# Delta Conveyance Project Biological Assessment

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# Acronyms and Abbreviations

| | |
|---|---|
| °C | Celsius |
| °F | Fahrenheit |
| AFRP | Anadromous Fish Restoration Program |
| AMM | avoidance and mitigation measure |
| ARIS | Adaptive Resolution Imaging Sonar |
| A-weighted decibel | dBA |
| BA | Biological Assessment |
| Banks Pumping Plant | Harvey O. Banks Pumping Plant |
| Bay-Delta WQCP | Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary |
| BDCP | Bay Delta Conservation Plan |
| BiOps | Biological Opinions |
| BMPs | best management practices |
| Caltrans | California Department of Transportation |
| CAMT | Collaborative Adaptive Management Team's |
| CCWD | Contra Costa Water District |
| CDFW | California Department of Fish and Wildlife |
| CEQA | California Environmental Quality Act |
| CESA | California Endangered Species Act |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| CLSM | controlled low-strength backfill material |
| cm | centimeters |
| CMP | Compensatory Mitigation Plan |
| CNDDB | California Natural Diversity Database |
| COA | Coordinated Operations Agreement |
| CPTs | cone penetration tests |
| $CT_{max}$ | critical thermal maximum |
| CVFPB | Central Valley Flood Protection Board |
| CVP | Central Valley Project |
| CVPIA | Central Valley Project Improvement Act |
| D-1641 | State Water Resources Control Board Water Right Decision 1641 |
| dB | decibels |
| Delta | Sacramento–San Joaquin Delta |
| Delta Reform Act | Sacramento–San Joaquin Delta Reform Act of 2009 |
| DIDSON | Dual-frequency identification sonar |
| DMM | deep mechanical mixing |
| DPS | Distinct Population Segment |
| DWR | California Department of Water Resources |
| E:I | Export to inflow ratio |
| East Contra Costa County HCP/NCCP | East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan |
| EFH | Essential Fish Habitat |

| | |
|---|---|
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| ERT | electrical resistivity tomography |
| ESA | Endangered Species Act |
| ESU | evolutionarily significant unit |
| Final EIR | Delta Conveyance Project Final EIR |
| FMWT | Fall Midwater Trawl |
| FR | Federal Register |
| FRFH | Feather River Fish Hatchery |
| GCID | Glenn-Colusa Irrigation District |
| GIS | Geographical Information System |
| HCP | Habitat Conservation Plan |
| I- | Interstate |
| IEP | Interagency Ecological Program |
| inSar | Interferometric Synthetic Aperture Radar |
| ITP | Incidental Take Permit |
| JPOD | Joint Point of Diversion |
| JSATS | Juvenile Salmon Acoustic Telemetry System |
| LFC | low-flow channel |
| LSZ | low salinity zone |
| MA | million acre-feet |
| MAF | million acre-feet |
| MAST | Management Analysis and Synthesis Team |
| mm | millimeters |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NCCP | Natural Community Conservation Plan |
| NED | National Elevation Dataset |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NTU | Nephelometric Turbidity Units |
| OCO | Operations Control Office |
| OMR | Old and Middle River |
| OPC | California Ocean Protection Council's |
| PBFs | physical or biological features |
| PCE | primary constituent element |
| PG&E | Pacific Gas and Electric Company |
| ppt | parts per thousand |
| PPV | peak particle velocity |
| proposed action | Delta Conveyance Project |
| psu | practical salinity units |
| Pub. Resources Code | California Public Resources Code |
| RBDD | Red Bluff Diversion Dam |
| Reclamation | U.S. Bureau of Reclamation |
| RM | River Mile |
| RMS | root mean square |
| RTM | reusable tunnel material |

| | |
|---|---|
| SaMT | Salmon Monitoring Team |
| SCADA | supervisory control and data acquisition |
| SEIR | Subsequent Environmental Impact Report |
| SEL | sound exposure level |
| $SEL_{cumulative}$ | cumulative sound exposure level |
| Skinner Fish Facility | John E. Skinner Delta Fish Protective Facility |
| SL | standard length |
| SLS | Smelt Larval Survey |
| SMSCG | Suisun Marsh Salinity Control Gate |
| SMT | Smelt Monitoring Team |
| SMUD | Sacramento Municipal Utility District |
| SPL | sound pressure level |
| SR | State Route |
| SRFG | Stanislaus River Fish Group |
| SST | Salmonid Scoping Team |
| SWP | State Water Project |
| SWPAO | State Water Project Analysis Office |
| TAF | thousand acre-feet |
| TBM | tunnel boring machine |
| TFCF | Tracy Fish Collection Facility |
| USACE | US Army Corps of Engineers |
| USC | United States Code |
| USFWS | U.S. Fish and Wildlife Service |
| WAPA | Western Area Power Administration |
| WOMT | Water Operation Management Team |

# Chapter 1
# Introduction

## 1.1 Purpose of this Document

As required by the by Section 7 of the federal Endangered Species Act (ESA) and its implementing regulations (50 Code of Federal Regulations [CFR] § 402 *et seq*.), federal agencies must ensure their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat through consultation with the National Marine Fisheries Service (NMFS) and/or the U.S. Fish and Wildlife Service (USFWS). Per the requirements of Section 7(b)(3) of ESA, at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the agency's actions would affect listed species and their critical habitats.

This Biological Assessment (BA), prepared consistent with the ESA, evaluates the potential effects of the proposed Delta Conveyance Project (proposed action) on listed and proposed species and designated and proposed critical habitat. Through informal consultation (50 CFR §§ 402.02, 402.13) with USFWS and NMFS, this document was developed by the U.S. Army Corps of Engineers (USACE) and the nonfederal agency applicant, the California Department of Water Resources (DWR), in collaboration with the California Department of Fish and Wildlife (CDFW). Through informal consultation, decisions were made regarding the species addressed, the methods used to assess effects on those species, and measures considered to ensure that effects are minimized. As a result of the informal consultation, the proposed action avoids and minimizes potential effects on listed species and supports the analyses needed to enable NMFS and USFWS to develop their biological opinions. The names and contact information for the responsible parties are presented in Table 1.1-1.

This BA presents USACE's assessment of construction, and construction-related maintenance effects of all the proposed action facilities within USACE's jurisdiction to threatened, endangered, and proposed species and the critical habitat that has been designated or proposed for them. This BA also includes, as an appendix, a programmatic discussion of the future proposed actions related to operations to inform the agencies' jeopardy analysis (Appendix 7A, *Framework for Programmatic Assessment for the Delta Conveyance Project and Sites Reservoir Project*). As described below in Section 1.7, *Consultation Approach*, effects from project operations on listed and proposed species will be evaluated in the U.S. Bureau of Reclamation (Reclamation) *2021 Consultation on the Long-Term Operation of the Central Valley Project and State Water Project Biological Assessment* (Bureau of Reclamation 2023). It is important to note, this BA is not requesting a permit for existing south Delta operations, including CVP, which would be covered under other permitting processes.

**Table 1.1-1. Responsible Parties, Respective Role, and Contact Information**

| Agency | Role | Contact Information |
|---|---|---|
| U.S. Army Corps of Engineers | Lead Federal Agency and Action Agency for Construction | Leah Fisher, Regulatory Division, Special Projects Branch, U.S. Army Corps of Engineers, Sacramento District, 1325 J Street, Room 1350, Sacramento, CA 95814.<br>leah.m.fisher@usace.army.mil |
| California Department of Water Resources | Applicant | Gardner Jones, Delta Conveyance Office, CA Department of Water Resources, 1416 9th Street Sacramento, CA 95814<br>(916) 612-6593. gardner.jones@water.ca.gov |

# 1.2 Applicant

USACE is the lead federal action agency for the ESA Section 7 consultation for all of the proposed action activities within USACE's jurisdiction. USACE is considering the issuance of permits to DWR for the proposed action pursuant to Rivers and Harbors Act Sections 10 and 14 (33 United States Code (USC) § 408), and Clean Water Act Section 404. DWR is proposing the construction and operation of new facilities, including new points of diversion. These proposed new facilities would work in conjunction with and modify the existing State Water Project (SWP). The modifications to and operation of the SWP would continue to be coordinated with the Central Valley Project (CVP) and are not within USACE jurisdiction.

DWR, as owner and operator of the SWP, is the entity undertaking all activities related to the proposed action, including construction and operation of the proposed new intakes, the conveyance tunnel, and associated structures. Because the action alternatives would alter federal levees and cross under a federal navigation project, permission from USACE is required under Section 14[1] of the Rivers and Harbors Act (33 USC § 408) (Section 408). In addition, the proposed work in navigable waters and discharge of dredged or fill material into waters of the United States requires authorization from USACE under Section 10 of the Rivers and Harbors Act (33 USC § 403) and Section 404 of the Clean Water Act (33 USC § 1344). DWR is the *requester* under Section 408 and DWR is the *applicant* under Sections 10 and 404.

# 1.3 Brief Description of the Proposed Action

In the Sacramento–San Joaquin Delta Reform Act of 2009 (Delta Reform Act), the California State Legislature recognized a linkage between ecosystem decline in the Sacramento–San Joaquin Delta (Delta) and reduced reliability of water exported from the Delta to millions of Californians and acres of productive farmland. Accordingly, it adopted the coequal goals for the Delta "of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem" (California Public Resources Code [Pub. Resources Code] § 29702(a)), acknowledging that providing a more reliable water supply involves "new … Delta conveyance facilities."

[1] This requirement was established in Section 14 of the Rivers and Harbors Act of 1899, which has since been amended several times and is codified at 33 USC § 408 (Section 408).

When the Delta Reform Act was enacted in 2009, planning was underway on the Bay Delta Conservation Plan (BDCP), an ambitious habitat conservation plan/natural community conservation plan that included new Delta conveyance among a host of conservation measures. In 2015, DWR announced it would consider and study a set of non-conservation plan conveyance-only alternatives to the BDCP, including the California WaterFix. DWR subsequently approved the California WaterFix. In 2019, however, newly elected Governor Gavin Newsom announced that he did not support California WaterFix, which had two main tunnels, but did support a single-tunnel project.

On April 29, 2019, Governor Newsom signed Executive Order N-10-19, directing the California Natural Resources Agency, California Environmental Protection Agency, and California Department of Food and Agriculture to develop a comprehensive strategy to build a climate-resilient water system and ensure healthy waterways through the twenty-first century. After a public input period, Governor Newsom released the *California Water Resilience Portfolio* on July 28, 2020 (California Natural Resources Agency et al. 2020). The *California Water Resilience Portfolio* identifies a suite of complementary actions to ensure safe and resilient water supplies, flood protection, and healthy waterways for the state's communities, economy, and environment. One of the projects identified in the portfolio is new diversion and conveyance facilities in the Delta to safeguard the SWP, referred to herein as the proposed action. DWR initiated the environmental planning process for a single-tunnel option to modernize Delta conveyance.

DWR's fundamental purpose in proposing to develop new diversion and conveyance facilities in the Delta is to restore and protect the reliability of SWP water deliveries south of the Delta, consistent with the *California Water Resilience Portfolio* (California Natural Resources Agency et al. 2020) in a cost-effective manner. This purpose gives rise to several related objectives of the Delta Conveyance Project.

- **Climate resiliency.** Addresses anticipated sea level rise and other reasonably foreseeable consequences of climate change and extreme weather events.
- **Seismic resiliency.** Minimizes health and safety risk to public from earthquake-caused reductions in water delivery quality and quantity from the SWP.
- **Water supply reliability.** Restores and protects ability of the SWP to deliver water in compliance with regulatory limits and SWP contractual agreements.
- **Operational resiliency.** Provides operational flexibility to improve aquatic conditions and manage future regulatory constraints**.**

The proposed action would involve the construction and operation of new SWP water conveyance facilities in the Delta that would be operated to meet the objectives stated above. The proposed action also includes maintenance of new diversion and conveyance facilities. The proposed action would include a new Bethany Reservoir Pumping Plant and Surge Basin to the south of Clifton Court Forebay, and the new Bethany Reservoir Aqueduct that would convey flows to a new Bethany Reservoir Discharge Structure on the shore of Bethany Reservoir. The aqueduct would consist of four pipelines including tunneled segments under the existing CVP C. W. "Bill" Jones Pumping Plant discharge pipelines and existing conservation easements adjacent to Bethany Reservoir. Collectively, these facilities are called the Bethany Complex.

Two new intake facilities located in the north Delta along the Sacramento River would convey up to 6,000 cubic feet per second of water from the north Delta via a tunnel that starts at the intakes, passes under various Delta islands and tracts (e.g. Lower Roberts Island), and terminates at the

Bethany Complex. The proposed Bethany Complex would be located south of Clifton Court Forebay and would include the Bethany Reservoir Pumping Plant, Surge Basin, Aqueduct, and a tunnel that conveys flows to a new Bethany Reservoir Discharge Structure on the shore of the reservoir. Intake components would include cylindrical tee fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, tunnel inlet, and other inlet structures. The proposed action also includes proposed interconnection facilities for Contra Costa Water District (CCWD). The new interconnection facility will include a pump station, a water conveyance pipeline, and an interconnection valve that together would supply water to CCWD's existing Middle River Pipeline.

The BA analyzes the proposed action against the environmental baseline. This includes analysis related to intake facilities on the Sacramento River, tunnel reaches and tunnel shafts, and Bethany Complex facilities that would connect to the existing SWP infrastructure. For more details on the proposed action, refer to Chapter 3, *Description of the Proposed Action*.

# 1.4 Relationship to Existing Biological Opinions

This BA is being submitted with a request for initiation of formal consultation that is expected to result in a biological opinion that would apply to the proposed action, including all construction-related activities of new facilities described in Chapter 3 as analyzed in this BA.

Reclamation has reinitiated consultation on the 2019 Biological Opinions (BiOps) on the coordinated long-term operation of the CVP and SWP. The Delta Conveyance Project will be consistent with the existing regulations and/or any new future requirements, as a result of the reinitiation process described above.

## 1.4.1 NMFS 2019 Biological Opinion on the Coordinated Operations of the CVP and SWP

On October 21, 2019, NMFS completed a biological opinion and incidental take statement (National Marine Fisheries Service 2019) in accordance with Section 7(a)(2) and 7(b) of the statute (16 USC § 1536), associated implementing regulations (50 CFR § 402), and agency policy and guidance (84 FR 44976). The NMFS 2019 BiOp evaluated the impact of CVP and SWP operations on the following federally listed species: Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), California Central Valley steelhead (*Oncorhynchus mykiss*), Southern Distinct Population Segment (DPS) of North American green sturgeon (*Acipenser medirostris*), and Southern Resident DPS of killer whale (*Orcinus orca*).

As part of the development of the NMFS 2019 BiOp, NMFS documented impacts from the proposed operations and worked with Reclamation to modify their proposed operations to minimize and offset those impacts. NMFS undertook two independent scientific peer reviews. Ultimately, NMFS concluded that Reclamation's proposed operations will not jeopardize threatened or endangered species or adversely modify their designated critical habitat.

### 1.4.2 USFWS 2019 Biological Opinion on the Coordinated Operations of the CVP and SWP

On October 21, 2019, USFWS completed a biological opinion and incidental take statement (U.S. Fish and Wildlife Service 2019) in accordance with Section 7(a)(2) and 7(b) of the statute (16 USC § 1536) and associated implementing regulations (50 CFR § 402). USFWS evaluated the impact of CVP and SWP water operations on species listed as threatened or endangered including delta smelt and 15 terrestrial species.

As part of the development of the USFWS 2019 BiOp, USFWS documented impacts from the proposed operations and worked with Reclamation to modify their proposed operations to minimize and offset those impacts. USFWS undertook two independent scientific peer reviews. Ultimately, USFWS concluded that Reclamation's proposed operations will not jeopardize threatened or endangered species or adversely modify their designated critical habitat.

## 1.5 Essential Fish Habitat Assessment

Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH) for species that are managed under federal fishery management plans for waters of the United States, Section 3 of the MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC § 1802). These waters include aquatic areas and their associated physical, chemical, and biological habitat features necessary to support the entire life cycle of the species in question, and may include areas historically used by these species. *Adverse effect* means any impact that reduces the 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. The detailed EFH analysis associated with the proposed action is in Appendix 5A, *Essential Fish Habitat Assessment*.

## 1.6 Species Considered

Pursuant to the interagency consultation requirements of Section 7 of the ESA, this BA has been prepared to assess the effects of the proposed action construction activities on all listed species and designated critical habitat designated under the ESA within the action area. Determination of which listed species should be included in this BA was based on review of Geographical Information System (GIS) distributional maps and water operations modeling, field visits, literature reviews, best professional judgment by qualified biologists, and discussions with federal and state agencies. Species lists were generated on January 6, 2022, by the USFWS' Bay-Delta Fish and Wildlife Office and on January 6, 2022, by the USFWS' Sacramento Fish and Wildlife Office (Appendix 1A, *USFWS Official Species List*). On March 1, 2024, NMFS confirmed the list of species under NMFS jurisdiction in an email. The species addressed in this BA have been derived from the species lists provided by USFWS and NMFS. Species considered for inclusion in this BA include all species on the USFWS and NMFS species lists and additional species with potential to occur in the action area. Reasons for not including species for further evaluation in the BA include: species' range does not overlap the action

area, neither suitable habitat nor known occurrences overlap with the action area, or occurrences have not been detected in the action area.

### 1.6.1 Species Addressed in This Biological Assessment

Table 1.6-1 identifies the listed species that may be affected by the proposed action, listing status (threatened or endangered), status of designated critical habitat in the action area, and which federal agency (USFWS or NMFS) retains jurisdiction and responsibility under Section 7 of the ESA. Throughout this document, the term *listed species* is used to refer to the threatened or endangered species shown in Table 1.6-1 or to the federally listed species' critical habitat and is not intended to include any other species listed under the ESA.

Additionally, in compliance with the MSA, this BA also includes analysis and background information related to the Central Valley fall-run and late fall–run Chinook salmon. This is in part because the Central Valley fall-run Chinook salmon are an important food source for Southern Resident killer whale.

### 1.6.2 Species Considered but Not Addressed Further

In addition to the species shown in Table 1.6-1, a number of listed species and their critical habitat were considered for inclusion in this BA because initial review indicated they could occur in the action area; however, based on analysis of the Delta Conveyance Project, USACE and DWR have determined that the proposed action would not affect (i.e., would have no effect on) these listed species or designated critical habitat (Table 1.6-2). The rationale for that determination is provided in Table 1.6-2.

**Table 1.6-1. Listed Species Addressed in This Biological Assessment**

| Common Name | Scientific Name | Status | Status of Critical Habitat | Jurisdiction | Effects Determination |
|---|---|---|---|---|---|
| Chinook salmon, Sacramento River winter-run ESU | *Oncorhynchus tshawytscha* | Endangered | Designated critical habitat in action area | NMFS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Chinook salmon, Central Valley spring-run ESU | *Oncorhynchus tshawytscha* | Threatened | Designated critical habitat in action area | NMFS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Chinook salmon, Central Valley fall-run ESU [a] | *Oncorhynchus tshawytscha* | Species of Concern | Not designated | NMFS | Species: Not Applicable<br>Critical Habitat: Not proposed |
| Chinook salmon, Central Valley late fall–run ESU [a] | *Oncorhynchus tshawytscha* | Species of Concern | Not designated | NMFS | Species: Not Applicable<br>Critical Habitat: Not proposed |
| Steelhead, California Central Valley DPS | *Oncorhynchus mykiss* | Threatened | Designated critical habitat in action area | NMFS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Green sturgeon, Southern DPS | *Acipenser medirostris* | Threatened | Designated critical habitat in action area | NMFS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Killer whale, Southern Resident DPS | *Orcinus orca* | Endangered | Designated critical habitat not in action area | NMFS | Species: May affect, not likely to adversely affect<br>Critical Habitat: Not likely to adversely affect |
| Delta smelt | *Hypomesus transpacificus* | Threatened | Designated critical habitat in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |

| Common Name | Scientific Name | Status | Status of Critical Habitat | Jurisdiction | Effects Determination |
|---|---|---|---|---|---|
| Longfin smelt | *Spirinchus thaleichthys* | Proposed Endangered and Candidate | Not designated | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: Not designated |
| San Joaquin kit fox | *Vulpes macrotis mutica* | Endangered | Not designated | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: Not designated |
| California least tern | *Sternula antillarum browni* | Endangered | Not designated | USFWS | Species: May affect, not likely to adversely affect<br>Critical Habitat: Not designated |
| Least Bell's vireo | *Vireo bellii pusillus* | Endangered | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Western yellow-billed cuckoo | *Coccyzus americanus occidentalis* | Threatened | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| California red-legged frog | *Rana draytonii* | Threatened | Designated critical habitat in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely to affect |
| California tiger salamander | *Ambystoma californiense* | Threatened | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Giant garter snake | *Thamnophis gigas* | Threatened | Not designated | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: Not designated |
| Delta green ground beetle | *Elaphrus viridis* | Threatened | Designated critical habitat in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |

| Common Name | Scientific Name | Status | Status of Critical Habitat | Jurisdiction | Effects Determination |
|---|---|---|---|---|---|
| Valley elderberry longhorn beetle | *Desmocerus californicus dimorphus* | Threatened | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Vernal pool fairy shrimp | *Branchinecta lynchi* | Threatened | Designated critical habitat in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Vernal pool tadpole shrimp | *Lepidurus packardi* | Endangered | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Colusa grass | *Neostapfia colusana* | Threatened | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Solano grass | *Tuctoria mucronata* | Endangered | Designated critical habitat not in action area | USFWS | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Northwestern pond turtle | *Actinemys marmorata* | Proposed Threatened [b] | Not proposed | USFWS | Species: Not Applicable<br>Critical Habitat: Not proposed |
| Western spadefoot | *Spea hammondii* | Proposed Threatened [b] | Not proposed | USFWS | Species: Not Applicable<br>Critical Habitat: Not proposed |

DPS = distinct population segment; ESA = federal Endangered Species Act; ESU = evolutionarily significant unit; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service.

[a] Included for Essential Fish Habitat analysis associated with the Magnuson-Stevens Fishery Conservation and Management Act.

[b] This species is proposed for listing under the federal ESA and as such is evaluated in this BA to support the USFWS conference opinion. The conference opinion does not make a determination regarding adverse effect, but only a finding as it relates to jeopardy (which is under the purview of USFWS) and therefore is not discussed here.

**Table 1.6-2. Species Considered but Not Addressed Further Because of "No Effect" Determinations**

| Common Name | Scientific Name | ESA Status | Potential for Effect | Potential to Affect Critical Habitat | Jurisdiction |
|---|---|---|---|---|---|
| Steelhead, Central California Coast DPS | *Oncorhynchus mykiss* | Threatened | The species' range does not overlap the action area. | Designated critical habitat not in action area | NMFS |
| Coho salmon, Southern Oregon/Northern California Coast ESU | *Orncorhynchus kisutch* | Threatened | The species' range does not overlap the action area. | Designated critical habitat not in action area | NMFS |
| Lange's metalmark butterfly | *Apodemia mormo langei* | Endangered | The species' range does not overlap the action area. | Designated critical habitat not in action area | USFWS |
| Conservancy fairy shrimp | *Branchinecta conservatio* | Endangered | Suitable habitat and known occurrences overlap with the west-central part of the action area, at the terminus of Lindsay Slough in the Cache Slough Complex, near the Jepson Prairie Reserve. However, this location is more than 13 miles from the nearest project feature. | Designated critical habitat not in action area | USFWS |
| Longhorn fairy shrimp | *Branchinecta longiantenna* | Endangered | In this region, the species is only known to occur in sandstone outcrop pools (U.S. Fish and Wildlife Service 2006; 2012) and that habitat type is not known to occur within the action area. In addition, there are no known occurrences within the action area. | Designated critical habitat not in action area | USFWS |
| San Bruno elfin butterfly | *Callophrys mossii bayensis* | Endangered | The species' range does not overlap the action area. | Proposed critical habitat not in action area | USFWS |
| Alameda whipsnake | *Masticophis lateralis euryxanthus* | Threatened | The species' range does not overlap the action area. | Designated critical habitat not in action area | USFWS |
| Western snowy plover | *Charadrius alexandrinus nivosus* | Threatened | The species' range does not overlap the action area. | Critical habitat not designated | USFWS |
| Riparian woodrat | *Neotoma fuscipes riparia* | Endangered | The species' range does not overlap the action area. | Critical habitat not designated | USFWS |

| Common Name | Scientific Name | ESA Status | Potential for Effect | Potential to Affect Critical Habitat | Jurisdiction |
|---|---|---|---|---|---|
| Large-flowered fiddleneck | *Amsinckia grandiflora* | Endangered | The species' range does not overlap the action area. | Designated critical habitat not in action area | USFWS |
| Succulent (fleshy) owl's clover | *Castilleja campestris* ssp. *succulenta* | Threatened | The species' range does not overlap the action area. | Designated critical habitat not in action area | USFWS |
| Palmate-bracted bird's-beak | *Chloropyron palmatum* | Endangered | The species' range does not overlap the action area. | Critical habitat not designated | USFWS |
| Contra Costa wallflower | *Erysimum capitatum* var. *angustatum* | Endangered | The species' range does not overlap the action area. | Designated critical habitat not in action area | USFWS |
| Contra Costa goldfields | *Lasthenia conjugens* | Endangered | The species' range abuts the action area north of Bethany Reservoir; however, there are no recorded occurrences that would be affected by the project. | Designated critical habitat overlaps with the action area but occurs more than 1,400 feet from the project footprint | USFWS |
| Antioch Dunes evening-primrose | *Oenothera deltoides* subsp. *howellii* | Endangered | Species' range does not overlap with the action area. | Designated critical habitat not in action area | USFWS |
| Keck's checkerbloom | *Sidalcea keckii* | Endangered | Species' range does not overlap with the action area. | Designated critical habitat not in action area | USFWS |
| Riparian brush rabbit | *Syvilagus bachmani riparius* | Endangered | Extirpated from most of its historic range and now restricted to Caswell Memorial State Park on the Stanislaus River, at the confluence with the San Joaquin River, and an adjacent portion of an overflow channel and Paradise Cut, Tom Paine Slough, and channels of the San Joaquin River. Species' current range does not overlap with the action area. No potential for effect to species and habitat from proposed action. | Critical habitat not designated | USFWS |

| Common Name | Scientific Name | ESA Status | Potential for Effect | Potential to Affect Critical Habitat | Jurisdiction |
|---|---|---|---|---|---|
| California condor | *Gymnogyps californianus* | Endangered | Condors can fly long distances in search of food and are known to fly 250 miles a day in search of food (U.S. Fish and Wildlife Service 2023a). Based on condor GPS data from 2021 to 2023, six birds from the Central California flock flew within 5 miles of the action area. Of these, one condor flew within the action area. GPS data indicates that there was no perching, landing, or roosting activity from this bird (Joseph Brandt pers. comm 2024). The action area does not support suitable nesting habitat for condors and there are no known breeding occurrences within the action area (U.S. Fish and Wildlife Service 2023b, 2013; California Department of Fish and Wildlife 2024). The nearest condor nest is greater than 50 miles away (Joseph Brandt pers. comm 2024). Because condors are not present on the ground in the action area and flyover presence is "infrequent" (Joseph Brandt pers. comm 2024), there is no potential for effect. | Designated critical habitat not in action area | USFWS |
| Monarch butterfly | *Danaus plexippus* | Candidate | There is limited potential for effects on the species. There is no overwintering habitat in the action area and proposed action would not result in a population-level effect because these activities would not result in a measurable decrease in the availability of host plants used for breeding, foraging, or roosting, | Critical habitat not designated | USFWS |

| Common Name | Scientific Name | ESA Status | Potential for Effect | Potential to Affect Critical Habitat | Jurisdiction |
|---|---|---|---|---|---|
| | | | or impede movement in the action area. The conservation measures would avoid and minimize effects on foraging and breeding habitat and individuals, and the CMP would offset any habitat loss. [a] | | |

DPS = distinct population segment; ESU = evolutionarily significant unit; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service.

[a] DWR will evaluate the effects to monarch butterfly when the species is proposed for listing either as a revision to this document or an amendment to the BA.

# 1.7 Consultation Approach

In 2015, the USFWS and NMFS promulgated an addition to the regulations on Interagency Cooperation (50 CFR 402) that is relevant to this consultation. The regulation added a "mixed programmatic action" for the purpose of issuing an Incidental Take Statement for take authorization. The regulation also approves "a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and any take of a listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further Section 7 consultation" (50 CFR § 402.2).

This distinction allows for an Incidental Take Statement to be issued for those parts of the proposed action that are specific enough that USFWS and NMFS can meet the regulatory burden of reasonable certainty. Where that degree of certainty is not met, USFWS and NMFS may analyze the future action to determine whether jeopardy of a listed species or destruction or adverse modification of designated critical habitat is likely to result from the entirety of the proposed action and make an overall conclusion for the listed species and designated critical habitat. Once sufficient detail is available for future actions, subsequent targeted Section 7 consultation on these actions will be initiated.

The proposed action includes site-specific construction and construction related maintenance. Future actions, related to operations, will be subject to subsequent Section 7 consultation. Chapter 3, Section 3.2, *Conveyance Facility Construction*, describes the various construction components of the proposed action for this consultation. Chapter 3, Section 3.3, *Intake Operations and Maintenance*, and Section 3.4, *Real-Time Operational Decision-Making Process*, include aspects of the proposed action that will be considered *programmatic*. Sections 3.3 and 3.4 are included to provide important details related to the proposed action.

USACE is requesting ESA section 7 consultation under this BA for construction of all proposed facilities and facility-related maintenance associated with initial construction and/or maintenance of any USACE authorized structure or fill, including any potential impacts associated with the conservation measures (details in Chapter 3, Section 3.6, *Conservation Measures*). Operations related to the Delta Conveyance Project are discussed programmatically in the project description (Section 3.15) of Reclamation's *2021 Consultation on the Long-Term Operation of the Central Valley Project and State Water Project Biological Assessment* (Appendix 7A; Bureau of Reclamation 2023). As part of this process, Reclamation is providing a programmatic assessment of Delta Conveyance Project operations in the context of the updated 2021 LTO BA Proposed Action (Appendix 7A) consultation, including coordinated operations of the SWP and CVP, the Delta Conveyance Project, and other projects consistent with its authorizations under law, including but not limited to the Central Valley Project Improvement Act of 1992 (PL 102-575, Title 34) and the Water Infrastructure Improvements for the Nation Act of 2016 (PL 114–322). Table 1.7-1 summarizes components of the mixed programmatic approach to be considered for Incidental Take coverage and for programmatic consultation.

To support the assessment of the project as a whole, this BA includes a summary of Delta Conveyance Project proposed operations. Operations and maintenance of the proposed action are assessed at a programmatic level for this BA; detailed effects analyses, as well as the qualitative, cumulative, and programmatic analyses that they inform, are presented in Appendix 5C, *Operations*

*and Maintenance Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, and Appendix 6C *Operations and Maintenance Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species*. Operational criteria, as described in Chapter 3 along with the rationale for its inclusion, reflect a reasonable representation of likely operations and decision making once the facilities are constructed, were developed based on best available information, and support the quantitative analysis consistent with the *Delta Conveyance Project Final Environmental Impact Report* (Final EIR) (California Department of Water Resources 2023). Additionally, this BA presents the information contained in the California Endangered Species Act (CESA) Incidental Take Application, which reflects further refinement of project operations. In addition to updated information to support future project-specific consultation for operations of Delta Conveyance Project, Guiding Principles have also been developed to avoid, minimize, and offset adverse effects of proposed operations to listed species and critical habitat (Section 3.15.8 of Appendix 7A; Bureau of Reclamation 2023). Collectively, this information is sufficient to support programmatic review of the proposed action.

**Table 1.7-1. Components of the Mixed Programmatic Approach**

| Activity | Standard Consultation | Framework Programmatic Consultation |
|---|---|---|
| Preconstruction (field investigations) | X | |
| Construction (north Delta intakes, tunnels, tunnel shaft sites, RTM sites, Bethany Complex, access roads, electrical facilities, SCADA facilities, fencing and lighting, park-and-ride lots, land reclamation, Contra Costa Water District settlement related facilities, and other construction support facilities) | X | |
| Construction monitoring and on-site, post-construction mitigation and restoration under the proposed action | X | |
| Near-term baseline studies [a] | X | |
| Post-construction (mitigation and restoration sites [e.g., Bouldin Island mitigation and restoration activities]) | X | |
| Project operations | | X |
| Monitoring, mitigation, and restoration associated with operations of new facilities developed under the proposed action | | X |
| Long-term studies and monitoring associated with construction, mitigation, and operations activities | | X |
| Maintenance activities anticipated to occur during the construction phase of the proposed action | X | |
| Maintenance activities anticipated to occur post-construction, during the operations phase of the proposed action | | X |
| Real-time operational decision making and adaptive management related to new facilities constructed under the proposed action | | X |
| Creation and enhancement at initial mitigation sites Bouldin Island and the Interstate 5 ponds | X | |
| Tidal restoration and channel margin enhancement mitigation sites | | X |

[a] Select baseline studies may be evaluated at project specific level based on ongoing coordination with the federal agencies

# 1.8 References

## 1.8.1 Printed References

Bureau of Reclamation. 2023. *2021 Consultation on the Long-Term Operation of the Central Valley Project and State Water Project Biological Assessment*. Interior Region 10, California – Great Basin Region, Sacramento, CA.

California Department of Fish and Wildlife. 2024. California Natural Diversity Database (CNDDB). RareFind 5. V.5.3.0.

California Department of Water Resources. 2023. *Delta Conveyance Project Final Environmental Impact Report*. December. (ICF 103653.0.003.) Sacramento, CA. Prepared by ICF, Sacramento, CA.

California Natural Resources Agency, California Environmental Protection Agency, and California Department of Food and Agriculture. 2020. *California Water Resilience Portfolio.* July. Available: https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/Final_California-Water-Resilience-Portfolio-2020_ADA3_v2_ay11-opt.pdf. Accessed: July 30, 2021.

National Marine Fisheries Service. 2019. *Biological Opinion on the Long-Term Operation of the Central Valley Project and the State Water Project*. WCRO-2016-00069. West Coast Region, Sacramento, CA.

U.S. Fish and Wildlife Service. 2006. *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*. Portland, OR.

U.S. Fish and Wildlife Service. 2012. *Longhorn Fairy Shrimp (*Branchinecta longiantenna*) 5-Year Review: Summary and Evaluation*. June. Sacramento Fish and Wildlife Office. Sacramento, CA.

U.S. Fish and Wildlife Service. 2013. *California Condor (*Gymnogyps californianus*) 5-Year Review: Summary and Evaluation*. U.S. Fish and Wildlife Service Pacific Southwest Region. June 2013

U.S. Fish and Wildlife Service. 2019. *Biological Opinion for the Reinitiation of Consultation on the Long Term Coordinated Operations of the Central Valley Project and State Water Project*. Service File No. 08FBTD00-2019-F-0164. October 21. Sacramento, CA.

U.S. Fish and Wildlife Service. 2023a. California Condor Species Account. California Condor Recovery Program. Pacific Southwest Region of the U.S. Fish and Wildlife Service. Available: https://www.fws.gov/CNO/es/CalCondor/Condor.cfm. Accessed: January 8, 2023.

U.S. Fish and Wildlife Service. 2023b. *5-Year Review. California Condor/*Gymnogyps californianus*.* August 25. Pacific Southwest Regional Office, Sacramento, CA.

## 1.8.2 Personal Communications

Joseph Brandt Assistant Field Supervisor. U.S. Fish and Wildlife Service. Ventura, CA. January 12, 2024—email to Amy Poopatanapong and Rebecca Sloan, ICF.

Chapter 2
# Consultation History

## 2.1 Consultation History

The California State Water Project (SWP) is a major inter-basin water storage and delivery system that diverts and rediverts water from the southern portion of the Sacramento–San Joaquin Delta (Delta). The SWP has a complex history of consultation under the Endangered Species Act (ESA) of 1973, as amended (16 United States Code § 1531 *et seq*.). The history of ESA Section 7 consultation on long-term operations of the SWP began in the early 1990s. The most recent Biological Opinions (BiOps) on the long-term operation of the Central Valley Project (CVP) and the SWP were issued by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) on October 21, 2019. Details related to the consultation history are hereby incorporated by reference from page 15, *Consultation History*, of the 2019 USFWS BiOp and from Section 1.4, *Consultation History*, of the 2019 NMFS BiOp (U.S. Fish and Wildlife Service 2019; National Marine Fisheries Service 2019).

Details of the Delta Conveyance Project (proposed action) are presented in Chapter 3, *Description of the Proposed Action*.

This Biological Assessment (BA) has been prepared by the U.S. Army Corps of Engineers (USACE) to initiate an interagency consultation consistent with ESA Section 7. USACE is the lead federal agency for this consultation. Details of the consultation approach are located in Chapter 1, *Introduction*, Section 1.7, *Consultation Approach*.

**Table 2.1-1. Chronology of Endangered Species Act Consultation for the Proposed Action**

| Date | Action |
|---|---|
| 2016 | U.S. Bureau of Reclamation (Reclamation), with DWR as the applicant, requested reinitiation of ESA Section 7 consultation with USFWS and NMFS on the coordinated tong-term operation of the Central Valley Project (CVP) and State Water Project (SWP) based on new information related to multiple years of drought, recent data on low delta smelt populations and extremely low salmonid population levels for the endangered winter-run Chinook salmon, and new available relevant information. |
| 2019 | Reclamation transmitted a Final Biological Assessment (BA) to U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) for reinitiation of consultation on the long-term operation of the CVP and SWP. |
| October 21, 2019 | NMFS issued a Biological Opinion (BiOp) with a finding of non-jeopardy for winter-run Chinook salmon, spring-run Chinook salmon, Central Valley steelhead, green sturgeon, and Southern Resident killer whale and no adverse modification to their designated critical habitat and provided reasonable and prudent measures to minimize incidental take. |
| October 21, 2019 | USFWS issued a BiOp with a finding of non-jeopardy for delta smelt and all terrestrial species evaluated and no adverse modification to their designated critical habitat and provided reasonable and prudent measures to minimize incidental take. |
| January 15, 2020 | California Department of Water Resources (DWR) issued a Notice of Preparation of an Environmental Impact Report for the Delta Conveyance |

| Date | Action |
|---|---|
| | Project. Pursuant to the California Environmental Quality Act (CEQA), DWR initiated the preparation of an Environmental Impact Report (EIR) for the Delta Conveyance Project in the Sacramento–San Joaquin Delta in California. DWR is the lead agency under CEQA. |
| February 19, 2020 | Record of Decision related to the Reinitiation of Consultation on the Coordinated Long-Term Modified Operations of the CVP and SWP was signed. The corresponding draft Environmental Impact Statement (EIS) was released by Reclamation on July 12, 2019, and the Final EIS was released on December 19, 2019. |
| August 20, 2020 | U.S. Army Corps of Engineers (USACE) issued a Notice of Intent to Prepare an EIS for construction of the Delta Conveyance Project. Proposed facility locations include Sacramento, San Joaquin, Contra Costa, and Alameda Counties in California (85 *Federal Register* 51420 [Aug. 20, 2020]). |
| March 10, 2021 | A Cooperating Agency Agreement between USACE, Sacramento District and NMFS for the Delta Conveyance Project EIS was signed and issued. The Cooperating Agency Agreement is related to the preparation of an EIS under the National Environmental Policy Act (NEPA) to evaluate the effects of the Delta Conveyance Project on the quality of the human environment. |
| April 16, 2021 | A Cooperating Agency Agreement between USACE, Sacramento District and the U.S. Environmental Protection Agency for the Delta Conveyance Project EIS was signed and issued. The Cooperating Agency Agreement is related to the preparation of an EIS under NEPA to evaluate the effects of the Delta Conveyance Project on the quality of the human environment. |
| September 30, 2021 | Reclamation requested to reinitiate consultation on the Long-Term Operation of the CVP and SWP under Section 7 of the ESA, due to anticipated modifications to the previous Proposed Action that may cause effects on federally listed species or designated critical habitat not analyzed in the current 2019 BiOps. On November 9, 2023, Reclamation delivered a biological assessment to USFWS and NMFS. BiOps are anticipated in 2024. |
| June 2020 – April 2024 | Continuing conversations with applicable federal agencies through informal consultation. |
| December 16, 2022 – March 16, 2023 | Public review of the USACE's Delta Conveyance Project draft Environmental Impact Statement. |
| February 2024 | USACE and DWR decided to pursue an ESA Section 7 compliance pathway for permitting of the proposed construction of water facilities and conservation measures associated with the Delta Conveyance Project. |
| May 2024 | USACE delivers a Delta Conveyance Project BA to NMFS and USFWS for consultation. |

## 2.2 References

California Department of Water Resources. 2020. *Notice of Preparation of Environmental Impact Report for the Delta Conveyance Project*. January 15. Available: https://water.ca.gov/News/Public-Notices/2020/Jan-20/Delta-Conveyance-NOP. Accessed: April 20, 2022.

U.S. Fish and Wildlife Service. 2019. *Biological Opinion for the Reinitiation of Consultation on the Coordinated Operations of the Central Valley Project and State Water Project*. Service File No. 08FBTD00-2019-F-0164. Sacramento, CA.

National Marine Fisheries Service. 2019. *Biological Opinion on the Long-Term Operation of the Central Valley Project and the State Water Project*. Consultation tracking number WCRO-2016-00069. West Coast Region, Sacramento, CA.

Chapter 3
# Description of the Proposed Action

## 3.1 Introduction

The California Department of Water Resources (DWR) has requested approval from the U.S. Army Corps of Engineers (USACE) for authorization under Section 14[1]of the Rivers and Harbors Act (33 United States Code [USC] § 408) (Section 408), Section 10 of the Rivers and Harbors Act (33 USC § 403), and Section 404 of the Clean Water Act (33 USC § 1344) to construct new State Water Project (SWP) points of diversion and additional conveyance facilities in the Delta. The existing SWP Delta water conveyance facilities include, Harvey O. Banks Pumping Plant (Banks Pumping Plant), the John E. Skinner Delta Fish Protective Facility, the Clifton Court Forebay, the Barker Slough Pumping Plant, and Suisun Marsh and Bay facilities. The Delta Conveyance Project (proposed action) would construct and operate new conveyance facilities in the Delta that would add to the existing SWP infrastructure. Two new intake facilities (near the communities of Courtland and Hood) would act as new points of diversion in the north Delta along the Sacramento River, and a tunnel and appurtenant facilities would convey water to the Bethany Complex. The two new intake facilities would divert up to a total of 6,000 cubic feet per second (cfs) of water from the north Delta. The proposed Bethany Complex would be south of Clifton Court Forebay and would include a surge basin, pumping plant, and aqueduct that conveys flows to a new discharge structure on the shore of Bethany Reservoir. The proposed action corresponds with Alternative 5 from the *Delta Conveyance Project Final Environmental Impact Report* (Final EIR). Details on Alternative 5 are located in the Final EIR, Chapter 3, *Description of the Proposed Project and Alternatives*.

The new intake facilities would provide an alternate location for diversion of water from the north Delta[2]. Intake components would include cylindrical tee fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, tunnel inlet, and other structures. The new intake facilities would be operated in coordination with the existing south Delta pumping facilities, resulting in a system also known as "dual conveyance" because there would be two complementary methods to divert and convey water. The following proposed operational criteria of the new facilities, the SWP and Central Valley Project (CVP), are not within USACE jurisdiction.

As discussed in Chapter 1, *Introduction*, this BA presents an assessment of the effects of the construction and maintenance related to construction of the proposed action on threatened and endangered species as well as their designated critical habitat. Table 1.7-1 in Chapter 1 summarizes components of the mixed programmatic approach to be considered for incidental take coverage and for associated consultation. A subsequent BA will be delivered that will amend the operations analysis to a project level. To provide a full context of the proposed action, operational components

[1] This requirement was established in Section 14 of the Rivers and Harbors Act of 1899, which has since been amended several times and is codified at 33 USC Section 408 (Section 408) (U.S. Army Corps of Engineers 2021).

[2] The proposed action does not propose a direct connection to the Central Valley Project (CVP) facilities, including the CVP's C.W. Bill Jones Pumping Plant (Jones Pumping Plant). It should be noted that because of the close proximity to the existing SWP facilities, operations at the Jones Pumping Plant is also limited in certain times due to the presence of special-status fish species in the south Delta.

are included in this chapter's description of the proposed action and are assessed as part of the effects analysis. Proposed operations of the proposed action are described in Appendix 7A, *Framework Programmatic Assessment for the Delta Conveyance Project and Sites Reservoir Project*. Proposed operations for the Delta Conveyance Project are included in this BA to support assessment of the project as a whole. Operations and maintenance of the proposed action are assessed at a programmatic level for this BA; detailed effects analyses, as well as the qualitative, cumulative, programmatic analysis that they inform, are presented in Appendix 5C, *Operations and Maintenance Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, and Appendix 6C, *Operations and Maintenance Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species*. To provide the full scope of the proposed action, this chapter includes details related to construction, operations, and maintenance.

### 3.1.1 Project Objectives

DWR's fundamental purpose in proposing to develop new diversion and conveyance facilities in the Sacramento–San Joaquin River Delta (Delta) is to restore and protect the reliability of State Water Project (SWP)) water deliveries south of the Delta, consistent with the *California Water Resilience Portfolio* (California Natural Resources Agency et al. 2020) in a cost-effective manner. This purpose gives rise to several related objectives of the Delta Conveyance Project:

- To help address anticipated rising sea levels and other reasonably foreseeable consequences of climate change and extreme weather events.
- To minimize the potential for public health and safety impacts from reduced quantity and quality of SWP water deliveries south of the Delta as a result of a major earthquake that could cause breaching of Delta levees and the inundation of brackish water into the areas where existing SWP and CVP pumping plants operate in the southern Delta.
- To protect the ability of the SWP to deliver water when hydrologic conditions result in the availability of sufficient amounts of water, consistent with the requirements of state and federal law, including the California and federal Endangered Species Acts and Delta Reform Act, as well as the terms and conditions of water delivery contracts and other existing applicable agreements.
- To provide operational flexibility to improve aquatic conditions in the Delta and better manage risks of further regulatory constraints on project operations.

### 3.1.2 Project Intake Facilities

The two new intake facilities would act as new points of diversion in the north Delta along the Sacramento River. The two new intake facilities would convey up to a total of 6,000 cfs of water from the north Delta. The water would then be conveyed via a single tunnel that would terminate at the Bethany Complex. Intake components will include cylindrical tee fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, tunnel inlet, and other inlet structures. Additional details are provided in Section 3.2, *Conveyance Facility Construction*.

### 3.1.3 Summary of Proposed Action

The proposed action includes the construction of Intakes B and C to convey up to a total of 6,000 cfs of water from the north Delta. From Intakes B and C, the alignment would then follow route to Twin

Cities Complex double launch shaft, New Hope Tract maintenance shaft, Canal Ranch Tract maintenance shaft, Terminous Tract reception shaft, King Island maintenance shaft, tunnel under Rindge Tract, Lower Roberts Island double launch shaft, Upper Jones Tract maintenance shaft, tunnel under Lower Jones Tract, tunnel under Victoria Island, Union Island maintenance shaft, tunnel under Coney Island, and Clifton Court Tract to the Bethany Complex's Surge Basin reception shaft. Figures 3.1-1 and 3.1-2 provide, respectively, a map and a schematic diagram depicting the alignment and conveyance facilities. Refer to Table 3.1-1 for a summary of the physical characteristics.

The proposed action includes constructing a new Bethany Reservoir Pumping Plant and Surge Basin located to the south of Clifton Court Forebay, and a new Bethany Reservoir Aqueduct that conveys flows to a new Bethany Reservoir Discharge Structure on the shore of Bethany Reservoir. The aqueduct would consist of four pipelines including tunneled segments under the existing CVP C. W. "Bill" Jones Pumping Plant (Jones Pumping Plant) discharge pipelines and existing conservation easements adjacent to Bethany Reservoir. Collectively, these facilities are called the Bethany Complex, described in Section 3.2.6, *Bethany Complex*.

The tunnel from the intakes to the Bethany Complex would have an inside diameter of 36 feet and outside diameter of 39 feet and extend approximately 45 miles from the intakes to the surge basin at the Bethany Reservoir Pumping Plant. The Twin Cities double shaft is used to bore one tunnel north to the intake shafts and one south to the Terminous Tract reception shaft. Lower Roberts Island would have a double launch shaft, which would allow one tunnel boring machine (TBM) to bore north to the Terminous Tract reception shaft and one to bore south toward the final reception shaft at the Bethany Reservoir Surge Basin. New shaft pads would be constructed of soil excavated from either the shaft site or nearby shaft sites. As examples, excess soil from excavation at the Twin Cities Complex would provide soil for the Twin Cities tunnel launch shaft pad and shaft pads at New Hope Tract, Canal Ranch Tract, Terminous Tract, and King Island. Similarly, soil from Lower Roberts Island would be used to construct Upper Jones Tract and Union Island shaft pads.

Delivery of tunnel segments, TBM machinery, other soil materials, and equipment would be by road. Rail would also be used to deliver tunnel segments to the Lower Roberts Island tunnel launch shaft site. For example, all deliveries to the Twin Cities Complex would be by road. Access roads would be modified to accommodate large construction vehicles.

The double launch shaft at Lower Roberts Island would require a shaft site to accommodate a double launch shaft with a figure eight configuration, RTM storage area, and corresponding access roads. Material excavated on-site would be used to construct the shaft pad. The RTM site would also house a rail-served materials depot. Rail access to Lower Roberts Island would be provided from existing Union Pacific Railroad or Burlington Northern and Santa Fe Railway tracks located on the Port of Stockton. Rail lines would be extended from one of the existing rail facilities in the Port of Stockton. Rail access would be extended over a new bridge over Burns Cutoff and continue to the tunnel segment storage area near RTM storage area.

Construction would also include interconnection facilities for Contra Costa Water District (CCWD). The facilities would consist of an interconnection pump station with water intake from the Union Island maintenance shaft on the main tunnel, and a new 1.6-mile conveyance pipeline that would extend from the pump station and connect to the existing CCWD Victoria Island Pipeline just downstream of the CCWD's existing Middle River Intake and Pumping Plant. The interconnection pipeline would be installed in a trench with open cut and cover construction along existing

roadways and within agricultural fields. The pipeline construction easement would be 100 feet wide for the entire length of the trench, including a 30-foot temporary construction easement around the 70-foot permanent easement. Dewatering may occur along the open trench, with flows collected, treated, and reused on-site. The portion of the interconnection pipeline that crosses Victoria Canal would be microtunneled. Launch and retrieval pits, approximately 35 feet wide by 50 feet long, would be placed within the 100-foot open trench construction easement on Union Island and Victoria Island to launch and receive microtunneling equipment. A permanent 70-foot wide easement would be maintained along the length of the pipeline in Union Island and Victoria Island. Air valves, blow offs, and access manways would be placed along the pipeline within the permanent easement. Pumped flow from the new Interconnection Pump Station would convey raw water from the Union Island shaft to CCWD's existing Transfer Pumping Station through the new conveyance pipeline and subsequently though CCWD's existing Victoria Island and Old River Pipelines. During periods when CCWD's existing Middle River and Old River Pumping Plants are in simultaneous operation with the Interconnection Pump Station, a maximum combined pumped flow of up to 250 cfs could be conveyed through the Victoria Island Pipeline and a maximum combined flow of up to 320 cfs could be conveyed through the Old River Pipeline. For more details on the CCWD facilities, refer to the *Delta Conveyance Final Draft Engineering Project Report Update Bethany Reservoir Alternative*, specifically Appendix A-1, Proposed Interconnection Facilities – Contra Costa Water District (CCWD) (Delta Conveyance Design and Construction Authority 2023.

**Table 3.1-1. Summary of Distinguishing Physical Characteristics**

| **Component** | **Description** [a] |
|---|---|
| Alignment | Bethany Reservoir |
| Conveyance capacity | 6,000 cubic feet per second |
| **Number of Intakes** | 2; Intakes B and C at 3,000 cfs each |
| Intake Construction Acres | Construction acres: Approximately 480<br>Permanent acres: Approximately 250 |
| **Tunnel from Intakes to Bethany Reservoir Pumping Plant** | |
| Diameter | 36 feet inside, 39 feet outside |
| Length | 45 miles |
| Number of tunnel shafts | 11 [b] |
| Launch shafts diameter | 115 feet inside |
| Reception and maintenance shafts diameter | 70 feet inside |
| Surge Basin reception shaft diameter | 120 feet inside |
| Twin Cities Complex | Construction acres: 586<br>Permanent acres: 222 |
| Lower Roberts Island Double Launch Shaft site | Construction acres: 610<br>Permanent acres: 300 |
| Upper Jones Tract Maintenance Shaft [c] | Construction acres: 11<br>Permanent acres: 11 |
| Union Island Maintenance Shaft [c] | Construction acres: 14<br>Permanent acres: 14 |
| **Bethany Complex** | |
| Bethany Reservoir Pumping Plant and Surge Basin site size (all facilities) | Construction acres: 213<br>Permanent acres: 184 |

| Component | Description [a] |
|---|---|
| Bethany Reservoir Pumping Plant pad site | 1,166 feet wide x 1,260 feet long (approximately 34 acres) |
| Surge basin | 815 feet wide x 815 feet long x 35 feet deep, approximately 15 acres |
| Bethany Reservoir Aqueduct | Four 15-foot-diameter parallel below-ground pipelines<br>14,900 linear feet each<br>Construction acres: 128 acres<br>Permanent acres: 68 |
| Aqueduct tunnels | Four 20-foot-diameter parallel tunnels along two reaches of the Aqueduct |
| Bethany Reservoir Discharge Structure | Construction acres: 15<br>Permanent acres: 13 |
| **RTM Volumes and Storage** | |
| Twin Cities Complex long-term RTM storage (approximate) | 214 acres x 15 feet high |
| Lower Roberts Island long-term RTM storage (approximate) | 189 acres x 15 feet high |
| Bethany Complex | No TBM RTM generated or stored |
| Total wet excavated RTM volume (for single main tunnel from intakes to Bethany Reservoir Surge Basin shaft) | 14.4 million cubic yards |

cfs = cubic feet per second; RTM = reusable tunnel material; TBM = tunnel boring machine. The height of the RTM storage stockpiles would decrease as the RTM subsides into the ground over time.

[a] Acreage estimates represent the permanent surface footprints of selected facilities. Overall project acreage includes some facilities not listed, such as permanent access roads.

[b] Number of shafts for the main tunnel from intakes to Bethany Reservoir Surge Basin shaft, counting the double shaft at Twin Cities Complex and the double shaft at Lower Roberts Island each as one shaft.

[c] These maintenance shafts are included in this table because they are distinctive to the proposed action.

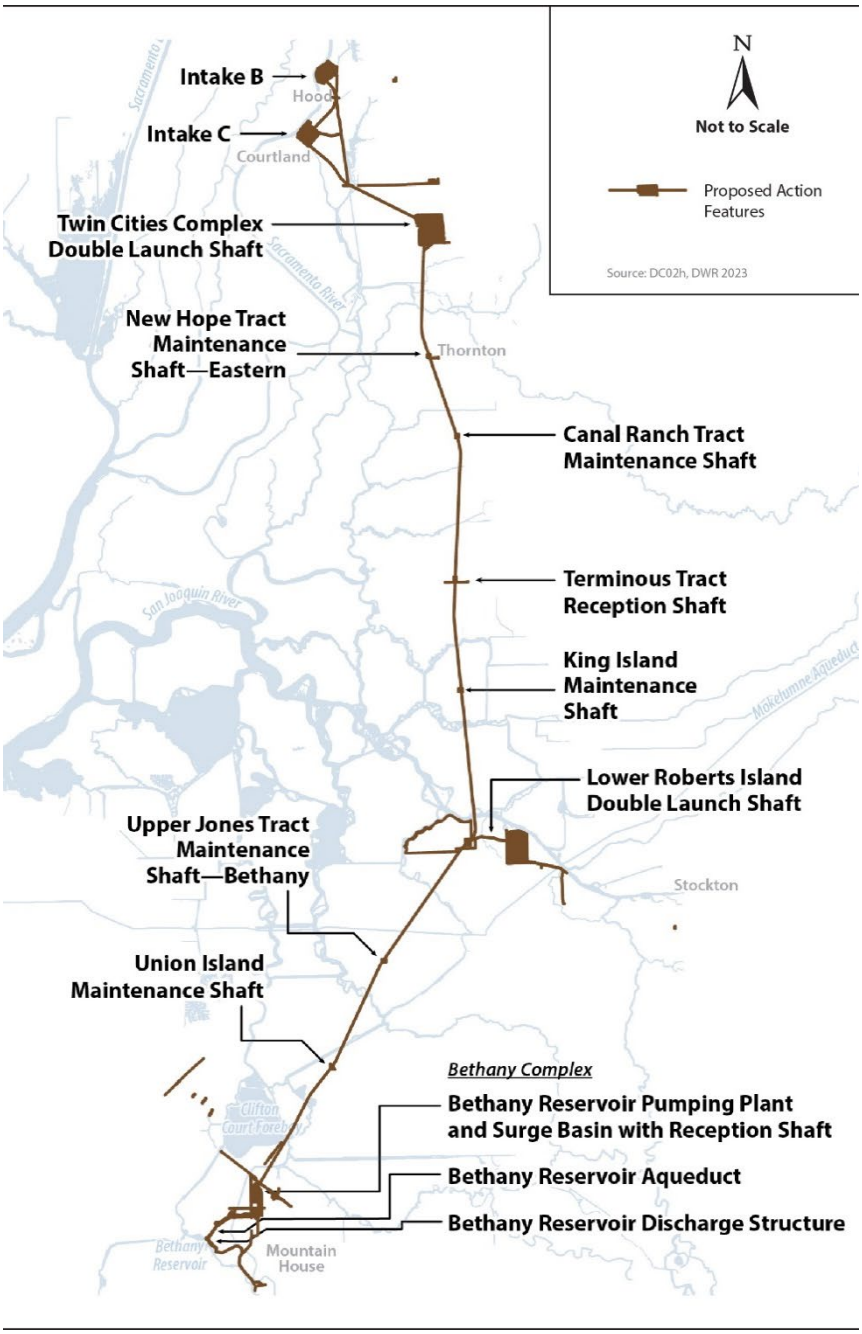


**Figure 3.1-1. Bethany Reservoir Alignment Map**

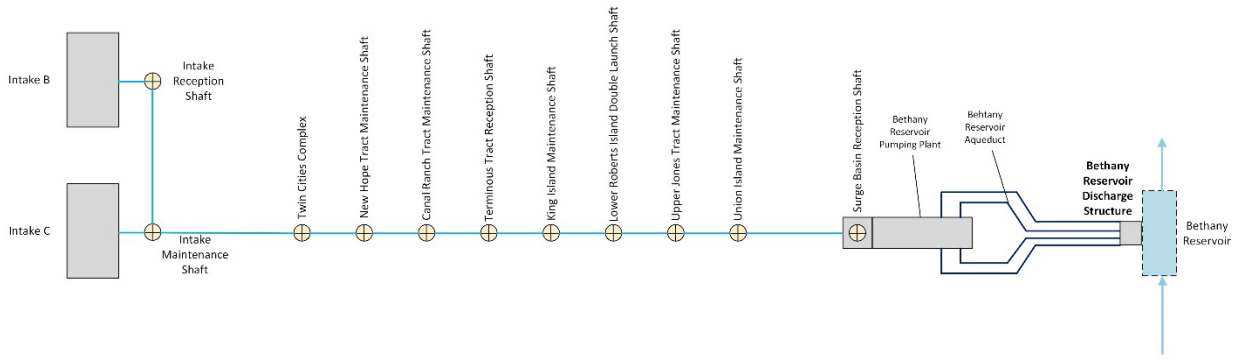


**Figure 3.1-2. Bethany Reservoir Project Schematic**

## 3.1.4 Existing SWP Facilities

The SWP facilities in the Delta provide for delivery of water supply to areas within and immediately adjacent to the Delta, and to regions south of the Delta. The SWP Delta facilities include the Banks Pumping Plant, the John E. Skinner Delta Fish Protective Facility, the Clifton Court Forebay, the Barker Slough Pumping Plant, Suisun Marsh Facilities, South Delta Temporary Barrier Project, San Luis Reservoir, and Feather River Facilities.

In the project area, the SWP is also operated to enhance flood management, recreational, and to provide water consistent with state and federal environmental laws. Within the project area, DWR holds contracts with public water agencies in the Feather River Area, North Bay Area, and South Bay Area. Water stored in the Oroville facilities provides water supply to the Feather River Service Area (i.e., Butte County, Yuba City, and Plumas County Flood Control and Water Conservation District) and is diverted through the Delta, along with available water in the Delta, for delivery to north-of-Delta contractors in Solano and Napa Counties and south-of-Delta SWP long-term water contractors (SWP water contractors) in the Bay Area and south beyond project boundaries.

## 3.1.5 Existing SWP Water Service Contracts

DWR has signed long-term contracts with 29 water agencies statewide to deliver water supplies developed from the SWP system. These contracts are with both municipal and industrial water users and agricultural water users. The contracts specify the charges that will be paid by the water agency for both (1) water conservation and (2) conveyance of water. The foundation allocation of water to each contractor is based on their respective "Table A" entitlement, which is the maximum amount of water that the agency may request from the SWP on an annual basis. DWR allocates Table A water as an annual supply made available for scheduled delivery throughout the year. Table A contracts total 4,173 thousand acre-feet (TAF), with more than 3 million acre-feet (MAF) for San Joaquin Valley and Southern California water users.

The State of California entered into long-term water supply contracts with water agencies in the 1960s. Under the contract terms, DWR provides water service to these public agencies from the SWP in exchange for payments. Current contracts are set to expire starting in 2035. SWP contract extension has been initiated, including the development of CEQA documentation.

Article 21 of the long-term SWP water supply contracts provides an interruptible water supply made available only when certain conditions exist: (1) The SWP share of San Luis Reservoir is

physically full or is projected to be physically full; (2) other SWP reservoirs south of the Delta are at their storage targets or the conveyance capacity to fill these reservoirs is maximized; (3) the Delta is in excess conditions; (4) current Table A demand is being fully met; and (5) Banks Pumping Plant has export capacity beyond that which is needed to meet current Table A and other SWP operational demands.

DWR proposes to operate the SWP, with the Delta Conveyance Project, in accordance with contracts with senior water rights holders (sometimes referred to as "settlement contractors") in the Feather River Service Area (approximately 983 TAF).

## 3.1.6 SWP Settlement Agreements

DWR has water rights settlement agreements to provide water supplies with entities north of Oroville, along the Feather River and Bear River and in the Delta. These agreements provide users with water supplies that they were entitled to prior to the construction of the SWP's Oroville Complex. Collectively, these agreements with more than 60 riparian diverters along the Feather, Yuba, and Bear rivers provide water for diversion (U.S. Department of Interior 2019). Table 3.1-2 summarizes the volume under the water rights settlement agreements. This summary text is included because of its relevance to the Coordinated Operations Agreement (COA) account and daily operations.

**Table 3.1-2. SWP Settlement Agreements**

| Location | Entity | Amount (acre-feet) |
|---|---|---|
| North of Oroville | Andrew Valberde | 135 |
| North of Oroville | Jane Ramelli | 800 |
| North of Oroville | Last Chance Creek Water District | 12,000 |
| Feather River | Garden Highway Mutual Water | 18,000 |
| Feather River | Joint Water Districts Board | 620,000 |
| Feather River | South Feather Water & Power | 17,555 |
| Feather River | Oswald Water District | 3,000 |
| Feather River | Plumas Mutual Water | 14,000 |
| Feather River | Thermalito Irrigation District | 8,200 |
| Feather River | Tudor Mutual Water | 5,000 |
| Feather River | Western Canal/Pacific Gas & Electric (PG&E) | 295,000 |
| Bear River | South Sutter/Camp Far West | 4,400 |
| Delta | Byron-Bethany Irrigation District | 50,000 |
| Delta | East Contra Costa Irrigation District | 50,000 |
| Delta | Solano Co./Fairfield, Vacaville, and Benicia | 31,620 |

## 3.1.7 SWP Allocation and Forecasting

At the beginning of each new water year, there is significant uncertainty as to the hydrologic conditions that will exist in the future several months, and hence the water supplies that will be allocated by the SWP to its water contractors. In recognition of this, DWR uses a forecasting water supply allocation process that is updated monthly, incorporates known conditions in the Central Valley watershed to date, and forecasts future hydrologic conditions in a conservative manner to

provide an accurate estimate of SWP water supplies that can be delivered to SWP contractors as the water year progresses.

There are many factors considered in the forecast-supply process. Some of these factors are the following:

- Water storage in Lake Oroville (both updated and end-of-water-year (September 30)
- Water storage in San Luis Reservoir (both updated and end-of-calendar-year)
- Flood operations constraints at Lake Oroville
- Snowpack surveys (updated monthly from February through May)
- Forecasted runoff in the Central Valley (reflects both snowpack and precipitation)
- Feather River settlement agreement obligations
- Feather River fishery flows and temperature obligations
- Anticipated depletions in the Sacramento and Delta basins
- Anticipated Delta standards and conditions
- Anticipated CVP operations for joint responsibilities
- Contractor supply requests and delivery patterns

Staff from both the Operations Control Office (OCO) and the State Water Project Analysis Office (SWPAO) coordinate their efforts to determine the current water supply allocations. OCO primarily focuses on runoff/operations models to determine allocations. SWPAO requests updated information from the contractors on supply requests and delivery patterns to determine allocations. Both OCO and SWPAO staff meet at least once a month with the Director of DWR to make final decisions on staff's proposed allocations.

The Initial Allocation for SWP Deliveries is made by December 1 of each year with a conservative assumption of future precipitation to avoid overallocating water before the hydrologic conditions are well defined for the year. As the water year unfolds, Central Valley hydrology and water supply delivery estimates are updated using measured and known information and conservative forecasts of future hydrology. DWR makes an initial SWP allocation on December 1; water allocations are updated monthly and finalized in May or June. Monthly briefings are held with the Director of DWR to determine formal approvals of delivery commitments announced by DWR.

Another water supply consideration is the contractual ability of SWP contractors to "carry over" allocated (but undelivered) Table A supplies from the previous year to the next if space is available in San Luis Reservoir. The carryover storage is often used to supplement an individual contractor's current year Table A allocations if conditions are dry. Carryover supplies left in San Luis Reservoir by SWP contractors can result in higher storage levels in San Luis Reservoir. As SWP pumping fills San Luis Reservoir, the contractors are notified to take, or lose, their carryover supplies. Carryover water not taken, after notice is given to remove it, then becomes water available for reallocation and delivery to all contractors in a given year.

Article 21 (surplus to Table A) water, which is delivered early in the calendar year, may be reclassified as Table A water later in the year depending on final allocations, hydrology, and

contractor requests. Reclassification does not affect the amount of water carried over in San Luis Reservoir, nor does it alter pumping volumes or schedules.

### 3.1.8 Daily Operations

After the allocations and forecasting process, U.S. Bureau of Reclamation and DWR coordinate their operations daily. Some factors Reclamation and DWR consider when coordinating their joint operations include required in-Delta flows, Delta outflow, water quality, schedules for the joint-use facilities, pumping and wheeling arrangements, and any facility limitations. Both the SWP and CVP must meet the flood obligations of individual reservoirs. CVP operations must also consider flows at Wilkins Slough and associated pump intake elevations.

During balanced water conditions, Reclamation and DWR maintain a daily water accounting of CVP and SWP obligations. This accounting allows for flexible operations and avoids the need to change reservoir releases made several days in advance (due to travel time from the Delta). Therefore, adjustments can be made "after the fact," using actual observed data rather than by prediction for the variables of reservoir inflow, storage withdrawals, and in-basin uses. This iterative process of observation and adjustment results in a continuous trueing up of the running COA account. If either the SWP or CVP is "owed" water (i.e., the project that provided more or exported less than its COA-defined share), each may request the other to adjust its operations to reduce or eliminate the accumulated account within a reasonable time.

The COA provides the mechanism for determining SWP and CVP responsibility for meeting in-basin use, but real-time conditions dictate real-time actions. Conditions in the Delta can change rapidly. For example, weather conditions combined with tidal action can quickly affect Delta salinity conditions and therefore the Delta outflow required to maintain joint salinity standards under D-1641.

Increasing or decreasing SWP or CVP exports can achieve changes to Delta outflow. Imbalances in meeting each other's initial shared obligations are captured by the COA accounting and balanced out later.

When more reaction time is available, reservoir release changes are used to adjust to changing in-basin conditions. If Reclamation decides the reasonable course of action is to increase upstream reservoir releases, the response may be to increase Folsom Reservoir releases first because the released water will reach the Delta before flows released from other CVP and SWP reservoirs. DWR's Lake Oroville water releases require about 3 days to reach the Delta, while water released from Reclamation's Shasta Reservoir requires 5 days to travel from Keswick Reservoir to the Delta. As water from another reservoir arrives in the Delta, Reclamation can adjust Folsom Reservoir releases downward. Alternatively, if sufficient time exists for water to reach the Delta, Reclamation may choose to make initial releases from Shasta Reservoir. Each occurrence is evaluated on an individual basis, and appropriate action is taken based on multiple factors. Again, the COA accounting captures imbalances in meeting each other's initial shared obligation.

The duration of balanced water conditions varies from year to year. Balanced conditions never occur in some very wet years, while very dry years may have long continuous periods of balanced conditions, and still other years may have had several periods of balanced conditions interspersed with excess water conditions. Account balances continue from one balanced water condition through the excess water condition and into the next balanced water condition. When either the SWP or CVP enters into flood control operations, the accounting is zeroed out for that project.

Reclamation and DWR staff meet daily to discuss and coordinate CVP and SWP system operations. Several items are discussed at this daily meeting, including:

- Current reservoir conditions
- Pumping status and current outages (for both the CVP and the SWP and how they are affecting combined operations)
- Upcoming planned outages (CVP and SWP) and what that means for future operations
- Current reservoir releases and what changes may be planned
- Current regulatory requirements and compliance status
- Delta conditions to determine if CVP and SWP pumping make use of all available water

Reclamation and DWR also coordinate with Hydrosystem Controllers and Area Offices to ensure that, if necessary, personnel are available to make the desired changes. Once Reclamation and DWR each decide on a plan for that day and complete all coordination, the respective agencies issue change orders to implement the decisions, if necessary.

### 3.1.9 Central Valley Project

The CVP, operated by Reclamation, was originally authorized by the Rivers and Harbors Act of 1935. The CVP was reauthorized by the Rivers and Harbors Act of 1937 for the purposes of "improving navigation, regulating the flow of the San Joaquin River and the Sacramento River, controlling floods, providing for storage and for the delivery of the stored waters thereof, for construction under the provisions of the Federal Reclamation Laws of such distribution systems as the Secretary of the Interior deems necessary in connection with lands for which said stored waters are to be delivered, for the reclamation of arid and semiarid lands and lands of Indian reservations, and other beneficial uses, and for the generation and sale of electric energy as a means of financially aiding and assisting such undertakings and in order to permit the full utilization of the works constructed." The CVP was reauthorized in 1992 through the Central Valley Project Improvement Act (CVPIA). The CVPIA modified that authorization under Rivers and Harbors Act of 1937, adding mitigation, protection, and restoration of fish and wildlife as a project purpose. Furthermore, the CVPIA specified that the dams and reservoirs of the CVP should now be used "first, for river regulation, improvement of navigation, and flood control; second, for irrigation and domestic uses and fish and wildlife mitigation, protection and restoration purposes; and, third, for power and fish and wildlife enhancement."

CVPIA (Public Law 102-575, Title 34) includes authorization for actions to benefit fish and wildlife intended to implement the purposes of that Title. Specifically, Section 3406(b)(1) is implemented through the Anadromous Fish Restoration Program (AFRP). The AFRP objectives, as they relate to operations, are further explained below. CVPIA Section 3406(b)(1) provides for modification of the CVP operations to meet the fishery restoration goals of the CVPIA, so long as the operations are not in conflict with the fulfillment of the Secretary of the Interior's contractual obligations to provide CVP water for other authorized purposes. The U.S. Department of the Interior decision on implementation of Section 3406(b)(2) of the CVPIA, dated May 9, 2003, provides for the dedication and management of 800,000 acre-feet of CVP-water yield annually by implementing upstream and Delta actions. The Department of the Interior manages and accounts for (b)(2) water pursuant to its May 9, 2003, decision and the Ninth Circuit's decision in *Bay Institute of San Francisco v. United*

*States*, 66 Fed. Appx. 734 (9th Cir. 2003), as amended, 87 Fed. Appx. 637 (2004). Additionally, U.S. Department of the Interior is authorized to acquire water to supplement (b)(2) water, pursuant to Section 3406(b)(3).

A portion of the water conserved in upstream reservoirs on the Sacramento and San Joaquin Rivers and their tributaries is pumped at the Jones Pumping Plant in the Delta and delivered south of the Delta, to the CVP service area.

## 3.1.10 Coordinated Operations Agreement

Reclamation and DWR would continue to operate their respective facilities in accordance with the COA, as amended. The COA defines the project facilities and their water supplies, sets forth procedures for coordinating operations, and identifies formulas for sharing joint responsibilities for meeting Delta standards and other legal uses of water. The COA further identifies how unstored flow is shared, sets up a framework for exchange of water and services between the projects, and provides for periodic review of the agreement.

In 2018, Reclamation and DWR amended four key elements of the COA to address changes since the COA was signed: (1) in-basin uses; (2) export restrictions; (3) CVP use of Banks Pumping Plant up to 195,000 acre-feet per year; and (4) periodic review. The COA sharing percentages for meeting Sacramento Valley in-basin uses now vary from 80% responsibility of the United States and 20% responsibility of the state of California in wet year types to 60% responsibility of the United States and 40% responsibility of the state of California in critical year types. In a dry or critical year following two dry or critical years, the United States and state of California will meet to discuss additional changes to the percentage sharing of responsibility to meet in-basin uses. When exports are constrained and the Delta is in balanced conditions, Reclamation may pump up to 65% of the allowable total exports with DWR pumping the remaining capacity. In excess conditions, these percentages change to 60%/40%. During excess conditions, Reclamation and DWR are obligated to export and store as much water as possible within their physical and contractual limits. The COA defines balanced conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow approximately equal the water supply needed to meet Sacramento Valley in-basin uses, plus exports. The COA defines excess conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses, plus exports.

## 3.1.11 Delta Operations Regulatory Setting

Refer to Table 3.1-3 for a summary of federal, state, and regional/local laws, regulations, and programs relevant to the proposed action. Non-federal laws, regulations, and programs are included to give relevant context to proposed action activities.

**Table 3.1-3. Laws, Regulations, and Programs Potentially Relevant to the Proposed Action and How It May Affect Surface Water**

| Law, Regulation, or Program | Description |
|---|---|
| **Federal** | |
| Federal Endangered Species Act (ESA) | Section 7 (a)(2) of the ESA requires all federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any federally listed species or result in the |

| Law, Regulation, or Program | Description |
|---|---|
| | destruction or adverse modification of designated critical habitat. Since the proposed action would likely adversely affect a listed species, including the take of a listed species, a biological assessment is being prepared and there will be a request for formal consultation with U.S. Fish and Wildlife Service (USFWS)and National Marine Fisheries Service (NMFS). |
| USFWS and NMFS BiOps on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project | The USFWS (2019a) BiOp and NMFS (2019) BiOp under the ESA determined that coordinated operations of the Central Valley Project (CVP)/State Water Project (SWP) are not likely to jeopardize the continued existence of delta smelt, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, Southern Resident killer whale, or the Southern Distinct Population Segment of green sturgeon, or destroy or adversely modify critical habitat for these species. The BiOps authorize operations until 2030. |
| Collaborative Science and Adaptive Management Program (CSAMP) | CSAMP, and its associated Collaborative Adaptive Management Team, focuses on science and adaptive management issues related to the BiOps for SWP/CVP operations. CSAMP has identified the need to maintain flexibility to address emerging science and information needs regarding water management and species of concern in the Delta and upriver, including actions to improve the resiliency of Delta smelt and salmonids. |
| Magnuson-Stevens Fishery Conservation and Management Act | Requires that all federal agencies consult with NMFS on activities or proposed activities authorized, funded, or undertaken by that agency that may adversely affect essential fish habitat of commercially managed marine and anadromous fish species. The Pacific Fishery Management Council designated the Delta, San Francisco Bay, and Suisun Bay as essential fish habitat to protect and enhance habitat for coastal marine fish and macroinvertebrate species that support commercial fisheries. An essential fish habitat analysis has been prepared as part of the biological assessment (Appendix 5A, *Essential Fish Habitat Assessment*) |
| Recovery Plan for Sacramento-San Joaquin Delta Native Fish Species | Ongoing revision of the plan (U.S. Fish and Wildlife Service 1995) will review the new information and develop a strategy for the conservation and restoration of Delta native fish through the identification of recovery actions that specifically address the threats to their existence. Species covered by this plan are delta smelt, longfin smelt, Sacramento splittail, and Sacramento perch. |
| Recovery Planning for Salmon and Steelhead in California | The Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead was released in July 2014 (National Marine Fisheries Service 2014). The California Central Valley Recovery Domain extends from the upper Sacramento River Valley to the northern portion of the San Joaquin River Valley (National Marine Fisheries Service 2014). |
| Recovery Plan for Green Sturgeon | The purpose and goal of the Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (National Marine Fisheries Service 2018) is to guide recovery of Southern Distinct Population Segment of green sturgeon and consequently remove it from the Federal List of Endangered and Threatened |

| Law, Regulation, or Program | Description |
|---|---|
| | Wildlife, through provision of recovery needs and implementation measures to address previously identified limiting factors. |
| Recovery Plan for San Joaquin Kit Fox | The Recovery Plan for Upland Species of the San Joaquin Valley, California was released in September 1998 (U.S. Fish and Wildlife Service 1998a). Species covered by this plan include San Joaquin kit fox. |
| Revised California Least Tern Recovery Plan | The plan was released in September 1985 (U.S. Fish and Wildlife Service 1985). The plan addresses threats for all breeding populations in the United States. |
| Draft Recovery Plan for Least Bell's Vireo | This plan was released in May 1998 (U.S. Fish and Wildlife Service 1998b). |
| Recovery Plan for the California Red-legged Frog | This plan was released in May 2002 (U.S. Fish and Wildlife Service 2002). |
| Recovery Plan for the Central California Distinct Population Segment of the California Tiger Salamander | This plan was released in June 2017 (U.S. Fish and Wildlife Service 2017b). This plan addresses the threats to the Central California Distinct Population Segment of California tiger salamander. |
| Recovery Plan for the Giant Garter Snake | This plan was released in 2017 (U.S. Fish and Wildlife Service 2017c). |
| Revised Recovery Plan for Valley Elderberry Longhorn Beetle | This plan was released in October 2019 (U.S. Fish and Wildlife Service 2019c). |
| Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon | The plan was released in December 2005 (U.S. Fish and Wildlife Service 2005). The plan addresses 33 vernal pool species including vernal pool fairy shrimp and vernal pool tadpole shrimp. |
| Fish and Wildlife Coordination Act (16 USC § 651 et seq.) | Grants the U.S. Secretary of the Interior the authority to aid federal, state, public, or private agencies in developing, protecting, rearing, or stocking all wildlife, wildlife resources, and their habitats (16 USC § 661). Under the Fish and Wildlife Coordination Act, whenever waters of any stream or other water body are proposed to be impounded, diverted, or otherwise modified by any public or private agency under federal permit, that agency must consult with USFWS and, in California, CDFW (16 USC §§ 661–667e, March 10, 1934, as amended 1946, 1958, 1978, and 1995). |
| Clean Water Act Section 303(d) | Requires states to identify waterbodies that do not meet water quality standards and are not supporting their designated beneficial uses. These waters are placed on the Section 303(d) List of Impaired Waters. This list defines low-, medium-, and high-priority pollutants that require immediate attention by federal and state agencies. Included on this list are the Delta, portions of San Francisco Bay, American River, and portions of the Sacramento River. |
| Clean Water Act Section 404 | Authorizes the USACE and the Environmental Protection Agency to issue permits to regulate the discharge of "dredged or fill materials into waters of the United States" (33 USC 1344). As applicable, permits in compliance with Clean Water Act (CWA) Section 404 must be obtained related to the proposed action. |
| Clean Water Act Section 401 | Specifies that states must certify that any activity subject to a permit issued by a federal agency meets all state water quality standards. In California, the State Water Resources Control Board (State Water |

| Law, Regulation, or Program | Description |
|---|---|
| | Board) and the Regional Water Boards are responsible for certifying activities subject to any permit issued by the USACE pursuant to Section 404 or pursuant to Section 10 of the Rivers and Harbors Act of 1899. |
| Rivers and Harbors Act of 1899 | Regulated under the CWA, the Rivers and Harbors Act of 1899 makes it unlawful to excavate, fill, or alter the course, condition, or capacity of any port, harbor, channel, or other areas within the reach of the act without a permit. Under Section 10 of the Rivers and Harbor Act, USACE regulates all structures and work in navigable waters. Section 14 of the Rivers and Harbors Appropriation Act of 1899, as amended, and codified in 33 USC 408 (Section 408) provides that the Secretary of the Army may, upon the recommendation of the Chief of Engineers, grant permission to other entities for the permanent or temporary alteration or use of any USACE Civil Works project. The proposed action may affect navigable waters and USACE levees within the project area. |
| **State** | |
| California Endangered Species Act (CESA) | Originally enacted in 1970, CESA was repealed and replaced by an updated version in 1984 and amended in 1997. This act states that "all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation, will be protected or preserved." This act grants CDFW enforcement authority. As such, actions that may affect protected species must be evaluated by CDFW. An entity with just cause, may request exemptions from take or harm prohibitions through consultation with CDFW. |
| CDFW Incidental Take Permit for Long-Term Operation of the SWP in the Sacramento-San Joaquin Delta (2020) | In 2020, CDFW issued an Incidental Take Permit (ITP), pursuant to Section 2081 of the California Fish and Game Code, for the ongoing and long-term operation of the SWP's existing facilities in the Delta. The new ITP covers aquatic species listed under CESA that are subject to incidental take from long-term operation of the SWP (i.e., delta smelt, longfin smelt, Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit, and Central Valley spring-run Chinook salmon). The 2020 ITP from CDFW expires on March 31, 2030; an ongoing consultation effort with the goal of obtaining an updated ITP is under way. |
| California Fish and Game Code Section 1602—Lake and Streambed Alteration Program | Section 1602 requires that before an entity substantially diverts or obstructs the natural flow of, or substantially changes or uses any material from the bed, channel, or bank of, any river, stream, or lake, or deposits or disposes of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake, it must submit a written notification to CDFW and pay a prescribed fee. If CDFW determines the activity may substantially adversely affect an existing fish or wildlife resource, it may issue a draft agreement with reasonable measures necessary to protect the resource, and the entity must conduct its activity in accordance with the final agreement. DWR will be seeking a 1602 agreement as part of the overall environmental compliance process. |
| Delta Reform Act | The Sacramento–San Joaquin Delta Reform Act of 2009 (Delta Reform Act) established the Delta Stewardship Council (DSC) to create a |

| Law, Regulation, or Program | Description |
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| | comprehensive, long-term, legally enforceable plan to guide how multiple federal, state, and local agencies manage the Delta's water and environmental resources. The 2009 legislation granted the DSC regulatory and appellate authority over certain actions that take place in whole or in part in the Delta and Suisun Marsh.<br>Since 2010, the DSC has developed, amended, and begun implementing what is called the *Delta Plan*. The *Delta Plan* covers five general topic areas and goals: increased water supply reliability, restoration of the Delta ecosystem, improved water quality, reduced risks of flooding in the Delta, and protection and enhancement of the Delta. The *Delta Plan* sets forth regulatory policies and recommendations that seek to influence the actions, activities, and projects of cities and counties and state, federal, regional, and local agencies toward meeting the goals in the five topic areas. State and local agencies that propose to carry out, approve, or fund a qualifying action in whole or in part in the Delta, called a "covered action," must certify that this covered action is consistent with the *Delta Plan* and must file a certificate of consistency with the DSC that includes detailed findings. |
| The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act | Requires that it is the policy of the State of California to increase the State's salmon and steelhead resources and directs CDFW to develop a plan and program that strives to double the salmon and steelhead resources (Fish & G. Code § 6902[a]). It is also the policy of the State that existing natural salmon and steelhead habitat shall not be diminished further without offsetting the impacts of lost habitat (Fish & G. Code § 6902[c]). |
| State Water Board: Water Quality Control Plan (1995) | The State Water Board adopted the 1995 Bay-Delta Water Quality Control Plan (1995 WQCP) on May 22, 1995, which was partially implemented by the State Water Board Water Right Decision 1641 (D-1641). The State Water Board amended the WQCP in 2006 (known as the Bay-Delta WQCP, discussed below), with additional changes made to the framework for the Lower San Joaquin River and Southern Delta Update and Sacramento-Delta Update in 2018. The proposed action will operate in accordance with the WQCP and any updates therein. |
| State Water Board Water Right Decision 1641 | As introduced above, D-1641 (issued December 29, 1999) and its subsequent revision (Revised D-1641, dated March 15, 2000), the State Water Board implements the objectives set forth in the 1995 WQCP, resulting in flow and water quality requirements for CVP/SWP operations to assure protection of beneficial uses in the Delta. The objectives and export restraints are designed to protect fisheries. The objectives vary throughout the year and according to the year's hydrology (wet, above normal, below normal, dry, critically dry). The proposed action will operate in accordance with the WQCP and any updates therein. |
| State Water Board: 2006 Revised WQCP (Bay-Delta WQCP) | The State Water Board undertook a proceeding under its water quality authority to amend the 1995 WQCP. The State Water Board adopted a revised WQCP on December 13, 2006. No changes to the beneficial uses from the 1995 WQCP were made in the 2006 Bay-Delta WQCP, nor were any new water quality objectives adopted in the 2006 version. |
| Central Valley Flood Protection Board (CVFPB) | Regulates the modification and construction of levees and floodways in the Central Valley defined as part of the Sacramento Valley and San Joaquin Valley flood control projects to ensure public safety. |

| Law, Regulation, or Program | Description |
|---|---|
| **Regional/Local** | |
| California EcoRestore | A multi-agency initiative launched in 2015 to advance 30,000 acres of habitat restoration and enhancement in the Delta, Suisun Marsh, and Yolo Bypass region. California EcoRestore and its partners pursue complex multi-benefit habitat restoration projects to deliver results. DWR is a lead partner on majority of projects focused on implementing a comprehensive suite of habitat restoration actions to support the long-term health of the Delta and its native fish and wildlife species. |
| Ecosystem Restoration Program | A multi-agency effort (CALFED, composed of CDFW, NMFS, and USFWS) aimed at improving and increasing aquatic and terrestrial habitats and ecological function in the Delta and its tributaries. Established in 2000, the ERP implements restoration projects through grants administered by the ERP Grants Program. The majority of these projects focus on fish passage issues, species assessment, ecological processes, environmental water quality, or habitat restoration. |
| Assembly Bill 1200 (2021) | On October 05, 2021, the bill added Sections 139.2 and 139.4 to the California Water Code, which require DWR to evaluate the potential effects on water supplies derived from the Delta resulting from subsidence, earthquakes, floods, changes in precipitation, temperature, and ocean levels, and a combination of those effects. |
| Voluntary Agreements | The California Natural Resources Agency and the California Environmental Protection Agency are leading an effort to negotiate voluntary agreements to increase flows for the environment, create 60,000 acres of new and restored habitat, and provide over $5 billion in new funding for environmental improvements and science.<br>In March 2022, a Memorandum of Understanding was signed that outlines terms for an 8-year program that would provide new flows for the environment to help recover salmon and other native fish, create new and restored habitat for fish and wildlife, and provide significant funding for environmental improvements and water purchases. It also outlines a governance and habitat monitoring framework with clear metrics and goals to allow state, federal and local partners to analyze progress, manage adaptively and decide whether the program should be continued, modified or ended after eight years. |
| Sacramento Valley Salmon Resiliency Strategy | In June 2017, the California Natural Resources Agency developed the Sacramento Valley Salmon Resiliency Strategy to address near- and long-term needs for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and California Central Valley steelhead. The goals and objectives of the Sacramento Valley Salmon Resiliency Strategy focus on addressing life-stage specific stressors, improving habitat conditions, and increasing overall viability of salmonid species. |
| Delta Smelt Resiliency Strategy | In July 2016, the California Natural Resources Agency developed the Delta Smelt Resiliency Strategy to address immediate and near-term need of delta smelt. The Delta Smelt Resiliency Strategy focuses on actions that can be implemented in the next few years to benefit delta smelt. These actions are intended to increase delta smelt growth rates and fecundity levels, as well as improve habitat conditions. |
| Bay-Delta WQCP= Water Quality Control Plan (1995) by the California State Water Board as revised in 2006<br>BiOps = Biological Opinion | |

| Law, Regulation, or Program | Description |
|---|---|
| CALFED = California Bay-Delta Authority<br>CDFW = California Department of Fish and Wildlife<br>CESA= California Environmental Species Act<br>CSAMP = Collaborative Science and Adaptive Management Program<br>CVP = Central Valley Project<br>CWA = Clean Water Act of 1972<br>D-1641= State Water Board Water Right Decision 1641<br>Delta Reform Act = Sacramento–San Joaquin Delta Reform Act of 2009<br>DSC = Delta Stewardship Council<br>DWR = California Department of Water Resources<br>ERP = Ecosystem Restoration Program<br>ESA = Federal Environmental Protection Act of 1970<br>ITP = California Department of Fish and Wildlife Incidental Take Permit pursuant to Section 2081 of the California Fish and Game Code<br>NMFS =National Marine Fisheries Service<br>SWP = State Water Project<br>USACE = United States Army Corps of Engineers<br>USC = United States Code<br>USFWS = United States Fish and Wildlife Service<br>WQCP = Water Quality Control Plan (1995) by the California State Water Board | |

# 3.2 Conveyance Facility Construction

This section describes the major construction activities and components of the conveyance facilities . Information on aspects of construction activities in relation to potential species impacts can be found in Chapter 5, *Effects Analysis for Chinook Salmon, California Central Valley Steelhead, Green Sturgeon, and Killer Whale*, and Chapter 6, *Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species.* For example, implementation of work windows to alleviate potential aquatic species impacts. Further details of construction activities are provided in the Engineering Project Reports (Delta Conveyance Design and Construction Authority 2023).

## 3.2.1 Field Investigations

*Field investigations* refer to data collection efforts to inform more detailed design and construction methods.

Field investigations will occur during the preconstruction and construction periods and are related to geotechnical, hydrogeologic, agronomic testing, and construction test projects (geotechnical investigations) that will occur following issuance of the BA and identification of an approved project footprint. These field investigations would, among other things, support Section 408 permitting, design, and construction phases (described below) and would be performed in accordance with standards of USACE, the American Society of Civil Engineers, California Division of Occupational Safety and Health, California Building Code, San Francisco Public Utilities Commission Seismic Design Criteria, American Nuclear Standards Institute, DWR's Division of Safety of Dams, Caltrans Seismic Design Criteria, Southern California Earthquake Center, and other relevant entities.

The following field investigation activities are anticipated to take place prior to the start of 65% level of design, and where applicable, to support the submission of a formal Section 408 permission application to USACE to address intake construction. The 65% level of design for the tunneled undercrossing of the Stockton Deep Water Ship Channel is related to Section 10 of the Rivers & Harbors Act. Geotechnical investigations and the installation of monitoring equipment would begin following completion of all required permits. These activities and installations are expected to be completed within approximately 2 years depending on availability of access to the project sites. Groundwater and other monitoring activities would be performed prior, during, and after intake construction completion and the tunneled undercrossing of the Stockton Deep Water Ship Channel.

#### 3.2.1.1 Investigations to Support Section 408 Permitting

As mentioned above, the following activities are anticipated to take place prior to the start of 65% level of design to support the submission of a formal Section 408 permission application to USACE to address intake construction. Geotechnical investigations and the installation of groundwater monitoring equipment would begin following completion of all required permits. These activities are expected to be completed within approximately 2 years, depending on availability of access to the project sites. Groundwater and other monitoring activities would be performed prior, during, and after intake construction completion.

##### Soil Boring and Cone Penetration Tests

Soil borings and cone penetration tests (CPTs) would be conducted within the construction boundaries at the intakes and within the Stockton Deep Water Ship Channel and adjacent non-project levees at the location of the proposed tunnel undercrossing. Drilling techniques would generate an approximately 4- to 8-inch-diameter boring. For CPTs, a cone-tipped rod with a diameter of 1 to 2 inches would be pushed through the ground. All CPT holes would be filled with grout following completion and prior to abandonment, and all soil borings not planned to function as a groundwater monitoring well would be completely grouted following boring. Groundwater monitoring wells would be constructed with casings, in accordance with state and local laws.

The information gained through soil borings and CPTs would be used to develop detailed design criteria for structure foundations, new and modified levee cross sections, ground improvement, dewatering methods and quantities, below-grade construction methods, need for impact pile driving, and methods to reduce ground settlement risk at all construction sites and at the undercrossing of the Stockton Deep Water Ship Channel. The information would also be used to determine the depths and widths of groundwater cutoff walls to be installed at the intakes. Soil samples obtained during soil borings would also be analyzed to determine the specific structural capabilities of the soil to construct embankments and levees.

##### Groundwater Testing and Monitoring

At each intake, one 12-inch-diameter steel-cased test well would be installed in a 24-inch-diameter borehole to conduct pumping tests. It is also assumed that vibrating wire piezometers would be installed in several levee borings, and 4-inch groundwater monitoring wells would be installed in several site borings at each intake to permit measurements of groundwater head, monitoring of groundwater elevations during the pumping tests, and the collection of water quality samples at the intake locations. At each intake, a surface water gauge would be installed to track the elevation of the adjacent river for use in analysis of the results.

Pumping tests would be conducted in the test wells. Water levels before, during, and following the various tests would be monitored using automated data loggers, which would also record barometric pressure and the level of the river. It is assumed that the groundwater monitoring program would be conducted partially using remotely monitored instrumentation and partially by on-site personnel.

### 3.2.1.2 Investigations Prior to Construction Phase

The following activities are anticipated to be conducted prior to the start of construction.

#### Investigation at Facility Locations

Explorations would occur at the intakes, tunnel shafts, tunnel alignments, power lines, access roads and bridges, railroads, levees, and at the terminal facilities. (Locations where investigations would occur include Bethany Reservoir Pumping Plant and Surge Basin, Bethany Reservoir Aqueduct, and Bethany Reservoir Discharge Structure.)

##### Soil Boring and Cone Penetration Tests

Land-based soil borings, overwater soil borings, and CPTs would be conducted within the construction boundaries of the intakes, tunnel shafts, tunnel alignments, power lines, access roads and bridges, railroads, and levees. Tests would be conducted at the Bethany Reservoir Pumping Plant and Surge Basin, Bethany Reservoir Aqueducts, and the Bethany Reservoir Discharge Structure.

The information collected would be used to develop detailed design of the structure and bridge foundations, new or modified levee cross sections, ground improvement methodology; and to determine selection of tunnel boring machine methods, dewatering methods and quantities, below-grade construction methods (such as at the shafts and the pumping plant), need for impact pile driving, and methods to reduce ground settlement risk at all construction sites and along the tunnel alignment. The information would also be used to determine the specific depths and widths of groundwater cutoff walls to be installed at select construction sites.

Soil samples obtained during soil borings also would be analyzed to determine the structural capabilities of the soil and/or RTM to construct tunnel shaft pads, and levee improvements. Soil and water quality tests would be conducted to determine the potential for the presence of high concentrations of metals, organic materials, or hazardous materials that would require specific treatment and/or disposal methods.

##### Bethany Fault Study

Electrical resistivity tomography (ERT) would be used to characterize subsurface soil characteristics above the Bethany Reservoir Aqueduct tunnels. ERT involves “a linear array of removable small steel electrodes (approximately 0.5 inch in diameter by 8 inches long) driven into the ground approximately every 10 feet over several hundred feet to induce a low current in the ground, while a small readout unit provides the measurements” (California Department of Water Resources 2020b:17).

### Groundwater Testing and Monitoring

A test well for pumping tests would be installed at each tunnel shaft and at each intake. At each intake, a surface water gauge would be installed to track the elevation of the adjacent river for use in analysis of the results. For the tunnel alignment, it is assumed that vibrating wire piezometers would be installed in boreholes drilled along the tunnel alignment at a frequency of on average every third borehole, or approximately every 3,000 feet. Two test wells would be installed at the Bethany Reservoir Pumping Plant and Surge Basin, and at each of the two planned tunneled sections of the Bethany Reservoir Aqueduct.

Pumping tests would be conducted in the test wells. Water levels before, during, and following the various tests would be monitored using automated data loggers, which would also record barometric pressure and the level of the river. The groundwater monitoring program would be implemented to determine the seasonal variations in groundwater elevations, the constituents of the groundwater (including the nature and presence of dissolved gas), and the interrelation between groundwater and surface water levels for several years before construction. It is assumed that management of the groundwater monitoring program would be conducted partially using remotely monitored instrumentation and partially by on-site personnel.

### Test Trenches

Test trenches approximately 30 feet long, 3 feet wide, and 10 feet deep would be implemented at all the facilities to confirm near-surface soils and to investigate potential buried magnetic anomalies. Trenches would be immediately backfilled following observations of the soil conditions encountered in the trench.

### Monument Installation

Metal survey monuments would be installed at all construction sites and approximately every mile along the tunnel alignments to allow the remote monitoring of surface elevations prior to the start of construction, during construction, and during operations. Monuments would be approximately 10 feet by 10 feet base and 3 feet high to be of adequate size to be visible from satellite-based Interferometric Synthetic Aperture Radar (inSar) used for remote monitoring. Concrete foundations would be installed for the monuments and the monuments would be left in place for the duration of construction. It is assumed that periodic monitoring of survey monuments would be conducted by security and on-site personnel.

## Geotechnical Pilot Studies for Settlement

Site-specific pilot studies would be conducted to test the geotechnical response to placement of fill at tunnel shaft sites, especially at Delta islands. Pilot studies are proposed at New Hope Tract, Canal Ranch Tract, Terminous Tract, King Island, Lower Roberts Island, Upper Jones Tract, and Union Island.

Test fills would be within the construction boundaries of the project and, where feasible, within or adjacent to the shaft pad sites. The test fills would be approximately 10 feet high and roughly 1,000 square feet in base area. The material would be purchased from a commercial enterprise that provides soil. The studies would include the installation of inclinometers, piezometers, and borehole extensometers within soil borings, as well as settlement plates buried within the fill, to verify estimates of consolidation and lateral spreading of pad fills in peat and soft soils.

Additional soil borings and CPTs would be completed within and adjacent to the test fill areas prior to their placement. Inclinometers and extensometers would be installed in holes drilled within and adjacent to the test fills. It is assumed that management of the pilot studies would be conducted by on-site personnel.

### Validation of Ground Improvement Methods

Ground improvement would likely consist of a combination of excavation of unsuitable soils and replacement with compacted suitable fill material, surcharging to induce consolidation before final construction, and *in situ* techniques such as deep mechanical mixing (DMM) method to mix amendments (such as cement) into the foundation to add strength and resistance to liquefaction, including the installation of a grid of DMM soil shear walls with cement under the footprints of large structures. Final site-specific methods would be determined through geotechnical investigations and test installations, especially on land with substantial deposits of peat and loose or soft soils. These investigations would include trial mix and DMM construction programs to confirm appropriate area and volume replacement ratios, desired cement content, and testing to confirm *in situ* strength and lateral extent.

These activities are proposed at New Hope Tract, Canal Ranch Tract, Terminous Tract, King Island, Lower Roberts Island, Upper Jones Tract, and Union Island.

### Pile Installation Methods at the Intake Location

The intake locations would include the construction of temporary in-river cofferdams. The cofferdams would employ the use of interlocking steel sheet piles. Pilot studies would be conducted to test pile installation and possible acoustic mitigation measures in the river at one intake site along the Sacramento River. The studies would include use of equipment to monitor vibrations in air and water and noise while test driving a variety of pile types using vibratory and driving methods to validate rates and penetration depths. Noise associated with vibratory pile driving is considerably lower than noise associated with impact hammer pile driving. Additionally, CPTs would be performed in the river from a barge to determine the *in situ* density of the soils prior to, during, and after test pile installation.

### Vibratory Testing of Dynamic Properties

Vibratory testing of dynamic properties of peat would be conducted in the Delta for validation of peat soil response during earthquakes. This would include continuation of previous studies in the Delta, including those on Sherman Island (Reinert et al. 2014), or additional peat studies at up to two sites at Lower Roberts Island, Upper Jones Tract, or Union Island.

### Location of Buried Groundwater and Natural Gas Wells

Desktop surveys of documented wells would be conducted and would include research of historical topographical mapping that may document the presence of wells that were not identified in the State of California oil and gas database, as maintained by California Department of Conservation (previously known as DOGGR and now known as CalGem [Geologic Energy Management Division]). A field test program would be used to evaluate the suitability of various geophysical techniques to detect buried and abandoned wells.

To identify and/or confirm the location of well casings, including wells that have not been identified in the published database, the use of wide-area airborne methods (drone, helicopter, and/or fixed-wing aircraft) to conduct magnetic surveys followed by more site-specific walk- or tow-over ground-based magnetic surveys is assumed. These surveys would be conducted at intake and tunnel shaft locations, along tunnel alignments, and at the Bethany Complex to identify buried groundwater and natural gas and oil wells. Surface geophysical surveys would also be used at these locations. The locations of identified wells would be evaluated to determine methods to abandon, relocate, or avoid the wells.

## West Tracy Fault Studies

Up to six test trenches (up to approximately 1,000 feet long, 3 feet wide, and 20 feet deep) would be excavated along a line running from the southeast of Byron to the southeast of Clifton Court Forebay to further investigate the nature and location of the West Tracy Fault between the town of Byron and the area southeast of the forebay. The trenches would remain open for up to 6 weeks, depending on the findings, and would be backfilled completely upon the completion of observation of soil conditions within the trench.

In addition to the test trenches, two arrays of surface geophysical surveys would be completed before, and along the alignment of, the excavation of the test trenches. Geophysical surveys would consist of noninvasive techniques that could be used to provide information on subsurface geologic conditions and anomalies, such as buried casings or abandoned wells. Seismic refraction/reflection techniques would be used at each of the two linear sites, referred to as geophysical arrays.

CPTs and soil borings would also be conducted. Select soil samples from the test borings would be subjected to age-dating laboratory testing.

## Agronomic Testing

If field investigations described above indicate it is warranted, additional agronomic testing would be conducted. Agronomic testing would include investigations and testing of compacted soil rehabilitation methods and rehabilitation treatments for establishing agricultural crop or native grass species. Agronomic testing would validate the reuse assumptions prior to reclamation of disturbed areas based on representative samples and likely tunneling conditioners. This pilot-scale testing would be used to refine program-level approaches and strategies for RTM stockpiling and reuse.

## Utility Potholing

Utility potholing, utilizing either a vacuum excavator or a backhoe, would be conducted to confirm locations of existing utilities such as public and residential utilities, surface water diversions, and agricultural drainage features. Utility potholing would be conducted at locations near the intakes, underground supervisory control and data acquisition (SCADA) and power corridors, road and bridge modifications including intersections, tunnel shaft sites, and along the tunnel alignment. Utility potholing would also be conducted at Union Island, Bethany Reservoir Pumping Plant and Surge Basin, the Bethany Reservoir Aqueduct, the Bethany Reservoir Discharge Structure, the raw water feed from Skinner Fish Facility, and at new road and road widening locations. The investigations would be conducted within the construction footprint.

The investigations would include vacuum or backhoe excavations, followed by noninvasive surface field surveys. Some features would not require utility potholing and would be located using only noninvasive surface field surveys.

### 3.2.1.3 Investigations during Construction Phase

As required by USACE Section 408 permitting and the Central Valley Flood Protection Board (CVFPB), the following activities would be conducted after the start of construction. These activities are primarily related to the installation of monitoring equipment, such as inclinometers, confirmatory sampling for areas of ground improvement, and investigations related to evaluation of changes in anticipated conditions or alternative contractor means and methods. These activities would also address USACE Section 408 and CVFPB requirements for monitoring through construction. Geotechnical investigations or the installation of monitoring equipment would be conducted within the first 2 years following the start of construction.

#### Soil Boring and Cone Penetration Tests

Soil boring and CPT investigations during construction would occur in the same locations as described in Section 3.2.1.2, *Investigations Prior to Construction Phase,* under *Investigation at Facility Locations*. These geotechnical investigations would generally be conducted within the first 2 years of the construction period, including during the period when ground improvement activities would be conducted, although they could extend throughout the duration of construction and commissioning to account for delayed starts and to resolve disputes. These investigations could be conducted at any location within the construction boundaries and would also be used to confirm the suitability of construction means and methods planned by the contractor.

### 3.2.1.4 Construction Monitoring

#### Monitoring for Ground Movement during Construction

Inclinometers and extensometers would be installed in vertical borings along levees at the intakes, along the tunnel alignment and at tunnel shafts. They would also be installed at King Island, Lower Roberts Island, Upper Jones Tract, and Union Island; and along levees near bridge improvements along Hood-Franklin Road over Snodgrass Slough, the access road to Lower Roberts Island over Burns Cutoff and Turner Cut, and at Bethany Complex.

No instrumentation is assumed at the new levees, while inclinometers are planned at 1000-ft centers along areas of levee improvements. Tilt meters, settlement plates, and survey monuments would be installed at all construction sites and approximately every mile along the tunnel alignment.

#### Groundwater Monitoring

Groundwater monitoring wells installed before construction could continue to be used during and following construction. Additional groundwater monitoring wells would be installed during construction if permanent easements or land ownership were not acquired before construction, or if initial monitoring results indicated the need for more detailed information related to groundwater elevation or water quality. It is anticipated that the groundwater monitoring locations would be located at the intakes, tunnel shafts, and access roads. Monitors would also be located at Bethany Complex. Monitoring wells would be located at approximately every 2 miles along the tunnel alignment between shafts. It is assumed that management of the groundwater monitoring program

would be conducted partially using remotely monitored instrumentation and partially by on-site personnel.

**Location of Buried Groundwater and Natural Gas Wells**

Land surveys, drilling, and trenching would be used at all intake and tunnel shaft locations, along tunnel alignments, and at the Bethany Complex to identify and abandon buried groundwater and natural gas and oil wells before and during construction.

## 3.2.2 North Delta Intakes

New intakes on the Sacramento River in the north Delta would be constructed. The two intakes (alone or in combination) on the east bank of the Sacramento River would divert water and convey it through a single main tunnel. Intake B would be just north of Hood, and Intake C would be between Hood and Courtland. Intakes B and C would each divert up to 3,000 cfs . Operated in a coordinated manner with the existing facilities, the north Delta facilities would provide flexibility to alter the location, amount, timing, and duration of diversions. A summary of intake characteristics is provided in Table 3.2-1.

At each intake, water would flow through cylindrical tee fish screens mounted on the intake structure to a sedimentation basin before reaching the intake outlet (tunnel inlet) shaft at each site (Figure 3.2-1). The intake outlet shaft would serve as the TBM reception or maintenance shaft during construction and as the intake outlet shaft and maintenance access during operation. These shafts would have an inside diameter of 83 feet.

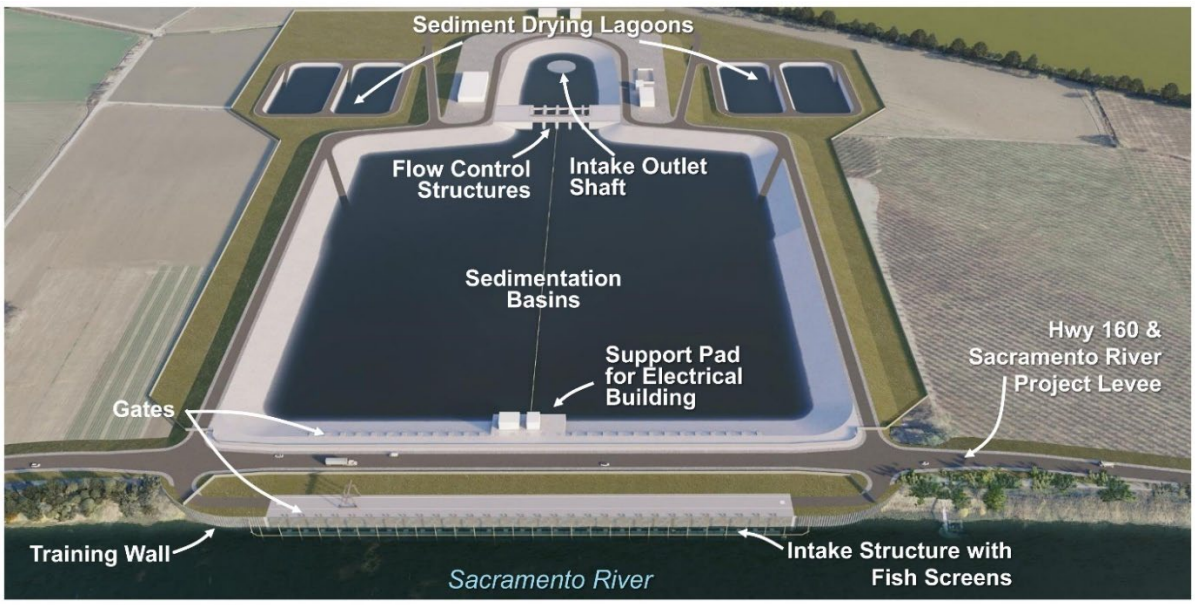


**Figure 3.2-1. Typical Intake Configuration**

From the intake outlet shaft, water would flow into a single-bore main tunnel that connects the intakes to the Twin Cities Complex, from which the tunnel route would extend south on a Bethany Reservoir alignment (Figure 3.2-1 and Figure 3.2-2). The Twin Cities Complex is described in Section 3.2.4, *Tunnel Shafts*.

Intakes would include state-of-the-art cylindrical tee fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and intake outlet shaft, embankments, and other appurtenant structures. Intakes would also include associated facilities to support construction and operations of the intakes. During construction, the intake footprints would contain areas for standby engine generators, staging and management of construction equipment and materials, and ground improvement and slurry cutoff wall material preparation areas. Standby engine generators would be permanently installed at the intakes. Construction access to the intake sites would be by means of new access/haul roads (Section 3.2.7, *Access Roads*). Permanent intake footprints when construction is complete would be smaller once certain construction-related features are removed.

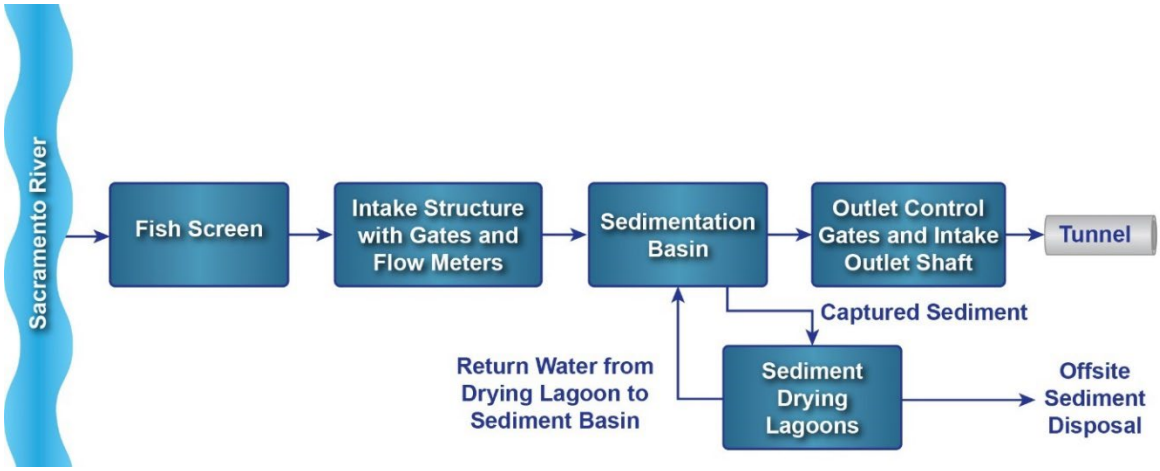


**Figure 3.2-2. Schematic of Delta Conveyance Project Intake Facilities**

**Table 3.2-1. Summary of Intake Characteristics**

| Feature | Intake B | Intake C |
|---|---|---|
| Maximum capacity (cubic feet per second) | 3,000 | 3,000 |
| Total size of construction site (approximately) | 242 acres | 239 acres |
| Total size of postconstruction site (approximately) | 123 acres | 109 acres |
| Intake structure length | 1,574 feet along river including training walls<br>964 feet along river for concrete structure only | 1,528 feet along river including training walls<br>964 feet along river for concrete structure only |
| Cylindrical tee screen assembly | 30 fish screen units | 30 fish screen units |
| Area of cylindrical tee screen (including fish screen and manifold assembly, and mounted on the face of the structure) | Each unit: 8 feet in diameter and 30 feet long | Each unit: 8 feet in diameter and 30 feet long |
| Sedimentation basin dimensions<br>(basin would be divided into two cells by a turbidity curtain) | Each cell = 1,300 feet long and 650 feet wide at top of the embankment | Each cell = 1,300 feet long and 645 feet wide at top of the embankment |

| Feature | Intake B | Intake C |
|---|---|---|
| | Each cell = 990 feet long and 500 feet wide at bottom of the embankment<br>Water surface elevation would vary from about 3 to 27 feet | Each cell: = 990 feet long and 495 feet wide at bottom of the embankment<br>Water surface elevation would vary from about 3 to 26 feet |
| Sediment basin radial gate flow control structure at the junction with the outlet structure and intake outlet shaft | Four large radial gates: 30 feet wide and 40 feet tall, each<br>One small radial gate: 15 feet wide and 8 feet tall<br>Top elevation of flow control structure = 30.3 feet<br>Bottom elevation of flow control structure = - 8.8 feet | Four large radial gates: 30 feet wide and 40 feet tall, each<br>One small radial gate: 15 feet wide and 8 feet tall<br>Top elevation of flow control structure = 29.3 feet<br>Bottom elevation of flow control structure = - 9 feet |
| Sediment drying lagoons dimensions<br>(four sediment drying lagoons at each intake) | Each approximately 146 feet wide and 350 feet long at the bottom of the embankment<br>Each approximately 15 to 18 feet deep, containing an average of 10 to 12 feet of water when in use | Each approximately 146 feet wide and 350 feet long at the bottom of the embankment<br>Each approximately 15 to 18 feet deep, containing an average of 10 to 12 feet of water when in use |
| Sediment drying lagoons outlet structure (to convey water from the lagoons to a pump to return any water to the sediment basin) | Each lagoon outlet structure = approximately 15 feet wide by 15 feet tall<br>Top elevation at the top of lagoon embankment<br>Bottom elevation 20 to 25 feet below top elevation | Each lagoon outlet structure = approximately 15 feet wide by 15 feet tall<br>Top elevation at the top of lagoon embankment<br>Bottom elevation 20 to 25 feet below top elevation |
| Intake outlet channel from flow control structure to intake outlet shaft | Bottom and inside of embankment: 750 feet long and 146 feet wide | Bottom and inside of embankment: 750 feet long and 146 feet wide |
| Length of temporary SR 160 levee | 4,250 feet along the centerline | 4,200 feet along the centerline |
| Length of permanent levee | 7,600 feet along the centerline | 6,200 feet along the centerline |
| Top elevation of permanent levee | 30.3 feet (20 to 23 feet above toe of temporary levee fill) | 29.3 feet (20 to 23 feet above toe of temporary levee fill) |
| Ground improvement under the levees and facilities embankments | Approximately 1.5 to 2.0 million cubic yards of deep mechanically mixed (DMM) wall sections and approximately 250,000 to 350,000 tons of cement | Approximately 1.5 to 2.0 million cubic yards of DMM wall sections and approximately 250,000 to 350,000 tons of cement |
| Cofferdam | Length = 2,942 feet (including sheet piles and DMM wall)<br>Elevation at the top of cofferdam = about 25 feet | Length = 2,897 feet (including sheet piles and DMM wall)<br>Elevation at the top of cofferdam = about 25 feet |
| Cofferdam impact pile driving duration (total hours)<br>(vibratory pile driving hours not included) | 15 | 14 |

| Feature | Intake B | Intake C |
|---|---|---|
| Onsite electrical substations facilities footprint | Facilities contained within a 75-foot-wide by 125-foot-long enclosure with a separate safety and security fence<br>Smaller transformers less than 10 feet wide by 10 feet long would be positioned at several locations around the site | Facilities contained within a 75-foot-wide by 125-foot-long enclosure with a separate safety and security fence<br>Smaller transformers less than 10 feet wide by 10 feet long would be positioned at several locations around the site |
| Standby engine generator/fuel tank—during construction and operation phases | 1 megawatt standby engine generator with a 1528 horsepower engine, installed inside a fenced area of about 30 feet by 30 feet at each electrical building, including both the generator and the fuel tank | 1 megawatt standby engine generator with a 1528 horsepower engine, installed inside a fenced area of about 30 feet by 30 feet at each electrical building, including both the generator and the fuel tank |
| Appurtenant Structures Dimensions—during Construction Phase | Office trailers, showers/ washrooms, canteen and common area, and bus shelter<br>Most of these buildings would be 15-feet tall or less (one story)<br>Other buildings for warehousing for materials and temporary work enclosures would be less than 20 feet tall | Office trailers, showers/ washrooms, canteen and common area, and bus shelter<br>Most of these buildings would be 15-feet tall or less (one story)<br>Other buildings for warehousing for materials and temporary work enclosures would be less than 20 feet tall |
| Appurtenant structures dimensions—during operations phase | One of the construction buildings would be converted for indoor storage of portable equipment and vehicles used for maintenance of all intakes. | One of the construction buildings would be converted for indoor storage of portable equipment and vehicles used for maintenance of all intakes. |
| Land reclamation | Approximately 119 acres | Approximately 130 acres |

Source: Delta Conveyance Design and Construction Authority 2022a, 2022b, 2023a, and 2023b. .
cfs = cubic feet per second; DMM = deep mechanical mixing; SR = State Route.

### 3.2.2.1 Cylindrical Tee Fish Screens

Fish screens installed on intake structures minimize aquatic species from being carried into the intake facilities along with the diverted water. The intake screens are designed to draw in water at reduced velocities to reduce potential effects to the subset of fish exposed to the intake screens.

The intake fish screens are part of an overall intake system that includes the screen units and an integrated screen cleaning system, piping, and flow control features. The "tee-shaped" screen units would consist of two fish screen cylinders installed on either side of a center manifold that would be connected to the facility's intake opening. Each intake fish screen would extend about 12 feet from the vertical face of the intake structure into the river. During diversion operations, water would flow from the Sacramento River through the fish screens and a 60-inch-diameter pipe and discharge into the sedimentation basins. Control gates would regulate the flow through each screen unit to the sedimentation basin (Figure 3.2-3).

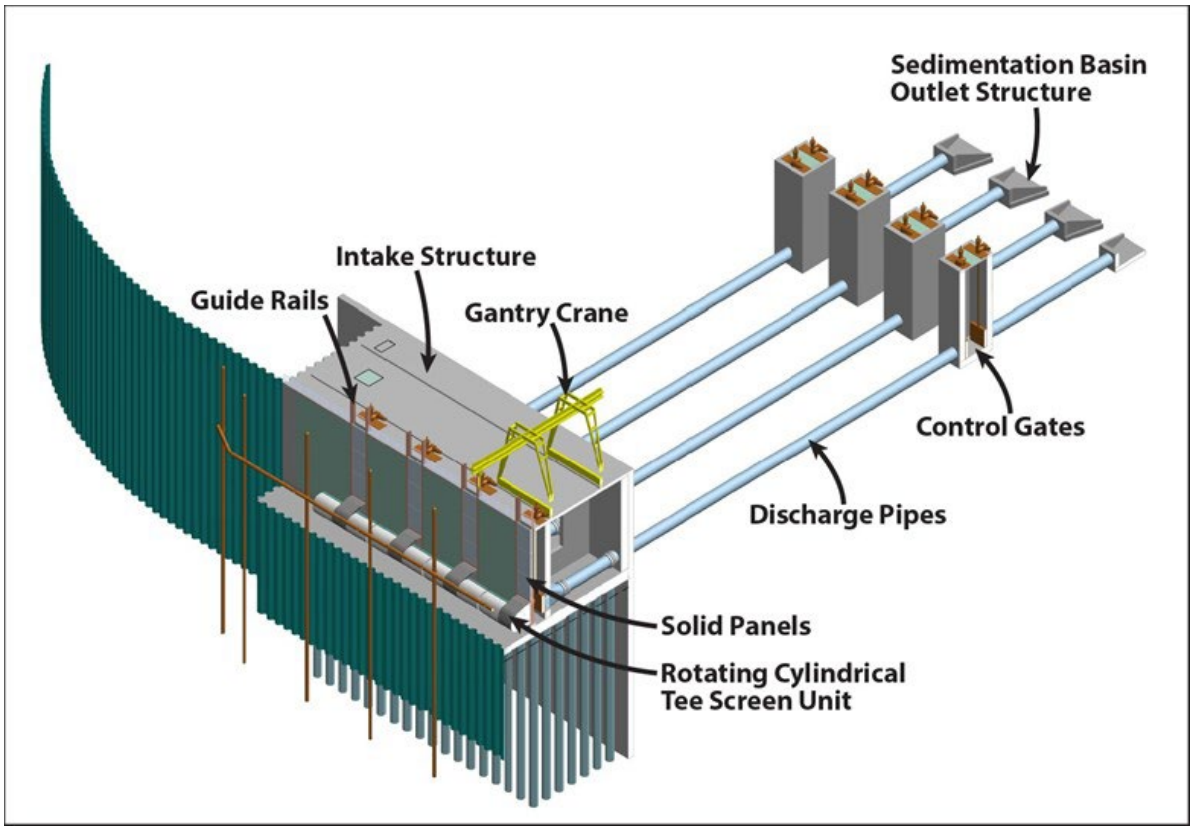


**Figure 3.2-3. Cylindrical Tee Screen Facility**

Installing the intake facility would require construction of a temporary cofferdam for in-river portions of intake construction to divert water and aquatic organisms around the work site and create a dry work area. Portions of the cofferdam would consist of interlocking steel sheet piles installed using a combination of vibratory and impact pile driving. Vibratory pile driving is a method by which the pile is vibrated into the soil beneath the site as opposed to being hammered in, as occurs in impact pile driving. Noise associated with vibratory pile driving is considerably lower than noise associated with impact hammer pile driving. To minimize disturbances from pile driving, vibratory pile driving would be used to the extent possible (where supported by additional geotechnical information). All pile driving would occur within the timeframe between 7:00 a.m. and 7:00 p.m. and would not occur outside of this timeframe. It is estimated that the longest installation period (at Intake C) would be no more than 255 hours over a 5- or 6- week period, including time for handling and preliminary vibratory pile driving. Assuming 2 minutes of driving time for each sheet pile pair, impact drive time would range from a total of 14 hours at Intake C with 3,000-cfs capacity, occurring over roughly 5 or 6 weeks. Each intake sheet pile construction period would be staggered by about 1 year.

### 3.2.2.2 Sedimentation Basins and Drying Lagoon

Diverted water would contain sediment suspended in the river water, a portion of which would be collected in a sedimentation basin. Each intake would have one sedimentation basin divided into two cells by a turbidity curtain (Figure 3.2-1). Water would flow from the intake through the sedimentation basin and through a flow control structure with radial gates into the outlet channel and shaft structure that would be connected to the tunnel system.

The screen and intake design would allow sufficient flow velocities in diversion pipes to sweep sediment into the sedimentation basin and prevent it from settling in the piping system. Once the diverted water enters the sedimentation basins, larger sand and silt sediment particles would settle while smaller silt and clay particles would be carried into the tunnel. A flow control structure with four large radial gates and one smaller gate would control the water level in the sedimentation basin and discharge flow into the intake outlet channel and outlet shaft. Tunnel and aqueduct velocity would be sufficient to transport these smaller particles to the Bethany Reservoir.

Each intake would have four concrete-lined sediment drying lagoons, each approximately 15 feet deep, containing an average of 10 to 12 feet of water within its embankments when in use. Once a year, during the summer months, the sedimentation basin would be dredged, one half at a time, and sediment slurry discharged to drying lagoons, dewatered, and allowed to dry naturally. The sediment is anticipated to be composed of large silt and sand particles with minimal organic material. During dredging operations, sediment is expected to accumulate to a depth of about 1 foot distributed over the floor of the drying lagoons. Water drained from the sediment drying lagoon outlet structures and underdrains would be pumped back into the sedimentation basin. The sediment remaining would be dried for 2 to 6 days, which would reduce the sediment moisture content to a point at which the sediment can be removed and transported without creating dust. If sediment is dried to a level that would create dust, the dust would be controlled by application of water from on-site supplies. The dried sediment would be removed by truck for disposal at a permitted disposal site or used for beneficial uses off-site. The fill and drain/dry sequence would take about 7 to 8 days, which would approximately match the dredged material filling rate so continuous operation would be possible. Each drying lagoon would be filled up to three times each year; however, generally this would only happen once per year for median project conditions. The filling process would be part of the overall sediment removal and disposal process which would be conducted once per year. During the filling period, it would take about 2 days to move sediment from the sedimentation basin to each sediment drying lagoon, about 2 days to remove most of the water back to the sedimentation basin, and about 3 to 4 days to dry and remove sediment from the basin for a total duration of 7 to 8 days. Up to about 1,800 to 2,100 cubic yards of sediment would be removed from each lagoon each time this cycle occurs. The volume of sediment collected would depend upon the volume, suspended sediment concentration, and flow rate of water diverted at the intake. Intake maintenance activities are described in Section 3.3.5, *Intake Maintenance Activities*.

#### 3.2.2.3 Temporary and Permanent Flood Control Levees and State Route 160

Constructing the intakes along the riverbank would require relocating the federal project levee (under USACE jurisdiction) and State Route (SR) 160 prior to building the intake structure and fish screens. The federal ("jurisdictional" or "project") levee was constructed as part of the Sacramento River Flood Control Project Levee program established by the USACE to provide flood management for surrounding lands. Altering a jurisdictional levee requires approval by USACE and CVFPB prior to undertaking any modifications and requires that conformance with flood control criteria be maintained continuously during construction of any modifications. A temporary jurisdictional levee would be built at the intake sites east of the existing levee to reroute SR 160 and maintain continuous flood protection during construction of the new intake facilities.

SR 160 is a State and County Scenic Highway that runs on top of the existing jurisdictional levee. The California Department of Transportation (Caltrans) is responsible for the state highway. DWR would collaborate with Caltrans to ensure the temporary relocation and subsequent permanent

realignment of SR 160 at the intakes conform to all Caltrans highway design, construction, and safety standards. Caltrans would assist DWR with the design of the temporary and permanent relocation of SR 160. Caltrans would also provide construction oversight for activities related to SR 160 relocation.

The temporary levee would also facilitate construction sequencing of the permanent jurisdictional levee around the perimeter of the intake shaft and sedimentation basin. The level of flood control afforded by the existing levee would be maintained during and after construction.

Between the temporary jurisdictional levee and the Sacramento River, a cofferdam would be constructed along the water side of the Sacramento riverbank adjacent to the existing SR 160 to provide a dry workspace for intake structure construction. Following construction of the intake structure and the permanent levee system on the land side of the temporary levee, the area to the east of the intake structure would be backfilled and SR 160 would be relocated on top of the backfill along the Sacramento River. The intake structure and the temporary and permanent levees, including the sedimentation basin, radial gate structure, and intake outlet channel embankments would be designed to protect the site and surrounding area from the 200-year flood event with climate change and sea level rise in the Sacramento River as defined in the *Preliminary Flood Water Surface Elevations* memorandum (California Department of Water Resources 2020a). This level of protection exceeds the requirements of both the USACE and CVFPB. The final configuration of the levee embankment around the intake outlet channel and shaft would protect the channel and shaft opening from the 200-year peak flood elevations plus extreme sea level rise assumed for the year 2100 and 3 feet of freeboard during operations (Table 3.2-2).

**Table 3.2-2 Water Surface and Flood Protection Levee Elevations**

| Intake | River Mile | 200-Year Max WSE + Climate Change+ Sea Level Rise (feet) | Top of Levee (feet) |
|---|---|---|---|
| B | 39.4 | 27.3 | 30.3 |
| C | 36.8 | 26.3 | 29.3 |

Source: Delta Conveyance Design and Construction Authority 2022c.
Max = maximum; WSE = water surface elevation.

### 3.2.2.4 On-Site Roads at the Intakes

Permanent paved roads and gravel-surfaced roads and work areas would be constructed at intakes for use during construction and later operations. At Intake B, approximately 8,900 feet of 20-foot-wide paved permanent roads would be installed on the intake site toward the end of construction. Several 24-foot-wide paved internal roads would be constructed around the base of the intake outlet shaft area, along the top of the embankments, and on ramps up the side of the embankments. About 6,500 feet of 20-foot-wide gravel roads with chip seal would be constructed around the sediment drying lagoons, along the length of the sedimentation basin parallel to SR 160, and to provide access along the sediment loading areas. All construction access and the primary maintenance access to the intake site would be from the intake access road.

Intake C would also have approximately 6,500 feet of 20-foot-wide gravel roads with chip seal around the same facilities as at Intake B. About 8,300 feet of paved permanent roads would be installed at Intake C near the end of construction, along with 24-foot paved internal access roads around the base of the intake outlet shaft area, along the top of the embankments, and on ramps up

the side of the embankments. All construction access and the primary maintenance access to the intake site would be from the intake access road.

Off-site access roads are described in Section 3.2.7.

## 3.2.3 Tunnels

The tunnel from the intakes to the Bethany Complex would have an inside diameter of 36 feet and outside diameter of 39 feet and extend 45 miles from the intakes to the surge basin at the Bethany Reservoir Pumping Plant. The bottom elevations of the tunnel from the intakes to the tunnel reception shaft at the Bethany Complex Surge Basin would range from -139 feet to -164 feet (North American Vertical Datum of 1988 [NAVD88]), with a top elevation near sea level.

## 3.2.4 Tunnel Shafts

TBMs would be used to bore the tunnels. Tunnel shafts to launch, remove, and/or maintain the TBMs would be constructed at intakes, along the alignment, and at the Bethany Complex (see Section 3.1.3, *Summary of Proposed Action,* for all shaft locations). The TBM would be lowered into a launch shaft and bore horizontally toward a reception shaft (Figure 3.2-4). Because the TBM cutterhead would need inspection and maintenance, maintenance shafts would be located approximately every 4 to 6 miles between launch and reception shafts to provide access for TBM maintenance, repair, access or evacuation, and logistic support in a free-air (not pressurized) environment. The northernmost intake shaft would serve as the reception shaft during construction. During operations, shafts at intakes would serve as intake outlet shafts to convey water into the tunnel system as well as for maintenance access to the tunnel. Reception shafts would be used to remove the TBM from the tunnel at the end of each drive. All tunnel shafts would be maintained during operations to provide access, as needed.

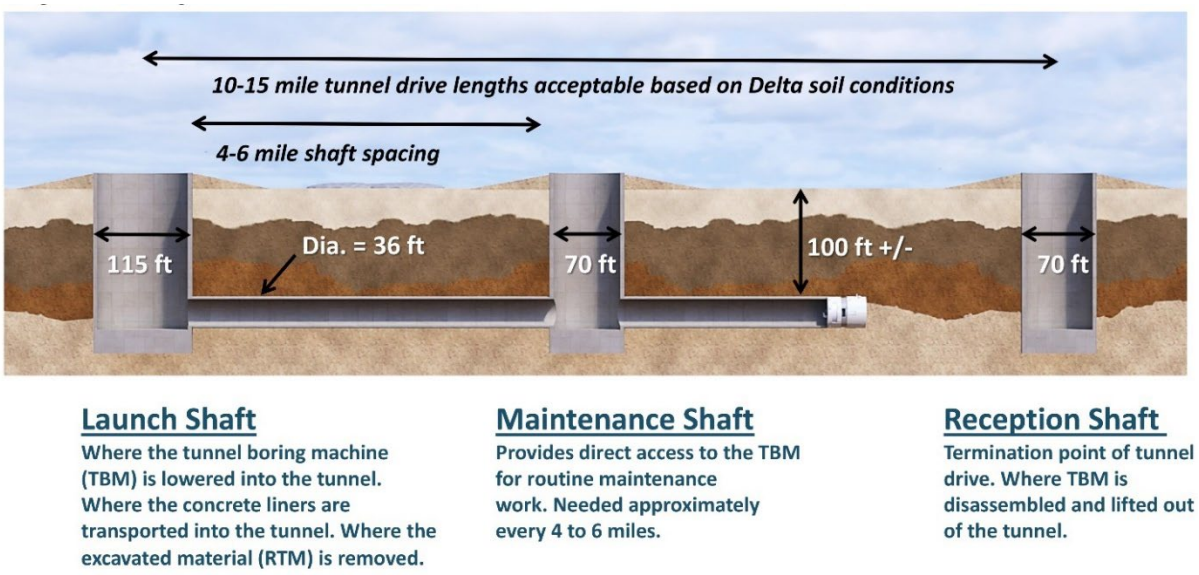


**Figure 3.2-4. Key Components of a Tunnel Drive**

Most shafts would require construction of a shaft pad. Tunnel shaft pads would be constructed above the ground surface to an elevation approximately equal to the adjacent levee system on the

island or tract (see Table 3.1-1 for physical dimensions). The height of the shaft pad would be sufficient to protect the tunnel and construction personnel from localized flooding but lower than the top of the shaft postconstruction to reduce the need for imported fill, which reduces related potential environmental effects. The final postconstruction shaft at the intakes would be raised above the shaft pad to an elevation above the maximum water surface in the tunnel for hydraulic surge events or the Sacramento River 200-year flood event with sea level rise and climate change hydrology for Year 2100, whichever is higher, including freeboard criteria. Note that the Sacramento River flood event water level is higher than the local 200-year flood event with sea level rise and climate change hydrology for year 2100 (including wind fetch wave run-up) at all of the tunnel shaft sites, so the river flood level controls over the local flood level for setting the tops of structures. A concrete cover with air venting provisions would be placed over the top of the shaft. Cranes would be used to move the concrete cover and move any large equipment. A scaffold will be erected to allow personnel into and out of the tunnel during operations.

### 3.2.4.1 Tunnel Launch Shafts

Tunnel launch shafts would generally have a finished inside diameter ranging from 110 to 120 feet and 8-foot thick walls. Tunnel launch shaft sites would include a shaft pad for the tunnel launch shaft with adjacent areas for equipment to excavate and support the shaft, cranes, and appurtenant items to move equipment into and out of the tunnel shaft, equipment holding areas, and areas to receive and manage the excavated RTM. Tunnel launch shaft sites would also include areas for tunnel liner segment storage, aggregate storage, slurry/grout mixing plants, electrical substation and electrical building, workshops and offices, water treatment tanks, access roads, and RTM handling, drying, and storage areas. Construction activities at the launch shafts would continue for 7 to 9 years.

#### Double Launch Shaft at Twin Cities Complex

Construction would include the double launch shaft at the Twin Cities Complex. The double launch shaft would be constructed in a figure eight configuration with an inside diameter of 115 feet to allow TBMs to excavate in both north and south directions (Figure 3.2-5). This double launch shaft would be part of a larger complex that houses other construction components to facilitate tunnel excavation at this site.

The Twin Cities Complex would be off Twin Cities Road approximately 0.5 mile northeast of the interchange with Interstate (I-) 5. Its northern boundary would fall between Dierssen and Lambert Roads, its eastern boundary along Franklin Boulevard, its western boundary offset from the I-5 embankment, and a majority of the southern boundary at Twin Cities Road. During construction, the Twin Cities Complex would occupy 586 acres. The permanent site size would be 222 acres. The construction site would be surrounded by a ring levee, with height varying from about 3.5 feet to 11.5 feet, designed to protect the facilities from the 100-year flood event with the Delta-specific Public Law 84-99 equivalent standards (i.e., 1.5 feet of freeboard above the 100-year Federal Emergency Management Agency flood elevation with 2:1 [horizontal to vertical; H:V] exterior slopes and 3H:1V interior slopes).

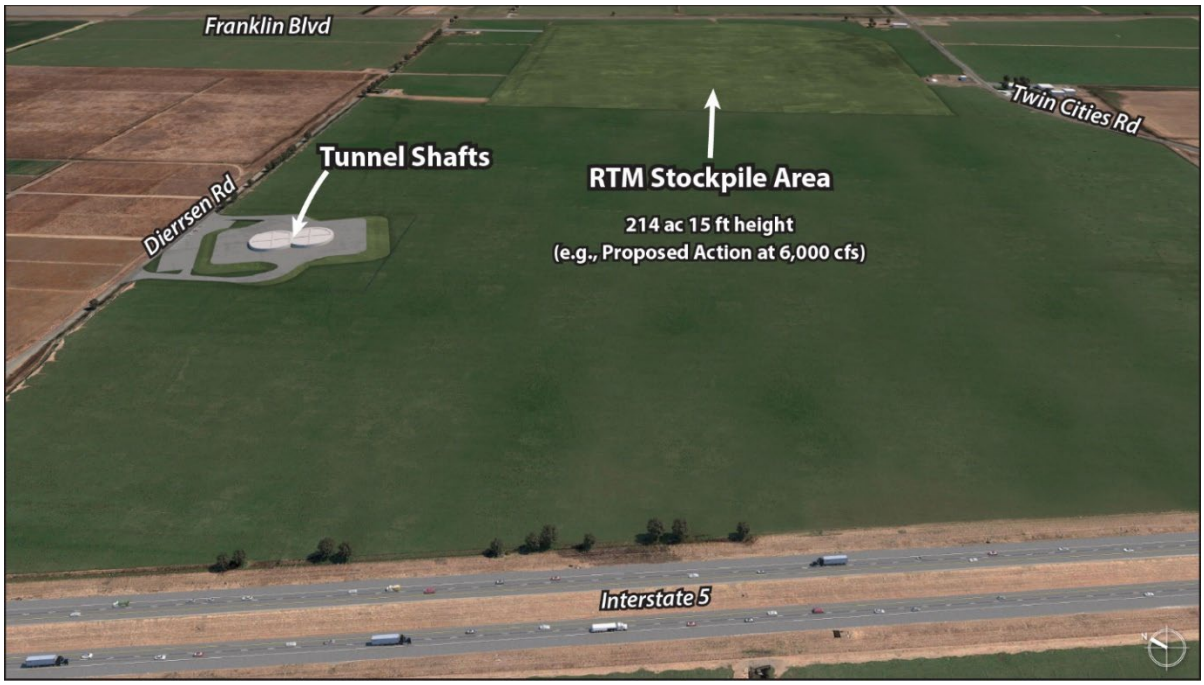


**Figure 3.2-5. Twin Cities Double Launch Shaft Plan**

The Twin Cities Complex during construction would contain the double launch shaft, tunnel segment storage, a grout plant, shops and offices for construction crews, parking, material laydown and erection areas, access roads, RTM conveyor and handling facilities (Section 3.2.5*, Reusable Tunnel Material*), a water treatment plant, emergency response facilities, and a helipad. Tunnel segments, TBM machinery, and other equipment would be delivered to the Twin Cities Complex by road.

Excavated soil and RTM from the Twin Cities Complex would be used for constructing the on-site ring levee and tunnel shaft pad at the Twin Cities Complex and for constructing shaft pads on New Hope Tract, Canal Ranch Tract, Terminous Tract, and King Island. See Section 3.2.10, *Soil Balance*.

No ground improvement would be expected for construction at the Twin Cities Complex because underlying soils appear to have low compressibility and are not anticipated to be subject to liquefaction. Any long-term RTM storage stockpile would be planted with erosion-control seed mix to stabilize the stockpile and avoid dust generation. Refer to Appendix 3A, *General Avoidance and Minimization Measures,* for information related to use of native seed mixes.

## Double Launch Shaft at Lower Roberts Island

Construction would include a double launch shaft at Lower Roberts Island. The double launch shaft would be constructed in a figure eight configuration with an inside diameter of 115 feet to allow TBMs to excavate in both north and south directions (like the double launch shaft at Twin Cities Complex; see Figure 3.2-5). Unlike the double launch shaft at Twin Cities Complex, Lower Roberts double launch shaft would not be part of a larger complex. See Section 3.1.3, *Summary of Proposed Action*, and Section 3.2.5*, Reusable Tunnel Material,* for details on materials housed and configuration of development.

The double launch shaft at Lower Roberts Island would be located off SR 4 approximately 1.8 miles northeast of the interchange with I-5. It would make use of the existing levee roads and need new

road developments; see Section 3.2.7 from more details. During construction, the double launch shaft at Lower Roberts Island would occupy 610 acres. The permanent site size would be 300 acres. The construction site would be surrounded by a ring levee, with height varying from about 3.5 feet to 11.5 feet, designed to protect the facilities from the 100-year flood event with the Delta-specific Public Law 84-99 equivalent standards (i.e., 1.5 feet of freeboard above the 100-year Federal Emergency Management Agency flood elevation with 2:1 [horizontal to vertical; H:V] exterior slopes and 3H:1V interior slopes).

No ground improvement would be expected for construction at the double launch shaft at Lower Roberts Island because underlying soils appear to have low compressibility and are not anticipated to be subject to liquefaction. Any long-term RTM storage stockpile would be planted with erosion-control seed mix to stabilize the stockpile and avoid dust generation. Refer to Appendix 3A for information related to use of native seed mixes.

### 3.2.4.2 Reception and Maintenance Shafts

Reception and maintenance shafts would have finished inside diameters of 70 feet. Tunnel reception and maintenance shaft sites would include areas for the tunnel shaft with adjacent areas for equipment to excavate the shaft, and cranes and appurtenant items to move equipment into and out of the tunnel shaft. Reception shaft sites would be larger than maintenance shaft sites because of the area needed to disassemble the TBM equipment prior to removal from the construction site. Construction activities at the maintenance and reception shaft sites would continue for approximately 2 years. Refer to Figure 3.2-6 for a typical site representation.

Because they would not be used to supply tunnel segments or remove RTM, reception and maintenance shaft sites would not require areas for storing tunnel liner segments or RTM handling. Shafts will have ready-mix concrete hauled in. These shafts would be powered by new power lines extending from existing, local distribution networks and would not need an electrical substation (Figure 3.2-13).

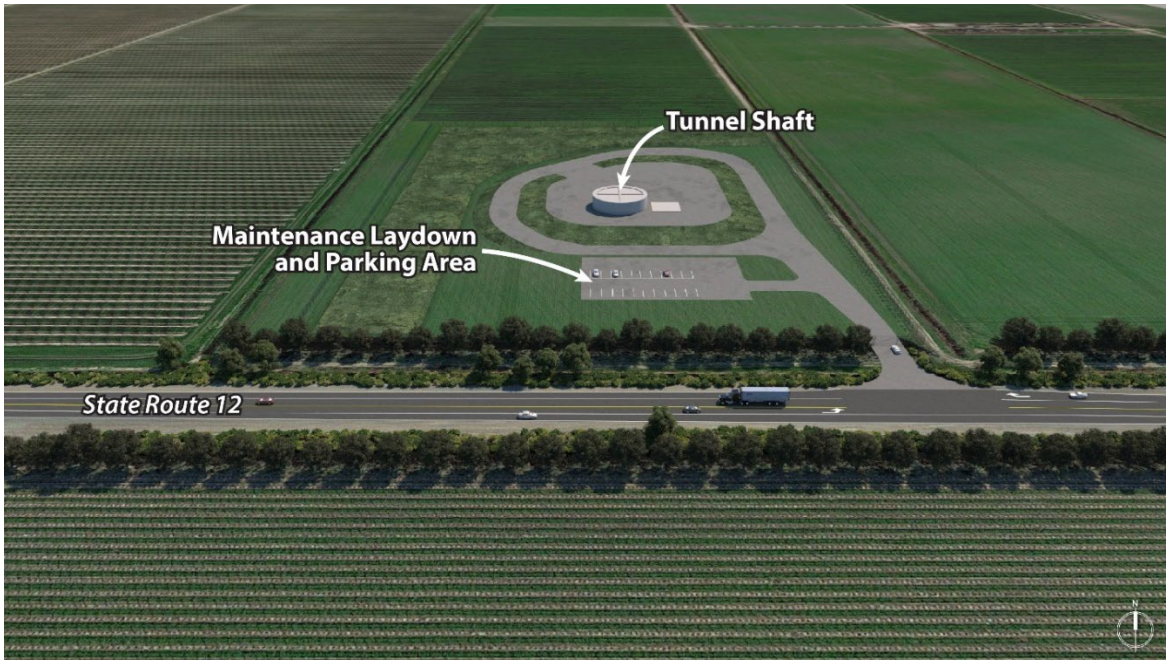

**Figure 3.2-6. Typical Maintenance and Reception Shaft Site Postconstruction**

### 3.2.4.3 Tunnel Shaft Maintenance

Tunnel shafts would be used for tunnel access postconstruction so that periodic inspections, repair, and maintenance activities could be performed. Design features of the gravity tunnel system should preclude the need for planned maintenance; necessary maintenance activities would be the result of inspection findings. However, it is anticipated that at some point during the service life of the system, some maintenance would be required. The maintenance work could range from cleaning out the tunnel invert with a loader or possibly patching or repairing the tunnel lining. Areas to perform inspection and maintenance activities would be provided adjacent to and on top of the shaft pads at each shaft location. Inspection and maintenance activities would comply with the confined space regulations in accordance with Occupational Safety and Health Administration requirements.

There would be daily inspection and security checks at shaft sites. Grounds maintenance would occur twice a year. All vegetation maintenance would be mechanical (e.g., with mower or other hand tools). At this time, the use of herbicides specifically, or pesticides in general, is speculative; because the location, timing, frequency, and methods of application are not known, thus, the use of chemicals to remove vegetation is not proposed. Repaving would occur every 15 years.

## 3.2.5 Reusable Tunnel Material

RTM would be generated at launch shafts as the TBMs bore the tunnel. RTM is the soil removed by the TBM boring the tunnel, mixed with conditioners, and lifted to the ground surface through the launch shaft. “Wet excavated RTM” sections refers to the bulk material, including conditioners, resulting from tunnel excavation. After RTM is removed from the tunnel, it would then be tested for hazardous materials, managed on-site to dry naturally, then stockpiled and transported for reuse or permanently stored.

RTM removed from the tunnel through the launch shafts would be transported by conveyor to handling and storage facilities near launch shaft sites. RTM excavation, testing, drying, and movement from the tunnel launch shaft sites during tunneling operations would occur year-round, 20 hours per day Monday through Friday and 10 hours on Saturdays, allowing time for equipment maintenance. RTM movement from temporary storage to dry stockpile areas would occur 5 days per week from sunrise to sunset. Permanent RTM stockpiles would be elevated above the surrounding grades, covered with excavated topsoil, and planted with native seed mixes primarily for erosion control, and potentially to create a natural habitat area when the stockpile is not being accessed for a soil material source. Recommended treatments for permanent RTM stockpiles would include spreading topsoil, cross disking, and planting native grasses. The planted vegetation would be managed by mechanical means (e.g., with mower or other hand tools) twice a year. The use of herbicides for vegetation management is speculative; because the location, timing, frequency, and methods of application are not known, thus, the use of chemicals to remove vegetation is not proposed. An access road would also be constructed from the existing paved road nearest to the stockpile.

### 3.2.5.1 Disposal of Reusable Tunnel Material

Excavated RTM would be placed in temporary stockpile areas and tested (generally once or twice a day) in accordance with the requirements of the Central Valley Regional Water Quality Control

Board and the Department of Toxic Substances Control for the presence of hazardous materials at concentrations above their regulatory threshold criteria. The contractor(s) would conduct chemical characterization of RTM and associated decant liquid prior to reuse or discharge, respectively, to determine whether it will meet requirements of the National Pollutant Discharge Elimination System and the Central Valley Regional Water Quality Control Board. All decant liquid would be collected and treated for direct on-site reuse or on-site storage to reduce water supply needs. If the amount of treated water flows from RTM decant, dewatering flows, and site runoff exceeds the on-site water demands and on-site storage, the treated flows would be discharged to adjacent water bodies in accordance with the stormwater pollution prevention plan, described in AMM-4a: *Develop and Implement Erosion and Sediment Control Plans* (Appendix 3A). While additives used to facilitate tunneling would be nontoxic and biodegradable, it is possible that some quantity of RTM would be deemed unsuitable for reuse and would be disposed of at a site approved for disposal of such material. This is expected to apply to approximately 1% to 5% of the total volume of excavated material.

It is anticipated that several stockpiles would be developed. Each temporary area would be generally sized to accommodate up to 1 week of RTM production to allow for testing of RTM for presence of contaminated or hazardous materials and suitability for reuse before stockpiling on-site or transporting off-site. Each stockpile area would be lined with impermeable lining material. Additional features of the long-term material storage areas would include berms and erosion protection measures to contain storm runoff as necessary and provisions to allow for truck traffic during construction.

RTM would require drying for long-term stockpiling and storage. Natural drying (evaporation) is the proposed method. The dried RTM would be piled and moved by bulldozers and motor scrapers, and then deposited in the dry stockpile areas near the tunnel launch shaft sites. RTM permanently stored at launch sites would be graded and planted with erosion-control seed mix to avoid the need for future handling and dust generation. For natural drying, wet RTM would be spread over a broad area in relatively thin lifts (e.g., 18 inches) and allowed to dry and drain naturally over a period of up to 1 year. If portions of the RTM were identified as hazardous, that material would be transported in trucks licensed to handle hazardous materials to a disposal location licensed to receive those constituents. If the RTM meets the criteria for reuse, the material would be moved by conveyor to a long-term on-site storage site.

A portion of the dried RTM generated at the Twin Cities Complex and Lower Roberts Island would be used to refill the areas excavated at the launch site where soil is removed to construct tunnel shaft pads and levee modifications. The remaining dried RTM would ultimately be moved to a single on-site long-term storage area at each launch shaft work area and planted with erosion-control seed mix to stabilize the stockpile and avoid dust generation.

## 3.2.6 Bethany Complex

The Bethany Complex would be constructed southeast of Clifton Court Forebay. The Bethany Reservoir Pumping Plant and Surge Basin would be located along Mountain House Road approximately 0.5 mile south of the intersection with Byron Highway. The Bethany Reservoir Aqueduct would extend approximately 2.8 miles from the pumping plant to a new discharge structure on the banks of the Bethany Reservoir (Figure 3.2-8) These facilities are described in the following sections and in Table 3.2-3. The Bethany Complex would be located on ground above the flood elevations for the 200-year flood event with sea level rise and climate change hydrology for

year 2100, as defined by DWR. Vegetation management within Bethany Complex would occur twice a year. All vegetation maintenance would be mechanical (e.g., with mower or other hand tools). At this time, the use of herbicides specifically, or pesticides in general is speculative; because the location, timing, frequency, and methods of application are not known, thus, the use of chemicals to remove vegetation is not proposed. Non-public paved roads will be repaved annually.

**Table 3.2-3. Bethany Complex Feature Ground Footprint Summary**

| Feature | Item | Quantities |
|---|---|---|
| Bethany Reservoir Pumping Plant and Surge Basin | Total size of construction site (approximately) | 213 acres |
| | Total size of postconstruction site (approximately) | 184 acres |
| | Land reclamation (approximately) | 29 acres |
| | Pumping plant pad site | 1,166-foot-wide x 1,260 feet long |
| | Surge basin site | Surge basin size: 815 feet wide x 815 feet long<br>Overflow shaft diameter: 120 feet<br>Overflow weir wall diameter: 180 feet<br>Six 5 feet by 5 feet vertical sluice gates within the perimeter of the overflow weir will allow stored water from a surge event to drain into the overflow shaft |
| | Diaphragm walls | Pumping plant: Approximately 6 foot wide by 252 foot deep by 1,438 feet long; 5-foot wide by 100-foot deep by 1,750 feet long; and 5 foot wide by 252 foot deep by 630 feet long diaphragm walls<br>Wet well inlet conduit: Approximately 6 feet wide by 252 feet deep by 800 feet long; and 5-foot-wide by 100-foot-deep by 160-foot-long diaphragm wall columns below foundation<br>Surge Basin: Approximately 3 feet wide by 137 feet deep by 3,260 feet long with two levels of tiebacks |
| | Foundational piles | Pumping plant: Approximately 53 drilled piers would be installed 50 feet deep below the pump discharge isolation gate valve gallery<br>Surge Basin: Approximately 2,530 drilled piers would be installed 60 feet deep below the surge basin base slab |
| | Pumping plant structure | Area of structure: 412 feet wide by 503 feet long<br>Top of slab of wet well, wet well inlet conduit and pumping plant dry pit pump bays: 47 feet<br>Top of canopy structures on the north end of each pumping plant dry pit above pad: 74.5 feet |

| Feature | Item | Quantities |
|---|---|---|
| | Pumps | Pumping plant: 14 pumps at 500 cfs, each, includes two standby pumps<br>Surge Basin: four rail-mounted pumps at 100 cfs, each, for dewatering surge basin<br>two vertical submersible pumps at 60 cfs each, for dewatering main tunnel |
| | Surge tanks for aqueduct to Bethany Reservoir Discharge Structure | Area of tank: 75-foot diameter by 20 feet high<br>Total number of tanks: four |
| | Bethany Reservoir Surge Basin tunnel reception shaft | Shaft depth during construction: 209 feet (depth from existing ground surface prior to excavation or fill)<br>Shaft depth during operations: 199 feet |
| | Concrete batch plants | Two batch plants in an area approximately 11.5 acres in size |
| Bethany Reservoir Aqueduct | Total size of construction site (approximately) | 128 acres |
| | Total size of postconstruction site (approximately) | 68 acres |
| | Land reclamation (approximately) | 60 acres |
| | Aqueduct trench (excludes tunneled portions of aqueduct) | Aqueduct trench from the Bethany Reservoir Pumping Plant to the tunnel under Jones Penstock: 7,900 feet long<br>Aqueduct trench from the tunnel under Jones Penstock to the tunnel under the conservation casement: 3,700 feet long<br>Each aqueduct trench is approximately 115 feet wide at the bottom, to accommodate four pipes 180 inches in diameter and 30 feet on center<br>A 24-foot-wide permanent gravel-surfaced patrol road would be placed on the completed fill in the center of the aqueduct |
| | Tunneled portions of aqueduct | Tunnel under Jones Penstock: Four 200-foot-long and 20-foot-diameter parallel tunnels (one per pipeline); tunnels separated by 40 feet between the center of each tunnel<br>Tunnel under conservation easement: Four 3,064 foot long and 20 foot diameter parallel tunnels (one per pipeline) separated by 40 feet between the center of each tunnel at the entrance portal end to about 70 feet at the shaft end |
| | CLSM processing area | 2 batch plants, each 100 feet wide by 100 feet long by 50 to 75 feet in height |
| | Total size of construction site (approximately) | 15 acres |

| Feature | Item | Quantities |
|---|---|---|
| Bethany Reservoir Discharge Structure | Total size of postconstruction site (approximately) | 13 acres |
| | Land reclamation (approximately) | None anticipated |
| | Tunnel shaft connection to the Bethany Reservoir Discharge Structure | Each of the four tunnels would extend upward vertically through shafts to discharge water into the Bethany Reservoir Discharge Structure. There would not be any tunnel shafts between the tunnel portal and the discharge structure (within the Conservation Easement) |
| | Discharge structure channels | Four channels extend from the vertical shaft to the bank of the Bethany Reservoir. The channels range in width from 55 feet at the vertical shaft to approximately 27.5 feet at the bank of the Bethany Reservoir |

### 3.2.6.1 Bethany Reservoir Pumping Plant

The Bethany Reservoir Pumping Plant would be needed to lift the water from the tunnel to Bethany Reservoir. The main tunnel from the intakes would terminate at a reception shaft within the surge basin on the north side of the Bethany Reservoir Pumping Plant. Water would enter the Bethany Reservoir Pumping Plant and be conveyed directly to Bethany Reservoir in a cement-mortar-lined, welded steel aqueduct system.

The Bethany Reservoir Pumping Plant would be a multilevel underground structure with its roof at grade. Flow capacity would range from a minimum of 300 cfs to a maximum of 6,000 cfs. The pumping plant would have twelve 500-cfs pumps to achieve the flow of 6,000 cfs and two standby pumps. In addition to the below-ground pumping plant and wet well, the site would include aboveground water storage tanks for hydraulic transient-surge protection of the discharge pipelines, electrical building with variable speed drives and switchgear, heating and air conditioning mechanical equipment yard, transformer yard, electrical substation adjacent to the electrical building, standby engine generator building with an isolated and fully contained fuel tank, equipment storage building with drive-through access, offices, welding shop, machine shop, storage area for spare aqueduct pipe sections and accessories, and a walled enclosure/storage facility for bulkhead panel gates that would be used to isolate portions of the Bethany Reservoir Pumping Plant during maintenance procedures. The pumping plant would include two separate dry-pit pump bays adjacent to the wet well.

Electrical, generator, and maintenance buildings, an electrical substation, surge tanks, and protective canopies on the site would be aboveground structures (Figure 3.2-7). The finished site pad elevation of 46.5 feet above mean sea level, at about existing grade, would be substantially above the elevation required to protect the facilities from surge events and the 200-year flood event including sea level rise in 2100, which is calculated to be a water surface elevation of 27.3 feet within the surge basin.

### 3.2.6.2 Bethany Reservoir Surge Basin

The surge basin would normally be empty when the Bethany Reservoir Pumping Plant is in operation. The top of the surge basin would be at existing grade and the bottom would be about 35 feet below the ground surface. The tunnel shaft within the surge basin would accommodate portable submersible pumps for dewatering the tunnel, if necessary. The top of the tunnel shaft would be at the floor of the surge basin and would be surrounded by an overflow weir wall inside the basin. A shaft pad would not be required at the surge basin reception shaft since natural ground elevations at this site are considerably above the potential flood stage, and groundwater intrusion is unlikely based on available information.

Under rare circumstances, potential transient-surge conditions could occur in the main tunnel between the intakes and Bethany Reservoir Pumping Plant or in the Bethany Reservoir Aqueduct. Along the main tunnel, the transient surge could occur if there was a simultaneous shutdown of the main raw water pumps in the pumping plant. The surge flows would discharge into the surge basin through the tunnel reception shaft. The circular weir wall around the top of the tunnel reception shaft (Figure 3.2-7) would allow the overflows to enter the surge basin but prevent water that enters the surge basin from reentering the main tunnel unless DWR operators open gates to allow the water to flow back in. The surge basin would also have pumps to remove the water more rapidly than gravity flow into the pumping plant to facilitate restarting the pumping plant after a surge event.

Transient-surge conditions in the Bethany Reservoir Aqueduct pipeline could also occur if there was a simultaneous shutdown of the Bethany Reservoir Pumping Plant pumps. Under this transient-surge scenario, water would flow from surge tanks located at the Bethany Reservoir Pumping Plant into the aqueduct pipelines and excess surge flows would be conveyed into Bethany Reservoir.

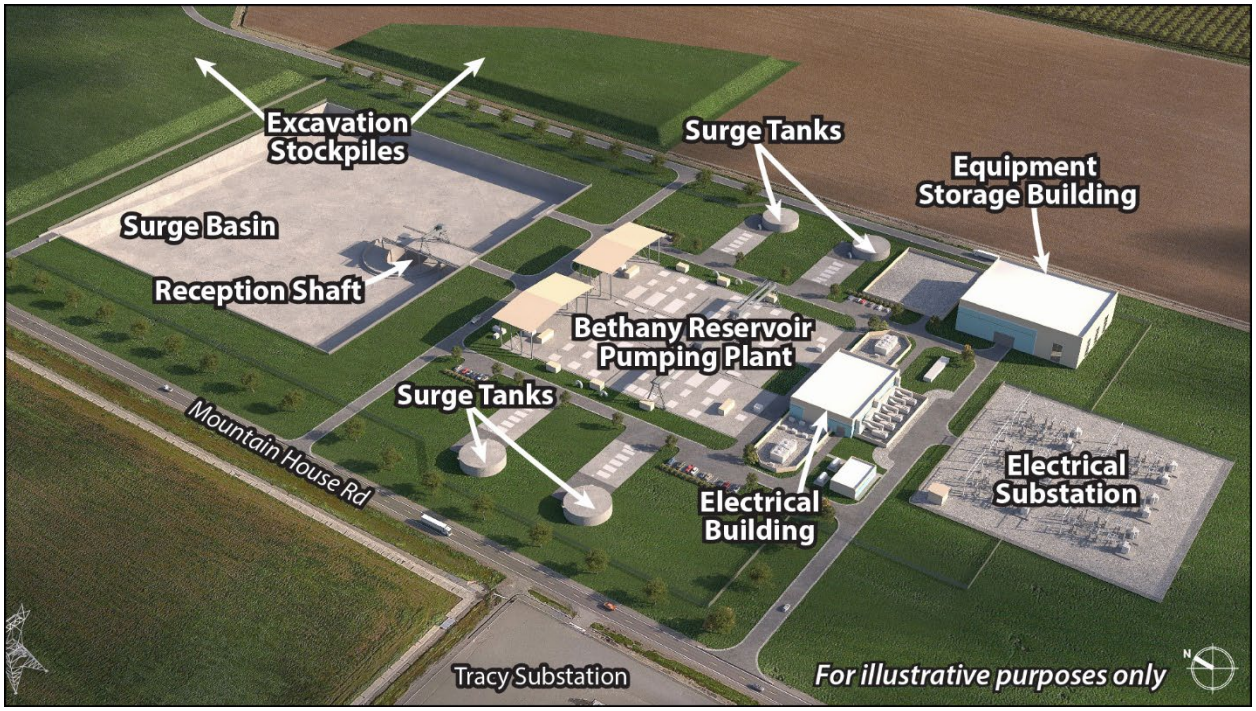


**Figure 3.2-7. Bethany Reservoir Pumping Plant and Surge Basin**

### 3.2.6.3 Bethany Reservoir Aqueduct

The aqueduct system would consist of four 15-foot-diameter parallel pipelines that would convey water from the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure, a distance of approximately 2.8 miles each. Each pipeline would have a maximum capacity of 1,500 cfs. The aqueduct system permanent footprint would be about 200 feet wide. Two separate aqueduct reaches would require parallel tunnels to carry each pipeline under existing features. The first reach would be under the Jones Pumping Plant discharge pipelines (about halfway from the Bethany Reservoir Pumping Plant to the discharge structure); at this location pipelines would run about 50 feet below ground surface for about 200 feet. Tunnels would also be needed under the existing conservation easements adjacent to Bethany Reservoir (at the last downstream reach of the aqueduct; Figure 3.2-8) for about 3,064 feet, ranging from 45 to 180 feet below ground surface.

**Figure 3.2-8. Bethany Reservoir Aqueduct Route with Tunnel Reaches**

The aqueduct pipelines would be laid mostly in open trenches,[3] constructed by open cut and backfill methods. The tops of the pipes would extend above the existing ground surface and be covered by a minimum of 6 feet of soil that would form a single mound of earth above the four pipelines (Figure 3.2-9). Excavated material from the Bethany Reservoir Aqueduct trenches and tunnels would be used for backfill of the trenches and also used to make controlled low-strength backfill material (CLSM) for pipe bedding and zone material.

[3] Open trenches would occur for the aqueduct pipelines except where the conservation easement prevents it; see aqueduct tunnel overlapping conservation easement lavender shading on Figure 3.2-8.

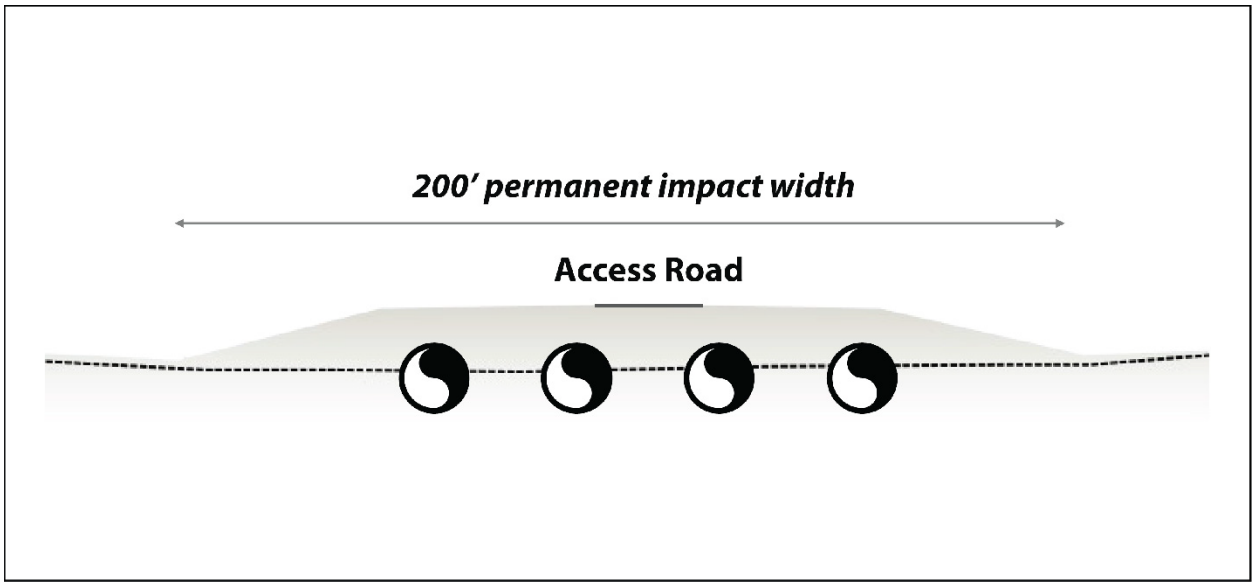


**Figure 3.2-9. Typical Completed Section for Open Cut Reaches of Pipeline Alignment**

The aqueduct pipelines would terminate near the bottom of four 55-foot-inside-diameter below-ground vertical shafts at the Bethany Reservoir Discharge Structure. The pipelines would make a 90-degree bend upward inside the shafts, ending at the floor of the discharge structure and flowing through a concrete channel into Bethany Reservoir (Figure 3.2-10). Bethany Reservoir serves several purposes: a forebay for the South Bay Pumping Plant (the start of the South Bay Aqueduct of the State Water Project), an afterbay for Banks Pumping Plant, a conveyance facility for the California Aqueduct, and a recreational facility. The reservoir does not serve as a storage reservoir.

## Staging Areas, Controlled Low-Strength Backfill Material Batch Plants, and Ancillary Facilities

In addition to pipelines and tunnels, the aqueduct construction site would include contractor staging areas, CLSM batch plants, and ancillary facilities. The CLSM would be used to improve the strength of soil placed under the aqueduct pipes installed in the trenches, and possibly to fill the space between the inside wall of the tunnel and the outside of the pipeline wall for the tunnels that carry the pipelines below the Jones discharge pipelines and the conservation easements adjacent to Bethany Reservoir.

A CLSM processing area at the tunnel portion of the aqueduct would include two side-by-side CLSM batch plants for trench work, each 100 feet wide by 100 feet long and 50 to 75 feet tall. CLSM production would also require 2.75 acres for soil storage of up to 30,000 cubic yards of soil up to 7 feet deep; two 30-foot-diameter, 10-foot-tall water storage tanks mounted on 8-foot-tall platforms and holding a total of 100,000 gallons of water; and cement storage silos 50 to 75 feet tall on a site 50 feet wide by 100 feet long.

## Aqueduct Tunnels

The aqueduct tunnels to carry the pipelines under the Jones discharge pipelines and the conservation easements would be constructed using a different method than used for the main tunnel between the intakes and the Bethany Reservoir Pumping Plant. Because of the shorter length

of these tunnels compared to the main tunnel, a TBM would not be used during construction. For the Jones pipeline crossing a digger shield outfitted with an excavator arm could be used for the anticipated ground conditions. To avoid extensive disturbance of sensitive habitat areas within the conservation easement crossing, several excavation methods have been identified including a roadheader. Soil material would be moved out of the tunnels at the entry portals. The excavation would be supported with rock reinforcement and/or steel ribs or lattice girders and shotcrete depending on-the-ground conditions. Construction of the aqueduct tunnels under the conservation easement would avoid surface disturbance within the conservation easement.

The excavated material from the aqueduct tunnels would be removed by different methods and would be in different geologic formations compared to the main tunnel bore; therefore, the excavated material characteristics would be different from the RTM from the main tunnel. The Bethany Reservoir Aqueduct tunneling machines also would not need additives; therefore, the excavated soil would not need to undergo the extensive drying that would be required for RTM from the TBMs on the main tunnel. Materials excavated from the aqueduct tunnels that are too wet or otherwise unsuitable for CLSM of backfill would be transported to the permanent excavation stockpile adjacent to the Bethany Reservoir Pumping Plant and dried as part of final disposal.

Tunneling under the Jones discharge pipelines would require excavation of a large cut to establish entry and exit portals. The entry portal would be located on the east side of the Jones discharge pipeline crossings. Excavation of these tunnels would end at the exit portal about 200 feet away on the west side of the Jones pipelines. Major facilities at the site would include mobile cranes, construction shops and offices, parking, material laydown and erection area, equipment staging, tunnel ventilation system housing, temporary electrical substation, and storage for topsoil stripping. Construction activities would include clearing and grubbing, water quality protection, ground improvement, and other activities as needed.

Tunneling under the conservation easement also would require tunnel entry portals on the east side and tunnel exit portals on the west side of the 3,064-foot crossing. The entry portals would be located on the east side of the conservation easement and west of the existing high-voltage power lines, outside of the conservation easement boundary. Excavation of these tunnels would end at the vertical shafts on the east side of the Bethany Reservoir Discharge Structure.

### 3.2.6.4 Bethany Reservoir Discharge Structure

The Bethany Reservoir Discharge Structure on the bank of the Bethany Reservoir comprises the aqueduct conservation easement tunnel vertical exit shafts, contractor staging areas, and ancillary facilities. The discharge structure site is on a narrow strip of land between the conservation easement and Bethany Reservoir; a 10-foot-wide buffer would separate the disturbance area from the conservation easement. Significant grading would be required to build the structure on the site, above reservoir surface water level, which varies considerably in elevation. Constructing a temporary cofferdam within the water near the shore in the reservoir would allow excavation, concrete, and backfill work to be completed on the reservoir bank within an area of dry ground excavated as much as 25 feet below the reservoir water surface.

The discharge structure would occupy 13 acres postconstruction. It would be divided into four separate channels, with a total width of approximately 327 feet encompassing the four 55-foot-wide aqueduct shafts with required approximately 81.5-foot center-to-center spacing (Figure 3.2-10). Each channel of the discharge structure would range from about 81 feet wide at the top of the

aqueduct shafts to approximately half of that width at the bank of the Bethany Reservoir. The concrete floor of the discharge structure at elevation 227.0 feet above mean sea level would end near the reservoir bank, and a layer of riprap would be placed between the structure and the temporary cofferdam to help stabilize and protect the bank and bed of the reservoir from the energy of the water being discharged, which is expected to be minor, given the relatively low discharge velocity. The top of the discharge would be approximately at the same elevation as the existing California Aqueduct Bikeway that will traverse through and over the structure.

**Figure 3.2-10. Bethany Reservoir Discharge Structure**

The Bethany Reservoir Discharge Structure would cross the existing California Aqueduct Bikeway, which is also used as a maintenance road. A 32-foot-wide bridge would span the four channels to maintain access for bikes and maintenance vehicles. Each of the four Bethany Reservoir Discharge Structure channels would be divided into two 21-foot-wide bays with radial gates and stop logs to prevent backflow in an emergency and double isolate the aqueduct system from Bethany Reservoir. A 16-foot-wide service deck would be installed on the opposite (reservoir) side of the gate and stop log area to facilitate operations and maintenance of the gates and installation and removal of stop logs. The bridge would include applicable openings for stop log installation and removal through traffic-rated hatches. Similarly, stop logs would be installed in open stop log grooves adjacent to the service deck. The radial gates would automatically close under pressure loss conditions in the aqueduct pipelines to prevent water from Bethany Reservoir from flowing into the aqueduct pipelines during the unlikely event of a pipeline break or valve malfunction. Due to the critical control nature of this facility, a standby engine generator would be provided for backup power in case of a power outage. A storage yard for isolation bulkhead gates is also included at the site.

## 3.2.7 Access Roads

Construction would require substantial transportation facility improvements. This would be to serve the construction and material delivery processes and access to compensatory mitigation sites.

Construction would require temporary relocation and realignment of SR 160 at the intakes (Figure 3.2-11), and new or improved access roads to intakes, tunnel shafts, and the Bethany Complex. Pavement conditions on existing county and local roads are predominantly classified as marginal to unacceptable. State routes are generally in good condition although pavement condition data were not available for all State routes at the time of the needs assessment.

DWR will conduct preconstruction pavement and roadway analyses of access roadway segments on local and county roads to determine whether they need improving. Road improvement activities would include pavement remediation (e.g., fill potholes, asphalt cracking, and slurry seals), widening to a minimum of 12 feet, roadway design to serve construction traffic with new roads, and constructing new bridges or widening existing bridges. Where road and bridge improvements are undertaken, wider shoulders would be considered to meet bicycle lane standards; design standards for each state or local entity that operates roads and bridges would be followed for all improvements on the existing respective roadways. Some project-area bridges rated as structurally deficient or functionally obsolete are scheduled to be replaced or rehabilitated by their respective jurisdictions. DWR would issue communications regarding roadway conditions and construction biweekly and post on the project information website in the multiple languages spoken in the Delta. This would inform residents, business owners, and farmers of daily road construction and high-volume construction traffic events (e.g., during hours of materials deliveries).

Modifications to existing roadways during project construction would be completed in accordance with Caltrans or county criteria, depending upon the owner of the roadway. Future roadway projects under consideration by local or state agencies were reviewed to potentially coordinate road improvements. The preconstruction pavement and roadway analysis will be included as part of the Geometric Approval Drawings submittal for review, comment, and refinement, in consultation with the applicable transportation entities, including Caltrans for state highways and intersection facilities and local agencies for local roadway and intersection facilities. Improvements to State Routes would be designed and constructed in collaboration with Caltrans. Project roadway improvements to existing State Routes, local roadways, and bridges would remain after construction.

Roads used for material hauling, construction equipment access, and employee access would consist of existing State routes and two-lane roadways in the Delta, new gravel (with chip seal) or paved roadways constructed from existing roads to construction sites, and new roads within facility construction sites. Truck routes were evaluated for existing and project truck volumes and will be improved where project truck traffic warrants improvement, based on the duration of work and expected commodities to be carried. Minimum requirements for truck routes are 12-foot-wide lanes and 4-foot-wide shoulders. Interstate, state, and local roads would also provide direct access to project work sites. Construction access roads would remain postconstruction for maintenance access to the facilities.

SR 160 near the north Delta intakes would be temporarily rerouted east of its existing alignment during the intake construction process and then relocated through the intake facility in the vicinity of the current SR 160 alignment. Lambert Road would be widened from Franklin Boulevard to the eastern side of the bridge over Snodgrass Slough.

A new 3.8-mile paved intake access/haul road would be constructed along the west side of the abandoned railroad embankment, to a new dedicated haul road east of the intakes. Approximately 180 feet of the existing bridge over Snodgrass Slough at Hood-Franklin Road would be widened. The

haul road would eliminate the need for construction traffic to travel through the main portion of the Town of Hood and on SR 160; it would not be a public road. All access for construction, plus most operations-phase access, would use the haul road to enter the intake sites.

A new 0.3-mile access road to the shaft site on New Hope Tract maintenance shaft would be constructed from Blossom Road. To access the Terminous Tract maintenance shaft site, a new uncontrolled interchange with longer acceleration and deceleration lanes along SR 12 would be built and 2.3 miles of SR 12 from I-5 to the tunnel shaft site would be improved. Access to the Lower Roberts Island double launch shaft would involve building a new 1.2-mile access road from West Fyffe Street to a new bridge; a new road and railroad bridges over Burns Cutoff from Port of Stockton; new 3.2-mile access road and rail lines along West House Road from the new bridge; and a new 1.6-mile access road on Lower Roberts Island. One mile of Dierssen Road between Franklin Boulevard and I-5 would be widened, and 0.48 mile of Franklin Boulevard would be widened between locations 0.22 mile north of Dierssen Road and 0.25 mile south of Dierssen Road. Twin Cities Road would be widened for 1 mile from a location 0.83 miles west of Franklin Boulevard to a location 0.17 mile east of Franklin Boulevard. Access to the Lower Roberts Island double launch shaft site would involve 1.2 miles of new paved road on Rough and Ready Road on Port of Stockton, a new bridge over Burns Cutoff from Port of Stockton, 2 miles of new paved road to West House Road with widening 1.2 miles of West House Road, and 1.3 miles of new paved road from West House Road to North Holt Road with a new bridge over Black Slough.

Construction would start with clearing, grubbing, and moving utilities. Existing drainage facilities either within the construction site or adjacent to construction sites would be rerouted to not affect overland drainage flows or groundwater seepage flows prior to construction. After completion of construction at a project site, the condition of the pavement of access roads would be analyzed and remediation would be completed as necessary to return the facility to the condition that DWR constructed.

