity (Potential)
Artificial Fill	None
Very Young Alluvial Fan Deposits	None
Young Axial Channel Deposits	0 to 10 ft below the surface: Low Deeper than 10 ft below the surface: High
Young Alluvial Fan Deposits	0 to 10 ft below the surface: Low Deeper than 10 ft below the surface: High
Old Alluvial Fan Deposits	High
Very Old Alluvial Fan Deposits	High
San Timoteo Formation, Middle Member, Unnamed Subunit	High

Source: Society of Vertebrate Paleontology and California Department of Transportation Guidelines.
ft = feet
SR-60 = State Route 60
WLC Pkwy = World Logistics Center Parkway

6.5.2 Very Young Alluvial Fan Deposits (Qf)

The Young Alluvial Fan Deposits are late Holocene in age (less than 4,200 years ago) (Morton and Matti, 2001). Although Holocene (less than 11,700 years ago) deposits can contain remains of plants and animals, only those from the middle to early Holocene (4,200–11,700 years ago) are considered scientifically important (SVP, 2010), and fossils from this time interval are not very common. As such, these deposits are assigned low paleontological sensitivity. However, the thickness of these deposits is unknown, and they may overlie older deposits that can contain scientifically significant fossils.

6.5.3 Young Axial Channel Deposits (Qya)

The Young Axial Channel Deposits are Holocene to late Pleistocene in age (less than 126,000 years ago) (Morton and Matti, 2001; and Morton and Miller, 2006), and fossils are known in similar-age deposits from scientific research, as well as from excavations for roads, housing developments, and quarries in Southern California (Jefferson 1991a, 1991b; Miller, 1971; Reynolds and Reynolds, 1991; Springer et al., 2009). The oldest deposits in this unit date to the end of the Rancholabrean North American Land Mammal Age (NALMA), which was named for the Rancho La Brea fossil site in central Los Angeles and dates from 11,000 to 240,000 years ago. The presence of *Bison* defines the beginning of the Rancholabrean NALMA (Bell et al., 2004), but fossils from this time also include other large and small mammals, reptiles, fish, invertebrates, and plants. There is a potential to encounter these types of fossils in the older sediments within this unit at depths beginning approximately 10 ft below the ground surface. Any vertebrate, invertebrate, and plant fossils recovered would be considered scientifically significant because they would add to our understanding of the environment of this area over the last 126,000 years and the evolution of the animals and plants that lived here. Therefore, these deposits are assigned a low paleontological sensitivity above a depth of 10 ft and a high sensitivity below that depth.

6.5.4 Young Alluvial Fan Deposits (Qyf, Qyf1, Qyf3, Qyf5, and Qyf7)

The Young Alluvial Fan Deposits, Undivided are Holocene to late Pleistocene in age (less than 126,000 years ago), Unit 1 is from the early Holocene to late Pleistocene (8,200 to 126,000 years ago), Unit 3 is from the middle Holocene (4,200 to 8,200 years ago), Unit 5 is from the late Holocene (less than 4,200 years ago), and Unit 7 is from the late Holocene to late Pleistocene (less than 126,000 years ago). (Morton and Matti, 2001; and Morton and Miller, 2006).

As noted above, although Holocene (less than 11,700 years ago) deposits can contain remains of plants and animals, only those from the middle to early Holocene (4,200 to 11,700 years ago) are considered scientifically important (SVP, 2010), and fossils from this time interval are not very common. The Holocene deposits overlie older, Pleistocene deposits, which have produced scientifically important fossils from elsewhere in Southern California (Jefferson 1991a, 1991b; Miller, 1971; Reynolds and Reynolds, 1991; Springer et al., 2009). There is a potential to begin encountering fossils in the older sediments within or beneath each unit beginning approximately 10 ft below the ground surface. Any vertebrate, invertebrate, and plant fossils recovered would be considered scientifically significant because they would add to our understanding of the environment of this area over the last 126,000 years and the evolution of the animals and plants that lived here. Therefore, these deposits are assigned a low paleontological sensitivity above a depth of 10 ft and a high sensitivity below that mark.

6.5.5 Old Alluvial Fan Deposits (Qof)

The Old Alluvial Fan Deposits formed during the late to middle Pleistocene and range in age from approximately 11,700 to 781,000 years ago (Morton and Matti, 2001; Morton and Miller, 2006). These deposits span the latest two NALMAs: the Rancholabrean (11,700 to 240,000 years ago) and the Irvingtonian (240,000 year ago to 1.8 Ma) (Bell et al., 2004; Sanders et al., 2009). Fossils are known in similar Rancholabrean and Irvingtonian deposits from excavations for roads, housing developments, and quarries, as well as scientific investigations in Southern California (Jefferson 1991a, 1991b; Miller, 1971; Pajak et al., 1996; Reynolds and Reynolds, 1991; Springer et al., 2009). These fossils include mammoths, mastodons, horses, bison, camels, saber-toothed cats, coyotes, deer, and sloths, as well as smaller animals like rodents, rabbits, birds, reptiles, and fish. Any vertebrate, invertebrate, and plant fossils recovered from these deposits would be considered scientifically significant because they would add to our understanding of the environment of this area during the Pleistocene and the evolution of the animals and plants that lived here. As such, these deposits are considered to have high paleontological sensitivity.

