UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS No: WCRO-2020-02048

June 24, 2021

Mr. Serge Stanich
Director of Environmental Services
California High Speed Rail Authority
770 L Street, STE 620
Sacramento, California 95814

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, for the California High Speed Rail San Jose to Merced Project Section

Dear Mr. Stanich:

Thank you for your letter of June 22, 2020, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the San Jose to Merced Section of the California High Speed Rail (HSR) project. This consultation was initiated on October 22, 2020, and it was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

The enclosed biological opinion is based on our review of the proposed action as detailed in the provided biological assessment, and its effects on the federally listed threatened Central California Coast steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS), South Central California Coast steelhead (*O. mykiss*) DPS, and their designated critical habitats. Based on the best available scientific and commercial information, NMFS concludes that the project is not likely to jeopardize the continued existence of these federally listed species or destroy or adversely modify their critical habitat. NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor the incidental take of federally listed fish that will occur with project implementation. NMFS also reviewed the proposed action for its effects on the federally listed threatened California Central Valley steelhead (*O. mykiss*) DPS and we concur with your conclusion that it is not likely to adversely affect the California Central Valley steelhead DPS.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. Enclosed we provide NMFS's review of the potential effects of the proposed action on EFH for Pacific Coast Salmon, as designated under the MSA. The document concludes that the project will adversely affect the EFH of Pacific Coast Salmon in the action area and has included EFH Conservation Recommendations.

As required by section 305(b)(4)(B) of the MSA, the Authority must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS EFH Conservation Recommendations unless NMFS and the Authority have agreed to use alternative time frames for the Authority's response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Authority must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)). In your response to the EFH portion of this consultation, we ask that you clearly identify the number of Conservation Recommendations accepted.

Please contact Katie Schmidt at the California Central Valley Office at (916) 930-3685, or at katherine.schmidt@noaa.gov, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for
California Central Valley Office

Enclosure

cc: To the File: ARN 151422-WCR2018-SA00467
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

California High Speed Rail San Jose to Merced Project Section

NMFS Consultation Number: WCRO-2020-02048

Action Agency: California High Speed Rail Authority

Affected Species and NMFS's Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Central California Coast steelhead *(Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
South-Central California Coast steelhead (*O. mykiss)*	Threatened	Yes	No	Yes	No
California Central Valley steelhead (*O. mykiss)*	Threatened	No	NA	No	NA

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for California Central Valley Office

Date: June 24, 2021

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Abbreviations and Acronyms

AMMs	avoidance and minimization measures
Authority	California High Speed Rail Authority
BA	biological assessment
BMPs	best management practices
BPG	Biogeographic Population Group
CCC	Central California Coast
CCO	California Coastal Office
CCV	California Central Valley
CCVO	California Central Valley Office
CDEC	California Data Exchange
cfs	cubic feet per second
CIP	cast-in-place
CMs	conservation measures
CV	Central Valley
dB	decibel
DPS	distinct population segment
DQA	Data Quality Act
EFH	essential fish habitat
EIR/EIS	Environmental Impact Report/Environmental Impact Statement
ESA	Endangered Species Act
FRA	Federal Railroad Administration
GAMMP	groundwater adaptive management and monitoring program
gpm	gallons per minute
HAPCs	Habitat Areas of Particular Concern
HCP	habitat conservation plan
HSR	High Speed Rail
Hz	hertz, cycles per second
ICF	ICF International, Inc.
ILF	in-lieu fee
ITS	incidental take statement
kV	kilovolt
LID	low impact development
LWM	large woody material
MOWF	maintenance-of-way facility
MOWS	maintenance-of-way siding
mph	mile per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
OHWM	ordinary high water mark
Opinion	biological opinion

PAHs	polycyclic aromatic hydrocarbons
PBF	physical or biological feature
PCE	primary constituent element
pCMP	preliminary compensatory mitigation plan
PFMC	Pacific Fishery Management Council
RMS	root mean square
ROW	right-of-way
RPMs	reasonable and prudent measures
RRP	restoration and revegetation plan
S-CCC	South-Central California Coast
SCVHA	Santa Clara Valley Habitat Agency
SCVOSA	Santa Clara Valley Open Space Authority
SEL	sound exposure level
SPCCP	spill prevention control and countermeasures plan
SWRCB	State Water Resources Control Board
SWPPP	stormwater pollution prevention plan
TBM	tunnel boring machine
TPSS	traction power substation
UPRR	Union Pacific Railroad
USFWS	United Stated Fish and Wildlife Service
WEAP	worker environmental awareness program
WOTUS	waters of the United States

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository. A complete record of this consultation is on file at the California Central Valley Office (CCVO) in Sacramento, California.

1.2. Consultation History

March 14, 2011: The Federal Railroad Administration (FRA) sent a memorandum of understanding to NMFS and to the United States Fish and Wildlife Service (USFWS) designating the California High Speed Rail Authority (Authority) to act on behalf of the FRA as a non-federal representative and the Authority has assumed FRA's responsibilities under Federal environmental laws for the California High Speed Rail (HSR) project.

May 2, 2017: NMFS, Authority, and ICF International, Inc. (ICF) staff began holding regular fish and aquatic resource working group meetings regarding the subsection's route and schedule, including pre-consultation technical assistance and initial development of a steelhead habitat model. Additional working group meetings occurred from this date until January 16, 2018, regarding steelhead habitat model parameters and modifications.

June 15, 2017: Authority/ICF staff shared a steelhead and Chinook salmon habitat suitability model for the San Jose to Merced Project Section portion in the Central Valley (CV).

April 18, 2018: The Authority issued a final memo to NMFS that outlined all creeks and streams they propose removing from the suitable steelhead habitat model developed for the San Jose to Merced HSR Project Section, noting that long-term effects may still come into play through water quality effects but that construction best management practices (BMPs) would likely be sufficient to avoid harm to NMFS trust resources.

November 8, 2018: The Authority requested a letter of concurrence from NMFS regarding their not likely to adversely affect (NLAA) determination for proposed Phase 2 Geotechnical

Investigations for the tunnel subsection to collect geotechnical data to inform the preliminary design of the HSR route selection on South-Central California Coast (S-CCC) steelhead distinct population segment (DPS) individuals.

December 3, 2018: NMFS issued a concurrence letter regarding the proposed Phase 2 Geotechnical Investigations for the San Jose to Merced HSR Project Section (NMFS 2018b).

July 23, 2019: The State of California signed a memorandum of understanding with the FRA in which, pursuant to 23 U.S.C. 327(a)(2)(B), the FRA assigned, and the State (acting through its California State Transportation Agency and the Authority) assumed, all of FRA's responsibilities for environmental review, consultation, or other action required or arising under listed Federal environmental laws, including the ESA, for the assigned railroad projects, including projects necessary for the design, construction, and operation of the HSR system (California State Transportation Agency 2019).

December 9, 2019: The Authority made the San Jose to Merced Administrative Environmental Impact Report/Environmental Impact Statement (EIR/EIS) Draft available to NMFS to review and provide comments.

December 20, 2019: NMFS staff, Katie Schmidt, submitted comments and questions regarding EIR/EIS sections and topics relevant to NMFS trust resources impacted by the proposed project.

February 7, 2020: A field tour was conducted of several of HSR crossings and major interactions with S-CCC or Central California Coast (CCC) steelhead DPS waterways and habitat with staff from ICF, the Authority, and NMFS California Coastal Office (CCO) and CCVO. Rail design and mitigation options were discussed onsite and en route. Visited sites include several locations along Pacheco Creek, Jones Creek in the Soap Lake floodplain, Llagas Creek, Coyote Creek, and Guadalupe River at Highway 87. A second site visit was planned to cover interaction sites north to complete the overview of the entire section.

March 17, 2020: The second field tour to visit the remaining crossings was tentatively scheduled for this date; however, due to the emerging outbreak of novel coronavirus SARS-CoV2 and associated NMFS safety and travel restrictions, this tour was pushed back indefinitely.

May 5, 2020: The Authority requested a species list from NMFS for the San Jose to Merced HSR Project Section via email.

May 15, 2020: NMFS provided an official species list to the Authority for the San Jose to Merced HSR Project Section, which identified the following NMFS trust resources:

- Threatened S-CCC steelhead, *Oncorhynchus mykiss*, DPS (62 FR 43937, 8/18/1997), and its critical habitat (70 FR 52488, 9/2/2005)
- Threatened CCC steelhead, *O. mykiss*, DPS (62 FR 43937, 8/18/1997), and its critical habitat (70 FR 52488, 9/2/2005)
- Pacific Coast Salmon - Coho and Chinook EFH

June 24, 2020: The Authority requested formal ESA/MSA consultations (Authority 2019a, 2020c, b, a) for the San Jose to Merced HSR Project Section via email. The provided consultation packet included a draft biological assessment (BA), maps of the proposed route (Authority 2019f, e), preliminary designs and figures, applicable design standards, proposed conservation measures (Authority 2020a), a preliminary compensatory mitigation plan (pCMP) (Authority 2019a), critical habitat figures, details of the developed steelhead habitat model (Authority 2020b), a steelhead impacts matrix, and other appendices.

July 7, 2020: NMFS issued an insufficiency letter with a request for more information regarding the pile driving plans for the section and the dewatering risks associated with the tunnel drilling and construction under the Pacheco Creek watershed.

July 25, 2020: Katie Schmidt provided comments and questions on the draft BA and parts of the consultation packet that required more information or clarification before sufficiency could be reached.

August 14 through August 27, 2020: A series of virtual workshops were held between Authority staff, ICF consultants, and Katie Schmidt to address the questions and concerns posed, and to clarify project information contained in the draft BA.

October 14, 2020: A virtual meeting was held between Authority, ICF, and NMFS staff as a final review of all changes that had occurred to the BA and consultation packet and whether the consultation could be initiated with the information available (several documents were to remain in their preliminary or draft forms). Authority agreed to produce a final revised BA and conservation measure document before the consultation was complete to solidify the project changes discussed in prior meetings.

October 22, 2020: NMFS issued a sufficiency letter notifying the Authority that the informational requirements for formal ESA/EFH consultation for the San Jose to Merced HSR Project Section had been met and that the consultation had been initiated.

October 28, 2020: The Authority submitted the final BA and conservation measures proposed for the section to NMFS.

February 23, 2021: The Authority and NMFS mutually agreed upon an extension date of April 6, 2021.

May 4, 2021: During the review of the draft biological opinion, NOAA and Authority representatives discussed the ongoing development of the draft. The Authority shared documentation supporting the independent utility of each of the eight HSR San Francisco to Anaheim Phase I sections, which would eventually link to create the state-wide system (Authority 2009). Because each section has independent utility and could be built, operated, and maintained without building the other sections, NMFS reasonably concluded that an effects analysis of the state-wide system was not required in this opinion. NMFS documented this determination in a memorandum to the file.

May 27, 2021: The Authority and NMFS mutually agreed upon a revised extension date of July 1, 2021.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Under MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910). Through a memorandum of understanding signed July 1, 2019, pursuant to 23 U.S.C. 327(a)(2)(B), the State of California (acting through its California State Transportation Agency and the Authority) assumed all of FRA's responsibilities for environmental review, consultation, or other action required or arising under listed Federal environmental laws, including the ESA, for the HSR system. The FRA funded the environmental review and preliminary engineering for the HSR system, as well as the construction activities of the first section to break ground (the Merced to Fresno Project Section).

1.3.1. Project Section Overview

The Authority proposes to construct, operate, and maintain the HSR San Jose to Merced Project Section, which is one of eight independent project sections comprising Phase I of the HSR system in California. The HSR system would be an electronically powered, steel-wheel-on-steel-rail system with state-of-the-art safety, signaling, and automatic train control systems. The trains would be capable of operating at speeds of up to 220 miles per hour (mph) where the alignment has a fully grade-separated, dedicated track, with the purpose of providing transit connection between the major population centers of the San Francisco Bay Area with the Los Angeles metropolitan region and urban centers in the California Central Valley at final build out. Each section of the HSR system has been designed to have independent utility regardless of whether other sections are completed, principally through the inclusion of logical termini and local benefits (Authority 2009). The proposed San Jose to Merced Project Section would provide the connection between the San Francisco-San Jose Bay Area to the rest of the statewide system. During operation, the San Jose to Merced section would support train service from San Jose to Gilroy, which would increase the connectivity and accessibility between the South Bay and the tri-county Monterey Bay area (Monterey, San Benito, and Santa Cruz counties). Implementation of the San Jose to Merced section also enables early, incremental improvements to the existing train services between San Francisco, San Jose, and Gilroy in coordination with Caltrain. By using lightweight, electrified trains compatible with HSR lines and equipment, Caltrain can operate with faster services within the San Jose to Merced section as well as on the San Francisco Peninsula lines.

More accurately, the San Jose to Merced Project Section will provide connection for the HSR line from Scott Boulevard in Santa Clara County, California, to Carlucci Road in Merced County, California, and not to the City of Merced (Figure 1). The CV Wye project extent, which connects to the end at Carlucci Road, and the Ranch Road to Merced project extent (part of the Merced to Fresno Project Section) will provide the final connection to the City of Merced. These project extents/sections have already received ESA/MSA review and incidental take coverage under NMFS opinion (WCR-2018-10897/WCRO-2018-00285 (NMFS 2019)). Thus, this opinion considers the route from Scott Boulevard to Carlucci Road as the Authority's HSR San Jose to Merced section, despite its given title.

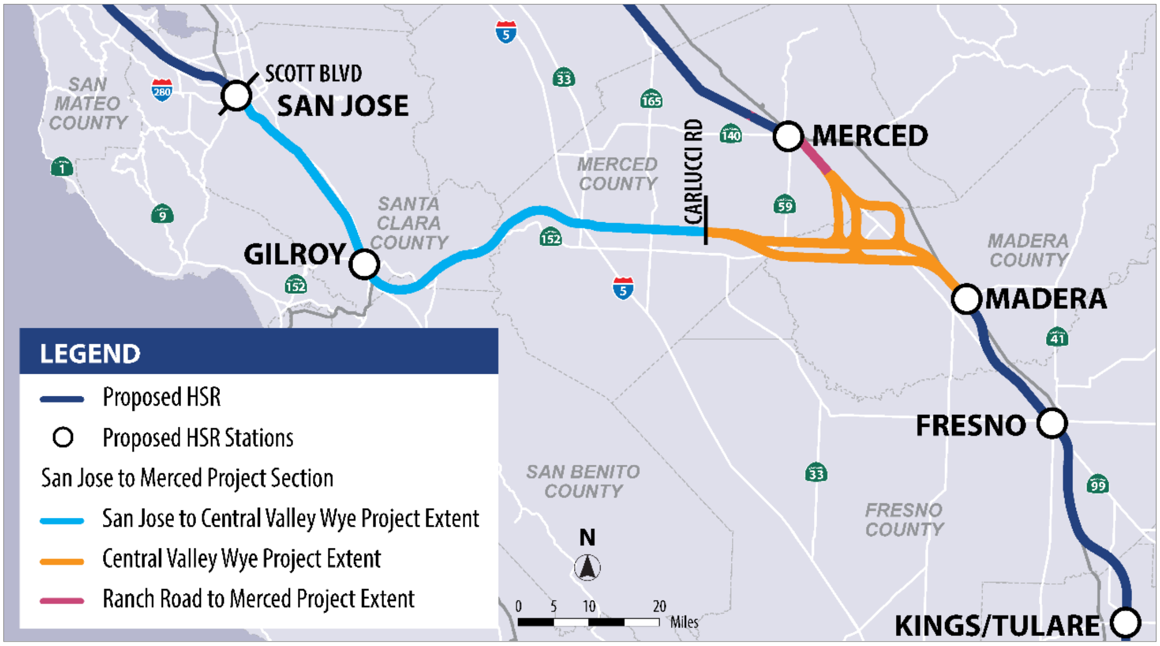

Figure 1. Geographic extent of the San Jose to Merced HSR (Scott Blvd to Carlucci Rd) Project Section route in light blue, including its westward connection to the Merced to Fresno section in the California Central Valley at Carlucci Road. The Merced to Fresno section consists of the CV Wye (orange) and its northward connection to Merced (maroon) (Authority 2020c).

Specifically, the Authority's Preferred Alternative, Alternative 4, was identified in the San Jose to Merced Project Section Draft EIR/EIS for the San Jose to Merced Project Section (Authority 2019f, e) as the most appropriate route to accomplish project goals while minimizing adverse impacts and is the Alternative submitted by the Authority for ESA/MSA consideration in this opinion. The Preferred Alternative of the San Jose to Central Valley Wye section is a 90-mile blended (Caltrain/HSR passenger and freight trains using the same tracks for portions of the alignment), alignment that would operate on two electrified passenger tracks and, for a short portion of the alignment, one conventional freight track predominantly within the existing Caltrain and Union Pacific Railroad (UPRR) right-of-way (ROW). It will extend blended electric-powered passenger railroad infrastructure and service from the southern limit of the Caltrain Peninsula Corridor Electrification Project through Gilroy, California. South and east of Gilroy, California, the HSR would operate on a new dedicated guideway to make the connection via tunnels to the California CV Wye section. Overall, the project section would be comprised of 15.2 miles on viaduct, 30.3 miles at grade, 25.9 miles on embankment, 2.3 miles in trench, and two tunnels with a combined length of 15.0 miles.

In addition to the construction of HSR system infrastructure (the track and route itself) of the Preferred Alternative, the proposed action also includes the construction and/or installation of all associated facilities necessary to support its operation, like train control and communication facilities, transit station modifications, highway and roadway modifications, freight or passenger rail modifications, maintenance stations, and wildlife crossings. A maximum train speed of 110 mph in the blended guideway would be enabled by continuous access-restriction fencing; four-quadrant gates, roadway lane channels, and railroad trespass deterrents at all public road grade crossings; and fully integrated communications and controls for train operations, grade crossings, and roadway traffic. Caltrain stations would be reconstructed to enable directional running as part of blended operations. For a full description of the auxiliary surface transportation modifications and components of the proposed action (i.e., state highway and local roadway modifications, freight/passenger railroad modifications, bridge reconstructions, traction power substations components, and communication system installation), see BA Chapter 2 (Authority 2020c).

Station modifications/redesigns:

- Reconstruction of College Park Caltrain Station
- New dedicated platforms, pedestrian concourse, replacement of 226 parking spaces, street improvements, and other modifications at San Jose Diridon Station (Figure 2)
- Reconstruction of the Morgan Hill Caltrain Station
- Reconstruction of the San Martin Caltrain Station
- Reconstruction of the Gilroy Caltrain Station
- New dedicated platforms/a new HSR station in the Downtown Gilroy Station, with replacement and addition of parking surfaces (Figure 3)

Other alignment and ancillary features:

- A 50-acre maintenance-of-way facility (MOWF) in south Gilroy near Bloomfield Avenue
- A 4-acre maintenance-of-way siding (MOWS) facility in the San Joaquin Valley near Henry Miller Road
- Associated railway support structures (e.g., traction power substations (TPSS), switching/paralleling stations)
- Approximately 29 at-grade road crossings
- At least 28 wildlife crossings or jump-outs

Electrical interconnections required for operation:

- Two 115/50 kilovolt (kV) or 230/50 kV single-phase transformers for each TPSS
- New 115 kV or 230 kV switching station or reconfiguration of existing facility within fence line
- Electrical network upgrades
- Two reconductor 115 kV power lines
- Co-location of new power lines with existing 230 kV transmission lines

The parts of the proposed action that are most likely to affect species and critical habitat under NMFS jurisdiction are crossings of above-grade or elevated track segments that span over waterways containing coastal steelhead habitat and the tunneling under designated critical habitat; these locations are identified in the Action Area description (section 2.3). All route and electrical interconnection crossings between this project section and steelhead habitat modeled by Authority consultants can be found in Appendix 5-D: Steelhead Crossing Map, Detailed (Authority 2020b).

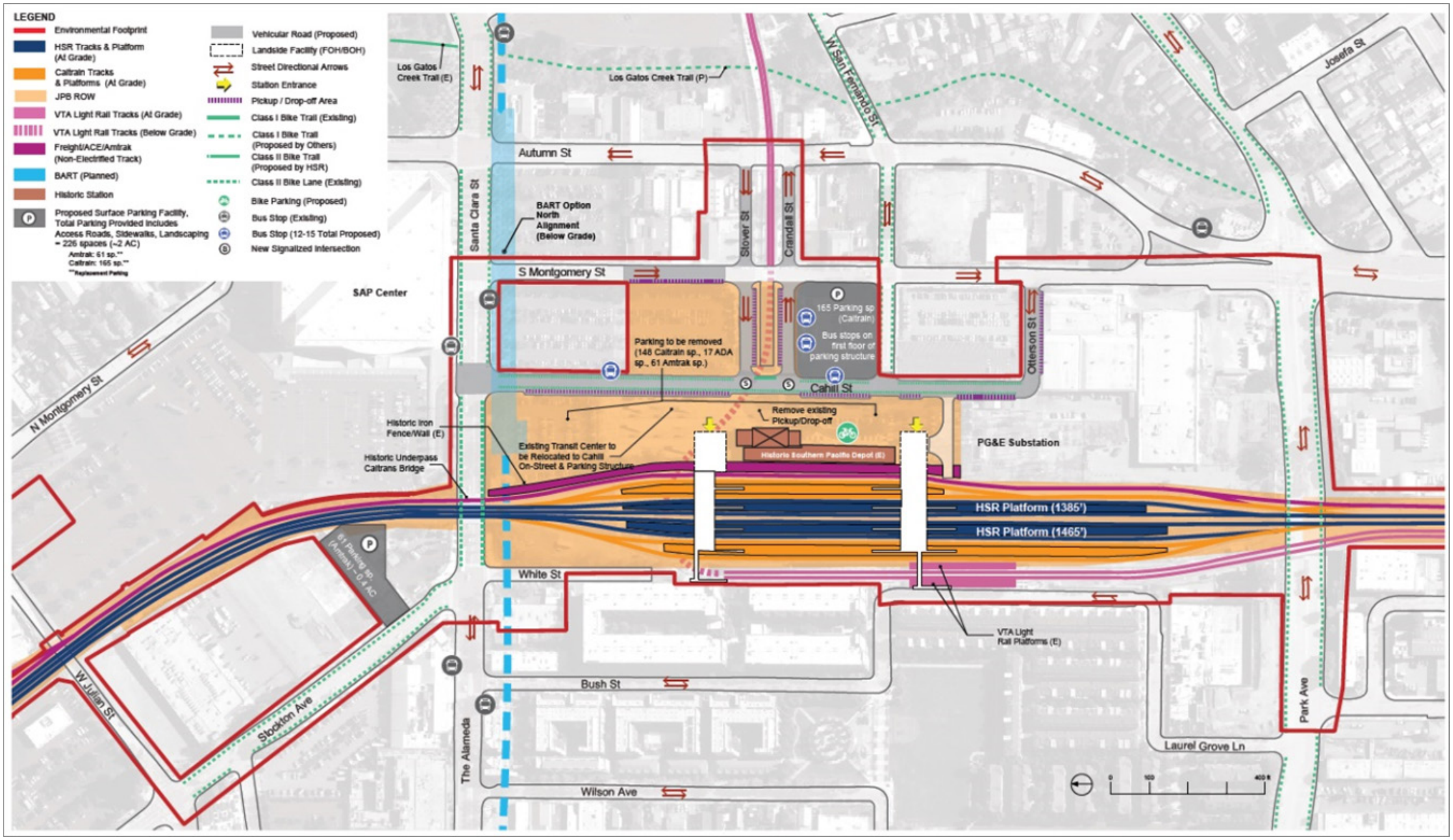

Figure 2. Preliminary design of modification and parking at San Jose Diridon Station (Authority 2020c).

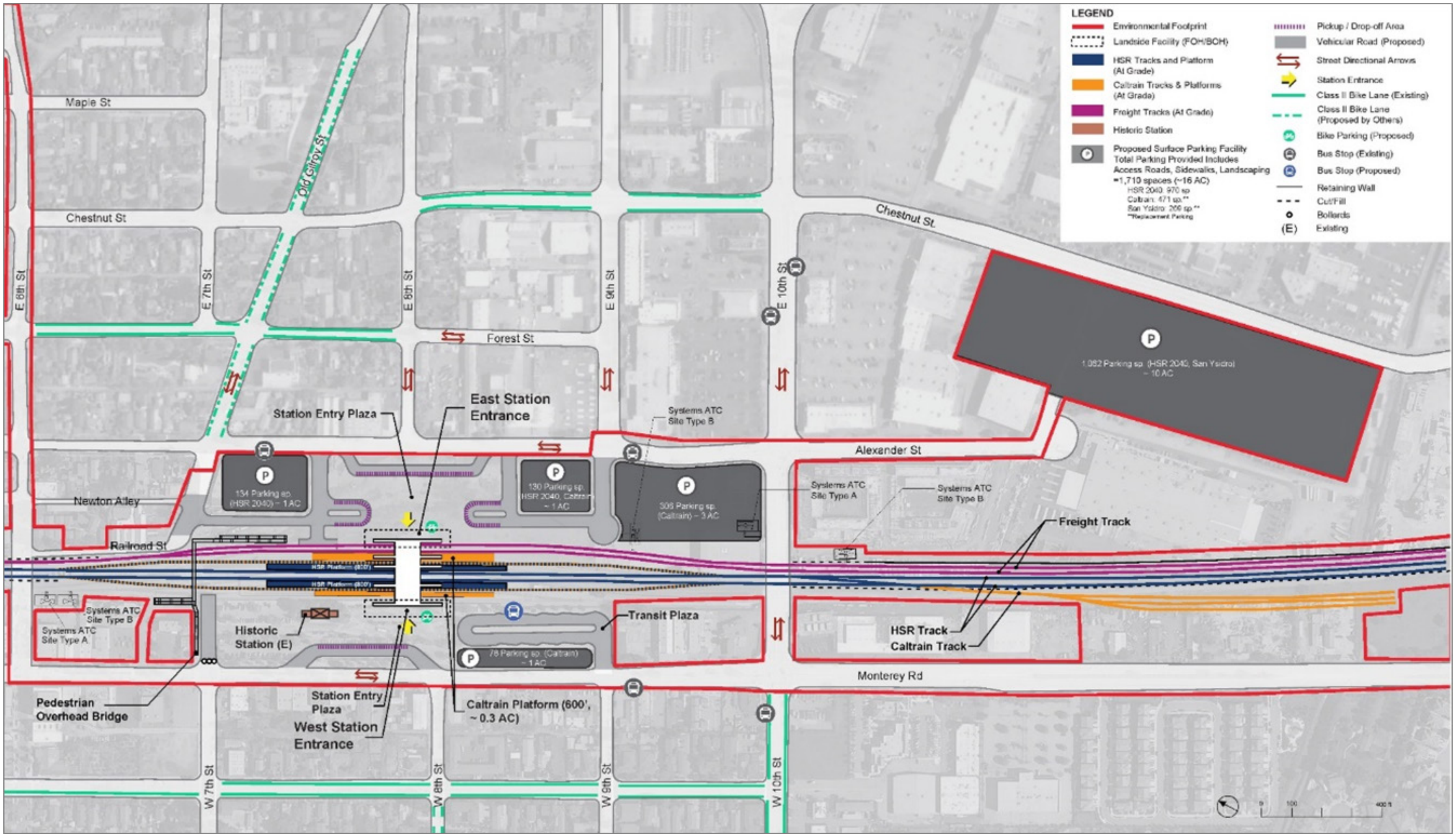

Figure 3. Preliminary design of modification and parking at Downtown Gilroy Station (Authority 2020c).

1.3.2. Construction

The Authority plans to begin implementing its construction plan after receiving the required environmental approvals and permits and securing funding. Given the size and complexity of the HSR project, the Authority assumes the design and construction work would likely be divided into several procurement packages. In general, the procurement packages would be grouped as follows:

- Tunnels
- Civil/structural infrastructure, including at-grade, viaduct, and trench track profiles; utility relocations; and roadway modifications
- Design and construction of passenger stations, maintenance facilities, and wayside facilities
- Rail infrastructure and testing including trackwork, design and construction of direct fixation track and subballast, ballast, ties and rail installation, switches, and special trackwork
- Core systems, such as traction power, train controls, communications, the operations center, and the procurement of trainsets

One or more design-build packages would be developed. The Authority would issue construction requests for proposals, begin right-of-way acquisition, and procure construction management services to oversee physical construction of the project. During peak construction periods, work would occur concurrently in different subsections, with overlapping construction of various project elements. Working hours and the number of workers present at any time would depend on the activities being performed. Construction fencing would be restricted to areas designated for construction staging and areas where public safety or environmentally sensitive resources are a concern. See section 1.3.4 Proposed Conservation Measures or Authority (2020a) Appendix 2-E for more details.

Preconstruction

During final design, the Authority would conduct several pre-construction activities to optimize construction staging and management. These activities include the following:

- Conducting additional geotechnical investigations to define precise geologic, groundwater, and seismic conditions along the alignment.
- Identifying construction laydown and staging areas used for mobilizing personnel, stockpiling materials, and storing equipment for building HSR or related improvements. Precasting yards would be identified for the casting, storage, and preparation of precast concrete segments; temporary spoil storage; workshops, and the temporary storage of delivered construction materials. Field offices and temporary jobsite trailers would also be located at the staging areas.
- Initiating site preparation and demolition, such as clearing, grubbing, and grading, followed by the mobilization of equipment and materials.
- Relocating utilities (overhead tension wires, pressurized transmission mains, oil lines, fiber optical conduits or cables, and communications lines or facilities) prior to construction.

- Implementing temporary, long-term, and permanent road closures to reroute or detour traffic away from construction activities. Handrails, fences, and walkways would be provided for the safety of pedestrians and bicyclists.
- Locating temporary batch plants to produce Portland Cement Concrete or asphaltic concrete needed for roads, bridges, aerial structures, retaining walls, and other large structures. The facilities generally consist of silos containing fly ash, lime, and cement; heated tanks of liquid asphalt; sand and gravel material storage areas; mixing equipment; aboveground storage tanks; and designated areas for sand and gravel truck unloading, concrete truck loading, and concrete truck washout.
- Conducting other studies and investigations, as needed, such as surveys of local business, farms or dairies, and wildlife refuges to identify usage, delivery, shipping patterns, and critical times of the day or year for business, planting, harvesting activities, or recreational activities.

Major Construction Activities

Major types of construction activities for the project include earthwork; bridge, aerial structure, and roadway crossings; railroad systems; and station construction, as briefly described in the following subsections.

Earthwork: Earthwork would be conducted using conventional earthmoving methods and heavy construction equipment, such as dozers, wheel loaders, scrapers, articulated trucks, rear dump trucks, or wagons. The type of equipment used would depend on the hauling distance, with trucks or wagons used for longer distances. The project would require earthwork construction of 53 to 59 miles of embankment or trench construction. The high amount of earthwork is predominantly due to the embankment and at-grade profile through the Morgan Hill and Gilroy Subsection. The project would also require greater quantities of embankment than excavation, requiring approximately an additional 2.3 million and 900,000 cubic yards of material, respectively. While fill material is likely to be acquired locally, ballast and subballast materials may be imported from off-site quarries. To minimize material transport, the preliminary engineering design has identified construction staging sites that would store excavated materials close to where they would be placed, minimizing repetitive handling of materials.

Bridge and Aerial Structure Construction: The majority of the elevated guideways would be designed and built using single box segmental girder construction. However, other structural types and construction methods will be considered as needed.

A typical aerial structure foundation pile cap is supported by an average of four large-diameter (5 to 9 feet) bored piles. Depth of piles depends on the geotechnical conditions at each pile site. Pile construction can be achieved by using rotary drilling rigs, and either bentonite slurry or temporary casings may be used to stabilize pile shaft excavation. The estimated pile production rate is 4 days per pile installation. Additional available pile installation methods include bored piles, rotary drilling cast-in-place (CIP) piles, driven piles, and a combination of pile jetting and driving. Following completion of the piles, pile caps can be constructed using conventional methods supported by structural steel: either precast and pre-stressed piles or cast-in-drilled hole piles. For pile caps constructed near existing structures such as railways, bridges, and underground drainage culverts, temporary sheet piling (i.e., temporary walls) may be used to minimize disturbances to adjacent structures. Sheet piling installation and extraction would likely be achieved using hydraulic sheet piling machines.

Typical aerial structures of up to 90 feet would be constructed using CIP bent caps and columns supported by structural steel and installed upon pile caps. A self-climbing formwork system may be used to construct piers and portal beams more than 90 feet high. The self-climbing formwork system is equipped with a winched lifting device, which is raised up along the column by hydraulic means with a structural frame mounted on top of the previous pour. In general, a 3-day cycle for each 12-foot pour height can be achieved. The final size and spacing of the piers depends on the type of superstructure and spans they are supporting.

The selection of superstructure type would consider the loadings, stresses, and deflections encountered during the various intermediate construction stages, including changes in static scheme, sequence of tendon installation, maturity of concrete at loading, and load effects from erection equipment. Accordingly, the final design will depend on the selected means and methods of construction, such as full-span precast, span-by-span, balanced cantilever segmental precast, and CIP construction on falsework (see Authority (2020c) Chapter 2 for more details on different superstructure designs and construction methods).

Tunnels: Tunnels would be used where the HSR system passes through a hill or mountain where the vertical profile is too deep to use an open cut to pass through the topography, such as through the Diablo Mountain Range to the California Central Valley. The project would require the construction of two tunnels—Tunnel 1 in the Morgan Hill and Gilroy Subsection and Tunnel 2 in the Pacheco Pass Subsection. These tunnels would be twin-bore, single-track tunnels, with lengths of approximately 1.6 and 13.5 miles, respectively, and a minimum internal diameter of 29.5 feet. Localized enlargements, or niches, may be required at intervals to accommodate equipment such as overhead contact system tensioning devices, traction power paralleling stations, ventilation fans, communication equipment, signaling equipment, and drainage systems. Cross passages, placed no more than 800 feet apart, would be required between adjacent tunnels to provide emergency exits. The Authority would acquire exclusive underground property approximately 132 feet wide and 62 feet high to accommodate both tunnels and all support elements. Preparation for and construction of these tunnels would generally proceed as follows:

- Construction of access roads to the future tunnel portal sites: a new access road would be constructed on the west side of State Route-152 from Walnut Avenue to the east portal of Tunnel 1, and a new road and bridge across Pacheco Creek would be constructed to the west portal of Tunnel 2. McCabe Road would be improved to provide access to the east portal of Tunnel 2.
- Construction of power system: overhead power lines would be installed to the construction staging areas, and portable diesel generators would be installed to provide backup power supply.
- Preparation of tunnel portals: a large, level area would be constructed at each tunnel portal including installation of retaining walls to minimize grading and slope modification. At the portals for Tunnel 2, this construction would likely include hillside slope reduction or application of drainage techniques, as well as ongoing monitoring and

maintenance, to reduce the potential for landslides. Tunnel portals would initially be used to store precast materials and equipment, assemble and maintain equipment, stockpile tunnel spoils, and conduct ongoing monitoring and measuring of safety and ventilation systems. Portals would also be designed to accommodate housing trailers, ventilation buildings, communications equipment, power facilities, water and sewage, lighting and fencing, and clear areas for parking and storage.

- Manufacturing and transport of precast tunnel support materials: manufacturing of precast materials, such as the tunnel lining segments would occur off-site and be transported to the tunnel portals.

Tunnel excavation would likely be conducted using a combination of tunnel boring machines (TBMs) and conventional tunneling methods at either end of the tunnel portals. The type of machine used would be determined by the Authority's design-build contractor, based on the tunnel length, the particular geology of the project, the amount of groundwater present and its condition, and other factors (further tunneling details available in Authority (2020c): Chapter 3.4 Potential Groundwater Depletion from Tunnel Construction). Tunnel excavation will generate large volumes of soil and rock materials (an estimated 0.5 million cubic yards from Tunnel 1 and 4.3 million cubic yards from Tunnel 2). Tunnel spoils would be temporarily stockpiled at the tunnel portal and, depending on geotechnical properties, distributed along the alignment and reused for embankment fill or non-structural fill. Depending on the rate of excavation completed, the transport of tunnel spoils could require approximately 160 three-axle dump truck trips per day at each tunnel portal.

Railroad Systems Construction: The HSR system will include trackwork, traction power electrification, signaling, and communications. After completion of earthwork and structures, trackwork is the first rail system to be constructed, and it must be in place at least locally to start traction power electrification and railroad signalizing installation. Trackwork construction generally requires the welding of transportable lengths of steel running onto longer lengths (approximately 0.25 mile), which are placed in position on crossties or track slabs and field-welded into continuous lengths.

Tie and ballast, and slab track construction would be used. Tie and ballast construction, which would be used for at-grade and minor structures, typically uses crossties and ballast that are distributed along the track bed by truck or tractor. In sensitive areas, such as where the HSR is parallel to or near streams, rivers, or wetlands, and in areas of limited accessibility, this operation may be accomplished by using the constructed rail line for material delivery. For major civil structures, slab track construction would be used. Slab track construction is a non-ballasted track form using precast supports to which the track is directly fixed.

Traction power electrification equipment to be installed includes TPSSs, traction power switching and paralleling stations, and the overhead contact system. Traction power facility equipment and houses are typically fabricated and tested in a factory, then delivered by tractor-trailer to a prepared site adjacent to the alignment. Substations are assumed to be located every 30 miles along the alignment. Traction power switching stations are located every 15 miles and traction power paralleling stations every 5 miles along the alignment. The overhead contact system is assembled in place over each track and includes poles, brackets, insulators, conductors, and other hardware. Signaling equipment to be installed includes wayside cabinets and bungalows, communications radio towers, wayside signals, switch machines, insulated joints, impedance bonds, and connecting cables. The equipment will support automatic train protection; enhanced automatic train protection; and positive train control to maintain train separation, routing at interlocking, and speed.

Station Construction: Because the HSR stations in San Jose and downtown Gilroy would be co-located with existing Caltrain stations, existing train operations would be maintained during HSR station construction/modification. The San Jose Diridon Station and downtown Gilroy station would be reconstructed to accommodate the HSR system and the east Gilroy station would be a new station. In summary, station construction would include demolition and site preparation, construction of new buildings and platforms, connecting the electrical and mechanical systems, and finishing with communication and security equipment (more details are in Authority (2020c) Chapter 2.3.3.5 Station Construction).

1.3.3. Long-term HSR operations and maintenance plans

The conceptual HSR service plan for Phase 1 describes service from Anaheim/Los Angeles through the CV from Bakersfield to Merced and northwest into the Bay Area, terminating in San Francisco. Subsequent stages of the HSR system include a southern extension from Los Angeles to San Diego via the Inland Empire and an extension from Merced north to Sacramento. Train service would run in diverse patterns between various terminals. Three basic service types are envisioned:

- Express trains would serve major stations only, providing fast travel times between Los Angeles and San Francisco during the morning and afternoon peak.
- Limited-stop trains would skip selected stops along a route to provide faster service between stations.
- All-stop trains would focus on regional service.

The majority of trains would provide limited-stop services and offer a relatively fast run time along with connectivity among various intermediate stations. Numerous limited-stop patterns would be provided to achieve a balanced level of service at the intermediate stations. The service plan envisions at least four limited-stop trains per hour in each direction, all day long, on the main route between San Francisco and Los Angeles. Each intermediate station in the Bay Area, the Central Valley between Fresno and Bakersfield, Palmdale in the high desert, and Sylmar and Burbank in the San Fernando Valley would be served by at least two limited-stop trains every hour—offering at least two reasonably fast trains an hour to San Francisco and Los Angeles. Selected limited-stop trains would be extended south of Los Angeles as appropriate to serve projected demand. The service plan provides direct train service between most station pairs at least once per hour.