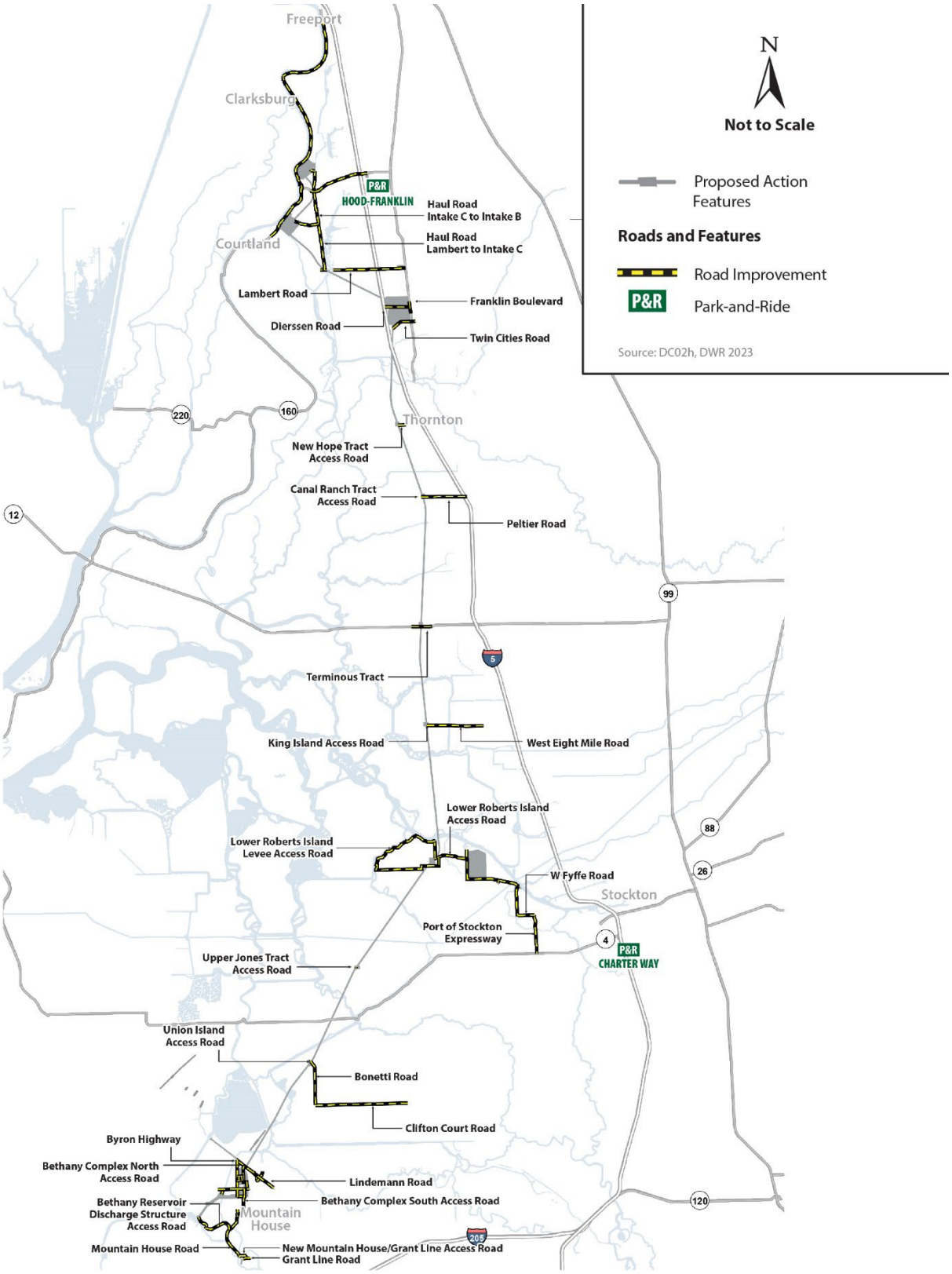


**Figure 3.2-11. Road Modifications**

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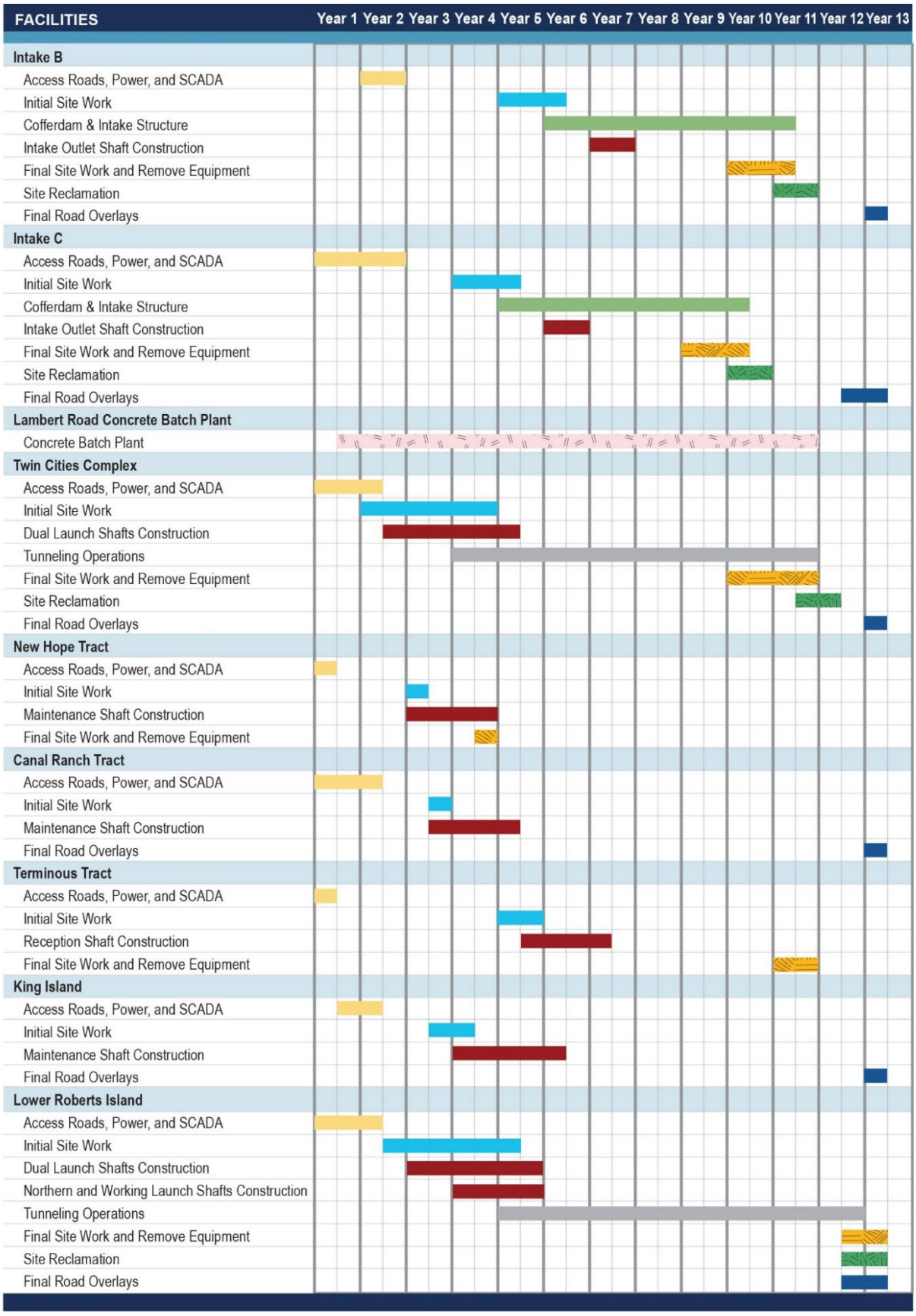
## 3.2.8 Rail-Served Materials Depots

Rail access to serve major construction sites would reduce truck use of local roads and highways. The UPRR and BNSF Railway serve the action area. Rail-served materials depots with rail sidings would be constructed and used to transport certain large volume construction materials. The rail siding would be designed to allow the train to leave or pick up rail cars, hold the rail cars, and off-load or load the rail cars. The depot would include areas where trains would move off the main line to deposit the rail cars and areas to transfer the materials to trucks.

A rail-served materials depot at Lower Roberts Island would be constructed. Rail access to Lower Roberts Island would be provided from an extension of an existing short haul line at the Port of Stockton. Rail access would be extended over a new bridge over Burns Cutoff and continue to the launch shaft site and RTM storage area.

## 3.2.9 Construction Schedule

Construction would take approximately 13 years. Construction would not take place in all locations at the same time. Rather, it would proceed in stages, starting with access roads and site work at the intakes and launch shafts, plus power and SCADA installed to facilities sites, then concurrent tunnel and facility construction, and finally proceeding to commissioning, site reclamation, and road overlays in the final years, as shown on Figure 3.2-12.




Bethany 6,000 cfs

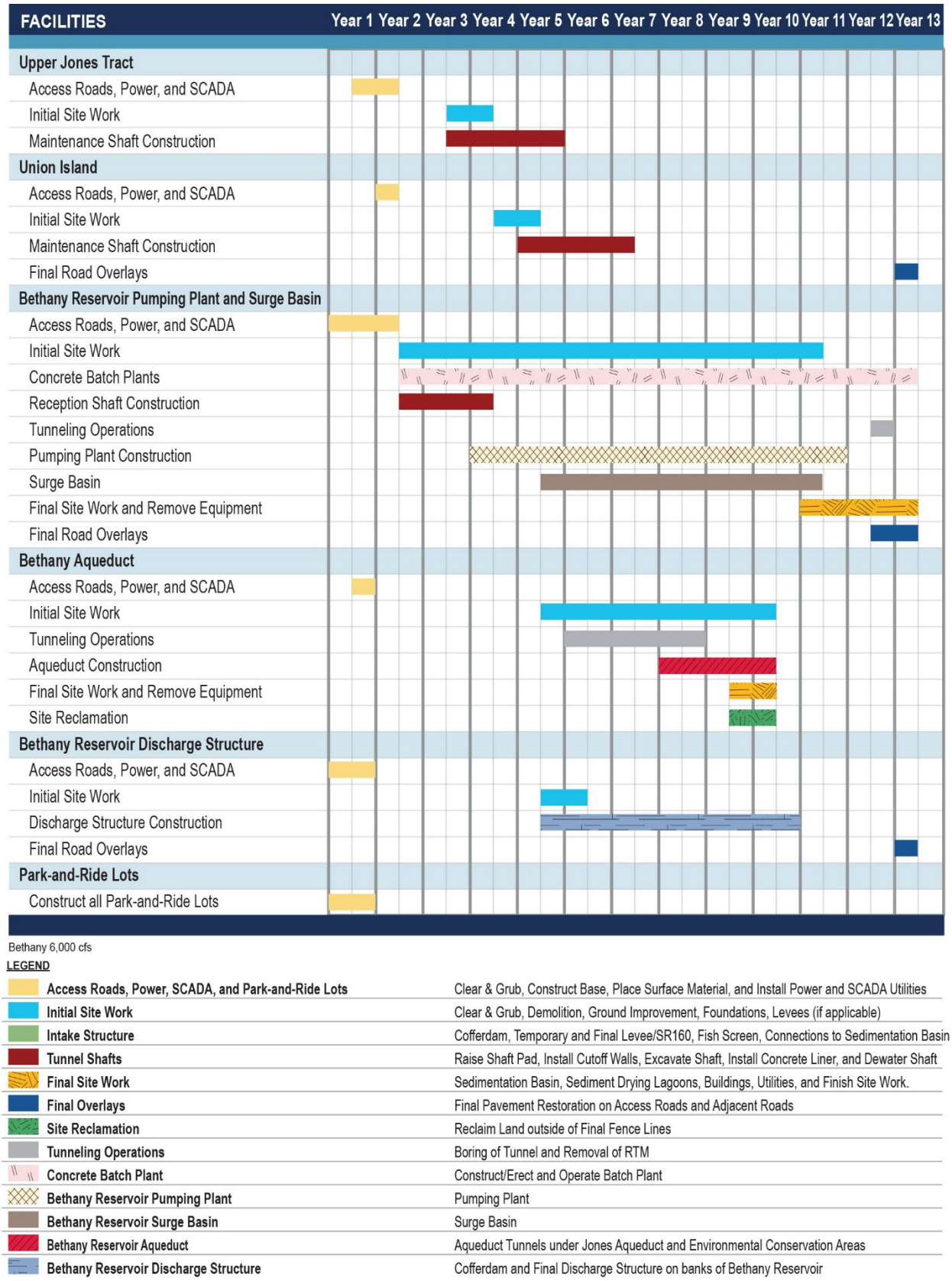



**Figure 3.5-12. Construction Schedule**

## 3.2.10 Soil Balance

Project construction would require large amounts of fill material at many facility sites and would also generate extensive amounts of excavated soils and RTM. Roads and compensatory mitigation would require imported materials from commercial sources. Construction would occur over a period of years at most sites, but not simultaneously at all sites. For example, tunnel launch shaft sites would require soil fill material several months before tunneling operations would produce large volumes of RTM. To optimize the movement of fill material and reduce the need for import, disposal, and stockpiling, an earthwork model was prepared to understand the total amount of soil fill required and produced at the various construction sites relative to the project schedule. The earthwork model analyzed soil fill material including structural and nonstructural fill, topsoil, peat, and imported specialty materials including gravel or aggregate base. Model results showed the volume of fill material produced on-site from excavation (including both RTM and surface soils), the volume needed on-site as structural fill, and where import material would be sourced from if a deficit occurs or where excess material would be stockpiled or disposed of if a surplus occurs.

It is expected that soils excavated on-site at intakes would balance on-site soil needs and no significant import or export of structural fill would be necessary. However, some imported fine-grained levee embankment core material may be required if on-site soils do not meet regulatory requirements for construction. RTM generated at launch shafts at the Twin Cities Complex and Lower Roberts Island would be used for backfilling borrow areas on-site. Soil excavated at the Twin Cities Complex would be used for shaft pads on New Hope Tract, Canal Ranch Tract, Terminous Tract, and King Island. Soils excavated at the Lower Roberts Island double launch shaft site would be used for the shaft pads on Lower Roberts Island, Union Island, and Upper Jones Tract, and RTM generated on-site would be used to backfill borrow areas on Lower Roberts Island.

## 3.2.11 Electrical Facilities

Power supplies would be needed at construction sites for the intakes, tunnel shafts, Bethany Complex facilities, concrete batch plants, and park-and-ride lots. Power supplies would also be needed during operations of the intakes, Bethany Reservoir Pumping Plant and Surge Basin, and Bethany Reservoir Discharge Structure, plus lights, security, and minor operations and maintenance (O&M) loads at all permanent locations.

Power demand during construction would include support for large equipment, such as cranes and ground improvement machines, TBM and associated equipment including ventilation, conveyors and pumps, small tools, and construction-support facilities. Support facilities would include, but not be limited to, construction trailers, temporary lighting, and electric vehicle charging stations. Some of this equipment could be powered by on-site generators or internal combustion engines; however, electrical grid service to the sites, if available, would be more efficient, use less diesel fuels, and produce fewer emissions. In addition, Appendix 3A includes AMM-7: *Off-Road Heavy-Duty Engines*, which states that DWR will consider use of electric or hybrid-electric off-road equipment (including generators) over diesel counterparts to the extent that they become commercially available and earn a track record for reliability in real-world construction conditions and become cost-effective.

Power for construction and operation of the conveyance facilities would be delivered on existing power lines to the extent possible, but the location or required load of some facilities would require either new aboveground power towers with lines or underground conduit to serve those specific areas. Some existing lines would require adding new towers to extend service to conveyance

facilities. Some existing lines would require adding new towers to extend service to conveyance facilities. Some power will also be abandoned or relocated, and some overhead lines, such as those crossing the intake haul road, will be moved underground to address overhead height constraints. For any aboveground power towers or lines that are new, non-specular materials would be used.

DWR is coordinating electric power transmission modifications with electricity providers Sacramento Municipal Utility District (SMUD), Western Area Power Administration (WAPA), and Pacific Gas and Electric Company (PG&E). These companies own and maintain high-voltage transmission lines in the action area (Figure 3.2-13).

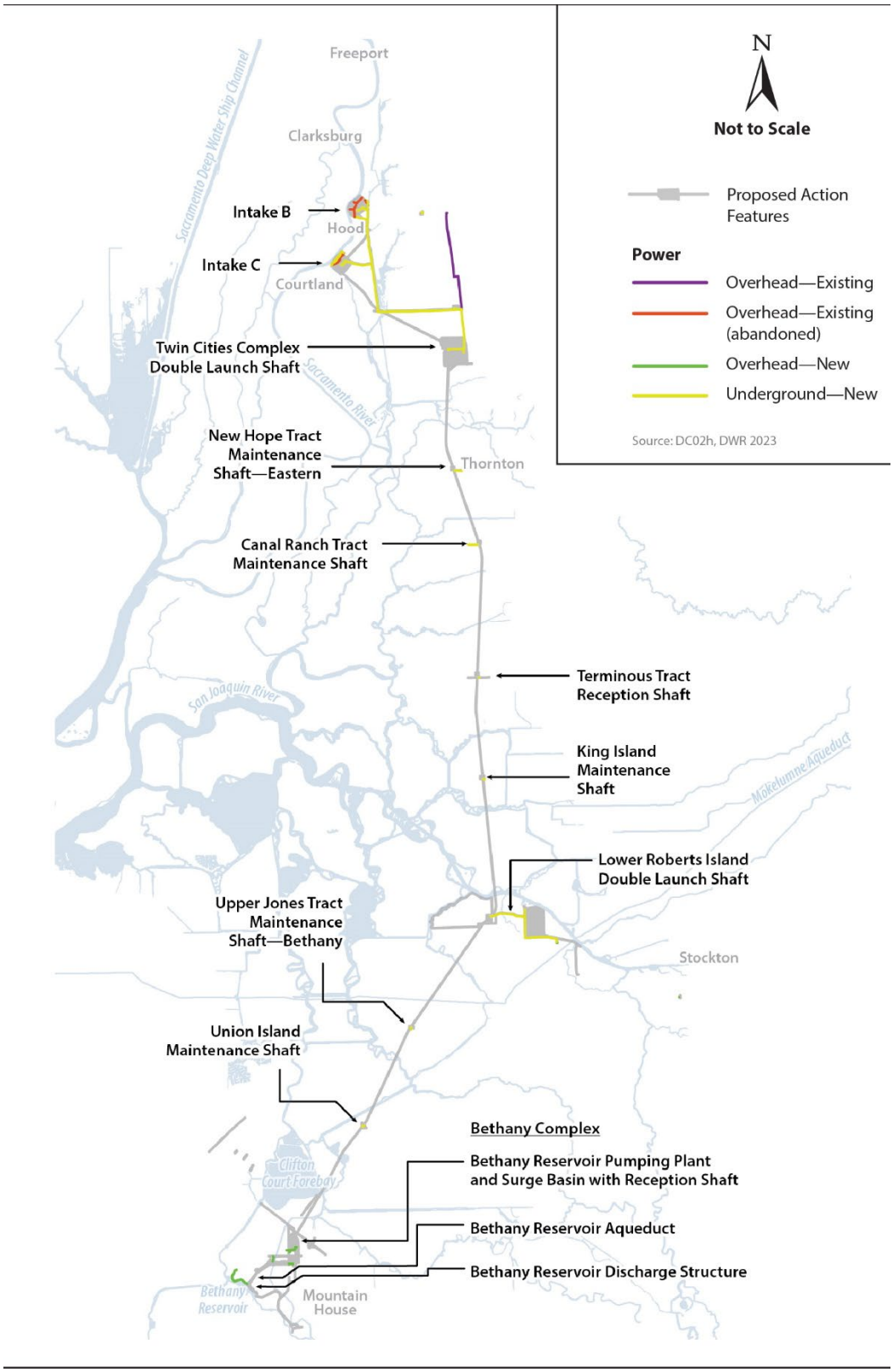



**Figure 3.2-13. Power Lines**

### 3.2.12 SCADA Facilities

SCADA systems and associated data communication systems are common features of water infrastructure that enable remote monitoring and control of the performance and operation of the system, including video security cameras. The new Delta Conveyance Project facilities would need to be integrated into SWP's existing SCADA system to allow for coordinated operations (Delta Conveyance Design and Construction Authority 2022d, 2023). The communications network would connect three major data centers, two intakes, and four remote data sites for the Bethany Complex. The major data centers would be at the existing DWR Project Control Center, DWR Operations and Maintenance Area Control Center at the Delta Field Division, and Bethany Reservoir Pumping Plant. SCADA would provide real-time performance data at intakes, tunnel launch shafts and some maintenance and reception shafts, and the Bethany Complex facilities. The communications aspects of the SCADA system would be used during construction to facilitate internet applications at the launch shaft sites, the intakes, and the Bethany Reservoir Pumping Plant.

The SCADA system would consist of SCADA equipment and communications links based upon fiber-optic cables that would be installed within and connecting to new structures. Whenever possible, the construction of fiber-optic based communications systems would use existing telecommunications infrastructure, dedicated conduits within project road modifications, and termination panels installed inside or on the buildings or structures. Wherever possible, underground routes would be located along existing roads and project access routes (Figure 3.2-14). SCADA fiber-optic cables serving the Bethany Reservoir Discharge Structure would be installed within the tunneled portion of the Bethany Reservoir Aqueduct; all construction and maintenance would take place from within the tunnels accessed from outside of the Bethany West Easement (Delta Conveyance Design and Construction Authority 2021).

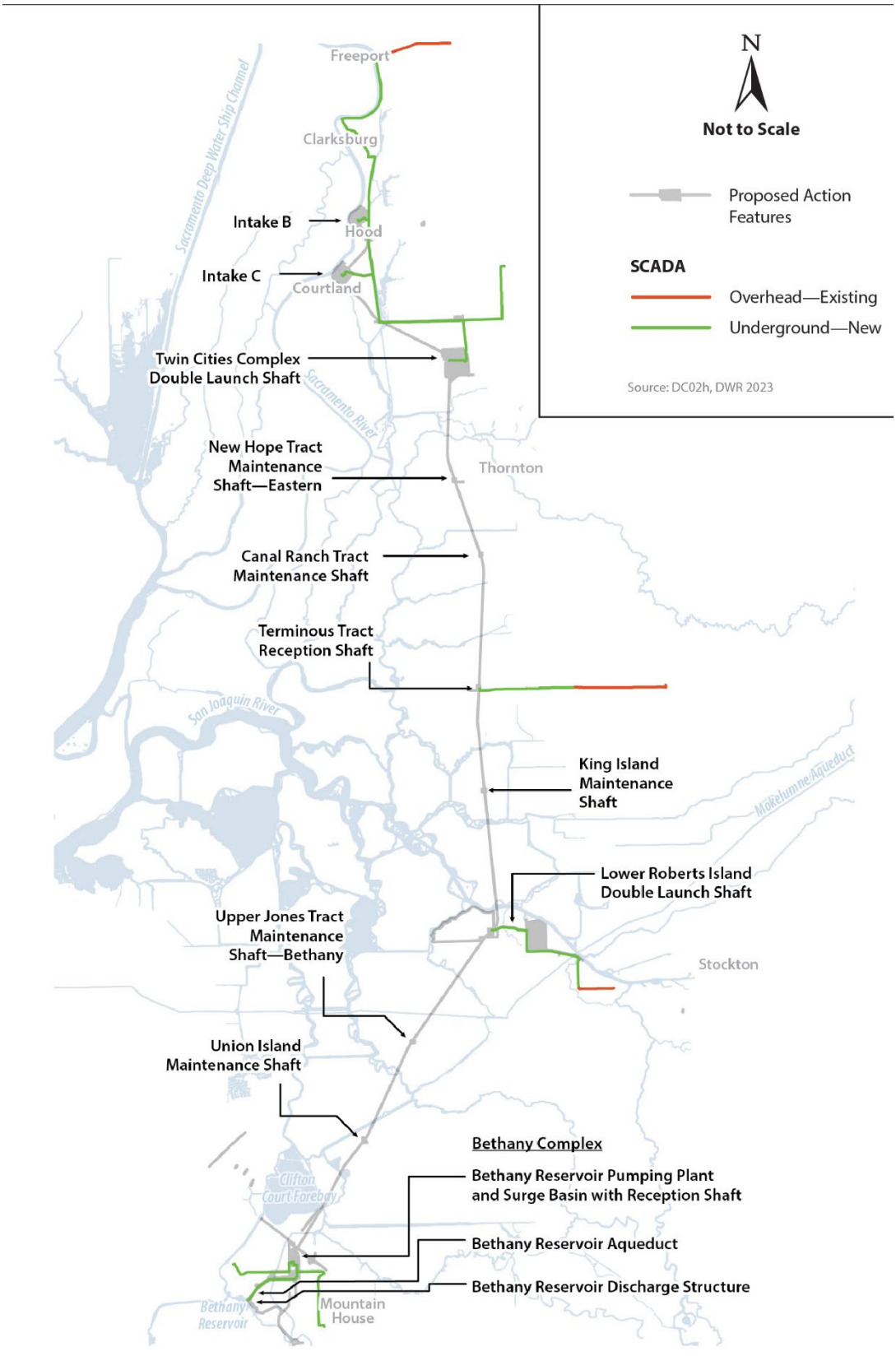



**Figure 3.2-14. SCADA Fiber Routes**

## 3.2.13 Fencing and Lighting

Construction site security for major work sites would include security guards stationed at the main entry and exit gates for 24-hour site access management and surveillance. Security personnel would be on-site with regular inspection rounds. Cameras would also be used at key locations. Once construction is complete, permanent security fencing would be in place, and cameras would be installed with either local recording devices or transmission capabilities. These cameras would be located at sites where permanent power and SCADA facilities are located. Security personnel would monitor the sites periodically.

During construction, park-and-ride lots would use downcast lighting. Permanent lighting at facility sites would be downcast, cut-off type fixtures with non-glare finishes and controlled by photocells and motion sensors, depending on the location. Construction and maintenance lighting would be similar except for a few necessary nighttime work activities that would require higher-illumination safety lighting of the work sites. Lights would provide good color with natural light qualities and minimum intensity with adequate strength for security, safety, and personnel access. The lights would comply with the Illuminating Engineering Society industry standards for light source and luminaire measurements and testing methods.

During construction, night lighting at park-and-ride lots would be controlled by motion detectors. During operations, the lights at the intakes, tunnel shafts, and Bethany Complex would be motion activated to minimize light and glare to adjacent properties.

## 3.2.14 Park-and-Ride Lots

Park-and-ride lots would be established near major commute routes, where workers could park and ride shuttle buses or vans to construction sites. The employee shuttles would be electric-powered, and the park-and-ride lots would be equipped with electric vehicle charging stations. Trucks arriving late at night could also use these lots to park overnight to minimize nighttime deliveries to construction sites. Lots would be lighted with nighttime security lighting with motion detectors. Park-and-ride lots would be removed after construction unless local communities are interested in maintaining these lots in the future through the Community Benefits Program. Lots would be established at the following sites.

- **Hood-Franklin Park-and-Ride Lot.** Parking for employees at intakes. This lot would be located along the south side of Hood-Franklin Road immediately east of I-5. The total construction area would be 4.1 acres. The land is currently mostly agricultural land; a Caltrans construction yard occupies a small portion.
- **Charter Way Park-and-Ride Lot.** Parking for employees at tunnel shafts on Lower Roberts, New Hope Tract, Canal Ranch Tract, Terminous Tract, and King Island. This lot would be located along the south side of Charter Way at the southwest corner of the I-5 overpass, on the south side of SR 4, just west of I-5. The total construction area would be 2.4 acres. The land is currently a private truck parking lot and would only require upgrade or replacement of pavement and lighting systems.

Limited on-site parking would be provided at the intakes and Lower Roberts Island double launch shaft to supplement the park-and-ride lots. On-site parking for all workers would be provided at all other construction sites, including the Twin Cities Complex, all maintenance and reception shafts, and the Bethany Complex. After construction, these facilities would be removed.

## 3.2.15 Land Reclamation

As a part of construction, some areas would be temporarily disturbed but not needed for long-term operations (e.g., construction staging areas). DWR would transfer this land to interested parties to be consistent with local land uses, including agricultural production or open space/natural habitat. To be able to use land for these purposes after construction, construction activities are necessary to reclaim this land.

All areas included in the construction boundary and not included in the postconstruction (permanent) project operations boundary are illustrated in Figure 3.2-15; areas to be included in land reclamation are located at the Intakes B and C, Twin Cities Complex, Lower Roberts Island double launch shaft, and Bethany Complex (see starred locations in the figure). Lands to be reclaimed would be those areas used during construction for material and equipment laydown and staging, material stockpiles, slurry/grout mixing plants, parking areas, and facilities/trailers. DWR would acquire the land for construction and would conduct agronomic testing to help determine whether the temporarily disturbed site could be reclaimed and final reclamation methods. The main goal of the land reclamation efforts would be to restore the soil health and condition, to the extent practical, in these temporary construction areas.

Construction activities, equipment, and material stockpiles could compact near-surface native soils or leave soils less suitable for agriculture or habitat. Initial reclamation tasks would include removal of all construction equipment and materials, demolition and removal of concrete slabs from temporary material storage areas, removal of temporary stockpiles/embankments, removal of temporary haul routes, and grading and leveling of the site to generally meet adjacent lands.

Initial soil treatments would depend on the actual disturbance, but for soils with more than minimal impact, the work would be expected to include ripping the soil and incorporating amendments (e.g., gypsum) to reduce compaction. This would be followed by spreading topsoil, cross disking, and fine grading/leveling to prepare the soil surface for future use. If the land transition would not occur in a relatively short period of time after construction, the areas would be drill seeded to provide erosion and dust control using a grass seed mix appropriate for the desired end use. Areas to be reclaimed to grassland would be seeded with a native grass and flowering forb mix, whereas areas to be reclaimed to agricultural use could be seeded with an erosion-control native seed mix.

Areas excavated to create borrow soil materials would be refilled to existing grade with soil or RTM from existing stockpiles at the end of construction. Treatments for reclamation using RTM base soil would be similar to those recommended for reclamation with native soils; however, additional treatments could be required to address soil conditions (for example, high or low pH). Lime and soil sulfur could be appropriate amendments for addressing soil pH; however, the actual amendments used would be based on soil tests performed at each of the sites postconstruction. Decisions on amendments to address nutrient deficiencies would be made in consultation with the end user. Topsoil would be spread to a depth of 1 foot over the RTM base soil. For agricultural uses, the top 1 foot of soil is typically most important and is where fertilizer application would be focused to address the specific needs of the crop.

Permanent RTM stockpiles would be expected at the tunnel launch sites. These stockpiles would be elevated above the surrounding grades and would be planted with native grasses primarily for erosion control, for habitat enhancement, and to blend with the surrounding area when the stockpile is not being accessed for a soil material source. Recommended treatments for permanent RTM stockpiles would include spreading topsoil, cross disking, and planting native grasses.

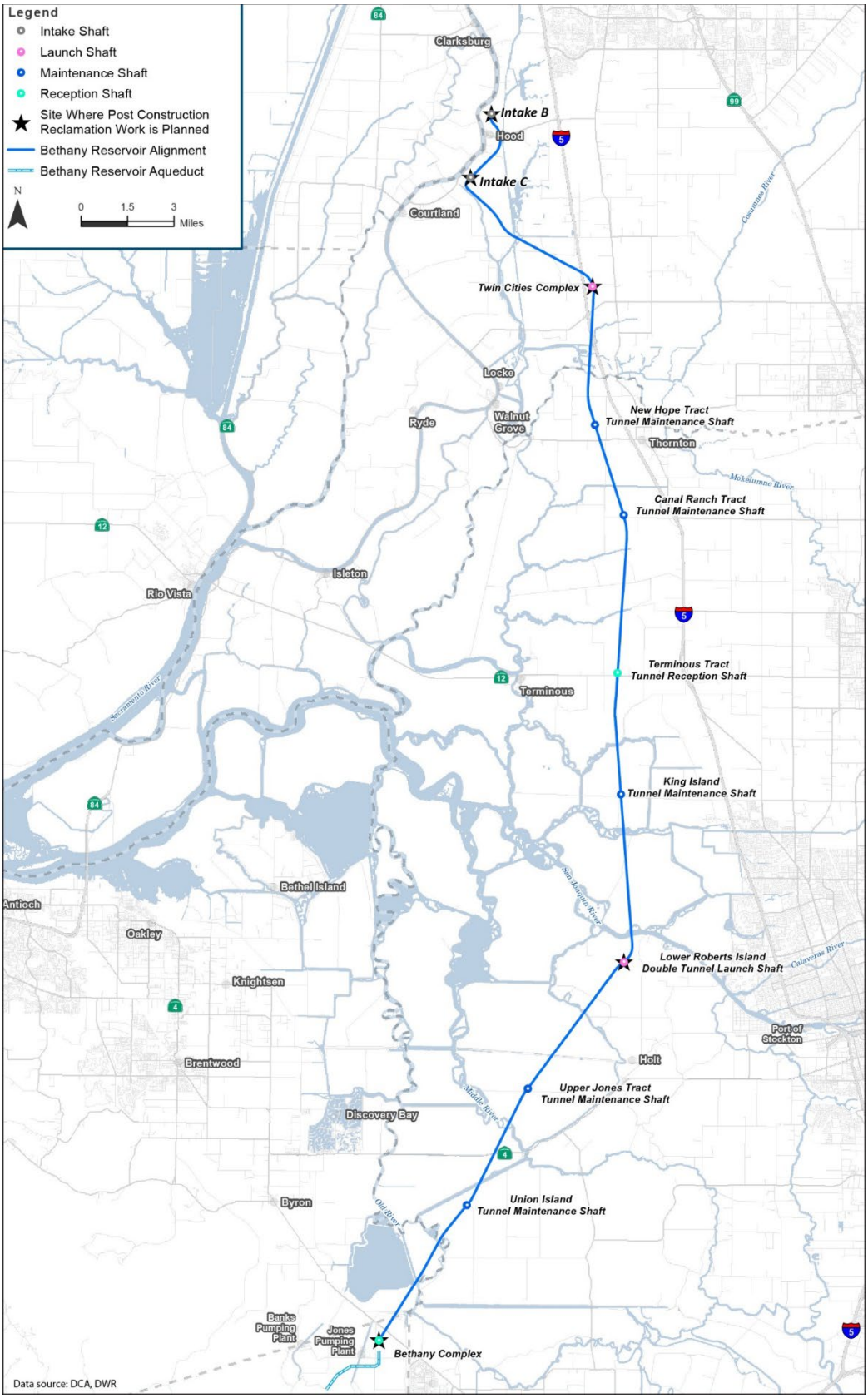



**Figure 3.2-15. Land Reclamation Areas Overview**

# 3.2.16 Other Construction Support Facilities

## 3.2.16.1 Concrete Batch Plants

Concrete batch plants would be located at Lambert Road at the intersection with Franklin Boulevard, and at the Bethany Reservoir Pumping Plant and Surge Basin construction site. The Lambert Road batch plant would be used for concrete delivery to the intakes, the Twin Cities Complex and the other tunnel shafts on New Hope Tract, Canal Ranch Tract, and King Island. Concrete for tunnel shaft sites on Terminous Tract, Lower Roberts Island, Upper Jones Tract, and Union Island would be provided from existing batch plants in Lodi and Stockton which are located in close proximity of these sites. The Bethany Complex concrete batch plants at the Bethany Reservoir Pumping Plant and Surge Basin site would be north of Kelso Road and the new Bethany access road east of Mountain House Road. These batch plants were sited to allow a central delivery location for cement and aggregate and site for distribution of the concrete around the Bethany Complex area.

The concrete batch plant sites would vary in size depending on location. They would include three bulk cement storage silos; a portable cement silo (trailer 10 feet tall by 60 feet long); a 500-square-foot batch trailer; four propane tanks; a 6,800-square-foot concrete block casting area; a 2,000- to 4,000-gallon diesel fuel tank; a 120,000-gallon water system consisting of six 20,000 gallons storage tanks and related collection facilities for stormwater and wash water; an admixing area that would include a pump house, admixture storage tanks, and secondary containment barriers; an aggregate storage area; a wash area for concrete mixing trucks and related returned concrete collection facilities; and parking for concrete trucks and employee vehicles. The concrete batch plant would include batcher, silo, and truck mixer dust collectors to minimize particulates in the surrounding air. Materials collected in the air filter bags would be hauled to licensed off-site disposal locations or added to the raw materials used to produce concrete. Concrete batch plant structures and equipment would be removed following construction.

## 3.2.16.2 Fuel Stations and Fuel Storage

Two fuel stations with multiple tanks for diesel and gasoline would be constructed at the Bethany Complex. Fuel would also be stored at all tunnel shaft sites and at the intakes. The fuel tanks would be aboveground and would be surrounded by protective bollards to protect against collisions. Double-walled tanks with built-in secondary containment or external secondary containment beneath/around the tanks would protect surroundings from fuel leaks. A protective containment would be used beneath each of the fuel tanks and a protective area would be constructed beneath the refueling area to help contain leaks that may occur during fueling. Spill containment kits would be placed at each of the fueling locations. All fuel stations and storage would be removed following construction.

## 3.2.16.3 Emergency Response Facilities

In general, it is expected that primary emergency response services would be provided by the construction contractors. As needed on a site-specific bases, the contractors will be required to prepare a Project Emergency Response Plan with detailed information regarding emergency services, access to construction sites, and emergency response times to Delta communities. The Project Emergency Response Plan requires on-site emergency response facilities and services at primary work sites during construction. Evaluations and discussions with local agencies would be conducted to determine the most appropriate method to coordinate between project contractor-

provided emergency response services at the construction sites and integration with local agencies. Additionally, DWR would enter into mutual aid agreements with emergency services agencies in the project area. Emergency response facilities at construction sites could be removed during construction demobilization depending on DWR's decision for need during operations.

### 3.2.16.4 Standby Engine Generators

Engine generators would be used during construction at the intakes, Twin Cities Complex, Lower Roberts Island shaft site, each of the Bethany Reservoir Aqueduct tunnel portals, and Bethany Reservoir Discharge Structure. Standby engine generators would be used in the event of power outages.

During operations, intakes would each have two permanent standby engine generators. The standby engine generators would be installed inside a fenced area on the top of site embankments, with the fuel tank. The fuel would be provided by a diesel tank with suitable containment, or a propane tank set above ground. The permanent standby engine generators would provide energy to operate the valves and gates, including the ability to stop diversions at the intake structure. The Bethany Reservoir Pumping Plant and the Bethany Reservoir Discharge Structure sites would each have a permanent standby engine generator with an isolated and fully contained fuel tank.

### 3.2.16.5 Local Water Supply, Drainage, and Utilities

Construction and operation would require services of power, water, telecommunications, and SCADA utilities. Refer to Section 3.2.11, *Electrical Facilities,* and Section 3.2.12, *SCADA Facilities,* for additional information.

All features would be designed to not increase peak runoff flows into adjacent storm drains, drainage ditches, or rivers and sloughs. At the intakes and tunnel shafts, water from dewatering activities and stormwater runoff on the construction site would be collected, treated, and stored on-site to reduce the need for off-site water sources. On-site reuse and storage would be maximized to reduce peak runoff rate from the site and the need to purchase water. If additional stored water is not needed, the treated stormwater runoff flows would be discharged to adjacent waterbodies in a manner that would not increase peak flow rates. Use of the treatment and storage facilities would avoid increased peak stormwater runoff flow rates from project construction sites.

Typical water demands at construction sites include dust control, soil stabilization, mixture with construction materials (e.g., slurry material or bentonite to form cutoff walls), tire wash basins, and restroom facilities. Water supplies in the vicinity of the construction sites are provided by on-site groundwater, import from local sources, exchanges, existing riparian diversions, new temporary appropriations, or existing SWP appropriations. None of the construction sites are served by local or regional water agencies. Existing groundwater supplies occur at all of the construction sites. Existing surface water right diversions occur on parcels at the intake sites, and Lower Roberts Island tunnel shaft site.

Most construction sites contain local irrigation and drainage facilities installed by existing or previous private landowners or reclamation districts. These systems may serve parcels that would be acquired for the project and adjacent parcels. Most of these existing facilities are buried and therefore not visible on aerial photographs. When the project can acquire access to specific parcels, irrigation and drainage facilities would be mapped for each site. If the facilities used by adjacent

properties to move water from the existing diversion are located on a parcel to be used for a project feature, pipelines or canals would be installed to maintain service to the adjacent properties.

Wastewater service for structures near the project construction sites consist of individual septic systems with septic tanks and leach fields. Regional wastewater facilities are provided to the communities of Courtland and Walnut Grove by the Sacramento Area Sewer District. Interceptor pipelines extend between these communities and a regional pumping plant at the Rio Cosumnes Correctional Center (near the Franklin Field along Bruceville Road). The Rio Cosumnes Correctional Center pumping plant lifts the wastewater into another interceptor that extends to the Sacramento Regional County Sanitation District wastewater treatment plant near the community of Elk Grove.

Wastewater facilities for all of the project construction sites would be provided with portable restrooms. Septic systems would also be constructed at the intakes, Twin Cities Complex, Lower Roberts Island, and at Bethany Reservoir Pumping Plant and Surge Basin site. Because of high groundwater and/or low soil permeability at these sites, the leach fields would be sized larger than for locations with more favorable soil conditions, in accordance with the applicable county regulations.

# 3.3 Intake Operations and Maintenance

The north Delta intakes operations criteria and mitigation[4] are intended to avoid, minimize, and fully mitigate the potential impacts of operating the north Delta intakes. The real-time decision making specific to the north Delta diversion operations would be mainly associated with reviewing real-time abiotic and fish monitoring data and ensuring weekly, daily, and sub-daily operations are consistent with the permitted criteria and within the effects analyzed in the permits.

The north Delta intakes would operate in conjunction with the existing SWP and potentially CVP intakes in the south Delta. Operations of the existing SWP facilities, and in coordination with CVP operations pursuant to the Coordinated Operations Agreement, will be governed by the applicable regulatory requirements specified under the State Water Resources Control Board (State Water Board) *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary* (Bay-Delta WQCP) and assigned to the SWP in the applicable water right decision, applicable biological opinions under ESA, applicable incidental take permit under CESA, and USACE Clifton Court diversion limits. The operations of the north Delta intakes would remain consistent with these existing regulatory requirements. The purpose of the project is to seek a new point of diversion, and is not seeking to expand water right quantity. In addition, diversions at the proposed north Delta intakes would be governed by new operational criteria specific to these intakes, such as the fish screen approach velocity requirements, bypass flow requirements, and pulse protection. These new criteria provide additional protections to the fish species over and above the protections from the state-of-the-art positive barrier fish screens included at the intakes. An overview of operational criteria is provided in Table 3.3-1, with additional detail for the north Delta intakes in Table 3.3-2.

[4] CMP-25: *Tidal Habitat Restoration to Mitigate North Delta Hydrodynamic Effects on Chinook Salmon Juveniles* would reduce negative hydrodynamic effects such as flow reversals in the Sacramento River at Georgiana Slough, thereby reducing the potential for negative effects on juvenile salmonids through-Delta survival as a result of factors such as flow-related changes in migration speed and probability of entering the low-survival interior Delta migration pathway.

## 3.3.1 New Operational Criteria for the North Delta Intakes

As described in Chapter 1, Section 1.7, *Consultation Approach*, a discussion of operations is included to support assessment of the project as a whole. Operations and maintenance of the proposed action are assessed at a programmatic level for this BA; detailed effects analysis, as well as the qualitative, cumulative, programmatic analysis that they inform, are presented in Appendices 5C, 6C, and 7A.

Several new operational criteria would govern the diversions at the north Delta intakes to minimize the near-field and the far-field effects of the intake operations.[5] The following criteria aim to minimize effects of the intake operations on fish passage, survival in the intake reach, and through-Delta survival of migrating fish.

- Approach and sweeping velocity requirements at the intake fish screens
- North Delta diversion bypass flow requirements
- Pulse protection
- Low-level pumping

These criteria are described in detail in the following sections.

### 3.3.1.1 Approach and Sweeping Velocity Requirements

Approach velocity is the velocity of water moving perpendicular to the screen surface, while sweeping velocity is the velocity of water moving parallel to and past the screens. The instantaneous diversions at the intakes would be subject to fishery agency velocity criteria: currently a maximum approach velocity of 0.2 feet per second (per U.S. Fish and Wildlife Service [USFWS] criteria for delta smelt). In addition, the Delta Conveyance Project would also include a minimum sweeping velocity of 0.4 feet per second (informed by real-time flow and river stage/cross-sectional area data downstream of the screened intake facility) to further minimize near-field effects of the intake operations, consistent with fish agency criteria. Recognizing that the intake facilities operate in a tidally influenced environment, these criteria are designed to reduce potential effects on the subset of fish exposed to the intake screens. The low approach velocity is intended to minimize effects associated with screen contact (e.g., impingement), while the sweeping velocity facilitates passage of fish and debris past the intakes. Refinements to these criteria would be considered through ongoing fish agency coordination as well as through real-time operations and adaptive management.

### 3.3.1.2 Bypass Flow Requirements

Bypass flow is the 3-day tidally averaged flow remaining in the Sacramento River immediately downstream of the north Delta intakes computed as flow measured at Freeport minus the diversion rate. The objectives of the north Delta diversion bypass flow criteria include regulation of diversions to minimize survival changes for emigrating salmonids in the intake reach, as well as through-Delta, and minimize the potential for upstream movement of fish with flow at two points of control: (1) Sacramento River upstream of Sutter Slough, and (2) Sacramento River downstream of Georgiana

[5] Near-field effects are those occurring in close proximity to intake screens, for example, entrainment or impingement; far-field effects are those occurring farther from intakes, for example, reduced survival because of less flow in the Sacramento River downstream of the intakes.

Slough. These points of control are used to minimize the potential for upstream advection toward the intakes and to minimize upstream advection into Georgiana Slough.

To ensure that these objectives are met, the bypass flow requirements are designed to reduce diversions at the intakes at certain times of the year (more restrictive from December through June) when the majority of listed fish are present. The bypass flow requirements are calculated based upon Sacramento River inflows at Freeport and vary progressively with increasing inflows.

From December through June, three levels (Levels 1, 2, and 3) of bypass flow requirements are proposed, with Level 1 being the most restrictive and Level 3 being the least restrictive of the diversions at the intakes. If high Sacramento River inflows occur for long durations, the bypass flow requirement can transition from Level 1 to Levels 2 and 3. To illustrate the effect of the bypass rules on the volume of Sacramento River flow that may be diverted, Table 3.3-2, Sub-Table A, shows the allowable north Delta diversions by month for each level, based on Sacramento River inflows at Freeport. The Level 1 bypass requirement would apply until the occurrence of 15 total days of bypass flows above 20,000 cfs. Following that, the Level 2 bypass flow requirement would apply. Level 2 would govern the allowable diversions until the occurrence of 30 total days of bypass flows above 20,000 cfs. At this point, the Level 3 bypass flow requirement would apply.

From July through September, the bypass flow requirement of at least 5,000 cfs in river after diverting at the north Delta intakes would apply. From October through November the minimum bypass flow requirement of at least 7,000 cfs in river after diverting at the north Delta intakes would apply.

#### 3.3.1.3 Pulse Protection

Pulse protection is initiated when a large number, and relatively high concentration, of winter-run-sized juvenile salmonids begin migrating into the Delta from upstream locations. Pulse protection helps further minimize potential decreases in survival for emigrating salmonids in the intake reach, as well as through-Delta, and minimize the potential for upstream advection of fish, further enhancing the protections offered by the bypass flow requirements.

A pulse flow is a natural occurrence typically caused by the first runoff event(s) of the season. Monitoring data suggests that these winter run-off events (e.g., as indicated by sharp increases in Wilkins Slough flows, located upstream of the confluence of the Feather and Sacramento Rivers) are often associated with large numbers of juvenile, winter-run-sized salmonids, moving from natal upstream locations into lower Sacramento River reaches and the Delta (del Rosario et al. 2013). When the pulse protection operation is triggered, bypass flow (and co-occurring fish) would be further protected by operating the north Delta intakes to the low-level pumping rules (Section 3.3.1.4, *Low-Level Pumping*).

If the pulse period begins before December 1, bypass criteria for that month would be implemented following the pulse period; and the second pulse period would have the same protective operation as the first pulse period, resulting in up to two pulse protection periods per water year.

The initiation and ending of pulse protection is defined by the following criteria: (1) increase in flow of the Sacramento River at Wilkins Slough by more than 45% within a 5-day period, and (2) Sacramento River flows greater than 12,000 cfs measured at Wilkins Slough. Low-level pumping would continue until (1) Wilkins Slough returns to pre-pulse flows (flow on first day of the 5-day increase), (2) Sacramento River at Wilkins Slough flows decrease for 5 consecutive days, or (3)

Sacramento River at Wilkins Slough flows that are greater than 20,000 cfs for 10 consecutive days. Up to two pulse protections are proposed.

#### 3.3.1.4 Low-Level Pumping

Low-level pumping of up to 6% of total Sacramento River flow at Freeport such that diversions would not reduce bypass flow below 5,000 cfs. No more than 900 cfs (total) can be diverted by all the intakes combined. Low-level pumping can occur in October through November during a pulse protection event. It can also occur in December through June during a pulse protection event or if the bypass flow rules defined in Table 3.3-2 result in less diversion than the low-level pumping. In addition, north Delta diversion levels at both intakes would be subject to a maximum approach velocity of 0.2 feet per second and a minimum sweeping velocity of 0.4 feet per second at the fish screens. Velocity compliance would be informed by real-time hydrological data measured at the intakes.

### 3.3.2 Existing Delta Operations Criteria

Operations of the existing facilities will be governed by the applicable existing and relevant future regulatory requirements. The operations of the north Delta diversion intakes would remain consistent with these existing regulatory requirements.

#### 3.3.2.1 Old and Middle River Flows

The Old and Middle River (OMR) flow criteria chiefly serve to constrain the magnitude of reverse flows in the Old and Middle Rivers to limit fish entrainment into the south Delta. The OMR criteria defined in the regulatory baseline (currently 2019 BiOps and 2020 ITP) are applicable. Key OMR criteria under the current BiOps and ITP are listed in Table 3.3-1.

#### 3.3.2.2 Delta Cross Channel Gate Operations Criteria

The operational criteria for the Delta Cross Channel are as specified in the regulatory baseline, which is currently State Water Board D-1641, with additional days closed from October 1 through January 31 based on the 2019 NMFS BiOp (closed based on fish migration from October 1 through December 14 unless adverse water quality conditions).

- **October–November.** Delta Cross Channel gates closed if fish are present.
- **December–May.** Delta Cross Channel gates closed.
- **June–September.** Delta Cross Channel gates open.

#### 3.3.2.3 Rio Vista Minimum Instream Flow Criteria

Rio Vista minimum instream flow criteria are as specified in the regulatory baseline (currently State Water Board D-1641):

- **September through December.** Operate in accordance with State Water Board D-1641.

#### 3.3.2.4 Delta Outflow Criteria

Delta outflow criteria are as defined in the regulatory baseline, which include the State Water Board D-1641, 2019 BiOps, and 2020 ITP (Table 3.3-1).

- **Spring outflow.** As defined in the regulatory baseline (currently 2020 ITP).
- **Summer and Fall Habitat Actions.** Same as 2019 BiOps and 2020 ITP requirements.
  - **Outflow.** State Water Board D-1641 and for summer/fall delta smelt habitat operate to meet X2 of 80 kilometers for September and October of above normal and wet years with transitional flows in last half of August; considered as In-Basin Use and shared according to COA Article 6(c).
  - **Suisun Marsh Salinity Control Gates (SMSCG) Action.** In wet (if needed), above normal, below normal, and dry years following wet and above normal years (conditioned on successful carryover of water from 100 TAF), operate SMSCG for 60 days; in dry years following below normal years operate SMSCG for 30 days.
  - **Additional 100 TAF of Delta Outflow.** Same as 2020 ITP requirements. A flexible block of water provided by SWP in wet and above normal years. Can be used in wet or above normal years to enhance Delta outflow or carried over to the following year, but subject to spill.

Delta outflow requirements established under D-1641 will be followed unless the outflow requirements are greater under the criteria listed above.

#### 3.3.2.5 Export to Inflow Ratio

Export to inflow (E:I) ratio requirements specified in State Water Board D-1641 are applicable. In computing the E:I ratio, the Sacramento River inflow is measured at Freeport upstream of the north Delta intakes and diversions at north Delta intakes are included in the total exports calculation.

#### 3.3.2.6 Other Criteria

Related to the Clifton Court Forebay, there are existing regulations, including the maximum allowable daily diversion rate into Clifton Court Forebay during the months of July, August, and September of calendar years 2021–2029, would be maintained consistent with the existing activity at 13,870 acre-feet to 14,860 acre-feet and the maximum 3-day average diversion rate would be maintained at 13,250 acre-feet to 14,240 acre-feet (990 acre-feet per day—equivalent to 500 cfs per day). This operational activity over the 3-month period would not exceed 90,000 acre-feet each year. It would not be greater than the total amount of export reductions to protect fishery resources in the current calendar year, any unreimbursed export reductions from the previous water year, and anticipated export reductions in the subsequent year to protect fishery resources.

### 3.3.3 Integration of North Delta Intakes with South Delta Facilities

The north Delta intakes would operate in conjunction with the existing south Delta intakes. The intakes would augment the ability to capture excess flows and improve the flexibility of the SWP operations such as for meeting the State Water Board D-1641 Delta salinity requirements. The Delta Conveyance Project would not change operational criteria associated with upstream reservoirs. Upstream of Delta facilities will continue to be operated to meet regulatory, environmental, and contractual obligations consistent with existing operations. The Delta Conveyance Project is not proposing to increase the total quantity of water permitted for diversion under existing DWR water rights. The following text describes the dual conveyance operations.

During the winter and spring, when there are excess flows in the system:

- The SWP would first use south Delta facilities to export water up to what is permitted under the existing water rights and all applicable state and federal law and regulations.
- The north Delta intakes would be used to capture excess flows when the south Delta exports are limited and not able to capture those flows.
- Shifting from south Delta intakes to north Delta intakes has trade-offs and is not expected unless there is an operational advantage to do so at the discretion of DWR and in coordination with fish and wildlife agencies (e.g., to provide additional real-time south Delta fish protections; to reduce salinity at Jersey Point). Note that DWR has added information to clarify operations under the Delta Conveyance Project in Chapter 1, Section 1.3, *Brief Description of the Proposed Action*, including south Delta considerations.
- There would likely be conditions where diversions through the north Delta intakes are not maximized even when the bypass flow requirements would allow greater diversions. Examples could be when other operational criteria are controlling or when south of Delta storage is full.

During the late spring, summer, and fall, when the SWP are typically operating to meet State Water Board D-1641 salinity requirements in the Delta:

- Both the existing south Delta intakes and the north Delta intakes would be operated together to meet the State Water Board D-1641 salinity requirements.
- Some level of combined SWP and CVP south Delta exports would be needed to manage salinity in the Old River and Middle River corridor. If the combined SWP and CVP south Delta exports are less than 3,000 cfs, SWP water would not be moved through the north Delta intakes.
- The south Delta exports and the north Delta diversions would be balanced and adjusted to meet the State Water Board D-1641 salinity requirements at the western Delta stations on the Sacramento and San Joaquin Rivers (e.g., increasing salinity at Jersey Point would cause a shift in diversions from south Delta to north Delta, whereas increasing salinity at Emmaton would cause a shift from north Delta to south Delta). This operation is expected to result in a more efficient system operation where less water would be required to meet the same water quality standards and result in additional water that could either remain in storage or be exported.
- Upstream SWP storage operations would continue to be managed to the existing and future regulatory and contractual obligations of the SWP in determining the amount of stored water available for exports. DWR would not increase storage withdrawal for exports even though the

intakes may provide additional diversion capacity. The only exception would be to divert any stored water that was a result of a more efficient system operation of the intakes. The upstream storage would be managed such that the benefit of the stored water is the same for all SWP contractors whether they choose to participate in the Delta Conveyance Project or not.

### 3.3.4 Use of North Delta Intakes for Wheeling

Under State Water Board D-1641 (December 1999, revised March 2000), Reclamation and DWR are authorized to use and exchange existing south diversion capacity between the SWP and CVP to enhance the beneficial uses of both projects. The sharing of the SWP and CVP export facilities is referred to as Joint Point of Diversion (JPOD). In general, JPOD capabilities are used to accomplish the following four objectives.

- When wintertime excess pumping capacity is available during Delta excess conditions, and total SWP and CVP San Luis Reservoir storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis Reservoir storage may elect to use JPOD capabilities.
- When summertime pumping capacity is available at the Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP releases for south-of-Delta water supplies.
- When summertime pumping capacity is available at the Banks or Jones Pumping Plants to facilitate water transfers, the JPOD may be used to further facilitate the water transfer.
- During certain coordinated SWP and CVP operation scenarios for fish entrainment management, the JPOD may be used to shift SWP and CVP exports to the facility with the least fish entrainment impact and minimize exports at the facility with the greatest fish entrainment impact.

The term *wheeling* means the transmission of water owned by one entity through the facilities owned by another entity, in this case CVP water wheeled through the SWP north Delta intakes. Wheeling through JPOD Stage 1 and Stage 2[6] would not be allowed through the north Delta intakes. In general, if conveyance capacity is available, wheeling[7] for CVP may be allowed subject to appropriate environmental review, permitting, and compensation.

Water transfers are voluntary actions proposed by willing buyers and sellers. DWR is one of several public agencies involved in approval and management of proposed water transfers that use SWP facilities. Because DWR's jurisdiction is limited to water transfers involving the Delta export facilities of the SWP, it has limited involvement in the statewide water transfer market.

Operations do not specifically propose to accommodate water transfers; however, constructing new Delta conveyance facilities could provide the ability for water transfers to occur through the facility by providing increased capacity. Related, DWR and other public agencies must allow bona fide

[6] The State Water Resources Control Board (State Water Board) Water Right Decision 1641 (D-1641) establishes three stages under which Joint Points of Diversion (JPOD) can be used by either DWR or the Reclamation for diversions of Delta water supplies at the SWP Banks Pumping Plant and CVP Tracy Pumping Plant (now called Jones Pumping Plant), respectively. Stage 1 allows JPOD use for selected purposes including the recovery of export reductions taken to benefit fish. Stage 2 allows JPOD use for any authorized purpose up to the current regulatory capacity of these facilities. Stage 3 allows JPOD use up to the physical capacity of these facilities authorized under their water right permits.

[7] The provisions of California Water Code Section 1810 outline the conditions under which wheeling can occur.

transferors use of up to 70% of the unused capacity of a public conveyance facility in exchange for fair compensation.[8] The project can potentially (1) add additional export capacity if current facilities are limited and/or (2) provide additional efficiency in moving water transfers across the Delta by potentially lowering the required carriage water to export the transfer supplies. Because of this potential, and the likely demand to use the project's conveyance capacity for future water transfers, CalSim 3 results were analyzed to identify available export capacity for water transfers with current facilities and increased available export capacity with the project if existing facilities are limited. In addition, these post-processed CalSim 3 results are compared with other transfer information such as (1) regulatory limitations, (2) supply limitations, and (3) historical water transfers. Of note, operations do not include water transfers.

### 3.3.5 Intake Maintenance Activities

Maintenance activities at the intakes would be conducted at varying frequencies. Daily maintenance activities would include inspections, security checks, and operations oversight. Less frequent maintenance activities include operability testing, cleaning, sediment removal, dewatering, and repaving. Maintenance activities that would occur regardless of operations are considered project-level activities and are therefore associated with this BA. Certain cleaning activities would not occur absent of operations. Vegetation management and dredging would occur regardless of operations.

The cylindrical tee fish screens and panels would be regularly inspected and maintained by manual cleaning to remove algae and other biofouling not cleaned by the automatic cleaning system. The screens would be raised out of the water and power washed with a high-pressure power washer approximately every 6 months. Sediment jetting the apron area below the screens at the base of the screen structure in the water to help keep sediment from accumulating would occur hourly or daily, depending on needs. A diver would inspect the screens and panels while in place and operating once or twice per year, often in conjunction with manual screen cleaning activities.

The debris fender at the upstream end of the log boom and the log boom would require maintenance to prevent corrosion and related deterioration. Debris would be removed manually from the top deck of the structure, by workers on boats, or by divers.

Sedimentation basins would be dredged once per year using a portable floating hydraulic suction dredge. Dredging would occur during summer months (assumed to be May through September) to maximize natural drying in the sediment drying lagoons. The dredge would discharge a sediment slurry into the sediment drying lagoons. The drying lagoons would include an outlet structure with an adjustable weir to decant water off the top of the sediment slurry and underdrains to transport water from beneath the dredged sediment. Decant and underdrain water would be pumped back into the sedimentation basin. It is expected that it would take about 2 days to fill each sediment drying lagoon, and 6 to 8 days to fill all four lagoons. The sediment is anticipated to be large silt and sand particles with minimal organic material. Once dry, the sediment would be trucked off-site for disposal at a permitted disposal site or for beneficial uses. The fill and drain/dry sequence would take about 7 to 8 days, which would approximately match the dredged material filling rate so continuous, or nearly continuous, operation would be possible.

Minor vegetation management would be conducted at least monthly along the side slopes of the basins to keep them free of unwanted growth. Vegetation would be removed manually (e.g., mowing,

[8] Water Code Section 1810 *et seq*.

cutting) or, possibly, with the use of herbicides. As described in Appendix 3A, AMM-14: *Construction Best Management Practices for Biological Resources*, all herbicides will be used in accordance with the manufacturer-recommended uses and applications and in such a manner as to prevent primary or secondary poisoning of special-status fish, wildlife, and plant species and depletion of prey populations upon which they depend. However, because the use of herbicides specifically, or pesticides in general, is speculative, and because the location, timing, frequency, and methods of application are not known, thus, the use of chemicals to remove vegetation is not proposed. Take authorization may be sought at a later date when additional detail is available, and potentially be obtained through the Delta Habitat Conservation Plan (an effort currently being pursued by DWR to receive federal incidental take coverage for cover day-to-day operations and maintenance activities performed across the state). Minor debris collection would be conducted continually.

Since the basin embankments would be the jurisdictional flood control levee, the levee side slopes and outside of the toe area would be inspected and maintained in full conformance with the CVFPB and USACE requirements. These requirements would include routine inspection and repair of all bulges, leaks, erosion, or other damage as soon as possible after detection.

## 3.3.6 Pump Maintenance Activities

Maintenance diversions may be necessary throughout the year to perform routine maintenance and testing of the main water supply pumps on approximately a monthly basis. The maintenance flow diversion rate is assumed to be one-half of a pump's rated capacity for 1 day per month per unit (up to a maximum of 480 cfs, depending on the alternative, conditions, and need). At all times, diversions will not reduce bypass flow below 5,000 cfs. Maintenance diversions would also be subject to meeting the approach and sweeping velocity criteria. Maintenance diversions will likely occur only when the north Delta intakes have not been operated for extended periods of time.

## 3.3.7 Delta Conveyance Project Preliminary Operations Criteria

A detailed table describing the operational criteria[9] is provided in Table 3.3-1, and additional detail for the north Delta intakes is provided in Table 3.3-2. Figure 3.3-1 provides a visual depiction of maximum allowable diversions in winter/spring and expected diversions in summer/fall. Figure 3.3-2 provides a depiction of the north Delta diversion operations concepts to minimize potential effects to aquatic species.

[9] In addition to the operational criteria developed for the north Delta intakes, routine maintenance and testing of the main water supply pumps is described in Section 3.3.6, *Pump Maintenance Activities*.

**Table 3.3-1. Delta Conveyance Project Preliminary Operations Criteria**

| Parameter | Delta Conveyance Project Criteria |
|---|---|
| **New Criteria** | |
| North Delta diversion operations | • Bypass Flow [a] Criteria (specifies bypass flow required to remain downstream of the north Delta intakes):<br>○ October through November: Minimum flow of 7,000 cfs required in river after diverting at the north Delta intakes.<br>○ December through June: Once the pulse protection (see below) ends, north Delta diversions will not exceed Level 1 pumping unless specific criteria have been met to increase to Level 2 or Level 3. If those criteria are met, operations can proceed as defined in Table 3.3-2. Allowable diversion will be greater of the following options: low-level pumping or the diversion allowed by the bypass flow rules in Table 3.3-2.<br>○ July through September: Minimum flow of 5,000 cfs required in river after diverting at the north Delta intakes.<br>• Pulse Protection (October through June):<br>○ Low-level pumping is allowed when river conditions are adequate during the pulse protection period.<br>▪ Definition: Low-level pumping of up to 6% of total Sacramento River flow at Freeport such that diversions will not reduce bypass flow below 5,000 cfs. No more than a total of 900 cfs can be diverted by all the intakes combined. Low-level pumping can occur in October–November during a pulse protection event and in December–June as defined in Table 3.3-2. In addition, north Delta diversion levels at all the intakes will be subject to a maximum approach velocity of 0.2 feet per second and a minimum sweeping velocity of 0.4 feet per second at the fish screens. Velocity compliance would be informed by real-time hydrological data measured at the intake locations.<br>○ Pulse triggering, duration, and conclusion is determined based on the criteria defined in Table 3.3-2.<br>○ If the initial pulse begins before December 1, the bypass flow criteria for the month (October and November) when the pulse occurred would take effect, following a pulse protection period. On December 1, the Level 1 rules defined in Table 3.3-2 apply unless a second pulse occurs. If a second pulse protection event occurs, Level 1 rules for December through June would take effect, following the second pulse protection period.<br>• Real-Time Operations: The operations criteria and tidal restoration mitigation are intended to minimize and fully mitigate the potential impacts of the NDD operations. The real-time decision-making specific to the NDD operations would be mainly associated with reviewing real-time abiotic and fish monitoring data and ensuring weekly, daily and sub-daily operations are consistent with the permitted criteria and within the effects analyzed in the permits. See Section 3.4, *Real-Time Operational Decision-Making Process,* for additional details.<br>• Adaptive Management: The Operations Adaptive Management and Monitoring Plan (OAMMP) will be used to evaluate and consider changes in operational criteria based on information gained before and after the new facilities become operational. This program will be used to consider and address scientific uncertainty regarding the Delta ecosystem and to inform project operations. |
| **Existing Delta Criteria** [b] | |
| South Delta operations | • Same as D-1641, 2019 BiOps and 2020 SWP ITP requirements including adult, larval, and juvenile longfin smelt protections.<br>• Adult, larval, and juvenile delta smelt protections (e.g., First Flush and Turbidity Bridge). |

| Parameter | Delta Conveyance Project Criteria |
|---|---|
| | • Winter-run/Spring-run/Steelhead Protection (discrete daily thresholds, onset of OMR, early and mid-season daily thresholds, single-year loss thresholds).<br>• OMR Flex (storm flex).<br>• Beginning and end of OMR protections. |
| Head of Old River Barrier operations | Same as 2019 BiOps and 2020 SWP ITP requirements; temporary barrier is not installed. |
| Delta Cross Channel gates | State Water Board D-1641 with additional days closed from October 1 to January 31 based on 2019 NMFS BiOp (closed based on fish migration from October 1 to December 14 unless adverse water quality conditions). |
| Spring outflow[10] | Same as 2020 SWP ITP requirements. |
| Additional 100 TAF of Delta Outflow | Same as 2020 SWP ITP requirements. |
| Summer and fall habitat actions | Same as 2019 BiOp and 2020 SWP ITP requirements. |
| Delta outflow | Delta outflow requirements established under D-1641 will be followed to the extent not superseded by criteria listed above. |
| Rio Vista minimum flow standard [b] | September through December: flows per D-1641 |
| Export to inflow ratio | Operational criteria are the same as defined under D-1641; north Delta intakes to be included in the export term for the E:I ratio calculation, such that combined export rate is defined as the Clifton Court Forebay inflow rate (minus actual Byron-Bethany Irrigation District diversions from Clifton Court Forebay), north Delta diversion rate, and the export rate of the Tracy pumping plant (now called Jones Pumping Plant). |

BiOp = Biological Opinion; cfs = cubic feet per second; E:I = export/inflow; ITP = Incidental Take Permit; OAMMP = Operations Adaptive Management and Monitoring Plan; OMR = Old and Middle River; NDD = north Delta diversion; State Water Board = State Water Resources Control Board; TAF = thousand acre-feet.

[a] Sacramento River flow upstream of the intakes to be measured flow at Freeport. Bypass flow is the 3-day tidally averaged Sacramento River flow computed as flow measured at Freeport minus the diversion rate. Sub-daily north Delta intakes' diversion operations will maintain fish screen approach and sweeping velocity criteria.

[b] Rio Vista minimum monthly average flow in cfs (7-day average flow not less than 1,000 below monthly minimum), consistent with the State Water Board D-1641.

[10] Spring outflow requirement is an existing regulatory requirement for the SWP. In complying with this existing requirement, total SWP exports including the north Delta diversions and the existing south Delta exports will be curtailed as needed.

**Table 3.3-2. North Delta Diversion Bypass Flow and Pulse Protection Requirements**

| **North Delta Diversion Bypass Flow and Pulse Protection Requirements**<br>This table further details a few of the criteria for the north Delta diversion operations included in Table 3.3-1. |
|---|
| **<u>Pulse Protection</u>**<br>Low-level pumping (Table 3.3-1) will be allowed when river conditions are adequate during the pulse protection period. Initiation of the pulse protection is defined by the following criteria: (1) Sacramento River daily average flow at Wilkins Slough increase by more than 45% within a 5-day period and (2) flow on the 5th day greater than 12,000 cfs.<br>The pulse protection continues until either (1) Sacramento River flow at Wilkins Slough returns to pre-pulse flow level (flow on first day of 5-day increase), or (2) Sacramento River flow at Wilkins Slough decreases for 5 consecutive days, or (3) Sacramento River flow at Wilkins Slough is greater than 20,000 cfs for 10 consecutive days. After pulse period has ended, operations will return to the bypass flow table (Sub-Table A).<br>If the initial pulse period begins before Dec 1, then any second pulse that may occur during December through June will receive the same protection, i.e., low-level pumping as described in Table 3.3-1, resulting in up to two pulses which would receive this protection per water year. |
| **<u>Bypass Flow Criteria</u>**<br>After initial pulse(s), allowable diversion will be subject to Level 1 bypass flow criteria (Sub-Table A) until 15 total days of bypass flows above 20,000 cfs occur. Then allowable diversion will be subject to the Level 2 bypass flow criteria until 30 total days of bypass flows above 20,000 cfs occur. Then allowable diversion will be subject to the Level 3 bypass flow criteria. |

cfs = cubic feet per second.

| **Sub-Table A. North Delta Diversion Bypass Flow Criteria** [a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level 1 Bypass Flow Criteria | | | Level 2 Bypass Flow Criteria | | | Level 3 Bypass Flow Criteria | | |
| If Sacramento River flow is over... | But not over... | The bypass is... | If Sacramento River flow is over... | But not over... | The bypass is... | If Sacramento River flow is over... | But not over... | The bypass is... |
| **December through April (Allowable diversion will be the greater of the low-level pumping or the diversion allowed by the following bypass flow rules)** | | | | | | | | |
| 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs | 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs | 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs |
| 5,000 cfs | 15,000 cfs | Flows remaining after low-level pumping | 5,000 cfs | 11,000 cfs | Flows remaining after low-level pumping | 5,000 cfs | 9,000 cfs | Flows remaining after low-level pumping |
| 15,000 cfs | 17,000 cfs | 15,000 cfs plus 80% of the amount over 15,000 cfs | 11,000 cfs | 15,000 cfs | 11,000 cfs plus 60% of the amount over 11,000 cfs | 9,000 cfs | 15,000 cfs | 9,000 cfs plus 50% of the amount over 9,000 cfs |

| Sub-Table A. North Delta Diversion Bypass Flow Criteria [a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level 1 Bypass Flow Criteria | | | Level 2 Bypass Flow Criteria | | | Level 3 Bypass Flow Criteria | | |
| If Sacramento River flow is over... | But not over... | The bypass is... | If Sacramento River flow is over... | But not over... | The bypass is... | If Sacramento River flow is over... | But not over... | The bypass is... |
| 17,000 cfs | 20,000 cfs | 16,600 cfs plus 60% of the amount over 17,000 cfs | 15,000 cfs | 20,000 cfs | 13,400 cfs plus 50% of the amount over 15,000 cfs | 15,000 cfs | 20,000 cfs | 12,000 cfs plus 20% of the amount over 15,000 cfs |
| 20,000 cfs | no limit | 18,400 cfs plus 30% of the amount over 20,000 cfs | 20,000 cfs | no limit | 15,900 cfs plus 20% of the amount over 20,000 cfs | 20,000 cfs | no limit | 13,000 cfs plus 0% of the amount over 20,000 cfs |
| **May (Allowable diversion will be the greater of the low-level pumping or the diversion allowed by the following bypass flow rules)** | | | | | | | | |
| 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs | 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs | 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs |
| 5,000 cfs | 15,000 cfs | Flows remaining after low-level pumping | 5,000 cfs | 11,000 cfs | Flows remaining after low-level pumping | 5,000 cfs | 9,000 cfs | Flows remaining after low-level pumping |
| 15,000 cfs | 17,000 cfs | 15,000 cfs plus 70% of the amount over 15,000 cfs | 11,000 cfs | 15,000 cfs | 11,000 cfs plus 50% of the amount over 11,000 cfs | 9,000 cfs | 15,000 cfs | 9,000 cfs plus 40% of the amount over 9,000 cfs |
| 17,000 cfs | 20,000 cfs | 16,400 cfs plus 50% of the amount over 17,000 cfs | 15,000 cfs | 20,000 cfs | 13,000 cfs plus 35% of the amount over 15,000 cfs | 15,000 cfs | 20,000 cfs | 11,400 cfs plus 20% of the amount over 15,000 cfs |
| 20,000 cfs | no limit | 17,900 cfs plus 20% of the amount over 20,000 cfs | 20,000 cfs | no limit | 14,750 cfs plus 20% of the amount over 20,000 cfs | 20,000 cfs | no limit | 12,400 cfs plus 0% of the amount over 20,000 cfs |
| **June (Allowable diversion will be the greater of the low-level pumping or the diversion allowed by the following bypass flow rules)** | | | | | | | | |
| 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs | 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs | 0 cfs | 5,000 cfs | 100% of the amount over 0 cfs |

| Sub-Table A. North Delta Diversion Bypass Flow Criteria [a] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Level 1 Bypass Flow Criteria | | | Level 2 Bypass Flow Criteria | | | Level 3 Bypass Flow Criteria | | |
| If Sacramento River flow is over... | But not over... | The bypass is... | If Sacramento River flow is over... | But not over... | The bypass is... | If Sacramento River flow is over... | But not over... | The bypass is... |
| 5,000 cfs | 15,000 cfs | Flows remaining after low-level pumping | 5,000 cfs | 11,000 cfs | Flows remaining after low-level pumping | 5,000 cfs | 9,000 cfs | Flows remaining after low-level pumping |
| 15,000 cfs | 17,000 cfs | 15,000 cfs plus 60% of the amount over 15,000 cfs | 11,000 cfs | 15,000 cfs | 11,000 cfs plus 40% of the amount over 11,000 cfs | 9,000 cfs | 15,000 cfs | 9,000 cfs plus 30% of the amount over 9,000 cfs |
| 17,000 cfs | 20,000 cfs | 16,200 cfs plus 40% of the amount over 17,000 cfs | 15,000 cfs | 20,000 cfs | 12,600 cfs plus 20% of the amount over 15,000 cfs | 15,000 cfs | 20,000 cfs | 10,800 cfs plus 20% of the amount over 15,000 cfs |
| 20,000 cfs | no limit | 17,400 cfs plus 20% of the amount over 20,000 cfs | 20,000 cfs | no limit | 13,600 cfs plus 20% of the amount over 20,000 cfs | 20,000 cfs | no limit | 11,800 cfs plus 0% of the amount over 20,000 cfs |
| **Bypass flow criteria for July through November** | | | | | | | | |
| If Sacramento River flow is over... | | | But not over... | | | The bypass is... | | |
| **July through September** | | | | | | | | |
| 0 cfs | | | 5,000 cfs | | | 100% of the amount over 0 cfs | | |
| 5,000 cfs | | | No limit | | | A minimum of 5,000 cfs | | |
| **October and November** | | | | | | | | |
| 0 cfs | | | 7,000 cfs | | | 100% of the amount over 0 cfs | | |
| 7,000 cfs | | | No limit | | | A minimum of 7,000 cfs | | |

cfs = cubic feet per second.

[a] Level 1, Level 2 and Level 3 Bypass Flow Criteria do not apply July through November. Minimum Bypass Flow Criteria are applicable July through November as described in the table.

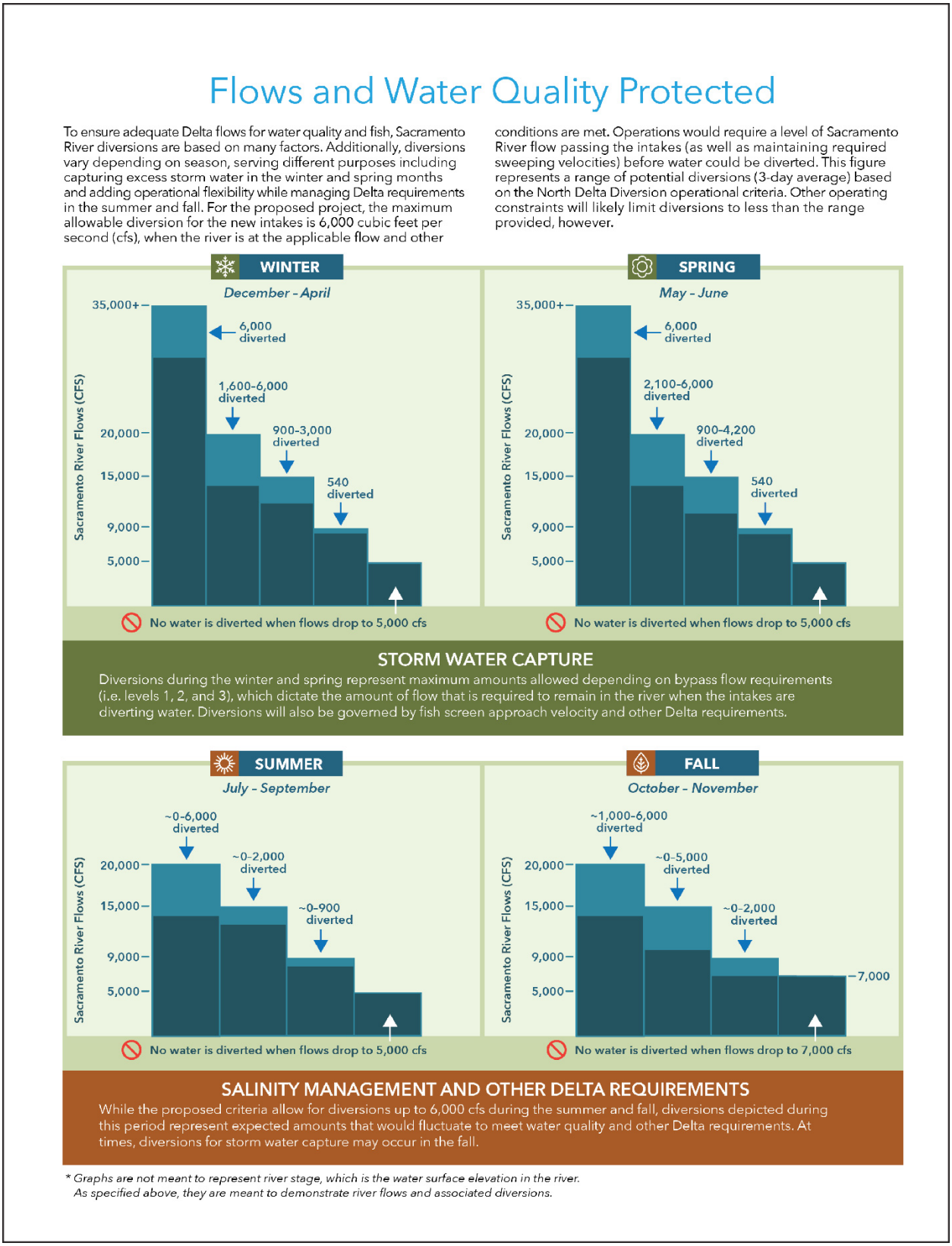



**Figure 3.3-1. Seasonal Diversions**

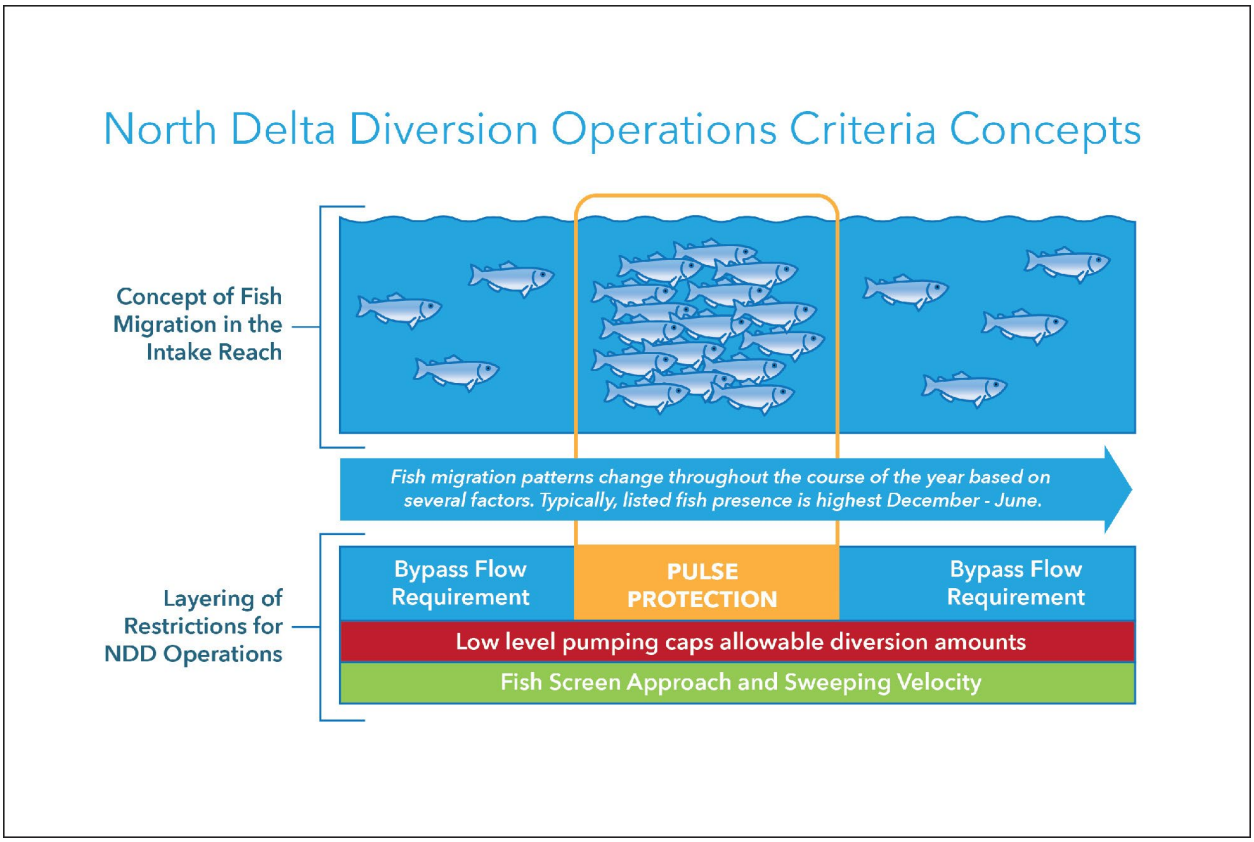



**Figure 3.3-2. North Delta Diversion Operations Concepts**

# 3.4 Real-Time Operational Decision-Making Process

The operations criteria and the mitigation is intended to minimize and mitigate the potential impacts of operating the north Delta intakes. The real-time decision making specific to the north Delta intake operations would be mainly associated with reviewing real-time abiotic and fish monitoring data and ensuring weekly, daily, and sub-daily operations are consistent with the permitted criteria and within the effects analyzed in the permits. Real-time operations, and operations in general, are included in this BA to allow the federal agencies to evaluate the whole of the action. Consultation for project-specific coverage of operations will occur in the future.

## 3.4.1 Ongoing Processes to Support Real-Time Decision Making

The 2019 BiOps and 2020 SWP ITP define the real-time operations decision-making process under the current operations. In general, SWP and CVP operators provide a weekly outlook on forecasted hydrologic conditions, projected operations based on those conditions, and an assessment of potential changes in flow and water quality based on those projected operations to the Salmon Monitoring Team (SaMT) and Smelt Monitoring Team (SMT). SaMT and SMT consider this

information along with the fish monitoring data to determine the risk to the listed fish species. For example, SaMT and SMT make recommendations when specific triggers specified in the 2019 BiOps or Conditions of Approval in the 2020 SWP ITP are active, typically from October through June. The two monitoring teams, including participants from CDFW, perform the ITP risk assessments. Based on these analyses, monitoring teams may recommend specific actions to the Water Operation Management Team (WOMT) that may change projected operations. The WOMT decides the final action. In addition, the WOMT may elevate the decision to the directors of DWR, Reclamation, and the permitting agencies if they are unable to agree on the action, consistent with the decision-making process identified in the 2019 BiOps and the 2020 SWP ITP.

DWR would work with the fishery agencies to integrate the Delta Conveyance Project into these existing real-time processes to facilitate additional real-time south Delta fish protections, depending on the conditions. The existing and/or future real-time decision processes would evaluate monitoring data and determine whether use of the new north Delta intakes could improve aquatic conditions in the south Delta, while maintaining species protections in the north Delta. Under these circumstances, the final decision would be at the discretion of DWR. In addition, the real-time decision-making framework would provide a process to consider operational decisions and ensure there are opportunities to respond to unique circumstances (e.g., where risks to species may be higher or lower than expected), although this is anticipated to be infrequent.

## 3.4.2 North Delta Diversions

During the time from permit issuance through initial north Delta diversion operations, DWR would conduct studies such as evaluating the relationship between the hydrologic conditions and the behavior of migrating juvenile salmonids in the Sacramento River reach between Wilkins Slough/Knights Landing and the north Delta intakes as part of the Operations Adaptive Management and Monitoring Plan (OAMMP) (Section 3.5, *Operations Adaptive Management and Monitoring Plan*). The studies would be focused on gathering additional real-time fish monitoring data to inform potential triggers for real-time operational responses of the north Delta intakes as a mechanism to further minimize exposure effects on the listed species. The real-time operation and the criteria would be refined if needed through the OAMMP process. The operational criteria elements that would be studied further based on real-time fish monitoring include hydrologic/behavioral cues upstream of and in the Delta for triggering, duration, and conclusion of pulse protection, Level 1, Level 2, and/or Level 3 bypass flow criteria and transitions, as well as diel (night/day) behavior in the intake reaches. The decision-making framework and potential real-time operational responses and considerations are discussed in the next section. As these studies will be occurring prior to operation, they are considered to be project-level studies and are therefore associated with this BA.

## 3.4.3 Real-Time Decision-Making Framework

Under existing operations, during periods of fishery concern for Delta water project operations (October to June) operators and fishery biologists meet frequently (typically weekly). Forecasted conditions and projected operations for the week ahead are presented to the SaMT and SMT technical teams and are considered in real time while taking into account fish monitoring data and other relevant information. With this weekly outlook, a risk-assessment is developed, and any potential concerns or real-time operational considerations are developed and presented to WOMT. This general process would continue and operations of the north Delta intakes would be integrated, as follows:

- **Weekly**—Continue the ongoing weekly outlook planning process.
- **Daily**—Operators (schedulers) will assess the hydrologic and Delta conditions and schedule a daily volume from the north Delta diversion within the regulatory requirements. These requirements would include north Delta diversion bypass requirements, Delta requirements, and any other required limitations such as presence of excess conditions. This scheduled volume would be coordinated with other SWP and CVP operations.
- **Sub-Daily**—Operators would operate the facility within the constraints at each intake, including minimum sweeping requirements and allowable approach velocities. To the extent possible, the SWP would prioritize north Delta diversion sub-daily diversions during daylight hours. As noted above, the diel behavior in the intake reaches would be studied further.

#### 3.4.3.1 Real-Time Actions

- **Near Field:** Fish screen performance criteria, including facility performance in meeting approach velocity compliance and sweeping velocity performance necessary to minimize entrainment and impingement impacts.
    - Provide and monitor real-time flows through each of the intake's screen units to demonstrate approach velocity compliance. During design of the intakes, computational modeling would be undertaken, and field measurements/baffle adjustments would be made during commissioning/operations, both to demonstrate compliance with velocity criteria. Individual intake screen unit flows can also be gathered and summed up to determine the intake's full diversion flow.
    - Provide and monitor velocity/flow gage downstream of each intake facility, along with the intake flows, to demonstrate sweeping velocity performance.
        - Velocity/flow gauges (i.e., Acoustic Doppler Current Profilers) downstream of each facility, along with an additional acoustic fish monitoring station (similar to side-scan sonar technology as described below in Far Field), to investigate fish distribution within the river's flow/velocity field. In conjunction with the intake facility flow measurements, these velocity/flow gauges can be used during facility operations to demonstrate screen sweeping-velocity performance. For example, following planned full-facility velocity performance evaluations, the average downstream river velocity would be correlated to each intake facility's sweeping-velocity performance and adjusted as appropriate.
    - Entrainment monitoring as necessary. As part of compliance monitoring, sub-sampling at each intake would be conducted to assess level of protection consistent with project design/assumptions.
    - Approach/sweeping criteria relaxation would be considered (with approval from regulatory agencies) when risk to covered species is low/absent (e.g., 0.3 feet per second approach velocity based on temperature/calendar off-ramps when smelt are unlikely to be in the intake reach). This would allow, among other opportunities, for periodic maintenance operational flexibility, such as during sedimentation basin dredging or individual screen unit outages, that may require a portion of the screen facility to be down. In no case would total designed diversion capacity be exceeded (e.g., 3,000 cfs as designed at intake facility).
    - Use of side-scan sonar technology (e.g., biosonic) to estimate presence and movement of large numbers of migrating juvenile chinook salmon-sized fish.

- **Far Field:** Bypass flow criteria and tidal restoration (i.e., sufficient acreage to minimize diversion-related increases in flow reversals at the Sacramento–Georgiana Slough junction)[11] proposed to minimize flow-survival effects of north Delta diversion operations are as follows.
  - For the previous week:
    - Provide daily and 3-day average Wilkins Slough, Freeport, and bypass flows including the daily north Delta diversion rates. Identify the north Delta diversion criteria in effect (pulse protection or level of the bypass flows). Provide cumulative count of days at the current bypass flow level or pulse protection.
    - Modeled Through-Delta Survival values.
    - Fish monitoring data (e.g., KLRST catch index) in addition to winter-run Chinook salmon and spring-run Chinook salmon juvenile production estimate and migration status (e.g., estimated fraction of population upstream, in Delta, past Chipps).
  - For the upcoming week:
    - Provide forecasted range of daily average Wilkins Slough and Freeport flows. Provide range of bypass flows and the estimated range of north Delta diversion rates. Identify the north Delta diversion criteria that will likely be in effect (pulse protection or level of the bypass flows).
    - Modeled Through-Delta Survival estimates for the likely bypass flows.
  - Data from the side-scan sonar technology (e.g., biosonic) to estimate presence and movement of large numbers of migrating juvenile Chinook salmon-sized fish.
- **Fish Considerations Included in the OAMMP:** Depending on the real-time assessment of presence and exposure/vulnerability of migrating listed fish, identify potential operational adjustments (if necessary, as determined through the adaptive management plan process) to minimize estimated impacts determined to be of significant concern (e.g., moderate to large decrease in estimated survival based on flow-survival relationship). Overall, studies included in the OAMMP will focus on: (1) providing a process to ensure effects are within the range analyzed in the project permits; (2) informing and identifying specific biological triggers; and (3) informing potential refinements of operational criteria. Below are examples of OAMMP outcomes and processes to collect data.
  - For example, collecting alternative/additional real-time fish data to inform north Delta diversion decision making, such as use of acoustically tagged juvenile Chinook salmon as cohort survival/migration surrogates through the intake reaches and through the Delta.
  - Potential north Delta diversion operational responses as determined through adaptive management plan include: transitioning between bypass criteria levels (e.g., Level 1 to Level 2 or pulse protection); or adjusting planned diversions to a level consistent with low concern based on flow-survival estimates and fish presence (i.e., more or less restrictive operations based on hydrological, biological, and diurnal conditions).

[11] Efficacy of tidal restoration to offset potential hydrodynamic changes due to operations of the north Delta intakes would be evaluated and considered during potential refinements to real-time operations and associated operational criteria, where applicable. Evaluation would occur and continue through project development and during the adaptive management plan, including during initial operations.

- Alternative mechanisms, such as operation of non-physical barrier technology at the Georgiana Slough junction with the Sacramento River, may also be considered in lieu of or in addition to north Delta diversion operational responses if deemed appropriate.

# 3.5 Operations Adaptive Management and Monitoring Plan

As appropriate, mitigation measures, such as implementation of the habitat creation and restoration actions in the Compensatory Management Plan (CMP; Appendix 3B, *Compensatory Management Plan for Special-Status Species and Aquatic Resources*), will integrate the concept of adaptive management in mitigation plan design, stand-alone site and/or resource-specific adaptive management plans will be adopted. In addition, the OAMMP will be used to monitor and consider the design and operation of the new north Delta diversions and determine whether they result in unanticipated effects that may warrant refinements in design, management, and/or operation (see Appendix 3C, *North Delta Diversion Operations Adaptive Management and Monitoring Plan*). Potential changes in operations could consider modified operational criteria (e.g., changes to the pulse-protection period length based on information gathered through the Delta Conveyance Project monitoring program) and additional operational criteria (e.g., layered onto those currently proposed in Section 3.3.1, *New Operational Criteria for the North Delta Intakes*.[12] Activities described within the OAMMP, with the exception of those that would occur prior to operations, are to be considered programmatic and will be analyzed at a project-specific level in subsequent consultation(s).

Adaptive management will focus on effects where uncertainties regarding the nature of the effects generally require a characterization of baseline conditions that can be compared to with-project effects. Monitoring is fundamental to adaptive management as a source of data with which to test alternative management strategies and measure progress toward accomplishing management objectives.

As described in Appendix 3B, Section 3B.6.4, *Adaptive Management*, an adaptive management and monitoring plan would be prepared for each mitigation site to help ensure habitat creation goals are met. The plans would outline key uncertainties for tidal wetlands, channel margin, riparian, and floodplain restoration projects intended to benefit listed terrestrial and fish species and offset potential effects of the project. Effectiveness monitoring and research studies would be necessary to examine the ecological function of planned restoration. These site-specific adaptive management plans for habitat creation and restoration would track progress toward management objectives, to improve understanding of restoration effectiveness, and to trigger remedial actions as needed to adjust management to achieve mitigation goals.

The OAMMP will integrate with, as appropriate, existing monitoring programs and SWP adaptive management efforts in the Delta to better understand uncertainties associated with north Delta diversion effects on listed fish species. Monitoring studies will be included in the OAMMP and are intended to address uncertainties about the potential effects on aquatic resources and inform the project's operation and adaptive management decision making. The following is a list of monitoring

[12] If any changes to the criteria included in Section 3.3.1 are identified that would allow increased diversions from the north Delta facilities that could potentially result in greater environmental effects, those changes would require additional CEQA and ESA/CESA review.

elements that are expected to be included in the OAMMP; however, final details of the OAMMP will be subject to fish and wildlife agency approval as part of compliance with the CESA process:

- Migration and survival studies through the intake reach and Delta
  - Including near-field assessment of intake exposure and far-field routing and survival.
  - Potential methods include acoustic telemetry studies of routing and survival in the Delta, including supplementation of existing acoustic arrays. The selection of acoustic telemetry technology (e.g., VEMCO, Juvenile Salmon Acoustic Telemetry System [JSATS]) for tags (transmitters), hydrophones, and receivers would likely be consistent with other concurrent studies and the regional acoustic telemetry array unless one technology is more optimal for a given experimental design.
- Predation studies
  - Including assessment of predator distribution and predation rates to evaluate predation risk.
  - Potential methods include using floating predation event recorders and tethering study designs, as well as acoustic tag data to capture potential predation events. In addition to studies to evaluate increased predation rates, Dual-Frequency Identification Sonar (DIDSON) or similar (e.g., Adaptive Resolution Imaging Sonar [ARIS]) camera surveys could be used to assess predator management strategies at in-water structures and habitat features of interest.
- Monitoring of abundance and distribution of listed species in the intake reach
  - Including assessment of baseline densities and seasonal and geographic distribution of all life stages of target aquatic species inhabiting the reaches of the lower Sacramento River and Delta.
  - Potential methods and approach include leveraging existing monitoring programs (e.g., Enhanced Delta Smelt Monitoring Program and USFWS Delta Juvenile Fish Monitoring Program) in the Delta, as well as supplemental sampling performed with specific gear types and technologies (e.g., eDNA transects and/or echo sounder transects to verify and calibrate catch detection data for newer, less-invasive sampling techniques.

# 3.6 Conservation Measures

Conservation measures are generally defined as "discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat" (50 CFR § 402.02). The conservation measure actions intended to avoid, minimize, and offset effects of the proposed action on listed species, and to provide for their conservation and management. These conservation measures are discussed in Sections 3.6.1, *General Avoidance and Minimization Measures*, 3.6.2, *Species-Specific Avoidance and Minimization Measures*, and 3.6.3, *Compensatory Mitigation*. The conservation measures are related to construction, therefore should be considered associated with project specific analysis.

The proposed action includes several activities that are not likely to adversely affect listed species and therefore will not require compensation. These activities include acquisition and protection of

mitigation lands for listed species of wildlife, the enhancement and management of protected and restored lands, and monitoring for listed species of fish and wildlife.

The protection of land requires no on-the-ground action or disturbance and thus has no potential to adversely affect species. Properly sited land protection will benefit listed species of wildlife by expanding and connecting existing protected lands. Grassland and vernal pool habitats will be protected to benefit San Joaquin kit fox, California tiger salamander, California red-legged frog, vernal pool fairy shrimp, and vernal pool tadpole shrimp. For details regarding the siting of lands that will be protected to benefit these species, see Section 3.6.2 and Appendix 3B. The Compensatory Mitigation Plan (CMP) contains actions that my mitigate species impacts and contains actions that may result in impacts to listed species, terrestrial and aquatic.

Enhancement, management and monitoring on protected and restored lands have potential to have some minor effects. For example, individuals could be harmed or harassed by management vehicles or personnel. These effects would be minimized through education and training, as described in Section 3.6.1. Monitoring would be performed by qualified biologists. If handling of the species is necessary, this work would be done by qualified personnel with appropriate scientific collection permits.

## 3.6.1 General Avoidance and Minimization Measures

The general avoidance and minimization measures are those conservation measures that apply to more than one species. These measures include precautionary actions that either prohibit an impact from occurring or reduce the severity of the effect if the impact cannot be avoided. Table 3.6-1 lists the general avoidance and minimization measures that would be implemented before and during construction in response to an adverse effect identified in Chapters 5 and 6. The full text for each measure is included in Appendix 3A.

**Table 3.6-1. General Avoidance and Minimization Measures Alphanumeric Code and Title**

| AMM | Title |
|---|---|
| AMM-1 | Conduct Environmental Resources Worker Awareness Training |
| AMM-2 | Develop and Implement Hazardous Materials Management Plans |
| AMM-3 | Develop and Implement Spill Prevention, Control, and Countermeasure Plans |
| AMM-4a | Develop and Implement Erosion and Sediment Control Plans |
| AMM-4b | Develop and Implement Stormwater Pollution Prevention Plans |
| AMM-5 | Develop and Implement a Fire Prevention and Control Plan |
| AMM-6 | Conduct Cultural Resources Awareness Training |
| AMM-7 | Off-Road Heavy-Duty Engines |
| AMM-8 | On-Road Haul Trucks |
| AMM-9 | On-Site Locomotives |
| AMM-10 | Marine Vessels |
| AMM-11 | Fugitive Dust Control |
| AMM-12 | On-Site Concrete Batching Plants |
| AMM-13 | DWR Best Management Practices to Reduce GHG Emissions |
| AMM-14 | Construction Best Management Practices for Biological Resources |
| AMM-15 | Sediment Monitoring, Modeling, and Reintroduction Adaptive Management |
| AMM-16 | Provide Notification of Construction and Maintenance Activities in Waterways |

| AMM | Title |
|---|---|
| AMM-17 | Avoid and Minimize Impacts on Terrestrial Biological Resources from Maintenance Activities |
| AMM-18 | Avoid and Minimize Operational Traffic Impacts on Wildlife |
| AMM-19 | Minimize Fugitive Light from Portable Sources Used for Construction |
| AMM-20 | Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences |
| AMM-21 | Develop and Implement a Noise Control Plan |
| AMM-22 | Electrical Power Line Support Placement |
| AMM-23 | Develop and Implement a Mercury Management and Monitoring Plan |
| AMM-24 | Minimize Access Road Impacts on Listed Amphibian Connectivity |
| AMM-25 | Develop and Implement a Fish Rescue and Salvage Plan |
| AMM-26 | Develop and Implement an Underwater Sound Control and Abatement Plan |
| AMM-27 | Develop and Implement a Barge Operations Plan |

DWR = California Department of Water Resources; GHG = greenhouse gas.

## 3.6.2 Species-Specific Avoidance and Minimization Measures

The following sections detail aspects of the proposed action intended to avoid and minimize adverse effects on listed species of wildlife and describe offsetting measures intended to compensate for adverse effects. In addition to species-specific avoidance and minimization measures) discussed below, general avoidance and minimization measures (Section 3.6.1) that would be implemented uniformly during construction and operations of proposed water facilities and performance of conservation measures are fully detailed in Appendix 3A.

### 3.6.2.1 San Joaquin Kit Fox Avoidance and Minimization Measure

The following measures for San Joaquin kit fox will only be required for surface construction activities occurring within suitable habitat as defined in Chapter 4, *Action Area and Environmental Baseline*, Section 4.4.9, *San Joaquin Kit Fox* and by additional assessments conducted during the planning for work in a given area. Surveys and monitoring will be conducted from locations where access is allowed.

As properties become accessible for initiating project activities within areas of modeled San Joaquin kit fox habitat, DWR will require suitability assessments of the modeled habitat by a biologist qualified to identify suitable habitat for this species.

1. For areas verified as being suitable for San Joaquin kit fox, preconstruction surveys will be initiated within 14 to 30 days prior to ground disturbance, vegetation removal, or establishment of staging areas related to project activities. A USFWS- and CDFW-approved biologist with experience surveying for and observing the species will survey the project footprint and the area within 200 feet beyond the footprint to identify known or potential San Joaquin kit fox dens. Adjacent parcels under different land ownership will not be surveyed unless access is granted within the 200-foot radius of the project footprint. The biologists will conduct these searches by systematically walking 30- to 100-foot-wide transects throughout the survey area; transect width will be adjusted based on vegetation height and topography. The biologist will conduct walking transects such that 100% visual coverage of the worksite footprint is achieved. Dens will be classified in one of the following four den status categories outlined in the

*Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or During Ground Disturbance* (U.S. Fish and Wildlife Service 2011).

a. **Potential den.** Any subterranean hole within the species' range that has entrances of appropriate dimensions for which available evidence is sufficient to conclude that it is being used or has been used by a San Joaquin kit fox. Potential dens comprise any suitable subterranean hole or any den or burrow of another species (e.g., coyote, badger, red fox, or ground squirrel) that otherwise has appropriate characteristics for kit fox use. If a potential den is found, the biologist will establish a 50-foot buffer using flagging.

b. **Known den.** Any existing natural den or artificial structure that is used or has been used at any time in the past by a San Joaquin kit fox. Evidence of use may include historical records; past or current radiotelemetry or spotlighting data; kit fox signs such as tracks, scat, or prey remains; or other reasonable proof that a den is being or has been used by a kit fox. If a known den is found, the biologist will establish a 100-foot buffer using flagging.

c. **Natal or pupping den.** Any den used by San Joaquin kit foxes to whelp or rear their pups. Natal or pupping dens may be larger with more numerous entrances than dens occupied exclusively by adults. These dens typically have more kit fox tracks, scat, and prey remains near the den and may have a broader apron of matted dirt or vegetation at one or more entrances. A natal den, defined as a den in which kit fox pups are actually whelped but not necessarily reared, is a more restrictive version of the pupping den. In practice, however, it is difficult to distinguish between the two types of dens; therefore, for purposes of this definition, either term applies. If a natal or pupping den is discovered, a buffer of at least 200 feet will be established using fencing but a final buffer will be established in coordination with USFWS and CDFW.

d. **Atypical den.** Any artificial structure that has been or is being occupied by a San Joaquin kit fox. Atypical dens may include pipes, culverts, and diggings beneath concrete slabs and buildings. If an atypical den is discovered, the biologist will establish a 50-foot buffer using flagging.

2. Disturbance to all San Joaquin kit fox den status categories (described directly above) will be avoided to the extent possible. Where dens are found during surveys and avoidance is not possible, the following procedures will be implemented.

a. If an atypical, natal or pupping, known or potential San Joaquin kit fox den is discovered within a project footprint, the den will be monitored for 3 days by a USFWS- and CDFW-approved biologist using a tracking medium or an infrared beam camera to determine whether the den is currently being used.

b. If an active natal or pupping den is found within a project footprint, USFWS and CDFW will be notified immediately.

c. If San Joaquin kit fox activity is observed at the potential, known, or atypical den during the preconstruction surveys, USFWS and CDFW will be notified immediately, and the den will be monitored will for 5 consecutive days from the time of the first observation.

d. Construction requirements from *Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or during Ground Disturbance* (U.S. Fish and Wildlife Service 2011) or the latest guidelines will be implemented.

e. If potential, known, atypical, or natal or pupping dens are identified within temporary work areas or within a 200-foot buffer of a temporary work area, exclusion zones around each den entrance or cluster of entrances will be demarcated. The configuration of exclusion zones will be circular, with a radius measured outward from the den entrance(s). No activities will occur within the exclusion zones. Exclusion zone radii for atypical dens and potential dens will be at least 50 feet and will be demarcated with four to five flagged stakes. Exclusion zone radii for known dens will be at least 100 feet and will be demarcated with staking and flagging that encircle each den or cluster of dens but do not prevent access to the den by the foxes. Exclusion zone radii for natal or pupping dens will be at least 200 feet and will be demarcated using fencing, but a final buffer will be established in coordination with USFWS and CDFW.

f. Written results of the surveys will be submitted to USFWS and CDFW within 5 calendar days of the completion of surveys and prior to the beginning of ground disturbance and/or construction activities in San Joaquin kit fox modeled habitat.

3. During construction, the following measures will be implemented for all activities in suitable San Joaquin kit fox habitat (as determined by a USFWS- and CDFW-approved biologist):

   a. The USFWS- and CDFW-approved biologist for San Joaquin kit fox will be the contact source for any employee or contractor who might incidentally observe or discover kit fox. If a kit fox is observed or discovered within the work area, all work will cease within 200 feet and the USFWS- and CDFW-approved biologist will contact USFWS immediately. The USFWS contact is the Assistant Field Supervisor of Endangered Species.

   b. New sightings of kit fox will be reported to the California Natural Diversity Database (CNDDB). A copy of the reporting form and a topographic map clearly marked with the location of where the kit fox was observed will also be provided to USFWS.

### 3.6.2.2 California Least Tern Avoidance and Minimization Measure

The following measures for California least tern will only be required for surface construction activities occurring within suitable habitat as defined in Chapter 4, Section 4.4.10, *California Least Tern,* and by additional assessments conducted during the planning for work in a given area to avoid and minimize impacts on California least tern nesting colonies and to avoid take of California least tern, as defined by the ESA.[13] Surveys and monitoring will be conducted from locations where access is allowed.

As properties become accessible for initiating project activities within areas of modeled California least tern habitat, DWR will require suitability assessments of the modeled habitat by a biologist qualified to identify suitable habitat for this species.

1. If suitable nesting habitat for California least tern (flat, unvegetated areas near aquatic foraging habitat) is identified during planning-level surveys the year prior to construction, DWR will require that at least three preconstruction surveys for this species will be conducted in all suitable habitat within 500 feet of the construction footprint, where construction-related noise

[13] Take is defined in the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm in the definition of "take" in the Act means an act which actually kills or injures wildlife. Such [an] act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR § 17.3)

levels could exceed 60 dBA (A-weighted decibel)$L_{eq}$ (1 hour), during the California least tern breeding season (April 15 to August 15). Construction-related noise level will be determined based on a noise contour map, created by a noise expert, showing the 60 dBA noise contour specific to the type and location of construction to occur in the area. Surveys will be conducted by a USFWS- and CDFW-approved biologist with experience observing the species and its nests. DWR will implement the following requirements to avoid loss of California least tern nesting colonies if construction will take place within 500 feet of a California least tern nest where construction-related noise levels could exceed 60 dBA $L_{eq}$ (1 hour) during the breeding season (April 15 to August 15 or extended as determined through surveys).

a. A USFWS- and CDFW-approved wildlife biologist will monitor construction activities within 500 feet of active nests to ensure that construction activities do not affect nest success. Reduced buffers may be allowed, through coordination with USFWS and CDFW, if a full-time USFWS- and CDFW-approved biologist is present to monitor the nest and has authority to halt construction if bird behavior indicates continued activities could lead to nest failure. Active nests will be monitored to track progress of nesting activities until the biologist determines that the young have fledged and are capable of independent survival or the nest site is no longer active.

b. Activities performed during the California least tern breeding season, in occupied least tern nesting habitat, with USFWS and CDFW approval and under the supervision of a USFWS- and CDFW-approved biologist will be limited to inspection, research or monitoring.

c. If a California least tern is found, construction activities will be limited such that sound will not exceed 60 dBA within 500 feet of the habitat being used until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area.

d. Portable and stationary equipment will be located, stored, and maintained as far as possible, with a minimum distance of 500 feet, from suitable California least tern habitat.

e. All lights will be screened and directed down toward work activities and away from suitable habitat. A biological construction monitor will ensure that lights are properly directed at all times during construction.

### 3.6.2.3 Least Bell's Vireo Avoidance and Minimization Measure

The following measures for least Bell's vireo will only be required for surface construction activities occurring between May 15 through September 1 within suitable habitat as defined in Chapter 4, Section 4.4.11, *Least Bell's Vireo,* and by additional assessments conducted during the planning for work in a given area to avoid and minimize impacts on least Bell's vireo. Surveys and monitoring will be conducted from locations where access is allowed.

As properties become accessible for initiating project activities within areas of modeled least Bell's vireo habitat, DWR will require suitability assessments of the modeled habitat by a biologist qualified to identify suitable habitat for this species.

1. Prior to the construction, a noise expert will create a noise contour map showing the 60 dBA noise contour specific to the type and location of construction to occur in the area.

2. Two weeks prior to construction, a USFWS- and CDFW-approved biologist will conduct daily surveys, consistent with a USFWS- or CDFW- approved survey protocol (U.S. Fish and Wildlife

Service 2001:1-3, or more current guidance) within 500 feet of suitable habitat where construction-related noise levels could exceed 60 dBA $L_{eq}$ (1 hour).

3. If a least Bell's vireo is found, construction activities will be limited such that sound will not exceed 60 dBA within 500 feet of the habitat being used until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area.
4. If surveys find least Bell's vireos in an area where vegetation will be removed, vegetation removal will be conducted when the USFWS- and CDFW-approved biologist has confirmed that least Bell's vireos are not present within 500 feet of vegetation removal activities.
5. Portable and stationary equipment will be located, stored, and maintained as far as possible, with a minimum distance of 500 feet, from suitable least Bell's vireo habitat.
6. All lights will be screened and directed down toward work activities and away from suitable habitat. A biological construction monitor will ensure that lights are properly directed at all times during construction. See Chapter 4 Section 4.4.11, *Least Bell's Vireo* for more details.

#### 3.6.2.4 Western Yellow-Billed Cuckoo Avoidance and Minimization Measure

The following measures for western yellow-billed cuckoo will only be required for surface construction activities occurring between May 15 through September 1 within suitable habitat as defined in Chapter 4, Section 4.4.12, *Western Yellow-Billed Cuckoo,* and by additional assessments conducted during the planning for work in a given area to avoid and minimize impacts on western yellow-billed cuckoo. Surveys and monitoring will be conducted from locations where access is allowed.

As properties become accessible for initiating project activities within areas of modeled western yellow-billed cuckoo habitat, DWR will require suitability assessments of the modeled habitat by a biologist qualified to identify suitable habitat for this species.

1. Prior to the construction, a noise expert will create a noise contour map showing the 60 dBA noise contour specific to the type and location of construction to occur in the area.
2. Two weeks prior to construction, a USFWS- and CDFW-approved biologist will conduct daily surveys, consistent with a USFWS- or CDFW-approved survey protocol (e.g., Halterman et al. 2015:9-42, or more current guidance), within 500 feet of suitable habitat where construction-related noise levels could exceed 60 dBA Leq (1 hour).
3. If a yellow-billed cuckoo is found, construction activities will be limited such that sound will not exceed 60 dBA within 500 feet of the habitat being used until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area.
4. If surveys find cuckoos in an area where vegetation will be removed, vegetation removal will be conducted when the USFWS- and CDFW-approved biologist has confirmed that cuckoos are not present within 500 feet of vegetation removal activities.
5. Portable and stationary equipment will be located, stored, and maintained as far as possible, with a minimum distance of 500 feet, from suitable western yellow-billed cuckoo habitat.
6. All lights will be screened and directed down toward work activities and away from migratory habitat. A biological monitor will ensure that lights are properly directed at all times during construction. See Section 4.4.12 for more details.

### 3.6.2.5 California Reg-Legged Frog Avoidance and Minimization Measure

The following measures for California red-legged frog will only be required for surface construction activities occurring within suitable habitat as defined in Chapter 4, Section 4.4.13, *California Red-Legged Frog,* and by additional assessments conducted during the planning for work in a given area to avoid and minimize impacts on California red-legged frog. Surveys and monitoring will be conducted from locations where access is allowed, including habitat delineation surveys, preconstruction surveys to determine presence, and clearance surveys conducted immediately prior to construction.

To the extent practicable, DWR will minimize impacts on critical habitat for California red-legged frog containing the primary constituent elements listed below.

1. Aquatic Breeding Habitat. Standing bodies of fresh water (with salinities less than 4.5 parts per thousand [ppt]), including: natural and manmade (e.g., stock) ponds, slow moving streams or pools within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest of years.
2. Non-Breeding Aquatic Habitat. Fresh water pond and stream habitats, as described above, that may or may not hold water long enough for the species to complete its aquatic life cycle but that do provide for shelter, foraging, predator avoidance, and aquatic dispersal for juvenile and adult California red-legged frogs. Other wetland habitats that would be considered to meet these criteria include, but are not limited to: plunge pools within intermittent creeks, seeps, quiet water refugia during high-water flows, and springs of sufficient flow to withstand short-term dry periods.
3. Upland Habitat. Upland areas adjacent to or surrounding breeding and non-breeding aquatic and riparian up to a distance of one mile in most cases (i.e., depending on surrounding landscape and dispersal barriers) including various vegetational series such as grassland, woodland, forest, wetland, or riparian areas that provide shelter, forage, and predator avoidance. Upland features are also essential in that they are needed to maintain the hydrologic, geographic, topographic, ecological, and edaphic features that support and surround the aquatic, wetland, or riparian habitat. These upland features contribute to the filling and drying of the wetland or riparian habitat and are responsible for maintaining suitable periods of pool inundation for larval frogs and their food sources, and provide breeding, non-breeding, feeding, and sheltering habitat for juvenile and adult frogs (e.g., shelter, shade, moisture, cooler temperatures, a prey base, foraging opportunities, and areas for predator avoidance). Upland habitat can include structural features such as boulders, rocks and organic debris (e.g., downed trees, logs), as well as small mammal burrows and moist leaf litter.
4. Dispersal Habitat. Accessible upland or riparian habitat within and between occupied or previously occupied sites that are located within one mile of each other, and that support movement between such sites. Dispersal habitat includes various natural habitats and altered habitats such as agricultural fields, which do not contain barriers to dispersal. Dispersal habitat does not include moderate to high density urban or industrial developments with large expanses of asphalt or concrete, nor does it include large lakes or reservoirs over 50 acres in size, or other areas that do not contain those features identified in primary constituent elements 1, 2, or 3 as essential to the conservation of the species.

During project implementation and prior to project construction, DWR will implement the following measures.

5. When each site is available for surveys, biologist approved by USFWS, will then delineate California red-legged frog habitat at each project site, based on an agreed upon definition of suitable habitat, including both aquatic and upland habitat.
6. Once habitat has been delineated, the qualified biologist will conduct preconstruction surveys performed using a method approved by USFWS to determine presence of the species on the project site to enable further determination of compensatory mitigation requirements. In the event of a dry year, the aquatic habitat will be evaluated based on general suitability (e.g., evidence of suitable ponding depths, proximity to occurrences) and the habitat will be assumed to represent occupied habitat.
7. To the greatest extent possible, identified and delineated habitat will be completely avoided.

For areas verified as being suitable for California red-legged frog and that cannot be avoided, the following measures will be implemented.

8. To the extent practicable, initial ground-disturbing activities will not be conducted between September 1 and April 30, to avoid the wet season which encompasses breeding as well as potential upland migration before and after. Once the area has been surveyed, initial ground disturbance has occurred, and exclusionary fencing is in place, the seasonal restriction would not apply.
9. Ground-disturbing activities will be designed to minimize or eliminate effects on rodent burrows that may provide suitable cover habitat for California red-legged frog. Surface-disturbing activities will avoid areas with a high concentration of burrows to the greatest extent practicable. In addition, when a concentration of burrows is present in a work site, the area will be staked or flagged to ensure that work crews are aware of their location and to facilitate avoidance of the area.
10. All initial ground disturbance or vegetation removal (clearing) will be limited to periods of no or low rainfall (less than 0.08 inch per 24-hour period and less than 40% chance of rain). To the extent practicable, clearing activities within California red-legged frog habitat will cease 24 hours prior to a 40% or greater forecast of rain from the closest National Weather Service weather station. Clearing may continue 24 hours after the rain ceases, if no more than 0.5 inch of precipitation is in the 72-hour forecast. If clearing must continue when rain is forecast (i.e., greater than 40% chance of rain), a USFWS-approved biologist will survey the work site before clearing begins each day rain is forecast. If rain exceeds 0.5 inch during a 24-hour period, clearing will cease until the NWS forecasts no further rain. Modifications to this timing may be approved by USFWS based on site conditions and expected risks to California red-legged frog. For a given site that has exclusion fencing in place and all surface soil disturbance completed (i.e., no burrows present), these restrictions would no longer apply.
11. To the maximum extent practicable, nighttime construction will be minimized or avoided when working in suitable California red-legged frog habitat. To the greatest extent practicable, earthmoving and construction activities will cease no less than 30 minutes before sunset and will not begin again prior to no less than 30 minutes after sunrise. Except when necessary for driver or pedestrian safety, artificial lighting at a work site will be prohibited during the hours of darkness when working in suitable California red-legged frog habitat.

12. If work must be conducted at night within 300 feet of California red-legged frog habitat, all lighting will be directed away and shielded from California red-legged frog habitat outside the construction area to minimize light spillover to the greatest extent possible. If light spillover into adjacent California red-legged frog habitat occurs, a USFWS-approved biologist will be present during night work to survey for California red-legged frogs in areas illuminated by construction lighting. If California red-legged frog is found to be illuminated, the USFWS-approved biologist has the authority to terminate the project activities until the light is directed away from the frog's location, or the California red-legged frog moves out of the illuminated area.
13. At least 30 days prior to any ground disturbance activities, DWR will prepare and submit a relocation plan for USFWS's written approval. The relocation plan will contain the name(s) of the USFWS-approved biologist(s) to relocate California red-legged frogs, the method of relocation (if different from described), a map, and a description of the proposed release site(s) outside of exclusion fencing and within 300 feet of the work area or at a distance otherwise agreed to by USFWS, and written permission from the landowner (if other than the State) to use their land as a relocation site.
14. When there is California red-legged frog habitat within 300 feet of construction activities, exclusion fencing will be installed along the perimeter of construction sites to protect California red-legged frog habitat and minimize the potential for frogs to enter the construction work area. The perimeter of construction sites will be fenced with fencing material suitable for excluding amphibians by no more than 14 days prior to the start of construction. The placement of exclusion fencing will be determined, in part, by the locations of suitable habitat for the species. A conceptual fencing plan will be submitted to USFWS prior to the start of construction and the approved California red-legged frog exclusion fencing will be shown on the final construction plans. DWR, as project proponent, will include the amphibian exclusion fence specifications including installation and maintenance criteria in the bid solicitation package special provisions. The amphibian exclusion fencing will remain in place for the duration of construction and will be regularly inspected and fully maintained. The biological monitor and construction manager will be responsible for checking the exclusion fencing around the work areas each day of construction for wildlife trapped inside and to ensure that they are intact and upright. This will be especially critical during times of inclement weather that can damage the fencing. Repairs to the amphibian exclusion fence will be made within 24 hours of discovery of a breach. Where construction access is necessary, gates will be installed in the exclusion fence and fencing will direct animals away from the work area to the extent practicable (e.g., fencing will flare out and turn back toward suitable habitat).
15. Preconstruction surveys will be conducted by a USFWS-approved biologist immediately prior to the initiation of any ground-disturbing activities or vegetation clearing, including immediately prior to exclusion fence installation, in areas identified as having suitable California red-legged frog habitat. These surveys will consist of walking the work site limits. The USFWS-approved biologist will investigate all potential areas that could be used by the California red-legged frog for feeding, breeding, sheltering, movement, or other essential behaviors. If there is a lapse in construction in a work area for 7 days or more, these preconstruction surveys will be repeated before activities resume.
16. The USFWS-approved biologist will conduct clearance surveys at the beginning of each day and regularly throughout the workday when construction activities are occurring that may result in take of California red-legged frog. These surveys will consist of walking surveys within the work sites and investigating suitable aquatic and upland habitat including potential refugia habitat

such as small woody debris, refuse, and burrow entrances, that are not directly disturbed by project activities.

17. If a California red-legged frog is encountered at any point within a work area activities within a minimum of 25 feet of the individual will cease immediately and the construction manager and USFWS-approved biologist will be notified, and the biologist will observe and follow within 10 feet of the individual to ensure it has safely left the area. The frog will be allowed to leave the area of its own volition, and work may resume when it is no longer in harm's way. Depending on site-specific conditions, such as the use of heavy equipment, a larger protective buffer may be established, as determined by the USFWS-approved biologist. If the frog does not move out of the area on its own, and it is determined by the USFWS-approved biologist that relocating the frog is necessary, these steps will be followed:

    a. Prior to handling and relocation, the biologist will take precautions to prevent introduction of amphibian diseases by following guidance in The Declining Amphibian Task Force Fieldwork Code of Practice (U.S. Fish and Wildlife Service 2019b), or the most up-to-date guidance available at that time. California red-legged frogs will also be handled and assessed according to the Restraint and Handling of Live Amphibians (U.S. Geological Survey National Wildlife Health Center 2001), or the most up-to-date guidance available at that time.

    b. California red-legged frogs will be captured by hand, dipnet, or other USFWS-approved methodology, transported, and relocated to nearby suitable habitat outside but within 300 feet of the work area, or at a distance otherwise specified in the relocation plan described in measure 13, and released as soon as practicable the same day of capture per the relocation plan. Holding/transporting containers and dipnets will be thoroughly cleaned, disinfected, and rinsed with fresh water prior to use within construction areas. USFWS will be notified within 24 hours of all capture, handling, and relocation efforts. USFWS-approved biologists will wear clean, new disposable surgical style (latex, nitrile, etc.) gloves and/or ensure that their hands are free of soaps, oils, creams, lotions, repellents, or solvents of any sort while capturing and relocating individuals. To avoid transferring disease or pathogens in handling of the amphibians, USFWS-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice" or the most up-to-date, agency-accepted guidance.

    c. If an injured California red-legged frog is encountered and the USFWS-approved biologist determines the injury is minor or healing and the frog is likely to survive, the frog will be released immediately, consistent with the preapproved relocation plan as described above. The frog will be monitored until it is determined that it is not imperiled by predators or other dangers.

    d. If the USFWS-approved biologist determines that the frog has major or serious injuries because of activities at the work site, the USFWS-approved biologist, or designee, will immediately take it to a USFWS-approved facility. If taken into captivity, the individual will not be released into the wild unless it has been kept in quarantine and the release is authorized by USFWS. DWR will bear any costs associated with the care or treatment of such injured frogs. The circumstances of the injury, the procedure followed, and the final disposition of the injured animal will be documented in a written incident report. Notification to USFWS of an injured or dead California red-legged frog in the project area will be reported within 24 hours and will include details such as whether or not its condition resulted from activities related to the proposed action. In addition, the USFWS-

approved biologist will follow up with USFWS within 2 calendar days of the finding. Written notification to USFWS will include the following information: the species, number of animals taken or injured, sex (if known), date, time, location of the incident or of the finding of a dead or injured animal, how the individual was taken, photographs of the specific animal, the names of the persons who observed the take or found the animal, and any other pertinent information. Dead specimens will be preserved, as appropriate, and held in a secure location until instructions are received from USFWS regarding the disposition of the specimen.

18. Work within suitable aquatic habitats will not begin until the habitat is dry or has been adequately surveyed and dewatered. Aquatic habitats that must be dewatered will be surveyed for California red-legged frogs prior to dewatering. Dewatering pumps will be screened with wire mesh not larger than 5 millimeters to prevent larvae from entering the pump. The biological monitor will be present during dewatering. Any California red-legged frogs found will be relocated per the relocation plan.

#### 3.6.2.6 California Tiger Salamander Avoidance and Minimization Measure

The following measures for California tiger salamander will only be required for surface construction activities occurring within suitable habitat as defined in Chapter 4, Section 4.4.14, *California Tiger Salamander* and by additional assessments conducted during the planning for work in a given area. Surveys and monitoring will be conducted from locations where access is allowed, including habitat delineation surveys, preconstruction surveys to determine presence, and clearance surveys conducted immediately prior to construction.

During project implementation and prior to project construction, DWR will implement the following measures.

1. When each site is available for surveys a USFWS- and CDFW- approved biologist will then delineate California tiger salamander habitat at each project site, based on the definition of suitable habitat, including both aquatic and upland habitat. The criteria used for assessing suitable habitat have been adopted from the primary constituent elements identified in the 2005 critical habitat designation for the Central Valley distinct population segment of California tiger salamander (70 FR 49390). Habitat deemed suitable will include at least one of the following:
    a. Aquatic—Standing bodies of fresh water (including natural and human-made [e.g., stock]) ponds, vernal pools, and other ephemeral or permanent waterbodies that typically support inundation during winter rains and hold water for a minimum of 12 weeks in a year of average rainfall.
    b. Upland—Upland habitats within 1.3 miles of suitable aquatic habitat that contain small mammal burrows or other underground habitat that California tiger salamander depend upon for food, shelter, and protection from the elements and predation. Accessible upland dispersal habitat between occupied locations that allow for movement between such sites.
2. Once habitat has been delineated, the USFWS- and CDFW-approved biologist will use preconstruction surveys performed using a method approved by USFWS and CDFW to determine presence of the species on the project site to enable further determination of compensatory mitigation requirements. In the event of a dry year, the aquatic habitat will be evaluated based on general suitability (e.g., evidence of suitable ponding depths, proximity to

occurrences) and the habitat will be assumed to represent occupied habitat. In areas where ground disturbance will occur, grasses within suitable upland habitat will be mowed within 24 hours of clearance surveys to allow the biologist to see and survey for California tiger salamander and burrows. Light mowing equipment will be used and will only occur during the day in dry conditions when California tiger salamander is unlikely to be aboveground.

3. To the greatest extent possible, identified and delineated habitat will be completely avoided.

For areas verified as being suitable for California tiger salamander and that cannot be avoided, the following measures will be implemented.

4. To the extent practicable, initial ground-disturbing activities will not be conducted between November 1 and March 31, or extended to April 30 during wet years, in areas identified during the planning stages as providing suitable California tiger salamander habitat, to avoid the period when they are most likely to be moving through upland areas. Once clearance surveys have been conducted, exclusionary fence is in place, the area has been surveyed, and initial ground disturbance has occurred, work within the disturbed area can occur outside the construction window (defined as April 1 through October 31 or, during wet years, May 1 through October 31).
5. If aquatic habitat is identified by the qualified biologist(s) within the project area southwest of Byron Highway, DWR will restrict construction activities to beyond 300 feet of breeding habitat, during the breeding season (November 1 through March 31, or extended to April 30 during wet years). Where aquatic habitat cannot be avoided by 300 feet during the breeding season, DWR will notify and coordinate with CDFW to implement site-specific avoidance and minimization measures. Where construction takes place in aquatic habitat during the nonbreeding season (April 1 through October 31, or delayed to May 1 during wet years), activities will not be initiated until after the habitat is no longer ponding water or until a USFWS- and CDFW-approved biologist has conducted clearance surveys of the aquatic habitat for presence of California tiger salamander and results have been submitted to the agencies. No work or dewatering will be allowed in occupied habitat. If a work site is to be temporarily dewatered by pumping, intakes will be completely screened with wire mesh not larger than 5 millimeters to prevent larger aquatic species from entering the pump system.
6. Ground-disturbing activities will be designed to minimize or eliminate effects on rodent burrows that may provide suitable cover habitat for California tiger salamander. Surface-disturbing activities will avoid areas with a high concentration of burrows to the greatest extent practicable. In addition, when a concentration of burrows is present in a work site, the area plus a 50-foot buffer will be staked or flagged to ensure that work crews are aware of their location and to facilitate avoidance of the area.
7. All initial ground disturbance or vegetation removal (clearing) will be limited to periods of no or low rainfall (less than 0.08 inch per 24-hour period and less than 40% chance of rain). DWR will avoid ground disturbance and vegetation removal during rainfall events and between sunset and sunrise. Clearing activities within California tiger salamander habitat will cease 24 hours prior to a 40% or greater forecast of rain from the closest National Weather Service weather station. Clearing may continue 24 hours after the rain ceases, if no more than 0.5 inch of precipitation is in the 72-hour forecast. If clearing must continue when rain is forecast (greater than 40% chance of rain), a USFWS- and CDFW-approved biologist will survey the work site before clearing begins each day rain is forecast. If rain exceeds 0.5 inch during a 24-hour period, clearing will cease until the NWS forecasts no further rain. If this measure cannot be

implemented as written or modifications to this timing is pursued, DWR will notify and coordinate with the agencies based on site conditions and expected risks to California tiger salamander. For a given site that has exclusion fencing in place and all surface soil disturbance completed (i.e., no burrows present), these restrictions would no longer apply. If there is a lapse in construction in a work area for 7 days or more due to weather conditions, preconstruction surveys will be repeated as described in California tiger salamander measure 11.

8. To the extent practicable, earthmoving and construction activities will cease no less than 30 minutes before sunset and will not begin again until no less than 30 minutes after sunrise within 300 feet of California tiger salamander habitat. Except when necessary for driver or pedestrian safety, to the greatest extent practicable, artificial lighting at a work site will be prohibited during the hours of darkness.
9. At least 30 days prior to any ground-disturbing activities, DWR will prepare and submit a relocation plan for USFWS's and CDFW's written approval. The relocation plan will contain the name(s) of the USFWS- and CDFW-approved biologist(s) to relocate California tiger salamanders, the method of relocation (if different from described), a map, and a description of the proposed release site(s) within 300 feet of the work area or at a distance otherwise agreed to by USFWS and CDFW, and written permission from the landowner (if other than the State) to use their land as a relocation site. The relocation plan will also include methods for searching for California tiger salamander (i.e., clearance surveys) in the work areas to avoid and minimize the potential for injury and mortality. Generally, work areas will be attempted to be cleared of California tiger salamanders by placing pit fall traps along the inside of the exclusion fence (i.e., within work areas) or by hand-excavating mammal burrows. Methods will be selected based on site-specific conditions in a given work area and will be approved by USFWS and CDFW. Any California tiger salamanders found will be relocated according to the agency approved relocation plan and will following the handling protocols outlined below.
10. When there is California tiger salamander habitat within 300 feet of construction activities, exclusion fencing will be installed along the perimeter of construction sites to protect California tiger salamander habitat and minimize the potential for salamanders to enter the construction work area. The perimeter of construction sites within 300 feet of California tiger salamander habitat will be fenced with fencing material suitable for excluding amphibians by no more than 14 days prior to the start of construction activities (e.g., staging, vegetation removal, grading) in a given area. The placement of exclusion fencing will be determined, in part, by the locations of suitable habitat for the species (defined above). A conceptual fencing plan will be submitted to USFWS and CDFW prior to the start of construction and the approved exclusion fencing will be shown on the final construction plans. DWR will include the amphibian exclusion fence specifications including installation and maintenance criteria in the bid solicitation package special provisions. The amphibian exclusion fencing will remain in place for the duration of construction and will be regularly inspected and fully maintained. The biological monitor and construction manager will be responsible for checking the exclusion fencing around the work areas each day of construction for wildlife trapped inside and to ensure that they are intact and upright. This will be especially critical during times of inclement weather that could damage the fencing. Repairs to the amphibian exclusion fence will be made within 24 hours of discovery of a breach. Where construction access is necessary, gates will be installed in the exclusion fence and fencing will be installed to direct animals away from the work area to the extent practicable (e.g., fencing will flare out and turn back toward suitable habitat).

11. Preconstruction surveys will be conducted by a USFWS- and CDFW-approved biologist immediately prior to the initiation of any ground-disturbing activities or vegetation clearing, including immediately prior to exclusion fence installation, in areas identified as having suitable California tiger salamander habitat. These surveys will consist of walking surveys within the work sites and investigating suitable aquatic and upland habitat including potential refugia habitat such as small woody debris, refuse, burrow entrances, etc., that are not directly disturbed by project activities. If there is a lapse in construction in a work area for 7 days or more, these preconstruction surveys will be repeated before activities resume.
12. The USFWS- and CDFW-approved biologist will conduct clearance surveys within the construction work area at the beginning of each day and regularly throughout the workday when construction activities are occurring that may result in take of California tiger salamander. Surveys will be conducted in the same manner as the preconstruction surveys.
13. If a California tiger salamander is observed at any point within a work area, the USFWS- and CDFW-approved biologist will implement the following species observation and handling protocol. Only USFWS- and CDFW-approved biologists will participate in activities associated with the capture, handling, and monitoring of California tiger salamanders. If a California tiger salamander is encountered in a construction area, activities within a minimum of 25 feet of the individual will cease immediately and the construction manager and USFWS- and CDFW-approved biologist will be notified, and the biologist will observe and follow within 10 feet of the individual to ensure it has safely left the area. Depending on site-specific conditions, such as the use of heavy equipment, a larger protective buffer may be established, depending on site-specific conditions such as the use of heavy equipment, as determined by the USFWS- and CDFW- approved biologist. The California tiger salamander will be allowed to leave the area of its own volition, and work may resume when it is no longer in harm's way. All personnel on-site will be notified of the finding and no work will occur within a minimum of 10 feet of the California tiger salamander, or a larger buffer depending on site-specific conditions, without a USFWS- and CDFW-approved biologist present. If the salamander does not move out of the area on its own, and it is determined by the approved biologist that relocating the California tiger salamander is necessary, these steps will be followed.
    a. Prior to handling and relocation, the USFWS- and CDFW-approved biologist will take precautions to prevent introduction of amphibian diseases in accordance with the *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander* (U.S. Fish and Wildlife Service 2003), or the most up-to-date guidance available at the time. Disinfecting equipment and clothing is especially important when biologists are coming to the action area to handle amphibians after working in other aquatic habitats. California tiger salamanders will also be handled and assessed according to the *Restraint and Handling of Live Amphibians* (U.S. Geological Survey National Wildlife Health Center 2001), or the most up-to-date guidance available at the time.
    b. California tiger salamanders will be captured by hand, dipnet, or other USFWS- and CDFW-approved methodology, transported, and relocated to nearby suitable habitat outside of the work area and released as soon as practicable the same day of capture. Following the conditions of the relocation plan described in measure 9, individuals will be relocated outside of the exclusion fencing and at a distance no greater than 300 feet outside of the work area to areas with an active rodent burrow or burrow system (unless otherwise approved by USFWS). Holding/transporting containers and dipnets will be thoroughly cleaned, disinfected, and rinsed with fresh water prior to use within the action area. USFWS

and CDFW will be notified within 24 hours of all capture, handling, and relocation efforts. USFWS- and CDFW-approved biologists will wear clean, new disposable surgical style (nitrile, etc.) gloves and/or ensure that their hands are free of soaps, oils, creams, lotions, repellents, or solvents of any sort while capturing and relocating individuals. To avoid transferring disease or pathogens in handling of the amphibians, USFWS- and CDFW-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice" or the most recent guidance.

c. If an injured California tiger salamander is encountered and the USFWS- and CDFW-approved biologist determines the injury is minor or healing and the salamander is likely to survive, the salamander will be released immediately, consistent with the preapproved relocation plan as described in measure 9. The California tiger salamander will be monitored until it is determined that it is not imperiled by predators or other dangers.

d. If the USFWS- and CDFW-approved biologist determines that the California tiger salamander has major or serious injuries because of activities at the work site, the USFWS- and CDFW-approved biologist, or designee, will immediately take it to a USFWS- and CDFW-approved facility. If taken into captivity, the individual will not be released into the wild unless it has been kept in quarantine and the release is authorized by USFWS. DWR will bear any costs associated with the care or treatment of such injured California tiger salamanders. The circumstances of the injury, the procedure followed, and the final disposition of the injured animal will be documented in a written incident report. Notification to USFWS and CDFW of an injured or dead California tiger salamander in the project area will be reported within 24 hours and will include details such as whether or not its condition resulted from activities related to the proposed action. In addition, the USFWS- and CDFW-approved biologist will follow up with USFWS and CDFW within 2 calendar days of the finding. Written notification to USFWS and CDFW will include the following information: the species, number of animals taken or injured, sex (if known), date, time, location of the incident or of the finding of a dead or injured animal, how the individual was taken, photographs of the specific animal, the names of the persons who observed the take or found the animal, and any other pertinent information. Dead specimens will be preserved, as appropriate, and held in a secure location until instructions are received from USFWS regarding the disposition of the specimen.

14. The USFWS- and CDFW-approved biologist will have the authority to stop activities at the work site if they determine that any of the avoidance and minimization measures are not being fulfilled.

15. If the exclusion fence is compromised during the rainy season, when California tiger salamanders are likely to be active, the fence will be repaired and a survey will be conducted immediately preceding construction activity that occurs in modeled or suitable California tiger salamander habitat, as determined by a USFWS- and CDFW-approved biologist, or in advance of any activity that may result in take of the species. The biologist will search along exclusion fences, and beneath vehicles each morning before they are moved. The survey will include a careful inspection of all potential hiding spots, such as along exclusion fencing; large, downed woody debris; and the perimeter of ponds, wetlands, and riparian areas. Any California tiger salamanders found will be captured and relocated according to the USFWS/CDFW-approved relocation plan.

16. If work must be conducted at night within 300 feet of California tiger salamander habitat, all lighting will be directed away and shielded from California tiger salamander habitat outside the construction area to minimize light spillover to the greatest extent possible. If light spillover into adjacent California tiger salamander habitat occurs, a USFWS- and CDFW-approved biologist will be present during night work to survey for burrows and emerging California tiger salamanders in areas illuminated by construction lighting. If California tiger salamander is found aboveground the USFWS- and CDFW-approved biologist has the authority to terminate the project activities until the light is directed away from the burrows, the California tiger salamander moves out of the illuminated area, or the California tiger salamander is relocated out of the illuminated area by the USFWS- and CDFW-approved biologist.
17. If requested before, during, or upon completion of ground disturbance and construction activities where suitable California tiger salamander habitat is present, DWR will require that USFWS and CDFW can access and inspect the work site for compliance with the description of the project and avoidance and minimization measures, and to evaluate effects on the California tiger salamander and its habitat. A USFWS- and CDFW-approved biologist will be on-site during all activities that may result in take of California tiger salamander.

#### 3.6.2.7 Giant Garter Snake Avoidance and Minimization Measure

The following measures for giant garter snake will only be required for surface construction and restoration activities occurring within suitable habitat as defined in Chapter 4, Section 4.4.15, *Giant Garter Snake,* and by additional assessments conducted during the planning for work in a given area. Surveys and monitoring will be conducted from locations where access is allowed, including habitat delineation surveys, preconstruction surveys to determine presence, and clearance surveys conducted immediately prior to construction.

During project implementation and prior to project construction, DWR, in agreement with CDFW and USFWS, will perform the following measures.

1. When each site is available for surveys, a USFWS- and CDFW-approved biologist will then delineate giant garter snake habitat at each project site, including both aquatic and upland habitat. Suitability of aquatic and upland habitat characteristics will be determined by the biologist consistent with the description of suitable habitat defined in Chapter 4, Section 4.4.15.
2. Once habitat has been delineated, the biologist will use giant garter snake preconstruction surveys performed using a method approved by USFWS and CDFW to determine presence of the species on the project site to enable further determination of compensatory mitigation requirements.
3. For sites where such surveys are performed, the surveys will conform to established protocols for giant garter snake surveys and all occurrence data gathered will be reported to the CNDDB and USFWS to add to the understanding of populations and occurrences for the species in the Delta.

To the greatest extent possible, identified and delineated habitat will be completely avoided. If the construction or restoration activity does not fully avoid effects on suitable habitat, the following measures will be implemented.

4. Initiate construction and conduct initial ground disturbance within suitable habitat in the summer months, between May 1 and October 1, and avoid giant garter snake habitat during periods of brumation (between October 1 and May 1). Suitability of aquatic and upland habitat

characteristics will be determined by the biologist consistent with the description of suitable habitat defined in Chapter 4, Section 4.4.15. Once initial ground disturbance removing suitable habitat within a construction site has been conducted prior to September 15 and exclusionary fencing is in place, work within the cleared area can occur between October 1 and May 1.

5. To the extent practicable, as determined by project engineers and contractors, in coordination with the USFWS- and CDFW-approved biologist, conduct all activities within paved roads, farm roads, road shoulders, and similarly disturbed and compacted areas; confine ground disturbance and habitat removal to the minimal area necessary to facilitate construction activities.
6. At least 30 days prior to any ground-disturbing activities, DWR will prepare and submit a relocation plan for USFWS's and CDFW's written approval. The relocation plan will contain the name(s) of the biologist(s) to relocate giant garter snakes, the method of relocation (if different from described), a map, and a description of the proposed release site(s) within 300 feet of the work area or at a distance otherwise agreed to by USFWS and CDFW, and written permission from the landowner (if other than the State) to use their land as a relocation site.
7. When there is giant garter snake habitat within 200 feet of construction activities, exclusion fencing will be installed along the perimeter of construction sites to protect giant garter snake habitat and minimize the potential for snakes to enter the construction work area. The perimeter of construction sites (except for work sites within areas of open water, like the Sacramento River) within or adjacent to giant garter snake habitat will be fenced with exclusion fencing by no more than 14 days prior to the start of construction activities (e.g., staging, vegetation removal, grading) in a given area. The placement of exclusion fencing will be determined, in part, by the locations of suitable habitat for the species. A conceptual fencing plan will be submitted to USFWS and CDFW prior to the start of construction and the approved exclusion fencing will be shown on the final construction plans. DWR, as project proponent, will include the exclusion fence specifications including installation and maintenance criteria in the bid solicitation package special provisions. The exclusion fencing will remain in place for the duration of construction and will be regularly inspected and fully maintained. The biological monitor and construction manager will be responsible for checking the exclusion fencing around the work areas each day of construction to ensure that they are intact and upright. This will be especially critical during times of inclement weather that can damage the fencing. Repairs to the exclusion fence will be made within 24 hours of discovery of a breach. Where construction access is necessary, gates will be installed in the exclusion fence and fencing will direct animals away from the work area to the extent practicable (e.g., fencing will flare out and turn back toward suitable habitat).
8. Immediately prior to the initiation of any vegetation clearing, ground-disturbing activities, and exclusion fence installation, the USFWS- and CDFW-approved biologist will survey suitable aquatic and upland habitat in the entire work site for the presence of giant garter snakes. Beginning no more than 7 days prior to initiating ground-disturbing activities during the active season (May 1 to October 1), the biologist shall conduct 2 days of walking preconstruction surveys within each construction site and a 3-foot boundary, surrounding the exclusion fencing, where access is allowed. If access is not allowed outside of the exclusion fencing, the biologist will conduct a visual survey of the 3-foot boundary from the edge of the exclusion fencing. The final preconstruction survey shall occur within 24 hours preceding exclusion barrier installation. If there is a lapse in construction in a work area for 7 days or more, these preconstruction surveys will be repeated before activities resume.

9. If exclusionary fencing is found to be compromised, a survey of the exclusion fencing and the area inside the fencing will be conducted immediately preceding construction activity that occurs in delineated giant garter snake habitat or in advance of any activity that may result in take of the species. The biologist will search along exclusionary fences, in pipes, and beneath vehicles before the vehicles are moved.
10. If a giant garter snake is found in the work area, activities within a minimum of 25 feet of the individual will cease immediately and the construction manager and USFWS- and CDFW-approved biologist will be notified, and the biologist will observe and follow within 10 feet of the individual to ensure it has safely left the area. Depending on site-specific conditions, such as the use of heavy equipment, a larger protective buffer may be established, as determined by the USFWS- and CDFW-approved biologist. The snake will be allowed to move of its own volition out of harm's way. If the snake does not move and it is deemed necessary to relocate the animal to prevent harm, the snake may be captured and relocated to suitable habitat a minimum of 200 feet outside of the work area in accordance with the relocation plan, prior to resumption of construction activity.
11. Within 24 hours prior to construction activities, and dredging, requiring heavy equipment, a USFWS- and CDFW-approved biologist will conduct a clearance survey of all the activity area not protected by exclusionary fencing where giant garter snake could be present. This survey of the work area will be repeated if a lapse in construction or dredging activity of 2 weeks or greater occurs during the aestivation period (October 1 to May 1) or if the lapse in construction activity is more than 12 hours during active season (May 1 to October 1). If a giant garter snake is encountered during surveys or construction, cease activities until appropriate corrective measures have been completed, it has been determined that the giant garter snake will not be harmed, or the giant garter snake has left the work area.
12. The USFWS- and CDFW-approved biological monitor will help guide access and construction work around wetlands, active rice fields, and other sensitive habitats capable of supporting giant garter snake to minimize habitat disturbance and risk of injuring or killing giant garter snakes.
13. Store equipment in designated staging area areas at least 200 feet away from giant garter snake aquatic habitat to the extent practicable.
14. Visually check for giant garter snake under any vehicles or equipment that have been idle for more than 1 hour, or parked overnight, prior to moving the vehicles. Check any crevices or cavities in the work area where individuals may be present, including stockpiles that have been left for more than 24 hours where cracks/crevices may have formed.

For activities that will occur within suitable giant garter snake habitat during the giant garter snake inactive season (October 2 to April 30) and will last more than 2 weeks, DWR will implement the following additional avoidance and minimization measures.

15. All aquatic giant garter snake habitat will be dewatered between May 1 and October 1 (giant garter snake active season) to the extent that the area is no longer suitable giant garter snake habitat, as defined in Chapter 4, Section 4.4.15. Dewatering will be limited to the immediate construction area and will remain dry for at least 15 consecutive days prior to excavating or filling the dewatered habitat. The USFWS- and CDFW-approved biologist will be on-site during dewatering activities to salvage and relocate any snakes that cannot escape on its own. Dewatering is necessary because aquatic habitat provides prey and cover for giant garter snake;

dewatering serves to remove the attractant and increase the likelihood that giant garter snake will move to other available habitat. Any deviation from this measure will be done in coordination with and with approval of USFWS and CDFW.

16. Following dewatering of aquatic habitat, all potential impact areas that provide suitable aquatic or upland giant garter snake habitat will be surveyed for giant garter snake by the biologist. If giant garter snakes are observed, they will be passively allowed to leave the potential impact area. If the snake does not move of its own accord and it is determined necessary, the snake will be relocated in accordance with the approved relocation plan.
17. Once habitat is deemed free of giant garter snakes, exclusion fencing will be installed around the construction site so no snakes may reenter prior to or during construction.

#### 3.6.2.8 Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure

The following measures will be required for surface construction and restoration activities occurring in suitable valley elderberry longhorn beetle habitat as defined in Chapter 4, Section 4.4.17, *Valley Elderberry Longhorn Beetle,* and by additional assessments conducted during the planning for work in a given area. Surveys and monitoring will be conducted from locations where access is allowed.

As properties become accessible for initiating project activities, DWR will require surveys for elderberry shrubs to be conducted in construction areas by a USFWS-approved biologist.

Elderberry shrubs will be avoided to the maximum extent practicable. Complete avoidance (i.e., no adverse effects) will be assumed when a buffer of at least 165 feet is established and maintained around elderberry shrubs containing stems measuring 1 inch or greater in diameter at ground level (U.S. Fish and Wildlife Service 2017a).

Elderberry shrubs determined or assumed to be occupied, according to the criteria in the 2017 Framework or the most recent available guidance at that time, that are identified within project footprints that cannot be avoided (i.e., those in the project footprint) will be transplanted to conservation areas identified in the CMP. Transplanting will follow the guidance outlined in USFWS's 2017 *Framework for Assessing Impacts on Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus)* (2017 Framework) or the most recent available guidance at that time.

For shrubs not directly affected by construction but that occur within 165 feet of ground-disturbing activities, the following measures, which come from the USFWS 2017 Framework, will be implemented to avoid or substantially reduce the impact consistent with the recommendations by a USFWS-approved biologist.

1. Fencing. All areas to be avoided during construction activities will be fenced and flagged as close to construction limits as feasible.
2. Avoidance area. Activities that may damage or kill an elderberry shrub (e.g., trenching, paving, etc.) may need an avoidance area of at least 20 feet from the drip-line, depending on the type of activity.
3. Timing. As much as feasible, all activities that occur within 165 feet of an elderberry shrub, will be conducted outside of the flight season of the species (March to July).

4. Trimming. Trimming may remove or destroy valley elderberry longhorn beetle eggs and/or larvae and may reduce the health and vigor of the elderberry shrub. In order to avoid and minimize adverse effects on valley elderberry longhorn beetle, trimming will occur between November 1 and February 1 and will avoid the removal of any branches or stems that are ≥ 1 inch in diameter. Measures to address regular or largescale maintenance (trimming) should be established in consultation with USFWS.
5. Chemical usage. Herbicides will not be used within the drip-line of an elderberry shrub. Insecticides will not be used within 100 feet of an elderberry shrub. All chemicals will be applied using a backpack sprayer or similar direct-application method.

#### 3.6.2.9 Vernal Pool Avoidance and Minimization Measure

The following measures will be required for surface construction and restoration activities occurring in suitable Delta green ground beetle, vernal pool fairy shrimp, vernal pool tadpole shrimp, Colusa grass, and Solano grass habitat as defined in Chapter 4, Section 4.4.16, *Delta Green Ground Beetle*, Section 4.4.18, *Vernal Pool Fairy Shrimp*, Section 4.4.19, *Vernal Pool Tadpole Shrimp*, Section 4.4.20, *Colusa Grass*, and Section 4.4.21, *Solano Grass,* and by additional assessments conducted during the planning for work in a given area. Surveys and monitoring will be conducted from locations where access is allowed.

As properties become accessible for initiating project activities, planning-level surveys will be conducted to assess the suitability of modeled habitat and, where suitable, conduct protocol-level surveys for vernal pool fairy shrimp, vernal pool tadpole shrimp, Delta green ground beetle, Colusa grass, and Solano grass.

To the extent practicable, work areas will be designed to avoid habitat for vernal pool invertebrates, plants, and critical habitat for vernal pool fairy shrimp. Where practicable, the project will be planned and designed to avoid ground-disturbing activities or alterations to hydrology within 250 feet of vernal pool aquatic invertebrate habitat. Where activities need to occur within 250 feet of habitat, those work areas will be assessed for their potential to alter the hydrology of the pool habitat such that the hydroperiod of the pool will no longer support the species. Where the USFWS agrees that any changes to the hydroperiod will not permanently affect habitat functionality, compensatory mitigation would not be required.

To the extent practicable, DWR will minimize impacts on critical habitat for vernal pool fairy shrimp. To achieve this, project construction will occur at least 250 feet from vernal pool fairy shrimp critical habitat containing the primary constituent elements defined below unless it is determined through USFWS review that the activities within the buffer will not substantially modify the primary constituent elements of vernal pool fairy shrimp critical habitat.

Primary constituent elements for vernal pool fairy shrimp are defined as follows (70 FR 46924–46998).

1. Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools.
2. Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18

days, in all but the driest years, thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

3. Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding.
4. Structure within the pools described above, consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

For suitable aquatic habitat for vernal pool fairy shrimp, vernal pool tadpole shrimp, Delta green ground beetle, Colusa grass, and Solano grass that will be affected by the project, protocol-level surveys for these species will be conducted to determine whether they are present or where time does not allow for surveys to be completed (e.g., dry years, timely access), the suitable habitat will be assumed to be occupied. Surveys will be conducted according to the most recent USFWS guidelines by USFWS-approved biologists with the appropriate recovery permit under Section 10(a)(1)(A) of the ESA.

Project elements will be designed to avoid direct and indirect effects on vernal pool aquatic invertebrate habitat to the extent practicable. Where avoidance is not possible, and construction occurs within 250 feet of vernal pool crustacean habitat, construction best management practices, as described in AMM-14: *Construction Best Management Practices for Biological Resources*, will be implemented to ensure that construction activities minimize effects on the habitat. Construction best management practices include protective fencing installed around vernal pool aquatic invertebrate habitat with signage identifying these areas as containing sensitive biological resources. A biological monitor will ensure that fencing and best management practices are maintained for the duration of construction and that construction personnel are provided the necessary worker awareness training.

### 3.6.2.10 Northwestern Pond Turtle Avoidance and Minimization Measure

The following measures for western pond turtle will be required only for surface construction occurring within 300 feet of suitable aquatic habitat as defined in Chapter 4, Section 4.4.22, *Northwestern Pond Turtle*, and by additional assessments conducted during project implementation and prior to project construction in a given area. Surveys and monitoring will be conducted from locations where access is allowed, including habitat delineation surveys, preconstruction surveys to determine presence, and clearance surveys conducted immediately prior to construction.

During project implementation and prior to project construction, DWR will perform the following measures.

1. When each site is available for surveys, a USFWS- and CDFW-approved biologist will then delineate northwestern pond turtle habitat at each project site, including both aquatic and upland habitat. Suitability of aquatic and upland habitat characteristics will be determined by the biologist consistent with the description of suitable habitat defined in Chapter 4, Section 4.4.22.

2. Once habitat has been delineated, the biologist will use northwestern pond turtle preconstruction surveys performed consistent with a USFWS- or CDFW-approved survey protocol (U.S. Geological Survey 2006, or more current guidance) to determine presence of the species on the project site to enable further determination of compensatory mitigation requirements.

To the greatest extent possible, identified and delineated habitat will be completely avoided and activities will be conducted within paved roads, farm roads, road shoulders, and similarly disturbed and compacted areas. If the construction or restoration activity cannot fully avoid effects on suitable habitat, the following measures will be implemented.

3. Initiate construction and conduct initial ground disturbance in suitable upland habitat within 300 feet of suitable aquatic habitat prior to the start of nesting season (August 1–February 28) and avoid northwestern pond turtle upland habitat during periods of nesting and nestling emergence (between March 1–July 31). Suitability of aquatic and upland habitat characteristics will be determined by the biologist consistent with the description of suitable habitat defined in Chapter 4, Section 4.4.22. Once initial ground disturbance removing suitable habitat within a construction site has been conducted and exclusionary fencing is in place and maintained, work within the cleared area can occur throughout the year.
4. At least 30 days prior to any ground-disturbing activities that could result in take of northwestern pond turtle, DWR will prepare and submit a relocation plan for USFWS's written approval. The relocation plan will contain the name(s) of the biologist(s) to relocate northwestern pond turtles or their nests, the method of relocation, a map, and a description of the proposed release site(s) that are a minimum of 300 feet outside of the work area or at a distance otherwise agreed to by USFWS, and written permission from the landowner (if other than the State) to use the land as a relocation site. Any capture and handling of turtles will be done by a USFWS-approved biologist wearing clean, new disposable surgical style (e.g., nitrile) gloves.
5. Within 72 hours prior to the initiation of any vegetation clearing, ground-disturbing activities, and exclusion fence installation or modification, the USFWS- and CDFW-approved biologist will conduct a preconstruction survey within suitable aquatic and upland habitat in the entire work site for the presence of northwestern pond turtles or nests. These surveys will consist of walking the work site limits. The biologist will investigate all potential areas that could be used by northwestern pond turtle for feeding, basking, nesting, or other essential behaviors. If there is a lapse in construction of 7 days or more for work areas surrounded by exclusion fencing, these preconstruction surveys will be repeated before activities resume.
6. When there is northwestern pond turtle habitat within 300 feet of construction activities, exclusion fencing will be installed along the perimeter of construction sites to protect northwestern pond turtle habitat and minimize the potential for turtles to enter the construction work area. The perimeter of construction sites (except for work sites within areas of open water, like the Sacramento River) within 300 feet of suitable northwestern pond turtle aquatic habitat will be fenced with exclusion fencing no more than 14 days prior to the start of construction activities (e.g., staging, vegetation removal, grading) in a given area. To the greatest extent feasible, exclusion fencing will be installed prior to the start of nesting season (March 1). The placement of exclusion fencing will be determined, in part, by the locations of suitable habitat for the species. A conceptual fencing plan will be submitted to USFWS and CDFW prior to the start of construction and the approved exclusion fencing will be shown on the final

construction plans. DWR, as project proponent, will include the exclusion fence specifications including installation and maintenance criteria in the bid solicitation package special provisions. The exclusion fencing will remain in place for the duration of construction and will be regularly inspected and fully maintained. Where openings need to be maintained, such as on the levee road, fencing will be installed to direct turtles away from the work area to the extent practicable (e.g., fencing will flare out and turn back toward the river and adjacent riparian). Where construction access is necessary, gates will be installed in the exclusion fence and fencing will direct animals away from the work area to the extent practicable (e.g., fencing will flare out and turn back toward suitable habitat).

7. The biological monitor and construction manager will be responsible for checking the exclusion fencing around the work areas each day of construction to ensure that they are intact and upright. Repairs to the exclusion fence will be made within 24 hours of discovery of damage. If exclusionary fencing is found to be compromised, the suitable habitat inside the fencing will be surveyed in advance of any activity that may result in take of the species. Following repairs, the biologist will search all potential areas that could be used by northwestern pond turtle for feeding, basking, nesting, or other essential behaviors, including along exclusion fencing and beneath vehicles before the vehicles are moved.
8. For work sites where exclusion fencing cannot be placed around the entire perimeter, the USFWS- and CDFW-approved biological monitor will help guide access and construction work around wetlands, ponds, and other sensitive habitats capable of supporting northwestern pond turtle to minimize habitat disturbance and risk of injuring or killing northwestern pond turtles.
9. The USFWS- and CDFW-approved biologist will conduct clearance surveys prior to the start of construction each day and regularly throughout the workday when construction activities are occurring that may result in take of northwestern pond turtle. Surveys will be conducted in the same manner as the preconstruction surveys.
10. If a northwestern pond turtle is encountered in a construction or restoration area, all personnel on-site will be notified and activities within a minimum of 25 feet of the individual will cease immediately, the construction manager and USFWS- and CDFW-approved biologist will be notified, and the biologist will observe and follow within 10 feet of the individual to ensure it has safely left the area. Depending on site-specific conditions, such as the use of heavy equipment or other activities that may cause harm to the individual, as determined by the biologist, a larger protective buffer may be established. The turtle will be allowed to leave the area of its own volition out of harm's way. If the turtle does not move out of the area on its own, and it is determined by the biologist, in coordination with the construction manager that relocating the turtle is necessary to prevent harm, the turtle may be captured and relocated to suitable habitat a minimum of 300 feet outside the work area in accordance with the relocation plan, prior to resumption of construction activity.
11. Equipment must be stored in designated staging area areas at least 300 feet away from northwestern pond turtle aquatic habitat to the extent practicable.
12. If a work site is to be temporarily dewatered by pumping during the northwestern pond turtle active season, intakes will be completely screened with wire mesh not larger than 5 millimeters to prevent juvenile northwestern pond turtles and other aquatic species from entering the pump system. Any turtles found in the dewatered area will be relocated according to the USFWS- and CDFW-approved relocation plan.

For proposed activities that will occur within suitable northwestern pond turtle aquatic habitat during the northwestern pond turtle inactive season (October 1 through February 28), DWR will implement the following additional avoidance and minimization measures.

1. All aquatic northwestern pond turtle habitat will be dewatered prior to the start of the inactive season (October 1) to the extent that the area is no longer suitable northwestern pond turtle habitat, as defined in Chapter 4, Section 4.4.22. Dewatering is necessary because aquatic habitat provides overwintering habitat for northwestern pond turtle; dewatering serves to remove the attractant and increase the likelihood that northwestern pond turtle will move to other available habitat. Pump intakes will be completely screened with wire mesh not larger than 5 millimeters to prevent juvenile northwestern pond turtle and other aquatic species from entering the pump system. Dewatering will be limited to the immediate construction area. The USFWS- and CDFW-approved biologist will be on-site during dewatering activities to salvage and relocate any turtles that cannot escape on their own according to the USFWS- and CDFW-approved relocation plan. Any deviation from this measure will be done in coordination with and with approval of USFWS and CDFW.
2. Following dewatering of aquatic habitat, all potential impact areas that provide suitable aquatic or upland northwestern pond turtle habitat will be surveyed for northwestern pond turtle by the biologist. If northwestern pond turtles are observed, they will be allowed to move of their own accord or relocated in accordance with the approved relocation plan.
3. Once habitat is deemed free of northwestern pond turtles, exclusion fencing will be installed around the construction site so no turtles may reenter prior to or during construction.

### 3.6.2.11 Western Spadefoot Avoidance and Minimization Measure

The following measures for western spadefoot will be required only for surface construction occurring within suitable habitat as defined in Chapter 4, Section 4.4.23, *Western Spadefoot,* and by additional assessments conducted during project implementation and prior to project construction. Surveys and monitoring will be conducted from locations where access is allowed, including habitat delineation surveys, preconstruction surveys to determine presence, and clearance surveys conducted immediately prior to construction.

During project implementation and prior to project construction, DWR will perform the following measures.

1. When each site is available for surveys a USFWS-approved biologist will then delineate western spadefoot habitat at each project site, based on the definition of suitable habitat, including both aquatic and upland habitat. Suitability of aquatic and upland habitat characteristics will be determined by the biologist consistent with the description of suitable habitat defined in Chapter 4, Section 4.4.23.
2. Once habitat has been delineated, the biologist will use western spadefoot preconstruction surveys performed consistent with a USFWS-approved survey protocol to determine presence of the species on the project site to enable further determination of compensatory mitigation requirements.
3. To the greatest extent possible, identified and delineated habitat will be completely avoided and activities will be conducted within paved roads, farm roads, road shoulders, and similarly

disturbed and compacted areas. If the construction or restoration activity cannot fully avoid effects on suitable habitat, the following measures will be implemented. Except for limited vegetation clearing necessary to minimize effects on nesting birds, initial suitable upland habitat clearance and disturbance will not be conducted between November 1 and March 31, with the period extending to April 30 during wet years. Once the initial ground disturbance has occurred, the area has been surveyed, and exclusionary fencing is in place, work in the disturbed area can occur outside the construction window (defined as April 1 through October 31 or, during wet years, May 1 through October 31).

4. Where construction or restoration activities take place in aquatic habitat, activities will not be initiated until after the habitat is no longer ponding water or until a USFWS-approved biologist has surveyed the aquatic habitat for presence of western spadefoot larvae. No work or dewatering will be allowed in occupied habitat. If a work site is to be temporarily dewatered by pumping, intakes will be completely screened with wire mesh not larger than 5 millimeters to prevent larger aquatic species from entering the pump system.
5. Ground-disturbing activities will be designed to minimize or eliminate effects on rodent burrows that may provide suitable upland habitat for western spadefoot. Surface-disturbing activities will avoid areas with a high concentration of burrows to the greatest extent practicable. In addition, when a concentration of burrows is present in a work site, the area plus a 50-foot buffer will be staked or flagged to ensure that work crews are aware of their location and to facilitate avoidance of the area.
6. All initial ground disturbance or vegetation removal (clearing) will be limited to periods of no or low rainfall (less than 0.08 inch per 24-hour period and less than 40% chance of rain). To the extent practicable, clearing activities within western spadefoot habitat will cease 24 hours prior to a 40% or greater forecast of rain from the closest National Weather Service weather station. Clearing may continue 24 hours after the rain ceases, if no more than 0.5 inch of precipitation is in the 72-hour forecast. If clearing must continue when rain is forecast (greater than 40% chance of rain), a qualified biologist will survey the work site before clearing begins each day rain is forecast. If rain exceeds 0.5 inch during a 24-hour period, clearing will cease until the National Weather Service forecasts no further rain. For a given site that has exclusion fencing in place and all surface soil disturbance completed (i.e., no burrows present), these restrictions would no longer apply.
7. To the extent practicable, earthmoving and construction activities will cease no less than 30 minutes before sunset and will not begin again until no less than 30 minutes after sunrise within 300 feet of western spadefoot habitat. Suitability of aquatic and upland habitat characteristics will be determined by the USFWS-approved biologist consistent with the description of suitable habitat defined in Chapter 4, Section 4.4.23.6, *Suitable Habitat Definition,* and by additional assessments conducted prior to ground disturbance. Except when necessary for driver or pedestrian safety, to the greatest extent practicable, artificial lighting at a work site will be prohibited during the hours of darkness.
8. At least 30 days prior to any ground-disturbing activities that could result in take of western spadefoot, DWR will prepare and submit a relocation plan for USFWS's written approval. The relocation plan will contain the name(s) of the biologist(s) to relocate western spadefoot, the method of relocation, a map, and a description of the proposed release site(s) a minimum of 300 feet outside of the work area or at a distance otherwise agreed to by USFWS and written permission from the landowner (if other than the State) to use their land as a relocation site.

9. When there is western spadefoot habitat within 300 feet of construction activities, exclusion fencing will be installed along the perimeter of construction sites to protect western spadefoot habitat and minimize the potential for spadefoot to enter the construction work area. The perimeter of construction and restoration sites within western spadefoot habitat will be fenced with fencing material suitable for excluding amphibians by no more than 14 days prior to the start of construction activities (e.g., staging, vegetation removal, grading) in a given area. The placement of exclusion fencing will be determined, in part, by the locations of suitable habitat for the species (defined above). A conceptual fencing plan will be submitted to USFWS and CDFW prior to the start of construction and the approved exclusion fencing will be shown on the final construction plans. DWR will include the amphibian exclusion fence specifications including installation and maintenance criteria in the bid solicitation package special provisions. The amphibian exclusion fencing will remain in place for the duration of construction and will be regularly inspected and fully maintained.
10. The biological monitor and construction manager will be responsible for checking the exclusion fencing around the work areas each day of construction for wildlife trapped inside and to ensure that they are intact and upright. This will be especially critical during times of inclement weather that can damage the fencing. Repairs to the amphibian exclusion fence will be made within 24 hours of discovery of a breach. Where construction access is necessary, gates will be installed in the exclusion fence and fencing will direct animals away from the work area to the extent practicable (e.g., fencing will flare out and turn back toward suitable habitat). If the exclusion fence is compromised during the rainy season, a survey will be conducted immediately preceding construction activity that occurs in suitable western spadefoot habitat, or in advance of any activity that may result in take of the species. The biologist will search along exclusion fences, and beneath vehicles each morning before the vehicles are moved. Surveys will be conducted in the same manner as the preconstruction surveys.
11. Preconstruction surveys will be conducted by a USFWS-approved biologist immediately prior to the initiation of any ground-disturbing activities or vegetation clearing, including immediately prior to exclusion fence installation, in areas identified as having suitable western spadefoot habitat. These surveys will consist of walking surveys within the work sites and investigating suitable aquatic and upland habitat including potential refugia habitat such as small woody debris, refuse, burrow entrances, etc., that are not directly disturbed by project activities. If there is a lapse in construction in a work area for 7 days or more, these preconstruction surveys will be repeated before activities resume.
12. The USFWS-approved biologist will conduct clearance surveys within the construction work area at the beginning of each day and regularly throughout the workday when construction activities are occurring that may result in take of western spadefoot. Surveys will be conducted in the same manner as the preconstruction surveys.
13. If a western spadefoot is encountered in a construction or restoration area, activities within a minimum of 25 feet of the individual will cease immediately, the construction manager and biological monitor will be notified, and the biological monitor will observe and follow the individual within 10 feet to ensure it has safely left the area. A larger protective buffer may be established, depending on site-specific conditions such as the use of heavy equipment, or other activities that may cause harm to the individual, as determined by the biological monitor. The spadefoot will be allowed to leave the area of its own volition out of harm's way. If the spadefoot does not move out of the area on its own, and it is determined by the biologist, in coordination with the construction manager that relocating the individual is necessary to prevent harm, the

individual may be captured and relocated to suitable habitat a minimum of 300 feet outside the work area in accordance with the relocation plan, prior to resumption of construction activity.

a. Prior to handling and relocation, the biologist will take precautions to prevent introduction of amphibian diseases by following guidance in *The Declining Amphibian Task Force Fieldwork Code of Practice* (U.S. Fish and Wildlife Service 2019b:1) or the most up-to-date guidance available at the time. Western spadefoot will also be handled and assessed according to the *Restraint and Handling of Live Amphibians* (U.S. Geological Survey National Wildlife Health Center 2001) or the most up-to-date guidance available at the time.

b. Western spadefoot will be captured by hand, dipnet, or other USFWS-approved methodology, transported, and relocated to nearby suitable habitat outside of the work area and released as soon as practicable the same day of capture.

### 3.6.3 Compensatory Mitigation

The CMP is included in Appendix 3B. The CMP describes project-specific and programmatic actions that would be implemented to offset the impacts associated with construction, operation, and maintenance of the proposed action. Creation and enhancement of the initial mitigation sites at Bouldin Island and the I-5 ponds are described in enough detail to be evaluated at the project level in Chapter 6. Tidal restoration and channel margin enhancement mitigation actions are described at a higher level of detail and therefore can only be evaluated programmatically in Chapter 6. Appendix 3B has been developed to support the proposed action associated with this BA. The CMP includes compensatory mitigation measures for each species, which are described in Attachment 3B.1, *Compensatory Mitigation Design Parameters*.

## 3.7 Reinitiation of Consultation

As provided in 50 CFR Section 402.16:

> Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal involvement or control over the action has been retained or is authorized by law and:
>
> (a) If the amount or extent of taking specified in the incidental take statement is exceeded;
>
> (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
>
> (c) If 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
>
> (d) If a new species is listed or critical habitat designated that may be affected by the identified action.

USACE as the federal action agency, with DWR as the applicant, will reinitiate consultation with USFWS and/or NMFS if any of these circumstances occur.

# 3.8 References Cited

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Chapter 4
# Action Area and Environmental Baseline

## 4.1 Introduction

This chapter describes the action area of the proposed action as well as the environmental baseline in the action area, including an overview of environmental conditions and a description of the effects of these conditions on the species included in this Biological Assessment (BA). Detailed species accounts for each aquatic and terrestrial species considered in this BA are provided in this chapter.

## 4.2 Action Area

The action area is defined as 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). For the purposes of this consultation, the action area includes those areas associated with proposed construction activities. The proposed action includes construction of new State Water Project (SWP) facilities. The proposed action's two new intake facilities would act as new points of diversion in the north Delta along the Sacramento River. The two new intake facilities would convey up to 6,000 cubic feet per second (cfs) of water from the north Delta. Intake components would include cylindrical tee fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, tunnel inlet, and other inlet structures. The action area also includes the lands between Clifton Court Forebay and Bethany Reservoir, where the Bethany Complex and associated features will be constructed, and at Bouldin Island and the Interstate (I-) 5 ponds, where mitigation construction activities may occur in waters of the United States. Additional details on the proposed action are found in Chapter 3, *Description of the Proposed Action*, Section 3.1.3, *Summary of Proposed Action*. The action area consists of the footprint of the proposed facilities, which include intakes in the north Delta, tunnel shafts, access roads, park-and-ride lots, and facilities associated with the proposed Bethany Complex. A detailed discussion of project facilities, including figures, can be found in Chapter 3.

For the Southern Resident killer whale, all nearshore coastal waters within their range in California, Oregon, and Washington are included in the study area because this distribution is consistent with the description provided by National Marine Fisheries Service (NMFS) (2009:158–160).

## 4.3 Environmental Context

This section includes a general description of environmental conditions in the action area to provide relevant background information for the environmental baseline. The environmental baseline for each species is presented below in Section 4.4, *Status of the Species/Environmental Baseline Summary*.

### 4.3.1 Historical Conditions

The modern Delta formed sometime between 10,000 and 6,000 years ago, when the rising sea level inundated a broad valley that occupied the Delta region. Despite its name, the Sacramento– San Joaquin River Delta is not simply the merging of two river deltas but is instead an elongated and complex network of deltas and flood basins with flow sources that include Cache Creek, Putah Creek, Sacramento River, Mokelumne River, San Joaquin River, and Marsh Creek. Based on current unimpaired flow estimates, the Sacramento River is the largest source of flows and has contributed an average of 73% of historical inflows into the Delta. The eastside tributaries, including the Mokelumne River, contribute about 6%, and the San Joaquin River contributes 21% (California Department of Water Resources 2007).

Currently, during high-flow events (when water from the Sacramento River spills into the bypasses), approximately 80% of Sacramento River flow enters the Yolo Bypass, a flood control bypass west of the city of Sacramento, via the Fremont Weir (Roos 2006). The flood stage flows can have many sources, including direct flows from tributaries such as the Feather and American Rivers, as well as flows transiting a system of passive and active weirs (James and Singer 2008; Singer et al. 2008; Singer and Aalto 2009). The Yolo Bypass also serves as a conduit for Cache Creek and Putah Creek, as their waters enter the Sacramento River via Cache Slough at the southern end of the Yolo Bypass. The San Joaquin River discharges into a broad network of sloughs and channels, and the Mokelumne River delta merges with the San Joaquin River delta on the eastern side of the Delta. On the southwest side of the Delta, the Marsh Creek delta merges with the San Joaquin River delta.

While flooding has always been a regular occurrence along the Sacramento River (Thompson 1957, 1960, 1961, 1965), the natural geomorphic processes and hydrologic regimes were completely disrupted by the enormous increase in sediment and debris generated by hydraulic mining operations in the central Sierra Nevada from 1853 to 1884 (Gilbert 1917; Mount 1995). Large volumes of mining sediment remain in the tributaries today (James 2004a; 2004b). The portion of the estimated 1.5 billion cubic feet of sediment that poured into the Sacramento Valley filled river channels and increased flooding severity and peak flows (Gilbert 1917; Kelley 1989; Mount 1995; James 2004a; Hitchcock et al. 2005; William Lettis & Associates 2005; James 2006; Central Valley Regional Water Quality Control Board 2008; James and Singer 2008; James et al. 2009). In the 1900s, another pulse of mining sediment was discharged into the Sacramento River watershed (James 1999). While it is often assumed the mining sediment has already passed through the Delta or is stored behind dams, large amounts remain within the system (James 1999, 2004a, 2004b, 2006; James and Singer 2008; James et al. 2009). Historically, the initial pulse of sediment made its way into the San Francisco Estuary where it filled shallow tidal bays. However, with current reduced sediment loads into the estuary, the remaining sediments in the estuary are being eroded and transported into the Pacific Ocean (Cappiella et al. 1999; Ganju and Schoellhamer 2010).

It is estimated that prior to reclamation actions (filling, dredging, channel straightening, levee construction, diking, and draining), nearly 60% of the Delta was inundated by daily tides. The tidal portion of the Delta consisted of backwater areas, tidal sloughs, and a network of channels that supported highly productive freshwater tidal marsh and other wetland habitats (Whipple et al. 2012). Similar complex drainage networks, ponds, and salt panes existed in tidal brackish marshes in Suisun Marsh and along the north shore of east Contra Costa County (Brown 2004; Whipple et al. 2012; San Francisco Estuary Institute 2010). The soils in these marshes were generally peat beds that accumulated and were preserved under anoxic conditions. In contrast, soils in channels and

along the higher-energy channel margins of islands tend to be composed primarily of mineral sediment (William Lettis & Associates 2005; Unruh and Hitchcock 2009).

