North County Corridor New State Route 108

Paleontological Evaluation Report

Cities of Modesto, Riverbank, and Oakdale

Stanislaus County, California

California Department of Transportation District 10

EA 10-0S8000

10-STA-108

SR 108 [PM 27.5/44.5], SR 219 [PM 3.7/4.8], SR 120 [PM 6.9-11.6]

Project ID. 1000000263

June 2016

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Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

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Summary of Findings

The California Department of Transportation (Caltrans), in cooperation with the North County Corridor Transportation Expressway Authority (NCCTEA), proposes to construct the North County Corridor New State Route 108 (NCC) in northern Stanislaus County, California. The project proposes to relocate the current alignment of State Route 108 (SR-108) to a more southerly alignment.

The area studied for this project is the Area of Project Disturbance (APD). The APD encompasses the horizontal and vertical extent of anticipated ground-disturbing activities. A locality search consisting of a request of fossil data from the Natural History Museum of Los Angeles County, a review of on-line fossil literature pertinent to the sediments within the APD, and a review of prior paleontological studies for the NCC were conducted for the APD and a 1-mile buffer to assist with determining the paleontological sensitivity of geologic formations.

There are three mapped geologic formations within the APD where excavation may occur. These include the Modesto Formation, the Riverbank Formation, and the Turlock Lake Formation. In addition, although not mapped, it is likely that artificial fill exists in some areas, especially near existing roads, canals, or other development. It is also likely that Unnamed Holocene Deposits are present in the upper several feet of all areas of the APD. All of the sediments within the APD, with the exception of the Artificial Fill, have the potential to contain paleontological resources.

The California Environmental Quality Act and Caltrans guidelines require that impacts to nonrenewable paleontological resources must be considered during project implementation, consistent with the recommendations of the Society of Vertebrate Paleontology (SVP). This evaluation indicates that sediments dating from the Pleistocene within the APD have the potential to contain significant nonrenewable paleontological resources. Based on the likelihood that Holocene sediments shallowly overlay the Pleistocene sediments throughout the APD, excavation associated with this project has a low potential to encounter paleontological resources for excavation in native (non-artificial fill) in the upper 5 feet (ft); and that the potential increases to high once a depth of 5 ft is reached.

To reduce impacts to nonrenewable paleontological resources, recommendations are made for the development of a Paleontological Mitigation Plan (PMP) for those portions of the NCC that are identified as having a high paleontological sensitivity.

These high sensitive areas include all locations where excavation will extend deeper than 5 ft beneath the natural surface. The PMP shall be prepared in accordance with Caltrans Standard Environmental Reference format and include SVP guidelines regarding conformable mitigation for nonrenewable paleontological resources. The PMP shall be implemented by a qualified paleontologist and shall include (but not be limited to) recommendations for worker awareness training, monitoring, screening, identification, curation, and reporting. Implementation of these recommendations will reduce impacts to nonrenewable paleontological resources. More project-specific measures may need to be developed during preparation of the PMP to refine these measures during final project design.

Table of Contents

List of Figures

List of Tables

Chapter 1 Introduction

1.1 Project Description

The California Department of Transportation (Caltrans) in cooperation with the North County Corridor Transportation Expressway Authority, proposes to construct the North County Corridor New State Route 108 (NCC) in northern Stanislaus County, California. The project would relocate the existing State Route 108 (SR-108), which currently runs through the Cities of Riverbank and Oakdale to the south, and would increase roadway capacity to accommodate existing and future traffic volumes.

The proposed project is located in Caltrans District 10 within portions of the Oakdale, Riverbank, and Modesto communities, Stanislaus County, California (see Figures 1 and 2). The North County Corridor New SR-108 Project will connect SR-219 near Modesto, CA to SR-120 near Oakdale, CA. The proposed project consists of four Build Alternatives (1A, 1B, 2A, and 2B) and the No-Build Alternative (see Figure 3).

The western terminus of all alternatives is at the SR-219 (Kiernan Avenue)/Tully Road intersection. The alternatives proceed to the vicinity of the Claus Road/Claribel Road intersection, where Segment 2 begins and the alternatives separate into two different alignments (A and B). In Segment 2, Alternatives 1A and 1B veer northeast near the Claus Road/Claribel Road intersection and pass through the southern boundary of Oakdale, and Alternatives 2A and 2B continue easterly along Claribel Road and turn northeastward past the intersection of Claribel Road/Bentley Road. Each of the alternatives then breaks into two possible alignments to their eastern terminus in Segment 3, just past the Oakdale-Waterford Highway. The eastern terminus of Alternatives 1A and 2A end along SR-108/120 just east of the City of Oakdale boundary. Alternatives 1B and 2B end farther east of the Alternatives 1A and 2A terminus, along SR-108/120 in the vicinity of Lancaster Road.

The proposed project improvements include:

- At grade intersection improvements;
- Grade separation structures at major roadway and railway crossings;
- Structures at various waterway crossings, such as the Hetch Hetchy Aqueduct, Modesto Irrigation District (MID) and Oakdale Irrigation District (OID) canals; and,

- County roadway improvements at various intersections.

The four alternatives would consist of two to three 12-foot-wide through lanes with 5-foot to 10-foot-wide left and right shoulders in each direction. The east-bound and west-bound alignments would be separated by a 46 to 70-foot-wide median, including the 5-foot to 19-foot-wide shoulders and 26-foot to 60-foot-wide graded, unpaved median area. Drainage swales would be located along either side of the new roadway.

As the proposed roadway would function as a freeway/expressway with controlled access, new and realigned local access roads are needed to provide continued access to existing properties. This would involve construction of a discontinuous local roadway system which would provide a 12-foot-wide through lane and a 8-foot-wide shoulder, in each direction. Up to a 12-foot-wide area would be provided between the right-of-way limit and the edge of pavement to allow for drainage ditches. Where required, turn lanes would provide connections to cross roads. Each of the four build alternatives includes these proposed local access roads which are delineated on Figure 3.

Elevated roadways, separated grade crossings, single point urban interchanges, signalized intersections, and roundabouts would be needed for each of the four alternatives. A Class 2 bike lane would also be constructed within the road shoulder from Claus Road to the eastern terminus at State-Route 108/120.

Various utilities exist throughout the project area that would need to be relocated. These include electric, telephone, water, sewer, and irrigation lines. At the time of this report, the exact locations to which the impacted utilities would be relocated is unknown, but relocation would take place within the currently defined project area.

Permanent right-of-way and temporary construction easements would also be required for the proposed project.

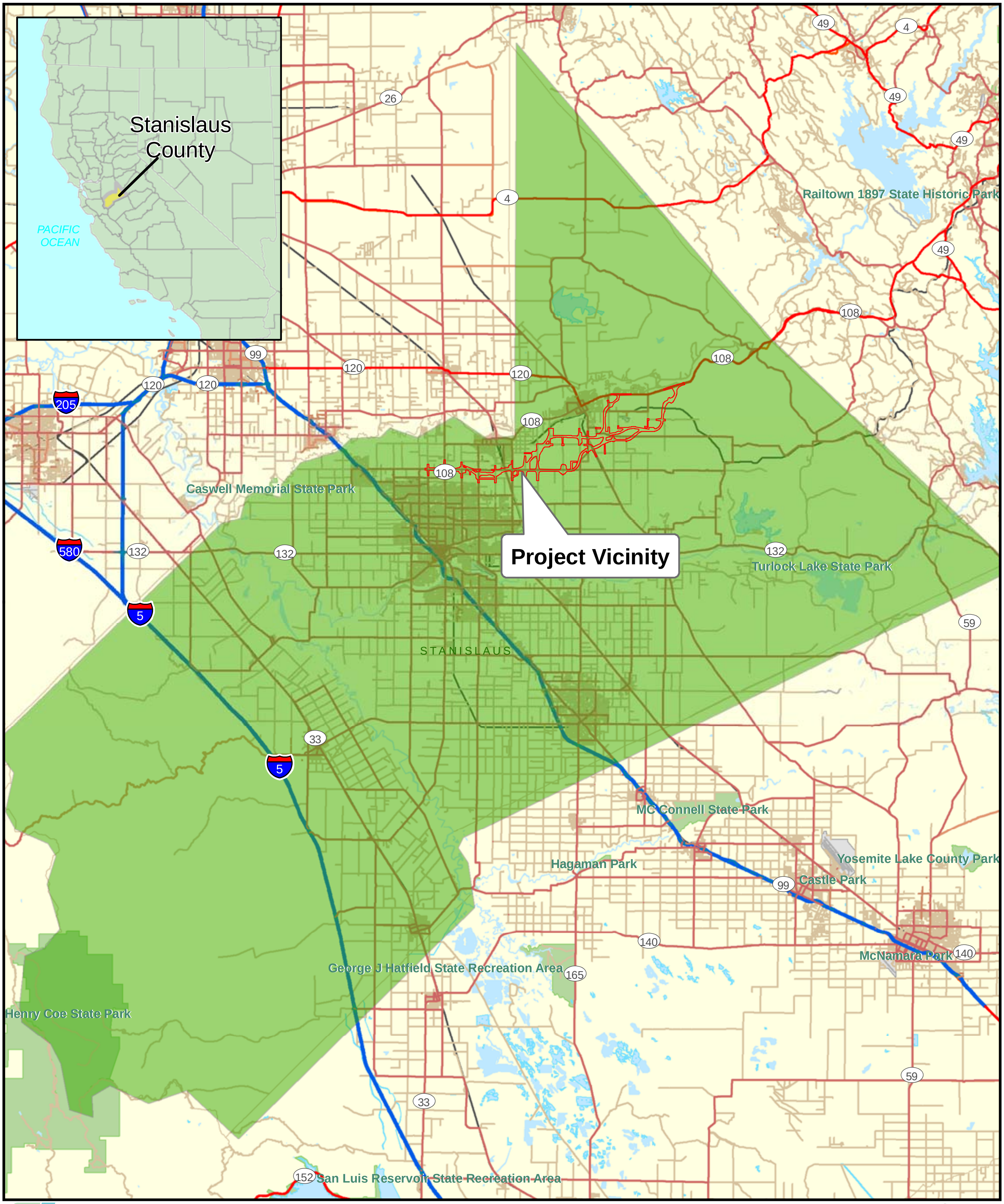

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FIGURE 1

Project Vicinity

EA: 10-0S800, Project ID # 1000000263
North County Corridor State Route 108 Project
Stanislaus County, California

SOURCE: ESRI 2008; Dokken Engineering 5/8/2014.
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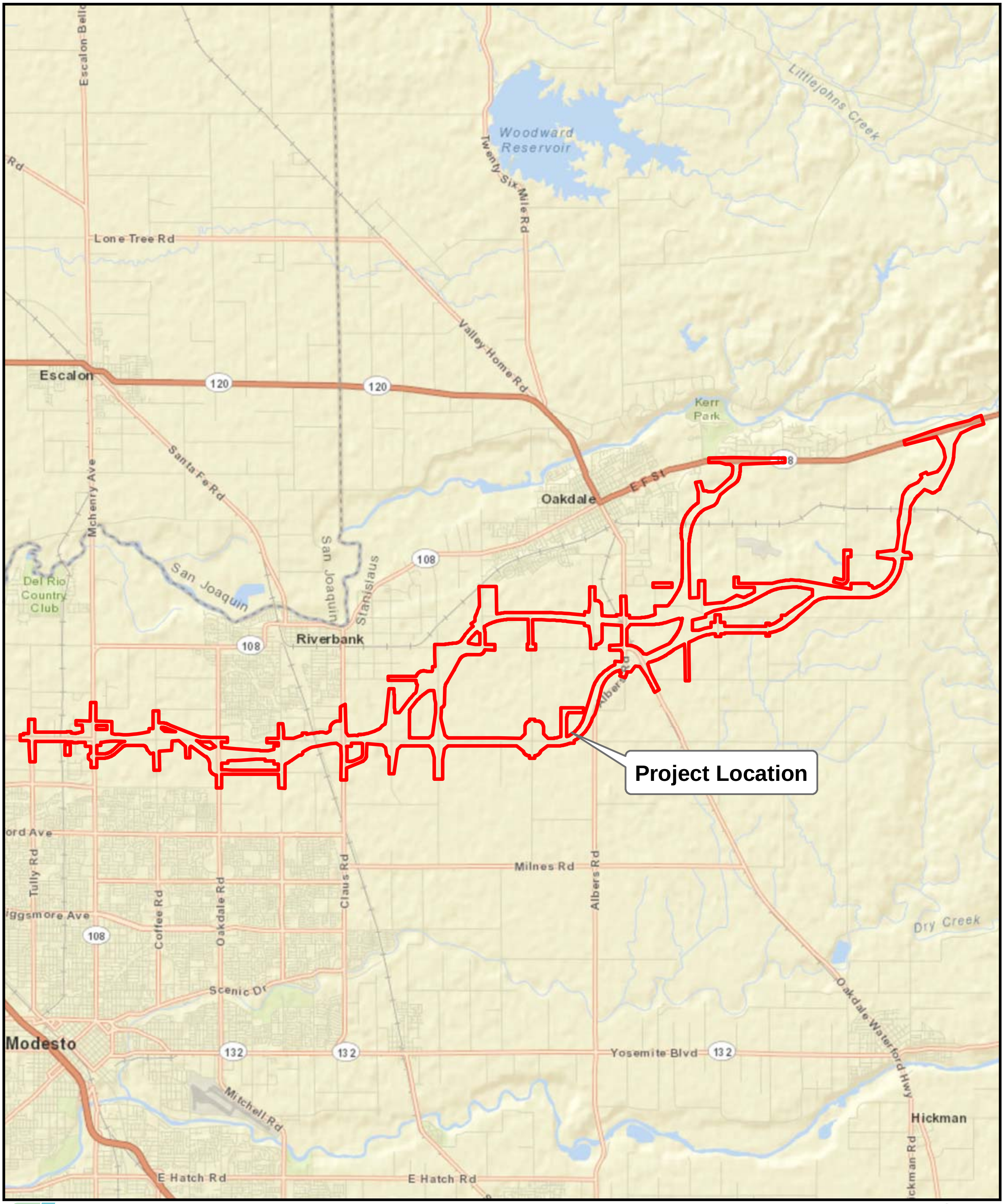

FIGURE 2

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Project Location

EA: 10-0S800, Project ID # 1000000263
North County Corridor State Route 108 Project
Stanislaus County, California

