

**PALEONTOLOGICAL IDENTIFICATION REPORT/
PALEONTOLOGICAL EVALUATION REPORT
STATE ROUTE HIGHWAY 1 AUXILIARY LANES AND BUS-ON-
SHOULDER IMPROVEMENTS – FREEDOM BOULEVARD TO
STATE PARK DRIVE – AND COASTAL RAIL TRAIL SEGMENT 12
PROJECT, UNINCORPORATED SANTA CRUZ COUNTY,
CALIFORNIA**

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Submitted to:



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Commission**
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SUMMARY OF FINDINGS

This combined Paleontological Identification Report and Paleontological Evaluation Report assesses the potential for impacting fossil resources for the proposed State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project (project) in Santa Cruz County, California. The California Department of Transportation (Caltrans) is the lead agency for the project under California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA).

The purpose of the project is to:

- Reduce congestion along Highway 1 through the project limits.
- Enhance bicycle and pedestrian connectivity along Segment 12 of the Coastal Rail Trail.
- Promote the use of alternative transportation modes to increase transportation system capacity and reliability.
- Provide Coastal Rail Trail access across State Route 1 at the two railroad bridges.

The project would include replacing the existing bridge over Aptos Creek and Spreckels Drive with a new bridge, replacing the two railroad bridges over Highway 1, and construction of a bicycle and pedestrian trail along an approximately 1.14-mile segment of the Santa Cruz Branch Line railroad right of way, from Rio Del Mar Boulevard to State Park Drive.

The project surface is mapped as the late Miocene to Pliocene (6.9 – 2.6 million years ago [Ma]) Purisima Formation; Pleistocene (2.6 Ma - 11,700 years ago) alluvial fan deposits, undivided aromas sand, eolian aromas sand, and marine terrace deposits; and Holocene (11,700 years old to modern) alluvium, dune sand, and basin deposits. The records search produced no records of vertebrate fossils within the project area or within a one-mile buffer around the project area, however eleven invertebrate localities from the Purisima Formation were discovered in that radius.

Thirty-five vertebrate localities were present from the Purisima Formation throughout Santa Cruz County; many of which were recovered from the Santa Cruz area. Notably, specimens of sea cow, various pinnipeds, dolphins and whales, sea birds, and fish have been recovered from this formation throughout the county. Several Pleistocene vertebrate fossils have been found within Santa Cruz County including two occurrences of Columbian mammoth (†*Mammuthus columbi*), deer (*Cervus* sp.), and unidentified mammal.

¹ † Taxon is extinct although all fossils from deposits older than Pleistocene are likely from extinct species.

Alison Bryson-Deveraux of Cogstone Resource Management, Inc. (Cogstone) performed a paleontological field survey of the project area on February 17, 2021. Areas along either side of Highway 1 were heavily graded and most embankments were either built up with a mix of native disturbed soil, artificial fill and gravels, or fenced and partially paved. Observable sediments were consistent with geologic mapping of deposits in the project area. No fossil resources were observed during the survey.

For the most part, fossils of extinct Pleistocene animals start appearing at about eight feet below the surface of California's large valleys where Holocene deposits are mapped at the surface. Accordingly, all areas mapped as Holocene-aged sediments are assigned low sensitivity less than eight feet below the original surface, increasing to high sensitivity at depths of greater than eight feet. Due to the abundant vertebrate fossils that have been recovered from the Purisima and Pleistocene-aged sediments elsewhere in the county, these units are given a high paleontological sensitivity at any depth. As a result, ground disturbance during project construction in these areas has the potential to disturb geologic units with high paleontological potential which could adversely affect paleontological resources. However, implementation of the proposed measures below would reduce impacts on paleontological resources to less than significant.

- Prior to the start of excavations, a qualified Principal Paleontologist (M.S. or Ph.D. in paleontology or geology and familiar with paleontological procedures and techniques) will be retained to prepare and implement a detailed Paleontological Mitigation Plan (PMP) prior to the start of construction. The PMP will include the following elements and stipulations:
 - The PMP will identify all areas where excavation will disturb *in situ* geologic units identified as highly sensitive for paleontological resources.
 - Spot checking may be required to confirm the extent of the low sensitivity deposits should they overlie high sensitivity units. This includes areas of artificial fill and Holocene sediments.
 - Full time monitoring will be required where disturbance more than eight feet deep into Holocene-aged sediments as well as all impacts to the Purisima Formation and Pleistocene-aged sediments.
 - Requirements for reduction of monitoring effort.
 - The paleontological monitor's authority to temporarily halt or divert construction equipment to investigate finds.
 - Protocols for fossil recovery, preparation, and curation.
 - Other pertinent items for the PMP as per Caltrans (2016).
- The qualified Principal Paleontologist will be present at pre-grading meetings to consult with grading and excavation contractors.
- Before excavation begins, a training session on fossil identification and the procedures to

follow should fossils be encountered will be conducted by the Principal Paleontologist or their designee for all personnel involved in earthmoving for the project.

- If unanticipated discoveries of paleontological resources occur during project construction, all work within 25 feet of the discovery must cease and the find must be protected in place until it can be evaluated by a qualified paleontologist. Work may resume immediately outside of the 25-foot radius.

INTRODUCTION

PURPOSE OF STUDY

This report presents the results of paleontological identification and evaluation study for the State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder (BOS) Improvements – Freedom Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project Highway 1 Auxiliary Lanes (State Park Drive to Freedom Boulevard) Project (project; Figures 1 – 5). This report combines the functions of the California Department of Transportation’s (Caltrans) Paleontological Identification Report (PIR) and Paleontological Evaluation Report (PER), as defined in Chapter 8 on “Paleontology” of Caltrans’ Standard Environmental Reference. Caltrans is the lead agency for the project under California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA).