In 2029, the assumed first year of HSR operation, two trains per hour would operate during peak travel times and one train per hour off-peak travel times between San Francisco and Bakersfield. When Phase 1 operations occur, this BA assumes the following service:

- Two peak trains per hour from San Francisco and Los Angeles (one in off-peak)

- Two peak trains per hour from San Francisco and Anaheim (one in off-peak)
- Two peak trains per hour from San Jose and Los Angeles
- One peak train per hour from Merced and Los Angeles
- One train per hour (peak and off-peak) from Merced and Anaheim

The Authority will regularly perform maintenance along the track and railroad ROW, as well as on the power systems, train control, signalizing, communications, and other vital systems required for the safe operation of the HSR system. The Authority expects maintenance methods to be comparable to those of existing European and Asian HSR systems, adapted to the specifics of the California HSR system, with inspection and maintenance for some project elements occurring several times per week (e.g. track and overhead power system) and some inspection occurring only a few times a year (e.g. structural inspection, vegetation control within the ROW). Approximately every 4–5 years, ballasted track would require tamping. This more intensive maintenance of the track uses a train with a succession of specialized cars to raise, straighten, and tamp the track, using vibrating "arms" to move and position the ballast under the ties. Steel structures would require painting every several years. Fencing and intrusion protection systems would be remotely monitored, as well as periodically inspected, with maintenance taking place as needed. The FRA will specify standards of maintenance, inspection, and other items in a set of regulations to be issued in the next several years.

1.3.4. Proposed Conservation Measures

The Authority proposes to employ a variety of BMPs and avoidance and mitigation measures (AMMs), also known as conservation measures (CMs), to reduce or avoid adverse impacts to a listed species and the habitats upon which they depend. The CMs that are directly applicable to listed species under NMFS jurisdiction (CCC and S-CCC steelhead) are reproduced below, though other proposed CMs will also be employed and are also expected to protect and conserve NMFS trust resources. A full description of all CMs proposed by the Authority is available in the BA, Appendix 2-E: Conservation Measures (Authority 2020a).

AMM-FISH-1: The Authority would implement general protection measures to protect and minimize effects on CCC and S-CCC steelhead and their habitat during construction. The following measures would be implemented during design:

- Design temporary night lighting of overwater structures (if needed) such that illumination of the surrounding water is avoided.
- Locate temporary construction areas (e.g., staging, storage, parking, and stockpiling areas) outside of channels and riparian areas wherever feasible.
- Minimize, to the extent feasible, the placement of footings and columns within the active channel (between top of bank) of steelhead critical habitat.
- The Authority will coordinate with NMFS and the USFWS and request review of design between approximately 75 and 90 percent design completion.
- The Authority has committed to using low-impact development methods for stormwater treatment, including locations that could otherwise contribute polluted stormwater to streams that provide habitat for fish listed under the federal Endangered Species Act (IAMF-HYD-#1). Such measures may consist of pervious hardscapes (for pollutant-generating areas such as parking lots), bioswales, infiltration basins, rain gardens, and

any and all other design measures that would capture and treat polluted runoff before it reaches sensitive natural waterways. Design review would include these systems.

- The following bank stabilization and erosion control measures would be implemented during design and construction to minimize habitat disturbance:
    - Temporarily fence areas of natural riparian vegetation that can be avoided with high-visibility environmentally sensitive areas fence to enforce avoidance.
    - Use "soft" approaches to bank erosion control to the extent possible (e.g., vegetative plantings, placement of large woody debris). Avoid hard bank protection methods (e.g., revetment) wherever feasible.
    - Avoid the use of wood treated with creosote or copper-based chemicals in bank stabilization efforts.
    - Use quarry stone, cobblestone, or their equivalent for erosion control along rivers and streams, complemented with native riparian plantings or other natural stabilization alternatives that would maintain a natural riparian corridor, where feasible. Cobble size types and spacing of riparian plantings, and other details on riparian restoration activities would be provided in the restoration and revegetation plan (RRP) described in AMM-GEN-12.
    - Revegetate temporarily disturbed areas with native plants to resemble the existing vegetation.

AMM-FISH-2: Near-water and in-water work would be conducted within specified work windows based on date, channel inundation, and water temperature. Work windows would include the general time periods when effects on migrating juvenile and adult CCC and S-CCC steelhead would be minimal. Additionally, in-water work would be allowed when salmonid use is temperature limited (defined as 1 week of average water temperature of 75°F or more); and work would be allowed in the channel and on the floodplain when channels are dry or ponded.

- During work windows, work would only be allowed in the channel and on the floodplain from 1 hour after sunrise until 1 hour before sunset.
- Near-water or over-water work is defined as construction activities occurring within the floodplain but not in the wetted channel (e.g., located between the wetted channel and the landside toe of the bordering levees or over the wetted channel). In-water work is defined as work within the wetted channel.
- The near-water construction work window would be April 30 through December 1. For in-water work, the construction work window would be June 15 through October 15. These periods may be extended subject to receipt of written authorization from NMFS that incidental take limits would not be exceeded.
- If channels are dry or ponded (i.e., lack continuous flow), or water temperatures average 75°F or more for 7 consecutive days, in-water and near-water work can proceed outside the work windows stated above. NMFS would be consulted to verify work can proceed if these conditions are present during construction.

AMM-FISH-3: The Authority would develop and implement an underwater sound control plan outlining specific measures to be implemented to avoid and minimize the effects of impact pile driving on CCC and S-CCC steelhead. Effects would be minimized by limiting the period during which impact pile driving may occur and by limiting or abating underwater noise generated during impact pile driving. The underwater sound control plan would be provided to NMFS for review and approval prior to in-water impact pile driving. The plan would evaluate the potential effects of impact pile driving on steelhead in the context of the following underwater noise thresholds established for disturbance and injury of fish (Caltrans 2015).

- Injury threshold for fish of all sizes includes a peak sound pressure level of 206 decibels (dB) relative to 1 micropascal.
- Injury threshold for fish less than 2 grams is 183 dB relative to 1 micropascal cumulative sound exposure level, and 187 dB relative to 1 micropascal cumulative sound exposure level for fish greater than or equal to 2 grams.
- Disturbance threshold for fish of all sizes is 150 dB root mean square (RMS) relative to 1 micropascal.

The underwater sound control plan would restrict in-water work to the in-water work window specified in permits issued by the fish and wildlife agencies (including NMFS), and to daylight hours between 1 hour after sunrise and 1 hour before sunset with a 12-hour break between pile driving sessions. The underwater noise generated by impact pile driving would be abated using the best available and practicable technologies. Examples of such technologies include, but are not limited to, the use of cast-in-drilled-hole rather than driven piles; use of vibratory rather than impact pile driving equipment; using an impact pile driver to proof piles initially placed with a vibratory pile driver; noise attenuation using pile caps (e.g., wood or micarta), bubble curtains, air-filled fabric barriers, or isolation piles; and installation of piling-specific cofferdams. Specific techniques to be used would be selected based on site conditions.

In addition to primarily using vibratory pile driving methods and establishing protocols for attenuating underwater noise levels produced during in-water construction activities, the Authority would develop and implement operational protocols for when impact pile driving is necessary. These operational protocols would be used to minimize the effects of impact pile driving on CCC and S-CCC steelhead. These protocols may include, but not be limited to, the following: monitoring the in-water work area for fish that may be showing signs of distress or injury as a result of pile-driving activities and stopping work when distressed or injured fish are observed; initiating impact pile driving with a "soft-start," such that pile strikes are initiated at reduced impact and increase to full impact over several strikes to provide fish an opportunity to move out of the area; restricting impact pile-driving activities to specific times of the day and for a specific duration to be determined through coordination with the fish and wildlife agencies; and, when more than one pile-driving rig is employed, initiating pile-driving activities in a way that provides an escape route and avoids "trapping" fish between pile drivers in waters exposed to underwater noise levels that could potentially cause injury. These protocols are expected to avoid and minimize the overall extent, intensity, and duration of potential underwater noise effects associated with impact pile-driving activities.

AMM-FISH-4: Construction within waterways may require temporary dewatering to minimize potential impacts on fisheries and minimize potential erosion, sediment loss, scour, or increases in turbidity. Fish rescue operations would occur at any in-water construction site that occurs in modeled steelhead habitat or habitat identified by project biologists during pre-construction surveys where dewatering and resulting isolation of fish may occur. Fish rescue and salvage plans would be developed by the Authority and would include detailed procedures for fish rescue and salvage to minimize the number of individuals of listed fish species subject to stranding during dewatering. The plans would identify the appropriate procedures for removing fish from construction zones and preventing fish from reentering construction zones prior to dewatering and other construction activities. A draft plan would be submitted to the fish and wildlife agencies for review and approval at least 48 hours prior to fish rescue and relocation. An authorization letter from NMFS would be required before in-water construction activities with the potential for stranding fish can proceed.

All fish rescue and salvage operations would be conducted under the guidance of a qualified fish biologist and in accordance with required permits. At each crossing of modeled steelhead habitat, the fish rescue plan would identify the appropriate procedures for excluding fish from the construction zone and for removing fish from areas subject to dewatering. The primary procedure would be to block off the construction area and use seines (nets) or dip nets to collect and remove fish, although electrofishing techniques may also be authorized under certain conditions. It is critical that fish rescue and salvage operations begin as soon as possible and be completed within 48 hours after isolation of a construction area to minimize potential predation and adverse water quality impacts (high water temperature, low dissolved oxygen) associated with confinement. Block nets, sandbags, or other temporary exclusion methods could be used to exclude fish or isolate the construction area prior to the fish removal process. The appropriate fish exclusion or collection method would be determined by a qualified fish biologist, in consultation with a designated fish and wildlife agency biologist, based on site-specific conditions and construction methods. Capture, release, and relocation measures would be consistent with the general guidelines and procedures set forth in Part IX of the most recent edition of the *California Salmonid Stream Habitat Restoration Manual* (Game) 2004) to minimize impacts on listed species of fish and their habitat.

All fish rescue and salvage operations would be conducted under the guidance of a fish biologist meeting the qualification requirements (refer to the following subsection, Qualifications of Fish Rescue Personnel). The following discussion addresses fish collection, holding, handling, and release procedures of the plan. Unless otherwise required by project permits, the Authority would provide the following:

- A minimum 48-hour notice to the appropriate fish and wildlife agencies of dewatering activities that are expected to require fish rescue.
- Unrestricted access for the appropriate fish and wildlife agency personnel to the construction site for the duration of implementation of the fish rescue plan.
- Temporary cessation of dewatering if fish rescue workers determine that water levels may drop too quickly to allow successful rescue of fish.
- A work site that is accessible and safe for fish rescue workers.

Qualifications of Fish Rescue Personnel: Personnel active in fish rescue efforts would include at least one person with a 4-year college degree in fisheries or biology or a related degree. This person also must have at least 2 years of professional experience performing field surveys and fish capture and handling procedures affecting juvenile salmonids. The person would have completed an electrofishing training course such as Principles and Techniques of Electrofishing (USFWS, National Conservation Training Center) or similar course, if electrofishing is used. To avoid and minimize the risk of injury to fish, attempts to seine or net fish would always precede the use of electrofishing equipment.

Seining and Dipnetting: Fish rescue and salvage operations would begin immediately after isolating the work area. If the enclosed area is wadeable (less than 3 feet deep), fish can be herded out within the work area by dragging a seine (net) through the enclosure prior to final closure of the downstream end of the isolation area. Depending on conditions, this process may need to be conducted several times. The net or screen mesh would be no greater than 0.125 inch, with the bottom edge of the net (lead line) securely weighted down to prevent fish from entering the area by moving under the net.

After isolation of the work area is complete, remaining fish in the enclosed area would be removed using seines, dip nets, electrofishing techniques, or a combination of these depending on site conditions. Dewatering activities would also conform to the guidelines specified in the Dewatering subsection. Following each sweep of a seine through the enclosure, the fish rescue team would do the following:

- Carefully bring the ends of the net together and pull in the wings, so that the lead line is kept as close to the substrate as possible.
- Slowly turn the seine bag inside out to reveal captured fish, so that fish remain in the water as long as possible before transfer to an aerated container.
- Follow the procedures outlined in the electrofishing section below and relocate fish to a predetermined release site.
- Dipnetting is best suited for small, shallow pools in which fish are concentrated and easily collected. Dip nets would be made of soft (nonabrasive) nylon material and small mesh size (0.125 inch) to collect small fish.

Electrofishing: After conducting the herding and netting operations described above, electrofishing may be necessary to remove as many fish as possible from the enclosure. Electrofishing would be conducted in accordance with NMFS electrofishing guidelines (NMFS 2000) and other appropriate fish and wildlife agency guidelines. Electrofishing would be conducted by one or two 3- to 4-person teams, with each team having an electrofishing unit operator and two or three netters. At least three passes would be made through the enclosed cofferdam areas to remove as many fish as possible. Fish initially would be placed in 5-gallon buckets filled with river water. Following completion of each pass, the electrofishing team would do the following:

- Transfer fish into 5-gallon buckets filled with clean river water at ambient temperature.
- Hold fish in 5-gallon buckets equipped with a lid and an aerator, and add fresh river water or small amounts of ice to the fish buckets if the water temperature in the buckets becomes more than 2°F warmer than ambient river waters.
- Maintain a healthy environment for captured fish, including low densities in holding containers to avoid effects of overcrowding.
- Use water-to-water transfers whenever possible.
- Release fish at predetermined locations.
- Segregate larger fish from smaller fish to minimize the risk of predation and physical damage to smaller fish from larger fish.

- Limit holding time to about 10 minutes, if possible.
- Avoid handling fish during processing unless absolutely necessary. Use wet hands or dip nets if handling is needed.
- Handle fish with hands that are free of potentially harmful products, including but not limited to sunscreen, lotion, and insect repellent.
- Avoid anesthetizing or measuring fish.
- Note the date, time, and location of collection; species; number of fish; approximate age (e.g., young-of-the-year, yearling, adult); fish condition (dead, visibly injured, healthy); and water temperature.
- If positive identification of fish cannot be made without handling the fish, note this and release fish without handling.
- In notes, indicate the level of accuracy of visual estimates to allow appropriate reporting to the appropriate fish and wildlife agencies (e.g., "Approx. 10–20 young-of-the-year steelhead").
- Release fish in appropriate habitat either upstream or downstream of the enclosure, noting release date, time, and location.
- Stop efforts and immediately contact the appropriate fish and wildlife agency if mortality during relocation exceeds the Authority's authorized take limits.
- Place dead fish of listed species in sealed plastic bags with labels indicating species, location, date, and time of collection, and store them on ice.
- Freeze collected dead fish of listed species as soon as possible and provide the frozen specimens to the appropriate fish and wildlife agencies, as specified in the permits.
- Sites selected for release of rescued fish either upstream or downstream of the construction area would be similar in temperature to the area from which fish were rescued, contain ample habitat, and have a low likelihood of fish reentering the construction area or being impinged on exclusion nets/screens.
- All equipment used in fish rescue and salvage activities must be sterilized prior to use to avoid introductions of aquatic invasive species and limit the spread of disease and parasites. Disinfection protocols are described by CDFW (2016).

Dewatering: Dewatering would be performed as specified in AMM-GEN-21 in association with fish rescue operations as described above. A dewatering plan would be submitted as part of the SWPPP/Water Pollution Control Program detailing the location of dewatering activities, equipment, and discharge point. Dewatering pump intakes would be screened to prevent entrainment of juvenile or parr-sized salmonids in accordance with NMFS (1997) screening criteria, including the following:

- Perforated plate: screen openings shall not exceed 3/32 inch (2.38 mm), measured in diameter.
- Profile bar: screen openings shall not exceed 0.0689 inch (1.75 mm) in width.
- Woven wire: screen openings shall not exceed 3/32 inch (2.38 mm), measured diagonally (e.g., 6–14 mesh).
- Screen material shall provide a minimum of 27 percent open area.

During the dewatering process, a qualified biologist or fish rescue team would remain on site to observe the process and remove additional fish using the previously described rescue procedures.

Contingency Plans: If fish rescue and salvage operations cannot be conducted effectively or safely by fish rescue workers and surveys observe five or more juvenile steelhead, dewatering must stop until the fish biologist can show that fish have left the area.

Final Inspections and Reporting: Upon dewatering to water depths at which neither electrofishing nor seining can effectively occur (e.g., less than 3 inches [0.1 meter]), the fish rescue team would inspect the dewatered areas to locate any remaining fish. Collection by dip net, data recording, and relocation would be performed as necessary according to the procedures outlined previously in Electrofishing. The fish rescue team would notify the Authority when the fish rescue has been completed and construction can recommence. The results of the fish rescue and salvage operations (including date, time, location, comments, method of capture, fish species, number of fish, approximate age, condition, release location, and release time) would be reported to the appropriate fish and wildlife agencies as specified in the pertinent permits**.**

Additional General CMs Pertinent to Steelhead Protection and Avoidance

- AMM-GEN-1: Project biologists will be assigned to the project section with NMFS approval for relevant species. The approved project biologists would be responsible for oversight of the construction and implementation of CMs and providing compliance and monitoring documentation.
- AMM-GEN-2: NMFS and other resource agency staff will be provided access to the construction site in coordination with construction site safety requirements.
- AMM-GEN-3: A worker environmental awareness program (WEAP) would be developed and trainings and training updates would be conducted by the project biologists for construction personnel working onsite.
- AMM-GEN-4: A WEAP would be created and implemented prior to starting operations and maintenance activities for operations and maintenance staff.
- AMM-GEN-5: A biological resources management plan would be prepared and implemented prior to construction, and would include the terms and conditions of applicable permits as well as the reporting responsibilities required by each regulatory agency.
- AMM-GEN-6: Non-monofilament substitutes would be used instead of plastic monofilament netting or other plastics in erosion control materials.
- AMM-GEN-8: Prior to construction, staging areas will be delineated outside of sensitive environmental areas to the extent practicable. Staging areas will be made in areas that will ultimately be occupied by permanent HSR facilities, reducing the overall disturbance footprint of the project.
- AMM-GEN-9: Waste materials from construction unsuitable for reuse would be disposed of in local landfills permitted to take the materials, in conformance with state and federal regulations.
- AMM-GEN-10: Prior to groundbreaking, all equipment entering the work area will be cleaned of mud and plant materials. Vehicle cleaning areas would be established and designed to contain and isolate organic material to minimize the spread of weed and invasive plant species.
- AMM-GEN-11: Prior to groundbreaking, a construction site BMP field manual would be created with the site housekeeping practices expected for the site and disseminated to the construction personnel. The manual would be updated by January 31 of each year.

- AMM-GEN-12: A RRP for upland vegetation would be prepared where vegetation or soils have been temporarily disturbed. The RRP activities would include (but are not limited to) grading landforms to pre-disturbance conditions, removal of invasive plant species, and revegetating with native plant species to the extent practicable. The RRP would be submitted to NMFS for review when relevant to our regulatory authority.
- AMM-GEN-13: A weed control plan would be prepared and implemented during construction to minimize or avoid the spread of weeds, including surveys, equipment cleaning, weed control treatments (herbicides, manual, and mechanical removal), and success criteria.
- AMM-GEN-14: Environmentally Sensitive Areas would be established with high-visibility fencing or other markers to restrict construction equipment and personnel from disturbing these areas, such as riparian areas not already within the footprint of permanent or temporary work locations.
- AMM-GEN-15: A designated biological monitor would be on site for all construction activities and conduct daily ‘sweeps’ to verify that no listed species are within the areas to be disturbed by the day’s schedule activities.
- AMM-GEN-17: A post-construction compliance report would be submitted to NMFS upon completion of the construction, including the success in meeting the proposed CMs and compensation measures, the observance or interactions with listed species, and other information.
- AMM-GEN-18: A groundwater adaptive management and monitoring program (GAMMP) would be prepared and implemented to minimize and mitigate for potential impacts to wetlands, creeks, ponds, etc., prior to, during, and after tunnel construction. The GAMMP would be submitted to NMFS for review where the section interacts with resources under its regulatory authority. The monitoring program would be designed to detect real-time changes in ground- and surface water in comparison to baseline conditions. Water storage tanks or water lines would be installed prior to tunneling with the purpose of providing supplemental water, in case dewatering associated with tunneling reduces the amount of surface water in a way that negatively impacts listed species.
- AMM-GEN-19: Biologists will verify the mapped land cover and habitats of listed species prior to ground disturbing activities, with the purpose of updating land cover maps used by the project.
- AMM-GEN-20: Biologists and general biological monitors have the authority to stop work to protect any federally listed species within the project footprint. Ground-disturbing activities would be suspended in the construction area where the construction activity could result in take of listed species; work may continue in other areas. Work suspension would continue until the individual leaves voluntarily, is relocated to an approved release area using NMFS-approved handling techniques and relocation methods, or as required by NMFS for those resources.
- AMM-GEN-21: A dewatering and water flow diversion plan would be prepared and submitted for review prior to construction, with measures to minimize turbidity and siltation. Dewatering would occur through flow diversion or isolating the in-water work area by channeling the stream to an alternative course, which would meet NMFS and CDFW fish passage criteria in steelhead waterways.

- AMM-GEN-22: Prior to starting operations and maintenance activities, the Authority would prepare an annual vegetation control plan for the purpose of maintaining clear areas around facilities, controlling invasive weeds, and reducing the risk of fire during the operational phase.
- AMM-GEN-23: NMFS would be notified as soon as practicable but no later than 24 hours after the discovery of a project-related death or injury of a listed species under its regulatory jurisdiction.
- AMM-GEN-24: Material and equipment storage on the floodplain of a river would be limited to April 15 to October 31. Outside of this period, equipment may enter the river channel areas but be removed daily and stored outside of areas subject to flooding.
- AMM-GEN-25: Excavated materials would be temporarily stockpiled in designated areas at or near the excavation site and redistributed according to the RRP.
- AMM-GEN-26: During construction, all known wildlife crossing structures would be maintained to be unobstructed to the extent possible or a temporary crossing area or structure will be created. This includes employing the use of vibratory rather than impact pile driving in or within 200 feet of waterbodies that provide habitat for steelhead.
- AMM-GEN-30: The Authority will build additional structures to address the permanent intermittent noises and vibration created by HSR operations
- AMM-GEN-34: Within 90 days of completing construction, the project biologist would direct the revegetation of riparian areas temporarily disturbed from construction activities with appropriate native plants and seeds, with stock originating from local sources to the extent feasible, consistent with the RRP.
- AMM-GEN-35: Within 90 days of completing construction, the Authority would begin the restoration of aquatic resources that were temporarily affect by construction, consistent with the RRP. If trees were removed, they will be used in bank stabilization efforts during site restoration where feasible and appropriate for enhancement of fish habitat.
- AMM-GEN-36: Prior to groundbreaking, the Authority will conduct a site assessment of the work areas to identify biological and aquatic resources, plant communities, land cover types, and distribution of special status species. Using these results, the Authority would then obtain the necessary authorizations to conduct habitat restoration, enhancement, or creation at the selected sites.
- AMM-GEN-40: Prior to construction, a spill prevention, control, and countermeasure plan will be developed, and it will be implemented during construction.
- AMM-GEN-45: Prior to construction, the Authority will prepare an operational stormwater management and treatment plan. To the extent feasible, stormwater treatment will employ bioretention/biofiltration with a sand/compost mix in filter columns as part of the treatment system for impervious surfaces designated for vehicle use (McIntyre 2015, 2016). If these methods are not feasible, stormwater treatment will use another method that will have equal or greater effectiveness in removing known toxins to aquatic species including steelhead. Low-impact development (LID) techniques will be employed where appropriate.
- AMM-GEN-46: Prior to construction, the Authority will prepare a flood protection plan. The HSR project is designed to remain in operation during flood events and to minimize increases in the 100- or 200-year flood elevations of the locale. This includes the use of native riparian plantings and other natural stabilization alternatives that would restore and

maintain a natural riparian corridor when using quarry stone or cobblestone in erosion control measures along rivers and streams. Review and coordination with NMFS on the flood protection plan will occur where bank stabilization is required in suitable habitat for listed species under NMFS jurisdiction.

- AMM-GEN-47: Prior to groundbreaking, a construction stormwater pollution prevention plan (SWPPP) will be prepared and implemented. The SWPPP would include incorporation of permeable surfaces into facility design where feasible and address how treated stormwater would be retained or detained onsite. Contamination of surface waters would be minimized by restricting fueling and other activities involving hazardous materials would to areas distant from surface water, daily equipment checks for leaks, and use of drip pans under stationary equipment. Current surface water quality would be maintained through the use of siltation fencing, wattle barriers, soil stabilized construction entrances, grass buffer strips, inlet protection, sediment traps, etc. Where and when feasible, construction will be limited to dry periods when waterbody flows are low or absent. A spill prevention and emergency response plan will also be developed and implemented as part of the SWPPP.
- AMM-GEN-48: Prior to the construction of any industrial-classed facility, the Authority would prepare and implement an industrial stormwater pollution prevention plan, as well as comply with existing water quality regulations and permits.
- AMM-GEN-49: The Authority would implement tunnel design features and construction methods that avoid or minimize hydrologic changes in groundwater supplies or surface water resources overlying the tunnel alignment.

1.3.5. Compensatory Mitigation

The Authority proposes to balance project objectives with minimizing impacts on waters of the United States (WOTUS) and other sensitive environmental resources, and has selected the preliminary Preferred Alternative route based on assessing the environmental impact of each proposed route. The Authority has also created a preliminary compensatory mitigation plan that identifies potential mitigation options to offset anticipated impacts on regulated WOTUS, and special-status species listed as threatened or endangered under the Federal ESA and/or the California Endangered Species Act, and certain non-listed special status species (Authority 2019a). The preliminary compensatory mitigation plan identifies options that would offset permanent, unavoidable losses of regulated waters and achieve a “no net loss” of wetlands as: 1) mitigation banks, 2) conservation banks, 3) in-lieu fee (ILF) programs, and/or 4) permittee-responsible mitigation. Permittee-responsible mitigation may include creation, restoration, enhancement, or preservation of suitable habitat. The components of the pCMP will undergo development and refinement as the Authority works with the wildlife agencies to complete the compensatory mitigation planning process. As this planning process progresses, the pCMP components will be used as the basis for development of a final compensatory mitigation plan.

The following is a proposed CM that applies to compensatory mitigation for steelhead impacts:

- **CM-FISH-1:** The Authority would provide compensatory mitigation for permanent impacts on habitat for CCC and SCCC steelhead that is commensurate with the type (spawning, rearing, migratory, or critical habitat) and amount of habitat lost as follows:

- Spawning aquatic and riparian habitat within critical habitat would be protected and restored or protected and enhanced at a minimum 3:1 ratio (protected: affected).
- All rearing and migratory aquatic and riparian habitat within critical habitat would be protected and restored or protected and enhanced at a minimum 2:1 ratio (protected: affected).
- All other rearing and migratory aquatic and riparian habitat outside critical habitat would be protected and restored or protected and enhanced at a minimum 1:1 ratio.

Unless agreed upon in coordination with NMFS, compensation would occur within the same DPS domain as the impact was incurred. Where feasible, on-site, in-kind mitigation would be prioritized. Off-site mitigation would prioritize actions recommended in local or regional conservation plans where there is coordination and approval by NMFS. Other options include the purchase of riparian and aquatic habitat credits at a NMFS-approved anadromous fish conservation bank or another NMFS-approved conservation option for the areal extent of riparian and suitable aquatic habitat affected by the proposed action.

The pCMP estimates that a total of 42 acres of mitigation need (31 acres of steelhead spawning, rearing, and migratory habitat and 11 acres of steelhead migratory and rearing habitat after temporary and permanent offset multipliers) will be incurred through the implementation of the Preferred Alterative/Alternative 4. At this time, the pCMP has identified that the mitigation banks that serve the impact area (Pajaro River Mitigation Bank and Sparling Ranch Conservation Bank) do not currently offer steelhead credits. The only in-lieu fee (ILF) program that could provide credits for the anticipated impacts to aquatic resources is the National Fish and Wildlife Foundation Sacramento District ILF Program, which covers the geographic area under jurisdiction of the USACE Sacramento District and is limited to the San Joaquin Valley; therefore this type of compensatory mitigation would also not be suitable to offset impacts to coastal steelhead.

The pCMP provides that the Authority would mitigate impacts to steelhead habitat on permittee-responsible mitigation sites. Regarding permittee-responsible mitigation, there are two properties under consideration that could offer benefit to the steelhead DPSs impacted by the proposed action -the Paxton property and the Montes property. Both properties have the potential to provide benefits to S-CCC steelhead that utilize the Pajaro River watershed if selected for restoration, establishment, or enhancement mitigation. The conservation actions that could occur on these properties may include the expansion of existing waterways, the creation and improvement of on-channel rearing and holding habitat, riparian expansion and restoration of channel complexity, sediment removal and erosion control, and the creation or improvement of backwater habitat. While the quantity of restoration and enhancement opportunities on these properties is unknown, the easement holders (The Nature Conservancy and the Santa Clara Valley Open Space Authority (SCVOSA)) are known to be interested and willing partners. Mitigation actions in this area would primarily contribute to improvements to migration and rearing habitat. Additionally, there may be on-site restoration and enhancement opportunities on Pacheco Creek, near Casa de Fruta, where permanent HSR ROW overlaps with the creek but no permanent construction would occur. There may also be opportunities to partner on restoration and enhancement of habitat on the Pacheco Preserve, a property held by the Santa Clara Valley

Habitat Agency (SCVHA (an interested partner in the region)). However, the pCMP describes potential mitigation at all of the sites described above as opportunities for habitat preservation, restoration, rehabilitation, and/or enhancement. The pCMP has not selected any site(s) on which the Authority proposes to mitigate impacts to steelhead habitat, nor has the pCMP described what specific actions the Authority proposes to mitigate impacts to steelhead habitat because it is unclear on which site(s) the Authority proposes to mitigate impacts to steelhead habitat, nor has the pCMP described when the Authority proposes any such actions would occur.

2. Endangered Species Act: Biological Opinion and Incidental Take Statement

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The Authority also determined the proposed action is not likely to adversely affect California Central Valley (CCV) steelhead or its critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (section 2.12).

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designations of critical habitat for listed species addressed in this opinion use the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02 (see Table 1 for a description of species, ESA listing classifications, and summary of species status). The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species (see Table 2 for a description of designated critical habitat, designation date and notice, and status summary).

More detailed CCC steelhead DPS and critical habitat listing information can be found at NOAA Fisheries West Coast Region's protected species CCC steelhead page, and more detailed information concerning S-CCC steelhead DPS and their critical habitat listing information can be found at NOAA Fisheries West Coast Region's protected species S-CCC steelhead page.

Table 1. Description of species, ESA listing classifications, and summary of species status.

Species	Listing Classification and Federal Register Notice	Status Summary
Central California Coast steelhead (anadromous *O. mykiss)* DPS	Original: Threatened, 62 FR 43937, August 18, 1997 Current: Threatened, 71 FR 834, January 5, 2006	The CCC steelhead DPS range includes all naturally spawned populations of steelhead in streams from the Russian River (inclusive) to Aptos Creek (inclusive), and the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers (71 FR 834, (NMFS 2016c)). This excludes the Sacramento-San Joaquin River Basin. Two artificial propagation programs are also considered to be part of the DPS: the Don Clausen Fish Hatchery and Kingfisher Flat Hatchery steelhead hatchery programs (71 FR 834, (NMFS 2016b)). As of 2016, the Don Clausen Hatchery was still in operations producing steelhead juveniles while Kingfisher Flat Hatchery operations had not occurred since 2014. Historically, approximately 70 populations supported the CCC steelhead DPS, with a possible abundance of nearly 100,000 spawning adults throughout its range, but since near the end of the 20th century substantial ubiquitous declines have been observed. Currently, the largest population (Russian River) may only see up to 7,000 adult returns while it is more common for most streams to host only 500 fish or less (NMFS 2016c). Their largescale decline has been attributed to a variety of factors but was primarily due to large-scale habitat degradation, historical overfishing, artificial propagation, and periodic climatic events like extended drought and poor ocean conditions. In 2016, a final recovery plan was completed for multiple coastal salmonid species, including CCC steelhead, and a recovery priority number of '5' was assigned to this DPS (NMFS 2016b, c, d). Recovery numbers are assigned based on a combination of the species' demographic risk and their recovery potential, and lower recovery priority numbers indicate higher priority in recovery plan development and implementation. According to the NMFS 5-year species status review (NMFS 2016b), the status of the CCC steelhead DPS has not changed since 2011, as updated information did not indicate a change in the biological risk category in either direction. The scarcity of CCC steelhead population abundance time-series data continues to hinder trend detection attempts. Steelhead still occur in the North Coastal and Interior strata and, based on more recent information, perhaps the population of the Santa Cruz Mountain stratum is larger than previously thought. However, hatchery-origin fish remain more prevalent than natural-origin fish in the Russian River, and an overall downward abundance trend was observed in one of the more robust populations, Scott Creek. Small fish passage improvement and habitat restoration projects have improved habitat conditions locally; however, the DPS still faces threats throughout the region from both legacy degradation and modification, as well as new urban growth, continued water diversions, and dams (NMFS 2016b).

Species	Listing Classification and Federal Register Notice	Status Summary
South-Central California Coast (S-CCC) steelhead (anadromous *O. mykiss*) DPS	Original: Threatened, 62 FR 43937, August 18, 1997 Current: Threatened, 71 FR 834, January 5, 2006	The S-CCC steelhead DPS range includes all naturally spawned steelhead populations in streams from the Pajaro River watershed in Santa Clara County in the north (inclusive) to, but not including, the Santa Maria River watershed in Santa Barbara County in the south. The freshwater-resident forms of *O. mykiss* (rainbow trout) also occur in these watersheds, frequently co-occur in the same river systems, and residents above and below impassable barriers are each other's closest relatives (Clemento et al. 2009, Pearse et al. 2014). Rainbow trout are not included in the S-CCC steelhead DPS. However, rainbow trout parents can produce anadromous offspring (Courter et al. 2013) and supplement the population of the anadromous form in that aspect. Resident populations can also be regarded as important reserves that will conserve the native genetic material of anadromous O. mykiss in the watersheds until the environment can better support anadromy. The historical annual run sizes were estimated at 27,000 adults in major watersheds near the turn of the century; however, now several thousand returning adults for the entire DPS would be considered a promising year (NMFS 2016c). A number of factors lead NMFS to listing S-CCC steelhead as threatened in 1997, including substantial declines to individual populations, the loss of freshwater and estuarine habitat, periodic poor ocean conditions, and a variety of land-use practices that have caused negative impacts at watershed scales (NMFS 2016a). In 2013, a final recovery plan was completed for the DPS and a recovery priority number of '3' was assigned (NMFS 2013). According to the NMFS 5-year species status review (NMFS 2016a), the status of the S-CCC steelhead DPS has likely remained the same since the 2010 5-year review as there was little evidence to indicate a change in either direction. Based on available information, annual runs that are currently being monitored across a limited but diverse set of basins within the range of the DPS are generally characterized as small (<10 fish) but surprisingly persistent. The Carmel River is the only watershed with available long-term monitoring data and a greater abundance that may enable trend detection, as the entire DPS suffers from the lack of comprehensive monitoring in all other streams and no new data has otherwise been made available. A decline has been noted in the Core 1 Carmel River population, a trend likely exacerbated by an extended drought and the influence of released hatchery-reared juvenile *O. mykiss*. However, the implementation of several habitat-restoring recovery actions may be bolstering abundance as habitat components and access to high quality stream reaches are improved (discussed in the critical habitat section, Table 2).

Table 2. Description of designated critical habitat, designation date and notice, and status summary.

Critical Habitat	Designation Date and Federal Register Notice	Description
CCC steelhead critical habitat	70 FR 52488, September 2, 2005	Designated critical habitat for CCC steelhead includes a total of 1,465 miles of stream habitat and 386 square miles of estuarine habitat in 46 watersheds (70 FR 52488). This encompasses most, but not all, occupied habitat but excludes some occupied habitat based on economic considerations within its range: Russian River 5th Field HUC 1114, Bodega 5th Field HUC 1115, Marin Coastal 5th Field HUC 2201, San Mateo 5th Field HUC 2202, Bay Bridges 5th Field HUC 2203, Santa Clara 5th Field HUC 2205, San Pablo 5th Field HUC 2206, and Big Basin 5th Field HUC 3304. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (70 FR 52488). PBFs include: Freshwater spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Degraded habitat conditions were one of the primary factors for listing the DPS and all life stages of CCC steelhead are still currently impaired by lack of complexity/shelter (in-stream large woody material (LWM)), high sediment loads, degraded water quality, lack of winter refugia, and reduced access to historic spawning and rearing habitats (NMFS 2016b, c). Habitat conditions are the most degraded in the Santa Cruz Mountains and San Francisco Bay strata. Restoration of steelhead habitat, including fish passage improvements, water conservation, and improvement of instream features has occurred periodically and improved critical habitat functionality, but only in those limited areas (NMFS 2016d). Notably, the development of the 2014 Groundwater Sustainability Management Act is expected to help alleviate the over extraction of aquifers upon which cold water fisheries such as CCC steelhead depend, though it may be some time before beneficial effects are seen. Additionally, the 2016 Adult Use of Marijuana Act legalized the farming of marijuana and is expected to reduce the number of illegal growing operations, reducing the prevalence of destructive marijuana farming on CCC steelhead critical habitat and a portion of the tax revenue paid from legal sales are allocated for environmental damage cleanup.

Critical Habitat	Designation Date and Federal Register Notice	Description
S-CCC steelhead critical habitat	70 FR 52488, September 2, 2005	Designated critical habitat for S-CCC steelhead includes a total of 1,249 miles of stream habitat and three square miles of estuarine habitat in 28 watersheds (NMFS 2013). This encompasses most, but not all, occupied habitat but excludes some occupied habitat based on economic considerations and all military lands within its range: Pajaro River 5th Field HUC 3305, Carmel River 5th Field HUC 3307, Santa Lucia 5th Field HUC 3308, Salinas River 5th Field HUC 3309, and Estero Bay 5th Field HUC 3310. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (70 FR 52488). PBFs include: Freshwater spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. The destruction, modification, and curtailment (blockage) of habitat was a primary cause for the decline of the S-CCC population and a reason for its listing. Many watersheds designated critical habitat still contain high-quality spawning and rearing habitat but are compromised by one or more anthropogenic factors, such as: dams and surface water diversions, groundwater extractions, levees and channelization, recreational facilities, urban development, roads and culverts that block access, agricultural development, non-point source pollution, and mining. While some historical threats have subsided, the historical damage has remained and is the primary reason the DPS remains threatened (NMFS 2016a). Any remaining freshwater and estuarine habitat still accessible to the DPS containing PBFs is considered to have a high intrinsic value to the recovery of the species. A number of recovery actions have been undertaken which could potentially lead to a future increase in individual populations as habitat conditions improve in these watersheds. Major actions include the removal of the San Clemente Dam and improved passage on the Carmel River, water releases from Uvas Dam to improve downstream habitat, modified water releases from Pacheco Dam in Pacheco Creek to improve flow conditions during critical periods, the river restoration associated with the Salinas River Multi-Demonstration project, and the removal of non-native invasive species and restoration efforts in Chorro Creek, San Luis Obispo Creek, Santa Rosa Creek, Pismo Creek, Coon Creek, Walters Creek, and Pennington Creek (NMFS 2013, 2016a).

2.2.1. Global Climate Change

Another factor affecting the rangewide status of CCC and S-CCC steelhead, and the aquatic habitats upon which they depend, is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir et al. 2013). While snow melt from the Sierra Nevada has declined, total annual precipitation amounts have shown no discernable change (Kadir et al. 2013). CCC and S-CCC steelhead may have already experienced some detrimental impacts from climate change especially during extended drought. NMFS believes the impacts on listed salmonids to date are likely fairly minor because natural, and local, climate factors likely still drive most of the climatic conditions steelhead experience, and many of these factors have much less influence on steelhead abundance and distribution than human disturbance across the landscape. In addition, CCC and S-CCC steelhead are generally not dependent on snowmelt driven streams like the CCV steelhead DPS, and thus are not expected to be directly adversely affected by changes to snow pack.

The threat to the existence of CCC and S-CCC steelhead from global climate change will increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley et al. 2007, Moser et al. 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004, Moser et al. 2012, Kadir et al. 2013, Bedsworth et al. 2018). Total precipitation in California may decline while critically dry years may increase (Lindley et al. 2007, Moser et al. 2012, McClure et al. 2013, Bedsworth et al. 2018). Wildfires are also expected to increase in frequency and magnitude (Westerling et al. 2006, Westerling and Bryant 2007, Allen et al. 2010, Westerling et al. 2011, Moser et al. 2012, Bedsworth et al. 2018).

In the San Francisco Bay region[1], warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan et al. 2012). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan et al. 2012).