SOURCE: World Street Map; Dokken Engineering 5/8/2014.
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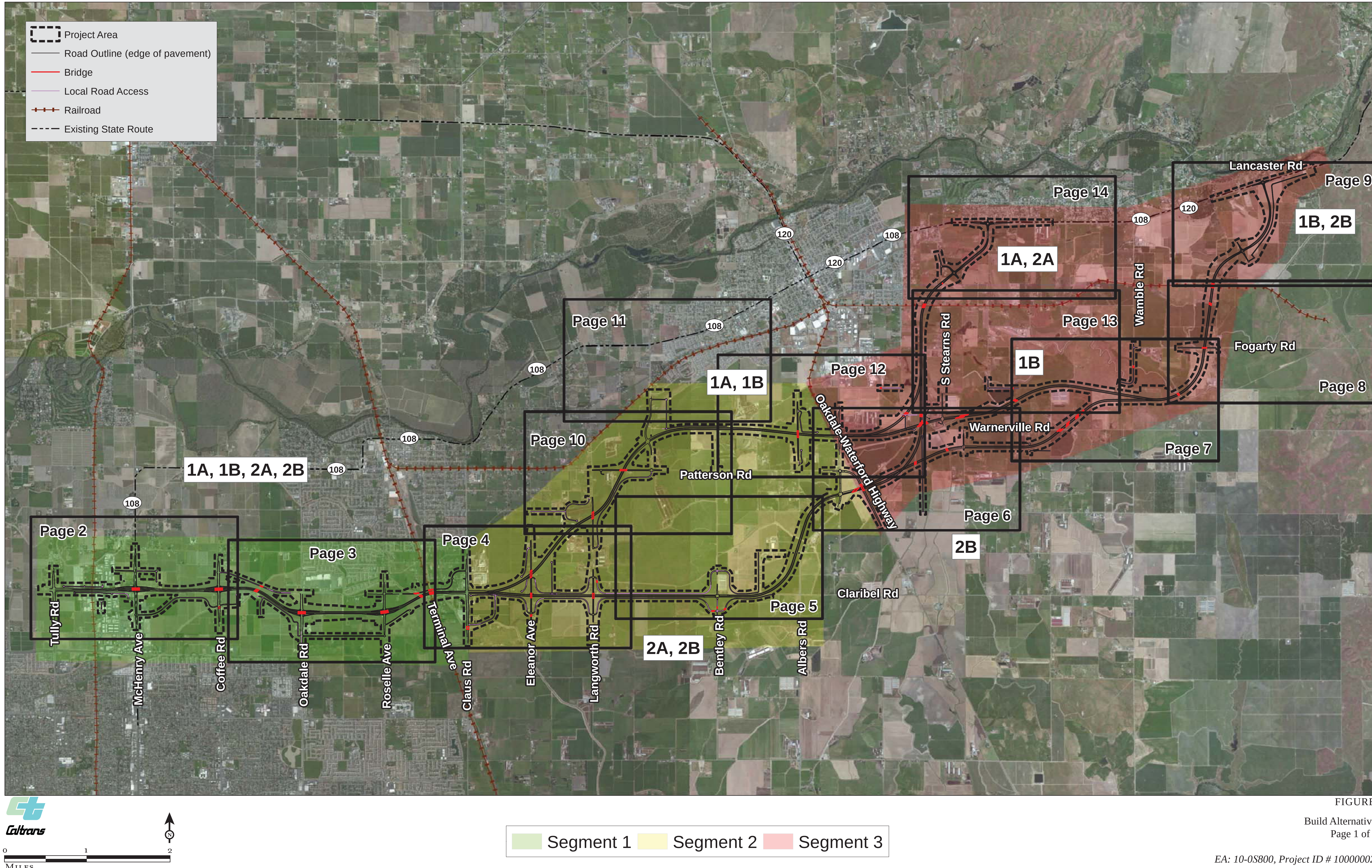

FIGURE 3

Build Alternatives
Page 1 of 14

EA: 10-0S800, Project ID # 1000000263
North County Corridor State Route 108 Project
Stanislaus County, California

SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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FIGURE 3

Build Alternatives

SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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North County Corridor State Route 108 Project
Stanislaus County, California

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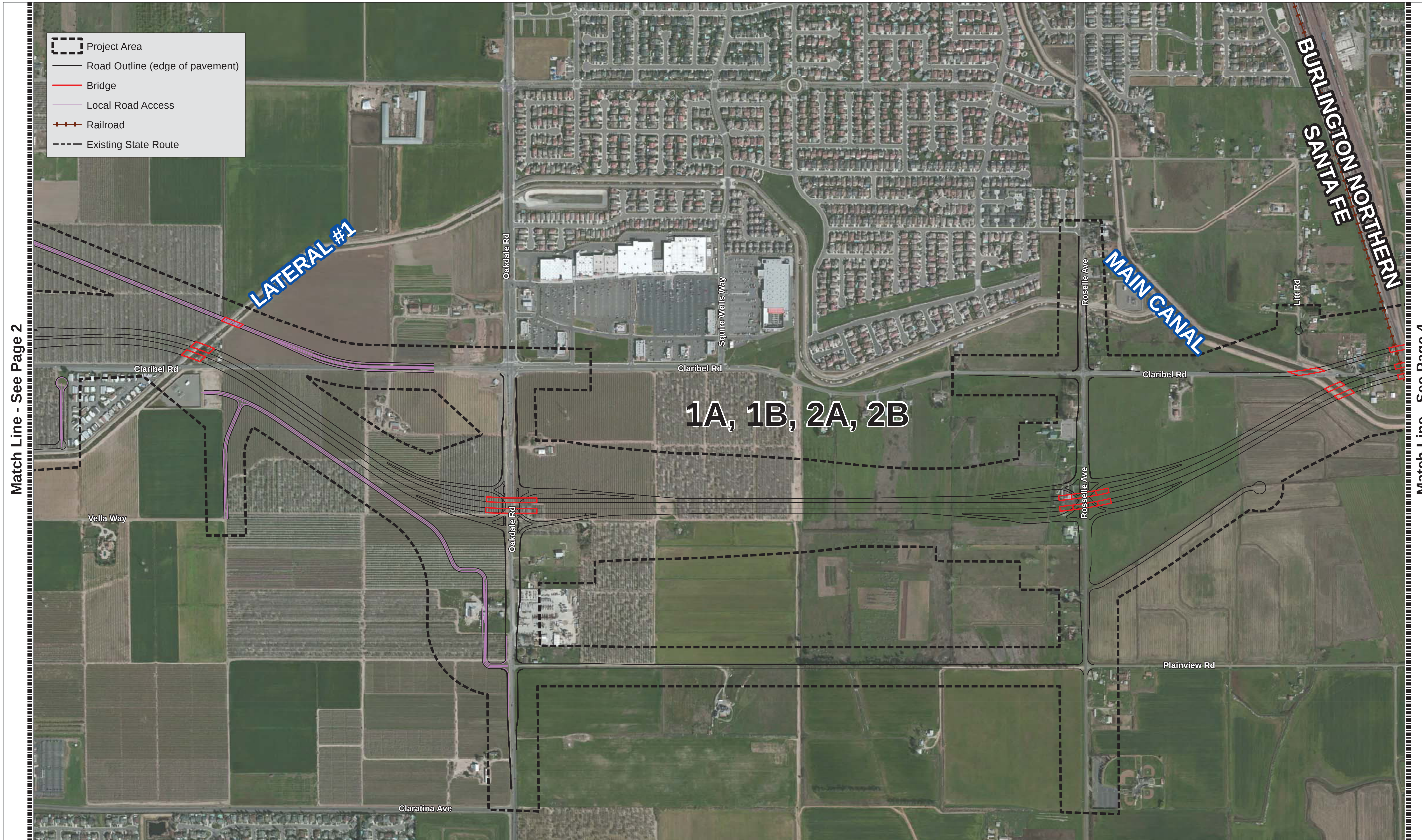

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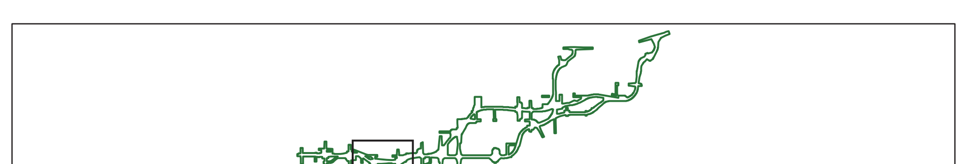

FIGURE 3

Build Alternatives
Page 3 of 14

EA: 10-0S800, Project ID # 1000000263
North County Corridor State Route 108 Project
Stanislaus County, California

SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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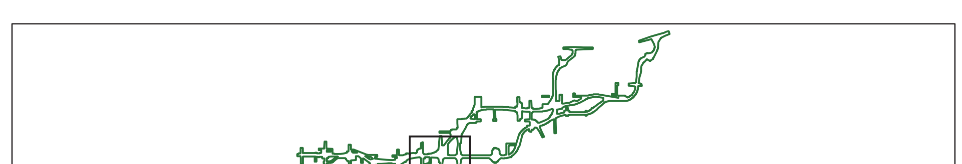

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SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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FIGURE 3

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Page 5 of 14

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North County Corridor State Route 108 Project
Stanislaus County, California

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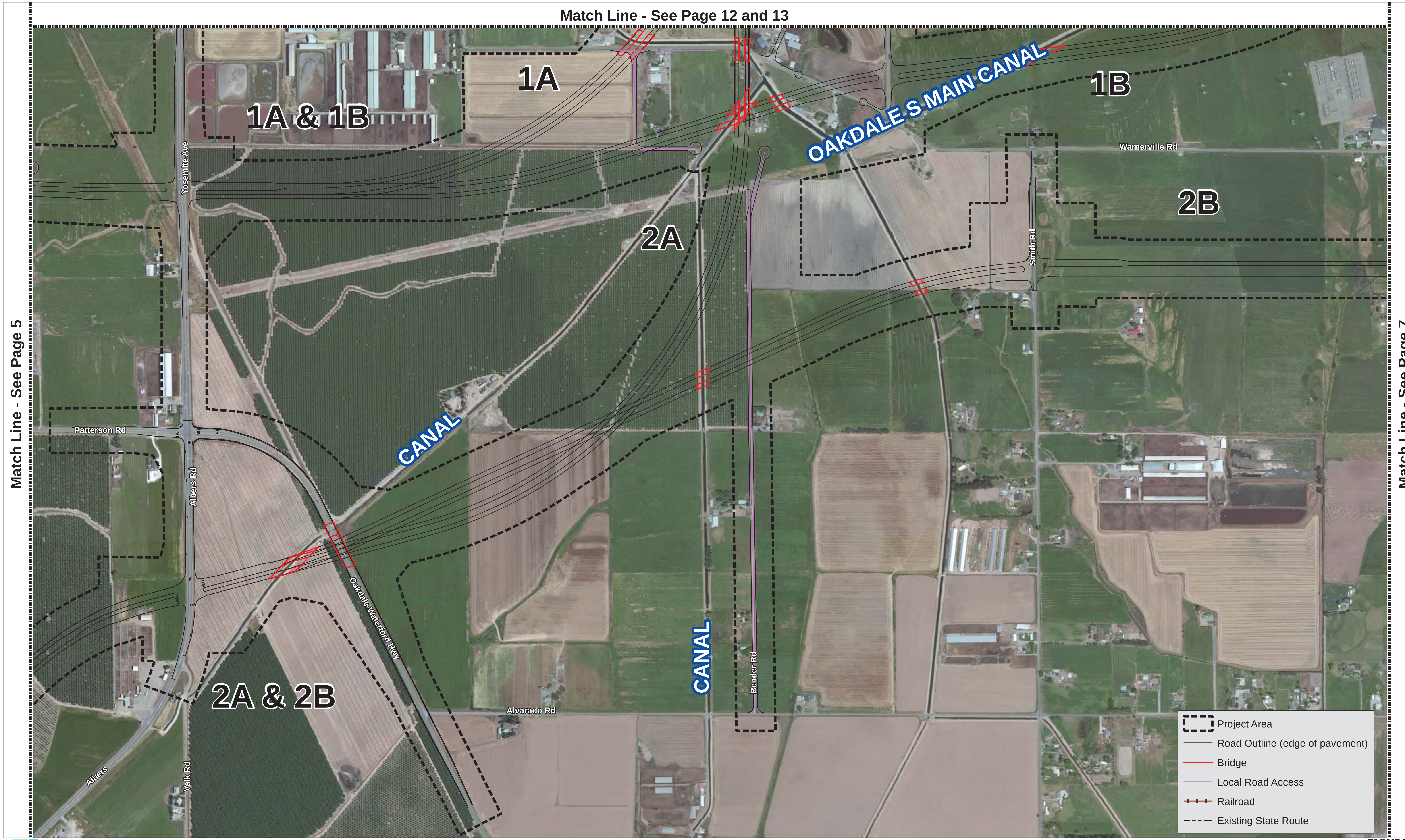

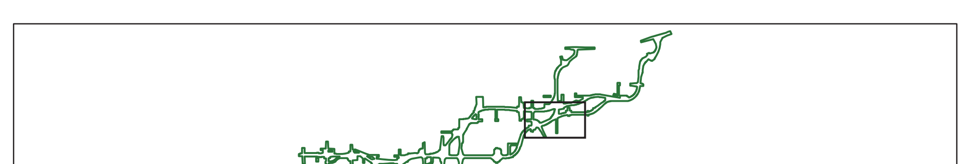

FIGURE 3

Build Alternatives

Page 6 of 14

EA: 10-0S800, Project ID # 1000000263
North County Corridor State Route 108 Project
Stanislaus County, California

SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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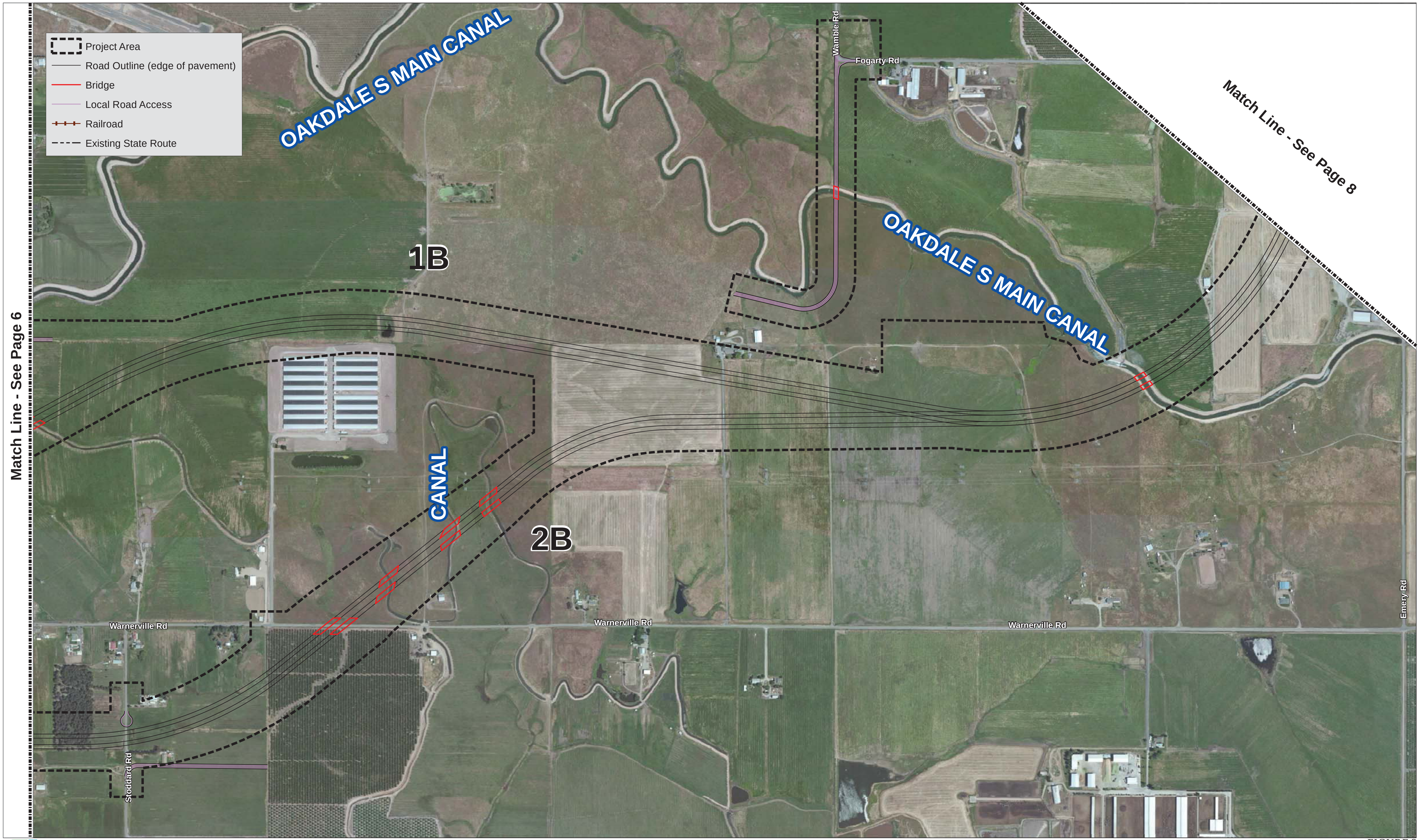

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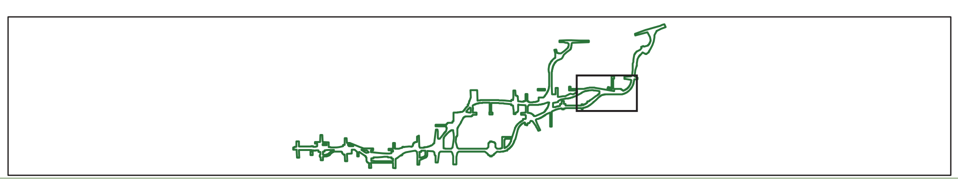