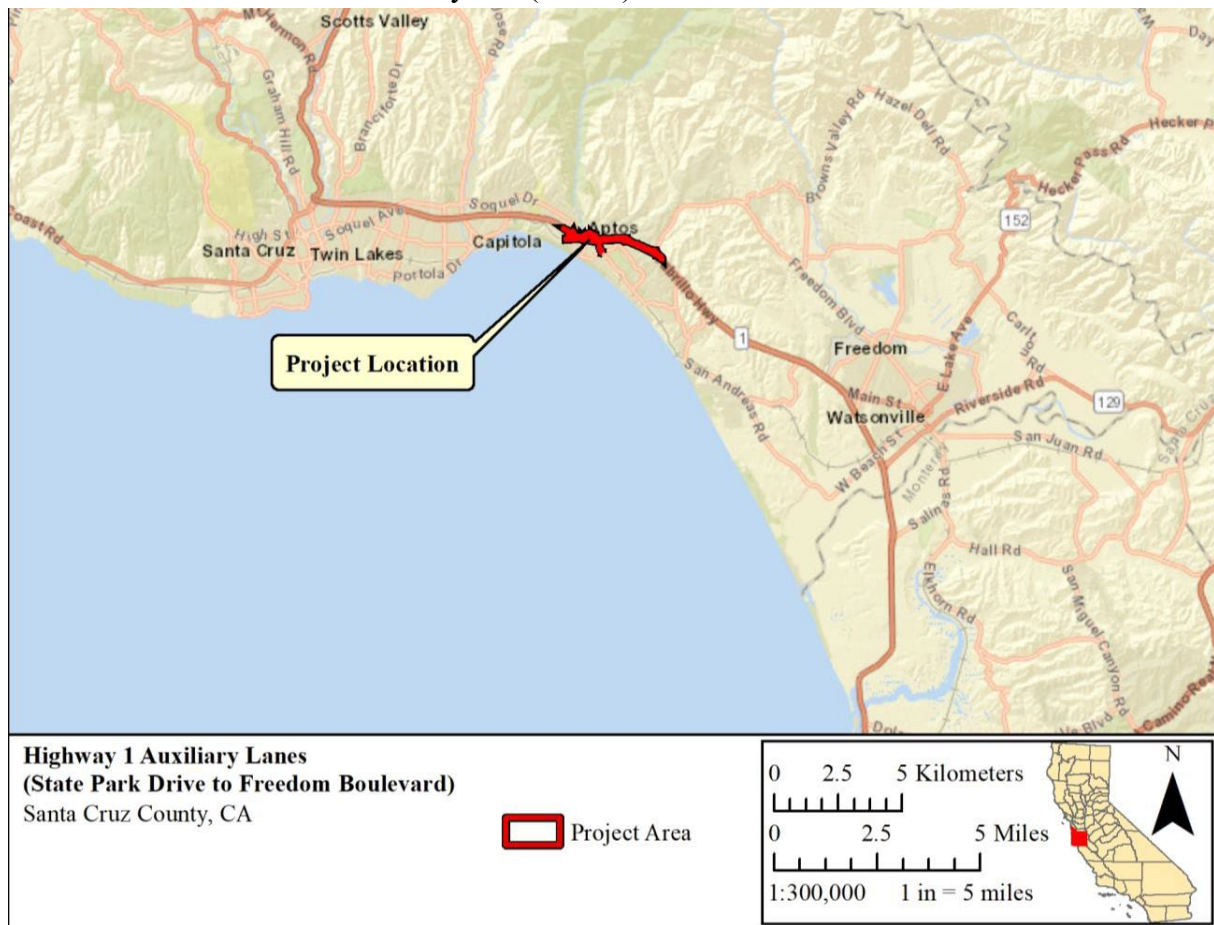


Figure 1. Project vicinity

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER

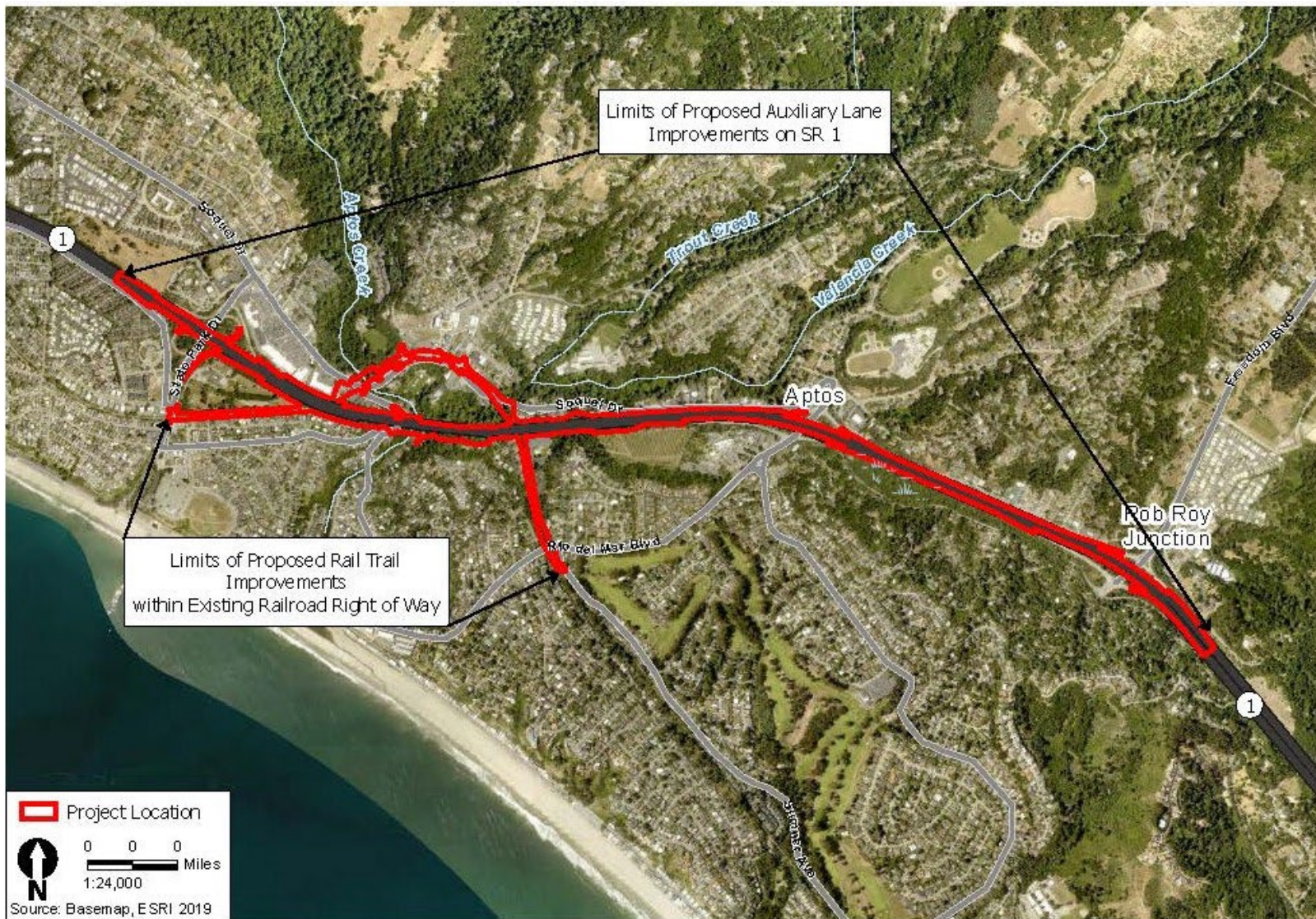


Figure 2. Project location

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER

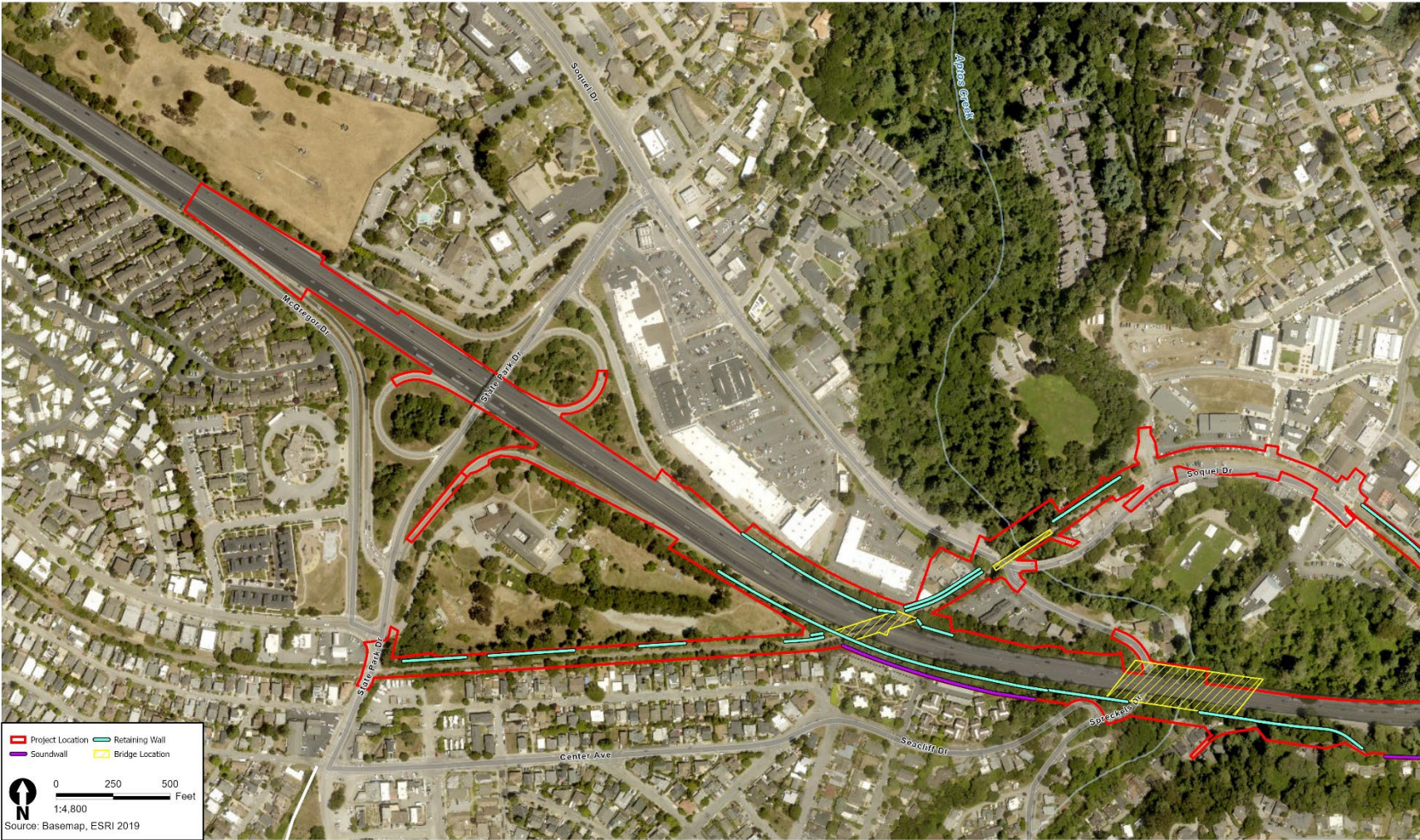


Figure 3. Western portion of project area

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER



Figure 4. Central portion of project area

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER



Figure 5. Eastern portion of project area

PURPOSE AND NEED

PURPOSE

The purpose of the project is to:

- Reduce congestion along State Route 1 (SR-1) through the project limits.
- Enhance bicycle and pedestrian connectivity along Segment 12 of the Coastal Rail Trail.
- Promote the use of alternative transportation modes to increase transportation system capacity and reliability.
- Provide Coastal Rail Trail access across SR-1 at the two railroad bridges.

NEED

The project is needed because:

- Several bottlenecks along SR-1 in the southbound and northbound directions cause congestion during peak hours, significantly delaying drivers.
- “Cut-through” traffic, or traffic on local streets, is increasing because drivers are seeking to avoid congestion on SR-1.
- There are limited opportunities for pedestrians and bicyclists to safely get across SR-1 and navigate the project corridor, even though portions of the project area are designated as regional bicycle routes.
- There are insufficient incentives to increase transit service in the SR-1 corridor because congestion threatens reliability and cost-effective transit service delivery.