6.5.6 Very Old Alluvial Channel Deposits (Qvof)

The Very Old Alluvial Fan Deposits were deposited during the middle to early Pleistocene and range in age from 126,000 years ago to 2.588 Ma (Morton and Matti, 2001; Morton and Miller, 2006). These deposits formed during an interval that spans three NALMAs: the Rancholabrean (11,000 to 240,000 years ago), the Irvingtonian (240,000 years ago to 1.8 Ma) and the Blancan (1.8 to 4.75 Ma) (Bell, 2004; Sanders et al., 2009). Fossils are known in similar Rancholabrean, Irvingtonian, and Blancan deposits from excavations for roads, housing developments, and quarries, as well as scientific investigations within the Southern California area (Bell et al., 2004; Jefferson 1991a, 1991b; Miller, 1971; Pajak et al., 1996). These fossils include mammoths, mastodons, horses,

camels, saber-toothed cats, coyotes, deer, peccaries, and sloths, as well as smaller animals such as rodents, rabbits, birds, reptiles, and fish. As such, these deposits are considered to have high paleontological sensitivity.

6.5.7 San Timoteo Formation, Middle Member, Unnamed Subunit (Tstd)

A variety of scientifically significant vertebrate remains have been recovered from the San Timoteo Formation in the San Timoteo Badlands. Most of these fossils have come from the younger, Pleistocene-age beds within this formation, which Morton and Matti (2001) refer to as the upper member. The best known of these fossils belong to the El Casco Local Fauna, an assemblage containing various species of mouse, horse, tapir, deer, sloth, muskrat, porcupine, and wolf that was collected approximately 2.5 mi north of the project area (Albright, 1999). More recent excavation in slightly older deposits in the upper member of this formation for the SCE El Casco Substation approximately 3 mi east of the project area yielded additional fossil material, including a wide range of plant, insect, mollusk, fish, amphibian, lizard, snake, and bird species, as well as small and large mammal taxa (Reynolds et al., 2012).

Albright (1999) collected a wide range of mammal fossils, including mouse, shrew, wood rat, kangaroo rat, porcupine, rabbit, and horse, from deposits of the San Timoteo Formation that range stratigraphically between the beds containing the El Casco Local Fauna and the base of the formation. These collections were made from multiple localities within 4 mi of the project area to the north and east (Albright, 1999). Among these collections, some of the fossils from the older beds have been dated to 3.0 to 3.8 Ma, and these older beds, which Albright (1999) called Unit 3, may be equivalent to the middle member of the San Timoteo Formation as defined by Morton and Matti (2001).

Any fossils recovered from the unnamed subunit of the middle member of the San Timoteo Formation within the project area would be very useful for resolving stratigraphic issues within the formation, as well as for biostratigraphic correlation throughout the region and North America. In addition, any fossils they produced would add to our understanding not only of the animals and plants that lived here, but also of the changes in the environment, climate, flora, and fauna of this area through the Pliocene. As such, the deposits of the unnamed subunit of the middle member of the San Timoteo Formation within the project area are assigned a high paleontological sensitivity rating.

7.0 RECOMMENDATIONS

7.1 RECOMMENDATIONS

Based on the results of this study and consideration of the development methods of the project, no special paleontological situations that would require project redesign to avoid critical fossil localities or deposits are anticipated for this project. However, the project area contains deposits with high paleontological sensitivity that would be impacted by project activities. As such, development of the Build Alternatives has the potential to impact scientifically significant, nonrenewable paleontological resources and preparation of a Paleontological Mitigation Plan (PMP) is recommended if either one of the Build Alternatives is selected. The PMP shall be developed concurrently with the final design plans and shall follow the Caltrans guidelines in the SER Environmental Handbook, Volume 1, Chapter 8 (Caltrans, 2017), as well as guidelines from the SVP. Following these guidelines, the PMP shall be prepared by a qualified paleontologist and shall include the following elements:

1. Required 1-hour preconstruction paleontological sensitivity training for earthmoving personnel,
2. A signed repository agreement,
3. Field and laboratory methods proposed (must be consistent with repository requirements),
4. All elements included in the PMP format (Caltrans, 2017), and
5. A required Paleontological Mitigation Report upon completion of project earthmoving.

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APPENDIX A

FOSSIL LOCALITY SEARCH RESULTS FROM THE SAN BERNARDINO COUNTY MUSEUM

CONFIDENTIAL
Removed for Distribution

APPENDIX B

RÉSUMÉ

SARAH RIEBOLDT, PH.D.

ASSOCIATE / SENIOR PALEONTOLOGIST

EXPERTISE

Paleontological Mitigation Reports

Paleontological Resource Monitoring

Fossil Collection, Salvage, Identification, and Curation

Federal, State, and Local Laws, Ordinances, Regulations, and Standards (LORS) Regarding Paleontological Resources

EDUCATION

University of California, Berkeley, Ph.D., Paleontology, 2005.

University of Colorado, Boulder, Magna cum Laude B.A., Biology, Minor in Geology, 1999.