Estuaries, including seasonally closed lagoons, may also experience changes detrimental to the survival and success of salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002, Ruggiero et al. 2010). Continued sea level rise (0.42 to 1.67 meters by 2100) is expected to cause sandbars to form farther inland which can affect the amount of time the lagoon is connected to the ocean (Dalrymple et al. 2012, Rich and Keller 2013). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures,

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[1] Both the San Francisco Bay and San Jose regions exhibit similar Mediterranean climate patterns. The action area is located within the Pacheco Pass to San Jose regions.

circulation, water chemistry, and food supplies (Feely et al. 2004, Osgood 2008, Abdul-Aziz et al. 2011, Doney et al. 2012, Turley 2018). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Santer et al. 2011).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The San Jose to Central Valley Wye HSR project extent begins at the existing San Jose Diridon train station on Scott Boulevard in Santa Clara, Santa Clara County, California. From there it extends south to Gilroy Station in Gilroy, California, and dips down briefly into San Benito County before turning east and tunneling into and under the Diablo Mountain Range near the San Luis Reservoir in Merced County. The route emerges near Santa Nella in Merced County and the project section ends at its connection with the CV Wye section of the HSR project at Carlucci Road in unincorporated Merced County (Figure 1, Figure 4). The action area includes all areas containing the HSR route alignment and features (the railway, embankments, aerial viaducts, trenches, and tunnels); new stations or station upgrades; parking lots; a maintenance-of-way facility (near Turner Island Road near Gilroy); all ancillary features (traction power substations, switching/paralleling stations, and communication/control stations); the necessary electrical interconnections, infrastructure, and upgrades; general network upgrades; wildlife crossings; all necessary modifications to existing highway, roads, and other railways; all HSR permanent and temporary ROW; and all temporary and permanent access roads. All GPS locations provided are approximate.

There are approximately 50 crossings that are expected to have some amount of interactions with species or habitats under NMFS jurisdiction (Figure 5 & 6) and approximately 32 crossings associated with some amount of overwater infrastructure (Figure 6), though many of these interactions or 'crossings' are associated with the high voltage connection lines or the proposed access roads and easements. The proposed route (EIR/EIS Preferred Alternative 4) will be examined from east (closest to the connection in the CCV) to west, as if traveling the proposed route. There are approximately seven under-/overcrossings of the route in the upper Pacheco Creek as the HSR route transitions from running underground in a tunnel to tunnel portals to running on an elevated viaduct, before entry into a second shorter tunnel. The first and longer tunnel originating from the CCV begins to interact with S-CCC steelhead watersheds in upper Pacheco Creek near Highway 152 by running underneath and alongside the stream when the route emerges from tunnel portals (Figure 7, Figure 8, and Figure 9). As Pacheco Creek meanders, the elevated viaduct will cross over the streambed several times (Figure 10, Figure 11); however, the exact placement of the supports in or around the streambed is unresolved at this time and the amount of route footprint that overlaps the streambed may increase or decrease as construction designs evolve and finalize. While this specific information is not available, NMFS is able to adequately assess the effects from support placement based on the following aspects of the proposed action.

- The Authority will adhere to their proposed commitment in AMM-FISH-1 to minimize placement of footings and columns within active streambed channels of steelhead critical habitat
- Final design decisions on footing and column placement in and around steelhead waterways will be made with NMFS technical assistance and input to minimize permanent harm to habitat functionality
- The Authority has the design expertise and capability to execute the agreed upon placements

There will likely be some crossings in which footing and columns unavoidably occupy and therefore would be expected to alter stream and sediment dynamics. A general analysis of artificial structure placement in and over waterways is included in this opinion in the effects analysis section 2.5.2.3.

The route over-crossings with major overwater structures expected to interact with species and habitats under NMFS jurisdiction are:

1) the elevated HSR viaduct between the two tunneling section near Casa de Fruta and Pacheco Pass Highway/Route 152 that crosses Pacheco Creek (36.984279, -121.382525, Figure 12 and Figure 13);
2) a second crossing of Pacheco Creek at lower elevation in the Santa Clara Valley (36.960575, -121.447664, Figure 14 and Figure 15);
3) a crossing over Tequisquita Slough (36.959881, -121.452624, Figure 14 and Figure 15);
4) a crossing over Miller Canal (36.957067, -121.501305, Figure 16 and Figure 17);
5) a crossing over Pajaro River mainstem (36.959315, -121.510344, Figure 16 and Figure 18);
6) a crossing over Llagas Creek (37.095616, -121.616306, Figure 20 and Figure 21);
7) a crossing over Guadalupe River (37.316871, -121.888413, Figure 23 and Figure 24), and
8) a crossing over Los Gatos Creek (37.323550, -121.902557, Figure 23 and Figure 25).

The route also gets close to Uvas Creek (36.964469, -121.532924, Figure 19) and Coyote Creek (37.225572, -121.749263, Figure 22) at its confluence with Fisher Creek. Though the HSR route does not cross these waterbodies, there may be some indirect or auxiliary interaction between the project and species or habitat under NMFS jurisdiction, and they are considered part of the action area until increased project design resolution shows otherwise. Waterways downstream of this action are also considered within its action area to the extent that water quality control monitoring can detect changes in turbidity or pollution from construction or operational stormwater discharges. Sections outside of the San Jose to Merced Project Section will be analyzed in their own biological opinions (Authority 2020c) as those sections are submitted to NMFS for review and will not be contained here, though all sections must be completed for the HSR system to achieve one of its purposes in connecting the major metropolitan and urban areas of the state of California.

The action area would also include any mitigation banks, conservation banks, or any areas restored through the payment of ILFs or permittee-responsible areas restored, or funded by the

Authority, to offset unavoidable adverse effects to special status species or habitats in this section. Since there are no NMFS-approved mitigation banks that offer steelhead or appropriate habitat type credits for the impacted DPSs that also include the action area of the project within their service areas, and there is no in-lieu fee program locations identified that could provide credits suitable to offset impacts to coastal steelhead, the Authority expects to conduct permittee responsible restoration to offset unavoidable impacts to steelhead and their habitats (Authority 2019a). As described in section 1.3.5 of this opinion (Proposed Federal Action/Compensatory Mitigation), while the preliminary compensatory mitigation plan is being drafted and includes several locations where there are opportunities for compensatory mitigation, the pCMP has not selected any site(s) on which the Authority proposes to mitigate impacts to steelhead habitat. Therefore, it is unclear what areas would be affected by proposed the compensatory mitigation component of the proposed action. In the future, when a site(s) for compensatory mitigation is confirmed, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, and at that time the action area will be revised to include the identified mitigation site, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center's programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

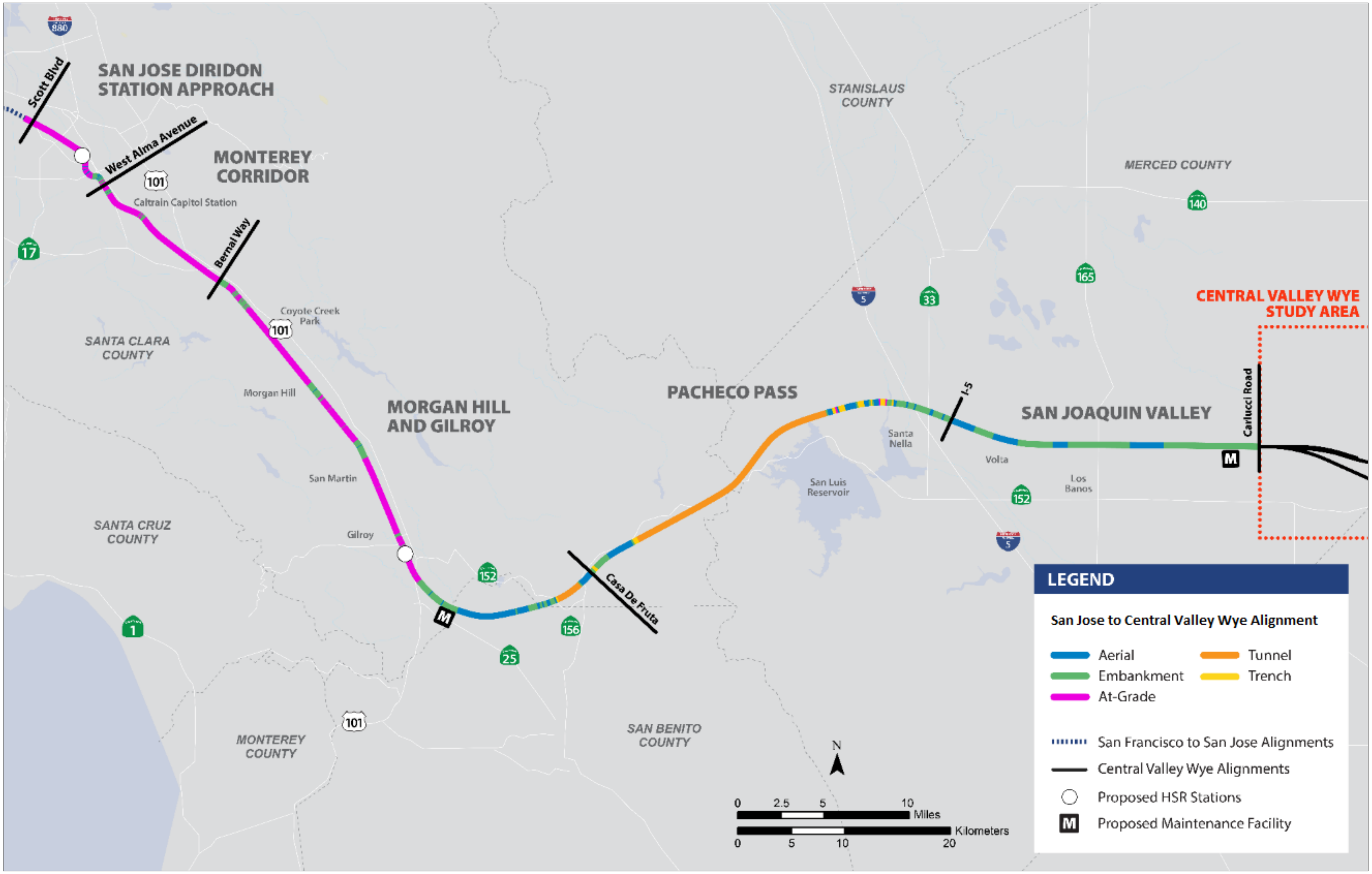


Figure 4. San Jose to Merced HSR Project Section (Scott Blvd to Carlucci Rd) alignment in greater detail, displaying the different track/infrastructure types proposed (aerial structure in blue, embankment support in green, at-grade route in magenta, tunneling in orange, and trench in yellow). The proposed location of a heavy maintenance facility is a black-blocked “M” (Authority 2020c).

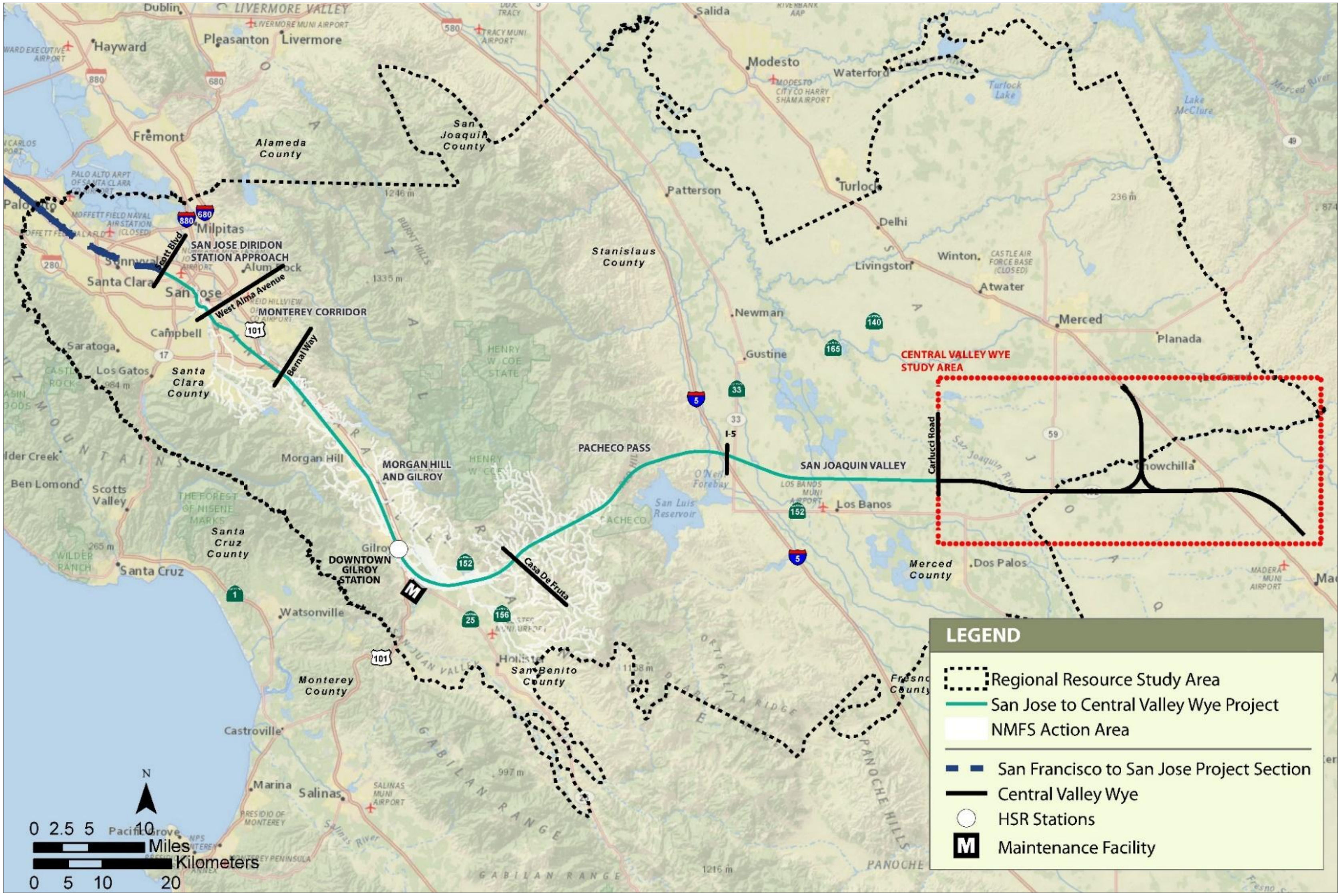


Figure 5. HSR Authority proposed NMFS action area (steelhead model: white stream segments) (Authority 2020c). However, the white area in the figure, which is described as the NMFS Action Area in the legend, does not include all areas described as the action area in this opinion.

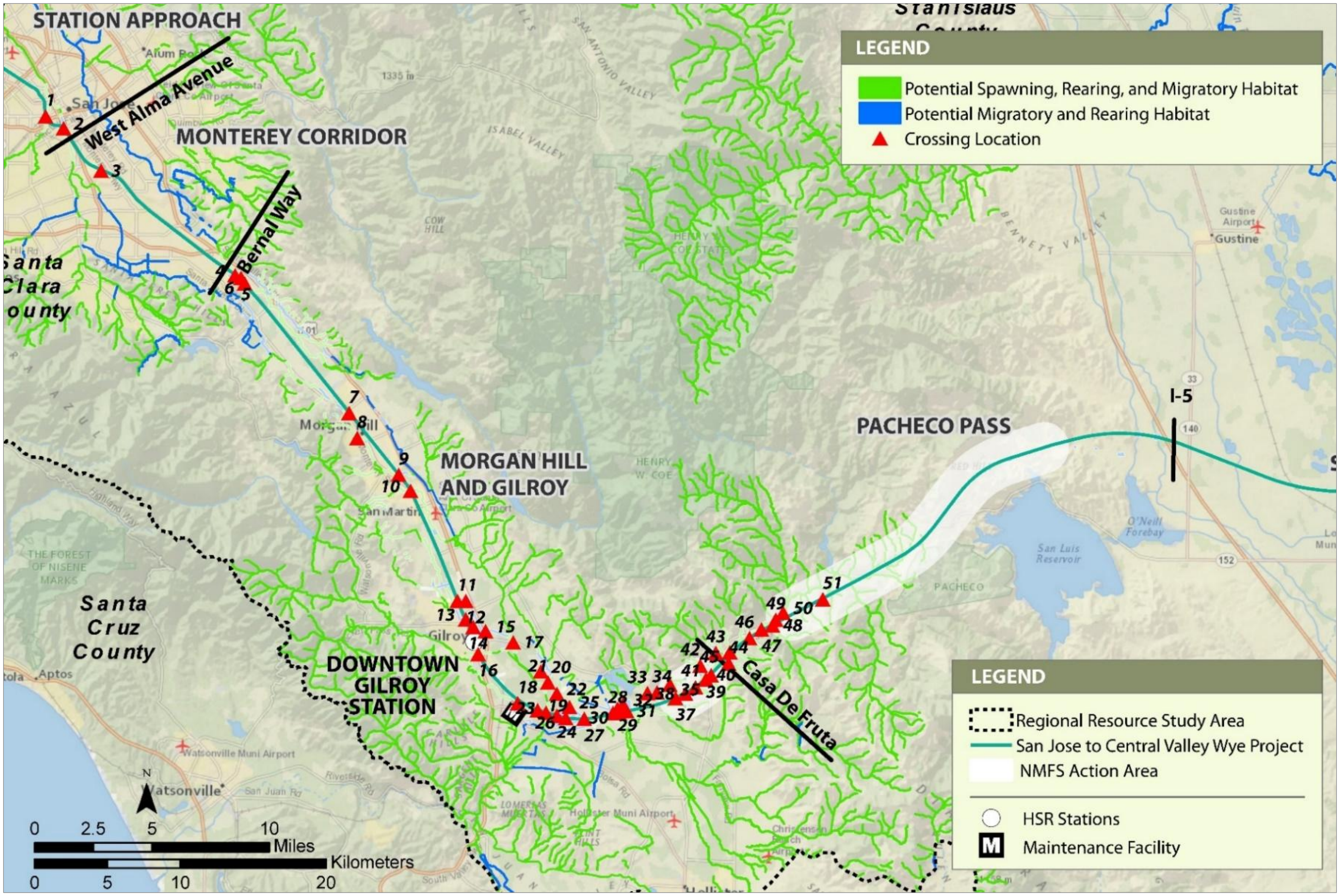


Figure 6. Map of locations where the proposed San Jose to Merced HSR route crosses waterbodies containing potential steelhead habitat (red triangles); however, some are waterways above the tunneled section (white outline) (Authority 2020c). The white area in the figure, which is described as the NMFS Action Area in the legend, does not include all areas described as the action area in this opinion.

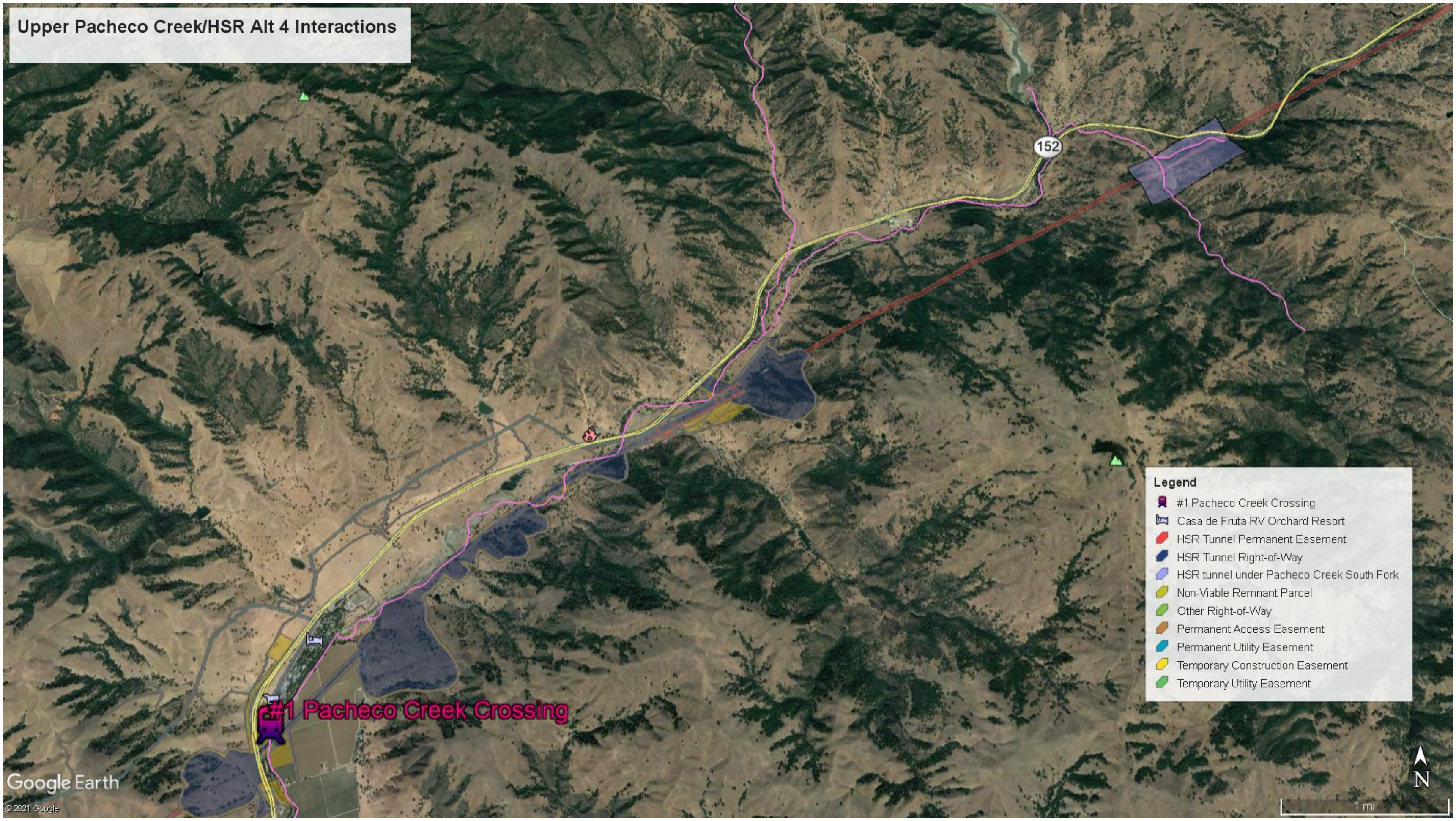


Figure 7. Overview of HSR Alternative 4 route planned for the upper Pacheco Creek tunneling (under-crossings), tunnel portal, and viaducts (overcrossings: Pacheco Creek Crossing #1) in relation to S-CCC steelhead designated critical habitat (pink) before the second tunnel.

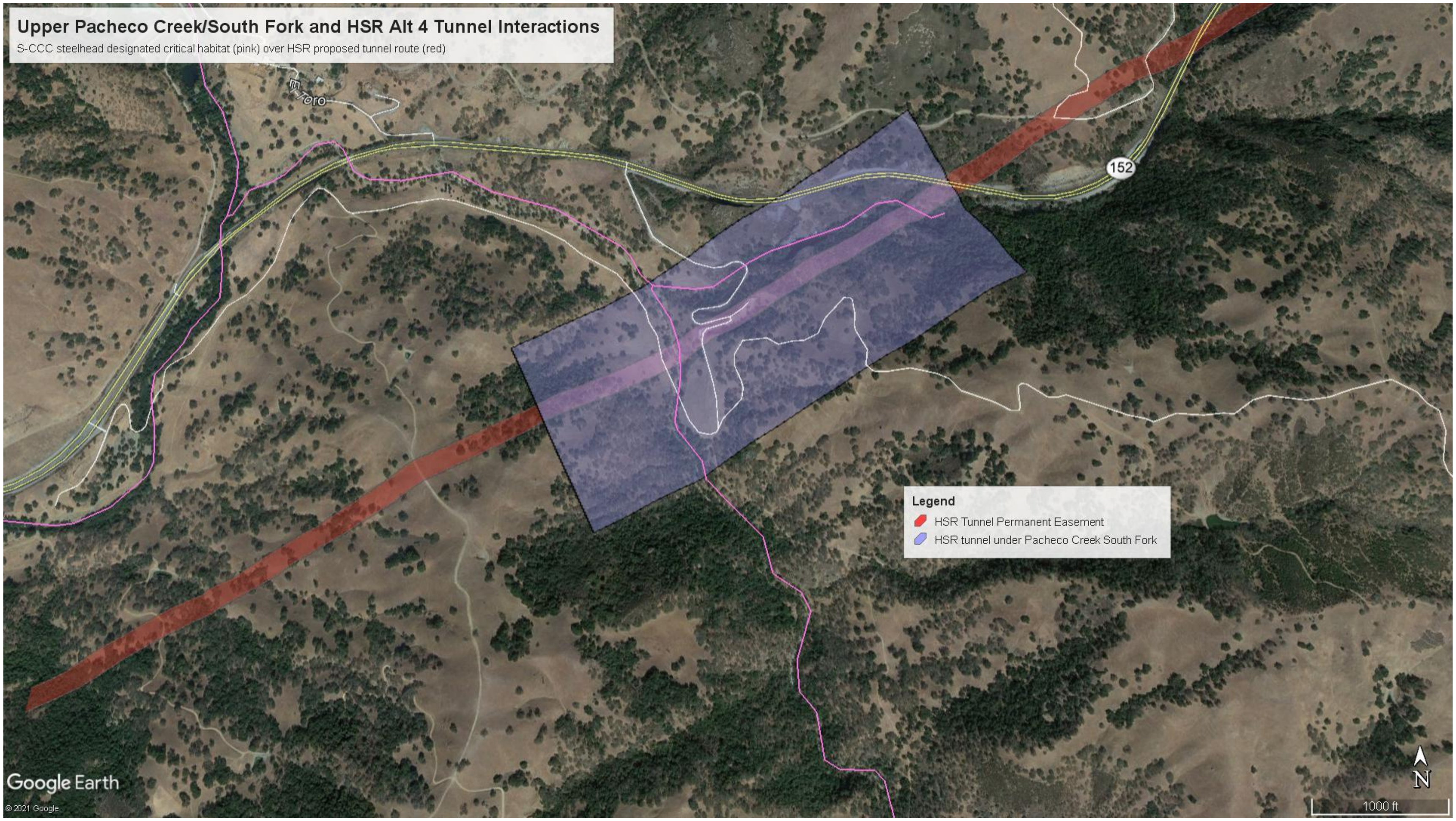


Figure 8. Close-up of HSR Alternative 4 route planned for the upper Pacheco Creek tunneling under-crossings (red) of Pacheco Creek mainstem and South Fork Pacheco Creek in relation to S-CCC steelhead designated critical habitat (pink line and pink layer) near Highway 152.

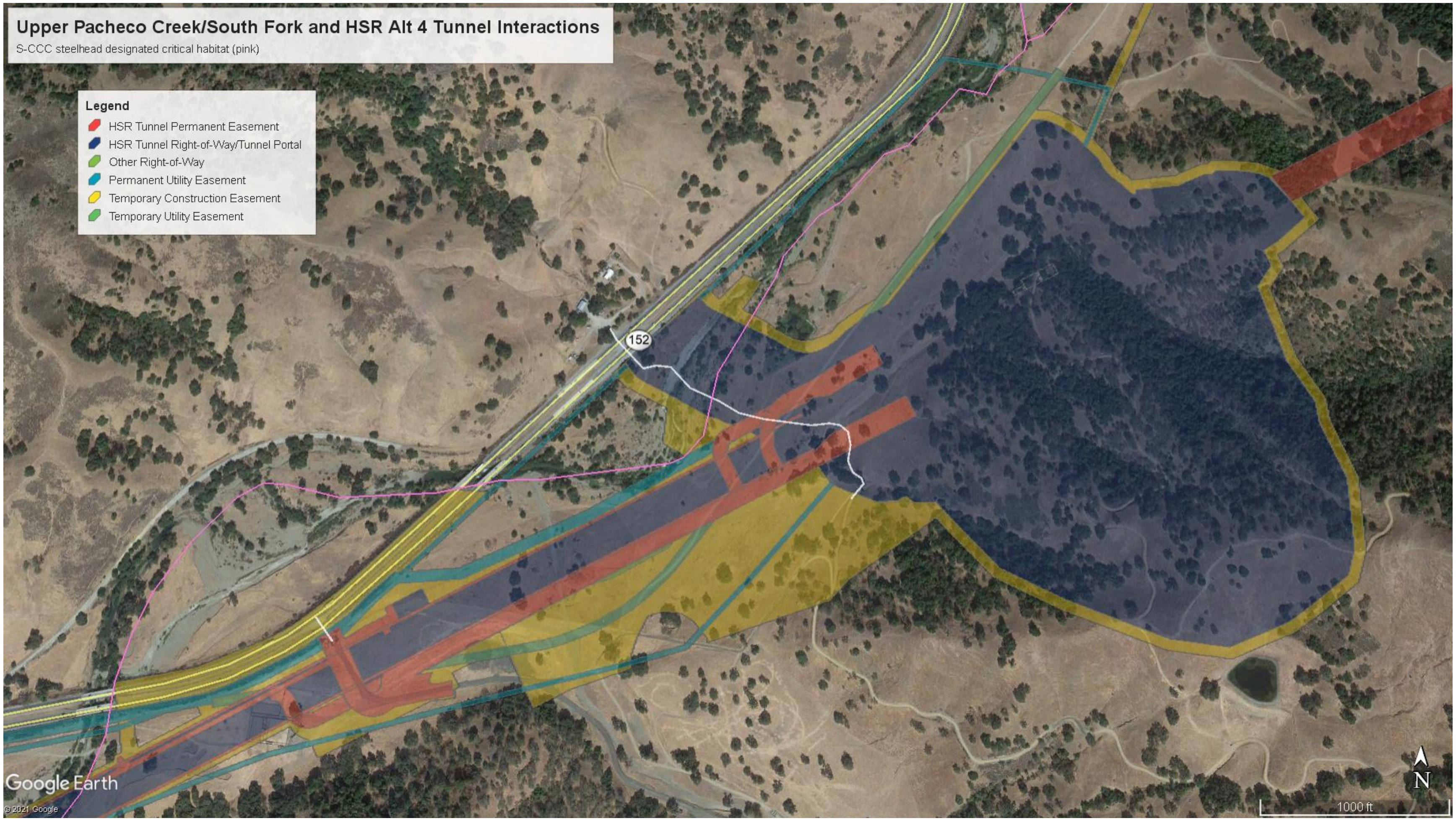


Figure 9. Most eastern tunnel portal and land stabilization area (dark blue) with permanent access from Highway 152 as tunnel transitions to viaduct in relation to S-CCC designated critical habitat in Pacheco Creek (pink line). Yellow layers indicate temporary construction easements, and teal layers indicate electrical interconnections.

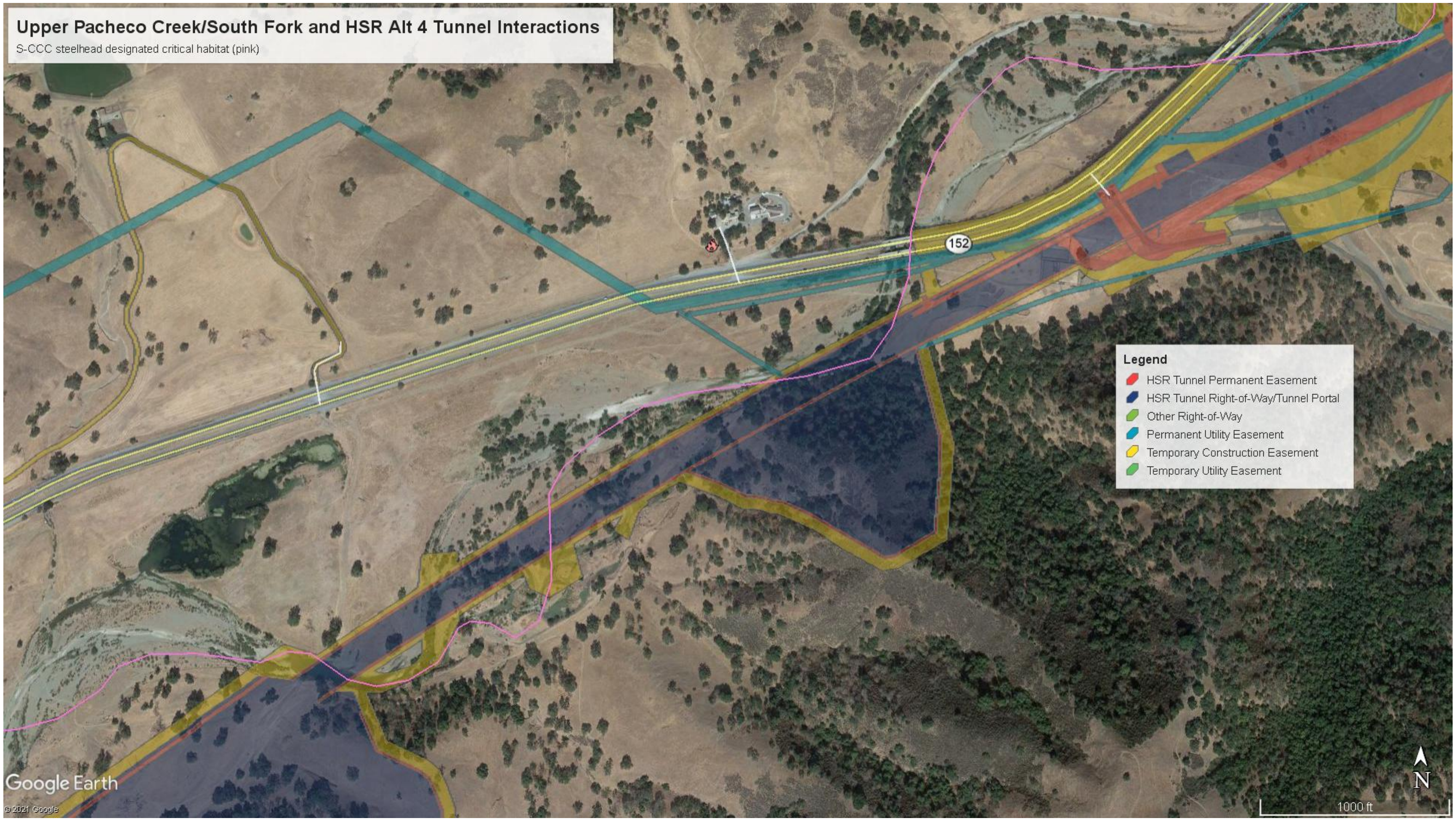


Figure 10. Close up of HSR elevated viaduct and slope stabilization ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat in Pacheco Creek (pink line), across from fire station and upstream from Casa de Fruta and overcrossing #1 and downstream from tunnel portal transition. Teal layers indicate electrical interconnections.

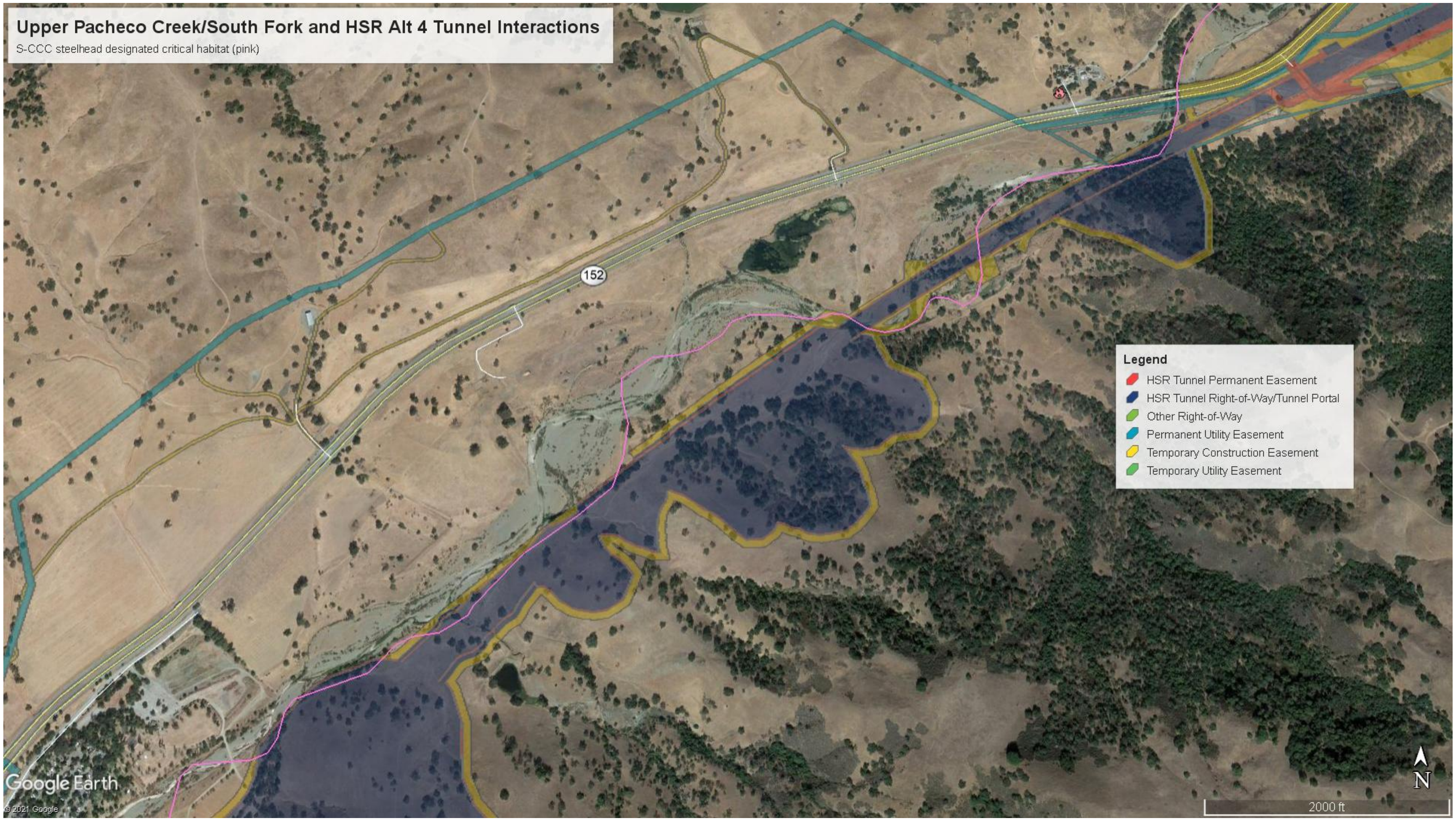


Figure 11. HSR elevated viaduct and slope stabilization ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat in Pacheco Creek (pink line), upstream from Casa de Fruta and overcrossing #1 and downstream from tunnel portal transition. Teal layers indicate electrical interconnections.