PROJECT DESCRIPTION

Auxiliary Lanes

Auxiliary lanes are designed to improve merging operations and reduce conflicts between traffic entering and exiting SR 1 by connecting the on-ramp of one interchange to the off-ramp of the next; they are not designed to serve through traffic. A southbound auxiliary lane and a northbound auxiliary lane would be added to the following segments of SR 1:

- Between the Freedom Boulevard and Rio Del Mar Boulevard interchanges.
- Between Rio Del Mar Boulevard and State Park Drive interchanges.

The total roadway widening would be approximately 2.6 miles in length. Southbound, the auxiliary lanes would begin at the existing State Park Drive loop on-ramp and end at the existing off-ramp to Freedom Boulevard. Northbound, the auxiliary lanes would begin at the existing Freedom Boulevard on-ramp and end at the existing diagonal off-ramp to State Park Drive.

The new auxiliary lanes would be 12 feet wide. From Freedom Boulevard to Rio Del Mar Boulevard, the width needed for the new lane would be added in the median. The existing median barrier would be reconstructed in its current location. From Rio Del Mar Boulevard to State Park Drive, the width

needed for the new lane would be added outside the existing shoulders; the outside shoulders would be standard 10-foot-wide.

Moosehead Drive to the south of SR 1, south of Aptos Creek, would be realigned where it runs parallel to SR 1 due to the outside widening of SR 1. A new retaining wall would be placed along the outside freeway shoulder to support the realignment that would include horizontal and vertical adjustments.

Structures – State Route 1

Auxiliary lane work would include the replacement of the two Santa Cruz Branch Line railroad bridges over SR 1 and widening of the SR 1 bridge over Aptos Creek and Spreckels Drive to accommodate the proposed auxiliary lanes. The existing two-span Santa Cruz Branch Line railroad bridges (underpass structures) are proposed to be replaced with longer spans to accommodate the planned SR 1 ultimate improvements that are a six-through-lane concept plus an auxiliary lane in each direction between interchanges. The ultimate SR 1 configuration was approved in the Final Environmental Impact Report/Environmental Assessment with a Finding of No Significant Impact for the Tier I High Occupancy Vehicle (HOV) Lanes and Tier II 41st Avenue to Soquel Avenue/Drive Auxiliary Lanes Project (Tier I/Tier II Final EA/EIR/FONSI). In addition to the railroad bridges, new trail overcrossings would be constructed adjacent to the new railroad bridges for the ultimate trail configuration of the Coastal Rail Trail Segment 12 for the SR 1 improvements.

The widening of the SR 1 bridge over Aptos Creek and Spreckels Drive would occur on the south side of SR 1 only and require abutment walls along the existing embankments along the south side of Aptos Creek and the embankment on the north side of Spreckels Drive. The widened bridge would accommodate six lanes, each 12-foot wide (four through-lanes plus an auxiliary lane in each direction), 10-foot-wide outside shoulders, and a 9-foot-wide median with a 2-foot-wide inside shoulder in the northbound direction and 5-foot-wide inside shoulder in the southbound direction. To accommodate the SR 1 ultimate improvements of six through-lanes plus an auxiliary lane in each direction, the SR 1 bridge over Aptos Creek and Spreckels Drive would be widened to the north (inland) side as part of a future project.

Retaining Walls – State Route 1

The build alternative would include retaining walls at the following locations along SR 1 (Figure 3).

Northbound

- “SR1” Station 258+90 – 261+26; max height = 15 feet
- “SR1” Station 288+07 – 296+00; max height = 15 feet

Southbound

- “SR1” Station 258+55 – 263+01; max height = 20 feet
- “SR1” Station 265+55 – 268+56; max height = 12 feet

- “SR1” Station 269+71 – 270+70; max height = 12 feet
- “SR1” Station 273+20 – 277+02; max height = 20 feet
- “SR1” Station 277+02 – 278+98; max height = 30 feet
- “SR1” Station 281+56 – 284+41; max height = 35 feet
- “SR1” Station 284+41 – 296+45; max height = 15 feet

The build alternative would evaluate sound walls at the following locations along SR 1.

Northbound

- “SR1” Station 258+57 – 267+49

Southbound

- “SR1” Station 263+18 – 266+78
- “SR1” Station 267+31 – 272+50
- “SR1” Station 284+79 – 291+52

Bus-on-Shoulder Features

BOS features are proposed, which would allow future bus operations on the outside shoulders of SR 1 through the interchanges during peak congestion periods. At the Freedom Boulevard, Rio Del Mar Boulevard, and State Park Drive interchanges, the project would widen and improve SR 1 shoulders, which currently lack the width and pavement structural section to support bus operations. The added auxiliary lanes coupled with the BOS improvements allow the transit operator to use the auxiliary lane in between interchanges and use the shoulder between the off-ramp and on-ramps through the interchanges. Within the Freedom Boulevard, Rio Del Mar Boulevard, and State Park Drive interchange areas, the highway shoulders would be 12 feet wide.

Other Features – State Route 1 Bus-on-Shoulder

New signs would be installed to advise motorists that only buses are allowed to use the highway shoulders through interchanges during peak traffic hours. Along northbound SR 1, a sign would be provided south of each of the three interchanges in the project area. Along southbound SR 1, a sign would be installed north of each interchange. Shoulders would be painted red to indicate bus-only use.

Coastal Rail Trail Segment 12

The limits of Coastal Rail Trail Segment 12 extend from the southern terminus of the trail segment at Sumner Avenue, just of the south of the Rio Del Mar Boulevard underpass, to the northern terminus at State Park Drive. The proposed Coastal Rail Trail Segment 12 includes the construction of a paved bicycle and pedestrian shared use trail within the SCBRL right-of-way on the inland side of the tracks, consistent with the approved Monterey Bay Sanctuary Scenic Trail (MBSST) Network Master Plan (MBSST Network Master Plan), with an optional first phase. The trail segment would include a new at-grade trail connection to Sumner Avenue just south of the Rio Del Mar Boulevard underpass where the existing railroad tracks pass under Rio Del Mar Boulevard and a new sidewalk on the north side of Sumner Avenue between the terminus of the trail and the existing sidewalk on Rio Del Mar Boulevard.

Structures

Coastal Rail Trail Segment 12 improvements cross several structures:

- At the two locations where the existing railroad bridges cross over SR 1, the Rail Trail will be placed adjacent to the reconstructed rail underpasses.
- Where the Rail Trail crosses over Aptos Creek, Valencia Creek and Soquel Drive, the existing structures have been evaluated for their load bearing capacities, and it has been determined there is not enough data to cantilever the Rail Trail. Therefore, the project would include construction of new Rail Trail bridges adjacent to the existing railroad structures.
- For areas where the Rail Trail is on an independent structure from the railroad bridges or grade, the separation between the two structures would be a minimum of 5 feet.

Retaining Walls

Retaining walls would be constructed in the following locations for the Coastal Rail Trail Segment 12 alignment.

- North of SR 1 (towards State Park Drive) – An approximate 6-foot high, 300-foot long retaining wall on the inland side of the trail.
- SR 1 to Soquel Drive—Retaining wall varying in height between approximately 5-feet and 20-feet, approximately 300-feet long on the inland side of the trail.
- Aptos Creek to Aptos Creek Road—Retaining wall varying in height between approximately 2-feet and 18-feet, approximately 400-feet long on the inland side of the trail.
- Trout Gulch Road to Valencia Creek—Retaining wall varying in height between approximately 2-feet and 18-feet, approximately 450-feet long on the inland side of the trail.
- South of SR 1 (towards Rio Del Mar Boulevard)—An approximate 12-foot-high, 400-foot long retaining wall on the inland side of the trail.
- Under Rio Del Mar Boulevard – Retaining wall varying in height between approximately 4-feet and 16-feet, approximately 1,000-feet long on the inland side of the trail.

Fencing

Fencing to separate trail users and the railroad for the ultimate trail improvements is proposed as shown in Figure 4. In accordance with the Federal Railroad Administration guidelines, there would be a 10-foot offset from the centerline of the railroad to the edge of the trail, although an 8-foot-6-inch offset from the centerline of the railroad may be allowed in some circumstances. The fencing would be constructed using concrete posts (4 feet 6 inches in height) etched to resemble wood, and multiple smooth wire strands. Fence post construction is anticipated to require 3-foot-deep excavation. The new trail bridges over Aptos Creek, Valencia Creek, and Soquel Drive would include a railing.

The Project is anticipated to require right of way acquisitions and utility relocations to accommodate the pavement widening and bridge work. Temporary construction easements are anticipated to be needed to construct retaining walls, sound walls, and the bridges.

Methods

PROJECT STUDY AREA

The project is mapped within section 13 of Township 11 South, Range 1 West and sections 16, 17, and 18 of Township 11 South, Range 1 East on the Soquel and Watsonville West 7.5-minute United States Geological Survey topographic maps within the Mount Diablo Base Meridian.

The project area spans approximately 2.6 miles along and adjacent to Highway 1.

PREVIOUS STUDIES

The preparation of this report included consulting a previous Paleontological Evaluation Report for the Santa Cruz-Aptos High Occupancy Vehicle Lane Widening Project (Fisk 2008, 2011) prepared for the Tier I/Tier II EIR/EA, as well as a Paleontological Evaluation Report for the State Route 1 Auxiliary Lanes from State Park Drive to Bay Avenue/Porter Street in Santa Cruz, California (Richards 2020). Additionally, the combined Tier I/Tier II Environmental Impact Report / Environmental Assessment (EIR/EA), which included High Occupancy Vehicle Lanes as the long-term vision (Tier I planning level) for a nine-mile corridor of SR-1, and Auxiliary Lanes between 41st Avenue and Soquel Drive for near-term implementation (Tier II project level) was consulted for this study.