PROFESSIONAL EXPERIENCE

Paleontologist, LSA, Irvine, California, April 2013–Present.

Project Manager, Department of Geological Sciences, California State University, Fullerton, and John D. Cooper Archaeological and Paleontological Center, Santa Ana, California, April 2012–April 2013.

Geologist, Geological Survey of Alabama, Tuscaloosa, Alabama, April 2010–February 2012.

Collections Assistant, Field Museum of Natural History, Chicago, Illinois, February 2009–February 2010.

PROFESSIONAL RESPONSIBILITIES

Dr. Rieboldt is an Associate and Senior Paleontologist at LSA with 18 years of experience in the paleontology and geology fields. She has conducted paleontological and geological fieldwork in California, Nevada, Utah, Wyoming, Colorado, Texas, and Alabama and has 8 years of experience working with natural history collections in several museums (the Field Museum of Natural History, the University of California Museum of Paleontology, and the University of Colorado Museum of Natural History). She has worked as a geologist and paleontological consultant on many different projects, including carbon sequestration and astrobiology research programs funded by the United States Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA), respectively, as well as on projects for the State of California Department of Parks and Recreation, Caltrans, and various private developers in California, Nevada, and Utah. She also has experience in monitoring the excavation and construction process on residential developments and a natural gas pipeline, as well as monitoring drilling and coring operations.

Dr. Rieboldt oversees the paleontological resources program at LSA and prepares and reviews paleontological assessment reports, mitigation plans, and monitoring reports. She provides guidance on the various federal, State, and local regulations and guidelines regarding paleontological resources as they apply to projects throughout the state. She also is responsible for scheduling paleontological monitors on both large- and small-scale projects.

PROJECT EXPERIENCE

State Route 120 at Union Road Interchange Project
Manteca, California

LSA conducted environmental technical studies for the State Route 120 (SR 120) at Union Road Interchange Project in Manteca in San Joaquin County. The California Department of Transportation (Caltrans) proposed this project to improve the functionality of the interchange by modifying the existing overcrossings and ramps, constructing auxiliary lanes, and installing signals for the interchange. Dr. Rieboldt analyzed the potential for the No Build Alternative and two Build Alternatives to impact paleontological resources in the Paleontological Identification Report (PIR) for this project.

Tegner Road Bridge Replacement at Turlock Irrigation District Lateral #5 Canal BRLO-5938(196) Project
Stanislaus County, California

LSA prepared an Initial Study and Mitigated Negative Declaration for the Tegner Road Bridge Replacement at Turlock Irrigation District Lateral #5 Canal BRLO-5938(196) Project in Stanislaus County. The proposed project involves the replacement of the bridge and improvements to the road approaches on Tegner Road and Harding Road. Dr. Rieboldt analyzed the potential for the project to impact paleontological resources and summarized the results of the analysis in a paleontological resources technical memorandum, as well as in the appropriate section of the environmental document.

PROFESSIONAL EXPERIENCE (CONTINUED)

Science Writer, University of California Museum of Paleontology, Berkeley, California, April 2009–November 2009.

Collections Assistant, Chicago Academy of Sciences, Chicago, Illinois, October 2008–February 2009.

Postdoctoral Research Associate, Center for Integrative Planetary Science, University of California, Berkeley, May 2005–December 2005.

Paleontological Consultant, Ric Windmiller Consulting, Auburn, California, June 2000–June 2005.

Graduate Student Researcher, Department of Integrative Biology, University of California, Berkeley, January 2004–December 2004.

Science Writer, University of California Museum of Paleontology, Berkeley, California, June 2003–December 2003.

Paleontological Consultant, California Department of Parks and Recreation, San Francisco, California, and University of California Museum of Paleontology, Berkeley, California, June 2001–December 2002.

Graduate Student Researcher, University of California Museum of Paleontology, Berkeley, California, August 2002–December 2002.

Paleontological Consultant, ECORP Consulting, Inc., Roseville, California, June 2002.

Paleontological Consultant, Jones & Stokes Associates, Sacramento, California, August 2001–January 2002.

PROJECT EXPERIENCE (CONTINUED)

North County Corridor New State Route 108 Project
Stanislaus County, California

LSA conducted environmental technical studies for the North County Corridor New State Route 108 (SR-108) Project in Stanislaus County. The proposed project involves relocating the current alignment of SR-108 in order to reduce congestion, improve traffic flow, and accommodate forecasted traffic demands in the northern part of Stanislaus County. LSA prepared the Paleontological Identification Report/Paleontological Evaluation Report and at the request of Caltrans, Dr. Rieboldt prepared a preliminary Paleontological Mitigation Plan (PMP) for this project.

SR-120/McKinley Avenue Interchange Project
Manteca, California

LSA is conducting environmental technical studies for the State Route 120 (SR-120)/McKinley Avenue Interchange Project in Manteca in San Joaquin County. The project involves the construction of a new interchange at SR-120 and McKinley Avenue in order to reduce congestion, improve traffic flow, and accommodate forecasted traffic demands in and around the City of Manteca. Dr. Rieboldt assisted in the preparation of the Paleontological Identification Report/Paleontological Evaluation Report and prepared the PMP for this project.