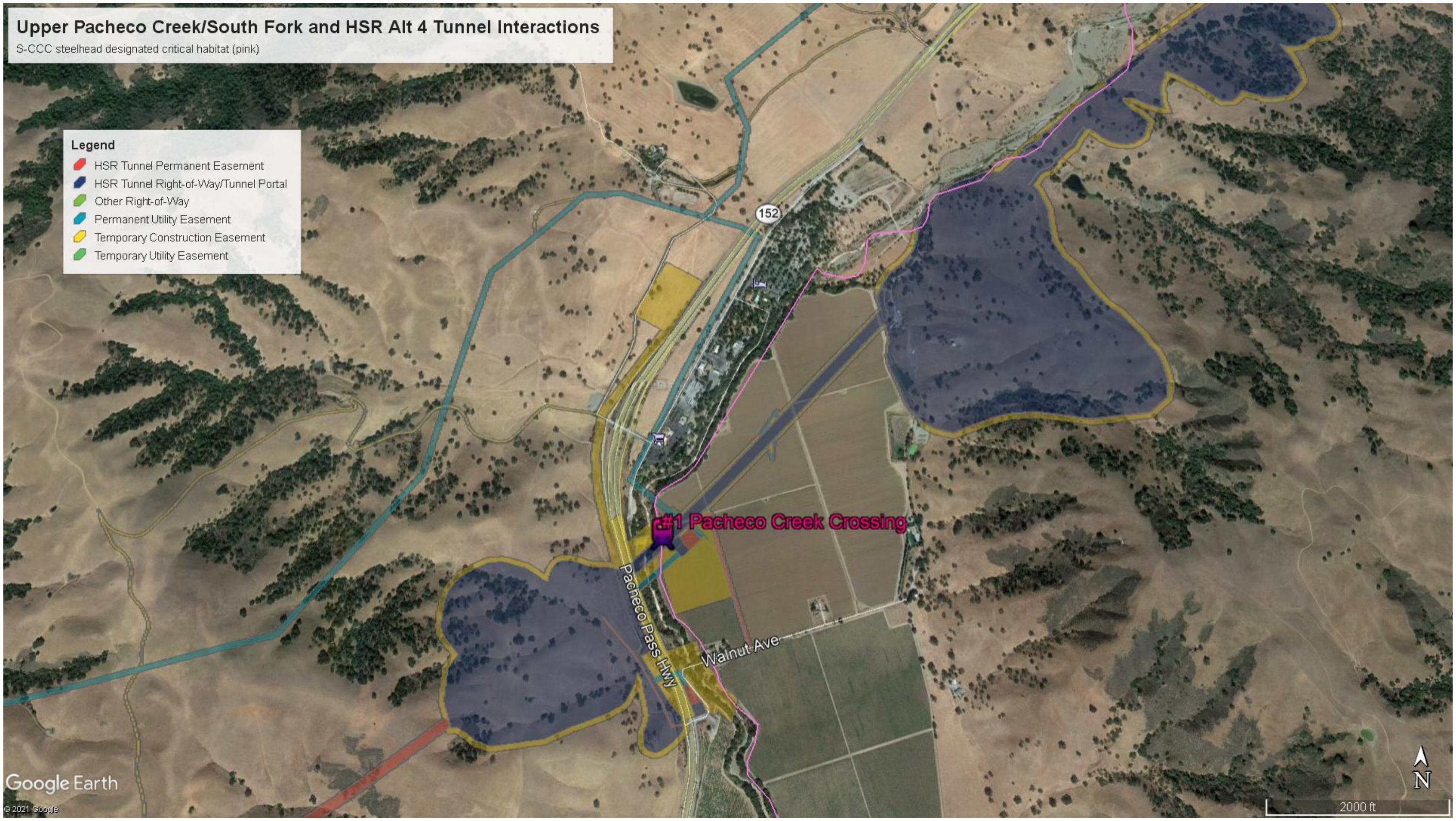


Figure 12. Pacheco Creek Crossing #1 HSR elevated viaduct and slope stabilization ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat in Pacheco Creek (pink line), just downstream from Casa de Fruta (bed and shopping cart icon) and before tunnel portal transition to second tunnel (red). Electrical interconnections in teal.

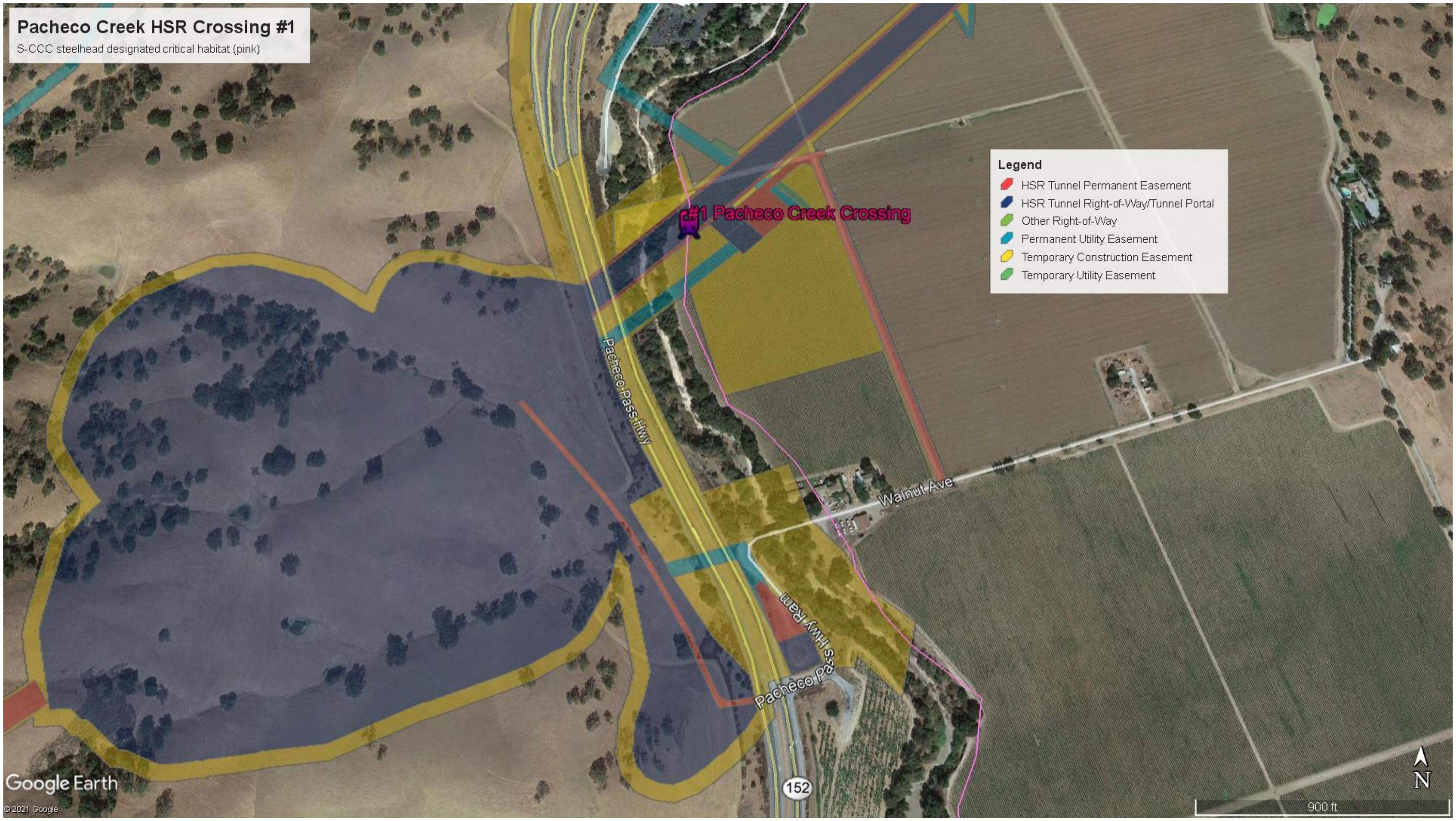


Figure 13. Close-up of Pacheco Creek Crossing #1 HSR elevated viaduct and slope stabilization ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat in Pacheco Creek (pink line), just downstream from Casa de Fruta and before tunnel portal transition to second tunnel (red). Electrical interconnections in teal.

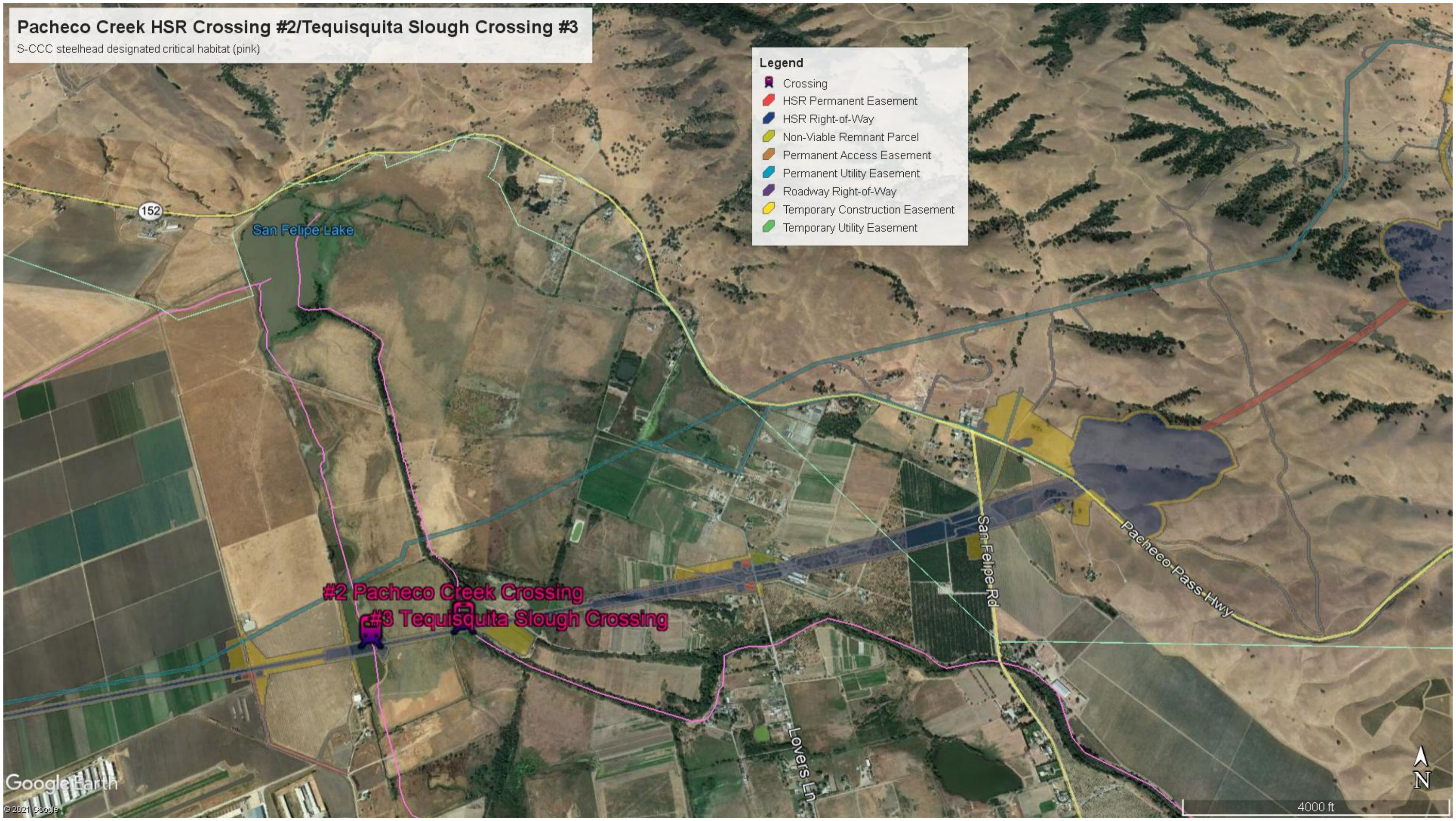


Figure 14. Pacheco Creek Crossing #2 and Tequisquita Slough Crossing #3 by HSR elevated viaduct and slope stabilization ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat in the Santa Clara valley floor (pink line), below the final tunnel portal transition from second tunnel (red). Electrical interconnections in teal.

Figure 15. Close up of Pacheco Creek Crossing #2 and Tequisquita Slough Crossing #3 by HSR elevated viaduct/berm and ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat in the Santa Clara valley floor (pink line). Electrical interconnections in teal.

Figure 16. Miller Canal crossing #4 and Pajaro River crossing #5 by HSR elevated viaduct and maintenance facility ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat (pink line). Electrical interconnections in teal.

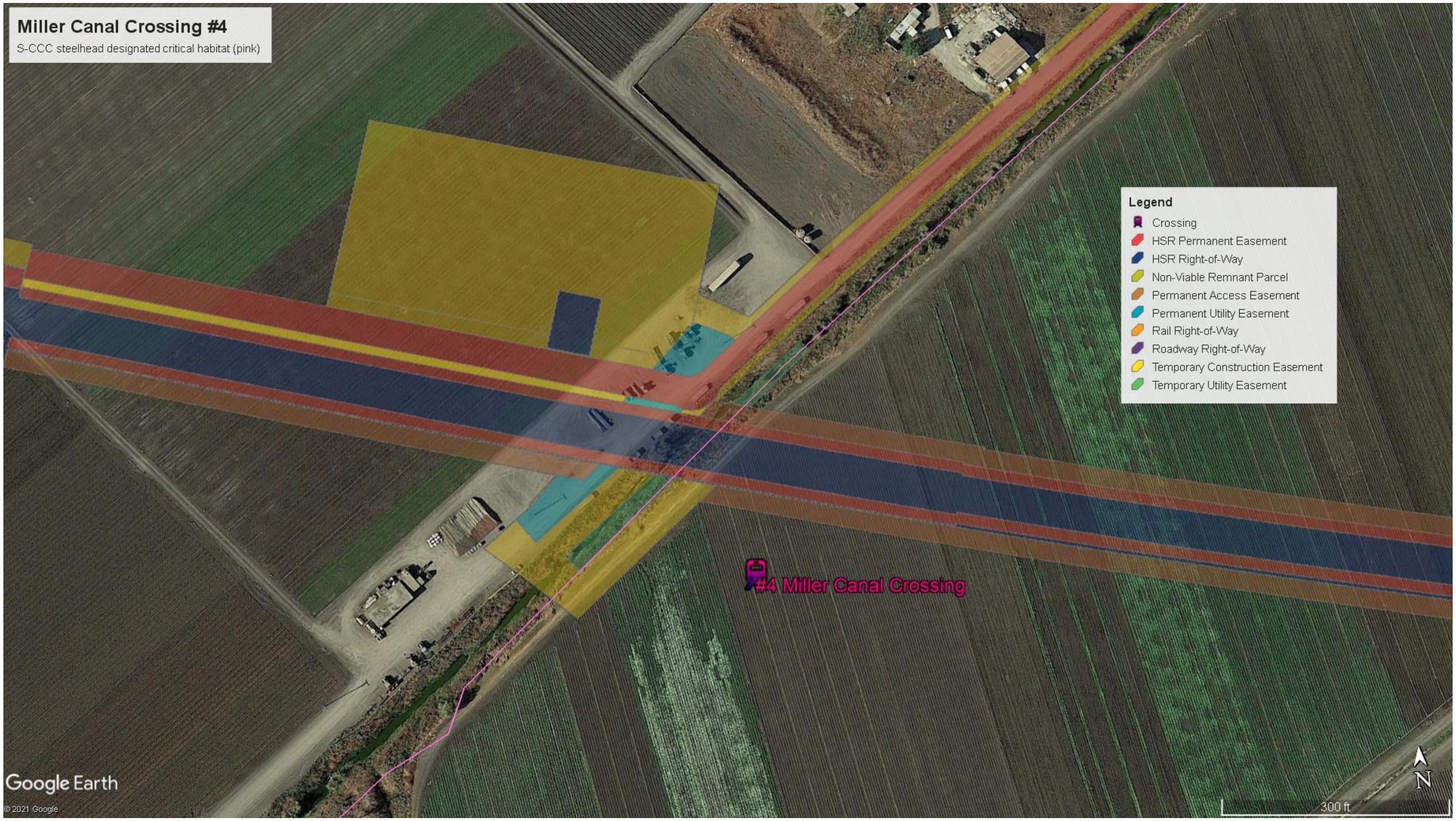


Figure 17. Close-up of Miller Canal crossing #4 by HSR elevated viaduct/berm (dark blue) and permanent ROW (orange) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat (pink line). Electrical interconnections in teal.

Figure 18. Close-up of Pajaro River crossing #5 by HSR elevated viaduct/berm and maintenance facility ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat (pink line). Electrical interconnections in teal.

Figure 19. Close-up of HSR elevated viaduct/berm route and maintenance facility ROW (dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat (pink line) in Uvas Creek. Electrical interconnections in teal.

Figure 20. Llagas Creek crossing #6 by HSR elevated viaduct and ROW (red/dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat (pink line) near Atherton Way Hidden Pond and Monterey Highway. Electrical interconnections/road re-route in teal.

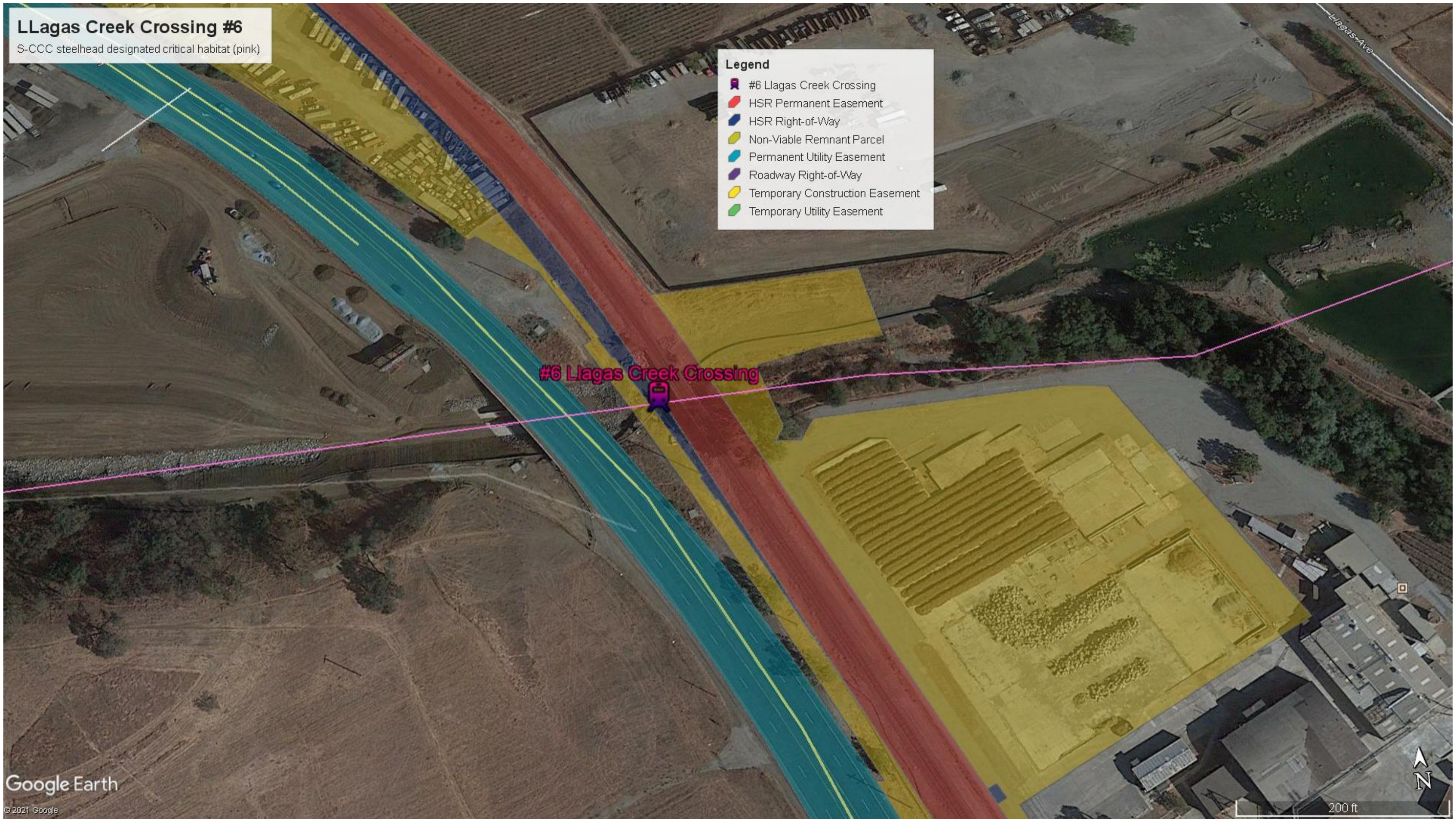


Figure 21. Close-up of Llagas Creek crossing #6 by HSR elevated viaduct and ROW (red/dark blue) with temporary construction easement estimates (yellow) relative to S-CCC steelhead designated critical habitat (pink line) near Atherton Way Hidden Pond and Monterey Highway. Electrical interconnections/road reroute in teal.

Figure 22. Close-up of Coyote Creek and HSR elevated viaduct and ROW (red) and planned wildlife under-crossings (green) with temporary construction easement estimates (yellow) relative to CCC steelhead designated critical habitat (light yellow line) near Monterey Highway/Old Monterey Highway/Highway 101.

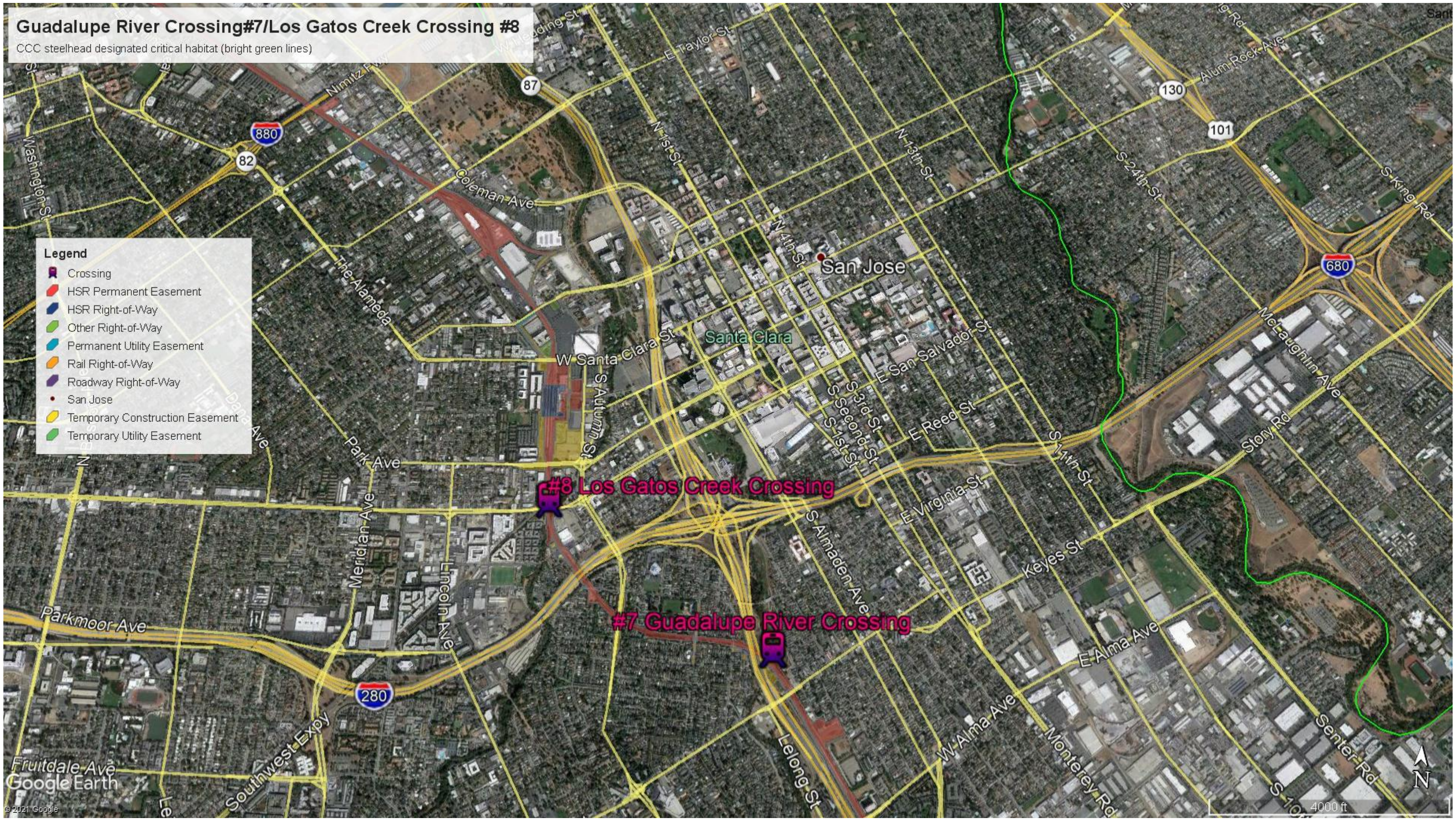


Figure 23. Guadalupe River crossing #7 and Los Gatos Creek Crossing #8 by HSR elevated viaduct, ROW, permanent buildings, and San Jose station (red/dark blue) with temporary construction easement estimates (yellow) relative to CCC steelhead designated critical habitat (bright green line) near Highway 280/680 exchange.

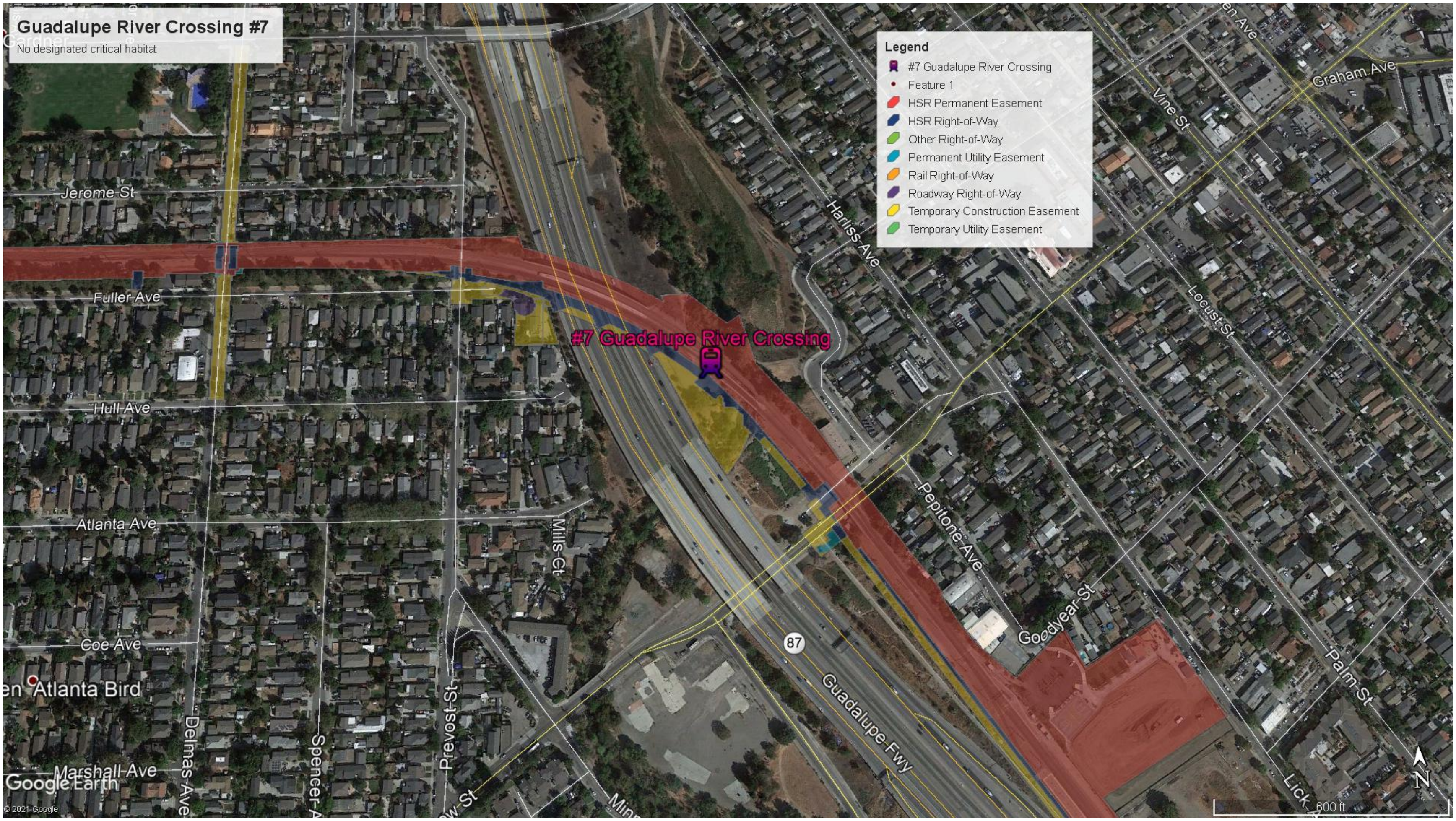


Figure 24. Close-up of Guadalupe River crossing #7 by HSR elevated viaduct, ROW, and permanent buildings (red/dark blue) with temporary construction easement estimates (yellow). No CCC steelhead designated critical habitat in the section of river crossed near Highway 87/Guadalupe Freeway.

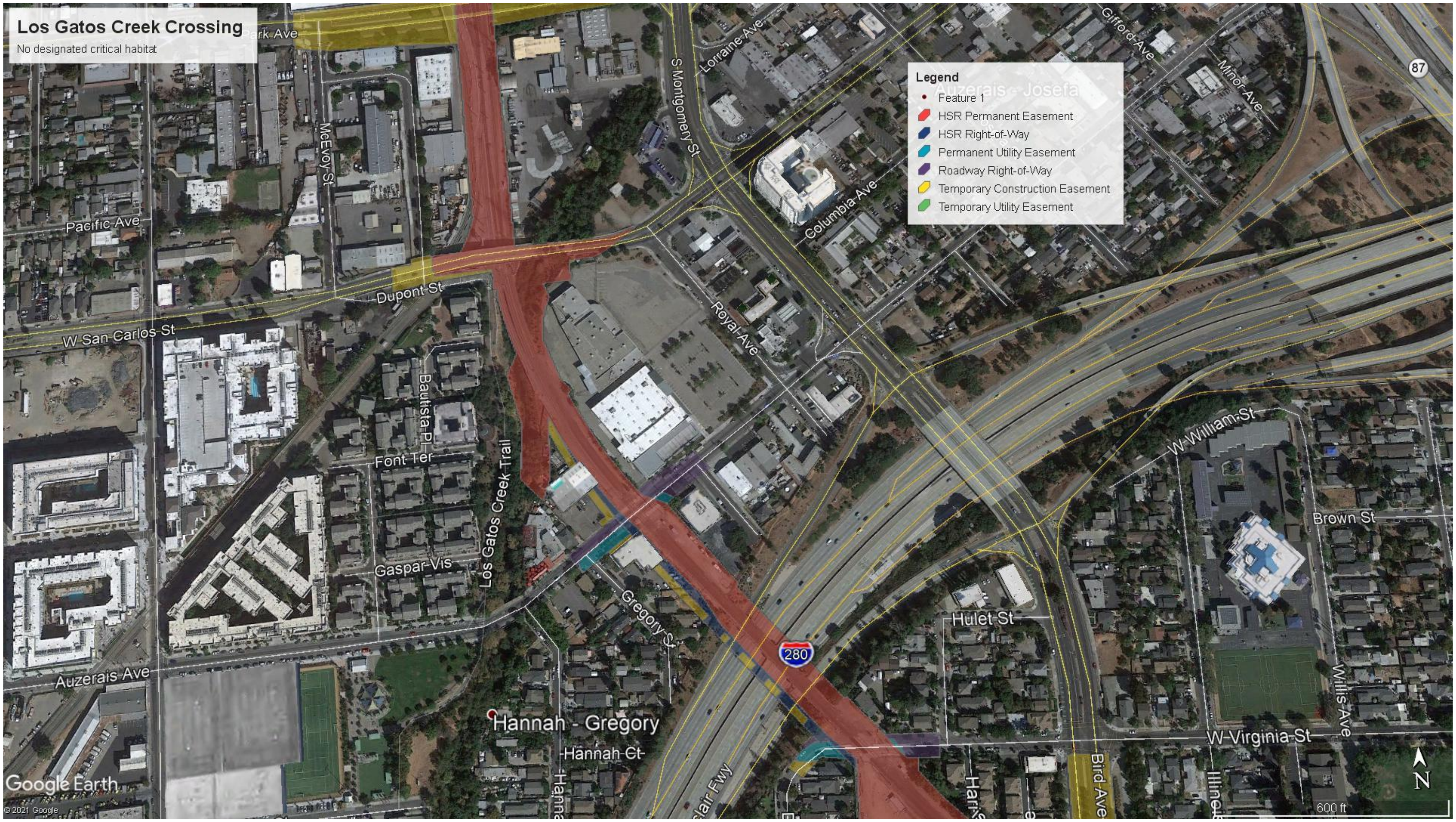


Figure 25. Close-up of Los Gatos Creek Crossing #8 by HSR elevated viaduct, ROW, permanent buildings, and San Jose station (red/dark blue) with temporary construction easement estimates (yellow) in its approach to San Jose Diridon Station. No CCC steelhead designated critical habitat in the section of stream crossed near Highway 280/Highway 87 exchange.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.4.1. Occurrence of listed species and critical habitat in the action area

The federally listed anadromous species that use and occupy the action area are adult and juvenile S-CCC and CCC steelhead. The Pajaro River is the migration corridor used by S-CCC steelhead to travel between the waterways the project interacts with (major overcrossings #1 through 6) and the Pacific Ocean via Monterey Bay, within the action area, that are also part of their designated critical habitat. All streams in the Pajaro River watershed are considered part of the Interior Coastal Range Biogeographic Population Group (BPG), and the Pajaro River is considered a Core 1 population (Core 1 populations are those identified by NMFS as a high priority for recovery actions based on a variety of factors; populations that should be focused on first in overall recovery efforts and strategies). The Guadalupe River (major overcrossing #7) and Coyote Creek are the migration corridors used by CCC steelhead in the action area, portions of which are also their designated critical habitat, between their upstream spawning and rearing habitats and the Pacific Ocean via San Francisco Bay. Coyote Creek is considered part of the Interior San Francisco Bay Diversity Stratum while Guadalupe River is part of the Coastal San Francisco Bay Diversity Stratum, however both streams' populations are considered essential populations in the CCC steelhead DPS. The portion of the Guadalupe River where the HSR route crosses (major overcrossing #7) is not CCC designated critical habitat, though CCC steelhead may use the waterway. Similarly, Los Gatos Creek (major overcrossing #8) is also not designated critical habitat but CCC steelhead may use the waterway.

In general, steelhead are described as a highly migratory species that exhibits a great amount of variation in the time and location spent at each life history stage compared to other members of the *Oncorhynchus* genus. Like other Pacific salmon, they follow an anadromous life history pattern of adults spawning in freshwater streams, juveniles undergoing physiological changes that allow them to migrate, feed, and mature in the ocean, to eventually return to their natal waters to complete the cycle and reproduce. While this basic life history pattern is observed by the species, the life history strategies of steelhead are extremely variable between individuals. In addition, steelhead are iteroparous (i.e., can spawn more than once in their lifetime (Busby et al. 1996)) and therefore may be expected to emigrate back down the system after spawning. As such, the determination of the presence or absence of steelhead in the action area accounts for both upstream and downstream migrating adult steelhead (kelts).

2.4.1.1. S-CCC steelhead

Adult S-CCC steelhead typically return to their spawning grounds in winter and early spring (winter-run type). However, the specific timing of their return can vary depending on factors such as available and sufficient flow in migration corridors and sandbar breaching. While the Pajaro River mouth tends to stay open through the summer, the opening can be relatively narrow and shallow. In late September through November as smaller storm flows occur, paradoxically the sandbar may close as sand is pulled off the beach. This forms a lagoon and prevents passage between the upper freshwater system and the ocean. In most years, the Pajaro River mouth is artificially breached by land managers to prevent the lagoon from flooding, typically sometime from late-October to November.

When adults achieve upstream passage, they migrate up to spawning reaches. Once there, females excavate a nest (redd) in gravels and deposit eggs to be fertilized by males. The eggs are covered with additional gravel and the embryos (later alevins) develop. Most adults will die shortly after spawning but, as previously indicated, some may survive spawning and return to the ocean to repeat the process. However, it is rare for steelhead to spawn more than twice before dying and females are more likely to survive to be kelts than males (Keefer et al. 2008, Matala et al. 2016). Kelts are expected to leave the freshwater system for the Pacific Ocean also in the winter while the river mouth sandbar is breached and river flows are higher.

Hatching and fry emergence depends on water temperature, with colder water temperatures extending development. Hatching may occur three weeks to two months after deposit while emergence may occur two to six weeks after hatching (Moyle 2002, Moyle et al. 2008, NMFS 2013). Eggs and fry therefore may be expected in certain sections of the action area between late fall and late spring.

The expression and success of each juvenile life history strategy is dependent on available water resources in the rearing period and access between areas. S-CCC steelhead typically employ an extended freshwater rearing period of one to three years before migrating to the ocean. During rearing, juvenile steelhead may follow various life history paths, transitioning between freshwater, estuarine, and lagoon areas as necessary and available. There is even a type of life history pathway expressed by S-CCC steelhead called “lagoon-anadromous” (Bond 2006) in which a fraction of the juvenile steelhead stay in a lagoon ecosystem for a year before completely out-migrating to the ocean. While rearing, juveniles feed and grow in habitat relatively free of competition and predators (NMFS 2013). Out-migration (emigration) of smolts to the ocean usually occurs in the late winter through the spring again while river mouths are breached.

Adult S-CCC steelhead may be expected in the action area between October and January as they return to spawn and some survive and exit to the Pacific Ocean. The action area of the project does not contain any lagoon or estuarine rearing options for S-CCC juveniles, however <1 year old to +1 year old juveniles may be present in any waterway containing water at any time in the action area as they over summer in freshwater habitat with suitable water temperature and dissolve oxygen levels to complete this life stage. See section 2.4.2: Factors affecting listed species, for a discussion on typical water flow patterns of the area.

2.4.1.2. S-CCC steelhead critical habitat

The action area contains designated critical habitat that supports the spawning, rearing, and migration activities of S-CCC steelhead. The Pacheco Creek/Pacheco Creek South Fork sections that interact with the HSR tunnel alignment host spawning habitat that is generally rated at good to fair, rearing habitat that is rated fair, and migration habitat that is rated good to fair. At major overcrossing #1, where the HSR will emerge from the hillside tunnel and cross Pacheco Creek for the first time, the spawning and rearing habitat is rated poor while the migration habitat is rated fair. Further downstream at major overcrossing #2, the spawning habitat is rated as poor and migration habitat is rated as fair, rearing habitat is not available. There is no adult holding habitat available in Pacheco Creek.

At nearby Tequisquita Slough, major overcrossing #3, the migration habitat is rated as poor and spawning and rearing habitat are not available, though historically this area was ideal floodplain rearing habitat for the population.

At major overcrossing #4 (Miller Canal), the migration habitat is rated as fair while spawning and rearing habitat are unavailable. At nearby major overcrossing #5, the mainstem of the Pajaro River, the migration habitat is rated as good, while spawning and rearing habitat are unavailable.

The route and footprint of the proposed ROW maintenance facility comes near Uvas Creek, which contains all three habitats types; spawning and rearing habitats rated in fair condition while migration habitat is rated as good.

At major overcrossing #6, over Llagas Creek, the spawning habitat is rated as fair and migration habitat is rated as poor, while rearing habitat is unavailable.

Overall, the habitat conditions in the Pajaro River watershed (part of the Interior Coast Range BPG) were rated as poor in the S-CCC steelhead recovery plan (NMFS 2013) and freshwater rearing habitat is mostly lacking in the project's action area. Previously a primary drainage for this BPG, the Pajaro watershed has been severely impaired by agriculture, urban and residential development, and the water resource use and management associated with such landscape changes. Legacy damage also occurred to the habitat suitability of the watershed through past intensive logging of the old growth forests in the upper watershed of the Pajaro River which removed the input of LWM to the system.

2.4.1.3. CCC steelhead

Adult winter steelhead freshwater presences varies but is correlated with higher flow events. Adults CCC steelhead express two reproductive ecotypes based on their state of sexual maturity at time of entry to freshwater and the duration of their spawning migration: stream maturing and ocean maturing. Stream maturing adults enter freshwater in an immature condition and require several months of holding in freshwater before spawning while their gonads mature (i.e., also referred to as summer steelhead). Ocean maturing adults enter freshwater with well-developed gonads ready for spawning (i.e., winter steelhead). Adult summer CCC steelhead begin their migration May through October and spawn in January and February, while winter CCC steelhead immigrate December through April and spawn shortly thereafter (Sharpovalov and Taft 1954, Moyle et al. 2008). As noted above, CCC steelhead spawning would be expected to occur from

December through April in spawning reaches. Again, adults may be capable of iteroparity and kelts can return to the ocean after spawning. For the populations of Guadalupe River and Coyote Creek in the action area, there are no sandbar dynamics that would inhibit the migration timing of either reproductive ecotype through the river mouth connections to the San Francisco Bay.