PROJECT PERSONNEL

Cogstone Resource Management Inc. (Cogstone) conducted the initial paleontological resources studies. A brief resume of the principal investigator is appended (Appendix A). Additional qualifications of key Cogstone staff are available at <http://www.cogstone.com/key-staff/>.

- Kim Scott served as the Principal Paleontologist for the project and co-wrote this report. Scott has a M.S. in Biology with an emphasis in paleontology from California State University, San Bernardino, a B.S. in Geology with an emphasis in paleontology from the University of California, Los Angeles, and over 25 years of experience in California paleontology and geology.
- Eric Scott served as the task manager and reviewed this report for quality control. Eric has an M.A. in anthropology, with an emphasis in biological paleoanthropology, from UCLA, and more than 36 years of experience in California paleontology.
- Kelly Vreeland co-authored this report. Kelly has an M.S. in geology, with an emphasis in paleontology, from CSU, Fullerton, as well as 10 years of experience in California paleontology and geology.
- Logan Freeberg prepared the geographic information system (GIS) maps used throughout this

report. Logan has a B.A. in anthropology from the University of California, Santa Barbara and a certificate in GIS from California State University, Fullerton, as well as 15 years of experience in California archaeology.

- Alison Bryson-Deveraux conducted the intensive pedestrian survey. Alison has a B.A. in anthropology from the UC, Santa Barbara and an M.A. in Historic Preservation from Prescott College, Arizona, as well as 12 years of experience in California archaeology.
- Debbie Webster provided technical editing.

This report was revised in 2022 by Stantec Consulting Services Inc. (Stantec) to address slight design changes and incorporate more recent geologic mapping. As the changes to the overall project footprint were minimal and did not extend beyond the area originally surveyed by Cogstone, an additional field survey was not conducted. Qualifications of key personnel are as follows:

- Alyssa Bell served as Principal Paleontologist and authored the revisions to the report initially prepared by Cogstone. Alyssa has a Ph.D. in paleontology from the University of Southern California and over 18 years of experience as a paleontologist.
- Geraldine Aron served as task manager and reviewed the report for quality control. Geraldine has a M.S. in geology from California State University Long Beach and over 24 years of experience as a paleontologist.
- Elisa Barrios prepared the updated GIS geology mapping for the revised project area. Elisa has a B.S. in geology for California State University, Los Angeles and an M.S. in GIS from the University of Southern California, with two years of experience in GIS work.

BACKGROUND

GEOLOGICAL SETTING

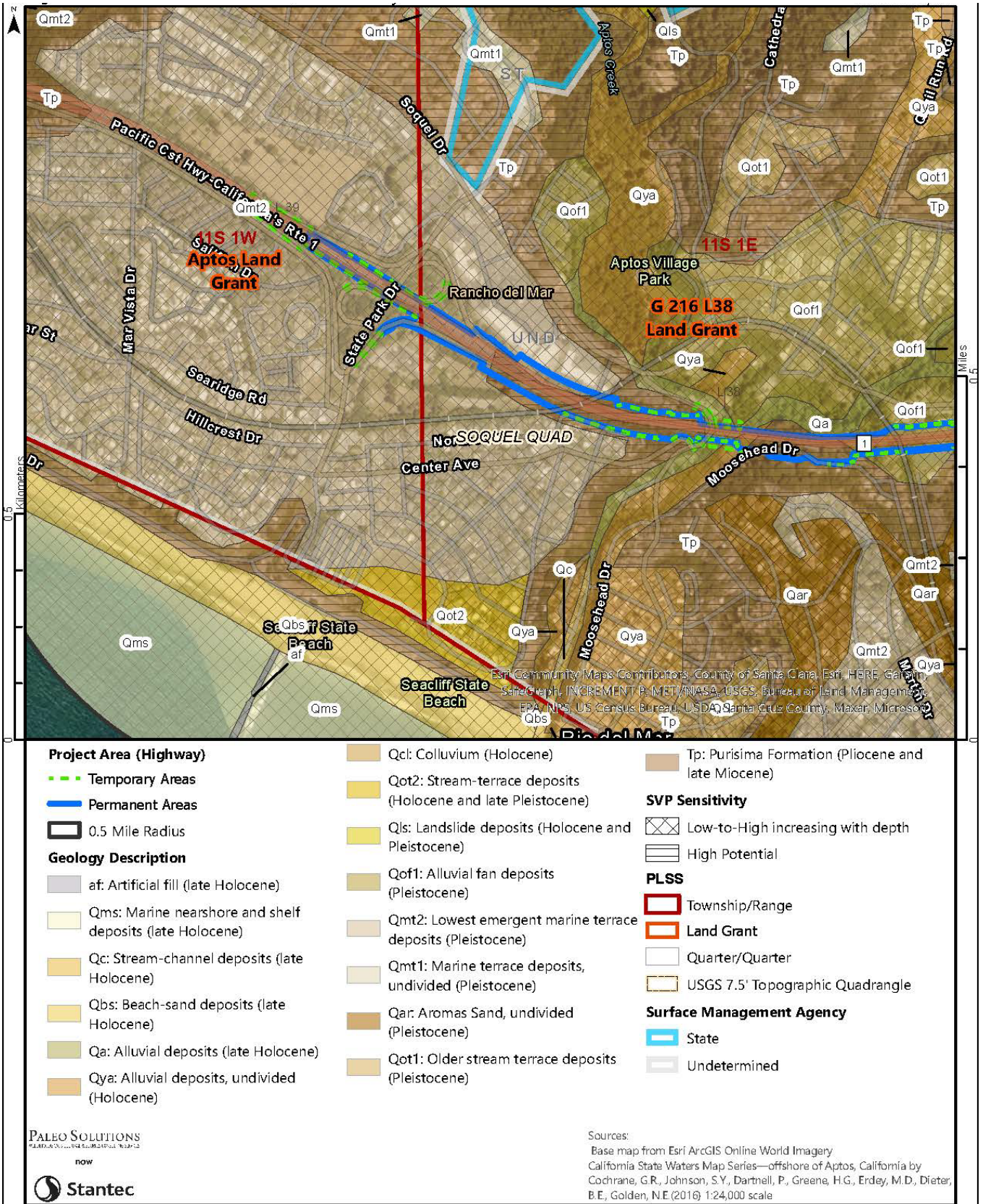
This project lies within the Coast Ranges Geomorphic Province. The Coast Ranges are typified by northwest-southeast trending mountains and valleys roughly parallel to the San Andreas Fault Zone. Mountains of the Coast Ranges are typically late Mesozoic to Cenozoic age (less than 200 million years old) and consist of metamorphic and sedimentary rocks.

STRATIGRAPHY

The project surface is mapped as the late Miocene to Pliocene (6.9 – 2.5 million years ago [Ma]) Purisima Formation; Pleistocene (2.6 Ma - 11,700 years ago)-aged sediments consisting of alluvial fan deposits, undivided Aromas Sand, eolian Aromas Sand, and marine terrace deposits; Holocene-aged (11,700 years old to modern) sediment consisting of alluvium, alluvial fan deposits, and colluvium; and artificial fill (Cochrane et al. 2016) (Figure 6 through Figure 8)

PURISIMA FORMATION, PLIOCENE AND UPPER MIOCENE (PPU)

The Purisima Formation consists of yellowish-gray tuffaceous and diatomaceous siltstone containing thick interbeds of bluish-gray, semifriable, fine-grained andesitic sandstone that occasionally contains shale, chert, and volcanic ash (Brabb 1997). This formation represents



State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER



State Route Highway 1 Auxiliary Lanes and Bus-on Shoulder Improvements – Freedom Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER
Figure 7. Geologic map of central Project area