FIGURE 3

Build Alternatives
Page 7 of 14

EA: 10-0S800, Project ID # 1000000263
North County Corridor State Route 108 Project
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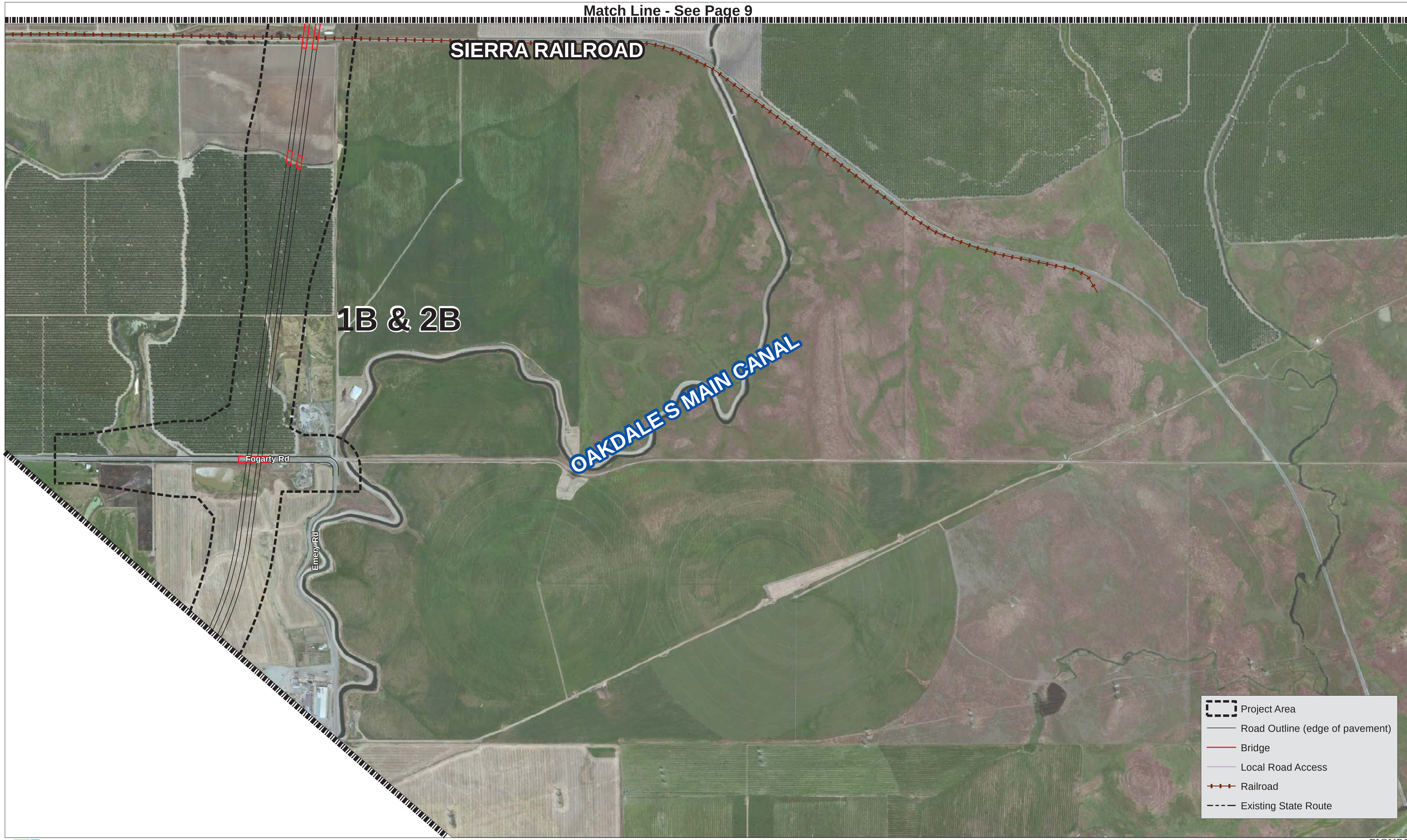

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SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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FIGURE 3
Build Alternatives
Page 9 of 14

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North County Corridor State Route 108 Project
Stanislaus County, California

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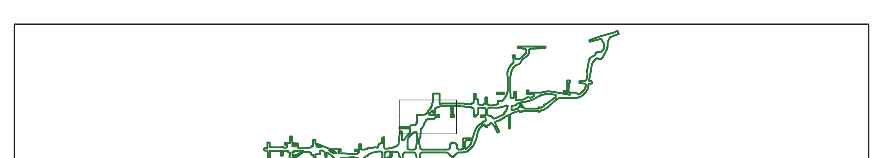

FIGURE 3

Build Alternatives
Page 10 of 14

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FIGURE 3

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Page 11 of 14

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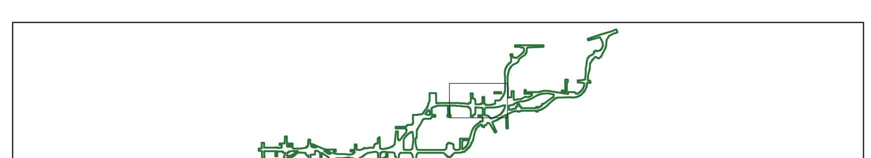

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FIGURE 3

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Page 12 of 14

EA: 10-0S800, Project ID # 1000000263

North County Corridor State Route 108 Project

Stanislaus County, California

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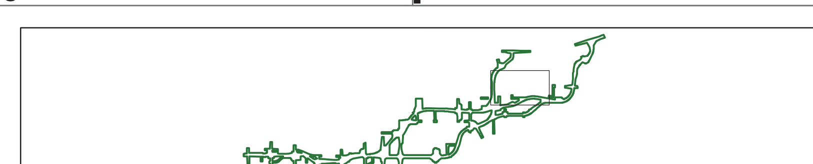

FIGURE 3

Build Alternatives

Page 13 of 14

EA: 10-0S800, Project ID # 1000000263

North County Corridor State Route 108 Project

Stanislaus County, California

SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.

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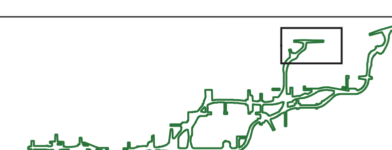

FIGURE 3

Build Alternatives
Page 14 of 14

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SOURCE: ESRI Maps Online March 2011; Dokken Engineering 5/8/2014.
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1.2 Summary of Excavation Parameters

Inclusive of all proposed build alternatives, the project will include excavation and grading to the following depths:

- Interchanges: 4–11 ft
- Railroad structures: 6–8 ft
- Bridges and wing walls: 60 ft deep piles
- Standard retaining walls and sound walls: 5 ft spread footings
- Minor structures: 5 ft spread footings
- Sign structures: 25–33 ft deep piles
- Signals: 13 ft deep piles
- Light poles: 10 ft deep piles
- Utility poles: 10–20 ft deep
- Standard sign posts: 6 ft deep
- Underground utilities: 5–10 ft deep
- Drainage structures: 5–15 ft deep
- Canal crossings: 6.5 ft
- Pavement structural section: 3 ft deep
- Cut slopes: 20–30 ft deep

1.3 Purpose of Investigation

Significant nonrenewable paleontological resources including vertebrate fossils and unique or scientifically important invertebrate fossils and remains of fossil plants are recognized by the State of California and the National Environmental Policy Act of 1969 (NEPA). These regulations require that adverse effects to paleontological resources be avoided, or if they cannot be avoided, mitigated. The paleontological records search and field assessment were conducted pursuant to the California Environmental Quality Act (CEQA), Public Resources Code (PRC) 21000 (Division 13), California Code of Regulations (CCR) 15000 (Title 14, Division 3, Chapter 1), CEQA Appendix G, and PRC 5097.5.

1.3.1 Federal 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, a license, authorization, or funding from a federal agency is required to complete the project. Because this project does not encroach onto federal land, the majority of federal regulations concerning paleontological resources do not apply (e.g., the Paleontological Resources Preservation Act). However, several regulations will apply because this project will receive federal funding and oversight is provided by Caltrans, as the designated federal representative of the Federal Highway Administration.

NEPA does not specifically direct federal agencies to preserve paleontological resources, but preserving “important historic, cultural, and natural aspects of our natural heritage”, (Section 1019(b)(4)) is interpreted to include fossils, or paleontological resources. It should be noted that throughout this document the terms “paleontological resource” or “fossil” or “fossil bearing formation” or “formation with a potential to yield fossils” are used interchangeably; there is no real difference in their definition, or significance.

As part of the Federal Aid Highway Act of 1956 (23 USC et seq.), the Archaeological and Paleontological Salvage (23 USC 305) 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.

1.3.2 California Department of Transportation Guidelines

As this project is either currently or will be within a State highway right-of-way and will be developed under the jurisdiction of Caltrans, the project is obligated to follow the guidelines specified in the Caltrans Standard Environmental Reference (SER). Specifically, the Caltrans *SER Environmental Handbook, Volume 1 Chapter 8* (Caltrans, 2012) addresses paleontology. The guidelines are designed to address impacts to paleontological resources prior to the beginning of construction. For most projects, three documents may be required: a Paleontological Identification Report (PIR), a Paleontological Evaluation Report (PER), and a Paleontological Mitigation Plan (PMP). The PIR and PER are often combined into a single document, and are prepared prior to completion of the Project Approval/Environmental Document (PA/ED) phase. The PMP must be developed prior to the beginning of construction, either towards the end of PA&ED phase, or during the Plans, Specifications, and Estimates (PS&E) phase.

The purpose of the PIR is to identify whether paleontological resources may be present within the APD; the purpose of the PER is to evaluate the significance of the resources, if it is determined that resources are likely to be present; and the purpose of the PMP is to develop mitigation for significant resources that may be impacted during project implementation. Occasionally, the PIR or the PIR/PER will determine that, despite the results of the literature search, it is unlikely that the project will encounter significant resources during construction. In these cases, a PMP will not be required, and the reason will be specified in the PIR/PER.

1.3.3 State Regulations

Under State law, paleontological resources are protected by both CEQA and PRC Section 5097.5.

Under CEQA, Appendix G, Lead Agencies are required to consider impacts to the direct or indirect destruction of unique resources that are of value to the region or State. Specifically, in Appendix G, Section V (c), Lead Agencies are required to consider impacts to paleontological resources.

The California 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.

1.3.4 Local Regulations

Caltrans is generally not required to comply with local ordinances and policies in areas within the State highway system. However, Caltrans does comply with local ordinances and policies where feasible. Various cities and counties have passed resolutions related to paleontological resources within their jurisdictions. These resolutions are usually included in the General Plan of the city, community, or county and provide additional guidance on assessment and treatment measures for projects subject to CEQA compliance. Provided below is a summary of any policies and ordinances regarding paleontological resources for the cities and county involved in this project. Project staff should periodically coordinate with local entities to update their knowledge of local requirements. It should be noted that, protection of paleontological resources following Caltrans guidelines and CEQA regulations will likely meet and/or exceed any paleontological protection guidelines of the cities through which the project passes.

1.3.4.1 Stanislaus County

The General Plan for the Stanislaus County, was adopted in 1994 and updated several times, with the latest update being in 2011 (Stanislaus County, 2011). The General Plan does not include any specific goals, policies, or measures to protect paleontological resources.

1.3.4.2 City of Modesto

The General Plan for the City of Modesto, was adopted on October 14, 2008, (City of Modesto, 2008). Within Chapter VII - Environmental Resources and Open Spaces Section of the General Plan are several measures designed to protect paleontological resources:

> **Paleontological Policies—Baseline Developed Area and Planned Urbanizing Area**
>
> a. To minimize potential adverse impacts to unique, scientifically important paleontological resources, project applicant(s) shall be required to do the following:
>
> > (1) Prior to grading or excavation activities in locations where there has not been previous development or where construction would occur at depths below existing foundations, roads, or trenches, construction personnel involved with earth-moving activities must immediately stop all earth-moving activities if bones or any other fossil materials are discovered. In that event, the City's Community and Economic Development Department must be notified of the discovery and a qualified paleontologist must be contacted.
> >
> > (2) If paleontological resources are discovered during earth-moving activities, the construction crew shall immediately cease work in the vicinity of the find, and the City Planning Department shall be notified. A qualified paleontologist shall evaluate the resource and

prepare a proposed mitigation plan in accordance with Society of Vertebrate Paleontology guidelines. The proposed mitigation plan may include a field survey of additional construction areas, sampling and data recovery procedures, museum storage coordination for any specimen recovered, and a report of findings. Recommendations determined by the lead agency to be necessary and feasible shall be implemented before construction activities can resume at the site where the paleontological resources were discovered.

1.3.4.3 City of Riverbank

The General Plan for the City of Riverbank was adopted in May 2010, (City of Riverbank, 2010). In the Goals, Policies, and Implementation section of the General Plan Policy CONS-2.1 provides protections to paleontological resources:

Goal CONS-2 Minimize Negative Impacts to Archaeological Resources

Policy CONS-2.1 Approved projects, plans, and subdivision requests shall incorporate all available measures, with a preference for avoidance, to reduce or eliminate impacts to known and unknown archaeological and paleontological resources.

1.3.4.4 City of Oakdale

The General Plan for the City of Oakdale, which was adopted July 18, 2006 (City of Oakdale, 2006) does not provide any specific protections for paleontological resources.

Chapter 2 Significance

2.1 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. According to Caltrans (2012), 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 Code of Federal Regulations [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.

Scientifically significant paleontological resources are "identified sites or geologic deposits containing individual fossils or assemblages of fossils that are unique or unusual, diagnostically or stratigraphically important, and add to the existing body of knowledge in specific areas, stratigraphically, taxonomically, or regionally" (Caltrans, 2012). Fossils are particularly important when they are found undisturbed in their primary context because they aid in stratigraphic correlation, evolution, and paleoclimatology.

The SVP provides the following definitions of significance:

- **Significant Paleontological Resources** are fossils and fossiliferous deposits, here defined as consisting of identifiable vertebrate fossils; uncommon invertebrate, plant, and trace fossils; and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information. Paleontological resources are considered to be older than recorded human history and/or older than middle Holocene (i.e., older than about 5,000 radiocarbon years) (SVP, 2010).
- A **Significant Fossiliferous Deposit** is a rock unit or formation that contains significant nonrenewable paleontological resources, here defined as comprising one or more identifiable vertebrate, invertebrate, plant, and trace fossils, as well as other data that provide taphonomic, taxonomic, phylogenetic, ecologic, and

stratigraphic information (ichnites and trace fossils generated by vertebrate animals [e.g., trackways or nests and middens] that provide datable material and climatic information). Paleontological resources are considered to be older than recorded history and/or older than 5,000 years before the present (SVP, 1995, 2010).

Generally, scientifically significant paleontological resources are identified sites or geological deposits containing individual fossils or assemblages of fossils that are unique or unusual, diagnostically or stratigraphically important, and that add to the existing body of knowledge in specific areas (SVP, 1995). Particularly important are fossils found *in situ* (undisturbed) in primary context (e.g., fossils that have not been subjected to disturbance). 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, 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

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

- **Taxonomy:** Assemblages that contain rare or unknown taxa, such as defining new (previously unknown to science) species or that represent 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 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 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, including water depth, temperature, salinity, substrate conditions, and even whether the area was in a high-energy location like 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. In addition, by studying the ratios of different species to each other's population densities, relationships between predator and prey can be determined. Preserved parts of plants can also lend insight into what was growing in the area at a particular time. 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 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.

2.2 Summary of Significance

This document uses an abbreviated summary to define significance in paleontological resources.

- All vertebrate fossils that can be related to a stratigraphic context are considered a significant nonrenewable paleontological resource. Invertebrate and plant fossils as well as other environmental indicators, such as grain size of the sediments, that help to establish environmental conditions (e.g., ponds, lakes, rivers, deep or shallow ocean depths) associated with vertebrate fossils are considered significant. Colors of the sediments can also help to establish low or high oxygen conditions during deposition. Certain invertebrate and plant fossils that are regionally rare or uncommon, or help to define stratigraphy, age, or taxonomic relationships are considered significant.