Egg hatch in approximately 25 to 35 days depending on water temperatures, and alevins remain in the gravel redd for two to three weeks after hatching. The fry that emerge from the redd will then rear in edge water habitats and gradually move to deeper faster waters or other areas better suited for rearing.

Juvenile CCC steelhead will rear in freshwater and estuarine habitats for one to two years before completing the transition to a smolt and completing their migration to the ocean. Many factors influence juvenile residence time; in low productivity systems juveniles may rear for more than two years to reach a minimum body size before leaving (McCarthy et al. 2009, Sogard et al. 2009). When juveniles are able to complete the physiological transition to a smolt, they typically emigrate sometime between February and June, with peaks in April and May, in the San Francisco Bay area (Fukushima and Lesh 1998). Due to their extended freshwater residency, juvenile CCC steelhead may be present in the action area in any waterbody providing suitable water quality conditions.

Adult CCC steelhead may be expected in the action area at the earliest in May (arriving summer steelhead) and at the latest in April (leaving winter steelhead that have survived and become kelts). The action area contains freshwater and estuarine rearing options for CCC juveniles, and spawning areas for CCC steelhead, therefore <1 year old to +1 year old juveniles may be present in any waterway containing water at any time in the action area, if suitable water temperatures and dissolved oxygen levels are also present.

2.4.1.4. CCC steelhead critical habitat

The action area contains designated critical habitat that supports the spawning, freshwater and estuarine rearing, and migration activities of CCC steelhead. The proposed HSR alignment comes close to Coyote Creek and includes a wildlife undercrossing that includes alterations to Fisher Creek, which is tributary to Coyote Creek at their confluence. Coyote Creek itself hosts spawning habitat of poor quality, rearing habitat of poor quality, and migration habitat of fair quality while Fisher Creek would be expected to host non-natal rearing when inundated. Coyote Creek does not offer estuarine habitat in the affected stream section. Water diversions and impoundments (Coyote and Anderson Reservoirs), mining, residential and commercial development, road and railway installations, and channel modifications have caused the greatest amount of impairment to Coyote Creek’s functionality as CCC steelhead habitat. Urbanization is still considered a threat to this waterway, but less so when compared to the Guadalupe River (NMFS 2016d).

At major overcrossings #7 over Guadalupe River and #8 over Los Gatos Creek, the actual stream sections crossed by the HSR system are not designated critical habitat for the population. However, the critical habitat designation for the waterway does begin approximately 2 miles downstream and exists in close proximity to the HSR alignment, ROW, and San Jose Diridon Station. The designated critical habitat in the Guadalupe River downstream contains spawning habitat in poor condition, rearing habitat of poor condition, and its migration habitat is in fair condition. It also offers estuarine habitat of poor condition, as this section of the river is close enough to San Francisco Bay to be tidally influenced. Like other waterways in the Coastal San Francisco Bay Diversity Stratum, the river has experienced a vast amount of urbanization, commercial and residential development, channel modifications, a high degree of road and railway densities, and a lack of large wood material, all of which have severely impaired its ability to support CCC steelhead (NMFS 2016d).

2.4.2. Factors affecting listed species

In the San Jose-San Francisco Bay Area, water agencies rely on a diverse portfolio of local and imported water sources (Ackerly et al. 2018). For example, while relatively far from the action area, approximately 60% of Bay Area water supply is sourced from the Sierra Nevada (Regional Water Management Group 2019), while some is made available by groundwater desalination and non-potable water reuse. Approximately two-thirds of the action area's community water systems are small, self-sufficient and locally-sourced, and serve less than 10,000 people each, a very small portion of the human population (Ackerly et al. 2018). In an effort to increase the Bay Area's climate change resiliency, efforts are being undertaken to expand water storage and conveyance infrastructure locally while also increasing water recycling, desalination, groundwater augmentation and banking, water transfer, and stormwater harvesting abilities (Ackerly et al. 2018).

Local surface water flows in the action area are directly coupled to winter precipitation, which is highly variable year to year. As such, there are several dams that form reservoirs to store and supply water for human and remaining agricultural needs. For example, the Santa Clara Water District owns and operations the Coyote Dam and LeRoy Anderson Dam on Coyote Creek, the Elmer J. Chesbro Dam on Llagas Creek, and the Uvas Dam on Uvas Creek, forming several, similarly-named reservoirs managed for water storage and delivery within the action area (Santa Clara Valley Water 2020). In the upper Pajaro watershed, the north fork of Pacheco Creek has been dammed by the North Fork Dam and forms the small Pacheco Reservoir (Wikipedia 2020b). The Santa Clara Water District also plans to expand the Pacheco Reservoir so that additional rain runoff can be stored and so that nearby water from San Luis Reservoir can be imported into supplement water needs in the near future. The existing water infrastructure and management has altered and currently controls the hydrographs experienced by steelhead in their accessible habitats.

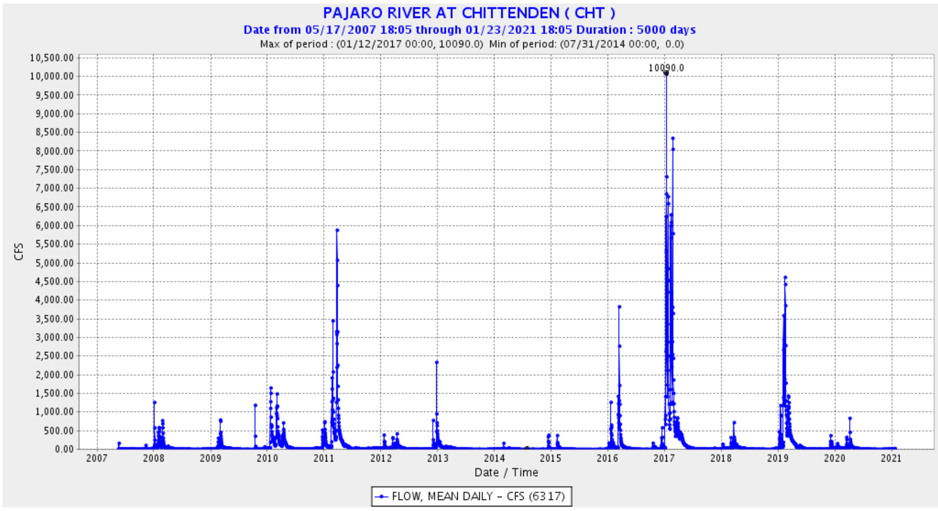
The natural waterbodies within the action area potentially affected by the proposed project vary in length and size. The furthest east stream segment, the South Fork of the Pacheco River, is approximately 48 miles from the Monterey Bay and Pacific Ocean; the affected Uvas and Llagas creeks are approximately 30 to 40 miles from the Monterey Bay and Pacific Ocean; and the Pajaro River mainstem at the crossing location is approximately 26 miles from the Monterey Bay and Pacific Ocean. The affected portion of Coyote Creek near the preferred alternative route is approximately 25 miles to the San Francisco Bay, and the Guadalupe River near the north most crossing is approximately 12 miles from San Francisco Bay (USGS 2015).

Water flow data is available from the California Data Exchange Center (CDEC) online for the Pajaro River at Chittenden (CHT), downstream of project interactions within its watershed.

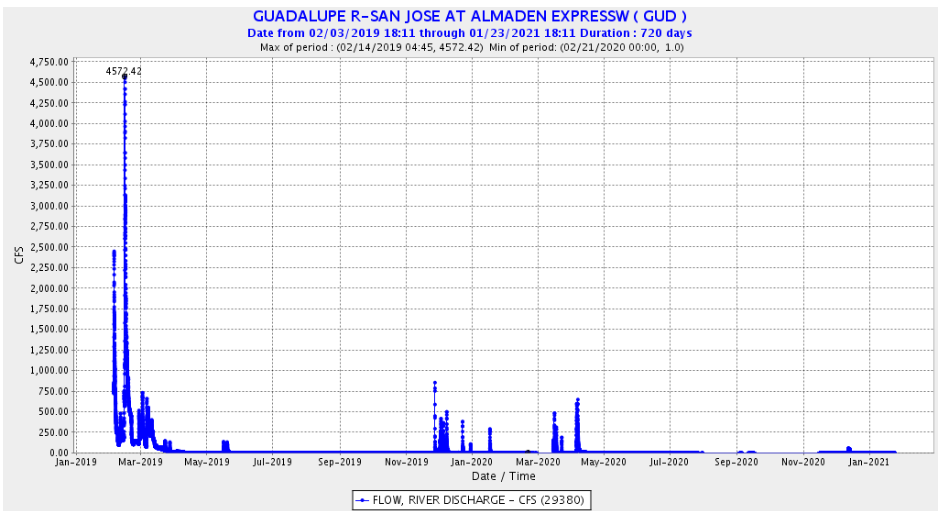
Mean daily flow in cubic feet per second (cfs) has been available since 1993, and is less than 20 river miles from the Pacific Ocean but also receives input from the San Benito River (CDEC 2021c). Water flow data as river discharge in cfs for events is stated as available for Coyote Creek at Madrone (CYO) for events since December 2017 to present, downstream of potential project interactions, but NMFS was unable to recover said data (CDEC 2020). Regarding surface water flows of the Guadalupe River, two data sources are available, one upstream and one downstream of the proposed HSR crossing. Upstream, Guadalupe River at the San Jose at Almaden Expressway (GUD) gauge provides flow as river discharge in cfs for events and data is available since 2016 to present (CDEC 2021a). Downstream, Guadalupe River above Highway 101 at San Jose (GRJ) gauge provides flow as river discharge in cfs for events and data is available since 2009 (CDEC 2021b).

Available CDEC data shows (Figure 26) the expected 'boom and bust' cycle of surface water available to CCC/S-CCC steelhead in the action area, with short and abrupt periods of high flows in winter following large precipitation events (atmospheric rivers) with low flow to dry streambeds persisting for extended periods from early summer to late fall/early winter. While the past characterization of the surface water of the area still mostly holds true, the highs and lows of the stream flows are predicted to become even more extreme as climate change progresses.

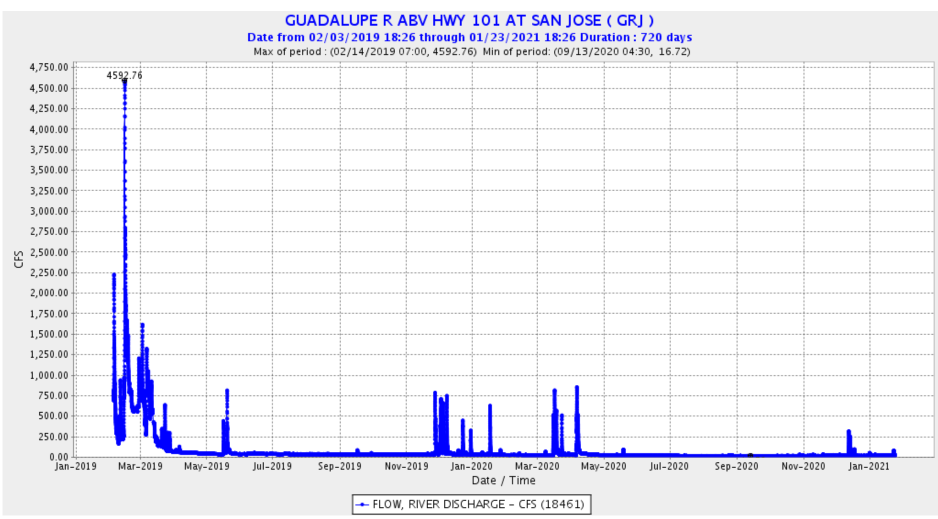
One such extreme precipitation event known as the 2017 Coyote Creek Flood, seen in Figure 26a where the Pajaro River recorded over a mean daily discharge of 10,000 cfs, when flooding outcome was more severe than previous 1997 record floods. The upstream Anderson Reservoir was beyond capacity and overflowed via its spillway into Coyote Creek (Wikipedia 2020a). The inundation of water forced 14,000 residents in low-lying areas to evacuate their homes, forced the closure of Highway 101, and necessitated the rescue of several people as flood waters reached a new record height of 14.4 feet.



a)



b)



c)

Figure 26. Recent stream flow data in the Pajaro River (a) and Guadalupe River (b, c) nearby major HSR crossing locations (CDEC 2021c, a, b).

2.4.3. Conservation and restoration efforts in the action area

2.4.3.1. NMFS recovery plans

Recovery is the process by which listed species and their ecosystems are restored to the point that the protections provided by the ESA are no longer necessary to ensure their continued existence. Recovering anadromous species like steelhead in the San Jose-San Francisco Bay Area is challenging due to the area's large and expanding human population, its large percentage of landscape being highly urbanized, the increasing demand for housing that leads to development of the remaining natural and pervious (agricultural) areas, the associated amount and extent of water use and manipulation, and legacy habitat damage that still persists and continues to inhibit steelhead population recovery (NMFS 2013, 2016c, d).

In the Recovery Plans (NMFS 2013, 2016c, d), NMFS established delisting/recovery criteria for the S-CCC and CCC steelhead DPSs, including that both DPSs must have robust, viable populations in several of the major tributaries affected by the proposed project in the action area. Though there are many more recovery actions that are directed to restore the marine, estuarine, and freshwater systems that these species depend on (described fully in their respective recovery plans), there are a series of actions/efforts that must be completed specific to these populations to successfully establish and persist.

Pertinent DPS-wide recovery actions for S-CCC steelhead in the action area include:

- Forming collaborations between water facility owners/operators so that water releases can maintain flows necessary to support all steelhead life history stages and habitat functionality.
- Forming collaborations with responsible agencies on flood control and management programs to ensure appropriate steelhead habitat protection and provisions (e.g., the collaboration between the Pajaro River Bench Excavation Program and US Army Corps of Engineers on lower Pajaro River Flood Control Program).
- Forming collaborations with responsible agencies and organizations in acquisition of fee-title to parcel or establishment of conservation easements over selected streams and riparian corridors to protect steelhead habitat.
- Physically modifying passage barriers to assist up- and downstream migration.
- Forming collaborations between California Department of Transportation and other responsible agencies with oversight on road practices to reduce or remove transportation related passage barriers, including railroad bridges, abutments, and similar structures.
- Enhancement and protection of natural in-channel and riparian habitat including appropriate management of flood control activities.

For the Pajaro River watershed specifically:

- Develop and implement operating criteria to ensure the pattern and magnitude of groundwater extractions and water releases from Uvas and Pacheco dams to provide essential life history and habitat requirements of steelhead.
- Modify passage impediments to allow natural steelhead migration to habitat above Uvas Dam.

- Manage instream mining to minimize impacts to critical steelhead life history patterns in major tributaries including Uvas, Llagas, and Pacheco creeks.

Pertinent DPS-wide recovery actions for CCC steelhead in the action area include:

- Increase the quality and extent of estuarine habitat by remove problematic infrastructure and fill material, and develop and implement estuary inflow and enhancement guidelines.
- Rehabilitate and enhance floodplain connectivity by finding opportunities for planned retreat of current urban development, and encouraging county zoning to consider the 20-year and 100-year flood zones to identify protective and compatible land use designations.
- Improve flow conditions by working with partners to reduce stormwater runoff by removing impervious surfaces and creating or expanding flood retention land and groundwater recharge basins, minimizing impacts to fisheries resources by integrating hydro-modification concerns into development planning, and improved coordination with State Water Resources Control Board (SWRCB) to establish and manage flows that fully protect salmonids.
- Modify or remove physical passage barriers at all new crossing and upgrades to existing bridges, culverts, fills, etc., to accommodate 100-year flood flows and use NMFS 2001 Salmonid Passage Guidelines in their designs or retrofits.
- Improve habitat complexity and riparian conditions through fish restoration projects and funding, by working with other agencies and landowners to keep beavers on the landscape with non-lethal damage management tactics, preserving older large diameter trees for canopy cover, and developing adequately sized riparian setbacks and buffers.
- Improving water quality by reducing toxicity, pollutants, and sediment.

For Coyote Creek (Interior San Francisco Bay Diversity Stratum) specifically:

- Passage barriers downstream of Anderson Dam should be systematically remedied, with priority on barriers lower in the system.
- Assisted or volitional passage programs should be developed and implemented for the movement of steelhead above Anderson Dam and then Coyote Dam to allow use of above reservoir freshwater habitat.
- Flows from Anderson and Coyote Reservoirs should be released in such a way as to benefit all life stages of steelhead within Coyote Creek.
- Where feasible, floodplains and side channels should be reconnected with the active stream channels.
- Instream habitat and cover should be improved downstream of Anderson Dam.
- Efforts should be undertaken to improve water quality throughout the urbanized reaches of Coyote Creek with a focus on limiting or treating urban runoff.

For Guadalupe River (Coastal San Francisco Bay Diversity Stratum) specifically:

- Passage barriers downstream of the reservoirs in the Guadalupe River watershed should be systematically remedied and overall passage improvement has the highest priority in this watershed.
- Assisted or volitional passage programs should be developed and implemented for the movement of steelhead above Lake Almaden and Guadalupe Reservoir.
- Reservoirs in the Guadalupe River watershed should be operated as to benefit steelhead of all life stages.
- Where feasible, floodplains and side channels should be reconnected with the active stream channels, including retrofitting existing development to restore connectivity and allow for natural channel functions.
- Instream habitat and cover should be improved, including the placement of large woody debris, rock weirs, and boulders. This will also increase the instream shelter ratings and pool volumes in degraded reaches.
- Efforts should be made to improve water quality throughout the Guadalupe River watershed, in particular focusing on limiting or treating urban runoff and remediating mercury mine sites.

2.4.3.2. Santa Clara Valley Habitat Conservation Plan

The Santa Clara Valley Habitat Conservation Plan (HCP) is a framework completed in 2012 that promotes the protection and recovery of natural resources, including endangered species, in the Santa Clara Valley by streamlining the environmental permitting process for planned development and infrastructure projects under the jurisdiction of the County of Santa Clara, the Santa Clara Valley Water District, the Santa Clara Valley Transportation Authority, or the cities of Gilroy, Morgan Hill, and San Jose when they seek to receive endangered species permits (SCVHA 2012b, a). Rather than permitting and mitigating for individual projects, the HCP evaluates the impacts and mitigation requirements comprehensively to better protect, enhance, and restore natural resources in specific areas of Santa Clara County to contribute to the recovery of endangered species (SCVHA 2012b) while offering ESA coverage for actions/projects described in the HCP. The HCP was developed with the help of the Santa Clara Valley Open Space Authority, USFWS, the California Department of Fish and Game, stakeholder groups, and the general public. It asks USFWS to issue a 50-year permit that authorizes the take of the covered species under the Natural Community Conservation Planning Act.

The Santa Clara Valley HCP includes steelhead and rainbow trout in the account of biological resources present with its action area (noting Coyote Creek, Guadalupe River, and tributaries of the Pajaro River as steelhead streams (SCVHA 2012a) and provides provisions and alternative measures for the minimization of take of other listed species affected by the HCP (referred to as covered species), but NMFS was not involved with the formation of the HCP or consulted with to exempt incidental take of S-CCC or CCC steelhead affected by projects otherwise covered by the HCP. Despite not being included as covered species, S-CCC and CCC steelhead may still receive some conservation benefits from the implementation of the Santa Clara HCP because its strategy includes:

1) The creation of a permanent reserve system with an aim to benefit natural communities and ecosystem function, protecting existing open spaces, and at least 100 miles of streams. All land acquisitions for the reserve system to be completed by Year 45 of the HCP permit term.
2) Habitat enhancement and restoration for wetland and stream habitat types by improving functional processes, species composition, and community structure; with a minimum of 90 acres of riparian woodland and scrub, wetlands, and ponds; and with a minimum of 1 mile of stream restored regardless of project subcomponent size. Remaining restoration will occur according to ratios of 1:1 or 2:1, with predicted impacts resulting in 500 acres of riparian woodland and scrub, wetlands, and ponds; and up to 10.4 miles of streams restoration needed to offset losses of these lands cover types and contribute to species recovery. Construction of all habitat restoration/creation projects to be completed by Year 40 of the HCP permit term.
3) Adaptive management and monitoring of HCP actions and outcomes through detailed guidelines and recommendations for each of the affected land cover types to be offset or restored, including riverine and riparian forests, wetlands, and pond, and for each covered species.

2.4.3.3. Upper Llagas Creek Flood Control Project in Santa Clara County

This project was originally proposed in 1968 in an effort to reduce and control flooding along 13.9 miles of Llagas Creek (Santa Clara Valley Water District 2019). Through extensive technical assistance with NMFS, the implementation of the project has evolved to include habitat enhancement and improvement tactics in stream reaches that support S-CCC steelhead, and mitigation for unavoidable project adverse effects, including construction of a sinuous flow-flow channel, revegetation with specific native species, sufficient fish passage flowing NMFS guidelines (NMFS 2011), removal of a fish ladder that is a partial passage barrier, a roughened step-pool channel, a re-route around a former gravel pit, and installation of complex habitat features throughout steelhead reaches (NMFS 2018a).

The project also includes the Lake Silveira Mitigation Element, a 52-acre wetland and riparian mitigation plot. The proposed design will eventually revert flow back into a 2,000 foot section historically occupied by the Llagas Creek channel but had since been converted for industrial uses, enhance wetlands around a perennial lake, and improve the natural riparian vegetation by removing invasive species and replacing them with native understory. NMFS concluded that this project, while a flood control action, would ultimately improve the quality, extent, and functionality of critical habitat available in the affected area, improving conditions for S-CCC steelhead overall.

2.4.3.4. Pacheco Reservoir Operations

From 2010 to 2012, the operating rules for the Pacheco Reservoir above Pacheco Creek were proposed to be revised to improve aquatic habitat downstream of North Fork Dam and also balance the needs of S-CCC steelhead that depend on these flow releases with human water needs (Micko 2014). Acceptance and implementation of revised water release amounts and schedule changes to benefit steelhead life history needs is still forthcoming, and may eventually be considered in conjunction with expansion of the storage capacity of the Pacheco Reservoir.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

This opinion will consider the consequences to CCC and S-CCC steelhead, and to their critical habitats, as related of the construction of the tunnels, waterway crossings, stations, maintenance yard, utility upgrades, etc., outlined in section 1.3 for the proposed action, the long-term consequences of HSR structure permanence in the landscape, and consequences associated with its operation in the action area, as described in more detail in the 2020 HSR BA (Authority 2020c).

2.5.1. Consequences to individuals

2.5.1.1. General construction activities

General construction encompasses work onsite to build the HSR system and necessary utilities, activities like site preparation, creation of access ways and roads, vegetation clearing and grubbing, operation of heavy machinery, vehicles, and tools, installation of falsework, BMPs, and fencing, and out-of-water earthwork and excavation. General construction activities have the potential to introduce noise, vibration, artificial light, and other physical disturbances into the immediate environment in and around the construction zone that can result in the harassment of fish by disrupting or delaying their normal behaviors and use of areas, and in extreme cases causing injury or mortality. These outcomes could occur immediately or later in time. The potential magnitude of effects depends on a number of factors, including type and intensity of disturbance, the proximity of disturbance-generating activities to the water body, the timing of the activities relative to the use and occurrence of the sensitive species in question, the life stages of the species affected, and the frequency and duration of disturbance periods.

Fish may exhibit avoidance behavior near construction activities that displace them from locations they would normally occupy due to the noise generated by the operation of construction machinery or movement of soils and rocks during earthwork periods. Depending on the innate behavior that is being disrupted, the adverse effects could vary. An example of an immediate adverse effect to individuals would be cessation or alteration of migratory behavior.

For juvenile fish, this effect may also include alteration of behaviors that are essential to their maturation and survival, such as feeding or sheltering, which co-occur with their outmigration from freshwater systems. In the context of construction at the stream crossings, the migratory and rearing behaviors of juvenile salmonids are expected to be affected by various construction-related effects.

In the absence of migration pattern alterations, general construction disturbance may increase fish physiological stress and increase risk of mortality. Fish vacating protective habitat due to disturbance may experience increased predation rates and decreased survival rates compared to those left undisturbed is an example of an indirect adverse consequence from construction. In extreme cases, general construction-related effects may also include debris and/or equipment falling into the channel. Such instances could cause physical injury or death if a fish was struck or crushed, or at least, acute avoidance tactics would be taken, altering any normal behaviors and inducing a high degree of acute physiological stress.

To minimize the impacts of construction on listed salmonids, the Authority has proposed to adhere to specific seasonal work windows for in-water and near-water construction activities of the HSR system in the section (pile-driving activities and associated consequences will be discussed in section 2.5.1.3 Vibratory and impact pile driving, below).

Proposed seasonal work windows:

- In-water work within the wetted channel: June 15 – October 15
- Near-water or over-water work: April 30 – December 1

Proposed daily work hours:

- In the channel or on the floodplain: 1 hour after sunrise until 1 hour before sunset

Proposed work window exceptions (with NMFS confirmation):

- When channels are dry, ponded, lack continuous flow, or
- Water temperatures average 75°F or more for 7 consecutive days

Adult S-CCC steelhead would not be expected to be able to reach the Pacheco Creek or Llagas Creek work areas until after the Pajaro River sandbar was breached, which typically occurs in late December. Since the in-water work window ends mid-October, an overlap between spawning behaviors, egg incubation, and in-water construction work are not expected and S-CCC steelhead redd success should not be impacted through this effect pathway. There is a low probability that near or overwater work may disturb the activities of adult S-CCC steelhead if they are spawning near work areas, as overlap may occur with the near-/over-water work window and spawning/egg incubation until December 1 of each year.

Adult CCC steelhead in this area are expected to display a winter-run life history, and peak spawning activity would be expected to occur December to February. While the proposed in-water work window is expected to avoid most of the spawning activity, downstream migration of kelt CCC steelhead can occur until as late as May. There is also a low probability in-water work would encounter small number of adult CCC steelhead migrating or possibly holding in freshwater pools over summer months. At the locations within the action area where this encounter could occur (Guadalupe River and Coyote Creek), the probability of adult presence is very low, but not impossible, if water conditions are suitable in summer months. And similarly to S-CCC steelhead adults, there is a low possibility that near or overwater work may disturb the activities of early spawning adult S-CCC steelhead in Coyote Creek or Guadalupe River near work areas until December 1 of each year.

In addition to the seasonal work windows, active work conducted in the channels or on the floodplains would be limited to daily hours from one hour after sunrise to one hour before sunset. These daily work hour restrictions are likely to further minimize adverse construction disturbance effects on fish migration and movement behaviors during crepuscular periods and at night. Research suggests that adult steelhead show the greatest amount of upstream movement in river mainstems from early dawn until approximately 0800 hours and show somewhat more movement nocturnally compared to mid-morning and evening hours (Keefer et al. 2012). Steelhead juveniles are known to change diel movement tactics as they leave their natal streams (Chapman et al. 2012) but given the diversity of stream habitats involved in this section of the HSR, it is difficult to predict juvenile steelhead movement patterns for each crossing location and how those patterns might change under the influence of daytime construction disturbance.

Because salmonid use of waterways is generally limited by warm water temperatures and adequate flows, the Authority has also requested an exception to the work windows for in-water and near-water construction if local water temperatures are on average 75°F or more for seven consecutive days. One study of juvenile steelhead in southern California streams reported survival and normal foraging and activity in waters that would be considered lethal (>77°F), however cool water refugia were not available to steelhead in this study (Spina 2006) and the author notes that in other studies where microhabitat selection was possible, steelhead were observed to move to their preferential water temperature ranges (Nielsen et al. 1994, Ebersole et al. 2001). If water temperatures exceed preferred steelhead temperature maximum (most studies show steelhead prefer water temperatures below 68°F) for a week or more, fish are likely to have already vacated the area to seek cool water refugia elsewhere and would no longer be present in the waterways near the construction sites to experience associated adverse effects. Seven consecutive days is ample time for individuals to move to other areas where water temperatures are more suitable or complete their outmigration to the Pacific Ocean. In such cases, there is no cause for construction to adhere to the work windows designed to avoid steelhead use if construction impacts to individual steelhead would not be likely. If such an environmental situation occurs prior to the in-water/near-water work window start, the Authority or its contractors will contact NMFS to confirm with staff that local water temperatures measured 75°F or more for at least seven consecutive days, that steelhead presence is not expected in the area, and that construction may commence outside of the stated work windows because additional interaction with steelhead is not expected to occur. Conversely, if water temperatures drop below 75°F again, the Authority and its contractors propose to revert back to the original work windows intended to minimize adverse construction effects to steelhead in the action area.

All construction activities, such as preparing the construction footprint and staging areas, are expected to create a small amount fugitive dust that may settle into nearby waterways. But, because of the expected small amount and limited duration (standard construction practices include watering dirt roads to suppress dust creation from vehicle/equipment movement), any turbidity increases caused by dust input will be a minimal impact to any fish occupying affected waters. Dust effects are expected to persist only as long as active construction is occurring and are therefore temporary.

Viaduct construction activity in or near waterways also includes the placement of structures, movement of materials, and disturbance of soils in the water channels and riparian corridor. Such disturbance is likely to mobilize sediment and increase the likelihood of erosion, possibly sending it into associated waterways at elevated rates, particularly after the first rain event. Localized increases in erosion and in-water turbidity are expected to have adverse effects on rearing steelhead present in the action area during the proposed construction windows. For salmonids specifically, high sedimentation and turbidity levels has been shown to decrease juvenile growth and survival as a result of reduced prey detection and availability, and individual physical injury rates increase in high turbidity due to increased activity in association with gill fouling and even peer aggression (Bash et al. 2001). Sigler et al. (1984), in a lab study using juvenile steelhead and coho salmon, found individuals to preferentially occupy parcels of water between 57 and 77 nephelometric turbidity units (NTU) when given a choice. This result suggests that juvenile salmonids may avoid waters of very low turbidities (i.e., clear waters). Coupled with information presented by Gregory (1993) which found that juvenile Chinook salmon decrease predator avoidance behaviors at increased turbidities, juvenile salmonids may avoid clear waters where they are easily visible to predators but since they experience negative physiological effects in muddy waters, they may be most successful overall in slightly cloudy waters. Adherence to the SWPPP and implementation and maintenance of erosion control BMPs will be especially important in preventing sediment-laden stormwater from adversely affecting incubating redds in spawning reaches, even after active construction ceases for the winter period. Disturbed areas are to be stabilized and re-contoured so as to not cause long-term sedimentation effects. Given the proposed development of a SWPPP and the other erosion control BMPs included in the project description and general Authority construction guidelines, it is unlikely that construction activities will alter the natural range of in-river turbidities to a degree that would adversely affect the salmonids using the action area, therefore adverse effects are expected to be minimal.

In summary, harm and harassment of listed steelhead due to general construction activities is expected to occur through disruption of normal fish behaviors and their use of the aquatic habitats near construction zones. Equipment operation, construction noise, soil disturbance, and general human presence in and near waterways and floodplain is expected to elicit these responses. These proposed in-water and near-/over-water work windows align with windows recommended by NMFS during early technical assistance meetings to avoid the majority of the time periods adult CCC/S-CCC steelhead would be expected to use freshwater habitats, but do not completely eliminate the probability of encountering and disturbing adult behaviors and use of their freshwater habitats. Because juvenile steelhead may utilize freshwater habitats to rear for multiple years before leaving for the ocean, juvenile steelhead could be present in any waterbody or ponded pools near the work areas, if that waterbody was connected to a steelhead waterway at any point in the year and given suitable water conditions. Given typical steelhead life history patterns for freshwater habitat use in the action area and the expected encounter probabilities during the proposed work windows, there is a low impact risk to individual adult CCC/S-CCC steelhead, and a moderate risk to juvenile steelhead, from general construction disturbance. Adults or juveniles may be deterred from using waterways near work areas, may delay their migration or spawning, and may experience elevated stress levels due to active general construction occurring in, near, or over waterways. Acute injury or mortality from general construction activity is not anticipated to be an adverse effect because it would require an extreme event to occur (e.g., overwater support failure resulting in debris and construction materials violently crashing down into a waterway containing listed species). Overall, adhering to the seasonal and daily work windows will substantially decrease the probability that listed fish will be present in the waterways affected by construction by decreasing the overlap between fish use and construction activities, therefore decreasing the extent of harm to individuals of these populations.

2.5.1.2. Potential contamination of waterways from construction, equipment operations, staging, storage, and maintenance

All activities that involve construction near, in, or over water (including seasonally dry channels) have some potential to deliver contaminants to surface waters, likely in liquid or particulate forms. Contaminants originating from construction areas can also be delivered to surface waters through stormwater discharges. Contaminants may also enter the aquatic environment through disturbance, resuspension, or discharge of contaminated soil and sediments from construction sites. Introduced or contamination originating from resuspension would be expected to be temporary in nature, persisting as long as stormwater discharges continue or as long as construction is ongoing. The proposed overcrossing sites in the action area have sediments that have been affected by historical and current urban discharges but, no specific information on sediment contaminants at these sites is currently available.

The operation of construction equipment/heavy machinery is likely to deposit trace amounts of heavy metals throughout the construction area (Paul and Meyer 2001). Heavy metals, even in trace amounts, have been shown to alter juvenile salmonid behavior through disruptions of various physiological mechanisms including sensory dampening, endocrine disruption, neurological dysfunction, and metabolic disruption (Scott and Sloman 2004). Oil-based products used in combustion engines for both fuel and mechanical lubrication contain polycyclic aromatic hydrocarbons (PAHs), which have been known to bio-accumulate in other fish taxa and cause carcinogenic, mutagenic, and cytotoxic effects to fish (Johnson et al. 2002, Incardona et al. 2009, Hicken et al. 2011). Studies have shown that increased exposure of salmonids to PAHs also results in reduced immunosuppression and therefore increases their susceptibility to pathogens (Arkoosh et al. 1998, Arkoosh and Collier 2002). Resuspension of contaminated sediments may also have adverse effects on fish that encounter sediment plumes or come into contact with deposited or newly exposed sediment. Exposure to contaminated sediments, either through direct exposure (e.g., swimming through plumes of re-suspended sediment) or foraging on contaminated food sources, could harm steelhead.

Though these substances can kill fish or elicit sub-lethal effects when introduced into waterways in sufficient concentrations, adverse effects from hazardous materials from HSR construction is not expected due to the numerous AMMs and BMPs integrated into the proposed action to control such pollutants and the implementation of an appropriate spill prevention control and countermeasures plan (SPCCP) and SWPPP. For example, the construction staging areas will be established in the same footprints that will ultimately be occupied by permanent HSR facilities when possible, to further reduce the amount of disturbance and temporary impacts to natural habitats. All equipment entering work areas will be cleaned of mud and therefore also be cleaned of any adherent trace contaminant material. Additional staging and material/equipment storage areas may occur seasonally in the floodplain of waterways, restricted to the period of April 15 to October 31, and only when areas are dry. At all other times, equipment may enter the river channel area for daily use but will be removed and stored outside areas subject to possible flooding at the end of each work day. Construction will be limited to dry periods when waterbody flows are low or absent, whenever feasible. Refueling and other maintenance would be conducted in areas distant from surface water and equipment would be checked daily for leaks. Any equipment or vehicles to be driven/operated in the floodplain or over water will be checked and maintained daily to ensure proper working conditions and prevention of leaks, and collection pans or absorbent pads will be placed underneath stationary equipment. Surface water quality would be maintained through the use of siltation fencing, wattle barriers, soil-stabilized construction entrances/exits, grass buffer strips, inlet protection, sediment traps, infiltration basins, etc. A spill prevention and emergency response plan will also be developed as part of the SWPPP. Due to the proposed pollution prevention BMPs/AMMs/CMs, adverse consequences to steelhead resulting from these activities are not expected to occur.

2.5.1.3. Vibratory and impact pile driving

Construction will require the use of both vibratory and impact pile driving to place the permanent columns that will support the HSR tracks for at least eight waterway crossings, and to stabilize slopes and abutments. Use of impact pile driving would be minimized through first using vibratory pile driving or placement of cast-in-drilled-hole concrete piles to the extent feasible, before impact pile driving is employed. Temporary sheet piles for cofferdams will be placed via vibratory pile driving into the wetted channel to form a dry work area. When construction is complete, vibratory pile driving will be used to remove the temporary cofferdam sheet piles. The Authority is not proposing the use of temporary support piles or the installation of falsework in conjunction with pile driving for this project section. An Underwater Sound Control Plan (AMM-FISH-3) and a Fish Rescue and Salvage Plan (AMM-FISH-4) are also proposed as part of the project.

Pile driving near or in water has the potential to kill, injure, and cause death of steelhead through infection via internal injuries, or cause sensory impairments leading to increased susceptibility to predation. The pressure waves generated from driving piles into river bed substrate propagate through the water and can damage a fish's swim bladder and other internal organs by causing sudden rapid oscillations in water pressure, which translates to rupturing or hemorrhaging tissue in the bladder when the air in the swim bladder expands and contracts in response to the pressure oscillations (Gisiner 1998, Hastings and Popper 2005, Popper et al. 2006). Sensory cells and other internal organ tissue may also be damaged by pressure waves generated during pile driving activities as sound reverberates through a fish's viscera (Caltrans 2015). In addition, morphological changes (damage) to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings and Popper 2005). Smaller fish with lower mass are more susceptible to the impacts of elevated sound fields than larger fish, so acute injury resulting from acoustic impacts are expected to scale based on the mass of a given fish. Since juveniles and fry have less inertial resistance to a passing sound wave, they are more at risk for non-auditory tissue damage (Popper and Hastings 2009) than larger fish (yearlings and adults) of the same species. Beyond immediate injury, multiple studies have also shown responses in the form of behavioral changes in fish due to human-produced noises (Wardle et al. 2001, Slotte et al. 2004, Hastings and Popper 2005, Popper and Hastings 2009, Vracar and Mijic 2011, Martin and Popper 2016, Pavlock McAuliffe 2016, Hawkins et al. 2017, Rountree et al. 2020).

Based on recommendations from the Fisheries Hydroacoustic Working Group (FHWG), NMFS uses an interim dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (NMFS 2008a, Caltrans 2015, 2019). The interim thresholds of underwater sound levels denote the expected instantaneous injury/mortality, cumulative injury, and behavioral changes in fishes. Impact pile driving is normally expected to produce underwater pressure waves at all three threshold levels. Vibratory pile driving generally stays below injurious thresholds but often introduces pressure waves that will incite behavioral changes. Even at great distances from the pile driving location underwater pressure oscillations/noises from pile driving is likely to induce flight responses, hiding, feeding interruption, or area avoidance, effectively blocking natural fish movement and use of the affected area. For a single strike, the peak exposure level (peak) above which injury is expected to occur is 206 dB (reference to 1 micro-pascal [1µpa] squared per second). However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB. Therefore, the accumulated sound exposure level (SEL) above which injury of fish is expected to occur is 187 dB for fish greater than 2 grams in weight and 183 dB for fish less than 2 grams. If either the peak SEL or the accumulated SEL threshold is exceeded, then physical injury is expected to occur. Behavioral effects may still occur below the thresholds for injury. NMFS uses a 150 dB root-mean-square (RMS) threshold for behavioral responses in salmonids and it is assumed that pile driving sounds less than 150 dB do not result in injury. Though the dB value is the same, the 150 dB RMS threshold for behavioral effects is unrelated to the 150 dB effective quiet threshold.

The Authority included a hydroacoustic analysis in the submitted BA (Authority 2020c), using anticipated pile sizes, the current alignment design, and the hydroacoustic data available in Caltrans (2015) to estimate probable underwater pressure outcomes. The pile sizes proposed in the alignment design are 16-inch concrete piles. In the current design, most piles to be driven using impact pile driving are located on land while 103 may be driven in water (major overcrossing #6, Llagas Creek). Sound levels produced by piles being driven on land are typically less than those of the same size driven in water. However, there are no data in Caltrans (2015) for 16-inch piles driven on land, so underwater information was used to represent the worst-case scenario. Data were reported for 16.5-inch concrete piles driven in water with a bubble curtain and data were reported for 18-inch concrete piles driven in water (Table 3).

Table 3. Real (observed field data reported in Caltrans (2015)) and assumed (*) hydroacoustic outputs for in-water impact pile driving measured at 10 meters from the struck pile, selected to represent the underwater sounds expected from the HSR project.