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER

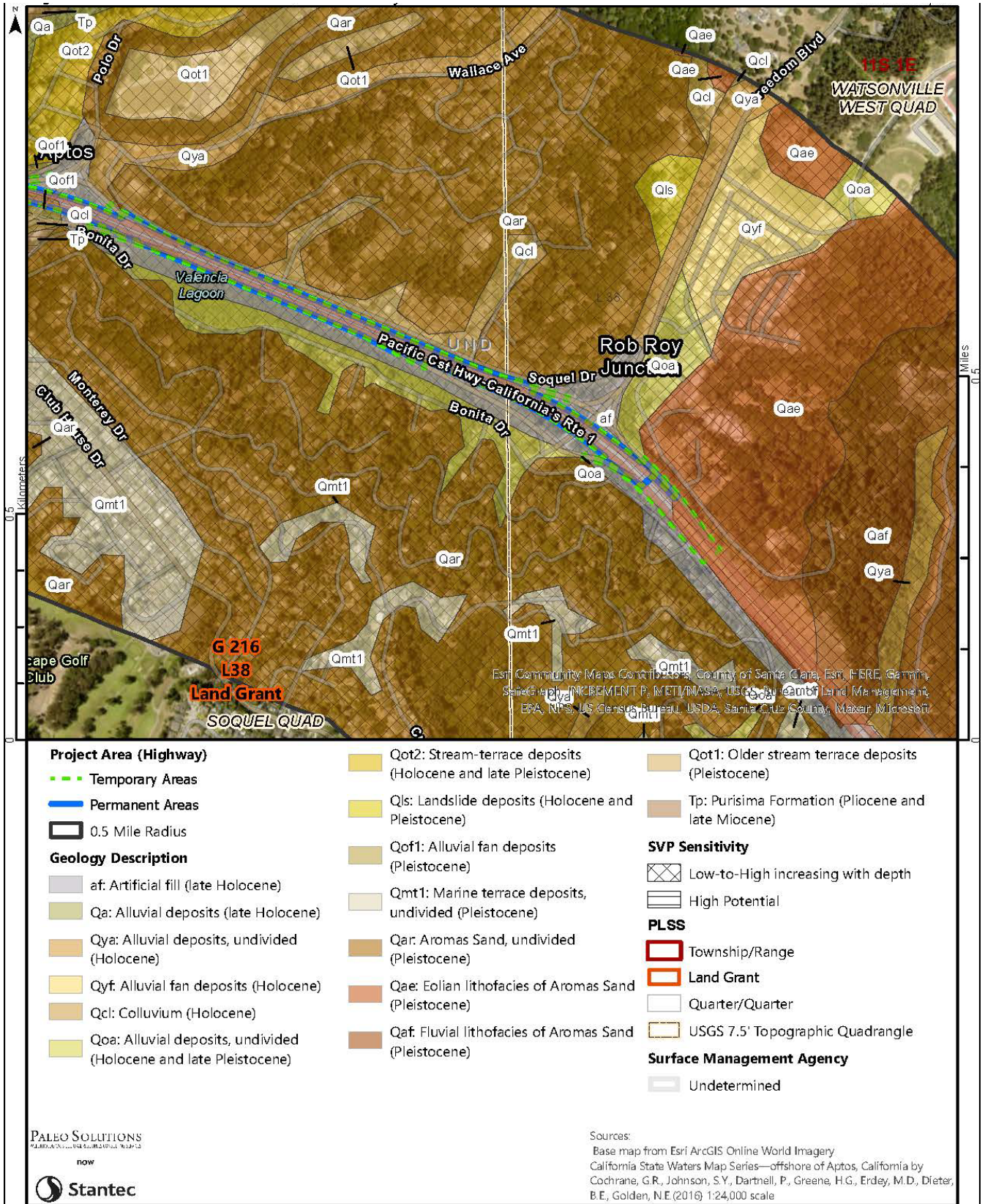


Figure 8. Geologic map of eastern Project area

deposition in shoreface to outer shelf and continental slope setting (Boessenecker 2011).

ALLUVIAL FAN DEPOSITS, PLEISTOCENE (QF)

Alluvial fans consist of semi consolidated, moderately to poorly sorted, discontinuous layers of silty clay, silt, sand, and gravel that was deposited by streams, sheet flow, and debris flow on alluvial fans adjacent to Santa Cruz Mountains. The thickness of this unit is variable and locally may be more than 50 feet thick (Brabb 1997).

MARINE TERRACE DEPOSITS, PLEISTOCENE (QMT)

This unit was deposited in a nearshore high-energy marine environment and consists of semi consolidated, generally well-sorted sand with a few thin, relatively continuous layers of gravel. The thickness of the unit is variable; maximum approximately 40 feet and thins to north where it ranges from five to 20 feet thick. Weathered zone ranges from five to 20 ft thick. As mapped, this unit locally includes many small areas of fluvial and colluvial silt, sand, and gravel, especially at or near old wave-cut cliffs (Brabb 1997).

AROMAS SAND, UNDIVIDED, PLEISTOCENE (QAR)

The undivided Aromas Sand is a heterogeneous sequence of mainly dark brown to red friable eolian and fluvial sand, silt, clay, and gravel. Several angular unconformities are present in the unit, with older deposits more complexly jointed, folded, and faulted than younger deposits. Total thickness may be more than 800 feet (Allen 1946, Brabb 1997).

AROMAS SAND, EOLIAN, PLEISTOCENE (QAE)

The eolian facies of the Aromas Sand is a moderately well sorted eolian sand with a highly variable degree of consolidation owing to differential weathering. This facies may be as much as 200 feet thick without intervening fluvial deposits. Several sequences may be present, separated by paleosols. The upper 10 to 20 feet of each dune sequence is oxidized and relatively indurated, with all primary structures destroyed by weathering. The lower part of each dune sequence below the weathering zone may be essentially unconsolidated (Brabb 1997).

ALLUVIUM, HOLOCENE (Q)

The Holocene alluvium consists of unconsolidated, heterogeneous clay, silt, sand, and gravel. These deposits are primarily more than five feet thick and grade into fluvial deposits locally. This unit may also contain portions of younger and older flood plain deposits where they were not differentiated while mapping (Brabb 1997).

ARTIFICIAL FILL, MODERN

These man-made deposits are usually less than 200 years old in California. Deposits are typically less than a few feet thick, however it can be substantially thicker in the areas of

overpasses, freeways, and other large earthworks. Any fossils that may be encountered therein are unlikely to be scientifically significant.

RECORDS SEARCH

A record search of the project area was obtained from the University of California, Museum of Paleontology (Holroyd 2021; Appendix B) for fossil localities within a one-mile radius of the project. Additional resources searched included the California Academy of Sciences paleontology database (CalAcad 2021), the Paleobiological Database (PBDB 2021), the University of California Museum of Paleontology online database (UCMP 2021), and print sources.

PURISIMA FORMATION

No record of vertebrate fossils was found from within the project area or within a one-mile buffer around the project area. However, thirty-five vertebrate localities producing over 1100 fossil vertebrates and nearly 400 invertebrates have been recorded from Santa Cruz County, many of which are within a ten-mile radius of the Project. Notably, several extinct species of sea cow, walrus, dolphin, whale, sea bird, fish, and shark have been recovered from this formation throughout the county (UCMP 2021; Appendix B, Table 3).

The UCMP records search produced eleven invertebrate localities from the Purisima Formation within a one-mile radius of the project area. Only locality has been formally cataloged with frilled dogwinkle (*Nucella lamellose*), mud snails (*Nassarius [Caesia] grammatus*), ark clam (*Anadara sp.*) and crab (Malacostraca).

PLEISTOCENE FOSSILS

Several Pleistocene vertebrate fossils have been found within Santa Cruz County including two occurrences of Columbian mammoth (†*Mammuthus columbi*), deer (*Cervus sp.*), and unidentified mammal (Hay 1927, Jefferson 1991, UCMP 2021; Appendix B, Table 4).

SURVEY

METHODS

The survey stage is a crucial part of the project's environmental assessment phase. Its purpose is to confirm that field observations conform to the geological maps of the project area. Sediments are assessed for their potential to contain fossils. Additionally, if there are known paleontological resources, the survey will verify the exact location of those resources, the condition or integrity of each resource, and the proximity of the resource to the project area.

Alison Bryson-Deveraux performed a paleontological field survey of the project area on February 17, 2021. All undeveloped ground surface areas within the ground disturbance portion of the project area were examined. When they were present, existing ground disturbances (e.g., cutbanks, ditches, animal burrows, etc.) were visually inspected. Photographs of the project area, including ground surface visibility and items of interest, were taken with a digital camera.

RESULTS

Accessible survey areas along either side of Highway 1 were heavily graded and most embankments were either built up with a mix of native disturbed soil, fill and gravels, or fenced and partially paved (Figure 6). Areas along the southbound side of Highway 1 were graded flat, and mulched with imported wood chips. Very few areas of open, native sediment were noted throughout the survey area. Survey locations around railroad tracks were generally built up and heavily graveled or they intersected paved roadways. Observable native sediments were consistent with prior geologic mapping (Brabb 1997, Wagner et al. 2002; Figure 9 through Figure 11). No fossils were observed during the survey.



Figure 9. Southbound Highway 1 southeast of the Rio Del Mar Bridge



Figure 10. Cut embankment off of Soquel Drive, northeast of Highway 1



Figure 11. Close up of Holocene sediments at the Soquel Drive cut embankment

PALEONTOLOGICAL SCIENTIFIC RELEVANCE CRITERIA

Only qualified, trained paleontologists with specific expertise in the type of fossils being evaluated can determine the scientific relevance of paleontological resources. Fossils are considered to be useful to science if one or more of the following criteria apply:

1. The fossils provide information on the evolutionary relationships and developmental trends among organisms, living or extinct.

2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein.
3. The fossils provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas.
4. The fossils demonstrate unusual or spectacular circumstances in the history of life.
5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations (Scott and Springer 2003; Scott et al. 2004).

Scientific relevance is assessed subsequent to recovery and identification of fossils, typically by the scientific institution receiving the fossils. Typically, all identifiable vertebrate fossils are to be curated in perpetuity at an accredited repository after excavations have finished.

Nonvertebrate fossils (plants, shells, trace fossils, etc.) may be collected as a representative sample when numerous fossils of the same species are present. Although initial identifications can be made in the field, final determination on fossil identifications and relevance to science must be made by the repository.