Digital 395 Project
San Bernardino, Kern, Inyo, and Mono Counties, California; Douglas and Washoe Counties and Carson City, Nevada

Dr. Rieboldt prepared the Paleontological Resources Monitoring and Mitigation Plan for the Digital 395 Project, which involved the installation of over 590 miles of fiber-optic line along United States Highway 395 on the east side of the Sierra Nevada. Running from Barstow, California, to Reno, Nevada, the project route passed through lands managed by the United States Department of the Interior, Bureau of Land Management; the United States Department of Agriculture, Forest Service; the United States Department of Defense; the States of California and Nevada; and the lands of several Native American tribes. As such, this project was subject to multiple federal, State, and local regulations and policies regarding paleontological resources.

State Route 99/120 Interchange Connector Project
Manteca, California

LSA prepared the environmental document and conducted environmental technical studies for the State Route 99/120 Interchange Connector Project in Manteca in San Joaquin County. Caltrans District 10, in cooperation with the San Joaquin Council of Governments proposed reconstructing the existing interchange in order to reduce congestion, improve operations, and accommodate forecasted traffic demands in and around the City of Manteca. Dr. Rieboldt prepared the Paleontological Identification Report/Paleontological Evaluation Report (PIR/PER) for this project.

PROFESSIONAL EXPERIENCE (CONTINUED)

Collections Assistant, University of California Museum of Paleontology, Berkeley, California, August 1999–December 1999.

Collections Assistant, University of Colorado Museum of Natural History, Boulder, Colorado, September 1997–May 1999.

TEACHING

Science Specialist, San Roque School, Santa Barbara, California, January 2006–June 2008.

Graduate Student Instructor, Department of Integrative Biology, University of California, Berkeley, August 2000–December 2000, January 2001–May 2001, and January 2003–May 2003.

AFFILIATIONS

Society of Vertebrate Paleontology

Geological Society of America

PROJECT EXPERIENCE (CONTINUED)

Interstate 5/Sperry Road Interchange Project
Patterson, California

LSA prepared the environmental document and conducted environmental technical studies for the Interstate 5/Sperry Road Interchange Project in Patterson, Stanislaus County. Caltrans, in conjunction with Stanislaus County and the City of Patterson proposed this project to improve operations, enhance safety, and increase capacity of the interchange. For this project, a No Build Alternative and two Build Alternatives, each with a variant, were evaluated. Dr. Rieboldt prepared the PIR/PER to determine the potential for this project to impact paleontological resources and make recommendations regarding mitigation of those impacts.

Mitsubishi Plant Expansion Project
Sacramento, California

Dr. Rieboldt prepared the Paleontological Resources Assessment for Mitsubishi Plant Expansion Project in Sacramento. This project included expanding the existing plant and constructing a new office building, all of which involved excavation into the late to middle Pleistocene Riverbank Formation, which is sensitive for paleontological resources. The paleontological assessment evaluated impacts to resources and made mitigation recommendations.

Rock Island and Hyla Pipe Vaults Project
San Luis Obispo County, California

LSA conducted paleontological resources monitoring for the Rock Island and Hyla Pipe Vaults Project in unincorporated San Luis Obispo County. This project involved installation of two buried concrete pipe vault crossings on the Arroyo Grande Oil Field operated by Freeport McMoran Oil and Gas. Dr. Rieboldt oversaw this project from beginning to end, preparing the Paleontological Resources Impact Mitigation Program, scheduling and supervising the paleontological monitoring, and preparing the final Paleontological Resources Mitigation Monitoring Report.

Newhall Ranch Road Bridge Widening Project
Santa Clarita, Los Angeles County, California

Dr. Rieboldt prepared the Paleontological Resources Assessment for the Newhall Ranch Road Bridge Widening Project, located in Santa Clarita, California. This project addressed existing and projected mobility and circulation deficiencies within the City and included widening the existing Newhall Ranch Road Bridge over Francisquito Creek and conducting associated transportation improvements. Through background research, a literature review, and fossil locality search, this assessment evaluated the potential for the project to impact paleontological resources and developed mitigation measures to minimize those impacts.

PROJECT EXPERIENCE (CONTINUED)

Railroad Avenue Multi-Use Trail Project
Santa Clarita, Los Angeles County, California

Dr. Rieboldt prepared the paleontological analysis for the Railroad Avenue Multi-Use Trail Project in Santa Clarita in Los Angeles County. This project proposed the construction of a 1.5-mile mixed-use pathway for pedestrians and bicycles along the east side of Railroad Avenue from Oak Ridge Drive to Lyons Avenue. Based on the results of a fossil locality search through the Natural History Museum of Los Angeles County and a review of geologic maps and relevant geological and paleontological literature, this analysis recommended the appropriate level of assessment that would be necessary for environmental compliance.

Weddington Street Project
Los Angeles, California

Dr. Rieboldt prepared the Paleontological Analysis Memorandum for the 15353–15385 Weddington Street Project, which involved the demolition of the existing three-story apartment building and construction of a new five-story condominium complex with subterranean parking. The paleontological analysis documented the location and nature of paleontologically sensitive sediments and made recommendations to ensure project development did not adversely affect those resources.