Pile Size/Situation	**Attenuation**	**Peak**	**SEL**	**RMS**
16.5-inch	Bubble curtain	182 dB	159 dB	171 dB
18-inch	No bubble curtain	185 dB	155 dB	166 dB
*16.5-inch	None	187 dB	164 dB	176 dB

The analysis also assumes that up to 20 piles may be driven per day and that it would take 800 strikes to drive each pile (20 piles x 800 strikes = 16000 strikes per day). Currently there are no data supporting fish tissue recovery between pile strikes so all strikes in one day in which the affected waterbody experiences pile driving are counted together regardless if there is a break in between strikes. After an overnight period, or after 12 hours, accumulated SEL is considered reset to zero.

Using the assumed worst-case scenario underwater sound levels in Table 3 for a 16.5-inch concrete pile without attenuation, and 16,000 impact strikes per day, the Authority's provided hydroacoustic analysis and the NMFS Pile Driving Calculator (NMFS 2008a) estimate that the distance that instantaneous mortality due to underwater pressures above the 206 dB peak threshold would be expected to occur is within 1 meter from the driven pile. For fish less than 2 grams (as would be expected in any areas containing spawning habitat, i.e., major overcrossings # 1, 2, 6, and 7) the distance at which injury is expected to occur due to cumulative SEL exposure above 183 dB is within 86 meters from the driven pile (Table 4). For fish above 2 grams (as could be expected in all wetted steelhead habitat locations), the distance at which injury is expected to occur due to cumulative SEL exposure above 187 dB is also 86 meters from the driven pile. The distance within which behavior changes are expected is 541 meters from the driven pile, where the RMS sound will be above 150 dB RMS. SELs below 150 dB are assumed to not accumulate or cause fish injury, or be significantly different from ambient conditions, (i.e., effective quiet).

Table 4. Estimated threshold distances to in-water adverse effects using assumed hydroacoustic metrics (187 dB peak, 164 dB SEL, 176 dB RMS) and 16,000 strikes/day, calculated by the NMFS pile driving calculator (NMFS 2008a).

Underwater sound control measures	**Peak (dB) ≥ 206**	**Cumulative SEL (dB) ≥187** Fish ≥ 2 g	**Cumulative SEL (dB) ≥183** Fish < 2 g	**RMS (dB) ≥150**
No attenuation	1 meter	86 meters	86 meters	541 meters
Attenuation	0 meters	40 meters	40 meters	251 meters

Underwater sound control measures/minimization measures are incorporated into conservation measures proposed by the Authority and to the extent feasible whenever impact pile driving is performed (e.g., de-watered cofferdams, bubble curtains, and vibration-damping pile caps). Given that at least one underwater sound measure would be employed during impact pile driving, 5 dB assumed hydroacoustic dampening (182 dB peak, 159 dB SEL, 171 dB RMS) would result in no instantaneous mortality threshold distance, a reduction of cumulative SEL (for all sizes of fish) threshold distances to only 40 meters, and a reduction of RMS threshold distance to 251 meters from the driven pile, with 16,000 strikes per day (Table 4).

Though the underwater pressure waves are expected to affect relatively large areas of the wetted channels, the number of individual fish affected by pile driving is expected to be small due to the life history patterns of the fishes, the in-water/pile driving work windows, and environmental factors that limit fish use of a waterway, such as expected seasonal low flow patterns. Restricting impact pile driving to the in-water/pile driving work window avoids the primary migration periods of both CCC and S-CCC steelhead adults and juveniles in the action area, and should also completely avoid egg incubation, alevins development, and fry emergence timing. However, rearing juveniles may remain in the action area throughout the year, including during the in-water work window. Therefore, juvenile steelhead are the life history stage principally at risk of exposure to pile-driving noise. In-water pile driving would start no earlier than June 15, which would limit the potential overlap between juvenile use of an area and hydroacoustic exposure, but not eliminate the risk. Adverse effects on juvenile steelhead would occur within areas subjected to pile driving and underwater sound levels associated with potential injury and behavioral effects, for as long as the pile driving is occurring. Underwater noise levels would return to baseline levels following cessation of pile driving. These adverse effects would occur for a total of approximately 44 days while work was completed (assuming that work at different sites is not concurrent, which would reduce the number of days needed).

In summary, any CCC or S-CCC steelhead juveniles present during the in-water/pile driving work window are expected to be adversely affected by the hydroacoustic effects produced by pile driving. These juveniles are expected to experience temporary disturbance of normal behaviors and migratory patterns from both impact and vibratory pile driving in-water and on land near waterways, and in a few instances, underwater pressure waves created by impact pile driving may cause injury and mortality. Because of the timing of the proposed work windows and fish use of the waterway, and what is known about the current abundance of these species in the action area, the overall number of individuals to be adversely affected is expected to be very low with perhaps at most one or two individuals experiencing injury. Otherwise, most will experience temporary increases to their risk of mortality from predation and reduced fitness from expending energy with a temporary reduction in feeding opportunity.

2.5.1.4. Cofferdam installation, flow redirection, and dewatering

During the in-water work windows, cofferdams will be installed on the river bank or near the water line to isolate and dewater areas below the ordinary high water mark (OHWM) before the construction. Cofferdams will be made of sheet piles, gravel-filled sandbags, or comparable materials. Any sheet piling will be installed around the work area to form a cofferdam via vibratory hammer pile driving (effects of vibratory pile driving examined above, section 2.5.1.3). Cofferdams are also effective as an underwater sound mitigation measure once installed. Dry work areas below the OHWM may also be established using sandbags, or other barriers similar to those listed above, in channels dry at the time of the start of work, installed before flows begin following local rainfall. This will redirect water around the active construction and maintain dry work areas while still allowing for stream flow in an alternate course. The alternative course may be some portion of the natural course, a pipe, or a constructed artificial channel.

Dewatering will be required when the isolated area contains ponded water within the work area portion of the isolation barrier, so that the soils below the OHWM may be accessed. Dewatering is projected to be employed at approximately 40 locations in the action area. Pumped out water will be directed or trucked to nearby infiltration pits/basins that will allow the water to return to the local water table without affecting in-stream water quality. Pump intakes would be screened to prevent the entrainment of juvenile or parr-sized salmonids from entering the pump system, screen mesh size determined according to NMFS (1997) guidelines. At the end of the work season, prior to the rainy season, water will be allowed to re-enter the work area by the isolating structures and the alternate flow pathway will be decommissioned. The sheet piles will be removed via a vibratory hammer and the areas will be restored to pre-construction condition.

The adverse effects associated with cofferdam installation via vibratory pile driving are expected to be much less than the pile driving effects described previously. Vibratory pile driving is not anticipated to produce peak or accumulative SEL levels that would cause instantaneous mortality or internal injuries, however behavioral changes and physiological stress is expected. The effect size of these impacts are well contained within the distance limits estimated for in-water impact pile driving. Other types of isolation barrier construction (i.e., sandbags) are not expected to cause disturbance or harassment of steelhead beyond levels already analyzed in the general construction activities, section 2.5.1.1.

Entrainment of juvenile into the pump intakes will be prevented by using the screens specified by NMFS guidelines however even if properly screened, juveniles remain at risk of being impinged upon the screen surface when intake velocity of the pump exceeds the swimming capabilities of juvenile fish. Injury resulting from impingement may be minor and create no long-term harm to the fish, or result in injuries leading to mortality either immediately or at some time in the future after contact with the screen, including predation or infections from wounds and abrasions associated with the screen contact. As the pumping activities will all follow NMFS screening guidelines, injury to fish caused by impingement will be minimized. As pumping activities may occur for several years during construction, a portion of fish exposed to the pumping activities are expected to result in injury or death from impingement.

Given that isolation barrier construction will occur during the dry season/within the work windows and likely in dry streambeds in advance of stream flows and steelhead use, the risk of exposure through overlapping stream use is low. However, there is a possibility that cofferdam installation will need to occur in a wetted channel or isolated pools of suitable temperatures and expose juvenile steelhead to adverse effects. Steelhead could be exposed to adverse effects associated with elevated turbidities if trapped inside a cofferdam being dewatered and if dewatered water is discharged into surface waters and its water quality is not sufficiently controlled. While the dewatering and water diversion plan has not been fully drafted (AMM-GEN-21), it is assumed that construction will utilize silt/turbidity curtains while working in water to minimize the mobilization of sediments into the water column outside of the turbidity barrier, as occurred during in-water construction at the San Joaquin River for an HSR viaduct bridge.

Inside a cofferdam being dewatered, turbidity is expected to be elevated and trapped juveniles are likely to experience respiratory stress and potentially asphyxiate if not captured and relocated promptly (see section 2.5.1.5 below). Similarly, it is expected that any water pumped out during dewatering will either be managed by collection into an infiltration basin or discharged behind the in-water turbidity curtain to control the impacts to downstream turbidity levels. Because of these CMs, and previously analyzed turbidity control BMPs, it is not expected that downstream turbidity will increase from the discharge water pumped from cofferdams. Turbidity may be temporarily elevated shortly after flows are restored to a dewatered area or channel, but in light of expected turbidity levels in the first rain flush of the season (expected to co-occur with rewetting the work area), the additional temporary elevation in turbidity associated with the proposed action is expected to be indistinguishable from background turbidity levels.

A portion of the streambed may temporarily be unavailable for steelhead use while the isolation barrier is intact and dewatered, while simultaneously having stream flows redirected into an artificially constructed channel during the work window. While juvenile steelhead would be unable to rear or feed in the streambed bottom isolated due to the cofferdam or flow reroute, the relative amount of area removed from their access would be relatively negligible. Because the Authority proposes to constructing the artificial channels so that they meet NMFS fish passage criteria (NMFS 2011) to ensure the flow re-routes do not become passage barriers, changes to the movement patterns of fishes is not expected. Both of these impacts are temporary as the stream flow and streambed access would be restored following the seasonal removal of these structures.

2.5.1.5. Fish capture, handling, and relocation associated with dewatering

If water temperatures remain suitable during the in-water work windows, there is also a small possibility that juvenile steelhead may become entrapped or stranded during cofferdam installation or stream re-routing in wetted areas, and risk asphyxiation or experience mortality. They may become injured or die during the dewatering process while entrapped and are expected to experience higher levels of physiological stress at sub-lethal levels. Entrapped fish will require capture and release (AKA "fish rescue") before they asphyxiate or the area is pumped dry to maximize their probability of survival and minimize the project's harm and injury to listed fishes from dewatering activities. A fish rescue plan will be drafted and approved by NMFS before dewatering activities that may involve fish commence, and will include methods for minimizing stress and the risk of mortality from capture and handling of fish (see AMM-FISH-4 (Authority 2020c, a)).

Prior to any potential fish rescue or fish handling associated with dewatering, the Authority or its contractors will contact NMFS so that such activities can be coordinated, staff are aware and available to respond to the activities, and to help ensure minimal adverse effects to fish through appropriate capture and handling procedures. It is expected that the number of juvenile salmonids to require fish rescue and handling will be very low, due to the seasonal in-water work windows, expected low abundance, and because dewatering and pumping should only occur at each location once per construction season during cofferdam establishment.

Stranded juvenile CCC/S-CCC steelhead would likely experience increased stress levels, shock, and suffer mild injuries during capture and handling, even if seasoned fisheries biologists perform the fish rescue with appropriate equipment under ideal conditions. Some juveniles may be killed during capture, handling, or transport, while others may be disoriented at release, leaving them more susceptible to predation. Furthermore, fish are more likely to develop serious infections from small wounds inflicted during handling compared to unhandled fish. The expected rate of immediate juvenile salmonid mortality due to capture and handling is expected to be low (i.e., no more than 3% of the total number of juveniles relocated). It is also possible that some juveniles will avoid the capture methods and die while hiding due to asphyxiation extremely elevated turbidity in the available water, desiccation, or receive fatal wounds in the dewatering/fish capture process. These potential adverse effects would be expected to occur at any of the construction sites that require dewatering with the steelhead habitat model area. Ideally, construction would not commence until channels are seasonally dry, however some juveniles may become entrapped in any ponded water within the construction zones. Though individual juveniles will experience increased stress and harm, it is preferable to capture and relocate them into connected aquatic habitat compared to the eventual mortality these individual would otherwise likely experience. Proposed CM AMM-FISH-4, which focuses on dewatering and fish rescue, was developed with technical assistance from NMFS staff and duplicated measures established in prior opinions dealing with Central Valley salmonids (Term and Condition 1i, (NMFS 2019)), and is expected to minimize stress, injury, and mortality of juvenile steelhead during capture and relocation to the greatest extent possible. Adults are not expected to become entrapped by a cofferdam/dewatering barrier and therefore would not be adversely affected by dewatering activities.

2.5.1.6. Tunneling

Much of the Preferred Alternative route from the California Central Valley to Gilroy (the Pacheco Pass Subsection) will be in a tunnel and tunneling/boring through the Diablo Range will be required. Tunnel boring has the potential to cause fractures in rock that can deplete groundwater levels and therefore could impact the hydrology of groundwater-dependent aquatic features on the surface (i.e., seeps, springs, creeks, and streams) and any SCCC steelhead using Pacheco Creek. There is no work window proposed for tunneling and TBM operations. To assess the potential for, and the likely magnitude and duration of, groundwater depletion, the following was evaluated:

- The tunneling methods to avoid and minimize short-term and long-term groundwater depletion
- Geologic setting
- How the tunneling methods and geologic setting combine to inform assumptions about the potential for effect
- The maximum spatial extent of groundwater depletion

There are two methods of tunneling being considered for HSR tunnel construction: TBMs and conventional methods. A roadheader is a more conventional method of tunnel excavation that consists of a boom-mounted cutting head, a loading device usually with a conveyor, and a crawler traveling track to move the machine forward into the rock face. The use of drill-and-blast techniques and hydraulic excavators may also be required. Both TBMs and conventional methods are likely to be used during construction, depending on the geology encountered.

The TBM-driven tunnels would be lined with bolted and gasketed concrete segments. These watertight segments would provide the primary groundwater control mechanism for the tunnel; therefore, significant long-term impacts on the groundwater system are not anticipated. However, temporary and localized impacts on the groundwater system may be experienced near the tunnel heading during excavation as a result of inflows at the tunnel face. This is of particular concern with a TBM operating in open mode and can be exacerbated by the use of pre-excavation drainage ahead of the face. The Authority plans to mitigate temporary impacts by using pre-excavation grouting to decrease the permeability of the ground around the tunnel or by using a pressurized TBM operating in closed mode to create a water barrier.

The conventionally excavated tunnels are currently anticipated to contain permanent formation drains behind the tunnel lining. This method has potential to result in permanent impacts on the local groundwater system in the area. For areas along the alignment identified as being sensitive to drawdown because of biological factors, the Authority plans to implement strict groundwater controls, may remove formation drains from the design plans in these section, and use a lining that would be designed as a watertight structure that would resist the full hydrostatic head.

The tunneling methods chosen, the pretreatment of the ground mass, and the tunnel lining design are significant factors in avoiding and minimizing groundwater depletion. At final build-out, groundwater intrusion into the tunnel would be an unsafe condition for train operations, and thus the tunneling methods and minimization measures employed are expected to avoid groundwater entry into the tunnel (and limit groundwater loss) as much as possible. It is also expected that the tunneling crew would seal the tunnel if and when leaks occur as quickly as possible during construction. The tunnel must be dry to operate the electrified HSR system, so all groundwater leaks would be permanently sealed when tunnel construction was complete, so impacts to the ground- and surface water levels are anticipated to be temporary and limited to the active tunneling period. The size and extent of temporary groundwater depletion would largely depend on the geology of the ground surrounding the excavation.

The proposed tunnels traverse the Diablo Range, one of three prominent northwest-trending physiographic features in the region, along with the Santa Clara Valley and southern Santa Clara Valley. The western and eastern margins of the Diablo Range are geologically composed of sedimentary rock described as the Great Valley Sequence, and the core or middle part of the Diablo Range consists of metamorphosed rock called the Franciscan Complex. The Great Valley Sequence is composed primarily of the Panoche Formation (unmetamorphosed sandstone, conglomerate, marine shales, generally considered weak rock for tunneling, HSR BA), while the Franciscan Complex is composed of Franciscan mélange (deformed and variably metamorphosed rock) and metagraywacke (fine-to-medium grained, poorly sorted, homogenous, dense, gray sandstones) types. These sediment types were confirmed when encountered in previous HSR tunneling investigations (NLAA letter of concurrence issued by NMFS in 2018 to these activities (NMFS 2018b)) and other projects through the Diablo Range near the proposed route area (United States Bureau of Reclamation 1976, 1986, Geomatrix Consultants 2006).

Tunnel 1 begins at the southern end of the Santa Clara Valley (from Gilroy) and curves gently to the northwest, terminating near California State Highway 152 just south of the Casa De Fruta restaurant where the route emerges to cross Pacheco Creek. The proposed tunnel is approximately 8,200 feet long, has a maximum depth of ground cover of 700 feet, and would be excavated through the Panoche Formation. The Santa Clara Tunnel was also excavated from Panoche Formation material in the action area, it encountered: approximately 60 percent sandstone with shale interbeds, described as a blocky and seamy rock mass; approximately 25 percent shale with sandstone or siltstone interbeds, classified as crushed; and approximately 15 percent shear zones that may exhibit caving or squeezing conditions. These shear zones were reported in the Santa Clara Tunnel to vary in thickness from paper-thin clay gouge seams to zones of gouge matrix over 60 feet wide. Considering the length of Tunnel 1, it is anticipated that it can be excavated by either TBM or roadheader method. Based on the geologic terrain of the region but limited information on the water level in the nearby creeks, it is estimated that the maximum groundwater head for Tunnel 1 would be on the order of 250 feet. For the Santa Clara

Tunnel, 95 percent of the tunnel was driven with less than 15 gallon per minute (gpm), or 0.04 cfs, inflows at the heading and 5 percent of inflows exceeded this amount. Groundwater inflows for the Santa Clara Tunnel decreased significantly within several days. Groundwater inflows into Tunnel 1 are anticipated to be similar.

Tunnel 2 begins approximately 3 miles east of the Casa De Fruta restaurant and exits the Diablo Range near Santa Nella, California. It has a total length of approximately 13.5 miles, with a maximum cover depth of 1,200 feet, and the encountered sediments vary. The groundwater depletion analysis for Tunnel 2 was broken down into subsections in the BA but is summarized here. Considering the length of Tunnel 2, the Authority anticipates that it will be excavated using TBM methods. It is estimated that the maximum groundwater head encountered could be on the order of 550 feet or tunneling could encounter a perched water table to the west of the active Ortigalita fault with significant amounts of water. In addition, the Ortigalita fault also intersects the San Luis Reservoir to the south, which could allow some water to flow along the fault from the reservoir. This is based on the groundwater levels estimated from a limited number of borings that were drilled in the area for the Pacheco Tunnel Reach 2 geology investigation (NMFS 2018) and the water level in the nearby creeks. Soil conditions around Tunnel 2 are anticipated to consist of mostly moist conditions, with anticipated local heading inflows likely of 200 gpm (0.54 cfs), down to less than 15 gpm in other areas. For the extreme combination of high rock mass permeability and high groundwater head (near Ortigalita fault and nearby San Luis Reservoir), temporary heading inflows greater than 200 gpm could occur. According to available data of other geotechnical activities, groundwater inflows decreased significantly within several days. Groundwater inflows into this section of Tunnel 2 are anticipated to be similar.

Based on the information gained from construction of the Irvington and Arrowhead tunnels (water conveyance tunnels), it is expected that the proposed HSR tunnel construction will likely affect groundwater and surface water resources within a maximum distance of approximately 1 mile from the tunnel alignments, but with most effects occurring within 0.25 to 0.5 mile of the tunnel alignments (Authority 2020c). Most resources within 1 mile of the tunnel alignments are expected to experience limited effects and the effects on surface water would be indistinguishable when compared to natural variability. The groundwater and surface water resources that directly overlie or are near the proposed tunnel alignments are anticipated to have the highest potential to be affected by tunneling. Effects on surface water features are expected to be temporary, lasting months to years after the tunnels become watertight.

Surface water conditions and flows in Pacheco Creek and supporting tributaries are ephemeral and dependent on annual rains. Potential groundwater depletion due to tunneling is a high concern in areas where the tunnel route occurs directly underneath the surface water features that are also designated S-CCC steelhead critical habitat (though this is not to say groundwater depletion is not of concern along the rest of the route in the S-CCC recovery domain). Pacheco Creek and Pacheco Creek South Fork exist over proposed tunneling Stations 3480 to 3520. In this section, the Authority predicts that some heading inflows may be 200 gpm or more temporarily, until tunnel leaks are sealed. 1 cfs of flow is approximately 374 gpm, so most of the impact would be less than 1 cfs of groundwater flow. Therefore, even if 200 gpm directly translated into an equal depletion of surface water, at most a temporary deficit of 0.5 cfs would be expected to be experienced by the surface water in Pacheco Creek. This deficit amount would only be expected to negatively impact egg, alevin, fry, or juvenile survival if a dry year type had already caused surface water elevation to be critically low.

Given the ecology of S-CCC steelhead using this area, this potential amount of flow deficit would likely only have adverse consequences if redds containing eggs existed in the overlying waterbodies *and* surface water conditions were already experiencing low or critically low water year conditions. The most serious outcome of tunnel dewatering would be reduced water quality and flow conditions of incubating redds with developing redds or alevins, which would lead to increased embryo/fry mortality and decreased production potential for the Pacheco Creek population. Outcomes for emerged fry to adult S-CCC steelhead could range from temporary displacement from the critical habitat to entrapment in pooled areas, depending on the extent of surface water draw down. Supplemental water with suitable water quality parameters may be sufficient to avoid redd failure, while fish capture and relocation (fish rescue) could be employed to avoid mortality to other S-CCC life stages. To further reduce the risk to species such as steelhead that may be using surface water during critical and sensitive life history periods, the Authority proposed AMM-GEN-18, which is to prepare and implement a groundwater adaptive management and monitoring program (GAMMP) prior to, during, and after tunnel construction. NMFS would be included in the program review and receive updates from the GAMMP, which aims to monitor and detect changes to groundwater before consequences manifest to overlying biological resources. The GAMMP will establish baseline groundwater and surface water hydrology conditions and the Authority will use these data to develop a model to predict if and how groundwater and surface water impacts are likely to occur.

In conjunction with the GAMMP monitoring, the Authority has also proposed to remediate adverse effects of tunneling on habitat function if the GAMMP detects deficiencies in surface waters that would lead to adverse effects to listed species. Specifically, supplemental water would be secured and made available to make up for any deficits in surface waters, according to a Pre-Tunneling Supplemental Water Provision Plan. The quality of the supplemental water would be determined in the Pre-Tunneling Plan and established considering the life history needs of the species present and typical baseline conditions for the given season and water year (Authority 2020a), including considering temperature, pH, and dissolved oxygen requirements. NMFS would receive regular reports on the surface and groundwater conditions as tunneling progressed.

The Authority proposed to discharge treated groundwater inflows back into receiving waterbodies. This would provide opportunities for water to percolate back into the water table, recharge downstream aquifers, and offset potential downstream reductions in groundwater levels and stream flows. Additionally, the Authority would consider using the treated effluent from the active treatment system to provide supplemental non-potable water as needed based on construction monitoring and adaptive management triggers, but only if the effluent meets appropriate water quality standards for the end use of the water. Providing adequate levels of water quality treatment to meet water quality standards for discharges into receiving waterbodies or reuse as part of the adaptive management program is expected to be challenging due to high pH levels associated with exposure to cement grouts and concrete as well as other construction materials in the interior of the tunnels. To meet water quality standards for beneficial reuse, settling ponds, storage tanks, and a series of treatment systems may be necessary. Only treated groundwater that meets appropriate water quality standards, as outlined in the GAAMP in coordination with the applicable resource agency, would be beneficially reused or discharged into receiving waterbodies.

While extent of water drawdown is not completely predictable at this time, groundwater resources are expected to recover from any tunneling effects by being recharged by natural precipitation. However, recharge could take months to years after the final tunnel lining system is installed, and there is a very low probability that groundwater and surface water hydrology could be permanently altered to the detriment of S-CCC steelhead. As such, the Authority proposes to compensate for this loss of habitat if it is determined through direct monitoring or data interpretation that substantial disruption (i.e., loss of 0.5 acre or greater) to habitat supporting special-status species has likely occurred during or after construction of the tunnel, and that habitat restoration efforts did not achieve success criteria or that such restoration was determined unfeasible.

Another effect of tunneling or excavating underground considered is the vibration from the operation of the tunneling machinery. The operation of the TBM will create vibrations that could propagate through the substrate and into the water column, which could affect steelhead if present in overlying waterbodies concurrent with tunneling excavation. Caltrans (2015) does not report any source levels associated with tunneling, but National Grid (2018) does report underwater sound levels in the water column immediately adjacent to an operating TBM. The reported sound levels there are 178 dB peak and 175 dB RMS. Therefore, it is assumed the TBM would generate continuous sound disturbance similar to a vibratory driver. As such, injury and accumulative effects would not be anticipated but, assuming that these source levels were measured at 10 meters from the TBM, the 150 dB RMS behavioral criterion would be exceeded within 464 meters of the TBM and steelhead using the waterway would alter their normal behaviors, including leaving the area or sheltering in place and experience elevated stress levels until TBM operations underneath the waterway ceased

In summary, tunneling may have adverse consequences to S-CCC steelhead that use the Pacheco Creek watershed. There may be temporary deficits in the surface flow of overlying waterbodies that could negatively affect the survival of sensitive early life stages of S-CCC steelhead if tunneling dewatering occurs at the same time S-CCC steelhead are using the waterbodies. However, after considering the information provided on prior tunneling efforts in the region and, assuming that groundwater outflows will be similar, and evaluating the Authority’s proposal to offset any measureable decreases in available surface water with supplemental water of sufficient quality the surface water reductions, changes in surface flows would be expected to occur for no more than two years, as the tunnel will be sealed as track/tunnel progress is completed and, would be expected to result in a less than 1 cfs deficit, if measureable at all after supplemental water is released. The groundwater tables are expected to return to normal levels quickly, based on data from past tunneling projects that occurred locally, and therefore no lasting impacts to the S-CCC steelhead population are expected due to tunneling, nor is it expected that tunneling will change the functionality of the designated critical habitat of Pacheco Creek in the long-term. During TBM and excavation operations under S-CCC waterways, behavioral changes and physiological stress are expected as the machinery creates vibrations similar to those of vibratory pile driving, while operations are ongoing and during the period when fish are using the waterways. Adverse effects from beneficial groundwater recharge from tunnel dewatering are not expected because flows ultimately discharged to surface waters containing S-CCC steelhead would be closely monitored to ensure the discharged waters meet strict water quality standards that would not be expected to harm steelhead.

2.5.1.7. Curing new concrete

The pouring of new concrete may negatively affect water quality by increasing the pH of water in contact with curing surfaces, though the amount the curing cement will increase pH in water decreases over time as the concrete cures. These pH changes can affect fish to varying degrees through direct damage to gills, eyes, and skin, and interfere with fishes' ability to dispose of metabolic wastes (ammonia) through their gills (Washington Department of Fish and Wildlife 2009). In addition, alkali may leak from freshly cast concrete for some time after curing if in contact with water, up to several days to months depending on the water in the water-cement ratio of the mix (CTC & Associates 2015).

Because the casting and curing of concrete will be done "in-the-dry," the potential that the curing concrete will adversely affect water quality and fish health is greatly reduced. New concrete is expected to mature and be practically inert within six months after casting, but it is possible that raised river heights caused by rain in the months following project completion may cause water to be in contact with the concrete before curing is complete. The relatively larger amount of stream volume expected when the concrete is in the last stages of maturing and is in contact with raised water levels is expected to dampen any potential changes in pH of stream water from contact down to immeasurable differences due to volumetric dilution, even if listed fishes are present while the cement is still precipitating alkali. Therefore, adverse effects to steelhead from chemical changes from new concrete are not expected to occur. Once the concrete is completely cured and chemically inert, potential pH changes are expected to cease.

2.5.1.8. Vibration and noise from HSR train operations

Once the California HSR system is completely constructed and regular ridership commences complete with regular schedules, trains running on the viaducts and tracks may disrupt normal fish behavior due to the noise and vibration that comes from high speed operation of the rolling stock and passenger cars. Japan's Shinkansen HSR is reported as running up to thirteen trains in each direction at peak hours with (Central Japan Railway Company 2019), sixteen cars in tow each (likely out of the major metropolitan hub of Tokyo, Japan). While it is currently unknown if the California HSR system will eventually run as many trains as the Shinkansen system per hour over CCC/S-CCC steelhead habitat waterways, it is expected that daily disturbance due to the train's schedule could occur often throughout the day and night once the system is in operation.

Quantification of the effects of HSR systems on aquatic organisms or fish is lacking, however it is generally accepted that transportation noise pollutes aquatic and marine environments (i.e. ship traffic in waterways and automotive and rail traffic over bridges permeating into the aquatic environment (Popper and Hastings 2009, Martin and Popper 2016, Pavlock McAuliffe 2016, Hawkins et al. 2017)), and that HSR systems regularly cause disturbance to human residents that live in close proximity to tracks in operation (Yokoshima et al. 2017), therefore disturbance to fish utilizing habitat under viaduct crossings is similarly expected. Studying fish responses to varying levels and types of transportation/disturbance sounds have produced unclear results (Federal Railroad Administration 2012), however, it can be assumed that due to the speed, wind shear, and vibrations that will be associated with the HSR operations (Hunt and Hussein 2007), fish will be startled as engines and passenger cars pass overhead throughout a 24-hour period. A study of ambient noise in large rivers with variously-sized bridges carrying both automotive and train (passenger or freight was not specified) overhead (Vracar and Mijic 2011), observed a maximum is at 22 hertz (Hz) with a mean level of 95 dB approximately 3-5 kilometers from the bridges, roads, and railways at the most comparably-sized river. While the waterbody sizes in this study were different than the areas being analyzed in this opinion, the trains running overhead in the study would likely be louder than the HSR system, and the measurement was taken from quite a distance away from sources, it offers insight into the expected maximum impact to the underwater sound environment from regular HSR operations, which are expected to be much quieter.

There are some mechanisms the Authority can incorporate to dampen operational vibration and sounds that transmit down the columns into the river channel and water column, but it is currently undecided which if any dampening tactics will be used and to what degree they will be incorporated into the track design (Authority 2019c, d). Adult steelhead that are temporarily startled by vibrations or sound are expected to leave the immediate area, moving either upstream or downstream. This would alter their migration and holding patterns. Juvenile steelhead are also expected to be startled and alter their migration patterns, and their foraging and resting behaviors. An unwarranted startle response would make juveniles susceptible to attack from piscivorous predators and increase their risk of mortality. Adverse effects associated with noise and vibration from train operation are expected to persist in perpetuity, as long as the HSR system is in operation.

2.5.2. Consequences to critical habitat

2.5.2.1. Site preparation and vegetation removal

Site preparation is required and will likely occur early in the seasonal near-water work window periods (April 30 onward) and will include pre-construction surveys, sensitive habitat identification, the installation of exclusionary fencing, and other similar BMPs intended to minimize impacts to natural habitats. Site preparation will also include earth moving, leveling, slope grading, excavation, road installation, and relocation or installation of HSR utilities. In the process of preparing the site for major construction, riparian vegetation and trees may be trimmed or removed for construction access and permanent structure placement. The consequences to individual fish from general construction activities near waterways is discussed above in section 2.5.1.1; this section will analyze the consequences of vegetation removal from site preparation and construction on the functionality of the critical habitat impacted by these activities.

The expected decreases in riparian vegetation will create physical changes in the habitat, which are expected to cumulatively decrease the survivorship of juvenile steelhead that use the area (Bjornn and Reiser 1991). Changes in vegetative cover can influence the macroinvertebrate prey assemblage, through alterations in shading, water temperatures, and nutrient inputs, to one less supportive of juvenile growth (Meehan et al. 1977). Removal of riverine vegetation will also reduce the natural cover that was previously available on site and reduce the general habitat complexity that would otherwise be beneficial to rearing steelhead’s growth, survival, and eventual migration out of freshwater. Particularly, at major overcrossings #5 through 8, riparian vegetation removals would decrease habitat complexity in stretches of streams that are already relatively sparsely covered due to long-term anthropogenic modifications and urbanization. Removing riparian trees also removes potential sources of large woody debris input over the long term, a legacy issue for critical habitat in the action area.

The Authority proposes to replace all removed vegetation with native plants on-site to resemble the existing community and to use 'soft' approaches to bank erosion where feasible, including vegetative plantings in bank stabilization efforts. Though the Authority has proposed to replant the disturbed areas with native riparian species (plan forthcoming, anticipated at a higher ratio than what was removed), there will be temporary reductions of vegetative cover at all crossing construction locations until the plantings establish and flourish. The period of reduced riverine vegetation functionality will begin when site preparation commences and will persist for several years while construction is ongoing, until replanting occurs. The replanting will likely take at least one year to execute, and it will be several years to decades until the vegetation matures to the pre-disturbance state, depending on the age of the trees removed. During this lengthy interim, juvenile steelhead are expected to experience reductions to their individual fitness due to these habitat changes. After the disturbed areas are fully restored with native plantings and 'soft' bank stabilization methods, there is potential for the critical habitat to be of greater complexity and functionality than its current baseline status, in some of the more degraded areas.

2.5.2.2. Installing hard armoring and bank/slope stabilization measures

Riprap/revetment will be placed into some stream banks throughout the action area, and several large slopes will be permanently stabilized near Pacheco Creek, to protect and secure the HSR tunnel portals, viaduct column footings, access roads, and other structures placed in stream channels within the OHWM or floodplain areas. As previously stated, "soft" approaches which incorporate vegetative plantings and large woody debris into the stabilization and revetment designs will be used to the extent possible. A combination of both tactics will likely be used at each site to maintain a more natural riparian corridor and maintain or increase steelhead habitat functionality, while ensuring bank and slope stability.

The consequences of installing bank armoring and slope stabilization on individual fish is covered under the discussion of general construction effects, as described in section 2.5.1.1. Once installed, hard revetment or riprap on stream banks removes the marginal shallow water habitat at the water/bank interface that provides refugia for rearing steelhead due to its shallow water prism, reduces the total amount of riparian vegetation that could be established in the future through physical occupation, changes the prey base through alteration of the benthic substrate type and local water dynamics, and often provides ambush habitat for non-native piscivorous fishes which are attracted to artificial hard surfaces with stark shading (Tiffan et al. 2016). In addition, the act of bank stabilization is expected to prevent normal stream processes from occurring, like natural stream braiding and erosion processes, which would otherwise create the habitat complexity that supports rearing salmonids and provide gravels for spawning or host prey species. Instead, the placement of any riprap or revetment is expected to perpetuate the channelization and homogenization of affected streams into the future. Therefore, the habitat changes that follow placement of the riprap is expected to have a negative impact through alteration of freshwater rearing habitats of juvenile CCC and S-CCC steelhead and will likely decrease their survivorship and growth in the area (Knudsen and Dilley 1987, Fischenich 2003).

Major slope stabilizations near Pacheco Creek will remove the possibility of those sediments gradually eroding and becoming a source for gravels in Pacheco Creek used by S-CCC steelhead. This will be detrimental to rearing habitat PBFs, because stream sediments are habitat for macroinvertebrate prey necessary to support juvenile growth, and to spawning habitat PBFs through removal of a portion of the source of spawning gravels in Pacheco Creek. However, the size of the permanent slope stabilization (though a large public work at a human scale) is relatively minor compared to the amount of area still available to contribute gravel upstream for natural erosion processes and gravel supply to this watershed, it is not anticipated that the slope stabilizations will have a measurable effects on the sediment type, size, or amount available to S-CCC steelhead critical habitat PBFs in Pacheco Creek.

2.5.2.3. Placement of permanent HSR structures and associated shading

At least eight major overcrossings would be constructed or modified as part of the proposed action, spanning waterways and stream channels used by CCC and S-CCC steelhead and hosting their designated critical habitat, in perpetuity. Some overcrossings are new structures, while others may utilize or retrofit existing railroad bridges in a blended service pattern or completely replace existing overwater crossings to become dedicated HSR structures. The crossings span, at the smallest, at approximately 100 feet in length and 80 feet in width, and, at the largest, 450 feet in length and 430 feet in width. Estimates indicate the structures would cover approximately 0.13 acres up to 2 acres of steelhead habitat at each overcrossing, for an approximation of a little less than 1 acre of habitat covered by HSR structures at each major crossing location, directly covering at total of 6.56 acres of steelhead habitat, including spawning habitat, rearing habitat, and migration corridors depending on location.

Overwater structures affect the amount of light that reaches the water column and the bottom of a streambed, which limits or prevents riparian and aquatic plant growth underneath and around the structure due to shading. Introduced shade has cascading effects on the benthic ecosystem immediately underneath the structure. This changes the type and amount of prey available to rearing juvenile steelhead that use these areas. Also, the shade created by artificial structures is drastic or sharp compared to that cast by overhanging vegetation (i.e., low and wide structures create stark high light and low light areas in the water column/substrate, versus the gradual and diffuse shading created by tree leaves). Predators are likely to hide in the shadowed areas to ambush prey, such as juvenile salmonids, coming in from bright light areas with greater success compared to predators not hiding in stark shadows (Helfman 1981). In some cases, overwater structures can serve as novel roosting or nesting for piscivorous birds (PFMC 2014), however at this time avian predators are not a notable source of mortality for juvenile salmonids in the recovery plans for the Santa Clara basin (NMFS 2013, 2016c, d). Therefore, the localized shading below the overhead crossings will cause negative changes to the rearing habitat PBFs in ways that are expected to reduce the overall fitness and survivorship of juvenile steelhead that must use the waterways.

The footings of the support columns of the HSR viaduct crossings will also permanently and physically occupy riparian and floodplain habitat due to their placement in these natural areas, though the Authority has designed the viaduct crossings to avoid placement in the active water channels to the extent practicable. While most of the support columns and footings will not be in water during normal flow conditions, during periods of flood flows or a wetter than average water year, the column footings are likely to interact with the stream flow as water levels rise. These structures will create a new source of water turbulence as they interact with the flows, and affect the water velocities steelhead will experience while using the areas under the viaduct crossings. In addition, the change in hydrodynamics around the hard artificial structures has the potential to create abnormal erosion and sediment deposition rates upstream and downstream from the supports and footings (Oregon Water Resources Research Institute 1995). Since Pacheco Creek hosts steelhead spawning habitat (i.e., available gravel), the area is also expected to provide suitable habitat for the benthic macroinvertebrate prey of rearing steelhead (Merz 2001, Merz and Ochikubo Chan 2005). Therefore, scour around these footings may remove or alter the local gravel beds and deposits, degrading PBFs of juvenile rearing habitat and adult spawning habitat.

The Authority has proposed to offset the occupational footprint of the viaducts over riparian habitat used by steelhead through compensatory mitigation (CM-FISH-1, discussed below in section 2.5.1.7). To reduce the overall impacts to channel dynamics from permanent structures, AMM-FISH-1 identifies that:

- The design-build team will minimize, to the extent feasible, the placement of footings and columns within the active channel (between top of bank) of steelhead critical habitat.
- The Authority will coordinate with NMFS and the USFWS and request review of design between approximately 75 and 90 percent design completion.

To address scour and sedimentation impacts, proposed AMM-GEN-46 also identifies that:

- Piers will be oriented parallel to the expected high-water flow direction to minimize flow disturbance.
- Engineering analyses will be conducted on the channel scour depths at each crossing to evaluate the depth for burying the bridge piers and abutments. Implement scour-control measures to reduce erosion potential around the piers and abutments.
- Bedding materials will be placed under the (revetment) stone protection at locations where the underlying soils require stabilization to prevent winnowing of soils as a result of streamflow velocity.

There is also a possibility that overwater HSR crossing structures may require nighttime lighting for operational safety reasons. It is likely that both juvenile steelhead and piscivorous predators will be attracted to night lighting in waterbodies in which they co-occur, degrading the value of rearing and juvenile migration PBFs in the area by concentrating predators and increasing the risk of mortality to individual juvenile steelhead over time at lighted locations.