Chapter 3 Sensitivity

3.1 Definition of Sensitivity

Sensitivity is often stated "potential," since decisions about how to manage paleontological resources must be based on "potential" because the presence of resources cannot be definitively known until construction excavation is underway. In accordance with the Caltrans *SER, Environmental Handvook Volume 1, Chapter 8* (Caltrans, 2012), 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. Each rating is described below.

- **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* (sp.) 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.
- **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 for containing 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. However, as excavation for construction gets

underway, it is possible that new and unanticipated paleontological resources might be encountered. If resources are determined to be significant, monitoring and mitigation is required.

- **No Potential:** Rock units of intrusive igneous origin, most extrusive igneous rocks, and moderately to highly metamorphosed rocks are classified as having no potential for containing 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.

According to the SVP (2010), protection of paleontological resources includes: (a) assessment of the area's potential to contain significant paleontological resources that could be directly or indirectly impacted, damaged, or destroyed by the proposed development; and (b) formulation and implementation of measures to mitigate these adverse impacts, including permanent preservation of the site and/or permanent preservation of salvaged fossils along with all contextual data in established institutions.

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 for the presence of 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 sensitivity: High, Low, No, and Undetermined. If a geographic area or geological unit is classed as having undetermined potential for paleontological resources, studies must be undertaken to determine if that rock unit has a sensitivity of either High, Low, or None. These categories are described in more detail below.

3.1.1 High Potential

Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. 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), and 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, etc.). 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, which contain potentially datable organic remains older than late Holocene, including deposits associated with animal nests or middens, and rock units, which may contain new vertebrate deposits, traces, or trackways, are also classified as having high potential.

3.1.2 Low Potential

Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus, preserve fossils only in rare circumstances, and 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 impact mitigation measures to protect fossils.

3.1.3 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 neither protection nor impact mitigation measures relative to paleontological resources.

3.1.4 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 if these rock units have high or low potential to contain significant paleontological resources. A field survey by a qualified professional to determine the specific paleontological resource potential of these rock units is required before a paleontological resource impact mitigation program can be developed. In cases where no subsurface data are available, paleontological potential can sometimes be determined by strategically located excavations into subsurface stratigraphy.

Given the range of criteria that may be used, assessments of significance should be based on the recommendations of a professional paleontologist with expertise in the region under study, and on the resources found in that region. An evaluation of a particular rock unit's significance rests on the known importance of specific fossils. Often this significance is reflected as a sensitivity ranking relative to other rock units in the same region. Regardless of the format used by a paleontologist to rank formations, the importance of any rock unit must be explicitly stated in terms of specific fossils known or suspected to be present (and if the latter, why such fossils are suspected), and why these fossils are of paleontological importance. Some land-managing agencies may require the use of specific guidelines to assess significance, whereas others may defer to the expertise of local paleontologists and provide little guidance. Because each situation may differ, it is important that there is a clear understanding among project staff which criteria will be used to assess the significance of rock units affected by a particular project.

If a paleontological resource is determined to be significant, of high sensitivity, or of scientific importance, a mitigation program must be developed and implemented. Mitigation plans are often developed prior to construction but mitigation is usually implemented during construction. It should be noted that mitigating during construction poses a greater risk of construction delays. As a practical matter, no consideration is generally afforded paleontological sites for which scientific importance cannot be demonstrated. If a paleontological resource assessment results in a determination that the site is insignificant or of low sensitivity, this conclusion should be documented in a PER and in the project's environmental document, in order to demonstrate compliance with applicable statutory requirements.

3.2 Summary of Sensitivity

This document uses an abbreviated summary to define paleontological sensitivity and the potential for significant paleontological resources.

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

Chapter 4 Methods

An APD was established to define the limits of potential impacts to paleontological resources. The APD encompasses the horizontal and vertical extent of anticipated ground-disturbing activities.

A locality search and literature review was conducted for the APD and surrounding areas. To ensure that research was comprehensive, the search area was expanded beyond the APD in an approximately 1 mile radius.

4.1 Locality Search

A locality search was conducted through the Natural History Museum of Los Angeles County (LACM) that included the APD and surrounding counties with outcrops of the same formations that are present in the APD. The results of the LACM locality search are included in Appendix B.

The locality search included a review of area geology and any fossil resources recovered within sediments similar to those that will be encountered during the project. In addition, the paleontological sensitivity of the sediments exposed in the APD was determined based on fossil finds from similar sediments in the vicinity of the APD.

The purpose of a locality search is to establish the status and extent of previously recorded paleontological resources within and adjacent to NCC APD and to determine which geologic sediments are likely to be exposed during ground-disturbing construction. This information informs the assessment of the potential effects of the proposed project on paleontological resources in the area, anticipating the kinds of resources that might be encountered during earthmoving activities, and determining the paleontological sensitivities for each geologic formation or unit exposed in the APD.

4.2 Literature Search

Literature search efforts involved review of available geological and paleontological literature concerning or related to the stratigraphy of the APD.

Documents previously prepared for the NCC were also reviewed; the documents included a PIR prepared in 2009 by ICF and a draft PER/PMP prepared in 2012 by ICF. Both the PIR and the draft PER/PMP included several other alternatives, slightly different alignments, and an overall larger search area compared to the current APD. Considering the larger search area, and after reviewing the locality searches in the draft PER/PMP, it was determined that no new formations would need to be addressed for the current APD (in fact some have dropped out) and a new PIR is not needed.

4.3 Field Inspection

4.3.1 Pedestrian Survey

A pedestrian survey was not completed during preparation of this PER. Per a discussion with Caltrans District 6 Paleontological Coordinator Richard Stewart on December 10, 2013, a pedestrian survey would not be required unless review of the project area using aerial photographs indicated the presence of significant geologic features (e.g., outcrops). The project area was reviewed using the aerial imagery in Google Earth; no significant geologic features were identified.

4.4 Personnel

This PER was prepared by Brooks R. Smith, an Associate at LSA Associates, Inc. and a member of the Cultural and Paleontological Resources Group. Mr. Smith has over 21 years of experience with paleontological mitigation and has extensive experience collecting paleontological resources, as well as writing paleontological assessment reports, surveying for paleontological resources, salvaging large fossil specimens, conducting fossil identification and curation, and writing final mitigation monitoring reports at the conclusion of construction projects (see Appendix A for resume).

Chapter 5 Results

5.1 Geologic Setting

The APD for the NCC is located in the northeastern San Joaquin Valley, at the base of the Sierra Nevada foothills and lies within the Great Valley Geomorphic Province (California Geological Survey, 2002). This province is an alluvial valley in the central portion of California that is approximately 50 miles wide and over 400 miles long. Its northern part is drained by the Sacramento River and is known as the Sacramento Valley; the southern portion is drained by the San Joaquin River and is known as the San Joaquin Valley. The San Joaquin Valley is formed by a large structural trough between the Coast Ranges and the Sierra Nevada.

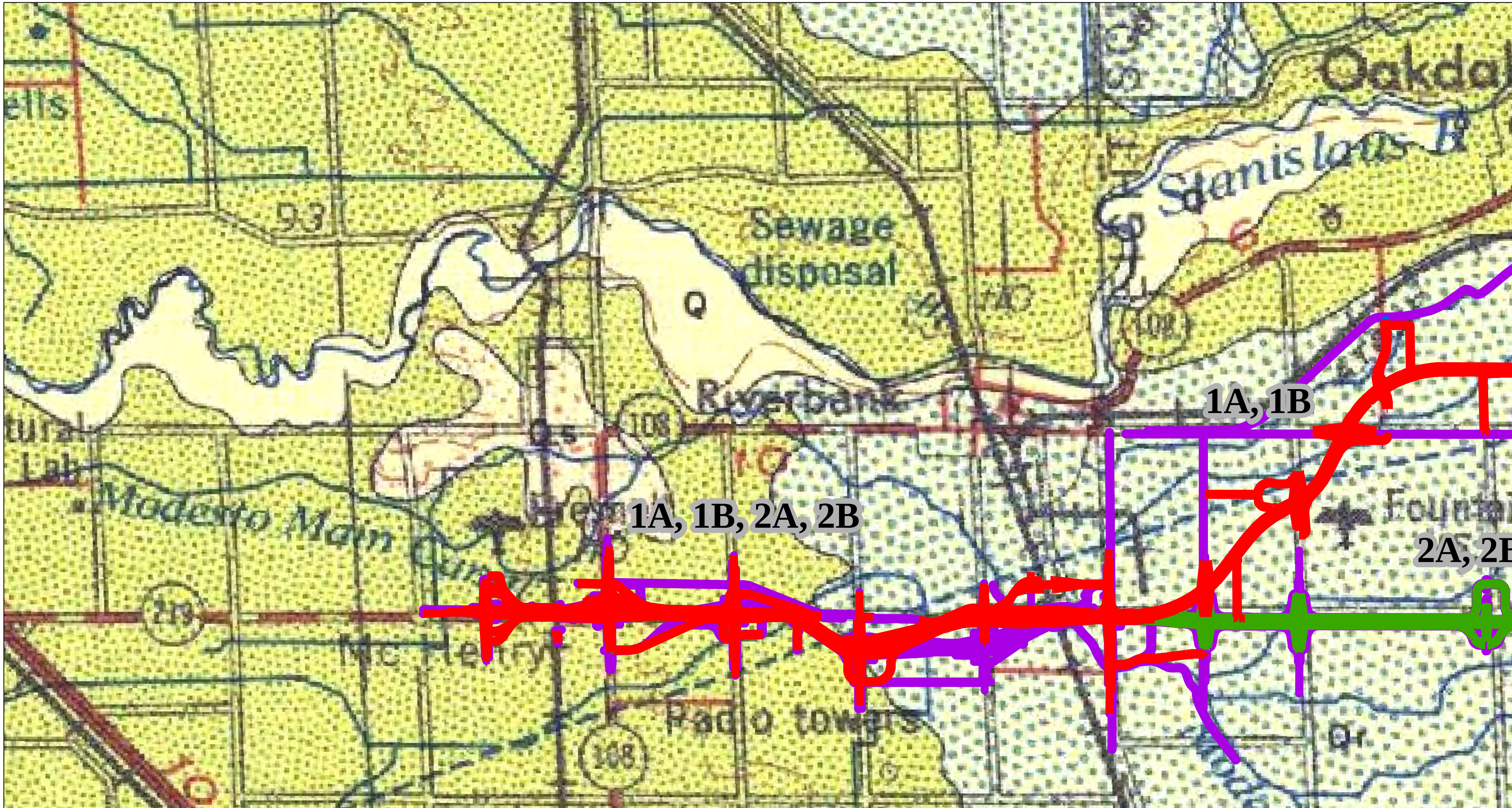
The San Joaquin Valley is filled with marine and alluvial sediments that are approximately 6 miles thick. These sediments have been deposited almost continuously since the Jurassic (201.3–145.0 million years ago [Ma]) (California Geological Survey, 2002) and overlie the westward-tilted block of the plutonic and metamorphic Sierra Nevada basement. The northern portion of the San Joaquin Valley was part of the Pacific Ocean and subject to submarine deposition from the Jurassic until the late Paleocene (59.2–56.0 Ma), when uplift of the Sierra Nevada relocated this portion of the San Joaquin Valley on or near the shore of the Pacific Ocean (Bartow, 1991:27). Between the Paleocene (66.0–56.0 Ma) and the Pliocene (5.333–2.588 Ma), deposition alternated between terrestrial and marine, depending on conditions. The entire valley did not become isolated from the Pacific Ocean until the Pliocene (Bartow, 1991:23).

In the northern San Joaquin Valley, the marine deposits of the latest Jurassic to Cretaceous (152.1–66.0 Ma) Great Valley Sequence are unconformably overlain by various Late Paleocene to Eocene (59.2–33.9) marine units (Bartow, 1991:17; Bartow and Nilsen, 1990). Unconformably overlying these Eocene formations, the Valley Springs Formation, a Late Oligocene to Middle Miocene (28.1–11.62 Ma) alluvial deposit, was the first subaerial deposit in the northern San Joaquin Valley (Bartow, 1991:20-21). The Valley Springs Formation was followed by deposition of the volcaniclastic Mehrten Formation (Bartow, 1991:21). Alluvial deposition resumed and then continued through the Miocene (23.03–5.333 Ma) and Pliocene (5.333–2.588 Ma), and continued into the Pleistocene (2.588 Ma–11,700 years before present [BP]). All the dates for the geologic periods and epochs are consistent with the International Commission on Stratigraphy (ICS) (2013).

During the Middle to Late Pleistocene (~781,000–11,700 years BP), changing climatic conditions resulted in the creation of a series of large alluvial fans on either side of the San Joaquin Valley (Atwater, 1982:5; Bartow, 1991:23–24; Rosenthal and Meyer, 2004:50), including the APD. Gale et al. (1938) and Piper et al. (1939) were the first to publish detailed geologic maps in the southern Sacramento/northern San Joaquin Valley areas. Both named the Pleistocene alluvial sediments in the region the Victor Formation. Davis and Hall (1959) proposed subdividing the Victor Formation by age, with the Turlock Lake Formation as the oldest, the Riverbank Formation in the middle, and the Modesto Formation as the youngest.

According to geologic mapping by Wagner et al. (1991), the APD contains three named formations from the Pleistocene: the Modesto Formation, the Riverbank Formation, and the Turlock Lake Formation. In general, the Modesto Formation is located in the western portion of the APD, the Riverbank Formation is located in the central portion of the APD, and the Turlock Lake Formation is located on the eastern end of the APD. According to Southard (2003), the Modesto Formation ranges in age from 40,000 to 10,000 years before present (BP), the Riverbank formation from 300,000 to 100,000 years BP, and the Turlock Lake Formation ranges in age from 700,000 to 500,000 years BP (see Table A). Marchand and Allwardt have similar ages of 75,000 to 9,000 for the Modesto Formation, 450,000 to 130,000 for the Riverbank Formation, and 730,000 to 500,000 for the Turlock Lake Formation. According to Marchand and Allwardt (1981), these three formations are basically large, extensive alluvial fan complexes with their source in the Sierra Nevada to the east. They are lithologically similar but may be distinguished and subdivided on the basis of soil profile development, topographic position and expression, local lithologic differences, and unconformities associated with buried soils. In addition, although not mapped by Wagner et al. (1991), Artificial Fill and Unnamed Holocene Deposits are likely to be present within the APD.

Figures 6a and 6b show the geology of the APD and the surrounding areas as mapped by Wagner et al. (1991). The geologic units that may be present in the APD are described in more detail below and are summarized in Table A.



LEGEND

Area of Potential Disturbance (ADP)

- Alternative 1A
- Alternative 1B
- Alternative 2A
- Alternative 2B

Geologic Formations

- Modesto Formation
- RIverbank Formation
- Turlock Lake Formation

Map Index

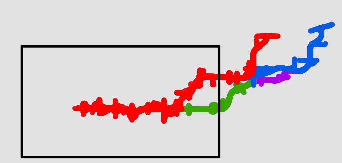


FIGURE 4a

Geologic Map of the Area of Potential Disturbance (APD) and Vicinity

EA: 10-0S800, Project ID # 1000000263
North County Corridor New State Route 108 Project
Stanislaus County, California

SOURCE: Wagner, D.L., Bortugno, E.J., and McJunkin, R.D., Geological Map of the San Fransisco-San Jose Quadrangle, California, 1:250,000, CDMG Regional Geographic Map Series, Map No. 5A, Geology, Sheet 1 of 5.