Reclamation occurred over vast areas in the Delta, Yolo Basin, Suisun Marsh, and the south shore of Suisun Bay between the 1850s and the early 1930s, completely transforming their physical structure (Thompson 1957, 1965; Suisun Ecological Workgroup 2001; Brown 2004; Whipple et al. 2012; San Francisco Estuary Institute 2010). Levee ditches were built to drain land for agriculture, human habitation, mosquito control, and other human uses while channels were straightened, widened, and dredged to improve shipping access to the Central Valley and to improve downstream water conveyance for flood management. During this period, over 300,000 acres of tidal marshes in the Delta were diked, drained, and converted to agriculture (Atwater et al. 1979). Thus, the complex, shallow, and dendritic marshlands were replaced by simplified, deep, and barren channels. This hydrogeomorphic modification fragmented aquatic and terrestrial habitats and decreased the value and quantity of available estuarine habitat (Herbold and Vendlinski 2012; Whipple et al. 2012).

Floodplain includes areas that are inundated by overbank flow during the winter and spring peak flows. Inundation can last for up to several months. In pre-settlement times, floodplain was arguably one of the most productive natural communities in the Delta, and its loss can be linked to the decline of many native Delta species. Reclamation, channel modification for flood control, and water removals for agriculture and export have resulted in a substantial reduction in floodplain areas. Floodplains provide important habitat for rearing, migrating, and adult fish; migratory waterfowl; and amphibians, reptiles, and mammals native to the Delta.

Under natural conditions, inflows from both the Sacramento and San Joaquin Rivers to the Delta were much lower from July through November compared to the December to June period (Bay Institute 1998), and in drought periods likely led to salinity intrusions. This difference was more dramatic in the San Joaquin River. The San Joaquin River has an upper watershed consisting of impermeable granitic rock that does not support dry season groundwater discharge. In contrast, the upper watershed of the Sacramento River is composed of permeable volcanic rock. As a result, groundwater discharge from this volcanic system historically maintained a summer base flow at Red Bluff of approximately 4,000 cfs, without which the Sacramento River would have nearly dried up each fall (Bay Institute 1998).

Water diversions in the San Joaquin Valley began earlier than those in the Sacramento Valley, and by 1870, flows of the San Joaquin River were significantly reduced (Jackson and Patterson 1977). Sacramento River diversions, particularly late spring, and summer diversions for rice irrigation, increased dramatically from 1912 to 1929. The combination of significant drought periods and increased diversion during the annual low-flow period resulted in unprecedented salinity intrusion into the Delta around 1920 (Jackson and Patterson 1977; Bay Institute 1998). The economic impacts of these diversion-caused saltwater intrusions ultimately led to the creation of the Central Valley Project (CVP) and the construction of dams for the storage and release of fresh water to prevent salinity intrusion (Jackson and Patterson 1977). Between the 1930s and 1960s, construction of dams and diversions on all major rivers contributing to the Delta resulted in substantial changes to Delta hydrodynamics (Bay Institute 1998). Four dams (Shasta, Oroville, Monticello, and Folsom) in the Sacramento Valley have individual storage capacities greater than 1 million acre-feet (AF) (10.8 million AF total); an additional four dams (New Melones, Don Pedro, New Exchequer, and Pine Flat) with storage capacities greater than 1 million AF (6.5 million AF total) drain into the San Joaquin Valley (California Department of Water Resources 1993).

The main effect of this upstream water development was the dampening of the seasonal high flows during the winter and spring and higher flows during the summer/fall into the Delta (Hutton et al. 2017a, 2017b). Historic reclamation of the Delta and upstream water development also accentuated salinity intrusions into the Delta. Current water management regulations have reduced the annual fluctuations in saltwater intrusion and salinity objectives have been placed at different locations in the Delta (Delta Stewardship Council 2022). Reclamation, dam construction, flood management, and water projects have greatly transformed the geometry and hydrology of the Delta, as well as downstream locations including Suisun Bay and Suisun Marsh (California Department of Water Resources 2013).

## 4.3.2 Physical Environment

The Delta is a complex network of over 700 miles of tidally influenced channels and sloughs. Prior to the effects of hydraulic mining, flood control, and agricultural and urban development, the Delta was a large tidal marsh fed by California's two largest rivers, the Sacramento and the San Joaquin (Delta Stewardship Council 2013:2,3). The passage of the federal Swamp Land Act of 1850 and similar California legislation in 1861 led to the conversion of seasonally and tidally flooded lands into croplands protected by levees and the formation of channels to move water out of the Delta (Delta Stewardship Council 2013:8). Further land use changes and urbanization have led to the loss of 95% to 97% of the historical tidal marsh wetlands in the Delta (Whipple et al. 2012:93, Delta Stewardship Council 2013:8).

The abundance of native wildlife and plant species has been reduced over time as a result of the extensive historical modifications to and loss of the habitats in the study area. For example, large mammal species, such as tule elk (*Cervus canadensis nannodes*), have been reduced in numbers across the state and in the region and are limited to a reintroduced population of 300 elk on Grizzly Island, west of the study area (California Department of Fish and Wildlife 2018a:245). Small mammal species, such as riparian brush rabbit (*Sylvilagus bachmani riparius*), now occur only in scattered locations in the study area (California Department of Fish and Wildlife 2020b). Habitat for several rare, threatened, or endangered species, such as the California black rail (*Laterallus jamaicensis coturniculus*) and Mason's lilaeopsis (*Lilaeopsis masonii*), are now limited to remnant marshes in the study area. Habitat modification has also led to conditions that favored invasive species and reduced native species diversity (San Francisco Estuary Institute 2014:22).

Although fragmented, limited riparian habitat remains in the study area. Remnant patches of tall riparian trees, such as Fremont cottonwood (*Populus fremontii*), western sycamore (*Platanus racemosa),* and Goodding's black willow (*Salix gooddingii*), persist, but the recruitment of these species is greatly impaired by lack of active floodplain habitat and hydrologic modifications (e.g., straightened and dredged channels, dams, water diversions, sedimentation from hydraulic mining, levees separating riparian vegetation from channel). The number of species of nesting birds and mammals that depend on riparian habitat and that may be found in the study area has declined during the last 150 years (Bay Institute 1998:3-1). The western yellow-billed cuckoo (*Coccyzus americanus*), the least Bell's vireo (*Vireo bellii*), which are both listed by California Department of Fish and Wildlife (CDFW) as endangered and by U.S. Fish and Wildlife Service (USFWS) as threatened and endangered, respectively, and the yellow warbler (*Setophaga petechia*), a California species of special concern, formerly nested throughout the Central Valley (Grinnell and Miller 1944:186–187; Grinnell and Miller 1944:398–400; 51 *Federal Register* [FR] 16474). Now these species are considered locally extirpated as breeders in the study area (U.S. Fish and Wildlife Service

2006a:7; Heath 2008:334; San Francisco Estuary Institute 2014:63), and occurrences within the study area are presumed to be migrating birds. Reports from early explorers describe the Delta and adjacent lands as an area with much greater wildlife species diversity than is currently found (Bay Institute 1998:2-70).

Grasslands with vernal pools, also known as vernal pool complexes, support high levels of endemic biodiversity in the Central Valley (Solomeshch et al. 2007:394–424). This habitat type generally occurs in the northeast, northwest, and southwest areas of the study area. The vernal pool landscape in the northeast and northwest portion of the study area has been affected to some degree by leveling for agricultural land uses (e.g., Stone Lakes National Wildlife Refuge). The grasslands that support vernal pools, including alkali seasonal wetlands, in the southwest study area have been fragmented by agricultural and residential development and by water management projects. Only limited habitat remains for vernal pool species, such as fairy shrimp and native plants. It is estimated that throughout the Central Valley, the acreage of grasslands with vernal pools has declined from 7 million acres during the 1700s to about 895,000 acres in 2005 (Holland 2009:1). Approximately 135,000 acres were estimated to have been lost from 1976 to 2005 (Holland 2009:3).

Most of the land in the action area has been converted to agricultural land uses, which provide limited habitat value to most species. However, some species, including Swainson's hawk (*Buteo swainsoni)* and greater sandhill crane (*Grus canadensis tabida*), use the alfalfa and field crop areas for foraging. Besides changing land use, agricultural practices can include (1) building levees, which modify hydrology, (2) applying pesticides and fertilizers, which alters surface and groundwater quality and may be toxic to certain species, reducing cover and prey availability (e.g., insects, rodents), and (3) other activities that can be detrimental to native plant and wildlife habitat.

The leveed, channelized reaches of the Sacramento River near the proposed north Delta intakes primarily function as a listed fish migration corridor. The physical and biological features of migration and rearing habitat for listed fish species have been degraded from historical conditions. The temporary and permanent footprints of the intake facilities are characterized by steep, riprap-armored levee slopes with low quantities of overhanging and instream woody cover. Vegetation densities are low and much of the levee slope is unshaded. Shallow water is limited to a narrow band along the steep levee slope and there is no off-channel or floodplain habitat. During and following construction, no significant changes would be expected in adult fish passage conditions (water depths and velocities) because of their use of deeper, offshore portions of the channel for holding and migration. Some reduction is expected in the quality of rearing and passage conditions for juveniles due to permanent losses of shallow water habitat, the structural and hydraulic changes associated with the presence of cofferdams and riprap, and removal of vegetation within the temporary and permanent footprints of the intake.

The climate in the Delta region is spatially variable but is generally characterized as hot Mediterranean (Köppen climate classification) (Kottek et al. 2006). The general climate becomes milder from east to west due to marine influence as it is affected by winds off the Pacific Ocean. Summers are hot with average summer highs in the upper 80s to lower 90s degrees Fahrenheit (°F), with little to no precipitation and low humidity. Heat waves are common in summer months, during which temperatures can reach triple digits for consecutive days. Periodically, a "Delta breeze" of cool and humid air from the ocean moves onshore and cools the Central Valley in the vicinity of the Delta by up to 7°F (3.9 degrees Celsius [°C]) (Pierce and Gaushell 2005). Winters are mild (average daily

highs during November through March are in the mid-50s to mid-60s °F) and wet. Approximately 80% of annual precipitation occurs from November to March.

Compared to 1960–2005 observations, annual average maximum daily temperatures across California are projected to increase by between 4.4°F and 5.8°F (2.4°C and 3.2°C) by 2050 and between 5.6°F and 8.8°F (3.1°C and 4.9°C) by 2100, depending on the GHG concentration trajectory assumed (California Governor's Office of Planning and Research et al. 2018:22–23). Warming will not be uniform across the state (California Department of Water Resources California Data Exchange Center 2020:14–15). Overall precipitation is projected to continue to be variable, and annual precipitation may broadly increase in the north and decrease in the southernmost regions of California (California Governor's Office of Planning and Research et al. 2018:25).

Sea level rise assumptions for the proposed action are based on the California Ocean Protection Council's (OPC) guidance updated in 2018, the State of California Sea-Level Rise Guidance (Guidance). This Guidance includes science-based methodology for state and local governments to analyze and assess the risks associated with sea level rise, and to incorporate sea level rise into their planning, permitting, and investment decisions. The guidance incorporates probabilistic sea level rise projections, which associate a likelihood of occurrence (or probability) with sea level rise heights and rates and are directly tied to a range of emissions scenarios. Guidance also includes an extreme scenario called the H++ scenario (resulting from loss of the West Antarctic ice sheet). The probability of this scenario is currently unknown, but its consideration is important, particularly for high stakes, long-term decisions. Under the extreme H++ scenario rapid ice sheet loss on Antarctica could drive rates of sea level rise in California above 50 mm/year (2 inches/year) by the end of the century, leading to potential sea level rise exceeding 10 feet. This rate of sea level rise would be about 30-40 times faster than the sea level rise experienced over the last century.

Recent modeling indicates that sea level at San Francisco (Golden Gate) tide gage may increase by as much as 1.8 feet (H++ scenario, which is an extreme modeling scenario resulting from loss of the West Antarctic ice sheet) by 2040 and 10.2 feet (H++ scenario) by 2100 (California Natural Resources Agency and California Ocean Protection Council 2018:18). It is expected that more land in the study area will be subject to inundation by 2100 in comparison to current conditions. Potential changes in inundation zones (i.e., tidal regime) may affect the salinity and suitable habitat for species in the Delta.

With sea level rise, flooding is a major concern for the Delta. Flooding can lead to overtopping or other levee failures (i.e., erosion, seepage) and result in flooding of Delta islands and low-lying areas. Tidal wetlands which are not protected by levees will be exposed to higher tide levels and more frequent (or permanent) inundation and in some areas will not recover, while in other areas will evolve and adapt over time (Delta Stewardship Council 2021).

#### 4.3.2.1 Non-Water Supply Delta Infrastructure and Uses

The Delta supports a substantial amount of infrastructure related to urban development, transportation, agriculture, recreation, energy, and other uses. Portions of six counties are included in the legal Delta: Yolo, Sacramento, Solano, Contra Costa, Alameda, and San Joaquin (California Department of Water Resources 2006).

The major land use for the Delta is agriculture, which represents approximately two-thirds of all surface area. There is increasing residential, commercial, and industrial land use in the Delta, most of which occurs around the periphery of the Delta. Major urban developments within the cities of

Sacramento, West Sacramento, Stockton, Tracy, Antioch, Brentwood, and Pittsburg are in the Delta. Small towns located wholly within the Delta are Clarksburg, Hood, Walnut Grove, Collinsville, Courtland, Locke, Ryde, Bethel Island, and Discovery Bay. The city of Isleton and portions of the cities of Stockton, Rio Vista, Antioch, Oakley, Sacramento, West Sacramento, Elk Grove, Tracy, Lathrop, and Pittsburg are in the Secondary Zone.

Several interstate highways (Interstates [I-] 5, 80, 205/580, and 680) and one state highway (State Route [SR] 99) are on the periphery of the Delta, and three state highways (SR 4, SR 12, and SR 160) and multiple county roads cut across the Delta. Three major railways cross through the Delta. The Delta contains a network of electrical transmission lines (over 500 miles [805 kilometers]) and gas pipelines (over 100 lines). Natural gas extraction and storage is another important Delta use. In addition to public and private marinas, two major ports (Stockton and Sacramento) and their associated maintained ship channels are in the Delta. These ports can handle large ships to move cargo to and from the Pacific Ocean. Much of the Delta, including more than 500 miles (805 kilometers) of navigable waterways, is used for a variety of recreational purposes including water sports, fishing, hunting, and wildlife viewing. The effects of this infrastructure on species are described in Section 4.4, as applicable.

# 4.4 Status of the Species/Environmental Baseline Summary

This section refers to the condition of the species or its designated critical habitat within the action area including basic biology, life history, status, and impacts from past and present projects in the action area.

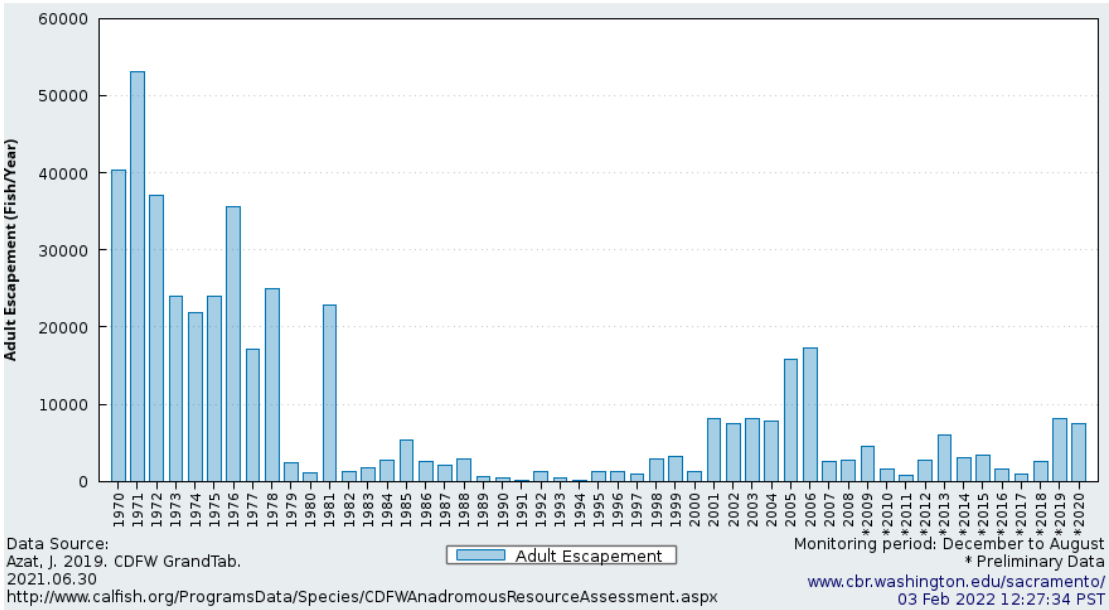
## 4.4.1 Chinook Salmon, Sacramento River Winter-Run ESU

### 4.4.1.1 Legal Status and Distribution

On May 16, 1989, the California Fish and Game Commission listed the Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU) as endangered under the California Endangered Species Act (CESA) due to persistent long-term declines (Figure 4.4.1-1). The NMFS, under an emergency interim rule, listed the Sacramento River winter-run Chinook salmon ESU as a threatened species under the federal Endangered Species Act (ESA) in August 1989 (54 FR 32085). In 1994, NMFS reclassified the ESU as endangered due to several factors: the continued decline and increased variability of run sizes including expected weak returns due to small year classes in 1991 and 1993, and continuing threats to the species (59 FR 440).

The ESU consists of one population in the mainstem of the upper Sacramento River in California's Central Valley below Keswick Dam, though efforts to reintroduce the run in Battle Creek have had success in recent years with at least 700 subadults and adults returning in 2020 as a result of juvenile releases undertaken in 2018 and 2019 (U.S. Fish and Wildlife Service 2020a). NMFS reaffirmed the listing of the Sacramento River winter-run Chinook salmon ESU as endangered on June 28, 2005 (70 FR 37160) and expanded the ESU to include winter-run Chinook salmon produced by the Livingston Stone National Fish Hatchery artificial propagation program in the ESU. From 1970 through 2020, the highest estimated run sizes occurred in the early 1970s (~40,000–50,000 adults), declining to a low in the early 1990s (~200 adults), increasing to higher levels in

mid-2000s (up to ~17,000 adults), before varying between just under 1,000 and approximately 10,000 adults since 2006 (Figure 4.4.1-1). Escapement in brood year 2022 was approximately 5,900 fish, lower than in the previous few years (Marcinkevage 2023:4).



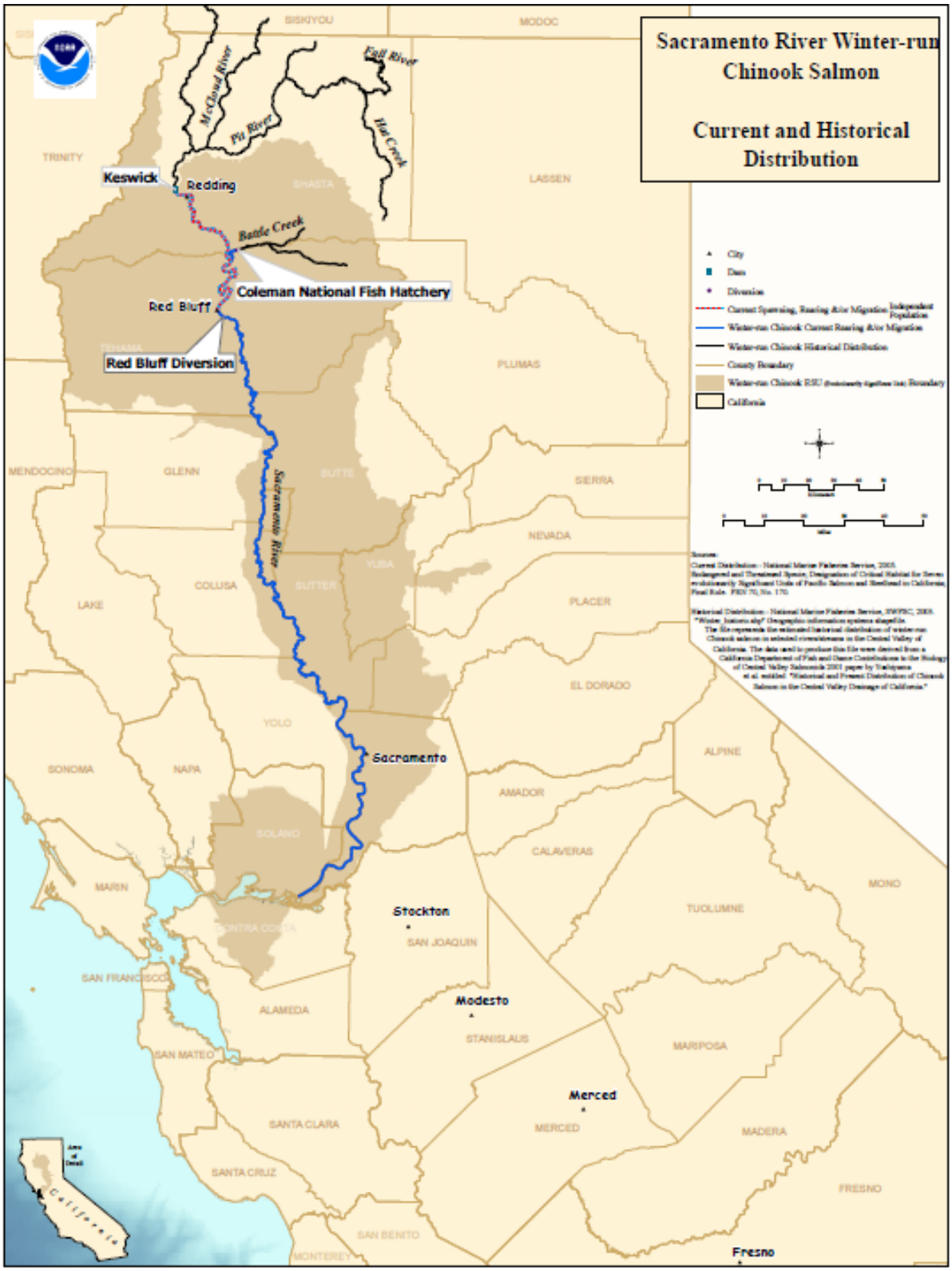

Source: Columbia Basin Research, University of Washington 2020.

**Figure 4.4.1-1. Winter-Run Chinook Salmon Adult Annual Escapement in the Central Valley, 1970–2020**

Adult Sacramento River winter-run Chinook salmon enter the San Francisco Bay in November to begin their spawning migration and continue upstream from December through early August to the extent of anadromy at the base of Keswick Dam (Figure 4.4.1-2). Adults prefer to hold in deep cold pools until they are sexually mature and ready to spawn in spring or summer. Upstream holding may last for a period of up to 8 months (Windell et al. 2017: 32). Winter-run Chinook salmon spawn in the upper mainstem Sacramento River from mid-April through August, peaking in June and July. Windell et al. (2017:6–8) reviewed habitat characteristics and factors affecting egg survival. Following spawning, fry and juvenile downstream movement begins in July/August, as shown by monitoring at Red Bluff (Table 4.4.1-1).

All known winter-run Chinook salmon production currently occurs either in the mainstem Sacramento River or Livingston Stone National Fish Hatchery (California Department of Fish and Game 2004) although a nascent reintroduction effort in Battle Creek led to the return of at least 700 subadults and adults in 2020 (U.S. Fish and Wildlife Service 2020a). Current spawning is confined to the mainstem of the Sacramento River above Red Bluff Diversion Dam (RBDD) (River Mile [RM] 243) and below Keswick Dam (RM 302) (National Marine Fisheries Service 2014), with access to historical habitat in upper Sacramento River tributaries no longer available (Figure 4.4.1-2). Until recent years, salmon passage was not possible above the Coleman Hatchery barrier weir located on Battle Creek due to the Wildcat Diversion Dam and Canal, which were removed in 2010. Beginning in 2012 and completed in 2018, the construction of the automated fish screens and fish ladders at the Eagle Canyon Diversion Dam and North Battle Creek Feeder Diversion Dam sites were implemented to provide fish passage on North Fork Battle Creek (Bureau of Reclamation 2022). Windell et al. (2017:6–8) reviewed habitat characteristics and factors affecting egg survival, among

which were in-river fishery and trampling, toxicity, and contaminants; redd quality; stranding and dewatering; dissolved oxygen; pathogens; water temperature; sedimentation and gravel quantity; and predation risk. Following spawning, fry and juvenile downstream movement begins in July/August, as shown by monitoring at Red Bluff (Table 4.4.1-1).




Source: National Marine Fisheries Service 2014:12.

**Figure 4.4.1-2. Current and Historical Sacramento River Winter-Run Chinook Salmon Distribution**

In addition to the Sacramento River, juveniles have also been found to rear in areas such as the lower American River, lower Feather River, Battle Creek, Mill Creek, Deer Creek, and the Delta (Phillis et al. 2018). Phillis et al. (2018) found with isotope data that 44% to 65% of surviving adults reared in nonnatal habitats as juveniles. The lower reaches of the Sacramento River, the Delta, and San Francisco Bay serve as migration corridors for both smolts and adults and are thought to serve as juvenile rearing habitat. Juvenile winter-run Chinook salmon begin to enter the Delta in October and smolt outmigration continues until April. Timing of smolt movement is thought to be correlated with winter rain events that result in pulse flows in the Sacramento River (del Rosario et al. 2013). Fry and smolts are known to use the Sacramento–San Joaquin Delta and Estuary as rearing habitat before entering the ocean (Sturrock et al. 2015). In addition to monitoring salvage of winter-run Chinook salmon at the Tracy Fish Collection Facility (TFCF) and the John E. Skinner Delta Fish Protective Facility (Skinner Fish Facility) in the south Delta, temporal occurrence of each life stage in the project area is monitored using screw trapping data in the rivers, trawls, and beach seines in the estuary and, more recently, acoustic tagging using a network of receivers located throughout the extent of their range, from Keswick Dam to the Golden Gate Bridge (e.g., Klimley et al. 2017).

Relative distribution, abundance, and migration timing in the Delta can be inferred from salvage monitoring data, the USFWS Delta Juvenile Fish Monitoring Program, Sherwood and Mossdale Trawls, and the Chipps Island Trawl. Juvenile mortality in the Delta from predation by piscivorous nonnative fishes and conditions that increase risk of mortality of salmonids have been at the forefront of special studies (e.g., Demetras et al. 2016) and reviews (Grossman 2016; Lehman et al. 2019). Special studies are also underway to describe factors such as rearing in Delta bays and marshes and identify variation in quality of rearing habitat. Johnson et al. (2017) give an overview of the various sampling programs providing monitoring of winter-run Chinook salmon.

#### 4.4.1.2 Life History and Habitat Requirements

Construction of Keswick and Shasta Dams for agricultural, municipal, and industrial water supply eliminated access to approximately 200 river miles of historical holding and spawning grounds above Keswick Dam (Yoshiyama et al. 1996). The Shasta Dam Fish Passage Evaluation is being undertaken to assess the feasibility of reintroducing anadromous fish upstream of Shasta Dam (Plumb et al. 2019). Rearing habitat quantity and quality has been reduced in the upper mainstem Sacramento River as a result of channel modification and levee construction (Lindley et al. 2009). Without access to historical coldwater spawning tributaries above Shasta Dam, persistence of the winter-run Chinook salmon ESU is dependent on maintaining adequate coldwater pool in Shasta Reservoir to maintain suitable temperatures for winter-run Chinook salmon egg incubation, fry emergence, and juvenile rearing. Cold water releases are facilitated by the operation of a temperature control device that allows selective withdrawal of water from different levels of the reservoir depending on temperature. Warm water releases during critically dry years contributed to low egg-to-fry survival rates. As part of a coordinated drought response, measures taken to preserve Shasta Reservoir's coldwater pool included relaxing Wilkins Slough navigational flow requirements, relaxing State Water Resources Control Board Water Right Decision 1641 (D-1641) Delta water quality requirements, and delaying Settlement Contractor depletions into the fall. Egg-to-fry survival rates was low in brood year 2022 (2.2%), likely the result of low thiamine levels despite more proactive water temperature management (Marcinkevage 2023:3, 6). Approximately 215,000 juvenile winter-run Chinook salmon from brood year 2022 were estimated to have passed RBDD, compared to approximately 570,000 from brood year 2021 and approximately 2.1 million from brood year 2020 (Marcinkevage 2023:3). Temperature-dependent egg mortality was estimated to

have been 75% in 2021 (National Marine Fisheries Service Southwest Fisheries Science Center 2021), compared to 17% in 2022 with the more proactive water temperature management (National Oceanic and Atmospheric Administration Fisheries 2023).

Much of the historical floodplain habitat has been developed or converted, which has decreased shallow water habitat with high residence time needed for food production (Jeffres et al. 2008; Katz et al. 2017; Ahearn et al. 2006). Juveniles have access to floodplain habitat in the Yolo Bypass only during moderate to high water years, and the quantity of floodplain available for rearing during drought years is currently limited. The *Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan*, *Long-Term Operation of the Central Valley Project and State Water Project Biological Opinion Reasonable and Prudent Alternative Actions I.6.1 and I.7* (Yolo Bypass Restoration Plan) includes notching the Fremont Weir, which will provide access to floodplain habitat for juvenile salmon over a longer period (California Department of Water Resources and Bureau of Reclamation 2012), and the California Department of Fish and Wildlife (2020) SWP ITP Condition of Approval 9.2.2 *Implement the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project* requires that the project be complete by 2026. Shoreline armoring and development have reduced access to floodplain rearing habitat for rearing juveniles in the Sacramento River and Delta (Boughton and Pike 2013). Floodplain availability has the potential to increase valuable prey resources and resilience in Chinook salmon (Goertler et al. 2018a, 2018b). Recent studies suggest Chinook salmon migration survival through the Yolo Bypass is comparable to that in the Sacramento River (Johnston et al. 2018; Pope et al. 2018); entry into the bypass over Fremont Weir may vary considerably even when river flow into the bypass is substantial, possibly as a function of fish cross-channel position in the Sacramento River (Pope et al. 2018); and travel time in low-flow years is more variable in the bypass than in the river (Johnston et al. 2018).

Juvenile migration corridors may be affected by reverse Old and Middle River flows that are exacerbated by south Delta export facility operations at the CVP and SWP pumping plants (discussed further in Section 4.4.2, *Chinook Salmon, Central Valley Spring-Run ESU*). Bidirectional flow in the Sacramento River at Georgiana Slough associated with lower Sacramento River inflow to the Delta causes juvenile Chinook salmon to enter into the interior Delta in greater numbers than with unidirectional flow at high Sacramento River inflow, which results in greater travel times and lower survival (Perry et al. 2013, 2018; see additional discussion in Section 4.4.2). This and other studies have typically used hatchery-origin juvenile late fall–run Chinook salmon large enough to bear acoustic tags, with the general movement patterns often assumed to be representative of other races including wild-origin winter-run juveniles, although this is uncertain and is being investigated further with Juvenile Salmon Acoustic Telemetry System (JSATS) tags that allow smaller fish to be tagged. The movement of juvenile Chinook salmon into Georgiana Slough reflects the combination of their river cross-sectional distribution and the splitting of water remaining in the Sacramento River and water entering Georgiana Slough as represented by the critical streakline (Hance et al. 2020). Modeling suggests south Delta exports have little influence on the proportion of Sacramento River flow entering Georgiana Slough (Cavallo et al. 2015).

Stressors thought to be of very high importance to winter-run Chinook salmon by NMFS (2014:27) include blockage of historical staging and spawning habitat by Shasta and Keswick Dams; flow fluctuations during spawning and incubation, water pollution, and water temperature impacts in the upper Sacramento River during embryo incubation; loss of juvenile rearing habitat in the form of lost natural river morphology and function, and lost riparian and instream cover; predation during juvenile rearing and outmigration; ocean harvest; and south Delta entrainment. A very recent potential threat identified for all runs of Chinook salmon is Thiamine Deficiency Complex, possibly

the result of the oceanic diet of anchovies as the main prey species of adults, which transferred negative effects to juveniles (National Oceanic and Atmospheric Administration Fisheries 2020a). Recent temperature modeling shows higher sensitivity to increases in water temperature because it leads to exponential increases in oxygen demand with a rise in temperature during the final weeks of egg-embryo maturation before the alevin stage (Martin et al. 2017; Anderson 2018). Individual-based modeling of winter-run Chinook salmon in the upper Sacramento River (Keswick Dam to RBDD) suggested superimposition (i.e., a female salmon making a redd on top of an existing redd) and predation of juveniles are the leading causes of mortality of eggs and juveniles (Dudley 2018). Turbidity reduces predation of migrating juveniles, and carrying capacity for larger juveniles is often reached (Dudley 2018). Water release scenarios that can cause turbid conditions could be used to assess increased turbidity and determine if that would increase juvenile survival (Dudley 2018). Further individual-based modeling suggested flow is not clearly linked to stranding risk on an annual basis but that there is evidence for increased stranding risk as flows decrease and there is a limited positive effect of flow on final outmigrant count; the proportion of eggs being superimposed increases with increasing flow (flow increases velocity, increasing spawner energy expenditure and thereby reducing the time spent guarding the redd, allowing other spawners to make redds on top of the existing redds); and temperature has the largest effect on final juvenile outmigrant count, with decreasing number of outmigrants with increasing temperature (Dudley 2019). Note that the studies by Dudley (2018, 2019) are based on modeling and field-based surveys of factors such as superimposition to validate the modeling results have apparently not been conducted. Martin et al. (2017) found that Chinook salmon embryo temperature tolerance increases with increasing water velocity (flow). Michel (2019) found a statistically significant positive correlation between Sacramento River flow and hatchery-origin winter-run Chinook salmon smolt to adult return ratio, which was higher than the correlation with indices of marine productivity. Increased hatchery production of winter-run Chinook salmon in response to drought conditions in 2014 through 2015 led to a greater proportion of hatchery-origin in-river spawners, above 80% in 2017 and 2018 and remaining at around 40% in 2019 and 2020 (U.S. Fish and Wildlife Service 2021a:7). This in part contributed to the elevated risk of extinction from low risk at the time of the 2010 5-year species status evaluation to moderate risk at the time of the most recent (2015) evaluation (National Marine Fisheries Service 2016a:34).

Climate experts predict physical changes to ocean, river, and stream environments along the West Coast that include warmer atmospheric temperatures, diminished snowpack resulting in altered streamflow volume and timing, lower late-summer flows, a continued rise in stream temperatures, and increased sea-surface temperatures and ocean acidity resulting in altered marine and freshwater food-chain dynamics (Williams et al. 2016). Climate change and associated changes in water temperature, hydrology, and ocean conditions are generally expected to have substantial effects on Chinook salmon populations in the future (National Marine Fisheries Service 2014; Lindley et al. 2009). Extreme heavy precipitation events and dry spells are projected to significantly increase throughout the state (California Governor's Office of Planning and Research et al. 2018:22, 26) and annual precipitation may broadly increase in the northern part of the state. This may aid in juvenile migration. Because the winter-run Chinook salmon rely on the coldwater pool in Shasta Reservoir to maintain spawning conditions in the mainstem Sacramento River, this run is particularly at risk from global warming. Drought years are predicted to occur with greater frequency in the Sacramento Valley with climate change (Purkey et al. 2008). The years of 2012 through 2016 had drought conditions (Lund et al. 2018), with the mean annual percentage of land experiencing some level of drought conditions ranging from 87.2% in 2012 to nearly 100% in 2014 and 2015; further widespread drought began in 2020 (~68% of land experiencing some level of

drought) and increased in extent so that in 2021 (99.9%) and 2022 (100%) all or nearly all of California was experiencing some level of drought.[1] High rainfall early in 2023 reduced the extent of California experiencing drought, with less than 4% of the state experiencing some level of drought by December 5, 2023. Increased water temperature associated with lower flows favors nonnative competitors and predators that are adapted to warm water because predation rates increase in response to elevated metabolic rates of predators (Petersen and Kitchell 2001). Increasing the frequency of dry years also reduces turbidity because sediment loads are not mobilized and transported downstream, although recent studies suggest climate change may increase the frequency of high-flow events, and therefore increase sediment transport downstream (Stern et al. 2020). Juvenile salmon are thought to use turbid water to avoid detection by predators (Gregory and Levings 1998). Increased prevalence of submerged aquatic vegetation in the Delta reduces water flow and therefore also reduces turbidity, which has the effect of creating cover for predators and making passing salmon easier for predators to detect (Hestir et al. 2016). Finally, climate change is projected to increase the variability of ocean conditions, such as the North Pacific Gyre Oscillation, the Pacific Decadal Oscillation, and El Niño Southern Oscillations (Di Lorenzo et al. 2010). Anomalies, such as the warm water blob in the North Pacific, disrupt upwelling processes, which drive plankton production in the California Current (Leising et al. 2015). Juvenile salmon distribution is associated with oceanic plankton distribution, and mismatches in space and time that reduce access to marine prey aggregations are thought to influence early marine survival of Central Valley salmon populations (Hassrick et al. 2016). Recent studies highlight the importance of forage availability, upwelling, and thermal fronts on juvenile Chinook salmon feeding in the ocean (Sabal et al. 2020).

Generalized life stage timing for winter-run Chinook salmon is summarized in Tables 4.4.1-1 and 4.4.1-2, with a quantitative summary for juveniles in Tables 4.4.1-2a and 4.4.1-2b. Appendix 12A, *Environmental Setting Background Information*, Attachment 12A.1, *Juvenile Salmonid Monitoring, Sampling, and Salvage Timing Summary from SacPAS*, of the *Delta Conveyance Project Final EIR* (Final EIR) provides additional summary information from the SacPAS database (California Department of Water Resources 2023).

**Table 4.4.1-1. Generalized Temporal Occurrence of Sacramento River Winter-Run Chinook Salmon Adults in the Sacramento River**

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| **Adults Freshwater** | | | | | | | | | | | | |
| Sacramento River basin | M | M | M | M | M | M | M | N | N | N | M | M |
| Upper Sacramento River spawning | N | N | N | N | L | H | H | M | N | N | N | N |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.
Source: National Marine Fisheries Service 2019:67.

[1] All statistics on percentage of California land area experiencing some level of drought cited in this section were based on data downloaded from US Drought Monitor, available https://www.drought.gov/states/california#historical-conditions, accessed December 12, 2023.

**Table 4.4.1-2. Generalized Temporal Occurrence of Sacramento River Winter-Run Chinook Salmon by Life Stage in the Delta**

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Life Stage | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Adult | M | H | H | H | M | M | N | N | N | N | M | M |
| Juvenile | L | M | H | M | N | N | N | N | N | L | L | M |
| Salvaged | M | H | H | L | L | L | N | N | N | N | N | L |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Note: Table reflects monitoring based on length-at-date classification of juvenile winter-run Chinook salmon. See Tables 4.4.1-2a and 4.4.1-2b for quantitative summary. The data in this category reflects juveniles entrained into the salvage facilities. See also annual summaries in California Department of Water Resources 2023: Appendix 12A, Attachment 12A.1, *Juvenile Salmonid Monitoring, Sampling, and Salvage Timing Summary from SacPAS*.

Source: National Marine Fisheries Service 2019:68.

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**Table 4.4.1-2a. Frequency of Occurrence (Percent) of Adipose Fin-Unclipped Winter-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 68.1% (586) | 57.8% (555) | 64.1% (641) | 39.9% (581) | 4.3% (607) | 0.6% (665) | 57.7% (742) | 95.1% (715) | 99.3% (670) | 99.4% (710) | 99.1% (692) | 93.5% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 22.8% (298) | 17.4% (270) | 8.5% (307) | 1.6% (313) | 0% (278) | 0% (111) | 0% (72) | 1.6% (62) | 7.8% (204) | 15.1% (325) | 19.3% (337) | 34.7% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 27.6% (413) | 24.1% (386) | 12.3% (423) | 2.8% (393) | 0% (349) | 0% (130) | Not Sampled | 11.8% (17) | 20.3% (148) | 22.4% (344) | 24.6% (345) | 36.9% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 9.2% (2,784) | 6.8% (2,149) | 1.8% (2,220) | 0.1% (2,060) | 0% (2,204) | 0% (2,107) | 0% (2,043) | 0% (2,090) | 0.2% (2,086) | 1.1% (3,316) | 3.8% (3,480) | 12.5% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 3.7% (3,402) | 6.4% (3,273) | 5% (3,524) | 2.5% (3,502) | 0% (2,908) | 0% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0.6% (2,664) | 2.6% (2,631) | 6.1% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 2.5% (4,225) | 5.9% (3,257) | 23.5% (3,445) | 12.6% (4,738) | 0.3% (6,348) | 0% (3,539) | 0% (2,441) | 0% (2,264) | 0% (2,290) | 0% (2,704) | 0% (2,612) | 1.3% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 29.8% (955) | 38.4% (874) | 56.7% (954) | 18.6% (930) | 1.1% (960) | 0% (930) | 0% (960) | 0% (940) | 0% (900) | 0% (929) | 0% (900) | 16% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one winter-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

**Table 4.4.1-2b. Frequency of Occurrence (Percent) of Adipose Fin-Clipped Winter-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 66.4% (586) | 60.5% (555) | 43.1% (641) | 12.4% (581) | 0.3% (607) | 0.2% (665) | 0% (742) | 0% (715) | 0% (670) | 0% (710) | 1.9% (692) | 37.6% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 5.7% (298) | 20.4% (270) | 8.8% (307) | 0% (313) | 0% (278) | 0% (111) | 0% (72) | 0% (62) | 0.5% (204) | 0% (325) | 0% (337) | 6.6% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 14.5% (413) | 21% (386) | 12.8% (423) | 0.8% (393) | 0% (349) | 0% (130) | Not Sampled | 0% (17) | 0% (148) | 0% (344) | 0% (345) | 3.5% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 0.4% (2,784) | 1% (2,149) | 0.5% (2,220) | 0% (2,060) | 0% (2,204) | 0% (2,107) | 0% (2,043) | 0% (2,090) | 0% (2,086) | 0% (3,316) | 0% (3,480) | 0.4% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 0.6% (3,402) | 2.8% (3,273) | 2.9% (3,524) | 0.7% (3,502) | 0% (2,908) | 0% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0% (2,631) | 0.5% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 1.5% (4,225) | 2.6% (3,257) | 8.6% (3,445) | 2% (4,738) | 0% (6,348) | 0% (3,539) | 0% (2,441) | 0% (2,264) | 0% (2,290) | 0% (2,704) | 0% (2,612) | 0.8% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 46.8% (955) | 42.2% (874) | 33.3% (954) | 8.7% (930) | 1% (960) | 0% (930) | 0% (960) | 0% (940) | 0% (900) | 0% (929) | 0% (900) | 15.2% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one winter-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

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## 4.4.2 Chinook Salmon, Central Valley Spring-Run ESU

### 4.4.2.1 Legal Status and Distribution

Spring-run Chinook salmon (*Oncorhynchus tshawytscha*), which were historically the most abundant run in the Central Valley (Yoshiyama et al. 1998). The Central Valley spring-run Chinook salmon has independent populations in Butte Creek, Mill Creek, and Deer Creek, with repopulation of a historically independent population in Battle Creek occurring; dependent populations occur in Antelope Creek, Big Chico Creek, Clear Creek, and Cottonwood/Beegum Creek (National Marine Fisheries Service 2016b; Goertler et al. 2020:2). There are also San Joaquin River spring-run Chinook salmon as a result of reintroduction efforts, and spring-running Chinook salmon in San Joaquin River tributaries. Spring-run Chinook salmon were extirpated from most rivers by mining or dam construction (Williams 2006). Due to the small number of these populations remaining and the significant hybridization with fall-run Chinook salmon that has occurred in the mainstem of the Sacramento (Moffett 1949) and Feather Rivers (Lindley et al. 2004), spring-run Chinook salmon were listed as threatened under the CESA in 1999. Native spring-run Chinook salmon have been extirpated from the San Joaquin River watershed, which represented a large portion of their historical range (see below for discussion regarding reintroduced spring-run Chinook salmon in the San Joaquin River). The (Central Valley) spring-run Chinook salmon ESU was listed as threatened under the ESA in 1999 because of the reduced range and small size of remaining spring-run Chinook salmon populations (64 FR 50393). On June 28, 2005, NMFS published the final hatchery listing policy (70 FR 37204) and reaffirmed the threatened status of the ESU (70 FR 37160). The ESU consists of naturally spawned spring-run Chinook salmon originating from the Sacramento River and its tributaries, and also from the Feather River Fish Hatchery (FRFH) Spring-Run Chinook Program (National Marine Fisheries Service 2016b).

### 4.4.2.2 Life History and Habitat Requirements

Life history and habitat requirements are largely the same as those described for winter-run Chinook salmon, with differences primarily in the duration and time of year that spring-run Chinook salmon adult and juveniles occupy freshwater habitat. Adult spring-run Chinook salmon enter fresh water as sexually immature fish between mid-February and July and remain in deep cold pools in proximity to spawning areas until late summer and early fall, when they are sexually mature and ready to spawn, depending on water temperatures (California Department of Fish and Game 1998; National Marine Fisheries Service 2009).

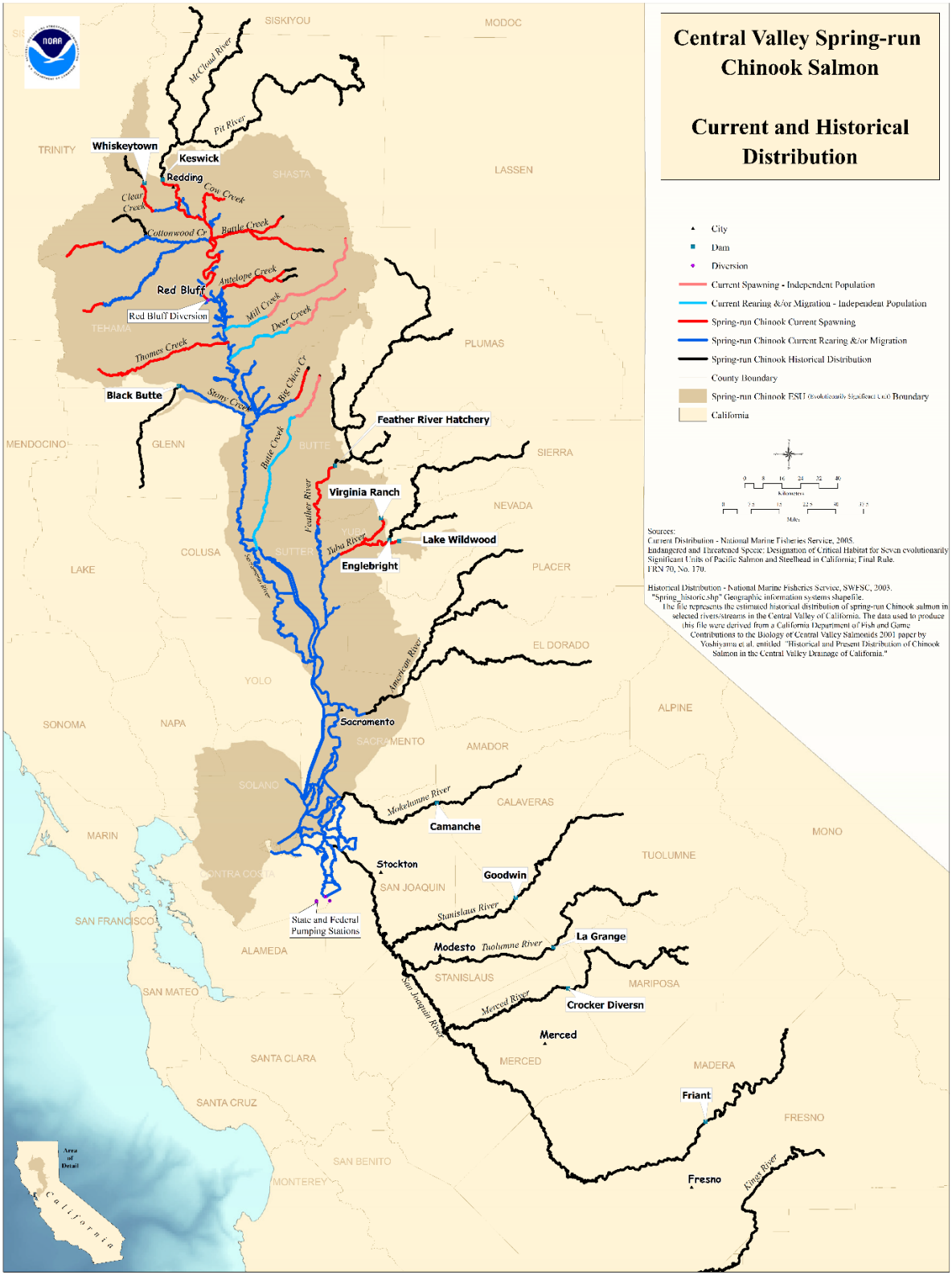
Spawning occurs in gravel substrate in relatively fast-moving, moderately shallow riffles or along banks with relatively high water, which promotes higher oxygen levels and reduced deposition of fines. Adult spawning conditions, incubation, and emergence from gravel is dependent on cold water temperatures (Myrick and Cech 2004). Fry emerge from gravels from November to March (Williams 2006). Post-emergent fry inhabit calm, shallow waters with fine substrates; fry depend on fallen trees, undercut banks, and overhanging riparian vegetation for refuge (Healey 1991).

Juvenile spring-run Chinook salmon can have highly variable outmigration timing based on various environmental factors (National Marine Fisheries Service 2009). Some juveniles begin outmigrating soon after emergence from gravel, whereas others oversummer and outmigrate as yearlings with the onset of intense fall storms (California Department of Fish and Game 1998). The outmigration period for spring-run Chinook salmon can extend from November to early May (National Marine

Fisheries Service 2009:94) or June (California Department of Fish and Game 1998:III-9), with residency in the Delta probably lessening as the season progresses into the late spring months (California Department of Fish and Game 1998:III-9). Peak movement of yearling spring-run Chinook salmon in the Sacramento River at Knights Landing occurs October through December (Goertler et al. 2020:3).

Juveniles prefer stream margin habitats with enough depth and velocities to provide suitable cover and foraging opportunities during rearing and downstream movement. Off-channel areas and floodplains can provide important rearing habitat. A greater availability of prey and favorable rearing conditions in floodplains increases juvenile growth rates compared with conditions in the mainstem Sacramento River, which can lead to improved survival rates during both their migration through the Delta and later in the marine environment (Sommer et al. 2001).

Spring-run Chinook salmon were historically the dominant run of salmon in the Central Valley; the Central Valley drainage is estimated to have supported annual runs of spring-run Chinook salmon as large as 600,000 fish between the late 1880s and 1940s (California Department of Fish and Game 1998). Following construction of major dams, annual runs were estimated to be no more than 26,000 fish in the 1950s and 1960s (Azat 2021; Yoshiyama et al. 1998). Dams on the Sacramento River blocked upstream passage of spring-run Chinook salmon to their historic spawning habitat and confined them to a much smaller area of the watershed (Figure 4.4.2-1). Nearly 50,000 adults were counted in the San Joaquin River (Fry 1961) before the construction of Friant Dam (completed in 1942). The San Joaquin River watershed populations were essentially extirpated by the 1940s, with only small remnants of the run persisting through the 1950s in the Merced River (Hallock and Van Woert 1959; Yoshiyama et al. 1998).




Source: National Marine Fisheries Service 2014:32.

**Figure 4.4.2-1. Current and Historical Central Valley Spring-Run Chinook Salmon Distribution**

Spring-run Chinook salmon populations historically occupied the headwaters of all major river systems in the Central Valley up to any natural barrier, such as an impassable waterfall (Yoshiyama et al. 1998). The Sacramento River was used by adults as a migratory corridor to spawning areas in upstream tributaries and headwater streams (California Department of Fish and Game 1998). The most complete historical record of spring-run Chinook salmon migration timing and spawning is contained in reports to the U.S. Fish Commissioners of Baird Hatchery operations on the McCloud River (California Department of Fish and Game 1998). Spring-run Chinook salmon migration in the upper Sacramento River and tributaries extended from mid-March through the end of July with a peak in late May and early June. Baird Hatchery intercepted returning adults and spawned them from mid-August through late September. Peak spawning occurred during the first half of September. The average time between the end of spring-run Chinook salmon spawning and the onset of fall-run Chinook salmon spawning at Baird Hatchery from 1888 through 1901 was 32 days.

The spring-run Chinook salmon ESU has displayed broad fluctuations in adult abundance. Estimates of spring-run Chinook salmon in the Sacramento River and its tributaries have ranged from 1,105 in 2017 to 25,890 in 1982. This estimate does not include in-river or hatchery spawners in the lower Yuba and Feather Rivers because CDFW's GrandTab does not distinguish between fall-run Chinook salmon and spring-run Chinook salmon in these rivers prior to 2005.[2]

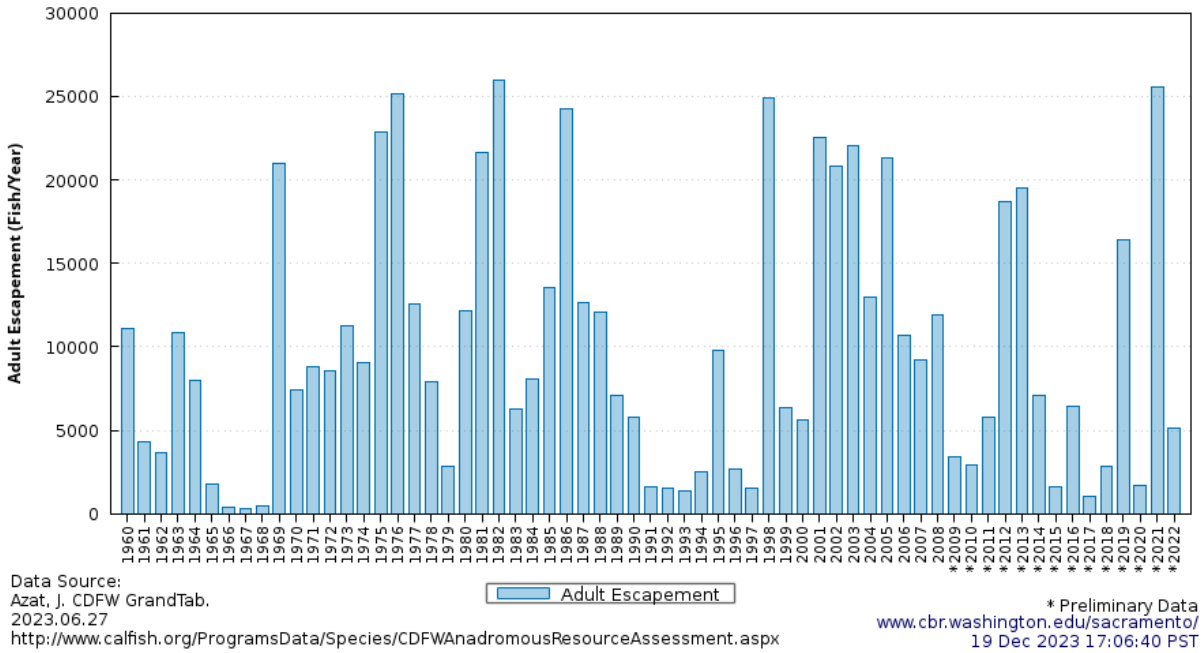
Since 1995, spring-run Chinook salmon annual run size estimates typically have been dominated by Butte Creek returns. Of the three tributaries producing naturally spawned spring-run Chinook salmon (Mill, Deer, and Butte Creeks), Butte Creek has produced an average of two-thirds of the total production over the past 10 years (Azat 2021). During recent years, spring-run Chinook salmon escapement estimates (excluding in-river spawners in the Yuba and Feather Rivers) have ranged from 23,810 in 2013 to 1,591 in 2017 throughout the tributaries to the Sacramento River surveyed.

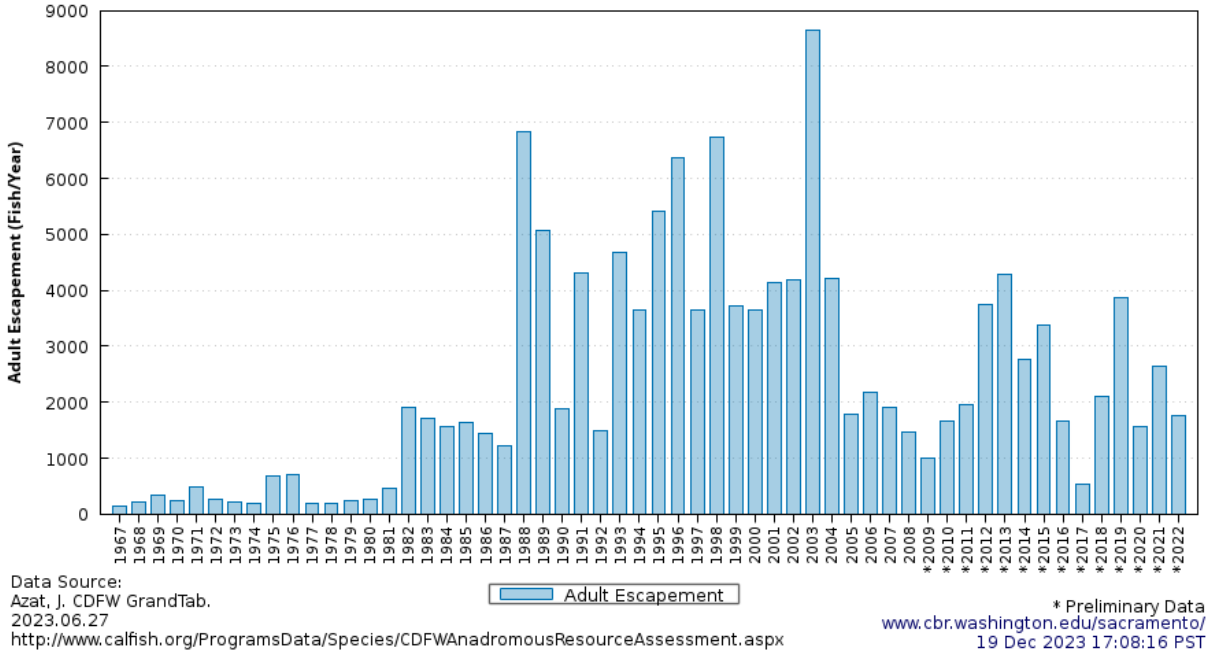
Recent spring-run Chinook salmon population estimates have fluctuated but generally remain low. In-river escapement was estimated to range between 1,059 and 16,189 fish during the years 2016 through 2020, with 1,688 estimated in 2020 (Figure 4.4.2-2). During these years, escapement to hatcheries ranged from 532 (2017) to 3,867 (2019) (Figure 4.4.2-2). Escapement estimates for 2022 were 5,132 for in-river spring-run Chinook salmon and 1,772 for hatchery spring-run Chinook salmon (Figure 2-9). In addition, fish monitoring is conducted throughout the year at the TFCF and the Skinner Fish Facility. Based on length-at-date criteria, during water year 2017, 26,551 wild (non-fin-clipped) juvenile spring-run and 963 hatchery (fin-clipped) spring-run Chinook salmon were observed at the TFCF and Skinner Fish Facility, and 9,487 wild juvenile spring-run and 1,010 hatchery spring-run were observed during water year 2018. Note, however, that length-at-date criteria for spring-run Chinook salmon are particularly prone to error because of the high overlap in lengths with the more abundant fall-run Chinook salmon, suggesting that actual spring-run entrainment is considerably lower than length-at-date criteria (Harvey et al. 2014). Recent data at the south Delta salvage facilities illustrate the extent of the errors: only two of 620 juvenile Chinook salmon examined in 2019, three of 750 juvenile Chinook salmon examined in 2020, and one of 99 juvenile Chinook salmon examined in 2021 that were classified as spring-run based on length-at-date criteria were confirmed to be genetic spring-run (the remainder were nearly all genetic fall-

[2] The Feather River Hatchery implemented a methodology change in 2005 for distinguishing spring-run from fall-run. Fish arriving prior to the spring-run spawning period were tagged and returned to the river. The spring-run escapement was the number of these tagged fish that subsequently returned to the hatchery during the spring-run spawning period.

run). No spring-run Chinook salmon have been collected in Contra Costa Water District's Fish Monitoring Program at the Rock Slough Intake since 2008. The most recent (2020) 5-year viability assessment by NMFS concluded that there was high extinction risk for spring-run Chinook salmon populations from Mill Creek, Deer Creek, Battle Creek, Clear Creek, and the Feather River Hatchery (Johnson et al. 2023:172). These populations were all assessed to have had moderate risk of extinction at the time of the previous viability assessment in 2015 and high risk of extinction at the time of the prior (2010) assessment, except the Feather River Hatchery population, which was assessed to have high risk of extinction in 2010, 2015, and 2020. The Butte Creek population was concluded to have low risk of extinction in the 2010, 2015, and 2020 assessments (Johnson et al. 2023:172).

Spring-run Chinook salmon are being reintroduced to the San Joaquin River as part of restoration efforts. These fish originate from Feather River broodstock (San Joaquin River Restoration Program 2018:2-3). In 2013, NMFS designated the Central Valley spring-run Chinook salmon reintroduced to the San Joaquin River as an experimental nonessential population in accordance with Section 10(j) of the ESA (78 FR 79622). This allows for the release of threatened California Central Valley spring-run Chinook salmon outside their current range. The population is considered an experimental, nonessential population (meaning that if the population does not survive, it will not threaten the whole ESU), because the population is geographically separate from the protected population of the same species (National Oceanic and Atmospheric Administration Fisheries 2020b). NMFS accounts for south Delta salvage of these reintroduced juveniles (adipose clipped and coded wire tagged) so that the reintroduction does not impose more than *de minimis* effects on water users (e.g., Strange 2020), although any naturally produced juveniles are not part of this accounting. Monitoring occurs for juvenile spring-run Chinook salmon released into the San Joaquin River because all fish are marked with adipose clips and coded wire tags (National Marine Fisheries Service 2022:4), allowing detection in monitoring programs such as the south Delta export salvage facilities. Adults are monitored using techniques such as video monitoring, traps, carcass surveys, and redd surveys (National Marine Fisheries Service 2022:7). Phenotypically spring-running Chinook salmon have been observed in the Tuolumne and Stanislaus Rivers of the San Joaquin River Basin in the last decade and may represent strays from the Feather River Hatchery (fall- or spring-run) or spring-run Chinook salmon produced in the Sacramento River Basin (National Marine Fisheries Service 2019:7).




Source: Columbia Basin Research, University of Washington 2023.

Note: Vertical axis scale differs between upper and lower panel.

**Figure 4.4.2-2. Spring-Run Chinook Salmon Adult In-River (Upper) and Hatchery (Lower) Annual Escapement in the Central Valley, 1970–2022**

Accessible habitat for spring-run Chinook salmon has been negatively affected by inadequate flows and increased water temperatures due to dam and water diversion operations on streams throughout the Sacramento River Basin (Section 4.4.1, *Chinook Salmon, Sacramento River Winter-Run ESU*). Among the most important stressors are agricultural diversions, diversion dams, and/or weirs on Deer, Mill, Antelope, and Butte Creeks impeding or blocking access to upstream spawning habitat, as well as entrainment in Antelope Creek resulting from terminal diversions and loss of channel connectivity (National Marine Fisheries Service 2014:44–45). In Deer, Mill, and Antelope Creeks, losses of suitable spawning gravel, the development of deep channels and levees, pollutants and siltation from urban development, mining, and water diversions are also stressors on spring-run Chinook salmon Central Valley ESU (National Marine Fisheries Service 2014).

The degradation and simplification of aquatic habitat in the Central Valley have reduced the resiliency of spring-run Chinook salmon to respond to additional stressors such as an extended drought, ocean harvest, and poor ocean conditions. Levee construction and maintenance projects have simplified riverine habitat and have disconnected rivers from the floodplain (National Marine Fisheries Service 2016b). Spring-run Chinook salmon migration survival and routing has been statistically correlated with flow, particularly at junctions where fish can route into the interior Delta and become entrained by the export facilities in the south Delta, as shown for acoustically tagged late fall–run Chinook salmon juveniles (e.g., Perry et al. 2018). Within the Delta, warming and stable hydrology has favored the expansion of introduced predators, which function as a source of mortality to juvenile salmonids when they are entrained toward the export facilities (Larry Walker Associates 2010).

Increased exports can influence the direction and velocity of flow in the south Delta, with high exports causing stronger reversal in flows nearer the export facilities (Grimaldo et al. 2009). When Sacramento River Basin-origin fish route into the interior Delta via Georgiana Slough or the Delta Cross Channel (DCC) and enter the south Delta, entrainment from reverse flows in Old and Middle River may result in longer travel time and indirect mortality (i.e., predation) and direct mortality through loss at the export facilities, as suggested by studies of movement pathways of radio-tagged juveniles (see summary by Vogel 2011:103–105).

Flow in the south Delta tends to be more complex than in the north Delta because of the influence of radial gate operations at the head of Clifton Court Forebay and the influence of exports on Old and Middle River (OMR) dynamics, as described above. This is further complicated by the presence of temporary barriers[3], lower inflow from the San Joaquin River, and greater tidal excursion. Highly channelized levee characteristics maintained for water conveyance diminish the potential for the Delta to function as rearing habitat for juvenile salmonids.

As discussed for winter-run Chinook salmon, juveniles have access to floodplain habitat in the Yolo Bypass only during mid- to high water years, and the quantity of floodplain available for rearing during drought years is currently limited, but notching of Fremont Weir due to the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan will provide access to floodplain habitat for juvenile salmon over a longer period (California Department of Water Resources and Bureau of Reclamation 2012:3). Juvenile spring-run Chinook salmon may also rear in the Sutter Bypass floodplain, with Butte Creek populations able to access the Sutter Bypass because of its connection to lower Butte Creek, whereas other populations and other races of Chinook

[3] The South Delta Temporary Barriers Project located at the CVP's Jones Pumping Plant and SWP's Banks Pumping Plant in the south Delta.

salmon are only able to access the floodplain during large Sacramento River flooding events (Cordoleani et al. 2020).

Recent work by the Collaborative Adaptive Management Team's (CAMT) Salmonid Scoping Team (SST) suggests that high correlations between inflows and exports make it difficult to evaluate their effects on salmon survival independently using statistical methods (SST 2017). There are very few observations of salmonid survival at high export rates, which makes it difficult to determine whether there is a relationship, but most acoustic tagging studies show support for a positive relationship between flow and survival (Perry et al. 2010, 2018; Michel et al. 2012; Buchanan and Skalski 2019; Buchanan et al. 2021). A key conclusion of the SST (2017:ES-5–ES-7) is that water export operations contribute to salmonid mortality in the Delta via direct mortality at the facilities, but direct mortality does not account for all of the mortality experienced in the Delta; the mechanism and magnitude of indirect effects of water project operations on Delta mortality outside the facilities is uncertain (SST 2017).

Temporary barriers are installed by DWR in the south Delta for the purpose of stabilizing and increasing water surface elevations to facilitate agriculture irrigation. A temporary barrier at the Head of Old River has previously been installed to reduce movement of migrating salmonids into Old River, which would include the experimentally reintroduced spring-run Chinook salmon as part of the San Joaquin River Restoration Program. Recent investigations of other juvenile salmonids have provided some support that the barrier may positively affect survival (steelhead; Buchanan et al. 2021), whereas another study did not find a statistically significant relationship between survival from the Head of Old River to Chipps Island and barrier presence (fall-run Chinook salmon; Buchanan and Skalski 2019).

Results of Chinook salmon survival and migration studies in the Sacramento and San Joaquin Rivers and Delta suggest that relationships between river flow and migration rates are more complicated than in the Pacific Northwest, where flow is more unidirectional (Zabel et al. 1998; Smith et al. 2002). Higher survival of acoustically tagged wild-origin spring-run Chinook salmon smolts from Mill Creek through the Sacramento River was observed in a wet year (2017) compared to historic drought conditions in 2015 (Notch et al. 2020). Cordoleani et al. (2018, 2019) found higher survival for wild-origin smolts from Butte Creek to the Golden Gate Bridge (spring-run and fall-run) in 2016 than 2015 correlated with greater flow in 2016 than 2015, and they found higher survival in 2017 than the prior two years correlated with greater flow in 2017 than those years. In the 2019 study, Chinook salmon smolts were tracked from the Sutter Bypass to the Golden Gate Bridge. Cordoleani et al. (2019:1) summarized their results to note that release date and Delta flow were significantly correlated with survival rates and that the results were largely driven by 2017 data, for which fish were released a month later than those in 2015 and 2016, and Delta flow and smolt survival were significantly higher than in the previous two years. They also noted that more tagging years including measurements of more potentially important environmental factors (such as turbidity) are required to robustly identify the influence of various factors on Butte Creek spring-run Chinook outmigrant smolt survival (Cordoleani et al. 2019:1).

As previously described in the winter-run Chinook salmon assessment above, routing down Georgiana Slough has also been shown to increase when unidirectional flow gives way to tidal influences and flow becomes more bidirectional, particularly below 20,000 cfs at Freeport (Perry et al. 2018). There is a positive correlation between through-Delta survival of large acoustically tagged late fall–run Chinook salmon and Sacramento River flow entering the Delta (Perry et al. 2018).

Historically, wherever spring-run Chinook salmon and fall-run Chinook salmon populations overlapped, they were naturally temporally segregated and genetic integrity was maintained. However, because of difficulties associated with holding adults over the summer in the Feather River, fish were left in the river until spawning, which presumably led to mixing with fall-run Chinook salmon in the hatchery (Williams 2006:33). Loss of life history diversity limits a species' ability to deal with environmental change, such as timing of ocean productivity, and leads to increased vulnerability through a weakened portfolio effect (Carlson and Satterthwaite 2011). Climate change may pose similar threats to spring-run Chinook salmon as were described for winter-run Chinook salmon, with increasingly high water temperatures and changes to ocean conditions being limiting factors. Like winter-run Chinook salmon, spring-run Chinook salmon are particularly vulnerable to these limiting factors because their life history is adapted to streams with snowmelt runoff, with relatively dependable, sustained high flows that allow fish to ascend to high enough elevations where water temperatures remain tolerably cool through the summer. Snowmelt runoff is relatively more important in the San Joaquin River and its major tributaries, where historically spring-run Chinook salmon were more abundant. Recoveries of coded wire tags and genetic samples suggest that spring-run Chinook salmon have a more northerly ocean distribution and mature later than winter-run Chinook salmon (Satterthwaite et al. 2018). Therefore, climate-induced changes in ocean prey distributions that limit access to coastal prey may disproportionately affect spring-run Chinook salmon that rely on marine resources to a greater degree in order to mature.

Generalized life stage timing for spring-run Chinook salmon is summarized in Tables 4.4.2-1 and 4.4.2-2, with a quantitative summary for juveniles in Tables 4.4.2-2a and 4.4.2-2b. Appendix 12A, Attachment 12A.1 of the Final EIR provides additional summary information from the SacPAS database (California Department of Water Resources 2023).

**Table 4.4.2-1. Generalized Temporal Occurrence of Central Valley Spring-Run Chinook Adults in the Sacramento River**

| | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | | Dec | |
| **Migration** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sac. River Basin | N | N | N | N | M | M | M | M | H | H | H | H | M | M | M | M | M | M | L | N | N | N | N | N |
| Sac. River Mainstem | N | L | L | L | M | M | M | M | M | M | M | M | M | M | L | L | N | N | N | N | N | N | N | N |
| Adult Holding | N | N | L | L | M | M | H | H | H | H | H | H | H | H | H | M | M | L | L | N | N | N | N | N |
| Adult Spawning | N | N | N | N | N | N | N | N | N | N | N | N | N | N | L | M | H | H | M | L | N | N | N | N |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Sources: National Marine Fisheries Service 2019:83.

Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after their hatch.

**Table 4.4.2-2. Generalized Temporal Occurrence of Central Valley Spring-Run Chinook Salmon by Life Stage in the Delta**

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Life Stage | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Adult | M | H | H | H | M | M | N | N | N | N | N | N |
| Juvenile | L | L | L | H | M | N | N | N | N | N | N | L |
| Salvaged | L | L | M | H | M | N | N | N | N | N | N | N |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Note: Table reflects monitoring based on length-at-date classification of juvenile spring-run Chinook Salmon. See Tables 4.4.2-4a and 4.4.2-4b for quantitative summary. The data in this category reflects juveniles entrained into the salvage facilities. See also annual summaries in California Department of Water Resources 2023: Appendix 12A, Attachment 12A.1, *Juvenile Salmonid Monitoring, Sampling, and Salvage Timing Summary from SacPAS*.

Source: National Marine Fisheries Service 2019:84.

**Table 4.4.2-2a. Frequency of Occurrence (Percent) of Adipose Fin-Unclipped Spring-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 57% (586) | 53.2% (555) | 78.2% (641) | 97.2% (581) | 74.1% (607) | 10.1% (665) | 1.6% (742) | 0.3% (715) | 0% (670) | 41.1% (710) | 79.2% (692) | 91.2% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 29.9% (298) | 30.7% (270) | 38.1% (307) | 59.4% (313) | 10.4% (278) | 0% (111) | 0% (72) | 0% (62) | 0.5% (204) | 1.2% (325) | 7.4% (337) | 30.9% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 30% (413) | 30.6% (386) | 45.4% (423) | 66.4% (393) | 11.5% (349) | 0% (130) | Not Sampled | 0% (17) | 0% (148) | 3.8% (344) | 6.7% (345) | 26.2% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 19.5% (2,784) | 23.6% (2,149) | 16.9% (2,220) | 9% (2,060) | 0.9% (2,204) | 0% (2,107) | 0% (2,043) | 0% (2,090) | 0% (2,086) | 0% (3,316) | 0.9% (3,480) | 13.9% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 4.7% (3,402) | 9.7% (3,273) | 17.2% (3,524) | 44.9% (3,502) | 9.7% (2,908) | 0% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0.1% (2,631) | 4.6% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 0% (4,225) | 0.2% (3,257) | 13.6% (3,445) | 77.5% (4,738) | 27.3% (6,348) | 0.6% (3,539) | 0% (2,441) | 0% (2,264) | 0.1% (2,290) | 0% (2,704) | 0% (2,612) | 0% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 1.4% (955) | 5.1% (874) | 48.3% (954) | 89.8% (930) | 69.3% (960) | 17.2% (930) | 0.3% (960) | 0% (940) | 0.1% (900) | 0% (929) | 0% (900) | 0% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

**Table 4.4.2-2b. Frequency of Occurrence (Percent) of Adipose Fin-Clipped Spring-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 1.2% (586) | 15.5% (555) | 26.1% (641) | 45.8% (581) | 18.8% (607) | 0.5% (665) | 0% (742) | 0.1% (715) | 0% (670) | 0% (710) | 0% (692) | 0% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 0% (298) | 4.4% (270) | 10.4% (307) | 29.7% (313) | 2.2% (278) | 0% (111) | 0% (72) | 0% (62) | 0% (204) | 0% (325) | 0% (337) | 0.6% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 0% (413) | 2.8% (386) | 5.2% (423) | 23.7% (393) | 1.7% (349) | 0% (130) | Not Sampled | 0% (17) | 0% (148) | 0% (344) | 0% (345) | 0% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 0% (2,784) | 1% (2,149) | 2.1% (2,220) | 2.5% (2,060) | 0.6% (2,204) | 0% (2,107) | 0% (2,043) | 0% (2,090) | 0% (2,086) | 0% (3,316) | 0% (3,480) | 0% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 0% (3,402) | 1.1% (3,273) | 4.9% (3,524) | 16.9% (3,502) | 7.9% (2,908) | 0% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0% (2,631) | 0% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 0% (4,225) | 0.1% (3,257) | 2.1% (3,445) | 21.4% (4,738) | 15% (6,348) | 1.6% (3,539) | 0% (2,441) | 0% (2,264) | 0% (2,290) | 0% (2,704) | 0% (2,612) | 0% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 0% (955) | 2.1% (874) | 16.7% (954) | 35.4% (930) | 32.8% (960) | 5.5% (930) | 0% (960) | 0% (940) | 0% (900) | 0% (929) | 0% (900) | 0% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

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#### 4.4.2.3 Critical Habitat

Critical habitat for the Central Valley spring-run Chinook salmon was designated on September 2, 2005, and includes the mainstem Sacramento River from Chipps Island (RM 0) to Keswick Dam, and tributary reaches, including the Feather and Yuba Rivers; Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear Creeks; and portions of the northern Delta (70 FR 52488).

Critical habitat consists of essential physical and biological features (PBFs) considered essential for the conservation of a species. PBFs outlined in the designation of critical habitat (70 FR 52488) include the following features.

- Unimpeded access for adults from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River.
- The availability of clean gravel for spawning substrate.
- Adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles.
- Water temperatures between 42.5°F and 57.5°F for successful spawning, egg incubation, and fry development.
- Habitat and prey free of contaminants.
- Riparian habitat that provides for successful juvenile development and survival.
- Unimpeded passage of juveniles downstream from the spawning grounds to San Francisco Bay and the Pacific Ocean.

### 4.4.3 Chinook Salmon, Central Valley Fall-Run and Late Fall–Run ESU

#### 4.4.3.1 Legal Status and Distribution

The fall-run and late fall–run Chinook salmon includes all spawning populations of fall-run and late fall–run Chinook salmon in the Sacramento and San Joaquin River basins and their tributaries east of Carquinez Strait (64 FR 50394). After reviewing the best available scientific and commercial information, on September 16, 1999, NMFS determined that listing Central Valley fall-run and late fall–run Chinook salmon was not warranted. On April 15, 2004, the Central Valley fall-run and late fall–run Chinook salmon ESU was identified by NMFS as a Species of Concern (69 FR 19975). The fall-run and late fall–run runs are included here because they are addressed in the Essential Fish Habitat) assessment (Appendix 5A, *Essential Fish Habitat Assessment*).

Freshwater essential fish habitat for Pacific salmon in the Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem, as described in Myers et al. (1998). Essential fish habitat includes not only the watersheds of the Sacramento and San Joaquin River basins but also the Delta, Suisun Bay, and the lower Sacramento River.

#### 4.4.3.2 Life History and Habitat Requirements

Adult fall-run Chinook salmon migrate through the Delta and into Central Valley rivers from June through December. Adult late fall–run Chinook salmon migrate through the Delta and into the Sacramento River from October through April. Adult Central Valley fall-run and late fall–run

Chinook salmon migrating into the Sacramento River and its tributaries primarily use the western and northern portions of the Delta, whereas adults entering the San Joaquin River system to spawn use the western, central, and southern Delta as a migration pathway.

Most fall-run Chinook salmon fry rear in fresh water from December through June, with outmigration as smolts occurring primarily from January through June. In general, fall-run Chinook salmon fry abundance in the Delta increases following high winter flows. Smolts that arrive in the estuary after rearing upstream migrate quickly through the Delta and Suisun and San Pablo Bays. A small number of juvenile fall-run Chinook salmon spend over a year in fresh water and outmigrate as yearling smolts the following November through April. Late fall–run fry rear in fresh water from April through the following April and outmigrate as smolts from October through February (Snider and Titus 2000). Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay (MacFarlane and Norton 2002).

Generalized life stage timing for Central Valley fall-run and late fall–run Chinook salmon is summarized in Tables 4.4.3-1 and 4.4.3-2 (with a quantitative summary for juveniles in Tables 4.4.3-1a, 4.4.3-1b, 4.4.3-2a, and 4.4.3-2b).

**Table 4.4.3-1. Generalized Temporal Occurrence of Adult and Juvenile Fall-Run Chinook Salmon at Locations in Central Valley**

| | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | | Dec | |
| **Adult** | | | | | | | | | | | | | | | | | | | | | | | | |
| Delta [a] | N | N | N | N | N | N | N | N | N | N | M | M | H | H | H | H | H | H | H | H | H | H | M | M |
| Sacramento River Basin [b] | N | N | N | N | N | N | N | N | N | N | N | N | L | L | L | L | M | M | H | H | H | H | H | H |
| San Joaquin River [b] | N | N | N | N | N | N | N | N | N | N | N | N | N | N | L | L | M | M | H | H | H | H | M | M |
| **Juvenile** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sacramento River at Red Bluff [c] | H | H | H | H | H | H | H | H | M | M | M | M | M | M | L | L | L | L | L | L | L | L | M | M |
| Delta (beach seine) [d] | H | H | H | H | H | H | H | H | M | M | M | M | L | L | L | L | L | L | N | N | L | L | M | M |
| Mossdale (trawl) [d] | M | M | H | H | H | H | H | H | H | H | M | M | N | N | N | N | N | N | N | N | N | N | N | N |
| West Sacramento River (trawl) [d] | M | M | H | H | H | H | H | H | H | H | L | L | L | L | L | L | L | L | N | N | L | L | L | L |
| Chipps Island (trawl) [d] | M | M | M | M | M | M | H | H | H | H | H | H | L | L | L | L | L | L | L | L | L | L | L | L |
| Knights Landing (trap) [e] | H | H | H | H | H | H | H | H | H | H | L | L | L | L | L | L | L | L | L | L | L | L | M | M |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Sources:

[a] State Water Project and Central Valley Project fish salvage data 1981–1988.

[b] Yoshiyama et al. 1998; Moyle 2002; Vogel and Marine 1991.

[c] Martin et al. 2001.

[d] U.S. Fish and Wildlife Service 2001.

[e] Snider and Titus 2000.

Note: Table reflects monitoring based on length-at-date classification of juvenile winter-run Chinook Salmon. See Tables 4.4.3-1a and 4.4.3-1b for quantitative summary. The data in this category reflects juveniles entrained into the salvage facilities. See also annual summaries in California Department of Water Resources 2023: Appendix 12A, Attachment 12A.1, *Juvenile Salmonid Monitoring, Sampling, and Salvage Timing Summary from SacPAS*.

**Table 4.4.3-1a. Frequency of Occurrence (Percent) of Adipose Fin-Unclipped Fall-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 99.8% (586) | 99.8% (555) | 99.4% (641) | 99.5% (581) | 100% (607) | 100% (665) | 98.9% (742) | 92.7% (715) | 64.2% (670) | 35.1% (710) | 17.8% (692) | 99.3% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 67.8% (298) | 75.6% (270) | 55.4% (307) | 65.5% (313) | 46.8% (278) | 13.5% (111) | 2.8% (72) | 3.2% (62) | 0% (204) | 0% (325) | 0.9% (337) | 33.4% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 58.1% (413) | 64.8% (386) | 58.4% (423) | 56% (393) | 40.7% (349) | 23.1% (130) | Not Sampled | 0% (17) | 0.7% (148) | 0% (344) | 0% (345) | 30.7% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 45.8% (2,784) | 59.7% (2,149) | 54.5% (2,220) | 36.8% (2,060) | 19.1% (2,204) | 4.4% (2,107) | 0.2% (2,043) | 0% (2,090) | 0% (2,086) | 0.1% (3,316) | 0% (3,480) | 18.8% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 32.3% (3,402) | 48.6% (3,273) | 39.6% (3,524) | 54% (3,502) | 58.3% (2,908) | 16% (2,316) | 4.1% (2,700) | 0.9% (2,637) | 0.2% (2,591) | 0% (2,664) | 0% (2,631) | 8.3% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 0% (4,225) | 1% (3,257) | 3.4% (3,445) | 60.2% (4,738) | 89.9% (6,348) | 52.9% (3,539) | 8.7% (2,441) | 1.9% (2,264) | 0.9% (2,290) | 0.7% (2,704) | 0.3% (2,612) | 0.1% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 20% (955) | 39.2% (874) | 39.6% (954) | 65.1% (930) | 83.6% (960) | 54.2% (930) | 11.1% (960) | 2.4% (940) | 2.8% (900) | 3.1% (929) | 3.8% (900) | 4.1% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

**Table 4.4.3-1b. Frequency of Occurrence (Percent) of Adipose Fin-Clipped Fall-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 2% (586) | 1.6% (555) | 20.7% (641) | 59.6% (581) | 70.5% (607) | 17.7% (665) | 2.8% (742) | 0.1% (715) | 0.3% (670) | 0.4% (710) | 7.2% (692) | 15.5% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 0% (298) | 0% (270) | 6.5% (307) | 32.6% (313) | 15.8% (278) | 0% (111) | 1.4% (72) | 0% (62) | 0% (204) | 0% (325) | 0% (337) | 0.3% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 0.2% (413) | 0.8% (386) | 6.4% (423) | 40.2% (393) | 20.6% (349) | 0% (130) | Not Sampled | 0% (17) | 0% (148) | 0% (344) | 0% (345) | 3% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 0% (2,784) | 3.2% (2,149) | 5.5% (2,220) | 5.2% (2,060) | 4.3% (2,204) | 0.9% (2,107) | 0% (2,043) | 0% (2,090) | 0% (2,086) | 0.1% (3,316) | 0% (3,480) | 0.1% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 0% (3,402) | 2.2% (3,273) | 2.1% (3,524) | 27.5% (3,502) | 22.1% (2,908) | 1.9% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0% (2,631) | 0% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 0.1% (4,225) | 0.2% (3,257) | 2.9% (3,445) | 43.8% (4,738) | 48% (6,348) | 8.6% (3,539) | 0.2% (2,441) | 0% (2,264) | 0% (2,290) | 3.5% (2,704) | 0.8% (2,612) | 0.3% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 3% (955) | 0% (874) | 2.2% (954) | 14.3% (930) | 39% (960) | 16.8% (930) | 0% (960) | 0% (940) | 1% (900) | 2.2% (929) | 4.2% (900) | 10.8% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

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Table 4.4.3-2, with a quantitative summary for juveniles in Tables 4.4.3-2a and 4.4.3-2b, shows the timing of the upstream presence of adult and juvenile life stages late fall–run Chinook salmon in the Sacramento River. The months included in this figure represent the periods during which the majority (more than approximately 90%) of fish in a life stage are present. The life history characteristics of late fall–run Chinook salmon are not well understood. Late fall–run Chinook salmon spawn in the Sacramento River, and eggs and alevins are in the gravel primarily from December to June, with a peak during January through March. Most adults (83.4%) spawn upstream of RBDD, and roughly two-thirds (67.6%) spawn just below Keswick Dam in the reach to the Anderson-Cottonwood Irrigation District diversion dam (Table 4.4.3-2).

**Table 4.4.3-2 Generalized Temporal Occurrence of Adult and Juvenile Late Fall–Run Chinook Salmon at Locations in the Central Valley**

| | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | | Dec | |
| **Adult** | | | | | | | | | | | | | | | | | | | | | | | | |
| Delta [a] | H | H | H | H | H | H | M | M | M | M | N | N | N | N | N | N | N | N | M | M | M | M | M | M |
| Sacramento River Basin [b] | H | H | H | H | H | H | M | M | N | N | N | N | N | N | N | N | N | N | M | M | M | M | M | M |
| **Juvenile** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sacramento River at Red Bluff [c] | H | H | H | H | H | H | H | H | M | M | L | L | L | L | H | H | H | H | H | H | H | H | M | M |
| West Sacramento River (trawl) [d] | M | M | M | M | N | N | L | L | N | N | L | L | L | L | L | L | L | L | M | M | H | H | H | H |
| Delta (beach seine) [d] | H | H | M | M | N | N | H | H | H | H | M | M | L | L | N | N | N | N | N | N | L | L | H | H |
| Chipps Island (trawl) [d] | M | M | M | M | N | N | N | N | L | L | L | L | L | L | L | L | L | L | L | L | M | M | H | H |
| Knights Landing (trap) [e] | M | M | M | M | N | N | M | M | M | M | L | L | N | N | N | N | N | N | L | L | M | M | H | H |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Sources:

[a] Moyle 2002.

[b] Yoshiyama et al. 1998; Moyle 2002; Vogel and Marine 1991.

[c] Martin et al. 2001.

[d] U.S. Fish and Wildlife Service 2001.

[e] Snider and Titus 2000.

Note: Table reflects monitoring based on length-at-date classification of juvenile winter-run Chinook Salmon. See Tables 4.4.3-2a and 4.4.3-2b for quantitative summary. The data in this category reflects juveniles entrained into the salvage facilities. See also annual summaries in California Department of Water Resources 2023: Appendix 12A, Attachment 12A.1, *Juvenile Salmonid Monitoring, Sampling, and Salvage Timing Summary from SacPAS*.

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**Table 4.4.3-2a. Frequency of Occurrence (Percent) of Adipose Fin-Unclipped Late Fall-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 99.8% (586) | 99.8% (555) | 99.4% (641) | 99.5% (581) | 100% (607) | 100% (665) | 98.9% (742) | 92.7% (715) | 64.2% (670) | 35.1% (710) | 17.8% (692) | 99.3% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 67.8% (298) | 75.6% (270) | 55.4% (307) | 65.5% (313) | 46.8% (278) | 13.5% (111) | 2.8% (72) | 3.2% (62) | 0% (204) | 0% (325) | 0.9% (337) | 33.4% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 58.1% (413) | 64.8% (386) | 58.4% (423) | 56% (393) | 40.7% (349) | 23.1% (130) | Not Sampled | 0% (17) | 0.7% (148) | 0% (344) | 0% (345) | 30.7% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 45.8% (2,784) | 59.7% (2,149) | 54.5% (2,220) | 36.8% (2,060) | 19.1% (2,204) | 4.4% (2,107) | 0.2% (2,043) | 0% (2,090) | 0% (2,086) | 0.1% (3,316) | 0% (3,480) | 18.8% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 32.3% (3,402) | 48.6% (3,273) | 39.6% (3,524) | 54% (3,502) | 58.3% (2,908) | 16% (2,316) | 4.1% (2,700) | 0.9% (2,637) | 0.2% (2,591) | 0% (2,664) | 0% (2,631) | 8.3% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 0% (4,225) | 1% (3,257) | 3.4% (3,445) | 60.2% (4,738) | 89.9% (6,348) | 52.9% (3,539) | 8.7% (2,441) | 1.9% (2,264) | 0.9% (2,290) | 0.7% (2,704) | 0.3% (2,612) | 0.1% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 20% (955) | 39.2% (874) | 39.6% (954) | 65.1% (930) | 83.6% (960) | 54.2% (930) | 11.1% (960) | 2.4% (940) | 2.8% (900) | 3.1% (929) | 3.8% (900) | 4.1% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

**Table 4.4.3-2b. Frequency of Occurrence (Percent) of Adipose Fin-Clipped Late Fall-Run Chinook Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 53.2% (586) | 7.7% (555) | 0.5% (641) | 0.3% (581) | 0.3% (607) | 1.1% (665) | 0% (742) | 0% (715) | 0.1% (670) | 0.3% (710) | 20.4% (692) | 56.6% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 11.7% (298) | 3% (270) | 0% (307) | 0% (313) | 0% (278) | 0% (111) | 0% (72) | 0% (62) | 0.5% (204) | 0% (325) | 0.9% (337) | 24.1% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 20.8% (413) | 2.8% (386) | 0% (423) | 0.5% (393) | 0% (349) | 0% (130) | Not Sampled | 0% (17) | 0% (148) | 0.3% (344) | 0.9% (345) | 20.4% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 4.2% (2,784) | 1.8% (2,149) | 0.5% (2,220) | 0% (2,060) | 0% (2,204) | 0% (2,107) | 0% (2,043) | 0% (2,090) | 0% (2,086) | 0% (3,316) | 0.3% (3,480) | 2.9% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 7.3% (3,402) | 1.9% (3,273) | 0.1% (3,524) | 0.1% (3,502) | 0% (2,908) | 0% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0.1% (2,631) | 6.7% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 23.6% (4,225) | 9.3% (3,257) | 2.7% (3,445) | 0.3% (4,738) | 0.1% (6,348) | 0% (3,539) | 0% (2,441) | 0% (2,264) | 0% (2,290) | 0% (2,704) | 0.6% (2,612) | 18.3% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 27.5% (955) | 2.4% (874) | 0% (954) | 0% (930) | 0% (960) | 0% (930) | 0% (960) | 0% (940) | 0% (900) | 0% (929) | 0.1% (900) | 25.2% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

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Juvenile fall-run and late fall–run Chinook salmon migrating through the Delta toward the Pacific Ocean use the Delta, Suisun Marsh, and the Yolo Bypass for rearing to varying degrees, depending on their life stage (fry versus juvenile), size, river flows, and time of year. Movement of juvenile Chinook salmon in the estuarine environment is driven by the interaction between tidally influenced saltwater intrusion through San Francisco Bay and freshwater outflow from the Sacramento and San Joaquin Rivers (Healey 1991).

In the Delta, tidal and floodplain habitat areas provide important rearing habitat for foraging juvenile salmonids, including fall-run Chinook salmon. Studies have shown that juvenile salmon may spend 2 to 3 months rearing in these habitat areas, and habitat losses resulting from land reclamation and levee construction are considered to be major stressors (Williams 2010).

The fall-run Chinook salmon has an ocean-maturing type of life history adapted for spawning in lowland reaches of big rivers, including the mainstem Sacramento River. The late fall–run Chinook salmon has a stream-maturing type of life history (Moyle 2002). Similar to spring-run, adult late fall–run Chinook salmon typically hold in the river for 1 to 3 months before spawning, while fall-run Chinook salmon generally spawn shortly after entering fresh water. Fall-run Chinook salmon migrate upstream past RBDD on the Sacramento River between July and December, typically spawning in upstream reaches from October through March. Late fall–run Chinook salmon migrate upstream past RBDD from August to March and spawn from January to April (National Marine Fisheries Service 2009; Tehama-Colusa Canal Authority 2008). The majority of young fall-run Chinook salmon migrate to the ocean during the first few months following emergence, although some may remain in fresh water and migrate as yearlings. Late fall–run Chinook salmon juveniles typically enter the ocean after 7 to 13 months of rearing in fresh water, at 150 to 170 mm in fork length, considerably larger and older than fall-run Chinook salmon (Moyle 2002). The primary spawning area used by fall-run and late fall–run Chinook salmon in the Sacramento River is the area from Keswick Dam downstream to RBDD. Spawning densities for all of the Chinook salmon runs are highest in this reach, but fall-run Chinook salmon generally spawn farther downstream in the reach than the other Chinook salmon runs (Gard 2003).

Results of mark-recapture studies conducted using juvenile Chinook salmon released into both the Sacramento and San Joaquin Rivers have shown high mortality during passage downstream through the rivers and Delta (Brandes and McLain 2001:62; Newman and Rice 2002; Buchanan et al. 2013). Juvenile salmon migrating from the San Joaquin River generally experience greater mortality than fish outmigrating from the Sacramento River. In years when spring flows are reduced and water temperatures are increased, mortality is typically higher in both rivers. As noted previously in the account for winter-run Chinook salmon (Section 4.4.1.2, *Life History and Habitat Requirements*), flow-survival relationships have been demonstrated for juvenile Chinook salmon in the Delta (Perry et al. 2018). Closing the DCC gates and installation of the Head of Old River Barrier to reduce the movement of juvenile salmon into the south Delta from the Sacramento and San Joaquin Rivers, respectively, may contribute to improved survival of outmigrating juvenile Chinook salmon from these watersheds.

Although not directly comparable to these previous coded wire tag studies in the San Joaquin River, Buchanan et al. (2013) found that survival of acoustically tagged hatchery-origin (Feather River) juvenile Chinook salmon was either not statistically different between routes (2009) or was higher through the south Delta via the Old River route than via the San Joaquin River (2010). Additionally, most fish in the Old River that survived to the end of the Delta had been salvaged from the federal

water export facility on the Old River and trucked around the remainder of the Delta (Buchanan et al. 2013; San Joaquin River Group Authority 2013). Buchanan et al. (2013) indicated that the differences in their results compared to past coded wire tag studies may reflect that an alternative nonphysical barrier was being used during their investigation to examine its ability to keep fish out of the Old River instead of the Head of Old River Barrier, which is a physical barrier that reduces not only the number of fish, but also the majority of flows, from entering the Old River. Nonphysical barriers may deprive smolts routed to the San Joaquin River of the increased flows needed for improved survival and may have created habitat for increased predation at the site (Buchanan et al. 2013). However, as previously noted in the spring-run Chinook account above, Buchanan and Skalski (2019) did not find a statistically significant relationship between juvenile fall-run Chinook salmon survival from the Head of Old River to Chipps Island and Head of Old River Barrier presence; Buchanan et al. (2021) did, however, find evidence for a positive Head of Old River Barrier effect on juvenile steelhead survival. Further discussion of through-Delta survival issues is provided below.

Annual fall-run and late fall–run Chinook salmon escapement to the Sacramento River and its tributaries has generally been lower in the last decade than historically, following peaks in the late 1990s to early 2000s (California Department of Fish and Wildlife 2018b) (Tables 4.4.3-1 and 4.4.3-2, with a quantitative summary for juveniles in Tables 4.4.3-1a, 4.4.3-1b, 4.4.3-2a, and 4.4.3-2b). Hatchery fall-run escapement was relatively consistent at approximately 50,000–60,000 fish during 2014–2018 (Tables 4.4.3-1 and 4.4.3-1b), with hatchery escapement of late fall–run in recent years estimated to be greater than in-river numbers (Tables 4.4.3-2 and 4.4.3-2b). Studies have suggested that hatchery-produced Chinook salmon may contribute large (approximately 90%) proportions of Chinook salmon to the mixed-stock fishery along the central California coast (Barnett-Johnson et al. 2007). Sturrock et al. (2019) found that transport distance of hatchery-origin juvenile Chinook salmon to release sites had increased over time (particularly during droughts) and was strongly associated with straying rate (averaging 0–9% vs. 7–89% for salmon released on site vs. in the bay upstream of Golden Gate Bridge, respectively), increasing the effects of hatchery releases on natural spawners. The authors suggested that decreasing variation in release location and timing could reduce spatiotemporal buffering, narrowing ocean arrival timings and increasing risk of mismatch with peak prey production. The percentage of hatchery-origin fish released downstream of the Delta has been variable over time. For example, from the mid-1980s to 2012, the proportion of hatchery fall-run Chinook salmon juveniles released downstream of the Delta by state and federal hatcheries varied from around 20% to 60% (Huber and Carlson 2015). Similarly, from 2013 to 2017, the percentage of juvenile fall-run and spring-run Chinook salmon released by state Central Valley hatcheries downstream of the Delta varied between 24% (2016) and 60% (2013) (California Department of Fish and Wildlife 2018a).

Beginning in 1995, restoration actions in Clear Creek have had a clear effect on fall-run Chinook salmon populations. The combined actions have contributed to a near fourfold increase in escapement of fall-run Chinook salmon to Clear Creek (population estimates average 1,749 from 1967 to 1991 and 7,333 from 1992 to 2017) (Clear Creek Technical Team 2018). Based on carcass surveys and juvenile outmigration trapping, fall-run Chinook salmon typically spawn in Clear Creek from late September through early December, and peak outmigration of juveniles occurs in January and February (Earley et al. 2013).

For late fall–run Chinook salmon generally (not just those in Clear Creek), peak spawning time is typically from October to November, but can continue through December and into January. Juveniles typically emerge from the gravel in December through March and rear in fresh water for 1 to 7 months (Moyle et al. 2015:543–552). Fall- and late fall–run Chinook salmon generally outmigrate as

age-0 fish, although some (8.3% in 2011) late fall–run Chinook salmon juveniles outmigrate in their second year. Outmigration is generally from April to June for late fall–run and November to May for fall-run Chinook salmon. Peak outmigration for fall-run in Clear Creek was in late December and the late fall–run peak outmigration was from mid-April to mid-May (Schraml et al. 2018).

Feather River fall-run Chinook salmon are partially hybridized with Feather River spring-run Chinook salmon, but they largely maintain separate fall and spring upstream adult migrations. Fall-run adults return to the Feather River as sexually mature fish and spawn from September to December. The fall-run spawning period begins after the spring-run spawning period, but the spawning periods overlap considerably, leading to superimposition of spring-run redds by subsequently spawning fall-run adults. For this reason, a separation weir has been proposed to physically separate Central Valley spring-run and fall-run Chinook salmon in the river (National Marine Fisheries Service 2016c). Suitable water temperatures for Chinook salmon spawning in the Feather River are 42°F to 58°F (5.5°C to 14.4°C). Incubation may extend through March with suitable incubation temperatures between 48°F and 58°F (8.9°C and 14.4°C) (California Department of Water Resources 2007:4.4-29). Studies have confirmed that juvenile rearing and probably some adult spawning are associated with secondary channels within the Feather River low-flow channel. The lower velocities, smaller substrate size, and greater amount of cover (compared to the main river channel) likely make these side channels more suitable for juvenile Chinook salmon rearing. Currently, this type of habitat comprises less than 1% of the available habitat in the low-flow channel (California Department of Water Resources 2007:4.4-16). Juvenile Chinook salmon in the Feather River have been reported to outmigrate as young-of-the-year (Seesholtz et al. 2004), and most appear to migrate out of the Feather River within days of emergence (National Marine Fisheries Service 2016b). Juvenile outmigration from the Feather River is generally from mid-November through June, with peak outmigration occurring from January through March (National Marine Fisheries Service 2016b).

The American River historically supported fall-run and perhaps late fall–run Chinook salmon (Williams 2001). Both natural-origin and hatchery-produced Chinook salmon spawn in the lower American River. An analysis by Palmer-Zwahlen et al. (2018) found that constant fractional marking results from 2013 show that approximately 86% of the fall-run Chinook salmon spawners returning to Nimbus Hatchery were hatchery-origin. Further, 71% of fall-run Chinook salmon recorded at the Hatchery Weir and 65% of carcasses were identified as hatchery fish. Adult fall-run Chinook salmon enter the lower American River from about mid-September through January, with peak migration from approximately mid-October through December (Williams 2001). Spawning in the American River occurs from about mid-October through early February, with peak spawning from mid-October through December. Chinook salmon spawning occurs within an 18-mile stretch from Paradise Beach to Nimbus Dam; however, most spawning occurs in the uppermost 3 miles (4.8 kilometers) (California Department of Fish and Game 2012a:95). Chinook salmon egg and alevin incubation occurs in the lower American River from about mid-October through April. This period varies widely from year to year, although most incubation occurs from about mid-October through January. Chinook salmon juveniles rear in the American River from about January to May (Snider and Titus 1995, 2002). Most Chinook salmon outmigrate from the lower American River as fry between December and July; outmigration peaks February to March (Snider and Titus 2002; Pacific States Marine Fisheries Commission 2014).

In the Stanislaus River, data collected by private fishery consultants, nonprofit organizations, and CDFW demonstrate that the majority of fall-run Chinook salmon adults migrate upstream from late September through December, with peak migration from late October through early November.

Most Chinook salmon spawning occurs between Riverbank (RM 33) and Goodwin Dam (RM 58.4) (Bureau of Reclamation 2012:6). Based on redd surveys conducted by FISHBIO, peak spawning typically occurs in November, with roughly 7% of spawning occurring prior to November 1, and 2% prior to October 15. The few redds created during late September and early October are typically in the reach just below Goodwin Dam. By late October, the amount of spawning in downstream locations increases as water temperatures decrease, and the median redd location is typically around Knights Ferry (State Water Resources Control Board 2015). In 2010, over 20% of the fall-run Chinook salmon observed passing the Stanislaus River weir had adipose fin clips, indicating the presence of a coded wire tag in their snout. Since there is no hatchery on the Stanislaus River, and no hatchery releases into this tributary have occurred since 2006, it is apparent that straying from other rivers is occurring (FISHBIO Environmental 2010). Subsequent surveys have also found a high proportion of hatchery-origin fish on the Stanislaus River spawning grounds (e.g., 2012: 83% [Palmer-Zwahlen and Kormos 2013:11]; 2014: 66% [Palmer-Zwahlen et al. 2018:8]). Rotary screw trap data indicate that about 99% of salmon juveniles migrate out of the Stanislaus River from January through May (Stanislaus River Fish Group 2004). Fry migration generally occurs from January through March, followed by smolt migration from April through May (Bureau of Reclamation 2012:8). Watry et al. (2012) found that in both 2010 and 2011, peak passage during the pre-smolt period generally corresponded with flow pulses. Zeug et al. (2014) examined 14 years of rotary screw trap data on the lower Stanislaus River and found a strong positive response in survival, the proportion of pre-smolt migrants, and the size of smolts when cumulative flow and flow variance were greater. From the data, they concluded that periods of high discharge in combination with high discharge variance are important for successful outmigration as well as migrant size and the maintenance of diverse migration strategies.

Mesick (2001) surmised that when water exports are high relative to San Joaquin River flows, little, if any, San Joaquin River water reaches San Francisco Bay, where it may be needed to help attract the salmon back to the Stanislaus River. During mid-October from 1987 through 1989, when export rates exceeded 400% of Vernalis flows, Mesick (2001) found that straying rates ranged between 11% and 17%. In contrast, straying rates were estimated to be less than 3% when Delta export rates were less than about 300% of San Joaquin River flow at Vernalis during mid-October. Marston et al. (2012) provided statistical relationships between straying rate and flow and exports, concluding that the results indicate that flow is the primary factor but that empirical data indicate that little if any pulse flow leaves the Delta when south Delta exports are elevated; they hypothesized that exports in combination with pulse flows may explain straying. Peterson et al. (2017) studied environmental factors and management actions influencing upstream migration patterns of adult fall-run Chinook in the Stanislaus River. They found that the Head of Old River Barrier had positive and consistent influences on daily counts in the years it was installed and that managed pulse flows resulted in immediate increases in daily passages, but the response was brief and represented a small portion of the total run.

One of the limiting factors for juvenile fall-run Chinook salmon from the Stanislaus River and elsewhere in the San Joaquin River Basin appears to be the high rates of mortality for juveniles migrating through dredged channels in the Delta, particularly the Stockton Deep Water Ship Channel (Newcomb and Pierce 2010). Pickard et al. (1982) reported that the survival of juvenile fish in the ship channel is highest during flood flows or when a barrier is placed at the Head of Old River that more than doubles the flow in the ship channel. As noted in the account for spring-run Chinook salmon (Section 4.4.2.2, *Life History and Habitat Requirements*), the SST's work suggests that high correlations between inflows and exports make it difficult to evaluate their effects on salmon

survival independently using statistical methods. The Stanislaus River Fish Group (SRFG) (2004) noted that escapement is also directly correlated with springtime flows, when each brood migrates downstream as smolts. However, the cause of the mortality in the ship channel has not been studied. Buchanan and Skalski (2019) found through-Delta survival of acoustically tagged fall-run Chinook salmon smolts was positively associated with Old River flow in the strongly tidal interior Delta but not with higher San Joaquin River flow either entering the Delta from upstream or in the Delta near the riverine/tidal interface. Survival in the upstream, more riverine region of the Delta was positively associated with San Joaquin River flow measured at the riverine/tidal interface and average net flow in the interior Delta, which the authors suggested provided evidence of different mechanisms driving survival in the upstream versus downstream reaches of the Delta (Buchanan and Skalski 2019). A large portion of juvenile fall-run Chinook salmon surviving through the Delta from the San Joaquin River Basin move through the CVP salvage facility (Buchanan et al. 2018).

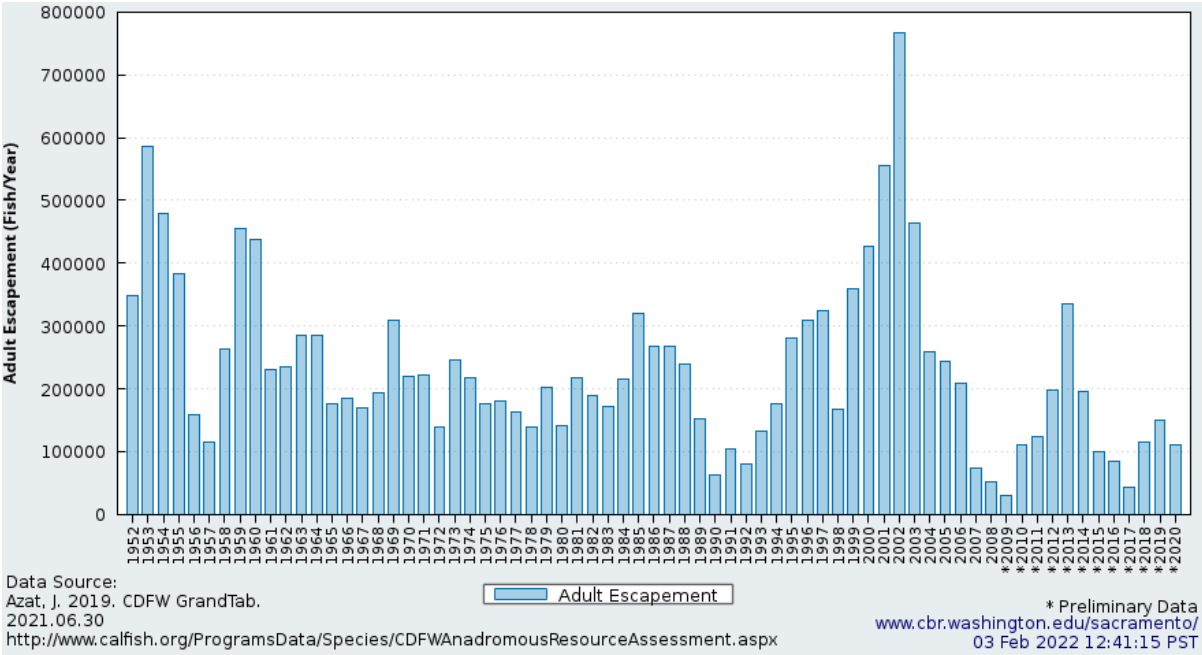


**Figure 4.4.3-1. In-River Escapement Numbers of Fall-Run Chinook, Sacramento and San Joaquin River Systems**

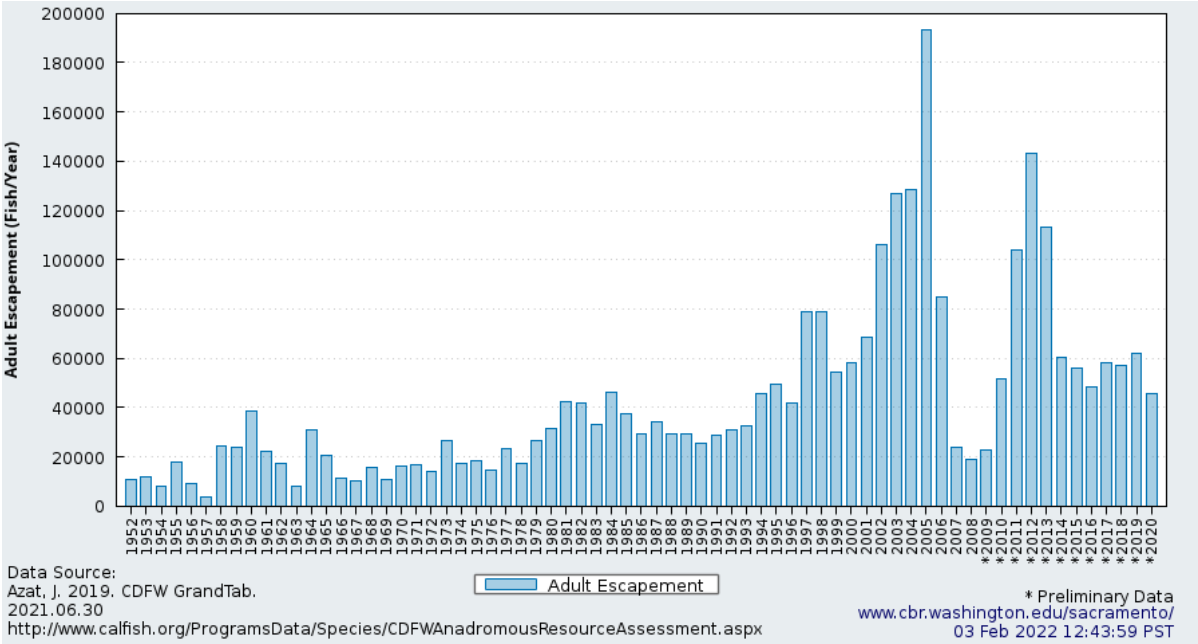


**Figure 4.4.3-2. Hatchery Escapement Numbers of Fall-Run Chinook, Sacramento and San Joaquin River Systems**

In the Sacramento and San Joaquin Rivers from 1952 through 2018, adult escapement estimates for late fall–run Chinook salmon have ranged from several hundred adults to more than 40,000 adults (Figure 4.4.3-3). Between 1971 and 1997, adult escapement showed a general trend of declining abundance. From 1990 through 2006, escapement increased substantially, but was also highly variable from year to year. Escapement estimates were lower than the previous 4 years in 2008 and 2009 but not on the magnitude that was observed for fall-run Chinook salmon. Sacramento River late fall–run Chinook salmon stock has hatchery and natural components from the upper Sacramento River basin (Figure 4.4.3-4).

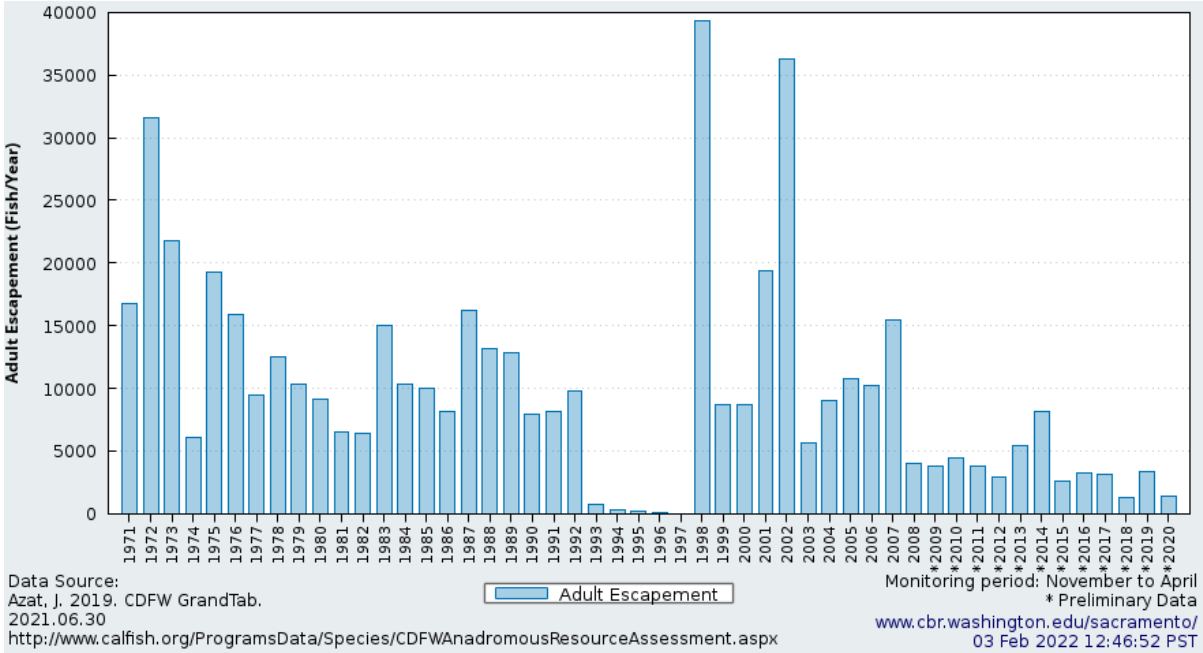


**Figure 4.4.3-3. In-River Escapement Numbers of Late Fall–Run Chinook, Sacramento and San Joaquin River Systems 1974–2020**

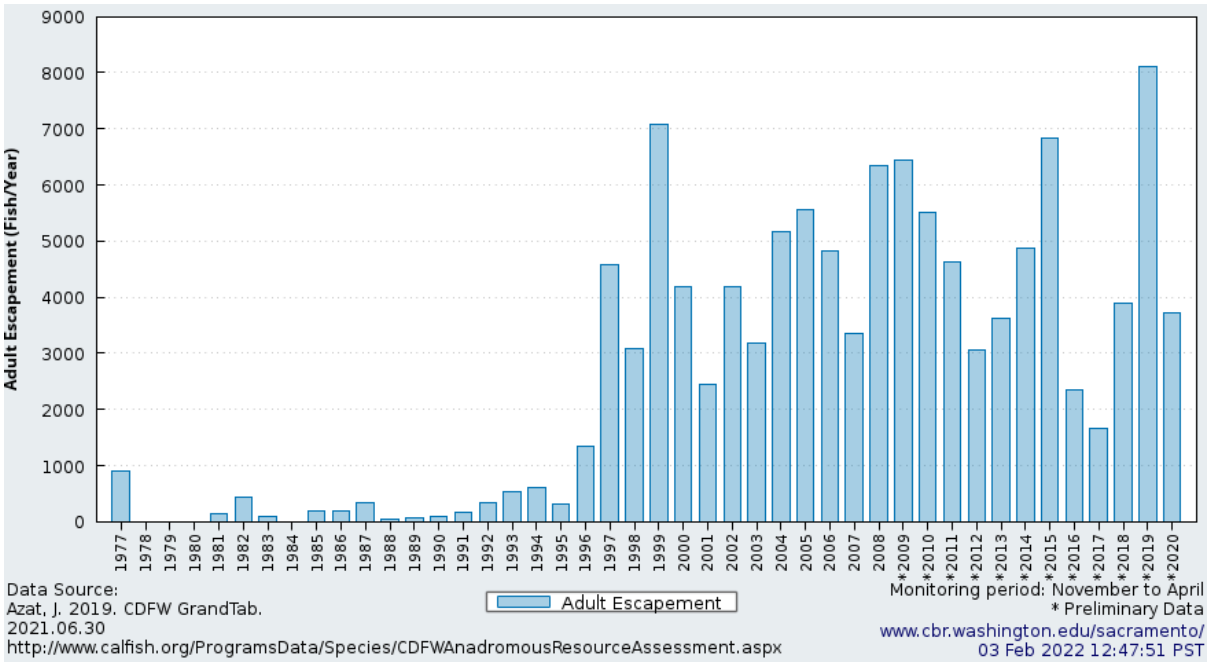


**Figure 4.4.3-4. Hatchery Escapement Numbers of Late Fall–Run Chinook, Sacramento and San Joaquin River Systems 1974–2020**

Factors affecting fall-run and late fall–run Chinook salmon are generally similar to those discussed above for winter-run and spring-run Chinook salmon. Recent life cycle modeling for fall-run suggested that among the processes examined, the most influential factors were temperature experienced during egg incubation, freshwater flow during juvenile outmigration, and

environmentally mediated predation during early marine residence (Friedman et al. 2019).[4] Michel (2019) found a statistically significant positive correlation between Sacramento River flow and hatchery-origin fall-run and late fall–run Chinook salmon smolt to adult return ratio, which was higher than the correlation with indices of marine productivity.

Central Valley fall-run and late fall–run Chinook salmon pass through the Delta as adults migrating upstream and juveniles outmigrating downstream. Adult fall-run and late fall–run Chinook salmon migrating through the Delta must navigate the many channels and avoid direct sources of mortality and minimize exposure to sources of nonlethal stress. Additionally, outmigrating juveniles are subject to predation and entrainment in the project export facilities and smaller diversions.

Dredging for gravel and gold, regulated flows, and the diking of floodplains for agriculture have substantially limited the availability of spawning and rearing habitat for fall-run Chinook salmon in the Stanislaus River (Bureau of Reclamation 2019). Reclamation has conducted spawning gravel augmentation to improve spawning and rearing habitats in the Stanislaus River reach between Goodwin Dam and Knights Ferry most years since 1999. The dredged areas also contain an abundance of large predatory fish, although SRFG concluded that there is uncertainty about whether predation is a substantial source of mortality for juvenile salmon. SRFG (2004) also concluded that water diversions for urban and agricultural use in all three San Joaquin River tributaries, which reduce flows and potentially result in unsuitably warm water temperatures during spring and fall, affecting fall-run Chinook salmon juvenile rearing and adult and juvenile migration in the lower San Joaquin River and Delta.

#### 4.4.3.3 Critical Habitat

Critical habitat has not been designated for fall-run or late fall–run Chinook salmon.

### 4.4.4 Steelhead, California Central Valley DPS

#### 4.4.4.1 Legal Status and Distribution

The California Central Valley Steelhead DPS was originally listed as threatened under the ESA on March 19, 1998 (63 FR 13347), and the listing was reaffirmed on January 5, 2006 (71 FR 834) and updated April 14, 2014 (79 FR 20802). The DPS includes naturally spawned anadromous *Oncorhynchus mykiss* (steelhead) originating below natural and human-made impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. This DPS includes steelhead from two artificial propagation programs: the Coleman National Fish Hatchery Program, and the Feather River Fish Hatchery Program (79 FR 20802: 20810). Factors contributing to listing for west coast steelhead, including the Central Valley DPS, include decline primarily caused by destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors (63 FR 13347: 13354). NMFS (2014:60) described some of the most important stressors to the Central Valley Steelhead DPS to be passage impediments and barriers, warm water temperatures for rearing, hatchery effects, limited quantity and quality of rearing habitat, predation, and entrainment.

[4] The most influential environmental processes were represented in the model by daily temperature at RBDD October 1–December 1; median February flow at Colusa; and an annual index of predation by common murre at Southeast Farallon Island.

Steelhead are broadly divided into two life history types, summer-run steelhead and winter-run steelhead, based on their state of sexual maturity at the time of river entry. Only winter-run steelhead are currently found in Central Valley rivers and streams. Historically, Central Valley steelhead were distributed from the upper Sacramento and Pit River systems (upper Sacramento, McCloud, Pit, and Fall Rivers) south to the Kings River (and possibly Kern River system in wet years) (McEwan 2001). Presently, Central Valley steelhead are found in the Sacramento River downstream of Keswick Dam, in major tributary rivers and creeks in the Sacramento River watershed, and in major tributaries of the San Joaquin River (Stanislaus, Tuolumne, Merced Rivers) and Delta (Mokelumne and Calaveras Rivers). The populations in the Feather and American Rivers are supported primarily by the Feather and Nimbus hatcheries. Other major steelhead populations in the Sacramento River watershed are found in Battle, Mill, Deer, Clear and Butte Creeks.

#### 4.4.4.2 Life History and Habitat Requirements

Upstream migration of Central Valley steelhead begins with estuarine entry from the ocean as early as July and continues through February or March in most years (McEwan and Jackson 1996; National Marine Fisheries Service 2009). Populations of steelhead occur primarily within the watersheds of the Sacramento River Basin, although not exclusively. Steelhead can spawn more than once, with post-spawn adults (typically females) potentially moving back downstream through the Delta after completion of spawning in their natal streams.

Upstream migrating adult steelhead enter the Sacramento River and San Joaquin River Basins through their respective mainstem river channels. Steelhead entering the Mokelumne River system (including Dry Creek and the Cosumnes River) and the Calaveras River system to spawn are likely to move up the mainstem San Joaquin River channel before branching off into the channels of their natal rivers, although some may detour through the south Delta waterways and enter the San Joaquin River through the Head of Old River.

Steelhead entering the San Joaquin River Basin appear to have a later spawning run, with adults entering the system starting in late October through December, indicating that migration up through the Delta may begin a few weeks earlier. During fall, warm water temperatures in the south Delta waterways and water quality impairment because of low dissolved oxygen at Stockton have been suggested as potential barriers to upstream migration (National Marine Fisheries Service 2009). Reduced water temperatures, as well as rainfall runoff and flood control release flows, provide the stimulus to adult steelhead holding in the Delta to move upriver toward their spawning reaches in the San Joaquin River tributaries. Adult steelhead may continue entering the San Joaquin River Basin through winter.

Juvenile steelhead can be found in all waterways of the Delta, but particularly in the main channels leading from their natal river systems (National Marine Fisheries Service 2009). Juvenile steelhead are recovered in trawls from October through July at Chipps Island and at Mossdale. Chipps Island catch data indicate there is a difference in the outmigration timing between wild and hatchery-reared steelhead smolts from the Sacramento and eastside tributaries. Hatchery fish are typically recovered at Chipps Island from January through March, with a peak in February and March corresponding to the schedule of hatchery releases of steelhead smolts from the Central Valley hatcheries (Nobriga and Cadrett 2001; Bureau of Reclamation 2008). The timing of wild (unmarked) steelhead outmigration is more spread out and based on salvage records at the CVP and SWP fish collection facilities, outmigration occurs over approximately 6 months with the highest levels of recovery in February through June (Aasen 2011, 2012). Steelhead are salvaged annually at the

project export facilities (e.g., 4,631 fish were salvaged in 2010, and 1,648 in 2011) (Aasen 2011, 2012).

Outmigrating steelhead smolts enter the Delta primarily from the Sacramento or San Joaquin Rivers. Mokelumne River steelhead smolts can either follow the north or south branches of the Mokelumne River through the central Delta before entering the San Joaquin River, although some fish may enter farther upstream if they diverge from the south branch of the Mokelumne River into Little Potato Slough. Calaveras River steelhead smolts enter the San Joaquin River downstream of the Port of Stockton. Studies of acoustically tagged juvenile steelhead found San Joaquin River flow at Vernalis, presence of a rock barrier at Head of Old River, fish size, and year to be significant predictors of through-Delta survival, whereas south Delta exports were not supported as significant predictors of survival (Buchanan et al. 2021). Prior to the installation of the Head of Old River Fish Control Gate, steelhead smolts exiting the San Joaquin River Basin could follow one of two routes to the ocean, either staying in the mainstem San Joaquin River through the central Delta, or entering the Head of Old River and migrating through the south Delta and its associated network of channels and waterways.

Central Valley steelhead use the San Francisco and San Pablo Bays as a migration corridor to and from the ocean. The juveniles move quickly through the bays on their way to the ocean, preying on a variety of macroinvertebrates and small fish.

Steelhead are broadly divided into two life history types, summer-run steelhead and winter-run steelhead, based on their state of sexual maturity at the time of river entry. Only winter-run steelhead are currently found in Central Valley rivers and streams. Historically, Central Valley steelhead were distributed from the upper Sacramento and Pit River systems (upper Sacramento, McCloud, Pit, and Fall Rivers) south to the Kings River (and possibly Kern River system in wet years) (McEwan 2001). Presently, Central Valley steelhead are found in the Sacramento River downstream of Keswick Dam, in major tributary rivers and creeks in the Sacramento River watershed, and in major tributaries of the San Joaquin River (Stanislaus, Tuolumne, Merced Rivers) and Delta (Mokelumne and Calaveras Rivers). The populations in the Feather and American Rivers are supported primarily by the Feather and Nimbus hatcheries. Other major steelhead populations in the Sacramento River watershed are found in Battle, Mill, Deer, Clear and Butte Creeks.

Adult steelhead migrate upstream past the Fremont Weir between August and March, but primarily from August through October, and they migrate upstream past RBDD during all months of the year, but primarily during September and October (National Marine Fisheries Service 2009). The primary spawning area used by steelhead in the Sacramento River is the area from Keswick Dam downstream to RBDD. Unlike Pacific salmon, steelhead may live to spawn more than once and generally rear in freshwater streams for 2 to 4 years before outmigrating to the ocean. Both spawning areas and migratory corridors are used by juvenile steelhead for rearing prior to outmigration. The Sacramento River functions primarily as a migration channel, although some rearing habitat remains in areas with setback levees (primarily upstream of Colusa) and flood bypasses (e.g., Yolo Bypass) (National Marine Fisheries Service 2009).

Recent steelhead monitoring data are scarce for the upper portion of the Sacramento River system. Hallock (1989) reported that steelhead had declined drastically in the Sacramento River upstream of the Feather River confluence. In the 1950s, the average estimated spawning population size upstream of the Feather River confluence was 20,540 fish (McEwan and Jackson 1996). In 1991 through 1992, the annual run size for the total Sacramento River system was likely fewer than

10,000 adult fish (McEwan and Jackson 1996). From 1967 to 1993, the estimated number of steelhead passing the Red Bluff Pumping Plant ranged from a low of 470 to a high of 19,615 (California Hatchery Scientific Review Group 2012). Steelhead escapement surveys at Red Bluff ended in 1993.

Both steelhead and resident (non-anadromous) rainbow trout (*O. mykiss*) occur in Clear Creek. Adult Central Valley steelhead populations in Clear Creek have been relatively stable between 2003 and 2011, with redd counts ranging from 42 to 409, with an average of 176 (Giovanetti et al. 2013; Provins and Chamberlain 2019). Adult Central Valley steelhead spawn in Clear Creek from early December to mid-March. Steelhead rear in Clear Creek year-round, and outmigration can occur in any month, although peak outmigration in 2011 was from February to June (Schraml et al. 2018).

California Central Valley steelhead adults migrate into the Feather River between July and March, and redd construction occurs from late December to March, peaking in late January (Federal Energy Regulatory Commission 2007:178; McEwan 2001). Spawning in the Feather River primarily occurs within the low-flow channel between the Fish Barrier Dam and the Thermalito Afterbay outlet, although a small amount of spawning occurs downstream of the Thermalito Afterbay outlet (Federal Energy Regulatory Commission 2007:169, 178). Nearly half of all observed redds are constructed in the uppermost mile of the low-flow channel (Federal Energy Regulatory Commission 2007:178). Fry begin to outmigrate in February, soon after emerging, with the majority outmigrating between March and mid-April. Most juveniles outmigrate by September, but a small portion of juveniles that do not outmigrate rear in the river for up to 1 year, most often in secondary channels of the low-flow channel (Federal Energy Regulatory Commission 2007:169).

Although some spawning by steelhead in the American River occurs naturally (Hannon and Deason 2008), the population is supported primarily by the Nimbus Fish Hatchery. The total estimated steelhead return to the river (spawning naturally and in the hatchery) has ranged from 946 to 3,426 fish, averaging 2,184 fish per year from 2002 to 2010 (California Hatchery Scientific Review Group 2012). Steelhead spawning surveys have shown approximately 300 steelhead spawning in the river each year (Hannon and Deason 2008). Lindley et al. (2007) classifies the listed (i.e., naturally spawning) population of American River steelhead at a high risk of extinction because it is reportedly mostly composed of winter-run steelhead originating from Nimbus Fish Hatchery; possibly up to 90% of spawners are of hatchery origin (Hannon and Deason 2008). NMFS considers the American River population to be important to the survival and recovery of the species (National Marine Fisheries Service 2014).

Steelhead from the American River (collected from both the Nimbus Fish Hatchery and the American River) are genetically more similar to Eel River and Mad River steelhead than other Central Valley steelhead stocks because individuals from these rivers were used as broodstock for Nimbus Hatchery (Nielsen et al. 2005; California Hatchery Scientific Review Group 2012). American River steelhead exhibit a slightly later upstream migration period than other Central Valley steelhead (Lee and Chilton 2007).

Adult steelhead migrate up the American River from October through April with a peak occurring from December through March (Surface Water Resources 2001). Adult steelhead have been caught in the Nimbus Fish Hatchery trap as early as the first week of October. Spawning typically occurs in the lower American River between late December and early April, with the peak occurring in late February to early March (Hannon and Deason 2008). Spawning occurs between Nimbus Dam and Paradise Beach, although approximately 90% of spawning occurs upstream of the Watt Avenue

Bridge (Hannon and Deason 2008). Embryo incubation occurs shortly after spawning in late December and generally extends through May, although incubation can occur into June in some years (Surface Water Resources 2001). Although steelhead embryo and alevin mortality from high flows in the American River has not been documented, flows high enough to mobilize spawning gravels and scour or entomb redds have been recorded during the spawning and embryo incubation periods (National Marine Fisheries Service 2009). Juvenile *O. mykiss* are present year-round throughout the lower American River, with rearing generally upstream of spawning areas. Juveniles can rear in the lower American River for a year or more before outmigrating as smolts from January through June (Snider and Titus 2000; Surface Water Resources 2001), although it is rare to find individuals older than young-of-the-year fry and parr (Snider and Titus 2002; Pacific States Marine Fisheries Commission 2014). Peak juvenile steelhead outmigration occurs from March through May (McEwan and Jackson 1996; Surface Water Resources 2001; Pacific States Marine Fisheries Commission 2014). Juvenile steelhead rear in the lower American River from Nimbus Dam to Paradise Beach. During summer months, juveniles occur in most major riffle areas, with the highest densities near the higher density spawning areas (Bureau of Reclamation 2008:3-21). The number of juveniles in the American River decreases throughout summer (Bureau of Reclamation 2008:3-20). Juveniles experience water temperature-related stress during summer and early fall (Water Forum 2005; National Marine Fisheries Service 2014) despite laboratory studies indicating that American River steelhead may be more tolerant of high temperatures than steelhead from other rivers (Myrick and Cech 2004).

Central Valley steelhead were thought to be extirpated from the San Joaquin River system (National Marine Fisheries Service 2009). However, monitoring has detected small self-sustaining (i.e., of natural origin, not of hatchery origin) populations of steelhead in the Stanislaus River and other streams previously thought to be devoid of steelhead (Stanislaus River Fish Group 2003; McEwan 2001). There is a catch-and-release steelhead fishery in the lower Stanislaus River between January 1 and October 15. Surveys of *O. mykiss* (resident rainbow trout and the anadromous steelhead) abundance and distribution conducted annually since 2009 have documented a relatively stable population. River-wide abundance estimates from 2009 to 2014 have averaged just over 20,220 (all life stages combined) and have never been estimated to be less than about 14,000 (2009). The highest densities and abundances of *O. mykiss* are consistently found in Goodwin Canyon. Key factors that may contribute to higher than average abundances in the Stanislaus River (relative to other San Joaquin River tributaries) include high gradient reaches that are typically associated with fast-water habitats, particularly in Goodwin Canyon (State Water Resources Control Board 2015).

Historically, the distribution of steelhead extended into the headwaters of the Stanislaus River (Yoshiyama et al. 1996). Steelhead currently can migrate more than 58 miles (93.3 km) up the Stanislaus River to the base of Goodwin Dam. In the Stanislaus River, there is little data regarding the migration patterns of adult steelhead since adults generally migrate during periods when river flows and turbidity are high, making fish difficult to observe with standard adult monitoring techniques. Stanislaus River weir data indicate that steelhead migrate upstream, through the south Delta and lower San Joaquin River, between September and March (Bureau of Reclamation 2014). High Delta export rates relative to San Joaquin River flows at Vernalis, when adults are migrating through the Delta (presumably December through May), may result in adults straying to the Sacramento River Basin.

It is believed that steelhead spawn primarily between December and March in the Stanislaus River. Although few steelhead spawning surveys have been conducted in the Stanislaus River, spawning *O. mykiss* were documented between Goodwin Dam and Horseshoe Bar in a 2014 spawning survey

(Bureau of Reclamation and California Department of Water Resources 2015:56). The spawning adults require holding and feeding habitat with cover adjacent to suitable spawning habitat. These habitat features are relatively rare in the lower Stanislaus River because of in-river gravel mining and the scouring of gravel from riffles in Goodwin Canyon.

Juvenile steelhead rear in the Stanislaus River for at least 1 year, and usually 2 years, before migrating to the ocean. As a result, flow, water temperature, and dissolved oxygen concentration in the reach between Goodwin Dam and the Orange Blossom Bridge (their primary rearing habitat) are critical during summer (Bureau of Reclamation 2012:11).

Small numbers of Central Valley steelhead smolts have been captured in rotary screw traps at Caswell State Park and near Oakdale (FISHBIO Environmental 2007:31; Watry et al. 2007, 2012), and data indicate that steelhead outmigrate primarily from February through May. Rotary screw traps are generally not considered efficient at catching fish as large as steelhead smolts, and the number captured is too small to estimate capture efficiency, so no steelhead smolt outmigration population estimate has been calculated. The capture of these fish in downstream migrant traps and the advanced smolting characteristics exhibited by many of the fish indicate that some steelhead/rainbow trout juveniles might outmigrate to the ocean in spring. However, it is not known whether the parents of these fish were anadromous or fluvial (i.e., migrate within fresh water). Resident populations of steelhead/rainbow trout in large streams are typically fluvial, and migratory juveniles look much like smolts.

Steelhead were historically present in the San Joaquin River, though data on their population levels are lacking (McEwan 2001). The current steelhead population in the San Joaquin River is substantially reduced compared with historical levels, although resident rainbow trout occur throughout the major San Joaquin River tributaries. Additionally, small populations of steelhead persist in the lower San Joaquin River and tributaries (e.g., Stanislaus, Tuolumne, and possibly Merced Rivers) (Zimmerman et al. 2009; McEwan 2001). Steelhead/rainbow trout of anadromous parentage occur at low numbers in all three major San Joaquin River tributaries. These tributaries have a higher percentage of resident rainbow trout compared to the Sacramento River and its tributaries (Zimmerman et al. 2009). Presence of steelhead smolts from the San Joaquin River Basin is estimated annually by CDFW based on the Mossdale Trawl (San Joaquin River Group Authority 2011). The sampling trawls capture steelhead smolts, although usually in small numbers. One steelhead smolt was captured and returned to the river during the 2009 sampling period (San Joaquin River Group Authority 2010), and three steelhead were captured and returned in both 2010 and 2011 (Speegle et al. 2013).

Generalized life stage timing for Central Valley steelhead is summarized in Tables 4.4.4-1 and 4.4.4-2, with a quantitative summary for juveniles in Tables 4.4.4-2a and 4.4.4-2b.

### Table 4.4.4-1. Generalized Temporal Occurrence of Central Valley Steelhead Adults

| | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | | Dec | |
| **Migration Life Stage: (a) Adult** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sacramento R. at Fremont Weir | L | L | L | L | L | N | N | N | N | N | N | L | L | L | L | M | H | H | H | M | L | L | L | L |
| Sacramento R. at Red Bluff Diversion Dam | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | M | M | H | M | L | L | L | L |
| San Joaquin River | H | H | M | M | L | L | N | N | N | N | N | N | L | L | L | L | M | M | M | M | M | M | H | H |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Source: National Marine Fisheries Service 2019:100.

### Table 4.4.4-2. Generalized Temporal Occurrence of Central Valley Steelhead by Life Stage in the Delta

| | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Life Stage | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Adult | M | M | M | M | H | N | L | M | H | M | M | M |
| Juvenile | L | M | M | H | H | L | L | N | L | N | N | L |
| Salvaged | M | H | H | M | L | L | N | N | N | N | L | L |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.

Source: National Marine Fisheries Service 2019:101.

Note: Table reflects monitoring based on length-at-date classification of juvenile winter-run Chinook Salmon. See Tables 4.4.4-2a and 4.4.4-2b for quantitative summary. The data in this category reflects juveniles entrained into the salvage facilities. See also annual summaries in California Department of Water Resources 2023: Appendix 12A, Attachment 12A.1, *Juvenile Salmonid Monitoring, Sampling, and Salvage Timing Summary from SacPAS*.

**Table 4.4.4-2a. Frequency of Occurrence (Percent) of Adipose Fin-Unclipped Steelhead Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 29.7% (586) | 28.8% (555) | 41% (641) | 69.4% (581) | 90% (607) | 85.6% (665) | 82.7% (742) | 91.9% (715) | 86.4% (670) | 63.2% (710) | 40.6% (692) | 34.4% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 4.7% (298) | 4.1% (270) | 5.2% (307) | 2.9% (313) | 4% (278) | 0% (111) | 0% (72) | 0% (62) | 0.5% (204) | 0.9% (325) | 0.9% (337) | 3.1% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 5.6% (413) | 5.4% (386) | 7.6% (423) | 5.6% (393) | 4.6% (349) | 0.8% (130) | Not Sampled | 0% (17) | 0% (148) | 0.3% (344) | 0% (345) | 1% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 0.2% (2,784) | 0.4% (2,149) | 0.5% (2,220) | 0.1% (2,060) | 0.3% (2,204) | 0% (2,107) | 0.1% (2,043) | 0% (2,090) | 0% (2,086) | 0% (3,316) | 0% (3,480) | 0.1% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 0.4% (3,402) | 0.8% (3,273) | 0.5% (3,524) | 0.4% (3,502) | 0.6% (2,908) | 0.2% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0% (2,631) | 0.1% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 0.4% (4,225) | 1.3% (3,257) | 2.1% (3,445) | 2.4% (4,738) | 2.2% (6,348) | 0.5% (3,539) | 0% (2,441) | 0% (2,264) | 0.1% (2,290) | 0% (2,704) | 0% (2,612) | 0% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 25.9% (955) | 48.3% (874) | 65.2% (954) | 54.3% (930) | 32.9% (960) | 12% (930) | 1.6% (960) | 0.1% (940) | 0.2% (900) | 0.6% (929) | 1.8% (900) | 3.8% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

**Table 4.4.4-2b. Frequency of Occurrence (Percent) of Adipose Fin-Clipped Steelhead Salmon Juveniles (Based on Length-at-Date Criteria) in Sacramento River and Delta Sampling Programs**

| Location | Sampling Dates | Sampling Units | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sacramento River RST at Red Bluff | 7/18/1994-7/31/2023 | Days | 68.6% (586) | 31.2% (555) | 17.6% (641) | 12.4% (581) | 4.8% (607) | 2.6% (665) | 0.8% (742) | 0.4% (715) | 0.1% (670) | 0.3% (710) | 0.6% (692) | 8.3% (588) |
| Sacramento River RST at Tisdale | 7/6/2010-12/18/2022 | Days | 19.5% (298) | 15.6% (270) | 9.1% (307) | 5.1% (313) | 1.1% (278) | 0% (111) | 0% (72) | 0% (62) | 0% (204) | 0% (325) | 0% (337) | 3.8% (320) |
| Sacramento River RST at Knights Landing | 10/2/2006-10/22/2022 | Days | 28.6% (413) | 26.4% (386) | 19.9% (423) | 7.4% (393) | 0.9% (349) | 0.8% (130) | Not Sampled | 0% (17) | 0.7% (148) | 0.3% (344) | 0% (345) | 3.2% (401) |
| Delta and Sacramento River Beach Seines | 1/3/2000-7/29/2022 | Seine Sets | 1.1% (2,784) | 4% (2,149) | 1.4% (2,220) | 0.5% (2,060) | 0% (2,204) | 0% (2,107) | 0.2% (2,043) | 0% (2,090) | 0% (2,086) | 0% (3,316) | 0% (3,480) | 0% (3,325) |
| Sacramento Trawl at Sherwood Harbor | 1/3/2000-7/29/2022 | Trawl Tows | 6.8% (3,402) | 15.3% (3,273) | 4.7% (3,524) | 1% (3,502) | 0.3% (2,908) | 0% (2,316) | 0% (2,700) | 0% (2,637) | 0% (2,591) | 0% (2,664) | 0% (2,631) | 0.2% (3,349) |
| Midwater Trawl at Chipps Island | 1/2/2000-7/29/2022 | Trawl Tows | 5.4% (4,225) | 23.5% (3,257) | 13.7% (3,445) | 4.5% (4,738) | 1.5% (6,348) | 0.1% (3,539) | 0% (2,441) | 0% (2,264) | 0% (2,290) | 0% (2,704) | 0% (2,612) | 0.4% (3,718) |
| Salvage | 1/1/1993-8/10/2023 | Days | 25.8% (955) | 56.6% (874) | 59.7% (954) | 34.1% (930) | 8.3% (960) | 3.9% (930) | 0.4% (960) | 0% (940) | 0% (900) | 0.1% (929) | 0.2% (900) | 2.4% (930) |

Note: RST = Rotary Screw Trap. Frequency of occurrence is percentage of sampling units with at least one spring-run Chinook salmon juvenile (based on length-at-date criteria) collected. Intensity of shading increases with increasing frequency of occurrence. Numbers in parentheses indicate number of sampling units.

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#### 4.4.4.3 Critical Habitat

Critical habitat for the Central Valley steelhead DPS was designated in 2005 and consists of all river reaches accessible to steelhead in the Sacramento and San Joaquin Rivers and their tributaries, the Delta, and the Yolo Bypass (70 FR 52488). In the Sacramento and San Joaquin Rivers and tributaries, critical habitat includes the river water column, river bottom, and adjacent riparian zone. Additionally, critical habitat includes the water column and essential foraging habitat and food resources west of Chipps Island and to San Francisco Bay and the Golden Gate Bridge.

Critical habitat consists of PBFs considered essential for the conservation of a species. The following PBFs are outlined in the designation of critical habitat (70 FR 52488).

- Unimpeded access from the Pacific Ocean to appropriate spawning areas in the Sacramento and San Joaquin Rivers and their tributaries.
- The availability of clean gravel for spawning substrate.
- Adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles.
- Water temperatures between 42.5°F and 57.5°F for successful spawning, egg incubation, and fry development.
- Habitat and prey free of contaminants.
- Riparian habitat that provides for successful juvenile development and survival.
- Unimpeded passage of juveniles downstream from the spawning grounds to San Francisco Bay and the Pacific Ocean.

### 4.4.5 Green Sturgeon, Southern DPS

#### 4.4.5.1 Legal Status and Distribution

As summarized by NMFS (2018:14), the southern DPS of North American green sturgeon was listed as threatened in 2006 (71 FR 17757) because of the following factors: (1) the Sacramento River contains the only known spawning population; (2) there has been a substantial loss of spawning habitat in the upper Sacramento and Feather Rivers; (3) the Sacramento River and Delta System face mounting threats to habitat quality and quantity; and (4) fishery-independent data indicated a decrease in observed numbers of juvenile green sturgeon collected. The NMFS (2018:22–26) recovery plan for the species noted numerous threats for the species, among which those of very high rank were altered water flow as a result of channel control structures and impoundments in the San Francisco Bay Delta Estuary, altered prey base as a result of non-native species in coastal bays and estuaries and the nearshore marine environment, and global climate change in coastal bays and estuaries.

Green sturgeon reach maturity around 14 to 16 years of age and can live to be 70 years old, returning to their natal rivers every 3 to 5 years for spawning (Van Eenennaam et al. 2005). Adult green sturgeon move through the Delta from February through April, arriving at holding and spawning locations the upper Sacramento River between April and June (Heublein 2006; Kelly et al. 2007). Following their initial spawning run upriver, adults may hold for a few weeks to months in the upper river before moving back downstream in fall (Vogel 2008; Heublein et al. 2009), or they

may migrate immediately back downstream through the Delta. Miller et al. (2020) also observed two adults that remained in the spawning reach for nearly a year, exiting in January or February in the year following spawning. Radio-tagged adult green sturgeon have been tracked moving downstream past Knights Landing during summer and fall, typically in association with pulse flows in the river (Heublein et al. 2009), similar to behavior exhibited by adult green sturgeon on the Rogue River and Klamath River systems (Erickson et al. 2002; Benson et al. 2007). However, the longer holding observed by Miller et al. (2020) of nearly a year has not been observed in other systems and was suggested by the authors as possibly being a feature of the Sacramento River population, individual variation, or related to the dry years during their study that may have delayed the flow cues needed to out-migrate. Anglers have reported catching a few green sturgeon in recent years in the San Joaquin River (California Department of Fish and Game 2012b), and this has been confirmed by capture during research surveys (Anderson 2018; Root et al. 2020).

Similar to other estuaries along the West Coast of North America, adult and subadult green sturgeon frequently congregate in the San Francisco Estuary during summer and fall (Lindley et al. 2008). Specifically, adults and subadults may reside for extended periods in the central Delta as well as in Suisun and San Pablo Bays, presumably for feeding, because bays and estuaries are preferred feeding habitat rich in benthic invertebrates (e.g., amphipods, bivalves, and insect larvae). In part because of their bottom-oriented feeding habits, sturgeon are at risk of harmful accumulations of toxic pollutants in their tissues, especially pesticides such as pyrethroids and heavy metals such as selenium and mercury (Israel and Klimley 2008; Stewart et al. 2004). Subadult and adult green sturgeon occupy a diversity of depths within bays and estuaries for feeding and migration. Tagged adults and subadults within the San Francisco Estuary and Delta occupy waters over shallow depths of less than 33 feet, either swimming near the surface or foraging along the bottom, although recent studies suggested adults tend to be benthically oriented in the San Francisco Estuary and Delta (Chapman et al. 2019). Juvenile green sturgeon are largely oriented at or near the bottom (Thomas et al. 2019).

Juvenile green sturgeon and white sturgeon are periodically (although rarely) collected from the lower San Joaquin River at south Delta water diversion facilities and other sites (National Marine Fisheries Service 2009; Aasen 2011, 2012). Green sturgeon are salvaged from the south Delta diversion facilities and are generally juveniles greater than 10 months but less than 3 years old (Bureau of Reclamation 2008). NMFS (2005) suggested that the high percentage of San Joaquin River flows contributing to the TFCF could mean that some entrained green sturgeon originated in the San Joaquin River Basin.

Green sturgeon larval distribution is estimated to extend at least 100 km (62 miles) downstream from spawning habitats on the Sacramento and Feather Rivers in high-flow years. This estimated downstream distribution corresponds with the Colusa area on the Sacramento River (RM 157) and the confluence of the Sacramento and Feather Rivers near Verona (RM 80) for larvae originating in the Sacramento River and Feather River, respectively (Heublein et al. 2017b:14). Juveniles are believed to use the Delta for rearing for the first 1 to 3 years of their lives before moving out to the ocean and are likely to be found in the main channels of the Delta and the larger interconnecting sloughs and waterways, especially within the central Delta and Suisun Bay and Suisun Marsh. Miller et al. (2020) found the greatest number of detections of acoustically tagged juvenile green sturgeon in the central Delta, with relatively few occurring in the Sacramento River main stem and north Delta sloughs (Sutter, Steamboat, Miner). Project operations at the DCC have the potential to reroute green sturgeon as they outmigrate through the lower Sacramento River to the Delta (Israel and Klimley 2008; Vogel 2011). When the DCC is open, there is no passage delay for adults, but juveniles

could be diverted from the Sacramento River into the interior Delta. This has been shown to reduce the survival of juvenile Chinook salmon (Brandes and McLain 2001; Newman and Brandes 2010; Perry et al. 2012), but it is unknown whether it has similar effects on green sturgeon.

#### 4.4.5.2 Life History and Habitat Requirements

The Sacramento River provides habitat for green sturgeon spawning, adult holding, foraging, and juvenile rearing. Sturgeon spawn in deep pools (averaging about 28 feet deep) (National Marine Fisheries Service 2018). Suitable spawning temperatures and spawning substrate exist for green sturgeon in the Sacramento River upstream and downstream of RBDD (Bureau of Reclamation 2008:8-7–8-8). Although the historical upstream extent of green sturgeon spawning in the Sacramento River is unknown, the observed distribution of sturgeon eggs, larvae, and juveniles indicates that spawning occurs from Hamilton City to as far upstream as the Inks Creek confluence and possibly up to the Cow Creek confluence (Brown 2007; Poytress et al. 2013). Adult green sturgeon that migrate upstream in April, May, and June are completely blocked by the Anderson-Cottonwood Irrigation District diversion dam (National Marine Fisheries Service 2009), rendering approximately 3 miles (4.8 km) of spawning habitat upstream of the diversion dam inaccessible. Based on the distribution of sturgeon eggs, larvae, and juveniles in the Sacramento River, California Department of Fish and Game (2002), now known as CDFW, indicated that green sturgeon spawn in late spring and early summer, although they periodically spawn in late summer and fall (as late as October) (Heublein et al. 2009, 2017b; National Marine Fisheries Service 2018). Green sturgeon eggs are believed generally to hatch about a week after fertilization (Heublein et al. 2017a). The number of green sturgeon accessing the upper Sacramento River appears to have increased following the decommissioning of RBDD (Steel et al. 2019).

Green sturgeon from the Sacramento River are genetically distinct from their northern counterparts, indicating a spawning fidelity to their natal rivers (Israel et al. 2004), even though individuals can range widely (Lindley et al. 2008). Larval green sturgeon have been regularly captured during their dispersal stage at about 2 weeks of age (24–34 mm [0.95–1.34 inches] fork length) in rotary screw traps at RBDD (California Department of Fish and Game 2002:7) and at about 3 weeks old when captured at the Glenn-Colusa Irrigation District (GCID) intake (Van Eenennaam et al. 2001). Young green sturgeon appear to rear for the first 1 to 2 months in the Sacramento River between Keswick Dam and Hamilton City (California Department of Fish and Game 2002:21).

The current population status is unknown (Beamesderfer et al. 2007; Adams et al. 2007). A genetic analysis of green sturgeon larvae captured in the Sacramento River resulted in an estimate of the number of adult spawning pairs upstream of RBDD ranging from 10 to 28 individuals between 2002 and 2006 (Israel and May 2010). Using results from acoustic telemetry and dual-frequency identification sonar (DIDSON) studies to locate green sturgeon in the Sacramento River to derive an adult spawner abundance estimate of 2,106 fish (95% confidence interval = 1,246–2,966), Mora et al. (2018) applied a conceptual demographic structure to the adult population estimate and generated a subadult Southern DPS green sturgeon population estimate of 11,055 (95% confidence interval = 6,540–15,571), together with an estimate of 4,387 juveniles (95% confidence interval = 2,595–6,179). It should be noted that the estimate does not include spawning adults in the lower Feather or Yuba Rivers (National Marine Fisheries Service 2019), with spawning confirmed in the Feather River (Seesholtz et al. 2015) and Yuba River (National Marine Fisheries Service 2018). Mora et al. (2018) cautioned that their juvenile and subadult green sturgeon estimates are less reliable than their adult estimates because the former were based on the ratios from a modeling study; the percentage of juvenile sturgeon is particularly uncertain because so little is known about this life

stage. Additionally, the modeling study upon which the juvenile and subadult estimates are based requires four assumptions that Mora et al. (2018) admitted are rarely met: (1) constant recruitment, (2) population equilibrium, (3) stable size and age structure, and (4) a lack of density dependence. Mora et al. (2018) suggested, however, that their study provided a rough estimate of total abundance that is suitable for assessing the impacts of take, such as that observed in coastal trawl fisheries and at large water diversions.

NMFS (2009) noted that, similar to winter-run Chinook salmon, the restriction of spawning habitat for green sturgeon to only one reach of the Sacramento River increases the vulnerability of this spawning population to catastrophic events, which is one of the primary reasons that the Southern DPS of green sturgeon was federally listed as a threatened species in 2006. However, there is evidence that green sturgeon spawn in the Feather River, although perhaps irregularly (Seesholtz et al. 2015).

Southern DPS North American green sturgeon are thought to have historically spawned in the Sacramento, Feather, and San Joaquin Rivers (Adams et al. 2007). Mora et al. (2009) estimated that large dams had blocked access to Keswick Dam blocks access to approx. 39 ± 14 km of habitat in the Pit, McCloud and Little Sacramento Rivers, Nimbus Dam blocks access to approx. 22 ± 8 km of habitat in the American River, Oroville Dam blocks access to approx. 16 ± 4 km of habitat in the Feather River, Friant Dam blocks approx. 12 ± 4 km of habitat in the San Joaquin River and Daguerre Dam blocks approx. 4 ± 2 km of habitat in the Yuba River. After hatching, green sturgeon larvae possess limited swimming ability and generally seek refuge in low-velocity and complex habitats, such as large cobble substrate (Kynard et al. 2005). While little is known about green sturgeon rearing, it is likely that juveniles rear near spawning habitat for a few months or more before migrating to the Delta (Heublein et al. 2017a:15).

Green sturgeon are also present in the San Joaquin River, but at considerably lower numbers than white sturgeon. Between 2007 and 2012, anglers reported catching six green sturgeon in the San Joaquin River (Jackson and Van Eenennaam 2013). In 2017, environmental DNA testing confirmed the identity of a green sturgeon observed in the Stanislaus River at Knights Ferry. Although the reported presence of green sturgeon in the San Joaquin River coincides with the spawning migration period of green sturgeon within the Sacramento River, no evidence of spawning has been detected (Jackson and Van Eenennaam 2013).

General life stage timing for Southern DPS green sturgeon is summarized in Tables 4.4.5-1 and 4.4.5-2.

**Table 4.4.5-1. Temporal Occurrence of Southern Distinct Population Segment Green Sturgeon by Life Stage**

| | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | | Dec | |
| **Life-Stage: (a) Adult-sexually mature** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sac River (river mile 332.5-451) | L | L | L | L | M | M | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | M | M | M |
| Sac River (<river mile 332.5) | L | L | L | M | M | M | M | M | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L |
| Sac-SJ-SF Estuary | L | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | L | L |

| Location | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | | Sep | | Oct | | Nov | | Dec | |
| **(b) Larva** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sac River (<River mile 332.5) | N | N | N | N | N | L | M | M | H | H | H | H | H | H | M | M | M | M | L | L | N | N | N | N |
| **(c) Juvenile (≤5 months old)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sac River (<river mile 332.5) | N | N | N | N | N | N | N | L | M | M | M | M | H | H | H | H | H | H | H | M | M | M | M | M |
| **(d) Juvenile (≤5 months old)** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sac River (<river mile 391) | M | M | M | M | L | L | L | L | L | L | L | M | M | M | M | H | H | H | H | H | H | H | H | L |
| **(e) Subadults and Non-spawning adults** | | | | | | | | | | | | | | | | | | | | | | | | |
| Sac-SJ-SF Estuary | M | M | M | M | M | M | M | M | M | M | H | H | H | H | H | H | H | H | H | H | H | H | M | M |
| Pacific Coast | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M |
| Coastal Bays & Estuaries | M | M | M | M | M | M | M | M | M | M | H | H | H | H | H | H | H | H | H | H | H | H | M | M |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.
Source: National Marine Fisheries Service 2019:113–114.

**Table 4.4.5-2. Temporal Occurrence of Southern Distinct Population Segment Green Sturgeon by Life Stage in the Delta**

| Life Stage | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Adult | M | M | M | M | M | M | M | M | M | M | M | M |
| Juvenile | M | M | M | M | M | M | M | M | M | M | M | M |
| Salvaged | L | L | L | L | L | N | M | H | L | L | L | L |

Relative Abundance: H=High (blue), M=Medium (green), L=Low (yellow), N=None.
Source: National Marine Fisheries Service 2019:115.

### 4.4.5.3 Critical Habitat

On October 9, 2009, NMFS designated critical habitat for the Southern DPS of North American green sturgeon. In the Central Valley, critical habitat for green sturgeon includes the Sacramento River downstream of Keswick Dam, the Feather River downstream of Fish Barrier Dam, the Yuba River downstream of Daguerre Point Dam, a portion of the lower American River, the Sutter and Yolo Bypasses, the Delta, and the San Francisco Estuary (74 FR 52300). Critical habitat also includes marine waters (out to the 60-fathom depth bathymetry line, relative to Mean Low Water) and several coastal bays and estuaries extending from Monterey Bay, California, northward to the Strait of Juan de Fuca, Washington (74 FR 52300).

NMFS has outlined specific PBFs essential for the conservation of the Southern DPS in freshwater riverine systems, estuarine areas, and coastal marine areas (74 FR 52300).

Freshwater riverine systems:

- Food resources—Abundant prey items for larval, juvenile, subadult, and adult life stages.
- Substrate type or size—Substrates suitable for egg deposition and development (e.g., bedrock sills and shelves, cobble and gravel, or hard clean sand, with interstices or irregular surfaces to

"collect" eggs and provide protection from predators, and free of excessive silt and debris that could smother eggs during incubation), larval development (e.g., substrates with interstices or voids providing refuge from predators and from high-flow conditions), and subadults and adults (e.g., substrates for holding and spawning).

- Water flow—A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages.
- Water quality—Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
- Migratory corridor—A migratory pathway necessary for the safe and timely passage of Southern DPS fish within riverine habitats and between riverine and estuarine habitats (e.g., an unobstructed river or dammed river that still allows for safe and timely passage).
- Depth—Deep (≥5 meters) holding pools for both upstream and downstream holding of adult or subadult fish, with adequate water quality and flow to maintain the physiological needs of the holding adult or subadult fish.
- Sediment quality—Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

Estuarine habitats:

- Food resources—Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages.
- Water flow—Within bays and estuaries adjacent to the Sacramento River (i.e., the Delta and the Suisun, San Pablo, and San Francisco Bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.
- Water quality—Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
- Migratory corridor—A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats.
- Depth—A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages.
- Sediment quality—Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

Nearshore coastal marine areas:

- Migratory corridor—A migratory pathway necessary for the safe and timely passage of Southern DPS fish within marine and between estuarine and marine habitats
- Water quality—Nearshore marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon.
- Food resources—Abundant prey items for subadults and adults, which may include benthic invertebrates and fishes.

# 4.4.6 Killer Whale, Southern Resident DPS

## 4.4.6.1 Legal Status and Distribution

This species account was adapted from the DWR (2020a) Final EIR for Long-Term Operation of the SWP. Southern resident killer whales are found primarily in the coastal waters offshore of British Columbia, and Washington and Oregon in summer and fall (National Marine Fisheries Service 2008). During winter, Southern Resident killer whales are sometimes found off the coast of central California and more frequently off the Washington coast (Hilborn et al. 2012).

The 2005 listing (70 FR 69903) of Southern Resident DPS killer whale as endangered lists several factors that may be limiting the recovery of killer whales, including the quantity and quality of prey, accumulation of toxic contaminants, and sound and vessel disturbance. The *Recovery Plan for Southern Resident Killer Whales* (National Marine Fisheries Service 2008) posits that reduced prey availability forces whales to spend more time foraging, which may lead to reduced reproductive rates and higher mortality rates. Reduced food availability may lead to mobilization of fat stores, which can release stored contaminants and adversely affect reproduction or immune function (National Marine Fisheries Service 2008).

## 4.4.6.2 Life History and Habitat Requirements

The Independent Science Panel reported that Southern Resident killer whales depend on Chinook salmon as a critical food resource (Hilborn et al. 2012). Hanson et al. (2010) analyzed tissues from predation events and feces to confirm that Chinook salmon were the most frequent prey item for the Southern Resident killer whale in two regions of the whale's summer range off the coast of British Columbia and Washington State, representing more than 90% of the diet in July and August. Samples indicated that when Southern Resident killer whales are in inland waters from May through September, they consume Chinook salmon stocks that originate from regions that include the Fraser River, Puget Sound, the Central British Columbia Coast, West and East Vancouver Island, and California's Central Valley (Hanson et al. 2010).

Significant changes in food availability for Southern Resident killer whale have occurred over the past 150 years, largely due to human impacts on prey species. Salmon abundance has been reduced over the entire range of Southern Resident killer whale, from British Columbia to California. NMFS (2008) indicates that wild salmon have declined primarily due to degraded aquatic ecosystems, overharvesting, and production of fish in hatcheries. NMFS (2008) supports restoration efforts, including habitat, harvest, and hatchery management considerations, and continued use of existing NMFS authorities under the ESA and Magnuson-Stevens Fishery Conservation and Management Act to ensure an adequate prey base.

Central Valley streams produce Chinook salmon that contribute to the diet of Southern Resident killer whale. The number of Central Valley Chinook salmon that annually enter the ocean and survive to a size susceptible to predation by Southern Resident killer whale is not known. NMFS (2019:131) reviewed available information from sources such as fishery harvest, escapement data, and diet studies for Chinook salmon stocks on the West Coast and concluded that Central Valley Chinook salmon constitute a sizable percentage of Chinook salmon that would be expected to be encountered by Southern Resident killer whale in coastal waters off California and Oregon, and at least a small portion of Chinook salmon in the ocean as far north as British Columbia. As summarized by NMFS (2019:132–133), a recent report evaluated 30 stocks of West Coast Chinook

salmon for recovery priority to increase Southern Resident killer whales' prey base, based on each stock's contribution to diet, degree of spatiotemporal overlap, and whether it would be consumed during times of killer whale reduced body condition or diversified diet. Central Valley stocks ranked 13 (spring-run Chinook salmon), 16 (fall and late fall–run Chinook salmon), and 21 (winter-run Chinook salmon) (National Marine Fisheries Service and Washington Department of Fish and Wildlife).

#### 4.4.6.3 Critical Habitat

Critical habitat for the Southern Resident DPS was designated under the ESA on November 29, 2006 (71 FR 69054). The critical habitat designation encompasses the Summer Core Area in Haro Strait and the waters around the San Juan Islands, the Strait of Juan de Fuca, and all of Puget Sound (Figure 4.4.6-1) but does not include any areas in California.

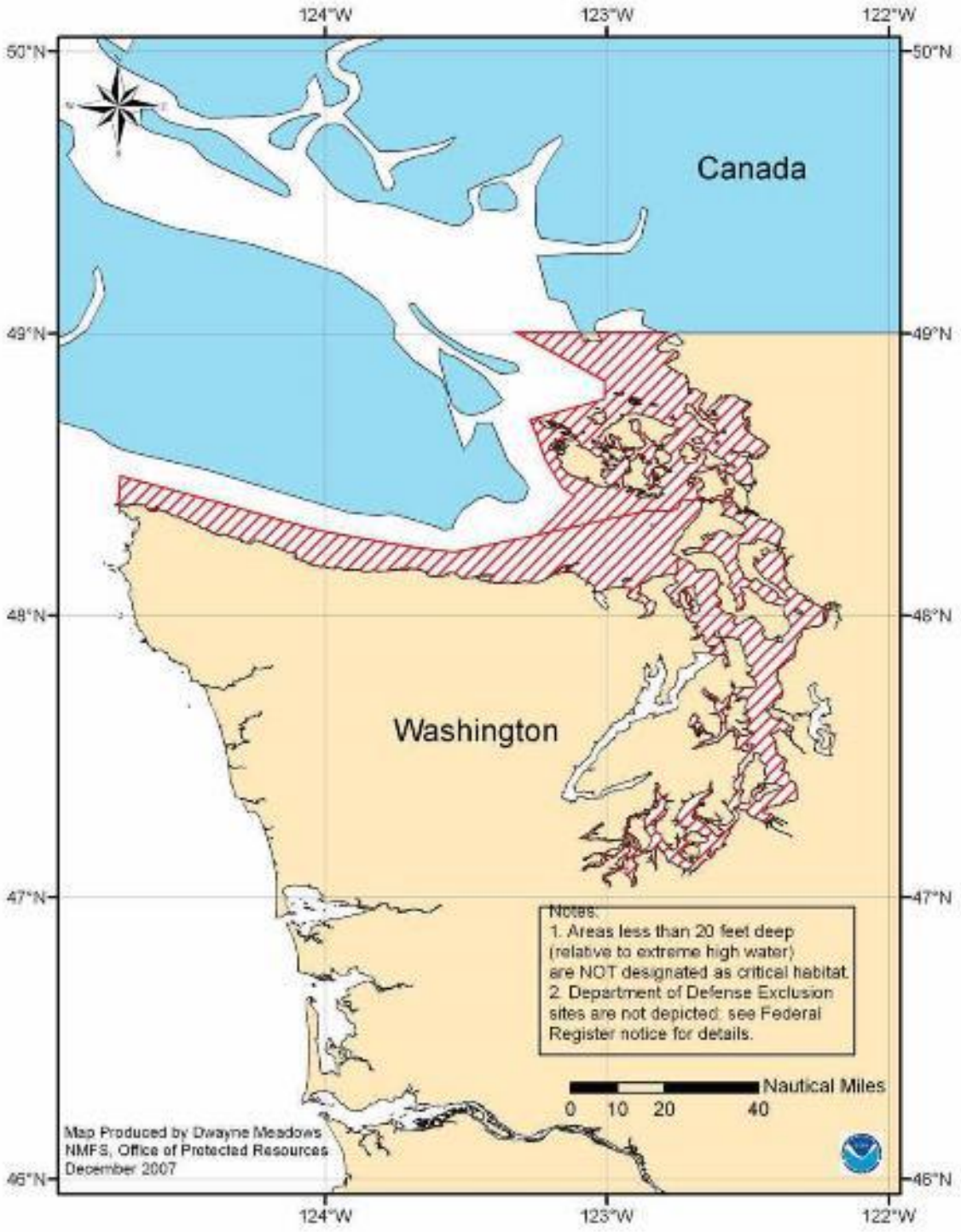



**Figure 4.4.6-1. Southern Resident Killer Whale Critical Habitat**

The critical habitat designation identified the following primary constituent elements considered essential for the conservation.

- Water quality to support growth and development.

- Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth.
- Passage conditions to allow for migration, resting, and foraging.

The Center for Biological Diversity proposes that the critical habitat designation be revised and expanded to include the addition of the Pacific Ocean region between Cape Flattery, Washington, and Point Reyes, California, extending approximately 47 miles (76 km) offshore. Based on new information, NOAA Fisheries intends to proceed with the petitioned action to revise critical habitat for Southern Resident Killer Whales (80 FR 9682).

## 4.4.7 Delta Smelt

### 4.4.7.1 Legal Status and Distribution

Delta smelt (*Hypomesus transpacificus*) was listed as a threatened species under the CESA and ESA in 1993 (58 *Federal Register* [FR] 12854) and USFWS designated critical habitat for the species in December 1994 (59 FR 65256). A 12-month finding on a petition to reclassify the delta smelt as an endangered species was completed on April 7, 2010. After reviewing all available scientific and commercial information, USFWS determined that reclassifying the delta smelt from threatened to endangered was warranted but was precluded by other higher priority listing actions (U.S. Fish and Wildlife Service 2010a). The recommendation of reclassifying delta smelt to endangered from threatened was confirmed by USFWS in November 2020, with USFWS noting that reclassifying the species to endangered status will not substantively increase protections for the delta smelt, but rather more accurately classify the species given its current status (85 FR 73175). As of May 3, 2022, the USFWS has declared that, although the species may warrant reclassification to endangered, due to its current protections of threatened, it will not be reclassified (87 FR 26172). An emergency petition was filed in February 2007 with the California Fish and Game Commission to elevate the status of delta smelt from threatened to endangered under the CESA (Bay Institute et al. 2007), with reclassification to endangered occurring in 2009.

Delta smelt are endemic to the San Francisco Estuary and Delta where the species primarily occupies open-water habitats in Suisun Bay, Suisun Marsh, and the Delta. On occasion, delta smelt distribution can extend up the Sacramento River to about Garcia Bend in the Pocket neighborhood of Sacramento, up the San Joaquin River from Antioch to areas near Stockton, up the lower Mokelumne River system, and west throughout the Napa River and San Francisco Bay. Delta smelt is primarily an annual species, completing its life cycle in 1 year, which typically occurs from April to the following April. In captivity, delta smelt can survive to spawn at 2 years of age (Lindberg et al. 2013), but age-2 delta smelt are now rare in the wild (Bennett 2005; Damon et al. 2016).

### 4.4.7.2 Life History and Habitat Requirements

Delta smelt complete their entire life cycle within the low-salinity zone of the Upper San Francisco Estuary, in the Napa River and in the tidal freshwater region of the Cache Slough Complex or move between the two regions of fresh water and low salinity (Bennett 2005; Sommer and Mejia 2013; Hobbs et al. 2019).[5] Komoroske et al. (2016) found that delta smelt can acclimate to salinities

[5] The low-salinity zone is frequently defined as waters with a salinity range of about 0.5 to 6 parts per thousand (Kimmerer 2004). As discussed further below, delta smelt are not solely restricted to the low-salinity zone.

greater than 6 ppt in the laboratory, but observations of delta smelt presence in waters having salinities exceeding 6 ppt in the wild are comparatively rare (92% of fish caught are at salinity <6 ppt; Komoroske et al. 2016). This could be because the osmoregulatory costs at such high salinities are too high to support growth and survival (Komoroske et al. 2016), or the discrepancy between field observations and laboratory observations may be evidence that delta smelt's distribution in the wild is due to a factor or factors other than salinity per se (U.S. Fish and Wildlife Service 2019a:122).

Although delta smelt are physiologically euryhaline (i.e., are able to tolerate 0.4 – 34.0 ppt), the cumulative costs associated with physiological adjustments required to achieve homeostasis across a large, fluctuating salinity gradient may be higher than the continual maintenance cost for homeostasis within the low-salinity zone (Komoroske et al. 2016:976).

Delta smelt spawning may occur at night with several males attending a female that broadcasts her eggs onto bottom substrate (Bennett 2005; Lindberg et al. 2020; Tsai et al. 2021a, 2021b). Although preferred spawning substrates are unknown, spawning habits of the delta smelt's closest relative, surf smelt (*Hypomesus pretiosus*), in addition to experimental trials, suggest that sand or small pebbles may be the preferred substrate (Bennett 2005; Lindberg et al. 2020). Hatching success peaks at water temperatures of 15 degrees Celsius (°C) to 16°C, ceasing when water temperatures exceed 20°C (60°F) (Bennett 2005). Water temperatures suitable for spawning occur most frequently during the months of March to May, but ripe female delta smelt have been observed as early as January and larvae have been collected as late as July (Damon et al. 2016). Most spawning occurs at 9°C to 18°C (48.2°F to 64.4°F) (Damon et al. 2016). Delta smelt appear to have one spawning season for each generation, which makes the timing and duration of the spawning season important every year. Damon et al. (2016) found all pre-spawn females achieved spawning size around April, which would result in only one spawn per female, with subsequent spawning events being rare except in exceptional years when the thermal spawning window extends past May. Kurobe et al. (2016) found that eggs (oocytes) matured from February to April during their study from November 2011 through April 2012. Prior studies suggested that spawning locations change based on hydrological conditions (reviewed by Bennett 2005:13). However, a more recent study indicated that the majority of regional movement from juvenile and subadult rearing locations to spawning areas occurs by January, spawning habitat locations are relatively constant within and between years, and no substantial further restructuring of the population at regional scales occurs after fish move to spawning locations (Polansky et al. 2018). The main spawning locations are in the lower Sacramento and San Joaquin Rivers, as well as the north Delta including the Cache Slough complex and Sacramento Deep Water Ship Channel (Polansky et al. 2018).

Although adult delta smelt can spawn more than once, as noted above, most spawning is complete by the time water temperature reaches 18°C (64.4°F) (Damon et al. 2016). The egg stage averages about 10 days before the embryos hatch into larvae (Bennett 2005). The larval stage averages about 30 days. Metamorphosing post-larvae appear in monitoring surveys from April into July of most years (Bennett 2005). By July, most delta smelt have reached the juvenile life stage. Delta smelt collected during the fall are considered subadults. Sampling for adult delta smelt by the Spring Kodiak Trawl survey begins in January, which generally aligns with the time period at which maturity is reached (Kurobe et al. 2016). Many delta smelt disperse to landward[6] habitats sometime after the first significant precipitation event of the winter, staging while sexual maturity is completed (Grimaldo et al. 2009; Sommer et al. 2011; Polansky et al. 2018). Some adult delta smelt

[6] Note that "landward" in this context does not necessarily mean "upstream," as there could be lateral movements (Murphy and Hamilton 2013).

exhibit very limited dispersal during the spawning season (Murphy and Hamilton 2013; Polansky et al. 2018).

In the wild, larval delta smelt are presumed to be surface-oriented, exhibiting greater dispersion during the night (Bennett 2005). Juvenile delta smelt vary their position in the water column with respect to tides, water quality and bathymetry; presumably these movements facilitate maintenance in favorable habitats (Feyrer et al. 2013). Adult delta smelt appear to use tidal migration and/or move horizontally toward shore during spawning migrations to upstream habitats (Bennett and Burau 2015). Laboratory studies of delta smelt of 32–68 millimeters (mm) standard length (SL) gave mean critical swimming velocity of around 28 centimeters (cm) per second, generally comparable to other fishes of similar size (Swanson et al. 1998).

From March through June, larval delta smelt rely heavily first on juvenile and then adult stages of the calanoid copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi*, as well as cladocerans (Nobriga 2002; Hobbs et al. 2006; Slater and Baxter 2014), and *Sinocalanus doerrii*. Nobriga (2002) found that delta smelt larvae expressed positive selection for *E. affinis* and *P. forbesi*, consuming these prey species in greater proportion than available in the environment. Such selection was not noted for other zooplankton prey. Regional differences in food use occur, with *E. affinis* and *P. forbesi* being major prey items downstream in the low-salinity zone with a transition to *S. doerrii* and cyclopoid copepods as major prey items upstream into the Cache Slough Complex. Juvenile delta smelt (June through September) rely extensively on calanoid copepods such as *E. affinis* and *P. forbesi*, especially in fresh water (salinity <1 ppt) and the Cache Slough Complex, but there is great variability among regions (Interagency Ecological Program, Management Analysis, and Synthesis Team 2015). Larger fish are also able to take advantage of mysids, cladocerans, and amphipods (Moyle et al. 1992; Lott 1998; Feyrer et al. 2003; Slater et al. 2019). The presence of several epibenthic species in diets therefore indicates that food sources for this species are not solely connected to pelagic pathways.

The California Department of Fish and Wildlife (CDFW) conducts three annual fish surveys (20-mm Survey, Summer Townet Survey, and Fall Midwater Trawl Survey) from which it develops indices of delta smelt's relative abundance. Each survey has variable capture efficiency (Mitchell et al. 2017), and in each, the frequency of zero catches of delta smelt is very high, largely due to the species' rarity (Latour 2016; Polansky et al. 2018) or because the surveys are carried out independent of other factors that affect catch, such as tide (Bennett and Burau 2015) and channel location (Feyrer et al. 2013). In addition, detection probability decreases with increasing water clarity (Peterson and Barajas 2018) and relatively high numbers of delta smelt may occur in areas without long-term sampling stations (Murphy and Weiland 2019). Mahardja et al. (2017) found high detection probability of delta smelt larvae/early juveniles by the 20-mm survey at the level of replication (three samples) at each site.