Adverse effects to CCC and S-CCC steelhead critical habitat PBFs, especially to those necessary for juvenile fitness, are expected to occur due to the placement of permanent structure in and over waterbodies hosting steelhead spawning, rearing, and migration habitat and these adverse effects will persist as long as the structures remain. These long-term adverse effects are expected to be largely remedied by incorporating plantings and large woody debris in nearby bank stabilization structures, or by installing fish habitat in the form of large woody debris such as root wads near pier footings to provide juveniles with escapement cover.

2.5.2.4. Installation of culverts and wildlife crossings and implications for PBFs of migration habitat

Several HSR crossings and proposed wildlife crossings will require the use of culverts or box culverts over CCC/S-CCC steelhead waterways; the project section is expected to require the use of twelve culverts according to the BA. While also causing the same adverse effects to critical habitat described above in connection to the placement of artificial structures and bank stabilization, modifications to confine and redirect streambeds like culverts also have the potential to restrict or prevent the movement of steelhead, affecting migratory corridor PBFs. Adverse impacts on the connectivity between spawning areas, rearing habitat, and estuarine rearing habitat will have adverse consequences for all life stages and therefore on the recovery potential of the populations that use affected waterways. Urban development and the associated implementation of transportation projects and railroad bridges are specifically listed as a threat to CCC steelhead through habitat modifications in their recovery plan (NMFS 2016d).

AMM-GEN-27 addresses HSR effects on wildlife movement, including influences of culverts and bridges on steelhead passage and migration corridors. While balancing the needs for terrestrial species to pass through the wildlife crossings on a dry portion of the crossing width, the CM proposes to use native earthen bottoms, avoidance of using artificial lights to wildlife crossing approaches, and that culverts and bridges within steelhead habitat replaced or modified by the proposed action will meet CDFW (2004) and NMFS (2011) fish passage requirements and be developed in coordination with NMFS staff (Authority 2020a). Because the culverts and box culverts are designed and constructed with technical assistance from NMFS as proposed, adverse impacts on migratory PBFs are not anticipated. Furthermore, more detailed culvert and box culvert designs would be required to enable analyses on passage conditions at different flow amounts, and additional incidental take coverage would be required if NMFS found that fish passage was restricted by the culvert designs selected.

2.5.2.5. Impacts from HSR system operation over time

General HSR System Operation

Currently, the state of California's electricity grid would power the HSR system, and is expected to require less than 1% of the state's future projected energy demands (Authority and FRA 2018). Because the power supplied by California's electricity grid is not necessarily from 100% renewable clean energy sources at this time, the Authority will instead obtain the quantity of power required for the HSR system by paying a clean-energy premium for the electricity consumed, with a goal of a net-zero rail system (Authority 2019b). Renewable energy sources such as sun, wind, geothermal, and bioenergy are cited as options. Over time, use of such renewable sources would be expected to decrease the amount of carbon released into the atmosphere; however, if hydropower was utilized, the perpetuation of greenhouse gas release from reservoirs could be considered an adverse effect of the HSR system (Deemer et al. 2016). Additionally, reliance on hydropower for electricity would likely be further linked to the decline of salmonids in California as dams continue to block salmonids from a majority of their spawning and holding habitats (NMFS 2013, 2014, 2016c, d), as well as controlling and adversely altering the water flow and water temperature regimes downstream. Since hydropower is not cited as a possible renewable energy source for the HSR system, it is not expected that the creation of the electricity used to power the high speed trains will cause adverse effects to listed salmonids or their designated critical habitat beyond baseline conditions.

Operational Pollution and Stormwater

While the HSR system is a passenger train designed to run on electricity and will not carry any cargo composed of hazardous material (Authority and FRA 2018), other sources of pollution are still expected to occur. While the exact vehicle type has not been selected, the HSR will use electronic propulsion power supplied by an overhead system on a steel-wheel-on-steel-rail track. Such systems are widely regarded as one of the least polluting transportation systems available, with the Japanese Shinkansen touting 1/8 to 1/12 the carbon emissions per passenger as an airplane for the same distance (Central Japan Railway Company 2019). However, all trains and machinery require lubricants that release PAHs, and the braking system will also release heavy metals and other compounds during breaking as the breaking pad materials are worn down and degraded by use (Brooks 2004, Burkhardt et al. 2008, Bobryk 2015, Levengood et al. 2015). Therefore, train operations are expected to contribute low-levels of heavy metals such as zinc, copper, lead, nickel, manganese, chromium, and iron to the environment immediately near tracks, and most studies indicate that the concentration of these metals and PAHs increases drastically at station platforms and at maintenance yards (Bukowiecki et al. 2007, Wilkomirski et al. 2011, Wilkomirski et al. 2012).

The Authority proposes to capture all stormwater runoff from created impervious surfaces (Authority and FRA 2018, Authority 2020c). In other sections, all stormwater runoff created by the HSR system, including the tracks, support structures, maintenance facilities, stations, passenger parking lots, and ROW access roads will be redirected as sheet flow into adjacent drainage systems or swales to infiltration basins designed as water quality control measures. No runoff from the proposed action will be directly discharged to any surface water body, including runoff from bridges, overpasses, underpasses, and aerial structures. The Authority is implementing LID designs and other stormwater BMPs to manage and treat stormwater and protect water quality as it leaves HSR station and passenger parking lot areas. Measures may include vegetated stream setbacks, vegetated buffer zones, tree planting and preservation, and/or vegetated swales (bioswales), in accordance with the Phase II Small Municipal Separate Stormwater Permit (State Water Board Order 2013-0001-DWQ). In addition, there are some studies that suggest that the green spaces created by railway ROW can be beneficial habitat for wildlife when not disturbed by regular railway operations (Lucas et al. 2017).

The exact stormwater control and treatment designs are still forthcoming, but due to the high degree of stormwater management attention in the BA (Authority 2020c), in addition to (Authority 2019g) public stormwater outreach efforts and LID stormwater control design plans in past documents (Authority 2012), it is anticipated the Authority will adequately control and treat all transportation pollution created by operation of the HSR system before discharge. Therefore, it is not expected that steelhead water quality or water quantity PBFs in critical habitat will be degraded or adversely affected through the introduction of heavy metals, PAHs, tire wear particles, and other general transportation pollution created or introduced by the project. In addition, it is expected that the HSR system will decrease the amount of passenger vehicles driving between the California Central Valley and the Santa Clara/San Jose Bay Area serviced by the system; therefore, overall transportation pollution that stormwater carries into adjacent waterways may decrease over time as HSR ridership increases and vehicular use decreases, potentially improving water quality over time.

HSR System Maintenance

As with any major transportation or infrastructure system that provides a service to the public, the Authority will perform regular structural, erosion, and disaster (flood, fire, and earthquake) safety checks to ensure the integrity of the tracks and support columns of the HSR system. Such protocol formations are in their infancy, and draft plans are not available to review, however it is assumed that some safety checks will be performed on these viaduct crossings and require personnel to be in close proximity to the river channels, and possibly require putting personnel or equipment in water. NMFS expects that the Authority will be in contact with staff when draft safety check protocols are available so that a determination can be made regarding listed salmonid interactions with Authority staff and actions at that time.

Similarly, it is expected that vegetation control near HSR tracks and column footings will be required in the future. Vegetation control plans and protocols have not been drafted, but these activities would likely include manual removals, such as trimming and “weed whacking”, and also some forms of herbicide application. If vegetation control is required in the riparian corridor, in floodplain habitat, or near waterways containing listed fish, the Authority will need additional ESA section 7 consultation with NMFS to ensure adverse effects to steelhead critical habitat are minimized and incidental take coverage is obtained prior to the commencement of such activities.

Catastrophic Accidents

A catastrophic derailment of the system while running is possible and a crash from a viaduct would certainly affect the immediate riparian environment around and below the accident, if a derailment were to occur while crossing a waterway. However, rigorous safety testing, which will occur before passenger trips commence, and many safety protocols will be followed during regular operations, so a derailment occurring at all is extremely unlikely. The comparative Japanese Shinkansen system has been in operation since 1964 and has no record of fatalities, injuries, or derailments (Sim 2017), despite some lapses in inspection protocols and material vetting before an oil leak was discovered and resolved on December 11, 2017. However other HSR systems have experienced crashes or derailments, such as the Santiago de Compostela rail disaster in 2013, the Wenzhou train collision in 2011, and the Eschede train disaster in Germany in 1998 (Wikipedia 2019). Compared to the total number of HSR systems in operation worldwide and the number of their lines and daily trip schedules, and their overall safety record, the occurrence of a derailment or catastrophic crash in the California HSR system would be is not expected to occur.

2.5.2.6. Compensatory Mitigation

As part of their proposed action, the Authority has proposed replanting and restoring habitat areas disturbed temporarily by HSR system construction, including augmenting or improving steelhead habitat as part of the project design whenever feasible. However, spawning, rearing, and migratory PBFs of steelhead habitat, including some in CCC/S-CCC steelhead designated critical habitat, will be permanently occupied by HSR structures, permanently over-shaded by HSR structure, or otherwise permanently modified in adverse ways by HSR actions. Also, some minor tributaries, canals, and other waterbodies (not part of designated critical habitat) are proposed to be permanently removed for the proposed maintenance facility and at sites subject to extensive cut-and-fill activities for slope stabilization. These waterbodies that are proposed for permanent removal only include areas that S-CCC steelhead may potentially use for rearing if sufficiently inundated in years with above average rainfall. Some of the waterbodies proposed for permanent removal are engineered agricultural discharge channels and stock ponds, and though several are ephemeral tributaries to steelhead creeks, these waterways do not contain rearing PBFs of good quality and are largely unsuitable or undesirable for steelhead use. Permanent removal of waterbodies will result in all current habitat functions supported by those waterbodies, and any future potential habitat functions, being lost. Removal of these waterbodies is not expected to have a measureable effect on PBFs associated with water quantity downstream because is not expected to alter flow patterns or water availability in the main designated critical habitat stream channels, as rain water entering the watershed will either enter the creeks through another pathway or infiltrate to the groundwater table, which will also maintain the surface water flow. The Authority proposes compensatory mitigation for the permanent removal of waterbodies accessible to adult or juvenile steelhead.

Table 5. S-CCC steelhead habitat amounts estimated to be impacted by the project (acres rounded from provided data, CH = designated critical habitat).

Habitat Impact Type	Vegetation Removal (acres)	Dewatered or Benthic/Streambed Disturbance (acres)	Permanent Artificial Structures (acres)	Total Impacted Acreage
Temporary Impacts to CH	22.57	18.95	0.44	41.96
Permanent Impacts to CH	22.28	1.67	8.61	32.56
Impacts to Other Steelhead Habitat	0.11	1.73	3.49	5.33

Table 6. CCC steelhead habitat amounts estimated to be impacted by the project (acres rounded from provided data, CH = designated critical habitat).

Habitat Impact Type	Vegetation Removal (acres)	Dewatered or Benthic/Streambed Disturbance (acres)	Permanent Artificial Structures (acres)	Total Impacted Acreage
Temporary Impacts to CH	0	0	0	0
Permanent Impacts to CH	0.18	0	0	0.18
Impacts to Other Steelhead Habitat	1.46	1.21	0.90	3.57

Based on the steelhead model developed by the Authority and designated critical habitat layers, 32.56 acres of permanent impacts and 41.96 acres of temporary impacts will occur to S-CCC steelhead designated critical habitat, with an additional 5.33 acres of permanent and temporary impacts to habitat accessible to S-CCC steelhead but not included in the critical habitat designation for the DPS (Table 5). And based on the steelhead model and designated critical habitat layers, 0.18 acres of permanent impacts will occur to CCC steelhead designated critical habitat, with an additional 3.57 acres of permanent and temporary impacts to habitat accessible to CCC steelhead but not included in the critical habitat designation for the DPS (Table 6). The Authority proposed CM-FISH-1 in which it would provide compensatory mitigation that is commensurate with the type of habitat affected (spawning, rearing, migratory, or critical habitat) and the amount of habitat lost in the following ratios (Authority 2020a). For spawning aquatic and riparian habitat within critical habitat, offset would be provided at a minimum 3:1 ratio (protected: affected); for all rearing and migratory aquatic and riparian habitat within critical habitat offset would be provided at a minimum 2:1 ratio (protected: affected), and for all other rearing and migratory aquatic and riparian habitat outside critical habitat offset would be provided at a minimum 1:1 ratio.

Unless agreed upon in coordination with NMFS, compensation would occur within the same DPS domain as the impact was incurred. Where feasible, on-site, in-kind mitigation would be prioritized. Off-site mitigation would prioritize actions recommended in local or regional conservation plans where there is coordination and approval by NMFS.

The Authority estimates that this section of the HSR project incurs approximately 42 acres of mitigation need (31 acres of spawning, rearing, and migratory habitat and 11 acres of potential migratory and rearing habitat) (Authority 2019a).[2] However, if less habitat acreage is impacted through complete avoidance through design/route decisions, or if on-site habitat restoration, rehabilitation, or augmentation was incorporated to a degree that maintained or enhanced

[2] The total estimated mitigation need of 42 acres is the sum of area where there would be permanent impacts to critical habitat and impacts to other steelhead habitat, without areas where there would be temporary impacts to critical habitat. The areas where there would be permanent and temporary impacts to critical habitat mostly overlap.

steelhead habitat functionality to pre-project condition or better, then the total amount of acres incurring mitigation need would be reduced.

As described in section 1.3.5 of this opinion (Proposed Federal Action/Compensatory Mitigation), since there are no NMFS-approved mitigation banks that offer steelhead or appropriate habitat type credits that also include the action area of the project within their service areas, and there is currently no in-lieu fee program that could provide credits suitable to offset impacts to coastal steelhead, the Authority expects to conduct permittee responsible restoration to offset unavoidable impacts to steelhead and their habitats (Authority 2019a). However, the pCMP describes potential mitigation at all of the sites described there as opportunities for habitat preservation, restoration, rehabilitation, and enhancement. The pCMP has not selected any site(s) on which the Authority proposes to mitigate impacts to steelhead habitat, nor has the pCMP described what specific actions the Authority proposes to mitigate impacts to steelhead habitat because it is unclear on which site(s) the Authority proposes to mitigate impacts to steelhead habitat, nor has the pCMP described when the Authority proposes any such actions would occur.

When any of these compensatory mitigation options are undertaken and implemented in full, NMFS expects these actions to have temporary adverse effects and permanent beneficial effects to S-CCC steelhead. Offset options still need to be identified for the CCC steelhead DPS. However, there is not enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze what temporary adverse effects are expected to occur as a consequence of that component. Nor is there enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze the expected relevance of any beneficial effects of that component to the listed steelhead and critical habitat that would be adversely affected by other components of the proposed action. Nor is there enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze the expected reliability and effectiveness of any beneficial effects of that component. Nor is there enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze whether there would be any potential delay between the expected adverse effects of other components of the proposed action and the expected beneficial effects of the compensatory mitigation component. In the future, when a site(s) for compensatory mitigation is confirmed and additional information about the proposed compensatory mitigation is available, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center's programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Human population growth in the action area will put increasing pressure on listed species and their habitats, as larger populations will require construction of new roadways, electric power generation facilities, utilities, schools, hospitals, and commercial and industrial facilities. Projections show that the populations of Santa Clara, San Benito, and Merced Counties will continue to grow at an average of 2 percent per year. By 2040, projections show that the population in each county will increase to 371,111, 75,941, and 2,403,756, respectively, which is a net increase of approximately 30 percent per county from 2020 (California Department of Finance (CDOF) 2016).

Urbanization primarily results in the conversion of agricultural, range, or natural lands to developed lands for housing, commercial, or governmental purposes. Urbanization effects on natural areas include habitat loss, degradation, and fragmentation, which leads to declines in overall habitat functionality. The loss of habitat occurs incrementally as urbans areas grow outward. The quality of remaining habitat at the edge of urban areas is degraded by pets (e.g., dogs and cats); the increased presence of humans; invasive species; and increased noise, light, and non-point source pollution. Development associated with urbanization can alter or block wildlife movement, impair typical behavioral patterns, and reduce food resource availability. Habitat loss and degradation can result in the reduction of food resources and breeding opportunities, which can then decrease survivability and make local populations more vulnerable to stochastic events.

Urban and suburban environments also affect an area’s hydrology, water quantity, and water quality. Development leads to the rerouting, straightening, and hardening of creeks, streams, and rivers. The hardening of previously pervious land cover types can increase peak flows during storm events and cause erosion. Development also brings an increase in non-point source pollutants such as trash, oil, gasoline, and chemical fertilizers and pesticides.

A primary concern for steelhead in the area is that the stormwater volume and contaminant load from impervious surfaces is likely to increase following HSR build-out, despite the Authority planning on treating all of its stormwater prior to discharge, because of the urban development expected to be associated with the project. Pollutants become more concentrated on impervious surfaces until either they degrade in place, or are transported via wind, precipitation, or active site management to another location. Stormwater runoff delivers a wide variety of pollutants to aquatic ecosystems, many of which are not listed by the EPA or SWRCB, so discharge of such pollutants often goes unregulated and uncontrolled. Increased urbanization of streams generally leads to decreases in the health and abundance of aquatic species (Hecht et al. 2007, Sandahl et al. 2007, Scholz 2011, McIntyre et al. 2012, McIntyre et al. 2015, Closs et al. 2016, Feist et al. 2017), including the abundance and health of salmonids of various species, both directly and indirectly through habitat effects. Most recently, mass mortality events of pre-spawn adult coho salmon have been linked to a vulcanization agent found in tire wear particles introduced to waterways through urban stormwater inputs that include road runoff (Scholz 2011, Spromberg et al. 2016, Feist et al. 2017, Tian et al. 2021), and this toxicant likely has similar implications to other salmonid species as well (McIntyre et al. 2018).

Post-construction stormwater runoff often picks up a variety of pollutants from both diffuse (nonpoint) and point sources before depositing them into receiving water bodies (EPA 1993). Constituents may include, but are not limited to: fertilizers, herbicides, insecticides, and sediments (landscaping/agriculture); oil, grease, PAHs, and other toxic compounds from motor vehicle operations (roads and parking lots); pathogens, bacteria, and nutrients (pet/dairy wastes, faulty septic systems); toxic metals and metalloid like aluminum, arsenic, copper, chromium, lead, mercury, nickel, and zinc (from building decay, manufacturing or industry byproducts); and the atmospheric deposition onto impervious surfaces from other surrounding land uses (manufacturing industry, freight and trucking exhaust, agriculture field treatments). Therefore, stormwater pollution created by local urban development associated with HSR station placement may be more likely to have a greater impact on aquatic life in receiving waterbodies than the stormwater output of the HSR project itself, since stormwater impacts directly associated with the HSR project will be more carefully planned and monitored compared to these non-federal actions.

Fish exposure to these ubiquitous pollutants in the freshwater and estuarine habitats is likely to cause multiple adverse sublethal effects to steelhead and salmon, even at pre-project, ambient levels (Spromberg and Meador 2005, Hecht et al. 2007, Sandahl et al. 2007, Macneale et al. 2010, Feist et al. 2017). For instance, stormwater contaminants accumulate in the tissues of juvenile salmonids, acquired from contaminant accumulation in the tissues of their prey (bio-accumulation). Depending on the level of concentration, those contaminants can cause a variety of lethal and sub-lethal effects on salmon and steelhead, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Hecht et al. 2007). Predators of salmonids, like killer whales (*Orcinus orca*), harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californicus*), are in turn at risk of ingesting toxins that have bio-accumulated in their salmonid prey or are adversely affected in other ways by stormwater toxins, even when far removed from the area of exposure (Grant and Ross 2002, Mos et al. 2006, NMFS 2008b).

Even at very low levels, chronic exposures to those contaminants have a wide range of adverse effects on the ESA-listed species considered in this opinion, including:

- Increases in early development issues in gastrulation, organogenesis (exposure of adults, sub-lethal effects passed to resulting offspring) which lowers hatching success.
- Decreases in juvenile survival through reduction in foraging efficiency, reduced growth rates and condition index.
- Increased delay in, or issues occurring during smoltification (only in salmonids) rooted in anion exchange, thyroxin blood hormone, and salinity tolerance.
- Increases in mortality due to increased susceptibility to diseases and pathogens, and depressed immune-competence.
- Decreased survivorship due to increased predation, reduced predator detection, less shelter use, and less use of schooling behaviors.
- Changes or delays to migration patterns, use of rearing habitats, ability of adults to home to natal streams, and spawning site selection.
- Changes to reproductive behaviors that affect production, including altered courtship behavior, reduced number of eggs produced, and decreased fertilization success.

Data that quantify the exact sublethal effects of urban stormwater on steelhead and Chinook salmon are limited, which makes analyzing the effects of new or additional sources of non-point stormwater discharge on these populations difficult. It is reasonable, however, to conclude that stormwater that is not sufficiently treated coming from sources outside of the Authority's jurisdiction will cause persistent adverse effects to listed salmonids that are realized at a watershed/basin level.

Finally, some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (section 2.4).

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (section 2.5) to the environmental baseline (section 2.4) and the cumulative effects (section 2.6), taking into account the status of the species and critical habitat (section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1. Summary of Effects of the Proposed Action on Listed Species

Most adverse effects to CCC and S-CCC steelhead individuals analyzed in this opinion will occur during the construction and tunneling periods of the proposed action, and are expected to be short-term disturbances; disruptions of normal behaviors, migration, and habitat use; temporary decreases in survivorship probabilities; and for very few individuals of each DPS, a short period in which some fish may be injured or be killed during cofferdam dewatering, fish capture and relocation, and during in-water impact pile driving. There are at least eight major overcrossings across the landscape in the action area at which these adverse effects will occur, and a period of two to ten years during construction when the effects may occur at any one construction site. After construction is complete and the areas are rehabilitated with vegetative replanting and large woody material, adverse effects associated with construction are expected to cease. One continuing effect of operations of the HSR system will be the disturbance associated with running high speed trains over waterways containing juvenile steelhead. Rail operations are expected to disrupt individual juvenile behaviors in perpetuity and will slightly increase the risk of predation to those juveniles when escapement cover is not readily available, resulting in reduced survival at HSR crossings.

2.7.2. Summary of Effects of the Proposed Action on PBFs of Designated Critical Habitat

The implementation of the proposed action will unavoidably alter S-CCC and CCC designated critical habitat. The placement of permanent, artificial, impervious structures (bridges and viaduct overcrossing structures and their footings) over waterways and in spawning reaches, in rearing areas, and in the floodplain is expected to remove proportional amounts of critical habitat through spatial occupation, change the aquatic ecosystem structure below the structures due to shading, create ambush predator habitat, and degrade freshwater habitat functionality locally. These impacts will in turn reduce the fitness and survivorship of juvenile steelhead using rearing and migratory habitat PBFs at each site within the action area. The installation of project structures also precludes the potential for these riparian and floodplain areas from returning to a completely natural state in the future, though the Authority proposes to restore and replant the areas to the extent possible. Once the HSR system is operational, railway pollution and automotive pollution sourced from HSR properties and parking lots will be controlled and prevented from entering waters containing steelhead critical habitat PBFs through the incorporation of LID designs and effective stormwater treatment and control devices.

As described in section 2.5.2.6, Effects of the Action/Compensatory Mitigation, there is not enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze temporary adverse effects and permanent beneficial effects expected to occur as a consequence of that component. Therefore, we do not consider any effects expected to occur as a consequence of that component in our jeopardy and adverse modification conclusions in this opinion. In the future, when a site(s) for compensatory mitigation is confirmed and additional information about the proposed compensatory mitigation is available, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center's programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

2.7.3. Summary of Environmental Baseline

Pajaro River S-CCC steelhead are considered a Core 1 population (high/highest priority for recovery) while CCC populations in Coyote Creek and Guadalupe River/Los Gatos Creek are considered essential with a secondary priority rating for recovery. Current critical habitat conditions in the Pajaro River are considered poor because of previous land use conversions, old-growth forest logging, and water resource development associated with agriculture, urban and residential development, and most of the freshwater estuarine rearing habitat is gone. Similarly, CCC designated critical habitat conditions are poor or the functionality of remaining critical habitat is greatly reduced due to human modifications associated with water resource development for human use, urbanization, and transportation installations, particularly due to railways.

A continuing pressure on steelhead in the action area is the full development local watersheds dependent on precipitation and the human population's use and reliance on this resource. Local water supplies are already limited and the area depends heavily on imported freshwater, and increased stormwater harvesting is planned for the future. The expectations of climate change in the action area is that precipitation, which already comes in 'boom and bust' events, will begin to fluctuate evermore so between extreme highs and lows, and that dry year types may become more frequent, in addition to becoming more severe, and that overall averages will be warmer, with the area becoming more chaparral-like with less fog cover (Ackerly et al. 2018). Better water quality control and adequate treatment of new sources of urban stormwater discharges throughout the action area are needed to ensure that the water quality of aquatic habitats will be maintained at sufficient levels into the future to sustain listed salmonids and human populations through all water year types. Some recovery actions and other conservation efforts have occurred that will benefit the DPSs, mainly habitat restoration projects and fish passage improvements, but it is questionable whether these efforts will be sufficient to remedy the existing degradation of the functionality of critical habitat or be resilient enough to outpace the expected outcomes of climate change to realize the recovery of these populations, considering the status quo.

2.7.4. Summary of Cumulative Effects

Beyond state and federal actions, urban development in the communities around HSR stations is expected increase in general as commuters and businesses capitalized on the convenience of being near a mode of transportation that provides fast access between the San Francisco/San Jose Bay Area, the California Central Valley and the southern California/Los Angeles metropolitan areas. And as the local human population increases, cumulative water quality impacts are also expected to increase, through increased urbanization effects, increased impervious surface cover, increased stormwater runoff and contaminate loads, increased discharges from wastewater treatment plants, and an increase in the demand for drinking water. This carries the potential of overdrawing local surface and groundwater supplies available for human use and not protecting sufficient amounts for CCC and S-CCC steelhead life history needs in surface waterbodies during dry and drought periods.

2.7.5. Effects of the Proposed Action on the Survival and Recovery of the DPSs and Designated Critical Habitat

Both S-CCC and CCC steelhead are listed as threatened under the ESA and the most recent 5-year status reviews for the DPSs concluded that the threatened status is still applicable (NMFS 2016a, b). They remain listed as threatened in large part because of widespread freshwater and estuarine habitat degradation and land use conversion for urban development and human use. The ubiquitous artificial modifications to, and destruction of, the freshwater and estuarine habitats upon which these species depend still persist and adverse effects are expected to increase as the human population continues to grow in the Santa Clara Valley/San Jose Bay Area. Specifically, railroad and transportation bridges and infrastructures have been identified as a threat to the CCC steelhead DPS due to the habitat changes associated with the infrastructure and past instances where railroad bridges and culverts impeded fish passage. Large scale restoration actions that improve the amount, quality, and access to freshwater and estuarine rearing habitats; remedy adult and juvenile passage conditions at impeding structures; allocate surface water for fish and wildlife uses at sufficient quantities and qualities; and install large woody material in streams are necessary to recover these species as self-sufficient, viable, wild breeding populations.

As another railroad/transportation project, the HSR system has the potential to further negatively impact the survival and recovery potential of the S-CCC and CCC DPSs. However, the consequences of construction are mostly attributed to temporary disturbances to a few individuals per year for each DPS, and at most a few individuals may experience injury or mortality in a worst case scenario per year construction is ongoing. The Pajaro River watershed hosts one of the larger S-CCC populations in its diversity group; the Coyote Creek and Guadalupe River also host one of the larger/largest in their respective diversity strata. Therefore, the total numbers of fish anticipated to be directly taken during construction of the proposed action is expected to be relatively small compared to the respective populations in each DPS, and have little measurable effect to the productivity potential of each DPS as a whole. Furthermore, since the construction phase of the project is temporary, once the HSR section is complete most incidental take avenues expected to result in direct injury or mortality of individuals will cease. In the long-term, the proposed action is not expected to reduce the survival and recovery potentials of the S-CCC or CCC DPSs.

The potential for long-term adverse changes to the freshwater habitats from the installation of the HSR system into the landscape are expected to be adequately addressed by incorporating steelhead needs into the project designs. The conservation measures proposed by the Authority acknowledge the utility of large woody material and vegetative riparian plantings in bank/slope stabilization measures, the need to restore or augment steelhead habitat onsite, and to meet steelhead passage requirements when installing bridges and culverts. Therefore, the proposed project is not expected to appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

Combining the adverse and beneficial effects associated with this proposed action, the environmental baseline and the cumulative effects, and taking into account the status of the species affected by the project, the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of the listed species.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS's biological opinion that the proposed action is *not* likely to jeopardize the continued existence of CCC steelhead or S-CCC steelhead, or destroy or adversely modify their respective designated critical habitat.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement (ITS).

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

1. General construction activities described in section 2.5.1.1 occurring in and near waterways are expected to harass adult and juvenile CCC and S-CCC steelhead by causing them to alter their normal behaviors associated with breeding, feeding, or sheltering, and create the likelihood of injury, even during the proposed in-water work window, due to disturbance. Because of the low amount of adult abundance in these watersheds during the work windows, it is expected that no more than 2 adult CCC steelhead and 2 adult S-CCC steelhead would be harassed by general construction activities per year construction is occurring. Juvenile abundance is expected to be slightly greater in these waterways as resident *O. mykiss* parents may also produce anadromous steelhead offspring in addition to anadromous juveniles produced by anadromous parents (McEwan 2001, Courter et al. 2013, Pearse and Campbell 2018) and due to the fact that juvenile steelhead may spend multiple years in freshwater before emigrating. Therefore, it is expected that no more than 5 juvenile CCC steelhead and no more than 5 juvenile S-CCC steelhead would be harassed by general construction activities per year construction is occurring.

2. In-water activities that contact the stream banks, stream margin, and channel bottom in association with, such as in-water work, cofferdam dewatering, and pile driving for both pile installation and removal (described in sections 2.5.1.1, 2.5.1.3, and 2.5.1.4), are expected to elevate turbidity locally and downstream of the construction locations, and will harm and harass adult and juvenile CCC and S-CCC steelhead by causing them to alter their normal behaviors, their migration patterns, and induce respiratory stress, as long as the elevated turbidities persist.

3. Vibratory and impact pile driving in and near waterways (section 2.5.1.3), and tunneling under waterways (section 2.5.1.6) are expected to harass, wound, or kill adult and juvenile CCC and S-CCC steelhead by introducing underwater pressure waves into the aquatic environment. The pressure waves created by pile driving and tunneling activities are expected to persist only as long as these activities are ongoing.

    a. The underwater pressure waves from vibratory pile driving and tunneling under waterways are not expected to reach injurious or mortalities levels ($<206\ dB_{PEAK}$, $<150\ dB_{RMS}$) but will harass and significantly disrupt normal fish behaviors up to 541 meters both upstream and downstream from the pile driving/tunneling location without attenuation.

    b. The underwater pressure waves from impact pile driving are expected to exceed injurious and mortality levels ($\geq 206\ dB_{PEAK}$, $\geq 183\ dB_{SEL}$ cumulative for fish less than 2 grams bodyweight, $\geq 187\ dB_{SEL}$ cumulative for fish greater than 2 grams bodyweight, and $\geq 150\ dB_{RMS}$) and harm listed fish as follows (from calculations in section 2.5.1.3): Instantaneous mortality is expected within a 1-meter radius from the driven pile. For fish less than 2 grams, injury leading to death due to cumulative SEL exposure above 183 dB is expected out to an 86-meter radius from the driven pile without the use of underwater sound control measures. For fish greater than 2 grams, injury leading to death due to cumulative SEL exposure above 187 dB is also expected out to an 86-meter radius from the driven pile without the use of underwater sound control measures.

4. Cofferdam dewatering (section 2.5.1.4) is expected to harass, wound, or kill juvenile CCC and S-CCC steelhead by entrapping them, necessitating their capture, handling, and relocation (section 2.5.1.5), which is likely to stress, shock, and injure them, resulting in immediate or delayed death, or susceptibility to predation. The number of juveniles salmonids entrapped by cofferdams, requiring capture and relocation is expected to be low, no more than 5 individuals from the CCC steelhead DPS and no more than 10 individuals from the S-CCC steelhead DPS over the course of construction of the San Jose to Merced Project Section. It is also possible fish will evade capture and become impinged on the intake screen or be wounded in other ways during dewatering. It is also estimated that no more than 3% of the total number of juveniles (which is no more than one juvenile from the CCC steelhead DPS and one juvenile from the S-CCC steelhead DPS) is expected to die due to capture, handling, and relocation by the Authority or its contractors.

5. Tunneling and surface water reduction due to groundwater dewatering associated with tunneling is expected to harm, wound, or kill juvenile S-CCC steelhead and incubating S-CCC steelhead redds in the Pacheco Creek watershed. Reductions in surface waters are also likely to dewater incubating eggs in redds, decreasing the amount of oxygen available to developing eggs and alevins, likely leading to increased egg/alevins/fry mortality rates and a decrease in S-CCC steelhead production rates in the Pacheco Creek watershed, especially during drier water years. Reductions in surface waters are likely to strand juvenile steelhead, causing them stress and injury from asphyxiation, potentially leading to death. The surface reductions are expected to persist for no more than two years following tunneling activities below the affected waterway.

6. Regular HSR operations (section 2.5.1.8) are expected to harass and cause behavioral changes and increased stress in juvenile and adult CCC and S-CCC steelhead as trains running overhead introduce sudden noise and vibrations into the underwater environment below. Disturbing fish will cause a net energy loss by unnecessarily expending energy through either interrupting breeding, resting or feeding, and potentially delay migration timing. Juvenile steelhead are likely to be startled by vibrations and noise created when high speed trains pass over the viaducts, causing them to flee when they otherwise may be resting or foraging, potentially creating situations in which they are more likely to be predated upon in these areas over the long term.

7. Site preparation, relocation of utilities, permanent waterbody removal, and vegetation removal in and near waterways (section 2.5.2.1) are expected to harm adult and juvenile CCC and S-CCC steelhead by reducing habitat quality (vegetation removal, temporary and permanent land disturbance and alteration, permanent natural waterbody removal, changes in natural shading) and these alterations are expected to reduce the growth and survival of salmonids in the action area, decreasing their overall fitness. Effects are

expected to persist for several years until the aquatic habitats are restored and vegetative plantings mature to pre-disturbance functionality, or indefinitely, depending on the alteration.

8. Placement of riprap and bank stabilization measures (section 2.5.2.2) is expected to harm juvenile CCC and S-CCC steelhead because the use of "hard" stabilization methods (i.e., riprap/revetment) will reduce the amount of feeding and sheltering/escapement areas locally. A reduction in the amount of feeding and resting areas is expected to reduce the fitness of fishes that would have otherwise used this area, in perpetuity.

9. Placement of permanent artificial structures and associated shading (section 2.5.2.3) is expected to harm juvenile CCC and S-CCC steelhead because the permanent structure occupation of habitat effectively reduces the amount of feeding and resting areas locally, and the shading of the viaduct over stream channels will change the local aquatic ecosystem composition/available salmonid prey base, and create ambush habitat for predators of juvenile steelhead, in perpetuity.

For incidental take avenues 2, 3, 5, 6, 7, 8, and 9, NMFS cannot, using the best available information, quantify and track the amount or number of individuals that are expected to be incidentally taken because of the variability and uncertainty associated with the population sizes of the species, annual variation in the timing of migration, and variability regarding individual habitat use of the action area. However, it is possible to express the extent of incidental take in terms of ecological surrogates for those elements of the proposed action that are expected to result in incidental take.

These ecological surrogates are measureable, and the Authority or its contractors can monitor them to determine whether the level of anticipated incidental take is exceeded over the course of project implementation. All incidental take and ecological surrogates are summarized in Table 7.

2.9.1.1. Incidental take associated with elevated in-stream turbidity plumes

The most appropriate threshold for incidental take consisting of fish disturbance and sub-lethal effects associated with elevated turbidity is an ecological surrogate of the amount of increase in turbidity generated by in-water activities such as pile driving, stream bottom disturbance ,and cofferdam dewatering (incidental take form #2). Increased turbidity is expected to cause harm and harass adult and juvenile CCC and S-CCC steelhead through elevated stress levels and disruption of normal habitat use locally. These responses are linked to decreased growth, survivorship, and overall reduced fitness as described for underwater noise avoidance, up to respiratory distress and reduced gill function.

The surrogate for turbidity increases will be based on juvenile salmonid sensitivity to raised turbidity levels. While NTUs can range over a 1,000 NTU in winter flood condition, typical conditions in an undisturbed stream is usually less than 50 NTU (however, local CDEC monitoring stations do not collect turbidity data). 50 NTU is already above the range at which steelhead experience reduced growth rates (25 NTU) but below the range steelhead would be expected to actively avoid the area. Therefore, within the already established disturbance surrogate for pile driving (section 2.9.1.2, below), water downstream of construction activities cannot be more than 50 NTU above the turbidity level observed in upstream measurements. Downstream of the construction underwater noise/pile driving disturbance surrogate boundary (see section 2.9.1.3 below), turbidity immediately downstream cannot measure more than 25 NTU above the ambient turbidity level in water measured immediately upstream of project activities. Since in-river values change daily, the upstream comparison value must therefore be taken daily, in association with the downstream readings, during in-water pile driving. Exceeding these tiered turbidity thresholds will be considered as exceeding the expected incidental take levels, triggering reinitiation of consultation.

2.9.1.2. Incidental take associated with underwater sound, pressure waves, and vibration from construction activities

The most appropriate threshold for incidental take consisting of temporary fish displacement, behavior modification and slight increases in stress levels associated with vibratory pile driving and tunneling (#3a), and impact pile driving (#3b) underwater sound greater than 150 dB_{RMS} but less than cumulatively injurious SEL (183 to 187 dB) is an ecological surrogate of the amount of area expected to experience the elevated underwater sound levels due to these activities within a certain distance from the construction activity.

Vibratory pile driving, impact pile driving, and underground tunneling are all expected to produce underwater pressure levels over 150 dB_{RMS} out to 541 meters from the location of the activities. Though these elevated levels are not expected to injure or kill fish directly, they are expected to cause disruption of normal habitat utilization and elicit temporary behavioral effects in juvenile and adult salmonids, leading to harm as described in section 2.5.1.6 and tunneling effects analyses. Any behavioral alterations in juvenile fish are expected to decrease their fitness and ultimate survival by decreasing feeding opportunities that will decrease their growth, and by causing area avoidance, which will delay their downstream migration and increase their predation risk. Adult fitness is expected to decrease slightly when area avoidance delays their upstream migration. This surrogate will apply to incidental take forms #3a and #3b, and is defined by the boundary of the location of the disruptive activity out to 541 meters upstream and downstream of the location. All other types of temporary disturbance effects related to noise or vibrations created by equipment operation, construction noise, and human presence is expected to also be contained within this boundary of anticipated incidental take, during the proposed work windows. Exceeding 150 dB_{RMS} beyond 541 meters from the active construction site or tunneling location will be considered exceeding expected incidental take levels for this surrogate.

Impact pile driving is expected to produce underwater pressure levels over 206 dB_{PEAK} out to 1 meter from the driven pile and cause instantaneous mortality within this boundary. Impact pile driving is also expected to produce underwater pressure levels over 183 and 187 dB_{SEL} cumulative out to 86 meters from the driven pile and cause sublethal injuries leading to death within this boundary, in addition to causing stress, disturbance, behavioral changes, and migration delays. Therefore, exceeding 187 dB_{SEL} cumulative beyond 86 meters from the driven pile, or exceeding 206 dB_{PEAK} beyond 1 meter from the driven pile will be considered exceeding expected incidental take levels from this effect avenue triggering reinitiation of consultation.

2.9.1.3. Incidental take associated with reductions in surface water flow from groundwater dewatering associated with tunneling activities

The most appropriate threshold for incidental take associated with surface water reductions caused by groundwater dewatering from tunneling is the amount of reduction to available surface waters (#5). Reducing surface water flows during S-CCC steelhead redd incubation periods is expected to result in embryo death and a decrease in hatching success when flows are not sufficiently offset. The Authority has proposed to monitoring the surface and groundwater levels during tunneling activities to ensure surface water is not adversely reduced, and to supplement the affected area with replacement water of sufficient quality (dissolved oxygen, temperature, and pH, free of pathogens) to support all affected steelhead life stages. In the areas in which S-CCC steelhead spawning and critical habitat in Pacheco Creek and Pacheco Creek South Fork overlap with tunneling activities, the Authority estimates that dewatering/heading inflow rates may be slightly more than 200 gpm, which is approximately 0.5 cfs. If steelhead redds are present, or suspected to be present, in waterways overlying or downstream of the tunneling locations, the measurable reduction in surface waters due to tunnel dewatering is likely to be less than 1 cfs compared to upstream measurements. When a measurable reduction is detected, supplemental water will then be provided to resolve the deficit. Within the time period between detecting surface flow deficits and offsetting the difference with supplemental water input, eggs and alevins incubating in redds are expected to experience increased risk of mortality and other sublethal effects leading to decreased survivorship. Therefore, tunnel dewatering leading to surface water flow deficits greater than 1 cfs after input of supplemental water will be considered exceeding expected incidental take levels from this effect avenue, triggering reinitiation of consultation.