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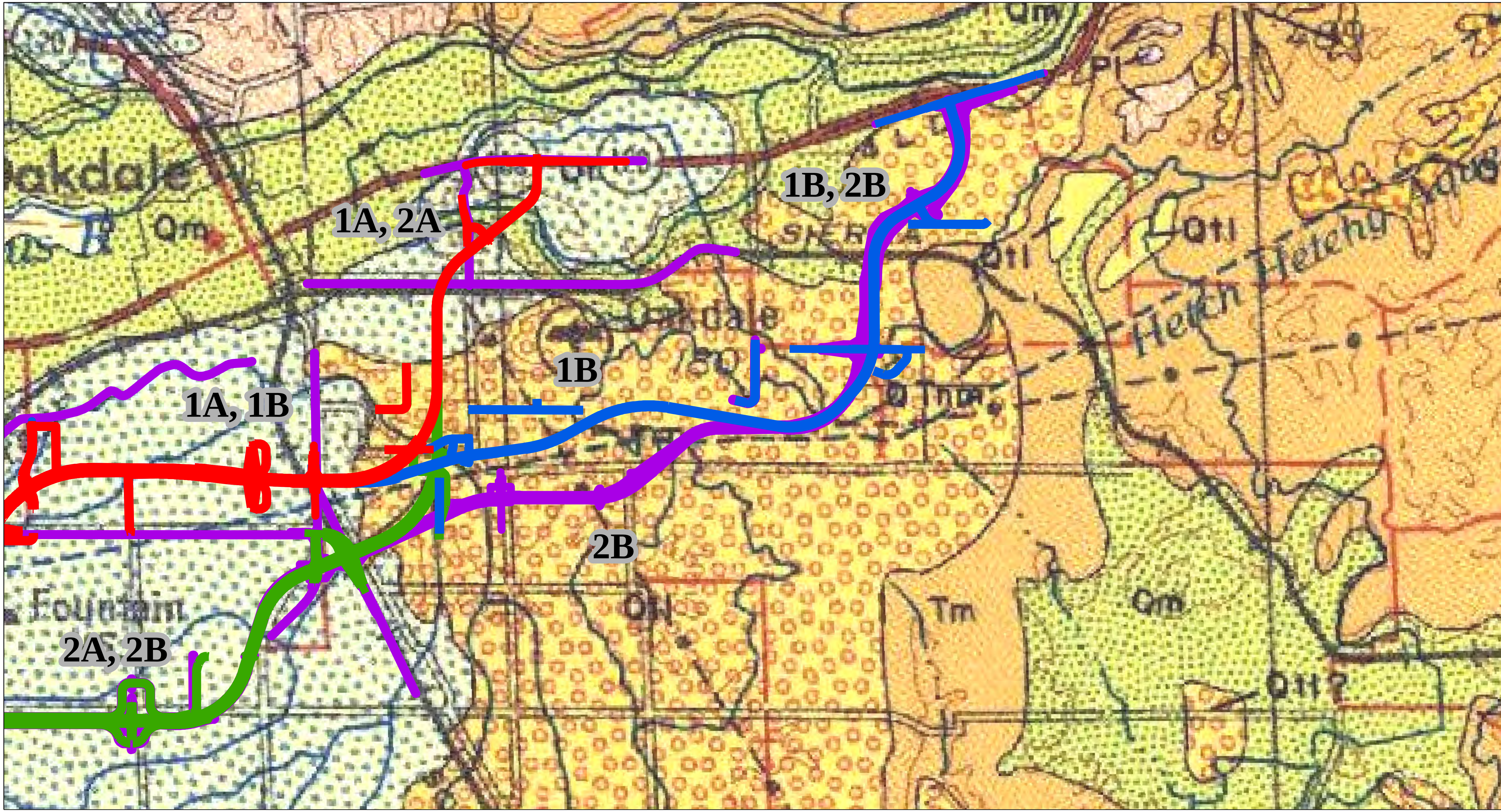

LEGEND

Area of Potential Disturbance (ADP)

- Alternative 1A
- Alternative 1B
- Alternative 2A
- Alternative 2B

Geologic Formations

- Modesto Formation
- RIverbank Formation
- Turlock Lake Formation

N

0 2000 4000
FEET

Map Index

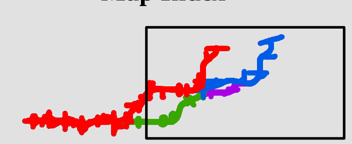

FIGURE 4b

Geologic Map of the Area of Potential Disturbance (APD) and Vicinity

EA: 10-0S800, Project ID # 1000000263
North County Corridor New State Route 108 Project
Stanislaus County, California

SOURCE: Wagner, D.L., Bortugno, E.J., and McJunkin, R.D., Geological Map of the San Fransisco-San Jose Quadrangle, California, 1:250,000, CDMG Regional Geographic Map Series, Map No. 5A, Geology, Sheet 1 of 5.

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Table A: Geologic Time Periods and Geologic Units within the North County Corridor New State Route 108 APD

Epoch	Age (years ago) Marchand and Allwardt (1981)	Age (years ago) Southard (2003)	Geologic Formation/Unit
Quaternary Period			
Holocene	Less than 100		Artificial Fill (not mapped, but known to be present)
Holocene	Less than 11,700		Unnamed Holocene Deposits (not mapped, but likely present in upper 5-10 feet)
Late Pleistocene to Holocene	75,000 to 9,000	40,000 to 10,000	Modesto Formation
Middle to late Pleistocene	300,000 to 100,000	450,00 to 130,000	Riverbank Formation
Early to middle Pleistocene	730,000 to 500,000	700,000 to 500,000	Turlock Lake Formation

5.1.1.1 Artificial Fill

This unit is not mapped by Wagner et al. (1991) (see Figures 6a and 6b) but likely exists in many areas of the APD, especially in areas with existing roads or development. Artificial Fill is soil/dirt that is placed by humans and can be either unconsolidated and loosely compacted, or engineered and densely compacted. Composition varies and is dependent on the source. It is often mixed with modern debris such as bricks, concrete, asphalt, glass, or wood. Depending on the area, thickness can be less than 1 ft or less to several hundred feet.

5.1.1.2 Unnamed Holocene Deposits

Unnamed Holocene Deposits are not mapped as being present within the project's APD on the geology map by Wagner et al. (1991) (see Figures 6a and 6b). However, these deposits are likely present at the surface within the APD and may extend up to 5 ft below the surface. Surficial Holocene geology is often not included on geology maps especially in the San Joaquin and Sacramento Valleys otherwise the maps would solely consist of these shallow Holocene sediments. These deposits are usually loosely consolidated and may consist of cobbles, sand, silt and/or clay deposited by wind, water, mass-wasting, and/or weathering. Windblown deposits generally consist of well-sorted sand with angular-to-rounded grains. Alluvial and colluvial deposits may be well-sorted to poorly sorted and may consist of angular-to-rounded material of every clast size. As the depositional environment for these deposits is similar to the

Modesto, Riverbank, and Turlock Lake Formations, it may be difficult to differentiate Unnamed Holocene Deposits from the underlying formation; however, they may be slightly less consolidated.

5.1.1.3 Modesto Formation

The Modesto Formation is mapped on the surface mainly in the western portion of the APD, but also in a small area on the eastern end of Alternatives 1A and 2A (see Figures 6a and 6b). The Modesto Formation is exposed for well over 400 miles extending from the northern end of the Sacramento River near Redding to the Kern River near Bakersfield in the south (Marchand and Allwardt, 1981; Atwater, 1982). The type section for the Modesto Formation is located along the south bluff of the Tuolumne River, south of the City of Modesto. Marchand and Allwardt (1981) proposed that the name “Victor Formation” be dropped in favor of the three formations named by Davis and Hall (1959): Turlock Lake, Riverbank, and Modesto formations for the Quaternary deposits in the Sacramento and San Joaquin Valleys. These names are now the accepted formational names in the area.

The Modesto Formation is essentially an alluvial fan deposit composed of interbeds of gravel, sand, and silt deposited by streams carrying glacial outwash from the western side of the Sierra Nevada throughout the entire Great Valley Geomorphic Province. The formation becomes increasingly dense and consolidated with depth, with colors typically ranging from light grayish-brown to light brown (Rosenthal and Meyer, 2004:66). Marchand and Allwardt (1981:52) indicate the maximum thickness for the Modesto Formation at up to 40 meters (131 ft). The Modesto Formation can be further divided into an upper and lower member. The lower member of the Modesto was deposited between approximately 75,000 and 27,000 years ago (Frye et al., 1968; Marchand and Allwardt, 1981:57) and is composed of consolidated, slightly weathered, well-sorted silt and fine sand, with occasional interbeds that contain gravels. The upper member of the Modesto Formation was deposited between approximately 14,000 and 9,000 years BP (Marchand and Allwardt, 1981:60) and is composed of unconsolidated, unweathered gravel, sand, silt, and clay. Marchand and Allwardt (1981:55) state that there is a discernable soil horizon between the upper and lower members in several areas indicating that there was a period of weathering and non-deposition between the end of the deposition of the lower member and the beginning of the deposition of the upper member. This period likely represents a period of glaciation with little to no active streams flowing that could carry sediment out of the Sierra Nevada. Unfortunately, geologic mapping by Wagner, et al. (1991) is not at a sufficient detail to specify which member is present within the APD.

5.1.1.4 Riverbank Formation

The Riverbank Formation is mapped on the surface in the central portion of the APD. Sediments now known as the Riverbank Formation were first recognized in the Merced River area by Arkley (1962) and were given their current name in eastern Stanislaus and northern Merced Counties by Davis and Hall (1959). Marchand and Allwardt (1981) have divided the Riverbank Formation into three units (lower, middle, and upper) based on superposition, paleosols (buried soils), and on geomorphic evidence. All these units appear to coarsen upward. The three units are similar, and not all are present in all areas because of erosion.

The Riverbank Formation in the northeastern San Joaquin Valley is primarily composed of arkosic sand with some scattered pebbles, gravel lenses, as well as some interbedded fine sand and silt. Sediment was derived from the Sierra Nevada, located to the east. Some of the finer grained deposits are well-stratified and may have been deposited in ponds or small lakes (lacustrine); while some of the well-sorted sandy deposits may represent sand dune deposits (aeolian). In surface exposures, however, lacustrine and aeolian deposits are relatively minor. In fact, the finer-grained alluvium is not as extensively exposed as in the Turlock Lake and Modesto Formations (Marchand and Allwardt, 1981).

The Riverbank Formation terraces and fans cut into Turlock Lake Formation or fill post-Turlock Lake Formation gullies and ravines. In addition, the Riverbank Formation itself contains gullies on its surface that have been filled in by the overlying lower member of the Modesto Formation (Marchand and Allwardt, 1981).

Marchand and Allwardt (1981) state that like the Turlock Lake Formation, the Riverbank Formation has variable thickness depending on how close the deposit is to major rivers. Marchand and Allwardt (1981) provide a total thickness range inclusive of all three units of this formation of 66 to 262 ft, based on a summary of various other studies in various areas.

5.1.1.5 Turlock Lake Formation

The Turlock Lake Formation is mapped as being present on the eastern portion of the APD. In the northeastern San Joaquin Valley, the Turlock Lake is subdivided into two informally named units (lower unit and upper unit) that are separated by a buried, well developed soil horizon that marks a disconformity (Marchand and Allwardt, 1981). This formation commonly stands topographically above the younger fans and terraces throughout the northeastern San Joaquin Valley, and its upper surface has been modified by erosion so that little of the original depositional surface remains, including alluvial fan morphology. Both the upper contact with the Riverbank Formation and lower contact with the Mehrten Formation are unconformable along the eastern edge of the San Joaquin Valley (Marchand and Allwardt, 1981), suggesting periods of non-deposition. The formation was first recognized by Arkley (1962) and named by Davis and Hall (1959) for arkosic (sediment that contains at least 25 percent of the mineral Feldspar) silt, sand, and gravel in eastern Stanislaus and northern Merced Counties.

According to Marchand and Allwardt (1981), the sediments of Turlock Lake are commonly indistinguishable from those of the older Laguna Formation or of the younger Riverbank and Modesto Formations. The Turlock Lake Formation sediments contain distinctive, strongly developed haploxeralfs (Noncalcic Brown soils) and underlie a topography that is generally much more dissected than the topography that is associated with younger Modesto Formation or the Riverbank Formation.

The Turlock Lake Formation consists primarily of arkosic alluvium composed of mostly fine sand, silt, and, in some places, clay that grades upward into coarse sand and occasional coarse pebbly sand or gravel. Pebbles and gravels are composed of granitic as well as metamorphic and volcanic rocks. Marchand and Allwardt (1981) state that the gravel and sand beds are typically massive, lenticular, cross-bedded, and difficult to trace laterally; while the beds of finer-grained sediment are commonly well-sorted, well-stratified, and internally laminated and, in many places, contain virtually unweathered grains of micas, feldspars, and mafic minerals. Marchand and Allwardt (1981) also state that some of the beds are of lacustrine origin and contain plant impressions. Marchand and Allwardt (1981) provide a thickness range of between 295 ft and 1,033 ft based on a summary of previous studies. They also state that the maximum age for this unit may be as old as 730,000 years BP based on the presence of the Bishop Tuff in a clay bed located at the base of this formation.

5.2 Paleontological Resources

5.2.1 Locality Search

5.2.1.1 Natural History Museum of Los Angeles County

The results of the LACM locality search indicate that the proposed NCC crosses sediments likely originating in the Stanislaus River located to the east. Sediments that may be present include younger Quaternary Alluvium from the Holocene and several older formations from the Pleistocene, including the Modesto Formation, the

Riverbank Formation, and the Turlock Lake Formation. The LACM has no records of fossil localities from within the Holocene sediments, but states that there is one locality in the search radius within Pleistocene deposits that are not assigned to a particular formation. This locality, LACM 3513, is a generalized locality from the Oakdale area that contained fossil specimens of Columbian Mammoth (*Mammuthus columbi*), camel (*Camelops* sp.) and horse (*Equus* sp.). Based on the "Oakdale" location, it is possible that the locality could be in any of the three formations, Modesto, Riverbank, or Turlock Lake, that are present within the APD. It should be noted that the LACM results also included formations such as the Pliocene Laguna Formation and the Miocene to Pliocene Mehrten Formation; however, although these formations occur within the search radius they do not occur within the APD.

Per the LACM, shallow excavations in the soil and younger Quaternary Alluvium occurring at the surface in the APD are unlikely to encounter significant vertebrate fossils. However, deeper excavations in the APD that extend into older sedimentary deposits of the Modesto Formation, the Riverbank Formation, and the Turlock Lake Formation are more likely to encounter significant fossil vertebrate remains. Therefore, it is the recommendation of the LACM that any substantial excavations in the APD, therefore, should be monitored closely to recover any fossil remains uncovered during construction.

5.2.1.2 University of California Museum of Paleontology

According to the PIR that was prepared previously (Allen, 2009), the University of California Museum of Paleontology (UCMP) has records of numerous fossil localities from Pleistocene sediments in Stanislaus County, as well as within the surrounding Madera, Sacramento, Fresno, Modesto, and Yolo counties. Most of these localities are not identified to a specific formation or unit, but are only described as "Pleistocene". It is likely that many of these are from one of the three Pleistocene Sediments within the APD. The only Pleistocene aged fossils attributable to a specific formation are those from the Fairmead Landfill that is located in an area mapped as the Turlock Lake Formation. The majority of the Pleistocene fossils in the UCMP database, in both number and diversity, come from the Fairmead Landfill.

5.2.2 Literature Search Results

5.2.2.1 Artificial Fill

Artificial Fill can contain fossils, but these fossils have been removed from their original location and are out of context. They are not considered to be important for scientific study.

5.2.2.2 Unnamed Holocene Deposits

These sediments were deposited during the Holocene and are less than 11,700 years old. They are likely present in the upper 5 to 10 ft of all areas of the APD and likely overlie Pleistocene sediments. Although these sediments can contain remains of plants and animals, generally not enough time has passed for the remains to become fossilized. In addition, the remains are contemporaneous with modern species, and these remains are usually not considered to be significant.

5.2.2.3 Modesto Formation

Within the Modesto Formation, Ibarra et al. (2009) and Dundas et al. (2009) report the occurrence of bison from a locality near Fresno, approximately 120 miles to the southeast. Cehrs et al. (1979) report the occurrence of mammoth from two gravel pits within the Modesto Formation just to the north of Clovis, approximately 100 miles to the southeast.