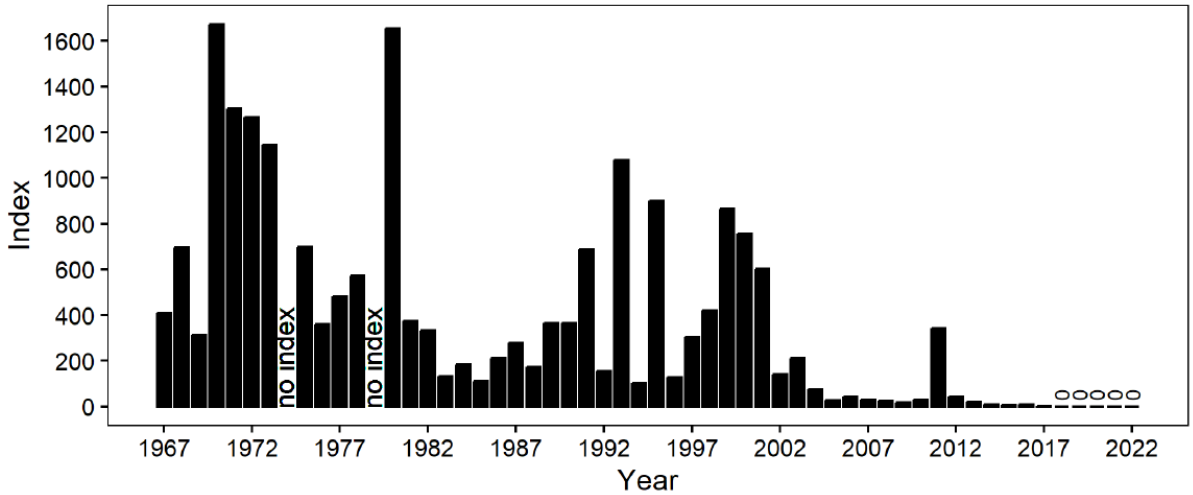
USFWS implemented a new smelt monitoring program in 2016, called the Enhanced Delta Smelt Monitoring program. This new program is used to measure the abundance and distribution of all life stages of delta smelt using a generalized random tessellation stratified design. Delta smelt population estimates are now derived from this survey.

The distribution of the delta smelt population varies with life stage, season, and environmental conditions (Bennett 2005; Sommer and Mejia 2013; Murphy and Hamilton 2013; Hobbs et al. 2019). Subadult and adult delta smelt typically make landward movements soon after "first flush" periods of initial winter precipitation and runoff, when turbidities elevate over 10 Nephelometric Turbidity

Units (NTU) (Grimaldo et al. 2009). During extreme wet years, some adults may move seaward into San Francisco Bay and the Napa River (see summary by Sommer and Mejia 2013). Larval delta smelt can be broadly distributed depending on hydrologic conditions during March and April. During wet years, larval delta smelt are generally distributed farther seaward than in drier years (Sommer and Mejia 2013). In contrast, during drier years, larval delta smelt are more upstream and in greater abundance in the Delta (Sommer and Mejia 2013). Juvenile delta smelt distribution is generally centered in the "North Delta Arc" (see Moyle et al. 2018:44), which extends from Cache Slough to Suisun Bay and Suisun Marsh (Merz et al. 2011; Murphy and Hamilton 2013).

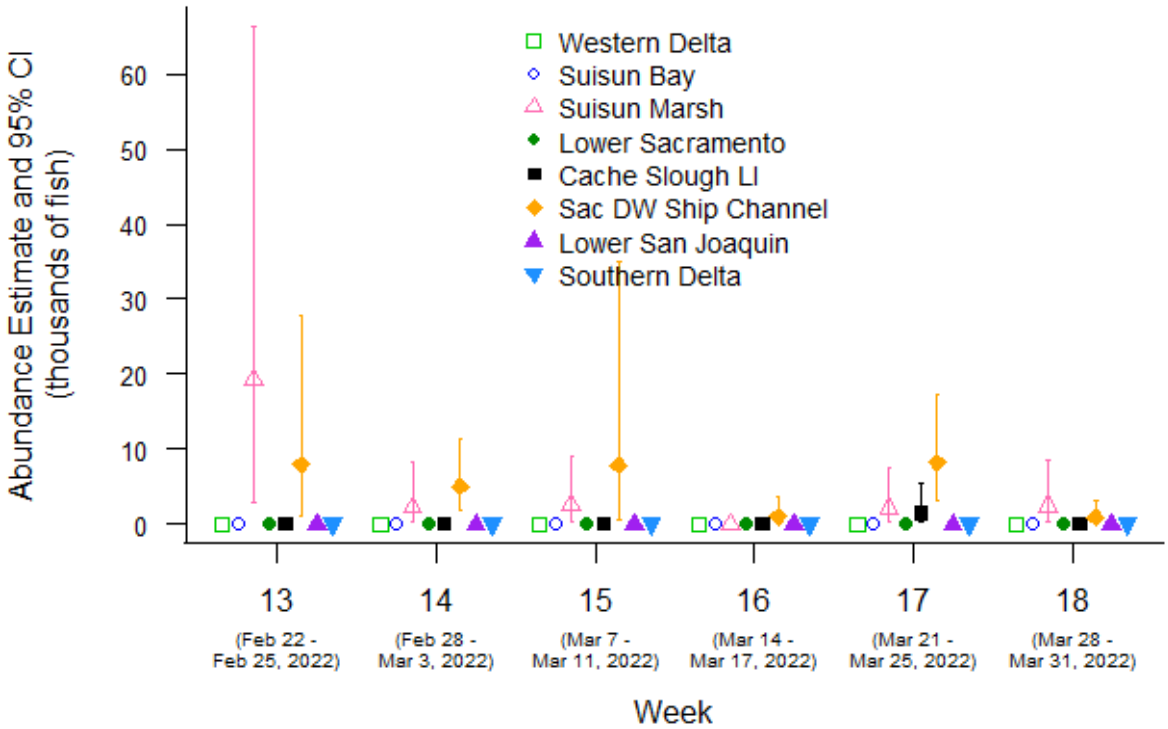
Trawl abundance indices indicate that the relative abundance of delta smelt has declined substantially since the 1980s. The observed decline in delta smelt abundance is generally consistent with declines of other pelagic species (longfin smelt and juvenile striped bass [*Morone saxatilis*]) in the Delta (Sommer et al. 2007; Baxter et al. 2010; Stompe et al. 2020).

The CDFW Fall Midwater Trawl (FMWT) Delta Smelt annual abundance index has been zero every year from 2018 through 2022 (Water Years 2019–2023), the lowest on record (Figure 4.4.7-1). All CDFW relative abundance indices show a declining trend since the early 2000s. USFWS implemented a new smelt monitoring program in 2016, called the Enhanced Delta Smelt Monitoring program. This new program is used to measure the abundance and distribution of all life stages of delta smelt using a generalized random tessellation stratified design. Delta smelt population estimates are now derived from this survey, with abundance suggested to be several thousand fish or fewer in recent years (see Figure 4.4.7-2 for 2022 as an example).




Source: White (2022).

**Figure 4.4.7-1. Time Series of the Fall Midwater Trawl Water Years 1967–2022 Abundance Index for Delta Smelt**




Source: U.S. Fish and Wildlife Service 2022a.

**Figure 4.4.7-2. Abundance Estimates for Delta Smelt from Enhanced Delta Smelt Monitoring Program Phase 1, Weeks 13–18, Water Year 2022**

The continued low spawning stock of Delta Smelt relative to historical numbers suggests the population would continue to be vulnerable to stochastic events and continued human-caused alteration of the Delta. As described in detail by CDFW (2021:10), the Experimental Release of Delta Smelt Project proposes to annually release up to 60,000 adult equivalents of surplus hatchery-origin delta smelt each year into a portion of the current range of the species for a 3-year period (2021–2024). For example, in water year 2023, nearly 44,000 marked delta smelt reared at the UC Davis Fish Conservation and Culture Laboratory were released into the Sacramento River at Rio Vista and the Sacramento Deep Water Ship Channel during late November and mid to late January (Columbia Basin Research, University of Washington 2023). The purpose of the Experimental Release of Delta Smelt Project is as part of an early experimental release effort to inform the feasibility of potential future supplementation efforts. The hatchery delta smelt are propagated at the University of California Davis Fish Conservation and Culture Laboratory in Byron, California. Considerable progress has been made on estimating absolute abundance of delta smelt, including adults (Polansky et al. 2019). These estimates are affected by factors such as fish behavior and local habitat features, such as turbidity influencing catchability (Polansky et al. 2019:721–722). However, turbidity may only have limited effects on catchability according to a recent simulation analysis (Tobias 2021). The continued low spawning stock of delta smelt relative to historical estimates suggest the population continues to be vulnerable to key threats (described below), especially when these stressors are occurring in consecutive years (e.g., drought) or across sequential life stages (e.g., high water temperatures).

Delta smelt are believed to be limited by a number of stressors, including water temperature, water quality, prey availability, entrainment at water diversions, increasing frequency and duration of

droughts and contaminants (Sommer et al. 2007; Miller et al. 2012; Wagner et al. 2011; Interagency Ecological Program Management Analysis and Synthesis Team 2015; Fong et al. 2016; Hamilton and Murphy 2020). Since 2010, several conceptual models (Interagency Ecological Program Management Analysis and Synthesis Team 2015) and empirical models (Thomson et al. 2010; Maunder and Deriso 2011; Miller et al. 2012; Rose et al. 2013a; Hamilton and Murphy 2018) have explored life cycle models for the delta smelt to identify and describe the reasons for the population decline. Some of these models have recreated a trend observed in abundance indices, but each model has applied different methodology and predictive covariates. Collectively, these modeling efforts generally support water temperature, water clarity, and prey availability as key factors that limit delta smelt populations, but water diversions and predation may also have significant impacts as well. The threats discussed below may be directly or indirectly affected by water operations.

All life stages of delta smelt are vulnerable to entrainment at the south Delta export facilities. In general, delta smelt salvage increases when certain conditions co-occur, principally when adult delta smelt move into the south Delta, when turbidity exceeds 10 to 12 NTU, and with increasing net OMR flow reversal (i.e., more negative net OMR flows) (Grimaldo et al. 2021). However, delta smelt movement leading to entrainment cannot only be predicted by migration, turbidity and OMR flows, but is complicated by unknown behaviors and needs further study (Smith 2019). Based on field and salvage data, Kimmerer (2008, 2011) calculated that from near 0% to 25% of the larval and juvenile delta smelt population and from 0% to 38% of the adult delta smelt population can be entrained at the CVP and SWP annually, in years with periods of high exports. Methods to calculate proportional loss estimates have been debated (Kimmerer 2011; Miller 2011) and work on entrainment estimation has continued (e.g., Smith 2019; Smith et al. 2020). Korman et al. (2021) provided preliminary estimates that adult delta smelt entrainment loss in 2002 was 35%, more than double the original estimate from Kimmerer (2008). Modeling efforts suggest that entrainment losses have the potential to adversely affect the delta smelt population (Kimmerer 2011; Rose et al. 2013a, 2013b; Kimmerer and Rose 2018), reflecting historical estimates of entrainment that were episodically high (Kimmerer 2008). More recently, delta smelt salvage has decreased due to declining abundance and salvage may no longer reflect the number of fish entrained in the south Delta or that enter the CVP and SWP fish facilities (U.S. Fish and Wildlife Service 2019a). Data on the distribution of the population (see Murphy and Hamilton 2013) suggest that entrainment is likely to be at the low end of the estimated range in most years. As a result of investigations into entrainment loss, entrainment risk has been limited by restrictions on export pumping (e.g., U.S. Fish and Wildlife Service 2008:280–282; U.S. Fish and Wildlife Service 2019a:40–49).

Delta smelt are most vulnerable to entrainment when, as adults, they move from brackish water into fresh water or as larvae, when they move from fresh water in the southern and central Delta into the brackish water of Suisun Bay. While some delta smelt live year-round in fresh water far from the CVP and SWP, most rear in the low-salinity regions of the estuary, also at a relatively safe distance from the SWP and CVP pumps. The timing, direction, and geographic extent of the spawning movements of adult delta smelt affect their entrainment risk (Sweetnam 1999; Sommer et al. 2011). Unlike the years prior to the 1990s, when high salvage of adult and juvenile delta smelt occurred at high, intermediate, or low export levels, the risk of entrainment for fish that move into the central Delta and south Delta is currently highest when net Delta outflow is at intermediate levels (about 20,000 to 75,000 cfs, turbidity is greater than 12 NTU in the Delta (U.S. Fish and Wildlife Service 2019a),and OMR flow is more negative than -5,000 cfs (U.S. Fish and Wildlife Service 2008). In contrast, when adult delta smelt move upstream to the Sacramento River and into the Cache Slough region or do not move upstream at all, entrainment risk is appreciably lower. During extreme wet

years, very few delta smelt (all life stages) are salvaged because the distribution shifts seaward away from the footprint of the SWP and CVP and because there is relatively less hydrodynamic influence of the south Delta export facilities (i.e., greater OMR flow; Grimaldo et al. 2009). Hierarchical modeling has recently been developed in order to characterize the potential for south Delta entrainment losses of vulnerable delta smelt life stages (Smith 2019; Smith et al. 2020). Smith (2019) estimated adult delta smelt south Delta entrainment loss during 1994 through 2016 to range from 53 fish in 2014 to just over 119,000 fish in 2004. Smith et al. (2020) estimated post-larval delta smelt south Delta entrainment loss during April–June 1995 through 2015 to range from less than 500 fish in 1995 to over 800,000 fish in 2002. Overall, delta smelt salvage has decreased since 2005 (U.S. Fish and Wildlife Service 2019a).

The Interagency Ecological Program (IEP) Management Analysis and Synthesis Team (MAST) delta smelt conceptual model report found statistically significant relationships of spring Delta outflow (represented by X2, which is the distance in kilometers from the Golden Gate Bridge to the point where the salinity on the bottom is 2 ppt) and prior indices of parental stock (FMWT or SKT indices) as predictors of larval/early juvenile delta smelt 20-mm Survey abundance indices for the post-Pelagic Organism Decline (Sommer et al. 2007) era (Interagency Ecological Program Management Analysis and Synthesis Team 2015:153–162). This report stressed that the "results are preliminary and included for illustrative purposes only; peer-reviewed publications of these analyses need to be completed before they can be used to draw any conclusions" (Interagency Ecological Program Management Analysis and Synthesis Team 2015:152). In contrast, more recent, peer-reviewed results from statistical population dynamics modeling by Polansky et al. (2021) did not find a well-supported link between March–May outflow and delta smelt recruitment.

During the late summer and fall, Delta outflow affects the location of the low-salinity zone within the upper estuary landscape. Higher Delta outflows (or low X2) expand the low-salinity zone, while lower outflows constrict the extent of the low-salinity zone (Feyrer et al. 2011; Bever et al. 2016). During the summer and fall, it has been hypothesized that environmental conditions improve for delta smelt as X2 moves seaward and the low-salinity zone expands habitat area (Interagency Ecological Program Management Analysis and Synthesis Team 2015). The overlap of the low-salinity zone with Suisun Marsh/Bay results in a considerable increase in a habitat index calculated by Feyrer et al. (2011). However, others (e.g., Manly et al. 2015) have questioned the use by Feyrer et al. (2011) of outflow and X2 location as an indicator of delta smelt habitat because other factors may be influencing survival. Some analyses have shown no relationship of fall X2 (ICF 2017b) or the volume of the low-salinity zone (Polansky et al. 2021) with juvenile delta smelt abundance/survival, whereas Polansky et al. (2021) found some evidence for lower fall X2 being positively related with delta smelt recruitment in the following spring. Polansky et al. (2021) did not find statistical support for volume of the low-salinity zone to be related to juvenile delta smelt survival (generally similar to the finding by Kimmerer et al. 2013), but did find the previous fall's mean X2 to be statistically supported as a potential negative influence on delta smelt recruitment. Murphy and Weiland (2019) found that the low-salinity zone is not a reliable indicator of delta smelt habitat and reported that delta smelt can be found in the lower Sacramento River, east of the Delta in largely freshwater conditions, as well as in western regions of the Delta, such as Suisun Bay, where salinity levels are typically higher. As both these conditions bound the range of the species, X2 does not determine the location of other important resources such as food or predators and therefore is not, by itself, a reliable surrogate for delta smelt habitat. Recent work suggested that summer/early fall Delta outflow provides a *P. forbesi* subsidy from the upper Delta to the western portion of the low-salinity zone (Kimmerer et al. 2018; Hamilton et al. 2020), resulting in low prey abundance in the low-

salinity zone, where mortality rate is high because of clam grazing; without subsidy from the Delta, abundance of *P. forbesi* would be zero (Kimmerer et al. 2019). Kimmerer et al. (2018) did not find a statistically significant relationship between *P. forbesi* density in the Delta and Delta outflow, whereas Hamilton et al. (2020) found statistically significant decreases in mean total copepod biomass with increasing September/October flow during higher flow conditions at most monitoring locations they examined in the San Francisco Estuary and Delta (discussed further below). Detailed examination of a fall flow action in 2017 did not provide evidence for an increase in delta smelt prey with increased outflow resulting in X2 farther downstream (Schultz et al. 2019). Variability in water temperature and turbidity are primarily driven by climate, but in general, Suisun Bay and Suisun Marsh tend to support more suitable water temperature and turbidity than the Delta (Nobriga et al. 2008). The Delta Smelt Summer-Fall Habitat Action under SWP/CVP long-term operations (e.g., California Department of Water Resources 2020a) includes reoperation of the Suisun Marsh Salinity Control Gates in order to increase overlap of relatively food-rich areas in Suisun Marsh with low-salinity water for delta smelt.

Delta smelt is considered a pelagic species, and their physical habitat is generally defined by water quality (Bennett 2005; Feyrer et al. 2007; Nobriga et al. 2008) with some association to bathymetric features (Feyrer et al. 2013) and velocity (Bever et al. 2016). Recent analyses indicate water body type and depth are also physical indicators of habitat quality, and seasonal prey density is an indicator of biological habitat quality (Hamilton and Murphy 2020). Feyrer et al. (2013) found that juvenile delta smelt were relatively abundant throughout the water column during flood tides and that during ebb tides they occurred only in the lower half and sides of the water column, suggesting a manipulation of position in the water column to facilitate retention in favorable habitats. Mitchell et al. (2017) sampled subadult delta smelt during flood tides (to maximize catch) and found delta smelt to be more abundant in surface trawl tows than in in oblique trawl tows covering the full water column, suggesting strong surface orientation possibly because of visual feeding; the authors noted that their results applied primarily to flood-tide sampling and that further research is needed to determine whether similar catch patterns occur during ebb tides. Bennett and Burau (2015) sampled delta smelt during the spawning migration and found that delta smelt were caught consistently at the shoal-channel interface during flood tides and near the shoreline during ebb tides in the turbid Sacramento River, with apparent selective tidal movements facilitating either maintenance of position or movement upriver on flood tides and minimizing advection down-estuary on ebb tides. As previously mentioned, after first flush and initial dispersal, adult delta smelt appear to hold their position geographically (Polansky et al. 2018).

Multiple field and modeling studies have established the association between elevated turbidity and the presence and abundance of delta smelt. Sommer and Mejia (2013) and Nobriga et al. (2008) found that late larval and juvenile delta smelt are strongly associated with turbid water, a pattern that continues through fall (Feyrer et al. 2007). Long-term declines in turbidity may also be a key reason that juvenile delta smelt now rarely occur in the south Delta during summer (Nobriga et al. 2008). Thomson et al. (2010) found decreases in turbidity were a significant predictor of delta smelt decline in abundance over time. Grimaldo et al. (2009) found that the presence of adult delta smelt at the fish salvage facilities was linked, in part, with high turbidity associated with first flush events. Recent modeling examining future climate scenarios predicts significant increases in large flow events and sediment loading to the Delta from the Sacramento River over the next century for two representative greenhouse gas concentration pathways, which could increase turbidity (Stern et al. 2020). Turbidity may also serve as a behavioral cue for small-scale (lateral and vertical movements in the water column) and larger-scale (migratory) delta smelt movements (Bennett and Burau

2015). The decline in turbidity appears to be attributable to a decline in sediment supply from upstream, trapping by invasive submerged aquatic vegetation, and a long-term decrease in wind speed (Hestir et al. 2016; Bever et al. 2018). In addition to occurrence, patterns of delta smelt survey catch in relation to turbidity in part may reflect differences in probability of capture, that is, greater ability to avoid capture in clearer water (Latour 2016; Peterson and Barajas 2018), although as previously noted a recent simulation analysis suggested that the effects of turbidity on catchability may be limited (Tobias 2021).

Upper water temperature limits for juvenile delta smelt survival are based on laboratory studies and corroborated by field data. Based on the critical thermal maximum (CTmax) juvenile delta smelt acclimated to 17°C (44.6°F) could not tolerate temperatures higher than 25.4°C (77.7°F) (Swanson et al. 2000). However, for juvenile delta smelt acclimated to 11.9°C, 15.7°C, and 19.7°C (53.4°F, 60.3°F, and 67.5°F), consistently higher CTmax values were estimated—27.1°C, 28.2°C, and 28.9°C (80.8°F, 82.8°F, and 84°F), respectively (Komoroske et al. 2014), which corresponded closely to the maximum water temperatures recorded in the Summer Townet and Fall Midwater Trawl. Swanson et al. (2000) used wild-caught fish, while Komoroske et al. (2014) used hatchery-reared fish, which may have contributed to the differences in results. Based on the Summer Townet Survey (Nobriga et al. 2008) and the 20 mm Survey (Sommer and Mejia 2013), most juvenile delta smelt were predicted to occur in field samples when water temperature was below 25°C (77°F). In a multivariate autoregressive modeling analysis with 16 independent variables, Mac Nally et al. (2010) found that high summer (June through September) water temperature had a negative effect on delta smelt subadult abundance in the fall. Water temperature was also one of several factors affecting delta smelt life stage dynamics in the state-space model of Maunder and Deriso (2011) and in an individual-based delta smelt life cycle model (Rose et al. 2013a, 2013b).

Harmful algal blooms, in particular *Microcystis*, are hypothesized to potentially have negative effects on delta smelt (Brooks et al. 2012). While recent research has resulted in improved understanding of the factors influencing the quantity, toxicity, and location of harmful algal blooms, there are still many uncertainties about their direct and indirect effects on delta smelt relative to other factors and about what can be done to prevent them. There is no routine quantitative monitoring program in place that specifically targets harmful algae. The Summer Townet and Fall Midwater Trawl surveys have included qualitative, visual assessment of *Microcystis* since 2007. Available studies in the Delta suggest that retention time and water temperature are key environmental correlates with *Microcystis* bloom amplitude and that once established, *Microcystis* is likely to be resistant to even very high flows as long as water quality (in particular water temperature) is favorable (Lehman et al. 2020).

Changes in phytoplankton production and phytoplankton species abundances observed and the invasion of *Potamocorbula* (overbite clam, Asian clam, Amur River clam) may have had important consequences for consumer species preyed upon by delta smelt. For example, there has been a decrease in mean zooplankton size (Winder and Jassby 2011) and a long-term decline in calanoid copepods, including a major step-decline in the abundance of the copepod *E. affinis*. These changes are possibly due to predation by *Potamocorbula* (Kimmerer et al. 1994) or to indirect effects of clam grazing on copepod food supply. Predation by *Potamocorbula* may also have been important for other zooplankton species (Kimmerer 2008).

The interaction of *Potamocorbula* grazing with the water's nutrient composition is also thought to have importance for delta smelt prey availability. As summarized by USFWS (2019a:115), diatoms (i.e., phytoplankton prey of delta smelt's zooplankton prey) preferentially take up ammonium over

nitrate but grow more slowly using ammonium. Consumption of diatoms by *Potamocorbula* prevents sufficient diatom metabolization of ammonium to lower levels that would allow more rapid diatom growth rates and greater diatom abundance for consumption by delta smelt zooplankton prey. A recent analysis concluded high ammonium loading is not a driver of low productivity in the San Francisco Bay-Delta (Strong et al. 2021).

In addition to a long-term decline in calanoid copepods and mysids (Orsi and Mecum 1986) in the Upper San Francisco Estuary, there have been numerous introductions of copepod species (Winder and Jassby 2011). *P. forbesi*, a calanoid copepod that was first observed in the estuary in the late 1980s, has replaced *E. affinis* as the most common delta smelt prey during the summer. It may have a competitive advantage over *E. affinis* because of its more selective feeding ability. Selective feeding may allow *P. forbesi* to utilize the remaining high-quality algae in the system while avoiding increasingly more prevalent low-quality and potentially toxic food items such as *Microcystis* (Mueller-Solger et al. 2006; Ger et al. 2010). After an initial rapid increase in abundance, *P. forbesi* declined somewhat in abundance from the early 1990s in the Suisun Bay and Suisun Marsh regions, but maintained its abundance, with some variability, in the central and southern Delta (Winder and Jassby 2011).

Another introduced cyclopoid copepod, which may affect delta smelt growth, is *Limnoithona tetraspina.* This copepod significantly increased in the Suisun Bay region beginning in the mid-1990s. It is now the most abundant copepod species in the Suisun Bay and confluence region of the estuary (Bouley and Kimmerer 2006; Winder and Jassby 2011). Gould and Kimmerer (2010) found that it grows slowly and has low fecundity. Based on these findings they concluded that the population success of *L. tetraspina* must be due to low mortality and that this small copepod may be able to avoid the visual predation to which larger copepods are more susceptible. It has been hypothesized that *L. tetraspina* is an inferior food for pelagic fishes including delta smelt because of its small size, generally sedentary behavior, and ability to detect and avoid predators (Bouley and Kimmerer 2006; Gould and Kimmerer 2010). Nevertheless, this copepod has been found in the guts of delta smelt when *Limnoithona* spp. occurs at extremely high densities relative to other zooplankton (Slater and Baxter 2014). It remains unclear if consuming this small prey is energetically beneficial for delta smelt at all sizes or if there is a breakpoint above which larger delta smelt receive little benefit from such prey. *Acartiella sinensis*, a calanoid copepod species that invaded at the same time as *L. tetraspina*, also reached considerable densities in Suisun Bay and the western Delta over the last decade (Hennessy 2010), although its suitability as food for delta smelt remains unclear.

In addition to the previously mentioned subsidy of *P. forbesi* to the low-salinity zone from the Delta that has been positively related to Delta outflow (Kimmerer et al. 2018, 2019), Hamilton et al. (2020) conducted modeling of potential Delta Sacramento and San Joaquin river flow management actions that suggested increasing flows in fall (September and October) of wetter years generally could have negative effects to copepod biomass, whereas increases in flows in the spring (April and May) of drier years could provide regional increases in biomass, particularly in the lower Sacramento and San Joaquin Rivers. The latter result is consistent with earlier studies showing X2 to be negatively correlated with *E. affinis* density (Kimmerer 2002). In addition to *Potamocorbula* grazing, recent studies have suggested that south Delta exports also negatively affect phytoplankton or zooplankton productivity (Hammock et al. 2019b; Kimmerer et al. 2019). Tidal wetlands have been suggested to confer substantial benefits to the foraging success of delta smelt, on the basis of observed stomach fullness increased with increasing adjacent tidal wetland area (Hammock et al. 2019a).

Modeling suggests that delta smelt declines are negatively associated with metrics assumed to reflect the abundance of predators in the estuary (Maunder and Deriso 2011; Miller et al. 2012; Hamilton and Murphy 2018). These metrics are composites of the relative abundance of Mississippi Silverside (*Menidia audens*), largemouth bass (*Micropterus salmoides*) and other centrarchids; these species are potential predators of concern because of their increasing abundance (Bennett and Moyle 1996; Brown and Michniuk 2007; Thomson et al. 2010) and because of inverse correlations between largemouth bass abundance and delta smelt abundance (Nobriga and Feyrer 2007; Thomson et al. 2010; Maunder and Deriso 2011). These correlations could represent predation on delta smelt by largemouth bass or, alternatively, the very different responses of the two species to changing habitat within the Delta (Moyle and Bennett 2008). Largemouth bass will readily eat delta smelt when the opportunity exists (Ferrari et al. 2014). However, there is little evidence that largemouth bass are major consumers of delta smelt due to low spatial co-occurrence (Nobriga et al. 2005; Baxter et al. 2010). Thus, the inverse correlations between these species may not be mechanistic. Rather, they may reflect adaptation to, and selection for, different environmental conditions, e.g., increased submerged aquatic vegetation providing greater habitat suitability for largemouth bass and lower habitat suitability for delta smelt (Ferrari et al. 2014).

Moyle et al. (2016) suggested that Mississippi silversides currently are the most important predators of delta smelt early life stages, as reflected in recent studies of delta smelt DNA in the prey consumed by silversides (Baerwald et al. 2012; Schreier et al. 2016), with two recent statistical examinations finding support for silverside abundance negatively affecting delta smelt survival and abundance (Hamilton and Murphy 2018; Polansky et al. 2021). Silversides may also compete with delta smelt for prey and may be at an advantage over delta smelt because they spawn repeatedly throughout late spring, summer, and fall (Bennett 2005). The closely related smelt species wakasagi (*Hypomesus nipponensis*) occurs in the Delta and has prompted concern because of its broader environmental tolerance than delta smelt (Swanson et al. 2000), which could lead it to outcompete delta smelt and hybridize with it. However, genetic analyses suggested relatively low levels of hybridization (Fisch et al. 2014).

During the period from 1963 through 1964, Stevens (1966) evaluated seasonal variation in the diets of juvenile striped bass (*Morone saxatilis*) throughout the Delta; only age 2 and age 3 striped bass contained more than trace amounts of delta smelt. The highest reported predation on Delta Smelt was 8% of the age 2 striped bass diet by volume during the summer. Thomas (1967) reported on spatial variation in the striped bass diet composition based on collections throughout the San Francisco Estuary and the Sacramento River above tidal influence. Delta smelt accounted for 8% of the spring diet composition and about 16% of the summer diet composition in the Delta. Brandl et al. (2021) used genetic analysis and found 1.3% of striped bass had delta smelt in their guts, noting that this was higher than in previous reports (0%–0.4%; Nobriga and Feyrer 2008), which could have been explained by factors such as the sensitivity of the genetic detection method or differences in season or location sampled. Although delta smelt are relatively rare in the stomachs of striped bass (Nobriga and Feyrer 2007; Nobriga et al. 2013), a recent examination suggested that striped bass are important to controlling delta smelt because historical data suggest that declines in delta smelt before the current-day monitoring program began were driven by the invasion of striped bass into the estuary (Nobriga and Smith 2020).

The anticipated effects of climate change on the San Francisco Estuary and watershed, such as warmer water temperatures, greater salinity intrusion, lower snowpack contribution to spring outflows from the Delta, and the potential for frequent extreme drought (Knowles and Cayan 2002; Dettinger 2005), indicate challenges to maintaining a sustainable delta smelt population (Brown et

al. 2013, 2016). A rebound in relative abundance during the very wet and cool conditions during 2011 indicated that delta smelt retained some population resilience (Interagency Ecological Program Management Analysis and Synthesis Team 2015). Examination of genetic effective population size during 2011–2014 found that delta smelt were not declining because of genetic factors and were not at immediate risk of losing genetic diversity (Finger et al. 2017). Since 2012, declines to record low population as estimated by abundance indices have been broadly associated with the 2012–2016 drought, and wetter conditions in 2017 and 2019 did not produce a rebound in delta smelt numbers similar to that seen in 2011. A more recent evaluation of effective population size has not been published since this further decline.

Central California's warm summers appear to be a source of energetic stress for delta smelt and warm springtime temperatures are assumed to compress the duration of their spawning season (Rose et al. 2013a; Moyle et al. 2016). Central California's climate is anticipated to get warmer (Cayan et al. 2009). Warmer estuary temperatures likely present a significant conservation challenge for delta smelt (Brown et al. 2013, 2016). Mean annual water temperatures within the Delta are expected to increase steadily during the second half of this century (Cloern et al. 2011). Long periods of higher than normal water temperatures in July and August 2017 had a major negative effect on delta smelt in 2017 (Flow Alteration–Management, Analysis, and Synthesis Team 2020). Flow Alteration–Management, Analysis, and Synthesis Team (2020) concluded that temperature is likely a primary factor in the lack of response of the delta smelt population to the high flows in 2017.

The frequency of occurrence (percentage of samples) of delta smelt by life stage and region from monitoring in the San Francisco Estuary and Delta as assessed by Merz et al. (2011) is provided in Table 4.4.7-1.

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**Table 4.4.7-1. Average Annual Frequency (Percent) of Delta Smelt Occurrence by Life Stage, Interagency Ecological Program Monitoring Program, and Region**

| Region | Average Annual Frequency (%) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Life Stage: | Larvae (<15 mm) | Sub-Juvenile (≥15, <30 mm) | | Juvenile (30–55 mm) | | | Subadult (>55 mm) | Mature Adults (>55 mm) | | Pre-Spawning[a] | Spawning[a] |
| Monitoring Program: | 20-mm | 20-mm | STN | 20-mm | STN | FMWT | FMWT | BS | BMWT | KT | KT |
| Years of Data Used: | 1995–2009 | 1995–2009 | 1995–2009 | 1995–2009 | 1995–2009 | 1995–2009 | 1995–2009 | 1995–2009 | 1995–2006 | 2002–2009 | 2002–2009 |
| Time Period: | Apr–Jun | Apr–Jul | Jun–Aug | May–Jul | Jun–Aug | Sep–Dec | Sep–Dec | Dec–May | Jan–May | Jan–Apr | Jan–May |
| San Francisco Bay | NS | NS | NS | NS | NS | NS | NS | 0.0 | 0.0 | NS | NS |
| West San Pablo Bay | NS | NS | NS | NS | NS | 0.2 | 0.0 | 0.0 | 1.2 | NS | NS |
| East San Pablo Bay | 0.0 | 1.0 | 0.0 | 2.8 | 3.6 | 0.7 | 0.6 | NS | 2.7 | NS | NS |
| Lower Napa River | 7.3 | 7.7 | 3.3 | 13.3 | 14.0 | 1.7 | 0.8 | NS | NS | 14.3 | 11.8 |
| Upper Napa River | 11.6 | 21.2 | NS | 12.0 | NS | NS | NS | NS | NS | NS | NS |
| Carquinez Strait | 5.7 | 9.3 | 1.1 | 24.4 | 33.7 | 1.9 | 3.3 | NS | 5.4 | 16.7 | 0.0 |
| Suisun Bay (SW) | 17.8 | 18.3 | 1.3 | 17.5 | 26.9 | 4.3 | 4.3 | NS | 4.3 | 23.3 | 5.6 |
| Suisun Bay (NW) | 2.2 | 8.9 | 1.1 | 21.7 | 34.8 | 7.3 | 10.0 | NS | 8.7 | 23.3 | 5.6 |
| Suisun Bay (SE) | 19.5 | 24.9 | 11.0 | 20.9 | 45.7 | 11.0 | 12.1 | NS | 6.5 | 28.3 | 6.9 |
| Suisun Bay (NE) | 17.8 | 19.2 | 33.6 | 29.7 | 66.7 | 20.3 | 29.3 | NS | 28.3 | 48.3 | 13.9 |
| Grizzly Bay | 16.3 | 27.6 | 17.9 | 42.9 | 72.8 | 15.0 | 19.6 | NS | 30.4 | 30.0 | 5.6 |
| Suisun Marsh | 21.4 | 33.6 | 14.2 | 18.5 | 19.2 | 22.8 | 27.2 | NS | NS | 62.0 | 23.1 |
| Confluence | 35.7 | 41.6 | 25.7 | 29.2 | 36.1 | 20.2 | 24.5 | 1.8 | 17.4 | 30.0 | 10.4 |
| Lower Sacramento River | 16.5 | 37.0 | 43.3 | 26.2 | 55.5 | 22.9 | 37.1 | NS | 18.8 | 54.4 | 17.8 |
| Upper Sacramento River | 10.8 | 8.2 | 1.3 | 0.0 | 0.0 | 2.7 | 8.0 | 5.8 | 16.7 | 21.7 | 15.3 |
| Cache Slough and Ship Channel | 17.2 | 47.3 | NS | 54.3 | NS | 9.8 | 26.7 | NS | NS | 33.9 | 21.1 |
| Lower San Joaquin River | 28.0 | 24.5 | 4.1 | 5.1 | 5.6 | 2.6 | 3.5 | 0.9 | 12.6 | 30.6 | 9.7 |
| East Delta | 14.6 | 8.8 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.6 | NS | 5.7 | 2.3 |
| South Delta | 18.4 | 10.8 | 0.0 | 1.4 | 0.3 | 0.0 | 0.0 | 0.3 | NS | 7.1 | 1.1 |
| Upper San Joaquin River | NS | NS | NS | NS | NS | NS | NS | 0.2 | NS | NS | NS |
| Sacramento Valley | NS | NS | NS | NS | NS | NS | NS | 0.2 | NS | NS | NS |

Source: Merz et al. 2011; California Department of Fish and Wildlife n.d.

20-mm = 20-millimeter Townet; BMWT = Bay Midwater Trawl; BS = Beach Seine; FMWT = Fall Midwater Trawl; KT = Kodiak Trawl; NS = indicates no survey conducted in the given life stage and region; NE = northeast; NW = northwest; SKT = Spring Kodiak Trawl; STN = Summer Townet; SE = southeast; SW = southwest.

[a] Gonadal stages of male and female delta smelt found in Spring Kodiak Trawl database were classified by CDFW following Mager 1996 (California Department of Water Resources n.d.).

Mature adults, pre-spawning: Reproductive stages[a]: females 1–3; males 1–4. Mature adults: spawning: Reproductive stages[a]: females 4; males 5.

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#### 4.4.7.3 Critical Habitat

The USFWS designated critical habitat for the delta smelt on December 19, 1994 (59 FR 65256). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; the Napa River; and the existing contiguous waters contained within the legal Delta, as defined in Section 12220 of the California Water Code (U.S. Fish and Wildlife Service 1994).

The primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle, including spawning, larval and juvenile transport, rearing, and adult migration back to spawning sites. Delta smelt are endemic to the San Francisco Bay/Delta) and the vast majority only live 1 year. Thus, regardless of annual hydrology, the estuary must provide suitable habitat all year, every year. The primary constituent elements essential to the conservation of the Delta smelt are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (59 FR 65256). The USFWS recommended in its designation of critical habitat for the delta smelt that salinity in Suisun Bay should vary according to WY type. For the months of February through June, this element was codified by the State Water Board's "X2 standard" described in D-1641 and the State Water Board's current Water Quality Control Plan.

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# 4.4.8 Longfin Smelt

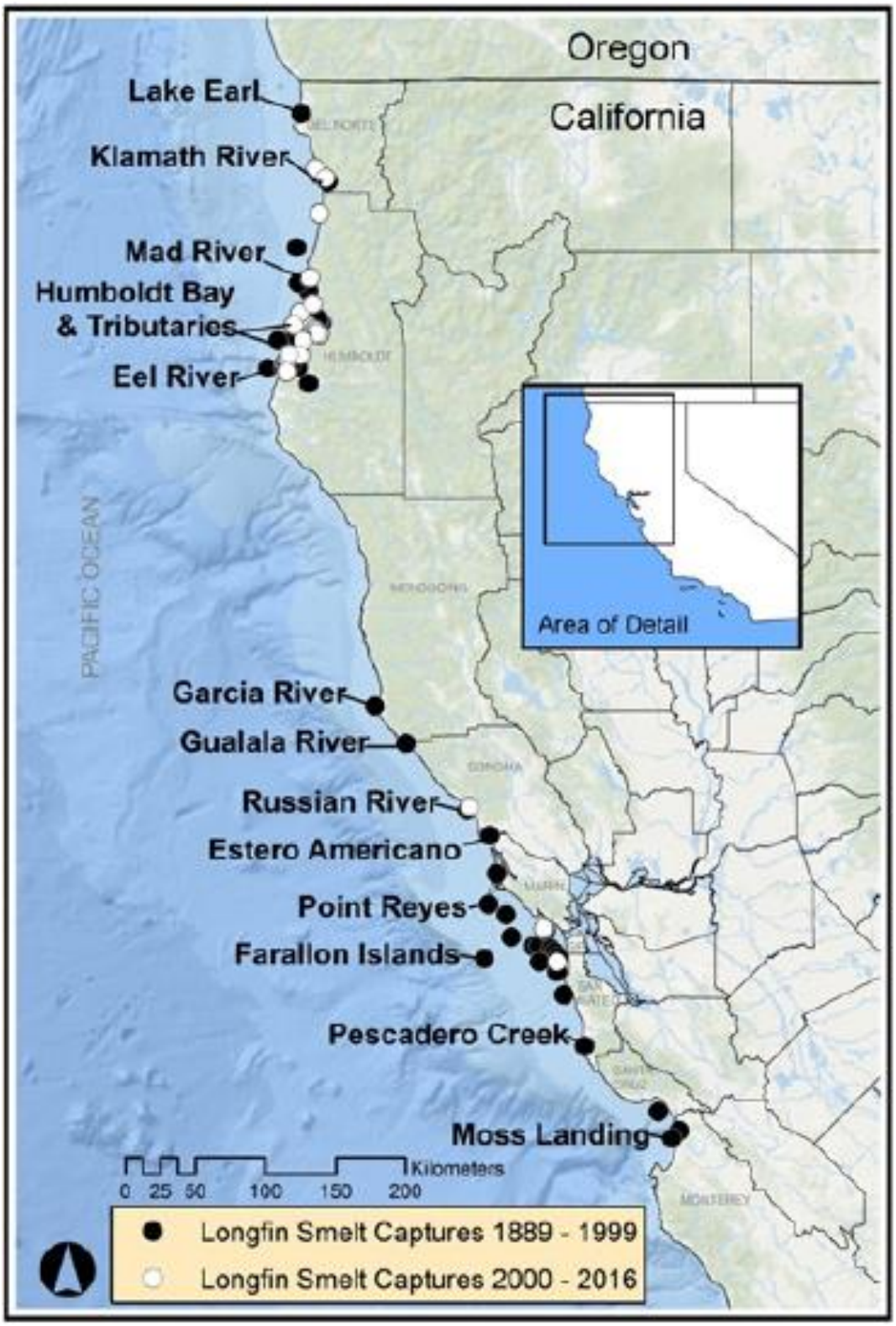
## 4.4.8.1 Legal Status and Distribution

The longfin smelt Bay-Delta DPS was determined to be a distinct population segment that warranted listing as an endangered or threatened species under the Endangered Species Act on April 2, 2012, but the listing was precluded by higher priority listing actions. On October 7, 2022, USFWS published a proposed rule that would find the longfin smelt, Bay-Delta DPS as an endangered species under the Endangered Species Act. This proposed rule's original comment period closed on December 6, 2022. On February 27, 2023, the USFWS reopened a 30-day comment period to allow for a public hearing held on March 14, 2023.

The longfin smelt (*Spirinchus thaleichthys)* is a small, euryhaline, anadromous, and largely semelparous fish with a life cycle of approximately 2 to 3 years (Rosenfield 2010).[7] Longfin smelt reach 90 to 110 mm SL, with a maximum size of 120 to 150 mm SL (Moyle 2002; Rosenfield and Baxter 2007). Longfin smelt belongs to the true smelt family Osmeridae and is one of three species in the *Spirinchus* genus; the night smelt (*Spirinchus starksi*) also occurs in California, and the shishamo (*Spirinchus lanceolatus*) occurs in northern Japan (McAllister 1963:10, 15). Delta smelt and longfin smelt hybrids have been observed in the San Francisco Estuary and Delta, although these offspring are not thought to be viable because delta smelt and longfin smelt are not closely related taxonomically or genetically (Fisch et al. 2013). Longfin smelt reside and rear in San Francisco Bay and in the nearshore ocean outside the Golden Gate (Garwood 2017). They spawn in tidal fresh water in the estuary's low-salinity zone where brackish and fresh waters meet (Grimaldo et al. 2017) and in freshwater in tributaries to the Bay (Lewis et al. 2020). Longfin smelt can be distinguished from other California smelt by their long pectoral fins that reach or nearly reach the bases of the pelvic fins, their incomplete lateral line, weak or absent striations on the opercular bones, low number of scales in the lateral series, and long maxillary bones (which in adults extend just short of the posterior margin of the eye [Moyle 2002]). Populations of longfin smelt occur along the Pacific Coast of North America from Hinchinbrook Island in Prince William Sound, Alaska, to the San Francisco Estuary (Lee et al. 1980) and have been detected as far south as Monterey Bay (Garwood 2017).

Longfin smelt are periodically caught in the nearshore ocean, suggesting that some individuals disperse out into the Gulf of the Farallones to feed and then swim back into the estuary (Rosenfield and Baxter 2007). Longfin smelt have been documented in Humboldt Bay, the Eel River estuary, the Klamath River estuary, Russian River, and in smaller river estuaries from the central and northern coast of California, including Pescadero Creek, the Garcia River, Gualala River, and Mad River (Figure 4.4.8-1) (Moyle 2002; Pinnix et al. 2004; Garwood 2017). It is not known what portion of ocean-bound fish return to San Francisco Bay each year or to other coastal streams north and south of San Francisco Bay (Rosenfield and Baxter 2007; Nobriga and Rosenfield 2016).

[7] Moulton (1974:50) stated, "Apparently a ripe female enters the river and spawns only once"; and Wang (2007: 39) cited Moyle (1976) in noting that "Most die after spawning, but a few females may live and spawn a second time."




Source: Garwood 2017. Note: Locations with black circles have not necessarily been sampled since 1999, so there is no implication regarding changes in occurrence over time intended by this figure.

**Figure 4.4.8-1. Locations of Longfin Smelt Captures, 1889–2016, Excluding the San Francisco Bay-Estuary**

### 4.4.8.2 Life History and Habitat Requirements

Genetic isolation exists between the population segment of longfin smelt in the San Francisco Estuary and populations north of the Columbia River Estuary (Stanley et al. 1995; Israel and May 2010; Saglam et al. 2021). Saglam et al. (2021) found evidence for significant contemporary migration northward from the San Francisco Estuary population to Humboldt Bay and the Columbia River Estuary, without significant southward migration. Due to the low likelihood of southward migration from more northern breeding populations as close as Humboldt Bay, USFWS determined that listing of the San Francisco Estuary population as a DPS is warranted (U.S. Fish and Wildlife Service 2012a). The Bay-Delta DPS of longfin smelt occurs throughout the San Francisco Bay and the Delta and in coastal waters west of the Golden Gate Bridge. Within the San Francisco Estuary and Central Valley watershed, they have been observed north as far as the town of Colusa on the Sacramento River, east as far as Lathrop on the San Joaquin River, and south as far as Alviso and Coyote Sloughs in the southern San Francisco Bay, as well as various tributaries in northern San Francisco Bay (Merz et al. 2013; Hobbs et al. 2015; Lewis et al. 2020).

In Lake Washington, longfin smelt spawn over sandy substrate (California Department of Fish and Game 2009:11), but spawning substrates are unknown in the San Francisco Estuary. Longfin smelt eggs are adhesive and demersal (Moyle 2002). Evidence from Grimaldo et al. (2017) suggests spawning habitats include open shallow water and tidal marshes. Longfin smelt produce between 1,900 and 18,000 eggs, with greater fecundity associated with fish with greater lengths (California Department of Fish and Game 2009). Incubation times for egg development range between 25 to 42 days (Rosenfield 2010). Evidence for individuals spawning multiple times in a season has not been provided, although some females may undergo repeated spawning events. Newly hatched larvae have been observed in salinities ranging from freshwater up to 12 practical salinity units (psu), with peak observations occurring between 2 and 4 psu (Grimaldo et al. 2017). Early juvenile longfin smelt (20–40 mm SL) are found in salinities up to 30 psu, but most are found in salinities between 2 to 18 psu (MacWilliams et al. 2016). By late summer, late juveniles can tolerate full seawater.

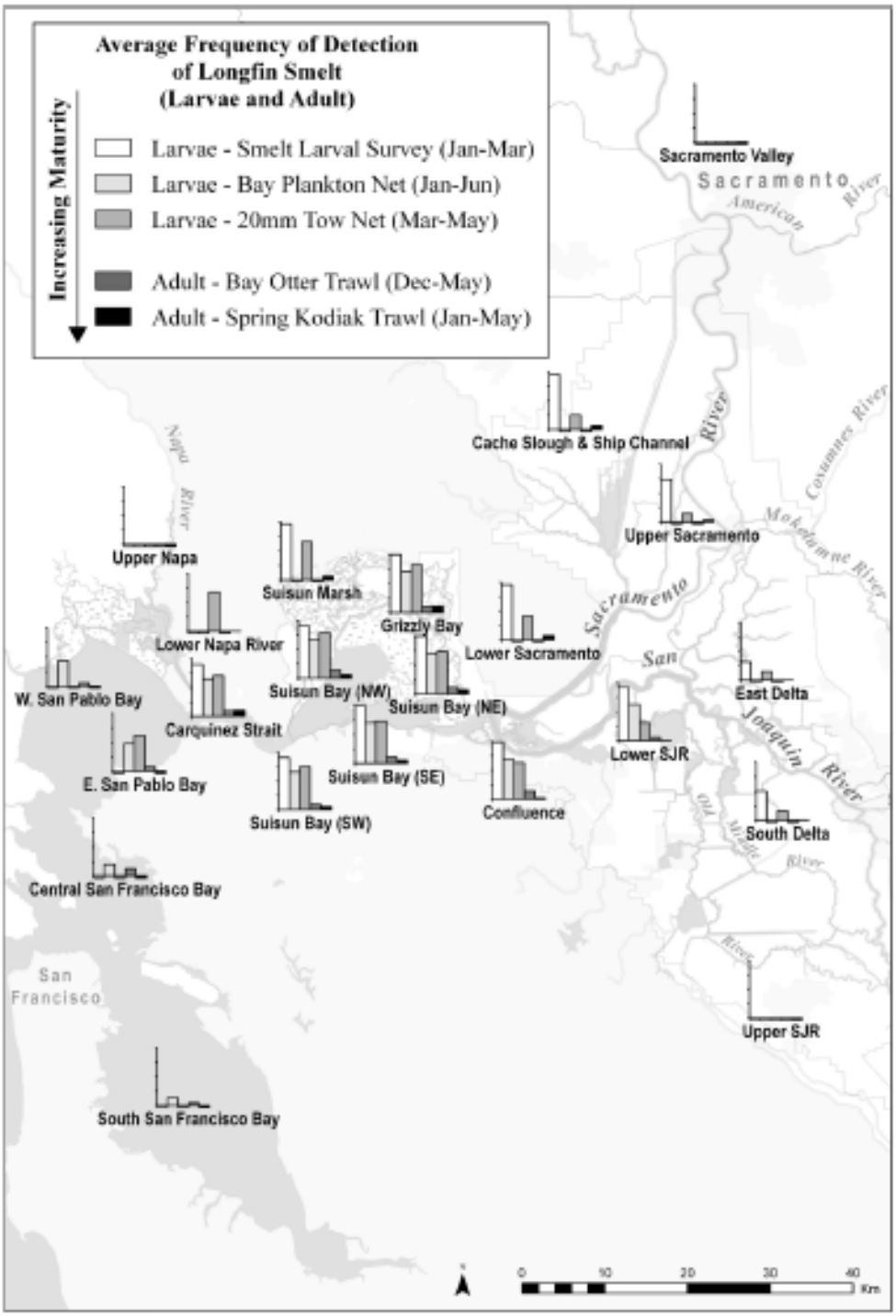
Longfin smelt are anadromous and semelparous, moving from saline to brackish or fresh water for spawning from November to May (Grimaldo et al. 2017; Lewis et al. 2020). Longfin smelt usually live for 2 years, spawn, and then die, although some individuals may spawn as 1-year-old or 3-year-old fish before dying (Rosenfield 2010). Age-2 adults appear to move into spawning areas during the late fall and early winter (Rosenfield and Baxter 2007). Spawning occurs at temperatures that range from 5°C to 15°C (41°F to 59°F) (Grimaldo et al. 2017). Peak spawning takes place in January and February of most years when water temperatures are between 5°C (41°F) and 11°C (51.8°F). CDFW Smelt Larval Survey (SLS) data show that spawning appears to be centered in brackish water (2 to 4 psu); however, special studies that cover regions seaward of the SLS extent found newly hatched larvae in salinities up to 12 psu and concentrations of larvae peak between 2 and 4 psu (Grimaldo et al. 2017, 2020). Hobbs et al. (2010) provides evidence that larvae with the greatest recruitment success to later life stages are those that reared in salinities around 2 ppt.

Newly hatched longfin smelt larvae appear to be surface-oriented and probably have little ability to control their position in the water column before they develop their air bladder (Bennett et al. 2002). Once their air bladder is developed (~12 mm SL), they can control their position in the water column by undergoing reverse diel vertical migrations or tidal vertical migration, depending on flow conditions (Bennett et al. 2002). Bennett et al. (2002) believed that the ability of longfin smelt to

undergo tidal vertical migrations allows them to maintain their position on the axis of the estuary. During the first few months of their lives (approximately January through May), longfin smelt primarily prey on calanoid copepods such as *P. forbesi* and *E. affinis*, before switching to mysids as soon as they are large enough to feed on them (Slater 2008; Baxter et al. 2010). Mysid density is positively related to spring Delta outflow (negatively related to spring X2) (Mac Nally et al. 2010), although note that Kimmerer (2002) found a changing relationship to X2 for the mysid *Neomysis mercedis* (negative prior to 1987; positive following 1987).

During late summer and early fall, juvenile and adult longfin smelt within the San Francisco Estuary are more common throughout San Francisco Bay than in other landward areas (Rosenfield and Baxter 2007; MacWilliams et al. 2016), although the extent of marine migration has yet to be quantified. During the spawning period in late fall and early winter, adults are more commonly found in San Francisco Bay tributaries and marshes (Lewis et al. 2020; Grimaldo et al. 2020), Suisun Bay, and the Delta (Rosenfield and Baxter 2007). Larval longfin smelt are broadly distributed throughout San Francisco Bay and its associated tributaries during wet years (MacWilliams et al. 2016; Lewis et al. 2020; Parker et al. 2017; Grimaldo et al. 2020). Analyses of multiple surveys by Merz et al. (2013) found that larvae were more frequently detected in the Delta in drier years than in wet years (Figure 4.4.8-2); however, the limited extent of the SLS to landward regions does not account for potential spawning in tributaries of San Francisco Bay (Lewis et al. 2020). In long-term channel surveys, albeit limited to regions landward of San Pablo Bay, more than 50% of the measured larval abundance in any given year between 2009 and 2015 occurred in Suisun Bay and Suisun Marsh (Grimaldo et al. 2017). In a 2-year study with greater spatial coverage than long-term surveys, Grimaldo et al. (2020) found that during the low-flow year of 2016, larval and post-larval longfin smelt were mostly distributed in Suisun Bay, whereas in the high-flow year of 2017, larval longfin smelt were mostly found in San Pablo and South Bays. Some juveniles and adults are believed to move to the coastal ocean during the summer and fall (Rosenfield and Baxter 2007; MacWilliams et al. 2016).

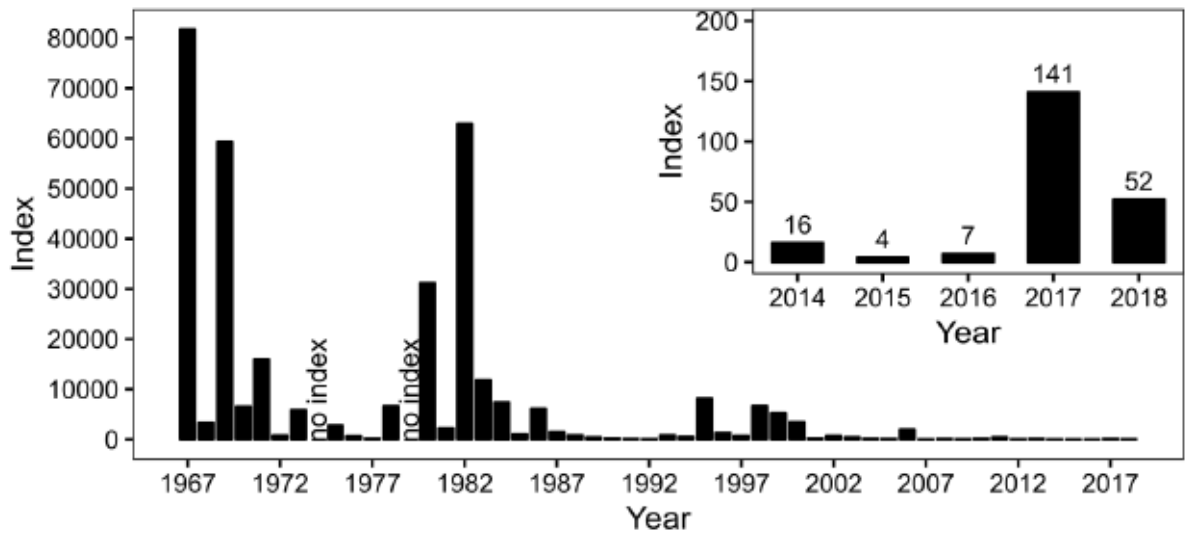
Abundance indices for the longfin smelt population have undergone a decline over time. For example, there was an approximate thirty-fold reduction in the fall midwater trawl index since the early 1980s (Figure 4.4.8-3) (Rosenfield and Baxter 2007; Sommer et al. 2007; Kimmerer et al. 2009), and an index of 2-year-olds based on the San Francisco Bay Study midwater and otter trawl went down from a mean of 1,931 in 1980 through 1986 (prior to the *Potamocorbula* invasion) to a mean of 918 during 1987 through 2002, with a further decline following the onset of the Pelagic Organism Decline to a mean of 422 during 2003 through 2013 (Nobriga and Rosenfield 2016). The rate of decline of the population suggested by abundance indices has been particularly steep, especially since the onset of the Pelagic Organism Decline (Sommer et al. 2007; Thomson et al. 2010), although a recent analysis of an integrated dataset featuring eight different surveys suggests that the original decline dates back to the early to mid-1980s (Stompe et al. 2020). Although the population has declined, the slope of the relationship between winter-spring flow and fall longfin smelt abundance indices remains unchanged, suggesting that flow or hydrological conditions may be strong drivers of their population abundance (Kimmerer et al. 2009; Maunder et al. 2015; Nobriga and Rosenfield 2016), although specific mechanisms are unknown. The intercept of this relationship has dropped nearly twofold, possibly because of declining food supply related to *Potamocorbula* (Kimmerer et al. 2009).




Source: Merz et al. 2013.

Note: To calculate the annual frequency of longfin smelt detection in a region, the percentage of sampling events where longfin smelt were observed is divided by the total number of sampling events for the region. In this graphic, where no column/bar is shown in the bar graph for a region, the average annual frequency of detection for the given longfin smelt life stage(s) was zero. Where the column is below the x-axis, a survey did not sample in that region (e.g., the Smelt Larval Survey, which does not include stations west of Carquinez Strait).

**Figure 4.4.8-2. Average Annual Frequency of Longfin Smelt Detection (%) for Larval and Adult Life Stages by Region and Interagency Ecological Program Survey Type**

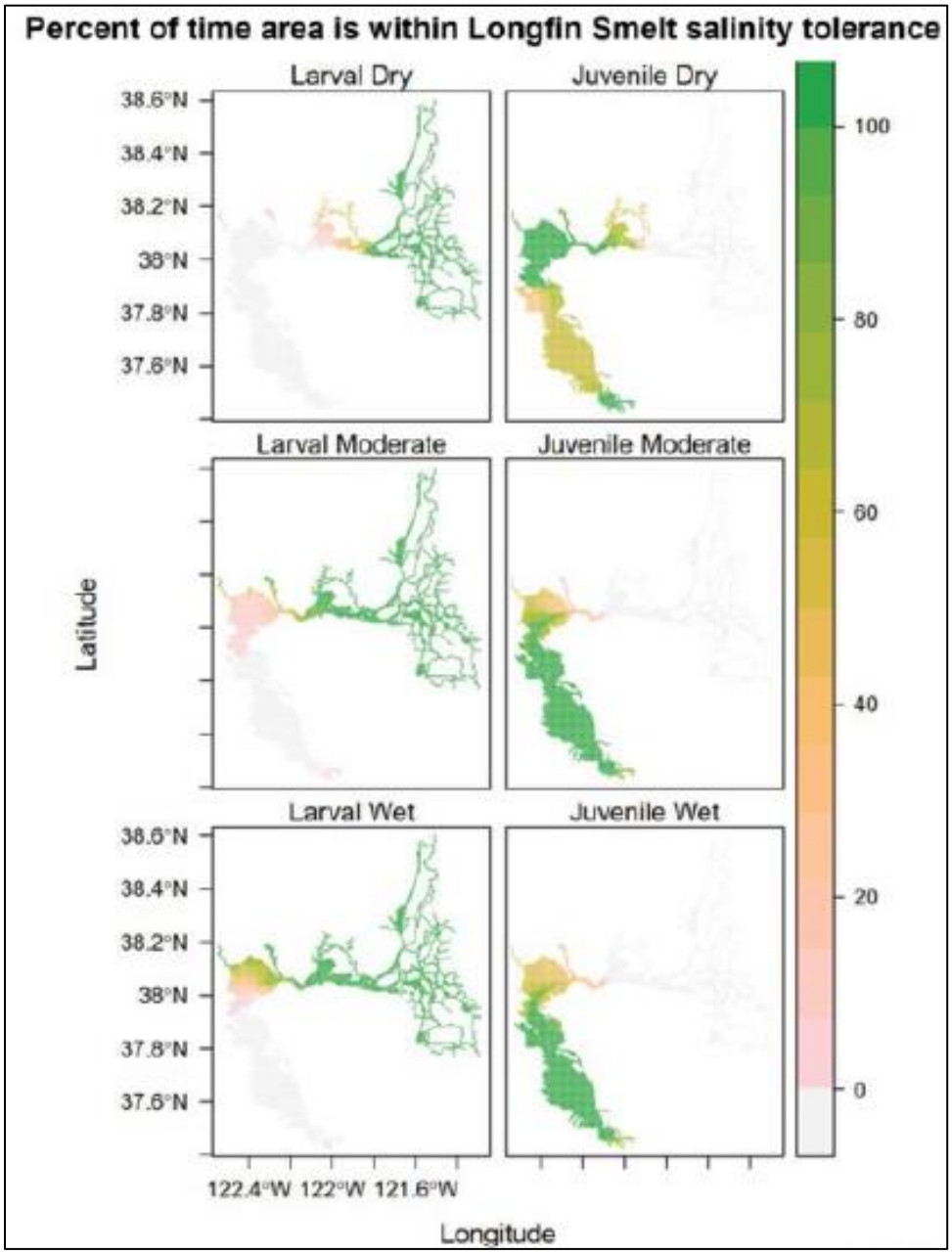



Source: White 2019.

**Figure 4.4.8-3. Longfin Smelt Fall Midwater Trawl Abundance Index, 1967–2018**

There are several threats to longfin smelt. The USFWS (2012a) determination that listing is warranted for the Bay-Delta DPS concluded that reductions in freshwater flow and introduced species are threats, and that ammonium may be a threat. The recent federal listing proposed rule examined threats facing the Bay-Delta DPS of the longfin smelt as including include habitat alteration and changes to hydrology associated with reduced and altered freshwater flows and resulting increases in saline habitat conditions; increased water temperatures; reduced food resource availability; predation; entrainment from freshwater diversion facilities; and contaminants 11 (87 FR 60957).The discussion below also describes other threats that have been noted (e.g., California Department of Fish and Game 2009), although as discussed further below, not all have been concluded to be of significance to the species (e.g., entrainment; U.S. Fish and Wildlife Service 2012a).

Longfin smelt are vulnerable to entrainment at the south Delta export facilities. The annual number of longfin smelt salvaged has been generally low since the 1980s, except in some years (1988, 2002), as illustrated for the SWP salvage facility (see Figure 2-5 in California Department of Water Resources 2019:2-15). In general, longfin smelt entrainment risk increases with reverse OMR flow (Grimaldo et al. 2009), and salvage can be higher in drier years compared to wetter years (as illustrated for the SWP salvage facility; see Figure 2-6 in California Department of Water Resources 2019:2-15), probably as a result of the landward shift in distribution in drier years. Figure 4.4.8-4 shows the distribution of larval and juvenile longfin smelt salinity tolerance in water years of varying runoff.




Source: California Department of Water Resources 2019:2-16.

Note: The larval maps span January 1–March 31 and the juvenile maps span April 1–August 31. Salinities are within the tolerable range for longfin smelt based on 10th- and 90th-percentile salinities for catches in the Smelt Larval Survey (larval) and the Bay Study (juvenile). The three water years are 2014 (labeled as "dry"; Sacramento Valley runoff = 4.29 million acre-feet [MAF] [October–March] and 7.46 MAF [total water year]), 2011 (labeled as "moderate"; Sacramento Valley runoff = 12.68 MAF [October–March] and 25.21 MAF [total water year]), and 2006 (labeled as "wet"; Sacramento Valley runoff = 18.06 MAF [October–March] and 32.09 MAF [total water year]) (all runoff values based on California Data Exchange Center [CDEC] [2020]). The color scale is the percentage of days in the evaluated range that met the salinity tolerance criteria (green = 100%; gray = 0% days in salinity tolerance range). Note that "tolerance" is not taken to mean physiological tolerance, but as described above, the 10th–90th percentile salinity of longfin smelt catches.

**Figure 4.4.8-4 Distribution of Larval and Juvenile Longfin Smelt Salinity "Tolerance" (10th–90th Percentile Salinity of Catch) in 2014 (Labeled "Dry"), 2011 (Labeled "Moderate"), and 2006 (Labeled "Wet") Water Years**

Larval longfin smelt are also susceptible to entrainment at the south Delta export facilities; however, because the salvage facilities generally do not sample fish smaller than 20 mm SL, it is difficult to ascertain how many larvae are entrained (California Department of Fish and Game 2009). Larval entrainment at the SWP is likely higher during drier periods compared to wetter periods, but overall larval entrainment risk is likely low because most longfin smelt hatch downstream of the Delta (Grimaldo et al. 2017). Overall, the effect of entrainment on the longfin smelt population has not been found to be important (Maunder et al. 2015), perhaps because a small fraction of the population is estimated to be entrained on an annual basis (California Department of Water Resources 2019:4-48, 4-55; Kimmerer and Gross 2022). Kimmerer and Gross (2022) examined available 2009–2020 survey data for all longfin smelt life stages and noted that vulnerability to south Delta entrainment is greatest in early larvae, but that larval losses to entrainment averaging 1.5% of the population were too low to measurably influence population dynamics. Consistent with this, Gross et al. (2022) used hydrodynamic and particle-tracking models to estimate that proportional larval entrainment was practically zero in the extreme wet year of 2017 and approximately 2% of the population in the moderately dry year of 2013. Application of the same methods gave estimates of just under 1% larval entrainment in 2021 and 1.3% larval entrainment in 2022 (Resource Management Associates 2023).

As previously described, longfin smelt abundance indices are positively correlated with winter-spring Delta outflow, negatively correlated with winter-spring X2 (Jassby et al. 1995; Kimmerer 2002; Kimmerer et al. 2009; Baxter et al. 2010; Mac Nally et al. 2010; Thomson et al. 2010; Mount et al. 2013; Nobriga and Rosenfield 2016), or positively correlated with general indicators of hydrological conditions (e.g., watershed runoff) (Maunder et al. 2015). Numerous mechanisms have been proposed for this relationship, including lower entrainment losses, advection to suitable habitat, reduced predation due to elevated turbidity, increased retention in favorable habitats, and access to marsh habitats that are unsuitable during drier periods.

The effect of entrainment appears to be unimportant (Maunder et al. 2015) or at least has diminished in recent decades, since longfin smelt population-level entrainment losses are low (see discussion above). Vertical retention via estuarine circulation is still hypothesized to be an important mechanism that retains age-0 longfin smelt in high-quality habitats during higher flows (Kimmerer et al. 2009), but horizontal retention in large, shallow bays is now hypothesized to be an important feature that enhances longfin smelt survival and abundance during higher flows based on new data that targeted larval and juvenile longfin smelt in shallow and marsh habitats (Grimaldo et al. 2020).

Kimmerer et al. (2009) concluded that habitat volume, as defined by salinity and water clarity, may be partly responsible for the longfin smelt abundance relationship with Delta outflow (X2), but that other mechanisms, such as outflow-driven retention, are more important. With respect to habitat availability, although freshwater flow affects dynamic habitat availability, recent investigations by Grimaldo et al. (2017, 2020) of stationary habitat found that larval longfin smelt were relatively abundant in tidal marsh and shallow open waters with salinity around 0 to 7 psu. This work suggests that stationary shallow habitat also provides key rearing habitat for larval longfin smelt, a situation that increased when San Pablo Bay and the south San Francisco Bay became freshwater to low-salinity habitat during wet years.

Adult longfin smelt use tidal marshes for spawning (Lewis et al. 2020). Larval longfin smelt use marsh and shoal habitats as rearing habitat (Grimaldo et al. 2017; Grimaldo et al. 2020). Juvenile

longfin smelt are mostly found in deeper channels, often exhibiting diel movements, presumably to reduce predation risk (Bennett et al. 2002).

The salinity distribution in the San Francisco Estuary is not solely dependent on Delta outflow. For example, MacWilliams et al. (2016) showed that salinity in San Francisco Bay was influenced by tributaries as well (e.g., in south San Francisco Bay). Figure 4.4.8-4 shows the availability of habitat for larval and juvenile longfin smelt based on longfin smelt salinity *tolerance* in water years of varying hydrology.[8] Habitat suitability is represented by the percentage of time when a specific location is within the salinity range where 80% of larval and juvenile longfin smelt were observed in the SLS and Bay Study surveys, respectively. Note that these surveys do include the full range occupied by the species and therefore limit the scope of inference regarding distribution.

Turbidity levels have declined in the Delta (Cloern et al. 2011). Although delta smelt has often been the focus for potential effects of turbidity reduction, some of the same mechanisms appear to be as important for longfin smelt (Mahardja et al. 2017). For example, young juvenile longfin smelt distribution in spring is negatively associated with water clarity (Kimmerer et al. 2009), and trends in abundance are also negatively associated with water clarity in fall (Thomson et al. 2010). Greater water clarity could somewhat reflect changes in catchability during surveys (fish are better able to avoid trawls when water is clearer) (Latour 2016; Peterson and Barajas 2018; although see Tobias 2021).

Longfin smelt have experienced a significant decline in food resources in recent decades (Sommer 2007). A decrease in foraging efficiency and/or the availability of suitable prey for various life stages of longfin smelt may result in reduced growth, survival, and reproductive success. This may contribute to an observed lower population abundance and a downward shift in the flow-abundance index relationship, particularly after the introduction of the invasive clam *Potamocorbula amurensis* (Feyrer et al. 2003; Nobriga and Rosenfield 2016). Other factors possibly affecting food resources include ammonium, which was found to be negatively associated with longfin smelt abundance indices in the population dynamics model of Maunder et al. (2015).

The effect of nonnative predators, such as Mississippi silversides (*Medinia beryllina*) and striped bass, has been identified as a potential threat to longfin smelt populations (Sommer 2007; Rosenfield 2010), with potentially large predation losses even if the predation rate is low (California Department of Fish and Game 2009). A composite index of predatory fish density in Central Bay and San Pablo Bay was found to be negatively associated with trends in longfin smelt abundance in population dynamics modeling by Maunder et al. (2015). Competition also occurs with species such as age-0 striped bass or American shad (*Alosa sapidissima*) (Feyrer et al. 2003), although the effect of competition on the longfin smelt population is unknown.

Water temperature tends to limit the upstream distribution of longfin smelt in the warmer months (Baxter et al. 2010), and spring (April–June) water temperature has been negatively correlated with survival (Maunder et al. 2015). By analogy with delta smelt (Brown et al. 2013, 2016), climate change could result in detrimental effects on longfin smelt ecology related to factors such as maturation and spawning season length and timing, as well as reduction in habitat extent; potential negative physiological effects of climate change have been demonstrated (Jeffries et al. 2016).

[8] As noted in Figure 4.4.8-4, *tolerance* is not taken to mean physiological tolerance, but as described above, the 10th–90th percentile salinity of longfin smelt catches.

#### 4.4.8.3 Critical Habitat

Critical habitat has not been designated for longfin smelt.

### 4.4.9 San Joaquin Kit Fox

#### 4.4.9.1 Legal Status and Distribution

San Joaquin kit fox was listed as endangered under the ESA on March 11, 1967 (32 FR 4001). It was listed as threatened species under the California ESA in 1971. In 2020, USFWS completed a 5-year review for this species and determined that the kit fox continues to meet the definition of endangered.

San Joaquin kit fox has historically occurred in semi-arid habitats of the San Joaquin Valley and in arid grassland of the adjacent foothills from as far north as Tracy, San Joaquin County and La Grange, Stanislaus County, south to Kern County (U.S. Fish and Wildlife Service 2020b:15). A patchwork of surveys and data in the California Natural Diversity Database (CNDDB) indicate that kit fox was likely distributed throughout most of its historical range through the early 2000s (U.S. Fish and Wildlife Service 2020b:27).

The northern range for the species consists of a narrow band of habitat along the western edge of the San Joaquin Valley from the San Luis Reservoir in western Merced County, north to central Alameda and Contra Costa Counties (Cypher et al. 2013:29). Kit fox observations in the northern range have become rare, and no populations are known to be present (U.S. Fish and Wildlife Service 2020b:15; California Department of Fish and Wildlife 2020a; Cypher et al. 2013:29). The northern part of the range is characterized by highly fragmented medium suitability habitat consisting primarily of dense grasslands dominated by wild oats, which may not be sufficient to sustain persistent populations of kit fox (Cypher et al. 2013:29).

#### 4.4.9.2 Life History and Habitat Requirements

Optimal habitat for San Joaquin kit fox includes arid shrublands and grasslands characterized by sparse or no shrub cover, sparse ground cover with patches of bare ground, short vegetative structure (herbaceous vegetation <18 inches tall), and sandy to sandy-loam soils (Cypher et al. 2007:25). Vernal pool complexes and alkali meadows in general do not provide good denning habitat for kit fox because they have moist or waterlogged clay or clay-like soils (U.S. Fish and Wildlife Service 2020b:17). Kit fox generally avoid steep terrain; slopes under 5% are optimal for kit fox and slopes greater than 15% are unsuitable (Cypher et al. 2007:25). Tall and dense vegetation is less optimal because it creates conditions that make it difficult for kit fox to detect approaching predators or to capture prey (Cypher et al. 2007:25). San Joaquin kit fox may construct their own dens, modify the burrow of other animals, or use human-made structures such as culverts and pipes (U.S. Fish and Wildlife Service 2020b:20). Natal and pupping dens are generally found on flatter ground with slopes of about 6 degrees (U.S. Fish and Wildlife Service 2020b:21).

Agricultural lands do not provide long-term suitable habitat for kit fox for a variety of reasons. Lands with row crops are subjected to weekly inundation during irrigation, which impedes kit fox foraging and precludes the establishment, maintenance, and use of earthen dens. Prey abundance is relatively low in row crops, and when land is converted to agricultural uses, prey diversity is reduced, prey species composition changes, and favored prey species such as kangaroo rats disappear. Although kit fox may enter the margins of row crops and farther into orchards at night

from natural lands, researchers found no evidence that kit fox were able to use farmland, even when it was the predominant available habitat (U.S. Fish and Wildlife Service 2010b:21).

San Joaquin kit fox is generally active year-round, with mating occurring between November and December and pups born between February and April (U.S. Fish and Wildlife Service 2020b:19). Juvenile dispersal occurs between June and late October (U.S. Fish and Wildlife Service 2020b:19).

The home ranges of San Joaquin kit foxes are extensive and vary by location. Home range size is thought to be related to prey abundance, and studies have reported home ranges as small as 128 acres and up to 5,952 acres (U.S. Fish and Wildlife Service 2020b:21). San Joaquin kit foxes appear to disperse readily, with dispersal distances varying greatly (1.1 to 50 miles; these were observed in studies from relatively large areas with little development). Successful dispersal appears to be a key factor for the recovery and survival of kit fox, partly because kit fox populations are becoming more fragmented, and successful dispersal among subpopulations helps to maintain genetic diversity, save declining populations, and prevent extinction (U.S. Fish and Wildlife Service 2010b:6, 107–108).

San Joaquin kit fox diet varies geographically, seasonally, and annually based on variation in abundance of potential prey (U.S. Fish and Wildlife Service 1998). In the southern and central portions of their range, kangaroo rats, pocket mice, white-footed mice (*Peromyscus* spp.), and other nocturnal rodents are key prey items. California ground squirrels, black-tailed hares (*Lepus californicus*), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), desert cottontails (*Sylvilagus audubonii*), ground-nesting birds, and insects are also taken (Jensen 1972; Archon 1992; Utah Division of Wildlife Resources 2010). In the northern part of their range, kit foxes most frequently consume California ground squirrels (Orloff et al. 1986). Cottontails, black-tailed hares, pocket mice, and kangaroo rats are also eaten (Hall 1983).

### 4.4.9.3 Impacts from Past and Present Actions

Habitat loss and fragmentation from urbanization and agricultural expansion are the principal activities that have affected San Joaquin kit fox in the San Joaquin Valley (Laughrin 1970; Jensen 1972; Morrell 1975; Knapp 1978). By 1979, an estimated 6.7% of the San Joaquin Valley floor's original native habitat south of Stanislaus County remained untilled and undeveloped (U.S. Fish and Wildlife Service 1998:129). Cypher et al. (2013) estimated that only 4,267 square kilometers of high suitable habitat and 5,569 square kilometers of medium suitable habitat remain, with much of the habitat highly fragmented. The majority of these habitat areas were located in the southern portion of the kit fox range, with 67% and 35% of this high and medium suitable habitat occurring in Kern and San Luis Obispo Counties, respectively.

In the northern part of the range which overlaps with the action area continued urbanization, primarily in Contra Costa and Alameda Counties, water storage and conveyance projects (e.g., CVP, SWP, Bethany Reservoir, South Bay Aqueduct), road construction, energy development (e.g., Mariposa Energy), and other activities continue to reduce and fragment remaining grassland habitats. These land conversions contribute to kit fox declines through displacement, isolation of remaining populations, creation of barriers to movement, mortality, and a reduction of prey populations (U.S. Fish and Wildlife Service 1998:130). However, just east of Bethany Reservoir is the Bethany West Conservation Easement, which protects grassland habitat in the action area from further development and fragmentation. This easement was purchased by DWR and is managed by CDFW to offset the effects of the South Bay Aqueduct project on California tiger salamander and California red-legged frog.

Although livestock grazing is not necessarily detrimental and, in fact, may be beneficial (Morrell 1975; Orloff et al. 1986), intensive overgrazing that destroys shrub cover and reduces prey abundance may be detrimental (O'Farrell et al. 1980; O'Farrell and McCue 1981; U.S. Fish and Wildlife Service 1998:130).

The use of pesticides and rodenticides also threatens kit foxes. Ground squirrel control programs in the 1970s severely reduced California ground squirrel populations in Contra Costa County and are thought to have contributed to kit fox declines in the northern range (Bell et al. 1994; U.S. Fish and Wildlife Service 1998:130). Kit fox is also susceptible to secondary poisoning from rodenticides (Standley et al. 1992).

Predation of San Joaquin kit foxes by coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and nonnative red fox (*Vulpes vulpes*) has also contributed to the decline of San Joaquin kit fox. Coyotes and red foxes also compete with kit foxes for the same prey (U.S. Fish and Wildlife Service 2020b:41).

### 4.4.9.4 Status of the Species in the Action Area

In a more recent assessment of the species' status, the USFWS rated the condition of the northernmost portion of the range (the Livermore Unit), which includes the westernmost portion of the action area, as being in a "very low" condition (U.S. Fish and Wildlife Service 2020b:51). The USFWS defines *very low condition* as showing "no evidence of a current population" and having records that are over 10 years old (U.S. Fish and Wildlife Service 2020b:50).

Within the action area, the range of the species, as currently depicted by USFWS (U.S. Fish and Wildlife Service 2018), is limited to areas of suitable habitat generally around Bethany Reservoir. There are nine CNDDB occurrences that overlap with the action area (California Department of Fish and Wildlife 2020a), but as mentioned above, there is no evidence of an existing population and thus these occurrences are considered historical. These occurrences are generally to the west of Clifton Court Forebay and consist of observations that range from 1972 to 2000. Some observations consist of observed tracks and others consist of adult and juvenile observations. The most recent occurrence from 2000 (#34) consists of an observation of dens (not adults), hearing a "yip," and relying on observations of Western Area Power Authority employees (California Department of Fish and Wildlife 2020a). As reported in the *Tracy Hills Habitat Conservation Plan* (ICF 2019:3-11), in 2015, Noreas conducted San Joaquin kit fox surveys for the Tracy Hills development project, located at the southeast edge of the city of Tracy; Noreas reported an unverified San Joaquin kit fox in the California Aqueduct right-of-way. The 2015 sighting remains unverified and is not reported in CNDDB (California Department of Fish and Wildlife 2020a).

### 4.4.9.5 Critical Habitat

Critical habitat has not been designated for San Joaquin kit fox.

### 4.4.9.6 Suitable Habitat Definition

As described above in Section 4.4.9.2, *Life History and Habitat Requirements*, suitable habitat for San Joaquin kit fox in the action area consists of grasslands, vernal pool complex, and alkali seasonal wetland complex with burrows. The areas of suitable habitat in the action area are limited to those described in Section 4.4.9.7, *Species Habitat Suitability Model.*

### 4.4.9.7 Species Habitat Suitability Model

The habitat model for San Joaquin kit fox includes grasslands where denning may occur and vernal pool complex and alkali seasonal wetland complex for dispersal and potential foraging. Habitat is further defined by soils and slopes. Soils were selected from the soil textural classes from the Soil Survey Geographic Database that could be used for establishing dens. Slope data was generated using the National Elevation Dataset (NED), which is a nationwide high-resolution elevation dataset. The extent of modeled habitat in the action area is depicted in Figure 6.3-1. For more information, refer to Chapter 6, *Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species*, Section 6.3, *Effects on San Joaquin Kit Fox.* The geographic limits of the model are based on the range as defined by USFWS in GIS files obtained from USFWS's Environmental Conservation Online System (U.S. Fish and Wildlife Service 2018). Modeled habitat is broken down into high-, moderate-, and low-quality categories and includes vegetation types from the land cover mapped in portions of the action area west of the legal Delta (ICF 2017a, 2018), soils data from the Soil Survey Geographic Database (Natural Resources Conservation Service 2020), and slope data generated using the NED (U.S. Geological Survey 2009a, 2009b, 2010).

#### High-Quality Habitat

High-quality habitat is characterized by the vegetation communities listed below, by soils suitable for denning, and by areas with slopes of less than 10%. Optimal habitat for kit foxes includes grasslands and areas with sandy to sandy-loam soils (Cypher et al. 2007:25). Natal dens appear to be restricted to slopes of 10% or less (U.S. Fish and Wildlife Service 2020b:23). In their 2020 species status assessment report, USFWS considered units with slopes of less than or equal to 10% to be of high value (U.S. Fish and Wildlife Service 2020b:49).

High-quality habitat is limited to the following vegetation type from the Sand Hill Wind Repowering Subsequent Environmental Impact Report (SEIR) Land Cover Dataset (ICF 2018) and East Bay RCIS 2017 Land Cover Dataset (ICF 2017a).

- Grassland
  - All types

High-quality habitat is limited to the following the Soil Survey Geographic Database soil textural classes, which are sandy to sandy-loam soils that Cypher et al. (2007) considered being optimal for denning.

- Loam
- Fine sandy loam
- Silt loam
- Sandy clay loam
- Very fine sandy loam

High-quality habitat is further limited to areas with the following slope from the NED.

- Slope ≤10%

### Moderate-Quality Habitat

Moderate-quality habitat has the same vegetation and soil types as high-quality habitat but is limited to areas with 11% to 30% slopes. Slopes greater than 15% are considered unsuitable (Cypher et al. 2007:25), and others have noted that most dens are found on slopes less than 30% (U.S. Fish and Wildlife Service 2020b:23). In their 2020 species status assessment report, USFWS considered units with slopes less than or equal to 30% to be of moderate value (U.S. Fish and Wildlife Service 2020b:50).

### Low-Quality Habitat

Low-quality habitat is considered to be areas where kit fox may forage and disperse but where denning is unlikely. Low-quality habitat includes vegetation types where denning is unlikely as a result of moist or waterlogged soils for an extended part of the year (U.S. Fish and Wildlife Service 2020b:17). It also includes areas with slopes greater than 30%, which USFWS considered to be of low value in their 2020 species status assessment report (U.S. Fish and Wildlife Service 2020b:50). Low-quality habitat includes all soil types.

Low-quality habitat is limited to the following vegetation types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018) and East Bay RCIS 2017 Land Cover Dataset (ICF 2017a).

- Grassland (includes grasslands on all soil textural classes <u>except</u> those identified in the high- and moderate-quality habitats regardless of slope and also includes those grasslands on slopes from the NED >30%, regardless of soil textural classes)
    - All types
- Vernal pool complex
    - All types
- Alkaline seasonal wetlands
    - All types

## 4.4.10 California Least Tern

### 4.4.10.1 Legal Status and Distribution

California least tern is listed as endangered under the state and federal endangered species acts. The species was listed by the California Fish and Game Commission pursuant to CESA (Fish and Game Code, Sections 2050 *et seq.)* on June 27, 1971, and by USFWS pursuant to the federal ESA on October 13, 1970 (35 FR 8491). California least tern is also designated as a state fully protected species. Critical habitat has not been designated for this species. In 1985, USFWS published a *Revised California Least Tern Recovery Plan*. In 2020, the USFWS completed a 5-year review for this species and recommended no change in current listing status due to the ongoing decline of individuals and pairs throughout their range, poor productivity throughout the last decade, and ongoing threats such as predation and lack of food availability to populations. The 5-year review found that the California least tern recovery effort had reduced threats to the population, but intensive, site-specific management was still necessary to maintain population levels (U.S. Fish and Wildlife Service 2020c:70–72).

The historical breeding range of California least tern extends along the Pacific Coast from approximately Moss Landing to the southern tip of Baja California, Mexico (Grinnell and Miller 1944:175, 186–187, 383–385). However, since about 1970, colonies have been reported north to San Francisco Bay and the Delta (U.S. Fish and Wildlife Service 2020c:7). In addition, isolated instances of nesting have been detected at more inland sites scattered in the Central Valley (U.S. Fish and Wildlife Service 2020c:7). The nesting range in California is somewhat discontinuous as a result of the availability of suitable estuarine shorelines, where California least terns often establish breeding colonies. Marschalek (2006:7) identified six geographic population clusters along the Pacific Coast in California: San Diego, Camp Pendleton, Los Angeles/Orange County, Ventura County, San Luis Obispo/Monterey County, and San Francisco Bay. As of 2016, most of the California population is concentrated in four counties: Ventura, San Diego, Orange, and Los Angeles (U.S. Fish and Wildlife Service 2020c:8).

Statewide surveys in 2016 estimated a minimum of 3,989 breeding pairs (which represented the lowest count since 2002), with about 86% of the breeding colonies occurring in Southern California; however, the minimum fledgling count in 2016 (1,612) was higher than in 2015 (1,514). The San Francisco Bay and central coast areas had the highest minimum fledgling to maximum pair ratio (1.37) and were the only two areas to meet statewide recovery criteria for the fledging to pair ratio. Statewide, the growth of the breeding population has been dramatic since state and federal listing of California least tern, from only several pairs in the late 1960s to a current minimum of 3,989 pairs (Frost 2017:11). However, as noted above, the 2016 survey found the lowest number of breeding pairs since 2002, resulting in concerns about increased threats including predation, low productivity and nest abandonment (Frost 2017:15). The estimated minimum number of pairs in 2017 increased to 4,095 breeding pairs, with the annual average reproductive success for the San Francisco Bay region being above average in comparison toother breeding colonies; the San Francisco Bay region includes the colonies from the Delta and the San Francisco Bay (U.S. Fish and Wildlife Service 2020c:15, 16).

### 4.4.10.2 Life History and Habitat Requirements

California least terns nest in loose colonies on barren or sparsely vegetated sandy or gravelly substrates above the high tide line along the coastline and in lagoons and bays of the California coast. Colonies are always near water that provides foraging opportunities. Foraging typically occurs in shallow estuaries or lagoons (Thompson et al. 2020; U.S. Fish and Wildlife Service 2020c:19). Nest sites are shallow depressions without nesting material, typically in barren sandy or gravelly substrate (U.S. Fish and Wildlife Service 2020c:6). Most nest sites are on developed lands, such as dikes (e.g., Pittsburg Power Plant), dredge spoils, sand-topped islands (e.g., Montezuma Wetlands), and airports (e.g., Alameda Point) (U.S. Fish and Wildlife Service 2020c:18). Prior to egg-laying, adults generally roost away from nest sites, from 0.25 mile at coastal sites to several miles at estuarine sites. This behavior is thought to be a form of predator avoidance (U.S. Fish and Wildlife Service 1985:7). California least terns select nesting colony sites that are free of human or predatory disturbance and near a foraging area. The availability of such sites is a limiting factor for the species.

California least terns are migratory and are present at nesting areas from mid-April to late September (U.S. Fish and Wildlife Service 2020c:6; Anderson and Rigney 1980; Patton 2002:6; Frost 2017:4). Courtship generally occurs during April and May and usually takes place away from the nesting area on exposed tidal flats or beaches. Nesting begins by mid-May (Massey and Atwood 1981). Clutch size ranges from one to four eggs but usually consists of two or three eggs, with a single brood raised each year. Incubation is usually 20 to 25 days, and young are fledged by 28 days.

The young will continue to depend on adults for an additional 2 weeks (Rigney and Granholm 2005:1–3). Wintering areas are largely unknown, but are suspected to be along the Pacific Coast of Central and South America (Rigney and Granholm 2005:1). In the San Francisco Bay Area and Suisun Bay, nesting colonies are typically located in abandoned salt ponds and along estuarine shores, often using artificially or incidentally created habitat (Rigney and Granholm 2005:1–3; Marschalek 2008:14). Foraging occurs in the bay or large river estuaries.

California least terns are very gregarious and nest, feed, roost, and migrate in colonies. They are highly sensitive to nest disturbance and will readily abandon nest sites if disturbed (Rigney and Granholm 2005:1–3).

The California least tern feeds in shallow estuaries and lagoons for small fish, including anchovies (*Engraulis* spp.), silversides (*Atherinops* spp.), and shiner surfperch (*Cymatogaster aggregata*) (Rigney and Granholm 2005:1–3). It hovers above the water, then plunges but does not completely submerge. It will also forage in the shallow tidal zone of the open ocean and in bays (Rigney and Granholm 2005:1–3).

### 4.4.10.3 Impacts from Past and Present Actions

The loss, degradation, and disturbance of suitable coastal strand and estuarine shoreline habitat from urban development and agriculture is the primary reason for the historical reduction of California least tern populations. In the action area, this development includes the CVP, SWP, Central Valley Flood Protection Plan, water treatment facilities, energy generation and distribution, and shipping, Most extant colonies occur on small patches of degraded nesting habitat surrounded by human activities. Most colony sites are in areas that were incidentally created during development projects. Further expansion and recovery of the California least tern population may require the creation or restoration of nesting habitat (U.S. Fish and Wildlife Service 2020c:71–72).

Human disturbance was noted as early as the mid-1920s as a factor in causing colony abandonment and California least tern population declines (Rigney and Granholm 2005:1–3), and is still considered a major threat to remaining colonies (Garrett and Dunn 1981; Marschalek 2009). There is no suitable natural habitat in California that is free of development, military, or recreation-related human disturbances; thus, opportunities for the species to develop new breeding territories are mostly restricted to artificially or incidentally created habitat. Fencing has been used to prohibit entry into colony sites, but this also restricts the movement of birds. Lack of fencing or damage to existing fencing has led to nesting failures (U.S. Fish and Wildlife Service 2020c:54).

Predation is regarded as the most significant threat to existing colonies and continues to be a rangewide threat to the species (U.S. Fish and Wildlife Service 2020c:39). Frost (2017) reports 485 eggs (and another 767 eggs lost to unknown causes), 63 chicks, 49 fledglings, and 54 adults were lost of predation in 2016. Most depredated California least tern eggs were taken by rats (*Ratus* spp.), common ravens (*Corvus corax*), coyotes (*Canis latrans*), northern harrier (*Circus cyaneus*), and California gulls (*Larus californicus)*, while most depredated California least tern chicks were taken by northern harriers, ants, gull-billed terns (*Gelochelidon nilotica*), American kestrels (*Falco sparverius*), peregrine falcons (*falco peregrinus*), raptor species, and red-trailed hawks (*Buteo jamaicensis*). Peregrine falcons, red-tailed hawks, and raptor species depredated the most fledglings, and peregrine falcons, great horned owls (*Bubo virginianus*), and raptor species depredated the most adults.

Researchers suggest changes in prey availability contributes to decline in least tern reproductive success and population size (U.S. Fish and Wildlife Service 2020c:18). Intervals of low and high breeding success are normal for seabirds; however, fluctuations in forage fish biomass can interrupt these breeding cycles and result in long-term declines (Cury et al. 2011:1704). Decreased nest success has been documented in years when adult terns bring inadequate or inappropriate fish sizes to feed mates and chicks (Massey et al. 1992:980; Keane 2001:9-10).

Additionally, since the completion of the 2006 5-year review, a growing concern for the California least tern is impacts to the habitat resulting from climate change (U.S. Fish and Wildlife Service 2020c:31, 69). Global sea level rise due to climate change could pose a threat to California least tern nesting in low-lying areas along estuaries or beaches (U.S. Fish and Wildlife Service 2020c:32). For example, loss of California least tern nests and eggs have been attributed to flooding at nine nest sites on the central coast and in Southern California, and the California Climate Change Center predicts specific sea level rise within San Diego County could impact currently used California least tern nesting sites (U.S. Fish and Wildlife Service 2020c:33). Changes in regional weather patterns has also been linked to changes in prey availability for breeding California least terns, and studies have documented reductions in breeding success following years of El Niño Southern Oscillation (U.S. Fish and Wildlife Service 2020c:55–56).

### 4.4.10.4 Status of the Species in the Action Area

Recently, seven California least tern nesting sites have been reported from the vicinity of the Delta. One site (the Pittsburg Power Plant) is in the action area (Frost 2016:63). Frost (2017:11) documented one breeding pair at this site in 2016, but no fledglings. The Pittsburg site was not surveyed in 2017 (U.S. Fish and Wildlife Service 2020c:95–96).

Three additional locations have been reported from just outside the action area, including Napa-Sonoma Marshes Wildlife Area Green Island Unit on the Napa River, east of the San Pablo Bay National Wildlife Refuge and northwest of American Canyon, where a minimum of 60 breeding pairs and 79 nests produced between 5 and 6 fledglings in 2016 (Frost 2017:11), and along a gravel road between treatment ponds at the Sacramento Regional Wastewater Treatment Plant (Bufferlands) east of Interstate (I-) 5, where terns were recorded in 9 of 10 years between 2008 and 2017, and a single pair attempted to nest in 8 of those years (Conard 2018). At the third location, Montezuma Wetlands on the eastern edge of Suisun Marsh near Collinsville, California least terns have nested since 2006. This colony site was unintentionally created as part of a wetlands restoration project (i.e., the goal of the restoration project was not to create California least tern habitat) (Marschalek 2008:14). A pile of sand and shells, formed during excavation of the wetland restoration site, attracted terns to the site, which to date has prevented completion of the restoration project. Frost (2017:12) reports a minimum of four breeding pairs, six nests, and one fledgling from this breeding colony in 2016. USFWS (2020c:95–96) reports a minimum of seven breeding pairs and a fledglings-per-pair ratio minimum of 0.63 in 2017.

There is one record of a California least tern foraging in the Clifton Court Forebay from 1994 (eBird 2021). However, California least tern is not expected to be foraging at the forebay because it is 20 miles from the nearest nesting site (Pittsburg), which is currently not supporting breeding.

The action area is on the eastern edge of the more successful breeding area of South San Francisco Bay. The locations of current or historical colonies are greater than 2 miles from construction areas, the typical distance California least terns will travel from their colonies to forage (Atwood and

Minsky 1983:70). For this reason, it is very unlikely that California least terns will forage in or near the water conveyance facility footprint.

### 4.4.10.5 Critical Habitat

Critical habitat has not been designated for California least tern.

### 4.4.10.6 Suitable Habitat Definition

As described above in Section 4.4.10.2, *Life History and Habitat Requirements*, and below in Section 4.4.10.7, *Breeding and Foraging Habitat Suitability Model*, suitable foraging habitat for California least tern includes all of the tidal perennial aquatic natural community within the action area. Suitable nesting habitat includes barren or sparsely vegetated gravelly substrates that are unlikely to occur within the Delta due to its highly altered landscape.

### 4.4.10.7 Breeding and Foraging Habitat Suitability Model

The Delta is considered to be at the northern limit of the species range where some small breeding populations occur (as described in Section 4.4.10.1, *Legal Status and Distribution*). As described in Section 4.4.10.2, *Life History and Habitat Requirements*, foraging typically occurs in shallow estuaries or lagoons (U.S. Fish and Wildlife Service 2020c:19). Consequently, modeled foraging habitat consists of tidal perennial aquatic habitat types. The modeled foraging habitat relies on both delineation data that was collected for a smaller portion of the action area, in what is called the *delineation study area,* and suitable habitats found in the data sets outside the delineation study area. The extent of modeled habitat in the action area is depicted in Figure 6.4-1. For more information refer to Chapter 6, Section 6.4, *Effects on California Least Tern*.

Nesting habitat is barren or sparsely vegetated sandy or gravelly substrates above the high tide line along the coastline (U.S. Fish and Wildlife Service 2006a:22–23). In the Delta, nesting colonies are often in artificially or incidentally created habitat (Rigney and Granholm 2005:1–3; Marschalek 2008:14) such as gravel roads, debris piles, and other conditions that mimic a natural sandy or gravelly substrate as evidenced by recent breeding occurrences in human-modified or artificial habitats at the Montezuma Wetlands, Pittsburg Power Plant, and the Bufferlands. Although future nesting habitat could occur incidentally in the Delta, it is not possible to accurately predict where; therefore, suitable nesting habitat cannot be modeled.

#### Inside the Delineation Study Area

Modeled habitat includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Tidal perennial aquatic
  - Tidal channel
  - Natural channel//
  - Water

### Outside the Delineation Study Area

Modeled habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Tidal perennial aquatic
  - Azolla (*filiculoides, microphylla*)
  - *Eichhornia crassipes*
  - *Lemna* (minor) and relatives
  - Ludwigia (*hexapetala, peploides*)
  - Naturalized temperate Pacific freshwater vegetation
  - Temperate Pacific freshwater aquatic bed

## 4.4.11 Least Bell's Vireo

### 4.4.11.1 Legal Status and Distribution

Least Bell's vireo was listed as endangered under the federal ESA on May 2, 1986 (51 FR 16474–16482). The species is also listed as endangered under the CESA in 1980. Least Bell's vireo is one of four subspecies of Bell's vireo and is the only subspecies that breeds entirely in California and northern Baja California (Kus 2002:2).

Least Bell's vireo, a riparian obligate, had a historical distribution that extended from coastal Southern California through the San Joaquin and Sacramento Valleys as far north as Tehama County near Red Bluff (Kus 2002:2; U.S. Fish and Wildlife Service 1998:7). The Sacramento and San Joaquin Valleys were the center of the historical breeding range supporting 60% to 80% of the population (51 FR 16474). Least Bell's vireo also occurred along western Sierra Nevada foothill streams and in riparian habitats of the Owens Valley, Death Valley, and Mojave Desert (Kus 2002:2; Grinnell and Miller 1944:175, 186–187, 383–385; U.S. Fish and Wildlife Service 1998:7). Least Bell's vireo was reported in Grinnell and Miller (1944:175, 186–187, 383–385) to occur from elevations ranging from –175 feet in Death Valley to 4,100 feet in Bishop, Inyo County. These and other historical accounts described the subspecies as common to abundant (Kus 2004), but no reliable population estimates are available prior to the federal listing of least Bell's vireo in 1986 (U.S. Fish and Wildlife Service 1998:7).

Coinciding with widespread loss of riparian vegetation throughout California (Katibah 1984:23), Grinnell and Miller (1944:384) began to detect population declines in the Sacramento and San Joaquin Valleys by the 1930s. Surveys conducted in late 1970s (Goldwasser et al. 1980:742) detected no least Bell's vireos in the Sacramento and San Joaquin Valleys, and the subspecies was considered extirpated from the region. By 1986, USFWS determined that least Bell's vireo had been extirpated from most of its historical range and numbered approximately 300 pairs statewide (51 FR 16474; Kus 2002:2).

The historical range was reduced to six California counties south of Santa Barbara, with the majority of breeding pairs in San Diego County (77%), Riverside County (10%), and Santa Barbara County (9%) (51 FR 16474).

Since federal listing in 1986, least Bell's vireo populations have gradually increased, and the subspecies has recolonized portions of its historical range. Increases are attributed primarily to riparian restoration and efforts to control the brood parasite brown-headed cowbird (Howell et al. 2010:105–109). By 1998, the total population of least Bell's vireo was estimated at 2,000 pairs and recolonization was reported along the Santa Clara River in Ventura County, the Mojave River in San Bernardino County, and sites in Monterey and Inyo Counties (Kus and Beck 1998:63–64; Kus 2002:4; U.S. Fish and Wildlife Service 2006b:6–7). A single nest was reported from Santa Clara County near Gilroy in 1997 (Kus 2002:2). Still, the distribution remained largely restricted to San Diego County (76%) and Riverside County (16%) (U.S. Fish and Wildlife Service 2006b:6–7).

By 2005, the population had reached an estimated 2,968 breeding pairs (Allen and Kus 2020:2) with increases in most Southern California counties and San Diego County (primarily Camp Pendleton Marine Corps Base) supporting roughly half of the current population (U.S. Fish and Wildlife Service 2006b:6–7). Recent occurrences have suggested a range expansion to the northern extent of the subspecies' historical breeding range.

### 4.4.11.2 Life History and Habitat Requirements

Least Bell's vireo is an obligate riparian breeder that typically inhabits willow riparian forest supporting a dense, shrubby understory of mulefat (*Baccharis salicifolius*) and other mesic species (Goldwasser 1981:15–16; Gray and Greaves 1981:609-610; Franzreb 1989:9, 13). Oak woodland with a willow riparian understory is also used in some areas (Gray and Greaves 1981:606), and individuals sometimes enter adjacent chaparral, coastal sage scrub, or desert scrub habitats to forage (Kus 2002:8; Kus and Miner 1989:299). While the species appears to be especially dependent on the presence of willows within occupied habitat, the structure is extremely important. Least Bell's vireos are characterized as preferring early successional habitat, inhabiting low, dense riparian growth along water or along dry parts of intermittent streams (U.S. Fish and Wildlife Service 1998:10). Similar habitats are used during the winter months. Nests are typically placed 1.6 to 4.9 feet (0.5 to 1.5 meters) above the ground, but can be up to 26 feet (8 meters) above the ground (Ehrlich et al. 1988). Goldwasser (1981:15–16) and Salata (1983:35, 52, 54) believed that structure and composition of vegetation below 10 and 13 feet, respectively, were critical. Salata (1983:35, 52, 54) also reported the importance of a mix of tree size classes, with a mean height of 26 feet. Gray and Greaves (1984) recommended protection of ground cover and low shrub layers. Vireos occur in disproportionately high frequencies in the wider sections (greater than 825 feet) of the riparian corridor relative to site availability (Kus 2002:7).

Early successional riparian habitat typically supports the dense shrub cover required for nesting and a diverse canopy for foraging. Although least Bell's vireo tends to prefer early successional habitat, breeding site selection does not appear to be limited to riparian stands of a specific age (Goldwasser 1981:15–16; Franzreb 1989:9, 13; Kus et al. 2020). If willows and other species are not managed, within 5 to 10 years they form dense thickets and become suitable nesting habitat (Goldwasser 1981:15–16; Kus 1998:80–82). Tall canopy tends to shade out the shrub layer in mature stands, but least Bell's vireo will continue to use such areas if patches of understory exist. In mature habitat, understory vegetation consists of species such as California wild rose (*Rosa*

*californica*), poison oak (*Toxicodendron diversilobum*), California blackberry (*Rubus ursinus*), grape (*Vitis californica*), and perennials that can conceal nests.

Least Bell's vireos use upland habitat, in many cases coastal sage scrub, adjacent to riparian habitat. Vireos along the edges of riparian corridors maintain territories that incorporate both habitat types, and a significant proportion of pairs with territories encompassing upland habitat place at least one nest there (Kus and Miner 1989:300, 302). Least Bell's vireo arrives on its breeding grounds in mid-March (Brown 1993), with males arriving slightly before females (Kus 2002:2-3). Least Bell's vireo shows a high degree of nest site tenacity (Greaves 1987:50–54). Most individuals depart by September (Brown 1993), although some individuals remain on their breeding grounds into late November (Kus 2002:3).

Least Bell's vireos winter in the Baja California Peninsula. Unlike during the breeding season, they are not limited in winter to willow-dominated riparian areas, but occupy a variety of habitats including mesquite scrub within arroyos, palm groves, and hedgerows bordering agricultural and residential areas. Uplands adjacent to riparian areas provide migratory stopover grounds, foraging habitat, and dispersal corridors for nonbreeding adults and juveniles (Kus and Miner 1989:300, 302; Riparian Habitat Joint Venture 2004:19, 44, 56, 73, 87).

Territory size ranges from 0.5 to 7.5 acres (0.2 to 3 hectares), but on average are between 1.5 and 2.5 acres (0.6 and 1 hectare) in Southern California (U.S. Fish and Wildlife Service 1998:14–15). Spatial differences in riparian habitat structure, patch size, and numerous other factors result in differences in the density of territories within and between drainages. Patch size and crowding did not influence least Bell's vireo reproductive success, at least as measured by singing rates and attraction of predators (U.S. Fish and Wildlife Service 1998:14–15).

Least Bell's vireo is insectivorous and preys on a wide variety of insects, including bugs, beetles, grasshoppers, moths, and especially caterpillars (Chapin 1925:25; Bent 1950:258–259; U.S. Fish and Wildlife Service 1998:19). Least Bell's vireo obtains prey primarily by foliage gleaning (picking prey from leaf or bark substrates) and hovering (removing prey from vegetation surfaces while fluttering in the air). Foraging occurs at all levels of the canopy but appears to be concentrated in the lower to middle stratas, particularly when pairs have active nests (Grinnell and Miller 1944:175, 186–187, 383–385; Goldwasser 1981:15–16; Gray and Greaves 1981:610; Salata 1983:35, 52, 54). USFWS (1998:9–10) determined that least Bell's vireo foraging time across heights was not simply a function of the availability of vegetation at those heights, but rather represented an actual preference for the 10- to 20-foot zone. Foraging occurs most frequently in willows (Salata 1983:35, 52, 54; U.S. Fish and Wildlife Service 1998:20), but occurs on a wide range of riparian species and even some non-riparian plants that may host relatively large proportions of large prey (U.S. Fish and Wildlife Service 1998:20).

### 4.4.11.3 Impacts from Past and Present Actions

Loss of habitat combined with increased brood parasite pressure from brown-headed cowbirds (*Molothrus ater*) (Goldwasser 1978; Beezley and Rieger 1987:55–56) are the major factors leading to the significant declines in populations of least Bell's vireo (Franzreb 1989:iii; 57 FR 34851–35453).

Habitat loss and degradation can occur through clearing of vegetation for agriculture, timber harvest, development, or flood management (U.S. Fish and Wildlife Service 1998:9–10; Kus et al. 2010:2, 9). Flood management projects have resulted in river channelization, which eliminates early

successional riparian habitat that least Bell's vireo use for breeding. Dam, levee, and other flood-control projects (e.g., Central Valley Flood Protection Plan) have hindered riparian re-establishment, creating more old-growth conditions (dense canopy and open understory) that are unfavorable to breeding vireos. Finally, habitat degradation associated with flood control projects encourages nest predation and parasitism. Agricultural land development, flood-control projects, and river and stream flow manipulation have not only affected habitat, but have also reduced water tables to levels that inhibit the growth of the dense vegetation least Bell's vireo prefers (Riparian Habitat Joint Venture 2004:19, 44, 56, 73, 87).

Grazing in the action area has also had a significant effect on riparian vegetation (Sedgwick and Knopf 1987). Cattle and other livestock trample vegetation and eat seedlings, saplings, shrubs, and herbaceous plants. This can lead to a reduction in cover and nesting sites, and affect insect prey populations.

Brood parasitism from brown-headed cowbirds has a major negative impact on least Bell's vireo. Sharp and Kus (2006:682) suggest that microhabitat cover around the nest is the most important habitat feature influencing brood parasitism of least Bell's vireo nests. They found non-parasitized nests had fewer trees greater than 3 inches in diameter at breast height within 37 feet of the nest and had less canopy cover within 16 feet than parasitized nests. They also suggest that cover near the nest reduces the chance that a cowbird will observe nesting activity and later parasitize the nest.

Row crops and orchards, which are common in the action area, also provide feeding grounds for brown-headed cowbirds. Young and Hutto (1999:41) found that distance to agriculture was the strongest predictor of cowbird presence and abundance. Riparian habitat that is fragmented by agriculture is therefore highly susceptible to cowbird brood parasitism. By as early as 1930, nearly every least Bell's vireo nest found in California hosted at least one cowbird egg (U.S. Fish and Wildlife Service 1998:9–10). Because a parasitized nest rarely fledges any vireo young, nest parasitism of least Bell's vireo results in drastically reduced nest success (Goldwasser 1978; Goldwasser et al. 1980:743–745; Franzreb 1989:9, 13; Kus 1999:165, 2002).

Predation is a major cause of nest failure in areas where brown-headed cowbird nest parasitism is infrequent or has been reduced by cowbird trapping programs. Most predation occurs during the egg stage. Predators likely include western scrub jays (*Aphelocoma californica*), Cooper's hawks (*Accipiter cooperii*), gopher snakes (*Pituophis melanoleucus*) and other snake species, raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), coyotes (*Canis latrans*), long-tailed weasels (*Mustela frenata*), dusky-footed woodrats (*Neotoma fuscipes*), deer mice (*Peromyscus maniculatus*), rats (*Rattus* spp.), and domestic cats (*Felis domesticus*) (Franzreb 1989:9, 13). Kus et al. (2008) investigated variables that influenced the likelihood of nest predation on least Bell's vireo at three spatial scales. They did not find strong predictors of predation risk at the nest site, surrounding habitat, or landscape scale, with the exception of proximity to golf courses, parks, and wetlands. Nest predation increased with proximity to golf courses, whereas nests near wetland habitats were twice as likely to succeed as those that were farther from wetlands (Kus et al. 2008).

#### 4.4.11.4 Status of the Species in the Action Area

Data on least Bell's vireo from the 1940s through the 1960s are lacking, but extensive surveys of the Central Valley in the late 1970s did not detect a single individual (Goldwasser et al. 1980:743–745). Least Bell's vireos are rarely observed in the Central Valley. According to eBird (2021), the species has been observed at eight distinct locations in the Central Valley between 2005 and 2019. There are no CNDDB records of least Bell's vireos breeding in the action area since at least the 1970s. Two

singing males were detected in the Yolo Bypass Wildlife Area in mid-April 2010, and again in 2011 (California Department of Fish and Wildlife 2020a). No least Bell's vireos were detected in the Yolo Bypass Wildlife Area during surveys in 2012. Protocol-level surveys have not been conducted for least Bell's vireo within the action area. However, there have been some relatively recent observations of nesting behavior in the Yolo Bypass Wildlife Area, Bufferlands' Upper Beach Lake, and on Bradford Island. Two singing males were detected in the Yolo Bypass Wildlife Area in mid-April through mid-August 2010 and again in early May through mid-July 2011 (California Department of Fish and Wildlife 2020a); territorial singing and courtship behavior are signs of possible breeding. In 2010, a vireo was seen in this area carrying nesting material, a sign of breeding (Whisler pers. comm.: 1–2). Least Bell's vireo was not detected in the Yolo Bypass Wildlife Area during surveys in 2012. One singing male was detected on one occasion in May 2013 but was not observed subsequently (Whisler pers. comm.:2). No least Bell's vireos have been detected in the Yolo Bypass Wildlife Area since 2013 (eBird 2021). One singing male was observed over 2 days at Upper Beach Lake on the Bufferlands property in late April 2013 but was not detected subsequently (eBird 2021). Singing males were detected on Bradford Island in June 2018, June and July 2019 (eBird 2021), and May and August 2020; begging young were heard in August 2020 (eBird 2020) potentially suggesting successful breeding.

The next-nearest known nest site since the 1930s is approximately 7 miles south of the action area at the San Joaquin River National Wildlife Refuge in the San Joaquin and Tuolumne River floodplain (Howell et al. 2010:105–109). This occurrence includes three nests between 2005 and 2007, all in a recently restored portion of San Joaquin River National Wildlife Refuge lands known as "Hagemann's Fields 6 and 9." The 2005 and 2006 nests were successful. The 2007 nest was not successful in that only a female returned to the area, and though a nest was constructed and the female laid eggs, the nest failed. The 2005 and 2006 nests were in a 3-year-old arroyo willow with understory plants including mugwort (*Artemisia douglasiana*), sunflower (*Helianthus annuus*), gumplant (*Grindelia hirsutula*), and creeping wild rye (*Leymus triticoides*) The 2007 nest was in a dead arroyo willow (Howell et al. 2010:105–109). One individual was also seen in the San Joaquin River National Wildlife Refuge along Ingram Creek in 2012 and 2016 (eBird 2021).

### 4.4.11.5 Critical Habitat

Final designation of critical habitat for least Bell's vireo was published in the *Federal Register* on February 2, 1994 (59 FR 14845–4867). There is no designated critical habitat for least Bell's vireo in the action area.

### 4.4.11.6 Suitable Habitat Definition

As described in Section 4.4.11.2, *Life History and Habitat Requirements*, least Bell's vireo nesting habitat includes early successional riparian habitat. Least Bell's vireos also use upland habitat adjacent to riparian habitat. Outside the breeding season, least Bell's vireo use upland habitats such as hedgerows as migratory stopover grounds, foraging habitat, and dispersal corridors for nonbreeding adults and juveniles (Kus and Miner 1989:300, 302; Riparian Habitat Joint Venture 2004:19, 44, 56, 73, 87).

### 4.4.11.7 Recolonization Habitat Suitability Model

The primary populations of least Bell's vireo currently occur in Southern California; however, over the last decade or more, sporadic occurrences of individuals displaying breeding behavior or

successful nesting have been reported in the Delta (see Section 4.4.11.4, *Status of the Species in the Action Area/Environmental Baseline*, for additional details). This is considered evidence that least Bell's vireos are slowly expanding their population back into their historic range. At the time of this writing, least Bell's vireo is not assumed to be a resident of the Delta and thus the model identifies areas of potential recolonization. Because there are so few occurrences in or around the Delta from which to confidently determine a range within the Delta, the entire Delta is assumed to have potential to provide recolonization habitat.

Least Bell's vireo typically nests in willow-dominated habitats and early successional riparian habitat typically supports the dense shrub cover required for nesting and a diverse canopy for foraging (Riparian Habitat Joint Venture 2004:19, 44, 56, 73, 87). Although least Bell's vireo tends to prefer early successional habitat, breeding site selection does not appear to be limited to riparian stands of a specific age. Therefore, in addition to all willow-dominated types, all other riparian habitats that may consist of a dense shrub layer are included in the model. The extent of modeled habitat in the action area is depicted in Chapter 6, Figure 6.5-1.

Modeled least Bell's vireo habitat includes the following land cover types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018) layers.

- Valley/foothill riparian
  - *Salix gooddinggii*
  - *Salix lasiolepis*
  - *Vitis californica*
  - *Salix exigua*
  - *Salix lucida*
  - *Populus fremontii*
  - *Alnus rhombifolia*
  - *Fraxinus latifolia*
  - *Acer negundo*
  - *Juglans hindsii* and hybrids
  - *Baccharis pilularis*
  - *Rosa californica*
  - *Cornus sericea*
  - *Quercus agrifolia*
  - *Quercus wislizeni* (tree)
  - *Quercus lobata*
  - *Rubus armeniacus*
  - *Sambucus nigra*

- *Platanus racemosa*
- *Salix laevigata*
- *Cephalanthus occidentalis*
- Californian broadleaf forest and woodland group
- Southwestern North American riparian evergreen and deciduous woodland
- Vancouverian riparian deciduous forest alliance
- Southwestern North American introduced riparian scrub
- Southwestern North American riparian/wash scrub

Modeled habitat also includes the following land cover types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021)[9] layer.

- Valley/foothill riparian
  - Forested wetland
  - Shrub scrub wetland

## 4.4.12 Western Yellow-Billed Cuckoo

### 4.4.12.1 Legal Status and Distribution

The Western DPS of the yellow-billed cuckoo was listed as threatened under the federal ESA on October 2, 2014 (79 FR 59991–60038). Western yellow-billed cuckoo is also listed as an endangered species under the CESA. A petition was submitted to USFWS on May 4, 2017, to delist yellow-billed cuckoo under the ESA; on June 27, 2018, USFWS issued a 90-day finding of the petition stating that action may be warranted and requested more information (83 FR 30091–30094). On September 16, 2020, USFWS issued a 12-Month Delisting Decision stating that delisting under the ESA was not warranted [85 FR 57816–578818].

The historical distribution of western yellow-billed cuckoo extended throughout the Central Valley (Belding 1890:57). In the mid-1940s, Grinnell and Miller (1944:175, 186–187, 383–385) considered the Central Valley distribution to extend from Bakersfield to Redding.

Currently, the known populations of breeding western yellow-billed cuckoo are in 12 states in the United States and six states in Mexico (85 FR 57817). Currently, the known populations of breeding western yellow-billed cuckoo are in several disjunct locations in California, Arizona, New Mexico, Texas, and northern Mexico (Halterman 1991:1, 5; Johnson et al. 2007:4; Dettling et al. 2015:1; Stanek 2014:14–15, 21–22; Parametrix Inc. and Southern Sierra Research Station 2015:65, 81). The only locations in California that currently sustain breeding populations include the Colorado River system in Southern California, the South Fork Kern River east of Bakersfield, isolated sites along the Sacramento River in Northern California, and a few occurrences that have been detected near the Eel River (Laymon and Halterman 1989:273; Laymon 1998:2–4; Halterman 2001:2; Hammond

[9] The DWR 2020 Aquatic Resources Delineation data is considered sufficient for evaluation of effects from the proposed action in this BA. The land cover data will be updated to include the final verified aquatic resources delineation data prior to submittal of this BA in support of the request for formal consultation.

2011:4; Stanek 2014:2). Many large riparian areas along the Sacramento River in Tehama County and along the Feather River in Yuba and Sutter Counties appear to be unoccupied, but represent potentially suitable habitat for western yellow-billed cuckoo (Gaines and Laymon 1984:59–60; Dettling et al. 2015:3, 4, 9–11). The current breeding population in California is estimated to be about 40–50 pairs (78 FR 61621–61666). Surveys conducted by Dettling et al. (2015:7) in 2010, 2012, and 2013 in 84 habitat patches along the Sacramento River and 31 habitat patches along the Feather River determined that there is a population of 30 pairs on the Sacramento River; western yellow-billed cuckoo was not detected along the Feather River.

Western yellow-billed cuckoos winter in South America from Venezuela to Argentina (Hughes 1999:3, 5, 11, 20; Sechrist et al. 2012:8) after a southern migration that extends from August to October (Laymon 1998:2–4). They migrate north and arrive at California breeding grounds between May and July, but primarily in June (Gaines and Laymon 1984:49; Hughes 1999:3, 5, 11, 20; 78 FR 61621).

### 4.4.12.2 Life History and Habitat Requirements

Western yellow-billed cuckoo is a riparian obligate species. Its primary habitat association is willow-cottonwood riparian forest, but other tree species such as white alder (*Alnus rhombifolia*) and box elder (*Acer negundo*) may be an important habitat element in some areas, including occupied sites along the Sacramento River (Laymon 1998:2–4, 11, 12). Nests are primarily in willow (*Salix* spp.) trees; however, other tree species are occasionally used, including Fremont cottonwood (*Populus fremontii*) and alder. Along the Sacramento River, orchards of English walnut (*Juglans regia*), prune, and almond trees have also been reportedly used for nesting (Laymon 1980:1, 3). Potential habitat also occurs in valley marshland with willow riparian corridors, such as that found in the Llano Seco area of Butte County.

On the Santa Ana River, nest site height in willow trees averaged 14 feet, but on the Sacramento River, a nest in a cottonwood tree was reported at 100 feet and canopy cover is typically dense (averaging 96.8% at the nest). Patch size was found to be the most important habitat variable to predict presence of western yellow-billed cuckoos on the Sacramento River (Girvetz and Greco 2009:24; Halterman 1991:3–4). Large patch sizes (minimum 50 acres to 100 acres, with a minimum width of 328.1 feet) are typically required for cuckoo occupancy (Laymon 1998; Riparian Habitat Joint Venture 2004:57). A willow-cottonwood forest patch greater than 1,980 feet wide and greater than 200 acres is classified as optimum habitat; a patch 660 to 1,980 feet wide and 102.5 to 200 acres is suitable; a patch 330 to 660 feet wide and 50 to 100 acres is marginal; and smaller patches are unsuitable (Laymon and Halterman 1989:272–273).

All studies indicate a highly significant association with relatively expansive stands of mature cottonwood-willow forests; however, western yellow-billed cuckoos will occasionally occupy a variety of marginal habitats, particularly at the edges of their range (Laymon 1998:2–4, 11, 12). Continuing habitat succession has also been identified as important in sustaining breeding populations (Laymon 1998:2–4, 11, 12). Meandering streams that allow for constant erosional and depositional processes create habitat for new rapidly growing young stands of willow, which create preferred nesting habitat conditions for western yellow-billed cuckoo. Lateral channel migration and point bar deposition that create new floodplains and channel bend cutoffs that create floodplain lakes are important processes that create viable western yellow-billed cuckoo habitat (Greco 2013:711–715).

The Riparian Habitat Joint Venture recommends restoring habitat in 25 locations to support 625 pairs (25 pairs per location) (Riparian Habitat Joint Venture 2004:19, 44, 56, 73, 87). Predictions suggest that a minimum of at least 25 pairs in a subpopulation, with interchange with other subpopulations, should be relatively safe from extirpation (Riparian Habitat Joint Venture 2004:19, 44, 56, 73, 87). To achieve this goal for the Sacramento Valley, it would be necessary to establish or preserve at least 6,070 hectares (15,000 acres) of optimum and suitable habitat. As of 1998, only 2,367 hectares (5,850 acres) of habitat were considered suitable (Laymon 1998:2–4, 11, 12).

### 4.4.12.3 Impacts from Past and Present Actions

Past and present development, agricultural, and flood management projects (e.g., Central Valley Flood Protection Plans) in the action area are attributed to the removal of riparian forests in the action area. Habitat loss continues as a result of bank stabilization and flood control projects, urbanization along edges of watercourses, agricultural activities (e.g., livestock overgrazing, encroachment from agriculture), conversion of native habitat to predominately nonnative vegetation, and river management that alters flow, natural stream processes, and sediment regimes (85 FR 57817–578818). Nesting cuckoos are also sensitive to habitat fragmentation that reduces patch size (Hughes 1999:3, 5, 11, 20). Pesticide use associated with agricultural practices may affect behavior and cause death or potentially affect prey populations (Hughes 1999:3, 5, 11, 20). The decline of prey populations has been found to have a strong effect on nesting success and pairs may forgo breeding in years with inadequate food supply (U.S. Forest Service 2005:20). Predation is a significant source of nest failures, which have been recorded at 80% in some areas (Hughes 1999:3, 5, 11, 20). Fragmentation of occupied habitats could make nest sites more accessible and more vulnerable to predation. Nestlings and eggs are vulnerable to predation by snakes, small mammals, and birds.

Overuse by livestock has been another major factor in the degradation and modification of riparian habitats in the western United States. The effects include changes in plant community structure and species composition and relative abundance of species and plant density (U.S. Forest Service 2005:3). Harris et al. (1988:21) believed that termination of grazing along portions of the South Fork of the Kern River in California was responsible for increases in riparian vegetation. Another likely factor in the loss and modification of western yellow-billed cuckoo habitat is the invasion by the exotic tamarisk (*Tamarisk* sp.).

To a lesser extent, effects of invasive species and the effects of climate change are also stressors affecting western yellow-billed cuckoo (85 FR 578818).

### 4.4.12.4 Status of the Species in the Action Area

There are no recently confirmed western yellow-billed cuckoo breeding locations in the action area (California Department of Fish and Wildlife 2020a); however, the species has been observed in the action area. In 2013, approximately 5 miles from the action area, there were two unconfirmed audible occurrences along the American River Parkway. These two occurrences were less than 5 miles apart along the river and heard on the same day (eBird 2021). In 2015 there was a confirmed visual occurrence along the American River near both 2013 audible occurrences and approximately 5 miles from the action area (eBird 2021). There are two records of western yellow-billed cuckoo observed at Cosumnes River Preserve on the same day in July 1996 and one observation of a cuckoo in flight at the Dow Wetlands Preserve in June 2005 (eBird 2021). In summer 2009, DWR detected

one, or possibly two, yellow-billed cuckoos in a remnant patch of riparian forest near Delta Meadows (California Department of Water Resources 2011). However, breeding status was not confirmed. Historic and recent sightings of western yellow-billed cuckoo near the action area are presumed to be migrating birds. Most riparian corridors in the action area do not support sufficiently large riparian patches or the natural, geomorphic processes that provide suitable breeding habitat (Greco 2013:711–715). Several remnant riparian patches in the vicinity of Mandeville and Medford Islands provide riparian vegetation suitable for western yellow-billed cuckoo but do not provide sufficiently large patch size to support breeding cuckoos. There have been very few occurrences of western yellow-billed cuckoo in the action area, and the birds found were likely to be migrating to northern breeding areas in the Sacramento Valley.

### 4.4.12.5 Critical Habitat

Designation of critical habitat for the Western DPS of yellow-billed cuckoo was published in the *Federal Register* on August 15, 2014 (57 FR 48547–48652) and was revised on April 21, 2021 (86 FR 20798–21005). There is no designated critical habitat for the Western DPS of yellow-billed cuckoo in the action area.

### 4.4.12.6 Suitable Habitat Definition

The western yellow-billed cuckoo habitat model described in Section 4.4.12.7, *Migratory Habitat Suitability Model*, uses existing, alliance-level vegetation data to identify suitable migratory habitat for western yellow-billed cuckoo. Suitable habitat for western yellow-billed cuckoo consists of riparian forest; no minimum patch size or minimum vegetation stature has been established for migratory use.

### 4.4.12.7 Migratory Habitat Suitability Model

As described in Section 4.4.12.4, *Status of the Species in the Action Area/Environmental Baseline*, there are no known breeding pairs in the action area; individuals detected in the action area are presumed to be migratory; and the riparian habitat patches are not large enough, nor do they have the floodplain function necessary, to support breeding. However, because there is a known breeding population on the Sacramento River north of the action area, it is assumed that individuals likely migrate through the region. Consequently, the action area is assumed to provide migratory habitat for the western yellow-billed cuckoo. As described in Section 4.4.12.2, *Life History and Habitat Requirements*, western yellow-billed cuckoo is a riparian obligate species and its primary habitat association is willow-cottonwood riparian forest. While riparian patch size is an important habitat component for breeding, there is no known minimum patch size for migratory habitat. The extent of modeled habitat in the action area is depicted in Figure 6.6-1.

Modeled western yellow-billed cuckoo migratory habitat includes the following land cover types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Valley/foothill riparian
  - *Populus fremontii*
  - *Alnus rhombifolia*

- *Fraxinus latifolia*
- *Acer negundo*
- *Juglans hindsii* and hybrids
- *Salix gooddinggii*
- *Salix lasiolepis*
- *Salix lucida*
- *Salix exigua*
- *Platanus racemosa* alliance
- *Salix laevigata* alliance
- *Cornus sericea*
- *Quercus lobata*
- *Quercus agrifolia*
- *Quercus wislizeni* (tree)
- *Rosa californica*
- *Sambucus nigra*
- *Vitis californica*
- *Rubus armeniacus*
- *Cephalanthus occidentalis*
- Californian broadleaf forest and woodland group
- Southwestern North American riparian evergreen and deciduous woodland
- Vancouverian riparian deciduous forest alliance
- Southwestern North American introduced riparian scrub
- Southwestern North American riparian/wash scrub

Modeled migratory habitat also includes the following land cover types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021)[10] layer.

- Valley/foothill riparian
  - Forested wetland
  - Shrub scrub wetland

[10] The DWR 2020 Aquatic Resources Delineation data is considered sufficient for evaluation of effects from the proposed action in this BA. The land cover data will be updated to include the final verified aquatic resources delineation data prior to submittal of this BA in support of the request for formal consultation.

# 4.4.13 California Red-Legged Frog

## 4.4.13.1 Legal Status and Distribution

California red-legged frog was listed as threatened under the federal ESA in 1996 (61 FR 25813) and is identified as a CDFW Species of Special Concern (California Department of Fish and Wildlife 2020b:43). A recovery plan was prepared for this species by USFWS in 2002, a 5-year review were released in 2022, and critical habitat for the species was designated in 2006 and revised in 2010 (U.S. Fish and Wildlife Service 2022:3, 4).

California red-legged frog is endemic to central California, with a range historically extending from southern Mendocino County, southward along the interior Coast Ranges to northern Baja California, Mexico, and inland from the vicinity of Redding, in Shasta County, along Sierra Nevada foothills south to Fresno County at elevations from sea level to approximately 5,000 feet (Nafis 2020; Thomson et al. 2016). Currently, populations are known from the San Francisco Bay Area and Coast Ranges to the Sierra Nevada, and a few populations in Ventura, Los Angeles, and Riverside Counties (Thomson et al. 2016:103–104). U.S. Fish and Wildlife Service (2022:2; 2017c) notes that the California red-legged frog is locally abundant in the nine-county San Francisco Bay Area and along the Pacific coast north of Ventura County. Isolated populations have been documented elsewhere within the species' historical range, including the Sierra Nevada, northern Coast Ranges, and northern Transverse Ranges (U.S. Fish and Wildlife Service 2022:2).

USFWS (2022:13) estimates that California red-legged frog has lost approximately 57% of its former range, with overall declines throughout its historical range in the Central Valley and coastal areas south of Santa Barbara County (U.S. Fish and Wildlife Service 2022:13). Coastal and Bay Area populations continue to flourish; however, even these areas have experienced significant localized declines (Jennings and Hayes 1994:62). New observations have been made in Santa Barbara County and there are translocated populations in Los Angeles, Mariposa, Riverside, and San Diego County (U.S. Fish and Wildlife Service 2022:8). Ten populations have been identified in the Sierra Nevada (Barry and Fellers 2013:481), and a previously unknown population was discovered in the southern foothills of the San Bernardino Mountains in 2017 (Backlin et al. 2017:1).

## 4.4.13.2 Life History and Habitat Requirements

California red-legged frog utilizes a variety of habitats, including various aquatic systems and riparian and upland habitats (U.S. Fish and Wildlife Service 2022:2; 2002:12). Hayes and Jennings (1988:146–147) describe aquatic breeding habitat requirements for California red-legged frog as coldwater pond habitats (including stream pools) with emergent and submergent vegetation, providing suitable cover for young and adults and ensuring successful reproduction. Optimal habitats are described as deep-water ponds or pools at least 2.3 feet deep along low-gradient streams with dense stands of overhanging willows and a fringe of cattails between the willow roots and overhanging willow limbs. Hayes and Jennings (1988:152) also note that California red-legged frogs may prefer pools along intermittent streams rather than backwater pools along perennial streams, possibly for predator avoidance, particularly American bullfrogs (*Lithobates catesbeianus*). California red-legged frog uses a variety of aquatic habitats that meet these requirements including ponds, marshes, low-gradient streams, and lagoons (Thomson et al. 2016:102–103).

California red-legged frogs often disperse from breeding sites to various aquatic, riparian, and upland estivation habitats during the summer (66 FR 14628); however, it is common for individuals

to remain in the breeding area year-round (66 FR 14628; Bulger et al. 2003:92; Fellers and Kleeman 2007:279–282). Adults may take refuge during dry periods in rodent holes or leaf litter in riparian habitats (U.S. Fish and Wildlife Service 2002:14). Within riparian areas, microhabitats utilized by California red-legged frogs include blackberry thickets, logjams, and root tangles (Fellers and Kleeman 2007:281).

California red-legged frogs travel through a variety of upland habitat types (e.g., grassland, riparian, woodlands) to reach breeding and nonbreeding sites, upland refugia and foraging habitats, or new breeding locations (Bulger et al. 2003:87–91; Fellers and Kleeman 2007:283–284). Frogs typically travel much shorter distances between aquatic and upland refugia and foraging habitats than when dispersing between breeding and nonbreeding aquatic habitats (Bulger et al. 2003:93–94). In one study, 90% of radio-tagged California red-legged frogs that did not make overland movements (i.e., non-migrating frogs) were found within 200 feet of aquatic habitat throughout the year; the farthest non-migrating movement was 427 feet from water and was in response to summer rain (Bulger et al. 2003:93). In another study, a radio-tagged California red-legged frog moved at least 0.9 mile and up to 1.7 mile over several months during the breeding season (Fellers and Kleeman 2007:282–283). The furthest documented dispersal distance has been 2.2 miles (Bulger et al. 2003:92). California red-legged frogs are most likely to make overland migrations through upland habitats at night during wet weather (Bulger et al. 2003:89; Fellers and Kleeman 2007:279). Breeding occurs between late November and late April (Thomson et al. 2016:102). Eggs hatch in 6 to 14 days, depending on water temperature (Thomson et al. 2016:102), with tadpoles undergoing metamorphosis in 4 to 7 months, although in some locations they have been known to overwinter (Nafis 2020) at some sites, completing metamorphosis the following spring (Fellers et al. 2001:156-157).

### 4.4.13.3 Impacts from Past and Present Actions

Urban development and agriculture actions have resulted in habitat loss and fragmentation (Fisher and Shaffer 1996:1393; Davidson et al. 2002:1588; U.S. Fish and Wildlife Service 2002:18, 28–29; 2022:18–23).

Urbanization and other actions, such as energy and water projects (e.g., Mariposa Energy, South Bay Aqueduct, CVP, and SWP), are accompanied by an increase in road densities. Roads create significant barriers to frog dispersal (Jochimsen et al. 2004:19–21) and can lead to reduced population density, genetic diversity, and population viability due to mortality caused by vehicle strikes (Carr and Fahrig 2001:1071; Glista et al. 2007:77). However, just east of Bethany Reservoir is the Bethany West Conservation Easement, which protects grassland habitat in the action area from further development and fragmentation. This easement was purchased by DWR and is managed by CDFW to offset the effects of the South Bay Aqueduct project on California tiger salamander and California red-legged frog.

The conversion of natural lands to agricultural uses, such as stands of monotypic row crops, can alter habitats to the extent that they become uninhabitable for California red-legged frog (U.S. Fish and Wildlife Service 2002:18, 28–29). Fisher and Shaffer (1996) suggest that intense farming in the San Joaquin Valley has resulted in drastic declines in California red-legged frog populations, due to a lack of suitable habitat. Pesticides, herbicides, and other agrochemicals are known to be toxic to various life stages of anurans (Davidson 2004:1900, Sparling and Fellers 2009:1696). Pesticide drift has also been suggested as a potential cause of declining populations of four species of ranids in California, including California red-legged frog (Davidson et al. 2002:1588; Davidson 2004:1900).

Exotic predatory fish and bullfrogs also pose significant threats to California red-legged frog. Hayes and Jennings (1986:490, 492) noted that locations in which exotic fish were present contained few California red-legged frogs. Bullfrogs have been implicated in the decline of the subspecies in several studies (Fisher and Shaffer 1996; Kiesecker and Blaustein 1998:782; Lawler et al. 1999:619), and Moyle (1973:21) indicated that bullfrogs might have been the most important factor in the extirpation of California red-legged frog from the Central Valley floor. Bullfrogs depredate and outcompete California red-legged frogs due to their larger size, more varied diet, and longer breeding season (Hayes and Jennings 1986:490, 492).

### 4.4.13.4 Status of the Species in the Action Area

California red-legged frog has potential to occur in the southwestern most portion of the action area in eastern Contra Costa and Alameda Counties and portions of western San Joaquin County.

There are 16 CNDDB occurrences of California red-legged frog in the action area split between Contra Costa and Alameda Counties (California Department of Fish and Wildlife 2020a).

### 4.4.13.5 Critical Habitat

Final designation of critical habitat for California red-legged frog was published in the *Federal Register* on March 17, 2010 (75 FR 12815). A portion of critical habitat unit CCS-2B overlaps with a portion of the action area southwest of Clifton Court Forebay.

### 4.4.13.6 Suitable Habitat Definition

As described above in Section 4.4.13.2, *Life History and Habitat Requirements*, suitable aquatic breeding habitat for California red-legged frog in the action area consists of perennial and intermittent streams, managed wetland, freshwater emergent wetland, and perennial aquatic natural communities (e.g., ponds). Other aquatic habitats that are suitable, though may not be present in the action area, include seasonal wetlands, springs, seeps, marshes, dune ponds, lagoons, and human-made aquatic features. The upland portion of the model includes areas within 300 feet of modeled aquatic habitat (refer to Section 4.4.13.2). The dispersal portion of the model includes areas within 2 miles of modeled aquatic habitat, which takes into consideration the previous studies discussed in Section 4.4.13.2 and guidance from the USFWS 2005 *Revised Guidance on Site Assessments and Field Surveys for the California Red-Legged Frog* (U.S. Fish and Wildlife Service 2005). The extent of modeled habitat in the action area is depicted in Figure 6.8-1.

### 4.4.13.7 Habitat Suitability Model

The northern/western-most boundary of the model starts near Antioch, then south on SR 4 to Balfour Road, then east on Balfour Road to Byron Highway, then south Byron Highway to SR 4, then east to the western bank of Old River, then south along the western bank to Old River's confluence with Italian Slough, then continues south along the western bank of Italian Slough to where Italian Slough turns to the west, at which point the geographic limits cross Italian Slough and continue south along the western edge of Clifton Court Forebay and the start of the California Aqueduct until Byron Highway, at which point the limits continue southeast on Bryon Highway to I-205 and then west on I-205 to the edge of the action area.

## Aquatic Habitat Model

The modeled aquatic habitat types are different within and outside of the DWR aquatic resources delineation study area.

### Inside the Delineation Study Area

Modeled habitat includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).[11]

- Tidal perennial aquatic
  - Natural channel
  - Tidal channel
- Nontidal freshwater perennial emergent wetland
  - Freshwater emergent wetland
- Tidal freshwater emergent wetland
  - Freshwater emergent wetland
- Valley/foothill riparian
  - Scrub shrub wetland
- Nontidal perennial aquatic
  - Natural channel
  - Depression

### Outside the Delineation Study Area

Modeled habitat includes the following types from the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019).

- Nontidal freshwater perennial emergent wetland
  - *Schoenoplectus (acutus, californicus*)
  - *Schoenoplectus americanus*
  - Typha (*angustifolia, domingensis, latifolia*)
  - Arid West freshwater emergent marsh
  - Naturalized warm-temperate riparian and wetland group
- Tidal freshwater emergent wetland
  - *Carex barbarae*
  - *Schoenoplectus (acutus, californicus)*

[11] The DWR 2020 Aquatic Resources Delineation data is considered sufficient for evaluation of effects from the proposed action in this BA. The land cover data will be updated to include the final verified aquatic resources delineation data prior to submittal of this BA in support of the request for formal consultation.

  - *Schoenoplectus americanus*
  - *Typha (angustifolia, domingensis, latifolia)*
  - Arid West freshwater emergent marsh
- Nontidal perennial aquatic
  - *Azolla (filiculoides, microphylla)*
  - *Eichhornia crassipes*
  - *Lemna* (*minor*) and relatives
  - *Ludwigia (hexapetala, peploides)*
  - Naturalized temperate Pacific freshwater vegetation
  - Temperate freshwater floating mat
  - Temperate Pacific freshwater aquatic bed
  - Water

## Upland Habitat Model

Modeled upland habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), and Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019).

- Grassland
  - All types
- Valley/foothill riparian
  - All types
- Alkaline seasonal wetland complex
  - All types

Modeled habitat also includes the following types from the Delta Conveyance Project Vernal Pool Complex (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019; California Department of Water Resources and GEI Consultants Inc. 2020).

- Vernal pool complex
  - All types

## Dispersal Habitat Model

Modeled dispersal habitat includes the following types from the 2018 Statewide Crop Mapping (Land IQ and DWR 2021).

- Agricultural
  - All types

Modeled dispersal habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta

Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Grassland
  - All types
- Valley/foothill riparian
  - All types
- Alkaline seasonal wetland complex
  - All types

Modeled habitat also includes the following types from the Delta vernal pool complex (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019; California Department of Water Resources and GEI Consultants Inc. 2020).

- Vernal pool complex
  - All types

## 4.4.14 California Tiger Salamander

### 4.4.14.1 Geographic Distribution and Status

The Central California DPS of California tiger salamander is listed as threatened (69 FR 47212) under the ESA on August 4, 2004, and listed as threatened under the CESA in 2020 (California Department of Fish and Wildlife 2020a:39). A recovery plan for the Central California DPS of the California Tiger Salamander was published June 6, 2017 (U.S. Fish and Wildlife Service 2017a:I-2, I-6–I-7). The most recent 5-Year Review for the species was published on August 10, 2023 (U.S. Fish and Wildlife Service 2023a). Isolated populations in Sonoma and Santa Barbara Counties are listed as endangered under the ESA and threatened under the CESA. California tiger salamander historically occurred throughout the Central Valley and surrounding foothills, from Yolo County south to Tulare County, and in the south coast ranges from north of Monterey Bay to San Luis Obispo County, although many of the populations in the Central Valley are now extirpated. Currently, the Central California DPS of this species is distributed along the foothills of the Central Valley and Inner Coast Range from Sacramento and Yolo counties in the north, to San Luis Obispo, Kern, and Tulare counties in the south (U.S. Fish and Wildlife Service 2017a:I-2, I-6–I-7; 2023a:3-4). California tiger salamander has a potential to occur in the study area generally in areas west of the Yolo Basin but including the Tule Ranch Unit of the Yolo Basin Wildlife Area, which includes western Yolo County and Solano County, and portions of eastern Contra Costa and Alameda Counties, and western portions of San Joaquin County.

There are numerous extant California tiger salamander CNDDB occurrences west of the Clifton Court Forebay area and several occurrences in the Jepson Prairie portion of the action area (California Department of Fish and Wildlife 2020a).

### 4.4.14.2 Life History and Habitat Requirements

California tiger salamander is found in annual grassland, vernal pool complexes, open mixed woodland and oak savanna communities in lowland and foothill regions of central California where

suitable aquatic sites, such as vernal pools, seasonal ponds or constructed ponds, are available for breeding (U.S. Fish and Wildlife Service 2009). The species is typically found at elevations from sea level to 2,000 ft, although the known elevational range extends up to 3,940 feet (U.S. Fish and Wildlife Service 2017a:I-2).

The suitability of California tiger salamander habitat is proportional to the abundance of upland refuge sites near aquatic breeding sites. Adult California tiger salamanders are terrestrial and spend much of the year in the underground burrows of small mammals, such as California ground squirrels (*Spermophilus beecheyi*) (Loredo et al. 1996:283; Trenham 2001:343–344) and Botta's pocket gopher (*Thomomys bottae*) (Jennings 1996:194). Active rodent burrow systems are considered an important component of California tiger salamander upland habitat (Loredo et al. 1996:283), as inactive burrow systems begin to deteriorate and collapse over time. Therefore, active ground-burrowing rodent populations are likely needed to sustain California tiger salamander populations. California tiger salamander is known to move up to 1.3 miles into upland habitat from aquatic habitat (U.S. Fish and Wildlife Service 2017a:I-4; Orloff 2007:26).

Historically, vernal pools and other seasonal rain pools were the primary breeding habitat of California tiger salamander (Barry and Shaffer 1994:159); however, the species is now known to also successfully reproduce in ephemeral and permanent human-made ponds (U.S. Fish and Wildlife Service 2017a:I-5). In the East Bay Regional Park District in Contra Costa and Alameda Counties, California tiger salamanders breed almost exclusively in seasonal and perennial stock ponds (Bobzien and DiDonato 2007:7). The presence of predatory fish and bullfrogs (*Rana catesbeiana*) can affect the habitat suitability of perennial ponds, making them less suitable than ephemeral ponds. Barry and Shaffer (1994:163) note that annual draining can prevent predatory species from establishing. The species is not known to breed in streams or rivers; however, breeding has been documented in ditches that contain seasonal wetland habitat and in slow-moving swales and creeks near other suitable breeding habitat (U.S. Fish and Wildlife Service 2017a:I-5).

Adult California tiger salamanders migrate from upland refuge sites to breeding pools during relatively warm late fall and early rains (Thomson et al. 2016), usually from November through April. Breeding generally occurs from December through March (Stebbins 2003). Eggs are laid individually or in clumps on submerged vegetation and debris in shallow water and generally hatch in 10 to 28 days (Jennings and Hayes 1994:12; U.S. Fish and Wildlife Service 2017a:I-3). Development through metamorphosis requires 3 to 6 months, beginning late spring or early summer. Post-metamorphic juveniles disperse from breeding sites at night during the late spring or early summer to upland burrows or soil crevices (U.S. Fish and Wildlife Service 2017a:I-3).

The proximity of refuge sites to aquatic breeding sites also affects the suitability of salamander habitat. Based on capture data from a single-season study at Olcott Lake in Jepson Prairie Preserve (Solano County), Shaffer and Trenham (2005:1163) estimated that 95% of adult and subadult tiger salamanders occurred within approximately 0.4 mile of the breeding pond. Their model also suggests that 85% of subadults were concentrated between 0.1 and 0.4 miles from the pond.

### 4.4.14.3 Impacts from Past and Present Actions

Residential and commercial development, road construction, and agricultural projects are considered the most significant threat to California tiger salamander (U.S. Fish and Wildlife Service 2017a:I-2, I-6–I-7). Approximately 75% of the species' historical natural habitat has been lost. The species has been eliminated from 55% to 58% of historical breeding sites. Holland (1998) indicated

that about 75% of the historical vernal-pool breeding habitat has been lost, although some question the reliability of this estimate.

Development, agriculture, energy (e.g., Mariposa Energy), and water projects (e.g., CVP, SWP, South Bay Aqueduct), and associated roads, lead to habitat fragmentation in the action area. Fragmentation of habitat leads to increasingly isolated populations with no mechanism for inter-pond dispersal, thus reducing the long-term viability of local populations. Additionally, roads often bisect habitat, creating a barrier to dispersal and leading to direct mortality of migrating salamanders (Twitty 1941:1; Barry and Shaffer 1994:162–163; Jochimsen et al. 2004:19–21). Construction activities such as grading or deep ripping also contribute to direct mortality (U.S. Fish and Wildlife Service 2017a:I-2, I-6–I-7). However, just east of Bethany Reservoir is the Bethany West Conservation Easement, which protects grassland habitat in the action area from further development and fragmentation. This easement was purchased by DWR and is managed by CDFW to offset the effects of the South Bay Aqueduct project on California tiger salamander and California red-legged frog.

Nonnative, invasive species, such as bullfrog, mosquitofish (*Gambusia affinis*), and various centrarchids that live in perennial ponds (e.g., stock ponds) are considered to have negatively affected California tiger salamander populations by preying on larval salamanders (Fisher and Shaffer 1996; U.S. Fish and Wildlife Service 2017a:I-2, I-6–I-7). Hybridization with the barred tiger salamander (*Ambystoma tigrinum mavortium*) is also a threat to this species (U.S. Fish and Wildlife Service 2023a:5). It has been suggested that nonnative alleles may be present in California tiger salamander populations found in the Altamont Hills near the action area; therefore, hybridization may be a threat in this region (U.S. Fish and Wildlife Service 2017a:I-2, I-6–I-7).

Pesticides, hydrocarbons, and other pollutants are all thought to negatively affect breeding habitat. Other sources of chemical pollution that may negatively affect California tiger salamander include the application of chemicals from agricultural production, landscape maintenance, and rodent and vector control programs (U.S. Fish and Wildlife Service 2017a). California ground squirrel and pocket gopher control operations may have the indirect effect of reducing the availability of upland burrows for use by California tiger salamanders (Loredo-Prendeville et al. 1994:74). Death by entombment could also result when burrow entrances are crushed during rodent control activities.

### 4.4.14.4 Status of the Species in the Action Area

California tiger salamander has a potential to occur in the action area generally in areas west of the Yolo Basin but including the Tule Ranch Unit of the Yolo Basin Wildlife Area, which includes western Yolo County and Solano County, portions of eastern Contra Costa and Alameda Counties, and western portions of San Joaquin County.

There are numerous extant California tiger salamander CNDDB occurrences west of the Clifton Court Forebay area and several occurrences in the Jepson Prairie portion of the action area (California Department of Fish and Wildlife 2020a).

### 4.4.14.5 Critical Habitat

Final designation of critical habitat for the Central California DPS of California tiger salamander was published in the *Federal Register* on August 23, 2005 (70 FR 49380–49458). There is no designated critical habitat for California tiger salamander in the action area. Critical habitat Unit 2, the Jepson Prairie Unit, is west of the action area.

### 4.4.14.6 Suitable Habitat Definition

As described above in Section 4.4.14.2, *Life History and Habitat Requirements*, suitable habitat for California tiger salamander includes aquatic habitat consisting of vernal pools, other seasonal pools, and ponds that inundate for at least 3 months and upland habitat consisting of adjacent annual grassland, including alkali grasslands, with small mammal burrows for refugia within at least 1.24 miles of aquatic habitat. This definition is consistent with the USFWS's 2003 *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander* (U.S. Fish and Wildlife Service 2003). The areas of suitable habitat in the action area are limited to those areas described in Section 4.4.14.7, *Habitat Suitability Model*.

### 4.4.14.7 Habitat Suitability Model

The habitat model for California tiger salamander includes both aquatic and upland habitats. The modeled aquatic habitat relies on both delineation data that were collected for a smaller portion of the action area, in what is called the delineation study area, and suitable habitats found in the Great Valley Ecoregion 2018 Vegetation Dataset, the Delta Vegetation and Land Use Update, and the Great Valley Vernal Pool Data.

The modeled upland habitat is limited to areas within 1.24 miles of suitable aquatic habitat, based on USFWS' 2003 *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander* (U.S. Fish and Wildlife Service 2003:4). For areas along the western edge of the action area, upland habitat was also identified by reviewing aerial photographs for aquatic habitat outside of, but within 1.24 miles of, the action area. The extent of modeled habitat in the action area is depicted in Figure 6.8-1.

Based on the known range and occurrences described in the section above, the California tiger salamander habitat model is constrained to the following portions of the action area.

- West of the Yolo Basin but including the Tule Ranch Unit of the CDFW Yolo Basin Wildlife Area.
- Within the Contra Costa, Alameda, and San Joaquin Counties portions of the action area starting near Antioch, then extending south on SR 4 to Balfour Road, then east on Balfour Road to Byron Highway, then south Byron Highway to SR 4, then east to the western bank of Old River, then south along the western bank to Old River's confluence with Italian Slough, then continue south along the western bank of Italian Slough to where Italian Slough turns to the west at which point the geographic limits cross Italian slough and continue south along the western edge of Clifton Court Forebay and the start of the California Aqueduct until Byron Highway at which point the limits continue southeast on Bryon Highway to I-205 and then west on I-205 to the edge of the action area.
- In Sacramento County south of the Cosumnes River and east of I-5.

The rationale for including each of the above locations in the habitat model is provided below.

- There is a cluster of extant occurrences at Jepson Prairie in Solano County, which increases the potential for occurrence on suitable habitat in the Cache Slough region and Yolo Basin.
- The areas within the action area surrounding Clifton Court Forebay are considered potentially suitable and were included in the species model because there is suitable grassland/vernal pool habitat within the accepted movements distance (1.24 miles) of known, extant occurrences west of Byron Highway and Clifton Court Forebay (California Department of Fish and Wildlife 2020a).

- In San Joaquin County, there is a CNDDB record just south of SR 120 near Manteca in the action area (California Department of Fish and Wildlife 2020a).
- The location in Sacramento County south of the Cosumnes River is included because it is on the edge of the action area and within the range of the species (although there are no records in this portion of the legal Delta).

## Aquatic Breeding Habitat Model

### Inside the Delineation Study Area

Modeled habitat includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Vernal pool complex
  - Vernal pool

### Outside the Delineation Study Area

Modeled habitat includes the following types from the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Vernal Pool Data (Witham et al. 2014).

- Vernal pool complex
  - *Distichlis spicata*
  - California annual herb/grass group
  - Californian mixed annual/perennial freshwater vernal pool/swale bottomland
  - Mediterranean California naturalized annual and perennial grassland

## Upland Habitat Model

### Inside the Delineation Study Area

Modeled habitat includes the following types from the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), and the Great Valley Vernal Pool Data (Witham et al. 2014).

- Vernal pool complex
  - All types
- Grassland
  - All types
- Alkaline seasonal wetland complex
  - *Distichlis spicata*

**Outside the Delineation Study Area**

Modeled habitat includes the following types from the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), and Great Valley Vernal Pool Data (Witham et al. 2014).

- Vernal pool complex
  - *Allenrolfea occidentalis*
  - *Frankenia salina*
  - *Suaeda moquinii*
  - Alkaline wetland
- Grassland
  - All types
- Alkaline seasonal wetland complex
  - *Distichlis spicata*

# 4.4.15 Giant Garter Snake

## 4.4.15.1 Geographic Distribution and Status

Giant garter snake was listed as threatened under the ESA on October 20, 1993 (58 FR 67046–67053) and listed as rare in 1971 and reclassified as threatened in 1985 under the CESA (California Department of Fish and Wildlife 2019). The *Draft Recovery Plan for the Giant Garter Snake* was completed in 1999, the most recent 5-year review was completed in 2020, and a revised recovery plan was released in 2015 (U.S. Fish and Wildlife Service 2020e:1-3). The final *Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*)* was published in 2017 (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8).

Giant garter snake historically occurred throughout the Central Valley of California. Its current range has been reduced to fragmented populations from Glenn County to the edge of the Delta, and south from Merced to Fresno Counties. The current known distribution of giant garter snakes is variable and extends from near Chico in Butte County, south to the Mendota Wildlife Area in Fresno County (U.S. Fish and Wildlife Service 2020e:4). There are nine recognized distinct populations of giant garter snake, which correspond to recovery units identified in the 2017 recovery plan: the Butte, Colusa, American, Yolo, Cosumnes-Mokelumne, Delta, San Joaquin, and Tulare Basins (U.S. Fish and Wildlife Service 2017b:iii).

## 4.4.15.2 Life History and Habitat Requirements

Giant garter snake is a highly aquatic, diurnal snake, relying on the presence of water throughout the summer months, and associated upland with burrows, crevices, or riprap for use as refugia during the late fall through early spring. Suitable aquatic habitat consists of marshes, sloughs, rice fields, and other water bodies, including lacustrine and riverine habitats, with emergent vegetation for basking and camouflage and a suitable prey base of fish and amphibians. Due to loss or degradation

of natural wetland habitat (Wylie et al. 1997:2), giant garter snakes now commonly use highly modified and degraded habitats including cultivated farmlands and water conveyance infrastructure (Hansen and Brode 1980:10; Brode 1988:27; U.S. Fish and Wildlife Service 2017b:iii, I-2). Giant garter snakes generally are not present in larger rivers and wetlands with sand, gravel, or rock substrates. In addition, the major rivers within the species' range have been highly channelized, removing oxbows and backwater areas that probably at one time provided suitable habitat. Riparian woodlands do not generally provide suitable habitat because most have excessive shade, lack of basking sites, and absence of prey populations. Giant garter snakes are also absent from most permanent waters that support established populations of predatory game fishes and from most sites that undergo routine dredging, mechanical or chemical weed control, or compaction of bank soils (Brode 1988:25–28; U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8).

Terrestrial habitat adjacent to suitable aquatic habitat is also an important resource for giant garter snake (Halstead et al. 2015:633). Terrestrial habitat serves two purposes for giant garter snake. Near aquatic habitat, upland can be used for thermoregulation and summer shelter in nearby burrows; further away from aquatic habitat, and above the high winter waters, the upland can provide refugia for brumation (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8). During the colder winter months (generally October 1 to April 1), giant garter snakes overwinter in upland areas that provide sufficient cover, which are usually mammal burrows and include human-made features such as riprap (U.S. Fish and Wildlife Service 2017b:I-3). They may overwinter as far as 650 to 820 feet from the edge of aquatic habitat (U.S. Fish and Wildlife Service 2017b:I-3). A study by Halstead et al. (2015:638) found that giant garter snakes spend more than half of their time in terrestrial habitat during the summer (U.S. Fish and Wildlife Service 2020e:17). Halstead et al. (2015) found the average snake to be within 98 feet of water with 95% of observations within 33 feet of water, with their model predicting that some individuals could be as far as 571 feet from water (U.S. Fish and Wildlife Service 2020e:17; Halstead et al. 2015:639).

Giant garter snakes emerge from winter brumation in early March or April, depending upon weather, and remain active through late September or early October. Breeding occurs from shortly after emergence until as late as May, with females giving birth from July through September.

### 4.4.15.3 Status of the Species in the Action Area

The entire action area falls within the range of giant garter snake where suitable habitat exists. The action area overlaps with the Delta Basin, Yolo Basin, and Cosumnes-Mokelumne Basin Recovery Units identified in the recovery plan (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8). Each of these basins includes an extant population of giant garter snake. Although giant garter snake may have occupied much of the Sacramento–San Joaquin Delta at one time, long-standing wetland reclamation projects for intense agricultural applications has eliminated most suitable habitat (Hansen 1986:14, 16–17) and prevented the reestablishment of viable giant garter snake breeding populations in the Delta, other than the three populations noted above. However, several occurrences of giant garter snake in the vicinity of Sherman and Twitchell Islands, Jersey Island, and Webb Tract (California Department of Fish and Wildlife 2020a) have USFWS and CDFW giant garter snake experts asking if these recent sightings in the central Delta may represent an extant population that lives in emergent vegetation along river edges. In 2022, giant garter snake was reported on the south shore of the San Joaquin River, near Antioch Point (California Department of Fish and Wildlife 2024a) and a snake was found at West False River Drought Barrier on Jersey Island (Wunderlich pers. comm.). There are numerous CNDDB occurrences for giant garter snake throughout the study area north of SR 4 (California Department of Fish and Wildlife 2020a). Giant

garter snake was observed at the Shin Kee Tract wetland site adjacent to the White Slough Wildlife Area south of SR 12 (Zentner Planning and Ecology 2019).

### 4.4.15.4 Impacts from Past and Present Actions

Habitat loss and fragmentation from development, flood control (e.g., Central Valley Flood Protection Plan), water projects (e.g., CVP and SWP) and agriculture actions and changes in agricultural and land management practices (including changes to rice production methods), and predation from introduced and native species are the main causes for the decline of giant garter snake (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8). Conversion of Central Valley wetlands for agriculture and urban uses has resulted in the loss of as much as 95% of historical habitat for giant garter snake (Wylie et al. 1997:2). In areas where giant garter snake has adapted to agriculture, maintenance activities such as vegetation and rodent control, bankside grading or dredging, and changes to water use regimes threaten their survival (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8; Wylie et al. 2004:9). In developed areas, vehicular mortality continues to be a threat, but this is not considered to be significant.

Giant garter snakes are predated upon by nonnative, invasive species such as bullfrogs (Dickert 2003). In areas near urban development, giant garter snakes may also fall prey to domestic or feral cats. In permanent waterways, introduced predatory game fishes, such as bass (*Micropterus* spp.), sunfish (*Lepomis* spp.), and channel catfish (*Ictalurus* spp.), prey on giant garter snakes and compete with them for smaller prey. While predation continues to be a threat, it is not considered to be significant (U.S. Fish and Wildlife Service 2017b:I-12).

### 4.4.15.5 Critical Habitat

Critical habitat has not been designated for giant garter snake.

### 4.4.15.6 Suitable Habitat Definition

Suitable habitat is described by USFWS in the 2017 final recovery plan (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8), including the following components quoted verbatim.

> **Aquatic Component.** The giant garter snake has been recognized as requiring aquatic habitat since it was first described and has been consistently observed and captured in association with aquatic habitats since accounts of the snake were first published (Fitch 1940; G. Hansen and Brode 1980). The aquatic component of the giant garter snake habitat has been regarded as necessary for the survival of the snake, and researchers acknowledge the following qualitative attributes of ideal aquatic habitat for the giant garter snake (G. Hansen 1986; G. Hansen and Brode 1980; Wylie *et al.* 1995; Dickert 2002; E. Hansen 2002):
>
> 1. Water present from March through November.
> 2. Slow moving or static water flow with mud substrate.
> 3. Presence of emergent and bankside vegetation that provides cover from predators and may serve in thermoregulation.
> 4. The absence of a continuous canopy of riparian vegetation.
> 5. Available prey in the form of small amphibians and small fish.
> 6. Thermoregulation (basking) sites with supportive vegetation such as folded tule clumps immediately adjacent to escape cover.

7. The absence of large predatory fish.
8. Absence of recurrent flooding, or where flooding is probable the presence of upland refugia.

**Upland Component.** Although the giant garter snake is predominately an aquatic species, incidental observations and radio telemetry studies have shown that the snake can be found in upland areas near the aquatic habitat component during the active spring and summer seasons (G. Hansen 1986, 1988; Brode and G. Hansen 1992; E. Hansen 2002; Dickert 2003; Wylie and Cassaza 2000, 2001; Wylie *et al.* 1995, 1997a, 2002a, 2003a, 2004, 2005). Upland habitat (land that is not typically inundated during the active season and is adjacent to the aquatic habitat of the giant garter snake) is used for basking to regulate body temperature, for cover, and as a retreat into mammal burrows and crevices in the soil during ecdysis (shedding of skin) or to avoid predation (G. Hansen and Brode 1993; Wylie *et al.* 2003a). Giant garter snakes have been observed using burrows for refuge in the summer as much as 50 meters (164 feet) away from the marsh edge (Wylie *et al.* 1997a). Important qualities of upland habitat have been found by researchers (E. Hansen 2003a; Wylie *et al.* 2003a). Important qualities of upland habitat have been found by researchers (E. Hansen 2003a; Wylie *et al.* 2003a) to include:

1. Availability of bankside vegetative cover, typically tule (*Scirpus* sp.) or cattail (*Typha* sp.), for screening from predators.
2. Availability of more permanent shelter, such as bankside cracks or crevices, holes, or small mammal burrows.
3. Free of poor grazing management practices (such as overgrazed areas).

*Upland Winter Refugia Component.* During the colder winter months, giant garter snakes spend their time in a lethargic state. During this period, giant garter snakes overwinter in locations such as mammal burrows along canal banks and marsh locations, or riprap along a railroad grade near a marsh or roads (Wylie *et al.* 1997a; Wylie *et al.* 2002a). Giant garter snakes typically do not over-winter where flooding occurs in channels with rapidly moving water, such as the Sutter Bypass (B. Halstead, USGS, pers. comm. 2011). Over-wintering snakes use burrows as far as 200 to 250 meters (656 to 820 feet) from the edge of summer aquatic habitat (G. Hansen 1988; Wylie *et al.* 1997a; P. Coates, pers. comm. 2010). (U.S. Fish and Wildlife Service 2017b:iii, 11–13, v-2, 8)

This ends the verbatim description of suitable habitat from the U.S. Fish and Wildlife Service 2017 recovery plan. The exact text from the recovery plan was included here because of the specificity, level of detail, and supporting documentation.

### 4.4.15.7 Habitat Suitability Model

The habitat model for giant garter snake includes both aquatic and upland habitats. The modeled aquatic habitat relies on both delineation data that were collected for a smaller portion of the action area, in what is called the delineation study area, and suitable habitats found in the data sets outside the delineation study area.

The modeled upland habitat includes suitable habitat within 200 feet of modeled aquatic habitat. The 200-foot buffer stems from previous USFWS guidance on upland habitat when considering impacts on the species. Though the species is known to utilize uplands further than 200 feet, as discussed in Section 4.4.15.2, *Life History and Habitat Requirements*, the model is intended to capture where the majority of actively used upland habitat occurs.

For the tidal perennial aquatic features of the model, modeled habitat only extends 20 feet into tidal perennial aquatic polygons from the edges of adjacent land. In tidal perennial aquatic features (e.g., the Sacramento and San Joaquin Rivers and tidal zones in the central Delta), giant garter snakes are likely limited to shallow, nearshore habitats providing emergent vegetation and vegetative cover.

Accordingly, tidal perennial aquatic features are buffered internally by 20 feet to capture the nearshore habitat and exclude the relatively deep-water areas that are considered unsuitable. The Clifton Court Forebay and Discovery Bay are excluded from modeled tidal perennial aquatic features, as the aquatic habitat is not suitable for giant garter snake. The extent of modeled habitat in the action area is depicted in Figure 6.9-1.

## Aquatic Habitat Model

### Inside the Delineation Study Area

Modeled habitat includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Tidal freshwater emergent wetland
  - Freshwater emergent wetland
- Nontidal freshwater perennial emergent wetland
  - Freshwater emergent wetland
- Agricultural
  - Agricultural ditch
- Nontidal perennial aquatic
  - Depression
  - Natural channel
- Tidal perennial aquatic
  - Tidal channel
  - Natural channel

Modeled habitat also includes the following types from the 2018 Statewide Crop Mapping (Land IQ and DWR 2021).

- Agricultural
  - Rice
  - Wild rice

### Outside the Delineation Study Area

Modeled habitat includes the following types from the 2018 Statewide Crop Mapping (Land IQ and DWR 2021).

- Agricultural
  - Rice
  - Wild rice

Modeled habitat includes the following type from the National Hydrography Dataset (U.S. Geological Survey 2020).

- Agricultural
  - Ditches

Modeled habitat also includes the following types from the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018) and the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019).

- Tidal perennial aquatic
  - All types
- Tidal freshwater emergent wetland
  - All types
- Nontidal freshwater emergent wetland
  - All types
- Nontidal perennial aquatic
  - All types

## Upland Habitat Model

Modeled habitat includes the following type from the Draft San Joaquin County 2017 Land Use Survey (California Department of Water Resources 2020b), Sacramento County 2015 Land Use Survey (California Department of Water Resources 2016), and Delta 2017 Land Use Survey (Land IQ 2019).

- Agricultural
  - Upland herbaceous

Modeled habitat includes the following type from the 2018 Statewide Crop Mapping (Land IQ and DWR 2021).

- Agricultural
  - Mixed pasture

Modeled habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018), and Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019).

- Alkaline seasonal wetland complex
  - *Allenrolfea occidentalis*
  - *Distichlis spicata*
  - *Frankenia salina*
  - *Juncus arcticus* (var. *balticus, mexicanus*)
  - Western North American disturbed alkaline marsh and meadow

- Grassland
  - All types
- Valley/foothill riparian
  - All types

Modeled habitat includes the following types from the Delta Conveyance Project Vernal Pool Complex (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019).

- Vernal pool complex
  - All types

## 4.4.16 Delta Green Ground Beetle

### 4.4.16.1 Legal Status and Distribution

Delta green ground beetle is listed as threatened under the federal ESA (45 FR 52807). Critical habitat was designated for the delta green ground beetle in 1980 (U.S. Fish and Wildlife Service 2020d). The most recent 5-year review for the species was published on March 23, 2021 (U.S. Fish and Wildlife Service 2021b).

Delta green ground beetle is endemic to California, and it has only been detected in the greater Jepson Prairie area in Solano County (U.S. Fish and Wildlife Service 2017d). The current known range of this federally listed threatened species is generally bound by Travis Air Force Base to the west, SR 113 to the east, Hay Road to the north, and Creed Road to the south (Arnold and Kavanaugh 2007:7).

### 4.4.16.2 Life History and Habitat Requirements

Delta green ground beetle typically occurs in the grassland-vernal pool complex and possibly in more open areas such as edges of pools, trails, roads, and ditches; however, this assumption may be because delta green ground beetles are more difficult to detect in denser grassland cover. Larvae hide under dense vegetation or cracks in the ground. Similar to other beetles in the genus, delta green ground beetles are thought to be generalized insect predators, possibly feeding primarily on springtails (*Collembola*) (U.S. Fish and Wildlife Service 2017d).

Adults seem to be active from February through mid-May, producing one generation per year (U.S. Fish and Wildlife Service 2017d).

### 4.4.16.3 Impacts from Past and Present Projects

Development and agriculture projects resulting in habitat loss and fragmentation are the largest threats to the survival and recovery of vernal pool species. Habitat loss generally is a result of agricultural conversion from rangelands to intensive farming, urbanization, aggregate mining, infrastructure projects (such as roads and utility projects), and recreational activities (such as off-highway vehicles and hiking) (U.S. Fish and Wildlife Service 2005:II-185–II-186, I-16–I-28). Habitat fragmentation occurs when vernal pool complexes are broken into smaller groups or individual vernal pools and become isolated from each other as a result of activities such as road development and other infrastructure projects (U.S. Fish and Wildlife Service 2005:I-17).

Inappropriate grazing practices have also been identified as a threat; these include complete elimination of grazing in areas where nonnative grasses dominate the uplands surrounding vernal pools, as well as inappropriate timing or intensity of grazing. Appropriate grazing regimes help control nonnative plants such as Italian ryegrass (*Lolium multiflorum*) and waxy mannagrass (*Glyceria declinata*), which, if unchecked, can increase thatch buildup, decrease ponding duration, and decrease the native vegetation grasses and forbs used by delta green ground beetle (U.S. Fish and Wildlife Service 2007).

Human disturbances and changes in land use practices can alter the hydrology of temporary waters and result in a change in the timing, frequency, or duration of inundation in vernal pools, which can create conditions that render existing vernal pools unsuitable for vernal pool species (U.S. Fish and Wildlife Service 2007:27).

Climate change is expected to affect vernal pool hydrology through changes in the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration. It is unknown at this time whether climate change in California will result in a localized, relatively small cooling and drying trend or in a warmer trend with higher precipitation events. It is possible that either scenario would result in negative effects on vernal pool invertebrate species. (U.S. Fish and Wildlife Service 2007).

Specific threats to delta green ground beetle habitat identified in the 2005 Vernal Pool Recovery Plan include the following.

- Due to its extremely limited distribution and population, delta green ground beetle is vulnerable to impacts on its habitat. Changes in vegetation management, specifically the temporary removal of managed grazing, have been suggested as an explanation for the apparent decline.
- There is some evidence indicating that the absence of grazing can have negative effects on the delta green ground beetle. The adverse consequences from a lack of grazing are clearly tied to the dominance of invasive nonnative plants in the greater Jepson Prairie ecosystem. Extensive growth of nonnative grasses and forbs, which is often accompanied by development of a thatch of dead plant material on the ground and in the shallower portions of vernal pools, may threaten the delta green ground beetle because the thatch may inhibit its normal foraging and other behavior and affect the availability of prey. Sheep grazing currently appears to be more compatible with delta green ground beetle populations than cattle grazing.
- The maintenance and monitoring of fuel pipelines and electricity transmission lines are ongoing activities that may pose a threat to the delta green ground beetle.
- Illegal collecting poses a potential threat to delta green ground beetles.
- Sludge application from wastewater treatment plants could present a threat to delta green ground beetles. The nutrients in sludge are likely to aggravate problems with invasive nonnative plant growth due to increased availability of nutrients. Water quality concerns also may exist if sludge is applied to pasture lands with vernal pools. The addition of sludge would probably be extremely detrimental to the delta green ground beetle, since the beetle is only found in areas with low-growing plants. The vegetation around the vernal pools would still be stimulated even with a much larger setback than the one proposed, and the higher and denser plants would make it much more difficult for the beetles to move about and catch their prey.

- The lack of basic life history information for the delta green ground beetle puts the species at risk of presently unknown threats, and the severity of impacts due to the threats discussed above are more or less unknown.

An additional threat to the Delta green ground beetle habitat, identified since the last 5-year review (U.S. Fish and Wildlife Service 2021b:3, 4), is the permanent removal of suitable habitat and loss of individuals from the *Pacific Gas and Electric Company's Bay Area Operations and Maintenance Habitat Conservation Plan* (ICF 2017c).

### 4.4.16.4 Status of the Species in the Study Area

Within the study area, suitable delta green ground beetle habitat is limited to vernal pool complex and grassland in an approximate 1,800-acre area west of SR 113 to the western edge of the Delta, which is east of Travis Air Force Base. One CNDDB occurrence, which is a compilation of multiple observations over multiple years across Jepson Prairie (California Department of Fish and Wildlife 2020a),.

### 4.4.16.5 Critical Habitat

The final rule designating critical habitat for delta green ground beetle was published in the *Federal Register* on August 8, 1980 (45 FR 52807–52810). Designated critical habitat for delta green ground beetle consists of two areas in Solano County. Critical habitat occurs northwest of the Cache Slough complex near Jepson Prairie. The primary constituent elements of critical habitat for delta green ground beetle are summarized here.

- Vernal pools and surrounding grassland habitat.
- Associated land areas that surround and drain into vernal pool habitat.

### 4.4.16.6 Species Habitat Suitability Model

The methods used to formulate species habitat suitability models, and the limitations of these models, are described in Appendix 6A, *Terrestrial Effects Analysis Methods*, Section 6A.5.1.1, *Suitable Habitat Models.*

#### GIS Model Data Sources

The delta green ground beetle model uses the following datasets.

- Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019).
- Delta Conveyance Project Vernal Pool Complex (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019).

#### Habitat Model Description

The habitat model for delta green ground beetle is limited to vernal pool complex (all types) and grasslands. The extent of modeled habitat in the study area is depicted in Figure 6.10-1.

#### Geographic Limits

The species is limited to the western portion of Solano County, west of SR 113 to the western edge of the study area, south of Hastings Road, and north of Creek Road (Figure 6.10-1).

#### Additional Model Parameters

Modeled habitat includes the following vegetation type from the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019):

- Grassland
  - All types

Modeled habitat also includes the following type from the Delta Conveyance Project Vernal Pool Complex dataset (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019).

- Vernal pool complex
  - All types

## 4.4.17 Valley Elderberry Longhorn Beetle

### 4.4.17.1 Legal Status and Distribution

Valley elderberry longhorn beetle is listed as threatened under the federal ESA (45 FR 52803). On October 2, 2006, the USFWS, in their 5-year review, recommended this species be removed from the endangered species list (U.S. Fish and Wildlife Service 2006c). On October 2, 2012, USFWS issued a proposed rule to remove the species from the endangered species list (77 FR 60238). However, USFWS withdrew the proposed rule on September 17, 2014, based on its determination that the proposed rule did not fully analyze the best available information (79 FR 55873). On September 26, 2023, the USFWS published a 5-year review for the species.

Valley elderberry longhorn beetle is one of three species of *Desmocerus* in North America and one of two subspecies of *D. californicus*. The valley elderberry longhorn beetle subspecies is a narrowly defined endemic taxon limited to portions of the Central mostly below 500 feet elevation (U.S. Fish and Wildlife Service 2017e:4).

At the time of the listing, the species was only known from Merced, Yolo, and Sacramento Counties (U.S. Fish and Wildlife Service 2019b:1) Subsequent surveys throughout the Central Valley discovered more locations and the current presumed range is now believed to extend from Shasta County to Madera County below 500 feet in elevation (U.S. Fish and Wildlife Service 2019b:1), including the valley floor and lower foothills (U.S. Fish and Wildlife Service 2023b:3). Previous descriptions of the range included areas that overlap with California elderberry longhorn beetle (*D. californicus californicus*) (U.S. Fish and Wildlife Service 2019b:1). Little is known about the historical abundance of valley elderberry longhorn beetle.

The current distribution of valley elderberry longhorn beetle is similar to its historical range, though it is "uncommon or rare, but locally clustered." Most of the approximately 270 CNDDB occurrences rangewide are based on observations of exit holes in elderberry stems or branches, rather than direct observation of individual beetles; many of these occurrences predate 1997, which was the most recent, comprehensive rangewide survey by observers known to be qualified to detect

occupancy of valley elderberry longhorn beetle (U.S. Fish and Wildlife Service 2019b:1–2). Approximately 130 known occurrences of valley elderberry longhorn beetle in the San Joaquin and Sacramento Valleys have been documented since the 1997 comprehensive rangewide survey (California Department of Fish and Wildlife 2020a). These occurrences have been found within 18 hydrologic units at 36 geographic locations in the Central Valley extending from Shasta County south to Fresno County.

### 4.4.17.2 Life History and Habitat Requirements

Valley elderberry longhorn beetle is closely associated with elderberry (*Sambucus* spp.). These plants are an obligate host plant for larvae and are necessary for the completion of the life cycle (U.S. Fish and Wildlife Service 2017e:4). The two main species of elderberry used by this species are the blue elderberry (*Sambucus nigra* subsp*. caerulea,* formerly *S. mexicana*) and red elderberry (*S. racemose*) (79 FR 55876). Elderberry is a component of riparian habitats throughout the Central Valley; however, elderberry shrubs can also be present in non-riparian valley oak and blue oak woodland habitats as well as in grasslands (U.S. Fish and Wildlife Service 2017e:6), which may extend beyond riparian zones. Although this shrub occasionally occurs outside riparian areas, shrubs supporting the greatest beetle densities are located in areas with significant riparian zones (79 FR 55878).