Additionally, surface water level must be maintained with at least 20 centimeters of stream depth over the redds until all fry emerge, using supplemental water of sufficient quality and quantity as to not cause further egg/alevin/fry mortalities. It is assumed that no additional take will be associated with supplemental water input. Stream flow reductions below these thresholds during tunneling will be considered exceeding allowable incidental take levels. If NMFS agrees via technical assistance that steelhead redds are not expected to be present but juvenile, yearling, or adult steelhead are likely to be present, then the amount of allowable surface water reduction may be up to 3 cfs compared to upstream, if Pacheco Creek is running at least 25 cfs daily. The Authority has proposed to monitor surface flow and stream condition during the tunneling period; these observations can be used to evaluate whether any flow reductions will lead to additional steelhead stranding or being isolated in pools, thereby causing a greater amount of incidental take of S-CCC steelhead than what is encompassed by this ecological surrogate, which would also exceed this ecological surrogate, triggering reinitiation of consultation.

2.9.1.4. Incidental take associated with vibration and noise from regular HSR train operations

The most appropriate threshold for incidental take associated with fish disturbance from HSR passenger trains running overhead occupied habitats (#6) is the addition of that noise and vibration to the underwater sound environment experienced by fish. However, quantifying the underwater sound signature emanating from high speed train operation specifically are not directly available in scientific literature, but estimates are available of overall underwater sound environments currently affected by anthropogenic noise over and near monitored waterways near passenger car railways. Roundtree et al. (2020) quantified that brook/creek habitats contained averages of 99.4 dB re 1µPA RMS while river habitats contained averages of 101.1 dB re 1µPA RMS. These situations are comparable to future HSR operations as some overcrossings will be blended with other railway operations, and some HSR overcrossings will be in close proximity to highway and other vehicular traffic (the only likely difference in the underwater sound environment will be a lack of boat traffic in the affected area due to the small size of most of the waterways in the action area). The train underwater sound contributions in Roundtree et al. (2020) were noted as being relatively brief and bolstered by any use of train horn. The distance to bridge was noted as being approximately 500 meters. Therefore, it is expected that the sound environment under and near HSR crossings will not exceed 100 dB re 1µPA RMS beyond 500 meters from the crossing location in the affected waterbody. This is similar to the disturbance limit established for vibratory pile driving, the main difference being that this disturbance is expected to occur regularly in perpetuity, affecting all future generations of steelhead in the action area. Causing the underwater sound environment to regularly exceed 100 dB re 1µPA RMS beyond 500 meters from the mid-line of the overcrossing bridge/culvert/viaduct structure will be considered exceeding expected incidental take levels from this effect avenue.

2.9.1.5. Incidental take associated with placement of riprap, bank and slope stabilization, habitat occupation by permanent structures and artificial materials, shading, and other habitat alterations

The most appropriate measurement of harm to CCC and S-CCC steelhead and the functionality of their habitats associated with site preparation, utility placement, vegetation removal, slope stabilization and permanent waterbody removal (#7); placement of permanent riprap and bank stabilization (#8); and permanent structure and otherwise occupation by artificial material and associated shading (#9) is a surrogate of the total amount of area affected by the degradation of habitat that could have otherwise supported steelhead. The artificial hard structures and materials will occupy benthic substrates that would have otherwise supported benthic prey of juvenile salmonids, reducing feeding opportunities and negatively affecting their future potential growth rates. The hard structures in stream bed, and the new water velocities created around them, also reduce the possibility of natural processes from otherwise occurring in the area, like aquatic vegetation or LWM establishment, preventing juveniles from resting or sheltering in the immediate project area. Any shading is related and proportional to the amount and degree of artificial structures overhanging the wetted channels and riparian corridor, and will change the local ecosystem structure and increase the amount of water column ambush predator habitat. While habitat functionality will not be lost completely in most cases, except for the permanent removal of natural waterbodies, the habitat alterations are expected to result in functional decreases that will be maintained in perpetuity; therefore, the adverse effects associated with these structures will also remain as long as the artificial structure and riprap remain.

The Authority estimates that a total of approximately 33 acres of S-CCC steelhead designated critical habitat will be permanently affected by the project section and that 42 acres of designated critical habitat will be temporarily affected by section construction. A total of 0.18 acres of CCC designated critical habitat will be permanently or temporarily impacted by the project. While oblique shading would cause a greater amount of area to be affected under the aerial structures caused by differing sunlight angles throughout the day, these amounts are omitted from this total for simplicity and because the area directly under the structure will experience the greatest reduction in surface lighting. Exceeding these total acreages stated above as surrogate amounts for incidental take described in #7, #8, and #9 above will be considered as exceeding the expected incidental take levels. If NMFS determines that onsite restoration, installed steelhead habitat augmentations, 'soft' bank armoring, or other steelhead habitat improvements undertaken, funded, or implemented by or on the behalf of the Authority are expected to adequately restore habitat functionality to prior levels or better, the improved/rehabilitated acreages will not be counted in the amount totaled towards the 'affected steelhead habitat' limits above.

Table 7. Summary of incidental take and ecological surrogates.

Incidental Take (#)	Form of Incidental Take	Measurable Limit	Duration
#1 General construction activities	Harassment	2 adult CCC steelhead 5 juvenile CCC steelhead 2 adult S-CCC steelhead 5 juvenile S-CCC steelhead	Per year construction is ongoing
#2 Elevated turbidity	Harm and harassment	In-stream turbidity immediately downstream of construction elevated no more than 50 NTUs compared to in-stream turbidity measurements immediately upstream of construction, within 541 meters from construction site. Beyond the 541-meter boundary, in-stream turbidity can be elevated no more than 25 NTUs compared to upstream measurements.	While construction is ongoing
#3a Vibratory pile driving, #3b Impact pile driving, #3a Tunneling vibrations	Harassment Injure Kill	Underwater noise/pressure may be no more than: • 206 dB_{PEAK} beyond 1 meter from driven pile • 187 dB_{SEL} cumulative beyond 86 meters from driven pile • 150 dB_{RMS} beyond 541 meters from driven pile or tunneling location	While pile driving or tunneling is ongoing
#4 Cofferdam dewatering and fish capture/ relocation	Capture Injure Kill	5 juvenile CCC steelhead 10 juvenile S-CCC steelhead No more than 3% mortality at immediate release	Over the course of construction of the section, when fish are handled by Authority staff/contractors

Incidental Take (#)	Form of Incidental Take	Measurable Limit	Duration
#5 Tunneling surface water reductions	Harassment Harm	When S-CCC steelhead redds are present in overlying waters, no more than 1 cfs reduction in flow and surface level water depth maintenance of at least 20 centimeters over all redds. When S-CCC steelhead redds are not present but individuals may be using surface waters, no more than 3 cfs reduction in flow if at least 25 cfs still available in Pacheco Creek.	Surface water reductions should cease within 3 years after tunnel construction and sealing is complete
#6 HSR operation noise/vibration	Harassment	Underwater noise/pressure not to exceed 100 dB re 1µPA RMS beyond 500 meters at all major crossing locations due to HSR operations	Permanent intermittent
#7 General habitat alteration/ vegetation removal/ waterbody removal, #8 Placement of riprap/ bank stabilization, #9 Permanent structures and shading	Harm through reduced survival and fitness	1 acre of permanent impacts to CCC steelhead designated critical habitat 33 acres of permanent impacts to S-CCC steelhead designated critical habitat	Maximum amount of permanently affected habitat section implementation

2.9.2. Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. Measures shall be taken by the Authority and its contractors to minimize the extent of disturbance, harassment, injury, and mortality to CCC and S-CCC steelhead caused by

construction activities and HSR operation in the action area, related to the consequences of the proposed action as discussed in this opinion.

2. Measures shall be taken by the Authority and its contractors to reduce the extent of harm, degradation, and alteration to the designated critical habitats of CCC and S-CCC steelhead, and other habitats which support these species in the action area, related to the consequences of the proposed action as discussed in this opinion.

3. The Authority or its contractors shall prepare and provide NMFS with updates, reports, and plans pertinent to monitoring the impacts to and amount of incidental take of listed species under NMFS jurisdiction in the action area.

2.9.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and the Authority or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The Authority or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:

    a. Measures shall be taken to maintain, monitor, and adaptively manage all CMs, AMMs, and BMPs with NMFS staff as they pertain to protecting listed species under NMFS jurisdiction throughout the life of the project to ensure their effectiveness.

    b. The Authority and its contractors shall work in coordination with NMFS throughout HSR project active construction phases by holding meetings between NMFS, USFWS, CDFW, Authority, and design-build contractor staff at least once a year construction is ongoing so that impacts on and interactions with listed fishes can be reduced or avoided to the greatest extent possible.

    c. The Authority and its contractors shall work in coordination with NMFS before and during active HSR operations and maintenance activities to develop specific BMPs and standard maintenance protocols so that impacts on, and interactions with, listed fishes can be reduced or avoided to the greatest extent possible.

        i. The Authority shall request NMFS review on draft plans for vegetation removal activities and herbicide use as regular maintenance near waterways containing listed salmonids, prior to undertaking said activities. NMFS comments shall be incorporated into vegetation removal and maintenance plans.

        ii. The Authority shall request NMFS review on drafts of HSR safety check protocols when possibility of interaction with listed fishes or their habitats is likely, prior to establishing said safety protocols.

d. In the course of monitoring the construction portion of the project, the Authority or its contractors shall contact and coordinate with NMFS within 24 hours after direct observation that incidental take of a listed fish or exceedance of its ecological surrogate has occurred (Table 7), or is suspected of being exceeded, so that both agencies can discuss how or whether incidental take levels can return back below applicable levels. Construction shall cease until coordination can take place and an adaptive management plan is adopted.

e. The Authority shall ensure its contractors comply with the terms and conditions in this opinion by including them in future contracts through specific requirements that address:

   i. Adherence to the NMFS terms and conditions identified in this opinion as part of the award packages as necessary to reduce and limit the amount of incidental take of listed anadromous fishes;

   ii. Explicit assignment of the responsibilities of implementation of the environmental CMs/AMMs/BMPs proposed for this action and related to NMFS trust resources required to meet the terms and conditions as part of the award packages, and;

   iii. Explicit assignment of responsibilities of the monitoring of NMFS resources and associated ecological surrogates to ensure the performance of the CMs/AMMs/BMPs associated with the terms and conditions stated below, as part of project award packages.

f. The schedule of the construction activities near steelhead waterways shall be adopted into the work plan as proposed in AMM-FISH-2 to avoid or limit construction interactions with CCC and S-CCC steelhead. Deviations from the proposed work windows or daily work windows shall require technical assistance approval from NMFS staff before the change is adopted into the construction schedule.

g. During construction activities, but especially pertaining to impact and vibratory pile driving periods:

   i. If any steelhead or salmon is injured or killed within the action area in relation to project activities, the Authority and its contractors shall cease construction actions and contact NMFS staff immediately to assign species identity.

   ii. If dead, the fish shall be recovered and placed on ice or frozen until transfer to NMFS can occur. If injured, the fish shall be gently handled only to take a photograph to enable later species assignment. Then it shall be immediately released back into the waterbody it was taken in, preferably in a shaded area with overhanging or in-water vegetation. However, the injured individual shall not be pursued if it proceeds to exit the immediate area under its own volition before being photographed.

   iii. Construction activities shall not resume until NMFS can evaluate the situation and determine if the take could have been avoided.

h. During in-water pile driving for installation and removal of cofferdams and permanent structures:

   i. Piles and sheet piles shall be driven as far as possible with vibratory hammering before using an impact hammer.

   ii. The underwater sound environment shall be monitored whenever in-water impact pile driving is employed to ensure ecological surrogates are not exceeded.

   iii. At least one underwater sound control measure shall be employed whenever in-water impact pile driving is used, such as cushion blocks, bubble curtains, de-watered cofferdams, or de-water caissons around the pile being driven.

   iv. Piles and cofferdams shall be inspected daily for accumulated debris and debris shall be removed. If the debris is natural large woody material, the Authority shall return the large woody material back to the waterway downstream of their structure or make the material available for restoration activities, preferably for fish habitat onsite.

i. A qualified biologist shall conduct water quality monitoring upstream and downstream of the location of in-water construction activities to ensure turbidity plumes created by construction do not exceed 50 NTUs above natural upstream measurements within 541 meters from location of in-water activities (the disturbance surrogate boundary), or 25 NTUs downstream of the disturbance surrogate boundary. If an in-river turbidity reading exceeds these thresholds, construction will cease and turbidity/sedimentation control AMMs/BMPs shall be adjusted until turbidity readings downstream cease exceeding the established thresholds.

j. During the in-water work windows, if cofferdams require dewatering, the enclosed area shall be checked for steelhead, according to the best recommendations of the assigned, on-site fish biologist, but considering the following:

   i. A final dewatering and fish capture/relocation plan shall be submitted to NMFS for review no later than 30 days prior to implementation.

   ii. NMFS staff shall be notified of any planned "fish rescue" or salvage activities at least two business days before fish capture and relocation activities begin, so that staff can advise these efforts or make a field visit to observe, if deemed necessary.

   iii. Juvenile steelhead entrapped shall be captured using nets (seines) or electrofishing of enclosed areas, water temperature permitting (less than 65°F). Fishing equipment used shall be in good condition and decontaminated if used outside of the watershed prior to the fish salvage event.

   iv. Persons performing salmonid captures shall be experienced juvenile salmonid handlers and be familiar with the fishing equipment in use.

v. If electrofishing is selected to be used in fish capture, the operator of the equipment shall have at least 100 hours of practical experience using such equipment in the field.

vi. Clean relocation equipment and containers shall be available and ready to receive fish on site during all fishing/fish salvage activities, preferably under shade.

vii. Captured *O. mykiss* shall be counted and assessed visually for immediate health condition and tentatively assigned to steelhead or resident life history group.

viii. If a steelhead dies, see retaining and reporting a mortality procedures above (Term and Condition 1g).

ix. The water quality of the transport water shall be monitored to ensure sufficient oxygen and temperature levels are maintained. Transport water shall be within 5°Fof the stream water to minimize shock and transport stress, and less than 64°F overall.

x. Captured juvenile steelhead shall be held in transport containers for no more than 30 minutes before release. Release locations shall be nearby, be the same water body from which they were removed, and the selected release area shall have complex shaded habitat if at all available, so juveniles may rest or hide after release.

xi. A report on fish rescue and relocation efforts and results shall be submitted to NMFS within 30 days of conclusion of the activities, indicating the number of salmonids that were handled, the number injured or killed, the transport water quality readings, total time in transport, and the location they were released into.

k. The Authority and its contractors shall ensure that surface water reductions in Pacheco Creek do not reach a level that will be detrimental to the survival and success of S-CCC steelhead eggs, alevins, fry, or juveniles beyond the ecological surrogate threshold.

i. The Authority and its contractors shall send the GAMMP in advance of tunneling activities under the Pacheco Creek watershed to NMFS for approval before commencing tunneling activities.

ii. Surface water level and flow monitoring shall be conducted upstream and downstream of affected stream reaches during normal S-CCC use periods of Pacheco Creek and Pacheco Creek South Fork.

iii. If NMFS expects that S-CCC steelhead may be using Pacheco Creek during tunneling dewatering periods, the Authority and its contractors shall prepare sufficient supplemental water to offset potential surface water reductions well in advance of active tunneling reaching sensitive stream reaches.

iv. Provided supplemental water shall be of suitable quality (temperature, pH, and dissolved oxygen levels, and be free of pathogens) and of sufficient quantity to avoid a detectible deficit in surface water beyond the ecological surrogate threshold so that all life stages of S-CCC steelhead dependent on the surface water of the Pacheco Creek watershed will be supported. Supplemental water shall be provided as long as all life stages are present in the Pacheco Creek watershed and tunnel dewatering is causing surface water flow to be reduced.

v. Tunneling operations shall cease if surface water monitoring indicates that the ecological surrogate threshold amount may be exceeded or has been exceeded, despite supplement water additions, though existing tunnel area shall be sealed and capped to prevent further groundwater dewatering during interim, and NMFS shall be contacted immediately. Tunneling operations shall only continue once NMFS agrees a suitable plan of action has been created and in place to avoid additional S-CCC steelhead take.

l. The Authority and its contractors shall prepare and adhere to a SPCCP and SWPPP for each construction site discussed in this opinion, to minimize the probability of introducing pollution into waterways and to reduce the amount discharged should an accidental or uncontrolled discharge occur.

i. Construction stormwater and erosion AMMs and BMPs shall be established prior to the start of construction and earthwork, and be maintained and monitored regularly to ensure effectiveness.

ii. Accidental spill containment and clean-up materials shall be present at all work locations and be accessible to construction crews at all times, to ensure rapid response to events. Materials and available amounts shall be adequate for the machinery and chemicals expected onsite.

iii. All equipment maintenance and fueling shall occur in paved areas whenever possible, and occur at least 200 feet away from the wetted channel, using full spill or leak containment systems.

iv. Equipment shall be checked for leaks and maintained regularly to ensure proper function before entering water channels or traveling over water channels. Equipment to be used stationary over water for long periods shall have drip pans or absorbent pads placed underneath to catch any and all leaks.

v. Should an accidental spill or discharge into steelhead habitat occur, NMFS shall be contacted within 24 hours with information regarding the event, including type of spill or breach, event duration, estimates on the amount and concentration of materials discharged, Authority/contractor immediate response, and the Authority’s and their contractors proposed long-term resolution to avoid such events. Environmental samples shall be taken and documentation made to track the efficacy of containment and clean-up efforts.

2. The following terms and conditions implement reasonable and prudent measure 2:

a. The Authority and its design-build team shall work with NMFS staff to ensure viaduct and crossing footings placed within the OHWM will demonstrate minimal hydraulic effects and not significantly alter the hydrology of steelhead critical habitat in ways that may impede their migration or cause changes in geomorphic processes that could alter the amount or availability of spawning habitat (i.e., gravel beds) through holding working group meetings when 75% and 90% project designs are available for the sections interacting with NMFS trust resources.

b. The Authority and its design-build team shall seek technical assistance from NMFS during the design phase (before construction) of overcrossings that involve alterations to stream bed bottoms such as in association with culverts or box culverts to be placed in designated CCC or S-CCC steelhead critical habitat to ensure the selected designs do not impede fish passage and sufficiently meet fish passage criteria (Game) 2004, NMFS 2011).

c. The Authority and its design-build team shall provide final crossing designs of each major overcrossing to NMFS at least one year prior to construction mobilization and site preparation start dates for consultation and coordination purposes, in case new information or project design changes warrant consultation re-initiation or opinion amendments.

   i. If consultation reinitiation or opinion amendments are not required, the Authority and its construction contractors shall again contact NMFS at least two months ahead of construction mobilization to discuss adaptively managing or avoiding interactions with special status anadromous fishes and the habitats they use in the upcoming construction season.

d. Decreases to the riparian vegetation available locally shall be minimized.

   i. Riparian vegetation removal shall be limited to the extent practicable for structure placement and construction access, and both trimming and removal shall be limited to the absolute minimum amount required for construction.

   ii. Riparian vegetation not planned for removal shall be clearly marked and areas of special biological significance that contain native, over-hanging riverine trees, floodplain habitat, or other habitat features that offer in-water heterogeneity such as large woody debris shall be fenced off or clearly marked before removal activities begin to ensure those resources are avoided and preserved.

   iii. Remaining trees shall be protected from damage during construction activities and during riprap placement to ensure their continuing survival as part of the riverine habitat. Protective measures may include wrapping their trunks with burlap and/or creating a scaffold buffer of scrap timber around the trunks, in both cases to buffer against damage. A qualified biologist shall confirm proper application of these protective measures and tree survival through the construction and restoration process.

e. Trees to be removed for the project shall be surveyed for species and number. The Authority or its contractors shall replant native species onsite at minimum a 3:1 ratio in-kind for the number of individual trees removed once construction is complete. Plantings shall be monitored and cared for at least three years after planting to ensure survival.

f. Native trees and large woody material removed for the project during site preparation shall either be placed back into the waterway to provide cover and habitat for listed salmonids, be secured in an affected waterway as fish habitat augmentation near major overcrossings, or be incorporated into bank stabilization and other 'soft' armoring designs for the project (FEMA 2009).

g. In-stream woody material refugia shall be placed and secured within 500 meters of overcrossing and viaduct footings in affected streams to minimize predation of juveniles expected from the regular disturbance of HSR trains running over the river channel on the viaducts and the artificial structures attracting more piscivorous predators to the area than would be expected without the overwater structures and ongoing HSR operations. The Authority shall contact NMFS for technical assistance on the placement and amount needed to provide optimal refuge for juveniles to hide in and avoid predation.

    i. The Authority shall estimate the distance to which 100 dB re 1µPA occurs in the underwater environment due to the normal operation of high speed trains running over waterways using empirical underwater sound monitoring taken once track sections are complete and the HSR system is operational, to better inform placement of fish habitat augmentation structures relative to HSR structures in and around streams.

h. The Authority shall design temporary and permanent night lighting of overwater structures so that the surface of the water is not illuminated and attractive to piscivorous predators and juvenile steelhead.

i. Temporary construction materials and BMPs shall consist of natural biodegradable materials and the use of plastic (such as monofilament and Visqueen) shall be minimized to the extent practicable. All materials intended for temporary use onsite shall be removed within 60 days post construction/project completion or at least three days before anticipated rainfall to reduce pollution and trash entering the waterways.

j. Temporary construction areas shall be utilized for staging, storage, parking, and stockpiling outside of the water channels, floodplains, and riparian areas whenever practicable.

k. The amount of new impervious surfaces placed or created in the action area by the proposed project shall be minimized, the use of permeable pavements or surfaces in lieu pavement or gravel shall be considered whenever feasible.

l. No environmental designs or project features shall include the incorporation or use of new or recycled tire particles or materials, especially not in stormwater infrastructure or in aquatic habitat restoration designs.

m. Disturbed areas that were graded will be re-contoured and stabilized at the end of the construction year to ensure erosion and sediment mobilization into steelhead waterways will be avoided. Once construction is complete, all disturbed areas shall be naturalized to the extent practicable.

n. The placement of artificial structures in the riparian corridor and on the river banks shall be limited to the extent practicable, both above and below the OHWM.

   i. The placement of riprap on the river bank shall be limited to the amount described in the submitted project BA or less. "Soft" or green approaches to bank stabilization shall be utilized to the extent practicable, hard bank protection methods shall be avoided whenever feasible, and all tactics shall include the placement of large woody material.

   ii. Wood treated with creosote or copper-based chemicals shall be avoided for use in bank stabilization efforts.

   iii. Whenever revetment/riprap must be used, quarry stone, cobblestone, or their equivalents shall be used and complemented with native riparian plantings, and other natural stabilization alternatives with the goal of maintaining a natural riparian corridor (FEMA 2009).

   iv. Temporarily disturbed areas shall be revegetated with native plants that resemble or improve the existing native vegetation diversity based on historical, locally appropriate assemblages.

   v. When revetment/riprap is placed, voids created by the boulders shall be filled by smaller diameter rocks/gravel when below the OHWM to avoid supporting piscivorous predator ambush habitat.

o. The use of pesticides and herbicides shall be avoided near wetted channels, floodplains, and uplands during weed control activities, and amounts used minimized, to the extent practicable.

p. Temporary sheet piles shall be completely removed from streams once construction is complete.

   i. Sediment suspension created during the removal of temporary sheet piles and cofferdams shall be controlled by encircling the in-water work area with a silt curtain, pulling the piles out slowly, and filling any streambed holes left by the piles with clean, native sediment, or appropriately-sized spawning gravel following pile removal.

3. The following terms and conditions implement reasonable and prudent measure 3:

a. The Authority and its contractors shall coordinate with NMFS, whenever NMFS requests, to allow staff safe and reliable access through HSR ROW and construction sites when site visits, in-stream monitoring, or fish salvage operations are required.

   i. The Authority shall designate an on-site point of contact who can facilitate access and ensure safety through HSR construction sites and ROW, and update NMFS of their contact information regularly.

b. Annual updates and reports required by these terms and conditions shall be submitted by December 31st of each year of construction.

c. Monitoring reports related to RPM 3 shall include record of adherence to project schedules, project milestone completion dates, and details regarding AMM/BMP implementation and performance, as well as any observed incidental take, incidents, or encounters relating to NMFS resources or their ecological surrogates.

d. Updates and reports required by these terms and conditions shall be sent to:

California Central Valley Office – c/o Cathy Marcinkevage
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814
Erin.strange@noaa.gov

California Coastal Office – c/o Joel Casagrande
National Marine Fisheries Service
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95404
Joel.casagrande@noaa.gov

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

- The Authority and its contractors should incorporate LID designs and features into HSR ROW and access roads, station design, maintenance facilities, utilities, and parking areas whenever feasible, including tree plantings, vegetated roofs, stormwater planters, infiltration or lined rain gardens, bioswales, vegetated strips, bioretention devices, and the enhancement of onsite hydrologic features that maximum water evapotransport and groundwater infiltration to minimize degradation to CCC and S-CCC designated critical habitat water quality and habitat function. Doing so would aid in the restoration of the functionality of existing critical habitat water quality and water quantity PBFs in general, and improve the resiliency and probability of recovery of CCC and S-CCC steelhead in the region.

- The Authority and its contractors should notify NMFS if any steelhead or salmonid juveniles are observed to be naturally isolated in disconnected or ponded water within their ROW and anticipate the fish being in danger of dying from receding water levels so that appropriate wildlife and fishery agencies may coordinate a fish rescue effort. The Authority and its contractors should enable and facilitate site and area access through the ROW/construction zone until the fish salvage efforts conclude. Any steelhead juveniles handled, injured, or killed by other organizations in this manner will not be tallied toward the incidental take associated with the Authority's incidental take for the proposed project, instead any incidental take associated with the rescue effort would be covered by permits held by the fish and wildlife agency sponsoring the rescue effort. Doing so will improve the probability the individuals relocated will survive to adulthood and improve the cohort productivity of the CCC/S-CCC steelhead populations involved.

- The Authority and its contractors should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local land management groups to identify opportunities for cooperative analysis, monitoring, and funding to otherwise support steelhead and watershed restoration projects and recovery action projects in the action area. Doing so would aid restoration of the functionality of existing critical habitats in general, and improve the resiliency and probability of recovery of CCC and S-CCC steelhead in the region.

- The Authority should use biodegradable oil in equipment and onsite vehicles. Doing so will reduce the amount of construction equipment contamination resultant from the project, and available critical habitat quality will be better maintained, in support of CCC/S-CCC steelhead.

- The Authority should submit a final CMP to NMFS prior to implementation of the proposed action. The final CMP should demonstrate that the compensatory mitigation plan for unavoidable impacts to steelhead habitat adequately meets the Authority's conservation goals and ratio targets proposed in CM-FISH-1. The final CMP should include:

    - Updated and accurate acreage estimates of types of steelhead habitat (spawning, rearing, and migratory, and designated critical habitat or auxiliary habitat, by DPS) to be temporary and permanently impacted by the project (permanent structures and bank/slope stabilization measures).

    - Updated and accurate acreage estimates of planned on-site restoration, including riparian replantings, incorporation of large woody material, enhancement of fish habitat, and where "soft" bank/slope stabilization designs were selected for use over hard revetment or riprap.

    - Identification of the property or properties selected to provide compensatory offsets for unavoidable impacts to S-CCC/CCC steelhead habitats, and identification of the conservation partners and agencies that will be responsible for holding and maintaining the conservation easements or fee-title to the identified parcels in perpetuity.

2.11. Reinitiation of Consultation

This concludes formal consultation for the proposed action.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if:

(1) The amount or extent of incidental taking specified in the ITS is exceeded,

(2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion,

(3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or

(4) a new species is listed or critical habitat designated that may be affected by the action.

An example of when reinitiation of consultation will likely be warranted under 50 CFR 402.16 is if the Authority or its contractors do not adhere to the work windows or daily work hours as proposed. In addition, when a site(s) for compensatory mitigation is confirmed and additional information about the proposed compensatory mitigation is available, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center’s programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

2.12. "Not Likely to Adversely Affect" Determinations

Species	Scientific Name	Original Listing Status	Current Listing Status	Critical Habitat Designated
California Central Valley steelhead DPS	*Oncorhynchus mykiss*	3/19/1998 63 FR 13347 Threatened	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488

California Central Valley (CCV) steelhead and its critical habitat occur downstream but within the watersheds potentially affected by the implementation of the San Jose to Merced Project Section. The connection point or action area of the HSR section considered in this opinion ends at least 5 miles upstream from the Middle San Joaquin River (in which individual CCV steelhead could reasonably occur in the future as restoration efforts and passage improvement projects proceed), and at least 16 miles upstream from the nearest waterbody designated as CCV steelhead critical habitat (the Merced River confluence with the Lower San Joaquin River). Consequences to CCV steelhead and a nonessential experimental 10(j) population of reintroduced CV spring-run Chinook salmon were considered in the opinion issued in 2019 for the Merced to Fresno HSR section, the next contiguous portion of the HSR system, which also includes the CV Wye connection (NMFS 2019). All reasonable and expected impacts to these populations from the HSR project for that action area are considered and contained in that opinion and will not be duplicated here.

Authority staff and ICF consultants considered the likelihood that individual CCV steelhead might access the CV waterways that interact with the HSR footprint proposed in the San Jose to Merced (in waterways crossed west of the CV Wye connection). In early technical assistance with NMFS staff (Kozlowski et al. 2017, 2018), despite this area historically hosting highly productive rearing for juvenile CCV steelhead, it was determined that all existing waterways of the San Jose to Merced HSR footprint have been highly manipulated and effectively block upstream progress in almost all water year types. Only in extreme, well above average water years would these multiple water control structures be expected to be overtopped enough to allow CCV steelhead passage to the San Jose to Merced project footprint. And during such extreme rainfall and flood years, we assume HSR construction would cease until on-the-ground conditions improved, precluding overlap between CCV steelhead presence and construction activities. The occurrence of such a situation would be so rare it would be considered a discountable consequence of the project, as it is extremely unlikely to occur. Furthermore, the currently proposed construction, operational, and maintenance CMs/AMMs/BMPs for the HSR system are expected to adequately avoid, minimize, and control any effects caused within the action area (e.g., contamination from accidental spills, sedimentation) so that these effects will not be transported and affect individuals or critical habitat functionality downstream. Therefore, NMFS concurs with the Authority's determination that the proposed San Jose to Merced Project Section is not likely to adversely affect CCV steelhead nor their designated critical habitat.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the Authority and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by PFMC-managed salmon within the USGS 4th field hydrologic units identified by the fishery management plan (PFMC 2014). This designation includes the 18050003 – Coyote hydrologic unit for all run-types of Chinook salmon, *O. tshawytscha*, and coho salmon, *O. kisutch* in the Santa Clara Valley and the 18040001 – Middle San Joaquin-Lower Chowchilla hydrologic unit for all runs of Chinook salmon in the California Central Valley that historically and currently use these watersheds. The fishery management plan also identifies Habitat Areas of Particular Concern (HAPCs) for Pacific Coast Salmon as: complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation.

Within the Santa Clara Valley portion of the action area, the Coyote hydrologic unit contributes to EFH watershed historically utilized by both Chinook and coho salmon, though currently may only occasionally host spawning of stray Central Valley fall-run Chinook salmon originating from Feather River Fish Hatchery and Mokelumne River Hatchery (Garcia-Rossi and Hedgecock 2002, Leal and Watson 2018, Leal 2021). Complex channels and floodplain habitats, and estuaries as well as their associated vegetation, may be found within Guadalupe River, Los Gatos Creek, and Coyote Creek, but have been degraded by urbanization and channelization of the waterways. Likewise, the floodplain of the Guadalupe River has also been highly urbanized and developed. Spawning habitat, if still available, is highly constrained in the action area. The watershed is currently impacted by the impassable LeRoy Anderson Dam.

Within the California Central Valley portion action area, the Middle San Joaquin-Lower Chowchilla hydrologic unit contributes to EFH watersheds utilized by Chinook salmon, including a fall-run and a nonessential experimental population of re-introduced spring-run Chinook salmon, though the spring-run historically dominated this watershed (NMFS 2014). The San Joaquin River is historical habitat for these two runs and contains the southernmost populations of Chinook salmon, though anthropogenic changes in the environment have severely impacted their ability to use this basin over the last century. The combined Sacramento – San Joaquin River system once supported Chinook salmon runs comparable to those of the Columbia and Fraser rivers (NMFS 2014). The freshwater Pacific Coast Salmon EFH components affected by this project include juvenile rearing habitat in floodplains, and the juvenile and adult migration corridors. The areas affected by the project footprint were historically vast floodplain and meandering channel habitat for the lower San Joaquin River but have been converted to agricultural fields or for cattle grazing, or are maintained as wildlife refuges or hunting clubs for waterfowl.

3.2. Adverse Effects on Essential Fish Habitat

Adverse effects of the proposed action on coho salmon and Chinook salmon EFH would be similar to the effects of the action on CCC/S-CCC steelhead and their designated critical habitats discussed in section 2.5, Effects of the Action. In summary, adverse effects to EFH quality include:

1. Temporary sedimentation and turbidity
2. Introduction of hazardous materials and contaminants to waterways and ecosystems during construction
3. Conversion of natural areas for project needs leading to the removal of EFH, including permanent removal of tributaries and minor waterbodies (HAPCs: complex channel and floodplain)
4. Temporary to long-term reductions in riparian vegetation (HAPCs: complex channel and floodplain, submerged aquatic vegetation)
5. Permanent placement of artificial structures in and over waterways, estuary habitat, and riparian corridors (HAPCs: complex channel and floodplain)
6. Permanent increases in impervious surfaces in the landscape, increased urbanization
7. Creation of predator cover and visual barriers
8. Permanent effects on foraging resources through shading (HAPCs: complex channel and floodplain, submerged aquatic vegetation)
9. Permanent bank and slope stabilization, hard armoring (HAPCs: complex channel and floodplain)
10. Permanent intermittent transportation noise

Proposed projects that occur in or along waterways often cause significant long-term or permanent negative impacts to aquatic habitat, and the HSR system is no different as the route crosses these watersheds multiple times in this section. Additionally, improved transportation infrastructure is associated with increased human population growth and urbanization effects that combine to cumulatively decrease the functionality of aquatic ecosystems over large landscapes via individually smaller but pervasive public and private actions (i.e., land development from rural/agriculture to housing and commercial lots, increased water demands, increases in impervious surfaces, point and non-point source pollution increases, increases in aquatic recreation, increases in bank protections to protect new land development, etc.). Therefore, direct and immediate impacts from construction are expected, and long-term effects of the existence and operation of the HSR system are expected into the future, as the implementation of the project will affect the quality and quantity of Pacific Coast Salmon EFH.

3.3. Essential Fish Habitat Conservation Recommendations

Many of the Pacific Salmon EFH concerns presented above are expected to be addressed through the ESA consultation RPM's 1-3 (section 2.9.3) and the Authority's plan to restore and rehabilitate salmonid habitat onsite and to also offset unavoidable impacts through permittee-responsible mitigation is expected to augment and improve the condition and availability of Pacific Coast Salmon EFH within the action area.

In addition to these efforts, NMFS determined that the following conservation recommendations are also necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

1. To address the increased impervious surface cover, increased general urbanization and continuing development and occupation of natural areas (#3 through #9), NMFS recommends the Authority examine its ROW and access road designs of the immediate project areas to maintain a contiguous, functional riparian corridor, to maintain natural hydrologic connectivity, and to create or maintain access to existing floodplain habitat whenever possible. Such designs could also include incorporation of stormwater treatment/LID tactics to treat project-associated stormwater before discharge and use of permeable pavements, further decreasing HSR indirect negative impacts on Pacific Coast Salmon EFH watersheds.

2. To address the creation of predator cover through installation of permanent in-water/over-water structures, shading, and offset the effects of permanent intermittent noise (#5, #7, #10), NMFS recommends also installing in-river LWM around or adjacent to the HSR viaduct crossing and footings so that juvenile Chinook and coho may also have access to predator refuges nearby the impacted locations. Enhance in-stream fish habitat by providing root wads and deflector logs below the stabilized bank, and by planting shaded riverine aquatic cover vegetation, as part of bank revitalization in conjunction with support footings so that the likelihood of scour caused by structure placement is reduced. The Authority should work with NMFS staff to ensure LWM installations are placed in arrangements and in sufficient numbers so that maximal benefits and use of salmon juveniles are likely and expected (Dollof and Melvin 2003).

3. To address potential effects of hard armoring to stabilize the banks and slopes (#9), NMFS recommends utilizing alternatives to traditional riprap and hard armoring, such as designing compacted fill lifts and vegetation plantings to stabilize banks while also enhancing the limited rearing and foraging EFH locally available to juvenile salmonids. This could involve

placing granular soil under compost socks above the OHWM. The compacted fill lifts would consist of compost socks, would have a minimum durability of one year and would be composed of biodegradable jute, sisal, burlap, or coir fiber fabric. A 12-inch diameter compost sock would be installed on the face of each lift and then the compost sock and soil at each lift would be wrapped with biodegradable material. The process would be repeated until the top of the site is reached. Once the compost socks and soil wraps have been placed, two 6-foot live willow branch cuttings would be placed per linear foot in each of the lifts and a 2-inch layer of topsoil would be placed over the cuttings. Hard bank protection should be a last resort and the following options should be explored beforehand for efficacy (tree revetments, stream flow deflectors, and vegetative riprap (FEMA 2009)). Exchanging riprap placement for these recommendations helps restore the disturbed ground, decreases the chance of future erosion events, and moves the riverbank back to a more natural state while still providing the stabilization needed for the continuous operations of the HSR system.

4. To address long-term reductions in riparian vegetation (effect #4), in areas where levees are under the jurisdiction of the United States Army Corps of Engineers or any other flood management agency, apply for and obtain a vegetation variance which will allow for the Authority or its contractors to re-plant the area with native species as described above in conservation recommendation #3, at least in the lower one-third of the waterside of the levee.

5. To address expected decreases in EFH water quality due to increased urbanization and stormwater discharge associated with HSR system implementation (effect #6), NMFS recommends that the Authority take efforts beyond its own properties to help the local communities (perhaps through permitting guidance or knowledge exchanges with the communities stations are located within):

    a. Install and monitor vegetated buffers along stormwater drains to streams, compost based bioretention filters, or bioswales in upland areas with the goals of trapping sediment, removing nutrients, tire wear particles, and metals, and moderating water temperatures, as feasible.

    b. Increase stormwater quality monitoring following National Pollutant Discharge Elimination System and State Water Resources Control Board requirements from all stormwater discharge points, and before and after pollution control BMPs to establish their performance over time, and adapt/replace/maintain stormwater quality BMPs, as necessary.

    c. Increase public access to knowledge about water quality issues and encourage local efforts to improve watershed water quality in general, especially regarding urban pollution that affects salmon EFH.

Fully implementing these five EFH conservation recommendations and RPM’s 1-3 (section 2.9.3 of the Opinion) would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, Pacific Coast salmon EFH and HAPCs.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Authority must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS's EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The Authority must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS's EFH Conservation Recommendations (50 CFR 600.920(l)).

4. Data Quality Act Documentation and Pre-Dissemination Review

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the California High Speed Rail Authority. Other interested users could include the United States Army Corps of Engineers, USFWS, California Department of Fish and Wildlife, SCVOSA, SCVHA, and the citizens of California. Individual copies of this opinion were provided to the Authority. The document will be available within two weeks at the NOAA Library Institutional Repository. The format and naming adheres to conventional standards for style.

4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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