Gust, et. al. (2012) report a very significant vertebrate collection from the upper and lower Modesto Formation during grading for the State Route 99 Arboleda Drive Project in Merced County, approximately 45 miles to the southeast. During monitoring a total of 1,667 fossils were collected from were collected from 39 project localities with depth ranging from 1.75 feet below the surface to 26.9 feet below the surface; with most falling in the range of 11 to 20 feet below the surface. Fossil specimens included large mammals like Columbian mammoth (*Mammuthus columbi*), giant ground sloth (*Paramylodom harlani*), western camel (*Camelops hesternus*), American llama (*Hemiauchena* sp.), ancient bison (*Bison antiquus*), two types of horse (*Equus occidentalis*, and *E. conversidens*), and deer (*Odocoileus hemionius*), dire wolf (*Canis dirus*), coyote (*Canis latrans*), and cougar (*Felis concolor*). Small mammals included jackrabbit (*Lepus californicus*) Audobon and Bachman's rabbits (*Sylvilagus auduboni* and *S. bachmani*), ground squirrel (*Spermophilus* sp.), kangaroo rat (*Dipodomys* sp.), pack rat (*Neotoma* sp.), pocket gopher (*Thomomys bottae*), vole (*Microtus* sp.), pocket mouse (*Perognathus* sp.), deer mouse (*Peromyscus* sp.), and harvest mouse (*Reithrodontomys* sp). Birds included Canada goose (*Branta canadensis*), California quail (*Calipepla californica*), western scrub jay (*Aphelocoma californica*), northern mocking bird (*Mimus polyglottos*), American robbin (*Turdus migratorius*), western meadowlark (*Sturnella neglecta*), and sparrow (*Zonotrichia* sp.). Fishes included minnows (Cyprinidae) and three-spine stickleback (*Gasterosteus aculeatus*). The western Pond turtle (*Clemmys marmorata*) was the only turtle identified. Snakes of the gopher snake family

(Colubridae) and rattlesnake (*Crotalus* sp.) were also found. In addition, several specimens of frog and toad were present, but could not be identified further.

The Modesto Formation was deposited during the Late Pleistocene and dates to the Rancholabrean North American Land Mammal Age (NALMA) (240,000-11,000 years BP). As such, fossils recovered from Late Pleistocene and Rancholabrean deposits elsewhere in California may also be found in Modesto Formation. Late Pleistocene vertebrates from San Joaquin County include horse, mastodon (*Mammut*), mammoth (*Mammuthus*), camelids, and bony fish (Jefferson, 1991a and 1991b,). Late Pleistocene fossils reported from Stanislaus County include giant ground sloths (*Paramylodon* and *Megalonyx*), horse, camel, bison (*Bison*), and gopher (*Thomomys*) (Jefferson, 1991a). Rancholabrean deposits elsewhere in California have also produced fossils of dire wolves, saber-toothed cats, bison, and other rodents, birds, reptiles, and amphibians (Bell et al., 2004; Rosenthal and Meyer, 2004:9-10; Savage, 1951; Stirton, 1951).

Based on their age, depositional environment, and the presence of fossils from other areas, the Late Pleistocene sediments of the Modesto Formation are sensitive for fossil resources and there is the possibility that scientifically significant paleontological resources may be discovered during project-related ground-disturbing activities. As such, the Modesto Formation is considered to have high paleontological sensitivity.

5.2.2.4 Riverbank Formation

Several fossils were found in this Formation during the construction and development of the ARCO Arena in Sacramento, California (Hilton, Daily and McDonald, 2000). Fossils from this formation include: Harlan's ground sloth (*Paramylodon harlani*); bison; coyote (*Canis cf. latrans*); horse; camel; squirrel (cf. *Sciurus* sp.), antelope (*Antilocapridae*), or deer (*Cervidae*); and mammoth; plant fossils include an unidentified leaf and a holly leaf cherry seed (*Prunus* cf. *ilicifolia*) (Jefferson, 1991a; Hilton, Dailey and McDonald, 2000). Based on the age of the Riverbank Formation that spans the period between the older Irvingtonian NALMA (1.8 million to 240,000 years BP) and the Rancholabrean NALMA (240,000 to 11,000 years BP), and the fact that it contains known paleontological resources, the Riverbank Formation is considered to have a high paleontological sensitivity.

5.2.2.5 Turlock Lake Formation

The Fairmead Landfill Fossil Locality contains some of the best examples of fossils from the Turlock Lake Formation. These fossils were found during paleontological mitigation monitoring associated with grading within the Fairmead Landfill located in Madera County beginning in 1993. The mid-Irvingtonian (0.78–.55 Ma) Fairmead Landfill locality has produced thousands of specimens representing 72 taxa (2 fish, 2 amphibians, 3 reptiles, 6 birds, 29 mammals, 1 bivalve, 1 gastropod, 12 plants/ palynomorphs, and 16 diatoms) (Dundas, et al., 1996). Some of these specimens include horse, camel, llama (*Tetrameryx irvingtonensis*), deer (*Odocoileus* sp.), ground sloths (Jefferson's ground sloth [*Megalonyx jeffersonii]*) and Harlan's ground sloth, saber-toothed cat (*Smilodon* sp.), dire wolf (*Canis dirus*), short-faced bear (*Arctodus* sp.), mammoth, pocket gopher (*Thomomys* sp.), diminutive antelope (*Capromeryx* sp.), coyote (*Canis latrans*), American cheetah (*Miracinonyx trumani*), pond turtle (*Clemmys* sp.), and tortoise (*Gopherus agassizii*) (Dundas, et al., 1996; UCMP search in Allen and Unsworth, 2012). Fossils from the Irvingtonian NALMA (1.8 million to 240,000 years BP) are less common than the younger Rancholabrean (240,000 to 11,700 years BP); as such fossils from the Turlock Lake Formation are very scientifically significant as they add to our understanding of vertebrate faunas from that time. Because it is known to contain vertebrate fossils, the Turlock Lake Formation is considered to have high paleontological sensitivity.

5.2.3 Records Search and Literature Search Conclusions

The specific sensitivities for units within the study area are listed in Table B according to the Paleontological Potential Sensitivity Scale used by Caltrans. Sensitivities (and potential) for the Modesto Formation, the Riverbank Formation, and the Turlock Lake Formation are all high based on the presence of significant fossil remains that have been recovered from these units in other areas. It is likely that similar significant resources may be encountered if these units are encountered during excavation associated with the NCC. Artificial Fill has no sensitivity; however, this layer may overlie sediments that are sensitive for paleontological resources (e.g., Modesto Formation). Unnamed Holocene Deposits are usually assigned a sensitivity of "low" as these they may transition into sediments that are sensitive for paleontological resources. In addition, Holocene deposits may be as old as 11,700 years, and the SVP considers paleontological resources to be older than 5,000 years. The Unnamed Holocene Deposits are too young to contain paleontological resources within the upper approximate 5 ft; however, once a depth of 5 ft is reached, it is more likely that the sediments from the Pleistocene will be encountered and these sediments have been documented to contain scientifically significant paleontological resources. Thus, once a depth of 5 ft is reached, the paleontological sensitivity of the APD becomes high, unless it can be shown that excavation in a particular area will be in Artificial Fill at depths deeper than 5 ft.

Table B: Geologic Units and Paleontological Sensitivity[1] within the North County Corridor Project APD

Geologic Unit	Paleontological Sensitivity (Caltrans)
Artificial Fill	None
Unnamed Holocene Deposits	Low 0 to 5 feet; High >5 ft
Modesto Formation	High
Riverbank Formation	High
Turlock Lake Formation	High

Source: SVP and Caltrans Guidelines.
[1] Also known as Paleontological Potential
APD = Area of Project Disturbance
Caltrans = California Department of Transportation
SVP = Society of Vertebrate Paleontology

- High sensitivity is based on formations or mappable rock units that are known to contain, or have the correct age and depositional conditions, to contain significant paleontological resources.
- Low sensitivity is based on formations that are not known, or do not have the correct age or depositional conditions, to contain significant paleontological resources.
- Artificial Fill has no sensitivity but may overlie sediments that are sensitive for paleontological resources.

5.2.4 Results Summary

Per the excavation parameters described in Section 1.4, ground disturbance associated with the NCC is anticipated to disturb sediments with high potential to contain significant, nonrenewable paleontological resources. Although it is not anticipated that special paleontological situations, such as articulated skeletons or dense concentrations of bones, are present in the APD that would require project redesign to avoid critical localities or strata, the entire APD is located in sediments identified as having high paleontological sensitivity below a depth of approximately 5 ft beneath the original ground surface. One LACM fossil locality is within the 1-mile search radius around the APD and could potentially be within the APD near the city of Oakdale. The LACM data was not precise enough to give an actual street address or coordinates; simply naming it “Oakdale”. Research has documented numerous fossil localities from other areas in the San Joaquin and Sacramento Valleys within the same three Pleistocene Formations that are present within the NCC.

Chapter 6 Recommendations

Based on the results of this PER, it is recommended that a PMP be prepared by a qualified paleontologist in accordance with the Caltrans SER guidelines. The PMP should be prepared following selection of a preferred alternative and when the design has reached a sufficient level of detail to accurately determine potential impacts to paleontological resources.

Key sections of the PMP include:

- **Description of the Resource:** A description of the rock units, boundaries of the fossiliferous formations, and locations of exposures in the vicinity of the project study area and in the APD.
- **Scientific Importance:** A clear, concise description of why the paleontological resource is significant or has scientific importance, and how fossils and associated information recovered during mitigation could be used by future researchers to fill current paleontological data gaps.
- **Scope of Work:** The work plan to mitigate project effects, including all fieldwork and laboratory efforts. This may include:
    - Procedures for interfacing paleontological and construction personnel should be developed in consultation with the Resident Engineer (RE).
    - Construction monitoring programs should be outlined.
    - Salvage methods should be outlined, from large specimen recovery to collection and processing of microfossils.
    - Recovered specimens should be prepared to a point of identification and stabilized for preservation in conformance with individual repository requirements.
    - All recovered specimens should be cataloged using the format of the proposed curation facility.
    - Not all located fossils need to be recovered. Criteria for the discarding of specific fossil specimens should be made explicit.
- **Decision Thresholds:** How and when fieldwork will achieve the mitigation goals, allowing fieldwork to cease, or any circumstances under which additional effort might be needed to achieve mitigation goals.
- **Schedule:** The schedule for completing the proposed work may appear as text or in graphic form (e.g., a timeline) and include a relative start date (i.e., based on

the construction schedule), the duration of fieldwork and laboratory processing, and the time required for report preparation.

- **Justification of Cost Estimate:** Provides narrative support for the cost estimate, including the basis for person-hour estimates, clarification of overhead percentages, and any other costs.
- **Cost Estimate:** This is often presented as an appendix; this documentation should present a tabular summary of costs for the proposed effort and include all proposed numbers and levels of personnel, time, and costs.
- **Curation:** The curation facility should be identified and a draft curation agreement included. A curation agreement with an approved facility must be in place prior to initiating any paleontological monitoring or mitigation activities.

The PMP should incorporate the "Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources" published by the SVP (2010) along with conditions of receivership that the repository institution will require when receiving fossils recovered from the construction project.

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City of Riverbank

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Appendix A Resume

BROOKS SMITH

ASSOCIATE/PALEONTOLOGIST

LSA

EXPERTISE

Paleontological Assessment Reports and Paleontological Resources Impact Mitigation Programs

Archaeological and Paleontological Mitigation Monitoring Reports

Paleontological and Archaeological Resource Monitoring

Archaeological Excavation

Fossil Collection, Salvage, Identification and Curation

GPS Data Collection and Analysis

Geologic Data Collection and Interpretation

EDUCATION

University of California, Santa Cruz, B.S., Earth Science (Geology), 1989.

California State University, Fullerton, Archaeological field methods course on San Nicolas Island, June–July 1993.

PROFESSIONAL RESPONSIBILITIES

Mr. Smith is a project manager at LSA with 21 years of experience in paleontology. He is responsible for scheduling paleontological and archaeological monitors on both large- and small-scale projects, as well as acting as an intermediary between clients and agencies such as the United States Department of Interior, Bureau of Land Management (BLM), and the United States Department of Agriculture, Forest Service (Forest Service). Mr. Smith also prepares paleontological assessment reports, paleontological resources impact mitigation programs (PRIMPs), and monitoring reports following the completion of both cultural and paleontological mitigation monitoring.

While in the field, Mr. Smith acts as a Field Director or Co-Field Director during field surveys for paleontological and archaeological resources prior to grading activities. Mr. Smith also monitors for and collects cultural and scientific resources during grading activities; documents and tests archaeological sites; assists with the salvage of large fossil remains with the use of plaster casts; assists with large-scale wet and dry screening of sediments for fossils; collects and analyzes data from handheld global positioning system (GPS) units; and collects and analyzes geologic and geomorphic data for use in reports.

PROJECT EXPERIENCE

Coyote Canyon Landfill
Newport Beach, California
Mr. Smith provided paleontological mitigation monitoring during the time the Coyote Canyon Landfill was active. Mr. Smith collected resources, prepared resources to the point of identification, identified collected resources, and input the resources into the fossil catalog.

Frank R. Bowerman (FRB) Landfill
Orange County, California
Mr. Smith has provided paleontological resources monitoring on this project and assisted in the salvage of large-scale paleontological resources. Mr. Smith has prepared several year-end summary reports as well as 3-year summary reports documenting monitoring activities as well as finds. Mr. Smith also prepared a paleontological resources assessment for the landfill

Prima Deshecha Landfill
San Juan Capistrano, California
Mr. Smith provided paleontological mitigation monitoring during excavation associated with landfill operations and collected paleontological resources as they were uncovered by the grading operations. Mr. Smith also assisted with cultural resources testing of several prehistoric sites that were within proposed expansion areas.

BROOKS SMITH
ASSOCIATE/PALEONTOLOGIST

PROFESSIONAL EXPERIENCE

Archaeological and Paleontological Surveyor, Monitor, Excavator, and Report Preparer; and Paleontological Field Director, LSA Associates, Inc., Irvine, California, July 1992–present.

Geologist, Mission Geoscience, Newport Beach, California, November 1993–February 1994.

Paleontologist, John Minch and Associates, San Juan Capistrano, California, February–June 1992.

Geologist, Soil and Testing Engineers, Inc., Placentia, California, September 1989–February 1992.

CERTIFICATIONS

40-Hour Hazardous Materials Handling and Response, current through January 2015

County of Orange, Certified Paleontologist

City of San Diego Qualified Paleontologist

PROFESSIONAL ORGANIZATIONS/ MEMBERSHIPS

San Diego Association of Geologists

UCSC Alumni Association

Society of Vertebrate Paleontology

PROJECT EXPERIENCE (CONTINUED)

California Department of Transportation
Orange, Riverside, and San Bernardino Counties, California
Mr. Smith has prepared numerous Paleontological Investigation Reports (PIRs) and Paleontological Evaluation Reports (PERs) for the California Department of Transportation (Caltrans) following the guidelines in the Caltrans Standard Environmental Reference, Environmental Handbook, Volume 1, Chapter 8 – Paleontology. These reports are usually combined into a single document and involve geological formation studies, paleontological research at local museums, and field surveys to help determine whether proposed Caltrans projects will encounter paleontological resources during project development, and if so, whether those paleontological resources are significant. Mr. Smith has also prepared Paleontological Mitigation Plans (PMPs) for Caltrans that include developed paleontological mitigation procedures that must be in place during Caltrans road widening projects in order to protect the significant paleontological resources that have the potential to be encountered during grading.

The Bluffs Retail Center
Newport Beach, California
LSA was retained by the Irvine Company to provide cultural and paleontological resource mitigation monitoring during grading associated with the Bluffs Retail Center located in Newport Beach. Mr. Smith provided archaeological and paleontological monitoring for this project. Mr. Smith also assisted with the salvage of several fossil localities that contained significant fossil shark teeth. Mr. Smith was also the lead author for the final paleontological mitigation monitoring report.

Orchard at Saddleback, Phase I
Lake Forest, California
LSA was retained by W.A.L.F. LLC to provide cultural and paleontological resource mitigation monitoring during grading associated with the Phase I portion of the Orchard at Saddleback, located within the City of Lake Forest. Mr. Smith provided archaeological and paleontological monitoring during grading and was the lead author for the final paleontological mitigation monitoring report.