Shrub characteristics and other environmental factors appear to have an influence on use by the valley elderberry longhorn beetle, with more exit holes found in shrubs in riparian habitat types than in non-riparian habitat types (79 FR 55878). Occupancy of elderberry shrubs varies based on elderberry condition, water availability, elderberry density, and the health of the riparian habitat, indicating that healthy riparian systems supporting a high density of elderberry clumps are the primary habitat of the beetle (U.S. Fish and Wildlife Service 2017e:7). Some studies have demonstrated, however, that valley elderberry longhorn beetles prefer elderberry shrubs with low to moderate levels of damaged stems (79 FR 55878).

Valley elderberry longhorn beetle is distributed throughout available habitat in a widely dispersed metapopulation (U.S. Fish and Wildlife Service 2019b:2; Talley et al. 2006). At local scales, the valley elderberry longhorn beetle occupies elderberry plants in clumps that vary by watershed (Talley et al. 2007). Local aggregations or clumps of occurrences appear to function like discreet demographic units of the valley elderberry longhorn beetle. At the landscape scale, data suggest occupancy status of suitable habitat can be somewhat predicted by distance from an occupied patch. A suitable patch of habitat is more likely to be occupied if there is occupied habitat within 6.2 to 12.4 miles of the suitable patch. At local scales (sites less than 6.2 miles apart) occupancy patterns appear to be random (Collinge et al. 2001:104).

Adult valley elderberry longhorn beetles' flight season is from March to July (U.S. Fish and Wildlife Service 2017e:11), with most records from late April to mid-May (79 FR 55877). The adult beetles feed on the elderberry foliage and possibly its flowers. During this time of activity, the beetles mate, and the female lays eggs on the living elderberry plant host. The eggs are typically placed individually or in small clusters within crevices in the bark or junctions of the stem and trunk or leaf petiole and stem. Eggs hatch within a few days and soft-bodied larvae emerge. The larvae are on the surface of the elderberry from a few minutes to several hours or a day and then bore to the center of the elderberry stems where they create a feeding gallery in the pith at the stem's center. The larvae develop for 1 to 2 years feeding on pith. The late instar larvae chew through the inner bark, all or most of the way to the surface, then return inside, plugging the holes with wood shavings. The larvae

move back down the feeding gallery to an enlarged pupal chamber packed with frass. Here the larvae metamorphose into pupae between January and April (79 FR 55876).

The length of pupation is thought to be about one month with the emergent adult remaining in the chamber for up to several weeks. Adults complete the hole in the outer bark and emerge during the flowering season of elderberry shrubs (79 FR 55876).

### 4.4.17.3 Impacts from Past and Present Actions

Habitat occupied by valley elderberry longhorn beetle tends to form and exist in riparian corridors and on the level open ground of periodically flooded river and stream terraces and floodplains. This geomorphic setting historically has been desirable for agricultural, urban, or industrial development. As a result, much of this habitat type has been converted, through the construction of dam and levee projects (e.g., Central Valley Flood Protection Plan), to land that could be developed. Although it has been estimated that 90% of California riparian habitat has been lost over the last century and a half (Smith 1977; Barr 1991:4, 6, 18–19; Naiman et al. 1993; Naiman and Décamps 1997), these losses are difficult to accurately quantify in terms of valley elderberry longhorn beetle habitat losses (Talley et al. 2006). Therefore, an unknown amount of riparian forest and elderberry savannah habitat has been lost and an unknown number of valley elderberry longhorn beetle populations as well (Collinge et al. 2001:104). Present day losses of valley elderberry longhorn beetle are most often associated with the conversion of agricultural areas to urban development and the maintenance of levees and other flood-management structures (U.S. Fish and Wildlife Service 2019b:2–3).

The best available data suggest the nonnative invasive species, Argentine ant (*Linepithema humile*), is a predation threat to the valley elderberry longhorn beetle (U.S. Fish and Wildlife Service 2019b:3). This ant is an aggressive competitor and predator of native arthropods throughout riparian habitats in California, and has been observed preying on valley elderberry longhorn beetle larvae (Talley et al. 2006). Argentine ants have been inadvertently introduced into valley elderberry longhorn beetle mitigation sites from nursery stock and are able to proliferate there due to irrigation established for mitigation plantings (Argentine ants require moisture) (Talley et al. 2006). The predation threat from Argentine ants is likely to increase in the Central Valley as colonies further expand into the species' range unless additional methods of successful control within natural settings become available (U.S. Fish and Wildlife Service 2019b:3).

The nonnative invasive European earwig (*Forficula auricularia*) is also considered to be a threat to the valley elderberry longhorn beetle through predation or by supporting higher populations of insect predators (Talley et al. 2006), although there is no clear evidence to suggest that earwig predation or presence constitutes a specific threat to the beetle (77 FR 60237).

Nonnative invasive plant species such as black locust (*Robinia pseudoacacia*), giant reed (*Arundo donax*), red sesbania (*Sesbania punicea*), Himalaya blackberry (*Rubus armeniacus*), tree of heaven (*Ailanthus altissima*), Spanish broom (*Spartium junceum*), Russian olive (*Elaeagnus angustifolia*), edible fig (*Ficus carica*), and Chinese tallowtree (*Sapium sebiferum*) may have significant indirect impacts on the valley elderberry longhorn beetle by affecting elderberry shrub vigor and recruitment (Talley et al. 2006). Ripgut brome (*Bromus diandrus*), foxtail barley (*Hordeum murinum*), Italian ryegrass (*Festuca perennis,* formerly *Lolium multiflorum*), and yellow starthistle (*Centaurea solstitialis*) may impair elderberry germination or establishment, or elevate fire risk (Talley et al. 2006).

Threats identified in the 2014 Withdrawal of the Proposed Rule included increased temperatures due to climate change, increased competition for the host plant from invasive plant species, and reduces survivorship of the host plant due to pesticides (79 FR :55889–55907). Increasing frequency and severity of wildfires and drought throughout the species range is also identified as a threat for the species in the foreseeable future (U.S. Fish and Wildlife 2023: 4).

### 4.4.17.4 Status of the Species in the Action Area

The current distribution of valley elderberry longhorn beetle in the action area is unknown. There are only four reported occurrences of valley elderberry longhorn beetle in the action area, including one along Middle River, north of Tracy, and three occurrences along small drainages between the Sacramento River and the Sacramento Deep Water Ship Channel in the vicinity of West Sacramento (California Department of Fish and Wildlife 2020a). There are additional historical occurrences along the Sacramento River corridor (Jones & Stokes 1985:33, 1986:15, 1987:25–27; U.S. Fish and Wildlife Service 1984:18–20; Barr 1991:4, 6, 18–19; Collinge et al. 2001:104). Comprehensive surveys for the species or its host plant, elderberry, have not been conducted and thus the population size and location of the species in the action area is unknown. Distribution is typically based on the occurrence of elderberry shrubs, which are known to occur along riparian corridors throughout the action area, including the Sacramento River, Stanislaus River, San Joaquin River, and along smaller natural and channelized drainages, as well as in upland habitats.

### 4.4.17.5 Critical Habitat

The USFWS promulgated the final ruling designating critical habitat for valley elderberry longhorn beetle on August 8, 1980 (45 FR 52804). Two critical habitat areas were designated along portions of the American River in Sacramento County (the Sacramento Zone and the American River Parkway Zone). Critical habitat for valley elderberry longhorn beetle is not located within the action area.

### 4.4.17.6 Suitable Habitat Definition

As described above in Section 4.4.17.2, *Life History and Habitat Requirements,* suitable habitat for valley elderberry longhorn beetle are elderberry shrubs throughout the action area at elevations below 500 feet (though all elevations in the action area are less than 500 feet). Elderberry shrubs in the action area could be found in riparian areas and other habitats such as along levee banks, in grasslands, and in agricultural settings where vegetation is not being maintained (e.g., fence rows, field edges, fallow fields).

### 4.4.17.7 Species Habitat Suitability Model

The habitat model for valley elderberry longhorn beetle includes both riparian and other potential habitat. The “other potential habitat” portion of the model includes some agricultural land cover types as well as some seasonal wetlands mapped by DWR. Though frequent vegetation management in agricultural lands may limit the development of suitable shrubs, elderberry shrubs in rural areas are typically found on fence rows, along roadsides, and in areas that are not subject to active tilling or vegetation management. The extent of modeled habitat in the action area is depicted in Figure 6.11-1.

As described in Section 4.4.17.2, the valley elderberry longhorn beetle range extends throughout the action area, based on the range described in the Framework for Assessing Impacts to the Valley

Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*) (U.S. Fish and Wildlife Service 2017e:4).

### Riparian Habitat

Modeled habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update, and the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018, 2019).

- Valley/foothill riparian
  - All types

### Other Potential Habitat

Modeled habitat also includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).[12]

- Other seasonal wetland
  - Seasonal wetland

Seasonal wetlands were individually selected by DWR staff that conducted the wetland delineation. These areas may have had some past disturbance but currently consist of herbaceous vegetation with some scattered shrubs. Though seasonally wet, these areas have the potential to support elderberry shrubs.

Modeled habitat also includes the following types from the Delta 2017 Land Use Survey (Land IQ 2019), Draft San Joaquin County 2017 Land Use Survey (California Department of Water Resources 2020b), Sacramento County 2015 Land Use Survey (California Department of Water Resources 2016), Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update, and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018, 2019):

- Agriculture
  - Semi-ag/rights-of-way
  - Upland herbaceous
  - Grassland
  - All types

[12] The DWR 2020 Aquatic Resources Delineation data is considered sufficient for evaluation of effects from the proposed action in this BA. The land cover data will be updated to include the final verified aquatic resources delineation data prior to submittal of this BA in support of the request for formal consultation.

# 4.4.18 Vernal Pool Fairy Shrimp

## 4.4.18.1 Legal Status and Distribution

Vernal pool fairy shrimp is listed as threatened under the ESA throughout its range (59 FR 48136). In September 2007, U.S. Fish and Wildlife Service published a 5-year review recommending that the species remain listed as threatened.

There is little information on the historical range of vernal pool fairy shrimp. The species is currently known to occur in a wide range of vernal pool habitats in the central western, southwestern, and Central Valley areas of California, and in two vernal pool habitats in the Agate Desert area of Jackson County, Oregon (U.S. Fish and Wildlife Service 2005:II-191–II-192). It has the largest geographical range of listed fairy shrimp in California, but is seldom abundant (U.S. Fish and Wildlife Service 2005:II-194). The species is currently found at locations across the Central Valley from Shasta County to Tulare and Kings Counties, in the central and southern Coast Ranges from Napa County to Los Angeles County, and inland in western Riverside County, California (U.S. Fish and Wildlife Service 2005:II-194–II-195; California Department of Fish and Wildlife 2020a).

## 4.4.18.2 Life History and Habitat Requirements

Vernal pool fairy shrimp is entirely dependent on the aquatic environment provided by the temporary waters of natural vernal pool and playa pool ecosystems as well as the artificial environments of ditches and tire ruts (59 FR 48136; U.S. Fish and Wildlife Service 2007:24, 26). The temporary waters fill directly from precipitation as well as from surface runoff and perched groundwater from their watersheds (U.S. Fish and Wildlife Service 2007:30). The watershed extent that is necessary for maintaining the hydrological functions of the temporary waters depends on a number of complex factors including soil properties, the existence of a perched aquifer overlying an impermeable soil layer, slope, effects of vegetation on evapotranspiration rates, compaction of surface soils by grazing animals, and other factors (U.S. Fish and Wildlife Service 2007:30).

The temporary waters that are habitat for the vernal pool fairy shrimp are extremely variable and range from clear sandstone pools with little alkalinity to turbid, alkaline vernal pools (U.S. Fish and Wildlife Service 2005:II-196). Vernal pool fairy shrimp have also occasionally been found in degraded vernal pool habitats and artificially created seasonal pools (Helm 1998:132). Vernal pool fairy shrimp commonly co-occur with other fairy shrimp and vernal pool tadpole shrimp (*Lepidurus packardi*) (U.S. Fish and Wildlife Service 2005:II-197).

Vernal pool fairy shrimp are adapted to the environmental conditions of their ephemeral habitats. One adaptation is the ability of vernal pool fairy shrimp eggs, or cysts, to remain dormant in the soil when their vernal pool habitats are dry. The cysts survive the hot, dry summers and cold, wet winters that follow until vernal pools and swales fill with rainwater and conditions are right for hatching. When the pools refill in the same or subsequent seasons some, but not all, of the cysts may hatch. The cyst bank in the soil may comprise cysts from several years of breeding (U.S. Fish and Wildlife Service 2005:II-195; 59 FR 48136). Beyond inundation of the habitat, the specific cues for hatching are unknown, although temperature and conductivity (solute concentration) are believed to play a large role (Helm 1998:132).

In a study using large plastic pools to simulate natural vernal pools, Helm found that vernal pool fairy shrimp can reproduce in as early as 18 days following hatching, with the average being 40 days

(Helm 1998:133). Site-specific conditions, primarily water temperature, have been shown to affect time to reach reproductive maturity (Helm 1998:132).

### 4.4.18.3 Impacts from Past and Present Actions

Threats to vernal pool habitat and vernal pool branchiopods in general, as well as specific threats to vernal pool fairy shrimp, are described in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208, 2007).

Agricultural conversion from rangelands to intensive farming, urbanization, aggregate mining, and infrastructure projects (such as roads and utility projects) are the primary drivers for habitat loss and fragmentation (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208). Habitat fragmentation occurs when vernal pool complexes are broken into smaller groups or individual vernal pools and become isolated from each other as a result of activities such as road development and other infrastructure projects (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208).

Inappropriate grazing practices have also been identified as a threat; these include complete elimination of grazing in areas where nonnative grasses dominate the uplands surrounding vernal pools, as well as inappropriate timing or intensity of grazing. Appropriate grazing regimes help control nonnative plants such as Italian ryegrass (*Lolium multiflorum*) and waxy mannagrass (*Glyceria declinata*), which, if unchecked, can increase thatch buildup, decrease ponding duration, and decrease the aquatic habitat available to the vernal pool fairy shrimp (U.S. Fish and Wildlife Service 2007).

Human disturbances and changes in land use practices can alter the hydrology of temporary waters and result in a change in the timing, frequency, or duration of inundation in vernal pools, which can create conditions that render existing vernal pools unsuitable for vernal pool species (U.S. Fish and Wildlife Service 2007:27).

Climate change is expected to affect vernal pool hydrology through changes in the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration. It is unknown at this time whether climate change in California will result in a localized, relatively small cooling and drying trend or in a warmer trend with higher precipitation events. However, it is possible that either scenario would result in negative effects on vernal pool invertebrate species. Cooling and drying trends could adversely affect vernal pool fairy shrimp through decreased inundation periods that do not allow the species sufficient time to complete its life cycle. In contrast, warmer conditions could increase inundation periods, which would not necessarily be a negative effect because increased inundation periods would increase available habitat for vernal pool fairy shrimp. However, increased inundation periods associated with a warming trend could also negatively affect the species by not providing cool enough temperatures for vernal pool fairy shrimp to hatch or reproduce (U.S. Fish and Wildlife Service 2007).

Specific threats to vernal pool fairy shrimp habitat identified in the 2005 Vernal Pool Recovery Plan include the following.

- Within the entire range of the species, more than half of the known populations of vernal pool fairy shrimp are threatened by development or agricultural conversion. Several populations are found on military bases, and although not an immediate threat, military activities can result in

alteration of pool characteristics, including introduction of nonnative plant species (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208, 2007).

- In the Livermore vernal pool region, the vernal pool fairy shrimp is primarily on private land, where it is threatened by development, including expansion of the Byron Airport.
- In the northeastern Sacramento Valley vernal pool region, most of the known occurrences are located on California Department of Transportation (Caltrans) rights-of-way and are thus threatened by various future road improvement projects in this region, particularly the future expansion of SR 99. Additional populations are threatened by commercial and residential development projects.
- Some occurrences on private land in the Northwestern Sacramento vernal pool region may be threatened by agricultural conversion or development.
- In the southern Sacramento vernal pool region, the vernal pool fairy shrimp is threatened by urban development. Both the South Sacramento and Placer county Habitat Conservation Plans address growth in the region.
- In the San Joaquin Valley region, the vernal pool fairy shrimp is found primarily on private land where it is threatened by direct habitat loss, including urban development and agricultural conversion.
- In the Solano-Colusa region, the vernal pool fairy shrimp is threatened by development on the private property where it occurs.

### 4.4.18.4 Status of the Species in the Action Area

Within the action area, vernal pool fairy shrimp has the potential to occur throughout but is generally limited to known areas of suitable habitat in and around Stone Lakes in Sacramento County, within the Yolo Bypass, within Solano County, and in eastern Contra Costa County near Clifton Court Forebay.

There are 19 CNDDB records for vernal pool fairy shrimp in the action area, which occur in the Stone Lakes National Wildlife Refuge (1), in the Yolo Bypass (8), in Jepson Prairie in Solano County (2), in southern Solano County near Montezuma Hills (1), in Antioch (1), and in the area of Clifton Court Forebay (6) (California Department of Fish and Wildlife 2020a).

### 4.4.18.5 Critical Habitat

The final rule designating critical habitat for vernal pool fairy shrimp was published in the *Federal Register* on February 10, 2006 (71 FR 7118–7316). Designated critical habitat for vernal pool fairy shrimp within the action area is located west of Clifton Court Forebay near Byron. The designated critical habitat for vernal pool fairy shrimp is in Unit 19B (10,707 total acres; an estimated 1,475 acres in the action area). The primary constituent elements of critical habitat for vernal pool fairy shrimp are summarized from 71 FR 7118-7316 below.

- Topographic features characterized by mounds and swales, and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools, providing for dispersal and promoting hydroperiods of adequate length in the pools.

- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum time period (18 days for vernal pool fairy shrimp) in all but the driest years, thereby providing adequate water for incubation, maturation, and reproduction. Although these features are inundated on a seasonal basis, they still promote the development of obligate wetland vegetation habitats typical of permanently inundated emergent wetlands.
- Sources of food, such as detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter.
- Structures within the vernal pools that provide shelter (organic and inorganic materials such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools).

### 4.4.18.6 Suitable Habitat Definition

As described above in Section 4.4.18.2, *Life History and Habitat Requirements*, and Section 4.4.18.4, *Status of the Species in the Action Area/Environmental Baseline*, suitable habitat for vernal pool fairy shrimp includes vernal pools, alkali seasonal wetlands, and other seasonal wetland types that provide appropriate hydroperiods and conditions. Vernal pool fairy shrimp can also be found in artificial features such as seasonal ditches and unvegetated low spots that pool during the winter. The vernal pool fairy shrimp range extends throughout the action area.

### 4.4.18.7 Species Habitat Suitability Model

The vernal pool fairy shrimp habitat model includes vernal pools, alkaline seasonal wetlands, and some seasonal wetlands. Vernal pool complexes in the western part of the action area often occur in a mosaic with alkaline seasonal wetlands; many of the species that occur in the vernal pool complex also occur in the alkaline seasonal wetland complex within this mosaic of natural communities. The modeled habitat relies on both aquatic resource delineation data that was collected for a smaller portion of the action area, in what is called the *delineation action area*, and suitable habitats found in the Great Valley Vernal Pool Data (Witham et al. 2014), Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update, and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018, 2019). The extent of modeled habitat in the action area is depicted in Figure 6.12-1.

#### Inside the Delineation Study Area

Modeled habitat includes the following types from the Great Valley Vernal Pool Data and DWR 2020 Aquatic Resources Delineation (Witham et al. 2014; California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).[13]

- Vernal pool complex
  - Alkaline wetland

[13] The DWR 2020 Aquatic Resources Delineation data is considered sufficient for evaluation of effects from the proposed action in this BA. The land cover data will be updated to include the final verified aquatic resources delineation data prior to submittal of this BA in support of the request for formal consultation.

  - Vernal pool

Modeled habitat also includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Alkaline seasonal wetland complex
  - Alkaline wetland
- Other seasonal wetlands
  - Seasonal wetlands

### Outside the Delineation Study Area

Modeled habitat includes the following types from the Great Valley Vernal Pool Data and Delta Vegetation and Land Use Update (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019).

- Vernal pool complex
  - All types

Modeled habitat also includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Alkaline seasonal wetland complex
  - All types

Outside the delineation study area, density class information from the Great Valley Vernal Pool Data (Witham at al. 2014) was used to report an estimated wetted acre. This includes the following cover classes: <2%, 2%–5%, 5%–10%, >10%, and 100% for individual pools. In the statutory Delta, the cover classes reported go only as high as 5%–10%.

## 4.4.19 Vernal Pool Tadpole Shrimp

### 4.4.19.1 Legal Status and Distribution

Vernal pool tadpole shrimp was listed as endangered throughout its range under the ESA on September 19, 1994 (59 FR 48136). In September 2007, USFWS published a 5-year review recommending that the species remain listed as endangered.

Historically, vernal pool tadpole shrimp probably did not occur outside of the Central Valley and Central Coast regions (U.S. Fish and Wildlife Service 2005:II-204). Currently, vernal pool tadpole shrimp occurs in the Central Valley of California and in the San Francisco Bay Area (U.S. Fish and Wildlife Service 2005:II–204). The species has a patchy distribution across the Central Valley of California from Shasta County southward to northwestern Tulare County (U.S. Fish and Wildlife Service 2007:4). In the Central Coast Vernal Pool Region identified in the Vernal Pool Recovery Plan, the vernal pool tadpole shrimp is found in the San Francisco Bay National Wildlife Refuge and on

private land in Alameda County near Milpitas (U.S. Fish and Wildlife Service 2007:14; California Department of Fish and Wildlife 2020a). The largest concentration of vernal pool tadpole shrimp occurrences is found in the Southeastern Sacramento Vernal Pool Region identified in the Vernal Pool Recovery Plan, where the species occurs on a number of public and private lands in Sacramento County (U.S. Fish and Wildlife Service 2005:II-206, 2007:14).

### 4.4.19.2 Life History and Habitat Requirements

Vernal pool tadpole shrimp occur in a wide variety of seasonal habitats, including vernal pools, ponded clay flats, alkaline pools, ephemeral stock ponds, and roadside ditches. Habitats where vernal pool tadpole shrimp have been observed range in size from small (less than 25 square feet), clear, vegetated vernal pools to highly turbid alkali scald pools to large (more than 100 acres) winter lakes (U.S. Fish and Wildlife Service 2007:3; Helm 1998:132,137). These pools and other ephemeral wetlands must dry out and be inundated again to remain suitable for the vernal pool tadpole shrimp. Any cysts remaining in the soil once the pool has dried must wait until the pool refills to hatch. Vernal pool tadpole shrimp can hatch multiple times in a single inundation event so long as the habitat remains inundated, sometimes for 6 months or more (U.S. Fish and Wildlife Service 2005:II–207).

Vernal pool tadpole shrimp commonly co-occur with other fairy shrimp (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208).

Like other vernal pool branchiopods, vernal pool tadpole shrimp are linked to the cycles of their ephemeral habitats. Vernal pool tadpole shrimp eggs, or cysts, remain dormant in the soil when their vernal pool habitats are dry. The cysts remain in the soil until later rainy seasons when conditions are right for hatching (59 FR 48138).

In a study using large plastic pools to simulate natural vernal pools, Helm found that vernal pool tadpole shrimp can reproduce as early as 41 days following hatching, with the average being 54 days (Helm 1998:133). Site-specific conditions, primarily water temperature, have been shown to affect time to reach reproductive maturity (Helm 1998:132).

Vernal pool tadpole shrimp have relatively high reproductive rates and may be hermaphroditic. Sex ratios can vary, perhaps in response to changes in water temperature (Ahl 1991:137, 139). Genetic variation among vernal pool tadpole shrimp corresponded with differences between sites in physical and chemical aspects of the pool habitat (depth, surface area, solutes concentration, elevation, and biogeographic region), and species richness was positively correlated with both depth and surface area (King et al. 1996). This result corresponds with the findings of other researchers that vernal pool crustaceans have low rates of gene flow between separated sites (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208). The low rate of exchange between vernal pool tadpole shrimp populations is probably a result of the spatial isolation of their habitats and their reliance on passive dispersal mechanisms (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208). However, the studies also found that gene flow between pools within the same vernal pool complex is much higher (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208). This indicates that vernal pool tadpole shrimp populations, like most vernal pool crustacean populations, are defined by vernal pool complexes and not by individual vernal pools (U.S. Fish and

Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208).

### 4.4.19.3 Impacts from Past and Present Actions

Development and agriculture actions resulting in habitat loss and fragmentation are the largest threats to the survival and recovery of vernal pool species. Habitat loss is a result of agricultural conversion from rangelands to intensive farming, urbanization, aggregate mining, infrastructure projects (such as roads and utility projects), and recreational activities (such as off-highway vehicles and hiking) (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208). Habitat fragmentation occurs when vernal pool complexes are broken into smaller groups or individual vernal pools and become isolated from each other as a result of activities such as road development and other infrastructure projects (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208).

Inappropriate grazing practices have also been identified as a threat; these include complete elimination of grazing in areas where nonnative grasses dominate the uplands surrounding vernal pools, as well as inappropriate timing or intensity of grazing. Appropriate grazing regimes help control nonnative plants such as Italian ryegrass (*Lolium multiflorum*) and waxy mannagrass (*Glyceria declinata*), which, if unchecked, can increase thatch buildup, decrease ponding duration, and decrease the aquatic habitat available to the vernal pool fairy shrimp (U.S. Fish and Wildlife Service 2007).

Human disturbances and changes in land use practices can alter the hydrology of temporary waters and result in a change in the timing, frequency, or duration of inundation in vernal pools, which can create conditions that render existing vernal pools unsuitable for vernal pool species (U.S. Fish and Wildlife Service 2005:II-192, II-194–II-195, II-197, I-1, J-28, I-16, I-17, II-31, II-198, II-204–II-206, II-185, II-208).

Climate change is expected to affect vernal pool hydrology through changes in the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration. It is unknown at this time whether climate change in California will result in a localized, relatively small cooling and drying trend or in a warmer trend with higher precipitation events. However, it is possible that either scenario would result in negative effects on vernal pool invertebrate species. Cooling and drying trends could adversely affect the vernal pool tadpole shrimp through decreased inundation periods that do not allow the species sufficient time to complete its life cycle. In contrast, warmer conditions could increase inundation periods, which would not necessarily be a negative effect because increased inundation periods would increase available habitat for the vernal pool tadpole shrimp. However, increased inundation periods associated with a warming trend could also negatively affect the species by not providing cool enough temperatures for the vernal pool tadpole shrimp to hatch or reproduce (U.S. Fish and Wildlife Service 2007).

Specific threats to vernal pool tadpole shrimp habitat identified in the 2005 vernal pool recovery plan included the following.

- The species is threatened by the encroachment of nonnative annual grasses on the San Francisco Bay National Wildlife Refuge in the Central Coast region, and by urban development where it is known to occur on private land in Alameda County.

- In the northeastern Sacramento Valley region, most of the known occurrences of the vernal pool tadpole shrimp are on Caltrans) rights-of-way, where they continue to be threatened by road improvement projects related to general urban growth.
- In the northwestern Sacramento Valley vernal pool region, the vernal pool tadpole shrimp is threatened by development on the few sites on private land where it is known to occur.
- In the southeastern Sacramento vernal pool region, extant populations of the vernal pool tadpole shrimp are threatened by continued extensive urban development.
- In the San Joaquin vernal pool region, the species is threatened by development on private land.
- In the Solano-Colusa region, the species is threatened by urbanization on private lands.
- In the Southern Sierra Foothills vernal pool region, the species is threatened by development of the University of California, Merced campus, which will likely contribute to significant growth in the region. Populations on the Stone Corral Ecological Reserve may be threatened by pesticide drift from adjacent farmlands.

### 4.4.19.4 Status of the Species in the Action Area

Within the action area, vernal pool tadpole shrimp has the potential to occur throughout but is generally limited to known areas of suitable habitat in and around Stone Lakes in Sacramento County, within the Yolo Bypass, within Solano County, and in eastern Contra Costa County near Clifton Court Forebay.

Fourteen CNDDB records for vernal pool tadpole shrimp are within the action area, which occur in an area southwest of Montezuma Hills (1), in the Jepson Prairie area (6), in the Yolo Bypass (4), in the Stone Lakes area (2), and one in an area just north of the Cosumnes River Preserve (California Department of Fish and Wildlife 2020a).

### 4.4.19.5 Critical Habitat

Final designation of critical habitat for vernal pool tadpole shrimp was published in the *Federal Register* on February 10, 2006 (71 FR 7118–7316). Designated critical habitat for vernal pool tadpole shrimp is located outside the action area to the northwest in the Jepson Prairie area near Fairfield. The primary constituent elements of critical habitat for vernal pool tadpole shrimp are summarized from 71 FR 7118-7316 below by the following habitat components.

- Topographic features characterized by mounds and swales, and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools, providing for dispersal and promoting hydroperiods of adequate length in the pools.
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum time period (41 days for vernal pool tadpole shrimp) in all but the driest years, thereby providing adequate water for incubation, maturation, and reproduction. Although these features are inundated on a seasonal basis, they still promote the development of obligate wetland vegetation habitats typical of permanently inundated emergent wetlands.

- Sources of food, typically detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter.
- Structures within the vernal pools that provide shelter (organic and inorganic materials such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools).

### 4.4.19.6 Suitable Habitat Definition

As described above in Section 4.4.19.2, *Life History and Habitat Requirements*, and Section 4.4.19.4, *Status of the Species in the Action Area/Environmental Baseline*, suitable habitat for vernal pool tadpole shrimp includes vernal pools, alkali seasonal wetlands, and other seasonal wetland types that provide appropriate hydroperiods and conditions. Vernal pool tadpole shrimp generally occur in pools that inundate for longer periods of time than other vernal pool crustaceans; however, for the purposes of this analysis the habitat for vernal pool fairy shrimp and vernal pool tadpole shrimp are treated as equivalent. The extent of modeled habitat in the action area is depicted in Figure 6.12-1.

### 4.4.19.7 Species Habitat Suitability Model

The vernal pool tadpole shrimp habitat model is the same as that for vernal pool fairy shrimp. Please see Section 4.4.18.7, *Species Habitat Suitability Model*, for a description of the model.

## 4.4.20 Colusa Grass

### 4.4.20.1 Geographic Distribution and Status

Colusa grass (*Neostapfia colusana*) is federally listed as threatened (62 FR 14338–14352) and state-listed as endangered (California Department of Fish and Wildlife 2022). Colusa grass is known from the Central Valley with scattered occurrences from Colusa County to Merced County (Reeder 2012:1468). It grows in the bottoms of large, deep vernal pools (California Department of Fish and Wildlife 2020b). The natural community type in the study area that provides habitat for Colusa grass is vernal pool complex. Threats to Colusa grass are competition with nonnative plants, agriculture, development, overgrazing, and flood-management actions (California Native Plant Society 2022a).

The California Rare Plant Rank of 1B.1 for Colusa grass indicates that it is rare, threatened, or endangered in California and elsewhere. Its state threat level (.1) indicates that it is seriously threatened in California (California Department of Fish and Wildlife 2024b; California Native Plant Society 2022a). Plants with rank of 1B are considered to meet the definitions of rare, threatened, or endangered as defined in Section 1901, Chapter 10 (Native Plant Protection Act) or Sections 2062 and 2067 (CESA) of the California Fish and Game Code (California Department of Fish and Wildlife 2024b).Historically, recorded Colusa grass occurrences are from Colusa, Merced, Solano, Stanislaus, and Yolo Counties. The current distribution encompasses the same regions, with the majority of occurrences in the Southern Sierra Foothills Vernal Pool Region identified by the Vernal Pool Recovery Plan, one or two occurrences in the San Joaquin Valley Vernal Pool Region in Merced County, and four occurrences in the Solano-Colusa Vernal Pool Region in southeastern Yolo and central Solano Counties (U.S. Fish and Wildlife Service 2005:II-58). Colusa grass has apparently been extirpated from Colusa County. Three CNDDB records for Colusa grass are within the study area,

which occur at Jepson Prairie west of Cache Slough Complex in Solano County and in Yolo County west of Yolo Bypass Wildlife Area (California Department of Fish and Wildlife 2020b).

### 4.4.20.2 Life History and Habitat Requirements

Colusa grass is an annual grass that grows in the deepest parts of large, deep vernal pools that retain water until May or June and flowers during summer months (U.S. Fish and Wildlife Service 2005:II-60). The species also occurs in the beds of intermittent streams and artificial ponds and can grow on pond margins (U.S. Fish and Wildlife Service 2005:II-61).

Long periods of inundation are required for seeds to germinate, in late spring when little standing water is left in pools (U.S. Fish and Wildlife Service 2005:II-60–II-61). Colusa grass typically grows in single-species stands, but it often co-occurs with other vernal pool species in the same pond. The species requires clay, silty clay, or silty clay loam soils with underlying impermeable layers ranging from claypan to lime-silica or iron-silica cemented hardpan and tuffaceous alluvium (U.S. Fish and Wildlife Service 2005:II-62).

### 4.4.20.3 Impacts from Past and Present Actions

Agricultural conversion from rangelands to intensive farming, urbanization, aggregate mining, infrastructure projects (such as roads and utility projects), and recreational activities (such as off-highway vehicles and hiking) have led to Colusa grass habitat loss and fragmentation of Colusa grass habitat (U.S. Fish and Wildlife Service 2005:I-1, I-16–I-28). Habitat fragmentation occurs when vernal pool complexes are broken into smaller groups or individual vernal pools and become isolated from each other as a result of activities such as road development and other infrastructure projects (U.S. Fish and Wildlife Service 2005: I-1, I-17).

Inappropriate grazing practices have also been identified as a threat; these include inappropriate timing and intensity of grazing, as well as elimination of grazing in areas where nonnative grasses dominate the uplands surrounding vernal pools. Appropriate grazing regimes help control nonnative plants such as Italian ryegrass (*Lolium multiflorum*) and waxy mannagrass (*Glyceria declinate*), which, if unchecked, can increase thatch buildup, decrease ponding duration, and decrease the aquatic habitat available to Colusa grass (U.S. Fish and Wildlife Service 2012b).

Human disturbances and changes in land use practices can alter the hydrology of temporary waters and result in a change in the timing, frequency, or duration of inundation in vernal pools, which can create conditions that render existing vernal pools unsuitable for vernal pool species (U.S. Fish and Wildlife Service 2005:I-1, I-16, I-17, I-23–II-24).

Climate change is expected to affect vernal pool hydrology through changes in the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration. It is unknown at this time whether climate change in California will result in a localized, relatively small cooling and drying trend or in a warmer trend with higher precipitation events. However, it is possible that either scenario would result in negative effects on vernal pool invertebrate species. Cooling and drying trends could adversely affect the Colusa grass through decreased inundation periods that do not allow the species sufficient time to complete its life cycle. In contrast, warmer conditions could increase inundation periods, which would not necessarily be a negative effect because increased inundation periods would increase available habitat for Colusa grass (U.S. Fish and Wildlife Service 2012b).

Specific threats to Colusa grass habitat identified in the 2005 Vernal Pool Recovery Plan include the following.

- Contamination from inundation by poultry manure, herbicide applications, and contamination of groundwater by industrial chemicals.
- Habitat conversion, including agricultural conversion, especially in Stanislaus County; urbanization, especially at the University of California campus and associated community development in eastern Merced County, proposed construction of a new prison and a landfill, a proposed flood control project in eastern Merced County, and runoff alterations are a threat to the two Yolo County occurrences.
- Almost all of the extant occurrences of *Neostapfia colusana* are subject to livestock grazing, thus to the extent inappropriate grazing practices are still being followed at certain sites, these sites may be threatened.
- Competition from invasive native and nonnative plants, especially in combination with adverse hydrology changes and adverse grazing practices.
- Vandalism (i.e., trampling near urban areas) and foraging by grasshopper outbreaks.
- Small population size at sites with fewer than 100 individuals.

### 4.4.20.4 Status of the Species in the Study Area

Within the Delta, Colusa grass has the potential to occur in known areas of suitable habitat in southeastern Yolo and central Solano Counties (U.S. Fish and Wildlife Service 2005:II-58).

Three CNDDB records for Colusa grass are within the Delta, which occur at Jepson Prairie west of Cache Slough Complex in Solano County and in Yolo County west of Yolo Bypass Wildlife Area (California Department of Fish and Wildlife 2020a).

### 4.4.20.5 Critical Habitat

Final designation of critical habitat for Colusa grass was published in the *Federal Register* on February 10, 2006 (71 FR 7118–7316). Designated critical habitat for Colusa grass consists of 152,093 acres located outside the action area in Yolo County west of Yolo Bypass Wildlife Area. The primary constituent elements of critical habitat for Colusa grass are summarized here from 71 FR 7249 by the following habitat components.

- Topographic features characterized by mounds and swales, and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools, providing for dispersal and promoting hydroperiods of adequate length in the pools.
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum time period to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently inundated emergent wetlands.

### 4.4.20.6 Suitable Habitat Definition

As described above in Section 4.4.20.2, *Life History and Habitat Requirements*, and Section 4.4.20.4, *Status of the Species in the Action Area/Environmental Baseline*, suitable habitat for Colusa grass includes large vernal pools that provide appropriate hydroperiods and conditions. The extent of suitable habitat in the study area is depicted in Figure 6.13-1.

### 4.4.20.7 Habitat Model Description

The Colusa grass habitat model includes vernal pools, alkaline seasonal wetlands, and some seasonal wetlands. Vernal pool complexes in the western part of the study area often occur in a mosaic with alkaline seasonal wetlands; many of the species that occur in the vernal pool complex also occur in the alkaline seasonal wetland complex within this mosaic of natural communities. The modeled habitat relies on both aquatic resource delineation data that was collected for a smaller portion of the study area, in what is called the delineation study area, and suitable habitats found in the Great Valley Vernal Pool Data (Witham et al. 2014), Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update, and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018, 2019).

#### Inside the Delineation Study Area

Modeled habitat includes the following types from the Great Valley Vernal Pool Data and DWR 2020 Aquatic Resources Delineation (Witham et al. 2014; California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Vernal pool complex
  - Alkaline wetland
  - Vernal pool

Modeled habitat also includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Alkaline seasonal wetland complex
  - Alkaline wetland
- Other seasonal wetlands
  - Seasonal wetlands

#### Outside the Delineation Study Area

Modeled habitat includes the following types from the Great Valley Vernal Pool Data and Delta Vegetation and Land Use Update (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019).

- Vernal pool complex
  - All types

Modeled habitat also includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and

Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Alkaline seasonal wetland complex
  - All types

Outside the delineation study area, density class information from the Great Valley Vernal Pool Data (Witham et al. 2014) was used to report an estimated wetted acre. This includes the following cover classes: <2%, 2%–5%, 5%–10%, >10%, and 100% for individual pools. In the statutory Delta, the cover classes reported go only as high as 5%–10%.

# 4.4.21 Solano Grass

## 4.4.21.1 Geographic Distribution and Status

Solano grass was listed as endangered throughout its range under the ESA on September 29, 1978 (43 FR 44810). In March 2009, USFWS published a 5-year review recommending that the species remain listed as endangered. Solano grass is also state-listed as endangered (California Department of Fish and Wildlife 2022).

The California Rare Plant Rank of 1B.1 for Solano grass indicates that it is rare, threatened, or endangered in California and elsewhere. Its state threat level (.1) indicates that it is seriously threatened in California (California Department of Fish and Wildlife 2024b; California Native Plant Society 2022b). Plants with rank of 1B are considered to meet the definitions of rare, threatened, or endangered as defined in Section 1901, Chapter 10 (Native Plant Protection Act) or Sections 2062 and 2067 (CESA) of the California Fish and Game Code (California Department of Fish and Wildlife 2024b).

Solano grass is known from only three occurrences in the southwestern Sacramento Valley in Solano and Yolo Counties, where it grows in vernal pools (California Department of Fish and Wildlife 2020a).

## 4.4.21.2 Life History and Habitat Requirements

Solano grass is an annual grass that grows in alkaline playas, intermittent lakes, and “relatively small” vernal pools. Seeds are presumed to germinate in May or June, and the species flowers in June and sets seeds in July (U.S. Fish and Wildlife Service 2005:II-107).

Solano grass requires turbid Northern Claypan vernal pools within annual grassland. The species often co-occur with other vernal pool species in the same vernal pool complex (U.S. Fish and Wildlife Service 2005:II-108).

## 4.4.21.3 Impacts from Past and Present Actions

Agricultural conversion from rangelands to intensive farming, urbanization, aggregate mining, infrastructure projects (such as roads and utility projects), and recreational activities (such as off-highway vehicles and hiking) have led to habitat loss and fragmentation of Solano grass habitat (U.S. Fish and Wildlife Service 2005:I-1, I-16–I-28). Habitat fragmentation occurs when vernal pool complexes are broken into smaller groups or individual vernal pools and become isolated from each

other as a result of activities such as road development and other infrastructure projects (U.S. Fish and Wildlife Service 2005:I-1, I-17).

Inappropriate grazing practices have also been identified as a threat; these include inappropriate timing and intensity of grazing, as well as elimination of grazing in areas where nonnative grasses dominate the uplands surrounding vernal pools. Appropriate grazing regimes help control nonnative plants such as Italian ryegrass (*Lolium multiflorum*) and waxy mannagrass (*Glyceria declinate*), which, if unchecked, can increase thatch buildup, decrease ponding duration, and decrease the aquatic habitat available to Solano grass (U.S. Fish and Wildlife Service 2012b).

Human disturbances and changes in land use practices can alter the hydrology of temporary waters and result in a change in the timing, frequency, or duration of inundation in vernal pools, which can create conditions that render existing vernal pools unsuitable for vernal pool species (U.S. Fish and Wildlife Service 2005:I-1, I-16, I-17, I-23, II-24).

Climate change is expected to affect vernal pool hydrology through changes in the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration. It is unknown at this time whether climate change in California will result in a localized, relatively small cooling and drying trend or in a warmer trend with higher precipitation events. However, it is possible that either scenario would result in negative effects on vernal pool invertebrate species. Cooling and drying trends could adversely affect the Solano grass through decreased inundation periods that do not allow the species sufficient time to complete its life cycle. In contrast, warmer conditions could increase inundation periods, which would not necessarily be a negative effect because increased inundation periods would increase available habitat for Solano grass (U.S. Fish and Wildlife Service 2012b).

Specific threats to Solano grass habitat identified in the 2005 Vernal Pool Recovery Plan include the following.

- Habitat degradation from discing, excavation, trampling by hunters, inappropriate grazing practices, and contamination from herbicide runoff, application of salt, and contamination of groundwater from industrial contaminants.
- Competition from aggressive plant species.
- Overcollection.
- Small population size.

### 4.4.21.4 Status of the Species in the Study Area

Within the study area, Solano grass has the potential to occur in known areas of suitable habitat in southeastern Yolo and central Solano Counties (U.S. Fish and Wildlife Service 2005:II-58).

No CNDDB records for Solano grass are located in the Delta (California Department of Fish and Wildlife 2020a).

### 4.4.21.5 Critical Habitat

Final designation of critical habitat for Solano grass was published in the *Federal Register* on February 10, 2006 (71 FR 7118–7316). Designated critical habitat for Solano grass consists of 440 acres located outside the action area in Yolo County west of Yolo Bypass Wildlife Area. The primary

constituent elements of critical habitat for Colusa grass are summarized here from 71 FR 7314 by the following habitat components.

- Topographic features characterized by mounds and swales, and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools, providing for dispersal and promoting hydroperiods of adequate length in the pools.
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum time period to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently inundated emergent wetlands.

### 4.4.21.6 Suitable Habitat Definition

As described above in Section 4.4.21.2, *Life History and Habitat Requirements*, and Section 4.4.21.4, *Status of the Species in the Action Area/Environmental Baseline*, suitable habitat for Solano grass includes vernal pools that provide appropriate hydroperiods and conditions. The extent of suitable habitat in the Delta is depicted in Figure 6.13-1.

### 4.4.21.7 Habitat Model Description

The Solano grass habitat model is the same as that for Colusa grass. Please see Section 4.4.20.7, *Habitat Model Description*, for a description of the model.

## 4.4.22 Northwestern Pond Turtle[14]

### 4.4.22.1 Geographic Distribution and Status

Northwestern pond turtle is proposed for listing as threatened under the ESA (88 FR 68370) and is a CDFW Species of Special Concern (U.S. Fish and Wildlife Service 2020f; California Department of Fish and Wildlife 2020b:44). Critical habitat has not yet been designated and no recovery plan has been developed for northwestern pond turtle.

The study area is within the range of northwestern pond turtle as depicted in Thomson et al. (2016:297). There are numerous records of northwestern pond turtle throughout the study area (California Department of Fish and Wildlife 2020a).

### 4.4.22.2 Life History and Habitat Requirements

Northwestern pond turtles are a highly aquatic species and can be found in a variety of habitat types including streams, rivers, sloughs, lakes, ponds, reservoirs, marshes, seasonal ponds, and other

[14] In 2017, western pond turtle was recognized and accepted by the scientific community as two separate species (northwestern pond turtle (*Actinemys marmorata*) and southwestern pond turtle (*Actinemys pallida*)) (Crother 2017: 82; Rhodin et al. 2017:76, 171–172). Because of the relatively recent split of the species into two separate entities, the majority of available research and information refers to a single species (western pond turtle). To be consistent with recent science and the proposed listing rule, this document will refer to the species as *northwestern pond turtle* (88 FR 68370); even though much of the life history information referenced in this section is for "western pond turtle."

wetland habitats (Thomson et al. 2016:300). They require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks for thermoregulation, and access to suitable upland habitat with loose soils for nesting, dispersal and overwintering (Thomson et al. 2016:300). Proximity of nesting site to aquatic habitat is dependent on availability, and the nest site is usually within 300 feet of the aquatic habitat but can be up to 1,640 feet away (Thomson et al. 2016:299).

Northwestern pond turtles are active year-round in warmer locations but will spend winter months in colder climates in a state of dormancy, often burrowing into loose soil or leaf litter on land, or using undercut banks, snags, rocks or bottom mud in ponds (Thomson et al. 2016:299–300). Breeding occurs from spring through fall, with nesting taking place from spring to early summer. Females lay 1 to 13 eggs, which will hatch in the fall, although the young will remain in the nest until the following spring (Thomson et al. 2016:299).

### 4.4.22.3 Status of the Species in the Action Area

The entire action area falls within the range of northwestern pond turtle where suitable habitat exists. The action area overlaps with the Bay Delta and Nevada analysis unit and the San Joaquin Valley analysis unit identified in the Species Status Assessment (U.S. Fish and Wildlife Service 2023c:34). Each of these basins includes an extant population of northwestern pond turtle. There are numerous CNDDB records of northwestern pond turtle throughout the action area (California Department of Fish and Wildlife 2020a).

### 4.4.22.4 Impacts from Past and Present Actions

Development and agricultural actions such as the CVP, SWP, and the Central Valley Flood Protection Plan have resulted in habitat loss and fragmentation for northwestern pond turtle. These projects have resulted in altered hydrology (including dams), increased predation from introduced and native species, competition from nonnative species and road mortality (U.S. Fish and Wildlife Service 2023c:41).

### 4.4.22.5 Critical Habitat

Critical habitat has not been designated for northwestern pond turtle.

### 4.4.22.6 Suitable Habitat Definition

As described above in Section 4.4.22.2, *Life History and Habitat Requirements*, suitable habitat for northwestern pond turtle includes aquatic habitat consisting of aquatic habitat with standing or slow-moving water and adjacent basking sites, upland nesting habitat with sparse vegetation, and upland overwintering/aestivation habitat. This definition is consistent with the USFWS's 2023 Species Status Assessment (U.S. Fish and Wildlife Service 2023c:28-30). The areas of suitable habitat in the action area are limited to those areas described in Section 4.4.22.7, *Habitat Suitability Model*.

### 4.4.22.7 Habitat Suitability Model

The habitat model for northwestern pond turtle includes both aquatic and upland habitats. The modeled aquatic habitat relies on both delineation data that were collected for a smaller portion of the study area, in what is called the delineation study area, and suitable habitats found in the datasets outside the delineation study area. The modeled upland habitat includes suitable habitats

within 650 feet of modeled aquatic habitat, which are intended to include areas where most pond turtles may feed, reproduce, and overwinter. This distance was chosen as an intermediate distance between the 300-foot distance from where turtles typically are found nesting and the greatest distance observed of 1,640 feet reported in Section 4.4.22.2. This distance would likely be protective of the majority of turtles nesting in the study area and also takes into consideration the limitations of suitable habitat beyond that distance in the Delta, where most of the aquatic habitat is adjacent to agricultural areas, which are generally not suitable for breeding due to ongoing disturbance. The extent of modeled habitat in the study area is depicted in Figure 6.14-1.

## Geographic Limits

The model boundary includes the entire study area, based on the species distribution described in Stebbins and McGinnis (2012:431) and Thomson et al. (2016:300).

## Additional Model Parameters

### Aquatic Habitat Model

#### *Inside the Delineation Study Area*

Modeled habitat includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Tidal perennial aquatic
  - Tidal channel
  - Natural channel
- Nontidal perennial aquatic
  - Depression
  - Natural channel
- Agricultural
  - Agricultural ditch
- Tidal freshwater emergent wetland
  - Freshwater emergent wetland
- Nontidal freshwater perennial emergent wetland
- Freshwater emergent wetland

#### *Outside the Delineation Study Area*

Modeled habitat includes the following types from the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019) and the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Tidal freshwater emergent wetland
  - *Lepidium latifolium*

  - *Phragmites australis—Arundo donax*
  - *Schoenoplectus (acutus, californicus)*
  - *Schoenoplectus americanus*
  - *Typha (angustifolia, domingensis, latifolia)*
  - Arid west freshwater emergent marsh
- Nontidal freshwater perennial emergent wetland
  - *Lepidium latifolium*
  - *Phragmites australis—Arundo donax*
  - *Schoenoplectus (acutus, californicus)*
  - *Schoenoplectus americanus*
  - *Typha (angustifolia, domingensis, latifolia)*
  - Arid west freshwater emergent marsh
  - Naturalized warm-temperate riparian and wetland group
- Tidal brackish emergent wetland
  - *Bolboschoenus maritimus*
  - *Lepidium latifolium*
  - *Phragmites australis—Arundo donax*
  - *Sarcocornia pacifica (Salicornia depressa)*
  - *Schoenoplectus (acutus, californicus)*
  - *Typha (angustifolia, domingensis, latifolia)*
  - Arid west freshwater emergent marsh
- Nontidal brackish emergent wetland
  - *Bolboschoenus maritimus*
  - *Lepidium latifolium*
  - *Phragmites australis—Arundo donax*
  - *Sarcocornia pacifica (Salicornia depressa)*
  - *Schoenoplectus (acutus, californicus)*
  - *Typha (angustifolia, domingensis, latifolia)*
  - Arid west freshwater emergent marsh
- Tidal perennial aquatic
  - All types, except conveyance channels west of Byron Highway.
- Nontidal perennial aquatic
  - All types, except conveyance channels.

Modeled habitat also includes the following types from the National Hydrography Dataset (U.S. Geological Survey 2020).

- Ditches

**Upland Habitat Model**

Modeled habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018).

- Grassland
  - All types
- Valley foothill riparian
  - All types
- Alkaline seasonal wetland complex
  - All types

Modeled habitat includes the following types from the DCP Vernal Pool Complex dataset (Witham et al. 2014; Chico State Research Foundation, Geographical Information Center 2019; California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Vernal pool complex
  - All types

Modeled habitat also includes the following type from the Delta 2017 Land Use Survey (Land IQ 2019), the Draft San Joaquin County 2017 Land Use Survey (California Department of Water Resources 2020b), and the Sacramento County 2015 Land Use Survey (California Department of Water Resources 2016).

- Agricultural
  - Upland herbaceous

# 4.4.23 Western Spadefoot

## 4.4.23.1 Geographic Distribution and Status

Western spadefoot is proposed for listing as threatened under the ESA (88 FR 84252) and is a CDFW Species of Special Concern (U. S. Fish and Wildlife Service 2023b; California Department of Fish and Wildlife 2020b:42). Critical habitat has not yet been designated and no recovery plan has been developed for western spadefoot.

The western spadefoot is found throughout the Central Valley and coastal lowlands from Shasta County in Northern California to Baja California in Mexico, at elevations ranging from sea level to 4,500 feet (Jennings and Hayes 1994:94; Stebbins and McGinnis 2012:157). The action area is within the range of western spadefoot as depicted in Thomson et al. (2016:131), but there are no records of

extant western spadefoot in the action area (California Department of Fish and Wildlife 2024a; 2020a). There is one possibly extirpated occurrence of western spadefoot (from 1922) reported along SR 4, southwest of Stockton (California Department of Fish and Wildlife 2024a).

#### 4.4.23.2 Life History and Habitat Requirements

This species occurs in grasslands, mixed woodland, open chaparral, and pine oak woodlands, with shallow temporary pools or washes. Adults remain in underground burrows for most of the year and typically make movements on rainy nights (California Department of Fish and Game 2000). On land, movement is generally thought to be nocturnal, with adults in Southern California moving as much as 860 feet between burrows and breeding ponds (Baumberger et al. 2019:6). Juveniles and adults are able to dig burrows 8 inches deep (Thomson et al. 2016:133), but will also make use of existing mammal burrows, and may have a preference for burrowing in or adjacent to existing small mammal burrows (Baumberger et al. 2019:12). Breeding occurs in temporary pools and drainages, although breeding can also occur in human-made water sources such as cattle ponds (Thomson et al. 2016:133).

Breeding coincides with the rainy season and varies depending on rainfall and region (Thomson et al. 2016:132). Eggs are laid in clusters and usually hatch in 3 to 4 days, with the average larval period reported to last 58 days (Thomson et al. 2016:132). Juveniles leave natal ponds shortly after metamorphosis from April to June (Thomson et al. 2016:133).

#### 4.4.23.3 Status of the Species in the Action Area

The entire action area falls within the range of western spadefoot. The action area overlaps with the following western spadefoot regions identified in the Species Status Assessment (U.S. Fish and Wildlife Service 2023d:39): Southeastern Sacramento Valley, San Joaquin Valley, Solano-Colusa, and Livermore. There are no CNDDB records of western spadefoot in the action area (California Department of Fish and Wildlife 2020a).

#### 4.4.23.4 Impacts from Past and Present Actions

Development, agriculture, and water projects (e.g., CVP, SWP, and South Bay Aqueduct) are the primary drivers of habitat loss and fragmentation in the action area. Overabundance of vegetation in vernal pool habitat, nonnative predators, drought, chemical contaminants, noise disturbance, disease, and effects of climate change are also known stressors to western spadefoot (U.S. Fish and Wildlife Service 2023d:22).

#### 4.4.23.5 Critical Habitat

Critical habitat has not been designated for western spadefoot.

#### 4.4.23.6 Suitable Habitat Definition

As described above in Section 4.4.23.2, *Life History and Habitat Requirements*, suitable habitat for western spadefoot includes aquatic breeding habitat consisting of vernal pools and other wetlands, upland habitat with grassland cover for feeding and construction of burrows, and upland dispersal habitat. This definition is consistent with the USFWS's 2023 Species Status Assessment (U.S. Fish and Wildlife Service 2023d:11). The areas of suitable habitat in the action area are limited to those areas described in Section 4.4.23.7, *Habitat Suitability Model*.

### 4.4.23.7 Habitat Suitability Model

The habitat model for western spadefoot includes both aquatic and upland habitats. The modeled aquatic habitat relies on both delineation data that were collected for a smaller portion of the study area, in what is called the delineation study area, and suitable wetland habitats found in the datasets outside the delineation study area. The modeled upland habitat includes suitable habitats within 1,200 feet of modeled aquatic habitat. While it is not known how far western spadefoot may range from aquatic habitat into upland habitat, research suggests that upland habitat, on average, falls within 1,207 feet of aquatic habitat (U.S. Fish and Wildlife Service 2005:II-231; Baumberger et al. 2019:10). The extent of modeled habitat in the study area is depicted in Figure 6.15-1.

#### Geographic Limits

The model boundary includes the entire action area based on the species distribution described in Thomson et al. (2016:131).

#### Additional Model Parameters

##### Aquatic Breeding Habitat Model

***Inside the Delineation Study Area***

Modeled habitat includes the following types from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020c, 2021).

- Vernal pool complex
  - Vernal pool
- Nontidal perennial aquatic
  - Depression

Some of the mapped depressions in the interior Delta were excluded from the model because, based on aerial reviews, they either lacked supporting uplands, appeared to be heavily managed wetlands, and/or were perennial.

***Outside the Delineation Study Area***

Modeled habitat includes the following types from the Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018), the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and the Great Valley Vernal Pool Data (Witham et al. 2014).

- Vernal pool complex
  - *Distichlis spicata*
  - California annual herb/grass group
  - Californian mixed annual/perennial freshwater vernal pool/swale bottomland
  - Mediterranean California naturalized annual and perennial grassland
- Nontidal perennial aquatic

- Water

**Upland Habitat Model**

***Inside the Delineation Study Area***

Modeled habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018), Great Valley Vernal Pool Data (Witham et al. 2014), and the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019).

- Grassland
  - All types
- Alkaline seasonal wetland complex
  - *Distchlis spicata*
- Vernal pool complex
  - All types

***Outside the Delineation Study Area***

Modeled habitat includes the following types from the Sand Hill Wind Repowering SEIR Land Cover Dataset (ICF 2018), East Bay RCIS 2017 Land Cover Dataset (ICF 2017a), Great Valley Ecoregion 2018 Vegetation Dataset (Chico State Research Foundation, Geographical Information Center 2018) and the Delta Vegetation and Land Use Update (Chico State Research Foundation, Geographical Information Center 2019), and the Great Valley Vernal Pool Data (Witham et al. 2014).

- Grassland
  - All types
- Alkaline seasonal wetland complex
  - *Distchlis spicata*
- Vernal pool complex
  - *Allenrolfea occidentalis*
  - *Suaeda moquinii*

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## 4.5.2 Personal Communications

Whisler, Edward. Biologist, EcoAnalysts Inc. July 13, 2015—email to Ellen Berryman, Technical Director, ICF, regarding survey effort and results for least Bell's vireo in the Yolo Bypass. ICF, Sacramento, CA.

Wunderlich, Veronica. Senior Environmental Scientist, DWR. January 12, 2024 – email to Danika Tsao, Senior Wildlife Biologist, ICF regarding giant garter snake occurrence from Jersey Island. ICF, Sacramento, CA.

Chapter 5

# Effects Analysis for Chinook Salmon, California Central Valley Steelhead, Green Sturgeon, and Killer Whale

## 5.1 Introduction

The potential effects of the proposed action on species under National Marine Fisheries Service (NMFS) jurisdiction are evaluated in this chapter. Those species include the following.

- Chinook salmon (*Oncorhynchus tshawytscha*), Sacramento River winter-run evolutionarily significant unit (ESU)
- Chinook salmon, Central Valley spring-run ESU[1]
- Chinook salmon, Central Valley fall-/late fall–run ESU
- Steelhead (*Oncorhynchus mykiss*), California Central Valley distinct population segment (DPS)
- Green sturgeon (*Acipenser medirostris*), Southern DPS
- Killer whale (*Orcinus orca*), Southern Resident DPS

These species are evaluated with regard to the effects of the proposed action: that is, water facility construction, facility maintenance, water facility operations, conservation measures, monitoring activities, and cumulative effects. To provide a full context of the proposed action, operational components are included in Chapter 3, *Description of the Proposed Action,* and are assessed as part of the effects analysis. Proposed operations of the proposed action are described in Appendix 7A, *Framework Programmatic Assessment for the Delta Conveyance Project and Sites Reservoir Project*. Proposed operations for the Delta Conveyance Project are included in this biological assessment (BA) to support assessment of the project as a whole. Although the operations and maintenance are assessed at a programmatic level for the BA, detailed effects analyses and the qualitative, cumulative, programmatic analysis that it informs are presented in Appendix 5C, *Operations and Maintenance Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale.* To provide the full scope of the proposed action, this chapter includes details related to construction, operations, and maintenance.

Effects on southern resident killer whale are addressed qualitatively within its own section because killer whales occur outside the Sacramento–San Joaquin Delta (Delta) and would not be exposed to the direct effects of the proposed action. Although not listed under the state or federal Endangered Species Acts, the fall-run/late fall–run Chinook salmon ESU is considered because it is the highest abundance Chinook salmon ESU from the Central Valley and, therefore, is important for potential indirect effects on killer whales as a food source, as well as for the essential fish habitat (EFH) assessment for Pacific salmon.

[1] As described in Section 4.4.2, *Chinook Salmon*, *Central Valley Spring-Run ESU*, of Chapter 4, this effects analysis includes consideration of effects in the Delta to both San Joaquin River spring-run Chinook salmon, which are considered to represent both the experimental, non-essential population reintroduced as part of the San Joaquin River Restoration Program and spring-running Chinook salmon observed in San Joaquin River tributaries in recent years.

This chapter also provides an analysis of effects on critical habitat for winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon (Section 5.5, *Effects of Water Facility Construction on Designated Critical Habitat*). For these four species, designated critical habitat is present in the Delta and adjacent areas. The analysis includes potential effects on the physical or biological features (PBFs)[2] of critical habitat for each species, as necessary. During the proposed 13 years of construction (Chapter 3, *Description of the Proposed Action*, Section 3.2.9, *Construction Schedule*), the fish species analyzed as part of this BA) would be in the vicinity of these activities. However, as a part of the Conservation Measures (Chapter 3, Section 3.6, *Conservation Measures*), potential effects related to active construction would be addressed. Section 5.2, *Temporal Occurrence*, and Section 5.3, *Spatial Occurrence*, give an overview of the potential exposure of these species in relation to the proposed action's construction.

The action area also occurs in designated EFH under the Magnuson–Stevens Fishery Conservation and Management Act for species in this Effects Analysis. This includes the four runs of Central Valley Chinook salmon and is described in further detail in Appendix 5A, *Essential Fish Habitat Assessment*. This assessment describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects resulting from the proposed action on EFH.

Figure 5.1-1 illustrates the location in the Delta of the proposed Intakes B and C and the bridge construction at Burns Cutoff and Snodgrass Slough. Additional environmental baseline information for each of these species is located in Chapter 4, *Action Area and Environmental Baseline*.

[2] The designations of critical habitat for listed species generally have used the term *primary constituent elements* (PCEs). NMFS and USFWS issued a final rule amending the regulations for designating critical habitat (81 *Federal Register* [FR] 7414, February 11, 2016), which replaced the term PCEs with PBFs. In addition, NMFS and USFWS issued a final rule revising the regulatory definition of *destruction or adverse modification* of critical habitat (81 FR 7214, February 11, 2016), which refers to PBFs, not PCEs. The shift in terminology does not change the approach used in conducting an analysis of the effects of the proposed action on critical habitat, which is the same regardless of whether the original designation identified PCEs or PBFs. In this BA, the term PBFs includes PCEs, as appropriate for the specific critical habitat.

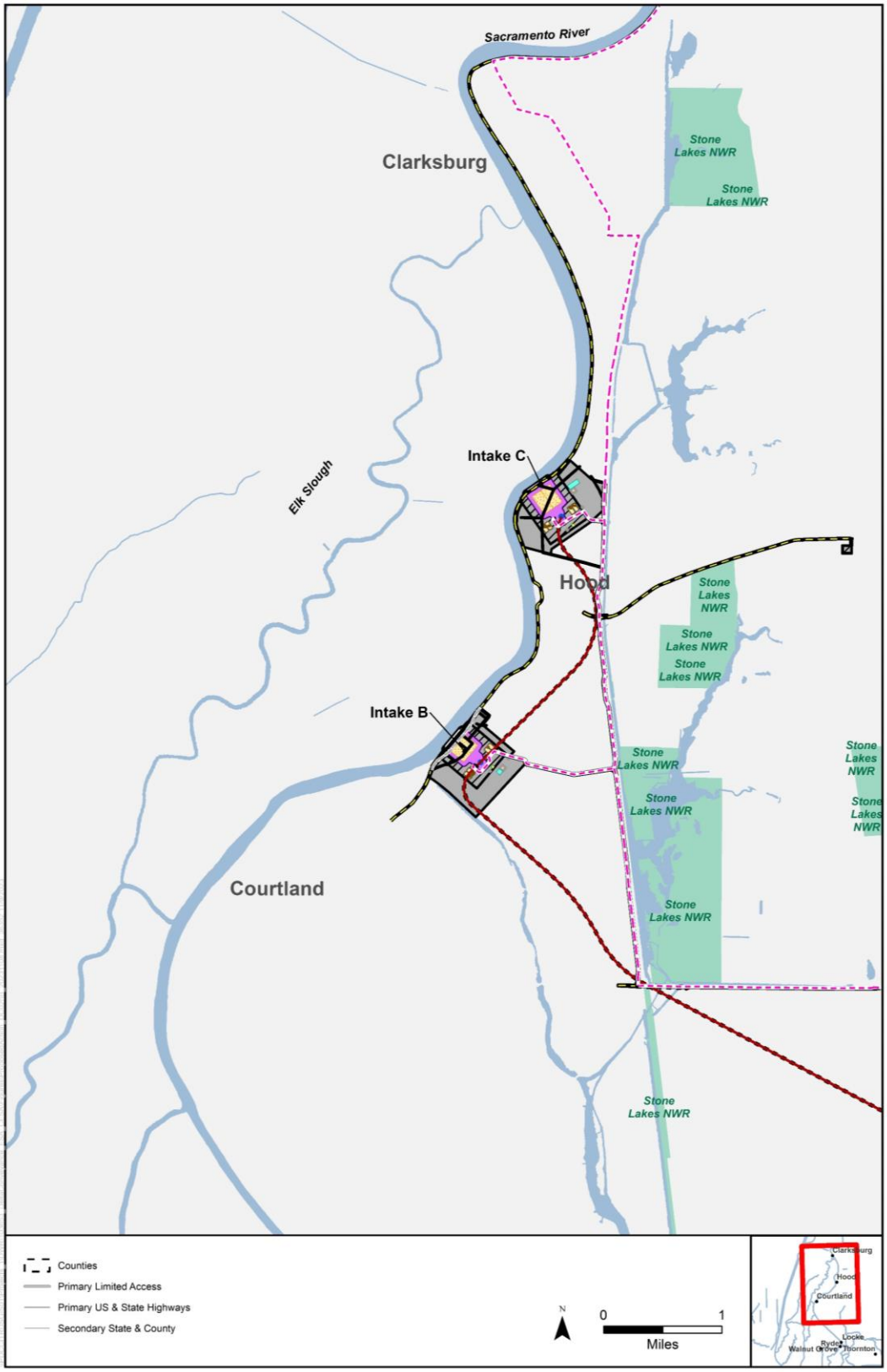


**Figure 5.1-1. Location of Intakes B and C**

# 5.2 Temporal Occurrence

## 5.2.1 Chinook Salmon, Sacramento River Winter-Run ESU

Adult Sacramento River winter-run Chinook salmon enter the San Francisco Bay in November (Table 4.4.1-1) to begin their spawning migration and continue upstream from December through early August to the extent of anadromy at the base of Keswick Dam. Upstream holding may last for a period of up to eight months (Windell et al. 2017:32). Winter-run Chinook salmon spawn in the upper mainstem Sacramento River from mid-April through August, peaking in June and July. All known winter-run Chinook salmon production currently occurs either in the mainstem Sacramento River or Livingston Stone National Fish Hatchery (California Department of Fish and Game 2004), although a nascent reintroduction effort in Battle Creek led to the return of at least 700 subadults and adults in 2020 (U.S. Fish and Wildlife Service 2020). Current spawning is confined to the mainstem of the Sacramento River above Red Bluff Diversion Dam (River Mile [RM] 243) and below Keswick Dam (RM 302) (National Marine Fisheries Service 2014b), with access to historical habitat in upper Sacramento River tributaries no longer available. Until recent years, salmon passage was not possible above the Coleman Hatchery barrier weir located on Battle Creek. Windell et al. (2017:6–8) reviewed habitat characteristics and factors affecting egg survival. Following spawning, fry and juvenile downstream movement begins in July/August, as shown by monitoring at Red Bluff.

The majority of emigrating juvenile winter-run Chinook salmon from the upper Sacramento River enters the Delta in December and January and can extend through April (Tables 4.4.1-2, 4.4.1-2a, and 4.4.1-2b), depending on the water year type. Beach seines and mid-water trawls on the mainstem Sacramento River, near the City of Sacramento, indicate that some fish enter the Delta as early as September in some years (U.S. Fish and Wildlife Service 2001, 2003). USFWS monitoring at Chipps Island in the western Delta indicates that winter-run Chinook salmon are detected leaving the Delta from September through June, with a peak in emigration occurring in March and April (Table 4.4.1-1). This peak in emigration timing is supported by the pattern of recoveries of winter-run-sized Chinook salmon at the State Water Project's (SWP's) John E. Skinner Delta Fish Protective Facility and the Central Valley Project's (CVP's) Tracy Fish Collection Facility in the south Delta (Tables 4.4.1-2, 4.4.1-2a, and 4.4.1-2b). A pattern of greatest temporal occurrence in the west Delta during January through April is indicated by genetic identification of winter-run Chinook juveniles caught at Chipps Island (Pyper et al. 2013), with this pattern generally also seen in salvage of genetically identified winter-run Chinook juveniles at the south Delta export facilities (Harvey et al. 2014).

Juveniles have also been found to rear in areas such as the lower American River, lower Feather River, Battle Creek, Mill Creek, Deer Creek, and the Delta (Phillis et al. 2018). Phillis et al. (2018) found with isotope data that 44% to 65% of surviving adults reared in nonnatal habitats as juveniles. The lower reaches of the Sacramento River, the Delta, and San Francisco Bay serve as migration corridors for both smolts and adults and are thought to serve as juvenile rearing habitat. Juvenile winter-run Chinook salmon begin to enter the Delta in October and smolt outmigration continues until April. Timing of movement of large portions of the juvenile population into the Delta is thought to be strongly correlated with winter rain events that result in pulse flows in the Sacramento River, resulting in variability between years depending on storm timing (del Rosario et al. 2013). There is later movement downstream of other juveniles from upstream rearing habitat, such as those described above (Phillis et al. 2018), so there is little variability in overall Delta exit as shown in trawling at Chipps Island (del Rosario et al. 2013). Fry and smolts are known to use the

San Francisco Estuary as rearing habitat before entering the ocean (Sturrock et al. 2015). In addition to monitoring salvage of winter-run Chinook salmon at the Tracy Fish Collection Facility and the John E. Skinner Delta Fish Protective Facility in the south Delta, temporal occurrence of each life stage in the action area is monitored using screw trapping data in the rivers, trawls, and beach seines in the estuary and, more recently, acoustic tagging using a network of receivers located throughout the extent of their range, from Keswick Dam to the Golden Gate Bridge (e.g., Klimley et al. 2017).Chinook Salmon, Central Valley Spring-Run Evolutionarily Significant Unit

Adult spring-run Chinook salmon enter the San Francisco Bay Estuary from the ocean from January to June, with a peak from February to April (Table 4.4.2-1), moving through the Delta prior to entering the Sacramento River system. The peak of young-of-year spring-run presence in the Delta is during the month of April, as indicated by the recoveries of spring-run-sized fish in the SWP and CVP salvage operations and the Chipps Island trawls (Tables 4.4.2-2, 4.4.2-2a, and 4.4.2-2b). Spring-run Chinook salmon young-of-year spring-run outmigration and fall-run Chinook salmon young-of-year outmigration overlap due to the similarity in their spawning and emergence times. The overlap of these two runs makes for an extended pulse of Chinook salmon smolts through the Delta each spring, frequently lasting into June. This broad period of juvenile outmigration helps the species adapt to variable conditions in the ocean that can affect individuals differentially, depending on when they enter the ocean (Johnson 2015). Therefore, the tail ends of the migratory periods of each species are important to species viability, even though the abundance of the juveniles at the extreme ends of the migration periods is small. As a result, this effects analysis evaluates effects of the proposed action during the entire period of spring-run Chinook salmon occurrence in the Delta (e.g., Tables 4.4.2-2, 4.4.2-2a, and 4.4.2-2b). Yearling juvenile spring-run Chinook salmon migration through the Delta occurs primarily in December and continues to May. For the purposes of this effects analysis, the timing for the San Joaquin River-basin spring-run Chinook salmon (including the spring-run Chinook salmon from the tributaries, discussed below) is assumed to be similar to that of the Sacramento River Basin populations. Studies to date show that juvenile spring-run Chinook salmon captured in rotary screw traps in the San Joaquin River at various locations are captured from November to January and late February to early May (National Marine Fisheries Service 2022).

## 5.2.2 Fall-Run/Late Fall–Run Chinook Salmon, Central Valley ESU

### 5.2.2.1 Central Valley Fall-Run Chinook Salmon

In the Sacramento River, adult fall-run Chinook salmon migrate upstream to spawn primarily during July through December, with a peak from October to December (Tables 4.4.3-1, 4.4.3-1a, and 4.4.3-1b).

Fall-run Chinook salmon fry (i.e., juveniles shorter than 2 inches long) in the Sacramento River generally emerge from December through March, with peak emergence occurring by the end of January. In general, fall-run Chinook salmon fry abundance in the Delta increases following high winter flows. Most fall-run Chinook salmon fry rear in fresh water from December through June, with emigration occurring from December through June and a peak from January through May (Tables 4.4.3-1, 4.4.3-1a, and 4.4.3-1b). Smolts that arrive in the estuary after rearing upstream migrate quickly through the Delta and Suisun and San Pablo Bays.

#### 5.2.2.2 Central Valley Late Fall–Run Chinook Salmon

Adult late fall–run Chinook salmon migrate upstream primarily during October through April (Tables 4.4.3-2, 4.4.3-2a, and 4.4.3-2b). Late fall–run Chinook salmon fry generally emerge from March through June. Late fall–run fry rear upstream year-round (Tables 4.4.3-2, 4.4.3-2a, and 4.4.3-2b) and emigrate as smolts from October through June.

### 5.2.3 Steelhead, California Central Valley DPS

Adult steelhead have the potential to be found within the Delta during much of the year, although the primary period of occurrence is late summer/fall/winter (Tables 4.4.4-2, 4.4.4-2a, and 4.4.4-2b). Unlike Chinook salmon, steelhead can spawn more than once, so post-spawn adults (typically females) have the potential to move back downstream through the Delta after completing their spawning in their natal streams. These fish are termed *runbacks* or *kelts*. Typically, adult steelhead moving into the Sacramento River Basin begin to enter the Delta during mid to late summer, with fish entering the Sacramento River system from July to early September (Table 4.4.4-1). Kelts typically are seen later in the spring, following spawning. Steelhead entering the San Joaquin River Basin are believed to have a later spawning run. Adults enter the system starting in July through March, indicating presence in the Delta a few weeks earlier (Table 4.4.4-1).

Juvenile steelhead are recovered in the USFWS Chipps Island trawls from late November through July. There appears to be a difference in the emigration timing between wild and hatchery-reared steelhead smolts. Adipose fin-clipped hatchery fish typically are recovered at Chipps Island from December through May, with the peak in recoveries occurring in February. This time period corresponds to the schedule of hatchery releases of steelhead smolts from the different Central Valley hatcheries (Nobriga and Cadrett 2001). The timing of wild steelhead (i.e., unclipped) emigration is more spread out. Emigration occurs over approximately 8 months, starting in late November and extending to July, with peaks from March to May, based on Chipps Island trawl data (Tables 4.4.4-2, 4.4.4-2a, and 4.4.4-2b). Juvenile salvage in the Delta starts in November and continues into June. The size of emigrating steelhead smolts typically ranges from 200 to 250 millimeter long, with wild fish tending to be at the upper end of this range (Nobriga and Cadrett 2001). The broad period of juvenile outmigration helps the species adapt to variable conditions in the ocean that can affect individuals differentially, depending on when they enter the ocean (Johnson 2015). Therefore, the tail ends of the migratory periods of each species are important to species viability, even though the abundance of the juveniles at the extreme ends of the migration periods is small. As a result, this effects analysis evaluates effects of the proposed action during the entire period of steelhead occurrence in the Delta.

### 5.2.4 Green Sturgeon, Southern DPS

Adult green sturgeon generally enter the San Francisco Bay estuary in early winter (January/February) (Table 4.4.5-1) before initiating their upstream spawning migration into the Delta. Adults move through the Delta from February through April,[3] arriving in the upper Sacramento River between April and June (Heublein 2006; Kelly et al. 2007). Following their initial spawning run upriver, adults may hold for a few weeks to months in the upper river (i.e., Glenn–

[3] This is consistent with the life history presented in a recent review by Klimley et al. (2015), whose Figure 1 showed upstream migration in March and April.

Colusa Irrigation District aggregation site; see Vogel 2005, 2008b) or immediately migrate back down river to the Delta. Those fish that hold upriver move back downstream later in the fall, during the first rains, per the review by Klimley et al. (2015). Recent evaluation of adult migration timing from acoustic telemetry studies during 2007–2017 by Colborne et al. (2022) found mean upstream migration dates in March and April (range February–June) and outmigration consisting of early migrants (generally May–June) and late migrants (November–January), with river discharge apparently cuing downstream migration. This is similar to behavior exhibited by adult green sturgeons on the Rogue and Klamath River systems (Erickson et al. 2002; Benson et al. 2007). Klimley et al. (2015:1-2) noted, "The southern DPS green sturgeon migrates in the spring to spawn in the Sacramento River and returns to the estuary in the fall, winter, and spring," suggesting that adults can be found in the Delta and estuary for much of the year. Acoustic telemetry studies by Miller et al. (2020) found that adult green sturgeon primarily used the mainstem Sacramento River for downstream migration, whereas for upstream migration, a similar proportion used the mainstem Sacramento River (46%) as the north Delta sloughs (Miner/Sutter Slough: 32%; Steamboat Slough: 13%).

Juveniles are believed to use the Delta for rearing for the first 1 to 3 years of their life before moving out to the ocean (Table 4.4.5-2). The greatest number of acoustically tagged juveniles was detected in the central Delta, whereas relatively few were detected in the mainstem Sacramento River and very few were detected in the north Delta sloughs (Miller et al. 2020). Juveniles are recovered at the SWP and CVP fish collection facilities year-round (Table 4.4.5-2).

# 5.3 Spatial Occurrence

Spatial occurrence is discussed below for winter-, spring-, and fall-/late fall–run Chinook salmon, California Central Valley steelhead, and green sturgeon.

## 5.3.1 Chinook Salmon, Sacramento River Winter-Run ESU

Based on studies of acoustically tagged fall-run Chinook salmon (Stein and Cuetara 2004), the main adult winter-run migration route through the Delta region may be the mainstem of the Sacramento River, with some migration also occurring in north Delta channels, as well as central Delta pathways, such as the lower San Joaquin River. Juvenile winter-run are present in the waterways of the north Delta (i.e., Sacramento River, Steamboat Slough, Sutter Slough, Miner Slough, and Cache Slough complex), central Delta (Georgiana Slough, Delta Cross Channel, Snodgrass Slough, and Mokelumne River complex below Dead Horse Island), south Delta leading to the SWP and CVP pumping facilities, including Old and Middle Rivers, and the interconnecting waterways between these main channels, such as Victoria Canal, Woodward Canal, and Connection Slough, and the western Delta, including the main channels of the San Joaquin and Sacramento Rivers and Three Mile Slough. Abundance tends to be greatest in the north Delta, reflecting presence of the ESU's only spawning population in the Sacramento River Basin and the main pathways through the Delta (Figure 5.3-1).

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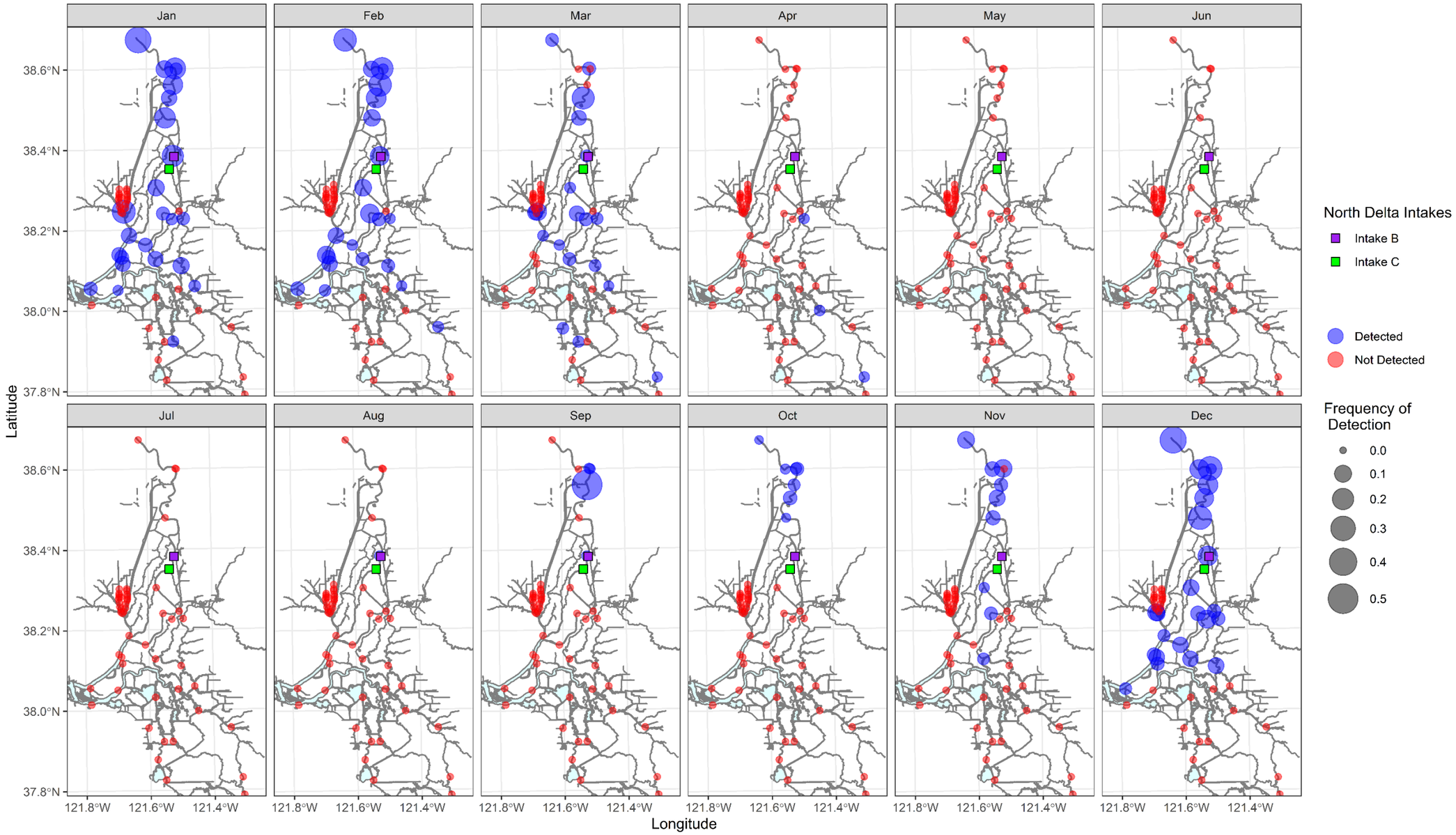


Source: Interagency Ecological Program et al. 202). Note: Chinook salmon race determined by length-at-date criteria, which may result in misclassification relative to genetic identity (Brandes et al. 2021).

**Figure 5.3-1. Frequency of Detection (Proportion of Samples) of Winter-Run Chinook Salmon by the Delta Juvenile Fish Monitoring Program's Beach Seine Sampling, 2000–2020.**

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### 5.3.2 Chinook Salmon, Central Valley Spring-Run ESU

As discussed for winter-run Chinook salmon, based on studies of acoustically tagged fall-run Chinook salmon (Stein and Cuetara 2004), the main adult spring-run migration route through the Delta region may be the mainstem of the Sacramento River, with some migration also occurring in north Delta channels, as well as central Delta pathways, such as the San Joaquin River. San Joaquin River-basin spring-run Chinook salmon presumably use the San Joaquin River as their main migration pathway through the Delta, both as juveniles (Cavallo et al. 2015) and adults, although, for juveniles, migration through the Old River pathway, including the fish-salvage facilities, also occurs (National Marine Fisheries Service 2022).

Juvenile Sacramento River Basin spring-run Chinook salmon are present in the same waterways as winter-run Chinook salmon in the north Delta, central Delta, south Delta, and the interconnecting waterways, including the main channels of the San Joaquin and Sacramento Rivers and Three Mile Slough. Abundance tends to be greatest in the north Delta, reflecting presence of the ESU's independent populations in the Sacramento River Basin and the main pathways through the Delta (Figure 5.3-2[4]).

[4] Presence of individuals in the San Joaquin River near the Head of Old River shown in Figure 5.3-2 is likely to be mostly genetic fall-run Chinook salmon classified as spring-run Chinook salmon based on length-at-date criteria (Brandes et al. 2021).

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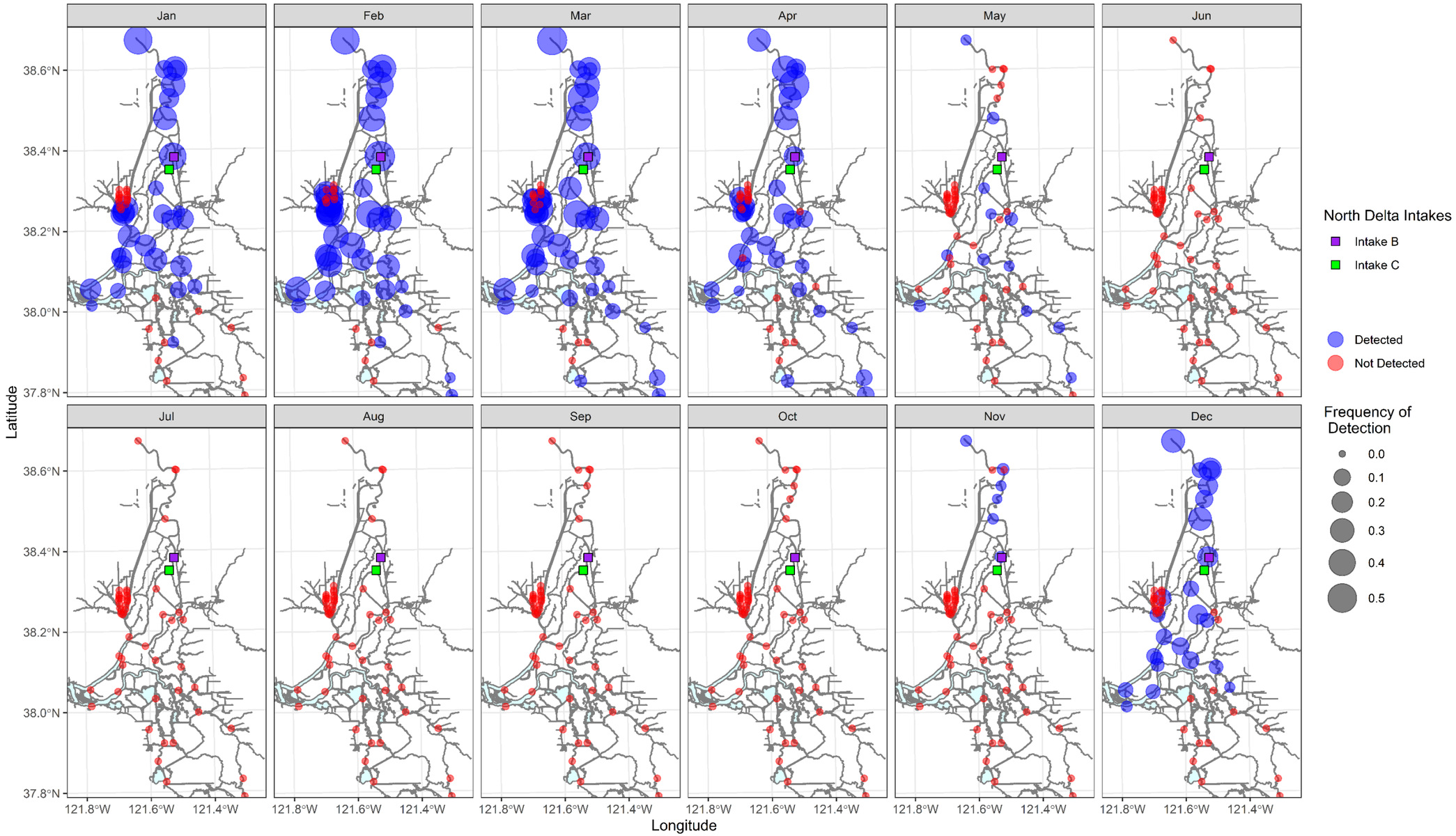


Source: Interagency Ecological Program et al. 2021. Note: Chinook salmon race determined by length-at-date criteria, which may result in misclassification relative to genetic identity (Brandes et al. 2021).

**Figure 5.3-2. Frequency of Detection (Proportion of Samples) of Spring-Run Chinook Salmon by the Delta Juvenile Fish Monitoring Program's Beach Seine Sampling, 2000–2020.**

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### 5.3.3 Fall-Run/Late Fall–Run Chinook Salmon, Central Valley ESU

The distribution of fall-run and late fall–run Chinook salmon is generally similar to that of winter-run and spring-run Chinook salmon described above. As with the other runs, juveniles tend to be more frequently occurring in the north Delta, whereas for fall-run Chinook salmon there is also appreciable occurrence in the south Delta, likely reflecting the contribution from San Joaquin River Basin populations (Figure 5.3-3 and Figure 5.3-4).

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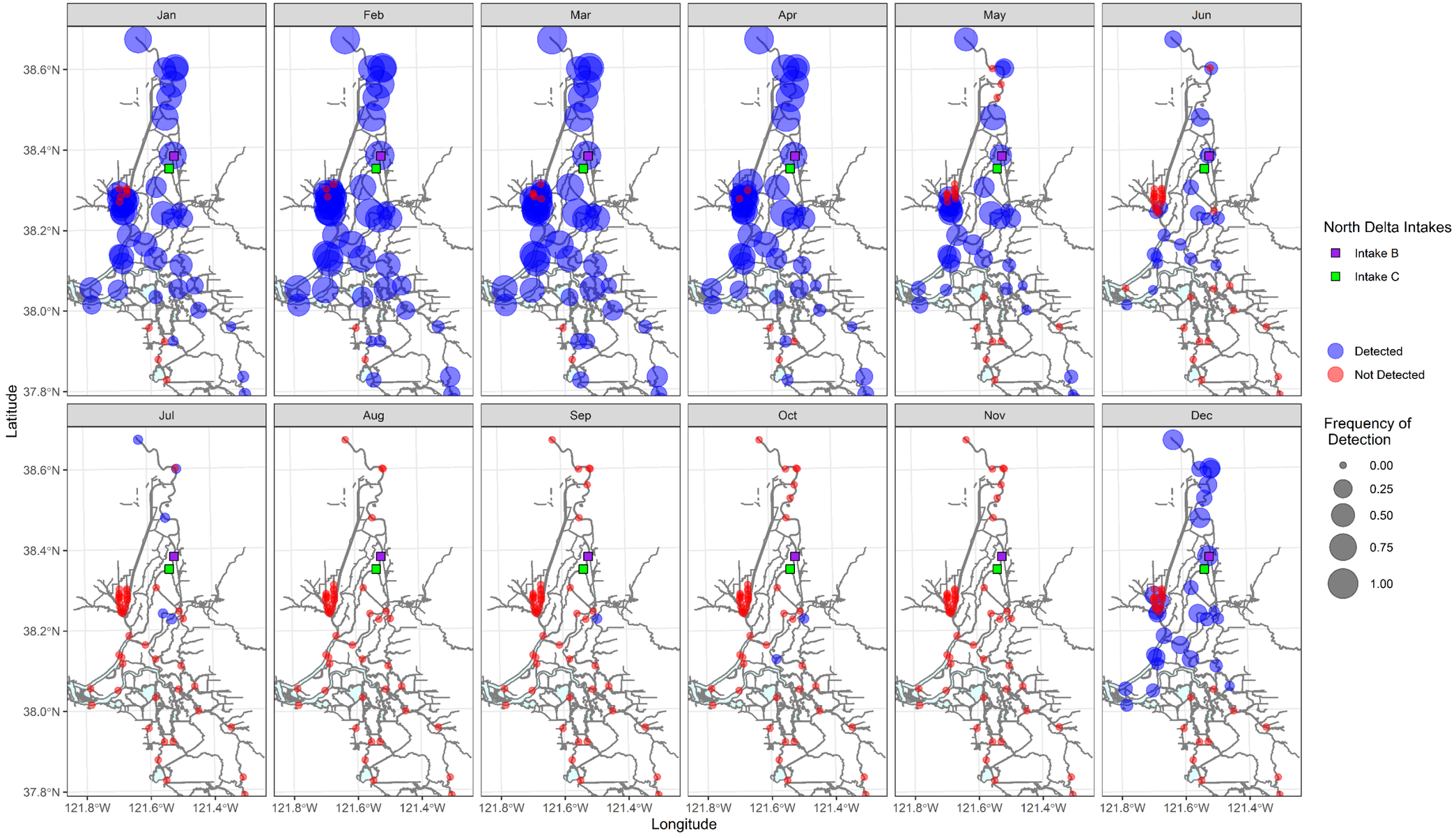
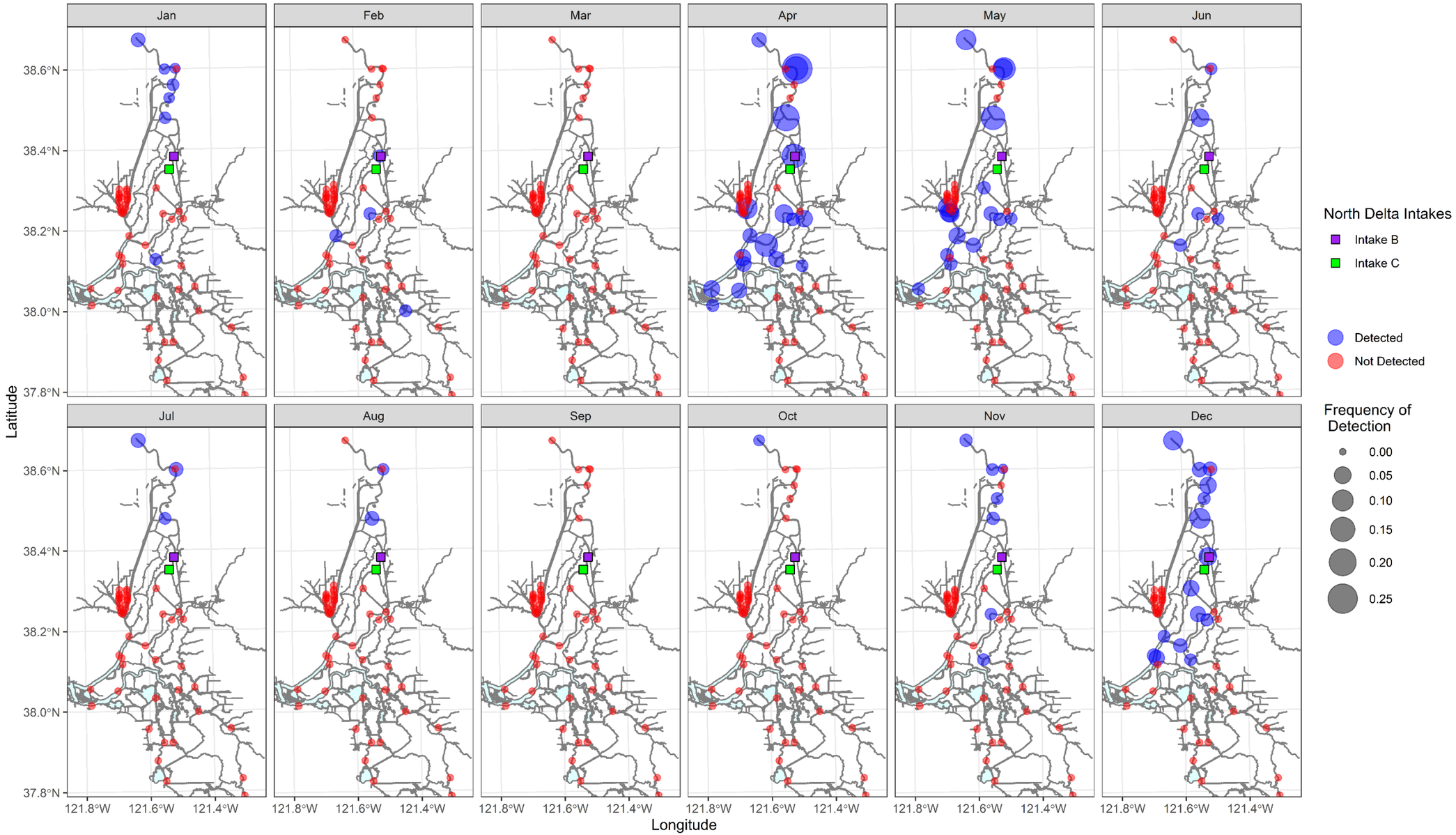



Source: Interagency Ecological Program et al. 2021. Note: Chinook salmon race determined by length-at-date criteria, which may result in misclassification relative to genetic identity (Brandes et al. 2021).

**Figure 5.3-3. Frequency of Detection (Proportion of Samples) of Fall-Run Chinook Salmon by the Delta Juvenile Fish Monitoring Program's Beach Seine Sampling, 2000–2020.**




Source: Interagency Ecological Program et al. 2021. Note: Chinook salmon race determined by length-at-date criteria, which may result in misclassification relative to genetic identity (Brandes et al. 2021).

**Figure 5.3-4. Frequency of Detection (Proportion of Samples) of Late Fall-Run Chinook Salmon by the Delta Juvenile Fish Monitoring Program's Beach Seine Sampling, 2000–2020.**

### 5.3.4 Steelhead, California Central Valley DPS

Populations of California Central Valley steelhead occur throughout the watersheds of the Central Valley; however, the primary population source occurs within the watersheds of the Sacramento River Basin. Upstream migrating adult steelhead enter both the Sacramento River Basin and the San Joaquin River Basin through their respective mainstem river channels. Adult steelhead entering the Mokelumne River system (including Dry Creek and the Cosumnes River) and the Calaveras River system are likely to move up the mainstem San Joaquin River channel before branching off into the channels of their natal rivers. It is also likely that some adult steelhead bound for the San Joaquin River system may detour through the South Delta waterways and enter the San Joaquin River through Old River near Mossdale. However, due to the number of potential routes, the early entrance of adults into the Delta, and the potential for the Delta Cross Channel to remain open for a substantial portion of the upstream spawning migration, the "actual" route that an adult steelhead follows before committing to its natal watershed could be quite complex. Therefore, adult steelhead could be in any of the larger channels in the Delta region during their spawning migrations. Likewise, steelhead kelts could also be found in any of the channels of the Delta during their return to the ocean. Data for this particular life stage is lacking.

Outmigrating steelhead smolts enter the Delta primarily from the Sacramento River (north Delta region) and from the San Joaquin River (south Delta region). Steelhead smolts from the Mokelumne River system and the Calaveras River system enter the Eastern Delta. Given the multiple points of entry into the Delta system, Central Valley steelhead are likely to be found in any of the waterways of the Delta, but particularly in the main channels leading to their natal river systems. Although potentially present throughout the Delta, detection in beach seines is greatest in the north Delta (Figure 5.3-5), likely reflecting the greater abundance of outmigrating juveniles from the Sacramento River Basin as opposed to the San Joaquin River Basin. The low detections overall likely reflect the relative inefficiency of this gear type (steelhead juveniles are relatively large and therefore better able to avoid capture than species such as Chinook salmon) as well as low absolute abundance compared to juvenile Chinook salmon, for example.

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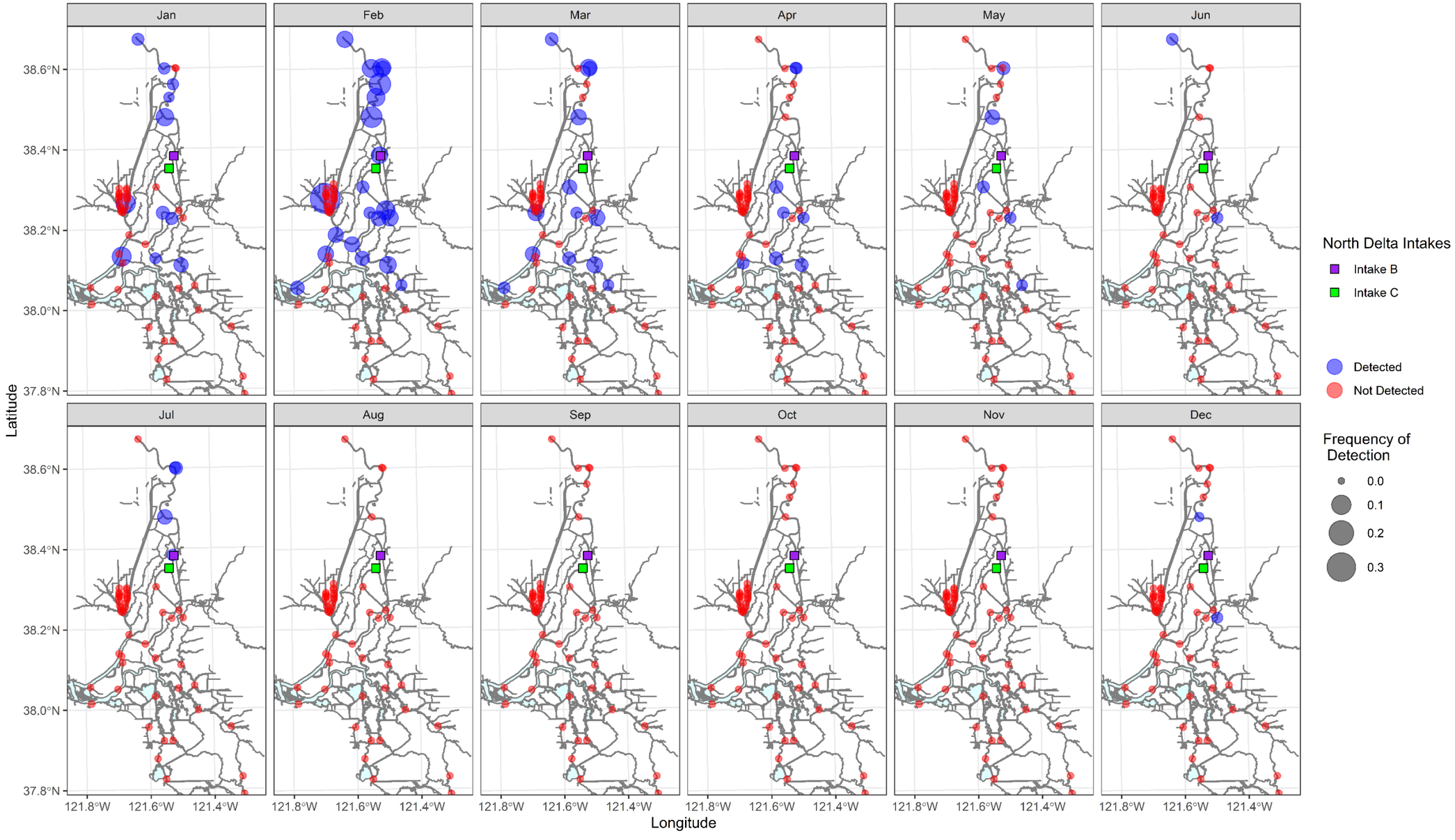


Source: Interagency Ecological Program et al. 2021.

**Figure 5.3-5. Frequency of Detection (Proportion of Samples) of Steelhead by the Delta Juvenile Fish Monitoring Program's Beach Seine Sampling, 2000–2020.**

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### 5.3.5 Green Sturgeon, Southern DPS

As described by NMFS (2019:790), current available information indicates that the Southern DPS of green sturgeon is composed of a single independent population, which spawns principally in the mainstem Sacramento River, but also opportunistically in the Feather and Yuba Rivers; thus, adult green sturgeon primarily use the mainstem of the Sacramento River through the Delta when making their upstream spawning migrations. Use of the north Delta sloughs is much less frequent (Miller et al. 2020). Based on sturgeon tag returns, sturgeon have been shown in the Delta throughout the year. Sturgeon report card data for 2007–2015, Gleason et al. (2008), DuBois et al. (2009, 2010, 2011, 2012, 2014), DuBois (2013), and DuBois and Harris (2015, 2016) show that reported green sturgeon captures by anglers in or near the Delta were consistently high in Suisun Bay and the Sacramento River between Knights Landing and Chipps Island, with other high-ranking areas that include San Pablo Bay and Carquinez Strait. Green sturgeon captured in these locations have ranged from 12 inches to 86 inches. Other areas within the Delta reaching relatively high ranks of total reported captures included the Sacramento Deepwater Ship Channel (fourth in 2015) and Montezuma Slough (fifth in 2015). The report card data confirm that green sturgeon occur quite broadly within the Delta, with individuals also having been caught in Old River (eight fish from 2007–2015) and in the San Joaquin River, between Stockton and the Highway 140 bridge, upstream of the Delta (40 fish from 2007 to 2015).

## 5.4 Effects of Water Facility Construction on Chinook Salmon, Central Valley Steelhead, and Green Sturgeon

This section discusses the effects resulting from construction of the proposed action. In addition, the effects analysis includes discussion of effects associated with existing conditions to provide a point of comparison to identify potential project effects.

Construction of water-conveyance facilities for the proposed action has the potential to affect all runs of Chinook salmon, Central Valley steelhead, and green sturgeon, which all have the potential to occur in select construction areas. These species would not be affected by construction activities associated with the proposed Bethany Complex features, which are outside the open Delta waters that these species inhabit. Potential effects arising from construction activities could consist of acoustic effects; sediment disturbance leading to increased suspended sediments, turbidity and contaminants; water quality effects from accidental spills and discharge of construction water; direct physical injury or mortality from in-water work; reduced prey availability; increased predation risk; increased water temperature; and reduced habitat extent and access. These potential effects are discussed in the sections below. Construction information is described generally in Chapter 3.

### 5.4.1 Acoustic Effects

Underwater noise would be generated by a variety of construction activities. including pile driving, boat operations, geotechnical investigations, riprap placement, and tunnel boring-machine activities. Impact pile driving in or near aquatic habitat generates sound levels that can injure or kill fish and other aquatic organisms. The proposed action includes physical or structural components

that would require vibratory and/or impact pile driving of temporary and permanent piles during construction. Several of these components involve pile-driving activities within or adjacent to water bodies supporting special-status fish species, resulting in potential exposure of species to pile-driving noise.

Research indicates that impact pile driving can result in significant effects on fish because of the high level of underwater sound produced (Popper and Hastings 2009:464–480). The effects of pile-driving noise on fish may include behavioral responses, physiological stress, temporary and permanent hearing loss, tissue damage (auditory and nonauditory), and direct mortality. Factors that may influence the magnitude of effects include species, life stage, and size of fish; type and size of pile and hammer; frequency and duration of pile driving; site characteristics (e.g., depth); and distance of fish from the source.

Dual interim criteria have been established to provide guidance for assessing the potential for injury of fish resulting from pile-driving noise (Fisheries Hydroacoustic Working Group 2008:1) and were used in the present analysis. The dual criteria for impact pile driving are (1) 206 decibels (dB)[5] for the peak sound pressure level (SPL); and (2) 187 dB for the cumulative sound exposure level ($SEL_{cumulative}$) for fish larger than 2 grams and 183 dB ($SEL_{cumulative)}$ for fish smaller than 2 grams. *Peak SPL* is considered the maximum sound pressure level a fish can receive from a single strike without injury. $SEL_{cumulative}$ is considered the total daily amount of acoustic energy that a fish can receive from single or multiple strikes without injury. The $SEL_{cumulative}$ threshold is based on the cumulative daily exposure of a fish to noise from sources that are discontinuous (i.e., noise that occurs only for about 8 to 12 hours in a day, with 12 to 16 hours between exposure). Per NMFS guidelines, this assumes that the fish is able to recover from such effects during this 12- to 16-hour "rest" period. These criteria relate to impact pile driving only. Vibratory pile driving generally is accepted as an effective measure for minimizing or eliminating the potential for injury of fish during in-water pile-driving operations, with only impact pile driving expected to produce sound levels that could injure fish (National Marine Fisheries Service 2015:50). The potential for physical injury to fish from exposure to impact pile-driving sounds was evaluated using a spreadsheet model NMFS[6] developed to calculate the distances from the pile that sound attenuates to the peak or cumulative criteria. These distances define the area in which the criteria are expected to be exceeded as a result of impact pile driving. The NMFS spreadsheet calculates these distances based on estimates of the single-strike sound levels for each pile type (measured at 10 meters from the pile) and the rate at which sound attenuates with distance. In the following analysis, the standard sound attenuation rate of 4.5 dB per doubling of distance was used in the absence of other data.[7] To account for the exposure of fish to multiple pile-driving strikes, the model computes $SEL_{cumulative}$ for multiple strikes based on the single-strike sound exposure level (SEL) and the number of strikes per day or pile-driving event. The NMFS spreadsheet also employs the concept of *effective quiet*, which assumes that cumulative exposure of fish to pile-driving sounds of less than 150 dB SEL does not result in injury or behavioral modification.

[5] Where sound levels in dB are referenced in this analysis, they are made relative to 1 microPascal (μPa, for peak and root mean square pressure) and 1 microPascal-squared-second ($\mu Pa^2s$, for sound exposure level).

[6] The spreadsheet was downloaded from www.fisheries.noaa.gov/southeast/consultations/section-7-consultation-guidance on February 4, 2021.

[7] A sound attenuation rate of 4.5 dB per doubling of distance is equivalent to a transmission loss constant of 15, the default value in the NMFS spreadsheet, which indicates that this value is to be used when site-specific values are unknown (as is the case in the present analysis).

The following analysis also considers the potential for pile-driving sound to affect fish behavior adversely. Potential mechanisms include startle or avoidance responses that can disrupt or alter normal activities (e.g., migration, holding, feeding) or expose individuals to increased predation risk. Insufficient data are currently available to support the establishment of a noise threshold for behavioral effects (Hastings and Popper 2005:46; Popper and Hastings 2009:464). NMFS, however, has concluded that a noise level of 150 dB root mean square (RMS) is an appropriate threshold for behavioral effects (California Department of Transportation 2015:4-23), so this value is used in the present analysis.

The following analysis uses peak SPLs and SELs measured during similar pile-driving operations[8] as a basis for estimating the distances at which sound levels would be expected to exceed the interim injury and behavioral thresholds (California Department of Transportation 2015:I-2). The following assessment presents the effect that is reasonably foreseeable based on the use of an impact driver with no attenuation (e.g., bubble curtains). Assumptions for the pile-driving analysis were developed based on the expected effect of pile driving at each intake, as described in the Conceptual Intake Cofferdam Construction Technical Memorandum (Delta Conveyance Design and Construction Authority 2022a). The assumptions reflect use of impact pile driving to the extent necessary when other methods (e.g., vibratory pile driving) are not able to complete construction requirements. An analysis of impact pile-driving noise was also conducted for the test-pile program, based on three types of pile[9] being tested at a single site.

The pile-driving analysis for the test-pile program reflected one pile of each type on three separate days at a single site, which would occur under the proposed action. The analysis indicated that the distance to sound-level thresholds would range from 28 feet (206 dB) to 24,135 feet (150 dB) (Table 5.4-1). The area of effect, accounting for attenuation of sound by river bends, ranges from 0.06 acre (206-dB threshold for sheet and steel pipe piles) to approximately 59 acres (150-dB threshold for H piles) (Table 5.4-1; Figure 5.4-1, Figure 5.4-2, and Figure 5.4-3). The duration of the test pile–impact driving at a single intake site would be 3 days (one day for each pile type; Table 5.4-1), although the actual duration of impact pile driving would be short (~2 minutes per pile; Delta Conveyance Design and Construction Authority 2022a).

**Table 5.4-1. Assumptions and Estimates of Impact Pile Driving Distance and Area of Acoustic Effect at a Single Intake Site for the Test Pile Program**

| Variable | Sheet Pile Pair | Steel Pipe Pile | H Pile |
|---|---|---|---|
| Number of piles | 1 | 1 | 1 |
| Number of piles per day | 1 | 1 | 1 |
| Number of days of pile driving | 1 | 1 | 1 |
| Number of strikes per pile | 19 | 19 | 19 |
| Number of strikes per day | 19 | 19 | 19 |

[8] Specifically, the assumed sound levels used for each intake were for 24-inch AZ® sheet piles in 15 meters of water. Although the intake sites are shallower than 15 meters, available sound level data for pile driving are not available for the specific depths and pile type likely to be used for construction; however, an assumption of 15 meters of depth is conservative, given that attenuation with distance is greater in shallower water (California Department of Transportation 2015:4-21).

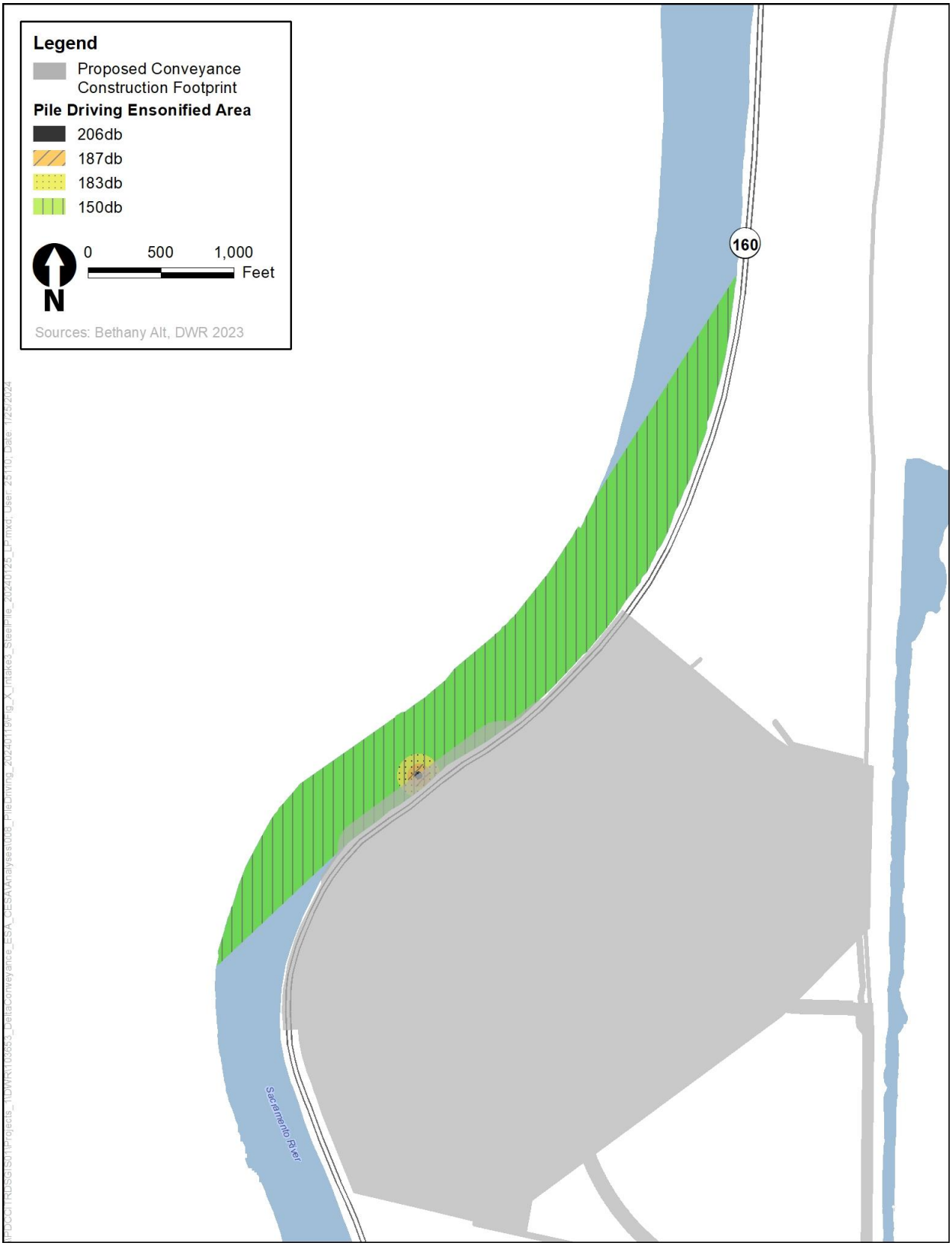
[9] The assumed sound levels were for a 24-inch AZ® sheet pile in 15 meters of water, a 30-inch steel pipe pile in 4–5 meters of water, and a 14-inch H pile in 6 meters of water.

| Variable | Sheet Pile Pair | Steel Pipe Pile | H Pile |
|---|---|---|---|
| Peak single-strike sound level at 10 meters [33 feet] (dB) | 205 | 205 | 208 |
| Sound exposure level at 10 meters [33 feet] (SEL, dB) | 180 | 180 | 177 |
| Root mean square at 10 meters [33 feet] (RMS, dB) | 190 | 190 | 193 |
| Distance to 206-dB threshold (feet) [a] | 28 | 28 | 45 |
| Distance to 187-dB threshold (feet) [a] | 80 | 80 | 50 |
| Distance to 183-dB threshold (feet) [a] | 147 | 147 | 93 |
| Distance to 150-dB threshold (feet) [a] | 15,228 | 15,228 | 24,135 |
| Area of 206-dB threshold (acres) | 0.06 | 0.06 | 0.15 |
| Area of 187-dB threshold (acres) | 0.46 | 0.46 | 0.18 |
| Area of 183-dB threshold (acres) | 1.28 | 1.28 | 0.60 |
| Area of 150-dB threshold (acres) | 58.41 | 58.41 | 58.64 |

Note: assumed testing would occur at Intake B.
dB = decibel; RMS = root mean square; SEL = sound exposure level.
[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going around corners at the bends in the river), which is accounted for in the area estimates given in the table.

Note: Decibel (dB) values indicate thresholds of effect.

**Figure 5.4-1. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for the Test Pile Program, Sheet Pile Pair**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 5.4-2. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for the Test Pile Program, Steel Pipe Pile**

Note: Decibel (dB) values indicate thresholds of effect.

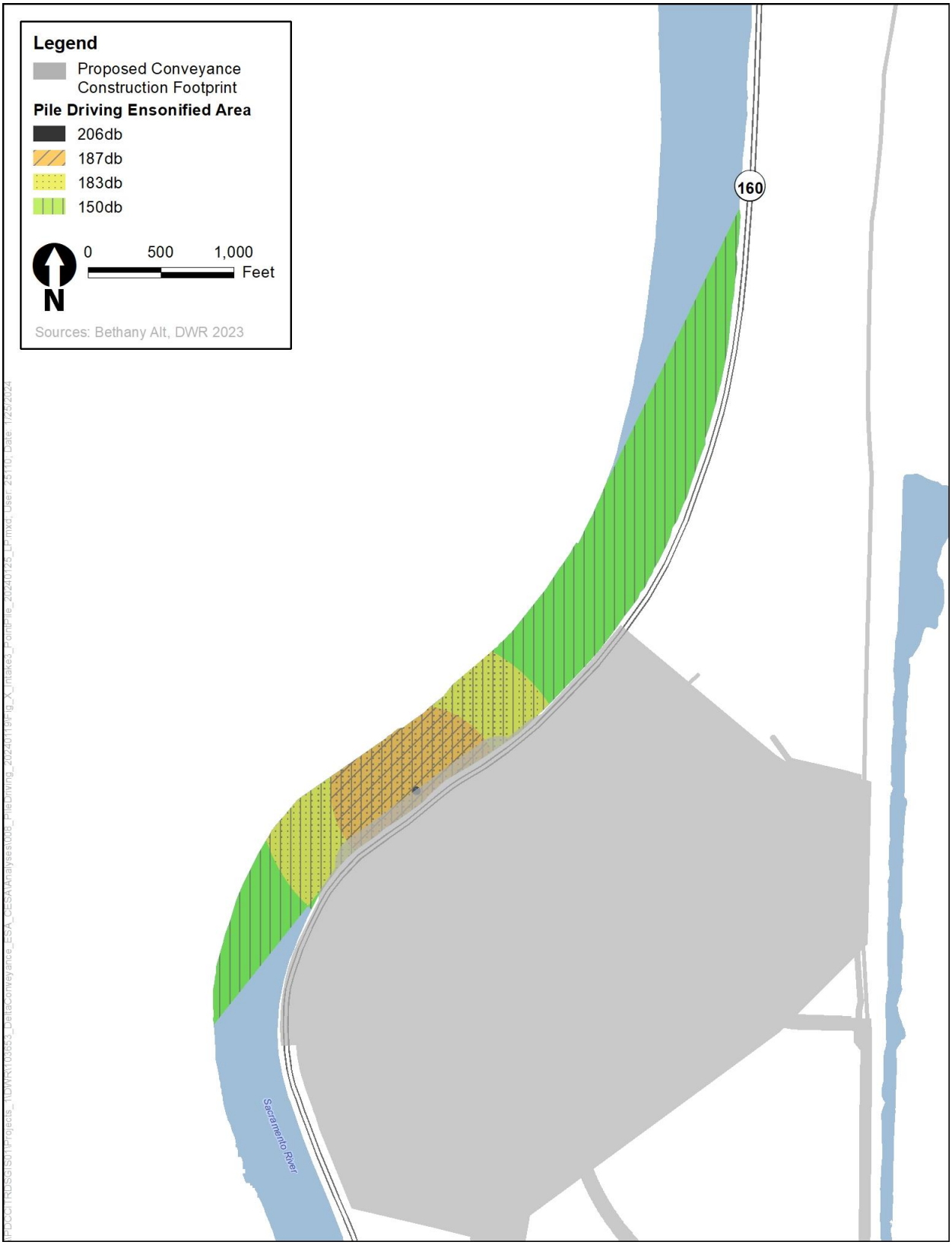
**Figure 5.4-3. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for the Test Pile Program, H Pile**

The pile driving analysis for construction of the cofferdams and training walls indicated that the distance to sound-level thresholds would range from 28 feet (206 dB) to 15,228 feet (150 dB), with area ranging from 0.06 acre (206-dB thresholds at both intakes) to over 134 acres (150-dB threshold at Intake C) (Table 5.4-2; Figure 5.4-4 and Figure 5.4-5). The duration of the impact pile driving acoustic effect at each intake would be 21 days (Table 5.4-2).

**Table 5.4-2. Assumptions and Estimates of Impact Pile Driving Distance and Area of Acoustic Effect at Each Intake for Construction of Cofferdams and Training Walls**

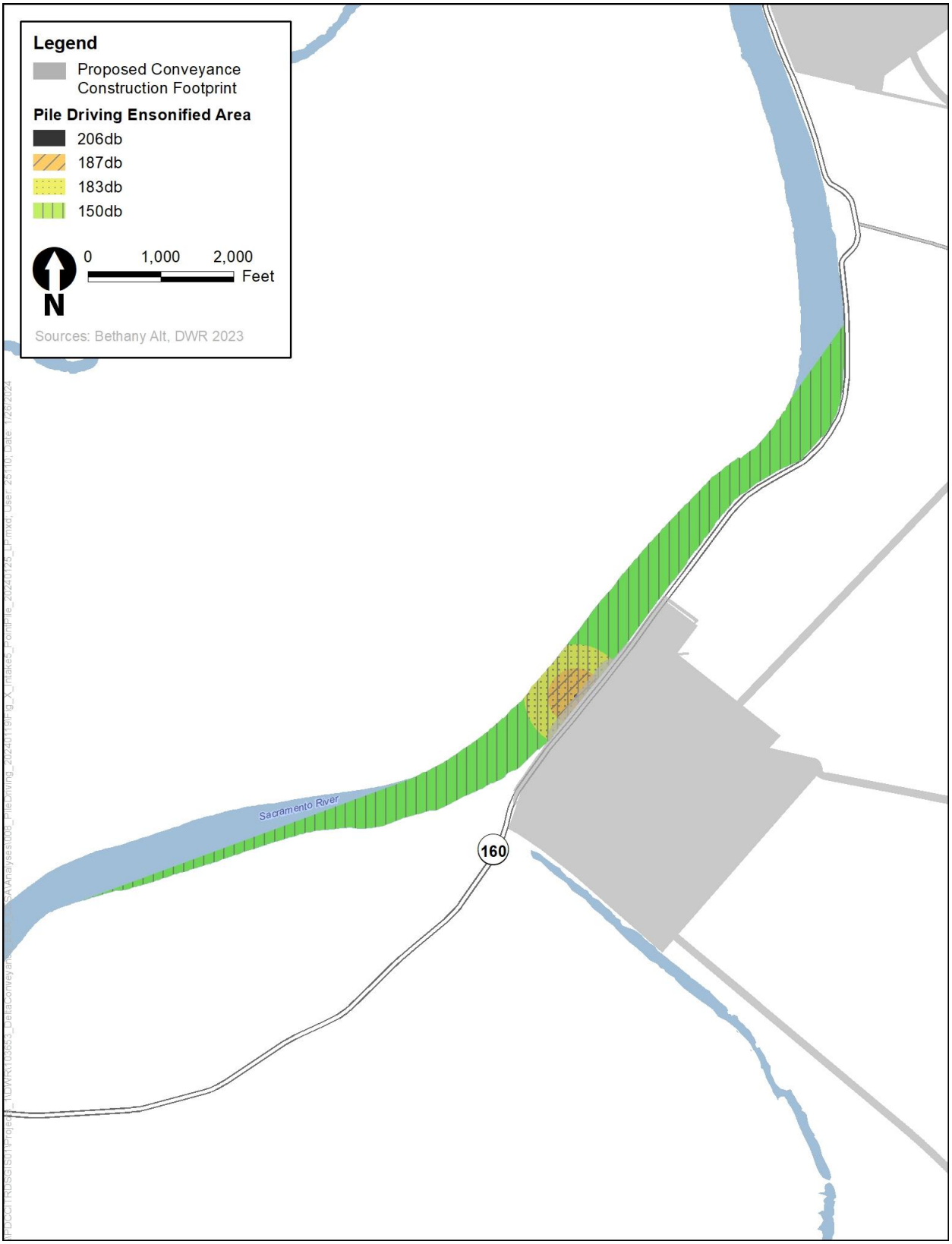
| Variable | Intake B | Intake C |
|---|---|---|
| Number of piles (pairs) | 420 | 410 |
| Number of piles per day | 20 | 20 |
| Number of days of pile driving | 21 | 21 |
| Number of strikes per pile | 19 | 10 |
| Number of strikes per day | 380 | 200 |
| Peak single-strike sound level at 10 meters [33 feet] (dB) | 205 | 205 |
| Sound exposure level at 10 meters [33 feet] (SEL, dB) | 180 | 180 |
| Root mean square at 10 meters [33 feet] (RMS, dB) | 190 | 190 |
| Distance to 206-dB threshold (feet) [a] | 28 | 28 |
| Distance to 187-dB threshold (feet) [a] | 588 | 383 |
| Distance to 183-dB threshold (feet) [a] | 1,086 | 708 |
| Distance to 150-dB threshold (feet) [a] | 15,228 | 15,228 |
| Area of 206-dB threshold (acres) | 0.06 | 0.06 |
| Area of 187-dB threshold (acres) | 12.30 | 6.72 |
| Area of 183-dB threshold (acres) | 25.06 | 18.47 |
| Area of 150-dB threshold (acres) | 67.69 | 134.10 |

dB = decibel; RMS = root mean square; SEL = sound exposure level.
[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going around corners at the bends in the river), which is accounted for in the area estimates given in the table.




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 5.4-4. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for Construction of Cofferdams and Training Walls**




Note: Decibel (dB) values indicate thresholds of effect.

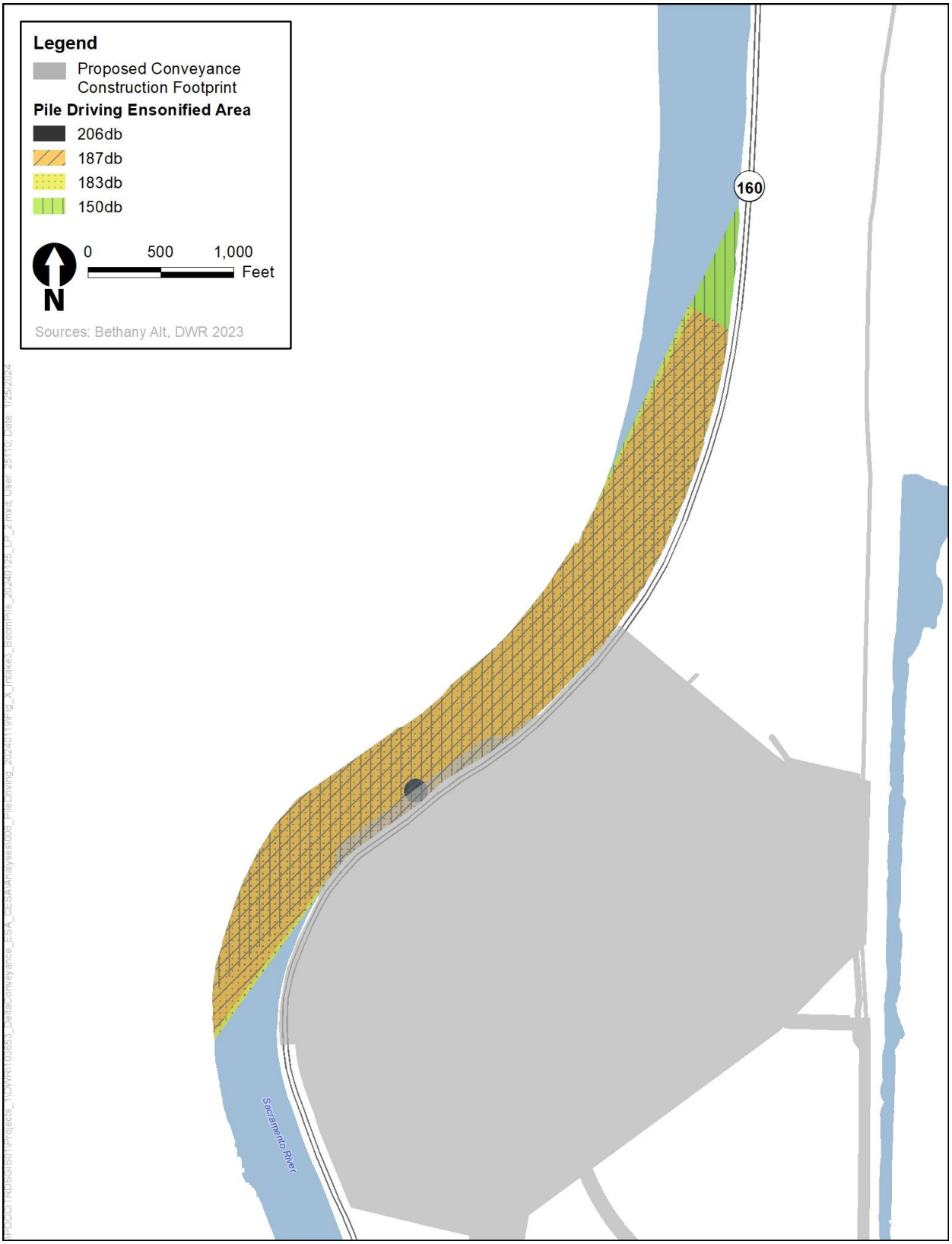
**Figure 5.4-5. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake C for Construction of Cofferdams and Training Walls**

Two to 4 days of pile driving would be required during the final year of construction at each intake, to install steel pipe piles to support the floating log boom. Existing geotechnical information suggests that all log-boom piles could be vibrated into place without the need for any impact pile driving, but a conservative estimate of impact pile driving that could be required was used for this analysis. This analysis indicated that the distance to sound-level thresholds would range from 82 feet (206 dB) to 13,061 feet (150 dB) (Table 5.4-3). The area of effect, accounting for attenuation of sound by river bends, ranges from 0.5 acre (206-dB threshold at Intakes B and C) to 118 acres (150-dB threshold at Intake C) (Table 5.4-3; Figure 5.4-6 and Figure 5.4-7).

**Table 5.4-3. Assumptions and Estimates of Impact Pile Driving Distance and Area of Acoustic Effect at Each Intake for Construction of Log Booms**

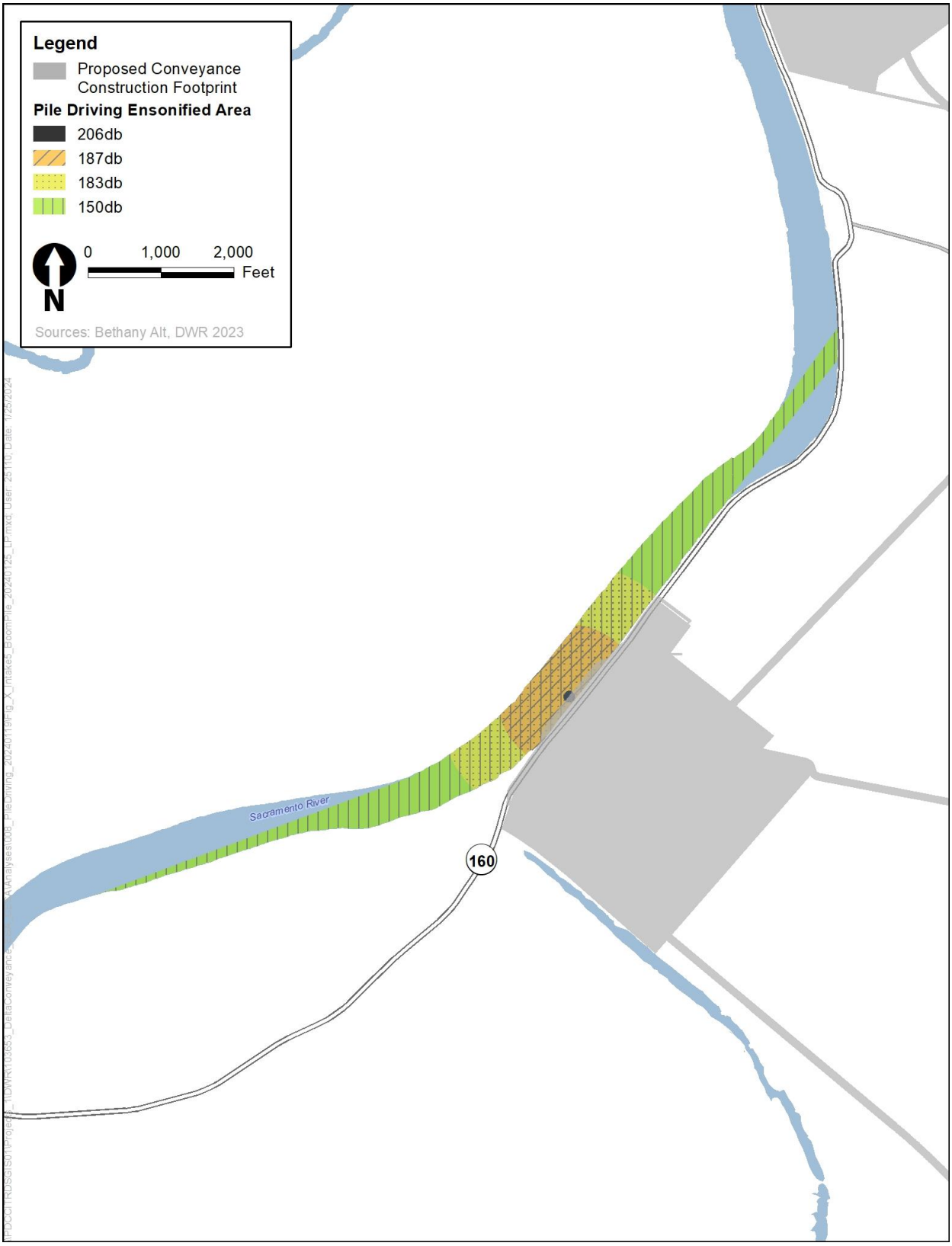
| Variable | Intake B | Intake C |
|---|---|---|
| Number of piles | 32 | 32 |
| Number of piles per day | 10 | 10 |
| Number of days of pile driving | 4 | 4 |
| Number of strikes per pile | 504 | 66 |
| Number of strikes per day | 5,040 | 660 |
| Peak single-strike sound level at 10 meters [33 feet] (dB) | 212 | 212 |
| Sound exposure level at 10 meters [33 feet] (SEL, dB) | 181 | 181 |
| Root mean square at 10 meters [33 feet] (RMS, dB) | 189 | 189 |
| Distance to 206-dB threshold (feet) [a] | 82 | 82 |
| Distance to 187-dB threshold (feet) [a] | 3,825 | 990 |
| Distance to 183-dB threshold (feet) [a] | 3,825 | 1,830 |
| Distance to 150-dB threshold (feet) [a] | 13,061 | 13,061 |
| Area of 206-dB threshold (acres) | 0.5 | 0.5 |
| Area of 187-dB threshold (acres) | 66.4 | 27.2 |
| Area of 183-dB threshold (acres) | 66.4 | 51.7 |
| Area of 150-dB threshold (acres) | 69.3 | 117.9 |

dB = decibel; RMS = root mean square; SEL = sound exposure level.
[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going around corners at the bends in the river), which is accounted for in the area estimates given in the table.




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 5.4-6. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for Construction of Log Booms**




Note: Decibel (dB) values indicate thresholds of effect.

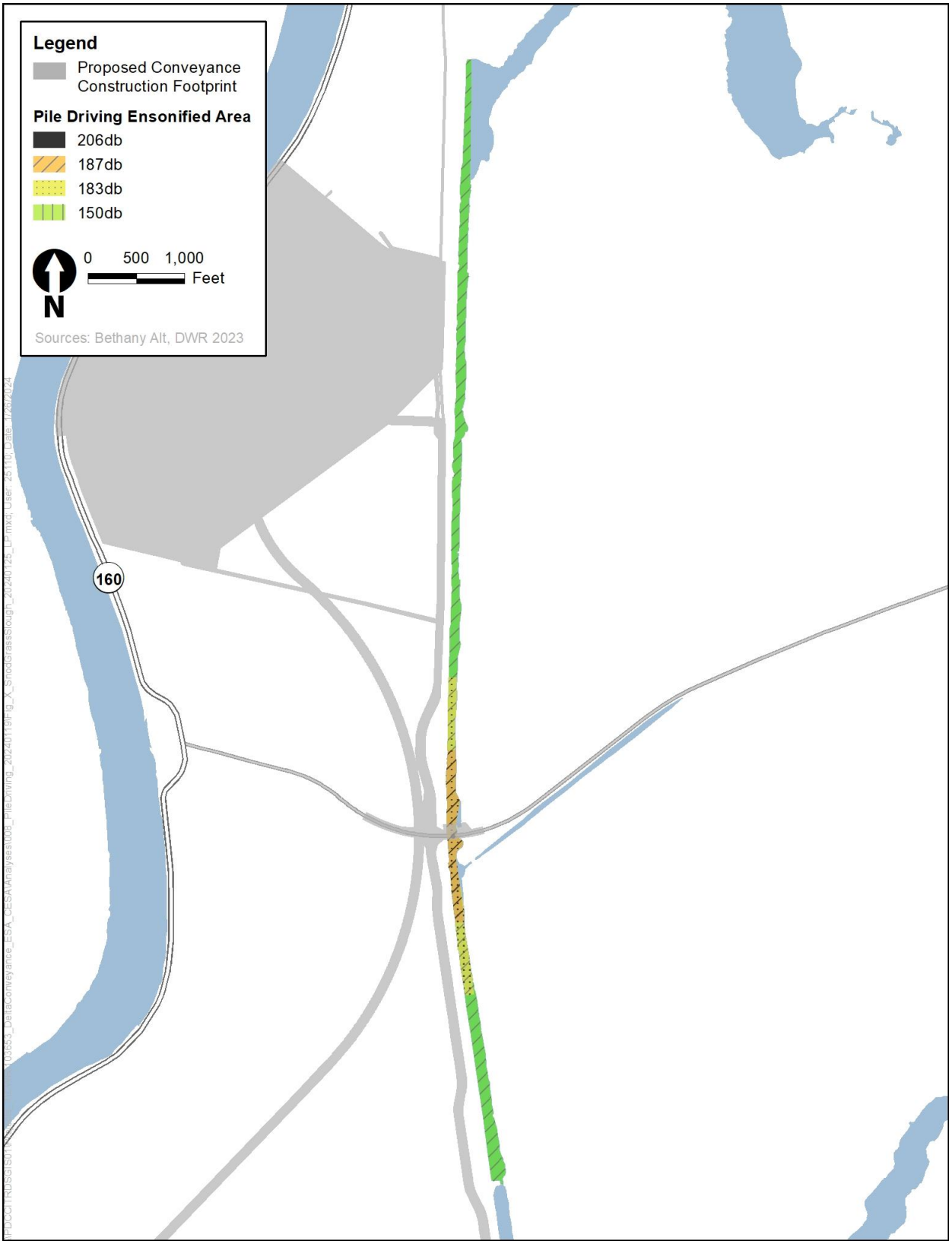
**Figure 5.4-7. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake C for Construction of Log Booms**

Pile driving would also be required at bridge crossings associated with the proposed action (Table 5.4-4). The area of effect, accounting for attenuation of sound by river bends, ranges from 0.04 acre (206-dB threshold at Snodgrass Slough) to 25 acres (150-dB threshold at Snodgrass Slough) (Table 5.4-4). The duration of the impact pile-driving acoustic effect at the bridge crossings would range from 5 days (Snodgrass Slough) to 9 days (Burns Cutoff) (Table 5.4-4; Figure 5.4-8 and Figure 5.4-9).

**Table 5.4-4. Assumptions and Estimates of Impact Pile Driving Distance and Area of Acoustic Effect at Each Bridge Crossing**

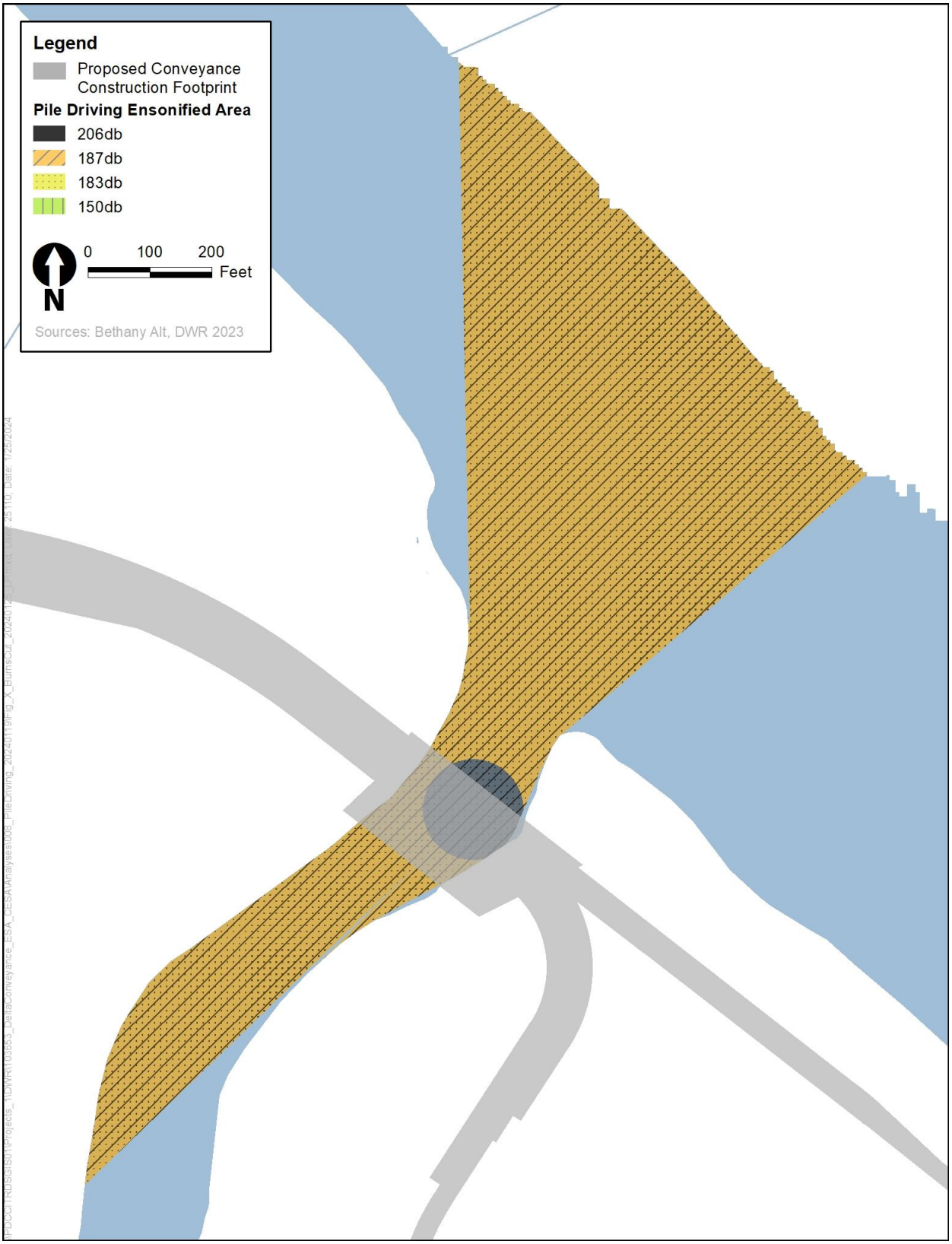
| Variable | Snodgrass Slough | Burns Cutoff |
|---|---|---|
| Pile diameter (steel pipe, inches) | 16 | 24 |
| Number of piles | 26 | 50 |
| Number of piles per day | 6 | 6 |
| Number of days of pile driving | 5 | 9 |
| Number of strikes per pile | 150 | 150 |
| Number of strikes per day | 900 | 900 |
| Peak single-strike sound level (dB) | 204 | 212 |
| Sound exposure level (SEL, dB) | 179 | 181 |
| Root mean square (RMS, dB) | 189 | 189 |
| Distance to 206-dB threshold (feet) [a] | 24 | 82 |
| Distance to 187-dB threshold (feet) [a] | 896 | 1,217 |
| Distance to 183-dB threshold (feet) [a] | 1,655 | 2,249 |
| Distance to 150-dB threshold (feet) [a] | 13,061 | 13,061 |
| Area of 206-dB threshold (acres) | 0.04 | 0.47 |
| Area of 187-dB threshold (acres) | 4.12 | 12.38 |
| Area of 183-dB threshold (acres) | 7.34 | 12.36 |
| Area of 150-dB threshold (acres) | 25.45 | 12.37 |

dB = decibel; RMS = root mean square; SEL = sound exposure level.
[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going around corners at the bends in the river), which is accounted for in the area estimates given in the table.




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 5.4-8. Estimates of Area of Acoustic Effect (Ensonified Area) at Snodgrass Slough for Bridge Construction**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 5.4-9. Estimates of Area of Acoustic Effect (Ensonified Area) at Burns Cutoff for Bridge Construction**

Boat operations during construction would result in temporary acoustic effects on special-status fish species. Barge/tugboat operations would be conducted to transport construction equipment and materials to each intake, for a total of 68 to 94 trips per intake (Table 5.4-5). There would be no more than two trips upstream and two trips downstream per day, with work assumed to be staggered sequentially by at least 1 year for each intake.

**Table 5.4-5. Barge Round Trips (Trips in Parentheses) Associated with Construction of Each Intake**

| Variable | Intake B | Intake C |
|---|---|---|
| Transport log boom and support pile installation | 2 (4) | 2 (4) |
| Transport clamshell excavator | 1 (2) | 1 (2) |
| Transport excavated/dredged material | 28 (56) | 19 (38) |
| Transport riprap | 16 (32) | 12 (24) |
| Total round trips (total trips) | 47 (94) | 34 (68) |

Note: Round trips are to/from the Port of Stockton. This table does not account for barge trips associated with the test-pile program (1 round trip [2 trips] at a single intake), the geotechnical investigations at the proposed intakes (1–3 round trips [2–6 trips], based on 1 round trip per intake), or the geotechnical investigations at bridges and tunnel crossings (up to 10 round trips [20 trips]).

Each barge round trip for transport of excavated/dredged material would be associated with 1 day of mechanical (i.e., clam shell) or hydraulic dredging to excavate and prepare the subgrade at the intake for riprap placement, that is, 19 to 28 days of dredging at each intake (Table 5.4-5). The Reine et al. (2014:3,292) review of potential dredging acoustic effects concluded that it is unlikely that conventional dredging operations can cause physical injury to fish species, while noting that, in theory, temporary hearing losses could occur if fish remained in the vicinity of a dredge for lengthy duration, although they suggested that the risk of this is low.

Boat operations for geotechnical investigations and the test-pile program likely would be conducted from a shallow-draft barge or ship, outfitted with the necessary equipment for the task, with the potential for temporary acoustic effects from boat noise being limited to behavioral effects, consistent with the above discussion for dredging effects. There would be two barge trips for the test-pile program (i.e., to and from a single intake site), two to six barge trips for the geotechnical investigations at the intakes (i.e., to and from each intake site), and up to 20 barge trips for the geotechnical investigations at bridges and tunnel crossings (i.e., to and from 10 sites). Acoustic effects from standard geotechnical penetration tests (i.e., dropping a 140-pound automatic hammer to drive a sampler about 1.5 feet) are limited to minimal, short-duration vibrations (National Marine Fisheries Service 2017:177).

Placement of riprap has the potential to result in temporary loud noises, although the available data from analogous situations in the Delta suggest that such effects would be limited: Sound data taken during the 2012 installation of rock barriers as part of DWR's Temporary Barriers Project showed that noise levels at 100 meters from construction were below the NMFS criteria for adverse behavioral effects (150 dB),[10] any effects would be limited to 24 to 32 days of riprap placement at each intake (corresponding to the number of round trips to transport riprap shown in Table 5.4-5).

Tunnel boring along the Bethany Reservoir Alignment would pass beneath 14 waterbodies a total of 17 times (Table 5.4-6). Tunnel boring is expected to progress at approximately 40 feet per day, with

[10] The greatest measured peak SPL at 100 meters was 149 dB for a single bucket drop of rock at the Old River near Tracy barrier (Shields 2012:7).

work undertaken up to 20 hours per day, 5 days per week, and up to 10 hours on Saturdays (Delta Conveyance Design and Construction Authority 2022c, 2022d), thereby passing under each waterbody for a number of days, depending on the width of the waterbody along the tunnel alignments. Acoustic modeling of potential effects was undertaken for the tunnel boring intersection with the San Joaquin River, which is the shallowest tunnel boring location passing beneath a waterbody (approximately 68 feet of cover between the crown of the tunnel and the bottom of the river channel). The overall SPL at the bottom of the channel was estimated at 104 dB (Delta Conveyance Design and Construction Authority 2022b), which is well below the 150-dB threshold for the behavioral modification described above, for example. Therefore, it would not be expected that fish and aquatic resources would be affected by noise from boring the tunnel alignments for the proposed action.

**Table 5.4-6. Name and Number of Waterbody Intersections of Tunnel-Boring Machine Routes**

| Waterbody | Number of Intersections |
|---|---|
| Beaver Slough | 1 |
| Disappointment Slough | 1 |
| Hayes Slough | 1 |
| Hog Slough | 1 |
| Middle River | 1 |
| Mokelumne River | 1 |
| Old River | 2 |
| San Joaquin River | 1 |
| Snodgrass Slough | 2 |
| Sycamore Slough | 1 |
| Victoria Canal | 1 |
| West Canal | 1 |
| Whiskey Slough | 1 |
| White Slough | 2 |
| Total | 17 |

Source: Delta Conveyance Design and Construction Authority 2022c, 2022d.

Drilling for subsurface power-transmission lines would pass once under Snodgrass Slough. Drilling for supervisory control and data acquisition would pass once under Burns Cutoff. Acoustic effects from subsurface drilling would be expected to be minimal, based on noise levels measured for underwater drilling of around 130 dB (Spiga et al. 2012:56–57, 78).

As described above, underwater noise levels from pile driving and other construction activities could affect adult and juvenile Chinook salmon, steelhead, and green sturgeon due to their temporal and spatial overlap with pile driving. If adult Chinook salmon are in the area of pile-driving noise during construction activities, then pile driving has the potential for injury and behavioral effects. Underwater noise levels of sufficient intensity to cause direct injury or mortality of fish could occur over a period of 30–33 days during the proposed in-water work period (June 1–October 31) over a 2-year period at each intake location. (See the related avoidance and mitigation measure [AMM], AMM-14: *Construction Best Management Practices for Biological Resources* in Appendix 3A, *General Avoidance and Minimization Measures.*) Underwater noise levels would return to baseline levels following cessation of pile driving and other construction activities and would not result in long-

term effects on special-status fish species. The proposed action would include AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan*, which includes limiting pile-driving timing and controlling or abating underwater noise generated during impact pile driving, for example, by starting impact pile driving at lower levels of intensity to allow fish to leave the area before the intensity is increased. For additional information about AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan*, refer to Chapter 3, Section 3.6.2, *Species-Specific Avoidance and Minimization Measures*.

## 5.4.2 Water Quality Effects

### 5.4.2.1 Sediment Disturbance

The construction of the proposed action would result in the generation and release of suspended sediments to the water column, temporarily increasing water-column turbidity above ambient levels and altering habitat conditions for fish and aquatic resource species. Turbidity-producing construction activities include bed and bank disturbance during cofferdam and log-boom installation, dredging for riprap placement adjacent to the new intake locations, and the placement of bed and bank riprap armoring. Propeller wash associated with boat traffic at construction sites may also produce localized turbidity pulses, depending on the location.

Given the nature and scope of construction activities and based on observations of similar in-water construction activities, increases in turbidity and suspended sediment generated during construction of the water-conveyance facilities would be temporary, localized, and unlikely to reach levels causing direct injury or mortality to any of the Chinook salmon runs, steelhead, or green sturgeon. NMFS (2008:95) reviewed observations of turbidity plumes during installation of riprap for bank protection projects on the Sacramento River and concluded that visible plumes are expected to be limited only to a portion of the channel width, extend no more than 1,000 feet downstream, and dissipate within hours of cessation of in-water activities. Based on these observations, NMFS (2008:95) concluded that such activities could result in turbidity levels exceeding 25–75 nephelometric turbidity units. This level of effect is considered representative of maximum potential turbidity effects from the proposed action.

Sediment at construction sites could include contaminants (e.g., metals, hydrocarbons such as oil and grease, organochlorine pesticides, polychlorinated biphenyls), so the potential exists for release and dispersal of these contaminants if these sediments are disturbed during construction. Fish and aquatic resources could be directly exposed to elevated levels of contaminants if they are in immediate proximity to construction activities that disturb contaminated sediments. The greatest potential for such effects would be during dredging/excavation for riprap placement, with lesser potential during pile driving for cofferdam and log-boom installation or from propeller wash by construction boat traffic. Bed disturbance could also result in indirect effects on fish and aquatic resources. Toxins in river channel sediments can enter the food chain via benthic organisms. If contaminated sediments are disturbed and become suspended in the water column, they also become available directly to pelagic organisms, including fish species and planktonic food sources of fish species. Thus, construction-related disturbance of contaminated bottom sediments opens up another potential pathway to the food chain, and the potential bioaccumulation of these toxins in various fish species. The bioaccumulation of toxins can lead to lethal effects, as well as several sublethal effects (e.g., effects on behavior, digestion, and immune system; Connon et al. 2011:290). The toxins in contaminated sediments generally are adhered to the sediment and, as described above for turbidity, elevated suspended sediment caused by construction activity for the proposed

action would be limited spatially to a portion of channel width and not extend far downstream, dissipating within hours of construction activities ceasing.

As described above, increases in turbidity and suspended sediment levels during construction of the proposed intakes would affect the water quality. Elevated turbidity and suspended sediment generated by in-water construction activities, including barge operation, primarily would affect migration corridors through temporary degradation of water quality, increases in exposure to mid-channel predators, and potential sedimentation of potential food-producing areas. These effects would have only a localized and temporary effect on habitat in the action area. AMM-27: *Develop and Implement a Barge Operations Plan* addresses bottom scour, bank erosion, accidental material spillage, sediment and benthic community disturbance from accidental or intentional barge grounding or deployment of barge spuds or anchors, and hazardous spills. Additionally, general avoidance and minimization measures (Chapter 3, Section 3.6.1, *General Avoidance and Minimization Measures*) are part of the proposed action and include AMM-4a*: Develop and Implement Erosion and Sediment Control Plans* and AMM-4b: *Develop and Implement Stormwater Pollution Prevention Plans*, which limit sedimentation entering waterbodies (Appendix 3A).

#### 5.4.2.2 Construction Contaminants

Construction of the proposed action could result in accidental spills of contaminants, including oil, fuel, hydraulic fluids, concrete, paint, and other construction-related materials, resulting in localized water quality degradation. This could, in turn, result in significant effects on fish and aquatic resources, through direct injury and mortality (e.g., damage to gill tissue causing asphyxiation) or delayed effects on growth and survival (e.g., increased stress or reduced feeding), depending on nature and extent of the spill and the contaminants involved, as generally illustrated for Chinook salmon in Puget Sound tributaries (Varanasi et al. 1993).

The greatest potential for an adverse water quality effect is associated with an accidental spill from construction activities occurring in or near surface waters. The north Delta intakes involve extensive in-water work, albeit with much of the work occurring inside a cofferdam. There is some potential for spills during drilled shaft work, cofferdam support installation, excavation of the cofferdam, and tremie pours of concrete (although additional concrete would be poured into the concrete base, thereby minimizing the potential for concrete mixing with water within the cofferdam prior to dewatering), but once cofferdams are installed and dewatered, any spills within the cofferdam essentially would preclude movement of spill materials into the river because of river water pressure on the cofferdams. Other construction elements that occur in upland areas or are isolated from fish-bearing waters have little potential for accidental spills that could affect fish. Discharge of water from construction sites could also affect water quality for fish and aquatic resources.

As described above, the potential release of contaminants through spills or sediment disturbance could affect winter-run Chinook salmon through adverse effects on water quality. AMM-27: *Develop and Implement a Barge Operations Plan*, AMM-2: *Develop and Implement Hazardous Materials Management Plans*, and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* will minimize contaminants entering waterbodies, and if they are accidentally released, then cleanup plans are in place to minimize effects on special-status species. For additional information about the AMMs, refer to Section 3.6 in Chapter 3 and to Appendix 3A.

### 5.4.3 Direct Physical Injury

In-water construction for the proposed action may result in direct physical injury or mortality to fish and aquatic resources from activities including pile driving, barge/tugboat operations, enclosing construction areas, riprap placement, and construction water diversion from surface waters. Installation of piles or placement of riprap could involve fish being crushed, although it would be expected that risk would be very low, based on the limited spatial extent of the work and the high probability of fish avoiding such activities; therefore, displacement of Chinook salmon, steelhead, and green sturgeon away from habitat near construction activities seems the most likely negative effect. Fish entrapped in construction areas enclosed by cofferdams would die without fish-rescue activities, although the number of fish being trapped in such areas would be a very low proportion of individuals relative to the overall extent of species' ranges. Barge and tugboat operations could result in direct physical injury or mortality of green sturgeon from propeller entrainment/strikes. Given the relatively limited use of barges and tugboats (i.e., approximately 42–68 trips per intake associated with intake construction [staggered by one year per intake], two trips for the test pile program, and two trips per intake for geotechnical investigations, and up to 20 trips for geotechnical investigations at bridges and tunnel crossings, plus maneuvering at each site; see discussion above in Section 5.4.1, *Acoustic Effects*), such effects would be expected to be limited.[11] The water supply needed for construction would be satisfied through a combination of the following: import from local sources, exchanges, use of existing riparian diversions, new temporary appropriations, or existing State Water Project appropriations. Surface water rights to be diverted from existing facilities would be available at the intake locations, and Lower Roberts Island at the tunnel shaft location. Therefore, at most construction sites, there would be no changes to surface waters related to construction water supplies. Any use of diversions will be screened, as appropriate, and additional authorizations addressed following development of detailed construction engineering, so at the limited number of sites that could use existing surface water rights, entrainment of fish would be low, based on low numbers of fish entrained at similar small intakes (e.g., Nobriga et al. 2004; Vogel 2013).

As described above, there is potential for injury during in-water construction activities from activities including pile-driving, barge/tugboat operations, enclosing construction areas, riprap placement, and construction water diversion from surface waters. These activities could have a temporary adverse effect on adult Chinook salmon, steelhead, and green sturgeon. AMM-1: *Conduct Environmental Resources Worker Awareness Training* will train workers on identification of special-status species and avoidance and minimization commitments. AMM-25: *Develop and Implement a Fish Rescue and Salvage Plan* will rescue any fish that may become trapped inside cofferdams. For additional information on AMM-25: *Develop and Implement a Fish Rescue and Salvage Plan*, see Chapter 3, Section 3.6.2.

[11] For example, for the California WaterFix project, NMFS (2017:256–263) estimated that ~23 barge trips per year to Intake A from the west Delta along the Sacramento River (a distance of 73 km [46 miles]) during June–October would result in annual propeller entrainment mortality of 0–1 juvenile winter-run Chinook salmon, 0 juvenile spring-run Chinook salmon, 104–199 juvenile fall-run Chinook salmon, 47–91 juvenile late fall–run Chinook salmon, and 1–2 juvenile steelhead. There would be 68–94 barge trips per intake, plus several additional trips for geotechnical work and the test pile program, potentially resulting in somewhat greater annual propeller entrainment mortality than estimated by NMFS (2017:256–263), but still very low in population-level terms. For example, for winter-run Chinook salmon, scaling up the California WaterFix estimate for the number of barge trips per intake gives estimates of ~4 fish taken per year as a result of barge trips associated with Intake B ([94 ÷ 23 trips] × 1 fish per year) and ~3 fish taken per year as a result of barge trips associated with Intake C ([68 ÷ 23 trips] × 1 fish per year).

### 5.4.4 Prey Availability

Proposed action–related construction has the potential to reduce prey availability (e.g., zooplankton, benthic invertebrates, small fish) for special-status fish species through disturbance of aquatic habitat. Prey species may be affected by pile driving (e.g., from noise effects or direct physical contact), barge and tugboat operations (e.g., noise, sediment disturbance), removal of riparian aquatic habitat (i.e., reducing habitat structures for prey in or above water) and riprap placement (e.g., direct physical contact, sediment disturbance). Isolation of construction areas with cofferdams would prevent special-status fish species access to prey in these areas until cofferdams are removed.[12] The potential effects would be limited in extent relative to the overall area of habitat available to special-status fish species in the Delta. Further discussion of habitat reduction is provided in Section 5.4.7, *Habitat Extent.*

As described above, the potential release of contaminants through spills or sediment disturbance could affect water quality and food resources (i.e., reduced abundance of benthic invertebrates and consumption of contaminated benthic invertebrates). AMM-27: *Develop and Implement a Barge Operations Plan*, AMM-2: *Develop and Implement Hazardous Materials Management Plans*, and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* will minimize contaminants entering waterbodies, and if they are accidentally released, then cleanup plans are in place to minimize effects on benthic invertebrates.

### 5.4.5 Predation

In-water structures used during construction would have the potential to provide habitat for predatory species. The cofferdams to be used during construction at the north Delta intakes would include flutes (i.e., vertical grooves), which may make them suitable as predatory fish habitat (Vogel 2008a:24). In-water structures, particularly cofferdams at the north Delta intakes, may, therefore, result in negative effects on small fish, such as downstream-migrating juvenile salmonids, or positive effects on larger predatory fish, such as black bass (*Micropterus lacepede*). Juvenile salmonids in the action area near the intakes could be subject to greater risk of predation if predatory fish move in and use the structures for cover; green sturgeon are less likely to be affected because of larger size (see Section 5.5.4, *Green Sturgeon*).

Overall, however, the potential effects from presence of in-water structures during construction would be limited because the overall extent would be low (Table 5.4-7 and Table 5.4-8), considering the already existing docks in the Delta (approximately 250 acres, or 0.44% of the total surface area of waterways; Lehman et al. 2019:12). The existing proportional extent of small docks in the Delta has been concluded not to be likely to have a population-level effect on species such as migrating juvenile salmonids (Lehman et al. 2019:14), so the addition of structures from construction of the proposed action would be expected to be limited in terms of additional negative effects.

In addition to in-water structure effects during construction, the various forms of in-water construction work (i.e., pile driving, barge and tugboat operations, and riprap placement) have the potential to increase predation risk for juvenile fish increasing disturbance and susceptibility to predation (e.g., by masking the sounds of approaching predators or causing fish to flee disturbed areas), which, in turn, could increase predation success of larger predatory fish, such as black bass. Such effects would be temporally and spatially limited in extent. Loss of shaded riparian aquatic

[12] Total construction duration at each intake is 5.5 years (see Figure 3.5-12 in Chapter 3).

habitat and other shallow-water habitat because of construction would also increase susceptibility to predation, but again this would be spatially limited (see discussion in Section 5.4.7 regarding extent of loss of habitat).

## 5.4.6 Water Temperature

Removal of trees at construction sites may reduce the extent of shaded riparian aquatic habitat (see Section 5.4.7 regarding effects on channel-margin habitat). This could potentially increase water temperature and have negative effects on fish and aquatic resources, depending on species-specific temperature preferences. However, such increases would be extremely localized and likely would only occur in any small, semi-isolated shallow areas away from the main river channel that are shaded by trees; this type of habitat does not occur at the construction sites, particularly the north Delta intakes, which include modified riverbanks, often with considerable extents of revetment. NMFS (2017:220) noted that the Sacramento River and Delta are wider, faster-moving waterbodies and, therefore, are less likely to experience warming of water temperatures caused by limited decreases in riparian vegetation, such as would occur with construction of the proposed action. This is because as the river channels become wider, a smaller fraction of the channel is affected by shading and the narrow riparian corridor found along those riverbanks. As further described by NMFS (2017:220), the volume of water present in the river channel acts as a thermal sink, resisting temperature changes caused by shading along a narrow riparian zone. Temperature changes are more influenced by the greater surface area of exposed open water in the river channel, ambient air temperatures over those exposed areas, solar irradiation, and the influence of water layers mixing within the main river channel. The effects on special-status fish from changes in water temperature would be expected to be minimal.

## 5.4.7 Habitat Extent

Construction of the proposed action would result in reduced habitat extent for fish species. The overall footprint of construction activities is approximately 1.5 acres of temporary effects[13] and approximately 5.6 acres of permanent effects on tidal perennial habitat (Table 5.4-7). The footprint effect on channel-margin habitat in the Sacramento River is approximately 494 linear feet of temporary impact and approximately 3,124 linear feet of permanent impact (Table 5.4-8).

**Table 5.4-7. Summary of Tidal Perennial Habitat Affected by Construction Activities (acres)**

| Impact Type | Feature | Waterbody | Proposed Action |
|---|---|---|---|
| Permanent Surface Impact | Access Railroad | Burns Cutoff | 0.163 |
| Permanent Surface Impact | Access Road | Burns Cutoff | 0.090 |
| Permanent surface impact | Access Road | Unknown | 0.061 |
| Permanent surface impact | Access Road/Power – Underground New | Unknown | 0.009 |
| Permanent surface impact | Access Road/SCADA – Underground New | Burns Cutoff | 0.107 |
| Permanent surface impact | County Road | Unknown | 0.163 |

[13] *Temporary effects* are the habitat extent acreage that can be returned to original basic use following completion of construction; *permanent effects* are the habitat acreage that cannot be returned to original basic use following completion of construction.

| Impact Type | Feature | Waterbody | Proposed Action |
|---|---|---|---|
| Permanent surface impact | Intake | Sacramento River | 4.983 |
| Permanent surface impact | All Combined Permanent | All Combined | 5.574 |
| Temporary surface impact | County Road | Unknown | 0.244 |
| Temporary surface impact | Intake Boundary | Sacramento River | 0.834 |
| Temporary surface impact | Power – Underground New | Unknown | 0.010 |
| Temporary surface impact | Railroad Work Area | Burns Cutoff | 0.054 |
| Temporary surface impact | Road Work Area | Burns Cutoff | 0.297 |
| Temporary surface impact | Road Work Area | Unknown | 0.084 |
| Temporary surface impact | Road Work Area/Power – Underground New | Unknown | 0.025 |
| Temporary surface impact | All Combined Temporary | All Combined | 1.548 |

ROW = right-of-way; SCADA = supervisory control and data acquisition.

**Table 5.4-8. Summary of Channel Margin Habitat Affected by Construction Activities (linear feet)**

| Impact Type | Feature | Waterbody | Proposed Action |
|---|---|---|---|
| Permanent surface impact | Intake | Sacramento River | 3,124 |
| Temporary surface impact | Intake | Sacramento River | 494 |

During construction, some areas would be affected, both temporarily and permanently. DWR proposes to offset effects on special-status fish habitat through restoration of tidal perennial habitat and channel-margin habitat at an approved restoration site and/or the purchase of conservation credits at an approved conservation bank (see Table 3B-4 in Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*).

# 5.5 Effects of Water Facility Construction on Designated Critical Habitat

This effects analysis provides an analysis of effects on critical habitat for winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. For all four species, designated critical habitat is present in the Sacramento River, the Delta, and adjacent areas. The analysis includes potential effects on the following PBFs of critical habitat for each species. Critical habitat is not designated in Snodgrass Slough or Burns Cutoff for any of these species.

## 5.5.1 Sacramento River Winter-Run Chinook Salmon

Sacramento winter-run Chinook salmon has ESA-designated critical habitat in the entire Sacramento River and its tributaries. Construction of water facilities would affect critical habitat where Intakes B and C would be constructed.

***PBF 1: Access from Pacific Ocean to spawning areas in the upper Sacramento River***

Underwater noise levels from pile driving, barge trips, and other construction activities would affect the designated critical habitat of winter-run Chinook salmon through temporary degradation of this PBF (i.e., unobstructed migratory pathways). Adverse effects on critical habitat would occur within

areas subjected to noise levels associated with potential injury and behavioral effects, as described above under Section 5.4.1. Underwater noise levels of sufficient intensity to cause direct injury or mortality of fish could occur over a period of approximately 25 days during the proposed in-water work period (June 1–October 31) over a 2-year period at each intake location. In addition to the work window, AMM-14: *Construction Best Management Practices for Biological Resources* and AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan* would be implemented to monitor and decrease noise levels from impact pile driving. Underwater noise levels would return to baseline levels following cessation of pile driving and other construction activities and would not result in long-term impacts on critical habitat.

***PBF 2: Water temperatures for successful fry development***

There is no expected increase in water temperature from construction activities (Section 5.4.6, *Water Temperature*). Therefore, there would be no effect on the PBF for adequate water temperatures for successful fry development.

***PBF 3: Habitat areas and prey that are not contaminated***

Increases in turbidity and suspended sediment levels during construction of the proposed intakes could affect this PBF. Elevated turbidity and suspended sediment generated by in-water construction activities primarily would affect rearing habitat and migration corridors through temporary degradation of water quality (Section 5.4.2, *Water Quality Effects*), increases in exposure to mid-channel predators, and potential sedimentation of food-producing areas. In reference to Chapter 3, Section 3.6, AMM-2: *Develop and Implement Hazardous Materials Management Plans*, AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*, AMM-4a: *Develop and Implement Erosion and Sediment Control Plans*, AMM-4b: *Develop and Implement Stormwater Pollution Prevention Plans*, and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize these effects on critical habitat in the action area.

The potential release of contaminants through spills or sediment disturbance could affect this PBF through reduced abundance of benthic invertebrates and consumption of contaminated benthic invertebrates (Section 5.4.4, *Prey Availability*). As noted previously, implementation of the AMMs would minimize contaminant effects on critical habitat, and any effects would be small.

***PBF 4: Riparian habitat that provides for successful juvenile development and survival***

Effects on the designated critical habitat of winter-run Chinook salmon include temporary impacts during construction on juvenile rearing and migration habitat, as described above (Section 5.4.7). There would be temporary effects on riparian vegetation during construction. DWR proposes to offset effects on the designated critical habitat of winter-run Chinook salmon through restoration of tidal perennial habitat and channel-margin habitat at an approved restoration site and/or the purchase of conservation credits at an approved conservation bank (see Table 3B-4 in Appendix 3B).

## 5.5.2 Central Valley Spring-Run Chinook Salmon

Sacramento spring-run Chinook salmon has ESA-designated critical habitat in the entire Sacramento River and its tributaries. Construction of water facilities would affect critical habitat where Intakes B and C would be constructed.

***PBF 1: Freshwater rearing habitat with water quantity and quality, floodplain connectivity, forage, and natural cover supporting juvenile development, growth, mobility, and survival***

As discussed above under Section 5.5.1, *Sacramento River Winter-Run Chinook Salmon*, increases in turbidity and suspended sediment levels and potential releases of contaminants during construction of the proposed intakes could affect water quality and also contaminate benthic invertebrates for juvenile spring-run Chinook salmon in the vicinity of construction. Implementation of AMMs would avoid and minimize negative water quality effects. Release of sedimentation and contaminants would have only a localized and temporary effect on critical habitat in the action area.

Loss of critical habitat would occur due to the construction of the intakes. DWR proposes to offset impacts to the designated critical habitat of spring-run Chinook salmon through restoration of tidal perennial habitat and channel-margin habitat at an approved restoration site and/or the purchase of conservation credits at an approved conservation bank (see Table 3B-4 in Appendix 3B).

***PBF 2: Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival***

As discussed in Section 5.5.1, underwater noise levels from pile driving and other construction activities may affect migration during construction. Adverse effects on critical habitat would occur within areas subjected to noise levels associated with potential injury and behavioral effects. Implementation of the in-water work window and AMMs would reduce noise levels from impact pile driving. Underwater noise levels would return to baseline levels following cessation of pile driving and other construction activities and would not result in long-term impacts on critical habitat. Predation is not expected to greatly increase during construction activities (Section 5.4.5, *Predation*).

## 5.5.3 California Central Valley Steelhead

California Central Valley steelhead has ESA-designated critical habitat in the entire Sacramento River and San Joaquin River, and their tributaries. Construction of water facilities would affect critical habitat. The PBFs and the effects on critical habitat are the same as for spring-run Chinook salmon. Implementation of the AMMs would avoid and minimize effects on critical habitat for California Central Valley steelhead.

## 5.5.4 Green Sturgeon

The southern distinct population green sturgeon has ESA-designated critical habitat in the Sacramento River, the Feather River, Yuba River, Sutter Bypass, Yolo Bypass, Sacramento–San Joaquin Delta, San Francisco Bay, San Pablo Bay, and Suisun Bay. Construction of water facilities would affect critical habitat where Intakes B and C would be constructed.

***PBF 1: Food resources for larval, juvenile, subadult, and adult life stages***

The potential release of contaminants through spills or sediment disturbance could affect this PBF through adverse effects on water quality and food resources, resulting in reduced abundance of benthic invertebrates and consumption of contaminated benthic invertebrates in the vicinity of construction. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans*, AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*, AMM-4a:

*Develop and Implement Erosion and Sediment Control Plans*, and AMM-4b: *Develop and Implement Stormwater Pollution Prevention Plans* will avoid and minimize effects on any contaminant releases that may occur. No long-term or permanent effects on critical habitat are expected.

***PBF 2: Water quality including temperature, salinity, oxygen content, and other chemical characteristics supporting growth and viability of all life stages***

Increases in turbidity and suspended sediment levels during construction of the proposed intakes could affect water quality. These effects would be limited to localized, temporary degradation of the physical and biological features of water quality and potential sedimentation of food-producing areas. Implementation of the AMMs under PBF 1 would be implemented to keep turbidity levels down. No long-term or permanent effects on critical habitat are expected.

There is no expected increase in water temperature from construction activities (Section 5.4.6).

***PBF 3: Migratory corridor free of obstruction and excessive predation with water quantity and quality conditions supporting safe and timely passage of juveniles and adults within and between riverine, estuarine, and marine habitats***

As discussed in Section 5.5.1, construction of the intakes would cause noise and disturbance and could preclude green sturgeon from using the Sacramento River to migrate upstream or downstream of the area during construction activities. AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan* would be implemented to dampen noise effects from impact pile driving. The potential for injury during in-water construction activities could occur from barge ship strikes. AMM-27: *Develop and Implement a Barge Operations Plan* would require a biological monitor to observe barge activities and report any damage to sensitive habitat or species. Increased predation during construction activities is not expected to occur to any great extent because green sturgeon occurring in construction areas would be larger than the size at which predation risk diminishes to zero (Baird et al. 2020; see also Section 5.4.5). No long-term or permanent effects on critical habitat are expected.