In the case of unidentifiable fossils, unless they can be used for radiometric dating, these typically do not meet the scientific relevance criteria listed above. In the case of isolated finds or single bones, while they may not initially appear to meet the scientific relevance criteria by themselves, they cannot immediately be discounted as not scientifically relevant. This is because the evaluation of evolutionary relationships, development of biological communities, interaction between paleobotanical and paleozoological biotas, or unusual or spectacular circumstances in the history of life (criteria 1, 3, and 4 above) require a large quantity of data to assess. The accumulation of information on localities of similar age with identifiable fossils recovered in a geographic area is necessary to build these data sets.

PALEONTOLOGICAL SENSITIVITY

Caltrans utilizes a tripartite scale to characterize paleontological sensitivity consisting of no potential, low potential, and high potential (Caltrans 2016, Table 1). Occurrences of fossil resources are closely tied to the geologic units (e.g., formations or members) that contain them. The probability for finding significant fossils in a project area can be broadly predicted from previous records of fossils recovered from the geologic units present in and/or adjacent to the study area.

Caltrans (2016) guidance for evaluating fossil deposits and sensitivity of resources states:

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 between project staff (Caltrans or local), consultants, and personnel from other agencies, as to exactly what criteria will be used to assess the significance of rock units affected by a particular project.

As a practical matter, no consideration is generally afforded to 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 Paleontological Evaluation Report (PER) and in the project's environmental document in order to demonstrate compliance with applicable statutory requirements.

If a paleontological resource is determined to be significant, of high sensitivity, or of scientific importance, and the project impacts it, a mitigation program must be developed and implemented. Mitigation can be initiated prior to and/or during construction. The latter is more common for Caltrans projects. It should be pointed out that mitigating during construction poses a greater risk of construction delays. Mitigation is an eligible federal project cost, in accordance with 23 U.S.C. 305, only if acceptable significance documentation is submitted. Thus, coordination between Caltrans, Federal Highway Administration, and all jurisdictional agencies is critical to formally establishing the significance of a resource. [PER Instructions, Chapter 8, Vol. 1, Standard Environmental Reference (SER), <https://dot.ca.gov/programs/environmental-analysis/standard-environmental-reference-ser/volume-1-guidance-for-compliance/ch-8-paleontology> accessed February 2021].

Table 1. Caltrans Paleontology Sensitivity Scale

Caltrans Sensitivity	Description
High Potential	<p>Rock units which, 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:</p> <ol style="list-style-type: none"> 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 <i>Neotoma</i> (sp.) middens; 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	<p>This category includes sedimentary rock units that:</p> <ol style="list-style-type: none"> 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. <p>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 this occurs, a Construction Change Order (CCO) must be prepared in order to have a qualified Principal Paleontologist evaluate the resource. If the resource is determined to be significant, monitoring and mitigation is required.</p>
No Potential	<p>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.</p>
Source: Caltrans 2016.	

CONCLUSIONS AND RECOMMENDATIONS

The surface of the project is mapped as Holocene-aged alluvium, alluvial fan deposits, and colluvium; Pleistocene-aged alluvial fan deposits, undivided and eolian Aromas Sand and marine terrace deposits; and the Purisima Formation. Additionally, Pleistocene-aged sediments and/or the Purisima Formation occur at depth below the Holocene-aged sediments. . The Pleistocene sediments and the Purisima Formation have produced fossils near the project area and elsewhere in the county.

For the most part, fossils of extinct Pleistocene animals start appearing at about eight feet below the surface of California's large valleys where Holocene-aged deposits are mapped at the

surface. Accordingly, all areas mapped as Holocene-aged sediments are assigned low paleontological sensitivity less than eight feet below the original surface and high sensitivity at depths of over eight feet (Table 2). Due to the abundant vertebrate fossils that have been recovered from Pleistocene-aged sediments and the Purisima Formation elsewhere in the county, these units are given a high paleontological sensitivity at any depth.

Table 2. Paleontological sensitivity of the geologic units in the Project area

Geologic Unit	Caltrans Sensitivity
Holocene deposits (alluvium, alluvial fans, colluvium)	0-8 feet bgs: Low >8 feet bgs: High
Pleistocene deposits (alluvial fan, undivided and eolian Aromas Sand, marine terrace deposits)	High, all depths
Purisima Formation, Pliocene and late Miocene	High, all depths

All depths refer to the original grade of the area.

As a result, ground disturbance during project construction in areas or at depths where geologic units with high paleontological potential are present (see Figure 6 through Figure 8 and Table 2) could adversely affect paleontological resources. However, implementation of the proposed measures below would reduce impacts to paleontological resources to less than significant.

- Prior to the start of excavations, a qualified Principal Paleontologist (M.S. or PhD in paleontology or geology familiar with paleontological procedures and techniques) will be retained to prepare and implement a detailed Paleontological Mitigation Plan (PMP) prior to the start of construction. The PMP will include the following elements and stipulations:
 - The PMP will identify all areas where excavation will disturb *in situ* geologic units identified as highly sensitive for paleontological resources.
 - Spot checking may be required to confirm the extent of the low sensitivity deposits should they overlie high sensitivity units. This includes areas of artificial fill and Holocene-aged sediments.
 - Full time monitoring will be required where disturbance more than eight feet deep into Holocene-aged sediments as well as all impacts to the Purisima Formation and Pleistocene-aged sediments.
 - Requirements for reduction of monitoring effort.
 - The paleontological monitor's authority to temporarily halt or divert construction equipment to investigate finds.
 - Protocols for fossil recovery, preparation, and curation.
 - Other pertinent items for the PMP as per Caltrans (2016).
- The qualified Principal Paleontologist will be present at pre-grading meetings to consult with grading and excavation contractors.

- Before excavation begins, a training session on fossil identification and the procedures to follow should fossils be encountered will be conducted by the Principal Paleontologist or their designee for all personnel involved in earthmoving for the project.
- If unanticipated discoveries of paleontological resources occur during project construction, all work within 25 feet of the discovery must cease and the find must be protected in place until it can be evaluated by a qualified paleontologist. Work may resume immediately outside of the 25-foot radius.

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APPENDIX A. QUALIFICATIONS



KIM SCOTT
Principal Investigator for Paleontology

EDUCATION

2013 M.S., Biology with a paleontology emphasis, California State University, San Bernardino
2000 B.S., Geology with paleontology emphasis, University of California, Los Angeles

SUMMARY QUALIFICATIONS

Scott has more than 20 years of experience in California paleontology. She is a qualified geologist and field paleontologist with extensive survey, monitoring and fossil salvage experience. In addition, she has special skills in fossil preparation (cleaning and stabilization) and preparation of stratigraphic sections and other documentation for fossil localities. Scott serves as company safety officer and is the author of the company safety and paleontology manuals.

SELECTED PROJECTS

Richmond San Rafael Bridge Access Improvement Project, Caltrans District 4, Marin and Contra Costa counties, CA. This project was for approximately 6 miles of improvements including bicycle and pedestrian access and a new automobile travel lane. Co-authored the Paleontological Identification Report. Sub to HNTB Corporation. Field Director/Report Co-author. 2015-2016.

Napa State Hospital, City of Napa, Napa County, CA. California Department General Services constructed a new kitchen for the California State Mental Hospital. Prepared a paleontological evaluation, monitored and prepared a monitoring report. Sub to ECORP. Co-Principal Investigator/Report Co-author. 2015.

Norris Canyon Estates, San Ramon, Contra Costa County, CA. Approximately 5.9 acres of San Catanio Creek tributaries were assessed for paleontological resources. Conducted record search, GIS mapping, paleontological resources survey, assessment report, mitigation plan, and sample report. Sub to ECORP. Field Director/Report Co-author. 2012-2014.

SR 99 widening at Arboleda, Caltrans District 10, Madera, CA. Five mile widening of SR-99 with a new interchange at Arboleda Ave. Paleontological Mitigation Plan followed by paleontological monitoring. Over 1600 fossils were recovered and processed. Field and Lab Director/Report Co-author. 2012-2013.

US 101 Express Lanes Project, Caltrans District 4, Santa Clara County, CA. The 37-mile linear project entails freeway widening and HOV lane conversion along US 101 and SR 85. Prepared Paleontological Evaluation Report and Mitigation Plan. Sub to URS Corp. Field Director/Report Co-author. 2012.

SR-85 Express Lanes Project, Caltrans District 4, Santa Clara County, CA. Caltrans with Santa Clara Valley Transportation Authority will convert the existing SR 85 single HOV lanes into express lane facilities. Prepared a combined Paleontological Evaluation Report / Paleontological Mitigation Plan (PER/PMP). Sub to URS. Field and Lab Director/Report Co-author. 2012.

FOSIL Geospatial Database, Caltrans Central Region. The project involved research to develop a comprehensive GIS-based, paleontology database application for project screening - Fossil Sensitivity Inventory Link (FOSIL). The database covers 3,000+ miles of Highway for 15 counties in central California that will be utilized as a management tool by Caltrans personnel in Districts 6, 9 and 10. Performed all background research and known records entry. Sub to URS Corporation. Paleontology Researcher. 2010-2011.