Haven and Fourth Street Hotels and Restaurant Project
Rancho Cucamonga, California

LSA is currently in the process of preparing technical analyses for the Haven and Fourth Street Hotels and Restaurant Project in the City of Rancho Cucamonga. The proposed project includes the development of two five-story 115-room hotels and an approximately 6,000 square foot restaurant on a 7.18-acre site. Dr. Rieboldt prepared the Paleontological Resources Report.

La Pata Avenue 1.8-Mile Gap Closure and Camino del Rio Extension Project
San Juan Capistrano, California

This project was a massive undertaking to extend La Pata Avenue and Camino del Rio in the City of San Juan Capistrano, Orange County, and involved the removal of 14.8 million cubic yards of earth material. Dr. Rieboldt oversaw the paleontological monitoring program conducted by LSA for this project. She also made preliminary identifications of fossils recovered from the project and will prepare the final paleontological monitoring report at the conclusion of the monitoring program.

SR-710 North Study
Los Angeles County, California

LSA is leading an environmental team to prepare an EIR/EIS for the State Route 710 North Study, which spans 23 cities and communities in Los Angeles County. This project, under the direction of Caltrans in cooperation with the Los Angeles Metropolitan Transportation Authority, proposes to improve mobility and relieve congestion between State Route 2 and Interstates 5, 10, 210, and 605 in east/northeast Los Angeles and the San Gabriel Valley. Development of this project involves four alternatives: Freeway Tunnel, Light Rail, Bus Rapid Transit, and Transportation System Management/Transportation Demand Management for which Dr. Rieboldt wrote the Paleontological Identification Report/Paleontological Evaluation Report and addressed public comments on the EIR/EIS.

NBCUniversal Studios G Lot Project
Universal City, Los Angeles County, California

Dr. Rieboldt prepared the Paleontological Resources Monitoring Plan (PRMP) and the Final Mitigation Monitoring Report for the NBCUniversal G Lot Project. For the PRMP, Dr. Rieboldt reviewed the area geology, the applicable City and County mitigation requirements, and the project development plans in order to create an appropriate plan for monitoring excavation activities. This project involved substantial excavation into the middle Miocene

PROJECT EXPERIENCE (CONTINUED)

(15.97 to 11.62 million years ago) Topanga Group and produced dozens of specimens of fossil leaves and bony fish, as well as a few whale specimens. As part of the mitigation monitoring report, Dr. Rieboldt documented project compliance with the applicable requirements and identified and described the fossils recovered. She also coordinated the curation of the recovered fossils into the Natural History Museum of Los Angeles County.

NBCUniversal Studios Universal Hollywood Drive Project
Universal City and Los Angeles, Los Angeles County, California

Dr. Rieboldt prepared the Paleontological Resources Monitoring Plan (PRMP) for the NBCUniversal Studios Universal Hollywood Drive Project, located in the City of Los Angeles and Universal City, which is in unincorporated Los Angeles County. This project involved improving and widening of Universal Hollywood Drive and included excavation into Holocene to Late Pleistocene (less than 126,000 years ago) Young Alluvial Deposits and Middle Miocene (15.97 to 11.62 million years ago) Topanga Group. The PRMP outlined the best practices for paleontological monitoring.

Foothill Parkway Westerly Extension Project
City of Corona and Unincorporated Riverside County, California

The Foothill Parkway Westerly Extension Project, located in the City of Corona and unincorporated Riverside County, involved construction of approximately 2 miles of roadway with associated structures and connector road improvements to accommodate existing and future traffic demands in that area. The project included excavation into paleontologically sensitive deposits of Holocene to Pleistocene Alluvial Deposits, the Paleocene Silverado Formation, and the Late Cretaceous Williams and Ladd Formations. Dr. Rieboldt prepared the Paleontological Resources Impact Mitigation Plan for this project, which outlined best practices for paleontological monitoring during project excavation, as well as procedures for preparing, curating, and documenting any recovered fossils.

Pio Pico Energy Center Project
San Diego County, California

Dr. Rieboldt prepared the Paleontological Resources Monitoring and Mitigation Plan for the Pio Pico Energy Center Project. This project involved the construction of a power plant for three General Electric natural gas-fired combustion turbine generators in an unincorporated area on Otay Mesa in San Diego County. Development of this project will include clearing and grading of the project area, construction of the power plant, and installation of the power plant as well as natural gas lines and electricity transmission lines, all within paleontologically sensitive sediments of the Late Oligocene (23.03–28.1 million years ago) Otay Formation. The Paleontological Resources Monitoring and Mitigation Plan followed all applicable State, County, and California Energy Commission requirements and guidelines.

Vernola Marketplace Apartments Project: Phases A and B
Jurupa Valley, California

Dr. Rieboldt prepared the Paleontological Resources Assessment for Phases A and B of the Vernola Marketplace Apartments Project in the City of Jurupa Valley in Riverside County. This project involves the development of 597 multifamily residential units on approximately 25.7 acres of land near the intersection of Interstate 15 and 68th Street. It includes excavation into Holocene through Early Pleistocene deposits, some of which are sensitive for paleontological resources. The paleontological assessment documented the location and nature of the sensitive sediments and made recommendations to ensure project development does not adversely impact those resources.