# 5.6 Effects of Conservation Measures

## 5.6.1 Compensatory Mitigation

Implementation of the compensatory mitigation plan could result in effects on special-status fish species. Details of compensatory mitigation are provided in Appendix 3B. A total of 18.3 acres of tidal perennial habitat and 3,619 linear feet of channel margin compensatory mitigation would be undertaken. Construction of aquatic habitat restoration for mitigation itself has the potential for negative effects on fish and aquatic species, with these effects generally including those previously discussed above in Section 5.4, *Effects of Water Facility Construction on Chinook Salmon, Central Valley Steelhead, and Green Sturgeon* (i.e., acoustic effects, sediment disturbance, water quality effects, direct physical injury, reduced prey availability, and increased predation). Potential short-term negative effects from construction of aquatic habitat as compensatory mitigation are exemplified by effects assessed for the Lower Yolo Tidal Restoration Project (National Marine Fisheries Service 2014a). To the extent practicable, grading and excavation (e.g., of marsh plains and tidal channels) would be performed prior to work, allowing species to enter restored areas (e.g., excavation of notches in the perimeter of levees to facilitate tidal flows to enter and leave) to

minimize negative effects on fish species. Excavation of levee perimeter notches to allow tidal exchange could result in several effects on fish species: temporary loss of aquatic and riparian habitat (e.g., increasing predation potential because of reduced cover, reduced substrate for prey, increased water temperature); degraded water quality from contaminants liberated from soils and increased suspended sediment that could affect fish directly if in very high concentration, as well as affecting prey availability; heavy machinery noise resulting in fish being inhibited in their movements near the work areas, and possibly being startled away from work areas and, therefore, becoming more susceptible to predation; direct strikes to fish from construction equipment performing in-water work, such as notch excavation in levees to restored tidal flow, leading to injury or mortality; and stranding of fish within enclosed construction areas (e.g., within cofferdams) that may be required during construction. As suggested for the Lower Yolo Tidal Restoration Project, however, such potential impacts can be minimized by construction techniques, where feasible, such as not operating heavy machinery from within the water; limiting construction to only the small areas necessary to meet restoration design (e.g., restoration of tidal connections, limiting work to low tide and daylight hours to the extent possible, installing sheet pile exclusion barriers with vibratory hammers). Potential negative effects from compensatory mitigation construction would be expected to affect very small numbers of individuals of fish and aquatic species that may occur near sites during in-water work. Construction of compensatory mitigation would include various AMMs, as necessary, and as described above for construction effects. These AMMs would limit the potential for negative effects by limiting work to the in-water work window and limiting the potential for water quality effects. Inclusion of selenium and methylmercury management as part of mitigation (AMM-23: *Develop and Implement a Mercury Management and Monitoring Plan*) would limit potential for negative effects from selenium or methylmercury production as a result of habitat restoration activities.

## 5.6.2 Avoidance and Minimization Measures

Some AMMs would involve in-water work that would have the potential to affect fish and aquatic species. The AMM with potential to result in effects on fish and aquatic species is AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan* (Appendix 3A). Temporary effects on fish and aquatic species resulting from implementation of AMMs would be similar to construction effects of the proposed action in certain construction areas and contribute to fish and aquatic species effects of the proposed action. DWR would develop and implement an underwater sound control and abatement plan that could include installation of an attenuation device, such as a bubble curtain, or other mechanism to minimize noise, such as air-filled fabric barriers, isolation piles, or installation of piling-specific cofferdams.

Abatement measures for underwater noise generated by impact pile driving include best available and practicable methods with the potential for negative effects on fish and aquatic species by trapping them within enclosed areas: bubble curtains, air-filled fabric barriers, isolation piles, or piling-specific cofferdams. Should fish and aquatic species become trapped within the area enclosed by these technologies, they would be exposed to high sound levels and may be injured, potentially fatally, by noise levels. However, the number of individuals potentially experiencing such effects would be low because of the small area affected and the likely disturbance and avoidance of the area by fish. The in-water work window for this measure also would limit the potential for temporal overlap with special-status fish species.

Overall, other AMMs implemented for the construction of the Water Conveyance Facilities, would be temporary and limited to the in-water work window during the construction phase of the project.

Potential effects would be reduced by limiting the duration of the activities to the extent possible, with AMM-2: *Develop and Implement Hazardous Materials Management Plans*, AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans;* AMM-4a: *Develop and Implement Erosion and Sediment Control Plans*, and AMM-4b: *Develop and Implement Stormwater Pollution Prevention Plans*. Additionally, AMM-14: *Construction Best Management Practices for Biological Resources* would minimize, but perhaps not completely avoid, the potential for injury or mortality. AMM-27: *Develop and Implement a Barge Operations Plan* would also minimize impacts from construction-related disturbance. Therefore, implementation of other AMMs is unlikely to result in effects on fish and aquatic species. For additional information about AMMs, refer to Section 3.6 of Chapter 3 or to Appendix 3A.

# 5.7 Effects on Southern Resident Killer Whale and Southern Resident DPS Killer Whale Critical Habitat

Southern Resident DPS killer whale is found in coastal waters off British Columbia, Washington, and Oregon in summer and fall (National Marine Fisheries Service 2008). During winter, killer whales are sometimes found off the central California coast but are more frequently reported off the Washington coast (Hilborn et al. 2012). The 2005 NMFS endangered listing (70 FR 69903) for the Southern Resident DPS killer whale lists several factors that may be limiting the recovery of killer whales (including the quantity and quality of prey).

Chinook salmon is an important component of the killer whale diet, and the Independent Science Panel reported that Southern Resident DPS killer whales depend on Chinook salmon as a critical food resource (Hilborn et al. 2012). Hanson et al. (2010) analyzed tissues from predation events and feces to confirm that Chinook salmon were the most frequent prey item for killer whales in two regions of the whale's summer range off the coast of British Columbia and Washington state, representing more than 90% of the diet in July and August. Samples indicated that when Southern Resident DPS killer whales are in inland waters from May to September, they consume Chinook salmon stocks that originate from regions that include the Fraser River, Puget Sound, the Central British Columbia Coast, West and East Vancouver Island, and California's Central Valley (Hanson et al. 2010). Available fish harvest data and killer whale diet and contaminants analyses suggest that Central Valley Chinook salmon comprise a significant portion of the total abundance of Chinook salmon available to killer whale throughout their range in most, if not all, years (National Marine Fisheries Service 2019).

Ford et al. (2016) helped confirm the importance of Chinook salmon to Southern Resident DPS killer whales in the summer months using DNA sequencing from whale feces. The researchers found that more than 90 percent of the whale's inferred diet consisted of salmonids; almost 80 percent was Chinook Salmon. Bellinger et al. (2015) estimated that Central Valley Chinook salmon comprised about 22 percent of the Chinook salmon sampled off the Oregon coast and about 50 percent of those sampled off the California coast (south to Big Sur). Although killer whale, an apex predator, eats a variety of other species, Central Valley Chinook Salmon (all runs) can be estimated to make up approximately 40% of the killer whale diet when killer whales are off the California coast and 18% of the killer whale diet when the killer whales are off the Oregon coast.

As discussed by NMFS (2017:831), individual-level effects on killer whale from changes in Chinook salmon prey could include changes in areas searched for prey and consequent changes in energy expended for such searches, resulting in changes in energy intake and the risk of nutritional stress. Changes in energy consumption and nutritional stress could lead to changes in body size, condition, and growth and changes in reproductive and survival rates for adults (National Marine Fisheries Service 2017:831).

The Southern Resident DPS of killer whale is thought to move with the seasonal abundance of salmonids returning to natal rivers to spawn from early summer through fall. There are correlations between the occurrence of southern residents and commercial and sport salmon fishery catches in waters off southeastern Vancouver Island and in Puget Sound (Stewart et al. 2023). This population of killer whales is commonly found off southeastern Vancouver Island and in Puget Sound, Washington, from late spring to late fall (Ford 2006, Osborne 1999). The winter distribution of Southern Resident DPS killer whales is poorly known. K and L pods have been observed off the mouth of the Columbia River and in Monterey Bay, California, associated with local production of Chinook Salmon (Wiles 2004; Balcomb 2006).

It is important to note that the proposed actions' construction and related maintenance would not affect ocean conditions.

### 5.7.1 Effects of Conservation Measures on Southern Resident DPS Killer Whale

Conservation measure construction components of the proposed action have the potential to affect Chinook salmon stocks, which form part of the diet of Southern Resident DPS killer whale. With the inclusion of conservation measures (Section 3.6 of Chapter 3 and Appendix 3A), the various proposed north Delta diversion construction activities would have minimal impacts on Chinook salmon stocks. This is in part through increased operational flexibility and habitat restoration. The restored tidal habitat areas would have the potential for positive effects on fall- and late fall–run Chinook salmon (refer to discussions in Section 5.6, *Effects of Conservation Measures*). The conservation measures potentially could also result in negative effects on individual fish such as: temporary loss of aquatic and riparian habitat leading to increased predation and reduced food availability; degraded water quality from contaminant discharge by heavy equipment and soils, and increased discharges of suspended solids and turbidity, leading to direct toxicological effects on fish health/performance (e.g., gill damage and reduced ability to take in oxygen, increasing metabolic cost), indirect impairment of aquatic ecosystem productivity (e.g., reduction in benthic macroinvertebrate production and availability), loss of aquatic vegetation providing physical shelter, and reduced foraging ability caused by decreased visibility; impediments and delay in migration caused by elevated noise levels from machinery; and direct injury or mortality from in-water equipment strikes or isolation/stranding within dewatered cofferdams. These potential effects would be minimized through restriction of in-water work to windows limiting exposure by reducing potential for spatiotemporal overlap and implementation of other AMMs to minimize the potential for effects when species do overlap with in-water work.

### 5.7.2 Effects on Southern Resident DPS Killer Whale Critical Habitat

Critical habitat for the Southern Resident DPS killer whale was designated in November 2006 (71 CFR 229). Three specific areas are designated: (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca, which comprises approximately 2,560 square miles (6,630 square kilometers) of marine habitat. The designation includes the following PBFs essential for conservation of the Southern Resident DPS killer whale.

1. Water quality to support growth and development; and
2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and
3. Passage conditions to allow for migration, resting, and foraging.

The proposed action has no potential to affect water quality or passage conditions within Southern Resident DPS killer whale critical habitat. Southern Resident DPS killer whales rely on 23 different species as prey, with salmon being the preferred prey (71 CFR 229). Given that critical habitat occurs within Puget Sound and the Strait of Juan de Fuca, the majority of prey consumed within critical habitat consists of populations native to rivers tributary to that habitat. The precise proportion of Central Valley-origin Chinook salmon consumed in the Southern Resident DPS killer whale diet when they are feeding within critical habitat has not been determined, but fewer than 10% of Central Valley-origin Chinook salmon are collected from as far north as Tillamook Head on the northern Oregon coast (Satterthwaite et al. 2013). Southern Resident DPS killer whale critical habitat is several hundred kilometers north of that area. The principal source of prey for Southern Resident DPS killer whale within critical habitat is Fraser River-origin Chinook salmon, with chum salmon also important for fall foraging in Puget Sound (National Marine Fisheries Service 2014b). The proposed action is unlikely to affect the production of Central Valley-origin Chinook salmon, and the proportion of Central Valley-origin Chinook salmon occurring within designated critical habitat is very low and, thus, has negligible potential to affect the Southern Resident DPS killer whale prey base within critical habitat.

## 5.8 Cumulative Effects on Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale

Cumulative effects are those effects of future state or private activities that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to ESA Section 7. The EIR includes a cumulative analysis consistent with CEQA and can further inform the potential for cumulative effects (see Section 12.3.4.2, *Cumulative Impacts of the Project Alternatives*, in Chapter 12, *Fish and Aquatic Resources*, of the *Delta Conveyance Project Final Environmental Impact Report* [California Department of Water Resources 2023]).

### 5.8.1 Water Diversions

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the California Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, their tributaries, and the Delta, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous or *osmeridae* (smelt) species (Mussen et al. 2013; Mussen et al. 2014). For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). This has improved, due to the Anadromous Fish Screen Program, part of the Central Valley Project Improvement Act, as well as DWR's fish-screening program. Although private irrigation diversions in the Delta are mostly unscreened, the total amount of water diverted onto Delta farms has remained stable for decades (Bureau of Reclamation 2019).

### 5.8.2 Agricultural Practices

Agricultural practices may affect riparian and wetland habitats negatively through upland modifications that lead to increased siltation or reductions in water flow in stream channels flowing into the action area, including the Sacramento River, Stanislaus River, San Joaquin River, and Delta. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed fish species by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into receiving waters. Sources of introduction vary from agricultural-use pesticide runoff to urban wastewater-treatment discharge and other potential sources. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may disrupt various physiological mechanisms and may affect reproductive success and survival rates of listed anadromous fish (Scott and Sloman 2004) negatively. However, the State of California issues Waste Discharge Requirements to dischargers, including irrigators, dairy operations, and cattle operations, that require implementation of BMPs designed to be protective of surface water quality, with benefits for listed fish species. Monitoring and reporting requirements associated with those Waste Discharge Requirements ensure compliance with BMPs. Agricultural practices introduce nitrogen, ammonium, and other nutrients into the watershed, which then flow into receiving waters, adding to other inputs, such as wastewater treatment (Lehman et al. 2014). Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may affect fish reproductive success and survival rates (Dubrovsky et al. 1998; Kuivila and Moon 2004; Scholz et al. 2012) negatively. Discharges occurring outside the action area that flow into the action area also contribute to cumulative effects of contaminant exposure.

### 5.8.3 Increased Urbanization

The Delta Protection Commission's *Economic Sustainability Plan* for the Delta reported an urban growth rate of about 54% within the statutory Delta between 1990 and 2010, as compared with a 25% growth rate statewide during the same period (Delta Protection Commission 2012). The report also indicated that population growth had occurred in the Secondary Zone of the Delta, but not in the Primary Zone, and that population in the central and south Delta areas had decreased since 2000.

Growth projections through 2050 indicate that all counties overlapping the Delta are projected to grow at a faster rate than the state as a whole. Total population in the Delta counties is projected to grow at an average annual rate of 2.2% from 2020 through 2030 (California Department of Finance 2023). Table 5.8-1 illustrates past, current, and projected population trends. As of 2010, the combined population of the Delta counties was approximately 3.8 million. Sacramento County contributed 37.7% of the population of the Delta counties, and Contra Costa County contributed 27.8%. Yolo County had the smallest population (200,849 or 5.3%) of all the Delta counties.

**Table 5.8-1. Population by County and Area, 2010–2060**

| Area | 2010 Population (millions) | 2019 Population (millions) | 2030 Projected Population (millions) | 2035 Projected Population (millions) | 2060 Projected Population (millions) |
|---|---|---|---|---|---|
| **Delta Region** | **5.30** | **5.82** | **6.37** | **6.61** | **7.43** |
| Alameda County | 1.52 | 1.67 | 1.83 | 1.90 | 2.16 |
| Contra Costa County | 1.05 | 1.15 | 1.25 | 1.30 | 1.45 |
| Sacramento County | 1.42 | 1.55 | 1.70 | 1.75 | 1.94 |
| San Joaquin County | 0.69 | 0.77 | 0.88 | 0.92 | 1.09 |
| Solano County | 0.41 | 0.44 | 0.47 | 0.48 | 0.52 |
| Yolo County | 0.20 | 0.22 | 0.24 | 0.25 | 0.28 |
| **South Bay Area [a]** | **1.85** | **2.02** | **2.17** | **2.25** | **2.51** |
| San Benito County | 0.06 | 0.06 | 0.07 | 0.08 | 0.09 |
| Santa Clara County | 1.79 | 1.96 | 2.09 | 2.17 | 2.42 |
| **San Joaquin Valley** | **3.14** | **3.42** | **3.77** | **3.92** | **4.46** |
| Stanislaus County | 0.52 | 0.56 | 0.61 | 0.63 | 0.73 |
| Merced County | 0.26 | 0.28 | 0.33 | 0.35 | 0.46 |
| Fresno County | 0.93 | 1.02 | 1.12 | 1.16 | 1.29 |
| Tulare County | 0.44 | 0.48 | 0.52 | 0.53 | 0.56 |
| Kings County | 0.15 | 0.15 | 0.17 | 0.18 | 0.20 |
| Kern County | 0.84 | 0.92 | 1.02 | 1.06 | 1.21 |
| **Central Coast** | **0.69** | **0.73** | **0.77** | **0.79** | **0.85** |
| San Luis Obispo County | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 |
| Santa Barbara County | 0.42 | 0.45 | 0.49 | 0.50 | 0.56 |
| **Southern California** | **21.04** | **22.33** | **23.28** | **23.62** | **23.68** |
| Ventura County | 0.83 | 0.85 | 0.86 | 0.86 | 0.78 |
| Los Angeles County | 9.85 | 10.26 | 10.38 | 10.39 | 9.61 |
| Orange County | 3.02 | 3.22 | 3.39 | 3.47 | 3.70 |
| San Diego County | 3.10 | 3.36 | 3.53 | 3.60 | 3.74 |
| San Bernardino County | 2.05 | 2.20 | 2.40 | 2.47 | 2.68 |
| Riverside County | 2.20 | 2.44 | 2.72 | 2.84 | 3.18 |
| **California** | **37.37** | **39.96** | **42.26** | **43.20** | **45.30** |

Source: California Department of Finance 2020.
[a] The population estimates for the South Bay Area do not include Alameda County because this is included in the Delta region total.

Table 5.8-2 presents more detailed information about populations of individual communities in the Delta.

**Table 5.8-2. Statutory Delta Communities Population, 2010 and 2018**

| Community | 2010 | 2018 | Average Annual Growth Rate 2010–2018 |
|---|---|---|---|
| **Alameda County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Livermore [a] | 80,968 | 89,027 | 1.24% |
| **Contra Costa County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Antioch | 102,372 | 110,730 | 1.02% |
| Brentwood | 51,481 | 60,446 | 2.18% |
| Oakley | 35,432 | 40,669 | 1.85% |
| Pittsburg | 63,264 | 70,492 | 1.43% |
| ***Small or Unincorporated Communities*** | | | |
| Bay Point | 21,349 | 25,165 | 2.23% |
| Bethel Island | 2,137 | 2,010 | -0.74% |
| Byron | 1,277 | 1,348 | 0.69% |
| Discovery Bay | 13,352 | 15,981 | 2.46% |
| Knightsen | 1,568 | 1,500 | -0.54% |
| **Sacramento County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Isleton | 804 | 583 | -3.44% |
| Sacramento | 466,488 | 495,011 | 0.76% |
| ***Small or Unincorporated Communities*** | | | |
| Courtland | 355 | 537 | 6.41% |
| Freeport | 38 | 81 | 14.14% |
| Hood | 271 | 303 | 1.48% |
| Walnut Grove | 1,542 | 1,300 | -1.96% |
| **San Joaquin County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Lathrop | 18,023 | 21,393 | 2.34% |
| Stockton | 291,707 | 306,283 | 0.62% |
| Tracy | 82,922 | 88,806 | 0.89% |
| ***Small or Unincorporated Communities*** | | | |
| Mountain House | 9,675 | 15,645 | 7.71% |
| Terminous | 381 | 411 | 0.98% |
| **Solano County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Rio Vista | 7,360 | 8,618 | 2.14% |
| **Yolo County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| West Sacramento | 48,744 | 52,826 | 1.05% |
| ***Small or Unincorporated Communities*** | | | |

| Community | 2010 | 2018 | Average Annual Growth Rate 2010–2018 |
|---|---|---|---|
| **Alameda County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Livermore [a] | 80,968 | 89,027 | 1.24% |
| Clarksburg | 418 | 442 | 0.72% |

Sources: U.S. Census Bureau 2012, 2018.
[a] Livermore is not in the statutory Delta but included because it is the closest community in Alameda County.

Increases in urbanization and housing developments can affect habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Increased growth would place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure, such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions would not require federal permits and, thus, would not undergo review through the Section 7 consultation process.

Increases in urbanization and housing developments can affect habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Increased growth would place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure, such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions would not require federal permits and, thus, would not undergo review through the Section 7 consultation process. Adverse effects on Chinook salmon, steelhead, green sturgeon, and their critical habitat may result from urbanization-induced point- and non-point–source chemical contaminant discharges within the action area. These contaminants include, but are not limited to, ammonia and free ammonium ion, numerous pesticides and herbicides, and oil and gasoline product discharges.

## 5.8.4 Recreational Activities in the Region

Increased urbanization is also expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency are recreational boating and fishing. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially would degrade riparian and wetland habitat by eroding channel banks and midchannel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments, thereby potentially resuspending contaminated sediments and degrading areas of submerged vegetation. This, in turn, would reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids and green sturgeon moving through the system. Increased recreational boat operation in the Delta is anticipated to result in more contamination from the operation of gasoline- and diesel-powered engines on watercraft entering the water bodies of the Delta.

## 5.8.5 Wastewater Treatment Plants

In order to comply with Order no. R5-2013-0124, the Sacramento Regional Wastewater Treatment Plant implemented compliance measures to reduce ammonia discharges. There were concerns that these discharges could be associated with direct ammonia toxicity to delta smelt and other species, prompting various studies (e.g., Werner et al. 2008). In addition to concerns about direct toxicity of ammonia to delta smelt, another important concern was that ammonium inputs affected the delta smelt food web by suppressing diatom blooms in the Delta and Suisun Bay (see summary of relevant

literature by Interagency Ecological Program, Management, Analysis, and Synthesis Team (2015:71), although a recent study did not find evidence supporting this mechanism (Strong et al. 2021). To the extent that such direct (i.e., toxicity) and indirect (i.e., food web suppression) effects were previously occurring, the recent completion of upgrades at the Sacramento Regional Wastewater Treatment Plant largely eliminated ammonia discharge and, therefore, the potential for negative effects.

### 5.8.6 Activities within the Nearshore Pacific Ocean

Future tribal, state, and local government actions would likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. Activities that are primarily conducted under state, tribal or federal government management may include changes in ocean policy and increases and decreases in the types of activities that currently occur, including changes in the types of fishing activities, resource extraction, or designation of marine protected areas, any of which could affect listed species or their habitat. Government actions are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope, which encompasses several government entities exercising various authorities, and the changing economies of the region, make analysis of cumulative effects speculative.

### 5.8.7 Other Activities

Other future, nonfederal actions within the action area that are likely to occur and may adversely affect winter-run Chinook salmon, spring-run Chinook salmon, Central Valley steelhead, and green sturgeon and their critical habitat include: the dumping of domestic and industrial garbage that decreases water quality; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; and state or local levee maintenance that may also destroy or adversely affect habitat and interfere with natural, long-term habitat-maintaining processes. However, these projects are likely to include BMPs and are regulated to avoid impacts on aquatic habitat.

### 5.8.8 Climate Change

The anticipated effects of climate change on the San Francisco Estuary and watershed, such as warmer water temperatures, greater salinity intrusion, lower snowpack contribution to spring outflows from the Delta, and the potential for frequent extreme drought (Knowles and Cayan 2002; Dettinger 2005), indicate challenges to salmonid and green sturgeon populations. Chinook salmon in the Central Valley are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats can support salmonid life stages (National Marine Fisheries Service 2019:152). This has been illustrated to result in the potential for populations being unlikely to persist (Thompson et al. 2012).

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# Chapter 6
# Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species

The following analyses describe effects of the proposed action on species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) to inform project-specific and programmatic consultation under Section 7(a)(1) of the federal Endangered Species Act (ESA). Activities subject to project-specific review include field investigations (e.g., geotechnical surveys and testing), conveyance facility construction and maintenance, and habitat creation and enhancement activities at the Bouldin Island and Interstate (I-) 5 ponds initial mitigation sites. Conveyance facility operations, tidal restoration, channel margin enhancement, and non-bank sites activities are subject to programmatic review. In the future, when project-specific detail is available for these activities, additional "step down" consultation will occur. Because the effects were evaluated first under programmatic consultation, the project-specific review would likely occur more expeditiously. See Chapter 1, *Introduction*, Section 1.7, *Consultation Approach*, for additional detail.

## 6.1 Effects on Delta Smelt

Potential effects of the proposed action on delta smelt are discussed for construction activities and conservation measures. Cumulative effects are also discussed. Proposed operations of the proposed action are described in Appendix 7A, *Framework Programmatic Assessment for the Delta Conveyance Project and Sites Reservoir Project*. Operations and maintenance of the proposed action are assessed at a programmatic level for this BA; detailed effects analyses, as well as the qualitative, cumulative, and programmatic analyses that they inform, are presented in Appendix 5C, *Operations and Maintenance Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, and Appendix 6C, *Operations and Maintenance Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species*. Analyses were developed in consideration of habitat attributes believed to be of importance to the species based on existing conceptual models (e.g., Interagency Ecological Program Management, Analysis, and Synthesis Team 2015; see summary by California Department of Water Resources 2020a:4–119) and best available methods (e.g., ICF International 2016a; U.S. Fish and Wildlife Service 2017a).

Throughout the delta smelt analysis, impacts based on life stage (migrating adults, spawning adults, eggs/embryos, larvae/young juveniles, and juveniles) are discussed. Details related to delta smelt life stage and occurrences can be found in Chapter 4, *Action Area and Environmental Baseline*, Section 4.4.7, *Delta Smelt*. Table 4.4.7-1 summarizes the average annual frequency of delta smelt occurrence by life stage and location, based on a review of historical monitoring data.

## 6.1.1 Effects of Construction Activities on Delta Smelt

The sections below discuss potential effects on delta smelt from construction activities. The timing of in-water work during a June–October work window avoids adult migration (December–March) and limits temporal overlap with spawning adults (February–June), eggs/embryos (March–June), and larvae/young juveniles (March–June). Although there is greater temporal overlap with juveniles (~July–December), there would be very limited spatial overlap because delta smelt juveniles would have moved downstream.[1] Given the location of the north Delta intakes upstream of the main range of delta smelt, there would be limited spatial overlap with construction locations in any case.

### 6.1.1.1 Turbidity and Suspended Sediment

Construction of the proposed action would result in the generation and release of suspended sediments to the water column, temporarily increasing water-column turbidity above ambient levels and altering aquatic habitat conditions. Turbidity-producing construction activities include bed and bank disturbance during cofferdam and log boom installation, dredging prior to riprap placement adjacent to the new intake locations, and the placement of bed and bank riprap armoring at the new intake locations in the north Delta (see Figure 3.1-1 in Chapter 3, *Description of the Proposed Action*). In-water work associated with riprap would have greater relative effects on turbidity than the other activities but would be limited to one season at each intake. Propeller wash associated with boat traffic at the intake sites during dredging and placement of riprap may also produce localized turbidity pulses, depending on location. Increases in turbidity and suspended sediment levels associated with these activities would be temporary and localized and unlikely to reach levels causing direct injury or mortality to delta smelt, as discussed further below.

Little is known about the sensitivity of delta smelt to turbidity and suspended sediment. In general, delta smelt are adapted to turbid waters, where they presumably benefit from increased feeding efficiency and avoidance of sight-feeding predators. In laboratory experiments, the feeding rates of delta smelt were found to be highest generally at turbidities less than or equal to 12 Nephelometric Turbidity Units (NTU), relatively persistent over a broad range of turbidities (12-120 NTU), and showed a strong decline at 250 NTU (Hasenbein et al. 2013). This finding is consistent with monitoring data that shows that delta smelt are often captured in turbidities between 10 and 50 NTU (Feyrer et al. 2007).

During in-water construction activities at the proposed intake sites, turbidity and suspended sediment levels in the river are anticipated to be greater than ambient river levels in the immediate vicinity of these activities, creating turbidity plumes that may extend several hundred feet downstream of construction activities. The National Marine Fisheries Service (NMFS) (2008) reviewed observations of turbidity plumes during installation of riprap for bank protection projects along the Sacramento River and concluded that visible plumes are expected to be limited only to a portion of the channel width, extend no more than 1,000 feet downstream, and dissipate within hours of cessation of in-water activities. Based on these observations, NMFS concluded that such activities could result in turbidity levels exceeding 25–75 NTUs. These levels would not be expected to adversely affect delta smelt based on the general association and feeding responses of delta smelt to turbidity (Hasenbein et al. 2013). However, under the assumption that there could be some effect up to 1,000 feet downstream from each intake, this could temporarily affect 1.7 acres of tidal

[1] Refer to AMM-14: *Construction Best Management Practices for Biological Resources*, for additional details on timing practices.

perennial habitat at Intake B and 2.5 acres of tidal perennial habitat at Intake C, although with limited temporal overlap for spawning adult delta smelt and early life stages (eggs/embryos; larvae/early juveniles) based on the work occurring at earliest in June.

Increases in suspended sediment during in-water construction activities may result in localized sediment deposition in the vicinity of the proposed intakes, degrading potential spawning habitat of delta smelt through burial of suitable substrates. However, the Sacramento River in the vicinity of the proposed intake sites likely does not support significant spawning of delta smelt because of the low quality of spawning habitat in the action area. There appears to be little or no habitat thought to be preferred by delta smelt for spawning in this reach, which is dominated by steep levee slopes, existing riprap, and low quantities of riparian and aquatic vegetation. Delta smelt eggs and embryos are demersal and adhesive, attaching to substrates with an adhesive stalk formed by the outer layer of the egg (Bennett 2005). Although the potential for exposure is low, individual eggs occurring in the vicinity of construction could be subject to burial by the deposition of suspended sediment that in-water construction activities generate.

#### 6.1.1.2 Contaminants

Construction of the north Delta intakes poses an exposure risk to delta smelt from potential spills of hazardous materials from construction equipment, barges and towing vessels, and other machinery and from potential mobilization of contaminated sediment. The risk of accidental spills of contaminants and other hazardous materials would exist throughout the construction period but would be highest during in-water construction activities due to the proximity of construction activities to the Sacramento River.

Construction of the north Delta intakes could result in accidental spills of contaminants, including oil, fuel, hydraulic fluids, concrete, and other construction-related materials, resulting in localized water-quality degradation and potential adverse effects on delta smelt. Potential effects of contaminants on fish include direct injury and mortality (e.g., damage to gill tissue causing asphyxiation) or delayed effects on growth and survival (e.g., increased stress or reduced feeding), depending on the type of contaminant, extent of the spill, and exposure concentrations. The risk of such effects is highest during in-water construction activities. The north Delta intakes involve extensive work, albeit with much of the work occurring inside a cofferdam. There is some potential for spills during drilled shaft work, cofferdam-support installation, excavation of the cofferdam, and tremie pours of concrete (although additional concrete would be poured into the concrete base, thereby minimizing the potential for concrete mixing with water within the cofferdam prior to dewatering), but once cofferdams are installed and dewatered, any spills within the cofferdam essentially would preclude movement of spill materials into the river because of river water pressure on the cofferdams. Other construction elements that occur in upland areas or are isolated from fish-bearing waters have little potential for accidental spills that could affect delta smelt.

As described in Chapter 3, Section 3.6, *Conservation Measures*, and Appendix 3A, *General Avoidance and Minimization Measures* (AMMs), AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*, are expected to minimize the potential for contaminant spills and guide rapid and effective response in the case of inadvertent spills of hazardous materials. With implementation of these and other required construction best management practices (BMPs) (e.g., AMM-4b: *Develop and Implement Stormwater Pollution Prevention Plans*), the risk of contaminant spills or discharges

to the Sacramento River from in-water or upland sources effectively would be minimized and avoided, respectively.

Contaminants may also enter the aquatic environment through disturbance, resuspension, or discharge of contaminated soil and sediments from construction sites. Sediments act as a *sink*, or source of contaminant exposure, depending on local hydrologic conditions, habitat type, and frequency of disturbance. Sediment is a major sink for more persistent chemicals that have been introduced into the aquatic environment, with most organic and inorganic anthropogenic chemicals and waste materials accumulating in sediment (Ingersoll et al. 1995). Thus, resuspension of contaminated sediments may have adverse effects on fish that encounter sediment plumes or come into contact with deposited or newly exposed sediment. Suspended sediment can also affect fish adversely by causing localized increases in chemical oxygen demand in waters in or near plumes.

The proposed intake sites are downstream of the City of Sacramento, where sediments have been affected by historical and current urban discharges from the city. No information on sediment contaminants at these sites are currently available. Metals, polychlorinated biphenyls, and hydrocarbons (typically oil and grease) are common urban contaminants that are introduced to aquatic systems via nonpoint-source stormwater drainage, industrial discharges, and municipal wastewater discharges. Many of these contaminants readily adhere to sediment particles and tend to settle out of solution relatively close to the primary source of contaminants. Polychlorinated biphenyls are persistent, adsorb to soil and organic matter, and accumulate in the foodweb. Lead and other metals also would adhere to particulates and can bioaccumulate to levels sufficient to cause adverse biological effects. Mercury is also present in the Sacramento River system and could be sequestered in riverbed sediments. Hydrocarbons biodegrade over time in an aqueous environment and do not tend to bioaccumulate or persist in aquatic systems.

Exposure of fish to contaminants as a result of spills or sediment disturbance can cause effects that range from physiological stress (potentially resulting in delayed effects on growth, survival, and reproductive success) to direct mortality (i.e., acute toxicity), depending on the concentration, toxicity, solubility, bioavailability, and duration of exposure, as well as the sensitivity of the exposed organisms. For example, delta smelt are highly sensitive to sublethal levels of pyrethrin, which causes neurological damage and results in impaired swimming ability and can have potential effects on chemosensory abilities (Connon et al. 2009). Such impairments may affect the ability of delta smelt to swim against tides or water currents, increasing their susceptibility to predation and lowering their ability to find food (Connon et al. 2009). Chemosensory impairment may also affect the ability of delta smelt to detect pheromones and find mates (Connon et al. 2009). In addition, contaminants can enter the aquatic food web and accumulate in fish through their diet, leading to adverse effects on behavior, tissues and organs, reproduction, growth, and immune system (Connon et al. 2009).

As previously noted, the timing of in-water construction activities (June 1–October 31) would avoid the delta smelt adult migration season and much of the spawning/early life stage period. Some risk would exist outside the in-water construction period. However, with the implementation of proposed pollution-prevention and erosion- and sediment-control AMMs, there is minimal risk of exposure of delta smelt to contaminants.

#### 6.1.1.3 Underwater Noise

Underwater noise would be generated by a variety of construction activities, including pile driving, tugboat operations, dredging, geotechnical investigations, riprap placement, and tunnel boring machine (TBM) activities. Impact pile driving in or near aquatic habitat generates sound levels that can injure or kill fish and other aquatic organisms. The proposed action includes physical or structural components that would require vibratory or impact driving of temporary and permanent piles during construction. Several of these components involve pile-driving activities within or adjacent to waterbodies supporting fish and aquatic species, resulting in potential exposure of species to pile-driving noise. The analysis below uses conservative estimates of impact pile driving based on available geotechnical data in references cited below.

Research indicates that impact pile driving can result in significant impacts on fish because of the high level of underwater sound produced (Popper and Hastings 2009:464–480). The effects of pile-driving noise on fish may include behavioral responses, physiological stress, temporary and permanent hearing loss, tissue damage (auditory and non-auditory), and direct mortality. Factors that may influence the magnitude of effects include species, life stage, and size of fish, type and size of pile and hammer, frequency and duration of pile driving, site characteristics (e.g., depth), and distance of fish from the noise source.

Dual interim criteria have been established to provide guidance for assessing the potential for injury of fish resulting from pile-driving noise (Fisheries Hydroacoustic Working Group 2008:1) and were used in the present analysis. The dual criteria for impact pile driving are (1) 206 decibels[2] (dB for the peak sound pressure level (SPL); and (2) 187 dB for the cumulative sound exposure level ($SEL_{cumulative}$) for fish larger than 2 grams, and 183 dB ($SEL_{cumulative}$) for fish smaller than 2 grams. The *peak SPL* is considered the maximum sound pressure level a fish can receive from a single strike without injury. $SEL_{cumulative}$ is considered the total daily amount of acoustic energy that a fish can receive from single or multiple strikes without injury. The $SEL_{cumulative}$ threshold is based on the cumulative daily exposure of a fish to noise from sources that are discontinuous (i.e., noise that occurs only for about 8 to 12 hours in a day, with 12 to 16 hours between exposure). This assumes that the fish is able to recover from such effects during this 12- to 16-hour "rest" period. These criteria relate to impact pile driving only. Vibratory pile driving is generally accepted as an effective measure for minimizing or eliminating the potential for injury of fish during in-water pile-driving operations, with only impact pile driving expected to produce sound levels that could injure fish (National Marine Fisheries Service 2015:50). The potential for physical injury to fish from exposure to impact pile-driving sounds was evaluated using a spreadsheet model NMFS developed[3] to calculate the distances from the pile that sound attenuates to the peak or cumulative criteria. These distances define the area in which the criteria are expected to be exceeded as a result of impact pile driving. The NMFS spreadsheet calculates these distances based on estimates of the single-strike sound levels for each pile type (measured at 10 meters from the pile) and the rate at which sound attenuates with distance. In the following analysis, the standard sound attenuation rate of 4.5 dB per

[2] Where sound levels in decibels (dB) are referenced in this analysis, they are made relative to 1 micropascal (1 μPa, for peak and root mean square pressure) and 1 micropascal-squared-second (1 $\mu Pa^2 s$, for sound exposure level).
[3] The spreadsheet was downloaded from https://www.fisheries.noaa.gov/southeast/consultations/section-7-consultation-guidance on February 4, 2021.

doubling of distance was used in the absence of other data.[4] To account for the exposure of fish to multiple pile-driving strikes, the model computes $SEL_{cumulative}$ for multiple strikes based on the single-strike sound exposure level (SEL) and the number of strikes per day or pile-driving event. The NMFS spreadsheet also employs the concept of "effective quiet." This assumes that cumulative exposure of fish to pile-driving sounds of less than 150 dB SEL does not result in injury or behavioral modification.

The following analysis also considers the potential for pile-driving sound to affect fish behavior adversely. Potential mechanisms include startle or avoidance responses that can disrupt or alter normal activities (e.g., migration, holding, feeding) or expose individuals to increased predation risk. Insufficient data are available currently to support the establishment of a noise threshold for behavioral effects (Hastings and Popper 2005:46; Popper and Hastings 2009:464). NMFS, however, has concluded that a noise level of 150 dB root mean square (RMS) is an appropriate threshold for behavioral effects (California Department of Transportation 2015:4-23), so this value is used in the present analysis.

The following analysis uses peak SPLs and SELs measured during similar pile-driving operations[5] as a basis for estimating the distances at which sound levels would be expected to exceed the interim injury and behavioral thresholds (California Department of Transportation 2015). The following assessment presents the effect that is reasonably foreseeable based on the use of an impact driver with no attenuation (e.g., bubble curtains). Assumptions for the pile-driving analysis were developed based on the expected impact pile driving at each intake, as described in the Conceptual Intake Cofferdam Construction Technical Memorandum (Delta Conveyance Design and Construction Authority 2022c). The assumptions reflect use of impact pile driving to the extent necessary when other methods (e.g., vibratory pile driving) are not able to complete construction requirements. An analysis of impact pile-driving noise was also conducted for the test-pile program, based on three types of piles[6] being tested at a single site.

The pile-driving analysis for the test-pile program reflected one pile of each type on three separate days at a single site. The analysis indicated that the distance to sound-level thresholds would range from 28 feet (206 dB) to 24,135 feet (150 dB) (Table 6.1-1). The area of effect, accounting for attenuation of sound by land at river bends (California Department of Transportation 2020a:4-32), ranges from 0.06 acre (206-dB threshold for sheet and steel pipe piles) to ~59 acres (150-dB threshold for H piles) (Table 6.1-1; Figure 6.1-1, Figure 6.1-2, and Figure 6.1-3). The duration of the test-pile impact driving at a single intake site would be 3 days (one day for each pile type; Table 6.1-1), although the actual duration of impact pile driving would be short (~2 minutes per pile; Delta Conveyance Design and Construction Authority 2022c).

[4] A sound attenuation rate of 4.5 dB per doubling of distance is equivalent to a transmission loss constant of 15, the default value in the NMFS spreadsheet; the NMFS spreadsheet indicates this value is to be used when site-specific values are unknown (as is the case in the present analysis).

[5] Specifically, the assumed sound levels used for each intake were for 24-inch AZ® sheet piles in 15 meters of water. Although the intake sites are shallower than 15 meters, available sound-level data for pile driving are not available for the specific depths and pile type likely to be used for construction; however, an assumption of 15 meters of depth is conservative given that attenuation with distance is greater in shallower water (California Department of Transportation 2015:4-21).

[6] The assumed sound levels were for a 24-inch AZ® sheet pile in 15 meters of water, a 30-inch steel pipe pile in 4–5 meters of water, and a 14-inch H pile in 6 meters of water.

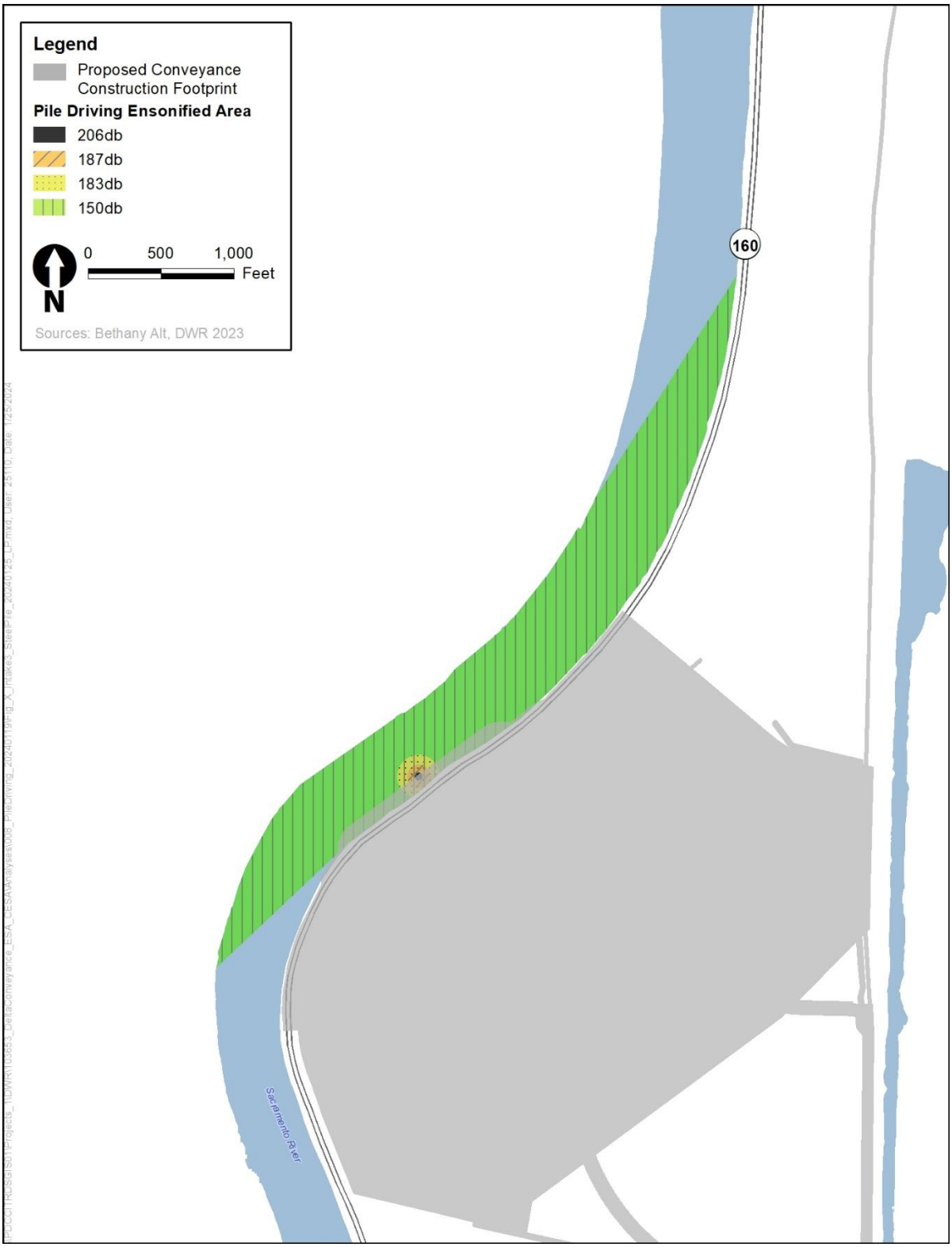
**Table 6.1-1. Assumptions and Estimates of Impact Pile-Driving Distance and Area of Acoustic Effect at a Single Intake Site for the Test-Pile Program**

| Variable | Sheet Pile Pair | Steel Pipe Pile | H Pile |
|---|---|---|---|
| Number of piles | 1 | 1 | 1 |
| Number of piles per day | 1 | 1 | 1 |
| Number of days of pile driving | 1 | 1 | 1 |
| Number of strikes per pile | 19 | 19 | 19 |
| Number of strikes per day | 19 | 19 | 19 |
| Peak single-strike sound level at 10 meters [33 feet] (dB) | 205 | 205 | 208 |
| Sound exposure level at 10 meters [33 feet] (SEL, dB) | 180 | 180 | 177 |
| Root mean square at 10 meters [33 feet] (RMS, dB) | 190 | 190 | 193 |
| Distance to 206-dB threshold (feet) [a] | 28 | 28 | 45 |
| Distance to 187-dB threshold (feet) [a] | 80 | 80 | 50 |
| Distance to 183-dB threshold (feet) [a] | 147 | 147 | 93 |
| Distance to 150-dB threshold (feet) [a] | 15,228 | 15,228 | 24,135 |
| Area of 206-dB threshold (acres) | 0.06 | 0.06 | 0.15 |
| Area of 187-dB threshold (acres) | 0.46 | 0.46 | 0.18 |
| Area of 183-dB threshold (acres) | 1.28 | 1.28 | 0.60 |
| Area of 150-dB threshold (acres) | 58.41 | 58.41 | 58.64 |

Note: Assumed testing would occur at Intake B.
dB = decibel; RMS = root mean square; SEL = sound exposure level.
[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going round corners at the bends in the river), which is accounted for in the area estimates given in the table.

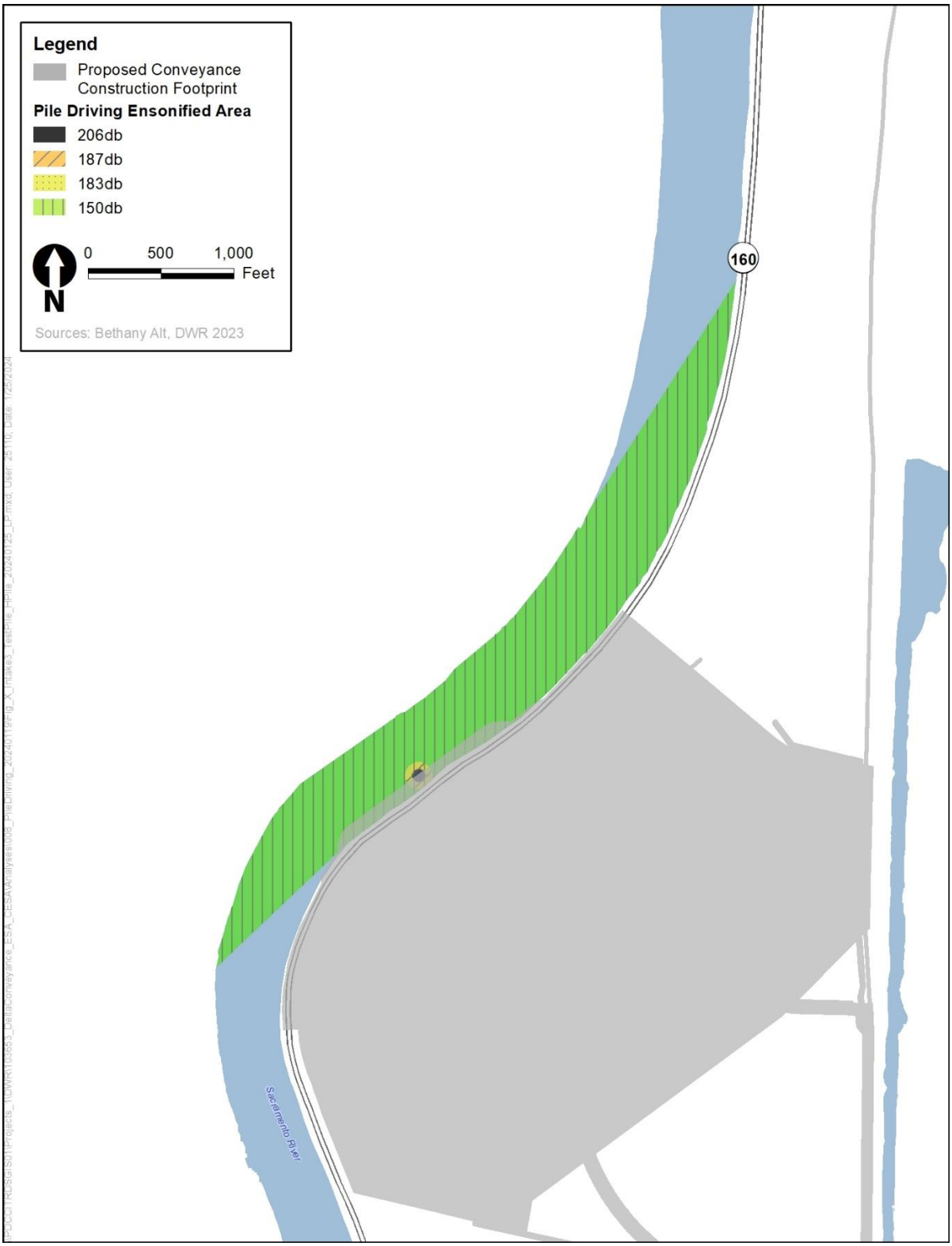
Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-1. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for the Test Pile Program, Sheet Pile Pair**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-2. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for the Test Pile Program, Steel Pipe Pile**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-3. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for the Test Pile Program, H Pile**

The pile-driving analysis for construction of the cofferdams and training walls indicated that the distance to sound-level thresholds would range from 28 feet (206 dB) to 15,228 feet (150 dB) (Table 6.1-2; Figure 6.1-4 and Figure 6.1-5). The area of effect, accounting for attenuation of sound by river bends, ranges from 0.06 acre (206-dB threshold) to 134.10 (150-dB threshold at Intake C) (Table 6.1-2).

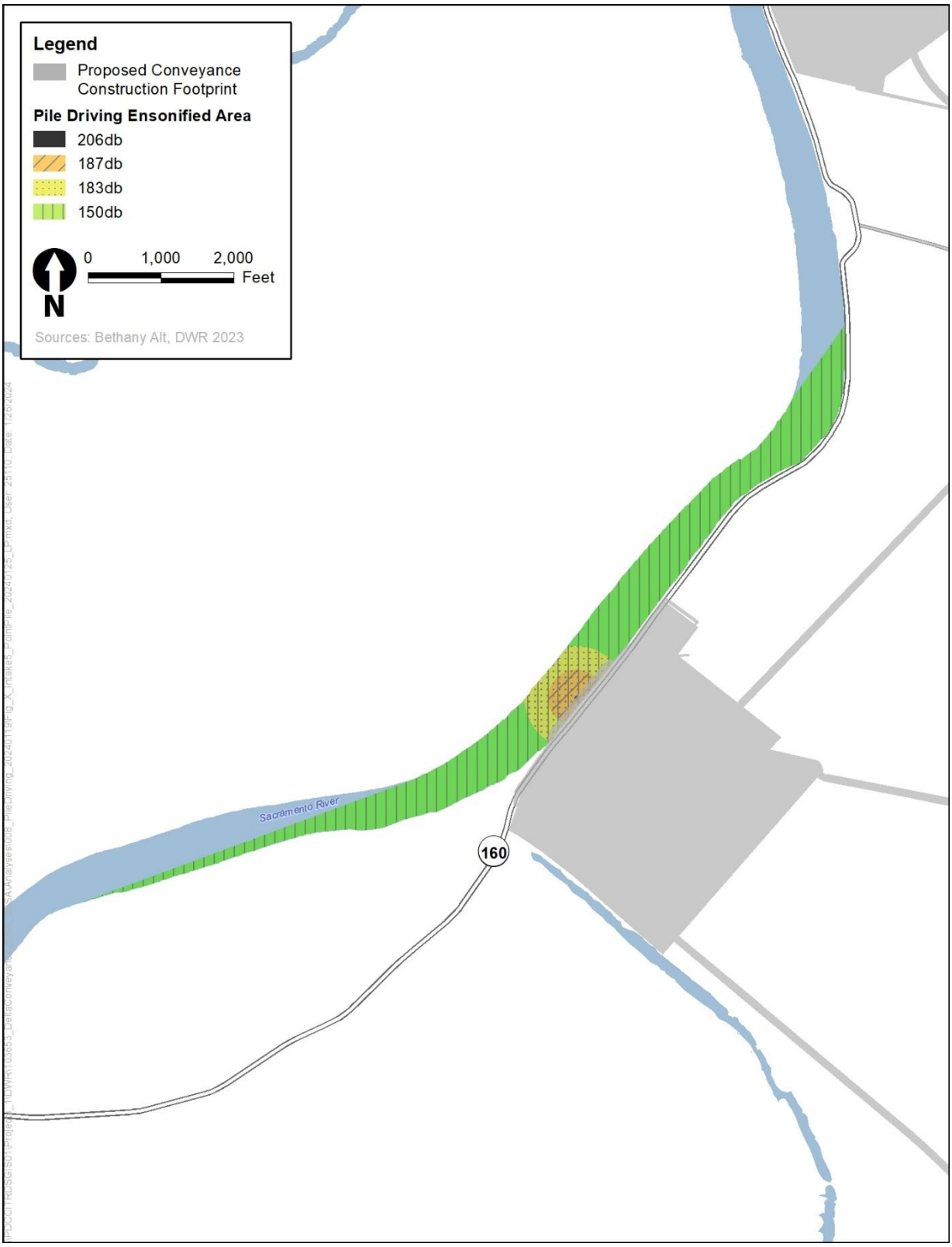
**Table 6.1-2. Assumptions and Estimates of Impact Pile-Driving Distance and Area of Acoustic Effect at Each Intake for Construction of Cofferdams and Training Walls**

| Variable | Intake B | Intake C |
|---|---|---|
| Number of piles (pairs) | 420 | 410 |
| Number of piles per day | 20 | 20 |
| Number of days of pile driving | 21 | 21 |
| Number of strikes per pile | 19 | 10 |
| Number of strikes per day | 380 | 200 |
| Peak single-strike sound level at 10 meters [33 feet] (dB) | 205 | 205 |
| Sound exposure level at 10 meters [33 feet] (SEL, dB) | 180 | 180 |
| Root mean square at 10 meters [33 feet] (RMS, dB) | 190 | 190 |
| Distance to 206-dB threshold (feet) [a] | 28 | 28 |
| Distance to 187-dB threshold (feet) [a] | 588 | 383 |
| Distance to 183-dB threshold (feet) [a] | 1,086 | 708 |
| Distance to 150-dB threshold (feet) [a] | 15,228 | 15,228 |
| Area of 206-dB threshold (acres) | 0.06 | 0.06 |
| Area of 187-dB threshold (acres) | 12.30 | 6.72 |
| Area of 183-dB threshold (acres) | 25.06 | 18.47 |
| Area of 150-dB threshold (acres) | 67.69 | 134.10 |

dB = decibel; RMS = root mean square; SEL = sound exposure level.
[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going round corners at the bends in the river), which is accounted for in the area estimates given in the table.

Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-4. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for Construction of Cofferdams and Training Walls**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-5. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake C for Construction of Cofferdams and Training Walls**

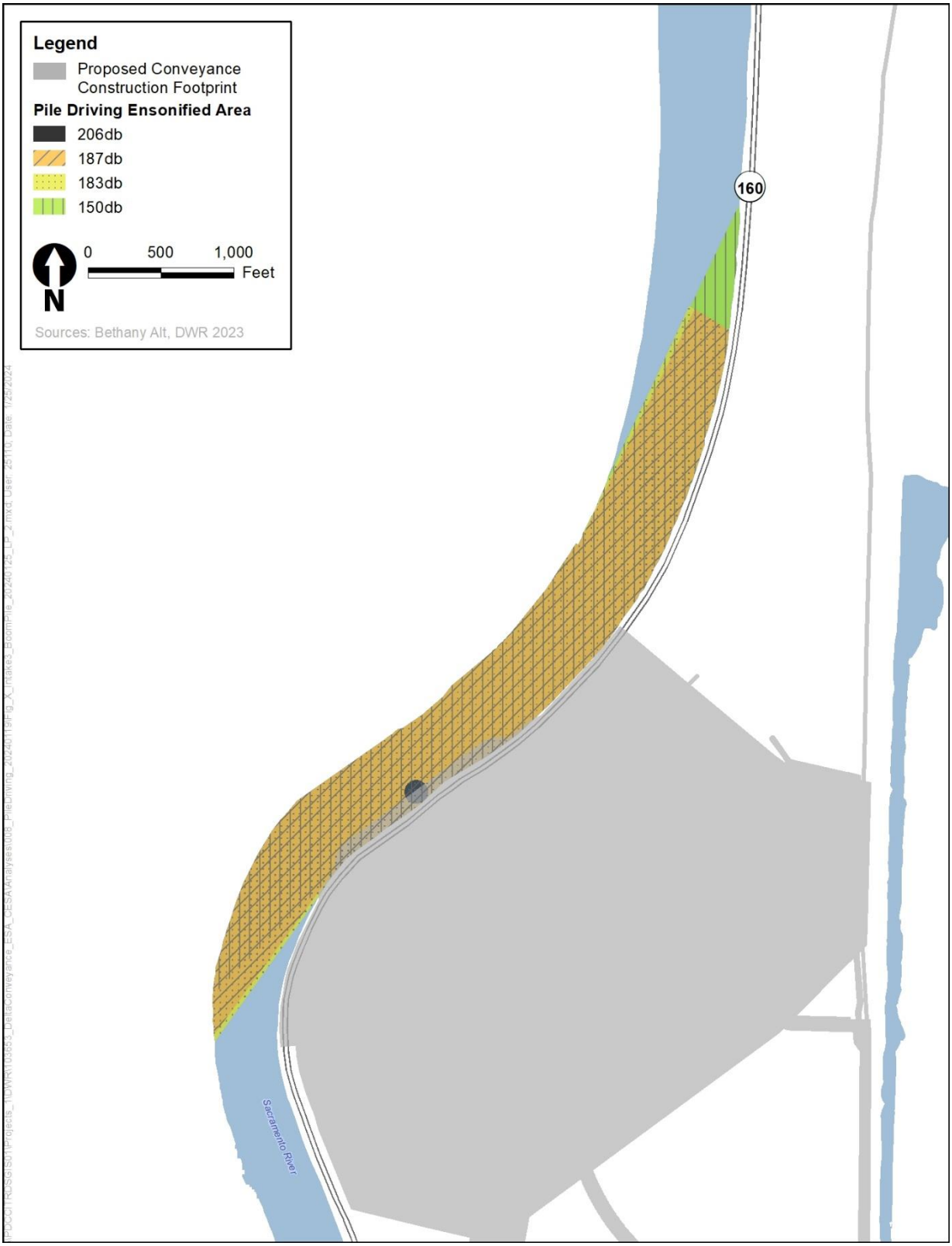
To install steel pipe piles to support the floating log boom, 2 to 4 days of pile driving would be required during the final year of construction. Existing geotechnical information suggests that all log-boom piles could be vibrated into place without the need for any impact pile driving, but this analysis used a conservative estimate of impact pile driving that could be required. This analysis indicated that the distance to sound-level thresholds would range from 82 feet (206 dB) to 13,061 feet (150 dB) (Table 6.1-3). Accounting for attenuation of sound by land at river bends, the area of effect ranges from 0.5 acre (206-dB threshold at Intakes B and C) to nearly 118 acres (150-dB threshold at Intake C) (Table 6.1-3; Figure 6.1-6 and Figure 6.1-7).

**Table 6.1-3. Assumptions and Estimates of Impact Pile-Driving Distance and Area of Acoustic Effect at Each Intake for Construction of Log Booms**

| Variable | Intake B | Intake C |
|---|---|---|
| Number of piles | 32 | 32 |
| Number of piles per day | 10 | 10 |
| Number of days of pile driving | 4 | 4 |
| Number of strikes per pile | 504 | 66 |
| Number of strikes per day | 5,040 | 660 |
| Peak single-strike sound level at 10 meters [33 feet] (dB) | 212 | 212 |
| Sound exposure level at 10 meters [33 feet] (SEL, dB) | 181 | 181 |
| Root mean square at 10 meters [33 feet] (RMS, dB) | 189 | 189 |
| Distance to 206-dB threshold (feet) [a] | 82 | 82 |
| Distance to 187-dB threshold (feet) [a] | 3,825 | 990 |
| Distance to 183-dB threshold (feet) [a] | 3,825 | 1,830 |
| Distance to 150-dB threshold (feet) [a] | 13,061 | 13,061 |
| Area of 206-dB threshold (acres) | 0.5 | 0.5 |
| Area of 187-dB threshold (acres) | 66.4 | 27.2 |
| Area of 183-dB threshold (acres) | 66.4 | 51.7 |
| Area of 150-dB threshold (acres) | 69.3 | 117.9 |

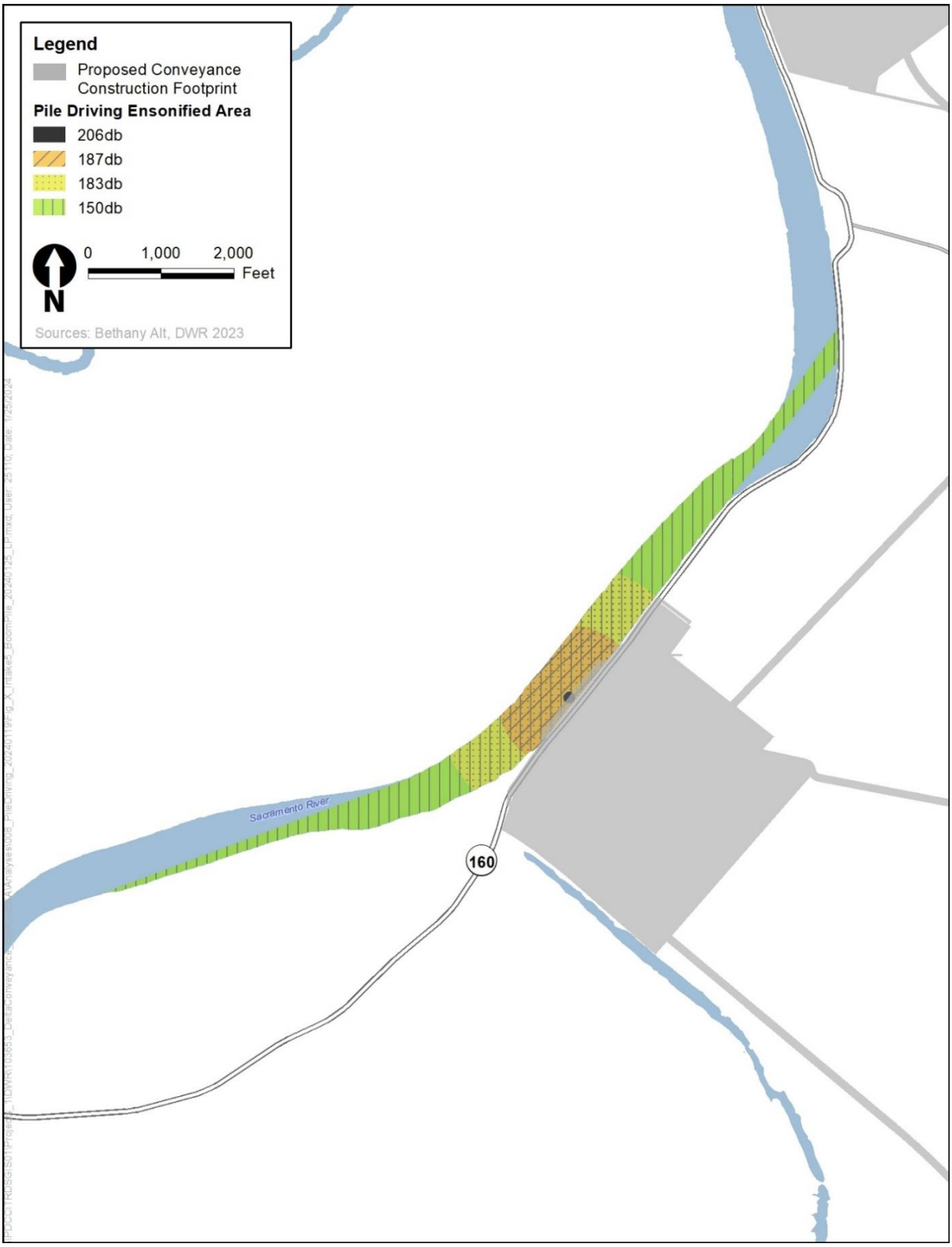
dB = decibel; RMS = root mean square; SEL = sound exposure level.

[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going around corners at the bends in the river), which is accounted for in the area estimates given in the table.




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-6. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake B for Construction of Log Booms**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-7. Estimates of Area of Acoustic Effect (Ensonified Area) at Intake C for Construction of Log Booms**

Restricting pile driving to June 1–October 31 at the north Delta intakes would avoid the adult delta smelt migration period (December–March) and most of the delta smelt spawning (February–June) and early life stages (March–June) seasons, although some potential for exposure of would occur in June. As noted above, fish smaller than 2 grams are more sensitive to underwater noise than larger individuals and may experience injury at 183 dB (Fisheries Hydroacoustic Working Group 2008). Larval and juvenile delta smelt generally are smaller than 2 grams, whereas adults average 2 to 3 grams (Foott and Bigelow 2010). Because some adult delta smelt are less than 2 grams, the lower injury threshold (183 dB) applies to this life stage, as well. As illustrated above, areas of habitat near the north Delta intakes that could be affected by pile driving at the 183-dB threshold ranged from 0.6 to 1.3 acres for the test-pile program (Table 6.1-1), 18.5 to 25.1 acres for construction of cofferdams and training walls (Table 6.1-2), and 51.7 to 66.4 acres for construction of log booms (Table 6.1-3).

In addition to the timing of the in-water work window to avoid delta smelt, potential exposure of the population to pile-driving noise would be minimized further by implementation of an underwater sound control and abatement plan (Appendix 3A and AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan*) that includes best available and practicable methods such as vibratory pile driving, attenuation devices, and other potential physical and operational measures (e.g., starting impact pile driving at lower levels of intensity to allow fish to leave the area before the intensity is increased) to avoid or minimize impacts on delta smelt. This plan would also include hydroacoustic monitoring and compliance requirements[7] that would be developed in coordination with USFWS, NMFS, and California Department of Fish and Wildlife (CDFW) to avoid and minimize potential impacts on listed fish species.

Pile driving would also be required at two bridge crossings (Table 6.1-4). Accounting for attenuation of sound by river bends, the area of effect ranges from 0.04 acre (206-dB threshold at Snodgrass Slough) to 12.37 acres (150-dB threshold at Burns Cutoff) (Table 6.1-4; Figure 6.1-8 and Figure 6.1-9). The location of this work likely has very little spatial overlap with delta smelt life stages because the Snodgrass Slough location is located far from the main tidally influenced channels through which most delta smelt likely move[8] and Burns Cutoff is in the south Delta, an area with few if any delta smelt occurring during the in-water work window (see, for example, Murphy and Hamilton 2013:Figures 3 and 4).

[7] As described in AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan* in Appendix 3A, where impact pile driving is required, DWR will monitor underwater sound levels and require compliance with underwater noise thresholds at a distance appropriate for protection of the species based on the results from calculations to be provided in the underwater sound control and abatement plan.

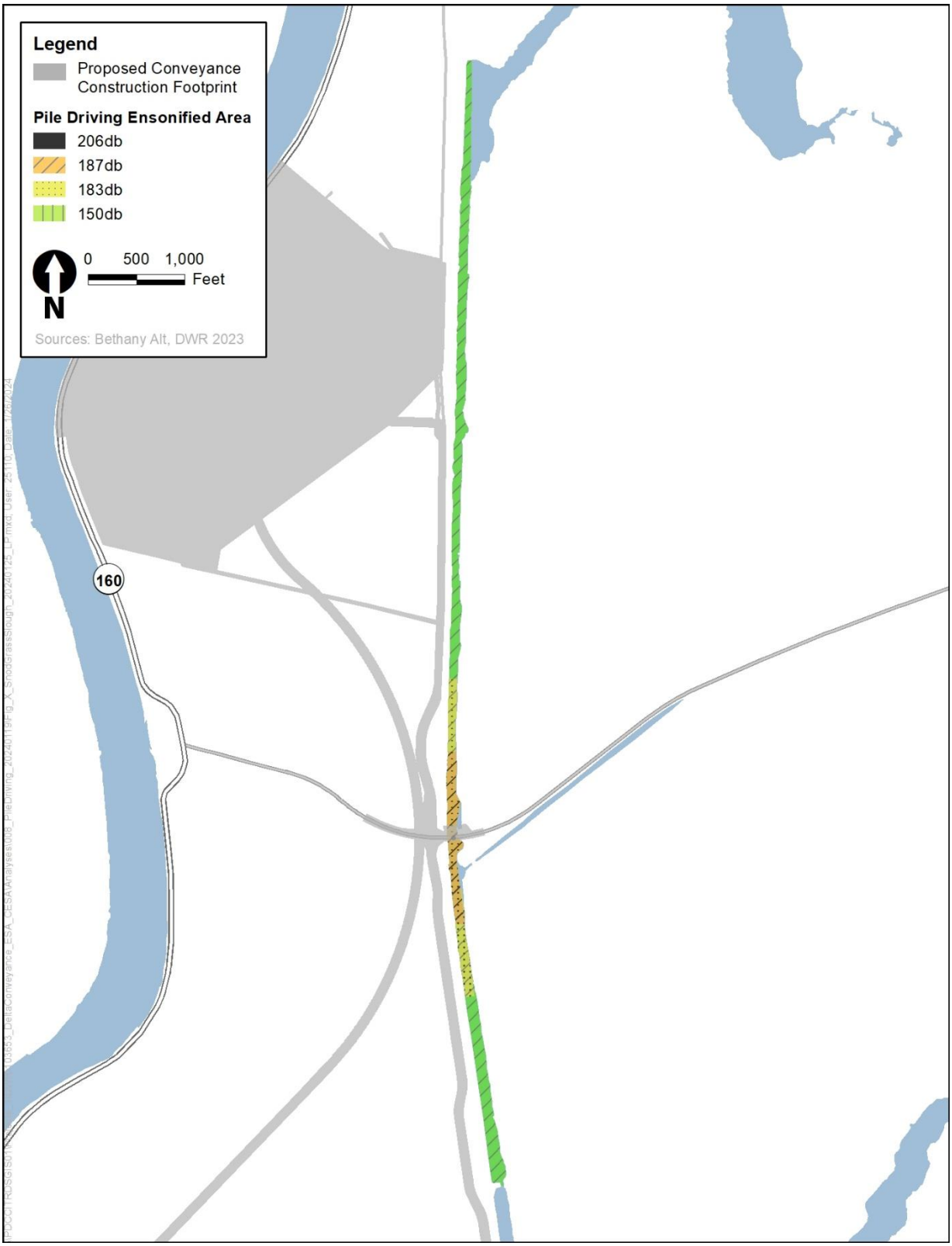
[8] For example, the site is approximately 7 miles upstream/inland from the junction of Snodgrass Slough with the lower Mokelumne River.

**Table 6.1-4. Assumptions and Estimates of Impact Pile-Driving Distance and Area of Acoustic Effect at Each Bridge Crossing**

| Variable | Snodgrass Slough | Burns Cutoff |
|---|---|---|
| Pile diameter (steel pipe, inches) | 16 | 24 |
| Number of piles | 26 | 50 |
| Number of piles per day | 6 | 6 |
| Number of days of pile driving | 5 | 9 |
| Number of strikes per pile | 150 | 150 |
| Number of strikes per day | 900 | 900 |
| Peak single-strike sound level (dB) | 204 | 212 |
| Sound exposure level (SEL, dB) | 179 | 181 |
| Root mean square (RMS, dB) | 189 | 189 |
| Distance to 206-dB threshold (feet)[a] | 24 | 82 |
| Distance to 187-dB threshold (feet)[a] | 896 | 1,217 |
| Distance to 183-dB threshold (feet)[a] | 1,655 | 2,249 |
| Distance to 150-dB threshold (feet)[a] | 13,061 | 13,061 |
| Area of 206-dB threshold (acres) | 0.04 | 0.47 |
| Area of 187-dB threshold (acres) | 4.12 | 12.38 |
| Area of 183-dB threshold (acres) | 7.34 | 12.36 |
| Area of 150-dB threshold (acres) | 25.45 | 12.37 |

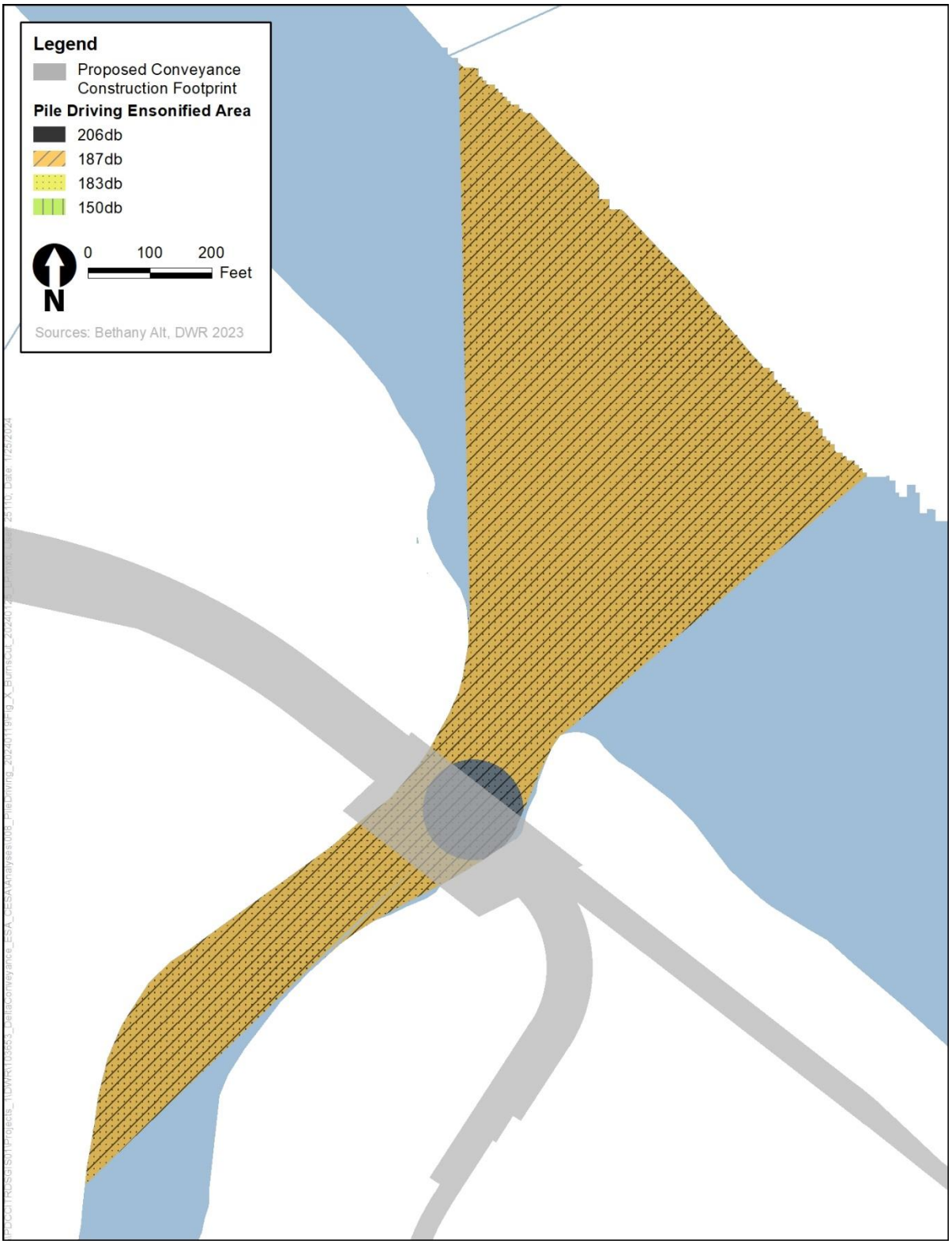
dB = decibel; RMS = root mean square; SEL = sound exposure level.

[a] Note that this distance does not account for sound attenuation by site configuration (e.g., sound not going round corners at the bends in the river), which is accounted for in the area estimates given in the table.




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-8. Estimates of Area of Acoustic Effect (Ensonified Area) at Snodgrass Slough for Bridge Construction**




Note: Decibel (dB) values indicate thresholds of effect.

**Figure 6.1-9. Estimates of Area of Acoustic Effect (Ensonified Area) at Burns Cutoff for Bridge Construction**

Boat operations during construction would result in temporary acoustic effects on fish and aquatic species. Barge/tugboat operations would be conducted to transport construction equipment and materials to each intake, for a total of 42 to 94 trips per intake (Table 6.1-5). There would be no more than two trips upstream and two trips downstream per day, with work assumed to be staggered sequentially by at least 1 year for each intake. Barge/tugboat operations would likely result in temporary behavioral effects on delta smelt in the vicinity, given noise levels that could exceed 150 dB RMS (e.g., tugboat/ship levels of up to 147-dB RMS at a distance of over 620 meters, which was calculated to be nearly 190 dB RMS at 1 meter; Reine et al. 2014).

**Table 6.1-5. Barge Round Trips (Trips in Parentheses) Associated with Construction of each Intake**

| Variable | Intake B | Intake C |
|---|---|---|
| Transport log boom and support pile installation | 2 (4) | 2 (4) |
| Transport clamshell excavator | 1 (2) | 1 (2) |
| Transport excavated/dredged material | 28 (56) | 19 (38) |
| Transport riprap | 16 (32) | 12 (24) |
| Total round trips (total trips) | 47 (94) | 34 (68) |

Note: Round trips are to and from the Port of Stockton. This table does not account for barge trips associated with the test-pile program (one round trip [two trips] at a single intake), the geotechnical investigations at the proposed intakes (one to three round trips [two to six trips], based on one round trip per intake), and the geotechnical investigations at bridges and tunnel crossings up to 10 round trips [20 trips]).

Each barge round trip for transport of excavated/dredged material would be associated with 1 day of mechanical (i.e., clam shell) or hydraulic dredging to excavate and prepare the subgrade at the intake for riprap placement, that is, 8 to 16 days of dredging at each intake (Table 6.1-5). Dredge equipment noise would vary depending on equipment type. For example, a hydraulic cutterhead dredge working in the Stockton Deep Water Ship Channel produced noise levels of around 152 dB to 157 dB at 1 meter from the source (Reine and Dickerson 2014). Reine et al.'s (2014:3,292) review of potential dredging acoustic effects concluded that it is unlikely that conventional dredging operations can cause physical injury to fish species, while noting that, in theory, temporary hearing losses could occur if fish remained in the vicinity of a dredge for lengthy duration, although they suggested that the risk of this is low. Other potential effects of dredging, such as direct physical injury, are discussed in subsequent sections.

Boat operations for geotechnical investigations and the test-pile program likely would be conducted from a shallow-draft barge or ship outfitted with the necessary equipment for the task, with the potential for temporary acoustic effects from boat noise being limited to behavioral effects, consistent with the above discussion for barge/tugboat operations and dredging effects. There would be two barge trips for the test-pile program (i.e., to and from a single intake site), two to six barge trips for the geotechnical investigations at the intakes (i.e., to and from each intake site), and up to 20 (to and from 10 sites) barge trips for the geotechnical investigations at bridges and tunnel crossings. Acoustic effects from standard geotechnical penetration tests (i.e., dropping a 140-pound automatic hammer to drive a sampler about 1.5 feet) are limited to minimal, short-duration vibrations (National Marine Fisheries Service 2017:177).

Placement of riprap has the potential to result in temporary loud noises, although the available data from analogous situations in the Delta suggest that such effects would be limited: Sound data taken during the 2012 installation of rock barriers as part of the California Department of Water Resources (DWR)'s Temporary Barriers Project showed that noise levels at 100 meters from

construction were below the NMFS criteria for adverse behavioral effects (150 dB),[9] any effects would be limited to 24 to 32 days of riprap placement at each intake (corresponding to the number of round trips to transport riprap shown in Table 6.1-5).

Tunnel boring for the proposed action would also pass beneath 14 separate waterbodies for a total of 17 crossings (Table 6.1-6). Tunnel boring is expected to progress at approximately 40 feet per day, with work undertaken up to 20 hours per day, 5 days per week and up to 10 hours on Saturdays (Delta Conveyance Design and Construction Authority 2022a, 2022b), thereby passing under each waterbody for a number of days that depends on the width of the waterbody along the tunnel alignments. Acoustic modeling of potential effects was undertaken for the proposed action's tunnel-boring intersection with the San Joaquin River, which is the shallowest tunnel-boring location passing beneath a waterbody (approximately 68 feet of cover between the crown of the tunnel and the bottom of the river channel). The overall sound pressure level at the bottom of the channel was estimated to be 104 dB (Delta Conveyance Design and Construction Authority 2022d), which is well below the 150-dB threshold for behavioral modification described above, for example. Therefore, noise from boring the tunnel alignments for the proposed action would not be expected to affect fish and aquatic resources.

**Table 6.1-6. Number of Waterbody Intersections of Tunnel Boring Machine Routes**

| Waterbody | Number of Intersections |
|---|---|
| Beaver Slough | 1 |
| Disappointment Slough | 1 |
| Hayes Slough | 1 |
| Hog Slough | 1 |
| Middle River | 1 |
| Mokelumne River | 1 |
| Old River | 2 |
| San Joaquin River | 1 |
| Snodgrass Slough | 2 |
| Sycamore Slough | 1 |
| Victoria Canal | 1 |
| West Canal | 1 |
| Whiskey Slough | 1 |
| White Slough | 2 |
| Total | 17 |

Source: Delta Conveyance Design and Construction Authority 2022a, 2022b.

Drilling for subsurface power-transmission lines would pass once under Snodgrass Slough. Acoustic effects from subsurface drilling would be expected to be minimal based on noise levels measured for underwater drilling of around 130 dB (Spiga et al. 2012:56–57, 78).

[9] The greatest measured peak sound pressure at 100 meters was 149 dB for a single bucket drop of rock at the Old River near Tracy barrier (Shields 2012:7).

#### 6.1.1.4 Fish Stranding

Installation of cofferdams to isolate the construction areas for the proposed intake sites has the potential to strand fish, including delta smelt, resulting in direct mortality of fish from dewatering, dredging, and pile driving within the enclosed areas of the channel. To minimize entrapment risk and the number of fish subject to capture and handling during fish rescue and salvage operations, cofferdam construction would be limited to the proposed in-water construction period (June 1–October 31) to avoid the peak abundance of adult and early life stage delta smelt in the north Delta. DWR would prepare and submit a fish rescue and salvage plan (Chapter 3, Section 3.6.2, *Species-Specific Avoidance and Minimization Measures*, AMM-25: *Fish Rescue and Salvage Plan*) to the fish and wildlife agencies (i.e., NMFS, USFWS, and CDFW) for review and approval prior to implementation. The plan would include detailed procedures for fish rescue and salvage, including collection, holding, handling, and release, which would apply to all in-water activities with the potential to entrap fish. All fish rescue and salvage operations would be conducted under the guidance of a qualified fish biologist. The biologist, in consultation with a designated agency biologist, would determine the appropriate fish collection and relocation methods based on site-specific conditions and construction methods. Collection methods may include seines, dip nets, and electrofishing, if permitted.

Spawning adult delta smelt may be present, although in low numbers, in the action area in June and subject to stranding in cofferdams. Adults would be expected to move away from active construction areas, but some risk of stranding would exist as long as the affected areas are accessible to fish. Fish rescue and salvage activities using accepted fish collection methods can result in injury or mortality, but these effects typically are minor and can often be avoided with appropriate training. However, adverse effects may still occur because of varying degrees of effectiveness of the collection methods and potential stress and injury associated with various capture and handling methods. Collection methods would be unlikely to effectively capture early life stages of delta smelt, although numbers in enclosed areas would be very low based on location. Juveniles rear downstream of the proposed intake sites in the summer and fall and therefore are unlikely to be stranded in enclosed areas.

#### 6.1.1.5 Direct Physical Injury

In-water construction for the proposed action may result in direct physical injury or mortality to fish and aquatic species from activities including pile driving, barge/tugboat operations, dredging, enclosing construction areas, riprap placement, and construction water diversion from surface waters. Installation of piles or placement of riprap could involve fish being crushed, although it would be expected that risk would be very low based on the limited spatial extent of the work and the high probability of fish avoiding such activities; therefore, displacement of fish away from habitat near construction activities seems the most likely negative effect. Dredging activities may crush or entrain fish and aquatic species, although the limited spatial and temporal extent of dredging would limit the potential for negative effects.[10] Dredging entrainment effects are most likely to occur on eggs and larvae, with mobile (juvenile and adult) fish less likely to be affected. Fish that are entrained may survive and avoid injury, depending on site conditions (Wenger et al. 2017:978–979), although mortality rates can be large for the fish that are entrained (LFR

[10] A mapbook showing the extent of permanent and temporary effects (see further discussion below in Section 6.1.1.6, *Loss or Alteration of Habitat*), which includes dredging in addition to other construction activities, is provided for the proposed action in the Final EIR, Chapter 3, *Description of the Proposed Project and Alternatives* (see Mapbook 3-3).

Levine·Fricke 2004). Fish entrapped in construction areas enclosed by cofferdams would die without fish rescue activities, although the number of fish being trapped in such areas would be a very low proportion of individuals relative to the overall extent of species' ranges (see discussion above in Section 6.1.1.4 *Fish Stranding*). Barge and tugboat operations could result in direct physical injury or mortality from propeller entrainment/strikes. Given the relatively limited use of barges and tugboats (i.e., approximately 42–94 trips per intake associated with intake construction [staggered by one year per intake], two trips for the test-pile program, two trips per intake for geotechnical investigations, and up to 20 trips for geotechnical investigations at bridges and tunnel crossings, plus maneuvering at each site; see discussion above in Section 6.1.1.3, *Underwater Noise*), such effects would be expected to be limited. As described in Chapter 3, construction activities may require various amounts of water depending on the activity and location. The water supply needed for construction will be satisfied through a combination of the following: import from local sources, exchanges, use of existing riparian diversions, new temporary appropriations, or existing State Water Project appropriations. Surface water rights to be diverted from existing facilities would be available at the intake locations, and Lower Roberts Island at the tunnel shaft location. Therefore, at most construction sites, there would be no changes to surface waters related to construction water supplies. Any use of diversions will be screened, as appropriate, and additional authorizations addressed following development of detailed construction engineering, so at the limited number of sites that could use existing surface water rights, entrainment of fish would be low, based on low numbers of fish entrained at similar small intakes (e.g., Nobriga et al. 2004; Vogel 2013).

In addition to the proposed work window (June 1–October 31), the potential for injury of listed fish species would be minimized by limiting the duration of in-water construction activities to the extent practicable and implementing AMM-1: *Conduct Environmental Resources Worker Awareness Training* (Appendix 3A; Chapter 3, Section 3.6.2), and Chater 5, Section 5.3.2, *Fish Rescue and Salvage Plan*. As previously discussed, the timing of in-water construction activities (June 1–October 31) would avoid the delta smelt adult migration season. Spawning adults may be present in very small numbers in June and therefore may be subject to injury. Although adults would be expected to move away from active construction areas, it is assumed that some potential for injury exists whenever heavy equipment or materials are operated or placed in open water. Based on the low utilization and expected avoidance of the intake sites by spawning adults, there is little or no risk of injury of delta smelt eggs or embryos. Although the potential for exposure is low, delta smelt larvae and early juveniles may be particularly vulnerable to injury because of their limited swimming abilities. However, effects would be limited based on the small proportion of adults that spawn in or upstream of the north Delta in June, the resulting low densities of larvae and juveniles passing the intake sites, and the limited influence of construction equipment and materials on passage conditions in the river. Juvenile delta smelt rear downstream of the proposed intake sites in the summer and fall and therefore are unlikely to be injured by construction activities.

### 6.1.1.6 Loss or Alteration of Habitat

Construction of the north Delta intakes would result in permanent loss or alteration of aquatic habitat that includes the designated critical habitat of delta smelt. The effects of construction activities on water quality, including turbidity and suspended sediment, underwater noise, and contaminants, were previously discussed above The overall footprint of construction activities is

approximately 1.5 acres of temporary impact[11] and approximately 5.6 acres of permanent[12] impact to tidal perennial habitat (Table ).[13] The total duration of construction work at each intake is 5.5 years (see Figure 3.2-12 in Chapter 3).

**Table 6.1-6a. Summary of Tidal Perennial Habitat Affected by Construction Activities (acres)**

| Impact Type | Feature | Waterbody | Proposed Action |
|---|---|---|---|
| Permanent Surface Impact | Access Railroad | Burns Cutoff | 0.163 |
| Permanent Surface Impact | Access Road | Burns Cutoff | 0.090 |
| Permanent surface impact | Access Road | Unknown | 0.061 |
| Permanent surface impact | Access Road/Power – Underground New | Unknown | 0.009 |
| Permanent surface impact | Access Road/SCADA – Underground New | Burns Cutoff | 0.107 |
| Permanent surface impact | County Road | Unknown | 0.163 |
| Permanent surface impact | Intake | Sacramento River | 4.983 |
| Permanent surface impact | All Combined Permanent | All Combined | 5.574 |
| Temporary surface impact | County Road | Unknown | 0.244 |
| Temporary surface impact | Intake Boundary | Sacramento River | 0.834 |
| Temporary surface impact | Power – Underground New | Unknown | 0.010 |
| Temporary surface impact | Railroad Work Area | Burns Cutoff | 0.054 |
| Temporary surface impact | Road Work Area | Burns Cutoff | 0.297 |
| Temporary surface impact | Road Work Area | Unknown | 0.084 |
| Temporary surface impact | Road Work Area/Power – Underground New | Unknown | 0.025 |
| Temporary surface impact | All Combined Temporary | All Combined | 1.548 |

ROW = right-of-way; SCADA = supervisory control and data acquisition.

During construction activities, DWR would implement AMM-14: *Construction Best Management Practices for Biological Resources*, to protect listed fish and their designated critical habitat (Appendix 3A). These BMPs include a number of measures to limit the extent of disturbance of aquatic and riparian habitat during construction and, following construction, to restore temporarily disturbed areas to preconstruction conditions. All construction and site-restoration BMPs would be subject to an approved construction and post-construction monitoring plan to ensure their effectiveness. DWR proposes to offset unavoidable habitat impacts at the proposed intake sites through habitat restoration mitigation (Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*, specifically CMP-23: *Tidal Perennial Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic Resources*).

[11] *Temporary effects* are the habitat extent acreage that can be returned to original basic use following completion of construction; *permanent effects* are the habitat acreage that cannot be returned to original basic use following completion of construction.

[12] All impacts on delta smelt habitat are assumed to be permanent because they would occur over multiple years, which could affect multiple generations of delta smelt, given that the species generally lives for approximately 1 year.

[13] A mapbook showing the extent of permanent and temporary effects is provided for the proposed action in the Final EIR, Chapter 3, *Description of the Proposed Project and Alternatives* (see Mapbook 3-3).

Construction of the two intake structures would result in a permanent loss or alteration of 5.8 acres of tidal perennial habitat near the northern limit of the geographic area used by delta smelt for migration, potential spawning, and larval dispersal to the estuary. Delta smelt adult upstream migration to access shallow water for spawning upstream of the north Delta intakes may be blocked, delayed, or impeded by the presence of cofferdams isolating lower-velocity, nearshore habitat (U.S. Fish and Wildlife Service 2017a:317–320). This impact could impede or delay access to shallow habitat upstream of the north Delta intakes. There is uncertainty about the impact because of delta smelt adults' potential use of low-velocity habitat along the opposite riverbank from the cofferdams, near the river bottom, or as created by the flutes of the cofferdams themselves. In addition, 2D modeling of the hydrodynamic effects of the cofferdams indicates that suitably low-velocity habitat (i.e., no more than 0.91 feet per second, per Swanson et al. 1998) would be present even at relatively high river flows.

The reduction in the extent of low-velocity shoreline areas and increased predation risk at the intake construction sites could potentially reduce the number of migrating adults that successfully pass the sites and survive to reach upstream spawning areas. The effect on passage success depends on the number attempting to pass the site on the east side of the river and the ability of adults to use alternative routes (e.g., the west side of the river would remain unaffected) or spawning areas (e.g., returning downstream to spawn). Overall, however, the small proportion of the population that migrates and spawns in the reaches between and upstream of the intake sites and 2D modeling of the hydrodynamic effects of the cofferdams, which shows that suitably low-velocity habitat (i.e., no more than 0.91 feet per second per Swanson et al. 1998) would be present even at relatively high river flows, indicate that any population-level effects would be very small.

There appears to be little or no habitat thought to be preferred by delta smelt for spawning at the proposed intake sites, which are dominated by steep levee slopes, existing riprap, and low quantities of riparian and aquatic vegetation. Consequently, permanent losses of nearshore habitat resulting from construction of the intakes would have little or no effect on spawning site selection or adult spawning success. Based on the small proportion of the population spawning in the action area, expected low utilization of the intake sites by spawning adults, and very limited contribution of this habitat to the overall spawning capacity, there is little risk of direct or indirect effects on egg/embryo production or survival.

Delta smelt larvae and early juveniles migrating from upstream spawning areas to estuarine rearing areas may be subject to an elevated risk of predation as they pass the intake construction sites because of the presence of in-water and overwater structures (providing shaded areas for predators) and the loss of shallow, low-velocity nearshore areas. To the extent that these conditions provide beneficial habitat or increased predation opportunities for predators of larvae and early juveniles (e.g., silversides; Baerwald et al. 2012), there could be an elevated risk of predation for these young life stages. However, it is not clear that these structures provide beneficial habitat because these small predators may be susceptible to the same larger predators that consume adult delta smelt. Therefore, elevated predation on delta smelt larvae is unlikely. As previously noted, juvenile delta smelt rear downstream of the proposed intake sites in the summer and fall and therefore are unlikely to be affected by losses or alteration of habitat during construction.

## 6.1.2 Effects of Construction Activities on Delta Smelt Critical Habitat

Construction activities would not affect the delta smelt critical habitat primary constituent elements (PCEs) 3 and 4 because there would be no effect on river flows or salinity as a result of these activities. The effects to PCEs 1 and 2 are described below.

For reference, below are summaries of the PCEs (U.S. Fish and Wildlife Service 2019a:177).

- PCE 1: *Physical Habitat*. Defined as the structural components of habitat. Physical habitat in the Delta has been changed substantially, with many of the changes occurring decades ago (Andrews et al. 2017; Gross et al. 2018). Important physical habitat attributes include substrate, water-depth variation and channel morphology for spawning adults, and potential foraging habitat for rearing juveniles along marsh edges (Bever et al. 2016; Hammock et al. 2019a). Information on spawning habitat is incomplete. Eggs of delta smelt are demersal and adhesive and therefore could be attached to any number of substrates.
- PCE 2: *Water*. Defined as water of suitable quality to support various delta smelt life stages with the abiotic elements that allow for survival and reproduction. Delta smelt inhabit open waters of the Delta and Suisun Bay. Certain conditions of temperature, turbidity, and food availability characterize suitable habitat for delta smelt. Factors such as high entrainment risk and contaminant exposure can degrade this PCE even when the basic water quality is consistent with suitable habitat (Hammock et al. 2015).
- PCE 3: *River flow*. Originally believed to be critical as transport flow to facilitate an extended spawning migration by adult fish and the transport of offspring to low-salinity rearing habitats (59 *Federal Register* 65256 [Dec. 19, 1994]). However, it has since been shown that although some individual fish may embark on what could be considered a short spawning migration, there is no population-scale spawning migration, per se, and most transport and retention mechanisms for delta smelt (and their prey) involve the selective use of tidal currents, rather than net flows (Kimmerer 2002; Kimmerer et al. 1998, 2014; Bennett et al. 2002; Bennett and Burau 2015). *River flow* includes both inflow to and outflow from the Delta, both of which influence the net movements of water through the Delta and further into the estuary (Kimmerer and Nobriga 2008).
- PCE 4: *Salinity*. Defined as the low salinity zone (LSZ) nursery habitat. The LSZ is where freshwater transitions into brackish water and is defined as 0.5–6.0 parts per thousand (Kimmerer 2004; MacWilliams et al. 2015). The LSZ expands and moves downstream when river flows into the estuary are high. Similarly, it contracts and moves upstream when river flows are low.

### 6.1.2.1 PCE 1: Physical Habitat (Spawning Substrate)

Construction of the north Delta intakes would result in the permanent loss of approximately 5.6 acres of tidal perennial habitat for delta smelt (Table 6.1-6a). Based on existing site conditions, none of this habitat is considered preferred spawning habitat for delta smelt. Increases in suspended sediment generated by in-water construction activities may result in localized sediment deposition in the vicinity of the proposed intakes, degrading potential spawning habitat of delta smelt through burial of suitable substrate. However, potential adverse effects of sedimentation on physical habitat (i.e., spawning substrate) from construction would be minimized by implementation of AMMs,

including working within an in-water work window that has limited overlap with the spawning season (Appendix 3A) and conducting barge operations in a manner so as to limit potential for disturbance (AMM-27: *Develop and Implement a Barge Operations Plan*). Additionally, the Sacramento River in the vicinity of the proposed intakes does not likely support significant spawning of delta smelt.

#### 6.1.2.2 PCE 2: Water

As described above in Section 6.1.2, *Effects of Construction Activities on Delta Smelt Critical Habitat*, construction activities have the potential for effects because of increased turbidity, suspended sediment, and contaminants, which could affect water quality (PCE 2). Effects would be limited temporally and spatially and minimized with various AMMs (Appendix 3A).

### 6.1.3 Effects of Conservation Measures on Delta Smelt and Delta Smelt Critical Habitat

#### 6.1.3.1 Effects of Conservation Measures on Delta Smelt

Implementation of the Compensatory Mitigation Plan (CMP) could result in impacts on delta smelt as analyzed in this section. Restoration of tidal perennial habitat or channel margin habitat as compensatory mitigation has the potential to affect delta smelt. Details of compensatory mitigation are provided in Appendix 3A. A total of 18.3 acres of tidal perennial habitat and 3,619 linear feet of channel margin habitat compensatory mitigation for construction impacts will be undertaken. Construction of aquatic habitat restoration for mitigation itself has the potential for negative effects on delta smelt, with these effects generally including those previously discussed above in Section 6.1.1 (i.e., acoustic effects, sediment disturbance, water quality effects, direct physical injury, reduced prey availability, and increased predation). Potential short-term negative effects from construction of aquatic habitat as compensatory mitigation are exemplified by effects assessed for the Lower Yolo Tidal Restoration Project (National Marine Fisheries Service 2014). To the extent practicable, grading and excavation (e.g., of marsh plains and tidal channels) would be done prior to work allowing species to enter restored areas (e.g., excavation of notches in the perimeter of levees to facilitate tidal flows to enter and leave) to minimize negative effects on fish species. Excavation of levee perimeter notches to allow tidal exchange could result in several effects on fish species including delta smelt: temporary loss of aquatic and riparian 29 habitat (e.g., increasing predation potential because of reduced cover, reduced substrate for prey, and increased water temperature); degraded water quality from contaminants liberated from soils and increased suspended sediment that could affect fish directly if in very high concentration, as well as affecting prey availability; heavy machinery noise resulting in fish being inhibited in their movements near the work areas, and possibly being startled away from work areas and, therefore, becoming more susceptible to predation; direct strikes to fish from construction equipment performing in-water work such as notch excavation in levees to restored tidal flow, leading to injury or mortality; and stranding of fish within enclosed construction areas (e.g., within cofferdams) that may be required during construction. As suggested for the Lower Yolo Tidal Restoration Project, however, such potential impacts can be minimized by construction techniques, where feasible, such as not operating heavy machinery from within the water; limiting construction to only the small areas necessary to meet restoration design (e.g., restoration of tidal connections; limiting work to low tide and daylight hours to the extent possible; and installing sheet pile exclusion barriers with vibratory hammers). Potential negative effects from compensatory mitigation construction would be expected to affect

very small numbers of individuals of fish and aquatic species, including delta smelt, that may occur near sites during in-water work. Construction of compensatory mitigation will include various mitigation measures and environmental commitments as necessary and as described above for construction effects (Appendix 3A). These mitigation measures would limit the potential for negative effects by limiting work to the in-water work window and limiting the potential for water quality effects. Inclusion of selenium and methylmercury management as part of overall *Delta Conveyance Project Final Environmental Impact Report* (Final EIR) mitigation for the proposed action (Mitigation Measure WQ-6: *Develop and Implement a Mercury Management and Monitoring Plan*, and Mitigation Measure WQ-10: *Develop and Implement a Selenium Management Plan*, discussed in Final EIR Chapter 9, *Water Quality*) would limit potential for negative effects from selenium or methylmercury production as a result of habitat restoration activities (California Department of Water Resources 2023).

Following completion of compensatory mitigation,[14] restored tidal habitat areas would have beneficial effects on delta smelt. Such effects include greater habitat extent (e.g., as shown for Liberty Island in the north Delta; Sommer and Mejia (2013) and greater food availability on-site or in nearby areas (Hammock et al. 2019b), but not at larger spatial scales, such as in other regions of the Delta (Herbold et al. 2014; Hartman et al. 2017; Kimmerer et al. 2018a). Efficacy monitoring would assess the degree to which positive effects occur and inform adjustment to sites, as necessary, to increase positive effects.

Of the other proposed conservation measures, AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan* (Appendix 3A) has the potential for limited negative effects to delta smelt, in addition to its minimization of pile-driving acoustic effects. DWR's development and implementation of the underwater sound control and abatement plan could include installation of an attenuation device, such as a bubble curtain, or other mechanism to minimize noise, such as air-filled fabric barriers, isolation piles, or installation of piling-specific cofferdams. Should fish and aquatic species, including delta smelt, become trapped within the area enclosed by these methods, they would be exposed to high sound levels and may be injured, potentially fatally, by noise levels. However, the number of individuals potentially experiencing such effects would be low because of the small area affected and the likely disturbance and avoidance of the area by fish including delta smelt. As previously noted in Section 6.1.1, *Effects of Construction Activities on Delta Smelt*, the in-water work window for this measure also would limit the potential for temporal overlap with delta smelt, and there is limited spatial overlap with the species given the location of the work outside the species' main range.

#### 6.1.3.2 Effects of Conservation Measures on Delta Smelt Critical Habitat

Conservation measures would not affect the delta smelt critical habitat PCEs 3 and 4 because there would be no effect on river flows or salinity as a result of these activities. The effects on PCEs 1 and 2 are described below.

[14] As described in Appendix 3B, compensatory mitigation will stay ahead of the cumulative, permanent suitable habitat loss by 10%; if this requirement cannot be met, the mitigation amount would be increased by 5% for every year of delay to offset the temporal loss of habitat.

### PCE 1: Physical Habitat (Spawning Substrate)

Although minimal, if any, effects to spawning substrate are anticipated, restoration of tidal habitat and channel margin habitat would have the potential to offset losses in spawning substrate and other shallow-water habitat, as well as losses of tidal perennial habitat.

### PCE 2: Water (Quality)

Construction-related effects to water quality (e.g., increases in suspended sediment during earth-moving activities) from conservation measures would be of similar nature to the construction-related effects described above, but would be limited in duration, occur during work windows to minimize exposure of delta smelt, and be minimized with standard AMMs. Therefore, there would be limited effects on PCE 2.

Sediment disturbance and releases of contaminants (e.g., fuel spills) during construction/removal activities have the potential to result in effects on the PCE 2 (e.g., by liberating contaminants), but the implementation of AMMs and the limited duration of work would minimize effects on this PCE.

## 6.1.4 Cumulative Effects on Delta Smelt

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area (50 Code of Federal Regulations [CFR] § 402.02). 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 federal Endangered Species Act.

### 6.1.4.1 Water Diversions

Water diversions for irrigated agriculture, municipal, and industrial use and managed wetlands are found throughout the Delta, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions have the potential to entrain and kill many life stages of aquatic species, including delta smelt. However, the vast majority of private unscreened diversions in the Delta are small pipes in large channels that do not operate every day of the year. As a result, even where they do regularly co-occur with these diversions, delta smelt appear to have low vulnerability to entrainment (Nobriga et al. 2004). Most of the 370 water diversions operating in Suisun Marsh are likewise unscreened (Herren and Kawasaki 2001).

New municipal water diversions in the Delta are screened routinely per various biological opinions. Private irrigation diversions in the Delta are mostly unscreened, but the total amount of water diverted to Delta farms has remained very stable for decades (Culberson et al. 2008), so the cumulative impact should remain similar to baseline. Ongoing nonfederal diversions of water within the action area (e.g., municipal and industrial uses, as well as diversions through intakes serving numerous small, private agricultural lands) are not likely to entrain very many delta smelt, based on the results of a study by Nobriga et al. (2004), which reasoned that the littoral location and low-flow operational characteristics of these diversions reduced their risk of entraining delta smelt.

### 6.1.4.2 Agricultural Practices

Farming occurs throughout the Delta, adjacent to waterways used by delta smelt. Agricultural practices introduce nitrogen, ammonium, and other nutrients into the watershed, which then flow

into receiving waters, adding to other inputs, such as wastewater treatment (Lehman et al. 2014); however, wastewater treatment provides the bulk of ammonium loading (Jassby 2008). Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may negatively affect delta smelt reproductive success and survival rates (Dubrovsky et al. 1998; Kuivila et al. 2004; Scholz et al. 2012). Discharges occurring outside the action area that flow into the action area also contribute to cumulative effects of contaminant exposure.

#### 6.1.4.3 Increased Urbanization

The Delta Protection Commission's *Economic Sustainability Plan* for the Delta reported an urban growth rate of about 54% within the statutory Delta between 1990 and 2010, as compared with a 25% growth rate statewide during the same period (Delta Protection Commission 2012). The report also indicated that population growth had occurred in the Secondary Zone of the Delta, but not in the Primary Zone, and that population in the central and south Delta areas had decreased since 2000. Growth projections through 2050 indicate that all counties overlapping the Delta are projected to grow at a faster rate than the state as a whole. Total population in the Delta counties is projected to grow at an average annual rate of 2.2% from 2020 through 2030 (California Department of Finance 2023). Table 6.1-7 illustrates past, current, and projected population trends. As of 2010, the combined population of the Delta counties was approximately 3.8 million. Sacramento County contributed 37.7% of the population of the Delta counties, and Contra Costa County contributed 27.8%. Yolo County had the smallest population (200,849 or 5.3%) of all the Delta counties.

**Table 6.1-7. Population by County and Area, 2010–2060**

| Area | 2010 Population (millions) | 2019 Population (millions) | 2030 Projected Population (millions) | 2035 Projected Population (millions) | 2060 Projected Population (millions) |
|---|---|---|---|---|---|
| **Delta Region** | **5.30** | **5.82** | **6.37** | **6.61** | **7.43** |
| Alameda County | 1.52 | 1.67 | 1.83 | 1.90 | 2.16 |
| Contra Costa County | 1.05 | 1.15 | 1.25 | 1.30 | 1.45 |
| Sacramento County | 1.42 | 1.55 | 1.70 | 1.75 | 1.94 |
| San Joaquin County | 0.69 | 0.77 | 0.88 | 0.92 | 1.09 |
| Solano County | 0.41 | 0.44 | 0.47 | 0.48 | 0.52 |
| Yolo County | 0.20 | 0.22 | 0.24 | 0.25 | 0.28 |
| **South Bay Area [a]** | **1.85** | **2.02** | **2.17** | **2.25** | **2.51** |
| San Benito County | 0.06 | 0.06 | 0.07 | 0.08 | 0.09 |
| Santa Clara County | 1.79 | 1.96 | 2.09 | 2.17 | 2.42 |
| **San Joaquin Valley** | **3.14** | **3.42** | **3.77** | **3.92** | **4.46** |
| Stanislaus County | 0.52 | 0.56 | 0.61 | 0.63 | 0.73 |
| Merced County | 0.26 | 0.28 | 0.33 | 0.35 | 0.46 |
| Fresno County | 0.93 | 1.02 | 1.12 | 1.16 | 1.29 |
| Tulare County | 0.44 | 0.48 | 0.52 | 0.53 | 0.56 |
| Kings County | 0.15 | 0.15 | 0.17 | 0.18 | 0.20 |
| Kern County | 0.84 | 0.92 | 1.02 | 1.06 | 1.21 |

| Area | 2010 Population (millions) | 2019 Population (millions) | 2030 Projected Population (millions) | 2035 Projected Population (millions) | 2060 Projected Population (millions) |
|---|---|---|---|---|---|
| **Central Coast** | **0.69** | **0.73** | **0.77** | **0.79** | **0.85** |
| San Luis Obispo County | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 |
| Santa Barbara County | 0.42 | 0.45 | 0.49 | 0.50 | 0.56 |
| **Southern California** | **21.04** | **22.33** | **23.28** | **23.62** | **23.68** |
| Ventura County | 0.83 | 0.85 | 0.86 | 0.86 | 0.78 |
| Los Angeles County | 9.85 | 10.26 | 10.38 | 10.39 | 9.61 |
| Orange County | 3.02 | 3.22 | 3.39 | 3.47 | 3.70 |
| San Diego County | 3.10 | 3.36 | 3.53 | 3.60 | 3.74 |
| San Bernardino County | 2.05 | 2.20 | 2.40 | 2.47 | 2.68 |
| Riverside County | 2.20 | 2.44 | 2.72 | 2.84 | 3.18 |
| **California** | **37.37** | **39.96** | **42.26** | **43.20** | **45.30** |

Source: California Department of Finance 2020a.
[a] The population estimates for the South Bay Area do not include Alameda County because this county is included in the Delta region total.

Table 6.1-8 presents more detailed information about populations of individual communities in the Delta.

**Table 6.1-8. Statutory Delta Communities Population, 2010 and 2018**

| Community | 2010 | 2018 | Average Annual Growth Rate 2010–2018 |
|---|---|---|---|
| **Alameda County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Livermore [a] | 80,968 | 89,027 | 1.24% |
| **Contra Costa County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Antioch | 102,372 | 110,730 | 1.02% |
| Brentwood | 51,481 | 60,446 | 2.18% |
| Oakley | 35,432 | 40,669 | 1.85% |
| Pittsburg | 63,264 | 70,492 | 1.43% |
| ***Small or Unincorporated Communities*** | | | |
| Bay Point | 21,349 | 25,165 | 2.23% |
| Bethel Island | 2,137 | 2,010 | -0.74% |
| Byron | 1,277 | 1,348 | 0.69% |
| Discovery Bay | 13,352 | 15,981 | 2.46% |
| Knightsen | 1,568 | 1,500 | -0.54% |
| **Sacramento County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Isleton | 804 | 583 | -3.44% |
| Sacramento | 466,488 | 495,011 | 0.76% |
| ***Small or Unincorporated Communities*** | | | |
| Courtland | 355 | 537 | 6.41% |

| Community | 2010 | 2018 | Average Annual Growth Rate 2010–2018 |
|---|---|---|---|
| Freeport | 38 | 81 | 14.14% |
| Hood | 271 | 303 | 1.48% |
| Walnut Grove | 1,542 | 1,300 | -1.96% |
| **San Joaquin County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Lathrop | 18,023 | 21,393 | 2.34% |
| Stockton | 291,707 | 306,283 | 0.62% |
| Tracy | 82,922 | 88,806 | 0.89% |
| ***Small or Unincorporated Communities*** | | | |
| Mountain House | 9,675 | 15,645 | 7.71% |
| Terminous | 381 | 411 | 0.98% |
| **Solano County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| Rio Vista | 7,360 | 8,618 | 2.14% |
| **Yolo County** | | | |
| ***Incorporated Cities and Towns*** | | | |
| West Sacramento | 48,744 | 52,826 | 1.05% |
| ***Small or Unincorporated Communities*** | | | |
| Clarksburg | 418 | 442 | 0.72% |

Sources: U.S. Census Bureau 2011, 2018.
[a] Livermore is not in the statutory Delta but is included because it is the closest community in Alameda County.

Increases in urbanization and housing developments can affect habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Increased growth would place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions would not require federal permits and, thus, would not undergo review through the Section 7 consultation process.

Adverse effects on delta smelt and their critical habitat may result from urbanization-induced point- and nonpoint-source chemical-contaminant discharges within the action area. These contaminants include, but are not limited to, ammonia and free ammonium ion, numerous pesticides and herbicides, and oil- and gasoline-product discharges. Increased urbanization also is expected to result in increased recreational activities in the region.

### 6.1.4.4 Wastewater Treatment Plants

Two wastewater treatment plants (one located on the Sacramento River near Freeport and the other on the San Joaquin River near Stockton) have received special attention because of the magnitude of their discharge of ammonia. The Sacramento Regional Wastewater Treatment Plant, in order to comply with Order R5-2013-0124, implemented compliance measures to reduce ammonia discharges. There were concerns that these discharges could be associated with direct ammonia toxicity to delta smelt and other species, prompting various studies (e.g., Werner et al. 2009). In addition to concerns about direct toxicity of ammonia to delta smelt, another important concern was that ammonium inputs affected the delta smelt foodweb by suppressing diatom blooms in the Delta and Suisun Bay (see summary of relevant literature by IEP MAST [2015:71]), although a recent

study did not find evidence supporting this mechanism (Strong et al. 2021). To the extent that such direct (toxicity) and indirect (foodweb suppression) effects were previously occurring, the recent completion of upgrades at the Sacramento Regional Wastewater Treatment Plant largely eliminated ammonia discharge and, therefore, the potential for negative effects. Ammonia discharge concerns have also been expressed with respect to the City of Stockton Regional Water Quality Control Plant, but its remoteness from the parts of the estuary frequented by delta smelt and its recent upgrades suggest that it is more a potential issue for migrating salmonids than for delta smelt.

#### 6.1.4.5 Other Activities

Other future, nonfederal actions within the action area that are likely to occur and may adversely affect delta smelt and their critical habitat include: dumping of domestic and industrial garbage that decreases water quality; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; and state or local levee maintenance that may also destroy or adversely affect habitat and interfere with natural, long-term habitat-maintaining processes. However, these projects are likely to include BMPs and are regulated to avoid impacts on aquatic habitat.

#### 6.1.4.6 Climate Change

The anticipated effects of climate change on the San Francisco Estuary and watershed, such as warmer water temperatures, greater salinity intrusion, lesser snowpack contribution to spring outflows from the Delta, and the potential for frequent extreme drought (Knowles and Cayan 2002; Dettinger 2005), indicate challenges to maintaining a sustainable delta smelt population (Brown et al. 2013, 2016). Climate change is expected to affect delta smelt habitat and prey availability. The projected increase in sediment entering the Delta over time from future climate change has the potential to result in more sediment entering the Delta than existing conditions. Given the importance of sediment as a component of delta smelt habitat (particularly when resuspended to create greater turbidity), this may be beneficial to delta smelt. Climate change-related reductions in spring Delta outflow and sea level rise result in predictions of lower smelt zooplankton prey *E. affinis* than existing conditions. Water temperature would be higher, reflecting climate change assumptions, and would decrease habitat suitability for delta smelt (e.g., mean July temperature at Rio Vista at 2040 modeled climate would be more often above the 21.9°C (71.4°F) threshold dividing adequate and unsuitable habitat per the affinity analysis of Hamilton and Murphy [2020]).

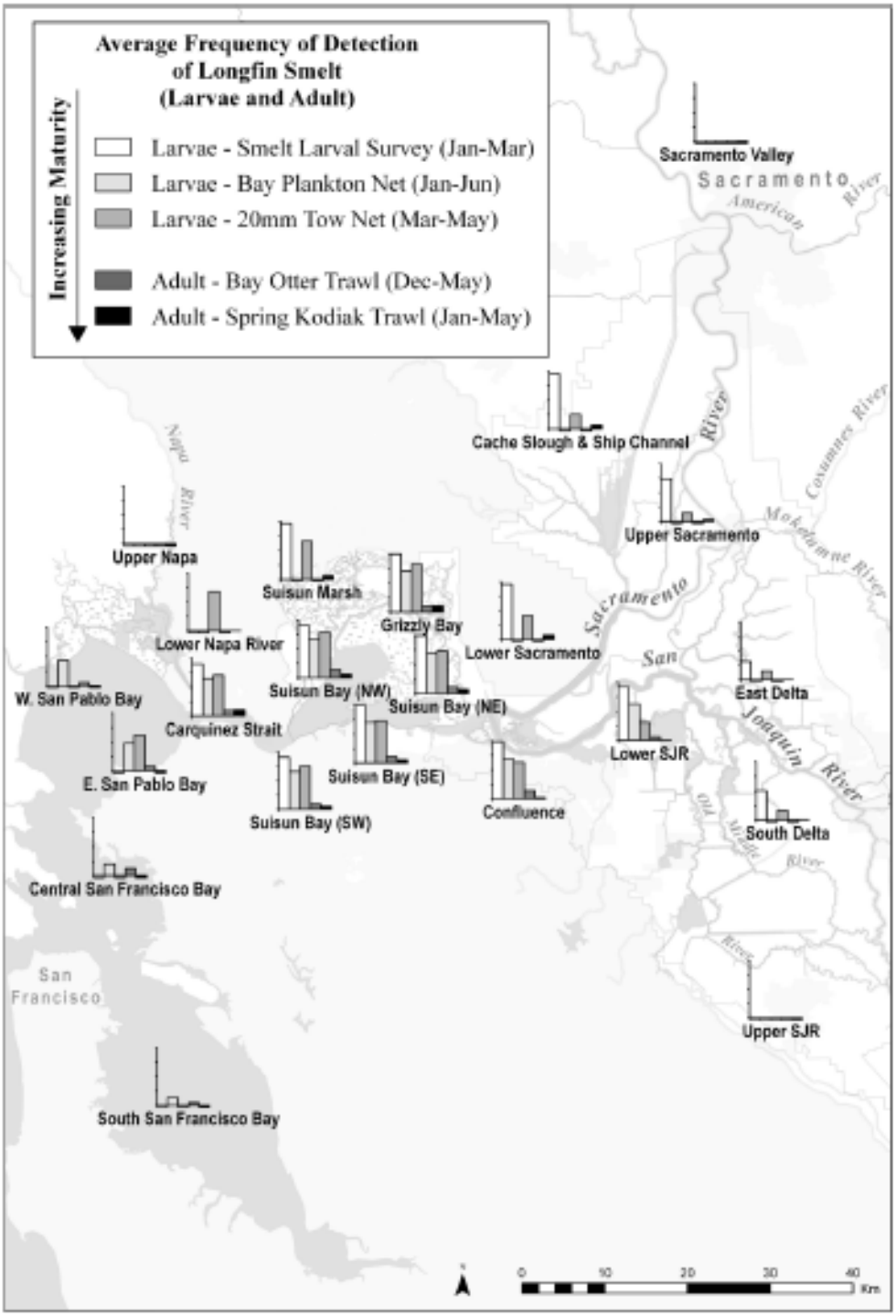
## 6.2 Effects on Longfin Smelt

As with delta smelt, potential effects are discussed in terms of construction activities and conservation measures. Analyses were developed in consideration of factors assessed to be of importance to the species based on available literature, including conceptual models (e.g., Baxter et al. 2010) and best available methods (e.g., ICF International 2016b; California Department of Water Resources 2020a).

### 6.2.1 Effects of Construction Activities on Longfin Smelt

As discussed in detail for delta smelt, potential effects on longfin smelt arising from construction activities could consist of acoustic effects; sediment disturbance leading to increased suspended

sediments, turbidity, and contaminants; water quality effects from accidental spills and discharge of construction water; direct physical injury or mortality from in-water work; reduced prey availability; increased predation risk; increased water temperature; and reduced habitat extent and access. As shown in Figure 6.2-1, larvae may be present in the north Delta during the months of January to June, and therefore may be present in small numbers near the construction area in June. Larvae may not be affected by pile driving but could be affected by water quality changes such as turbidity and contaminants. These activities will be restricted to a June 1 through October 31 in-water work window, at which time longfin smelt are least likely to occur in the project area. In addition to limiting activities to the in-water work window, the following AMMs will be implemented to avoid or minimize impacts due to increases in turbidity and suspended sediment levels on water quality and direct and indirect affects to listed fish species resulting from sediment-disturbing activities: AMM-1: *Conduct Environmental Resources Worker Awareness Training;* AMM-2*: Develop and Implement Hazardous Materials Management Plans*; AMM3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; AMM-4a*: Develop and Implement Erosion and Sediment Control Plans;* AMM-4b, *Develop and Implement Stormwater Pollution and Prevention Plans;* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A).




Source: Merz et al. 2013.

Note: To calculate the annual frequency of longfin smelt detection in a region, the percentage of sampling events where longfin smelt were observed is divided by the total number of sampling events for the region. In this graphic, where no column/bar is shown in the bar graph for a region, the average annual frequency of detection for the given longfin smelt life stage(s) was zero. Where the column is below the x-axis, a survey did not sample in that region (e.g., the Smelt Larval Survey, which does not include stations west of Carquinez Strait).

**Figure 6.2-1. Average Annual Frequency of Longfin Smelt Detection (%) for Larval and Adult Life Stages by Region and Interagency Ecological Program Survey Type**

#### 6.2.1.1 Effects of Conservation Measures on Longfin Smelt

The CMP could result in similar impacts on longfin smelt as analyzed under Section 6.2.1, *Effects of Construction Activities on Longfin Smelt* and as discussed for delta smelt (Section 6.1.3.1 *Effects of Conservation Measures on Delta Smelt*). Following completion of compensatory mitigation, restored tidal habitat areas would have beneficial effects on longfin smelt such as increased habitat extent or greater food availability; relatively high abundance of longfin smelt has been observed in various restored habitats in the lower San Francisco Estuary (Lewis et al. 2020).

### 6.2.2 Cumulative Effects on Longfin Smelt

Cumulative effects on longfin smelt generally would be the same as discussed above for delta smelt (Section 6.1.4, *Cumulative Effects on Delta Smelt*) (i.e., water diversions, agricultural practices, increased urbanization, and climate change). In addition, longfin smelt are known to be taken by commercial bay shrimp fisheries, although the take appears to be limited to approximately a few percent of the population (ICF International 2016b:4-294). Construction related to other programs, projects, and policies could combine with the effects of construction of the proposed action.

## 6.3 Effects on San Joaquin Kit Fox

Appendix 6A, *Terrestrial Effects Analysis Methods*, describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, *Status of the Species/Environmental Baseline Summary,* Section 4.4.9.6, *Suitable Habitat Definition*, and Section 4.4.9.7, *Species Habitat Suitability Model*, define suitable habitat and describe the habitat model for San Joaquin kit fox.

Suitable habitat for San Joaquin kit fox consists of arid shrublands and grasslands characterized by sparse or no shrub cover, sparse ground cover with patches of bare ground, short vegetative structure (herbaceous vegetation less than 18 inches tall), and sandy to sandy-loam soils (Cypher et al. 2007:25). San Joaquin kit fox generally avoid steep terrain. Habitat with slopes under 10% is considered high value, habitat with slopes between 10 and 30% is considered of moderate value, and habitat with slopes greater than 30% is considered low value (U.S. Fish and Wildlife Service 2020a:23, 49, 50). Tall and dense vegetation is less optimal because it creates conditions that make it difficult for kit fox to detect approaching predators or to capture prey (Cypher et al. 2007:25). See Section 4.4.9.2, *Life History and Habitat Requirements*, for a full description of suitable habitat.

High, moderate, and low value habitat occurs within the action area and overlaps with the project footprint. In addition, the action area is within the known historical range of the species. However, in the 2020 assessment of the species' status, USFWS rated the condition of the northernmost portion of the species' range (the Livermore Unit), which includes the habitat that overlaps with the action area, as being in a "very low" condition (U.S. Fish and Wildlife Service 2020a:51). The USFWS defines very low condition for San Joaquin kit fox as showing "no evidence of a current population" where the "only [occurrence] records are 10 years old or greater" (U.S. Fish and Wildlife Service 2020a:50). Specifically, surveys and monitoring conducted between 2009 and 2017, and again in 2021, to the east and west of Bethany Reservoir, which included den surveys and trail camera use, did not detect San Joaquin kit fox in these areas (Department of Water Resources 2021:2; Environmental Science Associates 2017:4-23). Based on this information, there is low potential for

San Joaquin kit fox to be present in the action area. However, because the action area maintains some connectivity with the region south of San Luis Reservoir where San Joaquin kit fox persist, it is assumed that there remains some potential for dispersing individuals to occur in the action area, and permanent protection of suitable San Joaquin kit fox habitat, such as the Bethany conservation easement and Mountain House Conservation Bank, occurs within the action area and may support San Joaquin kit fox if the species recovers.

There are 1,453.11 acres of modeled San Joaquin kit fox habitat in the southwest part of the action area west of Clifton Court Forebay of which 1,363.62 acres are modeled low-quality habitat, 11.21 acres are modeled moderate-quality habitat, and 78.28 acres are modeled high-quality habitat. There are 55.90 acres of modeled habitat that overlap with the project footprint, 55.63 acres of which are modeled low-quality habitat, 0.08 acre of which is modeled moderate-quality habitat, and 0.19 acre of which is modeled high-quality habitat. Table 6.3-1 summarizes the total affected San Joaquin kit fox modeled habitat.

**Table 6.3-1. Acres of Overlap between San Joaquin Kit Fox Modeled Habitat and the Construction Footprint by Activity Type**

| San Joaquin Kit Fox Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [b] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities [c] (Overhead and Underground) | Temporary Subtotal | |
| High Quality | 78.28 | - | - | - | - | 0.02 | 0.11 | - | - | 0.23 | 0.04 | - | - | 0.01 | 0.01 | 0.06 | 0.19 |
| Moderate Quality | 11.21 | - | - | - | - | - | 0.06 | - | - | 0.06 | 0.02 | - | - | - | - | 0.02 | 0.08 |
| Low Quality | 1,363.62 | - | 16.22 | 22.05 | - | - | 0.42 | - | - | 38.69 | 2.58 | - | 13.73 | - | 0.63 | 16.94 | 55.63 |
| **Total** | **1,453.11** | **-** | **16.22** | **22.05** | **-** | **0.02** | **0.59** | **-** | **-** | **38.98** | **2.64** | **-** | **13.73** | **0.01** | **0.64** | **17.02** | **55.90** |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

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**Table 6.3-2. Maximum Habitat Loss and Compensation for San Joaquin Kit Fox**

| | Permanent Habit Loss | Maximum Compensation Commitment (Acres) |
|---|---|---|
| | **Total Maximum Habitat Loss (Acres)** | **Protection or Restoration [a]** |
| High Quality | 0.23 | 38.98 [b] |
| Moderate Quality | 0.06 | - [b] |
| Low Quality | 38.69 | - [b] |
| **Total** | **38.98** | **38.98 [b]** |

Notes:
CMP = Compensatory Mitigation Plan.
[a] While the maximum mitigation commitment for San Joaquin kit fox is 38.98 acres, it is assumed that the 180.60 acres of grassland, vernal pool complex, and alkali seasonal wetland protection and enhancement for California tiger salamander in the Livermore recovery unit (as described in Attachment 3B.1, Table 3B.1-3, CMP-13: *California Tiger Salamander Habitat*) would benefit the San Joaquin kit fox and meet the compensatory mitigation commitment for the species.
[b] Compensatory mitigation for the San Joaquin kit fox, as achieved through protection of 180.60 acres of California tiger salamander upland habitat, would be of high-quality habitat.

## 6.3.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost, and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPT, soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex).

Geotechnical investigations associated with tunnel alignment water crossings, West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches and overwater and land-based CPTs and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section. All surface ground disturbance for field investigations for the tunneled portion of the Bethany Reservoir Aqueduct would occur outside of the Bethany Conservation Easement.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, temporary soil storage prior to backfilling trenches, and helicopter surveys to identify buried groundwater and natural gas wells. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of

testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

#### 6.3.1.1 Habitat Loss and Fragmentation

Field investigations would not result in any permanent loss of San Joaquin kit fox modeled habitat but would result in an estimated 2.64 acres of temporary disturbance (0.18% of all modeled habitat in the action area); 0.04 acres of which are high-quality habitat, 0.02 acre of which is moderate-quality habitat, and 2.58 acres of which are low-quality habitat (Figures 6.3-1 and 6.3-7). The habitat loss is associated with investigative work associated with the Bethany Fault which is just slightly north and east of the Bethany Reservoir. The temporary habitat loss associated with geotechnical investigations is of a small extent and a short duration and is not expected to adversely affect the species.

#### 6.3.1.2 Construction-Related Effects

Field investigations are very unlikely to result in injury or mortality of San Joaquin kit fox as the Bethany Fault study would be completed in a single day and conducted entirely on foot (Delta Conveyance Design and Construction Authority 2022e, 2022f). However, the presence of humans could result in minor disruption of normal behaviors. To minimize the potential for behavioral disruption, implementation of the *San Joaquin Kit Fox Avoidance Measure* described in Chapter 3, Section 3.6.2.1 would require an assessment to identify suitable San Joaquin kit fox habitat. Where suitable habitat is identified, a USFWS-approved biologist would perform preconstruction surveys for known or potential kit fox dens. If a den is discovered, a buffer would be established, and the den would be monitored for three days. If the den is found to be occupied by San Joaquin kit fox, the USFWS would be contacted, and all activities would cease until permission to proceed was obtained from as described in Section 3.6.2.1. Additionally, implementation of AMM-1*: Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would reduce the potential for behavioral disruption.

### 6.3.2 North Delta Intakes

The north Delta intakes would not overlap with San Joaquin kit fox modeled habitat; thus, north Delta intake construction would not affect San Joaquin kit fox.

### 6.3.3 Tunnels

The tunnel alignment from the north Delta intakes to the Bethany Complex does not overlap with San Joaquin kit fox modeled habitat; thus, tunnel construction would not affect San Joaquin kit fox.

### 6.3.4 Tunnel Shafts

Tunnel shafts would not overlap with San Joaquin kit fox modeled habitat; thus, tunnel shaft construction would not affect San Joaquin kit fox.

## 6.3.5 Reusable Tunnel Material

The reusable tunnel material (RTM) placement and RTM processing sites do not overlap with San Joaquin kit fox modeled habitat. Activities associated with RTM placement and processing would not affect San Joaquin kit fox.

## 6.3.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two sections that would pass under the Jones Pumping Plant discharge pipelines and the Bethany Conservation Easement (which would be tunneled). All other project features would be constructed on the surface. Bethany Complex facilities would be surrounded by security fencing during construction.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.3.6.1 Habitat Loss and Fragmentation

An estimated 22.05 acres of modeled San Joaquin kit fox low-quality habitat (1.6% of modeled low-quality habitat in the action area) would be permanently removed as a result of the Bethany Reservoir Aqueduct and the Bethany Reservoir Discharge Structure construction (Table 6.3-1) (Figures 6.3-10). The lost habitat is of low quality because soils are in low-quality textural classes (i.e., compacted soils) or have slopes greater than 30%—two features that are known to be unsuitable for denning (U.S. Fish and Wildlife Service 2020a:17, 50). The low value of the modeled habitat in this area is consistent with the USFWS description of this area as having a “very low” condition and “no evidence of a current population” (U.S. Fish and Wildlife Service 2020a:50-54).

While this habitat could still be used for dispersal and movement, the potential habitat loss will not affect connectivity or dispersal in the region because the loss is very small compared to the amount of available dispersal habitat (i.e., this habitat type is not limiting on the landscape), the project does not occur in any known movement corridors, nor does the project create any new barriers to movement. Construction of the Bethany Reservoir Aqueduct would not result in habitat fragmentation because the structure would be installed underground. The Bethany Reservoir Discharge Structure is unlikely to result in fragmentation of modeled San Joaquin kit fox habitat because the structure immediately abuts an existing facility that is regularly disturbed by human presence.

To minimize permanent habitat loss, the *San Joaquin Kit Fox Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.1 would require suitable San Joaquin kit fox habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through compensatory mitigation. While the maximum mitigation commitment for San Joaquin kit fox is 38.98 acres, it is assumed that the 180.60 acres of grassland, vernal pool complex, and alkali seasonal wetland protection and enhancement for California tiger salamander in the Livermore recovery unit would benefit the San Joaquin kit fox and meet the compensatory mitigation commitment for the species. See Appendix 3B, Section 3B.4.1.4, *Site Design and Development* and Attachment 3B.1, Table 3B.1-3, CMP-13: *California Tiger Salamander Habitat* for a description of how California tiger salamander (and San Joaquin kit fox) habitat would be protected, enhanced, and managed in perpetuity through the purchase of agency-approved mitigation bank credits or other site protection instruments.

### 6.3.6.2 Construction-Related Effects

Ground disturbing activities (such as grading, soil clearing) and the movement of construction vehicles and heavy construction equipment could injure or kill San Joaquin kit fox if individuals are present. Kit foxes could be struck by vehicles or could be entrapped in trenches, pipes, or culverts. Kit foxes and their prey could be exposed to construction-related fluids, such as fuels, oils, and paving material, that could injure individuals and contribute to habitat degradation. Overland driving could also crush dens.

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would reduce the potential for injury and mortality. Implementation of these measure would include (1) training construction staff on the needs of protecting San Joaquin kit fox, reporting requirements, and the ramifications for not following these measures; (2) having a biological monitor present who would ensure that non-disturbance buffers and associated construction fencing are intact and all other protective measures are being implemented; (3) ensuring trenches are covered at the end of the day or that wildlife escape ramps are installed; (4) limiting construction vehicle traffic to a maximum speed limit of 15 miles per hour on unpaved non-public access roads; (5) capping pipes at the end of each day; and (6) reducing the potential for discharge of construction materials in areas of potential habitat.

To avoid impacts on denning fox, the *San Joaquin Kit Fox Avoidance Measure* described in Chapter 3, Section 3.6.2.1 would require suitability assessments of the San Joaquin kit fox modeled habitat, preconstruction surveys for dens where the habitat is deemed suitable, and avoidance buffers and surveys where dens are identified. If a natal or pupping den is found to be occupied by San Joaquin kit fox, USFWS and CDFW would be notified immediately and the den would be monitored following the approach outlined in Section 3.6.2.1. With the implementation of these measures, and the low likelihood of San Joaquin kit fox presence, San Joaquin kit fox are not likely to be injured or killed by construction of the Bethany Complex.

## 6.3.7 Access Roads

The construction of new access roads and improvements to existing roads are necessary to support project construction and project facilities. Access road construction actions are described and evaluated in this section at the project level.

New access roads would be either gravel or paved and would be built to connect existing roads to construction areas and project facilities. Existing roads would be widened and improved to support the construction-related traffic. There are three regions where new access roads would be constructed and existing access roads would be improved in service of the Bethany Complex: to the northeast of the Bethany Complex, connecting Mountain House Road to Byron Highway; between Mountain House Road and the Bethany Reservoir Discharge Structure; and to the south of the Bethany Complex, connecting Mountain House Road to West Grant Line Road. All access roads described in this section occur west of Byron Highway. These access roads are described in Section Chapter 3, 3.2.7, *Access Roads*, and depicted in Figures 6.3-6, 6.3-11, and 6.3-12.

Construction activities for new and widened access roads include clearing, grubbing, moving utilities, paving, and the use of construction-related vehicles. Construction of access roads to the Bethany Complex would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where construction would occur at night. All lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity. Construction-related lighting would be downcast and motion-activated so as not to subject the immediate surroundings to light level extremes, however, these types of light generate an ambient nighttime luminescence that is visible from a distance (Chapter 3, Section 3.2.12).

### 6.3.7.1 Habitat Loss and Fragmentation

San Joaquin kit fox modeled habitat overlaps with the construction footprints for new and improved access roads. The overlapping access roads include widening of Mountain House Road, the new access road between Mountain House Road and the Bethany Reservoir Discharge Structure, and the new access road and interchange between Mountain House Road and Grant Line Road (Figures 6.3-1, 6.3-5, 6.3-10, and 6.3-11). Access road construction would result in the permanent removal of 16.22 acres (1.12% of modeled low-quality habitat in the action area) and the temporary disturbance of 13.73 acres of modeled low-quality habitat (Table 6.3.-1). The modeled habitat is of low-quality and the species is not likely to be present in the action area. As described in Appendix 3A, AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion.

The small portions of new access road construction is not expected to increase habitat fragmentation for San Joaquin kit fox. In addition to the low potential for the species to occur in the region, and thus be affected by new roads; the new road segments would not pose a new or substantial barrier to movement for a species like San Joaquin kit fox that is moderately mobile.

To minimize permanent habitat loss, the *San Joaquin Kit Fox Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.1 would require suitable San Joaquin kit fox habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided

and is permanently lost, the lost habitat would be offset through mitigation. While the maximum mitigation commitment for San Joaquin kit fox is 38.98 acres, it is assumed that the 180.60 acres of grassland, vernal pool complex, and alkali seasonal wetland protection and enhancement for California tiger salamander in the Livermore recovery unit would benefit the San Joaquin kit fox and meet the compensatory mitigation commitment for the species. See Appendix 3B, Section 3B.4.1.4, *Site Design and Development* and Attachment 3B.1, Table 3B.1-3, CMP-13: *California Tiger Salamander Habitat* for a description of how California tiger salamander (and San Joaquin kit fox) habitat would be protected, enhanced, and managed in perpetuity through the purchase of agency-approved mitigation bank credits or other site protection instruments.

#### 6.3.7.2 Construction-Related Effects

Ground disturbing activities (such as grading, soil clearing) and the movement of construction vehicles and heavy construction equipment could injure or kill San Joaquin kit fox if individuals are present. Kit foxes could be struck by vehicles or could be entrapped in trenches, pipes, or culverts. Kit foxes and their prey could be exposed to construction-related fluids, such as fuels, oils, and paving material, that could injure individuals and contribute to habitat degradation. Overland driving could also crush dens.

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would reduce the potential for injury and mortality. Implementation of these measure would include (1) training construction staff on the needs of protecting San Joaquin kit fox, reporting requirements, and the ramifications for not following these measures; (2) having a biological monitor present who would ensure that non-disturbance buffers and associated construction fencing are intact and all other protective measures are being implemented; (3) ensuring trenches are covered at the end of the day or that wildlife escape ramps are installed; (4) limiting construction vehicle traffic to a maximum speed limit of 15 miles per hour on unpaved non-public access roads; (5) capping pipes at the end of each day; and (6) reducing the potential for discharge of construction materials in areas of potential habitat.

To avoid impacts on denning fox, the *San Joaquin Kit Fox Avoidance Measure* described in Chapter 3, Section 3.6.2.1 would require suitability assessments of the San Joaquin kit fox modeled habitat, preconstruction surveys for dens where the habitat is deemed suitable, and avoidance buffers and surveys where dens are identified. If a natal or pupping den is found to be occupied by San Joaquin kit fox, USFWS and CDFW would be notified immediately and the den would be monitored following the approach outlined in Section 3.6.2.1. With the implementation of these measures, and the low likelihood of San Joaquin kit fox presence, San Joaquin kit fox are not likely to be injured or killed by construction of the access roads.

## 6.3.8 Electrical and SCADA Facilities

The following discussion includes a project-specific analysis of electrical and SCADA facilities construction (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new supervisory control and data acquisition (SCADA) lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10, *Electrical Facilities*, and Section 3.2.11, *SCADA Facilities*.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching, directional drilling, and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase. Temporary electrical facilities used during construction, such as temporary substations, will be removed when construction is complete.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.3.7, *Access Roads*. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

#### 6.3.8.1 Habitat Loss and Fragmentation

The construction footprints for electrical and SCADA facilities overlap with modeled San Joaquin kit fox habitat in locations along the alignment northeast of the Bethany Reservoir (Figures 6.3-6 – 6.3-10). A new overhead 11 kV power supply line from the Bethany Reservoir Discharge Structure would be constructed within the prism of an existing access road and would result in the permanent removal of 0.11 acres of modeled high-quality habitat (0.14% of modeled high-quality habitat in the action area), 0.06 acres of modeled moderate quality habitat (0.54% of modeled moderate-quality habitat in the action area), and 0.42 acres of modeled low-quality habitat (0.03% of modeled low-quality habitat in the action area) (Table 6.3-1). Construction of new SCADA lines along the Bethany Reservoir Aqueduct would result in the temporary disturbance of 0.01 acres of modeled high-quality habitat (0.01% of modeled low-quality habitat in the action area) (Table 6.3-1). Due to the small area of modeled habitat loss, construction of electrical and SCADA facilities would not cause additional habitat fragmentation in the region.

For more details about the activities associated with electrical power supply and SCADA, see Chapter 3, Section 3.2.10 and 3.2.11; for more details on schedule, see Section 3.2.8, *Construction Schedule.* To minimize permanent habitat loss, the *San Joaquin Kit Fox Avoidance and Minimization*

*Measure* described in Chapter 3, Section 3.6.2.1 would require suitable San Joaquin kit fox habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. While the maximum mitigation commitment for San Joaquin kit fox is 38.98 acres, it is assumed that the 180.60 acres of grassland, vernal pool complex, and alkali seasonal wetland protection and enhancement for California tiger salamander in the Livermore recovery unit would benefit the San Joaquin kit fox and meet the compensatory mitigation commitment for the species. See Appendix 3B, Section 3B.4.1.4, *Site Design and Development* and Attachment 3B.1, Table 3B.1-3, CMP-13: *California Tiger Salamander Habitat* for a description of how California tiger salamander (and San Joaquin kit fox) habitat would be protected, enhanced, and managed in perpetuity through the purchase of agency-approved mitigation bank credits or other site protection instruments. As described in Appendix 3A, AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion.

### 6.3.8.2 Construction-Related Effects

Construction of new electrical or SCADA facility could result in the injury or mortality if individuals enter the construction area and are struck by a vehicle or equipment. Individual kit foxes could be injured or killed if they become entrapped in open trenches. Additionally, human presence and noise from construction activities could disrupt foraging and dispersal behaviors. Construction-related contaminants such as gas, oil, and steering fluid could accidentally be discharged into suitable habitat. To minimize potential injury and mortality during construction of electrical power supply and SCADA facilities, the *San Joaquin Kit Fox Avoidance Measure* would require suitability assessments of the San Joaquin kit fox modeled habitat, preconstruction surveys, and avoidance buffers (Chapter 3, Section 3.6.2.1).

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would reduce the potential for injury and mortality. Implementation of these measure would include (1) training construction staff on the needs of protecting San Joaquin kit fox, reporting requirements, and the ramifications for not following these measures; (2) having a biological monitor present who would ensure that non-disturbance buffers and associated construction fencing are intact and all other protective measures are being implemented; (3) ensuring trenches are covered at the end of the day or that wildlife escape ramps are installed; (4) limiting construction vehicle traffic to a maximum speed limit of 15 miles per hour on unpaved non-public access roads; (5) capping pipes at the end of each day; and (6) reducing the potential for discharge of construction materials in areas of potential habitat.

To avoid impacts on denning fox, the *San Joaquin Kit Fox Avoidance Measure* described in Chapter 3, Section 3.6.2.1 would require suitability assessments of the San Joaquin kit fox modeled habitat, preconstruction surveys for dens where the habitat is deemed suitable, and avoidance buffers and surveys where dens are identified. If a natal or pupping den is found to be occupied by San Joaquin kit fox, USFWS and CDFW would be notified immediately and the den would be monitored following the approach outlined in Section 3.6.2.1. With the implementation of these measures, and the low likelihood of San Joaquin kit fox presence, San Joaquin kit fox are not likely to be injured or killed by construction of the electrical and SCADA facilities.

## 6.3.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[15] concrete and controlled low-strength backfill material (CLSM) batch plants and park-and-ride lots. Neither of these features overlap with San Joaquin kit fox modeled habitat.

Construction of a metering area off of Christensen Road would result in 0.01 acres of temporary impacts to San Joaquin kit fox high-quality modeled habitat (0.01% of modeled high-quality modeled habitat in the action area) (Table 6.3-1). The metering area would support new overhead power lines. Impacts from temporary habitat disturbance would be minimized as described in Section 6.3.8.1.

## 6.3.10 Contra Costa Water District Interconnection Facilities

The Contra Costa Water District (CCWD) interconnection facility construction area does not overlap with San Joaquin kit fox modeled habitat. Activities in this area would not result in effects on San Joaquin kit fox (Figures 6.3-5).

## 6.3.11 Compensatory Mitigation Plan

Construction of habitat creation and enhancement at Bouldin Island and the I-5 ponds under the CMP would not overlap with modeled San Joaquin kit fox habitat and is outside of the species' known range (Figure 6.3-1). Implementation of the CMP would not result in effects on San Joaquin kit fox.

### 6.3.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

Construction of habitat creation and enhancement at Bouldin Island and the I-5 ponds under the CMP would not overlap with modeled San Joaquin kit fox habitat and is outside of the species' known range (Figure 6.3-1). Implementation of the CMP would not result in effects on San Joaquin kit fox.

### 6.3.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. Mitigation or conservation bank credits purchased for these species would have been approved by USFWS. Through the approval process, any potential impacts on San Joaquin kit fox would have been addressed by the USFWS. However, depending on the location of the conservation bank, purchased credits may benefit the fox as the habitat types for these species overlap with that of the fox. Therefore, the purchase of mitigation or conservation bank credits for special-status species would not result in additional adverse effects to San Joaquin kit fox.

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As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.3.7, *Access Roads*, and Section 6.3.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

#### 6.3.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.3.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available.

A non-bank site would create or restore, protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. If non-bank sites are used for vernal pool or alkaline wetland creation or enhancement (Appendix 3B, Section 3B.3.2.4, *Vernal Pools and Alkaline Wetlands*), these activities could overlap with the northernmost portion of the San Joaquin kit fox range. The habitat quality in this area is mixed but mostly low quality and San Joaquin kit fox are likely absent (U.S. Fish and Wildlife Service 2020:50). In addition, creation, protection, and enhancement activities that could adversely affect San Joaquin kit fox in short-term would be beneficial in the long-term. Therefore, the use of non-bank mitigation sites for special-status species is not expected to adversely affect San Joaquin kit fox.

#### 6.3.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). There are no construction activities associated with implementation of site protection instruments.

#### 6.3.11.5 Channel Margin Enhancements

Channel margin enhancements would take place in the northern portion of the Delta along the Sacramento River in areas that are outside of the San Joaquin kit fox's range. Therefore, this activity is not expected to adversely affect San Joaquin kit fox.

#### 6.3.11.6 Tidal Perennial/Emergent Wetland Restoration

Tidal wetland restoration would occur in the Cache Slough and Lower Yolo Bypass region of the Delta. These areas are outside of the current San Joaquin kit fox range. Therefore, this activity is not expected to adversely affect San Joaquin kit fox.

### 6.3.12 Effects on Critical Habitat

Critical habitat has not been designated for San Joaquin kit fox.

### 6.3.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the ESA as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the ESA. Projects that result in take of San Joaquin kit fox would require incidental take authorization pursuant to the ESA and therefore are not addressed in this cumulative effects analysis because they require a federal action.

However, non-federal actions and climate change have potential to affect San Joaquin kit fox in the action area when grassland and arid shrubland habitat degradation occurs without USFWS authorization. The most likely non-federal action to affect San Joaquin kit fox is conversion of grassland, vernal pool complex, and alkali seasonal wetland complex habitat to agriculture or urban development, particularly on lands surrounding the Bethany Reservoir. Land use conversion is unlikely due to local land use regulations (e.g., zoning ordinances, general plan designations) in the cities of Brentwood, Pittsburg, Oakley, and Clayton that are covered by the East Contra Costa County HCP/NCCP.

Climate change threatens to modify annual weather patterns. Climate change scenarios have the potential to exacerbate drought, wildfire, and flooding events. Small, fragmented populations of San Joaquin kit fox are at higher risk of local extinction during extreme climatic events than are large populations on contiguous habitat (U.S. Fish and Wildlife Service 2020a:37). Climate change may result in a loss of San Joaquin kit fox and their prey, higher numbers of their predators, and increased exposure to parasites and disease. Drought is known to affect San Joaquin kit fox through changes in prey abundance, including giant kangaroo rat. Giant kangaroo rats are highly affected by changes in precipitation and vegetation growth (Germano and Saslaw 2017:1616). Changes in prey availability as a result of drought have been shown to affect kit fox reproduction (U.S. Fish and Wildlife Service 2020a:iv).

Because the species has low potential to occur in the action area and there is relatively low development pressure in the part of the action area where modeled habitat occurs, cumulative effects in the action area are not expected to appreciably diminish the likelihood of the species' long-term survival and recovery.

# 6.4 Effects on California Least Tern

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.10.6, *Suitable Habitat Definition*, and Section 4.4.10.7, *Breeding and Foraging Habitat Suitability Model*, define suitable habitat and describe the habitat model for California least tern.

California least tern nest in the Delta between mid-April and late September but overwinter to the south, likely in Central and South America. As described in Section 4.4.10.2, *Life History and Habitat Requirements,* nesting colonies are on artificially or incidentally created habitat (Rigney and Granholm 2005:1–3; Marschalek 2008:14) such as gravel roads and debris piles in the Delta. Because these are artificial or incidentally created habitats, it is not possible to model nesting habitat. There are four California least tern nesting sites that occur in and near the action area, all of which continue to be used almost every year by at least one nesting pair: Pittsburg Power Plant, Napa-Sonoma Marshes Wildlife Area Green Unit, Bufferlands, and Montezuma Wetlands. The closest distance between a known nesting location is approximately one mile; this occurs between the Bufferlands nesting site and access road and SCADA facilities northeast of the north Delta intakes. Nesting terns have high site fidelity and colonies are assumed to be stable in location with low potential for a new colony to be established.

During nesting, terns primarily forage within two miles of nesting locations (Atwood and Minsky 1983:70). Foraging typically occurs in shallow estuaries or lagoons (Thompson et al. 2020; U.S. Fish

and Wildlife Service 2020b:19). All tidal and non-tidal aquatic features are included in the California least tern habitat model (as described in Section 4.4.10.7). Because future nest locations cannot be predicted (though the potential for new nests is low) and birds migrating in and out of the region could occur anywhere, foraging habitat is mapped throughout the action area. All modeled foraging habitat in the action area is of reasonably good quality and is "non-limiting." That is, aquatic foraging habitat is abundant and is assumed to not limit the population in any way. Nesting habitat, however, is assumed to be limiting.

Activities associated with field investigations, north Delta intakes, access roads, and electrical and SCADA facilities overlap with California least tern modeled foraging habitat and occur in proximity to known nesting occurrences. The locations of this overlap with modeled foraging habitat are described in the sections below. Construction projects will be designed to avoid loss of California least tern nesting colonies if construction will take place within 500 feet of a California least tern nest during the nesting season (April 15 to August 15, or extended as determined through surveys) as described in Chapter 3, Section 3.6.2.2, *California Least Tern Avoidance and Minimization Measure*. Figure 6.4-1 provides an overview of the locations of surface impacts relative to California least tern modeled foraging habitat. Figures 6.4-1 through 6.4-28 include overview as well as "zoomed-in" figures depicting overlap between the project footprint, modeled habitat, and CNDDB occurrences.

There are 9,021.95 acres of modeled foraging habitat (open water) in the action area, 11.13 acres of which overlap with the project footprint (0.12% of total modeled habitat in the action area). Table 6.4-1 summarizes the total acreage of California least tern modeled foraging habitat that overlaps with the construction footprint. Compensatory mitigation is not proposed for foraging habitat because foraging habitat is not limited in the action area and the small decrease attributed to the project would not result in any measurable effect on California least tern. With the nesting avoidance measure and the insignificant effects to foraging habitat, the project may affect but is not likely to adversely affect California least tern.

**Table 6.4-1. Maximum Overlap between Project Features and Modeled Foraging Habitat for California Least Tern by Activity Type (Acres)**

| Least Tern Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities (Overhead and Underground) [c] | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Foraging | 9,021.95 | - | 0.58 | 0.27 | 5.82 | - | 0.29 | - | - | 6.96 | 3.36 | - | 0.70 | - | 0.11 | 4.16 | 11.13 |
| **Total** | 9,021.95 | **-** | 0.58 | 0.27 | 5.82 | **-** | 0.29 | **-** | **-** | **6.96** | 3.36 | **-** | 0.70 | **-** | 0.11 | **4.16** | **11.13** |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

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## 6.4.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPTs, soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to those described in the relevant, associated activity type sections. Geotechnical investigations associated with tunnel alignment water crossings—which include test trenches, overwater and land-based CPTs, and soil borings—largely fall outside of surface construction footprints and it is these impacts that are discussed in this section.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, temporary soil storage prior to backfilling trenches, and helicopter surveys to identify buried groundwater and natural gas wells. Ground disturbance for each field investigation site is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting. All surface ground disturbance for field investigations for the Bethany Reservoir Aqueduct tunnel would occur outside of the Bethany Conservation Easement.

### 6.4.1.1 Habitat Loss and Fragmentation

Field investigations could temporarily disturb up to an estimated 3.36 acres of California least tern modeled foraging habitat (0.04% of modeled foraging habitat in the action area) (Table 6.4-1). Overwater field investigations would not occur at all locations simultaneously, so the area of temporary disturbance at a given time would be very small relative to available habitat. This small, temporary effect on non-limiting foraging habitat would not adversely affect California least tern.

### 6.4.1.2 Construction-Related Effects

Overwater field investigations have potential to disrupt normal California least tern behavior. Heavy equipment, presence of humans, and use of helicopters would create noise, vibration, and visual disturbance within and adjacent to modeled California least tern foraging habitat and could alter typical foraging behaviors. Construction-related contaminants, such as gas, oil, or steering fluid, could accidentally be discharged into modeled foraging habitat and be consumed by a foraging tern.

Nesting locations will be avoided as described in Chapter 3, Section 3.6.2.2. Because foraging habit is not limited and readily available, individual foraging birds are not expected to be affected by the temporary loss of this small area. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would minimize the potential for spills and contamination. Given these reasons, the potential for adverse effects on foraging California least terns are extremely unlikely to occur and therefore insignificant.

## 6.4.2 North Delta Intakes

The north Delta intakes would be constructed on the east bank of the Sacramento River upstream and downstream of Hood. Two intakes would divert water from the Sacramento River and include cylindrical fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and shaft, embankments, and other appurtenant structures. Intakes would also include construction support facilities (e.g., emergency facilities, fuel station), electrical substations, switchyards, and access roads that fall within the north Delta intake facility footprints. The north Delta intakes would and be surrounded by security fencing. The construction actions associated with the north Delta intakes are described and evaluated at the project level.

Construction activities at each intake are described in Chapter 3, Section 3.2.2, *North Delta Intakes*. Intake construction would include ground clearing and grading, in-water and on-land pile driving; excavation; placement of fills, cutoff walls, structures; and drilling. These activities would require the use of loud, heavy equipment within the construction site as well as along the access roads to the site and limited nighttime work. Construction-related lighting would be downcast so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). The duration of the activity would be approximately 7 years at each intake. Implementation of intake construction at each location would be staggered by approximately 1 year. Intake C, the southern intake, would begin construction first; approximately 1 year later, construction would begin at Intake B, the northern intake. The result is that construction would overlap at both sites for approximately 6 years.

### 6.4.2.1 Habitat Loss and Fragmentation

The north Delta intakes would result in permanent removal of 5.82 acres of modeled foraging habitat (0.06% of modeled foraging habitat in the action area) (Table 6.4-1) (Figure 6.4-2). The small loss of non-limiting foraging habitat would not adversely affect California least tern.

### 6.4.2.2 Construction-Related Effects

The nearest nesting location, Bufferlands, is over four miles away and will not be affected. Pile driving would create noise and vibration effects, as well as visual disturbance, and could alter typical foraging behavior. Construction-related contaminants (e.g., gas, oil, and steering fluid) could accidentally be discharged into foraging habitat from pile driving or other near-water construction activities and be ingested by foraging terns.

Because foraging habit is not limited and readily available, individual foraging birds are not expected to be affected by the loss of a small foraging area. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would minimize the potential for spills and contamination. Given these reasons, the potential for adverse effects on foraging California least terns are extremely unlikely to occur and therefore insignificant.

## 6.4.3 Tunnels

Tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance to California least tern modeled habitat; therefore, this activity would not have an adverse effect on the species.

## 6.4.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. California least tern modeled habitat does not overlap with any tunnel shaft locations (Figure 6.4-1). Activities for these facilities would not affect the species.

## 6.4.5 Reusable Tunnel Material

RTM areas do not overlap with California least tern modeled habitat. Activities for these facilities would not affect the species (Figure 6.4-1).

## 6.4.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and the Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical, construction, and maintenance activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located in the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.4.6.1 Habitat Loss and Fragmentation

Construction of the Bethany Reservoir Aqueduct would result in permanent loss of 0.27 acre of modeled California least tern foraging habitat (<0.01% of modeled foraging habitat within the Delta) (Figures 6.4-1 and 6.4-6) (Table 6.4-1). Modeled foraging habitat that would be removed from

construction of Bethany Complex facilities meets the description of suitable California least tern habitat, but this small loss of non-limiting foraging habitat would not adversely affect California least tern.

#### 6.4.6.2 Construction-Related Effects

The nearest nesting location, east of Montezuma Slough, is over 25 miles away and will not be affected. Construction activities could create noise and vibration effects, as well as visual disturbance, and could alter typical foraging behavior. Construction-related contaminants (e.g., gas, oil, and steering fluid) could accidentally be discharged into foraging habitat near-water construction activities and be ingested by foraging terns. Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of least tern if they nested within the construction area.

Because foraging habitat is not limited and readily available, individual foraging birds are not expected to be affected by the loss of a small foraging area. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would minimize the potential for spills and contamination. Given these reasons, the potential for adverse effects on foraging California least tern is extremely unlikely to occur and therefore insignificant.

### 6.4.7 Access Roads

New access roads, a new access railroad spur on Lower Roberts Island, and improvements to existing public roads are necessary to support project construction and project facilities. In addition to these road and railroad features, impacts from levee improvements on Lower Roberts Island are also evaluated in this section (as the levee improvements would be adjacent to the access road, have similar impacts on species, and occur at roughly the same time). The construction actions associated with the access roads, access railroad spur, and Lower Roberts Island levee improvements are described and evaluated at the project level.

New access roads are either gravel or paved and would be created to provide connections between existing roads and construction areas for project facilities. The new access railroad spur would transport materials and equipment to the tunnel launch shaft. Existing roads would be widened and improved to support the construction-related traffic. The access roads impacts discussed in this section are those that are in service to, but occur outside of, facilities at the north Delta intakes, King Island, and Lower Roberts Island. These access roads are described in Chapter 3, Section 3.2.7 and depicted in Figure 6.4-1. Impacts from access road construction within the north Delta intakes, tunnel shafts, and RTM areas are described above in Section 6.4.2, *North Delta Intakes*, Section 6.4.4, *Tunnel Shafts*, and Section 6.4.5, *Reusable Tunnel Material*, respectively. Access roads for all other facilities do not overlap with modeled California least tern habitat.

Construction activities for access roads (which include the railroad spur and levee improvements on Lower Roberts Island) include clearing, grubbing, excavation, placement of fill, minor bridge construction, moving utilities, paving, and the use of construction vehicles. A new access railroad spur at Lower Roberts Island would be constructed adjacent to and concurrent with the access road at this location and would involve installing a bridge over Burns Cutoff, rail tracks, train use during construction, and the use of vehicles and heavy equipment to inspect and maintain the railroad right-of-way during project construction. Construction activities associated with new bridges and

improvements of an existing bridge include in-water construction and pile driving, excavation, and drilling. Construction of access roads would take place over several years during daylight hours.

#### 6.4.7.1 Habitat Loss and Fragmentation

Access roads would result in permanent removal of up to 0.58 acre (0.01% of modeled foraging habitat in the action area) and temporary removal of 0.70 acre (0.01% of modeled habitat in the action area) of modeled foraging habitat (Table 6.4-1). The modeled foraging habitat that would be affected by access road construction is located at Burns Cutoff at Lower Roberts Island and is generally considered good quality.

Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A). The small loss of non-limiting foraging habitat would not adversely affect California least tern.

#### 6.4.7.2 Construction-Related Effects

Construction-related contaminants, such as gas, oil, and steering fluid, could accidentally be discharged into foraging habitat from near-water construction activities. Pile driving would create noise and vibration effects in and adjacent to modeled foraging habitat, which could disrupt foraging behavior. Construction-related vehicles and equipment using access roads adjacent to modeled foraging habitat could increase the risk of injury or mortality due to collisions.

The closest distance between an access road construction site (north Delta intakes) and a known nesting location (Bufferlands) is one mile; thus, nesting habitat will not be affected. Access road construction activities are unlikely to result in adverse effects on foraging California least terns because the species is unlikely to be present at most access road work areas. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would minimize the potential for spills and contamination. Given these reasons, the potential for adverse effects on foraging California least terns are extremely unlikely to occur and therefore insignificant.

### 6.4.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching and directional drilling and use of heavy equipment and would mostly occur concurrent with access road construction. Cranes would be used during the line-stringing phase.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.4.7, *Access Roads*. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for additional details about the impact assessment method.

### 6.4.8.1 Habitat Loss and Fragmentation

Construction of new electrical and SCADA facilities would result in permanent loss of 0.29 acres of modeled foraging habitat and temporary disturbance of 0.11 acres of California least tern modeled foraging habitat (Table 6.4-1). Impacts to least tern modeled habitat would be greatly avoided because new electoral and SCADA facilities would be directionally bored under aquatic habitat features. The small loss of non-limiting foraging habit would not adversely affect California least tern. In addition, AMM-22: *Electrical Power Line Support Placement* (Appendix 3A) requires that the placement of power lines will avoid sensitive aquatic habitats to the maximum extent feasible.

### 6.4.8.2 Construction-Related Effects

Construction-related contaminants, such as gas, oil, steering fluid, and herbicides, could accidentally be discharged into foraging habitat from near-water construction activities. Tower or pole construction would create noise and vibration effects adjacent to modeled foraging habitat. Presence of construction vehicles, equipment, and personnel would create visual disturbances.

Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (described in Appendix 3B) would minimize the potential for spills and contamination. Individual foraging birds are not expected to be affected by the temporary activities occurring adjacent to foraging areas because foraging habit is not limited and readily available.

New aboveground power lines are not expected to increase the risk of bird strike for California least tern because there are no new lines between nesting and foraging habitat where terns would be expected to be moving; terns are able to maneuver relatively quickly around an obstacle and are not at high risk strike (Bevanger 1998); AMM-22: *Electrical Power Line Support Placement,* described in Appendix 3A, would require minimizing impacts on sensitive resources, incorporating bird-safe

design, and using bird flight diverters. For these reasons, the potential for adverse effects on foraging California least terns from the construction of electrical facilities is extremely unlikely to occur and therefore insignificant.

## 6.4.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[16] concrete and CLSM batch plants and park-and-ride lots. None of these features overlap with the California least tern modeled habitat, thus activities associated with these facilities are not expected to affect the species (Figure 6.4-1).

## 6.4.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with California least tern modeled habitat. Activities in this area would not have an adverse effect on the species (Figure 6.4-5).

## 6.4.11 Compensatory Mitigation Plan

Construction of habitat creation and enhancement at Bouldin Island and the I-5 ponds under the CMP would not overlap with modeled California least tern foraging habitat, and this activity would not have an adverse effect on the species (Figure 6.4-1).

### 6.4.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

Construction of habitat creation and enhancement at Bouldin Island and the I-5 ponds under the CMP would not overlap with modeled California least tern foraging habitat and this activity would not have an adverse effect on the species (Figure 6.4-1).

### 6.4.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. Lands protected for these species does not overlap with California least tern habitat and therefore the tern would not be adversely affected by implementation of this action.

### 6.4.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.4.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali

[16] As described in Appendix 6A, *Terrestrial Effects Analysis Methods,* the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.4.7, *Access Roads*, and Section 6.4.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

seasonal wetland habitat. These habitat types do not provide habitat for California least tern so the tern would not be adversely affected by implementation of non-bank site protection.

#### 6.4.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands (e.g., grassland, vernal pool complex) that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. As these habitat types do not overlap with California least tern, the implementation of site protection instruments would not affect the species.

#### 6.4.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. While not the target of enhancement actions, California least tern also has the potential to benefit from the increase in shallow, slow-moving marsh habitat that would promote prey populations along levees in the central Delta.

The locations for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

Enhancement would entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.
- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

### Habitat Loss and Fragmentation

While the exact location of the channel margin enhancement is not known, it is likely to be placed in the central Delta (e.g., Sacramento River between Freeport and Georgiana Slough, Mokelumne River near Bouldin Island). As California least tern forages in aquatic habitat, and channel margin enhancement will take place in nearshore areas and require some in-water work, it is assumed that channel margin enhancement would result in the temporary loss of a small amount of California least tern foraging habitat. Because aquatic foraging habitat is not limiting, the duration of the loss would be short, and the habitat would be improved in the long-term (e.g., greater potential for prey items); channel margin enhancement actions are not expected to adversely affect California least tern.

### Construction-Related Effects

Although the locations of channel margin enhancement are not known, all potential sites are greater than one mile away from the nearest nesting location, Bufferlands, and therefore construction activity will not adversely affect nesting California least tern. Construction activities would create noise and visual disturbance and could alter typical foraging behavior. Construction-related contaminants (e.g., gas, oil, and steering fluid) could accidentally be discharged into foraging habitat and be ingested by foraging terns.

Because foraging habit is not limited and readily available, individual foraging birds are not expected to be affected by the loss of a small foraging area. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would minimize the potential for spills and contamination. With these measures in place, adverse effects on foraging California least terns are not likely to occur.

## 6.4.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

### Habitat Loss and Fragmentation

Tidal restoration will result in the temporary disturbance of existing tidal channels that have potential to provide California least tern foraging habitat in the Cache Slough or Lower Yolo Bypass region. Because the loss of habitat would be temporary (construction is not expected to last more than 2 years) and the project would result in a long-term increase in tidal perennial habitat (i.e., least tern foraging habitat), tidal restoration is not expected to adversely affect California least tern.

### Construction-Related Effects

The nearest nesting location to Cache Slough and Lower Yolo Bypass where tidal restoration may occur is the Bufferlands site over one mile away so tidal restoration would not adversely affect known nesting locations. However, there is some potential for foraging birds to be affected by noise and human presence during construction. Also, construction-related contaminants (e.g., gas, oil, and steering fluid) could accidentally be discharged into foraging habitat and be ingested by foraging terns.

Foraging habitat is not limited and readily available elsewhere and thus the temporary construction-related disturbances are not expected to affect individual foraging birds. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would minimize the potential for spills and contamination. With this measure in place, adverse effects on foraging California least terns are not likely to occur.

### 6.4.12 Effects on Critical Habitat

Critical habitat has not been designated for the California least tern.

### 6.4.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Projects that result in take of California least tern would require incidental take authorization pursuant to the Endangered Species Act and therefore are not addressed in this cumulative effects analysis because they require a federal action.

The likelihood that open-water habitat loss could reach a scale as to affect California least tern is extremely unlikely. However, nonfederal activities and climate change have the potential to affect California least tern in the action area when foraging habitat degradation occurs without USFWS authorization. The most likely activity to affect the quality of open-water habitat is unauthorized water pollution. Poor water quality may decrease prey species density or increase toxin loading such that nesting success and survivorship are affected.

Climate change threatens to modify annual weather patterns. It may result in a decrease of California least tern prey density and an increase in the number of their predators, parasites, and disease. Since the habitat near the action area with the highest likelihood of supporting nesting California least terns is within the Suisun Marsh area where development is prohibited or highly restricted, cumulative effects in the action area are not expected to appreciably diminish the likelihood of the species' long-term survival and recovery.

## 6.5 Effects on Least Bell's Vireo

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.11.6, *Suitable Habitat Definition*, and Section 4.4.11.7, *Recolonization Habitat Suitability Model*, define suitable habitat and describe the habitat model for least Bell's vireo.

The primary populations of least Bell's vireo currently occur in Southern California, and the species is rarely observed in the Central Valley. While there are no known extant occurrences that overlap with the project footprint (California Department of Fish and Wildlife 2020b), there are relatively recent reports of individuals displaying nesting behavior or successfully nesting in the Delta (see

Section 4.4.11.4, *Status of the Species in the Action Area/Environmental Baseline*). These occurrences indicate the species is attempting to recolonize the Central Valley.

Least Bell's vireo modeled habitat is located throughout the action area. Activities associated with field investigations, north Delta intakes, tunnel shafts, RTM management, access roads, electrical facilities, SCADA facilities, Bethany Complex, and the CMP overlap with least Bell's vireo modeled habitat and have the potential to affect least Bell's vireo. Figures 6.5-1 through 6.5-29 include overview as well as "zoomed-in" figures depicting overlap between the project footprint, modeled habitat and CNDDB occurrences.

There are 17,386.63 acres of modeled least Bell's vireo recolonization habitat in the action area. An estimated 17.34 acres (0.10% of total modeled habitat in the action area) of modeled least Bell's vireo habitat would be adversely affected by the project. Effects from these activities are described in the sections below. Table 6.5-1 summarizes the total estimated habitat loss of least Bell's vireo modeled habitat and Table 6.5-2 summarizes the proposed acres of compensation.

**Table 6.5-1. Maximum Habitat Loss of Modeled Habitat for Least Bell's Vireo by Activity Type (Acres)**

| Least Bell's Vireo Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Nesting and Migratory | 17,386.63 | - | 2.77 | 0.22 | 6.35 | - | 0.11 | - | 0.23 | 9.68 | 0.71 | - | 2.04 | - | 4.92 | 7.67 | 17.34 |
| **Total** | 17,386.63 | - | 2.77 | 0.22 | 6.35 | - | 0.11 | - | 0.23 | 9.68 | 0.71 | - | 2.04 | - | 4.92 | 7.67 | 17.34 |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

**Table 6.5-2. Maximum Habitat Loss and Compensation for Least Bell's Vireo**

| | Permanent Habit Loss (Acres) | Maximum Compensation Commitment (Acres) | With Full Implementation of the Compensatory Mitigation Plan [c] |
|---|---|---|---|
| | Total Maximum Habitat Loss (Acres) | Restoration/Creation (Acres) [a] | Creation and Enhancement [b] (Acres) |
| **Recolonization Total** | 9.68 | 19.36 | 204.79 |

Notes:
CMP = Compensatory Mitigation Plan.
[a] See CMP-21 in Table 3B.1-3 of Attachment 3B.1, *Compensatory Mitigation Design Parameters,* for the full commitment to create or restore least Bell's vireo riparian habitat.
[b] See Table 3B-4 in Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*, for the creation and enhancement commitment for least Bell's vireo.
[c] This effect analysis assumes that existing, low-quality least Bell's vireo habitat would be temporarily disturbed from implementation of the CMP enhancement and creation actions. The temporary disturbance is expected to convert existing, low-quality habitat to enhanced, high-quality habitat.

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## 6.5.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost, and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPTs), soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex). Geotechnical investigations associated with tunnel alignment water crossings, West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches and overwater and land-based CPTs and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, temporary soil storage prior to backfilling trenches, and helicopter surveys to identify buried groundwater and natural gas wells. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

### 6.5.1.1 Habitat Loss and Fragmentation

The West Tracy Fault and Bethany Fault investigations do not overlap with modeled least Bell's vireo habitat. Geotechnical investigations associated with the tunnel alignment would overlap with modeled least Bell's vireo habitat.

An estimated 0.71 acre of modeled least Bell's vireo recolonization habitat would be temporarily disturbed as a result of field investigations (<0.01% of all modeled recolonization habitat in the action area). Modeled recolonization habitat near field investigation footprints for the north Delta intakes and Twin Cities Complex is considered high- to moderate-quality because many riparian corridors in this region are relatively wide with continuous canopy. Habitat surrounding field investigation footprints west of Thornton and on Canal Ranch Tract, Terminous Tract, Lower Roberts Island, and Jones Tract follow established roadways, sloughs, or agricultural ditches and generally consists of narrow, linear patches of riparian habitat that are lower quality. Field investigations for the West Tracy Fault, Bethany Fault, and the Bethany Complex overlap with a few isolated patches that are unlikely to provide high-quality habitat. As the patches of lost habitat are very small and generally of lower quality, the incremental decrease in connectivity is not expected to result in additional, substantial fragmentation. The implementation of AMM-14: *Construction Best*

*Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion (Appendix 3A).

#### 6.5.1.2 Construction-Related Effects

Overland driving and ground disturbance could injure or kill vireos that are present near work locations. Ground disturbing activities (such as pile driving test methods), helicopters, and human presence would create noise, vibration, and visual disturbance and could disrupt normal behaviors of least Bell's vireo if present in or near the work area. If least Bell's vireo nest in or adjacent to field investigation work areas, construction-related noise and visual disturbances during the breeding season could mask calls, disrupt foraging and nesting behaviors, and reduce the quality of nesting habitat. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled recolonization habitat exposing vireos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals, as well as lead to habitat degradation and reduced reproductive success. While these impact mechanisms would exist at the field investigation sites, they are unlikely to result in adverse effects on nesting least Bell's vireo because the species is unlikely to be present given the species rarely nests in the Central Valley, and the nearest known potential nesting location is approximately 12 miles west of the nearest field investigation area on Terminous Tract.

To minimize injury and mortality during field investigations, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require preconstruction surveys, consistent with a USFWS- or CDFW-approved survey protocol, in suitable least Bell's vireo habitat where construction-related noise levels would exceed 60 dBA $L_{eq}$ (1 hour). If least Bell's vireo is found, construction activities and vegetation removal would be conducted when the USFWS- and CDFW-approved biologist has confirmed that least Bell's vireos are not present within 500 feet. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area.

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further minimize potential for injury and mortality by training construction staff on the regulatory requirements for sensitive species, having a biological monitor present during ground disturbing activities, maintaining non-disturbance buffers, and delineating work areas (Appendix 3A). To reduce effects of contamination from fuel or oil, AMM-2*: Develop and Implement Hazardous Materials Management Plans* and AMM-3*: Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be implemented.

### 6.5.2 North Delta Intakes

The north Delta intakes would be constructed on the east bank of the Sacramento River near the town of Hood. Two intakes would divert water from the Sacramento River and include cylindrical fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and shaft, embankments, and other appurtenant structures. Intakes would also include construction support facilities (e.g., emergency facilities, fuel station), electrical substations, switchyards, and access roads that fall within the north Delta intake facility footprints. The north Delta Intakes would be surrounded by security fencing. The construction actions associated with the north Delta intakes are described and evaluated at the project level.

Construction activities at each intake are described in Chapter 3, Section 3.2.2. Intake construction would include ground clearing and grading; in-water and on-land pile driving; excavation; placement of fills, cutoff walls, and structures; and drilling. These activities would require the use of loud, heavy equipment within the construction site as well as along the access roads to the site and limited nighttime work. Construction-related lighting would be downcast so as not to subject the immediate surroundings to light level extremes; however, these types of light generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). The duration of the activity would be approximately 7 years at each intake. Implementation of intake construction at each location would be staggered by approximately 1 year. Intake C, the southern intake, would begin construction first; approximately 1 year later, construction would begin at Intake B, the northern intake. The result is that construction would overlap at both sites for approximately 6 years.

#### 6.5.2.1 Habitat Loss and Fragmentation

An estimated 6.35 acres of modeled recolonization habitat would be permanently lost as a result of north Delta intakes construction (<0.04% of modeled recolonization habitat within the action area). The effects to modeled habitat would occur where Intakes B and C be constructed on the Sacramento River's east bank between Clarksburg and Courtland (Figures 6.5-2, 6.5-12, and 6.5-13). Modeled recolonization habitat near the north Delta intakes is made up of narrow, discontinuous strips of riparian corridor that is generally considered to be of low- to moderate- quality. Due to the degraded existing condition, an incremental decrease in riparian connectivity from intake construction is not likely to substantially increase fragmentation.

To minimize permanent habitat loss, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require suitable least Bell's vireo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity least Bell's vireo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-21: *Least Bell's Vireo*).

#### 6.5.2.2 Construction-Related Effects

Vegetation removal in advance of ground clearing and grading activities could result in the potential for injury and mortality. Pile driving, excavation, and drilling would require the use of loud, heavy equipment within the construction site and along the access roads to the site. Noise, vibration, and visual disturbance during the nesting season could alter typical foraging and nesting behaviors, such as advertisement calls and territorial singing, and reduce the functions of recolonization habitat for the species. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into recolonization habitat and result in the injury or mortality of individuals and lead to the degradation of habitat. Construction-related night lighting may also have the potential to affect least Bell's vireo through changes in nighttime behaviors or making vireos more vulnerable to night predators (e.g., owls, cats, racoons); however, night-lighting will only be used during concrete pouring and thus will be short in duration.

To minimize injury and mortality during north Delta intake construction, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require USFWS- or CDFW- approved survey protocol in all suitable least Bell's vireo habitat prior to construction. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not

exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would minimize the potential for spills and contamination. To minimize the effects of night lighting, all lights would be screened and directed away from least Bell's vireo habitat as described in *Least Bell's Vireo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.3). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

## 6.5.3 Tunnels

Tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance to least Bell's vireo modeled habitat; therefore, this activity would not have an adverse effect on the species.

## 6.5.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. Least Bell's vireo modeled habitat overlaps with tunnel shaft work area at Twin Cities Complex (Figures 6.5-3 and 6.5-19). The construction actions associated with tunnel shafts are described and evaluated at the project level.