Orchard at Saddleback, Phase II
Lake Forest, California
LSA was retained by We Trust America to provide cultural and paleontological resource mitigation monitoring during grading associated with the Phase II portion of the Orchard at Saddleback, located within the City of Lake Forest. Mr. Smith provided archaeological and paleontological monitoring during grading and was the lead author for the final paleontological mitigation monitoring report, as well as co-author for the cultural resources monitoring report.

PROJECT EXPERIENCE (CONTINUED)

Del Mar Fairgrounds
Del Mar, California
LSA was retained by the 22nd District Agricultural Association to provide technical studies needed to assist the 22nd District Agricultural Association during future expansion plans at the Fairgrounds. Mr. Smith authored the paleontological resources assessment report.

Laguna Canyon Road (State Route 133) Widening
Orange County, California
LSA was retained by Caltrans to provide cultural and paleontological resource mitigation monitoring along Laguna Canyon Road during its widening and realignment between State Route 73 (SR-73) and Old Laguna Canyon Road. Mr. Smith provided archaeological and paleontological monitoring for this project, as well as preparation of stratigraphic sections and identification of paleontological specimens. Mr. Smith also assisted on the excavation of archaeological site CA-ORA-1055 and was the lead author for the final paleontological mitigation monitoring report, as well as a contributing author for the final archaeological mitigation monitoring report.

Los Coches Creek Area Middle School
El Cajon, California
Mr. Smith performed a cultural resources survey of an 80-acre parcel as part of an assessment report prior to the construction of the school. During the survey, Mr. Smith recorded numerous undiscovered prehistoric and historic cultural resources.

Marine Corps Base Camp Pendleton
San Diego, California
LSA was contracted to conduct extensive testing of an ethnographically recorded village site. Mr. Smith provided cultural resource testing of Site CA-SDI-10156/H. LSA was contracted to provide cult6ural resource monitoring during removal of potentially hazardous soil in the Stewart Mesa area of the base. Mr. Smith delineated known cultural resource sites and provided monitoring during excavation.

Southern California Edison (SCE) On-Call
Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties, California
LSA performs archaeological resource assessments for SCE’s pole replacement program. Assessments include record searches for previously recorded resources and studies; field surveys around poles; recordation observed resources, if any; and recommendations. To date, over 1,000 poles have been assessed. Mr. Smith performed field surveys, recorded resources, and synthesized data.

State Route 73 Widening
Costa Mesa, California
LSA was contracted to provide paleontological monitoring during the widening of SR-73 between stations 74+00 and 82+00. The project area is located in the median of SR-73 within an approximately 0.5-mile stretch between the Birch Street overcrossing on the south and the northbound Bristol Street overcrossing on the north. Mr. Smith provided paleontological monitoring and fossil identification, and wrote the mitigation monitoring report.

PROJECT EXPERIENCE (CONTINUED)

San Joaquin Hills Transportation Corridor (State Route 73)
Orange County, California
LSA was contracted to provide paleontological mitigation monitoring for the San Joaquin Hills Transportation Corridor between El Toro Road in the south and Newport Coast Drive in the north. Mr. Smith provided paleontological resource monitoring (scheduling up to five monitors), fossil identification and curation, and assisted with writing the final mitigation monitoring report.

State Route 71 (SR-71) Widening
Chino, California
LSA was contracted to provide paleontological and cultural resource monitoring during the widening of SR-71. Mr. Smith provided paleontological and cultural resource monitoring, fossil identification, and curation of collected paleontological remains.

El Camino Real Widening North of Cougar Drive
Carlsbad, California
LSA provided paleontological resources mitigation monitoring during the widening of a portion of El Camino Real north of Cougar Drive in the City of Carlsbad from two lanes to three. The project involved removing a section of hill measuring approximately 100 feet long, 30 feet wide, and up to 15 feet high in the Cretaceous Point Loma Formation. LSA collected several fossil localities containing clams, snails, crabs, and plant material. Mr. Smith provided some of the monitoring for this project, and was the lead author for the mitigation monitoring report.

San Diego Gas & Electric (SDG&E) On-Call Environmental Services
California
LSA provides support documentation to SDG&E to satisfy Natural Communities Conservation Plan (NCCP), California Environmental Quality Act, California Public Utility Commission (CPUC), California Coastal Commission, United States Army Corps of Engineers (Corps), California Department of Fish and Game (CDFG), and Regional Water Quality Control Board requirements. Mr. Smith mainly works on SDG&E projects that require cultural resource studies. Representative projects include the following:

- **Shadowridge-Meadowlark Tap: Rebuild TL 13811:** LSA provided a cultural resource assessment for an approximately 4-mile transmission line located in San Diego. The assessment included a cultural resources search through the South Coastal Information Center, and an intensive pedestrian survey for all proposed new pole locations and staging areas. Finally, LSA made recommendations for each separate pole location. Mr. Smith was involved in all aspects of the cultural resource assessment.
- **Firestorm 2007 Environmental and Biological Monitoring:** LSA provided on-call support for monitoring services immediately following the October 2007 wildfires in San Diego, including documentation of access road regrading and erosion control consultation; data compilation, analysis, and interpretation; and data form entry for compliance with Corps Regional General Permit 63. Mr. Smith provided both cultural and biological surveys along several of the burned pole alignments.

PROJECT EXPERIENCE (CONTINUED)

Southern California Gas Company (SCG)
Los Angeles County, California
LSA was retained by SCG to provide cultural resource monitoring for its Line 85, Line 119, and Line 225 located in the Angeles National Forest (ANF) north of Castaic Lake. As these lines pass through the ANF and are located on land under the jurisdiction of the Forest Service, it was necessary for LSA to apply for an Archaeological Resources Protection Act (ARPA) Permit for each line. LSA's role on these projects was to ensure that mitigation measures developed by the Forest Service to protect cultural resources were implemented and followed. These measures included: providing worker training for the identification and importance of cultural resources; protecting the National Register of Historic Places-listed Old Ridge Route, a historic road built in 1915 between Los Angeles and Bakersfield; monitoring for cultural resources during construction and having a monitor present at each work area; counting and documenting the numbers and types of vehicles traveling along the Old Ridge Route on a daily basis; and providing video documentation of the Old Ridge Route both before and after the project was completed. Mr. Smith was the project manager for these three SCG projects and scheduled up to three monitors per day at various locations, depending on daily construction needs; provided cumulative vehicle counts on a weekly basis to the ANF; and coordinated between the ANF archaeologist and SCG as needed. Mr. Smith also assisted in preparing reports at the completion of each project documenting the results of the monitoring.

South Orange County Infrastructure Improvement Project, State Route 241 (SR-241)
Orange and San Diego Counties, California
The Transportation Corridor Agencies (TCA) proposes extending existing SR-241 from its current terminus at Oso Parkway south to Interstate 5, just south of San Clemente. The project is located in portions of both southern Orange County and northern San Diego County. Mr. Smith assisted during surveying all the unsurveyed portions of the project, recording new cultural resources that were discovered and writing the survey reports and other cultural resource documents associated with this project. Mr. Smith also provided cultural resource clearance during the initial geotechnical investigations associated with the project to ensure no undiscovered cultural resources were impacted.

Plains All American Pipeline (PAAPL)
Los Angeles County, California
LSA was retained as a subconsultant to Stantec Consulting to provide cultural resource monitoring during repairs to several of PAAPL's pipelines (including Line 2000 and Line 63), and during a geotechnical investigation to address landslide problems in the Angeles National Forest (ANF) north of Castaic Lake. As these projects are located on lands administered by the Forest Service, it was necessary for LSA to apply for an ARPA Permit for each project to protect cultural resources and ensure all protection measures required by the Forest Service were implemented and followed. These measures included: providing worker training for the identification and importance of cultural resources; protecting the National Register of Historic Places-listed ORR, a historic road built in 1915 between Los Angeles and Bakersfield; monitoring for cultural resources during construction and having a monitor present at each work area; counting and documenting the numbers and types of vehicles traveling along the ORR on a daily basis; and providing video documentation of the ORR both before and after each project's completion. Mr. Smith was the project manager for projects and scheduled monitors, provided cumulative vehicle counts on a weekly basis to the Forest Service; provided coordination between the Forest Service archaeologist, PAAPL, and Stantec as needed; and assisted with the preparation of the final monitoring reports.

Moro Ridge Radio Site Project
Crystal Cove State Park, California
Mr. Smith prepared a paleontological resources assessment for the Moro Ridge Radio Site project. This project proposed to add an 800-megahertz (MHz) public safety radio facility to the Newport Coast area, where coverage is currently lacking. The assessment included an examination of geology maps, research into expected fossils within the geologic formations in the project area, a field survey to confirm the geology and determine whether there were any paleontological resources exposed on the surface of the project area, and recommendations for mitigating impacts to paleontological resources during construction.

SELECTED REPORTS

Paleontological Resources Analysis for the SR-55/Newport Boulevard Improvement Project, City of Costa Mesa, County of Orange, California. LSA project number TRT1101A. September 2012.

Paleontological Resources Identification Report for the State Route 55 Improvement Project Between Interstate 405 and Interstate 5, Cities of Santa Ana, Irvine, and Tustin, County of Orange, California. Report prepared for the California Department of Transportation, District 12. LSA project number HDR1102. September 2012.

Paleontological Mitigation Plan for the State Route 73 Detention Basin Storm Water Mitigation and Slope Stability Project, Cities of Laguna Niguel, Aliso Viejo, Laguna Beach, Irvine, and Newport Beach, County of Orange, California. Report prepared for the California Department of Transportation, District 12. LSA project number CDT1120. August 2012.

Paleontology Memo for the Towne Center Residential Project, City of Lake Forest County of Orange, California. LSA project number CLF1201. July 2012.

Paleontological Resources Assessment for the Camarillo Academy High School + Performing Arts Center, Ventura County, California. Report prepared for the Oxnard Union High School District. LSA project number OSD1102. July 2012.

Paleontological Resources Identification and Evaluation Report for the State Route 57/Lambert Road Interchange Improvement Project, City of Brea, County of Orange, California. Report prepared for the California Department of Transportation, District 12. LSA project number RBF1104. May 2012.

Paleontological Resources Impact Mitigation Plan for the CVS Pharmacy Store, City of Menifee, County of Riverside, California. Report prepared for KZ Development Company, LP. LSA project number KDZ1001. March 2012.

Paleontological Resources Impact Mitigation Plan for the South Coast Winery Report and Spa Hotel Expansion, Riverside County, California. Report prepared for South Coast Winery, Resort and Spa. LSA project number SGV1001. March 2012.

Paleontological Locality Search of the Proposed Valle Vista Channel Extension Project in the Community of Valle Vista, Riverside County, California. Letter report prepared for the Riverside Flood Control and Water Conservation District. LSA project number RCF1102. February 2012.

Paleontological Resources Assessment for the Taft Recycling and Sanitary Landfill, Kern County California. Report prepared for the Kern County Waste Management Department. LSA project number KCY1102. February 2012.

Paleontological Resources Assessment for the Cottonwood Avenue Building Expansion Project, City of Riverside, Riverside County, California. Report prepared for PanCal Sycamore Canyon 257 LLC. LSA project number PNC1101. February 2012.

Paleontological Mitigation Plan for the I-10/Tippecanoe Avenue Interchange Improvement Project, Phase 2, Cities of Loma Linda and San Bernardino, San Bernardino County, California. Report prepared for the California Department of Transportation, District 8. LSA project number RMN0802A. February 2012.

Paleontological Resources Identification and Evaluation Report for the Shoemaker Bridge Replacement Project, City of Long Beach, Los Angeles County, California. Report prepared for the California Department of Transportation, District 7. LSA project number URS1002. December 2011.

Paleontological Resource Assessment and Paleontological Resources Impact Mitigation Monitoring Plan for Stratford Ranch Industrial Park, Tentative Tract 36382, City of Perris, Riverside County, California. Report prepared for Mission Pacific Land Company. LSA project number MPL1101. December 2011.

Paleontological Mitigation Report for the Interstate 215/State Route 74 Interchange Improvements Project, Riverside County, California. Report prepared for the California Department of Transportation, District 8. LSA project number RCN1002. December 2011.

Paleontological Resources Assessment for the Quail Brush Generation Project, San Diego County, California. Report prepared for Tetra Tech EC. LSA project number TTE1101. November 2011.

Paleontological Mitigation Plan for the Tippecanoe Avenue Interchange Improvement Project, Phase 1, Cities of Loma Linda and San Bernardino, San Bernardino County, California. Report prepared for the California Department of Transportation, District 8. LSA project number RMN0802A. November 2011.

Paleontological Assessment for the Vancouver Street Sewer Extension Project, City of Carlsbad, San Diego County, California. Letter report prepared for the City of Carlsbad. LSA project number HCR1103A. November 2011.

Paleontological Analysis fort the State Route 125/State Route 94 Interchange Branch Connector Project, San Diego County, California. LSA project number TYL1003. October 2011.

Supplemental Paleontological Resources Identification and Evaluation Report for the Mid County Parkway Project, Riverside County, California. Report prepared for the California Department of Transportation, District 8. LSA project number JCV531. September 2011.

Paleontological Mitigation Plan, I-15/I-215 Interchange Improvements Project, Community of Devore, San Bernardino County, California. Report prepared for the California Department of Transportation, District 8. LSA project number LIM0705. September 2011.

Paleontological Monitoring Report for Geotechnical Trench Excavations for the I-15/I-215 Interchange Improvements Project, Community of Devore, San Bernardino County, California. Report prepared for the California Department of Transportation, District 8. LSA project number LIM0705. August 2011.

Paleontological Resources Assessment, Tentative Tract 36382, Altfillisch Property Project, City of Eastvale, Riverside County, California. Report prepared for Altfillisch Construction Company. LSA project number AFL1101. July 2011.

Addendum, Paleontological Identification and Evaluation Report for the Interstate 215/Barton Road Interchange Improvement Project, Cities of Grand Terrace and Colton, San Bernardino County, California. Report prepared for the California Department of Transportation, District 8. LSA project number SBA330. July 2011.

Paleontological Resources Assessment for the Southern California Edison Banducci Substation and Telecommunications Routes Project, Tehachapi, Kern County, California. Letter report prepared for Southern California Edison. LSA project number SCE1105A. July 2011.

Paleontological Resource Assessment for Utility Pothole Program, Interstate 15/Interstate 215 Interchange Improvements Project, San Bernardino County, California. Letter report prepared for the California Department of Transportation, District 8. LSA project number LIM0705. June 2011.

Paleontological Resources Assessment for the Ocotillo Sol Photovoltaic Project, Imperial County, California. Letter report prepared for the Bureau of Land Management, California Desert District. LSA project number SGE0905-T009B. May 2011.

Paleontological Mitigation Recommendations for Utility Pothole Program, Interstate 15/Interstate 215 Interchange Improvements Project, San Bernardino County, California. Letter report prepared for the California Department of Transportation, District 8. LSA project number LIM0705. April 2011.

Results of Archaeological Resource Monitoring for Plains All American Pipeline Line-2000 Dig 20 and 21 Anomaly Repair Projects, Angeles National Forest, Los Angeles County, California. Report prepared for Angeles National Forest, Supervisor’s Office. LSA project numbers SNS1003 and SNS1005. April 2011.

Paleontological Resources Assessment for the Chevron Pipe Line Company Midway-Belridge Pipeline Replacement Project, Kern County, California. Report prepared for Chevron Pipe Line Company. LSA project number SNS1004. March 2011.

Cultural Resources Assessment and Class III Inventory for the Chevron Pipe Line Company Midway-Belridge Pipeline Replacement Project, Kern County, California. Report prepared for Chevron Pipe Line Company. LSA project number SNS1004. March 2011.

Paleontological Resources Assessment for the Perris Boulevard Widening Project, City of Perris, Riverside County, California. Letter report prepared for Mr. Kenneth Phung. LSA project number TLK1001. February 2011.

Paleontological Resources Assessment for the Perris Boulevard Widening Project, City of Perris, County of Riverside, California. Letter report prepared for the City of Perris. LSA project number TLK1001. February 2011.