SR-60/Theodore Street Interchange Project
Moreno Valley, California

LSA is conducting environmental technical studies for air quality and biological, cultural, and paleontological resources for the State Route 60 (SR-60)/ Theodore Street Interchange Project in the City of Moreno Valley in

PROJECT EXPERIENCE (CONTINUED)

Riverside County. The proposed project involves reconstruction of the local interchange at SR-60 and Theodore Street in order to reduce congestion, improve traffic flow, and accommodate forecasted traffic demands in and around Moreno Valley. Project development includes removal and replacement of the Theodore Street bridge over SR-60, auxiliary lanes along SR-60, and new entrance and exit ramps from SR-60 to Theodore Street. Dr. Rieboldt prepared the Paleontological Identification Report/Paleontological Evaluation Report for this project.

San Onofre Nuclear Generating Station Project
San Diego County, California

As part of an on-call contract with SCE, Dr. Rieboldt prepared the Paleontological Resources Assessment for the San Onofre Nuclear Generating Station (SONGS) Project, located on the Camp Pendleton Marine Corps Base in San Diego County. This assessment provided a review of the 17 geologic units within the surrounding SONGS facilities and their paleontological sensitivity ratings. Based on the paleontological sensitivities of these 17 geologic units and potential construction methods, the assessment also provided recommendations for mitigating impacts to paleontological resources that may be encountered during development of any future projects at the SONGS facilities.

Central Region Landfills – Frank R. Bowerman Landfill Wetlands Basin, Phase VIIIC, and East Flank Landslide Projects
Orange County, California

Dr. Rieboldt prepared the Final Paleontological Mitigation Monitoring Report for the Wetlands Basin, Phase VIIIC, and East Flank Landslide Projects. To date, LSA has collected over 100 fossil specimens from these combined projects, and the recovery of these specimens was completed without delay to the project schedule. The most notable specimens collected included several early Miocene (18–20 million years before present) whale fossils and leaves and molluscs from the Cretaceous (72–83 million years before present). As part of the mitigation monitoring report, Dr. Rieboldt documented project compliance with the applicable State and County requirements for paleontological resources. She also identified and described the scientific significance of the fossils recovered.

Newport Coastal Coverage Solution Project
Crystal Cove State Park
Orange County, California

The Newport Coastal Coverage Solution Project, located in Crystal Cove State Park in Orange County, involved installation of a building for communications equipment with associated access roads to improve safety communications in that area. The project included excavation into paleontologically sensitive deposits of the Middle Miocene Topanga Group and possibly Middle to Late Miocene Monterey Formation. Because this project was within the boundaries of a State Park, Dr. Rieboldt obtained the required permit for paleontological field work on State lands and prepared the Paleontological Resources Impact Mitigation Plan, which outlined best practices for paleontological monitoring during project excavation, as well as procedures for preparing, curating, and documenting any recovered fossils.

Hidden Canyon Project
Orange County, California

Dr. Rieboldt prepared the Paleontological Mitigation Monitoring Report for the Hidden Canyon Project. LSA collected specimens of sharks, rays, whales, and mollusks from the Early Miocene to Early Oligocene (15.97–33.9 Ma) Vaqueros Formation. As part of the mitigation monitoring report, Dr. Rieboldt documented project compliance with the applicable State and City of Irvine requirements for paleontological resources. She also identified and described the fossils recovered.

PROJECT EXPERIENCE (CONTINUED)

Aldi Distribution Center Project
Moreno Valley, Riverside County, California

Dr. Rieboldt prepared the Final Paleontological Mitigation Monitoring Report for the Aldi Distribution Center Project in Moreno Valley in Riverside County. This project involved excavation into paleontologically sensitive Late Pleistocene deposits and produced specimens of horse (*Equus*), camel (*Hemiauchenia*) and giant ground sloth (*Megalonyx jeffersonii or Nothrotheriops shastensis*). For the final report, Dr. Rieboldt identified and described the recovered material and documented project compliance with the applicable State, City, and project-specific requirements for paleontological resources.

City of Menifee On-Call Cultural Resources Studies Peer Review Projects
Menifee, California

LSA is under contract with the City of Menifee in Riverside County to provide on-call peer review of cultural and paleontological resources documents prepared for project compliance with applicable federal, State, City, and project-specific requirements and guidelines for cultural and paleontological resources. These documents may include field survey reports, assessments, mitigation monitoring programs, and final mitigation reports. Dr. Rieboldt is conducting the peer review of all paleontological documents under this contract.

Ball Road Sanitary Sewer and Storm Drain Improvements Project
Anaheim, California

Dr. Rieboldt prepared the Paleontological Analysis Memorandum for the Ball Road Sanitary Sewer and Storm Drain Improvements Project in the City of Anaheim in Orange County. This project involved the replacement and upgrade of the sewer and storm drain facilities along Ball Road and into Carbon Creek, demolishing an abandoned railroad bridge. It includes excavation into Holocene to Late Pleistocene deposits, some of which were sensitive for paleontological resources. The paleontological analysis documented the location and nature of the sensitive sediments and made recommendations to ensure project development did not adversely impact those resources.