APPENDIX B. RECORDS SEARCH

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
Boulevard to State Park Drive – and Coastal Rail Trail Segment 12 Project PIR/PER

UCMP Records Search

From: Patricia HOLROYD <pholroyd@berkeley.edu>
Sent: Wednesday, February 17, 2021 4:21 PM
To: Logan Freeberg
Cc: Kelly Vreeland
Subject: Re: Santa Cruz Hwy 1 Aux Lanes paleo record search

Dear Logan,

I have conducted a review of the University of California Museum of Paleontology records for paleontological resources in or near your project area. Multiple invertebrate collections have been made at Seacliff State Beach, at the northern end of your project area. These are recorded in the UCMP database as UCMP localities A9736, A9737, D8008, D8103, D9054, D9055, D9632, D9633, IP9769, IP9850, IP11253 and are from the Purisima Formation. Two of these UCMP A9736 and A9737 are currently listed in the database as Merced Formation, but that is an outdated stratigraphic name for rocks in that area. All of these list the locality as some variation of 0.5-1 km NW of the pier or from "behind the parking lot". On modern maps, these almost certainly refer to the exposures on the NE side of Las Olas and State Park Drive. Few specimens have been formally cataloged from these collections; only those of locality D8008 have been databased and can be viewed at this link

<https://ucmpdb.berkeley.edu/cgi/ucmp_query2?admin=&table=ucmp2&where-loc_ID_num=D8008>. These include gastropods, clams, and crabs.

No vertebrates have yet been found in the project area and buffer, but the Purisima Formation elsewhere in Santa Cruz County has produced many marine mammals.

Billing will arrive separately from our campus business office.

Thank you, Pat Holroyd

Patricia A. Holroyd, Ph.D.
Senior Museum Scientist
Museum of Paleontology
University of California
Berkeley, CA 94720

Table 3. Fossils of the Purisima Formation in the Vicinity of the Alignment

Extinct animals are noted by † although all fossils from deposits older than Pleistocene are likely from extinct species. All data from UCMP (2021).

Common Name	Taxon	Age/ dates	Locality	Location
sea cow	† <i>Hydrodamalis</i> sp.	Miocene, Hemphillian	UCMP V92059, V92060, V73006	Almar Ave. 1, Almer Ave 2, Almar Ave
sea cow	Sirenia			
dugong	† <i>Dusisiren</i> sp.			
northern fur seal	<i>Callorhinus</i> sp.			
earred seal	† <i>Sonomatherium schonewalder</i>			
earred seal	Otariidae			
rorqual whale	Balaenopteridae			
dolphin	† <i>Parapontoporia</i> sp.			
whale	Cetacea			
rhinoceros auklet	<i>Cerorhinca</i> sp.			
auk	<i>Mancalla</i> sp.			
auk	Alcidae			
bird	Aves			
amberjack	<i>Seriola</i> sp.			
jack	Carangidae			
grouper	<i>Epinephelus</i> sp.			
grouper	Serranidae			
mako shark	† <i>Isurus hastalis</i>			
white shark	<i>Isurus</i> sp.			
angelshark	<i>Squatina</i> sp.			
cartillagenous fish	Chondrichthyes			
ark clam	<i>Anadara</i> sp.	Pliocene	UCMP D3241	Borregas Creek
bivalve	Bivalvia			
moon snail	† <i>Nassarius (Demondia) californianus</i> (previously <i>Caesia</i>)			
moon snail	<i>Nassarius</i> sp.			
moon snail	<i>Neverita</i> sp.			
snail	Gastropoda			
walrus	† <i>Valenictus</i> sp.	Miocene, Hemphillian to Pliocene, Blancan	UCMP V90046, V90047, V90048, V90049, V99866, V99867, V99868, V99869, D7254, IP9718, IP9723, V7078	Capitola 1 - Lower Shell Bed Facies; Capitola 2 - Clinocardium Facies; Capitola 3 - Upper Shell Bed Facies; Capitola 4 - Concretionary Bed; Capitola Beach, Capitola-New Brighton
walrus	† <i>Dusignathinae</i>			
walrus	Odobenidae			
fur seal	† <i>Callorhinus gilmorei</i>			
earred seal	Otariidae			
pinniped	Pinnipedia			
carnivore	Carnivora			
baleen whale	† <i>Herpetocetus</i> sp.			
rorqual whale	Balaenopteridae			
baleen whale	Mysticeti			
ocenaic dolpin	Globicephalinae			
dolphin	Delphinidae			
dolphin	† <i>Parapontoporia sternbergi</i>			
dolphin	† <i>Parapontoporia wilsoni</i>			

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
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Common Name	Taxon	Age/ dates	Locality	Location
dolphin	† <i>Parapontoporia sp.</i>	Miocene, Hemphillian to Pliocene, Blancan	<i>continued</i> UCMP V90046, V90047, V90048, V90049, V99866, V99867, V99868, V99869, D7254, IP9718, IP9723, V7078	<i>continued</i> Capitola 1 - Lower Shell Bed Facies; Capitola 2 - Clinocardium Facies; Capitola 3 - Upper Shell Bed Facies; Capitola 4 - Concretionary Bed; Capitola Beach, Capitola-New Brighton
dolphin	†Pontoporiidae			
narwhal or beluga whale	Monodontidae			
porpoise	† <i>Semirostrum sp.</i>			
porpoise	Phocoenidae			
dolphin	Delphinoidea			
toothed whale	Odontoceti			
whale	Cetacea			
horse	†Equidae			
mammal	Mammalia			
auk	<i>Alca sp.</i>			
murrelet	<i>Brachyramphus sp.</i>			
rhinoceros auklet	<i>Cerorhinca sp.</i>			
auk	<i>Mancalla sp.</i>			
murrelet	<i>Synthliboramphus sp.</i>			
auk	Alcidae			
cormorant	<i>Phalacrocorax sp.</i>			
grebe	<i>Podiceps sp.</i>			
shearwater	<i>Puffinus sp.</i>			
grebe	Podicipediformes			
bird	Aves			
sea turtle	† <i>Psephophorus sp.</i>			
reptile or bird	Sauria			
sturgeon	<i>Acipenser sp.</i>			
sturgeon	Acipenseridae			
large-tooth flounder	<i>Paralichthys sp.</i>			
bony fish	Osteichthyes			
basking shark	<i>Cetorhinus maximus</i>			
basking shark	<i>Cetorhinus sp.</i>			
sixgill shark	<i>Hexanchus sp.</i>			
great white shark	<i>Carcharodon carcharias</i>			
white shark	<i>Carcharodon sp.</i>			
white shark	Lamnidae			
eagle ray	<i>Myliobatis sp.</i>			
big skate	<i>Raja binoculata</i>			
skate	Rajidae			
ray	Batoidea			
cartillagenous fish	Chondrichthyes			
barnacle	Balanidae			
decapod	Decapoda			
ark clam	† <i>Anadara trilineata</i>			
ark clam	<i>Anadara sp.</i>			
cockle	<i>Clinocardium sp.</i>			
Pacific geoduck	<i>Panopea generosa</i>			

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
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Common Name	Taxon	Age/ dates	Locality	Location
lucine clam	† <i>Lucinoma annulatum</i>	Miocene, Hemphillian to Pliocene, Blancan	<i>continued</i> UCMP V90046, V90047, V90048, V90049, V99866, V99867, V99868, V99869, D7254, IP9718, IP9723, V7078	<i>continued</i> Capitola 1 - Lower Shell Bed Facies; Capitola 2 - Clinocardium Facies; Capitola 3 - Upper Shell Bed Facies; Capitola 4 - Concretionary Bed; Capitola Beach, Capitola-New Brighton
duck clam	† <i>Pseudocardium densatum</i>			
surf clam	† <i>Spisula coosensis</i>			
California softshell clam	<i>Cryptomya californica</i>			
macoma	<i>Macoma</i> sp.			
venus clam	† <i>Leukoma staleyi</i>			
venus clam	<i>Leukoma</i> sp.			
marine clam	<i>Yoldia</i> sp.			
bivalve	<i>Bivalvia</i>			
marine snail	<i>Ophiodermella</i> sp.			
nutmeg snail	Cancellariidae			
carinate dove shell	<i>Alia carinata</i> (was <i>A. gouldi</i>)			
dove snail	<i>Mitrella</i> sp.			
moon snail	† <i>Nassarius (Demondia)</i> <i>californianus</i> (previously <i>Caesia</i>)			
moon snail	† <i>Nassarius (Caesia) grammatus</i> (previously <i>Caesia</i>)			
moon snail	<i>Nassarius</i> sp.			
Lewis' moon snail	<i>Neverita lewisii</i> (was <i>Euspira</i>)			
moon snail	<i>Glossaulax reclusiana</i>			
moon snail	Naticidae			
olive shell	<i>Olivella</i> sp.			
marine snail	<i>Megasurcula stearnsiana</i>			
marine snail	<i>Odostomia</i> sp.			
snail	Gastropoda			
ocenaic dolpin	Globicephalinae	Pliocene, Hemphillian	UCMP V99879	Eisenman's Pilot Whale
dolphin	Delphinidae	Miocene, Hemphillian	UCMP V83013	Lighthouse Point
rhinoceros auklet	<i>Cerorhinca</i> sp.			
sea cow	Sirenia	Miocene, Hemphillian	UCMP V92056	Merced Ave. 1
walrus	Odobenidae			
large fur seal	† <i>Thalassoleon</i> sp.			
auk	<i>Mancalla</i> sp.			
pacific salmon	<i>Oncorhynchus</i> sp.			
basking shark	<i>Cetorhinus</i> sp.			
mako shark	† <i>Isurus hastalis</i>			
mackerel shark	<i>Lamna</i> sp.	Miocene, Hemphillian to Pliocene	UCMP V77140, D8007	New Brighton Beach, New Brighton State Beach
whale	Cetacea			
mud shrimp	<i>Callianassa</i> sp.			
swimming crab	Portunidae			
ark clam	<i>Anadara</i> sp.			
lucine clam	† <i>Lucinoma annulatum</i>			
marine clam	† <i>Mactromeris albaria</i>			
surf clam	<i>Spisula</i> sp.			