Construction activities associated with tunnel and tunnel shaft activities are described in Chapter 3, Section 3.2.4, *Tunnel Shafts,* and would include vegetation clearing, grading, excavation, soil compaction, and the use of heavy construction equipment. Construction of the tunnel shafts would take multiple years. Construction activities would persist for 7 to 9 years at launch shafts and for 2 years at reception and maintenance shafts. Construction would occur day and night. See Section 3.2.4 for details on construction timing and duration. Construction-related lighting would be shielded and oriented in such a manner so as not to subject the immediate surroundings to extremes in the levels of light, however, these types of light generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). See Section 3.2.8 for a complete description of construction activity and timing details.

### 6.5.4.1 Habitat Loss and Fragmentation

The Twin Cities Complex would result in permanent habitat loss of 0.23 acre of modeled least Bell's vireo recolonization habitat (<0.01% of modeled habitat within the action area) (Table 6.5-1 and Figures 6.5-3 and 6.5-18). Modeled recolonization habitat at the Twin Cities Complex consists of isolated, narrow riparian strips along agricultural ditches and is likely considered lower quality due to lack of continuous riparian canopy. Due to the degraded nature of the riparian habitat and the small amount of loss, the small decrease in connectivity is not expected to result in a substantial increase in habitat fragmentation.

To minimize permanent habitat loss, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require suitable least Bell's vireo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity least Bell's vireo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-21: *Least Bell's Vireo*).

#### 6.5.4.2 Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual least Bell's vireos or nests, resulting in injury or mortality to birds or disturbance of nests. Construction would create noise, vibration, light, and visual disturbances that could affect normal least Bell's vireo foraging and nesting behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled recolonization habitat exposing vireos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during tunnel shaft construction, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require protocol surveys in all suitable least Bell's vireo habitat. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be screened and directed away from least Bell's vireo habitat as described in *Least Bell's Vireo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.3). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

### 6.5.5 Reusable Tunnel Material

RTM areas do not overlap with least Bell's vireo modeled habitat. Activities for these facilities would not affect the species (Figure 6.5-1)

### 6.5.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.5.6.1 Habitat Loss and Fragmentation

An estimated 0.22 acre of modeled least Bell's vireo recolonization habitat would be permanently lost as a result of construction of the Bethany Complex (<0.01% of modeled recolonization habitat in the action area) (Table 6.5.-1). Modeled recolonization habitat surrounding the Bethany Complex is very sparse and consists of small, isolated patches of riparian vegetation that lacks a contiguous canopy. The modeled habitat that overlaps the Bethany Reservoir Discharge Structure (Figures 6.5-6 and 6.5-29) is found along the eastern, riprapped bank of Bethany Reservoir, consists of sparse riparian shrubs, and is considered low quality. The loss of small patches of low-quality riparian habitat would not affect least Bell's vireo connectivity.

To minimize permanent habitat loss, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require suitable least Bell's vireo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity least Bell's vireo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-21: *Least Bell's Vireo*).

### 6.5.6.2 Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual least Bell's vireos or nests, resulting in injury or mortality to birds or nests. Construction would create noise, vibration, light, and visual disturbances that could affect normal least Bell's vireo foraging and nesting behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled recolonization habitat exposing vireos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during Bethany Complex construction, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require protocol surveys in all suitable least Bell's vireo habitat. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities

would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21*: Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be screened and directed away from least Bell's vireo habitat as described in the *Least Bell's Vireo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.3). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

## 6.5.7 Access Roads

New access roads, a new access railroad spur on Lower Roberts Island, and improvements to existing public roads are necessary to support project construction and project facilities. In addition to these road and railroad features, impacts from levee improvements on Lower Roberts Island are also evaluated in this section (as the levee improvements would be adjacent to the access road, have similar impacts on species, and occur at roughly the same time). The construction actions associated with the access roads, access railroad spur, and levee improvements on Lower Roberts Island are described and evaluated at the project level. New access roads would be either gravel or paved and would provide connections between existing roads and construction areas for project facilities. The new access railroad spur would transport materials and equipment to the tunnel launch shaft. Existing roads would be widened and improved to support the construction-related traffic.

The access roads impacts discussed in this section are those that overlap with modeled least Bell's vireo habitat and occur outside of facilities at the north Delta intakes, Twin Cities Complex, King Island, Lower Roberts Island, Union Island, and Bethany Complex. Three new sections of access roads would be constructed in service of the Bethany Complex: to the north of the Bethany Complex, between the complex and Byron Highway; between Mountain House Road and Bethany Reservoir; and to the south, a new road segment and intersection connecting Mountain House Road and to Grant Line Road. Access roads are described in Chapter 3, Section 3.2.7 and depicted in Figure 6.5-1. Impacts from access road construction within the north Delta intakes, tunnel shafts, RTM areas, and Bethany Complex are described above in Section 6.5.2, Section 6.5.4, Section 6.5.5, and in Section 6.5.6, respectively. Access roads for all other facilities do not overlap with modeled least Bell's vireo habitat.

Construction activities for access roads (which include the railroad spur and levee improvements on Lower Roberts Island) include clearing, grubbing, excavation, placement of fill, minor bridge construction, moving utilities, paving, and the use of construction vehicles. A new access railroad spur at Lower Roberts Island would be constructed adjacent to and concurrent with the access road at this location and would involve installing a bridge over Burns Cutoff, rail tracks, train use during construction, and the use of vehicles and heavy equipment to inspect and maintain the railroad right-of-way during project construction. Construction of access roads would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where construction would occur at night. All lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity so as not

to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance ( Chapter 3, Section 3.2.12).

#### 6.5.7.1 Habitat Loss and Fragmentation

Access road construction would result in permanent removal of 2.77 acres of modeled recolonization habitat (0.02% of modeled recolonization habitat in the action area) and the temporary removal of 2.04 acres of modeled recolonization habitat (Table 6.5-1). These patches of migratory habitat follow established roadways, sloughs, or agricultural ditches and generally consists of narrow, linear patches of riparian habitat that vary in canopy coverage from sparse to dense. As with other activities, small, incremental increases in fragmentation are not expected to adversely affect the species.

To minimize permanent habitat loss, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require suitable least Bell's vireo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity least Bell's vireo upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-21: *Least Bell's Vireo*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

#### 6.5.7.2 Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual least Bell's vireos or nests, resulting in injury or mortality to birds or nests. Construction would create noise, vibration, light, and visual disturbances that could affect normal least Bell's vireo foraging and nesting behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled recolonization habitat exposing vireos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during tunnel shaft construction, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require protocol surveys in all suitable least Bell's vireo habitat. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be downcast and directed away from least Bell's vireo habitat as described in the *Least Bell's Vireo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.3). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual*

*Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

## 6.5.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching, directional drilling, and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.5.7. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.5.8.1 Habitat Loss and Fragmentation

Construction of new electrical facilities would result in the permanent loss of 0.11 acre of least Bell's vireo modeled recolonization habitat (<0.01% of modeled recolonization habitat within the action area). Construction of SCADA lines would result in temporary disturbance of 4.92 acres of least Bell's vireo recolonization habitat (0.03% of modeled recolonization habitat within the action area). Mapped construction footprints for electrical facilities and SCADA lines overlap with modeled least Bell's vireo recolonization habitat in several locations along the alignment (Figure 6.5-1).

Electrical and SCADA facilities overlap with modeled habitat at the Twin Cities Complex, New Hope Tract, Canal Ranch Tract, Terminous Tract, and Lower Roberts Island. The patches of lost riparian habitat occur along established roadways, sloughs, or agricultural ditches and are generally narrow with canopy coverage that varies from sparse to dense. The loss of these small, scattered patches of riparian habitat are not expected to adversely affect existing connectivity for least Bell's vireo.

To minimize permanent habitat loss, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require suitable least Bell's vireo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity least Bell's vireo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-21: *Least Bell's Vireo*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.5.8.2 Construction-Related Effects

Site preparation for construction of new electrical or SCADA facilities would remove vegetation and could potentially result in the injury or mortality of least Bell's vireo individuals or nest if present. Tower or pole construction and trenching work would create noise and vibration effects adjacent to modeled recolonization habitat. Construction-related contaminants such as gas, oil, and steering fluid could accidentally be discharged into recolonization habitat.

To minimize injury and mortality, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require protocol surveys in all suitable least Bell's vireo habitat. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A). To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place.

Aboveground power lines could contribute to increased risk for bird strikes. However, most new project lines would be placed on existing poles and towers and therefore would not substantially alter the existing landscape. Also, the species does not form flocks and generally remains at or below the riparian canopy. Therefore, it is highly unlikely that this species would experience an increased risk of bird strikes at project transmission lines. Nonetheless, implementation of AMM-22: *Electrical Power Line Support Placement* (described in Appendix 3A) would require designing and constructing power transmission and distribution lines to avoid sensitive habitats to the maximum extent feasible, incorporate bird-safe design, and use bird flight diverters.

## 6.5.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[17] concrete batch plants and park-and-ride lots. None of these features overlap with least Bell's vireo modeled habitat, thus activities associated with these facilities are not expected to affect the species.

## 6.5.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with least Bell's vireo modeled habitat. Activities in this area are not expected to adversely affect the species.

## 6.5.11 Compensatory Mitigation Plan

The CMP would offset the permanent loss of sensitive natural communities and habitat for special-status species, including least Bell's vireo, by creating and enhancing habitat on Bouldin Island and the I-5 ponds, and tidal habitat restoration and managing these areas in perpetuity. The habitat creation and enhancement sites would overlap with modeled least Bell's vireo recolonization habitat (Figures 6.5-1, 6.5-32, and 6.5-33).

Construction of habitat creation and enhancement sites under the CMP would involve ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel to enhance and restore habitats. Construction would take several years to construct and would not require night lighting.

### 6.5.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

Riparian creation and enhancement at Bouldin Island would offset the permanent loss of sensitive natural communities and habitat for special-status species, including least Bell's vireo. Site construction would include ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel. Construction would take several years to construct and would not require night lighting.

#### Habitat Loss and Fragmentation

Habitat creation and enhancement at Bouldin Island and the I-5 ponds would affect 12.31 acres of modeled least Bell's vireo recolonization habitat (0.07% of modeled recolonization habitat within the action area) but would create up to 156.91 acres of suitable habitat. The creation and enhancement actions are assumed to convert the existing, low-quality habitat to high-quality least Bell's vireo habitat that will be protected and managed in perpetuity as described in *CMP-21 Least Bell's Vireo Habitat* (See Table 3B.1-3). The creation and enhancement actions at Bouldin Island and the I-5 ponds are assumed to have a long-term benefit to the species.

[17] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations such as the north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.5.7, *Access Roads*, and Section 6.5.6, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

### Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual least Bell's vireos or nests, resulting in injury or mortality to birds or nests. Construction would create noise, vibration, light, and visual disturbances that could affect normal least Bell's vireo foraging and nesting behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled recolonization habitat exposing vireos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during construction of the Bouldin Island and DWR ponds initial mitigation sites, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require protocol surveys in all suitable least Bell's vireo habitat. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be screened and directed away from least Bell's vireo habitat as described in the *Least Bell's Vireo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.3). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A). With these measures in place, construction of the initial mitigation sites is not likely to adversely affect western least Bell's vireo.

## 6.5.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The vernal pool, pond, and grassland communities that would be protected for these species does not overlap with least Bell's vireo habitat and therefore the vireo would not be adversely affected by implementation of this action.

## 6.5.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.5.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. These habitat types do not overlap with least Bell's vireo habitat so the species would not be adversely affected by implementation of non-bank site protection.

### 6.5.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). There are no construction activities associated with implementation of site protection instruments.

### 6.5.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP(Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

#### Habitat Loss and Fragmentation

Potential channel margin enhancement areas would overlap with modeled least Bell's vireo recolonization habitat and would likely result in the temporary disturbance of least Bell's vireo habitat. However, modeled recolonization habitat in areas that would be targeted for channel margin enhancement are primarily made up of narrow, discontinuous strips of riparian corridor that is generally considered to be of low- to moderate- quality. In addition, channel margin enhancement activities would restore riparian areas and likely increase the quality and extent. The long-term benefit to riparian habitat at channel margin enhancement sites would offset any temporary habitat loss and benefit the species in the long-term.

#### Construction-Related Effects

Construction activities could include ground disturbance, require some vehicle traffic and use of heavy equipment. Noise, vibration, and visual disturbance during the nesting season could alter typical foraging and nesting behaviors, such as advertisement calls and territorial singing, and reduce the functions of recolonization habitat for the species. Use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of least Bell's vireo, if the species is present.

To minimize injury and mortality during channel margin enhancement construction, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require USFWS- or CDFW- approved survey protocol in all suitable least Bell's vireo habitat prior to construction. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A). To reduce

effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be implemented. With these measures in place, adverse effects to least Bell's vireo from channel margin enhancement is not likely to occur.

#### 6.5.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

There is potential for tidal wetland restoration in lower Yolo Bypass or Cache Slough Complex to result in the temporary loss of least Bell's vireo habitat. This loss could occur where there are riparian sections along the portions of removed levees. All other riparian habitat that may occur on the site would not be expected to be affected by the restoration. This is because this habitat typically occurs around the edges of the agricultural plots that are restored in this region. And other than those sections of the levee that are removed to allow for the restoration of tidal flows onto the property, these existing riparian areas are expected to be protected and enhanced and more than offset any loss associated with levee breaching. This assumption is supported by the USFWS's concurrence that the Yolo Flyway Farms and Lookout Slough tidal restoration projects were "not likely to adversely affect" least Bell's vireo (U.S. Fish and Wildlife Service 2017b, 2020c) and further supported by the "no effect" determination for the Lower Yolo and Lookout Slough restoration project (U.S. Fish and Wildlife Service 2019b; ); all tidal restoration projects in the Cache Slough/lower Yolo Bypass part of the Delta. With this information, tidal restoration associated with the proposed action is not likely to adversely affect least Bell's vireo.

## Construction-Related Effects

Tidal wetland restoration areas could occur adjacent to suitable least Bell's vireo habitat within the action area. Construction activities could include ground disturbance, require some vehicle traffic and use of heavy equipment, and use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of least Bell's vireo, if the species is present. Noise, vibration, and visual disturbance during the nesting season could alter typical foraging and nesting behaviors, such as advertisement calls and territorial singing, and reduce the functions of recolonization habitat for the species. Use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of least Bell's vireo, if the species is present.

To minimize injury and mortality during tidal wetland restoration construction, the *Least Bell's Vireo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.3 would require USFWS- or CDFW- approved survey protocol in all suitable least Bell's vireo habitat prior to construction. If least Bell's vireo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the vireo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would minimize the potential for spills and contamination. To minimize the effects of night lighting, all lights would be screened and directed away from least Bell's vireo habitat as described in the *Least Bell's Vireo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.3). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A). With these measures in place, adverse effects to least Bell's vireo from tidal restoration construction is not likely to occur.

### 6.5.12 Effects on Critical Habitat

There is no designated critical habitat for least Bell's vireo in the action area.

### 6.5.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Projects that result in take of least Bell's vireo would require incidental take authorization pursuant to the Endangered Species Act and therefore are not addressed in this cumulative effects analysis because they require a federal action.

However, non-federal activities and climate change have potential to affect least Bell's vireo in the action area when recolonization habitat degradation occurs without USFWS authorization. The most likely activity to affect the quality of early successional riparian habitat is conversion of riparian habitat to agriculture or urban development. Although land use conversion is unlikely due to land use controls, if agricultural and/or urban development is proposed in or near least Bell's vireo occupied habitat, it could contribute to a cumulative adverse effect on least Bell's vireo in the action area. Loss of and degradation of riparian habitat may decrease availability of suitable nesting sites, decrease prey species density, and increase habitat fragmentation such that reproductive success and survivorship are affected. Additionally, agricultural habitats also provide habitat for brown-headed cowbirds, a brood parasite on least Bell's vireo, which would contribute to negative effects on least Bell's vireo.

Climate change threatens to modify annual weather patterns. Predicted drier weather may decrease the availability of precipitation and groundwater that supports riparian habitat. Increased potential for wildfire as warming increases threatens habitat and, if burned repeatedly, would prevent it from recovering. Spring heat waves also endanger young birds in the nest. Since the habitat within the action area with the highest likelihood of supporting nesting least Bell's vireo is Bouldin Island, where the CMP would offset the loss of nesting and foraging habitat for special-status birds by creating and protecting riparian habitat, cumulative effects in the action area are not expected to appreciably diminish the likelihood of the species' long-term survival and recovery.

## 6.6 Effects on Western Yellow-Billed Cuckoo

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.12.6, *Suitable Habitat Definition*, and Section 4.4.12.7, *Migratory Habitat Suitability Model*, define suitable habitat and describe the habitat model for western yellow-billed cuckoo.

Current nesting populations (areas which have consistently supported numerous nesting pairs) in California are found at three locations: Sacramento River, Kern River, and the California side of the lower Colorado River (U.S. Fish and Wildlife Service 2019c:7). Riparian forest patch size was found to be the most important habitat variable to predict presence of western yellow-billed cuckoos on the Sacramento River (Girvetz and Greco 2009:10). There are no known western yellow-billed

cuckoo breeding pairs in the action area; individuals detected in the action area are presumed to be migratory (Section 4.4). Western yellow-billed cuckoo is migratory, and most individuals migrate to California breeding grounds between May and July and migrate away from breeding grounds between late July to mid-September (Laymon 1998; Hughes 2020) to winter in South America. Section 4.4.12.2, *Life History and Habitat Requirements*, describes the western yellow-billed cuckoo migratory habitat, which primarily consists of willow-cottonwood riparian forests.

Western yellow-billed cuckoo modeled habitat is located throughout the action area, where willow-riparian cottonwood forest is modeled. Activities associated with field investigations, north Delta intakes, tunnel shafts, RTM, access roads, electrical and supervisory and data acquisition (SCADA) facilities, Bethany Complex, and the CMP overlap with western yellow-billed cuckoo modeled habitat, occur in proximity to known occurrences, and, as such, have the potential to affect western yellow-billed cuckoo. Figures 6.6-1 through 6.6-29 include overview as well as "zoomed-in" figures depicting overlap between the project footprint, modeled habitat, and CNDDB occurrences.

There are 17,296.15 acres of modeled western yellow-billed cuckoo migratory habitat in the action area. An estimated 17.34 acres (0.10% of total modeled habitat in the action area) of modeled western yellow-billed cuckoo habitat would be adversely affected by the project. Effects from these activities are described in the sections below. Table 6.6-1 summarizes the total estimated habitat loss of western yellow-billed cuckoo modeled habitat and Table 6.6-2 summarizes the proposed acres of compensation.

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**Table 6.6-1. Maximum Habitat Loss of Modeled Habitat for Western Yellow-Billed Cuckoo by Activity Type (Acres)**

| Western Yellow-Billed Cuckoo Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Migratory | 17,296.15 | - | 2.77 | 0.22 | 6.35 | - | 0.11 | - | 0.23 | 9.68 | 0.71 | - | 2.04 | - | 4.92 | 7.67 | 17.34 |
| **Total** | **17,296.15** | **-** | **2.77** | **0.22** | **6.35** | **-** | **0.11** | **-** | **0.23** | **9.68** | **0.71** | **-** | **2.04** | **-** | **4.92** | **7.67** | **17.34** |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

**Table 6.6-2 Maximum Habitat Loss and Compensation for Western Yellow-Billed Cuckoo**

| | Permanent Habit Loss (Acres) | Maximum Compensation Commitment (Acres) | With Full Implementation of the Compensatory Mitigation Plan |
|---|---|---|---|
| | Total Maximum Habitat Loss (Acres) | Restoration/Creation (Acres) [a] | Creation and Enhancement [b] (Acres) |
| **Migratory Total** | **9.68** | 19.36 | **204.79** |

[a] See CMP-16 in Table 3B.1-3 of Attachment 3B.1, *Compensatory Mitigation Design Parameters,* for the full commitment to create or restore western yellow-billed cuckoo riparian habitat.
[b] See Table 3B-4 in Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*, for the creation and enhancement commitment for western yellow-billed cuckoo.

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## 6.6.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed lost and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPTs, soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g. Bethany Complex).

Geotechnical investigations associated with tunnel alignment water crossings, West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches and overwater and land-based CPTs and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section. All surface ground disturbance for field investigations for the Bethany Reservoir Aqueduct tunnel would occur outside of the Bethany Conservation Easement.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

### 6.6.1.1 Habitat Loss and Fragmentation

The West Tracy Fault and the Bethany Fault investigations do not overlap with modeled western yellow-billed cuckoo habitat. Geotechnical investigations associated with the tunnel alignment would overlap with western yellow-billed cuckoo habitat.

An estimated 0.71 acre of modeled western yellow-billed cuckoo habitat would be temporarily disturbed as a result of field investigations (<0.01% of all modeled migratory habitat in the action area). Modeled migratory habitat near field investigation footprints for the north Delta intakes and Twin Cities Complex is considered high- to moderate-quality because many riparian corridors in this region are relatively wide with continuous canopy. Habitat surrounding field investigation footprints west of Thornton and on Canal Ranch Tract, Terminous Tract, Roberts Island, and Jones Tract follow established roadways, sloughs, or agricultural ditches and generally consists of narrow, linear patches of riparian habitat that are lower quality. Field investigations for the West Tracy Fault, Bethany Fault, and the Bethany Complex overlap with a few isolated patches that are unlikely to provide high-quality habitat. As the patches of lost habitat are very small and generally of lower

quality, the incremental decrease in connectivity is not expected to result in additional, substantial fragmentation. The implementation of AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion (Appendix 3A).

#### 6.6.1.2 Construction-Related Effects

Overland driving and ground disturbance could injure or kill western yellow-billed cuckoos that are migrating through the action area or are near work areas. Ground disturbing activities, helicopters, and human presence would create noise, vibration, and visual disturbance and could disrupt normal behaviors of cuckoos and reduce the functions of migratory habitat if present in or near the work area. Construction-related contaminants, such as gas, oil, or steering fluid, could accidentally be discharged into modeled migratory habitat, exposing western yellow-billed cuckoos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals, as well as lead to habitat degradation.

To minimize injury and mortality during field investigations, implementation of *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.4 would require preconstruction surveys, consistent with a USFWS- or CDFW-approved survey protocol (e.g., Halterman et al. 2015:9-42, or more current guidance), in suitable habitat where construction-related noise levels could exceed 60 dBA $L_{eq}$ (1 hour). If surveys find western yellow-billed cuckoo in the area where vegetation would be removed, vegetation removal would be done when the birds are not present within 500 feet of vegetation removal activities.

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Species* would further reduce the potential injury or mortality by training construction staff on the regulatory requirements for sensitive species, having a biological monitor present during ground disturbing activities, maintaining non-disturbance buffers, and delineating work areas (Appendix 3A).

To further minimize effects of noise on yellow-billed cuckoos, implementation of AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A) would require site-specific measures to avoid or reduce noise impacts related to construction and would include measures such as restrictions on use of construction equipment, use of noise reducing technologies, and installation of noise barriers. Avoidance of effects on yellow-billed cuckoo from construction contaminants such as fuel or oil would be minimized with implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* by implementing spill prevention and control plans and with implementation of the *Western Yellow-billed Cuckoo Avoidance and Minimization Measure*, by locating, storing, and maintaining portable and stationary equipment as far as possible, with a minimum distance of 500 feet, from suitable western yellow-billed cuckoo habitat. To minimize the potential effects of dust on cuckoo, implementation of AMM-11: *Fugitive Dust Control* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would minimize this potential disturbance by having a biological monitor present and reducing the potential for discharge of construction-related dust in potential habitat.

## 6.6.2 North Delta Intakes

The north Delta intakes would be constructed on the east bank of the Sacramento River near the town of Hood. Two intakes would divert water from the Sacramento River and include cylindrical fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and shaft, embankments, and other appurtenant structures. Intakes would also include construction support facilities (e.g., emergency facilities, fuel station), electrical substations, switchyards, and access roads that fall within the north Delta intake facility footprints. The north Delta intakes would be surrounded by security fencing. The construction actions associated with the north Delta intakes are described and evaluated at the project level.

Construction activities at each intake are described in Chapter 3, Section 3.2.2. Intake construction would include ground clearing and grading; in-water and on-land pile driving; excavation; placement of fills, cutoff walls, and structures; and drilling. These activities would require the use of loud, heavy equipment within the construction site as well as along the access roads to the site and limited nighttime work. Construction-related lighting would be downcast so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). The duration of the activity would be approximately 7 years at each intake. Implementation of intake construction at each location would be staggered by approximately 1 year. Intake C, the southern intake, would begin construction first; approximately 1 year later, construction would begin at Intake B, the northern intake; The result is that construction would overlap at both sites for approximately 6 years.

### 6.6.2.1 Habitat Loss and Fragmentation

An estimated 6.35 acres of modeled migratory habitat would be permanently lost as a result of north Delta intakes construction (<0.04% of modeled migratory habitat within the action area) (Table 6.6-1). The effects on modeled habitat would occur where Intakes B and C would be constructed on the Sacramento River's east bank between Clarksburg and Courtland (Figures 6.6-2, 6.6-12, and 6.6-13). The modeled habitat that would be permanently lost as a result of construction of the north Delta intakes is found along the Sacramento River, sloughs, agricultural ditches, and Stone Lakes National Wildlife Refuge; some habitat consists of narrow, linear riparian patches that are unsuitable for nesting cuckoo, and other patches are relatively wide with dense, contiguous canopy. The vegetation provides suitable foraging habitat and could be used by migrating individuals. Due to the degraded existing condition, an incremental decrease in riparian connectivity from intake construction is not likely to substantially increase fragmentation.

To minimize permanent and temporary habitat loss, the *Western Yellow-billed Cuckoo Avoidance and Minimization Measure* detailed in Chapter 3, Section 3.6.2.4 commits to preconstruction surveys in all suitable western yellow-billed cuckoo habitat in the construction area, with surveys performed in accordance with any required USFWS or CDFW survey protocols and permits applicable at the time of construction. If surveys find western yellow-billed cuckoo in the area where vegetation would be removed, vegetation removal would be done when the birds are not present within 500 feet of vegetation removal activities. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity western yellow-billed cuckoo aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-16: *Western Yellow-billed Cuckoo Habitat*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A)

#### 6.6.2.2 Construction-Related Effects

Vegetation removal in advance of ground clearing and grading activities would result in the potential for injury and mortality. Pile driving, excavation, and drilling would require the use of loud, heavy equipment within the construction site and along the access roads to the site. Noise, vibration, and visual disturbance during the migratory season could alter typical foraging and movement behaviors, such as contact calls and predator avoidance, as well as reduce the functions of foraging habitat for the species. Construction-related night lighting may also have the potential to affect western yellow-billed cuckoo through changes in nighttime behaviors, foraging behavior, or making cuckoos more vulnerable to night predators (e.g., owls, cats, racoons) (Hughes 2020); however, night-lighting will only be used during concrete pouring and thus will be short in duration. Construction-related contaminants, such as gas, oil, or steering fluid, could accidentally be discharged into migratory habitat and result in the injury or mortality of individuals and lead to the degradation of habitat.

To minimize injury and mortality during north Delta intake construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require USFWS- or CDFW- approved survey protocol in all suitable western yellow-billed cuckoo habitat prior to construction. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in *AMM-21: Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would minimize the potential for spills and contamination. To minimize the effects of night lighting, all lights would be screened and directed away from western yellow-billed cuckoo habitat as described in *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further minimize potential for injury and mortality by training construction staff on the regulatory requirements for sensitive species having a biological monitor present during ground disturbing activities, maintaining non-disturbance buffers, and delineating work areas (Appendix 3A).

### 6.6.3 Tunnels

Tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance to western yellow-billed cuckoo modeled habitat; therefore, this activity would not have an adverse effect on the species.

## 6.6.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. Western yellow-billed cuckoo modeled habitat overlaps with tunnel shaft work areas at Twin Cities Complex (Figures 6.6-3 and 6.6-19). Tunnel shaft construction at the north Delta intakes, Twin Cities Complex, New Hope Tract, and Canal Ranch Tract are within 1,200 feet of modeled western yellow-billed cuckoo migratory habitat. The construction actions associated with tunnel shafts are described and evaluated at the project level.

Construction activities associated with tunnel and tunnel shaft activities are described in Chapter 3, Section 3.2.4 and would include vegetation clearing, grading, excavation, soil compaction, and the use of heavy construction equipment. Construction of the tunnel shafts would take multiple years. Construction activities would persist for 7 to 9 years at launch shafts and for 2 years at reception and maintenance shafts. Construction would occur day and night. See Section 3.2.4 for details on construction timing and duration. Construction-related lighting would be shielded and oriented in such a manner so as not to subject the immediate surroundings to extremes in the levels of light, however, these types of light generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). See Section 3.2.8 for a complete description of construction activity and timing details.

### 6.6.4.1 Habitat Loss and Fragmentation

The Twin Cities tunnel shaft complex would result in permanent habitat loss of 0.23 acre of modeled western yellow-billed cuckoo migratory habitat (0.001% of modeled habitat within the action area) (Figure 6.6-19). The quality of modeled habitat that would be temporarily disturbed from tunnel shaft consists of small, narrow, linear riparian patches lacking continuous canopy that are considered low quality migratory habitat. Habitat fragmentation from habitat loss due to construction of tunnel shafts is not expected to affect migratory western yellow-billed cuckoos in this area because migratory habitat is not limited in the area and migrating birds could use small habitat patches and easily move from one location to the next during migration.

To minimize permanent habitat loss, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.4 would require suitable western yellow-billed cuckoo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity western yellow-billed cuckoo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-16: *Western Yellow-billed Cuckoo Habitat*).

Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.6.4.2 Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual western yellow-billed cuckoos, resulting in injury or mortality to birds or disturbance of nests that are present within the tunnel shaft construction

footprint. Construction would create noise, vibration, and visual disturbances that could affect normal western yellow-billed cuckoo foraging and migratory behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled migratory habitat exposing cuckoos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during tunnel shaft construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require protocol surveys in all suitable western yellow-billed cuckoo habitat. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be screened and directed away from western yellow-billed cuckoo habitat as described in *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize potential construction-related disturbance by training construction staff on the regulatory requirements for sensitive species, having a biological monitor present during ground disturbing activities, maintaining non-disturbance buffers, and delineating work areas (Appendix 3A).

## 6.6.5 Reusable Tunnel Material

RTM areas do not overlap with western yellow-billed cuckoo modeled habitat. Activities for these facilities would not affect the species (Figure 6.6-1)

## 6.6.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be

outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities, such as mowing or vegetation clearing, would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.6.6.1 Habitat Loss and Fragmentation

An estimated 0.22 acre of modeled western yellow-billed cuckoo migratory habitat (0.001% of modeled migratory habitat in the action area) would be permanently lost as a result of construction of the Bethany Complex (Table 6.6-1). Modeled migratory habitat surrounding the Bethany Complex is very sparse and consists of small, isolated patches of riparian vegetation that lacks a contiguous canopy. The modeled habitat that overlaps the Bethany Reservoir Discharge Structure (Figures 6.6-6 and 6.6-29) is found along the eastern, riprapped bank of Bethany Reservoir, consists of sparse riparian shrubs lacking tall overstory, and is considered poor quality. The loss of small patches of low-quality riparian habitat would not affect western yellow-billed cuckoo connectivity.

To minimize permanent habitat loss, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.4 would require suitable western yellow-billed cuckoo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity western yellow-billed cuckoo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-16: *Western Yellow-billed Cuckoo Habitat*).

### 6.6.6.2 Construction-Related Effects

Although most of the construction footprint of the Bethany Complex does not overlap with modeled western yellow-billed cuckoo migratory habitat, and the portion that does overlap contains poor quality habitat, there is potential for indirect effects because modeled migratory habitat occurs in the vicinity of construction. Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual western yellow-billed cuckoo, resulting in injury or mortality. Construction would create noise, vibration, light, and visual disturbances that could affect normal western yellow-billed cuckoo migratory behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled migratory habitat exposing cuckoos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during Bethany Complex construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require protocol surveys in all suitable western yellow-billed cuckoo habitat. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In

addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be screened and directed away from western yellow-billed cuckoo habitat as described in *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

## 6.6.7 Access Roads

New access roads, a new access railroad spur on Lower Roberts Island, and improvements to existing public roads are necessary to support project construction and project facilities. In addition to these road and railroad features, impacts from levee improvements on Lower Roberts Island are also evaluated in this section (as the levee improvements would be adjacent to the access road, have similar impacts on species, and occur at roughly the same time). The construction actions associated with access roads, access railroad spur and levee improvements on Lower Roberts Island are described and evaluated at the project level.

New access roads would be either gravel or paved and would provide connections between existing roads and construction areas for project facilities. The new access railroad spur would transport materials and equipment to the tunnel launch shaft. Existing roads would be widened and improved to support the construction-related traffic.

The access roads impacts discussed in this section are those that are in service to, but occur outside of, facilities at the north Delta intakes, Twin Cities Complex, King Island, Lower Roberts Island, Union Island, and Bethany Complex. Three new sections of access roads would be constructed in service of the Bethany Complex: to the north of the Bethany Complex, between the complex and Byron Highway; between Mountain House Road and Bethany Reservoir; and to the south, a new road segment and intersection connecting Mountain House Road and to Grant Line Road. Access roads are described in Chapter 3, Section 3.2.7 and depicted in Figure 6.6-1. Impacts from access road construction within the north Delta intakes, tunnel shafts, RTM areas, and Bethany Complex are described above in Section 6.6.2, Section 6.6.4, Section 6.6.5, and Section 6.6.6. Access roads for all other facilities do not overlap with modeled western yellow-billed cuckoo habitat.

Construction activities for access roads (which include the railroad spur and levee improvements on Lower Roberts Island) include clearing, grubbing, excavation, placement of fill, minor bridge construction, moving utilities, paving, and the use of construction vehicles. A new access railroad spur at Lower Roberts Island would be constructed adjacent to and concurrent with the access road at this location and would involve installing a bridge over Burns Cutoff, rail tracks, train use during construction, and the use of vehicles and heavy equipment to inspect and maintain the railroad right-of-way during project construction. Construction of access roads would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where

construction would occur at night. All lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance ( Chapter 3, Section 3.2.12).

#### 6.6.7.1 Habitat Loss and Fragmentation

Access roads would result in permanent removal of 2.77 acres of modeled migratory habitat (0.02% of modeled migratory habitat in the action area) (Table 6.6-1). Temporary removal of 2.04 acres of modeled migratory habitat (Table 6.6-1) would occur for temporary access road work areas. These patches of migratory habitat follow established roadways, sloughs, or agricultural ditches and generally consists of narrow, linear patches of riparian habitat that vary in canopy coverage from sparse to dense. As with other activities, small, incremental increases in fragmentation are not expected to adversely affect the species.

To minimize permanent habitat loss, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.4 would require suitable western yellow-billed cuckoo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity western yellow-billed cuckoo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-16: *Western Yellow-billed Cuckoo Habitat*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

#### 6.6.7.2 Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual western yellow-billed cuckoo, resulting in injury or mortality. Construction would create noise, vibration, light, and visual disturbances that could affect normal western yellow-billed cuckoo migratory behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled migratory habitat exposing cuckoos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during tunnel shaft construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require protocol surveys in all suitable western yellow-billed cuckoo habitat. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights

would be downcast and directed away from western yellow-billed cuckoo habitat as described in the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction;* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

## 6.6.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching, directional drilling, and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.4.7. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.6.8.1 Habitat Loss and Fragmentation

Construction of new electrical facilities would result in the permanent loss of 0.11 acre of western yellow-billed cuckoo modeled migratory habitat (<0.01% of modeled migratory habitat within the action area). Construction of SCADA lines would result in temporary disturbance of 4.92 acres of western yellow-billed cuckoo migratory habitat (0.03% of modeled migratory habitat within the

action area). Mapped construction footprints for electric power and SCADA lines overlap with modeled western yellow-billed cuckoo migratory habitat in several locations along the alignment (Figure 6.6-1).

Electrical and SCADA facilities overlap with modeled habitat at the Twin Cities Complex, New Hope Tract, Canal Ranch Tract, Terminous Tract, and Lower Roberts Island. The patches of lost riparian habitat occur along established roadways, sloughs, or agricultural ditches and are generally narrow with canopy coverage that varies from sparse to dense. The loss of these small, scattered patches of riparian habitat are not expected to adversely affect existing connectivity for western yellow-billed cuckoo.

To minimize permanent habitat loss, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.4 would require suitable western yellow-billed cuckoo habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity western yellow-billed cuckoo habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-16: *Western Yellow-billed Cuckoo Habitat*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.6.8.2 Construction-Related Effects

Site preparation for construction of new electrical and SCADA facilities would remove vegetation and could potentially result in the injury or mortality of western yellow-billed cuckoo individuals if present. Tower or pole construction and trenching work would create noise and vibration effects adjacent to modeled migratory habitat. Construction-related contaminants such as gas, oil, and steering fluid could accidentally be discharged into migratory habitat.

To minimize injury and mortality, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require protocol surveys in all suitable western yellow-billed cuckoo habitat. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A). To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be implemented.

Aboveground power lines could contribute to increased risk for bird strikes. However, most new project lines would be placed on existing poles and towers and therefore would not substantially alter the existing landscape. Also, the species does not form flocks and generally remains at or below the riparian canopy. Therefore, it is highly unlikely that this species would experience an increased risk of bird strikes at project transmission lines. Nonetheless, implementation of AMM-22: *Electrical Power Line Support Placement* (Appendix 3A) would require designing and constructing power supply and distribution lines to avoid sensitive habitats to the maximum extent feasible, incorporate bird-safe design, and use bird flight diverters.

## 6.6.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[18] concrete and CLSM batch plants and park-and-ride lots. None of these features overlap with western yellow-billed cuckoo modeled habitat, thus activities associated with these facilities are not expected to affect the species.

## 6.6.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with western yellow-billed cuckoo modeled habitat. Activities in this area would not adversely affect the species.

## 6.6.11 Compensatory Mitigation Plan

The CMP would offset the loss of sensitive natural communities and habitat for special-status species, including western yellow-billed cuckoo, by creating and enhancing habitat on Bouldin Island and the I-5 ponds, and tidal habitat restoration and managing these areas in perpetuity. The habitat creation and enhancement sites would overlap with modeled western yellow-billed cuckoo habitat (Figures 6.6-1, 6.6-32, and 6.6-33).

Construction of habitat creation and enhancement sites under the CMP would involve ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel to enhance and restore habitats. Construction would take several years to construct and would not require night lighting.

### 6.6.11.1 Initial Mitigation Sites: Bouldin Island and the I-5 Ponds

Riparian creation and enhancement at Bouldin Island would offset the permanent loss of sensitive natural communities and habitat for special-status species, including western yellow-billed cuckoo. Site construction would include ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel. Construction would take several years to construct and would not require night lighting.

#### Habitat Loss and Fragmentation

Habitat creation and enhancement at Bouldin Island and the I-5 ponds would affect 12.31 acres of modeled western yellow-billed cuckoo migratory habitat (0.07% of modeled migratory habitat within the action area). The creation and enhancement actions are assumed to convert the existing, low-quality habitat to high-quality western yellow-billed cuckoo habitat that will be protected and managed in perpetuity as described in CMP-16: *Western Yellow-Billed Cuckoo Habitat* (Table 3B.1-3). The creation and enhancement actions at Bouldin Island and the I-5 ponds are assumed to have a long-term benefit to the species.

[18] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.4.7, *Access Roads*, and Section 6.4.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

### Construction-Related Effects

Vegetation clearing, ground disturbing activities (such as grading), vehicles, and heavy construction equipment could strike or crush individual western yellow-billed cuckoo, resulting in injury or mortality. Construction would create noise, vibration, light, and visual disturbances that could affect normal western yellow-billed cuckoo migratory behaviors. Construction-related contaminants such as gas, oil, or steering fluid could accidentally be discharged into modeled migratory habitat exposing cuckoos (and/or their prey items) to toxic materials, which could result in injury and mortality of individuals.

To minimize injury and mortality during CMP construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require protocol surveys in all suitable western yellow-billed cuckoo habitat. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21: *Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would be put in place. To minimize the effects of night lighting, all lights would be screened and directed away from western yellow-billed cuckoo habitat as described in *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4). In addition, AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* and AMM-20: *Install Visual Barriers along Access Routes, Where Necessary, to Prevent Light Spill from Truck Headlights toward Residences* would further minimize effects of night lighting (Appendix 3A).

## 6.6.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The vernal pool, pond, and grassland communities that would be protected for these species do not overlap with western yellow-billed cuckoo habitat and therefore the cuckoo would not be adversely affected by implementation of this action.

## 6.6.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.6.11.5, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to further, “step down” consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. These habitat types do not overlap with western yellow-billed cuckoo habitat so the species would not be adversely affected by implementation of non-bank site protection.

### 6.6.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

### 6.6.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP(Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. While not the target of enhancement actions, western yellow-billed cuckoo also has the potential to benefit from the increase in riparian habitat along levees in the central Delta.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

#### Habitat Loss and Fragmentation

Potential channel margin enhancement areas would likely result in the temporary disturbance of western yellow-billed cuckoo habitat. However, modeled migratory habitat in areas that would be targeted for channel margin enhancement are primarily made up of narrow, discontinuous strips of riparian corridor that is generally considered to be of low- to moderate- quality. In addition, channel margin enhancement activities would restore riparian areas and likely increase the quality and extent of the habitat. The long-term benefit to riparian habitat at channel margin enhancement sites would offset any temporary habitat loss and benefit the species in the long-term.

#### Construction-Related Effects

Construction activities could include ground disturbance, require some vehicle traffic and use of heavy equipment. Noise, vibration, and visual disturbance during the nesting season could alter typical foraging and nesting behaviors, such as advertisement calls and territorial singing, and reduce the functions of migratory habitat for the species. Use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of western yellow-billed cuckoo, if the species is present.

To minimize injury and mortality during channel margin enhancement construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require USFWS- or CDFW- approved survey protocol in all suitable western yellow-billed cuckoo habitat prior to construction. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area.

To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in AMM-21*: Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would minimize the potential for spills and contamination. Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further minimize potential for injury and mortality by training construction staff on the regulatory requirements for sensitive species having a biological monitor present during ground disturbing activities, maintaining non-disturbance buffers, and delineating work areas (Appendix 3A). With these measures in place, adverse effects to western yellow-billed cuckoo from channel margin enhancement are not likely to occur.

### 6.6.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

There is potential for tidal wetland restoration in lower Yolo Bypass or Cache Slough Complex to result in the temporary loss of western yellow-billed cuckoo habitat. This loss could occur where there are riparian sections along the portions of removed levees. All other riparian habitat that may occur on the site would not be expected to be affected by the restoration. This is because this habitat typically occurs around the edges of the agricultural plots that are restored in this region. And other than those sections of the levee that are removed to allow for the restoration of tidal flows onto the property, these existing riparian areas are expected to be protected and enhanced and more than offset any loss associated with levee breaching. This assumption is supported by the "no effect" determinations for the Yolo Flyway Farms and Lower Yolo tidal restoration projects (U.S. Fish and Wildlife Service 2017b; U.S. Fish and Wildlife Service 2019b); both of which are tidal restoration projects in the Cache Slough/lower Yolo Bypass part of the Delta. With this information, tidal restoration associated with the proposed action is not likely to adversely affect western yellow-billed cuckoo.

## Construction-Related Effects

Tidal wetland restoration areas could occur adjacent to suitable western yellow-billed cuckoo habitat within the action area. Construction activities could include ground disturbance, require some vehicle traffic and use of heavy equipment. Noise, vibration, and visual disturbance during the migratory season could alter typical foraging and movement behaviors, such as contact calls and predator avoidance, as well as reduce the functions of foraging habitat for the species. Use of contaminants such as fuels, oils, and herbicides could result in the injury, mortality, and disruption of normal behaviors of western yellow-billed cuckoo, if the species is present.

To minimize injury and mortality during tidal wetland restoration construction, the *Western Yellow-Billed Cuckoo Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.4) would require USFWS- or CDFW- approved survey protocol in all suitable western yellow-billed cuckoo habitat prior to construction. If western yellow-billed cuckoo is found, vegetation removal would not be conducted within 500 feet of the occupied habitat. In addition, construction activities would be limited such that sound would not exceed 60 dBA within 500 feet of the habitat being used by the cuckoo until the USFWS- and CDFW-approved biologist has confirmed that the bird has left the area. To meet this noise minimization requirement, measures may be put in place to minimize noise at the source, as described in *AMM21: Develop and Implement Noise Abatement Plan* (Appendix 3A).

To reduce effects of contamination from fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plan,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would minimize the potential for spills and contamination. Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further minimize potential for injury and mortality by training construction staff on the regulatory requirements for sensitive species having

a biological monitor present during ground disturbing activities, maintaining non-disturbance buffers, and delineating work areas (Appendix 3A). With these measures in place, adverse effects to western yellow-billed cuckoo from tidal restoration construction is not likely to occur.

## 6.6.12 Effects on Critical Habitat

There is no designated critical habitat for western yellow-billed cuckoo in the action area.

## 6.6.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Projects that result in take of western yellow-billed cuckoo would require incidental take authorization pursuant to the Endangered Species Act and therefore are not addressed in this cumulative effects analysis because they require a federal action.

However, non-federal activities and climate change have potential to affect western yellow-billed cuckoo in the action area where migratory habitat degradation occurs without USFWS authorization. The most likely activity to affect the quality of migratory habitat is conversion of willow-cottonwood riparian forest to agricultural or other uses such as urban expansion, river flow management, stream channelization, and livestock grazing (U.S. Fish and Wildlife Service 2007a). Urbanization along edges of watercourses, agricultural activities, and river management that alter flows and sediment regimes contribute to loss of cuckoo habitat. Nesting cuckoos are also sensitive to habitat fragmentation that reduces patch size (Dobkin 1994; Hughes 1999:3, 5, 11, 20, Hughes 2020). Pesticide use associated with agricultural practices may affect behavior and cause death or potentially affect prey populations (Hughes 2020). The decline of prey populations has been found to effect nesting success, and breeding cuckoos may forego nesting if local food supply is inadequate on breeding grounds following spring migration (78 FR 61660). Predation may account for a significant source of nest failures, which have been recorded at 80% in some areas (Nolan 1963; Nolan and Thompson 1975); some predation has been attributed to human-adaptive avian predators that frequent agricultural areas and can exploit nests in vegetation that lacks height, structure, and complexity of mature riparian habitat (78 FR 61655). Fragmentation of occupied habitats could make nest sites more accessible and more vulnerable to predation. Although land use conversion is unlikely due to land use controls if agricultural and/or urban development is proposed in or near western yellow-billed cuckoo occupied habitat, it could contribute to a cumulative adverse effect on yellow-billed cuckoo in the action area. Loss of and degradation of riparian habitat may decrease availability of suitable nesting sites, decrease prey species density, and increase habitat fragmentation such that reproductive success and survivorship are affected. Additionally, overuse of riparian habitat by livestock has been another major factor in the degradation and modification of riparian habitats in the Western United States. The effects include changes in plant community structure and species composition and relative abundance of species and plant density (Wiggins 2005:3).

Climate change threatens to modify annual weather patterns and contribute to additional declines in population numbers (Anders and Post 2006). Predicted drier weather may decrease the availability of precipitation and groundwater that supports riparian habitat. Increased potential for wildfire as warming increases threatens habitat and, if burned repeatedly, would prevent it from recovering.

Spring heat waves also endanger young birds in the nest. Climate change may also contribute to the conversion of native habitat to predominately nonnative vegetation.

# 6.7 Effects on California Red-Legged Frog

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.13.6, *Suitable Habitat Definition*, and Section 4.4.13.7, *Habitat Suitability Model*, define suitable habitat and describe the habitat model for California red-legged frog.

California red-legged frog modeled habitat is located in the southwestern part of the action area near Clifton Court Forebay. There are multiple occurrences in this region, including extant populations in and adjacent to Italian Slough, Byron-Bethany Irrigation District Canal, and along the northeast border of Bethany Reservoir (California Department of Fish and Wildlife 2020b). Byron Highway, which runs northwest to southeast along the southwest border of Clifton Court Forebay, is considered a somewhat permeable barrier to California red-legged frog movement. Also, habitat quality is assumed to decrease west to east, between Bethany Reservoir and Clifton Court Forebay, as the density of artificial water conveyance infrastructure and agricultural land cover types increase, and occurrences decrease.

Activities associated with field investigations, access roads, electrical facilities, SCADA facilities, and the Bethany Complex have the potential to affect California red-legged frog. Figures 6.7-1 through 6.7-18 include overview as well as “zoomed-in” figures depicting overlap between the project footprint, modeled habitat, critical habitat, and CNDDB occurrences.

Modeled California red-legged frog habitat occurs in the southwestern part of the action area near Clifton Court Forebay, including 148 acres of aquatic and 668 acres of modeled upland habitat. Excluding dispersal habitat, an estimated 10.12 acres (1.2% of total modeled habitat in action area) of California red-legged frog modeled habitat would be adversely affected by the project, which includes 0.34 acre of aquatic habitat (0.2% of modeled aquatic habitat in the action area) and 9.78 acres of modeled upland habitat (1.5% of modeled upland habitat in the action area). Effects from these activities are described in the sections below. Table 6.7-1 summarizes the maximum affected acreage of California red-legged frog modeled habitat and Table 6.7-2 summarizes the proposed acres of compensation. Dispersal habitat was modeled to evaluate barriers to movement.

**Table 6.7-1. Maximum Habitat Loss of Modeled Habitat for California Red-Legged Frog by Activity Type (Acres)**

| California Red-Legged Frog Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Aquatic | 148 | - | 0.21 | - | - | - | - | - | - | 0.21 | - | - | 0.12 | - | - | 0.12 | 0.34 |
| Upland | 668 | - | 3.79 | 3.21 | - | 0.02 | 0.05 | - | - | 7.06 | - | - | 2.11 | 0.01 | 0.60 | 2.72 | 9.78 |
| Dispersal [d] | 21,580 | - | 47.29 | 315.55 | - | - | 0.64 | - | - | 363.48 | 21.03 | - | 25.47 | 0.01 | 1.46 | 47.97 | 411.45 |
| **Total [e]** | **22,396** | **-** | **51.29** | **318.76** | **-** | **0.02** | **0.69** | **-** | **-** | **370.75** | **21.03** | **-** | **27.70** | **0.02** | **2.06** | **50.81** | **421.57** |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.
[d] Overlap between the project footprint and dispersal habitat is described here to inform the impact discussion on movement.
[e] Total is of aquatic and upland habitat. Dispersal habitat is not counted as total habitat loss or disturbance.

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**Table 6.7-2. Maximum Habitat Loss and Compensation for California Red-Legged Frog**

| | Permanent Habit Loss | Maximum Compensation Commitment (Acres) |
|---|---|---|
| | **Total Maximum Habitat Loss (Acres)** | **Protection or Restoration [a]** |
| Aquatic | 0.21 | 0.63 |
| Upland | 7.06 | 7.06 |
| **Total** | **7.27** | **7.69** |

[a] See CMP-14: *California Red-Legged Frog Habitat*, described in Attachment 3B.1, *Compensatory Mitigation Design Parameters,* for details about the protection and restoration commitments for California red-legged frog.

## 6.7.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Agronomic testing, utility potholing, and pilot studies for settlement would occur within the existing project footprints and would therefore not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex). Geotechnical investigations associated with the West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches, CPTs, and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

### 6.7.1.1 Habitat Loss and Fragmentation

Field investigations do not overlap with modeled California red-legged frog aquatic and upland habitat (Figures 6.7-7, 6.7-10, and 6.7-11). Field investigations do overlap with dispersal habitat, but because field investigations are temporary activities that last no more than 30 days, fragmentation of habitat is not a concern.

#### 6.7.1.2 Construction-Related Effects

Field investigation locations overlap with dispersal habitat, and thus have potential to affect dispersing individuals, in two locations: northeast of Bethany Reservoir and to the south and southeast of Clifton Court Forebay. Ground disturbance within this dispersal habitat could injure or kill individuals either moving between locations or seeking refuge in a burrow or soil crevice or under leaf litter. California red-legged frog could also be trapped in open trenches or other excavations and become vulnerable to desiccation and predation. Construction activities could also result in the exposure of California red-legged frog to construction-related fluids, such as fuels and oils, which could result in the injury and mortality of dispersing individuals.

The potential for field investigations to affect individuals would be minimized by isolating activities to the dry season to the extent practicable, along with other measures described in Chapter 3, Section 3.6.2.5, *California Red-Legged Frog Avoidance and Minimization Measure*. In addition, AMM-1: *Conduct Environmental Resources Worker Awareness Training* requires training construction staff on the regulatory requirements for sensitive species. AMM-14: *Construction Best Management Practices for Biological Resources* requires a construction monitoring plan be prepared, a relocation plan be approved by USFWS prior to ground disturbance and requires speed limits on all non-public, project-related access roads. AMM-14 also requires all excavated, steep-walled holes or trenches more than 6 inches deep to be covered with plywood or similar material at the close of each working day and/or to be provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

Avoidance of impacts on California red-legged frog from vehicle-related contaminants such as fuel or oil would be minimized with implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*, by implementing spill prevention and control plans. Disruptions to frog behavior and movement from noise and vibration are not expected to be measurable given the short duration and small extent of ground disturbance. Where disruptions do occur, implementation of the minimization measure detailed in Chapter 3, Section 3.6.2.5 and AMM-14: *Construction Best Management Practices for Biological Resources* are expected to minimize the effect with pre-disturbance detection, work stoppage (if detected), and relocation if needed. However, the threshold at which disruption of normal behaviors would occur is unknown.

### 6.7.2 North Delta Intakes

The north Delta intake construction area does not overlap with California red-legged frog modeled habitat and this activity would not have an adverse effect on the species (Figure 6.7-2).

### 6.7.3 Tunnels

The tunnel alignment from the north Delta intakes to the Bethany Complex does not overlap with California red-legged frog modeled aquatic or upland habitat. There is a small amount of overlap between the subsurface tunnel feature and dispersal habitat. Because the tunnel is below the surface, there are no direct effects from tunneling. However, the tunnel boring machine creates vibrations that reach the surface and could affect the behavior of amphibians such as the California red-legged frog. Because the tunnel alignment overlaps with dispersal habitat (and not aquatic or upland habitat) at the eastern edge of the species' range, vibration from tunneling is not expected to

adversely affect the species (Figure 6.7-1). However, the threshold at which disruption of normal behaviors would occur is unknown.

## 6.7.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. One reception shaft within the Bethany Reservoir surge basin overlaps with modeled California red-legged frog dispersal habitat. That impact is discussed along with other construction-related impacts under Section 6.7.6, *Bethany Complex*, below.

## 6.7.5 Reusable Tunnel Material

RTM areas would not overlap with California red-legged frog modeled habitat; thus, RTM area construction would not affect California red-legged frog (Figure 6.7-1).

## 6.7.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and operations within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.7.6.1 Habitat Loss and Fragmentation

With the exception of impacts on aquatic habitat as a result of electrical and SCADA facilities and access road construction that occurs outside the main Bethany Complex (as described in Sections 6.7.8 and 6.7.7, respectively), no aquatic habitat would be affected by the Bethany Complex (Figures 6.7-6, 6.7-14 through 6.7-16). An estimated 3.21 acres of modeled upland habitat (0.5% of modeled upland habitat in the action area) and 315.55 acres of modeled dispersal habitat (1.5% of modeled

dispersal habitat in the action area) would be permanently lost as a result of construction of the Bethany Complex (Table 6.7-1).

Lost habitat from Bethany Complex construction is a mix of low-quality habitat near Byron Highway and higher quality habitat near Bethany Reservoir. The Bethany Reservoir Pumping Plant and Surge Basin footprint are located southwest of Clifton Court Forebay in primarily agricultural lands with lower upland and dispersal habitat value. The discharge structure is just to the east of Bethany Reservoir where the habitat value is considered higher because the primary land cover type is grassland and there are known, extant occurrences in the region (e.g., occurrences #28, #100) (California Department of Fish and Wildlife 2020b). In addition to habitat loss, the construction of the Bethany Complex would result in further fragmentation of modeled dispersal habitat and create additional barriers to movement.

Chapter 3, Section 3.6.2.5 commits to delineating and avoiding suitable California red-legged frog habitat to the greatest extent possible. Where delineated suitable habitat cannot be avoided and is permanently lost, 0.63 acre of aquatic habitat and 21.00 acres of upland habitat would be protected or restored, or the equivalent amount of agency-approved mitigation bank credits or other site protection instruments would be purchased, as described in CMP-14: *California Red-Legged Habitat* (Table 3B.1-3). The measure would require protection of suitable habitat prioritized in the East San Francisco Bay core recovery area, which is one of the core recovery areas identified in the *Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*)* (U.S. Fish and Wildlife Service 2002), at a location subject to USFWS approval.

### 6.7.6.2 Construction-Related Effects

Construction of the Bethany Complex has potential to result in California red-legged frog injury and mortality. Construction-related contaminants such as gas, oil, steering fluid, and cement could accidentally be discharged into California red-legged frog habitat. Vehicles and heavy equipment used at the construction site could crush individuals if present within the construction footprint. California red-legged frog could also be trapped in open trenches or other excavations or become entangled in erosion control materials. Light and vibration could disrupt normal behaviors and increase susceptibility to predation. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be created and implemented. AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would reduce the potential of injury or mortality from construction equipment by training construction staff on the regulatory requirements for sensitive species; instituting speed limits; requiring the presence of a biological monitor; covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp; prohibiting plastic monofilament netting or similar material for erosion control; capping ends of stored pipes and culverts; and implementing non-disturbance buffers using construction fencing, where applicable.

Chapter 3, Section 3.6.2.5 would minimize impacts by requiring preconstruction surveys, requiring the presence of a qualified biological monitor, minimizing ground disturbing activities, minimizing nighttime construction, avoiding initial ground disturbance work during periods of rainfall,

implementing a relocation plan, installing exclusion fencing 14 days prior to construction where California red-legged frog habitat is within 300 feet to reduce effects of construction, and directing night lighting away from California red-legged frog habitat outside of the construction area. As described in Section 3.2.12, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity. AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* would further minimize effects of night lighting.

## 6.7.7 Access Roads

The construction of new roads and improvements to existing roads are necessary to support project construction. New access roads would be either gravel or paved and would be built to connect existing roads to construction areas. Existing roads would be widened and improved to support the construction-related traffic. The access roads that overlap with California red-legged frog modeled habitat are those that are in service to, but occur outside of, the Bethany Complex. Impacts from access road construction within the Bethany Complex are described above in Section 6.7.6. The construction actions associated with access roads are described and evaluated at the project level.

There are three regions where new access roads would be constructed and existing access roads would be improved in service of the Bethany Complex: to the northeast of the Bethany Complex, connecting Mountain House Road to Byron Highway; between Mountain House Road and the Bethany discharge structure; and to the south of the Bethany Complex, connecting Mountain House Road to Grant Line Road (Figures 6.7-17 and 6.7-18). All access roads described in this section occur west of Byron Highway. For more information about access roads see Chapter 3, Section 3.2.7.

Construction activities for new and widened access roads include clearing, grubbing, moving utilities, paving, and the use of construction vehicles. Construction of access roads to the Bethany Complex would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where construction would occur at night. All lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity. Construction-related lighting would be downcast and motion-activated so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Chapter 3, Section 3.2.12).

### 6.7.7.1 Habitat Loss and Fragmentation

Access roads would result in the permanent loss of 0.21 acre of modeled aquatic habitat and 3.79 acres of modeled upland habitat. There is also a temporary loss of 0.12 acre of modeled aquatic habitat and 2.11 acres of modeled upland habitat. Table 6.7-1 details the acres of habitat lost due to access roads.

The access roads being constructed in this area affect a combination of lower quality habitat that occurs within agricultural lands and higher quality grazed grasslands interspersed with stock ponds, drainage ditches, water infrastructure, and natural creeks and drainages. Several known occurrences of California red-legged frog are recorded in the area east and south of Bethany Reservoir where several access roads would be constructed (California Department of Fish and Wildlife 2020b).

Three new access road segments and the widening of existing public roads in service to the Bethany Complex would incrementally increase habitat fragmentation and decrease connectivity because these roads occur adjacent to aquatic habitat, between aquatic and upland habitat, or in proximity (< 300 feet) to a known CNDDB occurrence (California Department of Fish and Wildlife 2020b). The access roads that would incrementally increase fragmentation are as follows.

- Widened portions of Mountain House Road (Figure 6.7-15)
- Improvements to the intersection of Mountain House Road and Grant Line Road, including a new paved road extension of Mountain House Road, new bridge over Mountain House Creek, new intersection with Grant Line Road, and widened merge lane on Grant Line Road (Figure 6.7-16)
- New intersection of Byron Highway and Lindeman Road (Figures 6.7-6 and 6.7-16)
- New DWR access road from the Bethany Reservoir Discharge Structure to Mountain House Road (Figure 6.7-15)

There is some potential for an increase in injury and mortality as a result of an increase in traffic volume during construction. These impacts are discussed in the section directly below.

To minimize permanent and temporary habitat loss, the *California Red-Legged Frog Avoidance and Minimization Measure* detailed in Chapter 3, Section 3.6.2.5 commits to delineating and avoiding suitable habitat to the greatest extent possible. Where delineated suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset as described in CMP-14: *California Red-Legged Frog Habitat* (Table 3B.1-3). To minimize the incremental decrease in California red-legged frog habitat connectivity from the construction of access roads, AMM-25: *Minimize Access Road Impacts on Listed Amphibian Connectivity* would require new and widened roads to be designed to reduce barriers to movement. Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.7.7.2 Construction-Related Effects

Access road construction has potential to result in injury or mortality of California red-legged frogs. Construction-related contaminants such as gas, oil, steering fluid, and cement could accidentally be discharged into California red-legged frog habitat. Individuals could be crushed by heavy equipment constructing the roads or by the increased construction traffic using the new and improved roads, especially during the wet season. California red-legged frogs could be trapped in open trenches or other excavations or become entangled in erosion control materials. Noise, vibration, and light could disrupt normal behaviors or movement patterns or make individuals more vulnerable to predation. However, the threshold at which disruption of normal behaviors would occur is unknown.

The primary method by which injury and mortality would be minimized is the application of measures outlined in Chapter 3, Section 3.6.2.5. This measure requires delineation of suitable habitat by an USFWS approved biologist prior to construction. If suitable habitat is present, presence/absence surveys would be conducted prior to ground disturbance or occupancy would be assumed. If presence is detected or the species is assumed to be present, occupied habitat would be delineated and avoided, if feasible. If avoidance of occupied habitat is not feasible, construction initiation in these areas would be restricted to periods outside of the wet season or to days of low or no rain as specifically defined in detail in Section 3.6.2.5. The measure would also require presence

of a qualified biological monitor, creation of a relocation plan, installation of exclusion fencing 14 days prior to construction where California red-legged frog habitat is within 300 feet, and the directing of night lighting away from California red-legged frog habitat outside of the construction area.

To reduce the potential effects of contamination, management and spill prevention plans would be developed under AMM-2: *Develop and Implement Hazardous Materials Management Plans*, and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*. AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would reduce the potential of injury or mortality from construction equipment by requiring training construction staff on the regulatory requirements for sensitive species, setting speed limits, requiring posted wildlife crossing signs, having a biological monitor present, restricting ingress/egress at the project site to routes identified in project plans, limiting vehicle parking to established areas, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, prohibiting plastic monofilament netting or similar material for erosion control, capping ends of stored pipes and culverts, and implementing non-disturbance buffers using construction fencing, where applicable.

## 6.7.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intake and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.7.7. The duration of construction and installation of new electrical

and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.7.8.1 Habitat Loss and Fragmentation

Electrical and SCADA facilities serving the Bethany Complex overlap with modeled California red-legged frog habitat. Construction of electrical and SCADA facilities would result in the permanent loss of 0.05 acre of upland habitat (<0.01% of all modeled upland habitat in the action area) and 0.64 acre of dispersal habitat (<0.01% of all modeled dispersal habitat in the action area) and temporary removal of 0.60 acre of modeled upland habitat (0.09% of all modeled upland habitat in the action area) and 1.46 acres of modeled dispersal habitat (<0.01% of all modeled dispersal habitat in the action area). See Table 6.7-1 and Figures 6.7-7, 6.7-12 through 6.7-17.

Bethany Complex power and SCADA facilities are located west of Byron Highway. As described in Section 6.7.7, modeled upland and dispersal habitat in this region is a combination of high- and low-quality habitat with several known occurrences in the area east and south of Bethany Reservoir (California Department of Fish and Wildlife 2020b). Because the patches of permanent and temporary habitat loss are small, construction activities associated with the electrical facilities are not likely to have a substantial effect on California red-legged frog. In addition, the measure detailed in Chapter 3, Section 3.6.2.5 commits to delineating and avoiding suitable California red-legged frog habitat to the greatest extent possible. Where delineated suitable habitat cannot be avoided, the loss of upland habitat would be offset through implementation of CMP-14: *California Red-Legged Frog Habitat*, described in Attachment 3B.1. The measure would require protection of suitable habitat prioritized in the East San Francisco Bay core recovery area, which is one of the core recovery areas identified in the *Recovery Plan for the California Red-Legged Frog (*Rana aurora draytonii*)* (U.S. Fish and Wildlife Service 2002), at a location subject to USFWS approval. Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* as described in Appendix 3A.

### 6.7.8.2 Construction-Related Effects

Vehicles and heavy equipment associated with power and SCADA facilities construction could injure or kill California red-legged frog if individuals are present within the construction footprint. Construction-related contaminants such as gas, oil, and steering fluid could accidentally be discharged into California red-legged frog habitat. California red-legged frog could also be trapped in open trenches or become entangled in erosion control materials. Construction of electrical and SCADA facilities could generate light and vibrations, which could disrupt normal behaviors and cause California red-legged frog to be more visible at night and make them vulnerable to predation or result in increased energy expenditures those these effects would be limited due to the short duration of power and SCADA facilities construction. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans. AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would reduce the potential of injury or mortality from construction equipment by requiring training construction staff on the regulatory requirements for sensitive species, speed limits, a biological monitor present, and non-disturbance

buffers. In addition, Chapter 3, Section 3.6.2.5 would require presence/absence surveys would be conducted prior to ground disturbance if suitable habitat is present (or occupancy would be assumed). If presence is detected or the species is assumed to be present, occupied habitat would be delineated and avoided, if feasible. If avoidance is not feasible, construction initiation in these areas would be restricted to periods outside of the wet season as specifically described in the measure. The measures would also require presence of a qualified biological monitor, minimization of ground disturbing activities, minimization of construction, implementation of a relocation plan, installation of exclusion fencing 14 days prior to construction to reduce effects of construction where California red-legged frog habitat is within 300 feet, and the directing of night lighting away from California red-legged frog habitat outside of the construction area.

## 6.7.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[19] concrete and CLSM batch plants and park-and-ride lots. None of these features overlap with the California red-legged frog modeled habitat.

Construction of a metering area off of Christensen Road would result in 0.02 acres of permanent impacts to California red-legged frog modeled upland habitat (<0.01% of all modeled upland habitat in the action area) and 0.01 acres of temporary habitat disturbance (<0.01% of all modeled upland habitat in the action area). The metering area would support new overhead power lines. The small permanent loss of modeled habitat would not result in habitat fragmentation. Impacts to habitat and California red-legged frog would be minimized as described in Section 6.7.8.1.

## 6.7.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with California red-legged frog modeled habitat. Activities in this area would not have an adverse effect on the species (Figure 6.7-5).

## 6.7.11 Compensatory Mitigation Plan

The wetland creation and enhancement sites under the CMP do not overlap with California red-legged frog modeled habitat; therefore, these activities would not have an adverse effect on the species (Figure 6.7-1).

### 6.7.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

The Bouldin Island and I-5 pond creation and enhancement sites do not overlap with California red-legged frog modeled habitat (Figure 6.7-1); therefore, these activities would have no effect on the species.

[19] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, e.g., north Delta intakes, Bethany Complex, etc. For example, there are impacts from road work areas included in Section 6.7.7., *Access Roads*, and Section 6.7.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside those primary construction locations.

### 6.7.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. Mitigation or conservation bank credits purchased for these species would be purchased at banks that have been approved by USFWS. Through the approval process, any potential impacts on California red-legged frog from restoration, creation, enhancement, management, maintenance, or monitoring would have been addressed by the USFWS through credit approval process. Because the approved bank would provide bank credits for California red-legged frog, the purchase is assumed to be beneficial for the species.

### 6.7.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.7.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would create or restore, protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. If non-bank sites are used for vernal pool or alkaline wetland creation or enhancement (Appendix 3B, Section 3B.3.2.4), these activities could occur in areas where California red-legged have potential to occur.

Construction and management activities could include ground disturbance, require some vehicle traffic and use of heavy equipment, and use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of California red-legged frog. Chapter 3, Section 3.6.2.5 would minimize impacts by requiring preconstruction surveys, requiring the presence of a qualified biological monitor, minimizing ground disturbing activities, minimizing nighttime construction, and avoiding initial ground disturbance work during periods of rainfall, implementing a relocation plan, installing exclusion fencing 14 days prior to construction to reduce effects of construction where California red-legged frog habitat is within 300 feet of construction activities. To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* (Appendix 3A) would require spill prevention and control plans be created and implemented. With these measures in place, and the long-term benefits associated with protection and long-term management of California red-legged frog habitat, implementation of non-bank sites is not expected to adversely affect the species.

### 6.7.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

#### 6.7.11.5 Channel Margin Enhancements

Channel margin enhancements would take place in areas that do not provide habitat for California red-legged frog and would be outside of the species' current range. Therefore, this activity would have no effect on California red-legged frog.

#### 6.7.11.6 Tidal Perennial/Emergent Wetland Restoration

Tidal wetland restoration would take place in areas outside of the current California red-legged frog range. Therefore, this activity would have no effect on California red-legged frog.

### 6.7.12 Effects on Critical Habitat

There are over 1.6 million acres of designated critical habitat for California red-legged frog, and approximately 44,470 acres of critical habitat in Unit CCS-2B (50 CFR Part 17, 12816–12959). Approximately 1,946 acres of critical habitat unit CCS-2B overlaps with the action area to the west of Clifton Court Forebay (Figures 6.7-1, 6.7-6, and 6.7-7). The Primary Constituent Elements (PCEs) for California red-legged frog are defined below (50 CFR Part 17, 12816–12959).

1. Aquatic Breeding Habitat. Standing bodies of fresh water (with salinities less than 4.5 parts per thousand), including natural and manmade (e.g., stock) ponds, slow-moving streams or pools within streams, and other ephemeral or permanent water bodies that typically become inundated during winter rains and hold water for a minimum of 20 weeks in all but the driest of years.
2. Non-Breeding Aquatic Habitat. Freshwater pond and stream habitats, as described above, that may not hold water long enough for the species to complete its aquatic life cycle, but which provide for shelter, foraging, predator avoidance, and aquatic dispersal of juvenile and adult California red-legged frogs. Other wetland habitats considered to meet these criteria include but are not limited to: plunge pools within intermittent creeks, seeps, quiet water refugia within streams during high water flows, and springs of sufficient flow to withstand short-term dry periods.
3. Upland Habitat. Upland areas adjacent to or surrounding breeding and non-breeding aquatic and riparian habitat up to a distance of 1 mile in most cases (i.e., depending on surrounding landscape and dispersal barriers) including various vegetational types such as grassland, woodland, forest, wetland, or riparian areas that provide shelter, forage, and predator avoidance for the California red-legged frog. Upland features are also essential in that they are needed to maintain the hydrologic, geographic, topographic, ecological, and edaphic features that support and surround the aquatic, wetland, or riparian habitat. These upland features contribute to: (1) Filling of aquatic, wetland, or riparian habitats; (2) maintaining suitable periods of pool inundation for larval frogs and their food sources; and (3) providing nonbreeding, feeding, and sheltering habitat for juvenile and adult frogs (e.g., shelter, shade, moisture, cooler temperatures, a prey base, foraging opportunities, and areas for predator avoidance). Upland habitat should include structural features such as boulders, rocks and organic debris (e.g., downed trees, logs), small mammal burrows, or moist leaf litter.
4. Dispersal Habitat. Accessible upland or riparian habitat within and between occupied or previously occupied sites that are located within 1 mile of each other, and that support movement between such sites. Dispersal habitat includes various natural habitats, and altered

habitats such as agricultural fields, that do not contain barriers (e.g., heavily traveled roads without bridges or culverts) to dispersal. Dispersal habitat does not include moderate- to high-density urban or industrial developments with large expanses of asphalt or concrete, nor does it include large lakes or reservoirs over 50 acres (20 hectares) in size, or other areas that do not contain those features identified in PCE 1, 2, or 3 as essential to the conservation of the species.

The Bethany Reservoir Aqueduct, Bethany Reservoir Discharge Structure, access road to the Bethany Reservoir Discharge Structure, and underground SCADA fiber routes overlap with critical habitat unit CCS-2B for California red-legged frog (50 CFR Part 17, 12816–12959) (Figures 6.7-1, 6.7-5, and 6.7-6). The proposed action would permanently remove 0.01 acre of modeled aquatic habitat (which is assumed to meet the criteria of PCE 1 and PCE 2); 1.65 acres of modeled upland habitat (which partially meets the criteria for PCE 3), and 43.61 acres of modeled dispersal habitat (which meets the criteria for PCE 3 and PCE 4) within this unit. This is less than 0.01% of total California red-legged frog designated critical habitat, and 0.10% of California red-legged frog critical habit in Unit CCS-2B (50 CFR Part 17, 12816–12959). Permanent and temporary habitat loss due to the proposed action would result in fragmentation and isolation of habitat within this critical habitat unit, but this effect would be small because the access road would not be heavily traveled, and the Bethany Reservoir Discharge Structure is located adjacent to the edge of Bethany Reservoir (and therefore does not pose a new, substantial barrier to movement).

Effects would be avoided and minimized through implementation of measures such as AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; AMM-14: *Construction Best Management Practices for Biological Resources;* and AMM-17: *Avoid and Minimize Impacts on Terrestrial Biological Resources from Maintenance Activities* (Appendix 3A). In addition, the measures presented in Chapter 3, Section 3.6.2.5 would implement measures such as delineating suitable habitat and minimizing ground disturbing activities within suitable habitat.

Where delineated suitable habitat cannot be avoided and is permanently lost, the loss of habitat would be offset through implementation of CMP-14: *California Red-Legged Frog Habitat*, described in Attachment 3B.1. The measure would require protection of suitable habitat prioritized in the East San Francisco Bay core recovery area, which is one of the core recovery areas identified in the *Recovery Plan for the California Red-Legged Frog (Rana aurora draytonii)* (U.S. Fish and Wildlife Service 2002), at a location subject to USFWS approval. Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

The proposed action would not appreciably reduce the conservation value of critical habitat for California red-legged frog because the impact is to a small percentage of designated critical habitat; the impact occurs in a very small portion at the northeastern edge of designated critical habitat in an area that is already highly fragmented with water conveyance facilities and roads; avoidance and minimization measures would be implemented; and compensation would protect California red-legged frog habitat in perpetuity.

## 6.7.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future

federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Projects that result in take of California red-legged frog would require incidental take authorization pursuant to the Endangered Species Act and therefore are not addressed in this cumulative effects analysis because they require a federal action.

Non-federal activities could affect California red-legged frog in the action area when habitat loss and degradation occur without USFWS authorization. The most likely activity of this type is conversion of rangeland to urban uses. Unauthorized take as a result of urbanization is unlikely where most of the habitat occurs west of Clifton Court Forebay because urbanization within the cities of Brentwood, Pittsburg, Oakley, and Clayton is covered by the East Contra Costa County Habitat Conservation Plan (HCP)/Natural Community Conservation Plan (NCCP). Urban development outside these incorporated cities (i.e., in the jurisdiction of Contra Costa County) is not covered by the East Contra Costa County HCP/NCCP. Although unlikely to occur due to land use controls, if urban development were proposed in or near the community of Byron it could contribute to a cumulative adverse effect on California red-legged frog in the action area.

Climate change also threatens to modify annual weather patterns. Climate change may result in a loss of California red-legged frog and/or prey and/or increased numbers of their predators, parasites, and disease. Since the habitat in the action area with the highest likelihood of supporting California red-legged frog is within the East Contra Costa County HCP/NCCP and East Alameda County Conservation Strategy, where large scale conservation efforts would be implemented, cumulative effects in the action area are not expected to appreciably diminish the likelihood of the species' long-term survival and recovery.

# 6.8 Effects on California Tiger Salamander

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.14.6, *Suitable Habitat Definition*, and Section 4.4.14.7, *Habitat Suitability Model*, define suitable habitat and describe the habitat model for California tiger salamander.

Section 4.4.14.2, *Life History and Habitat Requirements*, describes the California tiger salamander upland and aquatic habitat. The species is found in annual grassland, vernal pool complexes, open mixed woodland, and oak savanna communities in lowland and foothill regions of central California where suitable aquatic sites, such as vernal pools, seasonal ponds or constructed ponds, are available for breeding (U.S. Fish and Wildlife Service 2017c:I-2, I-6–I-7). The suitability of California tiger salamander habitat is proportional to the abundance of upland refuge sites (e.g., small mammal burrows) near aquatic breeding sites.

California tiger salamander modeled habitat is located in the northern (northwest of Clarksburg), west-central (north of Rio Vista and south of Birds Landing), and southwestern (surrounding Byron and west and southwest of Clifton Court Forebay) portions of the action area, all of which have extant or historical occurrences in the vicinity (California Department of Fish and Wildlife 2020b). However, the project footprint only overlaps with modeled habitat in the southwestern part of the action area, west, south, and southwest of Clifton Court Forebay, where there are known, extant

occurrences (California Department of Fish and Wildlife 2020b; Delta Habitat Conservation and Conveyance Program 2011:6-25).

Activities associated with field investigations, access roads, electrical facilities, SCADA facilities, and Bethany Complex overlap with California tiger salamander modeled habitat, and occur in proximity to known occurrences, and, as such, have the potential to affect California tiger salamander. Figures 6.8-1 through 6.8-17 include overview as well as "zoomed-in" figures depicting overlap between the project footprint, modeled habitat and CNDDB occurrences.

There are 16,728.99 acres of modeled California tiger salamander habitat in the action area, 9,326.57 acres of which are aquatic habitat[20] and 7,402.42 acres of which are upland habitat. An estimated 79.49 acres (0.48% of total modeled habitat in action area) of modeled California tiger salamander habitat would be adversely affected by the project, 0.2 acre of which is modeled aquatic habitat (<0.1% of modeled aquatic habitat in action area) and 79.29 acres of which are modeled upland habitat (1.07% of modeled upland habitat in action area). Effects from these activities are described in the sections below. Table 6.8-1 summarizes the total estimated habitat loss of California tiger salamander modeled habitat and Table 6.8-2 summarizes the proposed acres of compensation.

[20] Aquatic habitat for California tiger salamander is mapped primarily using a vernal pool complex data layer. Because vernal pool complex is primarily grassland land cover with seasonal wetted pools distributed throughout, the aquatic model is primarily made up of grassland habitat. This approach was necessary as there are no publicly available data layers that include just the wetted pool features. For this reason, the aquatic habitat model most likely overestimates the acreage of impacted to wetted pool features.

**Table 6.8-1. Maximum Habitat Loss of Modeled Habitat for California Tiger Salamander by Activity Type (Acres)**

| California Tiger Salamander Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Aquatic [d] | 9,326.57 | - | - | 0.20 | - | - | - | - | - | 0.20 | - | - | - | - | - | - | 0.20 |
| Upland | 7,402.42 | - | 12.55 | 47.03 | - | 0.02 | 0.61 | - | - | 60.20 | 4.92 | - | 12.58 | 0.02 | 1.56 | 19.08 | 79.29 |
| **Total** | **16,728.99** | **-** | **12.55** | **47.23** | **-** | **0.02** | 0.61 | **-** | **-** | **60.40** | **4.92** | **-** | **12.58** | **0.02** | **1.56** | **19.08** | **79.49** |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.
[d] The aquatic habitat model for California tiger salamander includes vernal pool complex, a natural community made up of pool features in a grassland matrix. As a result, the acres of modeled habitat represent mostly upland acres (rather than aquatic acres). Therefore, this number overestimates available habitat and impacts.

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**Table 6.8-2. Maximum Habitat Loss and Compensation for California Tiger Salamander**

| California Tiger Salamander Modeled Habitat | Permanent Habit Loss (Acres) | Maximum Compensation Commitment (Acres) |
|---|---|---|
| | **Total Maximum Habitat Loss (Acres)** | **Protection/ Restoration (Acres) [a]** |
| Aquatic | 0.20 | 0.60 |
| Upland | 60.20 | 180.60 |
| **Total** | **60.40** | **181.20** |

[a] See CMP-13 in Table 3B.1-3 of Attachment 3B.1, *Compensatory Mitigation Design Parameters,* for the full commitment to protect or restore California tiger salamander habitat.

# 6.8.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost, and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Agronomic testing, utility potholing, and pilot studies for settlement would occur within the existing project footprints and would therefore not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex).

Geotechnical investigations associated with the West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches, CPTs, and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section. All surface ground disturbance for field investigations for the Bethany Reservoir Aqueduct tunnel would occur outside of the Bethany Conservation Easement.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

## 6.8.1.1 Habitat Loss and Fragmentation

An estimated 4.92 acres of modeled upland habitat would be temporarily disturbed as a result of field investigations (0.07% of all modeled upland habitat in the action area) (Figure 6.8-6). The field investigations include geotechnical exploration in the Bethany Complex (west of Byron Highway) and trench work at the West Tracy Fault (east of Byron Highway) and Bethany Fault. Modeled

upland habitat surrounding geotechnical sites at the Bethany Complex is of higher quality as it consists of lightly grazed rolling hills of nonnative annual grassland with several known occurrences of California tiger salamander within one mile. Modeled upland habitat that overlaps with the West Tracy Fault site is considered lower quality, as the primary land cover type is agriculture, and the parcel sizes are smaller. Because of the small footprint of the Bethany Fault investigations and the short (1 day) duration of the disturbance, impacts on modeled habitat are not quantified and are considered negligible. The implementation of AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion (Appendix 3A).

#### 6.8.1.2 Construction-Related Effects

Overland driving or ground disturbance could injure or kill California tiger salamander if individuals are present aboveground within field investigation work areas. California tiger salamander could also be trapped in open trenches or other excavation pits/trenches and become vulnerable to desiccation and predation. Field investigations have the potential to produce subsurface vibrations, which could be detectible by California tiger salamander. The threshold at which disruption of normal behaviors would occur is unknown; however, subsurface vibrations from field investigations would not be anticipated to exceed those experienced under existing conditions. Construction-related contaminants, such as fuels, cement, and oils, could be accidentally discharged or spilled into modeled upland habitat exposing salamanders to toxic materials, which could result in the injury and mortality, as well as lead to habitat degradation.

To minimize injury and mortality during field investigations, the *California Tiger Salamander Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.6 would require delineation of California tiger salamander habitat at each project site. If suitable habitat is present, the measure requires an approved biologist to perform presence/absence surveys or assume presence. If presence is detected or the species is assumed to be present, occupied habitat would be avoided to the greatest extent possible. If avoidance is not possible, wildlife exclusion fencing may be erected around some field investigation activity sites (e.g., boring) where California tiger salamander habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the measure specifies that initial ground disturbance does not occur between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows be avoided to the extent feasible; and ground disturbance and vegetation removal be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

Disruptions to California tiger salamander behavior and movement from noise and vibration are not expected given field investigations would not cause noise and vibrations exceeding those experienced under existing conditions, and activities would be short in duration and require a small extent of ground disturbance that field investigations would cause. Where disruptions do occur, implementation of the avoidance and minimization measure in Chapter 3, Section 3.6.2.6 and AMM-

14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would minimize the effect with pre-disturbance detection, require work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.8.2 North Delta Intakes

The north Delta intake construction area does not overlap with California tiger salamander modeled habitat. Activities in this area would not affect the species (Figures 6.8-1 and 6.8-2).

## 6.8.3 Tunnels

The tunnel alignment from the north Delta intakes to the Bethany Complex does not overlap with California tiger salamander modeled habitat. Activities in this area would not affect the species (Figure 6.8-1).

## 6.8.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove tunnel boring machines at the intakes, along the tunnel alignment, and at the Bethany Complex. California tiger salamander modeled habitat does not overlap with any tunnel shaft locations (Figure 6.8-1).

## 6.8.5 Reusable Tunnel Material

RTM areas do not overlap with California tiger salamander modeled habitat. Activities for these facilities would not affect the species (Figure 6.8-1).

## 6.8.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities, such as mowing or vegetation clearing, would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.8.6.1 Habitat Loss and Fragmentation

An estimated 0.2 acre of aquatic habitat (<0.01% of modeled habitat in the action area) and 47.03 acres of upland habitat (0.64% of the modeled upland habitat in the action area) would be permanently lost as a result of construction at the Bethany Complex (Table 6.8-1, Figures 6.8-6). Modeled California tiger salamander habitat in the vicinity of the Bethany Complex is a mix of low-quality, agricultural habitat near Byron Highway and higher quality grassland habitat near Bethany Reservoir. Construction of the Bethany Complex is likely to incrementally increase habitat fragmentation in the region, but this impact is not considered substantial as the overall quality of the habitat would still be relatively high.

The *California Tiger Salamander Avoidance and Minimization Measure* detailed in Chapter 3, Section 3.6.2.6 requires suitable habitat be avoided to the greatest extent possible. Where suitable habitat cannot be avoided, habitat would be protected or restored, or the equivalent amount of agency-approved mitigation bank credits or other site protection instruments would be purchased, as described in CMP-13: *California Tiger Salamander Habitat* (Table 3B.1-3). In addition, implementation AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction (Appendix 3A).

### 6.8.6.2 Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill California tiger salamander. Open trenches or other excavation pits have the potential to entrap California tiger salamander should they fall in and not be able to climb out. Salamanders could become entangled in erosion control materials. Most ground squirrel burrows are found within 2 to 3 feet below the ground surface, occasionally up to 6 feet or more (Quinn et al. 2018); therefore, horizontal directional drilling of the Bethany Reservoir Aqueduct is not likely to result in injury or mortality of individuals. Construction activities have the potential to produce subsurface vibrations, which could be detectable by California tiger salamander and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during the day, during dry periods). However, the threshold at which disruption of normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into California tiger salamander habitat and cause injury or mortality or degrade habitat. Nighttime lighting used during Bethany Complex construction could illuminate adjacent suitable salamander habitat and has the potential to disrupt normal behaviors and make individuals more visible and vulnerable to predators (e.g., owls, foxes, racoons).

To reduce the potential for injury and mortality during construction of the Bethany Complex, the *California Tiger Salamander Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.6 requires avoidance of occupied habitat to the greatest extent possible. If avoidance is not

possible, wildlife exclusion fencing would be erected along the perimeter of construction sites where California tiger salamander habitat is within 300 feet of construction activities, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, initial ground disturbance would be avoided between November 1 and March 31 (extended to April 30 during wet years) to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and initial ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits; requiring steep-walled holes or trenches more than 6 inches deep be covered or an escape ramp be provided; capping ends of stored pipes and culverts; and prohibiting plastic monofilament netting or similar material for erosion control (Appendix 3A). To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be written and implemented. AMM-19: *Minimize Fugitive Light from Portable Sources Used for Construction* would require construction-related light and glare to be minimized to the maximum extent feasible, given safety considerations, by using the lowest feasible wattage and height, screening and directing down toward work activities, and minimizing the number of nighttime lights used (Appendix 3A). The *California Tiger Salamander Avoidance and Minimization Measure Mitigation Measure* would also require night lighting within 300 feet of California tiger salamander habitat be directed away and shielded from California tiger salamander habitat outside the construction area to minimize light spillover to the greatest extent feasible (Chapter 3, Section 3.6.2.6).

## 6.8.7 Access Roads

The construction of new access roads and improvements to existing roads are necessary to support project construction and project facilities. New access roads would be either gravel or paved and would be built to connect existing roads to construction areas and project facilities. Existing roads would be widened and improved to support the construction-related traffic. The construction actions associated with access roads are described and evaluated at the project level.

The access roads impacts discussed in this section are those that are in service to, but occur outside of, the Bethany Complex. Impacts from access road construction within the Bethany Complex are described above in Section 6.8.6, *Bethany Complex*. Three new sections of access roads would be constructed in service of the Bethany Complex: to the north of the Bethany Complex, between the complex and Byron Highway; between Mountain House Road and Bethany Reservoir; and to the south, a new road segment and intersection connecting Mountain House Road and to Grant Line Road. All access roads described in this section occur west of Byron Highway. These access roads are described in Chapter 3, Section 3.2.7 and depicted in Figures 6.8-1 and 6.8-17.

Construction activities for new and widened access roads include clearing, grubbing, moving utilities, paving, and the use of construction-related vehicles. Construction of access roads to the Bethany Complex would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road, where construction would occur at night. All lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity. Construction-related lighting would be shielded and oriented in such a manner so as not to subject the immediate surroundings to light level extremes,

however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Chapter 3, Section 3.2.12).

### 6.8.7.1 Habitat Loss and Fragmentation

Access roads would result in permanent removal of 12.55 acres of modeled upland habitat (0.16% of modeled upland habitat in the action area) and temporary removal of 12.58 acres of modeled upland habitat (0.01% of modeled upland habitat in the action area) (Table 6.8-1). Access roads would not result in loss of modeled aquatic habitat. The modeled upland habitat in this region is considered to be of higher quality given the large parcels sizes, primary land cover type (grazed grasslands), and the presence of California tiger salamander (California Department of Fish and Wildlife 2021).

Three new access road segments and the widening of existing public roads in service to the Bethany Complex would incrementally increase habitat fragmentation and decrease connectivity because these roads occur within upland habitat or in proximity (<1.24 miles) to aquatic habitat or a known CNDDB occurrence (California Department of Fish and Wildlife 2020b). The access roads that would incrementally increase fragmentation are as follows.

- Widened portions of Mountain House Road (Figures 6.8-16 and 6.8-17)
- New DWR access road from the Bethany Reservoir Discharge Structure to Mountain House Road (Figure 6.8-16)

There is some potential for an increase in injury and mortality as a result of an increase in traffic volume during construction. These impacts are discussed in the section directly below.

To minimize permanent and temporary habitat loss, the *California Tiger Salamander Avoidance and Minimization Measure* detailed in Chapter 3, Section 3.6.2.6 commits to delineating and avoiding suitable habitat to the greatest extent possible. Where delineated suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset as described in CMP-13*, California Tiger Salamander Habitat* (Table 3B.1-3). To minimize the incremental decrease in California tiger salamander habitat connectivity from the construction of access roads, AMM-25: *Minimize Access Road Impacts on Listed Amphibian Connectivity* would require new and widened roads to be designed to reduce barriers to movement. Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.8.7.2 Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill California tiger salamander. Open trenches or other excavation pits have the potential to entrap California tiger salamander should they fall in and not be able to climb out. Salamanders could become entangled in erosion control materials. Subsurface vibrations from construction could be detectible by California tiger salamander and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during the day, during dry periods). However, the threshold at which disruption of normal behaviors would occur is unknown. Nighttime lighting has the potential to disrupt normal behaviors or make individuals more vulnerable to predators (e.g., owls, foxes, racoons). Construction-related contaminants, such as gas, oil, and cement, or erosion and

sedimentation could accidentally be discharged into California tiger salamander habitat and cause injury or mortality or degrade habitat.

To reduce the potential for injury and mortality during access road construction, implementation of the *California Tiger Salamander Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.6 would require the determination of suitable habitat. If suitable habitat is present, presence/absence surveys would be performed, or presence assumed. If presence is detected or the species is assumed to be present, occupied habitat would be avoided if possible. If avoidance is not possible, wildlife exclusion fencing would be erected around the perimeter of construction sites where California tiger salamander habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the avoidance measure requires initial ground disturbance be avoided between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows be avoided to the extent feasible; and initial ground disturbance and vegetation removal be conducted during periods of no to low rainfall.

Implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by training construction staff on the regulatory requirements for sensitive species; setting speed limits; requiring posted wildlife crossing signs; requiring steep-walled holes or trenches more than 6 inches deep be covered or provided an escape ramp to the extent feasible; ends of stored pipes and culverts be capped; and plastic monofilament netting or similar material for erosion control by prohibited. To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be written and implemented (Appendix 3A).

## 6.8.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed to extend power supplies at all project facility locations. A new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the Bethany Complex. SCADA lines would be placed within existing roadway and telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the

activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Construction of new above ground electrical facilities would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching and directional drilling and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.8.7, *Access Roads*. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for additional details about the impact assessment method.

### 6.8.8.1 Habitat Loss and Fragmentation

Construction footprints for electrical and SCADA facilities overlap with modeled California tiger salamander habitat near the Bethany Complex and the existing Banks Pumping Plant and Jones Pumping Plant (Figures 6.8-1 and 6.8-14). Construction of the electrical facilities would result in the permanent loss of 0.61 acre of modeled upland habitat (<0.01% of all modeled upland habitat in the action area). Construction of the SCADA facilities would result in the temporary loss of 1.56 acres of upland habitat (Table 6.8-1, Figures 6.8-14). The lost habitat is located west of Byron Highway. This area is dominated by annual grassland habitats and generally considered to be higher quality for California tiger salamander due to the large patch size, grassland land cover, and low road density.

The *California Tiger Salamander Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.6 requires avoiding suitable California tiger salamander habitat to the greatest extent possible. Where delineated suitable habitat cannot be avoided, CMP-13: *California Tiger Salamander Habitat*, requires lost habitat be offset through the purchase of agency-approved mitigation bank credits or other site protection instruments (as described in Table 3B.1-3). AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A, would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction.

### 6.8.8.2 Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill California tiger salamander. Open trenches have the potential to entrap California tiger salamander should they fall in and not be able to climb out. Salamanders could become entangled in erosion control materials. Construction activities have the potential to produce subsurface vibrations, which could be detected by California tiger salamander and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during the day, during dry periods). However, the threshold at which disruption of normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into California tiger salamander habitat and cause injury or mortality or degrade habitat.

To reduce the potential for injury and mortality during construction, *California Tiger Salamander Avoidance and Minimization Measure* described in (Chapter 3, Section 3.6.2.6) requires delineation of suitable habitat and the determination of presence. If presence is detected or if the species is assumed to be present, occupied habitat would be avoided if possible. If avoidance is not possible, wildlife exclusion fencing would be erected around the perimeter of construction sites where California tiger salamander habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. The measure also requires initial ground disturbance be avoided between November 1 and March 31 (extended to April 30 during wet years) to the extent feasible; disturbance to rodent burrows be avoided to the extent feasible; and ground disturbance and vegetation removal be conducted during periods of no to low rainfall. AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits Appendix 3A). Implementation of AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp; capping ends of stored pipes and culverts; and disallowing plastic monofilament netting or similar material for erosion control. Additionally, AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require each project contractor to develop and implement a spill prevention, control, and countermeasure plan for each project site; these plans would ensure prevention of and preparedness for responding to potential hazardous spills and chemical discharges at project sites.

## 6.8.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[21] concrete and CLSM batch plants and park-and-ride lots. None of these features overlap with the California tiger salamander modeled habitat; thus, activities associated with these facilities are not expected to affect the species.

Construction of a metering area off of Christensen Road would result in 0.02 acres of permanent impacts (<0.01% of all modeled upland habitat in the action area) and 0.02 acres of temporary habitat disturbance (<0.01% of all modeled upland habitat in the action area) to California tiger salamander modeled upland habitat. The metering area would support new overhead power lines. The small permanent loss of modeled habitat would not result in habitat fragmentation. Impacts to habitat and California tiger salamander would be minimized as described in Section 6.8.8.1.

## 6.8.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with California tiger salamander modeled habitat. Activities in this area would not adversely affect the species.

[21] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.8.7, *Access Roads*, and Section 6.8.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

## 6.8.11 Compensatory Mitigation

The wetland creation and enhancement sites under the CMP do not overlap with California tiger salamander modeled habitat. Activities in this area would not adversely affect the species (Figure 6.8-1).

### 6.8.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

The Bouldin Island and I-5 pond creation and enhancement sites do not overlap with California tiger salamander modeled habitat (Figure 6.8-1); therefore, these activities would have no effect on the species.

### 6.8.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. Mitigation or conservation bank credits purchased for these species would be purchased at banks that have been approved by USFWS. Through the approval process, any potential impacts on California tiger salamander from restoration, creation, enhancement, management, maintenance, or monitoring would have been addressed by the USFWS through credit approval process. Because the approved bank would provide bank credits for California tiger salamander, the purchase is assumed to be beneficial to the species.

### 6.8.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.8.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would create or restore, protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. If non-bank sites are used for vernal pool or alkaline wetland creation or enhancement (Appendix 3B, Section 3B.3.2.4), these activities could occur in areas where California tiger salamander have potential to occur.

Construction and management activities could include ground disturbance, require some vehicle traffic and use of heavy equipment, and use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of California tiger salamander. Chapter 3, Section 3.6.2.6 would minimize impacts by requiring preconstruction surveys, requiring the presence of a qualified biological monitor, minimizing ground disturbing activities, minimizing nighttime construction, avoiding initial ground disturbance work during periods of rainfall, implementing a relocation plan, and installing exclusion fencing around the perimeter of construction sites where California tiger salamander habitat is within 300 feet of construction activities 14 days prior to construction to reduce effects of construction. To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be created and implemented (Appendix 3A). With these measures in place, and the long-term benefits associated with protection and long-term management of California tiger salamander habitat, implementation of non-bank sites is not expected to adversely affect the species.

### 6.8.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

### 6.8.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the waterside of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

The location(s) for channel margin enhancement is not known; however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for migrating salmonids that would benefit from enhancement actions.

Enhancement would entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat would primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion-resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction would vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability, and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.

- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

**Habitat Loss and Fragmentation**

Channel margin enhancement has the potential to result in a loss of modeled California tiger salamander habitat; however, because the project would occur along existing levees of agricultural properties, impacts on modeled habitat are unlikely, and only a relatively small amount of habitat has the potential to be affected. To minimize permanent habitat loss, the *California Tiger Salamander Take Minimization Measure* (Chapter 3, Section 3.6.2.6) requires avoidance of suitable California tiger salamander habitat to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Appendix 3B, Section 3B.1, *Introduction*, Section 3B.2.4, *Mitigation Design Parameters*, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines and*, Table 3B.1-3, CMP-13: *California Tiger Salamander Habitat*).

**Construction-Related Effects**

Use of construction vehicles and heavy equipment could injure or kill California tiger salamander. Open trenches or other excavation pits have the potential to entrap California tiger salamander if they should fall in and not be able to climb out. Salamanders could become entangled in erosion-control materials. Construction activities have the potential to produce subsurface vibrations, which could be detectible by California tiger salamander and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during the day, during dry periods). However, the threshold at which disruption of normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into California tiger salamander habitat and cause injury or mortality or degrade habitat.

To reduce the potential for injury and mortality during construction of channel margin enhancement sites, the *California Tiger Salamander Take Minimization Measure* (Chapter 3, Section 3.6.2.6) requires avoidance of occupied habitat to the greatest extent possible. If avoidance is not possible, wildlife exclusion fencing would be erected around the perimeter of construction sites where California tiger salamander habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, initial ground disturbance would be avoided between November 1 and March 31 (extended to April 30 during wet years) to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and initial ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, requiring steep-walled holes or trenches more than 6 inches deep be covered or an escape ramp be provided, capping ends of stored pipes and culverts, implementing a relocation plan, and prohibiting plastic monofilament netting or similar material for erosion control. To reduce the potential effects of

contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be written and implemented (Appendix 3A).

### 6.8.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area.

Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Tidal wetland restoration sites at lower Yolo Bypass and the Cache Slough Complex have potential to overlap with California tiger salamander habitat, particularly if the selected site includes grassland and vernal pool complex habitats that border the Cache Slough Complex to the south and east (i.e., the upland areas connected to the greater Jepson Prairie area). California tiger salamander habitat in this region is known to be occupied (California Department of Fish and Wildlife 2020) and is generally considered high quality.

Construction of tidal restoration sites typically include a landside levee that protects adjacent uplands from flooding, thus avoiding impacts on California tiger salamander habitat. However, there remains some potential for suitable California tiger salamander habitat to be permanently lost. The *California Tiger Salamander Minimization Measure* detailed in Chapter 3, Section 3.6.2.6 requires suitable habitat be avoided to the greatest extent possible. Where suitable habitat cannot be avoided, and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*, and Table 3B.1-3, CMP-13: *California Tiger Salamander Habitat*). In addition, AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction (Appendix 3A). If California tiger salamander habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

## Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill California tiger salamander. Open trenches or other excavation pits have the potential to entrap California tiger salamander should they fall in and not be able to climb out. Salamanders could become entangled in erosion control materials. Construction activities have the potential to produce subsurface vibrations, which could be detectible by California tiger salamander and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during the day, during dry periods). However, the threshold at which disruption of normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into California tiger salamander habitat and cause injury or mortality or degrade habitat.

To reduce the potential for injury and mortality during construction of tidal wetland restoration sites, the *California Tiger Salamander Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.6 requires avoidance of occupied habitat to the greatest extent possible. If avoidance is not possible, wildlife exclusion fencing would be erected around the perimeter of construction sites where California tiger salamander habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, initial ground disturbance would be avoided between November 1 and March 31 (extended to April 30 during wet years) to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits; requiring steep-walled holes or trenches more than 6 inches deep be covered or an escape ramp be provided; capping ends of stored pipes and culverts; implementing a relocation plan; and prohibiting plastic monofilament netting or similar material for erosion control (Appendix 3A). To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be written and implemented.

### 6.8.12 Effects on Critical Habitat

The action area does not overlap with designated California tiger salamander critical habitat.

### 6.8.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Projects that result in take of California tiger salamander would require incidental take authorization pursuant to the Endangered Species Act and therefore are not addressed in these cumulative effects analysis because they require a Federal action.

Non-federal activities could affect California tiger salamander in the action area when habitat loss and degradation occur without USFWS authorization. The most likely activity of this type is conversion of rangeland to urban uses. Unauthorized take as a result of urbanization is unlikely where most of the habitat occurs west of Clifton Court Forebay because urbanization within the cities of Brentwood, Pittsburg, Oakley, and Clayton is covered by the East Contra Costa County HCP/NCCP. Urban development outside these incorporated cities (i.e., in the jurisdiction of Contra Costa County) is not covered by the East Contra Costa County HCP/NCCP. Although unlikely to occur due to land use controls, if urban development were proposed in or near the community of Byron it could contribute to a cumulative adverse effect on California tiger salamander in the action area.

Climate change also threatens to modify annual weather patterns. Climate change may result in a loss of California tiger salamander and/or prey, and/or increased numbers of their predators, parasites, and disease. Since the habitat in the action area with the highest likelihood of supporting California tiger salamander is within the East Contra Costa County HCP/NCCP, where large scale conservation efforts would be implemented, cumulative effects in the action area are not expected to appreciably diminish the likelihood of the species' long-term survival and recovery.

## 6.9 Effects on Giant Garter Snake

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.15.6, *Suitable Habitat Definition*, and Section 4.4.15.7, *Habitat Suitability Model*, define suitable habitat and describe the habitat model for giant garter snake.

Giant garter snake modeled habitat is located throughout the action area and is concentrated near the northern and central portions of the action area in Yolo Bypass, Cache Slough Complex, east of the Sacramento River at Stone Lakes National Wildlife Refuge, Delta Meadows State Park, and Cosumnes River Preserve and along rivers, sloughs, agricultural waterways, and natural and managed wetlands in the central Delta. Modeled habitat is less available in the southern portion of the study area, where sloughs, the San Joaquin River, agricultural waterways, and a few natural drainages provide modeled aquatic and associated upland habitat. There are several giant garter snake occurrences reported within the action area, several of which occur in proximity to project features. These occurrence locations include: the Stone Lakes National Wildlife Refuge, Bufferlands, Delta Meadows State Park, White Slough Wildlife Area, Stockton, Empire Tract, Sherman Island, Jersey Island, Webb Tract, Twitchell Island, and Medford Island (California Department of Fish and Wildlife 2020b).

Activities associated with field investigations, north Delta intakes, tunnel shafts, RTM sites, access roads, electrical facilities and SCADA, Bethany Complex, and implementation of the CMP overlap with giant garter snake modeled habitat. Table 6.9-1 details the permanent and temporary habitat loss associated with each project activity feature. Figure 6.9-1 provides an overview of the locations of surface impacts relative to giant garter snake modeled aquatic and upland habitat. Figures 6.9-2 through 6.9-7 shows CNDDB occurrences in the context of three regional construction areas: North Delta intakes, Twin Cities, and Lower Roberts Island.

There are 106,533.78 acres of modeled giant garter snake habitat in the action area, 55,384.97 acres of which are aquatic habitat and 51,148.80 acres of which are upland habitat. An estimated 132.47 acres (0.12% of total modeled habitat in action area) of modeled giant garter snake habitat would be adversely affected by the project, 23.52 acres of which are modeled aquatic habitat (0.04% of modeled aquatic habitat in action area) and 108.95 acres of which are modeled upland habitat (0.21% of modeled upland habitat in action area). Effects from these activities are described in the sections below. Table 6.9-1 summarizes the total estimated habitat loss of giant garter snake modeled habitat and Table 6.9-2 summarizes the proposed acres of compensation.

**Table 6.9-1. Maximum Habitat Loss of Modeled Habitat for Giant Garter Snake by Activity Type (Acres)**

| Giant Garter Snake Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [d, d] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations [d] | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary subtotal | |
| Aquatic | 55,384.97 | 0.25 | 4.24 | 0.27 | 2.03 | - | 0.38 | 0.54 | 1.94 | 9.65 | 3.28 | - | 8.58 | - | 2.01 | 13.87 | 23.52 |
| Upland | 51,148.80 | 5.90 | 29.31 | 7.32 | 12.17 | - | 0.85 | - | 15.69 | 71.24 | 11.34 | - | 16.12 | - | 10.24 | 37.70 | 108.95 |
| **Total** | **106,533.78** | **6.15** | **33.55** | **7.59** | **14.19** | - | **1.23** | **0.54** | **17.64** | **80.89** | **14.62** | **-** | **24.70** | - | **12.25** | **51.57** | **132.47** |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.
[d] Field Investigations and Electrical Facilities will avoid aquatic features, which include suitable aquatic giant garter snake habitat, to the greatest extent feasible; see AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A).

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**Table 6.9-2. Maximum Habitat Loss and Compensation for Giant Garter Snake**

| | Permanent Habitat Loss (Acres) | Total Compensation Commitment (Acres) [a] | | With Full Implementation of the Compensatory Mitigation Plan [d] |
|---|---|---|---|---|
| | Total Maximum Habitat Loss (Acres) | Protection (Acres) | Restoration/ Creation (Acres) | Creation and Enhancement [b, c] (Acres) |
| Aquatic | 9.65 | 0 | 19.3 | 150.54 |
| Upland | 71.24 | 0 | 142.48 | 189.81 |
| Total | 80.89 | 0 | 161.78 | 340.35 |

[a] See Table 3B.1-3 in Attachment 3B.1, *Compensatory Mitigation Design Parameters*, for the design commitments and guidelines for giant garter snake creation and enhancement. Also see Section 3B.3.3.1, *Freshwater Marsh and Riparian Terrestrial Species*, and Table 3B-4 in Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources,* for additional details regarding the compensation commitments.
[b] See Appendix 3B, Section 3B.4.1.4, *DWR I-5 Ponds*, for mitigation site objectives, site selection criteria, baseline conditions, and site design and development details. See Attachment 3B.1 for specific design commitments and guidelines for giant garter snake.
[c] See Tables 3B-13 and 3B-14 in Appendix 3B for the estimated total acres of giant garter snake aquatic habitat (freshwater emergent wetland) and upland habitat (grassland) that would be created and enhanced with full implementation of the initial mitigation sites at the DWR I-5 ponds.
[d] Initial mitigation sites include the Bouldin Island and DWR I-5 ponds projects and are described in Appendix 3B. This take analysis assumes implementation of these two mitigation projects would have an overall benefit to giant garter snake, as described in Section 6.9.11.1, *Initial Mitigation Sites: Bouldin Island and I-5 Ponds*.

## 6.9.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost, and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPTs, soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex).

Geotechnical investigations associated with the tunnel alignment water crossings, West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches, and overwater and land-based CPTs and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section. All surface ground disturbance for field investigations for the Bethany Reservoir Aqueduct tunnel would occur outside of the Bethany Conservation Easement.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany

Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

#### 6.9.1.1 Habitat Loss and Fragmentation

An estimated 3.28 acres of giant garter snake modeled aquatic habitat and 11.34 acres of modeled upland habitat would be temporarily disturbed as a result of field investigations (<0.01% of modeled aquatic habitat and <0.1% of modeled upland habitat in the study area) (Figure 6.9-1). Field investigation impacts occur throughout the project alignment and the affected habitat is of varying quality. Modeled habitat near the north Delta intakes and Twin Cities Complex (where field investigations will occur) consists of aquatic habitat found along agricultural ditches, which is generally considered low quality because they do not hold permanent water. Affected modeled habitat along the tunnel alignment consists of levees, emergent wetland, riparian, agricultural crops, fallow fields, and grazed grassland, which varies from low to moderate quality. Field investigations for the Bethany Reservoir Aqueduct tunnel do not overlap with modeled giant garter snake habitat. No giant garter snake occurrences overlap with field investigation footprints (California Department of Fish and Wildlife 2020b). The temporary nature and small extent of field investigation sites would not increase habitat fragmentation in the action area.

Implementation of the *Giant Garter Snake Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat be delineated and completely avoided to the greatest extent possible. Where suitable habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 1), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. As required by AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A), temporarily disturbed areas would be restored to pre-disturbance conditions within 1 year of construction completion.

#### 6.9.1.2 Construction-Related Effects

Field investigations could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Field investigation activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could be detectible by giant garter snake. The threshold at which disruption of normal behaviors would occur is unknown; however, subsurface vibrations from field investigations would not be anticipated to exceed those experienced under existing conditions.

To reduce the potential for injury, mortality, or disruption of normal behaviors during field investigation activities, the *Giant Garter Snake Avoidance and Minimization Measure* in Chapter 3,

Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan, and if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat would be dewatered between May 1 and September 30, limited to the immediate construction area. The dewatered area would remain dry at least 15 consecutive days prior to excavating or filling dewatered habitat.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

Disruptions to giant garter snake behavior and movement from noise and vibration are not expected given field investigations would not cause noise and vibrations exceeding those experienced under existing conditions and activities would be short in duration and require a small extent of ground disturbance. If disruptions do occur, implementation of the avoidance and minimization measure in Chapter 3, Section 3.6.2.7 and AMM-14 (Appendix 3A) would minimize the effect with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.9.2 North Delta Intakes

The north Delta intakes would be constructed on the east bank of the Sacramento River upstream and downstream of Hood. Two intakes would divert water from the Sacramento River and include cylindrical fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and shaft, embankments, and other appurtenant structures. Intakes would also include construction support facilities (e.g., emergency facilities, fuel station), electrical substations, switchyards, and access roads that fall within the north Delta intake facility footprints. The north Delta intakes would be surrounded by security fencing. The construction actions associated with the north Delta intakes are described and evaluated at the project level.

Construction activities at each intake are described in Chapter 3, Section 3.2.2. Intake construction would include ground clearing and grading; in-water and on-land pile driving; excavation; placement of fills, cutoff walls, and structures; and drilling. These activities would require the use of loud, heavy equipment within the construction site as well as along the access roads to the site and limited nighttime work. Construction-related lighting would be downcast so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). The duration of the activity would be approximately 7 years at each intake. Implementation of intake construction at each location would be staggered by approximately 1 year. Intake C, the southern intake, would begin

construction first; approximately 1 year later, construction would begin at Intake B, the northern intake. The result is that construction would overlap at both sites for approximately 6 years.

#### 6.9.2.1 Habitat Loss and Fragmentation

The north Delta intakes would result in the permanent removal of 2.03 acres of giant garter snake modeled aquatic habitat (<0.01% of modeled aquatic habitat within the Delta) and 12.17 acres of modeled upland habitat (0.02% of modeled upland habitat within the Delta) (Figures 6.9-2, 6.9-12, and 6.9-13). Modeled habitat near the north Delta intakes consists of aquatic habitat found along the Sacramento River and agricultural ditches. Modeled habitat along the Sacramento River is considered lower quality because of increased flow and sparse emergent vegetation. Agricultural ditches are also assumed to be of lower quality as they typically do not hold permanent water. An incremental decrease in connectivity due to the construction of the north Delta intakes is not expected to substantially affect giant garter snake because the existing habitat is of low quality (and is therefore unlikely to be functioning as an important movement route) and the extent of lost habitat is small.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, *Site Design and Development*, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

#### 6.9.2.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could result in injury or mortality. Giant garter snake could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake habitat be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation within delineated habitat would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where there is giant garter snake habitat within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat in the immediate construction area would be

dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.7 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.9.3 Tunnels

Tunnel construction occurs completely subsurface and does not result in any surface disturbance.

The primary mechanism by which tunnel construction may affect a species is through vibration. Water conveyance tunnels connecting the north Delta intakes to the Bethany Complex would be constructed using subsurface horizontal TBMs. The TBM would operate 20 hours per day, 5 days per week, and would move at a rate of approximately 40 feet per day, depending on the soil types encountered. The depth of the main tunnel crown would be approximately 103 feet below mean sea level at Intake B, with elevation decreasing at a constant rate to 128 feet below mean sea level at the Bethany Complex. At a depth of 110 feet, groundborne vibration from a TBM that would reach the surface is estimated to be 0.003 in/sec peak particle velocity (PPV).

During tunnel construction, conveyors inside of the tunnel hauling workers and material would also produce localized groundborne vibration. However, conveyors would be operated at slow speeds and would not result in excessive vibrations or groundborne noise from the tunnel floor.

### 6.9.3.1 Habitat Loss and Fragmentation

The tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance; therefore, this activity would not result in loss or fragmentation of modeled giant garter snake habitat (Figure 6.9-1).

### 6.9.3.2 Construction-Related Effects

Tunnel construction would take place below modeled giant garter snake aquatic and upland habitat. Reptiles are very sensitive to vibration, as they use it for foraging as well as predator detection. As a result, construction vibration could be detectible by giant garter snake, disrupt normal behavior, and result in increased energy expenditures.

Vibration becomes slightly perceptible to humans at 0.012 in/sec PPV (California Department of Transportation 2020b:21). At the surface, TBM vibration is 0.003 in/sec PPV and not perceptible to humans. However, the vibration sensitivity of snakes greatly exceeds that of humans, typically by a

margin of 20 to 40 dB, indicating that snakes are 10 to 100 times more sensitive to vibration than humans (Hartline 1971). Accordingly, TBM vibrations from tunnel construction would presumably be perceptible to giant garter snakes at the surface. However, TBM vibration levels are far less than the background levels of vibration from heavy equipment and trucks that occur throughout the giant garter snake's range in the Delta, which is approximately 0.01 in/sec PPV (Federal Transit Administration 2018:18). Also, because the TBM would advance approximately 40 feet per day, TBM vibration that could be perceived by a giant garter snake would be temporary, as vibrations would diminish as the TBM moves away from a snake's location. For these reasons, the giant garter snake is unlikely to be substantially affected by tunnel boring.

## 6.9.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. Giant garter snake modeled habitat overlaps with tunnel shaft work areas at Twin Cities Complex and Lower Roberts Island (Figures 6.9-3, 6.9-4, 6.8-19, and 6.9-20). The construction actions associated with the tunnel shafts are described and evaluated at the project level.

Construction activities associated with tunnel and tunnel shaft activities are described in Chapter 3, Section 3.2.4 and would include vegetation clearing, grading, excavation, soil compaction, and the use of heavy construction equipment. Construction of the tunnel shafts would take multiple years. Construction activities would persist for 7 to 9 years at launch shafts and for 2 years at reception and maintenance shafts. Construction would occur day and night. See Section 3.2.8 for a complete description of construction activity and timing details.

### 6.9.4.1 Habitat Loss and Fragmentation

Tunnel shafts would result in permanent loss of 1.94 acres of modeled giant garter snake aquatic habitat and 15.69 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.03% of modeled upland habitat within the study area) (Figure 6.9-1). Affected modeled habitat from tunnel shaft construction would occur at the Twin Cities Complex and Lower Roberts Island. Habitat in these areas consist of agricultural ditches and narrow patches of adjacent upland habitat, which are considered low quality due to the lack of permanent water. An occurrence at the Cosumnes River Preserve is approximately 2 miles south of the Twin Cities Complex and an occurrence along the San Joaquin River is approximately 0.7 mile northwest of the Lower Roberts Island tunnel shaft work area (California Department of Fish and Wildlife 2020b). The incremental decrease in habitat connectivity from the construction of these two complexes is not expected to affect giant garter snake because of the low quality of existing habitat and the small amount of loss.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

#### 6.9.4.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30) within delineated habitat, preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat in the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require placing barriers around the shaft excavation sites to prevent entry into the shaft, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.9.5 Reusable Tunnel Material

RTM would be removed through tunnel launch shafts and transported to handling and storage facilities within the tunnel launch shaft sites, where it would be tested and dried, then transported for reuse or stockpiled and permanently stored. The construction actions associated with RTM are described and evaluated at the project level.

Construction activities at each RTM site would include the use of heavy equipment for ground clearing and grading and soil tilling and rotation. Material would be moved to the site using a conveyor belt, and on-site, long-term storage is assumed. Trucks and other large equipment could

also be used for movement of the material within the construction site. The RTM storage areas would be active for several years while tunneling is underway. The placement of RTM would be ongoing throughout tunnel construction. As material is removed from the tunnel, it would be placed or stacked within the RTM site. The Twin Cities Complex, which includes an RTM site, requires construction of a ring levee that surrounds the entire complex; because the construction of the ring levee would have approximately the same impacts as that of the RTM site, the impacts from ring levee construction are discussed in this section. RTM storage area construction, placement, handling, drying and equipment maintenance would occur during day and night, almost continuously through tunnel excavation. For more details about the activities associated with RTM placement, see Chapter 3, Section 3.2.5; for more details on schedule, see Section 3.2.8.

### 6.9.5.1 Habitat Loss and Fragmentation

The Twin Cities Complex ring levee and Lower Roberts Island RTM area overlap with modeled giant garter snake aquatic habitat (Figures 6.9-3 and 6.9-4). Construction of RTM area would result in permanent loss of 0.54 acre of modeled giant garter snake aquatic habitat (<0.01% of modeled aquatic habitat within the study area) and 0 acres of modeled giant garter snake upland habitat (0.0% of modeled upland habitat within the action area). The modeled aquatic habitat that would be removed consists of unvegetated agricultural irrigation ditches and is considered low quality. Habitat fragmentation due to RTM area construction is not expected to affect giant garter snake because of the low quality of the existing habitat and the small area of suitable habitat would be affected.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, *Site Design and Development*, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

### 6.9.5.2 Construction-Related Effects

RTM area construction could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would

be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat in the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.9.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities, such as mowing or vegetation clearing, would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

#### 6.9.6.1 Habitat Loss and Fragmentation

Construction of the Bethany Reservoir Aqueduct would result in permanent loss of 0.27 acre of modeled giant garter snake aquatic habitat and 7.32 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.01% of modeled upland habitat within the Delta) (Figures 6.9-6 and 6.9-51). Modeled aquatic habitat and associated upland habitat that would be removed from construction of Bethany Complex facilities meet the description of suitable giant garter snake habitat, but these areas are not likely to be occupied due to the low degree of connectivity to occupied habitats and the lack of current or historic occurrences in the south Delta. The nearest occurrence is approximately 15 miles northeast of the Bethany Complex facilities (California Department of Fish and Wildlife 2020b). For these same reasons, habitat fragmentation is unlikely to occur.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

#### 6.9.6.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown. While these effect mechanisms would exist at Bethany Complex construction areas, the likelihood of effects are minimal because giant garter snake is unlikely to be present. As a result, impacts on giant garter snake from construction activities are extremely unlikely to occur and therefore discountable.

### 6.9.7 Access Roads

The construction of new access roads, a new access railroad spur on Lower Roberts Island, and improvements to existing roads are necessary to support project construction and project facilities. In addition to these road and railroad features, impacts from levee improvements on Lower Roberts Island are also evaluated in this section (as the levee improvements would be adjacent to the access road, have similar impacts on species, and occur at roughly the same time). The construction actions associated with access roads, access railroad spur, and levee improvements on Lower Roberts Island are described and evaluated at the project level.

New access roads would be either gravel or paved and would be built to connect existing roads to construction areas and for project facilities. The new access railroad spur would transport materials

and equipment to the tunnel launch shaft. Existing roads would be widened and improved to support the construction-related traffic, and existing roads in the vicinity of the intakes and shafts would be repaved every 15 years. The access roads impacts that overlap with giant garter snake modeled habitat are those that are in service to, but occur outside of, facilities at the north Delta intakes, Twin Cities Complex, King Island, Lower Roberts Island, Union Island, and Bethany Complex.

There are three regions where new access roads would be constructed and existing access roads would be improved in service of the Bethany Complex: to the northeast of the Bethany Complex, connecting Mountain House Road to Byron Highway; between Mountain House Road and the Bethany discharge structure; and to the south of the Bethany Complex, connecting Mountain House Road to Grant Line Road. These access roads are described in Chapter 3, Section 3.2.7 and depicted in Figure 6.9-1. Impacts from access road construction within the north Delta intakes, tunnel shafts, RTM areas, and Bethany Complex are described above in Section 6.9.2, *North Delta Intakes*, Section 6.9.4, *Tunnel Shafts*, Section 6.9.5, *Reusable Tunnel Material*, and above in Section 6.9.6, *Bethany Complex*, respectively. Access roads for all other facilities do not overlap with modeled giant garter snake habitat.

Construction activities for access roads (which include the railroad spur and levee improvements on Lower Roberts Island) include clearing, grubbing, excavation, placement of fill, minor bridge construction, moving utilities, paving, and the use of construction vehicles. A new access railroad spur at Lower Roberts Island would be constructed adjacent to and concurrent with the access road at this location and would involve installing a bridge over Burns Cutoff, rail tracks, train use during construction, and the use of vehicles and heavy equipment to inspect and maintain the railroad right-of-way during project construction. Construction of access roads would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where construction would occur at night.

#### 6.9.7.1 Habitat Loss and Fragmentation

Access roads would result in permanent loss of 4.24 acres of modeled giant garter snake aquatic habitat and 29.31 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.06% of modeled upland habitat within the study area) and temporary impacts on 8.58 acres of modeled giant garter snake aquatic habitat and 16.12 acres of modeled upland habitat (0.2% of modeled aquatic habitat and 0.03% of modeled upland habitat within the study area) (Figure 6.9-1). Access road impacts occur throughout the project alignment and the affected habitat is of varying quality. Modeled habitat near the north Delta intakes and Twin Cities Complex (where field investigations will occur) consists of aquatic habitat found along agricultural ditches, which is generally considered low quality because they do not hold permanent water. Modeled aquatic habitat at Lower Roberts Island occurs in agricultural ditches and slow-moving water with emergent vegetation along the bank of the San Joaquin River and Burns Cutoff is considered low to moderate quality. Although the modeled habitat that would be removed for construction of access roads at the Bethany Complex fits the description of suitable giant garter snake habitat, it is considered lower quality due to the lack of connectivity between modeled habitat patches and the lack of any current or historic giant garter snake occurrences in the south Delta. The nearest occurrence is approximately 15 miles northeast of Bethany Complex access roads. No giant garter snake occurrences overlap with access road footprints (California Department of Fish and Wildlife 2020b). Habitat fragmentation due to construction of access roads is not expected to affect giant garter snake connectivity as the patches of lost habitat are small, scattered throughout action area and generally of low quality.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

#### 6.9.7.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could be detectible by giant garter snake and also disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where there is giant garter snake habitat within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat within the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.9.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical or SCADA facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching, directional drilling, and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.9.7. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.9.8.1 Habitat Loss and Fragmentation

Electrical and SCADA facilities serving the north Delta intakes, Twin Cities Complex, Terminous Tract tunnel shaft, Lower Roberts Island tunnel shaft and RTM area, and Bethany Complex overlap with modeled giant garter snake habitat. Construction of new electrical facilities would result in the permanent loss of 0.38 acre of giant garter snake modeled aquatic habitat and 0.85 acre of modeled upland habitat (<0.01% of modeled aquatic habitat and <0.01% of modeled upland habitat within the study area). Construction of SCADA facilities would result in a temporary disturbance of 2.01 acre of giant garter snake modeled aquatic habitat and 10.24 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.02% of modeled upland habitat within the study area) (Figures 6.9-8 through 6.9-56).

Modeled habitat that would be removed due to construction of power and SCADA facilities serving the north Delta intakes and Twin Cities Complex consists of aquatic habitat found along agricultural ditches, which is generally considered low quality because they do not hold permanent water. Terminous Tract modeled habitat consists of emergent wetlands and sloughs at and adjacent to White Slough Wildlife Area and is considered good quality habitat. Modeled aquatic habitat at Lower Roberts Island consist of agricultural ditches and slow-moving water with emergent vegetation along the bank of the San Joaquin River and Burns Cutoff which is considered low to moderate quality. Although the modeled habitat that would be removed for construction of access roads at the Bethany Complex fits the description of suitable giant garter snake habitat, it is considered lower quality due to the lack of connectivity between habitat patches and the lack of any current or historic giant garter snake occurrences in the south Delta.

An aboveground power line serving the north Delta intakes and Twin Cities Complex that would be installed on existing poles along Franklin Boulevard overlaps with giant garter snake occurrence #52; an underground SCADA line serving the Terminous Tract tunnel shaft overlaps with giant garter snake occurrence #49 at White Slough Wildlife Area; and an aboveground SCADA line serving the Lower Roberts Island tunnel shaft overlaps with a giant garter snake occurrence #351 in Stockton (California Department of Fish and Wildlife 2020b). Habitat fragmentation from power and SCADA facilities construction is not expected because the project features are either above or below ground.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

### 6.9.8.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where there is giant garter snake habitat within 200 feet. The measure also requires preparation of

a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat within the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.9.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[22] concrete and CLSM batch plants and park-and-ride lots. None of these features overlap with giant garter snake modeled habitat, thus activities associated with these facilities are not expected to affect the species (Figure 6.9-1).

## 6.9.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facilities would be constructed to deliver water from the Union Island tunnel shaft to the existing CCWD Middle River Pipeline on Victoria Island. The CCWD interconnection facilities would include an interconnection pump station, a new underground 1.6-mile conveyance pipeline, and an interconnection valve to connect to the existing CCWD Middle River Pipeline. The construction actions associated with the CCWD interconnection facilities are described and evaluated at the project level.

The interconnection pump station facilities would be located within the Union Island tunnel shaft footprint. Pump station facilities include two to six submersible vertical turbine pumps installed within the Union Island maintenance shaft, 24-inch diameter pump discharge pipes, an aboveground surge tank system, underground vaults containing isolation butterfly valves and flow meters, an electrical building, electrical transformers, equipment yard, and a new electrical power connection to the existing overhead line adjacent at the Union Island tunnel shaft site.

The interconnection pipeline would consist of a 42- to 66-inch diameter underground pipeline continuing north from the Union Island shaft site along Bonetti Road, crossing under Victoria Canal,

[22] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, e.g., such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.9.7, *Access Roads*, and Section 6.9.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

then turning west along an existing farm road, then connecting with the CCWD Middle River Pipeline at the Middle River Intake and Pumping Plant. A permanent 70-foot wide easement would be maintained along the length of the pipeline on Union Island and Victoria Island. Air valves, blow offs, and access manways would be placed along the pipeline within the permanent easement.

The interconnection valve would be located in a buried vault (approximately 11.5 feet by 15.5 feet by 12.0 feet) on the interconnection pipeline just prior to connecting to the Middle River pipeline within the existing CCWD pumping plant facility on Victoria Island.

Construction of the interconnection pump station facilities would take place within the construction footprint of the Union Island tunnel shaft, and activities would be similar to those occurring for tunnel shaft construction (Section 6.9.4). Installation of electrical power connections would be similar to those described in Section 6.9.8, *Electrical and SCADA Facilities.*

The interconnection pipeline would be installed in a trench with open cut and cover construction along existing roadways and within agricultural fields. The pipeline construction easement would be 100 feet wide for the entire length of the trench, including a 30-foot temporary construction easement around the 70-foot permanent easement. Dewatering may occur along the open trench, with flows collected, treated, and reused on-site. The portion of the interconnection pipeline that crosses Victoria Canal would be microtunneled. Launch and retrieval pits, approximately 35 feet wide by 50 feet long, would be placed within the 100-foot open trench construction easement on Union Island and Victoria Island to launch and receive microtunneling equipment.

Construction of the interconnection valve vault would take place within the 100-foot wide CCWD pipeline construction easement adjacent to the existing CCWD pump station facility. Following installation of the vault, pavement would be replaced within the work area surrounding the vault.

Construction of the CCWD interconnection facilities would take place after the Union Island maintenance shaft is complete and is estimated to take 18 months. The interconnection pump station, open cut portions of the interconnection pipeline, and the interconnection valve would not require nighttime construction. Microtunneling of the pipeline under Victoria Canal would require continuous construction, including nighttime activity, for a duration of approximately 2 weeks.

### 6.9.10.1 Habitat Loss and Fragmentation

The CCWD interconnection facility construction footprint overlaps with modeled giant garter snake habitat and would result in the permanent loss of 0.25 acre of modeled giant garter snake aquatic habitat (<0.01% of modeled aquatic habitat within the study area) and 5.90 acre of modeled giant garter snake upland habitat (0.01% of modeled upland habitat within the study area) (Table 6.9-1) (Figure 6.9-5).

Modeled aquatic habitat and associated upland habitat that would be removed from construction of CCWD interconnection pipeline meet the description of suitable giant garter snake habitat, but these areas are not likely to be occupied due to the lack of current or historic occurrences in the south Delta. The nearest giant garter snake occurrence is approximately 10 miles northeast of the CCWD interconnection facilities (California Department of Fish and Wildlife 2020b). For these same reasons, habitat fragmentation is unlikely to occur.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot

be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

### 6.9.10.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Take Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat within the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep, providing an escape ramp, and placing barriers around the microtunneling launch and retrieval sites to prevent entry into the launch and retrieval pits; capping ends of stored pipes and culverts; and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Take Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

# 6.9.11 Compensatory Mitigation

## 6.9.11.1 Initial Mitigation Sites: Bouldin Island and the I-5 Ponds

The CMP (Appendix 3B) would offset the permanent loss of wetlands and habitat for special-status species, including giant garter snake, by creating and enhancing habitat on Bouldin Island and I-5 ponds and managing these areas in perpetuity. The habitat creation and enhancement sites would overlap with modeled giant garter snake habitat (Figures 6.9-1, 6.9-57 through 6.9-61).

Construction of habitat creation and enhancement sites under the CMP would involve ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel to enhance and restore habitats. Habitat creation and enhancement would take several years to construct and would not require night lighting.

### Habitat Loss and Fragmentation

Habitat creation and enhancement of the initial mitigation sites at Bouldin Island and the I-5 ponds would affect 96.33 acres of modeled giant garter snake aquatic habitat and 199.29 acres of modeled upland habitat (0.17% of modeled aquatic habitat and 0.39% of modeled upland habitat within the project area). However, the disturbance would be temporary in that it would occur over one construction season, and one of the primary purposes of the initial mitigation projects is to create and enhance giant garter snake habitat. The creation and enhancement actions at the initial mitigation sites would convert the existing, low-quality aquatic habitat (e.g., depression [lake/pond], agricultural ditch) and upland habitat (grassland patches and agricultural fields along agricultural ditches, valley/foothill riparian) to 144.47 acres of moderate- to high-quality aquatic habitat (nontidal freshwater emergent wetland and depression [lake/pond]) and 181.91 acres of moderate- to high-quality upland giant garter snake habitat (uplands adjacent to aquatic habitat with available bankside cover, burrows or cracks for refuge, and management practices that prohibit overgrazing) at the initial mitigation sites that would be protected and managed in perpetuity. In addition, CMP-0: *General Design Guidelines* (Attachment 3B.1, Table 3B.1-2) requires compensatory mitigation lands address critical life functions for species and that there be no net loss in species habitat or habitat value as a result of compensatory mitigation.

See Tables 3B-7, 3B-13, and 3B-14 in Appendix 3B to better understand the increase in extent of high-quality aquatic habitat and Section 3B.7 to better understand how habitat function would be defined and monitoring.

### Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could be detectible by giant garter snake and also disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat in the immediate work area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2*: Develop and Implement Hazardous Materials Management Plans* and AMM-3*: Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans and have a biological monitor present (Appendix 3A).

### 6.9.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be purchased to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, alkali seasonal wetland, and vernal pool habitat. Mitigation or conservation bank credits for these species or wetlands would be purchased at banks that have been approved by USFWS, and would have measures to avoid, minimize, and offset any effects to listed species. In addition, mitigation bank credits would be purchased within recovery units for these species in areas that are not likely to provide suitable giant garter snake habitat. Therefore, the purchase of mitigation or conservation bank credits for special-status species would not result in additional adverse effects on giant garter snake.

### 6.9.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.9.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. Vernal pool and alkali seasonable wetland habitat is not suitable for giant garter snake and therefore this activity would have no effect on giant garter snake.

### 6.9.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

### 6.9.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for migrating salmonids that would benefit from enhancement actions.

Enhancement would generally entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, likely through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is generally anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.

- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

## Habitat Loss and Fragmentation

While the exact location of the channel margin enhancement is not known, it is likely to be placed in the central Delta (e.g., Sacramento River between Freeport and Georgiana Slough, Mokelumne River near Bouldin Island). As giant garter snakes are assumed to occur throughout the central Delta, and channel margin enhancement will take place in the nearshore and levee upland areas where giant garter snakes occur, it is assumed that any ground disturbance would result in temporary habitat loss. The existing quality of the channel margin habitat in the central Delta is typically low. The aquatic habitat is comprised of nearshore riprap areas and agricultural ditches with levee top roads and nearby agricultural areas serving as the primary upland habitat. If giant garter snake habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

However, once constructed, channel margin enhancement actions are assumed to benefit giant garter snake by increasing the extent and quality of the existing habitat. The enhancement actions are expected to replace hardened, riprap shoreline with a mix of emergent and riparian vegetation and biologically friendly engineered structures (e.g., biotechnical erosion protection) as described in Section 3B.4.3.3.3, *Design Criteria and Concepts*, of Appendix 3B. In addition, bank slopes will be increased to increase the area of shallow, nearshore habitat. Not only will this action increase the complexity and extent of foraging aquatic habitat for the giant garter snake, but it is also expected to increase the abundance of prey species. Where setback levees are used on the land side of the levee, increased slopes will increase the extent of upland habitat. And, regardless of the use of setback levees, existing levee vegetation will be replaced with native grassland vegetation, increasing the quality of the upland habitat for giant garter snake. With these increases in quality and quantity of giant garter snake aquatic and upland habitat, the temporary habitat loss is assumed to be offset by the long-term benefit of the program. Therefore, channel margin enhancements are considered beneficial overall.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

## Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to

September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (May 1 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat within the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.7) and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans and have a biological monitor present (Appendix 3A). With these measures in place, channel margin enhancement construction actions are not likely to adversely affect giant garter snake.

### 6.9.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby

restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Although the exact location of tidal restoration is unknown, any tidal restoration project in Cache Slough or lower Yolo Bypass (where tidal restoration is planned to occur) would likely result in the conversion of low- and moderate-quality aquatic and upland giant garter snake habitat to moderate- and high-quality aquatic and upland habitat. This assumption is based on three recent restoration projects in this same region: Lookout Slough, Lower Yolo, and Yolo Flyway Farms (U.S. Fish and Wildlife Service 2017b, 2019b, 2020c). Regulatory compliance documents for these three restoration projects report a net loss of lower quality habitat such as agricultural ditches, seasonal wetlands, and agricultural lands (e.g., grazing or row/field crops) and a net increase in the higher quality tidal emergent wetland. Because there was a net increase in higher quality aquatic foraging habitat (tidal emergent wetland), and some upland basking and refugia habitat would remain in the form of levee tops and adjacent grassland habitat (as was the case in the example projects), these tidal restoration projects were assumed to produce a net benefit to giant garter snake.

The net loss of giant garter snake upland habitat would occur when upland features on agricultural lands are modified to create tidal habitat and flooded as part of the restoration process. This work requires converting agricultural lands to tidal channels, emergent wetlands, and topographic depressions. Upland levee habitat used for basking and refugia would also be lost in those reaches where portions of the levee are removed to allow for tidal connectivity. If small, interior levees exist

on the property, these features could be graded to achieve topographical or elevational design requirements, though in many cases, these features would be allowed to persist as they foster the formation of mixed plant communities and high tide refugia habitat for wetland species. If giant garter snake habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

Temporary loss of aquatic habitat would also occur during construction, though these effects would not be expected to last more than 2 years and would be offset by the net increase in tidal emergent wetland. Because high quality foraging habitat is limiting for giant garter snake, and because upland habitat is typically not limiting, a net increase in aquatic habitat that is likely to result from tidal restoration in the Cache Slough/Lower Yolo Bypass region is assumed to result in a net benefit for giant garter snake.

To minimize permanent habitat loss, the *Giant Garter Snake Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.7 would require suitable giant garter snake aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity giant garter snake aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-15: *Giant Garter Snake Habitat*).

## Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of giant garter snake within restoration work areas if they are moving on the surface during the summer months (April 16 to September 30) or occupying mammal burrows or other subsurface refugia during the winter months (October 1 to April 15). Construction vehicle traffic during the active season (April 16 to September 30) could also result in injury or mortality. Giant garter snake could also be trapped in open trenches and become vulnerable to predation. Construction activities could also result in the exposure of giant garter snake to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality. Construction noise and vibration could also be detectible by giant garter snake and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Giant Garter Snake Avoidance and Minimization Measure*(Chapter 3, Section 3.6.2.7) would require suitable giant garter snake aquatic and upland habitat to be delineated and completely avoided to the greatest extent possible. If habitat cannot be avoided, construction initiation would be limited to the summer months (April 16 to September 30), preconstruction surveys would be conducted, and exclusion fencing would be erected around the perimeter of construction sites where giant garter snake habitat is within 200 feet. The measure also requires preparation of a relocation plan and, if construction activities will occur within suitable habitat during the giant garter snake inactive season, aquatic habitat within the immediate construction area would be dewatered between May 1 and September 30. The dewatered area would remain dry for at least 15 consecutive days prior to excavating or filling dewatered habitat.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits (Appendix 3A). AMM-14 would also require covering steep-walled holes or trenches providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The *Giant Garter Snake Avoidance and Minimization Measure*(Chapter 3, Section 3.6.2.7) and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2*: Develop and Implement Hazardous Materials Management Plans* and AMM-3*: Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans and have a biological monitor present (Appendix 3A).

## 6.9.12 Effects on Critical Habitat

Critical habitat has not been designated for giant garter snake.

## 6.9.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Potential cumulative effects on giant garter snake in the action area include habitat loss and fragmentation, changes in agricultural and land management practices, predation from introduced and native species, and water pollution. Both habitat loss and fragmentation, and changes in land management practices, could result from conversion of agricultural land to more developed land uses (which is not likely to be extensive due to existing constraints upon land use changes) or from conversion of agricultural land to different crop types having lower habitat suitability (which is not foreseeable). Habitat loss or degradation from agricultural practices is not expected to increase in the foreseeable future as agriculture in the Delta is assumed to be fully developed. Predation by an existing introduced native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable, nor are the consequences of such an introduction.

Water pollution effects on the physiology of giant garter snakes or giant garter snake prey could result from a variety of causes, including agricultural practices, increased urbanization, and wastewater treatment plants. The input of pesticides and herbicides associated with agricultural practices are likely to be maintained, because the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects. Water quality effects of urbanization include point and nonpoint-source water quality impairments, such as oil, gasoline, herbicides, pesticides, or heavy metals, and there is a potential for those effects to further degrade water quality as further urbanization occurs in the action area. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; therefore, this stressor is likely to diminish over time. Some of these effects would improve and

others would impair habitat quality for giant garter snake in the action area; their net effect is to approximately maintain current conditions for the foreseeable future.

These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the proposed action, nor are they expected to alter the efficacy of offsetting measures in the proposed action such as habitat creation and restoration.

# 6.10 Effects on Delta Green Ground Beetle

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4*,* Section 4.4.16.6, *Species Habitat Suitability Model*, define suitable habitat and describe the habitat model for Delta green ground beetle.

Delta green ground beetle modeled habitat is located in the northwestern portion of the action area and is limited to vernal pool complex in open habitats in the grassland-vernal pool matrix. Suitable habitat in the study area would be vernal pool complexes and annual grasslands in the Jepson Prairie area. There is one occurrence reported within the action area, which is a compilation of multiple observations over multiple years across Jepson Prairie (California Department of Fish and Wildlife 2020).

Activities associated with implementation of the CMP tidal habitat mitigation framework in the Cache Slough Complex overlap with Delta green ground beetle modeled habitat. Figure 6.10-1 provides an overview of the area where modeled Delta green ground beetle habitat overlaps with potential tidal wetland restoration could occur.

There is no modeled Delta green ground beetle habitat in the action area. An unknown area of modeled Delta green ground beetle habitat would be affected by tidal wetland restoration. Effects from these activities are described in the sections below.

## 6.10.1 Field Investigations

Field investigations would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.2 North Delta Intakes

The north Delta intakes would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.3 Tunnels

The tunnel alignment would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.4 Tunnel Shafts

Tunnel shafts would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.5 Reusable Tunnel Material

RTM areas would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.6 Bethany Complex

The Bethany Complex would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.7 Access Roads

Access roads would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.8 Electrical and SCADA Facilities

Electrical and SCADA facilities would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[23] concrete batch plants and park-and-ride lots. These features would not overlap with modeled Delta green ground beetle habitat; therefore, this activity would not have an adverse effect on the species (Figure 6.10-1).

## 6.10.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with Delta green ground beetle modeled habitat. Activities in this area would not adversely affect the species.

## 6.10.11 Compensatory Mitigation Plan

Implementation of the CMP would offset the permanent loss of wetlands and habitat for special-status species. The CMP outlines three basic methods by which mitigation will be achieved: the purchase of bank credits; creation, restoration, and enhancement; and protection, management, and monitoring. The tidal wetland restoration sites that will be sited in the Cache Slough Complex or Lower Yolo Bypass would overlap with modeled Delta green ground beetle habitat.

[23] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, e.g., such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.10.7, *Access Roads*, and Section 6.10.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

#### 6.10.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

Habitat creation and enhancement at Bouldin Island and the I-5 ponds would not overlap with Delta green ground beetle habitat; therefore, these activities would have no effect on the species (Figure 6.10-1).

#### 6.10.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The most likely location for the purchase of bank credits would be in the foothills to the west and south of Byron nearest the location of the impact and where all four species have overlapping habitat. However, there is potential that bank credits purchased for the vernal pool branchiopods or for California tiger salamander could overlap with the Delta green ground beetle range. Mitigation or conservation bank credits for these species would be purchased at banks that have been approved by the USFWS and would have measures to avoid, minimize, and offset any effects to listed species. Therefore, the purchase of conservation bank credits for special-status species would not result in additional adverse effects on Delta green ground beetle.

#### 6.10.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.10.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat in a quantity and quality sufficient to offset the adverse effects consistent with the biological opinion.

Non-bank sites for vernal pool or alkaline wetland creation, protection, or enhancement (Appendix 3B, Section 3B.3.2.4) could take place within modeled Delta green ground beetle habitat. Construction and management activities could include ground disturbance, require some vehicle traffic and use of heavy equipment, and use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of Delta green ground beetle. However, non-bank mitigation would create or restore vernal pool habitat and would be expected to provide an overall benefit to Delta green ground beetle if non-bank mitigation occurs within the species' range.

Implementation of *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would avoid and minimize construction-related effects on Delta green ground beetle by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. To minimize effects of spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be created and implemented (Appendix 3A). With these measures in place, and the long-term benefits associated with protection and long-term management of Delta green ground beetle habitat, implementation of non-bank sites is not expected to adversely affect the species.

### 6.10.11.4 Site Protection Instruments

Site protection instruments for greater sandhill crane, Swainson's hawk and tricolored blackbird would primarily consist of the protection and management of existing agricultural areas, but may also include protection and management of natural communities (e.g., grasslands or vernal pool complex), as described in CMP-18a: *Sandhill Crane Roosting Habitat*, CMP-18b: *Sandhill Crane Foraging Habitat*, CMP-19a: *Swainson's Hawk Nesting Habitat*, CMP-19b: *Swainson's Hawk Foraging Habitat*, CMP-22a: *Tricolored Blackbird Nesting Habitat*, and CMP-22b: *Tricolored Blackbird Foraging Habitat* in Table 3B.1-3. No construction activities would occur for site protection instruments.

### 6.10.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

Enhancement would generally entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, likely through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is generally anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.
- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

### Habitat Loss and Fragmentation

Channel margin enhancement has the potential to result in a loss of modeled Delta green ground beetle habitat, however, because the project will occur along existing levees of agricultural properties impacts on modeled habitat are unlikely, and only a relatively small amount of habitat has the potential to be affected.

To minimize permanent habitat loss, the *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and implementation of the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines)*.

### Construction-Related Effects

Ground-disturbing activities (e.g., excavation) have the potential for injury or mortality to Delta green ground beetle. Use of vehicles and heavy equipment could crush Delta green ground beetle, and construction-related fluids or sediments could be inadvertently discharged into suitable habitat, resulting in injury, mortality, or habitat degradation.

The *Vernal Pool Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.9) would avoid and minimize construction-related effects on Delta green ground beetle by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, channel margin enhancement construction is not likely to adversely affect Delta green ground beetle.

## 6.10.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including through food production) of one or more life stages of each listed fish species addressed

in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area.

Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Tidal wetland restoration sites at lower Yolo Bypass and the Cache Slough Complex have potential to overlap with Delta ground beetle habitat, particularly if the selected site includes or is adjacent to grassland and vernal pool complex upland habitats that border the Cache Slough Complex to the south and east (i.e., the upland areas connected to the greater Jepson Prairie area) where Delta ground beetle is known to occur (California Department of Fish and Wildlife 2020) and is generally considered high quality. Construction of tidal restoration sites typically include a landside levee that protects adjacent uplands from flooding, thus avoiding impacts on vernal pool habitat where the Delta green ground beetle occurs. However, there remains some potential for suitable Delta green ground beetle habitat to be temporarily or permanently lost.

To minimize permanent habitat loss, the *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and

minimize effects on the habitat. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines)*. If Delta ground beetle habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

### Construction-Related Effects

Ground-disturbing activities (e.g., excavation) have the potential for injury or mortality to Delta green ground beetle. Use of vehicles and heavy equipment could crush Delta green ground beetle, and construction-related fluids or sediments could be inadvertently discharged into suitable habitat, resulting in injury, mortality, or habitat degradation.

The *Vernal Pool Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.9) would avoid and minimize construction-related effects on Delta green ground beetle by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, tidal wetland restoration construction is not likely to adversely affect Delta green ground beetle.

## 6.11 Effects on Valley Elderberry Longhorn Beetle

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4*,* Section 4.4.17.6, *Suitable Habitat Definition*, and Section 4.4.17.7, *Species Habitat Suitability Model*, define suitable habitat and describe the habitat model for valley elderberry longhorn beetle.

The valley elderberry longhorn beetle's host plant is the red or blue elderberry shrub (*Sambucus* spp.*).* Elderberry shrubs occur along riparian corridors throughout the action area, including the Sacramento River, San Joaquin River, and along smaller natural and channelized drainages, as well as in upland areas such as grasslands, oak woodlands, and agricultural areas. Valley elderberry longhorn beetle occur most frequently and are most abundant in riparian zones (Talley et al. 2006: 10; Collinge et al. 2001:111).

There are four reported California Natural Diversity Database (CNDDB) occurrences of valley elderberry longhorn beetle in the action area: one along Middle River, north of Tracy, and three occurrences along small drainages between the Sacramento River and the Sacramento Deep Water Ship Channel in the vicinity of West Sacramento (California Department of Fish and Wildlife 2020b) No CNDDB occurrences of valley elderberry longhorn beetle (California Department of Fish and Wildlife 2020b) would be permanently or temporarily affected by project construction.

Activities associated with field investigations, north Delta intakes, tunnel shafts, RTM, access roads, Bethany Complex, electrical and SCADA facilities, other construction support facilities, and implementation of the CMP have the potential to affect valley elderberry longhorn beetle. Figures 6.11-1 through 6.11-70 include overview as well as "zoomed-in" figures depicting overlap between the project footprint, modeled habitat, and CNDDB occurrences.

There are 20,458.28 acres of modeled valley elderberry longhorn beetle riparian habitat[24] in the action area. An estimated 30.36 acres (0.15% of total modeled habitat in the action area) of modeled valley elderberry longhorn beetle riparian habitat would be adversely affected by the project. Effects from these activities are described in the sections below. Table 6.11-1 summarizes the total estimated habitat loss of valley elderberry longhorn beetle modeled riparian habitat and Table 6.11-2 summarizes the proposed acres of compensation.

[24] While elderberry longhorn beetle does occur outside the riparian zone, non-riparian habitat take estimates are not provided because non-riparian types that have potential to provide habitat—grasslands, oak woodland, agricultural lands—are abundant and would provide an extreme overestimation of affected occupied habitat. The riparian model is assumed to be sufficient to inform a conservative take estimate for those elderberry bushes that occur in both riparian and non-riparian habitat types. Conservation measures would require all elderberry bushes within the construction footprint, regardless of the natural community in which they occur, be counted against take limits and mitigated. To provide context to the analysis, a non-riparian model is presented in Figure 6.11-1 but no impacts would be reported.

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**Table 6.11-1. Maximum Habitat Loss of Modeled Habitat for Valley Elderberry Longhorn Beetle by Activity Type (Acres)**

| Valley Elderberry Longhorn Beetle Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Riparian Habitat | 20,458.28 | - | 10.06 | 1.04 | 7.01 | - | 0.43 | - | 0.94 | 19.47 | 2.38 | - | 3.25 | - | 5.26 | 10.89 | 30.36 |
| **Total** | 20,458.28 | - | 10.06 | 1.04 | 7.01 | - | 0.43 | - | 0.94 | 19.47 | 2.38 | - | 3.25 | - | 5.26 | 10.89 | 30.36 |

Notes:
CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

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**Table 6.11-2. Maximum Habitat Loss and Compensation for Valley Elderberry Longhorn Beetle**

| | Permanent Habit Loss (Acres) | Maximum Compensation Commitment (Acres) | Full Implementation of the Compensatory Mitigation Plan [e] |
|---|---|---|---|
| | Total Maximum Habitat Loss (Acres) | Restoration/Creation (Acres) | Creation and Enhancement [a] (Acres) |
| Riparian | 19.47 | 58.41 [c, d] | 204.79 [d] |
| Non-Riparian [b] | | | |

Notes:
[a] See Table 3B-4 in Appendix 3B, *Compensatory Mitigation for Special-Status Species and Aquatic Resources*, for the estimated total acres of valley elderberry longhorn beetle habitat that would be created and enhanced with full implementation of the initial mitigation sites.
[b] While take limits are informed by the riparian model, take within non-riparian habitat is possible and conservation measures provide for preconstruction surveys of suitable, non-riparian valley elderberry longhorn beetle habitat and compensation for the loss of occupied or assumed occupied habitat.
[c] The maximum compensation commitment assumes impacted habitat is all riparian and therefore a 3:1 mitigation ratio is applied. However, it is likely that impacted habitat will be a mix of riparian and non-riparian habitat. In those instances, a 1:1 mitigation ratio will be applied to lost non-riparian habitat consistent with the Valley Elderberry Longhorn Beetle Framework (U.S. Fish and Wildlife Service 2017d).
[d] All elderberry shrubs that are one inch or greater in diameter at ground level in riparian habitat that will be affected will be transplanted to restored or created habitat as described in CMP-12, Valley Elderberry Longhorn Beetle Habitat, in Attachment 3B.1. Any shrubs that require transplantation per the Valley Elderberry Longhorn Beetle Framework (U.S. Fish and Wildlife Service 2017d) will be relocated to the mitigation areas identified in the CMP.
[e] This effects analysis assumes that existing, low-quality valley elderberry longhorn beetle riparian habitat would be temporarily disturbed from implementation of the CMP enhancement and creation actions. The temporary disturbance is expected to convert existing, low-quality habitat to enhanced, high-quality habitat.

## 6.11.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost, and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPTs, soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex).

Geotechnical investigations associated with tunnel alignment water crossings, West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches and overwater and land-based CPTs and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section. All surface ground disturbance for field investigations for the Bethany Reservoir Aqueduct tunnel would occur outside of the Bethany Conservation Easement.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, temporary soil storage prior to backfilling trenches, and helicopter surveys to identify buried groundwater and natural gas wells. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

#### 6.11.1.1 Habitat Loss and Fragmentation

Field investigations would not result in any permanent habitat loss or fragmentation of valley elderberry longhorn beetle modeled habitat but would result in an estimated 2.38 acres (<0.01% of all modeled riparian habitat and in the action area) of temporary disturbance. The temporary disturbance from test trenches, CPTs, and soil borings occurs in small patches all along the tunnel alignment between the north Delta intakes and Bethany Complex. The quality of the affected riparian habitat is mixed, with some impacts on relatively high quality riparian vegetation with large, contiguous patches of riparian vegetation which provides higher quality habitat to the beetle because of its limited physical dispersal capability (U.S. Fish and Wildlife Service 2017c:7). Other patches of affected habitat—those areas west of Thornton on Canal Ranch Tract, Terminous Tract, Roberts Island, and Jones Tract—generally consist of lower quality habitat with narrow, linear patches of riparian habitat that vary in canopy coverage from patchy to contiguous.

Implementation of *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would require preconstruction surveys for elderberry shrubs in construction areas. If elderberry shrubs are found, they would be avoided to the maximum extent practicable per the measure. Complete avoidance (i.e., no adverse effects) would be assumed when a buffer of at least 165 feet is established and maintained around elderberry shrubs containing stems measuring 1 inch or greater in diameter at ground level (U.S. Fish and Wildlife Service 2017d). Shrubs that cannot be avoided would be transplanted to conservation areas identified in Appendix 3B. Construction activities that occur within 165 feet of a shrub containing stems measuring 1 inch or greater in diameter at ground level but that would not take the shrub could proceed per the measures outlined in Section 3.6.2.8 consistent with the USFWS 2017 Framework. Additionally, implementation of AMM-14: *Construction Best Management Practices for Special-Status Species,* detailed in Appendix 3A, would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion.

#### 6.11.1.2 Construction-Related Effects

Overland driving and vegetation removal or trimming could injure or kill beetles that are present near work locations if shrubs are inadvertently damaged by construction activities. Construction activities conducted adjacent to occupied or assumed occupied habitat during the beetle flight season (March to July) could disrupt feeding, breeding, and dispersal between shrubs, and cause potential injury or mortality of valley elderberry longhorn beetle. Also, work within 165 feet of host elderberry shrubs could result in dust accumulation on shrubs and the discharge of construction-related fluids in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

To minimize injury and mortality during field investigations, implementation of the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would reduce direct effects on the species by conducting surveys, establishing non-disturbance buffers, and implementing avoidance measures. Additionally, this measure would transplant shrubs that cannot be avoided within the construction footprint to a conservation area identified in Appendix 3B.

The potential impacts of injury, mortality, and the disruption of normal behaviors of all life stages of valley elderberry longhorn beetle from project construction would be further reduced by the implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources*. These measures would reduce potential effects by training construction staff on the needs for protecting elderberry shrubs and would ensure that non-disturbance buffers and associated construction fencing are being implemented where applicable. Additionally, to protect valley elderberry longhorn beetle and its host plant, AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential effects of accidental chemical spills and AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat (Appendix 3A). These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.2 North Delta Intakes

The north Delta intakes would be constructed on the east bank of the Sacramento River near the town of Hood. Two intakes would divert water from the Sacramento River and include cylindrical fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and shaft, embankments, and other appurtenant structures. Intakes would also include construction support facilities (e.g., emergency facilities, fuel station), electrical substations, switchyards, and access roads that fall within the north Delta intake facility footprints. The north Delta intakes would be surrounded by security fencing. The construction actions associated with the north Delta intakes are described and evaluated at the project level.

Construction activities at each intake are described in Chapter 3, Section 3.2.2. Intake construction would include ground clearing and grading; in-water and on-land pile driving; excavation; placement of fills, cutoff walls, and structures; and drilling. These activities would require the use of loud, heavy equipment within the construction site as well as along the access roads to the site and limited nighttime work. Construction-related lighting would be downcast so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). The duration of the activity would be approximately 7 years at each intake. Implementation of intake construction at each location would be staggered by approximately 1 year. Intake C, the southern intake, would begin construction first; approximately 1 year later, construction would begin at Intake B, the northern intake. The result is that construction would overlap at both sites for approximately 6 years.

### 6.11.2.1 Habitat Loss and Fragmentation

Construction of the north Delta intakes would result in the permanent loss of 7.01 acres (<0.03% of modeled riparian habitat within the action area) of valley elderberry longhorn beetle modeled riparian habitat. The impacts would occur where Intakes B and C overlap with the Sacramento River's east bank between Clarksburg and Courtland (Figures 6.11-2, 6.11-13, and 6.11-15). Loss of

habitat would result from vegetation removal in advance of grading and excavation for the construction project infrastructure.

Most of the modeled riparian habitat near the north Delta intakes is of low quality as it exists in very narrow corridors along levees, road, and agricultural fields. Because the riparian habitat in this region is already quite sparse and lacking complexity without any known occurrences, intake construction is not likely to substantially fragment habitat.

The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) would require surveys for elderberry shrubs within 165 feet of construction activities. For shrubs not directly affected by construction but that occur within 165 feet of ground-disturbing activities, the additional avoidance and minimization measures described in Section 3.6.2.8 would be implemented. When elderberry shrubs cannot be avoided, shrubs would be transplanted as described in CMP-12: *Valley Elderberry Longhorn Habitat* (Table 3B.1-3 in Appendix 3B). Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*).

#### 6.11.2.2 Construction-Related Effects

Vegetation removal or trimming could injure or kill beetles that are present in occupied shrubs near work locations. Construction activities conducted adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle as well as disrupt feeding, breeding, and dispersal behaviors. Also, work within 165 feet of host elderberry shrubs could result in dust accumulation on shrubs and the contamination of soils from construction-related fluids (e.g., oil, gas, steering fluids).

To minimize injury and mortality during construction of the north Delta intakes, the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 requires elderberry shrubs be avoided to the maximum extent practicable with the establishment of non-disturbance buffers of 165 feet. Where avoidance is not possible, the measure requires the shrubs be transplanted to conservation areas. In addition, AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce potential effects by training construction staff about on the needs of protecting elderberry shrubs and requiring biological monitors where appropriate. Further, implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential effects of accidental chemical spills. Finally, to minimize the potential effects of dust, implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These AMM measures are described in Appendix 3A and would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

### 6.11.3 Tunnels

Tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance to valley elderberry longhorn beetle modeled habitat; therefore, this activity would not have an adverse effect on the species.

## 6.11.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. Valley elderberry longhorn beetle modeled habitat overlaps with the tunnel shaft work area at the Twin Cities Complex (Figures 6.11-3 and 6.11-24). The construction actions associated with tunnel shafts are described and evaluated at the project level.

Construction activities associated with tunnel shaft are described in Chapter 3, Section 3.2.4 and would include vegetation clearing, grading, excavation, soil compaction, and the use of heavy construction equipment. Construction of the tunnel shafts would take multiple years. Construction activities would persist for 7 to 9 years at launch shafts and for 2 years at reception and maintenance shafts. Construction would occur day and night. See Section 3.2.4 for details on construction timing and duration. Construction of the tunnel shafts would take multiple years. See Section 3.2.8 for a complete description of construction activity and timing details.

### 6.11.4.1 Habitat Loss and Fragmentation

The Twin Cities Complex tunnel shaft would result in 0.94 acre (<0.01% of modeled habitat in the action area) of modeled valley elderberry longhorn beetle riparian habitat loss (Table 6.11-1, Figures 6.11-3, 6.11-24, and 6.11-25). The modeled riparian habitat that would be lost as a result of construction at the Twin Cities Complex consists of isolated, narrow strips along agricultural ditches and is considered low quality. Because of the low quality of the modeled habitat in the region, and thus the low likelihood of valley elderberry longhorn beetle presence, the incremental increase in habitat fragmentation would not be expected to result in a substantial decrease in connectivity.

Implementation of the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would require surveys for elderberry shrubs within 165 feet of construction activities. For shrubs not directly affected by construction but that occur within 165 feet of ground-disturbing activities, the additional avoidance and minimization measures described in Section 3.6.2.8 would be implemented. When elderberry shrubs cannot be avoided, shrubs would be transplanted as described in CMP-12: *Valley Elderberry Longhorn Habitat* (Table 3B.1-3 in Appendix 3B). Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*).

### 6.11.4.2 Construction-Related Effects

Vegetation removal and ground-disturbing activities could damage or remove occupied shrubs. Construction activities during the beetle flight season (March to July) could result in injury or mortality of valley elderberry longhorn beetles or disrupt feeding, breeding, and dispersal activities. Also, work within 165 feet of host elderberry shrubs could affect shrubs through dust accumulation or the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids).

To minimize injury and mortality during construction, the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would require avoidance of elderberry shrubs to the maximum extent practicable through establishment of non-

disturbance buffers. Where shrubs cannot be avoided, shrubs would be transplanted as described in CMP-12: *Valley Elderberry Longhorn Habitat* in Table 3B.1-3 of Appendix 3B.

AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would result in further reduction in the potential for injury and mortality by training construction staff and requiring a biological monitor where appropriate. Additionally, AMM-14 would reduce speed limits to 15 miles per hour on unpaved, non-public access roads during construction. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce effects of accidental chemical spills. To minimize the potential effects of dust, implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential. These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.5 Reusable Tunnel Material

RTM construction areas do not overlap with valley elderberry longhorn beetle modeled habitat. Activities in this area would not adversely affect the species (Figure 6.11-1).

## 6.11.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.11.6.1 Habitat Loss and Fragmentation

An estimated 1.04 acres of modeled valley elderberry longhorn beetle riparian habitat (<0.01% of modeled riparian habitat in the action area) would be permanently lost as a result of construction of

the Bethany Complex (Table 6.11-1 and Figures 6.11-6, 6.11-60, and 6.11-66). Bethany Complex construction activities would also take place in modeled non-riparian habitat; if occupied elderberry shrubs are present in the non-riparian construction area, the shrubs would be identified by preconstruction surveys.

Modeled riparian habitat surrounding the Bethany Complex is very sparse and consists of small, isolated patches of riparian shrubs or trees. The modeled habitat that overlaps with the Bethany Reservoir Discharge Structure riprapped bank consists of sparse riparian shrubs and is generally considered to be low quality. Because the existing habitat quality is low and fragmented, the incremental decrease in connectivity from Bethany Complex construction is not expected to have a substantial effect on the species.

The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) would require preconstruction surveys for elderberry shrubs, establishment of non-disturbance buffers if occupied shrubs are present (to the extent practicable), and transplantation if avoidance of the shrub is not possible. Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, *Site Design and Development*, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*).

### 6.11.6.2 Construction-Related Effects

Vegetation removal, ground-disturbing activities (such as grading), and construction equipment movement could injure or kill valley elderberry longhorn beetles. Construction activities conducted adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle or disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust accumulating on shrub leaves and the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids) in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

DWR would minimize the potential for injury and mortality to valley elderberry longhorn beetle habitat as described in *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.8. Per this measure, elderberry shrubs would be avoided to the maximum extent practicable. Where shrubs cannot be avoided, the measure would require shrubs be transplanted to a conservation area identified in Appendix 3B.

Additionally, AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce potential effects by training construction staff and requiring a biological monitor where applicable. Additionally, AMM-14 would reduce speed limits to 15 miles-per-hour on unpaved non-public access roads during construction. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would minimize the potential for spills. AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust onto shrubs. These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.7 Access Roads

New access roads, a new access railroad spur on Lower Roberts Island, and improvements to existing public roads would be necessary to support project construction and project facilities. In addition to these road and railroad features, impacts from levee improvements on Lower Roberts Island are also evaluated in this section (as the levee improvements would be adjacent to the access road, have similar impacts on species, and occur at roughly the same time). New access roads would be either gravel or paved and would provide connections between existing roads and construction areas for project facilities. The new access railroad spur would transport materials and equipment to the tunnel launch shaft. Existing roads would be widened and improved to support the construction-related traffic. The construction actions associated with the access roads, access railroad spur, and levee improvements on Lower Roberts Island are described and evaluated at the project level.

The access road Impacts discussed in this section are those that are in service to, but occur outside of, facilities at the north Delta intakes, Twin Cities Complex, King Island, Lower Roberts Island, Union Island, and Bethany Complex. Three new sections of access roads would be constructed in service of the Bethany Complex: to the north of the Bethany Complex, between the complex and Byron Highway; between Mountain House Road and Bethany Reservoir; and to the south, a new road segment and intersection connecting Mountain House Road and to Grant Line Road. Access roads are described in Chapter 3, Section 3.2.7 and depicted in Figure 6.11-1. Impacts from access road construction within the north Delta intakes, tunnel shafts, RTM areas, and Bethany Complex are described above in Section 6.11.2, *North Delta Intakes*, Section 6.11.4, *Tunnel Shafts*, Section 6.11.5, *Reusable Tunnel Material*, and Section 6.11.6, *Bethany Complex*, respectively.

Construction activities for access roads (which include the railroad spur and levee improvements on Lower Roberts Island) include clearing, grubbing, excavation, placement of fill, minor bridge construction, moving utilities, paving, and the use of construction-related vehicles. A new access railroad spur at Lower Roberts Island would be constructed adjacent to and concurrent with the access road at this location and would involve installing a bridge over Burns Cutoff, rail tracks, train use during construction, and the use of vehicles and heavy equipment to inspect and maintain the railroad right-of-way during project construction. Construction of access roads would take place over several years during daylight hours, except for the traffic bypass at Mountain House Road, where construction would occur at night.

### 6.11.7.1 Habitat Loss and Fragmentation

Access roads would result in the permanent removal of 10.06 acres of modeled riparian habitat (0.05% of modeled riparian habitat in the action area) and the temporary removal of 3.25 acres of modeled riparian habitat (0.02% of modeled riparian habitat in the action area). Access road construction activities would also take place in modeled non-riparian habitat; if occupied elderberry shrubs are present in the non-riparian construction area, the shrubs would be identified by preconstruction surveys and either avoided or transplanted as described in Chapter 3, Section 3.6.2.8.

Habitat surrounding access road footprints at the north Delta intakes and on Canal Ranch Tract, Lower Roberts Island, and Linderman Road follow established roadways, sloughs, or agricultural ditches and generally consists of narrow, linear patches of riparian vegetation that vary in density from patchy to contiguous. Habitat surrounding the Bethany Complex access roads is dominated by

grazed grasslands with few isolated patches of riparian vegetation that are unlikely to provide high-quality habitat. Because the existing habitat is low quality and fragmented, an incremental decrease in connectivity is not expected to adversely affect valley elderberry longhorn beetle.

The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would require preconstruction surveys for elderberry shrubs, non-disturbance buffers, and avoidance to the extent practicable. When elderberry shrubs cannot be avoided, shrubs would be transplanted to conservation areas identified in Appendix 3B. Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*). AMM-14: *Construction Best Management Practices for Special-Status Species* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion.

### 6.11.7.2 Construction-Related Effects

There is potential for injury and mortality of elderberry beetles from vegetation removal or trimming that would take place in advance of access road construction. Construction-related vehicles traveling on access roads adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle as well as disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust and the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids) in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

To minimize injury and mortality during construction of access roads, implementation of the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* would be required (Chapter 3, Section 3.6.2.8). This measure requires elderberry shrubs be avoided to the maximum extent practicable through the application of preconstruction surveys and 165-foot non-disturbance buffers. Where avoidance is not possible, the measure would require shrubs be transplanted to a conservation area.

Potential project construction effects would be further reduced by the implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A). These measures would reduce potential effects by training construction staff on the needs for protecting elderberry shrubs and providing requirements for biological monitors and non-disturbance barriers. Additionally, AMM-14 would reduce speed limits to 15 miles per hour on unpaved non-public access roads during construction to reduce potential for vehicle strike and dust generation. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential for accidental chemical spills. Implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Section 3.2.10 and Section 3.2.11.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching, directional drilling, and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase. Temporary electrical facilities used during construction, such as temporary substations, will be removed when construction is complete.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.11.7, *Access Roads*. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.11.8.1 Habitat Loss and Fragmentation

Construction of new electrical facilities would result in the permanent loss of 0.43 acre of valley elderberry longhorn beetle modeled riparian habitat (<0.01% of modeled riparian habitat within the action area). Construction of SCADA lines would result in temporary disturbance of 5.26 acres of valley elderberry longhorn beetle riparian habitat (0.03% of modeled riparian habitat within the action area). Electrical and SCADA facility construction activities would also take place in modeled non-riparian habitat; if elderberry shrubs are present in the non-riparian construction area, the shrubs would be identified by preconstruction surveys and transplanted to a conservation area if occupied.

The affected modeled riparian habitat near electrical and SCADA facilities at the north Delta intakes, Twin Cities Complex, New Hope Tract, Canal Ranch Tract, Terminous Tract, Lower Roberts Island, and Bethany Complex follow established roadways, sloughs, or agricultural ditches and generally consists of narrow, linear patches of riparian vegetation that vary in density from one individual shrub to a small stand of riparian vegetation. Because the existing habitat is considered low quality and fragmented, any incremental decrease in fragmentation is not likely to result in a substantial decrease in connectivity.

The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) would require preconstruction surveys for elderberry shrubs and avoidance buffers of 165 feet around occupied shrubs if practicable. When elderberry shrubs cannot be avoided, shrubs would be transplanted to conservation areas as described in the measure. Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*). Additionally, the implementation of AMM-14: *Construction Best Management Practices for Special-Status Species* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction completion (Appendix 3A).

### 6.11.8.2 Construction-Related Effects

Site preparation for construction of new underground electrical and SCADA facilities could remove and/or trim vegetation and result in the injury or mortality of valley elderberry longhorn beetle individuals if occupied shrubs are present within the construction footprint. Construction activities conducted adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle as well as disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust accumulation on shrubs. Construction-related contaminants such as gas, oil, and steering fluid could accidentally be discharged into riparian and non-riparian habitat.

To minimize injury and mortality during construction of electrical and SCADA facilities, *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) would require occupied elderberry shrubs be avoided to the maximum extent practicable. Where occupied shrubs cannot be avoided, the measure requires shrubs be transplanted to a conservation area identified in Appendix 3B.

Implementation of General Avoidance and Minimization Measures AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A, would reduce potential construction related effects by training construction staff on the needs of protecting elderberry shrubs including use of biological monitors and non-disturbance buffers. Additionally, AMM-14 would reduce speed limits to 15 mile-per-hour on unpaved non-public access roads during construction to reduce potential for vehicle strike. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential for accidental chemical spills. To minimize dust production, implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[25] concrete and CLSM batch plants and park-and-ride lots. None of these features overlap with valley elderberry longhorn beetle modeled habitat; thus, activities associated with these facilities are not expected to affect the species.

## 6.11.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facilities would be constructed to deliver water from the Union Island tunnel shaft to the existing CCWD Middle River Pipeline on Victoria Island. The CCWD interconnection facilities would include an interconnection pump station, a new underground 1.6-mile conveyance pipeline, and an interconnection valve to connect to the existing CCWD Middle River Pipeline. The construction actions associated with the CCWD interconnection facilities are described and evaluated at the project level.

The interconnection pump station facilities would be located within the Union Island tunnel shaft footprint. Pump station facilities include two to six submersible vertical turbine pumps installed within the Union Island maintenance shaft, 24-inch diameter pump discharge pipes, an aboveground surge tank system, underground vaults containing isolation butterfly valves and flow meters, an electrical building, electrical transformers, equipment yard, and a new electrical power connection to the existing overhead line adjacent at the Union Island tunnel shaft site.

The interconnection pipeline would consist of a 42- to 66-inch diameter underground pipeline continuing north from the Union Island shaft site along Bonetti Road, crossing under Victoria Canal, then turning west along an existing farm road, then connecting with the CCWD Middle River Pipeline at the Middle River Intake and Pumping Plant. A permanent 70-foot wide easement would be maintained along the length of the pipeline on Union Island and Victoria Island. Air valves, blow offs, and access manways would be placed along the pipeline within the permanent easement.

The interconnection valve would be located in a buried vault (approximately 11.5 feet by 15.5 feet by 12.0 feet) on the interconnection pipeline just prior to connecting to the Middle River pipeline within the existing CCWD pumping plant facility on Victoria Island.

Construction of the interconnection pump station facilities would take place within the construction footprint of the Union Island tunnel shaft, and activities would be similar to those occurring for tunnel shaft construction (Section 6.11.4). Installation of electrical power connections would be similar to those described in Section 6.11.8, *Electrical and SCADA Facilities.*

The interconnection pipeline would be installed in a trench with open cut and cover construction along existing roadways and within agricultural fields. The pipeline construction easement would be 100 feet wide for the entire length of the trench, including a 30-foot temporary construction easement around the 70-foot permanent easement. Dewatering may occur along the open trench,

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As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.11.7, *Access Roads*, and Section 6.11.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

with flows collected, treated, and reused on-site. The portion of the interconnection pipeline that crosses Victoria Canal would be microtunneled. Launch and retrieval pits, approximately 35 feet wide by 50 feet long, would be placed within the 100-foot open trench construction easement on Union Island and Victoria Island to launch and receive microtunneling equipment.

Construction of the interconnection valve vault would take place within the 100-foot wide CCWD pipeline construction easement adjacent to the existing CCWD pump station facility. Following installation of the vault, pavement would be replaced within the work area surrounding the vault.

Construction of the CCWD interconnection facilities would take place after the Union Island maintenance shaft is complete and is estimated to take 18 months. The interconnection pump station, open cut portions of the interconnection pipeline, and the interconnection valve would not require nighttime construction. Microtunneling of the pipeline under Victoria Canal would require continuous construction, including nighttime activity, for a duration of approximately 2 weeks.

### 6.11.10.1 Habitat Loss and Fragmentation

The CCWD interconnection facility construction footprint does not overlap with modeled valley elderberry longhorn beetle riparian habitat (Figures 6.11-1 and 6.11-5). Construction activities would take place in modeled non-riparian habitat; if occupied elderberry shrubs are present in the non-riparian construction area, the shrubs would be identified by preconstruction surveys and either avoided or transplanted as described in Chapter 3, Section 3.6.2.8.

The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would require preconstruction surveys for elderberry shrubs, non-disturbance buffers, and avoidance to the extent practicable. When elderberry shrubs cannot be avoided, shrubs would be transplanted to conservation areas identified in Appendix 3B. Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*).

### 6.11.10.2 Construction-Related Effects

There is potential for injury and mortality of elderberry beetles from vegetation removal or trimming that would take place in advance of construction. Construction-related vehicles traveling on access roads adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle, as well as disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust and the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids) in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

To minimize injury and mortality during construction, the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* would be required (Chapter 3, Section 3.6.2.8). This measure requires elderberry shrubs be avoided to the maximum extent practicable through the application of preconstruction surveys and 165-foot non-disturbance buffers. Where avoidance is not possible, the measure would require shrubs be transplanted to a conservation area.

Potential project construction effects would be further reduced by AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for*

*Biological Resources* (Appendix 3A). These measures would reduce potential effects by training construction staff on the needs for protecting elderberry shrubs and providing requirements for biological monitors and non-disturbance barriers. Additionally, AMM-14 would reduce speed limits to 15 miles per hour on unpaved non-public access roads during construction to reduce potential for vehicle strike and dust generation. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential for accidental chemical spills. Implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.11 Compensatory Mitigation Plan

### 6.11.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

The Bouldin Island and I-5 pond mitigation sites would offset the loss of sensitive natural communities and habitat for special-status species, including valley elderberry longhorn beetle, by creating and enhancing habitat on Bouldin Island and the I-5 ponds, and tidal habitat restoration, and managing these areas in perpetuity. The habitat creation and enhancement sites would overlap with modeled valley elderberry longhorn beetle riparian habitat (Figures 6.11-1, 6.11-71 through 6.11-75).

Construction of habitat creation and enhancement sites under the CMP would involve ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel to enhance and restore habitats. Construction would take several years to construct and would not require night lighting.

#### Habitat Loss and Fragmentation

Habitat creation and enhancement at Bouldin Island and the I-5 ponds would affect 47.67 acres of modeled valley elderberry longhorn beetle riparian habitat (0.23% of modeled riparian habitat within the action area). The creation and enhancement actions are assumed to convert the existing, low-quality habitat to high-quality valley elderberry longhorn beetle habitat that will be protected and managed in perpetuity as described in CMP-12: *Valley Elderberry Longhorn Beetle Habitat* (Table 3B.1-3). The creation and enhancement actions at Bouldin Island and the I-5 ponds are assumed to have a long-term benefit to the species.