Howland's Landing Well Project
Santa Catalina Island, California

As part of an on-call contract with SCE, Dr. Rieboldt prepared the Paleontological Resources Assessment for the Howland's Landing Well Project on Santa Catalina Island in Los Angeles County. This emergency project involved drilling exploration wells to determine where fresh water could be reached and then drilling, constructing, and testing the final well, which would provide fresh water for the Howland's Landing area. The project included excavation into Holocene to Late Pleistocene deposits and metamorphic rocks of the Late Cretaceous Catalina Schist, a part of the Franciscan Formation. Although Pleistocene sediments could have been present at depth and had the potential to contain scientifically important fossils, the excavation methods used for this project precluded the recovery of paleontological resources. The paleontological assessment documented the location and nature of the sensitive sediments and, based on the excavation methods, recommended that no paleontological mitigation was required for the project.

Sesi Property Landfill Closure Project
San Diego, California

Dr. Rieboldt prepared the Paleontological Mitigation Monitoring Report for the Sesi Property Landfill Closure Project. This project involved constructing a monolithic landfill cover with surface drainage facilities and other improvements for closure of landfilled auto-shredder waste on the Sesi property in the City of San Diego, San Diego County. Development of this project involved excavation into the paleontologically sensitive Otay and Lindavista Formations and therefore, required full-time monitoring during ground-disturbing activities in native deposits.

PROJECT EXPERIENCE (CONTINUED)

Morse Street Townhomes Project
Oceanside, California

Dr. Rieboldt prepared the Paleontological Assessment for the Morse Street Townhomes Project. This project involved the development of 38 townhomes on a 2.3-acre parcel of land near the intersection of Morse Street and the Pacific Coast Highway in the City of Oceanside in San Diego County. Development of this project included clearing and grading to prepare the project area, construction of the various buildings, and the installation of utilities.

Stratford Ranch Residential Project
Perris, California

Dr. Rieboldt prepared the Paleontological Resources Assessment for the Stratford Ranch Residential Project in the City of Perris in Riverside County. The project included a new residential community with 400 lots and a 15-acre Stockpile Plan on approximately 80 acres in northeastern Perris. Project development involved clearing and grading to prepare the project area, construction of a new road within the area, and installation of on-site storm drains, new water service, new sewer lines, new electric service, new natural gas lines, and a new telecommunication infrastructure system to serve the planned residential uses.

34202 Del Obispo Street Project
Dana Point, California

LSA conducted environmental technical studies for the 34202 Del Obispo Street Project in the City of Dana Point in Orange County. This mixed-use project involves the development of a residential community, commercial space, and a small amount of parkland/open space. Dr. Rieboldt prepared the Paleontological Resources Assessment for this project.

Spieker Continuing Care Retirement Community Project
San Juan Capistrano, California

Dr. Rieboldt prepared the Paleontological Resources Assessment as one of several environmental technical studies LSA conducted for the Spieker Continuing Care Retirement Community Project in the City of San Juan Capistrano in Orange County. This project involved the development of a Continuing Care Retirement Community designed for residents over the age of 60 years and included the construction of independent living residences, community buildings, and a health care center.

Kaiser Bellflower East Center Demolition Project
Los Angeles County, California

The proposed project involves demolition of the existing Administration Building and East Center Wing of the Kaiser Bellflower Medical Center and remodeling of the exterior and lobby of the West Wing of the Medical Center. Excavation activities associated with this project are anticipated to reach 15–20 feet below ground surface. Dr. Rieboldt wrote the Paleontological Resources Memorandum and the Paleontological Resources Impact Mitigation Program for this project.

Vancouver Street Sewer Extension Project
Carlsbad, California

Dr. Rieboldt prepared the Paleontological Resources Monitoring and Mitigation Plan for the Vancouver Street Sewer Extension Project. This project involved the extension of an existing sewer line from Vancouver Street to Via de Canto through Hidden Canyon Community Park in the City of Carlsbad in San Diego County. Development of this project included traditional excavation, as well as horizontal directional drilling, for the installation of the sewer line segments.

PROJECT EXPERIENCE (CONTINUED)

Durfee Avenue Grade Separation Project
Pico Rivera, California

LSA conducted environmental technical studies for the Durfee Avenue Grade Separation Project in the City of Pico Rivera in Los Angeles County. The project proposed to lower Durfee Avenue below the Union Pacific Railroad (UPRR) tracks to improve safety for vehicular, rail, and pedestrian traffic along Durfee Avenue and nearby streets and the railroad right-of-way. Project development included lowering Durfee Avenue, Walnut Avenue, and Stephens Street; raising the UPRR tracks; and relocating various wet and dry utilities. Following through on due diligence for the client, Dr. Rieboldt prepared the paleontological assessment for this project.