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Common Name	Taxon	Age/ dates	Locality	Location
gaper clam	<i>Tresus</i> sp.	Miocene, Hemphillian to Pliocene	<i>continued</i> UCMP V77140, D8007	<i>continued</i> New Brighton Beach, New Brighton State Beach
horsemussel	<i>Modiolus</i> sp.			
razor clam	<i>Solen</i> sp.			
white-sand macoma	<i>Macoma secta</i>			
macoma	<i>Macoma</i> sp.			
venus clam	† <i>Leukoma staley</i>			
venus clam	<i>Leukoma</i> sp.			
bivalve	Bivalvia			
marine snail	† <i>Ophiidermella graciosa</i>			
whelk	† <i>Clinopegma stantoni</i>			
slipper shell	<i>Crepidula</i> sp.			
moon snail	<i>Neverita</i> sp.			
olive shell	<i>Callianax</i> sp.			
snail	Gastropoda			
walrus	†Dusignathinae	Miocene, Hemphillian to Pliocene	UCMP V6875, V85027, V90041, V90042, V90043, V92003, V93187, V98862, D3402	Opal Cliffs, Opal Cliffs 1, Opal Cliffs 2, Opal Cliffs B, Opal Cliffs C, Opal Cliffs K, Opal Cliffs L, Opal Cliffs monodontid
walrus	Odobenidae			
large fur seal	† <i>Thalassoleon macnallyae</i>			
earred seal	Otariidae			
carnivore	Carnivora			
rorqual whale	Balaenopteridae			
baleen whale	Balaenidae			
baleen whale	† <i>Herpetocetus bramblei</i>			
baleen whale	Cetotheriidae			
baleen whale	Mysticeti			
porpoise	† <i>Semirostrum</i> sp.			
porpoise	Phocoenidae			
dolphin	Delphinidae			
dolphin	Delphinoidea			
dolphin	† <i>Parapontoporia sternbergi</i>			
dolphin	† <i>Parapontoporia wilsoni</i>			
dolphin	† <i>Parapontoporia</i> sp.			
dolphin	Pontoporiidae			
narwhal or beluga whale	Monodontidae			
toothed whale	Odontoceti			
whale	Cetacea			
mammal	Mammalia			
murrelet	<i>Brachyramphus</i> sp.			
rhinoceros auklet	<i>Cerorhinca</i> sp.			
auk	† <i>Mancalla vegrandis</i>			
auk	<i>Mancalla</i> sp.			
auk	Alcidae			
loon	Gaviidae			

State Route Highway 1 Auxiliary Lanes and Bus-on-Shoulder Improvements – Freedom
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Common Name	Taxon	Age/ dates	Locality	Location
sea gull	Laridae	Miocene, Hemphillian to Pliocene	<i>continued</i> UCMP V6875, V85027, V90041, V90042, V90043, V92003, V93187, V98862, D3402	<i>continued</i> Opal Cliffs, Opal Cliffs 1, Opal Cliffs 2, Opal Cliffs B, Opal Cliffs C, Opal Cliffs K, Opal Cliffs L, Opal Cliffs monodontid
shearwater	<i>Puffinus</i> sp.			
gannet	† <i>Morus howardi</i>			
gannet	<i>Morus</i> sp.			
booby	† <i>Sula humeralis</i>			
gannet or booby	Sulidae			
pelicans and allies	Pelecaniformes			
bird	Aves			
sturgeon	<i>Acipenser</i> sp.			
wolffish	<i>Anarrhichthys</i> sp.			
sabertooth salmon	† <i>Smilodonichthys</i> sp.			
bony fish	Osteichthyes			
basking shark	<i>Cetorhinus maximus</i>			
sixgill shark	<i>Hexanchus</i> sp.			
white shark	<i>Carcharodon</i> sp.			
white shark	Lamnidae			
eagle ray	<i>Myliobatis</i> sp.			
cartilaginous fish	Chondrichthyes			
crab	† <i>Cancer marri</i>			
decapod	Decapoda			
walrus	Odobenidae	Miocene, Hemphillian	UCMP V85067	Perry's Odobenid
sea cow	Desmostylia	Miocene, Hemphillian	UCMP V2701, V6617, V70183	Santa Cruz 1, Santa Cruz 2, Santa Cruz 3
Santa Cruz walrus	† <i>Dusignathus santacruzensis</i>			
whale	Cetacea			
California beaver	† <i>Castor californicus</i>			
baleen whale	Mysticeti	Miocene, Hemphillian	UCMP V100013	Scotts Valley High School
rorqual whale	Balaenopteridae	Miocene, Hemphillian	UCMP V71151	Seabright
bottlenose dolphin	<i>Tursiops</i> sp.			
ark clam	<i>Anadara</i> sp.	Pliocene	UCMP D8008	Seacliff State Beach
frilled dogwinkle	<i>Nucella lamellosa</i>			
moon snail	† <i>Nassarius (Caesia) grammatus</i> (previously <i>Caesia</i>)			
crab	Decapoda			
invertebrates	unlisted		UCMP A9736, A9737, D8103, D9054, D9055, D9632, D9633, IP9769, IP9850, IP11253	Seacliff State Beach

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Common Name	Taxon	Age/ dates	Locality	Location
walrus	† <i>Odobeaenops agomphos</i>	Miocene, Hemphillian	UCMP V88070	Sharks Cove
baleen whale	† <i>Nannocetus</i> sp.			
beluga whale	† <i>Denebola</i> sp.			
bird	Aves			
large-tooth flounder	<i>Paralichthys</i> sp.			
Pacific sanddab	<i>Citharichthys sordidus</i>	Miocene, Hemphillian	UCMP V76109	Soquel Cliff
speckled sanddab	<i>Citharichthys stigmaeus</i>			
sanddab	<i>Citharichthys</i> sp.			
English sole	<i>Parophrys vetulus</i>			
Soquel croaker	† <i>Puriscion soqueli</i>			
basking shark	<i>Cetorhinus maximus</i>			
mackerel shark	<i>Lamna</i> sp.			
rays	Myliobatidae			
big skate	<i>Raja binocularata</i>			
skate	<i>Raja</i> sp.			
sea cow	†Hydrodamalinae	Miocene, Hemphillian	UCMP V99875, V99876, V99877	Steamer's Lane 1, Steamer's Lane 2, Steamer's Lane 3
Santa Cruz walrus	† <i>Dusignathus santacruzensis</i>			
walrus	Dusignathinae			
walrus	† <i>Imagotaria</i> sp.			
walrus	Odobenidae			
large fur seal	† <i>Thalassoleon macnallyae</i>			
baleen whale	† <i>Norrisanima miocaena</i> (was <i>Megaptera</i>)			
rorqual whale	Balaenopteridae			
baleen whale	Balaenidae			
baleen whale	† <i>Nannocetus</i> sp.			
baleen whale	Mysticeti			
dolphin	† <i>Albireo</i> sp.			
dolphin	Delphinidae			
dolphin	† <i>Parapontoporia wilsoni</i>			
river dolphin	Lipotidae			
dolphin	Delphinoidea			
sperm whale	Physeteroidea			
toothed whale	Odontoceti			
whale	Cetacea			
mammal	Mammalia			
bird	Aves			
large-tooth flounder	<i>Paralichthys</i> sp.			
flounder or sole	Pleuronectiformes			
sixgill shark	<i>Hexanchus</i> sp.			
mako shark	† <i>Isurus hastalis</i>			
megalodon shaek	† <i>Otodus megalodon</i>			
moon snail	<i>Sinum scopulosum</i>	Pliocene	UCMP D5412	Waddell Creek

Table 4. Pleistocene Fossils of the in the Vicinity of the Alignment

Extinct animals are noted by † although all fossils from deposits older than Pleistocene are likely from extinct species.

Common Name	Taxon	Age/ dates	Locality	Location	Reference
deer	<i>Cervus sp.</i>	Pleistocene	UCMP V2016006	SR-129	UCMP 2021
mammal	unknown				
Columbian mammoth	† <i>Mammuthus columbi</i>	Pleistocene	unknown	Aptos	Jefferson 1991, Hay 1927
Columbian mammoth	† <i>Mammuthus columbi</i>	Pleistocene	unknown	Santa Cruz County	Jefferson 1991, Hay 1927