Paleontological Resources Identification and Evaluation Report for the Shoemaker Bridge Replacement Project, City of Long Beach, Los Angeles County, California. Report prepared for the California Department of Transportation, District 7. LSA project number URS1002. February 2011.

*Cultural Resources Monitoring for the Restoration Work for Southern California Gas Company's Line-85 Permanent Repairs Project, Angeles National Forest, Los Angeles County, Californi*a. Letter report prepared for the Angeles National Forest on behalf of Southern California Gas Company. LSA project number SCG0801. January 2011.

Paleontological Assessment for the Five Winds Ranch Project, City of Yucaipa, San Bernardino County, California. Letter report prepared for the City of Yucaipa Public Works Department. LSA project number YCA1002. November 2010.

Paleontological Mitigation Plan Mission Boulevard Widening Project, City of Ontario, San Bernardino County, California. District 08-SBD-O-Ontario. EA 08-924850. Report prepared for the California Department of Transportation, District 8. LSA project number DMJ0602. October 2010.

Paleontological Assessment for the CVS Pharmacy Store, Huntington Beach, California. Letter Report prepared for KZ Development Company, LP. LSA project number KDZ1002. October 2010.

Paleontological Assessment for the 5-Winds Ranch, City of Yucaipa, California. Letter Report prepared for the Public Works Department, City of Yucaipa. LSA project number YCA1102. October 2010.

Paleontological Resource Assessment for the Southern California Edison Pisgah Substation Upgrade/Expansion, San Bernardino County, California. Letter report prepared for Southern California Edison. LSA project number SCE0801Y. September 2010.

Paleontological Mitigation Report for the Vail Lake Transmission Main and Pump Station Project, Riverside County, California. Report prepared for Kennedy/Jenks Consultants. LSA project number KJE0601. September 2010.

Results of Cultural *Resources Monitoring for the Southern California Gas Company Ivy Street Bridge Pipeline Boring Project, City of Murrieta, County of Riverside, California.* (co-authored with Terri Fulton). Prepared for San Diego Gas and Electric Company. LSA project number SCG0602k. September 2010.

Results of Archaeological Resource Monitoring for Plains All American Pipeline Line-2000 Templin Highway Anomaly Repair Project, Angeles National Forest, Los Angeles County, California. (Co-authored with Antonina Delu, M.A., RPA). Prepared for the Angeles National Forest on behalf of Stantec Consulting Services. LSA project number SNS1002. September 2010.

Results of Archaeological Resource Monitoring for Plains All American Pipeline Osito Canyon Geotechnical Boring Project, Angeles National Forest, Los Angeles County, California. (Co-authored with Antonina Delu, M.A., RPA). Prepared for the Angeles National Forest on behalf of Stantec Consulting Services. LSA project number SNS1001. September 2010.

Paleontological Mitigation Plan for State Route 91 Widening Project Between State Route 55 and State Route 24, Cities of Anaheim and Yorba Linda, Orange County, California. District 12-ORA-91, PM 9.1 to 15.1. Prepared for the California Department of Transportation, District 12. LSA project number CDT1001. May 2010.

C*ultural Resources Monitoring for the Southern California Gas Company Trabuco Creek Bridge Betterment Project (eTS8327), City of San Juan Capistrano, Orange County, California.* Letter Report prepared for the City of San Juan Capistrano on behalf of Southern California Gas Company. LSA project number SCG0902. March 2010.

Results of Archaeological Resource Monitoring for Southern California Gas Company Line-119 Abandonment Project, Angeles National Forest, Los Angeles County, California. (Co-authored with Antonina Delu, M.A., RPA). Prepared for the Angeles National Forest on behalf of Southern California Gas Company. LSA project number SCG0602J. March 2010

Results of Archaeological Resource Monitoring for Southern California Gas Company Line-225 - Templin Highway Repair Project, Angeles National Forest, Los Angeles County, California. (Co-author with Antonina Delu, M.A. RPA) Prepared for the Angeles National Forest on behalf of Southern California Gas Company. LSA project number SCG0602I. March 2010.

Paleontological Resources Identification and Evaluation Report for State Route 91 Corridor Improvements Project, Cities of Anaheim, Yorba Linda, Corona, Norco and Riverside Counties of Orange and Riverside, California. Districts 8 and 12 – ORA-91-R14.43/R18.91; RIV-91-R0.00/R13.04; RIV-15-35.64/45.14. (Co-authored with Robert Reynolds and Michael Pasenko) Prepared for the California Department of Transportation, District 8. LSA project number PAZ0701. January 2010.

Paleontological Mitigation Report for the Widening of El Camino Real North of Cougar Drive, City of Carlsbad, San Diego County, California. Report prepared for the City of Carlsbad, Design Division. LSA project number HCR0803. January 2010.

Paleontological Resources Mitigation Plan for the Vail Lake Transmission Main and Pump Station Project, Riverside County, California. Report prepared for Kennedy/Jenks Consultants. LSA project number KJE0601. January 2010.

Draft Paleontological Identification and Evaluation Report for State Route 91 Westbound Widening (Northbound State Route 55 to the Westbound State Route 91 Connector through the Tustin Avenue Interchange), City of Anaheim, Orange County, California. Prepared for the California Department of Transportation, District 12. LSA project number CDT0806B. January 2010.

Paleontological Resources Assessment for the Imperial Valley Photovoltaic Project. Prepared for SDG&E Environmental Services. LSA project number SGE0905-T009B. December 2009.

Paleontological Resource Analysis of the Interstate 215/Washington Street Interchange Project, Cities of Colton and Grand Terrace, San Bernardino County, California. LSA project number SBA330. October 2009.

Cultural Resource Monitoring for the Del Obispo Street Undergrounding of Overhead Utilities and Widening, City of San Juan Capistrano, Orange County, California. (With Deborah McLean as primary author.) Prepared for the City of San Juan Capistrano. LSA project number CSJ0803. September 2009.

Paleontological Identification and Evaluation Report for I-215 High Occupancy Vehicle Gap Closure Project Cities of Colton, Grand Terrace San Bernardino, San Bernardino County, and City of Riverside, Riverside County, California. Prepared for the California Department of Transportation, District 8. LSA project number SBA330. August 2009.

Results of Archaeological Resource Monitoring for Southern California Gas Company Line-85 Permanent Repairs Project, Angeles National Forest, Los Angeles County, California. (Co-authored with Antonina Delu, M.A., RPA). Prepared for the Angeles National Forest on behalf of Southern California Gas Company. LSA project number SCG0801. August 2009.

Paleontological Mitigation Plan State Route 91 Eastbound Lane Addition Project Between State Route 241 and State Route 71, Orange County, California, and Riverside County, California. Prepared for the California Department of Transportation, District 12. LSA project number CDT0805. May 2009.

Paleontological Resources Letter Report for the Moro Ridge Radio Site Project, Orange County, California. Prepared for the County of Orange. LSA project number ORG0801. May 2009.

Paleontological Identification and Evaluation Report for I-10/Tippecanoe Avenue Interchange Project, Cities of Loma Linda and San Bernardino, San Bernardino County, California. Prepared for the California Department of Transportation, District 8. LSA project number RMN0802. April 2009.

Paleontological Resources Due Diligence for the Lazy W Ranch Project in Hot Springs Canyon, Orange County California. Memo Prepared for Erin Razban, LSA Associates, Inc. LSA project Number LZW0901. March 2009.

Paleontological Resources Assessment for the Hanford Municipal Airport Improvements Project, City of Hanford, Kings County, California. Prepared for Mead & Hunt, Inc. LSA project number MHN0801. February 2009.

Paleontological Resources Identification and Evaluation Report for SR-73 Basin Sedimentation Project Between Jamboree Road and I-5/SR-73 Interchange; Cities of Laguna Niguel, Aliso Viejo, Laguna Beach, Irvine, and Newport Beach; County of Orange, California. Prepared for the California Department of Transportation, District 12. LSA project number CDT0807. January 2009.

Appendix B Locality Search Results from the Natural History Museum of Los Angeles County

Natural History Museum
of Los Angeles County
900 Exposition Boulevard
Los Angeles, CA 90007

tel 213.763.DINO
www.nhm.org

Vertebrate Paleontology Section
Telephone: (213) 763-3325
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e-mail: smcleod@nhm.org

30 December 2013

LSA Associates, Inc.
20 Executive Park, Suite 200
Irvine, California 92614

Attn: Brooks Smith, Associate, Cultural & Paleontological Resources Group

re: Paleontological Resources Records Check for the proposed North County Corridor Project, LSA Project # DHG1301, Task 4.27, in the Cities of Modesto, Riverbank and Oakdale, Stanislaus County, project area

Dear Brooks:

I have thoroughly searched our paleontology collection records for the locality and specimen data for the proposed North County Corridor Project, LSA Project # DHG1301, Task 4.27, in the Cities of Modesto, Riverbank and Oakdale, Stanislaus County, project area project area as outlined on the portions of the Avena, Salida, Escalon, Riverbank, Oakdale, Waterford, Knights Ferry, and Paulsell USGS topographic quadrangle maps that you sent to me via e-mail on 11 December 2013. We have one vertebrate fossil locality that lies within the boundaries of the proposed project area, another locality that lies just outside the boundary, and additional localities somewhat nearby from the same sedimentary deposits that occur in the proposed project area.

The general geologic setting for the entire proposed project area is one of fluvial deposits derived from the Stanislaus River and other drainages from the Sierra Nevada Mountains to the east. Older deposits occur in the east closer to the mountains and the younger deposits anywhere in the drainages and predominate in the lower lying western portions of the proposed project area. From youngest to oldest the geologic units in the proposed project area are: younger Quaternary Alluvium of Holocene age to Recent; the Pleistocene age Modesto Formation, Riverbank Formation, and Turlock Lake Formation; the Pliocene age Laguna Formation; and the late Miocene to Pliocene age Mehrten Formation.

The younger Quaternary Alluvium deposits, occurring at the surface mostly in active drainages in the proposed project area, typically do not contain any significant vertebrate fossils, at least in the uppermost layers, and we have no vertebrate fossil localities anywhere nearby from these deposits. At relatively shallow depth, however, the younger Quaternary Alluvium is often underlain by older sedimentary deposits that may well contain significant fossil vertebrate remains. We do not have any fossil vertebrate localities designated as coming from the Pleistocene deposits that occur in the proposed project area: the Modesto, Riverbank, and Turlock Lake Formations. We do have a vertebrate fossil locality that occurs within the proposed project area, though, that probably comes from one of these rock units. Our vertebrate fossil locality LACM 3513, an older generalized locality only designated as being from Oakdale, produced fossil specimens of Columbian mammoth, *Mammuthus columbi*, camel, *Camelops*, and horse, *Equus*.

We do not have any vertebrate fossil localities designated as coming from the Laguna Formation, although that sedimentary rock unit of consolidated alluvium has the potential to produce vertebrate fossils. We have one vertebrate fossil locality just outside the boundaries of the proposed project area that probably comes from the Mehrten Formation. This locality, LACM 3949, situated east-northeast of Oakdale on the northern side of the Stanislaus River in the bluffs above Rodden Road just east of McLeod Road, produced fossil specimens of horse, Equidae, rhinoceros, *Teleoceras*, and camel, *Titanotylopus*. Just southeast of the proposed project area, around the Modesto Reservoir and Turlock Lake, we have a considerable number of vertebrate fossil localities from the Mehrten Formation, including LACM 3904-3947, 3950, 4670, 4953, and 5375-5376. These localities have produced an extensive composite fossil fauna (see faunal list in an appendix). Of particular note, J. A. Harrison figured a specimen of extinct wolverine, *Plesiogulo marshalli*, from one of these localities (1981. A Review of the Extinct Wolverine, *Plesiogulo* (Carnivora: Mustelidae), from North America. Smithsonian Contributions to Paleobiology, 46:1-27). In additional, D. R. Prothero (2005. The Evolution of North American Rhinoceroses. Cambridge University Press, Cambridge, UK 218 pp.) published on fossil rhinoceras, *Teleoceras*, specimens from these localities and X. Wang et al. (1999. Phylogenetic Systematics of the Borophaginae (Carnivora: Canidae). Bulletin of the American Museum of Natural History, 243:1-391) as well as Z, J. Tseng (2011. Variation and implications of intra-dentition Hunter-Schreger band pattern in fossil hyaenids and canids (Carnivora, Mammalia). Journal of Vertebrate Paleontology, 31(5):1163-1167) published on the fossil dogs *Osteoborus*, *Borophagus parvus* and *Borophagus secundus*, from these Mehrten Formation deposits.

Shallow excavations in the soil and younger Quaternary Alluvium occurring at the surface in the proposed project areas are unlikely to encounter significant vertebrate fossils. Deeper excavations in the proposed project area that extend into older sedimentary deposits, as well as any excavations in the exposures of the Modesto Formation, the Riverbank Formation, the Turlock Lake Formation, the Laguna Formation or the Mehrten Formation, however, may well encounter significant fossil vertebrate remains. Any substantial excavations in the proposed project area, therefore, should be monitored closely to quickly and professionally recover any fossil remains uncovered while not impeding development. Any fossils collected should be placed in an accredited scientific institution for the benefit of current and future generations.

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosures: appendix, invoice

Composite fossil fauna from the Mehrten Formation
based on specimens from the LACM collections

Osteichthyes	
Cypriniformes	
Cyprinidae	- minnows
Salmoniformes	
Salmonidae	- salmon
Oncorhynchus	
Amphibia	
Anura	
Bufonidae	- toads
Bufo	
Ranidae	- frogs
Rana	
Urodela	
Plethodontidae	- lungless salamanders
Batrachoseps	
Reptilia	
Squamata	
Anguidae	- alligator lizards
Gerrhonotus	
Colubridae	- colubrid snakes
Coluber	
Diadophis	
Pituophis	
Thamnophis	
Testudinata	
Emydidae	- pond turtles
Clemmys	
Testudinidae	- tortoises
Geochelone	
Aves	
Anseriformes	
Anatidae	- geese
Branta	
Passeriformes	- perching birds
Podicipediformes	
Podicipedidae	- grebes

Composite fossil fauna from the Mehrten Formation
based on specimens from the LACM collections [continued]

- Mammalia
  - Artiodactyla
    - Antilocapridae - pronghorn antelopes
      - *Ilingoceros*
    - Camelidae - camels
      - *Hemiauchenia vera*
      - *Megatylopus*
      - *Procamelus*
    - Palaeomerycidae - deer-like even-toed ungulates
      - *Pediomeryx*
    - Tayassuidae - peccaries
      - *Prosthennops*
  - Carnivora
    - Canidae - dogs
      - *Borophagus parvus*
      - *Borophagus secundus*
      - *Canis*
      - *Osteoborus cyonoides*
      - *Vulpes*
    - Felidae - cats
      - *Pseudaelurus*
    - Mustelidae - fishers, martens, wolverines etc.
      - *Martes*
      - *Plesiogulo marshalli*
      - *Sminthosinus*
    - Procyonidae - raccoons
      - *Procyon*
    - Ursidae - bears
  - Insectivora
    - Soricidae - shrews
      - *Cryptotis*
    - Talpidae - moles
      - *Scalopoides*
  - Lagomorpha
    - Leporidae - rabbits
      - *Hypolagus edensis*
      - *Hypolagus furlongi*
      - *Hypolagus limnetus*
      - *Hypolagus vetus*

Composite fossil fauna from the Mehrten Formation
based on specimens from the LACM collections [continued]

Mammalia		
Perissodactyla		
Equidae		- horses
Dinohippus	*interpolatus*	
Neohipparion	*gidleyi*	
Plesippus		
Pliohippus		
Rhinocerotidae		- rhinoceroses
Teleoceras		
Proboscidea		
Gomphotheriidae		- gomphothere elephants
Rodentia		
Castoridae		- beaver
Dipoides	*vallicula*	
Hystricops		
Cricetidae		- deer mice
Peromyscus		
Geomyidae		- pocket gophers
Pliosaccomys		
Heteromyidae		- pocket mice
Perognathus		
Sciuridae		- squirrels
Spermophilus	*argonatus*	
Xenarthra		
Megalonychidae		- ground sloths