SR-94/SR-125 Interchange Branch Connector Project
San Diego County, California

LSA conducted cultural and paleontological resources assessments for the State Route 94/State Route 125 (SR-94/SR-125) Interchange Branch Connector Project in San Diego County. The project involved the construction of a freeway-to-freeway connector to allow direct south-to-east movement for the SR-94/SR-125 interchange in order to improve regional circulation and reduce traffic on local streets in the Cities of La Mesa and Lemon Grove, and in the unincorporated community of Spring Valley. Project development included construction of a freeway connector between southbound SR-125 and eastbound SR-94, auxiliary lanes on those freeways, and new noise barriers and retaining walls, as well as modifications to existing structures. Dr. Rieboldt prepared the Paleontological Identification Report/Paleontological Evaluation Report for this project.

Surfside Inn Pedestrian Overcrossing Project
Dana Point, California

LSA conducted cultural and paleontological resources assessments for the Surfside Inn Pedestrian Overcrossing Project in the City of Dana Point in Orange County. The project involved replacement and rehabilitation of the pedestrian overcrossing across the Pacific Coast Highway and Metrolink right-of-way from the Capistrano Surfside Inn to Doheny State Beach. Dr. Rieboldt prepared the paleontological resources assessment.

Adelanto Solar Project
San Bernardino County, California

Dr. Rieboldt prepared a paleontological resources analysis report for the Adelanto Solar Project in San Bernardino County. This report included a summary of the geology and potential paleontological resources of the project area, results from a paleontological locality search through the San Bernardino County Museum, and recommendations for mitigating potential impacts to paleontological resources.

North Star Solar Project
Fresno, California

LSA conducted a paleontological resources assessment for the proposed North Star Solar Switching Station and Generation Tie Line (Gen Tie) Project in Fresno County. The purpose of this project is to generate and transmit renewable solar electricity from proven technology at a competitive cost, with low environmental impact, and deliver it to market as soon as possible. The project consists of an approximately 1.5 mile-long gen tie line that will tie into a new 115-kilovolt switching station, an expansion of the existing PG&E Mendota substation. Project construction work will involve location preparation, foundation installation, power pole placement, generation line installation, and erection and connection of the gen tie line and switching station equipment. Dr. Rieboldt prepared the Paleontological Resources Assessment for this project.

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2011 Oxygen-isotope trends and seawater temperature changes across the Late Cambrian Steptoean positive isotope excursion (SPICE event). Geology 39(10): 987-990.

Lipps, J.H., and S.E. Rieboldt
2005 Habitats and taphonomy of life on Europa. Icarus 177:515-527.

Parham, J.F., and S.E. Rieboldt
2005 *Contia tenuis* (Sharp-tailed snake): Reproduction. Natural History Note. Herpetological Review 36(4):456.

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Mount Diablo State Park Paleontological Resources Inventory and Management Recommendations. Prepared for the State of California Department of Parks and Recreation, Bay Area District. December 2002.

Paleontological Resources Assessment for Bayside Covenant Church, Sierra College Boulevard and Cavitt-Stallman Road, City of Roseville, Placer County, California. Prepared for Bayside Covenant Church. June 2002.

Paleontological Resources Assessment for the Riverbend Park Project, Lompoc, California. Prepared for the City of Lompoc. January 2002.

Recommendations for Compliance with Regulatory Requirements and Mitigation Measures for Paleontological Resources for the Mountain Park Community Development Project. Prepared for the Irvine Company. November 2001.

Paleontological Resources Assessment and Mitigation Measures for the Sacramento Regional County Sanitation District 17-Mile Interceptor Project, Sacramento and Yolo Counties, California. (Co-authored with Jere Lipps, Ph.D.) Prepared for the Sacramento Regional County Sanitation District on behalf of Jones & Stokes Associates, Inc. October 2001.

Scope of Work for Paleontological Investigation Report/Paleontological Evaluation Report for I-680 Northbound Sunol Grade Project. Prepared for Caltrans and Alameda County Congestion Management Agency. August 2001.

PRESENTATIONS

RECS (Research Experience in Carbon Sequestration) Workshop, (Birmingham, Alabama). June 6, 2011.

Geological Society of America Annual Meeting, (Denver, Colorado), "Taphonomy of Jupiter's Icy Moon Europa." November 7–10, 2004.

Bioastronomy Meeting: Habitable Worlds, (Reykjavik, Iceland), "Life, Past and Present, on Jupiter's Icy Moon, Europa." July 12–16, 2004.

35th Lunar and Planetary Science Conference (Houston, Texas), "Geosciences at Jupiter's Icy Moons: The Midas Touch." March 16, 2004.

Seventh Field Conference of the International Subcommission on Cambrian Stratigraphy: The Cambrian System of South China, (Guiyang, China), "Cambrian Inarticulate Brachiopods from Nevada and Texas." August 2001.

PRESENTATIONS (CONTINUED)

Fourth International Brachiopod Congress (London, England), "Can Oxygen Isotopes from Inarticulate Brachiopods Resolve the Causes of Faunal Turnovers in the Cambrian?" July 10–14, 2000.

Geological Society of America Cordilleran Section Meeting, (Berkeley, California), "Inarticulate Brachiopods from the Pioche Formation (Lower and Middle Cambrian), Nevada and their Relation to the Extinction of the Olenellida." June 2–4, 1999.