#### Construction-Related Effects

Potential for injury and mortality to beetles would result from overland driving, vegetation removal, and ground clearing and grading activities to construct habitat enhancement and restoration. Construction activities conducted adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle as well as disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust and the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids) in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.8 would require elderberry shrubs be avoided to the maximum extent practicable and transplantation of occupied shrubs where avoidance is not possible. Temporary disturbance of habitat and the potential impacts of injury, mortality, and the disruption of normal behaviors of larvae and adults would be further reduced by the implementation of AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A). Additionally, AMM-14 would reduce speed limits to 15 miles-per-hour on unpaved non-public access roads during construction to reduce potential for vehicle strike. Implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential of accidental chemical spills. Finally, implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These measures would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

### 6.11.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, alkali seasonal wetland, and vernal pool habitat. The vernal pool, pond, and grassland communities that would be protected for these species do not provide habitat for valley elderberry longhorn beetle and therefore would not be adversely affected by implementation of this action.

### 6.11.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.11.11.5, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. These habitat types do not provide habitat for valley elderberry longhorn beetle so the species would not be adversely affected by implementation of non-bank site protection.

### 6.11.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

### 6.11.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration

habitat for juvenile salmonids. While not the target of enhancement actions, valley elderberry longhorn beetle also has the potential to benefit from the increase in riparian habitat in the central Delta.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

Enhancement would entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.
- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

### Habitat Loss and Fragmentation

Potential channel margin enhancement areas in the north Delta have potential to overlap with modeled valley elderberry longhorn beetle habitat. Where overlap occurs, habitat has potential to be affected. The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) would require preconstruction surveys for elderberry shrubs and avoidance buffers of 165 feet around occupied shrubs if practicable. When elderberry shrubs cannot be avoided, shrubs would be transplanted to conservation areas, as described in the measure. Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*).

### Construction-Related Effects

Channel margin enhancement areas could occur adjacent to suitable valley elderberry longhorn beetle habitat within the action area. Construction -related vehicles traveling adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle as well as disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust and the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids) in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

To minimize injury and mortality during channel margin enhancement construction, the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) requires elderberry shrubs be avoided to the maximum extent practicable with the establishment of non-disturbance buffers of 165 feet. Where avoidance is not possible, the measure requires the shrubs be transplanted to conservation areas. In addition, AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce potential effects by training construction staff about on the needs of protecting elderberry shrubs and requiring biological monitors where appropriate. Further, implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential effects of accidental chemical spills. Finally, to minimize the potential effects of dust, implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These AMM measures are described in Appendix 3A and would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Potential tidal wetland restoration in lower Yolo Bypass and the Cache Slough Complex has potential to overlap with valley elderberry longhorn beetle habitat. The *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) would require preconstruction surveys for elderberry shrubs and avoidance buffers of 165 feet around occupied shrubs if practicable. When elderberry shrubs cannot be avoided, shrubs would be transplanted to conservation areas, as described in the measure. Permanent loss of valley elderberry longhorn beetle habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity valley elderberry longhorn beetle habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-12: *Valley Elderberry Longhorn Beetle Habitat*). If valley elderberry longhorn beetle habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

### Construction-Related Effects

Tidal wetland restoration areas could occur adjacent to suitable valley elderberry longhorn beetle habitat within the action area. Construction -related vehicles traveling adjacent to occupied habitat during the beetle flight season (March to July) could cause potential injury or mortality of valley elderberry longhorn beetle as well as disrupt feeding, breeding, and dispersal. Also, work within 165 feet of host elderberry shrubs could result in dust and the accidental discharge of construction-related fluids (e.g., oil, gas, steering fluids) in areas where shrubs occur, which could affect the vigor of shrubs, resulting in a further loss of habitat for valley elderberry longhorn beetle.

To minimize injury and mortality during tidal wetland restoration construction, the *Valley Elderberry Longhorn Beetle Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.8) requires elderberry shrubs be avoided to the maximum extent practicable with the establishment of non-disturbance buffers of 165 feet. Where avoidance is not possible, the measure requires the shrubs be transplanted to conservation areas. In addition, AMM-1: *Conduct Environmental Resources Worker Awareness Training* and AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce potential effects by training construction staff about on the needs of protecting elderberry shrubs and requiring biological monitors where appropriate. Further, implementation of AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would reduce the potential effects of accidental chemical spills. Finally, to minimize the potential effects of dust, implementation of AMM-11: *Fugitive Dust Control* would reduce the potential for discharge of construction-related dust in potential habitat. These AMM measures are described in Appendix 3A and would be applied where shrubs are identified within or adjacent to work areas, regardless of the presence of modeled habitat.

## 6.11.12 Effects on Critical Habitat

There is no designated critical habitat for valley elderberry longhorn beetle in the action area.

## 6.11.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Projects that result in take of valley elderberry longhorn beetle would require incidental take authorization pursuant to the Endangered Species Act and therefore are not addressed in this cumulative effects analysis because they require a federal action.

However, non-federal activities and climate change have potential to affect valley elderberry longhorn beetle in the action area when riparian and non-riparian habitat degradation occurs without USFWS authorization. The most likely activity to affect the quality of riparian habitat is conversion of riparian habitat to agriculture or urban development. Although land use conversion is unlikely due to land use controls, if agricultural and/or urban development is proposed in or near valley elderberry longhorn beetle occupied habitat, it could contribute to a cumulative adverse effect on valley elderberry longhorn beetle in the action area. Additionally, future maintenance of levees and other flood control structures may result in additional losses of riparian vegetation and elderberry shrubs (U.S. Fish and Wildlife Service 2019c). Loss of and degradation of riparian habitat

may decrease availability of suitable elderberry shrub patches and increase habitat fragmentation such that a particular area of suitable habitat (occupied or unoccupied) is located farther apart than the dispersal capabilities of elderberry beetles. Valley elderberry longhorn beetle have limited dispersal capabilities (U.S. Fish and Wildlife Service 2017c:7) and data suggest that the occupancy status of a particular area of suitable habitat is spatially correlated across distance of 6.2 to 12.4 miles within the same drainage (U.S. Fish and Wildlife Service 2019c; Collinge et al. 2001). Lack of contiguous intact riparian habitat could increase the distance between occupied and unoccupied habitat patches. Habitat fragmentation decreases the likelihood of successful colonization of unoccupied habitat (Collinge et al. 2001) and could make subpopulations more vulnerable to stochastic events.

Climate change threatens to modify annual weather patterns. Predicted drier weather may decrease the availability of precipitation and groundwater that supports riparian habitat, further decreasing availability of potentially suitable habitat for valley elderberry longhorn beetle. Increased potential for wildfire as warming increases threatens habitat and, if burned repeatedly, would prevent it from recovering. Additionally, suitable conditions occur for invasive Argentine ants, which have been confirmed at locations occupied by the beetle (U.S. Fish and Wildlife Service 2019c:3; Huxel 2000:81, 83), and may be exacerbated by climate change. The invasive ants attack and consume beetle larvae and have been reported to interfere with adult beetle behavior (U.S. Fish and Wildlife Service 2019c:3). Invasive ants would contribute to negative effects on valley elderberry longhorn beetle.

# 6.12 Effects on Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Sections 4.4.18.7, *Species Habitat Suitability Model*, and 4.4.19.7, *Species Habitat Suitability Model,* describes the habitat suitability models for vernal pool fairy shrimp and vernal pool tadpole shrimp, respectively.

Vernal pool fairy shrimp and vernal pool tadpole shrimp (branchiopods) occur in several locations around the edges of the action area, such as Montezuma Hills, Jepson Prairie, northern Yolo Bypass, Stone Lakes, and west of Clifton Court Forebay (California Department of Water Resources 2011:S-3; California Department of Fish and Wildlife 2020b). Vernal pool fairy shrimp critical habitat occurs in the area west of Clifton Court Forebay. To conservatively estimate potential impacts on vernal pool species and critical habitat, a vernal pool habitat model was created. As described in Chapter 4, the vernal pool fairy shrimp and tadpole shrimp habitat model was created using mapped vernal pools and alkali seasonal wetlands from the DWR 2020 Aquatic Resources Delineation (California Department of Water Resources and GEI Consultants Inc. 2020; California Department of Water Resources 2020b; California Department of Water Resources 2021) (other sources were used for locations outside the aquatic resources delineation study area as described in Chapter 4, Sections 4.4.18.7 and 4.4.19.7).

The vernal pool branchiopod effects analysis considered both direct effects, which occur within the construction footprint where activities intersect with modeled habitat, and indirect effects, where activities have the potential to result in changes to pool hydrology such that the hydroperiod may be

either increased or decreased, thereby becoming less suitable as habitat for vernal pool fairy shrimp or tadpole shrimp. The indirect effects analysis was conducted on a pool-by-pool basis, primarily using distance from the construction activity (within 250 feet), activity type, and topography to determine whether activities would have the potential to negatively affect hydrology. For a complete discussion on vernal pool branchiopod impact methods, see Section 6A.5.1.2, *Vernal Pool Branchiopods*, in Appendix 6A.

Permanent and temporary construction activities associated with field investigations, access roads, the Bethany Complex, electrical and SCADA facilities, and other construction support facilities have the potential to directly or indirectly affect modeled vernal pool fairy and tadpole shrimp habitat. The West Tracy Fault field investigation activities occur within vernal pool fairy shrimp critical habitat (Unit 19B). No critical habitat for vernal pool tadpole shrimp would be affected by the project activities. None of the affected pools are known to be occupied by vernal pool fairy shrimp or tadpole shrimp per the CNDDB (California Department of Fish and Wildlife 2020b). Figures 6.12-1 through 6.12-17 include overview as well as "zoomed-in" figures depicting overlap between the project footprint, modeled habitat, critical habitat, and CNDDB occurrences.

There are 13,819.36 acres of modeled listed branchiopod habitat in the action area. An estimated 15.06 acres (0.10% of total modeled habitat in action area) of branchiopod modeled habitat would be adversely affected as a result of project construction; 0.42 acre of which is permanently, directly affected by construction and 14.64 acres of which may be indirectly affected. Of the 15.06 acres of direct and indirect effects on modeled branchiopod habitat, 0.23 acre is mapped within critical habitat Unit 19B. Table 6.12-1 summarizes the total estimated affected acreage of vernal pool fairy shrimp and vernal pool tadpole shrimp modeled habitat and Table 6.12-2 summarizes the maximum acreage of proposed compensation. Actual compensation will be based on adverse impacts on occupied pools, as determined through protocol presence/absence surveys or when occupancy is assumed.

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**Table 6.12-1. Estimated Maximum Listed Branchiopod Habitat Loss by Activity Type (Acres)**

| Listed Branchiopod Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Directly Affected Habitat | 13,819.36 | - | 0.22 | 0.20 | - | - | - | - | - | 0.42 | 0.57 | - | 0.19 | - | - | 0.76 | 1.18 |
| Indirectly Affected Habitat [d] | | - | 7.02 | 7.09 | - | 0.54 | - | - | - | 14.64 | 4.11 | - | 1.67 | - | - | 6.38 | 21.03 |
| **Total** | 13,819.36 | - | 7.24 | 7.29 | - | 0.54 | - | - | - | 15.06 | 4.68 | - | 1.86 | - | - | 7.15 | 22.21 |

Notes:
RTM = reusable tunnel material; SCADA = supervisory control and data acquisition;; CCWD = Contra Costa Water District.
[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).
[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).
[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.
[d] Indirect effects occur where construction activities are within 250 feet of mapped vernal pool habitat. There are two types of permanent indirect effects: those that have potential to result in adverse effects to the entire pool and those that would be limited to the portion of the mapped habitat that overlaps within 250 feet of the construction activity. See Section 6A.5.1.2, *Vernal Pool Branchiopods*, in Appendix 6A, for the rationale as to why impacts are considered direct, indirect, permanent, or temporary.

**Table 6.12-2. Loss and Conservation of Modeled Habitat for Listed Branchiopods**

| Compensation Type | Direct and Indirect Habitat Loss (Acres) | Total Habitat Compensation if all Impacts Occur (Acres) | |
|---|---|---|---|
| | | Conservation Bank [a] | Non-Bank Site [b] |
| Protection [c] | 14.64 | 29.28 | 43.92 |
| Restoration [d] | 0.42 | 0.42 | 0.84 |

Notes:
[a] The compensatory mitigation ratio for direct loss is 2:1 at a USFWS-approved conservation bank and 3:1 at a non-bank site.
[b] The compensatory mitigation ratio for indirect loss is 1:1 at a USFWS-approved conservation bank and 2:1 at a non-bank site.
[c] Protection would be provided in compensation for both direct and indirect habitat loss.
[d] Restoration would be provided in compensation for direct habitat loss.

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## 6.12.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which would result in temporary habitat disturbance additional to that incurred by construction). Agronomic testing, utility potholing, and pilot studies for settlement would only occur within the existing project footprints and would therefore not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex). Geotechnical investigations associated with the West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches, CPTs, and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section.

Field investigations may include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each of which would include 0.07 acre of ground disturbance with a temporary work area footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

### 6.12.1.1 Habitat Loss and Fragmentation

Field investigations associated with the tunnel to the Bethany Complex, the tunnel to the Bethany Reservoir Discharge Structure, and the West Tracy Fault overlap with modeled habitat for listed branchiopods (Figure 6.12-7). Impacts from field investigations (geotechnical work) associated with the tunnel near the Bethany and Bethany Reservoir would be avoided per AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A). However, field investigations associated with the West Tracy Fault and the modeled habitat south of Clifton Court Forebay near the Delta-Mendota Canal cannot be avoided as there is no siting flexibility associated with this work. The temporary work area associated with the West Tracy Fault and the tunnel field investigations would result in 0.57 acre of direct impacts (temporary) on modeled habitat (<0.01% of all modeled habitat in the action area) (Figure 6.12-7). Trenching and boring activities do not overlap with modeled habitat at the West Tracy Fault, but boring activities could occur within modeled vernal pool habitat over the tunnel alignment near the Delta-Mendota Canal (Figure 6.12-7). Even though West Tracy Fault and tunnel field investigations could result in direct effects (temporary), the adjacent habitat is not expected to be indirectly affected because the borings and CPTs will be backfilled with grout and the native soil profile would be restored within the test trenches such that the hydroperiod of the adjacent habitat would not be affected.

Directly affected vernal pool fairy shrimp and vernal pool tadpole shrimp habitat would be offset through CMP-8: *Vernal Pool Complex*. For those vernal pools that are determined to be adversely

affected and occupied (or assumed occupied) as described in Chapter 3, Section 3.6.2.9, the measure would require the purchase of credits at a USFWS-approved conservation bank or at a non-bank site approved by USFWS as described in CMP-8. If non-bank mitigation is pursued under CMP-8, mitigation at a non-bank location would be prioritized in the Altamont Hills recovery area, which is one of the core recovery areas identified in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (U.S. Fish and Wildlife Service 2005).

West Tracy Fault field investigations occur within the vernal pool complex located northwest of Clifton Court Forebay, just east of Byron Highway. The quality of this complex is considered high given the relatively large patch size and the presence of intact natural topography. The small amount of temporary impacts in this location is not expected to further fragment habitat in the region. This is primarily because the impact is a small, temporary decrease in the existing connectivity.

To minimize permanent habitat loss, *Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require suitable vernal pool invertebrate habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity vernal pool invertebrate habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-11: *Vernal Pool Aquatic Invertebrate Habitat*).

#### 6.12.1.2 Construction-Related Effects

Ground-disturbing activities (e.g., excavation and soil boring) that occur within 250 feet of an aquatic feature occupied or presumed occupied by listed branchiopods have potential to result in the loss or degradation of that habitat and the potential for injury or mortality to listed branchiopods. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat. To minimize effects from construction-related fluids and contaminants, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*.

### 6.12.2 North Delta Intakes

The construction footprint for the north Delta intakes does not overlap with modeled habitat for vernal pool fairy shrimp or vernal pool tadpole shrimp (Figures 6.12-1 and 6.12-2). Additionally, there is no modeled habitat for vernal pool fairy shrimp or vernal pool tadpole shrimp within 250 feet of the north Delta intake construction footprint; therefore, construction of the north Delta intakes would not affect listed branchiopods.

### 6.12.3 Tunnels

The tunnel alignment does not overlap with listed branchiopod modeled habitat except at one location directly south of the Delta-Mendota Canal. However, tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance to listed branchiopod modeled habitat; therefore, this activity would not have an adverse effect on listed branchiopods.

## 6.12.4 Tunnel Shafts

The construction footprints for tunnel shafts do not overlap with any modeled habitat for listed branchiopods and there is no modeled habitat within 250 feet of any tunnel shaft construction footprint (Figure 6.12-1). Therefore, construction of tunnel shafts would not affect listed branchiopods.

## 6.12.5 Reusable Tunnel Material

The construction footprints for RTM placement and processing sites do not overlap with modeled vernal pool fairy shrimp or vernal pool tadpole shrimp habitat and there is no modeled habitat within 250 feet of any RTM sites (Figure 6.12-1). Therefore, RTM placement and processing would not affect listed branchiopods.

## 6.12.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.12.6.1 Habitat Loss and Fragmentation

Construction of the Bethany Reservoir Aqueduct would result in permanent direct and indirect effects on listed branchiopod habitat. The Bethany Reservoir Aqueduct construction footprint directly overlaps with a portion of two mapped pool features located just north of the aqueduct. Indirect effects to listed branchiopod modeled habitat were also assumed for these two pools because significant changes in local topography related to the aqueduct construction have a high potential for adversely affecting the pool hydrology.

There is an additional, but distinct, modeled habitat patch just to the north of the two pools that overlap with the footprint. Although this pool is not mapped as being hydrologically connected, it is

within 250 feet of the footprint and has the potential to be hydrologically affected because it is downslope from construction activities. This pool is also assumed to be adversely affected in its entirety. As a result, 0.20 acre of modeled listed branchiopod habitat (<0.01% of listed branchiopod habitat in the action area) would be directly affected and 7.09 acres would be indirectly affected from construction of the Bethany Reservoir Aqueduct (Table 6.12-1) (Figures 6.12-6 and 6.12-14).

Direct and indirect impacts on vernal pool fairy shrimp and vernal pool tadpole shrimp habitat would be offset through implementation of CMP-8: *Vernal Pool Complex*, described in Attachment 3B.1. For those vernal pools that are determined to be adversely affected and occupied (or assumed occupied) as described in Chapter 3, Section 3.6.2.9, the measure would require the purchase of credits at a USFWS-approved conservation bank or at a non-bank site approved by USFWS as described in CMP-8. If non-bank mitigation is pursued under CMP-8, mitigation at a non-bank location would be prioritized in the Altamont Hills recovery area, which is one of the core recovery areas identified in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (U.S. Fish and Wildlife Service 2005).

The Bethany Reservoir Aqueduct is not expected to substantially increase fragmentation of vernal pool branchiopod habitat due to proximity of adjacent, unaffected pools. In addition, vernal pool branchiopod cysts would still be able to be transported between pools via biotic mechanisms such as birds, cattle, and amphibians.

To minimize permanent habitat loss, *Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require suitable vernal pool invertebrate habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity vernal pool invertebrate habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-11: *Vernal Pool Aquatic Invertebrate Habitat*).

### 6.12.6.2 Construction-Related Effects

Ground-disturbing activities (e.g., excavation and grading) that occur within 250 feet of an aquatic feature occupied or presumed occupied by listed branchiopods have potential to result in the loss or degradation of that habitat and the potential for injury or mortality to listed branchiopods. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat. To minimize effects from construction-related fluids and contaminants, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*.

## 6.12.7 Access Roads

New access roads and improvements to existing public roads are necessary to support project construction. New access roads are either gravel or paved and would be created to provide connections between existing roads and construction and operations areas. Existing public roads would be widened and improved to support the construction-related traffic. The construction actions associated with access roads are described and evaluated at the project level.

Impacts discussed in this section are those that occur outside of large facilities, such as the north Delta intakes or Bethany Complex. Impacts from access road construction within the north Delta intakes and Bethany Complex are described above in Section 6.12.2, *North Delta Intakes*, and Section 6.12.6, *Bethany Complex*. Three new sections of access roads would be constructed in service of the Bethany Complex: to the north of the Bethany Complex, between the complex and Byron Highway; between Mountain House Road and Bethany Reservoir; and to the south, a new road segment and intersection connecting Mountain House Road to Grant Line Road. Additionally, road improvements would occur on Hood-Franklin Road between I-5 and the north Delta intakes. Construction activities for access roads include clearing, grubbing, moving utilities, paving, resurfacing, and the use of construction vehicles. Construction of access roads to the Bethany Complex would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road, where construction would occur at night.

### 6.12.7.1 Habitat Loss and Fragmentation

There are three regions where access roads overlap with or occur within 250 feet of listed vernal pool branchiopod modeled habitat: south of Mountain House Road where the new access road to the Bethany discharge structure would be constructed (Figures 6.12-16), where a new connection between Mountain House Road and Grant Line Road will be constructed (Figures 6.12-16 and 6.12-17), and road improvements on Hood-Franklin Road. Access roads are further described in Chapter 3, Section 3.2.7.

Access road construction related to the improvement (i.e., road widening) of Mountain House Road and the construction of a new access road connecting Mountain House Road to Grant Line Road would result in direct impacts on 0.41 acre of modeled listed branchiopod habitat (<0.01% of modeled vernal branchiopod habitat in the action area): 0.22 acre from permanent activities and 0.19 acre from temporary activities. In addition, access road construction would indirectly affect 8.69 acres (0.06% of modeled vernal branchiopod habitat in the action area) of vernal pool habitat (Table 6.12-1) (Figure 6.12-16). Hood-Franklin Road improvements, which do not overlap with but are within 250 feet of modeled habitat and CNDDB occurrence #632, are assumed to avoid both direct and indirect effects because the road resurfacing would be limited to the existing road footprint.

Directly and indirectly affected vernal pool fairy shrimp and vernal pool tadpole shrimp habitat would be offset through implementation of CMP-8: *Vernal Pool Complex*, described in Attachment 3B.1. For those affected vernal pools that are occupied (or assumed occupied), the measure would require the purchase of credits at a USFWS-approved conservation bank or at a non-bank site approved by USFWS. Mitigation at a non-bank location would be prioritized in the Altamont Hills recovery area, which is one of the core recovery areas identified in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (U.S. Fish and Wildlife Service 2005:Figure III-6a). Improvements to, and new segments of, Mountain House Road are not expected to substantially increase fragmentation of vernal pool branchiopod habitat due to proximity of adjacent, unaffected pools. In addition, vernal pool branchiopod cysts would still be able to be transported between pools via abiotic (e.g., wind and overland water flow) and biotic mechanisms such as birds.

To minimize permanent habitat loss, *Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require suitable vernal pool invertebrate habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through

mitigation. The CMP would create, enhance, and manage in perpetuity vernal pool invertebrate habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-11: *Vernal Pool Aquatic Invertebrate Habitat*).

#### 6.12.7.2 Construction-Related Effects

Ground-disturbing activities (e.g., excavation and soil boring) that occur within 250 feet of an aquatic feature occupied or presumed occupied by listed branchiopods have potential to result in the loss or degradation of that habitat and the potential for injury or mortality to listed branchiopods. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat. To minimize effects from construction-related fluids and contaminants, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*.

### 6.12.8 Electrical and SCADA Facilities

Electrical and SCADA facilities would overlap with or would be within 250 feet of modeled vernal pool fairy shrimp and vernal pool tadpole shrimp habitat. However, these activities would all be located within the footprints for construction or improvement of access roads. As a result, no additional impacts are incurred from the construction of electrical or SCADA facilities.

An occurrence of vernal pool tadpole shrimp (CNDDB occurrence #210) overlaps with overhead SCADA fiber routes on State Route (SR) 12; however, the occurrence is displayed in the CNDDB GIS data with an accuracy of 5 miles and there is no modeled habitat within the portion of the occurrence polygon that overlaps with the construction footprint. Therefore, proposed action activities would not affect this CNDDB occurrence. Another occurrence of vernal pool tadpole shrimp (CNDDB occurrence #84) overlaps with overhead electrical lines on Franklin Boulevard where new overhead electrical lines would be installed on existing poles. This construction activity would not affect the occurrence because these activities would not require ground disturbance, and thus would not cause adverse effects on habitat or change the hydrology of the pools.

### 6.12.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[26] concrete and CLSM batch plants and park-and-ride lots. Although the Hood-Franklin Park-and-Ride lot does not directly overlap with vernal pool fairy shrimp or vernal pool tadpole shrimp modeled habitat, construction of the facility would occur within 250 feet of vernal pool habitat. The park-and-ride lot would be removed following construction but because it would be in place for over 1 year the impact would

[26] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.12.7, *Access Roads*, and Section 6.12.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

be considered permanent. The construction actions associated with the Hood-Franklin Park-and-Ride lot are described and evaluated at the project level.

### 6.12.9.1 Habitat Loss and Fragmentation

Construction of the Hood-Franklin Park-and-Ride lot has the potential to indirectly affect 0.54 acre of modeled listed branchiopod habitat (<0.01% of modeled vernal branchiopod habitat in the action area) (Table 6.12-1) because the changes in topography from construction have potential to affect the hydrology of the adjacent vernal pool habitat (Figure 6.12-9).

Indirect effects on vernal pool fairy shrimp and vernal pool tadpole shrimp habitat would be offset through implementation of CMP-8: *Vernal Pool Complex*, described in Attachment 3B.1. The measure would require habitat protection through the purchase of credits at a USFWS-approved conservation bank or at a non-bank site approved by USFWS. Mitigation at a non-bank location would be prioritized in the Altamont Hills recovery area, which is one of the core recovery areas identified in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (U.S. Fish and Wildlife Service 2005:Figure III-6a).

To minimize permanent habitat loss, *Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require suitable vernal pool invertebrate habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity vernal pool invertebrate habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-11: *Vernal Pool Aquatic Invertebrate Habitat*).

### 6.12.9.2 Construction-Related Effects

Ground-disturbing activities (e.g., excavation and soil boring) that occur within 250 feet of an aquatic feature occupied or presumed occupied by listed branchiopods have potential to result in the loss or degradation of that habitat and the potential for injury or mortality to listed branchiopods. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat. To minimize effects from construction-related fluids and contaminants, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*.

## 6.12.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with listed vernal pool branchiopod modeled habitat. Activities in this area would not have the potential for incidental take of the species (Figure 6.12-5).

# 6.12.11 Compensatory Mitigation Plan

## 6.12.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

Construction activities for habitat creation and enhancement at Bouldin Island and the I-5 ponds under the CMP would not overlap with modeled listed branchiopod habitat (Figure 6.12-1). No modeled habitat for listed branchiopods occurs within 250 feet of the construction footprint for the initial mitigation sites; therefore, implementation of the initial mitigation sites would not result in impacts on listed branchiopods.

## 6.12.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. Mitigation or conservation bank credits purchased for these species would be purchased at banks that have been approved by USFWS. Through the approval process, any potential impacts on vernal pool c from restoration, creation, enhancement, management, maintenance, or monitoring would have been addressed by the USFWS. Because the approved bank would provide bank credits for vernal pool fairy shrimp and vernal pool tadpole shrimp, the purchase is assumed to be beneficial to the species.

## 6.12.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.12.11.2 are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, “step down” consultation when site-specific information becomes available. A non-bank site would create or restore, protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. If non-bank sites are used for vernal pool or alkaline wetland creation or enhancement (Appendix 3B, Section 3B.3.2.4), these activities could occur in areas where vernal pool fairy shrimp and vernal pool tadpole shrimp have potential to occur.

Ground-disturbing activities (e.g., excavation and grading) that occur within 250 feet of an aquatic feature occupied or presumed occupied by listed branchiopods have potential to result in the loss or degradation of that habitat and the potential for injury or mortality to listed branchiopods. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat. To minimize effects from construction-related fluids and contaminants, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*.

## 6.12.11.4 Site Protection Instruments

Site protection instruments for greater sandhill crane, Swainson’s hawk, and tricolored blackbird would primarily consist of the protection and management of agricultural areas but may also include protection and management of natural communities (e.g., grasslands or vernal pool complex) in the action area (Appendix 3B, Section 3B.4.2.2, Attachment 3B.1, Table 3B.1-3, CMP-18a: *Sandhill Crane Roosting Habitat*, CMP-18b: *Sandhill Crane Foraging Habitat*, CMP-19a:

*Swainson's Hawk Nesting Habitat*, CMP-19b: *Swainson's Hawk Foraging Habitat*, CMP-22a: *Tricolored Blackbird Nesting Habitat*, and CMP-22b: *Tricolored Blackbird Foraging Habitat*). No construction activities would occur for site protection instruments.

### 6.12.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. While not the target of enhancement actions, California least tern also has the potential to benefit from the increase in shallow, slow-moving marsh habitat that would promote prey populations along levees in the central Delta.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

Enhancement would entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.

- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

### Habitat Loss and Fragmentation

Channel margin enhancement has the potential to result in a loss of modeled vernal pool branchiopod habitat, however, because the project will occur along existing levees of agricultural properties impacts on modeled habitat are unlikely, and only a relatively small amount of habitat has the potential to be affected. To minimize permanent habitat loss, the *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and implementation of the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines* and CMP-8: *Vernal Pool Complex*, and Table 3B.1-3, CMP-11: *Vernal Pool Invertebrate Habitat)*.

### Construction-Related Effects

Ground-disturbing activities (e.g., excavation) that occur within 250 feet of an aquatic feature occupied or presumed occupied by vernal pool branchiopods have potential to result in the loss or degradation of that habitat and injury or mortality. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat.

Implementation of *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would avoid and minimize construction-related effects on vernal pool branchiopods by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, channel margin enhancement construction is not likely to adversely affect vernal pool branchiopods.

## 6.12.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area.

Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Tidal wetland restoration sites at lower Yolo Bypass and the Cache Slough Complex have potential to overlap with vernal pool branchiopod habitat, particularly if the selected site includes grassland and vernal pool complex habitats that border the Cache Slough Complex to the south and east (i.e., the upland areas connected to the greater Jepson Prairie area). All three vernal pool branchiopods species are known to occur in this region (California Department of Fish and Wildlife 2020).

Construction of tidal restoration sites typically include a landside levee that protects adjacent uplands from flooding, thus avoiding impacts on vernal pool habitat. However, there remains some potential for suitable vernal pool habitat to be permanently lost. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and implementation of the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines* and CMP-8: *Vernal Pool Complex*, and Table 3B.1-3, CMP-11: *Vernal Pool Invertebrate Habitat)*.

### Construction-Related Effects

Ground-disturbing activities (e.g., excavation) that occur within 250 feet of an aquatic feature occupied or presumed occupied by vernal pool branchiopods have potential to result in the loss or degradation of that habitat and injury or mortality. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat.

Implementation of *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would avoid and minimize construction-related effects on vernal pool branchiopods by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, tidal wetland construction is not likely to adversely affect vernal pool branchiopods.

## 6.12.12 Effects on Vernal Pool Fairy Shrimp Critical Habitat

There are 597,821 total acres of critical habitat designated for vernal pool fairy shrimp, 4,925 acres of which are within critical habitat unit 19B. Of the 4,925 acres within critical habitat unit, approximately 1,475 acres overlap with the action area (Figures 6.12-6, 6.12-7, 6.12-10, 6.12-12, and 6.12-13). There is no critical habitat for vernal pool tadpole shrimp that overlaps with the action area. For the purposes of this analysis, modeled habitat for vernal pool fairy shrimp is assumed to include all PCEs for vernal pool fairy shrimp, which are defined as follows (70 FR 46936).

1. Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools.
2. Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years, thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.
3. Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding.
4. Structure within the pools described above, consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools that provide shelter.

Areas supporting the PCEs include the depressional wetlands (vernal pool type wetlands) and the surrounding watershed (i.e., 250 feet around the vernal pools). Approximately 0.57 acre of the West Tracy Fault work area overlaps with vernal pool modeled habitat that is within designated critical

habitat for vernal pool fairy shrimp. As described above in Section 6.12.1.1, *Habitat Loss and Fragmentation*, the West Tracy Fault work is only expected to result in temporary effects on vernal pool fairy shrimp critical habitat and indirect effects are avoided because the borings and CPTs would be backfilled with grout and the native soil profile would be restored within the test trenches such that the hydroperiod of the habitat would not be affected. These temporary activities are not expected to result in hydrological changes that could indirectly affect areas outside the field investigations temporary construction footprint (for the aforementioned reasons).

The temporary ground disturbance related to field investigations is not expected to appreciably reduce the conservation value of critical habitat for vernal pool fairy shrimp because the impact is temporary; the disturbance is a small percentage of total critical habitat; and the impact occurs at eastern edge of critical habitat unit 19B where the existing condition is degraded due to proximity to agricultural land use and smaller patch sizes.

## 6.12.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the ESA as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the ESA. Projects that result in take of listed branchiopods would require incidental take authorization pursuant to the ESA and therefore are not addressed in this cumulative effects analysis because they require a federal action.

However, non-federal activities and climate change have potential to affect vernal pool fairy shrimp and vernal pool tadpole shrimp in the action area when habitat loss and habitat degradation occurs without USFWS authorization. The most likely activity of this type is agricultural conversion. If agricultural conversion is proposed in or near vernal pool fairy shrimp or vernal pool tadpole shrimp suitable habitat, it could contribute to a cumulative adverse effect on listed branchiopods in the action area. Unauthorized take as a result of urban development is unlikely where modeled habitat and critical habitat occurs west of Clifton Court Forebay because urbanization in this area is covered by the *East Contra Costa County Habitat Conservation Plan/Natural Communities Conservation Plan.*

Climate change threatens to modify annual weather patterns and may result in a loss of vernal pool habitat. Predicted drier weather may decrease precipitation that inundates vernal pools, leading to decrease or lack of reproductive output if pools fail to inundate or dry up before reproduction is complete (U.S. Fish and Wildlife Service 2007b:44). For population maintenance, vernal pools must last longer, on average, than the time needed for a species to reach maturity and produce viable eggs, and relatively small changes in the timing or amount of precipitation could affect population dynamics (Graham 2003). Climate change could also adversely affect vernal pool branchiopods through changes in vernal pool inundation pattern and temperature regimes in pools (U.S. Fish and Wildlife Service 2007b:44). The ability of vernal pool branchiopods to survive changes in inundation pattern and temperature regimes through range shifts depends on the species' ability to disperse to pools with suitable conditions (Bohanak and Jenkins 2003; Bonte et al. 2004). Loss and fragmentation of vernal pool habitat likely decreases dispersal ability (U.S. Fish and Wildlife Service 2007b:44). Although vernal pool branchiopods have developed a life history strategy to survive periods of drought, they must complete their life cycle within limited temperature ranges to reach maturity and reproduce; predicted variability in precipitation could cause pools to dry before vernal pool branchiopods complete their life cycle or cause water temperatures to exceed conditions

suitable for hatching and persistence (U.S. Fish and Wildlife Service 2007b:44). Climate change may also result in the alteration of vernal pool habitats through changes to water chemistry of pools due to increases in carbon dioxide from the atmosphere (Field et al. 1999), thereby affecting suitability of pools for specific species (Eriksen and Belk 1999; Graham 2003).

# 6.13 Vernal Pool Grasses

Because they occupy the same habitat type and location in the action area, Colusa grass and Solano grass are treated together in this analysis. Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Sections 4.4.20.6, *Suitable Habitat Definition,* and 4.4.21.6, *Suitable Habitat Definition*, and Sections 4.4.20.7, *Habitat Model Description*, and 4.4.21.7, *Habitat Model Description*, define suitable habitat and describe the habitat model for Colusa grass and Solano grass.

Colusa and Solano grass habitat is located in the northwestern portion of the action area in Jepson Prairie and is limited to vernal pool complex, growing in the bottom of large, deep vernal pools. There are occurrences of both grasses in this region of the action area (California Department of Fish and Wildlife 2020b).

## 6.13.1 Field Investigations

Field investigations would occur outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.2 North Delta Intakes

The north Delta intakes are outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.3 Tunnels

The tunnel alignment is outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.4 Tunnel Shafts

Tunnel shafts are outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.5 Reusable Tunnel Material

RTM areas are outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.6 Bethany Complex

The Bethany Complex is outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.7 Access Roads

Access roads are outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.8 Electrical and SCADA Facilities

Electrical and SCADA facilities are outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[27] concrete batch plants and park-and-ride lots. These features are outside of the range of Colusa grass and Solano grass; therefore, this activity would not have an adverse effect on the species (Figure 6.13-1).

## 6.13.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with vernal pool grasses modeled habitat. Activities in this area would not adversely affect the species.

## 6.13.11 Compensatory Mitigation

The CMP would offset the permanent loss of wetlands and habitat for special-status species by creating and enhancing habitat and managing these areas in perpetuity. The tidal wetland restoration sites at the Cache Slough Complex overlap with suitable vernal pool grass habitat.

### 6.13.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

Habitat creation and enhancement at Bouldin Island and the I-5 ponds are outside of the range of Colusa grass and Solano grass; therefore, these activities would have no effect on the species (Figure 6.13-1).

### 6.13.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be used to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, and vernal pool tadpole shrimp. The location of these banks has potential to overlap with vernal pool plant habitat. Mitigation or conservation bank credits purchased for these species would be purchased at banks

[27] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, e.g., such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.13.7, *Access Roads*, and Section 6.13.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

that have been approved by USFWS. Through the approval process, any potential impacts on vernal pool plants from restoration, creation, enhancement, management, maintenance, or monitoring would have been addressed by the USFWS through the credit approval process. Because the approved bank would provide bank credits for vernal pool branchiopods, the purchase is assumed to either have no effect or to be beneficial to vernal pool grasses.

### 6.13.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.13.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat in a quantity and quality sufficient to offset the adverse effects consistent with the biological opinion.

In the event that non-bank sites are used for vernal pool or alkaline wetland creation or enhancement (Appendix 3B, Section 3B.3.2.4), these activities could occur in areas where Colusa grass or Solano grass occur. Construction and management activities could include ground disturbance (e.g., excavation and grading) within 250 feet of an aquatic feature occupied or presumed occupied by one or more vernal pool plants which have potential to result in the temporary disturbance of that habitat and the potential for loss of individual plants. However, non-bank mitigation would create or restore vernal pool habitat and would be expected to provide an overall benefit vernal pool grasses if non-bank mitigation occurs within the species' range.

Implementation of *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would avoid and minimize effects on vernal pool grasses due to construction of non-bank mitigation by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, non-bank mitigation construction is not likely to adversely affect vernal pool grasses.

### 6.13.11.4 Site Protection Instruments

Site protection instruments for greater sandhill crane, Swainson's hawk, and tricolored blackbird would primarily consist of the protection and management of agricultural areas but may also include protection and management of natural communities (e.g., grasslands or vernal pool complex) in the action area (Appendix 3B, Section 3B.4.2.2, Attachment 3B.1, Table 3B.1-3, CMP-18a: *Sandhill Crane Roosting Habitat*, CMP-18b: *Sandhill Crane Foraging Habitat*, CMP-19a: *Swainson's Hawk Nesting Habitat*, CMP-19b: *Swainson's Hawk Foraging Habitat*, CMP-22a: *Tricolored Blackbird Nesting Habitat*, and CMP-22b: *Tricolored Blackbird Foraging Habitat*). No construction activities would occur for site protection instruments.

### 6.13.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids. While not the target of enhancement actions, California least tern also has the potential to benefit from the increase in shallow, slow-moving marsh habitat that would promote prey populations along levees in the central Delta.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for listed fish species that would benefit from enhancement actions.

Enhancement would entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.
- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

### Habitat Loss and Fragmentation

Channel margin enhancement has the potential to result in a loss of modeled Colusa grass and Solano grass habitat, however, because the project will occur along existing levees of agricultural properties impacts on modeled habitat are unlikely, and only a relatively small amount of habitat has the potential to be affected. To minimize permanent habitat loss, the *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would require vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and implementation of the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines* and CMP-8: *Vernal Pool Complex)*.

### Construction-Related Effects

Ground-disturbing activities (e.g., excavation) that occur within 250 feet of an aquatic feature occupied or presumed occupied by vernal pool grasses have potential to result in the loss or degradation of that habitat and the potential for loss of individual plants. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat.

Implementation of *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would avoid and minimize construction-related effects on vernal pool grasses by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, channel margin enhancement construction is not likely to adversely affect vernal pool grasses.

## 6.13.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area.

Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Tidal wetland restoration sites at lower Yolo Bypass and the Cache Slough Complex have potential to overlap with Colusa grass and Solano grass habitat, particularly if the selected site includes grassland and vernal pool complex habitats that border the Cache Slough Complex to the south and east (i.e., the upland areas connected to the greater Jepson Prairie area). Vernal pool habitat in this region is known to be occupied by the vernal pool plant species (California Department of Fish and Wildlife 2020).

Construction of tidal restoration sites typically include a landside levee that protects adjacent uplands from flooding, thus avoiding impacts on vernal pool habitat. However, there remains potential for suitable Colusa grass and Solano grass habitat to be permanently lost. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and implementation of the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines* and CMP-8: *Vernal Pool Complex)*.

## Construction-Related Effects

Ground-disturbing activities (e.g., excavation) that occur within 250 feet of an aquatic feature occupied or presumed occupied by vernal pool grasses have potential to result in the loss or degradation of that habitat and the potential for loss of individual plants. For example, construction-related fluids or sediments could be inadvertently discharged into aquatic habitat.

Implementation of *Vernal Pool Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.9 would avoid and minimize construction-related effects on vernal pool grasses by requiring vernal pool habitat to be avoided to the extent practicable and, when avoidance is not possible, implementing construction BMPs to avoid and minimize effects on the habitat. In addition, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. With these measures in place, channel margin enhancement construction is not likely to adversely affect vernal pool grasses.

# 6.14 Northwestern Pond Turtle

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Chapter 4, Section 4.4, Section 4.4.22.6, *Suitable Habitat Definition*, and Section 4.4.22.7, *Habitat Suitability Model*, define suitable habitat and describe the habitat model for northwestern pond turtle.

Northwestern pond turtle modeled habitat is located throughout the action area along rivers, sloughs, agricultural waterways, open waterbodies, and natural and managed wetlands throughout the Delta. There are several western pond turtle occurrences reported within the action area, some of which occur in proximity to project features. These occurrence locations include: Stone Lakes National Wildlife Refuge, Cosumnes River Preserve, Delta Meadows State Park, White Slough Wildlife Area, Staten Island, Bouldin Island, Empire Tract, Sherman Island, Jersey Island, Twitchell Island, Clifton Court Forebay, and the Delta Mendota Canal intake channel (California Department of Fish and Wildlife 2020b).

Activities associated with field investigations, north Delta intakes, tunnel shafts, RTM sites, access roads, electrical facilities and SCADA, Bethany Complex, other construction support facilities, the CCWD interconnection facility, and implementation of the CMP overlap with northwestern pond turtle modeled habitat. Table 6.14-1 details the permanent and temporary habitat loss associated with each project feature. Figure 6.14-1 provides an overview of the locations of surface impacts relative to northwestern pond turtle modeled aquatic and upland habitat. Figures 6.14-2 through 6.14-68 show CNDDB occurrences in the context of three regional construction areas: north Delta intakes, Twin Cities, Lower Roberts Island, CCWD Interconnection, Bethany Complex, and West Tracy Fault.

There are 173,637.64 acres of modeled northwestern pond turtle habitat in the action area, 110,519.78 acres of which are aquatic habitat and 63,117.86 acres of which are upland habitat. An estimated 223.60 acres (0.13% of total modeled habitat in action area) of modeled northwestern pond turtle habitat would be adversely affected by the project, 52.73 acres of which are modeled aquatic habitat (0.05% of modeled aquatic habitat in action area) and 170.87 acres of which are modeled upland habitat (0.27% of modeled upland habitat in action area). Effects from these activities are described in the following sections. Table 6.14-1 summarizes the total estimated habitat loss of northwestern pond turtle modeled habitat and Table 6.14-2 summarizes the proposed acres of compensation.

**Table 6.14-1. Maximum Habitat Loss of Modeled Habitat for Northwestern Pond Turtle by Activity Type (Acres)**

| Northwestern Pond Turtle Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c, d] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations[d] | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Aquatic | 110,519.78 | 0.33 | 4.32 | 3.58 | 7.69 | 0.04 | 0.55 | 5.12 | 12.03 | 33.68 | 6.51 | - | 9.52 | - | 3.03 | 19.05 | 52.73 |
| Upland | 63,117.86 | 5.90 | 45.77 | 34.96 | 16.58 | 1.46 | 1.40 | 0.10 | 9.93 | 116.09 | 12.02 | - | 27.88 | 0.02 | 14.86 | 54.78 | 170.87 |
| **Total** | **173,637.64** | **6.23** | **50.09** | **38.54** | **24.27** | **1.50** | **1.95** | **5.22** | **21.96** | **149.77** | **18.53** | **-** | **37.40** | **0.02** | **17.89** | **73.83** | **223.60** |

Notes:

CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.

[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).

[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).

[c] Electrical Facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

[d] Field Investigations and Electrical Facilities will avoid aquatic features, which include suitable aquatic northwestern pond turtle habitat, to the greatest extent feasible; see AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A).

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**Table 6.14-2. Maximum Habitat Loss and Compensation for Northwestern Pond Turtle**

| | Permanent Habitat Loss (Acres) | Total Compensation Commitment (Acres) [a] | | With Full Implementation of the Compensatory Mitigation Plan |
|---|---|---|---|---|
| | Total Maximum Habitat Loss (Acres) | Protection (Acres) | Restoration/ Creation (Acres) | Creation and Enhancement[b,c] (Acres) |
| Aquatic | 33.68 | 0 | 33.68 | 233.94 |
| Upland | 116.09 | 0 | 116.09 | 456.10 |
| Total | **149.77** | **0** | **149.77** | **690.04** |

[a] See Table 3B.1-3 in Attachment 3B.1, *Compensatory Mitigation Design Parameters*, for the design commitments and guidelines for northwestern pond turtle creation and enhancement. Also see Section 3B.3.3.1, *Freshwater Marsh and Riparian Terrestrial Species*, and Table 3B-4 in Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources* for additional details regarding the compensation commitments.
[b] See Appendix 3B, Section 3B.4.1.4, *DWR I-5 Ponds*, and Section 3B.4.1.3, *Bouldin Island Mitigation Sites*, for mitigation site objectives, site selection criteria, baseline conditions, and site design and development details. See Attachment 3B.1 for specific design commitments and guidelines for northwestern pond turtle.
[c] See Tables 3B-13 and 3B-14 in Appendix 3B for the estimated total acres of northwestern pond turtle aquatic habitat and upland habitat that would be created and enhanced with full implementation of the initial mitigation sites at Boulding Island and the DWR I-5 ponds.

## 6.14.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost, and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Field investigations within proposed surface construction footprints (including portions of tunnel alignments), which include test trenches, CPTs, soil borings, electrical resistivity tomography, groundwater testing and monitoring, monument installation, agronomic testing, utility potholing, and pilot studies for settlement, would not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex).

Geotechnical investigations associated with the tunnel alignment water crossings, West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches, and overwater and land-based CPTs and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section. All surface ground disturbance for field investigations for the Bethany Reservoir Aqueduct tunnel would occur outside of the Bethany Conservation Easement.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be

removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

#### 6.14.1.1 Habitat Loss and Fragmentation

An estimated 6.51 acres of northwestern pond turtle modeled aquatic habitat and 12.02 acres of modeled upland habitat would be temporarily disturbed as a result of field investigations (0.01% of modeled aquatic habitat and 0.2% of modeled upland habitat in the study area) (Figure 6.14-1). Field investigation impacts occur throughout the project alignment and the affected habitat is of varying quality. Modeled habitat near the north Delta intakes and Twin Cities Complex (where field investigations will occur) consists of aquatic habitat found along agricultural ditches, which is generally considered low quality because they do not hold permanent water. Affected modeled habitat along the tunnel alignment consists of levees, emergent wetland, riparian, agricultural crops, fallow fields, and grazed grassland, which varies from low to moderate quality. Field investigations for the Bethany Reservoir Aqueduct tunnel do not overlap with modeled northwestern pond turtle habitat. Western pond turtle occurrence number 451 overlaps with field investigation footprints along the tunnel alignment near Cosumnes River Preserve (California Department of Fish and Wildlife 2020b). The temporary nature and small extent of field investigation sites would not increase habitat fragmentation in the action area.

The *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

#### 6.14.1.2 Construction-Related Effects

Field investigations could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. The threshold at which disruption of normal behaviors would occur is unknown; however, subsurface vibrations from field investigations would not be anticipated to exceed those experienced under existing conditions.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March).

Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.2 North Delta Intakes

The north Delta intakes would be constructed on the east bank of the Sacramento River upstream and downstream of Hood. Two intakes would divert water from the Sacramento River and include cylindrical fish screens, intake structures, sedimentation basins, sediment drying lagoons, flow control structures, intake outlet channel and shaft, embankments, and other appurtenant structures. Intakes would also include construction support facilities (e.g., emergency facilities, fuel station), electrical substations, switchyards, and access roads that fall within the north Delta intake facility footprints. The north Delta intakes would be surrounded by security fencing. The construction actions associated with the north Delta intakes are described and evaluated at the project level.

Construction activities at each intake are described in Chapter 3, Section 3.2.2. Intake construction would include ground clearing and grading; in-water and on-land pile driving; excavation; placement of fills, cutoff walls, and structures; and drilling. These activities would require the use of loud, heavy equipment within the construction site as well as along the access roads to the site and limited nighttime work. Construction-related lighting would be downcast so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Section 3.2.12). The duration of the activity would be approximately 7 years at each intake. Implementation of intake construction at each location would be staggered by approximately 1 year. Intake C, the southern intake, would begin construction first; approximately 1 year later, construction would begin at Intake B, the northern intake. The result is that construction would overlap at both sites for approximately 6 years.

### 6.14.2.1 Habitat Loss and Fragmentation

The north Delta intakes would result in the permanent removal of 7.69 acres of northwestern pond turtle modeled aquatic habitat (0.01% of modeled aquatic habitat within the Delta) and 16.58 acres of modeled upland habitat (0.03% of modeled upland habitat within the Delta) (Figures 6.14-2, 6.14-13 through 6.14-15). Modeled habitat near the north Delta intakes consists of aquatic habitat

found along the Sacramento River and agricultural ditches. Modeled habitat along the Sacramento River is considered lower quality because of increased flow. Agricultural ditches are also assumed to be of lower quality as they typically do not hold permanent water. An incremental decrease in connectivity due to the construction of the north Delta intakes is not expected to substantially affect northwestern pond turtle because the existing habitat is of low quality (and is therefore unlikely to be functioning as an important movement route) and the extent of lost habitat is small.

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*).

### 6.14.2.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March) and would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects

with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.3 Tunnels

Tunnel construction occurs completely subsurface and does not result in any surface disturbance.

The primary mechanism by which tunnel construction may affect a species is through vibration. Water conveyance tunnels connecting the north Delta intakes to the Bethany Complex would be constructed using subsurface horizontal TBMs. The TBM would operate 20 hours per day, 5 days per week, and would move at a rate of approximately 40 feet per day, depending on the soil types encountered. The depth of the main tunnel crown would be approximately 103 feet below mean sea level at Intake B, with elevation decreasing at a constant rate to 128 feet below mean sea level at the Bethany Complex. At a depth of 110 feet, groundborne vibration from a TBM that would reach the surface is estimated to be 0.003 in/sec PPV.

During tunnel construction, conveyors inside of the tunnel hauling workers and material would also produce localized groundborne vibration. However, conveyors would be operated at slow speeds and would not result in excessive vibrations or groundborne noise from the tunnel floor.

### 6.14.3.1 Habitat Loss and Fragmentation

The tunnels would be constructed using subsurface horizontal TBMs and would not result in any surface disturbance; therefore, this activity would not result in loss or fragmentation of modeled northwestern pond turtle habitat (Figure 6.14-1).

### 6.14.3.2 Construction-Related Effects

Tunnel construction would take place below modeled northwestern pond turtle aquatic and upland habitat. Reptiles are very sensitive to vibration, as they use it for foraging as well as predator detection. As a result, construction vibration could be detectible by northwestern pond turtle, disrupt normal behavior, and result in increased energy expenditures.

Vibration becomes slightly perceptible to humans at 0.012 in/sec PPV (California Department of Transportation 2020b:21). At the surface, TBM vibration is 0.003 in/sec PPV and not perceptible to humans. However, the vibration sensitivity of turtles greatly exceeds that of humans, typically by a margin of 20 dB, indicating that turtles are 10 times more sensitive to vibration than humans[28] (Hartline 1971; Christensen et al. 2012). Accordingly, TBM vibrations from tunnel construction would presumably be perceptible to northwestern pond turtle at the surface. However, TBM vibration levels are far less than the background levels of vibration from heavy equipment and trucks that occur throughout the northwestern pond turtle range in the Delta, which is approximately 0.01 in/sec PPV (Federal Transit Administration 2018:18). Also, because the TBM would advance approximately 40 feet per day, TBM vibration that could be perceived by a

[28] Based on testing using whole-body vibration monitoring techniques, turtles were found to be less sensitive to vibration compared to snakes by approximately 20 dB. From data obtained from testing vibration sensitivity of snakes it can be inferred that turtles are 20 dB more sensitive to vibration than humans (i.e., approximately 10 times more sensitive than humans).

northwestern pond turtle would be temporary, as vibrations would diminish as the TBM moves away from a turtle's location. For these reasons, northwestern pond turtle is unlikely to be substantially affected by tunnel boring.

## 6.14.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove TBMs at the intakes, along the tunnel alignment, and at the Bethany Complex. Northwestern pond turtle modeled habitat overlaps with tunnel shaft work areas at Twin Cities Complex, Canal Ranch Tract, Terminous Tract, King Island, Lower Roberts Island, Upper Jones Tract, and Union Island (Figures 6.14-24 to 6.14-45). The construction actions associated with tunnel shafts are described and evaluated at the project level.

Construction activities associated with tunnel and tunnel shaft activities are described in Chapter 3, Section 3.2.4 and would include vegetation clearing, grading, excavation, soil compaction, and the use of heavy construction equipment. Construction of the tunnel shafts would take multiple years. Construction activities would persist for 7 to 9 years at launch shafts and for 2 years at reception and maintenance shafts. Construction would occur day and night. See Section 3.2.8 for a complete description of construction activity and timing details.

### 6.14.4.1 Habitat Loss and Fragmentation

Tunnel shafts would result in permanent loss of 12.03 acres of modeled northwestern pond turtle aquatic habitat and 9.93 acres of modeled upland habitat (0.01% of modeled aquatic habitat and 0.02% of modeled upland habitat within the study area) (Figure 6.14-1). Affected modeled habitat from tunnel shaft construction would occur at the Twin Cities Complex, Canal Ranch Tract, Terminous Tract, King Island, Lower Roberts Island, Upper Jones Tract, and Union Island. Habitat in these areas consist of agricultural ditches and narrow patches of adjacent upland habitat, which are considered low quality due to the lack of permanent water. Occurrences at the Twin Cities Complex, Canal Ranch Tract, and Terminous Tract are approximately 0.5 mile from tunnel shaft work areas (California Department of Fish and Wildlife 2020b). The incremental decrease in habitat connectivity from the construction of these tunnel shafts is not expected to affect northwestern pond turtle because of the low quality of existing habitat and the small amount of loss.

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*).

### 6.14.4.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings,

and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, placing barriers around the shaft excavation sites to prevent entry into the shaft, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.5 Reusable Tunnel Material

RTM would be removed through tunnel launch shafts and transported to handling and storage facilities within the tunnel launch shaft sites, where it would be tested and dried, then transported for reuse or stockpiled and permanently stored at the Twin Cities Complex or Lower Roberts Island tunnel launch shaft sites. The construction actions associated with RTM are described and evaluated at the project level.

Construction activities at each RTM site would include the use of heavy equipment for ground clearing and grading and soil tilling and rotation. Material would be moved to the site using a conveyor belt, and on-site, long-term storage is assumed. Trucks and other large equipment could also be used for movement of the material within the construction site. The RTM storage areas would be active for several years while tunneling is underway. All RTM areas would be constructed as needed, depending on location. The Twin Cities Complex includes construction of a ring levee that surrounds the entire complex; because the construction of the ring levee would have approximately the same impacts as that of the RTM site and would occur at roughly the same time, the impacts from ring levee construction are discussed in this section. RTM storage area construction,

placement, handling, drying and equipment maintenance would occur during day and night, almost continuously through tunnel excavation. For more details about the activities associated with RTM placement, see Chapter 3, Section 3.2.5; for more details on schedule, see Section 3.2.8.

### 6.14.5.1 Habitat Loss and Fragmentation

The Twin Cities Complex ring levee and Lower Roberts Island RTM area overlap with modeled northwestern pond turtle aquatic habitat (Figures 6.9-3 and 6.9-4). Construction of RTM area would result in permanent loss of 5.12 acres of modeled northwestern pond turtle aquatic habitat (<0.01% of modeled aquatic habitat within the study area) and 0.10 acre of modeled northwestern pond turtle upland habitat (<0.01% of modeled upland habitat within the action area) (Figures 6.14-24 and 6.14-41). The modeled aquatic habitat that would be removed consists of unvegetated agricultural irrigation ditches and is considered low quality. Habitat fragmentation due to RTM area construction is not expected to affect northwestern pond turtle because of the low quality of the existing habitat and the small area of suitable habitat would be affected.

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*).

### 6.14.5.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45–180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods. Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, *Fencing and Lighting*, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.14.6.1 Habitat Loss and Fragmentation

Construction of the Bethany Complex would result in permanent loss of 3.58 acres of modeled northwestern pond turtle aquatic habitat and 34.96 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.06% of modeled upland habitat within the Delta) (Figures 6.14-6, 6.14-57, and to 6.14-63). The modeled aquatic habitat that would be removed consists largely of unvegetated agricultural irrigation ditches and is considered low quality; modeled aquatic habitat at the Bethany Reservoir that would be removed is of moderate quality due to presence of rip-rap for basking sites on the reservoir shore. Habitat fragmentation due to RTM area construction is not

expected to affect northwestern pond turtle because of the low quality of the existing habitat and the small area of suitable habitat would be affected.

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*).

### 6.14.6.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.7 Access Roads

The construction of new access roads, a new access railroad spur on Lower Roberts Island, and improvements to existing roads are necessary to support project construction and project facilities. In addition to these road and railroad features, impacts from levee improvements on Lower Roberts Island are also evaluated in this section (as the levee improvements would be adjacent to the access road, have similar impacts on species, and occur at roughly the same time). The construction actions associated with the access roads, access railroad spur, and levee improvements on Lower Roberts Island are described and evaluated at the project level.

New access roads would be either gravel or paved and would be built to connect existing roads to construction areas and for project facilities. The new access railroad spur would transport materials and equipment to the tunnel launch shaft. Existing roads would be widened and improved to support the construction-related traffic. The access roads impacts that overlap with northwestern pond turtle modeled habitat are those that are in service to, but occur outside of, facilities at the north Delta intakes, Twin Cities Complex, King Island, Lower Roberts Island, Union Island, and Bethany Complex.

There are three regions where new access roads would be constructed and existing access roads would be improved in service of the Bethany Complex: to the northeast of the Bethany Complex, connecting Mountain House Road to Byron Highway; between Mountain House Road and the Bethany discharge structure; and to the south of the Bethany Complex, connecting Mountain House Road to Grant Line Road. These access roads are described in Chapter 3, Section 3.2.7 and depicted in Figure 6.14-1. Impacts from access road construction within the Bethany Complex and the Hood Franklin park and ride are described above in Section 6.14.6, *Bethany Complex,* and below in Section 6.14.9, *Other Construction Support Facilities*, respectively. Access roads for all other facilities do not overlap with modeled northwestern pond turtle habitat.

Construction activities for access roads (which include the railroad spur and levee improvements on Lower Roberts Island) include clearing, grubbing, excavation, placement of fill, minor bridge construction, moving utilities, paving, and the use of construction vehicles. A new access railroad spur at Lower Roberts Island would be constructed adjacent to and concurrent with the access road at this location and would involve installing a bridge over Burns Cutoff, rail tracks, train use during construction, and the use of vehicles and heavy equipment to inspect and maintain the railroad right-of-way during project construction. Construction of access roads would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where construction would occur at night.

### 6.14.7.1 Habitat Loss and Fragmentation

Access roads would result in permanent loss of 4.32 acres of modeled northwestern pond turtle aquatic habitat and 45.77 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.07% of modeled upland habitat within the study area) and temporary impacts on 9.52 acres of modeled northwestern pond turtle aquatic habitat and 27.88 acres of modeled upland habitat (0.01% of modeled aquatic habitat and 0.04% of modeled upland habitat within the study area) (Figure 6.14-1). Access road impacts occur throughout the project alignment and the affected habitat is of varying quality. Modeled habitat near the north Delta intakes and Twin Cities Complex (where field investigations will occur) consists of aquatic habitat found along agricultural ditches, which is generally considered low quality because they do not hold permanent water. Modeled aquatic habitat at Lower Roberts Island occurs in agricultural ditches and slow-moving water with

emergent vegetation along the bank of the San Joaquin River and Burns Cutoff is considered low to moderate quality. Modeled aquatic habitat near the Bethany Complex consists of agricultural ditches and the rip-rapped shoreline of the Bethany Reservoir, which are considered low to moderate quality habitat. A northwestern pond turtle occurrence at Cosumnes River Preserver overlaps with access road footprint at the Twin Cities Complex, an occurrence on Terminous Tract is approximately 0.1 mile east of road improvements on SR 12, and an occurrence at Stone Lakes NWR is approximately 0.3 mile southeast of road improvements at SR 160 near the north Delta intakes (California Department of Fish and Wildlife 2020b). Habitat fragmentation due to construction of access roads is not expected to affect northwestern pond turtle connectivity as the patches of lost habitat are small, scattered throughout action area and generally of low quality.

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.14.7.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or

providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical or SCADA facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections. The construction actions associated with electrical and SCADA facilities are described and evaluated at the project level.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intakes and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Sections 3.2.10 and 3.2.11.

Construction of electrical power and SCADA lines and the substation on Lower Roberts Island would require site preparation, tower or pole construction, and line stringing. Construction of underground power and SCADA lines would involve trenching, directional drilling, and use of heavy equipment and would mostly occur concurrent with access road improvements and construction. Cranes would be used during the line-stringing phase.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.14.7. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.14.8.1 Habitat Loss and Fragmentation

Electrical and SCADA facilities serving the north Delta intakes, Twin Cities Complex, Terminous Tract tunnel shaft, Lower Roberts Island tunnel shaft and RTM area, and Bethany Complex overlap with modeled northwestern pond turtle habitat. Construction of new electrical facilities would result in the permanent loss of 0.55 acre of northwestern pond turtle modeled aquatic habitat and 1.40 acre of modeled upland habitat (<0.01% of modeled aquatic and upland habitat within the study area). Construction of SCADA facilities would result in a temporary disturbance of 3.03 acre of northwestern pond turtle modeled aquatic habitat and 14.86 acres of modeled upland habitat (<0.01% of modeled aquatic habitat and 0.02% of modeled upland habitat within the study area) (Figures 6.14-8 to 6.14-63).

Modeled habitat that would be removed due to construction of power and SCADA facilities serving the north Delta intakes and Twin Cities Complex consists of aquatic habitat found along agricultural ditches, which is generally considered low quality because they do not hold permanent water. Terminous Tract modeled habitat consists of emergent wetlands and sloughs at and adjacent to White Slough Wildlife Area and is considered good quality habitat. Modeled aquatic habitat at Lower Roberts Island consist of agricultural ditches and slow-moving water with emergent vegetation along the bank of the San Joaquin River and Burns Cutoff which is considered low to moderate quality. The modeled aquatic habitat that would be removed at the Bethany Complex consists largely of unvegetated agricultural irrigation ditches and is considered low quality.

An aboveground power line serving the north Delta intakes and Twin Cities Complex that would be installed on existing poles along Franklin Boulevard is approximately 2.2 miles south of a northwestern pond turtle occurrence at Cosumnes River Preserve; an underground SCADA line serving the Terminous Tract tunnel shaft overlaps with northwestern pond turtle occurrence #68 at White Slough Wildlife Area; and an underground SCADA line serving the Bethany Complex is approximately 0.3 mile south of an occurrence along the Delta Mendota Canal (California Department of Fish and Wildlife 2020b). Habitat fragmentation from power and SCADA facilities construction is not expected because the project features are either above or below ground.

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*). Temporary habitat loss would be restored to pre-disturbance conditions with implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* described in Appendix 3A.

### 6.14.8.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and

disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[29] concrete and CLSM batch plants, park-and-ride lots, and a metering area off of Christensen Road. The park-and-ride lot would be removed following construction but because it would be in place for over 1 year the impact would be considered permanent. The metering area would support new overhead power lines and impacts would be considered permanent. The construction actions associated with these other construction support facilities are described and evaluated at the project level.

[29] As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.14.7, *Access Roads*, and Section 6.14.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

### 6.14.9.1 Habitat Loss and Fragmentation

Construction of the CLSM batch plants, Hood-Franklin Park-and-Ride lots, and metering area off of Christensen Road would result in the permanent loss of 0.04 acre of northwestern pond turtle modeled aquatic habitat and 1.46 acres of modeled upland habitat (<0.01% of modeled aquatic and upland habitat within the study area) and temporary disturbance of 0.02 acre of modeled upland habitat (<0.01% of modeled upland habitat within the study area) (Figures 6.14-3 and 6.14-15). Modeled aquatic habitat that would be removed consists of agricultural ditches that are assumed to be of lower quality as they typically do not hold permanent water. The nearest occurrence is approximately 2.1 miles south of the Lambert Road CLSM batch plant and 1.4 miles northwest of the Hood Franklin park-and-ride. The nearest occurrence to the metering area is approximately 1.16 miles northeast (California Department of Fish and Wildlife 2020b).

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*).

### 6.14.9.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or

providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facilities would be constructed to deliver water from the Union Island tunnel shaft to the existing CCWD Middle River Pipeline on Victoria Island. The CCWD interconnection facilities would include an interconnection pump station, a new underground 1.6-mile conveyance pipeline, and an interconnection valve to connect to the existing CCWD Middle River Pipeline. The construction actions associated with the CCWD interconnection facilities are described and evaluated at the project level.

The interconnection pump station facilities would be located within the Union Island tunnel shaft footprint. Pump station facilities include two to six submersible vertical turbine pumps installed within the Union Island maintenance shaft, 24-inch diameter pump discharge pipes, an aboveground surge tank system, underground vaults containing isolation butterfly valves and flow meters, an electrical building, electrical transformers, equipment yard, and a new electrical power connection to the existing overhead line adjacent at the Union Island tunnel shaft site.

The interconnection pipeline would consist of a 42- to 66-inch diameter underground pipeline continuing north from the Union Island shaft site along Bonetti Road, crossing under Victoria Canal, then turning west along an existing farm road, then connecting with the CCWD Middle River Pipeline at the Middle River Intake and Pumping Plant. A permanent 70-foot wide easement would be maintained along the length of the pipeline on Union Island and Victoria Island. Air valves, blow offs, and access manways would be placed along the pipeline within the permanent easement.

The interconnection valve would be located in a buried vault (approximately 11.5 feet by 15.5 feet by 12.0 feet) on the interconnection pipeline just prior to connecting to the Middle River pipeline within the existing CCWD pumping plant facility on Victoria Island.

Construction of the interconnection pump station facilities would take place within the construction footprint of the Union Island tunnel shaft, and activities would be similar to those occurring for tunnel shaft construction (Section 6.14.4). Installation of electrical power connections would be similar to those described in Section 6.14.8, *Electrical and SCADA Facilities.*

The interconnection pipeline would be installed in a trench with open cut and cover construction along existing roadways and within agricultural fields. The pipeline construction easement would be 100 feet wide for the entire length of the trench, including a 30-foot temporary construction easement around the 70-foot permanent easement. Dewatering may occur along the open trench, with flows collected, treated, and reused on-site. The portion of the interconnection pipeline that crosses Victoria Canal would be microtunneled. Launch and retrieval pits, approximately 35 feet

wide by 50 feet long, would be placed within the 100-foot open trench construction easement on Union Island and Victoria Island to launch and receive microtunneling equipment.

Construction of the interconnection valve vault would take place within the 100-foot wide CCWD pipeline construction easement adjacent to the existing CCWD pump station facility. Following installation of the vault, pavement would be replaced within the work area surrounding the vault.

Construction of the CCWD interconnection facilities would take place after the Union Island maintenance shaft is complete and is estimated to take 18 months. The interconnection pump station, open cut portions of the interconnection pipeline, and the interconnection valve would not require nighttime construction. Microtunneling of the pipeline under Victoria Canal would require continuous construction, including nighttime activity, for a duration of approximately 2 weeks.

### 6.14.10.1 Habitat Loss and Fragmentation

The CCWD interconnection facility construction footprint overlaps with modeled northwestern pond turtle habitat and would result in the permanent loss of 0.33 acre of modeled northwestern pond turtle aquatic habitat (<0.01% of modeled aquatic habitat within the study area) and 5.90 acres of modeled northwestern pond turtle upland habitat (0.01% of modeled upland habitat within the study area) (Table 6.14-1) (6.14-5).

Modeled habitat near the CCWD interconnection facilities consists of aquatic habitat found along Victoria Canal and agricultural ditches. Modeled aquatic habitat that would be removed consists of agricultural ditches that are assumed to be of lower quality as they typically do not hold permanent water. The nearest occurrence is approximately 1.3 miles west of the CCWD interconnection facilities (California Department of Fish and Wildlife 2020b).

To minimize permanent habitat loss, the *Northwestern Pond Turtle Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle aquatic and upland habitat to be evaluated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost habitat would be offset through mitigation. The CMP would create, enhance, and manage in perpetuity northwestern pond turtle aquatic and upland habitat (Appendix 3B, Section 3B.4.1.4, and Attachment 3B.1, Table 3B.1-3, CMP-30: *Northwestern Pond Turtle Habitat*).

### 6.14.10.2 Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by

a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.11 Compensatory Mitigation

### 6.14.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

The CMP (Appendix 3B) would offset the permanent loss of wetlands and habitat for special-status species, including northwestern pond turtle, by creating and enhancing habitat on Bouldin Island and I-5 ponds and managing these areas in perpetuity. The habitat creation and enhancement sites would overlap with modeled northwestern pond turtle habitat (Figures 6.14-1, 6.14-69 through 6.14-73).

Construction of habitat creation and enhancement sites under the CMP would involve ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel to enhance and restore habitats. Habitat creation and enhancement would take several years to construct and would not require night lighting.

#### Habitat Loss and Fragmentation

Habitat creation and enhancement of the initial mitigation sites at Bouldin Island and the I-5 ponds would affect 103.99 acres of modeled northwestern pond turtle aquatic habitat and 274.41 acres of modeled upland habitat (0.09% of modeled aquatic habitat and 0.43% of modeled upland habitat within the project area). However, the disturbance would be temporary in that it would occur over one construction season, and one of the primary purposes of the initial mitigation projects is to create and enhance northwestern pond turtle habitat. The creation and enhancement actions at the initial mitigation sites would convert the existing, low- to high-quality aquatic habitat (e.g., depression [lake/pond], agricultural ditch) and upland habitat (grassland patches and agricultural fields along agricultural ditches, valley/foothill riparian) to 233.94 acres of moderate- to high-

quality aquatic habitat (nontidal freshwater emergent wetland and depression [lake/pond]) and 456.10 acres of moderate- to high-quality upland northwestern pond turtle habitat (uplands adjacent to aquatic habitat) at the initial mitigation sites that would be protected and managed in perpetuity. In addition, CMP-0: *General Design Guidelines* (Attachment 3B.1, Table 3B.1-2) requires compensatory mitigation lands address critical life functions for species and that there be no net loss in species habitat or habitat value as a result of compensatory mitigation.

See Tables 3B-7, 3B-13, and 3B-14 in Appendix 3B to better understand the increase in extent of high-quality aquatic habitat and Section 3B.7 to better understand how habitat function would be defined and monitoring.

## Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Northwestern pond turtle could be trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

### 6.14.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be purchased to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, alkali seasonal wetland, and vernal pool habitat. Mitigation or conservation bank credits for these species or wetlands would be purchased at banks that have been approved by USFWS, and would have measures to avoid, minimize, and offset any effects to listed species. Therefore, the purchase of mitigation or conservation bank credits for special-status species would not result in additional adverse effects on northwestern pond turtle.

### 6.14.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.9.11.2, *Mitigation/Conservation Bank Credits*, are not available in part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down" consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. Vernal pool and alkali seasonable wetland habitat is not suitable for northwestern pond turtle and therefore this activity would have no effect on northwestern pond turtle.

### 6.14.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

### 6.14.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the water side of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

The location(s) for channel margin enhancement is not known, however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for migrating salmonids that would benefit from enhancement actions.

Enhancement would generally entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee.

While enhanced habitat will primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, likely through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction will vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is generally anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.
- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

## Habitat Loss and Fragmentation

While the exact location of the channel margin enhancement is not known, it is likely to be placed in the central Delta (e.g., Sacramento River between Freeport and Georgiana Slough, Mokelumne River near Bouldin Island). As northwestern pond turtles are assumed to occur throughout the Delta, and channel margin enhancement will take place in the nearshore and levee upland areas where northwestern pond turtles occur, it is assumed that any ground disturbance would result in temporary habitat loss. The existing quality of the channel margin habitat in the central Delta is typically low. The aquatic habitat is comprised of nearshore riprap areas and agricultural ditches with levee top roads and nearby agricultural areas serving as the primary upland habitat. If northwestern pond turtle habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

However, once constructed, channel margin enhancement actions are assumed to benefit northwestern pond turtle by increasing the extent and quality of the existing habitat. The enhancement actions are expected to replace hardened, riprap shoreline with a mix of emergent and riparian vegetation and biologically friendly engineered structures (e.g., biotechnical erosion protection) as described in Section 3B.4.3.3.3 of Appendix 3B. In addition, bank slopes will be increased to increase the area of shallow, nearshore habitat. Not only will this action increase the extent of aquatic habitat for the northwestern pond turtle, but it is also expected to increase the abundance of prey species. Where setback levees are used on the land side of the levee, increased

slopes will increase the extent of upland habitat. And, regardless of the use of setback levees, existing levee vegetation will be replaced with native grassland vegetation, increasing the quality of the upland habitat for northwestern pond turtle. With these increases in quality and quantity of northwestern pond turtle aquatic and upland habitat, the temporary habitat loss is assumed to be offset by the long-term benefit of the program. Therefore, channel margin enhancements are considered beneficial overall.

## Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

### 6.14.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area. Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

#### Habitat Loss and Fragmentation

Although the exact location of tidal restoration is unknown, any tidal restoration project in Cache Slough or lower Yolo Bypass (where tidal restoration is planned to occur) would likely result in the conversion of low- and moderate-quality aquatic and upland northwestern pond turtle habitat to moderate- and high-quality aquatic and upland habitat. This assumption is based on three recent restoration projects in this same region: Lookout Slough, Lower Yolo, and Yolo Flyway Farms

(California Department of Fish and Wildlife 2020; U.S. Fish and Wildlife Service 2017b, 2019b). Regulatory compliance documents for these three restoration projects report a net loss of lower quality habitat such as agricultural ditches, seasonal wetlands, and agricultural lands (e.g., grazing or row/field crops) and a net increase in the higher quality tidal emergent wetland. Because there was a net increase in higher quality aquatic foraging habitat (tidal emergent wetland), and some upland basking and refugia habitat would remain in the form of levee tops and adjacent grassland habitat (as was the case in the example projects), these tidal restoration projects were assumed to produce a net benefit to northwestern pond turtle.

The net loss of northwestern pond turtle upland habitat would occur when upland features on agricultural lands are modified to create tidal habitat and flooded as part of the restoration process. This work requires converting agricultural lands to tidal channels, emergent wetlands, and topographic depressions. Upland levee habitat used for basking and refugia would also be lost in those reaches where portions of the levee are removed to allow for tidal connectivity. If small, interior levees exist on the property, these features could be graded to achieve topographical or elevational design requirements, though in many cases, these features would be allowed to persist as they foster the formation of mixed plant communities and high tide refugia habitat for wetland species. If northwestern pond turtle habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

Temporary loss of aquatic habitat would also occur during construction, though these effects would not be expected to last more than 2 years and would be offset by the net increase in tidal emergent wetland. Because high quality foraging habitat is limiting for northwestern pond turtle, and because upland habitat is typically not limiting, a net increase in aquatic habitat that is likely to result from tidal restoration in the Cache Slough/Lower Yolo Bypass region is assumed to result in a net benefit for northwestern pond turtle.

## Construction-Related Effects

Ground disturbance could result in the injury, mortality, and disruption of normal behaviors of northwestern pond turtle adults, eggs, and hatchlings if they are occupying aquatic or upland work areas. Construction vehicle traffic could result in injury or mortality. Construction activities could also result in the exposure of northwestern pond turtle to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by northwestern pond turtle and disrupt normal behaviors and result in increased energy expenditures. However, the threshold at which disruption of normal behaviors would occur is unknown.

To reduce the potential for injury, mortality, or disruption of normal behaviors during construction, the *Northwestern Pond Turtle Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.10 would require suitable northwestern pond turtle habitat be evaluated and avoided to the greatest extent possible. If suitable habitat cannot be avoided, a preconstruction survey will be conducted by a qualified biologist immediately prior to ground-disturbing activities or vegetation clearing, and exclusion fencing would be installed around the perimeter of the work area, when suitable aquatic habitat is present within 300 feet of the work area, prior to the start of nesting season (March). Exclusion fencing would remain in place for the duration of construction. The measure also requires clearance surveys by a qualified biologist at the beginning of each work day and regularly throughout each work day when activities may result in take of northwestern pond turtle. The

measure also requires preparation of a relocation plan, and if dewatering is required, intakes will be screened with wire mesh no larger than 5 millimeters, and any turtles found within the dewatered area would be relocated.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

The avoidance and minimization measure in Chapter 3, Section 3.6.2.10 and AMM-14 would minimize construction-related effects with pre-disturbance detection, work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.14.12 Effects on Critical Habitat

Critical habitat has not been designated for northwestern pond turtle.

## 6.14.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Potential cumulative effects on northwestern pond turtle in the action area include habitat loss and fragmentation, changes in agricultural and land management practices, predation from introduced and native species, and water pollution. Both habitat loss and fragmentation, and changes in land management practices, could result from conversion of agricultural land to more developed land uses (which is not likely to be extensive due to existing constraints upon land use changes) or from conversion of agricultural land to different crop types having lower habitat suitability (which is not foreseeable). Habitat loss or degradation from agricultural practices is not expected to increase in the foreseeable future as agriculture in the Delta is assumed to be fully developed. Predation by an existing introduced native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable, nor are the consequences of such an introduction.

Water pollution effects on the physiology of northwestern pond turtle or its prey could result from a variety of causes, including agricultural practices, increased urbanization, and wastewater treatment plants. The input of pesticides and herbicides associated with agricultural practices are likely to be maintained, because the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects. Water quality effects of urbanization include point and nonpoint-source water quality impairments, such as oil, gasoline, herbicides, pesticides, or heavy metals, and there is a potential for those effects to further degrade water quality as further urbanization occurs in the action area. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in

response to regulatory and economic factors increasing the value of reusable water; therefore, this stressor is likely to diminish over time. Some of these effects would improve and others would impair habitat quality for northwestern pond turtle in the action area; their net effect is to approximately maintain current conditions for the foreseeable future.

These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the proposed action, nor are they expected to alter the efficacy of offsetting measures in the proposed action such as habitat creation and restoration.

# 6.15 Western Spadefoot

Appendix 6A describes the definitions, methods, and assumptions used to analyze the effects of the proposed action on terrestrial species, including impact categories, effect mechanisms, and habitat model development. Section 4.4, Section 4.4.23.6, *Suitable Habitat Definition*, and Section 4.4.23.7, *Habitat Suitability Model*, define suitable habitat and describe the habitat model for western spadefoot.

Western spadefoot modeled habitat is located in the northern part of the action area near Hood, west of the Sacramento River in Yolo and Solano Counties, around the I-5 ponds, and southwest of Clifton Court Forebay (Figure 6.15-1). There are no reported extant CNDDB occurrences in the action area; there is one possibly extirpated occurrence (from 1922) reported along SR 4, southwest of Stockton (California Department of Fish and Wildlife 2024, 2020b). Habitat quality is assumed to decrease west to east, as the density of artificial water conveyance infrastructure and agricultural land cover types increase, and natural land cover types decrease.

Construction activities associated with field investigations, access roads, electrical and SCADA facilities, and the Bethany Complex have the potential to affect western spadefoot. Figures 6.15-1 through 6.15-17 include overview as well as “zoomed-in” figures depicting overlap between the project footprint and modeled habitat.

There are 14,856.63 acres of modeled western spadefoot habitat in the action area. An estimated 33.10 acres (0.22% of total modeled habitat in action area) of western spadefoot modeled habitat would be permanently lost by the project, which includes 0.20 acre of aquatic habitat (<0.01% of modeled aquatic habitat in the action area) and 32.90 acres of modeled upland habitat (1.13% of modeled upland habitat in the action area). Effects from these activities are described in the sections below. Table 6.15-1 summarizes the maximum affected acreage of western spadefoot modeled habitat and Table 6.15-2 summarizes the proposed acres of compensation.

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**Table 6.15-1. Maximum Habitat Loss of Modeled Habitat for western Spadefoot by Activity Type (Acres)**

| Western Spadefoot Modeled Habitat | Total Modeled Habitat in the Action Area | Permanent Modeled Habitat Loss from Construction [a] | | | | | | | | | Temporary Modeled Habitat Disturbance from Construction [b] | | | | | | Total Affected Modeled Habitat (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CCWD | Access Road | Bethany Complex | North Delta Intakes | Other Construction Support Facilities | Electrical Facilities [c] (Overhead and Underground) | RTM | Tunnel Shaft | Permanent subtotal | Field Investigations | CCWD | Access Road | Other Construction Support Facilities | Electrical and SCADA Facilities (Overhead and Underground) | Temporary Subtotal | |
| Aquatic | 11,937.05 | - | - | 0.20 | - | - | - | - | - | 0.20 | - | - | - | - | - | - | 0.20 |
| Upland | 2,919.58 | - | 5.91 | 26.93 | - | 0.02 | 0.05 | - | - | 32.90 | 1.96 | - | 1.93 | 0.01 | 0.43 | 4.34 | 37.24 |
| **Total [d]** | **14,856.63** | **-** | **5.91** | **27.13** | **-** | **0.02** | **0.05** | **-** | **-** | **33.10** | **1.96** | **-** | **1.93** | **0.01** | **0.43** | **4.34** | **37.44** |

Notes:

CCWD = Contra Costa Water District; RTM = reusable tunnel material; SCADA = supervisory control and data acquisition.

[a] Permanent Habitat Loss includes potential permanent and long-term temporary impacts. Long-term temporary impacts are those impacts that would be restored to pre-project conditions, but not within 1 year from initial ground disturbance (as temporary impacts would be).

[b] Temporary Habitat Loss includes potential temporary impacts from construction that would be restored to pre-disturbance conditions within 1 year of construction completion, as described in AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A, *General Avoidance and Minimization Measures*).

[c] Electrical facilities include potential habitat loss as a result of the construction of overhead and underground power transmission lines. Potential habitat loss from the construction of electrical facilities (i.e., lines, substations, switchyards, and switching stations) that occur within larger facilities (e.g., Bethany Complex) is captured in the large facility impact acreage.

[d] Total is of aquatic and upland habitat. Dispersal habitat is not counted as total habitat loss or disturbance.

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**Table 6.15-2. Maximum Habitat Loss and Compensation for Western spadefoot**

| | Permanent Habit Loss | Maximum Compensation Commitment (Acres) |
|---|---|---|
| | Total Maximum Habitat Loss (Acres) | Protection or Restoration [a] |
| Aquatic | 0.20 | 0.6 |
| Upland | 32.90 | 32.90 |
| **Total** | **33.10** | **33.50** |

[a] See CMP-31: *Western Spadefoot*, described in Attachment 3B.1, *Compensatory Mitigation Design Parameters,* for details about the protection and restoration commitments for western spadefoot.

# 6.15.1 Field Investigations

Field investigation actions described are for new proposed actions and have not been previously consulted upon. Field investigation actions are described and evaluated at the project or site level. Field investigations would occur after EIR approval and before and during construction. Some investigations would occur within the construction footprint (where suitable habitat is already assumed to be lost and thus no additional habitat loss from future field investigations would be incurred) and some would occur outside the construction footprint (which results in temporary habitat disturbance additional to that incurred by construction). Agronomic testing, utility potholing, and pilot studies for settlement would occur within the existing project footprints and would therefore not result in habitat loss additional to the loss described in the relevant, associated activity type sections (e.g., Bethany Complex). Geotechnical investigations associated with the West Tracy Fault, Bethany Fault, and the tunnel for the Bethany Reservoir Aqueduct, which include test trenches, CPTs, and soil borings, largely fall outside of surface construction footprints and it is these impacts that are discussed in this section.

Field investigations include activities such as overland driving, equipment storage, pit digging, soil boring, trenching, and temporary soil storage prior to backfilling trenches. West Tracy Fault investigations would involve up to 6 test trenches, each 0.07 acre with a temporary work footprint of up to 4.59 acres. Excavation and backfilling of the test trenches would last up to 12 days. Bethany Fault investigations would take place above the Bethany Reservoir Aqueduct tunnel outside of the Bethany Conservation Easement and consist of a linear array of electrodes driven into the ground over several hundred feet; the electrodes would induce a low current into the ground and be removed upon completion of testing. Ground disturbance for other field investigations is not expected to exceed 0.84 acre and would not last more than 30 days. Field investigations would not require nighttime lighting.

## 6.15.1.1 Habitat Loss and Fragmentation

An estimated 1.96 acres of western spadefoot modeled upland habitat would be temporarily disturbed as a result of field investigations (0.07% of modeled upland habitat in the study area) (Figures 6.15-1 and 6.15-7). Field investigation impacts occur throughout the project alignment and the affected habitat is of varying quality. Impacted modeled habitat east of the north Delta intakes is generally a mix of vernal pool complex and annual grassland land cover types that are considered high-quality habitat. Modeled habitat near the Twin City Complex is predominately agricultural and likely provides lower quality habitat for western spadefoot. The field investigations include geotechnical exploration in the Bethany Complex (west of Byron Highway) and trench work at the West Tracy Fault (east of Byron Highway) and Bethany Fault. Modeled upland habitat surrounding

geotechnical sites at the Bethany Complex and West Tracy Fault is of higher quality as it consists of a mix of annual grassland and vernal pool complex. Because of the small footprint of the Bethany Fault investigations and the short (1 day) duration of the disturbance, impacts on modeled habitat are not quantified and are considered negligible. The temporary nature and small extent of field investigation sites would not increase habitat fragmentation in the action area.

Temporary habitat loss would be restored to pre-disturbance conditions within 1 year of construction with implementation of AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A).

### 6.15.1.2 Construction-Related Effects

Overland driving or ground disturbance could injure or kill western spadefoot if individuals are present aboveground within field investigation work areas. Western spadefoot could also be trapped in open trenches or other excavation pits/trenches and become vulnerable to desiccation and predation. Field investigations have the potential to produce subsurface vibrations, which could be detectible by western spadefoot. The threshold at which disruption of normal behaviors would occur is unknown; however, subsurface vibrations from field investigations would not be anticipated to exceed those experienced under existing conditions. Construction-related contaminants, such as fuels, cement, and oils, could be accidentally discharged or spilled into modeled upland or aquatic habitat exposing individuals to toxic materials, which could result in injury and mortality, as well as lead to habitat degradation.

To minimize injury and mortality during field investigations, the *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If full avoidance of suitable habitat is not possible, seasonal avoidance of habitat will be implemented, wildlife exclusionary fencing will be erected around western spadefoot habitat within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the measure specifies that initial ground disturbance would not occur between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

Disruptions of western spadefoot behavior and movement from noise and vibration are not expected given field investigations would not cause vibrations exceeding those experienced under existing conditions, and activities would be short in duration and require a small extent of ground disturbance that field investigations would cause. Where disruptions do occur, implementation of the avoidance and minimization measure in Chapter 3, Section 3.6.2.6 and AMM-14: *Construction Best Management Practices for Biological Resources* would minimize the effect with pre-disturbance detection, require work stoppage if an individual is detected, and relocation (if needed). To reduce

the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.15.2 North Delta Intakes

The north Delta intake construction area does not overlap with western spadefoot modeled habitat. Activities in this area would not affect the species (Figures 6.15-1 and 6.15-2).

## 6.15.3 Tunnels

The tunnel alignment from the north Delta intakes to the Bethany Complex does not overlap with western spadefoot modeled habitat. Activities in this area would not affect the species (Figure 6.15-1).

## 6.15.4 Tunnel Shafts

There are three types of tunnel shafts: launch shafts, maintenance shafts, and reception shafts. The purpose of the tunnel shafts is to launch, maintain, and remove tunnel boring machines at the intakes, along the tunnel alignment, and at the Bethany Complex. Western spadefoot modeled habitat does not overlap with any tunnel shaft locations (Figure 6.15-1).

## 6.15.5 Reusable Tunnel Material

RTM areas do not overlap with western spadefoot modeled habitat. Activities for these facilities would not affect the species (Figure 6.15-1).

## 6.15.6 Bethany Complex

The Bethany Complex would include a pumping plant, surge basin, reception shaft, discharge structure, and aqueduct. In addition, a construction water pipeline, electrical substation, switchyard, and access roads would be used in support of construction and facilities within the Bethany Complex footprint. The construction actions associated with the Bethany Complex are described and evaluated at the project level.

The Bethany Reservoir Aqueduct that connects the Bethany Reservoir Pumping Plant to the Bethany Reservoir Discharge Structure would be aboveground, except for two tunneled sections that would pass under the Jones Pumping Plant discharge pipelines and Bethany Conservation Easement. The tunneled portion of the Bethany Aqueduct under the conservation easement would be constructed at a depth of 45 to 180 feet below ground surface, and entry and exit portals to the aqueduct would be outside of the conservation easement (Chapter 3, Section 3.2.6.3). All geotechnical and construction activities would avoid surface disturbance to the conservation easement. No surface facilities (e.g., roads, utilities, or other structures) would be located on top of the conservation easement.

Construction activities at the Bethany Complex include vegetation clearing, grading, excavation, soil compaction, building of structures, and the use of construction-related vehicles. Sheet piles for construction of the discharge structure would be installed using vibratory pile driving methods.

Construction of the Bethany Complex would take place over several years and may require night lighting. As described in Chapter 3, Section 3.2.12, all lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity.

### 6.15.6.1 Habitat Loss and Fragmentation

An estimated 0.20 acre of aquatic habitat (<0.002% of modeled habitat in the action area) and 26.93 acres of upland habitat (0.92% of the modeled habitat in the action area) would be permanently lost as a result of construction at the Bethany Complex (Table 6.15-1, Figure 6.15-6). Modeled western spadefoot habitat in the vicinity of Bethany Complex is a mix of low-quality, agricultural habitat near Byron Highway and higher quality annual grassland habitat near Bethany Reservoir. Construction of the Bethany Complex is likely to incrementally increase habitat fragmentation in the region, but this impact is not considered substantial as the overall quality of the remaining habitat would be relatively high and there are no new barriers to movement.

The *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 requires western spadefoot aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided, compensatory habitat would be preserved and created through purchasing of the equivalent amount of agency-approved mitigation bank credits or other site protection instruments, as described in CMP-31: *Western Spadefoot,* in Attachment 3B.1 (Table 3B.1-3) to offset the loss. In addition, implementation of AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction (Appendix 3A).

### 6.15.6.2 Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill western spadefoot. Open trenches or other excavation pits have the potential to entrap western spadefoot should individuals fall in and not be able to climb out. Construction activities have the potential to produce subsurface vibrations, which could be detectable by western spadefoot, disrupt normal behaviors, and cause individuals to emerge aboveground at inappropriate times (e.g., before seasonal rain pools fill). Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into western spadefoot habitat and cause injury or mortality or degrade habitat.

To minimize injury and mortality during construction activities, the *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If full avoidance of suitable habitat is not possible, seasonal avoidance of habitat would be implemented. Wildlife exclusionary fencing would be erected around the construction area where western spadefoot habitat is within 300 feet. A biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the measure specifies that initial ground disturbance would not occur between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals. The typical tunnel depth for the western spadefoot is 3 feet (1 meter) (Stebbins and McGinnis 2012); therefore, injury, mortality, or disruptions to behavior and movement from noise and vibration caused by horizontal directional drilling of the Bethany Reservoir Aqueduct are not likely to occur. Surface construction activities have the potential to produce subsurface vibrations, which could be detectable by western spadefoot, disrupt normal behaviors, and cause individuals to emerge aboveground at inappropriate times (e.g., during dry periods). However, the threshold at which disruption of normal behaviors would occur is unknown. Where disruptions do occur, implementation of the *Western Spadefoot Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.6 and AMM-14 (Appendix 3A) would minimize the effect with pre-disturbance detection, require work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.15.7 Access Roads

The construction of new roads and improvements to existing roads are necessary to support project construction. New access roads would be either gravel or paved and would be built to connect existing roads to construction areas. Existing roads would be widened and improved to support the construction-related traffic. The access roads that overlap with western spadefoot modeled habitat are those that are in service to, but occur outside of, the Bethany Complex; improvements to Hood-Franklin Road, and an intake haul road to north Delta intakes. Impacts from access road construction within the Bethany Complex are described above in Section 6.15.6. Impacts from access road construction within the north Delta intakes are described above in Section 6.15.2. The construction actions associated with the access roads are described and evaluated at the project level.

There are three regions where new access roads would be constructed and existing access roads would be improved in service of the Bethany Complex: to the northeast of the Bethany Complex, connecting Mountain House Road to Byron Highway; between Mountain House Road and the Bethany discharge structure; and to the south of the Bethany Complex, connecting Mountain House Road to Grant Line Road (Figures 6.15-1). A haul road would be constructed and used to access the northern intake facility. Additionally, an existing road would be improved along Hood-Franklin Road in service to a Park-and-Ride on Hood-Franklin Road. For more information about access roads see Chapter 3, Section 3.2.7. Access roads are depicted in Figures 6.15-1, 6.15-7, and 6.15-18.

Construction activities for new and widened access roads include clearing, grubbing, moving utilities, paving, and the use of construction vehicles. Construction of access roads to the Bethany Complex would take place over several years during daylight hours, with the exception of the traffic bypass at Mountain House Road where construction would occur at night. All lights used during nighttime construction would be downcast, cut-off type fixtures with non-glare finishes, natural light qualities, and minimum intensity. Construction-related lighting would be downcast and

motion-activated so as not to subject the immediate surroundings to light level extremes; however, these types of lights generate an ambient nighttime luminescence that is visible from a distance (Chapter 3, Section 3.2.12).

### 6.15.7.1 Habitat Loss and Fragmentation

There are three areas where access roads overlap with or occur adjacent to western spadefoot modeled habitat: road improvements on Hood-Franklin Road, an intake haul road to the intake north of Hood (Intake B), and an access road from the Bethany Reservoir Discharge structure (Figures 6.15-1). Access roads are further described in Chapter 3, Section 3.2.7. Access roads would not result in loss of modeled aquatic habitat. The modeled upland habitat that overlaps with road improvement activities around both north Delta intakes are near Stones Lake National Wildlife Refuge is considered to be of higher quality given the large seasonal wetland/vernal pool complex present. The modeled upland habitat that overlaps with the access road near the Bethany Reservoir Discharge Structure is of moderate quality, consisting of rolling hills of annual grasslands.

Access road construction would result in the loss of 5.91 acres of upland habitat (0.20% of modeled western spadefoot habitat in the action area) and 1.93 acres of temporary disturbance to upland habitat (<0.001% of modeled western spadefoot habitat in the action area) (Figure 6.15-1). The road improvements near north Delta intakes and Hood-Franklin Road would not increase habitat fragmentation as access roads that overlap with model habitat are existing roads and no new roads are proposed in modeled habitat western spadefoot habitat. Access road construction at Bethany Reservoir Discharge Structure would be a new road within undeveloped habitat and could contribute to habitat fragmentation.

To minimize permanent and temporary habitat loss, *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require suitable western spadefoot aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided, habitat would be preserved and created through purchasing of the equivalent amount of agency-approved mitigation bank credits or other site protection instruments, as described in CMP-31: *Western Spadefoot* in Attachment 3B.1 (Table 3B.1-3). In addition, implementation AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction (Appendix 3A).

### 6.15.7.2 Construction-Related Effects

Ground-disturbing activities (e.g., excavation and soil boring) that occur within occupied or presumed occupied by western spadefoot habitat have potential to result in the loss or degradation of that habitat and the potential for injury or mortality to western spadefoot individuals. For example, construction-related fluids or sediments could be inadvertently discharged into modeled habitat. Used of construction vehicles and heavy equipment could injure or kill western spadefoot. Subsurface vibrations from construction could be detected by western spadefoot, disrupt normal behaviors, and cause individuals to emerge aboveground at inappropriate times (e.g., when seasonal pools are dry).

To minimize injury and mortality during access road construction, the *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If full avoidance of suitable habitat is not

possible, seasonal avoidance of habitat will be implemented, wildlife exclusionary fencing will be erected around western spadefoot habitat within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the measure specifies that initial ground disturbance would not occur between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals.

Disruptions of western spadefoot behavior and movement from noise and vibration are not expected given access road construction would not cause vibrations exceeding those experienced under existing conditions, and activities would be short in duration and require a relatively small extent of ground disturbance. Where disruptions do occur, implementation of the avoidance and minimization measures in Chapter 3, Section 3.6.2.6 and AMM-14: *Construction Best Management Practices for Biological Resources* (Appendix 3A) would minimize the effect with pre-disturbance detection, require work stoppage if an individual is detected, and relocation (if needed). To minimize effects from construction-related fluids and contaminants, the following general measures described in Appendix 3A would be implemented: AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*.

## 6.15.8 Electrical and SCADA Facilities

The following discussion includes an analysis of electrical facility types (e.g., electrical powerlines, substation on Lower Roberts Island) where they occur outside one of the project feature footprints described in the above sections (e.g., north Delta intakes, Bethany Complex). Where the construction footprint of an electrical facility type (e.g., switching station, substation) falls within a larger facility construction footprint, such as Bethany Complex, the effects associated with that facility type are discussed in the relative sections.

Most of the power for project construction and operation would be supplied by existing power lines or new lines added to existing poles, but additional electrical facilities would be needed at all project facility locations. Power lines for the intake and tunnel shafts would be placed underground while a new aboveground high-voltage power transmission line would be constructed to power the Bethany Complex. A new aboveground power line and substation would also be constructed at Lower Roberts Island.

Similar to power, new SCADA lines would be needed at the intakes, tunnel launch shafts, and the Bethany Complex. SCADA lines could be placed within existing telecommunications infrastructure corridors where possible, including on existing aboveground poles. Where existing infrastructure is not available, SCADA lines would be buried, primarily along existing roads and access routes. For

more details about the activities associated with electrical and SCADA facilities, see Chapter 3, Sections 3.2.10 and 3.2.11.

Underground power would mostly be installed alongside existing or new roads within the roadway right-of-way; however, there are a few short sections of line that move away from the road alignment into agricultural lands at Lower Roberts Island and the Twin Cities Complex. Construction of electrical and SCADA facilities would require vehicular access to each tower or pole location. Vehicular access routes to new tower or pole locations would use existing routes or new access routes as described in Section 6.15.7. The duration of construction and installation of new electrical and SCADA facilities would not be more than 1 year at any one location. See Appendix 6A for details about the impact assessment method.

### 6.15.8.1 Habitat Loss and Fragmentation

Construction footprints for electrical and SCADA facilities overlap with modeled western spadefoot habitat near Hood Junction, Franklin Blvd., Bruceville Road, west SR 12, and Bethany Complex (Figures 6.15-10, 6.15-11, 6.15-15, and 6.15-16). Construction of the electrical facilities would result in the permanent loss of 0.05 acre of modeled upland habitat (<0.01% of modeled upland habitat in the action area). Construction of the electrical and SCADA facilities would result in temporary disturbance of 0.43 acre of upland habitat (Table 6.15-1; 0.001% of modeled upland habitat in the action area). The temporarily disturbed habitat is a mix of low-quality agricultural land cover and higher quality annual grassland landcover. The temporary disturbance would not result in an increase in habitat fragmentation because permanent habitat loss is very small no new barriers to movement would be created.

The *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 requires western spadefoot aquatic and upland habitat to be delineated and avoided to the greatest extent possible. Where suitable habitat cannot be avoided, habitat would be preserved and created through purchasing of the equivalent amount of agency-approved mitigation bank credits or other site protection instruments, as described in CMP-31: *Western Spadefoot* in Attachment 3B.1 (Table 3B.1-3). In addition, implementation AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction (Appendix 3A).

### 6.15.8.2 Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill western spadefoot. Spade could become entrap in open trenches if they fall in and cannot climb out. Spadefoot could become entangled in erosion control material. Construction activities have the potential to produce subsurface vibrations, which could be detected by western spadefoot and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., when seasonal pools are dry). However, the threshold at which disruption of normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into spadefoot habitat and cause injury or mortality or degrade habitat.

To minimize injury and mortality during construction, the *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If full avoidance of suitable habitat is not possible, seasonal avoidance of habitat will be implemented, wildlife exclusionary fencing will be erected around

western spadefoot habitat within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the measure specifies that initial ground disturbance would not occur between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals. To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

## 6.15.9 Other Construction Support Facilities

Other construction support facilities include the following project feature types where they occur outside one of the project feature footprints described in the above sections:[30] concrete and controlled low-strength backfill material (CLSM) batch plants, park-and-ride lots, and a metering area near Christensen Road. CLSM batch plants and park-and-ride lots do not overlap with western spadefoot modeled habitat.

Construction of the metering area would result in the permanent loss of 0.02 acre (<0.01% of modeled upland habitat within the study area) and temporary disturbance of 0.01 acre of modeled western spadefoot upland habitat (<0.01% of modeled upland habitat within the study area) (Figure 6.15-3). The metering area would support new overhead power lines. The small permanent loss of modeled habitat would not result in habitat fragmentation and would not adversely affect western spadefoot. Impacts to habitat and western spadefoot would be minimized as described in Section 6.15.8.1.

## 6.15.10 Contra Costa Water District Interconnection Facilities

The CCWD interconnection facility construction area does not overlap with western spadefoot modeled habitat. Activities in this area would not adversely affect the species (Figure 6.15-5).

## 6.15.11 Compensatory Mitigation Plan

### 6.15.11.1 Initial Mitigation Sites: Bouldin Island and I-5 Ponds

The Bouldin Island and I-5 Pond 6 creation and enhancement sites do not overlap with western spadefoot modeled habitat; therefore, construction activities at those sites would have no effect on

As described in Appendix 6A, the project features evaluated in this section occur outside the primary construction locations, such as north Delta intakes and Bethany Complex. For example, there are impacts from road work areas included in Section 6.3.7, *Access Roads*, and Section 6.3.6, *Bethany Complex*, but the road work area described in this section occurs in a discreet location, outside a large project footprint.

the species. However, western spadefoot modeled habitat overlaps with initial mitigation sites at the Ponds 7 and 8 (Figures 6.15-1 and 6.15-18).

Construction of habitat creation and enhancement sites under the CMP would involve ground disturbance, grading, vegetation removal, the use of heavy equipment, and presence of personnel to enhance and restore habitats. Habitat creation and enhancement would take several years to construct and would not require night lighting.

## Habitat Loss and Fragmentation

Western spadefoot modeled habitat overlaps with I-5 Ponds 7 and 8. The creation and enhancement of habitats at these initial mitigation sites would impact 59.83 acres of modeled spadefoot aquatic habitat and 89.90 acres of modeled upland habitat. This represents 0.50% of the modeled aquatic habitat and 3.07% of the modeled upland habitat within the action area.

Despite this, it is unlikely that Ponds 7 and 8 have ever been or will become occupied by the western spadefoot. Many of the Delta islands were historically tidal marsh and therefore did not historically support appropriate habitat for vernal pool species. While Ponds 7 and 8 are technically within the species defined range, there are no known spadefoot populations within a 20-mile radius of the initial mitigation sites (California Department of Fish and Wildlife 2024). The only exception is the occurrence, from 1922, along SR 4; this population is considered extirpated and is separated from more recent occurrences by significant migration barriers (e.g., I-5, I-205, I-580, active agriculture, and urban development) (California Department of Fish and Wildlife 2024). Ponds 7 and 8 are unlikely to be occupied by western spadefoot due to the absence of possible immigration routes and the presence of movement barriers, such as SR 12 to the south and active agriculture to the east, west, and north of the property.

Additionally, the disturbance to modeled habitat at Ponds 7 and 8 would be temporary in that it would occur over one construction season. The creation and enhancement actions at the initial mitigation sites would convert the existing, low- to high-quality aquatic habitat (e.g., depression [lake/pond], agricultural ditch) and upland habitat (grassland patches and agricultural fields along agricultural ditches, valley/foothill riparian) to moderate- to high-quality aquatic habitat (nontidal freshwater emergent wetland and depression [lake/pond]) and moderate- to high-quality upland habitat (uplands adjacent to aquatic habitat). The initial mitigation sites that would be protected and managed in perpetuity for other special-status species may be suitable for western spadefoot, should occupation ever occur. Modeled habitat loss at Ponds 7 and 8 is not likely to adversely affect western spadefoot and would not increase habitat fragmentation

CMP-0: *General Design Guidelines* (Attachment 3B.1, Table 3B.1-2) requires compensatory mitigation lands address critical life functions for species and that there be no net loss in species habitat or habitat value as a result of compensatory mitigation. See Tables 3B-7, 3B-13, and 3B-14 in Appendix 3B to better understand the increase in extent of high-quality aquatic habitat and Section 3B.7 to better understand how habitat function would be defined and monitored.

## Construction-Related Effects

Western spadefoot is unlikely to be affected by construction-related activities at Ponds 7 and 8 because the property is not likely occupied by western spadefoot. However, if the species were occupying work areas, ground disturbance could result in the injury, mortality, and disruption of normal behaviors of western spadefoot adults, eggs, and hatchlings. Westen spadefoot could be

trapped in open trenches or other excavations and become vulnerable to predation. Construction activities could also result in the exposure of western spadefoot to construction-related fluids, such as fuels, oils, and cement, which could result in injury and mortality of eggs, hatchlings, and adults. Construction noise and vibration could be detectible by western spadefoot and disrupt normal behaviors and result in increased energy expenditures. The threshold at which disruption of normal behaviors would occur is unknown.

To minimize injury and mortality during construction, the *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If full avoidance of suitable habitat is not possible, seasonal avoidance of habitat will be implemented, wildlife exclusionary fencing will be erected around western spadefoot habitat within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, the measure specifies that initial ground disturbance does not occur between November 1 and March 31 (extended to April 30 during wet years), to the extent feasible; disturbance to rodent burrows be avoided to the extent feasible; and ground disturbance and vegetation removal be conducted during periods of no to low rainfall.

Implementation of AMM-14: *Construction Best Management Practices for Biological Resources,* detailed in Appendix 3A, would further reduce the potential for injury or mortality from construction vehicles by setting speed limits. AMM-14 would also require covering steep-walled holes or trenches more than 6 inches deep or providing an escape ramp, capping ends of stored pipes and culverts, and disallowing plastic monofilament netting or similar material for erosion control. Before such holes or trenches are filled, they would be thoroughly inspected for trapped animals. Construction activities have the potential to produce subsurface vibrations, which could be detectable by western spadefoot and disrupt normal behavior; however, the threshold at which disruptions of normal behavior would occur is unknown. Where disruptions do occur, implementation of the *Western Spadefoot Avoidance and Minimization Measure* in Chapter 3, Section 3.6.2.6 and AMM-14 (Appendix 3A) would minimize the effect with pre-disturbance detection, require work stoppage if an individual is detected, and relocation (if needed). To reduce the potential effects of contamination from spills such as fuel or oil, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would implement spill prevention and control plans (Appendix 3A).

### 6.15.11.2 Mitigation/Conservation Bank Credits

Mitigation or conservation bank credits may be purchased to meet compensatory mitigation requirements for California red-legged frog, California tiger salamander, western spadefoot, vernal pool fairy shrimp, vernal pool tadpole shrimp, alkali seasonal wetland, and vernal pool habitat. Mitigation or conservation bank credits for these species or wetlands would be purchased at banks that have been approved by USFWS, and would have measures to avoid, minimize, and offset any effects to listed species. Therefore, the purchase of mitigation or conservation bank credits for special-status species would not result in additional adverse effects on western spadefoot.

### 6.15.11.3 Non-Bank Site

In the instance that mitigation or conservation bank credits for vernal pools and alkali seasonal wetlands described in Section 6.15.11.2, *Mitigation/Conservation Bank Credits*, are not available in

part or in full, a non-bank site may be used. Non-bank sites are evaluated programmatically and would be subject to future, "step down' consultation when site-specific information becomes available. A non-bank site would protect, enhance, and manage suitable vernal pool or alkali seasonal wetland habitat. If non-bank sites are used for vernal pool or alkaline wetland creation or enhancement (Appendix 3B, Section 3B.3.2.4), these activities could occur in areas where western spadefoot have potential to occur.

Construction and management activities could include ground disturbance, require some vehicle traffic and use of heavy equipment, and use of contaminants such as fuels, oils, and herbicides, which could result in the injury, mortality, and disruption of normal behaviors of western spadefoot. Chapter 3, Section 3.6.2.11 would minimize impacts by requiring preconstruction surveys, requiring the presence of a qualified biological monitor, minimizing ground disturbing activities, minimizing nighttime construction, avoiding initial ground disturbance work during periods of rainfall, implementing a relocation plan, and installing exclusion fencing around the perimeter of construction sites where western spadefoot habitat is within 300 feet of construction activities 14 days prior to construction to reduce effects of construction. To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans,* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be created and implemented (Appendix 3A). With these measures in place, and the long-term benefits associated with protection and long-term management of Western spadefoot habitat, implementation of non-bank sites is not expected to adversely affect the species.

### 6.15.11.4 Site Protection Instruments

Site protection instruments may be used to protect and enhance agricultural and other lands that provide suitable habitat for species such as greater sandhill crane, Swainson's hawk, and tricolored blackbird. Site protection instruments, including real estate protection instruments, ensure the long-term protection of a mitigation site (Wood and Martin 2016). No construction activities would occur for site protection instruments.

### 6.15.11.5 Channel Margin Enhancements

To offset the adverse effects of project construction on juvenile salmonids, a total of 3,619 linear feet of channel margin habitat would be constructed and maintained as part of the CMP (Appendix 3B). Channel margin enhancement would improve channel geometry and restore riparian, marsh, and mudflat habitats on the waterside of levees along channels that provide rearing and outmigration habitat for juvenile salmonids.

The location(s) for channel margin enhancement is not known; however, locations along the Sacramento River between Freeport and Georgiana Slough, especially near the north Delta intakes, have been identified as areas of low-quality habitat for migrating salmonids that would benefit from enhancement actions.

Enhancement would entail replacing armored or otherwise altered channel banks with more natural shoreline habitats that provide shallow, slow-velocity river margins, overhanging riparian vegetation, and future woody debris sources. To maintain the current extent of in-water habitat and level of flood protection, the existing levee would need to be reconstructed to be set back from the shoreline. Waterside and landside improvements would be implemented to create enhanced channel margin habitat and provide continued flood protection.

Waterside improvements would entail degrading the existing levee to create gently sloping banks that gradually transition from tule marsh to riparian vegetation on the face of the new setback levee. While enhanced habitat would primarily be provided by native vegetation, ballasted large wood may be incorporated into the channel bank in some locations for enhanced complexity and refugia. While the heavily vegetated bank would provide some wave attenuation value, erosion protection may still be required along the waterside of the setback levee. Bio-technical bank treatments, which combine cobble and other erosion-resistant materials with willows and other plantings, would be employed as much as possible. Following all grading, the site would be revegetated, through a combination of active and passive methods. Riparian and upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas would be revegetated through a combination of active planting and passive natural recruitment.

Landside improvements would include the construction of a new setback levee behind and connected to the existing levee. The actual extent of earthmoving required for levee construction would vary significantly by site depending on the degree of land subsidence and the level of flood protection needed. It is anticipated that imported fill would be needed to construct some or all of the new setback levee. Material generated by degrading the existing levee would be reused in the new levee construction as much as feasible based on timing, soil suitability, and other factors.

Channel margin enhancement would involve using the following equipment.

- Large mechanized equipment (typically, a trackhoe) to remove riprap from channel margins.
- Grading equipment such as trackhoes and bulldozers to modify the channel margin side of levees or setback levees to create low floodplain benches with variable surface elevations that create hydrodynamic complexity and support emergent vegetation.
- Trackhoes, bulldozers, and cranes to install large woody material (e.g., tree trunks and stumps) into constructed low benches or into existing riprapped levees to provide physical complexity.

#### Habitat Loss and Fragmentation

Channel margin enhancement has the potential to result in a loss of modeled western spadefoot habitat; however, because the project would occur along existing levees of agricultural properties, impacts on modeled habitat are unlikely, and only a relatively small amount of habitat has the potential to be affected. To minimize permanent habitat loss, the *Western Spadefoot Avoidance and Minimization Measure* (Chapter 3, Section 3.6.2.11) would require suitable western spadefoot habitat to be avoided to the greatest extent possible. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines and*, Table 3B.1-3, CMP-31: *Western Spadefoot Habitat*).

#### Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill western spadefoot. Open trenches or other excavation pits have the potential to entrap western spadefoot if they should fall in and not be able to climb out. Spadefoot could become entangled in erosion-control materials. Construction activities have the potential to produce subsurface vibrations, which could be detectible by western spadefoot and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during the day, during dry periods). However, the

threshold at which disruption of normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into western spadefoot habitat and cause injury or mortality or degrade habitat.

To reduce the potential for injury and mortality during construction of channel margin enhancement sites, the *Western Spadefoot Avoidance Minimization Measure* (Chapter 3, Section 3.6.2.11) r would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If avoidance is not possible, wildlife exclusion fencing would be erected around the perimeter of construction sites where western spadefoot habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, initial ground disturbance would be avoided between November 1 and March 31 (extended to April 30 during wet years) to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and initial ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits, requiring steep-walled holes or trenches more than 6 inches deep be covered or an escape ramp be provided, capping ends of stored pipes and culverts, implementing a relocation plan, and prohibiting plastic monofilament netting or similar material for erosion control. To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be written and implemented (Appendix 3A).

### 6.15.11.6 Tidal Perennial/Emergent Wetland Restoration

To offset the adverse effects of project construction and operations on listed fish species (e.g., Chinook salmon, delta smelt), a total of 3,500 acres of tidal habitat would be constructed and maintained as part of the CMP (Appendix 3B). Tidal perennial and tidal freshwater emergent wetland habitats provide important foraging and refugia habitat for listed fish species. The restoration of tidal perennial and wetland habitat, particularly complex wetland systems containing dendritic channels and shallow subtidal areas, is intended to support improved survival and growth (including food production) of one or more life stages of each listed fish species addressed in the biological assessment. Tidal restoration sites within the lower Yolo Bypass and Cache Slough Complex will be prioritized as these areas would provide greater benefits for target fish species.

Tidal restoration will generally be achieved by reconnecting former wetland areas to adjacent tidal sloughs and rivers. Restoration would primarily occur through breaching or setback of levees, thereby restoring tidal fluctuation to land parcels currently isolated behind those levees. Where practicable and appropriate, portions of restoration sites will be raised to elevations that will support tidal marsh vegetation following levee breaching.

Typical actions required to create suitable tidal marsh habitat at these sites include grading, planting, and infrastructure modifications, such as protection, removal and/or relocation of existing utilities, pumping systems, and other water management structures. Earthwork often includes breaching an existing levee or berm to reintroduce tidal action to the site. Other grading may be performed prior to breaching to create wetland features that enhance habitat function, including tidal channels, tidal pannes and tidal ponds. At certain sites, more significant earthmoving may be required to raise subsided areas to intertidal elevations or to reinforce surrounding levees.

Depending on the project location, it also may be necessary to construct an entirely new flood control levee along portions of the project perimeter to protect adjacent properties. The actual extent of earthmoving required can vary significantly depending on the existing topography of the site.

Following earthwork and grading, the site would be revegetated, likely through a combination of active and passive methods. Any riparian and/or upland areas would be actively seeded, planted, and temporarily irrigated during the initial establishment period. Intertidal wetland areas may revegetate actively, be allowed to recolonize passively through natural recruitment, or experience a combination of the two.

Levee breaching will require removing levee materials from within and adjacent to tidal and other aquatic habitats. Levee breaching will entail in-water work using construction equipment such as bulldozers, backhoes, and barges. Removed levee materials will be placed on the remaining levee sections, placed within the restoration area, or hauled to a disposal area.

Typically work would be sequenced so that grading and infrastructure improvements occur first, followed by planting and finally breaching of the existing levee to reintroduce tidal action.

## Habitat Loss and Fragmentation

Tidal wetland restoration sites at lower Yolo Bypass and the Cache Slough Complex have potential to overlap with western spadefoot habitat, particularly if the selected site includes grassland and vernal pool complex habitats that border the Cache Slough Complex to the south and east (i.e., the upland areas connected to the greater Jepson Prairie area).

Construction of tidal restoration sites typically include a landside levee that protects adjacent uplands from flooding, thus avoiding impacts on western spadefoot habitat. However, there remains some potential for suitable western spadefoot habitat to be permanently lost. The *Western Spadefoot Avoidance and Minimization Measure* detailed in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. Where suitable habitat cannot be avoided, and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Appendix 3B, Section 3B.1, Section 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*, and Table 3B.1-3, CMP-31: *Western Spadefoot Habitat*). In addition, AMM-14: *Construction Best Management Practices for Biological Resources* would ensure that temporarily disturbed areas are restored to pre-disturbance conditions within 1 year of construction (Appendix 3A). If spadefoot habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Appendix 3B, Sections 3B.1 and 3B.2.4, and Attachment 3B.1, Table 3B.1-2, CMP-0: *General Design Guidelines*).

## Construction-Related Effects

Use of construction vehicles and heavy equipment could injure or kill spadefoot individuals. Open trenches or other excavation pits have the potential to entrap western spadefoot should they fall in and not be able to climb out. Spadefoot could become entangled in erosion control materials. Construction activities have the potential to produce subsurface vibrations, which could be detectible by spadefoot and disrupt normal behaviors and cause individuals to emerge aboveground at inappropriate times (e.g., during dry periods). However, the threshold at which disruption of

normal behaviors would occur is unknown. Construction-related contaminants, such as gas, oil, and cement, or erosion and sedimentation could accidentally be discharged into spadefoot habitat and cause injury or mortality or degrade habitat.

To reduce the potential for injury and mortality during construction of tidal wetland restoration sites, the *Western Spadefoot Avoidance and Minimization Measure* described in Chapter 3, Section 3.6.2.11 would require delineation of western spadefoot habitat at each project site. Identified and delineated habitat be delineated and completely avoided to the greatest extent possible. If avoidance is not possible, wildlife exclusion fencing would be erected around the perimeter of construction sites where spadefoot habitat is within 300 feet, and a biological monitor would conduct daily clearance inspections prior to commencement of activities. Additionally, initial ground disturbance would be avoided between November 1 and March 31 (extended to April 30 during wet years) to the extent feasible; disturbance to rodent burrows would be avoided to the extent feasible; and ground disturbance and vegetation removal would be conducted during periods of no to low rainfall.

AMM-14: *Construction Best Management Practices for Biological Resources* would further reduce the potential for injury or mortality from construction vehicles by setting speed limits; requiring steep-walled holes or trenches more than 6 inches deep be covered or an escape ramp be provided; capping ends of stored pipes and culverts; implementing a relocation plan; and prohibiting plastic monofilament netting or similar material for erosion control (Appendix 3A). To reduce the potential effects of contamination from spills, AMM-2: *Develop and Implement Hazardous Materials Management Plans* and AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans* would require spill prevention and control plans be written and implemented.

## 6.15.12 Effects on Critical Habitat

Critical habitat has not been designated for western spadefoot.

## 6.15.13 Cumulative Effects

Cumulative effects are defined under Section 7 of the Endangered Species Act as the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions are not addressed in a Section 7 cumulative effects analysis because they require separate consultation pursuant to Section 7 of the Endangered Species Act. Potential cumulative effects on western spadefoot in the action area include habitat loss and fragmentation, changes in agricultural and land management practices, predation from introduced and native species, and water pollution. Both habitat loss and fragmentation, and changes in land management practices, could result from conversion of agricultural land to more developed land uses (which is not likely to be extensive due to existing constraints upon land use changes) or from conversion of agricultural land to different crop types having lower habitat suitability (which is not foreseeable). Habitat loss or degradation from agricultural practices is not expected to increase in the foreseeable future as agriculture in the Delta is assumed to be fully developed. Predation by an existing introduced native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable, nor are the consequences of such an introduction.

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Chapter 7
# Effects Determinations

## 7.1 Introduction

The Biological Assessment (BA) determination of effects on listed species and their designated critical habitat presented in this chapter considers direct and indirect effects of the proposed action. As detailed in Section 1.7, *Consultation Approach,* of Chapter 1, *Introduction*, this BA focuses on construction-related effects. However, the determination of effects also considers dependent effects associated with proposed operations of the proposed action as described in Appendix 7A (*Framework Programmatic Assessment for the Delta Conveyance Project and Sites Reservoir Project*). Proposed operations for the Delta Conveyance Project are included in this BA to support assessment of the project as a whole. Operations and maintenance are assessed at a programmatic level for this BA; detailed effects analyses, as well as the qualitative, cumulative, and programmatic analyses that they inform, are presented in Appendix 5C, *Operations and Maintenance Effects Analysis for Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*, and Appendix 6C, *Operations and Maintenance Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species*.

The determination of effects in this chapter also considers effects associated with actions identified in the environmental baseline and effects anticipated to result from future state or private activities that are reasonably certain to occur (i.e., cumulative effects). This chapter presents a summary of the effects on the listed species and their designated critical habitat from construction of the proposed action that were discussed in detail in Chapters 4 through 6.

## 7.2 Chinook Salmon, Sacramento River Winter-Run Evolutionarily Significant Unit

### 7.2.1 Determination of Effects on Sacramento River Winter-Run Chinook Salmon

The proposed action is expected to result in incidental take of Sacramento River winter-run Evolutionarily Significant Unit (ESU) Chinook salmon associated with construction effects because there would be the potential for spatial and temporal overlap with the species population, as well as loss of aquatic habitat. Specific construction activities with potential effects include pile driving, in-water use of construction equipment, and the accidental discharge of contaminants (Chapter 5, *Effects Analysis for Chinook Salmon, California Central Valley Steelhead, Green Sturgeon, and Killer Whale*, Section 5.4, *Effects of Water Facility Construction on Chinook Salmon, Central Valley Steelhead, and Green Sturgeon*). Pile driving during construction at the north Delta intakes would result in sound levels potentially harmful to fish in the vicinity when adult Sacramento River winter-run Chinook salmon could be present in the north Delta (June and July). While acoustic effects (sounds levels) are a prominent source of potential impact, other sources of potential impacts include water quality effects, direct physical injury, prey availability, predation, water temperature, and habitat extent. Juvenile Sacramento River winter-run Chinook salmon are not expected to be in the north Delta from June through October. In addition to pile driving, the effects of construction activities include permanent loss of channel margin habitat of approximately 3,124 linear feet of Sacramento

River channel and a temporary impact on 494 linear feet. Tidal perennial habitat would also be affected, with a permanent loss of 5.6 acres and a temporary loss of 1.5 acres.

These impacts would be minimized through avoidance and minimization measures (AMMs), including channel margin and tidal perennial habitat restoration (Table 3B.S-1). The loss of the channel margin habitat directly affects designated critical habitat and would be mitigated at an approved restoration site and/or through the purchase of conservation credits at an approved conservation bank. Additionally, construction-related impacts would be minimized by AMM-26: *Develop and Implement an Underwater Sound Control and Abatement Plan* and AMM-27: *Develop and Implement a Barge Operations Plan.*

The proposed action also contains several general AMMs described in Appendix 3A, *General Avoidance and Minimization Measures*, that would avoid and minimize effects on Sacramento River winter-run Chinook salmon. These general AMMs include AMM-1: *Conduct Environmental Resources Worker Awareness Training*; AMM-2: *Develop and Implement Hazardous Materials Management Plans*; AMM-3: *Develop and Implement Spill Prevention, Control, and Countermeasure Plans*; AMM-4a: *Develop and Implement Erosion and Sediment Control Plans*; AMM-4b: *Develop and Implement Stormwater Pollution Prevention Plans*; and AMM-14: *Construction Best Management Practices for Biological Resources*. AMM-14: *Construction Best Management Practices for Biological Resources* includes an in-water work window to limit temporal overlap of fish and aquatic resources with construction activities, particularly for listed species such as migrating salmonids. The in-water work period varies depending on location/activity, but is generally from June to October, thereby avoiding or limiting temporal overlap with species such as Sacramento River winter-run Chinook salmon.

Operations and maintenance of the new water conveyance facilities are dependent on the construction associated with the proposed action. As described in Appendix 5C, there is the potential for adverse effects on Sacramento River winter-run Chinook salmon from operations and maintenance because of factors such as near-field effects (e.g., impingement and predation at the north Delta intakes) and far-field effects (e.g., reduced flow leading to lower through-Delta survival or inundation of riparian and wetland bench rearing habitat). Such effects would be minimized through measures such as the north Delta intake cylindrical fish screens and operating criteria, as well as through compensatory mitigation (tidal perennial habitat and channel margin habitat).

In summary, in consideration of the potential effects of the proposed action and the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may affect, and is likely to adversely affect, the Sacramento River winter-run Chinook salmon ESU.

### 7.2.2 Cumulative Effects and the Changing Baseline

Cumulative effects on Sacramento River winter-run Chinook salmon include effects associated with water diversions, agricultural practices, and increased urbanization. These effects would accrue over the duration of the proposed action. Non-federal water diversions are potentially a cause of mortality via entrainment, but ongoing projects, such as the CVPIA fish screen program, are reducing the number of such diversions and their mortality risk, so this effect is likely to diminish over time. Potentially adverse agricultural practices primarily entail water quality impairments; the action area is already fully developed with regard to agricultural land uses, and regulations in place constrain the associated water quality effects, so this effect is likely to be maintained in the future. Adverse effects of urbanization include point- and nonpoint-source water quality impairments and increased vessel traffic in waterways. These activities are likely to further degrade Chinook salmon habitat over time. Some of these effects will improve, and others would impair habitat quality for Chinook salmon in the action area; their net effect is to maintain current conditions approximately

for the foreseeable future because improvements are generally implemented to compensate for adverse project effects through the Endangered Species Act (ESA) consultation and other environmental review processes. These cumulative effects have little potential to impair the effectiveness of AMMs described in the proposed action, nor are they expected to alter the efficacy of offsetting measures in the proposed action, such as habitat creation and restoration. The environmental baseline for Sacramento River winter-run Chinook salmon is described in Chapter 4, *Action Area and Environmental Baseline*. The baseline is expected to change given the span of time until the beginning of water operations under the proposed action and of the duration of the proposed operations. The principal anticipated changes include climate change and certain federal actions that are reasonably certain to occur but have not yet been implemented. Foreseeable climate change effects, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for Chinook salmon and increase year-to-year fluctuations in population sizes, although there is the potential for some positive effects as well as negative effects. For example, juvenile Chinook salmon through-Delta survival modeling comparing the No Project Alternative (2040) to existing conditions (2020) found modest positive differences during December–April, with negative effects in other months during October–June (see discussion of No Project Alternative operations effects on winter-run Chinook salmon in *Delta Conveyance Project Final EIR* [California Department of Water Resources 2023]). There also would be changes in the marine environment where Chinook salmon spend most of their life cycle. Marine changes, and their likely effects on Chinook salmon, are difficult to forecast, and may include both beneficial and adverse consequences.

### 7.2.3 Determination of Effects on Sacramento River Winter-Run Chinook Salmon Designated Critical Habitat

The proposed action is likely to adversely affect the physical and biological features of designated critical habitat for Sacramento River winter-run Chinook salmon because of the temporary impairment of critical habitat functions associated with in-water construction activities and the permanent impairment associated with permanent placement of in-water structures. In summary, the proposed action is likely to adversely affect the physical and biological features of designated critical habitat for Sacramento River winter-run Chinook salmon because of the temporary impairment of critical habitat functions associated with in-water construction activities and permanent impairment associated with permanent placement of in-water structures. However, these effects would be avoided, minimized, and/or compensated for. The impairment associated with in-water construction activities would be minimized through AMMs. The impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial aquatic habitat and channel margin restoration (Appendix 3B, *Compensatory Mitigation Plan for Special-Status Species and Aquatic Resources*, Attachment 3B.1, *Compensatory Mitigation Design Parameters*, CMP-23: *Tidal Perennial Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic Resources*, and CMP-24: *Channel Margin Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic Resources*).

# 7.3 Chinook Salmon, Central Valley Spring-Run Evolutionarily Significant Unit

## 7.3.1 Determination of Effects on Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit

The proposed action is expected to result in incidental take of Central Valley spring-run ESU Chinook salmon associated with construction effects because there would be the potential for spatial and temporal overlap with the species population as well as loss of aquatic habitat. Specific construction activities with potential effects include pile driving, in-water use of construction equipment, fish-rescue efforts, and possibly the accidental discharge of contaminants (Chapter 5, Section 5.4). Pile driving during construction at the north Delta intakes and bridges would result in sound levels potentially harmful to fish in the vicinity when adult Central Valley spring-run Chinook salmon could be present in the north Delta (June–August). Juvenile Central Valley spring-run Chinook salmon are not expected to be in the north Delta from June to October. In addition to pile driving, there would be a permanent loss of channel margin habitat of approximately 3,124 linear feet of Sacramento River channel and a temporary impact of 494 linear feet. Tidal perennial habitat would also be affected, with a permanent loss of 5.6 acres and a temporary loss of 1.5 acres.

As discussed in Section 7.2, *Chinook Salmon, Sacramento River Winter-Run Evolutionarily Significant Unit*, the impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial aquatic habitat and channel margin restoration (Appendix 3B, Attachment 3B.1, CMP-23: *Tidal Perennial Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic* Resources, and CMP-24: *Channel Margin Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic Resources*).

Operations and maintenance of the new water conveyance facilities are dependent on the construction associated with the proposed action. As described in Appendix 5C, there is the potential for adverse effects on Central Valley spring-run Chinook salmon from operations and maintenance because of factors such as near-field effects (e.g., impingement and predation at the north Delta intakes) and far-field effects (e.g., reduced flow leading to lower through-Delta survival or inundation of riparian and wetland bench rearing habitat). Such effects would be minimized through measures such as the north Delta intake cylindrical fish screens and operating criteria, as well as through compensatory mitigation (tidal perennial habitat and channel margin habitat).

In summary, in consideration of the potential effects of the proposed action and the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may, affect and is likely to adversely affect, the Central Valley spring-run Chinook salmon ESU.

## 7.3.2 Cumulative Effects and the Changing Baseline

Cumulative effects on Central Valley spring-run Chinook salmon are the same as those effects on the Sacramento River winter-run Chinook salmon. Cumulative effects on Central Valley spring-run Chinook salmon include effects associated with water diversions, agricultural practices, increased urbanization, and climate change. Refer to Section 7.2.2, *Cumulative Effects and the Changing Baseline*, for additional information.

### 7.3.3 Determination of Effects on Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit Designated Critical Habitat

The proposed action is likely to adversely affect the physical and biological features of designated critical habitat for Central Valley spring-run Chinook salmon due to the temporary impairment of critical habitat functions associated with in-water construction activities and permanent impairment associated with permanent placement of in-water structures.

In summary, the proposed action is likely to adversely affect the physical and biological features of designated critical habitat for Central Valley spring-run Chinook salmon because of the temporary impairment of critical habitat functions associated with in-water construction activities and permanent impairment associated with permanent placement of in-water structures. However, these effects would be avoided, minimized, and/or compensated for. The impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial habitat and channel margin restoration (Section 3B.4.3, *Tidal Habitat Mitigation Framework*, in Appendix 3B).

## 7.4 Steelhead, California Central Valley Distinct Population Segment

### 7.4.1 Determination of Effects on California Central Valley Distinct Population Segment Steelhead

The proposed action is expected to result in incidental take of California Central Valley Distinct Population Segment (DPS) steelhead associated with construction effects because there would be the potential for spatial and temporal overlap with the species population, as well as loss of aquatic habitat. Specific construction activities with potential effects include pile driving, in-water use of construction equipment, fish rescue efforts, and possibly the accidental discharge of contaminants (Chapter 5, Section 5.4). Pile driving during construction at the north Delta intakes and bridges would result in sound levels potentially harmful to fish in the vicinity when adult and juvenile California Central Valley steelhead could be present in the north Delta (June–October). In addition to pile driving, there would be a permanent loss of channel margin habitat of approximately 3,124 linear feet of Sacramento River channel and a temporary impact of 494 linear feet. Tidal perennial habitat would also be affected, with a permanent loss of 5.6 acres and a temporary loss of 1.5 acres.

As discussed in Section 7.2, the impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial aquatic habitat and channel margin restoration (Appendix 3B, Attachment 3B.1, CMP-25: *Tidal Habitat Restoration to Mitigate North Delta Hydrodynamic Effects on Chinook Salmon Juveniles* and CMP-26: *Channel Margin Habitat Restoration for Operations Impacts on Chinook Salmon Juveniles*).

Operations and maintenance of the new water conveyance facilities are dependent on the construction associated with the proposed action. As described in Appendix 5C, there is the potential for adverse effects on California Central Valley steelhead from operations and maintenance because of factors such as near-field effects (e.g., impingement and predation at the north Delta intakes) and far-field effects (e.g., reduced flow leading to lower through-Delta survival). Such effects would be minimized through measures such as the north Delta intake cylindrical fish screens

and operating criteria, as well as through compensatory mitigation (tidal perennial habitat and channel margin habitat).

In summary, in consideration of the potential effects of the proposed action and the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may affect, and is likely to adversely affect, the California Central Valley steelhead.

### 7.4.2 Cumulative Effects and the Changing Baseline

Cumulative effects on California Central Valley steelhead are the same as those effects on the Sacramento River winter-run Chinook salmon. Cumulative effects on California Central Valley steelhead include effects associated with water diversions, agricultural practices, increased urbanization, and climate change. Refer to Section 7.2.2 for additional information.

### 7.4.3 Determination of Effects on California Central Valley Steelhead Distinct Population Segment Designated Critical Habitat

The proposed action is likely to adversely affect the physical and biological features of designated critical habitat for California Central Valley steelhead because of the temporary impairment of critical habitat functions associated with in-water construction activities and the permanent impairment associated with permanent placement of in-water structures.

In summary, the proposed action is likely to adversely affect the physical and biological features of designated critical habitat for California Central Valley steelhead because of the temporary impairment of critical habitat functions associated with in-water construction activities and permanent impairment associated with permanent placement of in-water structures. However, these effects would be avoided, minimized, and/or compensated for. The impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial habitat and channel margin restoration.

## 7.5 Green Sturgeon, Southern Distinct Population Segment

### 7.5.1 Determination of Effects on Southern Distinct Population Segment Green Sturgeon

The proposed action may result in incidental take of Southern DPS green sturgeon associated with construction effects because there would be the potential for spatial and temporal overlap with the species population, as well as loss of aquatic habitat. Specific construction activities with potential effects include pile driving, in-water use of construction equipment, fish-rescue efforts, and possibly the accidental discharge of contaminants (Chapter 5, Section 5.4). Pile driving during construction at the north Delta intakes and bridges would result in sound levels potentially harmful to fish in the vicinity when adult and juvenile green sturgeon could be present in the north Delta (June–October), although there is evidence based on other sturgeon species that individuals may move away from the vicinity of impact pile driving (Krebs et al. 2016). There would be a permanent loss of channel margin habitat of approximately 3,124 linear feet of Sacramento River channel and a temporary impact on 494 linear feet.

As discussed in Section 7.2, the impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial aquatic habitat and channel margin restoration (Appendix 3B, Attachment 3B.1, CMP-25: *Tidal Habitat Restoration to Mitigate North Delta Hydrodynamic Effects on Chinook Salmon Juveniles* and CMP-26: *Channel Margin Habitat Restoration for Operations Impacts on Chinook Salmon Juveniles*).

Operations and maintenance of the new water conveyance facilities are dependent on the construction associated with the proposed action. As described in Appendix 5C, there is the potential for adverse effects on green sturgeon from operations and maintenance because of factors such as reduced Delta outflow, although this is uncertain. In summary, in consideration of the potential effects of the proposed action and the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may affect, and is likely to adversely affect, the Southern DPS green sturgeon.

### 7.5.2 Cumulative Effects and the Changing Baseline

Cumulative effects on Southern DPS green sturgeon are consistent with the other fish species discussed in Sections 7.2, 7.3, *Chinook Salmon, Central Valley Spring-Run Evolutionarily Significant Unit*, and 7.4, *Steelhead, California Central Valley Distinct Population Segment*. Cumulative effects on Southern DPS green sturgeon include effects associated with water diversions, agricultural practices, increased urbanization, and climate change. Refer to Section 7.2.2 for additional information.

### 7.5.3 Determination of Effects on Southern Distinct Population Segment Green Sturgeon Designated Critical Habitat

The proposed action is likely to adversely affect the physical and biological features of designated critical habitat for Southern DPS green sturgeon due to the temporary impairment of critical habitat functions associated with in-water construction activities and permanent placement of in-water structures. Effects on Southern DPS green sturgeon critical habitat would be avoided, minimized, and/or compensated for. The impairment associated with in-water construction activities would be minimized through AMMs. The impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial aquatic habitat and channel margin habitat (Appendix 3B, Attachment 3B.1, CMP-23: *Tidal Perennial Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic Resources* and CMP-24: *Channel Margin Habitat Restoration for Construction Impacts on Habitat for Fish and Aquatic Resources*).

## 7.6 Killer Whale, Southern Resident Distinct Population Segment

### 7.6.1 Determination of Effects on Southern Resident Killer Whale

The proposed action has insignificant potential to alter the Southern Resident DPS killer whale prey base. The effects analysis for salmonids, including the essential fish habitat (EFH) assessment, including fall-run Chinook salmon, does not find evidence that the proposed action would lead to any measurable reduction in abundance of Central Valley salmonid populations that would affect the

Southern Resident DPS killer whale prey base. Based on the effects analysis and in consideration of the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may affect, but is not likely to adversely affect, Southern Resident DPS killer whale.

### 7.6.2 Cumulative Effects and the Changing Baseline

Cumulative effects of the proposed action on Southern Resident DPS killer whale are anticipated to be limited. Refer to Section 7.2.2 for additional information.

### 7.6.3 Determination of Effects on Southern Resident Killer Whale Designated Critical Habitat

Based on the effects analysis, the proposed action would have no effect on designated critical habitat for the Southern Resident DPS killer whale due to the proposed action's negligeable potential to affect the Southern Resident DPS killer whale prey base.

## 7.7 Delta Smelt

### 7.7.1 Determination of Effects on Delta Smelt

The proposed action has the potential to result in incidental take of delta smelt associated with construction effects, including underwater noise from pile driving, in-water use of construction equipment, fish-rescue efforts, and accidental discharge of contaminants (Chapter 6, *Effects Analysis for Delta Smelt, Longfin Smelt, and Terrestrial Species*, Section 6.1.1, *Effects of Construction Activities on Delta Smelt*). The effects of construction activities would be minimized through AMMs, and all habitat losses would be offset by tidal perennial habitat restoration. Additionally, in-water construction activities would occur in areas where (and/or during periods when) delta smelt are likely not present but could be present in very low densities. As described in Chapter 6, Section 6.1.1, the timing of in-water work (June–October) avoids adult migration (December–March) and limits temporal overlap with spawning adults (February–June), eggs/embryos (March–June), and larvae/young juveniles (March–June). Although there is greater temporal overlap with juveniles (~July–December), there would be very limited spatial overlap because delta smelt juveniles would have moved downstream. As described in Chapter 6, Section 6.1.1.6, *Loss or Alteration of Habitat*, outside of the in-water work window, the presence of cofferdams at the north Delta intakes could impede or delay access to upstream shallow habitat for migrating adults, but adults could use low-velocity habitat along the opposite riverbank from the cofferdams, near the river bottom, or as created by the flutes of the cofferdams themselves. As 2D modeling illustrates, suitably low-velocity habitat would be present even at relatively high river flows. Given the location of the north Delta intakes upstream of the main range of delta smelt, there would be limited spatial overlap with construction locations in any case.

Operations and maintenance of the new water conveyance facilities are dependent on the construction associated with the proposed action. As described in Appendix 6C, there is the potential for adverse effects on delta smelt from operations and maintenance because of factors such as north Delta intake effects (e.g., entrainment, impingement, upstream access, and predation) and habitat effects (e.g., reduced food availability and sediment entrainment). Such effects would be minimized through measures such as the north Delta intake cylindrical fish screens and operating criteria, AMM-15: *Sediment Monitoring, Modeling, and Reintroduction Adaptive Management*, and compensatory mitigation (tidal perennial habitat).

In summary, in consideration of the potential effects of the proposed action and the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may affect, and is likely to adversely affect, delta smelt.

### 7.7.2 Cumulative Effects and the Changing Baseline

Cumulative effects on delta smelt are consistent with those effects on the other fish species discussed in Sections 7.2, 7.3, 7.4, and 7.5, *Green Sturgeon, Southern Distinct Population Segment*. Cumulative effects on delta smelt include effects associated with water diversions, agricultural practices, increased urbanization, and climate change. Refer to Section 7.2.2 for additional information.

### 7.7.3 Determination of Effects on Delta Smelt Critical Habitat

The proposed action is likely to adversely affect the physical and biological features of designated critical habitat for delta smelt due to the temporary impairment of critical habitat functions associated with in-water construction activities and permanent impairment associated with permanent placement of in-water structures.

In summary, the proposed action is likely to adversely affect the physical and biological features of designated critical habitat for delta smelt because of the temporary impairment of critical habitat functions associated with in-water construction activities and permanent placement of in-water structures. However, these effects would be avoided, minimized, and/or compensated for. The impairment associated with permanent placement of in-water structures would be offset by habitat restoration in the form of tidal perennial habitat. The impairment associated with in-water construction activities would be minimized through AMMs. The impairment associated with permanent placement of in-water structures and dependent operations-related effects would be offset by the development of tidal habitat.

## 7.8 Longfin Smelt

### 7.8.1 Determination of Effects on Longfin Smelt

The proposed action has the potential to result in incidental take of longfin smelt associated with construction effects, including underwater noise from pile driving, in-water use of construction equipment, fish-rescue efforts, and accidental discharge of contaminants (Chapter 6, Section 6.2.1, *Effects of Construction Activities on Longfin Smelt*). As discussed in Chapter 6, Section 6.2.1, larvae may be present in the north Delta from January to June and therefore may have some spatial/temporal overlap with construction. The effects of construction activities would be minimized through AMMs, and all habitat losses would be offset by tidal perennial habitat restoration. Additionally, in-water construction activities would occur in areas where (and/or during periods when) longfin smelt are likely not present but could be present in very low densities.

Operations and maintenance of the new water conveyance facilities are dependent on the construction associated with the proposed action. As described in Appendix 6C, there is the potential for adverse effects on longfin smelt from operations and maintenance because of factors such as north Delta intake effects (e.g., entrainment, impingement, upstream access, and predation) and habitat effects (e.g., Delta outflow-abundance). Such effects would be minimized through measures such as the north Delta intake cylindrical fish screens and operating criteria, and through compensatory mitigation (tidal perennial habitat).

In summary, in consideration of the potential effects of the proposed action and the dependent action of operations and maintenance of the new water conveyance facilities once constructed, the proposed action may, affect and is likely to adversely affect, longfin smelt.

### 7.8.2 Cumulative Effects and the Changing Baseline

Cumulative effects on longfin smelt are consistent with those effects on the other fish species discussed in Sections 7.2, 7.3, 7.4, 7.5, and 7.7, *Delta Smelt*. Cumulative effects on longfin smelt include effects associated with water diversions, agricultural practices, increased urbanization, and climate change. Refer to Section 7.2.2 for additional information.

## 7.9 San Joaquin Kit Fox

### 7.9.1 Determination of Effects on San Joaquin Kit Fox

There is low potential for the proposed action to affect San Joaquin kit fox. The proposed action will result in the permanent loss of 38.69 acres of modeled low-quality dispersal habitat, 0.06 acres of modeled moderate quality habitat, and 0.13 acres of modeled high quality habitat. Field investigations and construction of access roads would temporarily disturb another 16.94 acres of modeled low- quality habitat, 0.06 acre of which is modeled high-quality habitat, and 0.02 acre of which is modeled moderate-quality habitat. However, the San Joaquin kit fox modeled habitat that overlaps with the proposed action is in a "very low" condition, which is defined by the U.S. Fish and Wildlife Service (USFWS) as showing "no evidence of a current population" (U.S. Fish and Wildlife Service 2020:50). The species has not been detected in the region since 2000 (CNDDB occurrence #34), when there was an observation of dens (not adults), hearing a "yip," and relying on observations of Western Area Power Authority employees (California Department of Fish and Wildlife 2020a). An unverified San Joaquin kit fox from the southeast edge of the city of Tracy was reported in 2015 (ICF 2019:3-11), which is approximately 8 miles southeast of the project area. The species has not been detected, nor is it expected to occur elsewhere within the action area, as shown on Figure 6.3.

While there is very low potential for an individual to be present in the vicinity of the proposed action, if the species were to occur it would be likely to be adversely affected by the permanent loss of 38.88 acres of modeled San Joaquin kit fox habitat. These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of injury, mortality, and harassment of individuals and would be offset by the creation and enhancement of 178.74 acres of grassland and vernal pool complex habitat protected and managed for California tiger salamander. This conservation action will occur in the Concord/Livermore Recovery Unit for California tiger salamander which overlaps with San Joaquin kit fox habitat and would benefit the fox if it reestablishes in the region.

### 7.9.2 Determination of Effects on San Joaquin Kit Fox Designated Critical Habitat

Critical habitat has not been designated for San Joaquin kit fox.

# 7.10 California Least Tern

## 7.10.1 Determination of Effects on California Least Tern

There is minimal potential for the proposed action to affect California least tern. Nesting habitat would be avoided with a 500-foot buffer; and while the proposed action would result in the permanent loss of 6.96 acres of open water that constitute modeled California least tern foraging habitat, 3,500 acres of tidal perennial aquatic restoration (Appendix 3B, Section 3B.4.3) would result in a net gain of 3,492.98 acres of foraging habitat. Field investigations and construction of access road, supervisory control and data acquisition (SCADA) facilities would temporarily disturb another 4.16 acres of foraging habitat. The only construction activity that occurs within 2 miles—the typical foraging distance for California least tern (Atwood and Minsky 1983)—of a known nesting location (Bufferlands) is the north Delta intake and adjacent access roads. However, foraging habitat in the region (i.e., San Francisco Bay and the study area) is abundant and is not considered limiting for California least tern (e.g., there are 9,021.95 acres of modeled foraging habitat in the action area, as shown on Figure 6.4). Also, the project would result in a net gain of foraging habitat. Therefore, because of the nesting avoidance measure, the amount of available foraging habitat in the action area, the proposed action's distance from known nesting sites, the net gain in total foraging habitat, and the insignificant total permanent and temporary foraging habitat loss due to the proposed action, it is concluded that the proposed action may affect, but is not likely to adversely affect, California least tern.

## 7.10.2 Determination of Effects on California Least Tern Designated Critical Habitat

Critical habitat has not been designated for California least tern.

# 7.11 Least Bell's Vireo

## 7.11.1 Determination of Effects on Least Bell's Vireo

Overall effects of the proposed action on least Bell's vireo would include removal of 9.68 acres of modeled recolonization habitat. This loss would be offset with the restoration or creation of 19.36 acres of recolonization habitat (Table 6.5-2). Toward this goal, California Department of Water Resources (DWR) would create and enhance up to 204.79 acres of suitable least Bell's vireo recolonization habitat (riparian habitat), primarily on Bouldin Island, as described in Table 3B-4 in Appendix 3B. The proposed action may affect least Bell's vireo based on the following factors.

- Project-related activities would occur within and adjacent to modeled least Bell's vireo habitat.
- Least Bell's vireos have been detected near the action area, as shown on Figure 6.5, in recent years.
- Restoration of least Bell's vireo habitat would beneficially affect the species.

The proposed action is likely to adversely affect least Bell's vireo as the result of harm from the permanent loss of 9.68 acres of least Bell's vireo habitat. These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of injury, mortality, and harassment of individuals and would be offset by the creation and enhancement of 19.36 acres of suitable habitat based on current project impact estimates.

Thus, the proposed action may affect, and is likely to adversely affect, the least Bell's vireo.

### 7.11.2 Cumulative Effects

Potential cumulative effects on least Bell's vireo in the action area, as shown on Figure 6.5, include habitat loss and fragmentation and predation from native and non-native species. Habitat loss and fragmentation could result from conversion of riparian habitat to alternative cover types, which is not likely to be extensive because of existing regulatory constraints instituted to protect riparian natural communities. Predation by existing native and non-native species would be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable, nor are the consequences of such an introduction. These cumulative effects are not expected to substantially impair habitat quality for least Bell's vireo in the action area. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the proposed action, nor are they expected to alter the efficacy of offsetting measures in the proposed action such as habitat creation and restoration.

Climate change is likely to alter habitat conditions for least Bell's vireo between now and the completion of the proposed action. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2*., Physical Environment* include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for least Bell's vireo by increasing the frequency of flood disturbance in riparian habitat, and potentially increasing the fragmentation of that habitat.

### 7.11.3 Determination of Effects on Least Bell's Vireo Designated Critical Habitat

There is no designated least Bell's vireo critical habitat in the action area.

## 7.12 Western Yellow-Billed Cuckoo

### 7.12.1 Determination of Effects on Western Yellow-Billed Cuckoo

Overall effects of the proposed action on western yellow-billed cuckoo would include the loss of 9.68 acres of habitat. This loss would be offset with the restoration or creation of 19.36 acres of migratory habitat (Table 6.6-2). Toward this goal, DWR would create and enhance up to 204.79 acres of suitable western yellow-billed cuckoo migratory habitat (riparian habitat), primarily on Bouldin Island, as described in Table 3B-4 in Appendix 3B. The proposed action may affect western yellow-billed cuckoo based on the following factors.

- Project-related activities would occur within and adjacent to western yellow-billed cuckoo modeled habitat.
- Migratory western yellow-billed cuckoos have been detected in the action area, as shown in Figure 6.6, in recent years.
- Creation and enhancement of western yellow-billed cuckoo migratory habitat (riparian habitat) will beneficially affect the species.

The proposed action is likely to adversely affect the western yellow-billed cuckoo as the result of harm from the permanent loss of 9.68 acres of modeled western yellow-billed cuckoo migratory habitat. These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of injury, mortality, and harassment of individuals, and offset by the creation and enhancement of 19.36 acres of suitable habitat based on current project impact estimates.

Thus, the proposed action may affect, and is likely to adversely affect, the western yellow-billed cuckoo.

### 7.12.2 Cumulative Effects

Potential cumulative effects on western yellow-billed cuckoo in the action area, as shown on Figure 6.6, include habitat loss, habitat fragmentation, and predation from non-native and native species. Habitat loss and fragmentation could result from conversion of riparian habitat to alternative cover types, which is not likely to be extensive because of existing regulatory constraints instituted to protect riparian natural communities. Predation by existing native and non-native species would be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable; nor are the consequences of such an introduction. These cumulative effects are not expected to substantially impair habitat quality for western yellow-billed cuckoo in the action area. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the proposed action, nor are they expected to alter the efficacy of offsetting measures in the proposed action such as habitat creation and restoration.

Climate change is likely to alter habitat conditions for western yellow-billed cuckoo between now and the completion of the proposed action. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2, *Physical Environment*, include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, larger floods. These effects would tend to impair habitat quality and quantity for western yellow-billed cuckoo by increasing the frequency of flood disturbance in riparian habitat and thus scouring and clearing areas of habitat temporarily, and potentially increasing the fragmentation of that habitat.

### 7.12.3 Determination of Effects on Western Yellow-Billed Cuckoo Designated Critical Habitat

There is no designated western yellow-billed cuckoo critical habitat in the action area, as shown on Figure 6.6.

## 7.13 California Red-Legged Frog

### 7.13.1 Determination of Effects on California Red-Legged Frog

Permanent effects of the proposed action on California red-legged frog and its habitat would be small and would be offset with protection and restoration of its habitat. The proposed action may affect the California red-legged frog based on the following factors.

- Project-related activities would occur within and adjacent to California red-legged frog modeled habitat.

- California red-legged frog presence has been recorded in the vicinity of areas proposed for clearing and construction.
- Protection or restoration of California red-legged frog habitat would beneficially affect the species.

The proposed action is likely to adversely affect the California red-legged frog as follows.

- Harm could result from the permanent and temporary loss of 0.34 acre of modeled aquatic habitat, 9.78 acres of modeled upland habitat and 411.45 acres of modeled dispersal habitat and potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance activities.
- Harassment could result from noise, lighting, and vibrations, and other human disturbance adjacent to occupied California red-legged frog habitat during construction, operations, and maintenance.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of individuals and offset by the protection and restoration of 0.21 acre of aquatic habitat and 7.00 acres of upland habitat based on current project impact estimates.

Thus, the proposed action may affect, and is likely to adversely affect, the California red-legged frog.

## 7.13.2 Cumulative Effects

Potential cumulative effects on California red-legged frog in the action area, as shown on Figure 6.7, include habitat loss and impairment, primarily through conversion of rangeland to more developed land uses. This is not likely to be extensive, because of lower developmental pressures and existing or developing habitat conservation plans (East Contra Costa County HCP/NCCP) in the region of the action area that includes California red-legged frog modeled habitat.

Climate change is likely to alter habitat conditions for California red-legged frog between now and the completion of the proposed action. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2. *Physical Environment*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for California red-legged frog, with potential adverse effects on species status in the action area.

## 7.13.3 Determination of Effects on California Red-Legged Frog Designated Critical Habitat

The proposed action overlaps with designated California red-legged frog critical habitat unit CCA-2B west of Clifton Court Forebay as described in Chapter 6, Section 6.6.12, *Effects on Critical Habitat*. The project would permanently remove 0.21 acre of modeled aquatic habitat, 7.06 acres of modeled upland habitat, and 363.48 acres of modeled dispersal habitat within this unit. Of the removed modeled habitat that overlaps with critical habitat unit CCA-2B, 0.01 acre of modeled aquatic habitat meets the criteria of primary constituent element (PCE) 1 and PCE 2; 1.65 acres of modeled upland habitat partially meet the criteria for PCE 3; and 43.61 acres of modeled dispersal habitat meet the criteria for PCE 3 and PCE 4. As these modeled acres are assumed to meet the criteria for several of the PCEs, these acres are therefore assumed to be adversely affected.

This is less than 0.01% of total California red-legged frog designated critical habitat, and 0.10% of California red-legged frog critical habit in Unit CCS-2B (50 Code of Federal Regulations Part 17, 12816–12959). This is less than 0.01% of total California red-legged frog critical habitat, which is over 1.6 million acres.

The project would not appreciably reduce the conservation value of critical habitat for California red-legged frog because the extent of the loss is small compared to the number of critical habitat acres, the 21.66 acres of habitat protection will be in the East San Francisco Bay core recovery area (or another area subject to USFWS approval), and the implementation of avoidance and minimization measures.

# 7.14 California Tiger Salamander

## 7.14.1 Determination of Effects on California Tiger Salamander

Permanent effects of the proposed action on California tiger salamander and its habitat would be small and would be offset with protection and restoration of its habitat. The proposed action may affect the California tiger salamander based on the following factors.

- Project-related activities would occur within and adjacent to California tiger salamander modeled habitat.
- California tiger salamander presence has been recorded in the vicinity of areas proposed for clearing and construction.
- Protection and restoration of California tiger salamander aquatic and upland habitat would beneficially affect the species.

The proposed action is likely to adversely affect the California tiger salamander as follows.

- Harm could result from the permanent and temporary loss of 0.20 acre of modeled aquatic habitat and 79.29 acres of modeled upland habitat potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance activities.
- Harassment could result from noise, lighting, vibrations, and other human disturbance adjacent to occupied California tiger salamander aquatic and upland habitat during construction, operations, and maintenance.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of individuals and offset by the protection or restoration of up to 0.60 acre of aquatic habitat and 178.74 acres of upland habitat based on current project impact estimates.

Thus, the proposed action may affect, and is likely to adversely affect, the California tiger salamander.

## 7.14.2 Cumulative Effects

Potential cumulative effects on California tiger salamander in the action area, as shown on Figure 6.8, include habitat loss and impairment, primarily through conversion of rangeland to more developed land uses. Unauthorized take as a result of urbanization is unlikely because of lower

development pressure and existing or developing habitat conservation plans (East Contra Costa County HCP/NCCP).

Climate change is likely to alter habitat conditions for California tiger salamander between now and the completion of the proposed action. The principal concern is climate change. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2., *Physical Environment*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for California tiger salamander, with potential adverse effects on species status in the action area.

### 7.14.3 Determination of Effects on California Tiger Salamander Designated Critical Habitat

There is no designated California tiger salamander critical habitat in the action area, as shown on Figure 6.8.

## 7.15 Giant Garter Snake

### 7.15.1 Determination of Effects on Giant Garter Snake

Permanent effects of the proposed action on giant garter snake and its habitat would be small and would be offset with the creation or restoration of 21.68 acres of aquatic habitat and 105.03 acres of upland habitat. Toward this goal, DWR would create and enhance up to 18.78 acres of aquatic habitat and up to 130.64 acres of upland habitat at the I-5 ponds, as described in Table 3B-4 in Appendix 3B. The proposed action may affect the giant garter snake based on the following factors.

- Project-related activities will occur within and adjacent to giant garter snake modeled habitat.
- Giant garter snake presence has been recorded in the vicinity of areas proposed for clearing and construction.
- Protection and restoration of giant garter snake habitat would beneficially affect the species.

The proposed action is likely to adversely affect the giant garter snake as follows.

- Harm could result from the permanent and temporary loss of 23.52 acres of aquatic habitat and 108.95 acres of upland habitat potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance activities.
- Harassment could result from noise, lighting, and vibrations, or other human disturbance adjacent to occupied giant garter snake habitat during construction, operations, and maintenance.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of individuals and offset by the creation and restoration of 21.68 acres of aquatic habitat and 105.03 acres of upland habitat.

Thus, the proposed action may affect, and is likely to adversely affect, the giant garter snake.

### 7.15.2 Cumulative Effects

Potential cumulative effects on giant garter snake in the action area, as shown on Figure 6.9, include habitat loss and fragmentation, changes in agricultural and land management practices, predation from non-native and native species, and water pollution. Both habitat loss and fragmentation and changes in land management practices could result from conversion of agricultural land to more developed land uses, from conversion of agricultural land to different crop types having lower habitat suitability, or from changes to irrigation methods (e.g., conversion from flood irrigation to drip irrigation). Predation by existing introduced and native species is likely to be maintained at levels comparable to current conditions; the introduction of new predators or parasites is possible, but not foreseeable; nor are the consequences of such an introduction. Water pollution effects could result from a variety of causes, including agricultural practices, increased urbanization, and wastewater treatment plants. Water quality effects of urbanization include point-source and nonpoint-source water quality impairments, and there is a potential for those effects to further degrade water quality as additional urbanization occurs in the action area. Wastewater treatment plants also contribute to impaired water quality, but significant improvements in discharge water quality and reductions in discharge water volume have occurred in recent years, primarily in response to regulatory and economic factors increasing the value of reusable water; thus, this stressor is likely to diminish over time. Some of these effects would improve, and others would impair habitat quality for giant garter snake in the action area; their net effect would approximately maintain current conditions for the foreseeable future. These cumulative effects have little potential to impair the effectiveness of avoidance and minimization measures described in the proposed action, nor are they expected to alter the efficacy of offsetting measures in the proposed action such as habitat creation and restoration.

Climate change is also likely to alter habitat conditions for giant garter snake between now and the completion of the proposed action. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2. *Physical Environment* , include sea level rise, reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for giant garter snake and would also increase the potential for year-to-year fluctuations in population sizes, with potential adverse effects on species status in the action area.

### 7.15.3 Determination of Effects on Giant Garter Snake Designated Critical Habitat

Critical habitat has not been designated for the giant garter snake.

## 7.16 Delta Green Ground Beetle

### 7.16.1 Determination of Effects on Delta Green Ground Beetle

There is modeled Delta green ground beetle habitat in the action area, but the construction footprint of the proposed action is outside of the modeled habitat for Delta green ground beetle; therefore, the proposed action would not affect the species.

Activities associated with implementation of the CMP tidal habitat mitigation framework in the Cache Slough Complex overlap with Delta green ground beetle modeled habitat. An unknown area of modeled Delta green ground beetle habitat would be affected by tidal wetland restoration. Harm

could occur as a result of land clearing and construction equipment usage within vernal pool habitat where the Delta green ground beetle occurs.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of individuals. Where suitable habitat cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Section 3B.1, *Introduction*, and Section 3B.2.4, *Mitigation Design Parameters*, in Appendix 3B and Table 3B.1-2, CMP-0: *General Design Guidelines* in Attachment 3B.1). If Delta ground beetle habitat is permanently lost, the CMP and site-specific permitting approvals would ensure that there is no significant loss in habitat or habitat value by adjusting the overall commitment (Sections 3B.1 and 3B.2.4 in Appendix 3B and Table 3B.1-2, CMP-0: *General Design Guidelines* in Attachment 3B.1).

Thus, CMP tidal habitat mitigation framework may affect, and is likely to adversely affect, the Delta green ground beetle.

### 7.16.2 Cumulative Effects

Potential cumulative effects on Delta green ground beetle in the action area include habitat loss and impairment, primarily through conversion of vernal pools to more developed land uses and or degradation of vernal pool natural communities through habitat fragmentation and encroachment of development. This is unlikely to occur because of regulatory prohibitions on such activity. If it were to occur, via unauthorized actions, for example, such development could have an adverse effect on Delta green ground beetle in the action area.

Climate change is likely to alter habitat conditions for Delta green ground beetle between now and the completion of the proposed action. The principal concern is climate change. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2. *Physical Environment*, include increased climate variability as seen in changes such as more intense droughts and larger floods. These effects would tend to impair habitat quality and quantity for Delta green ground beetle, with potential adverse effects on species status in the action area. The environmental baseline for Delta green ground beetle may also be affected by future habitat protection and restoration efforts in the Delta that may protect existing habitat or create new habitat.

### 7.16.3 Determination of Effects on Delta Green Ground Beetle Designated Critical Habitat

Critical habitat has been designated for Delta green ground beetle and occurs in the western extent of the the action area, west of Hasting Tract. No construction activiies would take place in Delta green ground beetle crtical habitat; therefore, the proposed action would have no effect on designated critical habitat for Delta green ground beetle.

## 7.17 Valley Elderberry Longhorn Beetle

### 7.17.1 Determination of Effects on Valley Elderberry Longhorn Beetle

Permanent effects of the proposed action on valley elderberry longhorn beetle and its habitat would be small and would be offset with the restoration or creation of 38.94 acres of riparian habitat. Toward this goal, DWR would create and enhance up to 204.79 acres of riparian habitat, primarily

on Bouldin Island, as described in Table 3B-4 in Appendix 3B. The proposed action may affect the valley elderberry longhorn beetle based on the following factors.

- Project-related activities would occur within and adjacent to valley elderberry longhorn beetle modeled habitat.
- Protection of riparian habitat suitable and managed for elderberry shrubs and planting of elderberry seedlings and associated natives in conservations areas would beneficially affect the species.

The proposed action is likely to adversely affect the valley elderberry longhorn beetle as follows.

- Harm could result from the permanent and temporary loss of 30.36 acres of modeled riparian habitat.
- Harm could also result from the deposition of construction-related dust and other airborne particulate matter on elderberry shrubs, which could stress and damage shrubs, resulting in effects on valley elderberry longhorn beetle.
- Harm could occur as a result of transplanting shrubs that are occupied and operating equipment in the vicinity of occupied shrubs if adults are actively dispersing between shrubs.
- Harassment could result from lighting, dust, and other disturbances adjacent to occupied valley elderberry longhorn beetle habitat during construction, operations, and maintenance.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of injury, mortality, and harassment of individuals, and offset by the creation and enhancement of up to 38.94 acres of riparian habitat into which elderberry seedlings and transplanted shrubs would be planted.

Thus, the proposed action may affect, and is likely to adversely affect, the valley elderberry longhorn beetle.

## 7.17.2 Cumulative Effects

Potential cumulative effects on valley elderberry longhorn beetle in the action area include habitat loss and impairment. Although unlikely to occur because of land use controls, such development could have an adverse effect on valley elderberry longhorn beetle in the action area.

Climate change is also likely to alter habitat conditions for valley elderberry longhorn beetle between now and the completion of the proposed action. The principal concern is climate change. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2. *Physical Environment*, include increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for valley elderberry longhorn beetle, with potential adverse effects on species status in the action area.

## 7.17.3 Determination of Effects on Valley Elderberry Longhorn Beetle Designated Critical Habitat

Critical habitat has been designated for valley elderberry longhorn beetle, but does not occur within the action area. The proposed action would have no effect on designated critical habitat for valley elderberry longhorn beetle.

# 7.18 Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

## 7.18.1 Determination of Effects on Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

Permanent effects of the proposed action on vernal pool fairy shrimp and vernal pool tadpole shrimp and their habitat would be small and would be offset with protection and restoration of their habitat. The proposed action may affect the vernal pool fairy shrimp and vernal pool tadpole shrimp based on the following factors.

- Project-related activities would occur within and adjacent to vernal pool fairy shrimp and vernal pool tadpole shrimp modeled habitat.
- Protection and restoration of vernal pool fairy shrimp and vernal pool tadpole shrimp would benefit the species.

The proposed action is likely to adversely affect the vernal pool fairy shrimp and vernal pool tadpole shrimp as follows.

- Harm could result from the permanent loss of 0.42 acre of modeled habitat for the species.
- Harm could result from altering the hydrology of vernal pool fairy shrimp and vernal pool tadpole shrimp habitat within 250 feet of construction areas, which could reduce the hydroperiod of affected habitat, making it less suitable for the species.
- Harm could occur as a result of changes to water quality in watersheds that support vernal pool fairy shrimp and vernal pool tadpole shrimp habitat.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of injury and mortality of individuals and the conversion of habitat and offset by the protection or restoration of habitat. If an existing conservation bank is used to offset effects, up to 29.70 acres of credits would be provided. If DWR selects a non-bank site, habitat losses would be offset by the restoration and protection of up to 44.76 acres of existing habitat based on current project impact estimates.

Thus, the proposed action may affect, and is likely to adversely affect, the vernal pool fairy shrimp and vernal pool tadpole shrimp.

## 7.18.2 Cumulative Effects

Potential cumulative effects on vernal pool fairy shrimp and vernal pool tadpole shrimp in the action area include habitat loss and impairment, primarily through conversion of vernal pool or degraded vernal pool natural communities to more developed land uses. This is unlikely to occur because of regulatory prohibitions on such activity. If it were to occur, for example via unauthorized actions, such development could have an adverse effect on vernal pool fairy shrimp and vernal pool tadpole shrimp in the action area.

Climate change is likely to alter habitat conditions for vernal pool fairy shrimp and vernal pool tadpole shrimp between now and the completion of the proposed action. The principal concern is climate change. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2, *Physical Environment*, include increased climate variability as seen in changes such as more intense droughts and larger floods. These effects would tend to impair habitat quality and quantity for vernal pool

fairy shrimp and vernal pool tadpole shrimp, with potential adverse effects on species status in the action area. The environmental baseline for vernal pool fairy shrimp and vernal pool tadpole shrimp may also be affected by future habitat protection and restoration efforts in the Delta that may protect existing habitat or create new habitat.

### 7.18.3 Determination of Effects on Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Designated Critical Habitat

There are 597,821 acres of critical habitat designated for vernal pool fairy shrimp, of which 1,475 acres overlap with the action area. All overlapping acres fall within critical habitat Unit 19B. Of the 1,475 acres of critical habitat that overlap with the action area, 10.1 acres of PCEs (0.21% of total designated critical habitat in Unit 19B), as represented by modeled habitat, are assumed to be adversely affected.

The proposed action would not appreciably diminish the value of the designated critical habitat to conservation because of the implementation of avoidance and minimization measures and the purchase of 29.70 acres of conservation bank credits or the restoration and protection of 44.76 acres of vernal pool fairy and tadpole shrimp habitat.

There is no designated critical habitat for vernal pool tadpole shrimp in the action area. Because there is no vernal pool tadpole shrimp critical habitat in the action area, the proposed action will have no effect on vernal pool tadpole shrimp critical habitat.

## 7.19 Vernal Pool Grasses

Because they occupy the same habitat type and location in the action area, Colusa grass and Solano grass are treated together in this analysis.

### 7.19.1 Determination of Effects on Vernal Pool Grasses

Colusa grass and Solano grass habitat is located in the northwestern portion of the action area in Jepson Prairie and is limited to vernal pool complex, growing in the bottom of large, deep vernal pools. There are occurrences of both grasses in this region of the action area (California Department of Fish and Wildlife 2020b). The construction footprint of the proposed action is outside the range of Colusa grass and Solano grass; therefore, the proposed action would not affect Colusa grass and Solano grass.

Activities associated with implementation of the CMP channel margin enhancement and tidal habitat mitigation framework have the potential to result in a in a loss of modeled Colusa grass and Solano grass habitat. An unknown area of modeled vernal pool grass habitat would be affected by channel margin enhancement and tidal wetland restoration activities. Harm could occur to vernal pool habitat as a result of land clearing and construction equipment where the vernal pool grasses occur.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of vernal pool plants. Where suitable habitat for vernal pool plants cannot be avoided and is permanently lost, the lost suitable habitat would be offset through mitigation determined by site-specific permitting and the CMP (Sections 3B.1 and 3B.2.4 in Appendix 3B and Table 3B.1-2, CMP-0: *General Design Guidelines* and CMP-8: *Vernal Pool Complex* in Attachment 3B.1).

Thus, the CMP channel margin and tidal habitat mitigation framework may affect, and is likely to adversely affect, Solano grass and Colusa grass.

### 7.19.2 Cumulative Effects

Potential cumulative effects on vernal pool grasses in the action area include habitat loss and impairment, primarily through conversion of vernal pool or degraded vernal pool natural communities to more developed land uses. This is unlikely to occur because of regulatory prohibitions on such activity. If it were to occur, for example via unauthorized actions, such development could have an adverse effect on vernal pool grasses in the action area.

Climate change is likely to alter habitat conditions for vernal pool grasses between now and the completion of the proposed action. The principal concern is climate change. Foreseeable climate change effects, include increased climate variability as seen in changes such as more intense droughts and larger floods. These effects would tend to impair habitat quality and quantity for vernal pool grasses, with potential adverse effects on species status in the action area. The environmental baseline for vernal pool grasses may also be affected by future habitat protection and restoration efforts in the Delta that may protect existing habitat or create new habitat.

### 7.19.3 Determination of Effects on Vernal Pool Grasses Designated Critical Habitat

Critical habitat has been designated for Solano and Colusa grass, but critical habitat does not occur within the action area. The proposed action would have no effect on designated critical habitat for Solano and Colusa grass.

## 7.20 Northwestern Pond Turtle

### 7.20.1 Determination of Effects on Northwestern Pond Turtle

Permanent effects of the proposed action on northwestern pond turtle and its habitat would be small and would be offset with compensatory mitigation acreage commitment of 33.70 acres of aquatic habitat and 115.49 acres of upland habitat. Toward this goal, DWR would create and enhance up to 373.47 acres of aquatic habitat and up to 774.43 acres of upland habitat at the I-5 ponds, as described in Table 3B-4 in Appendix 3B. The proposed action may affect the northwestern pond turtle based on the following factors.

- Project-related activities will occur within and adjacent to northwestern pond turtle modeled habitat.
- Northwestern pond turtle presence has been recorded in the vicinity of areas proposed for clearing and construction.
- Protection and restoration of northwestern pond turtle habitat would beneficially affect the species.

The proposed action is likely to adversely affect the northwestern pond turtle as follows.

- Harm could result from the permanent and temporary loss of 52.73 acres of aquatic habitat and 170.87 acres of upland habitat potentially occupied by the species.
- Harm could occur as a result of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance activities.

- Harassment could result from noise, lighting, and vibrations, or other human disturbance adjacent to occupied northwestern pond turtle habitat during construction, operations, and maintenance.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of individuals and offset by the creation and enhancement of 233.94 acres of aquatic habitat and 456.10 acres of upland habitat at initial mitigation sites.

Thus, the proposed action is not likely to adversely affect the continued existence of the northwestern pond turtle.

### 7.20.2 Cumulative Effects

Potential cumulative effects on northwestern pond turtle in the action area include habitat loss and fragmentation, altered hydrology, contaminants, predation by bullfrogs, road impacts, and climate change (88 *Federal Register* [FR] 68377).

Climate change (including increased temperatures, severe drought, extreme flood events, and severe wildfire) is likely to alter habitat conditions for northwestern pond turtle between now and the completion of the proposed action. Foreseeable climate change effects, described in Chapter 4, Section 4.3.2, *Physical Environment*, sea level rise, include reduced Sierra Nevada winter snowpack, warmer water temperatures, and increased climate variability as seen in changes such as more severe winter storms, more intense droughts, and larger floods. These effects would tend to impair habitat quality and quantity for northwestern pond turtle and could threaten individuals and populations, with potential adverse effects on species status in the action area.

### 7.20.3 Determination of Effects on Northwestern Pond Turtle Designated Critical Habitat

Critical habitat has not been designated for the northwestern pond turtle.

## 7.21 Western Spadefoot

### 7.21.1 Determination of Effects on Western Spadefoot

Permanent effects of the proposed action on western spadefoot and its habitat would be small and would be offset with compensatory mitigation acreage commitment of 0.60 acre of suitable aquatic habitat and 32.84 acres of suitable upland habitat. The proposed action may affect western spadefoot based on the following factors.

- Project-related activities will occur within and adjacent to western spadefoot modeled habitat.
- Protection and restoration of suitable western spadefoot habitat would beneficially affect the species.

The proposed action is likely to adversely affect the western spadefoot as follows.

- Harm could result from the permanent and temporary loss of 0.20 acre of aquatic habitat and 37.24 acres of upland habitat potentially occupied by the species.
- Harm could occur because of use of land clearing and construction equipment, vehicular transportation, and other construction, operations, and maintenance activities.

- Harassment could result from noise, lighting, and vibrations, or other human disturbance occurring adjacent to occupied western spadefoot habitat during construction, operations, and maintenance.

These adverse effects would be minimized through implementation of avoidance and minimization measures to reduce the risk of harm or harassment of individuals and offset by the creation and enhancement of 0.60 acre of suitable aquatic habitat and 32.84 acres of suitable upland habitat.

Thus, the proposed action is not likely to adversely affect the continued existence of western spadefoot.

### 7.21.2 Cumulative Effects

Potential cumulative effects on western spadefoot in the action area include habitat loss, habitat fragmentation, degradation, or alteration from urbanization and land conversion, nonnative predators, disease, wildfire, chemical contamination, noise disruptions, and the effects of climate change related to drought and increasing temperatures, and their cumulative impacts (88 FR 84261).

Low but persistent level of habitat loss from development and land conversion is expected to occur to varying degrees within the range of western spadefoot in the future, especially near urbanized areas (88 FR 84262). Effects of habitat loss have resulted in the remaining habitat becoming fragmented and of lower quality.

The effects of climate change through drought conditions and increased temperatures are likely to affect western spadefoot because the species is dependent on the timing and amount of seasonal precipitation to provide suitable breeding and foraging habitat. Additionally, the seasonal ponds must stay inundated and within specific temperature range to allow western spadefoot to meet its life-history needs. Drought conditions would decrease the availability and quality of breeding and foraging habitat, as well as dispersal opportunities. Increased ambient temperatures could influence pond temperatures and cause seasonal ponds to dry up sooner, thereby decreasing the availability of suitable habitat for western spadefoot (88 FR 84263). Foreseeable climate change effects are described in Chapter 4, Section 4.3.2*, Physical Environment* These effects would tend to impair habitat quality and quantity for western spadefoot and could threaten individuals and populations, with potential adverse effects on species status in the action area.

### 7.21.3 Determination of Effects on Western spadefoot Designated Critical Habitat.

Critical habitat has not been designated for western spadefoot.

## 7.22 Conclusion

The effects of the proposed action were assessed using the best available science. Table 7.22-1 summarizes the effects determinations discussed in this chapter.

**Table 7.22-1. Determination of Effects on Species Addressed in this BA**

| Common and Scientific Names | Scientific Name | Jurisdiction | Status | Effect Determination |
|---|---|---|---|---|
| | | | | |

| Common and Scientific Names | Scientific Name | Jurisdiction | Status | Effect Determination |
|---|---|---|---|---|
| Chinook salmon, Sacramento River Winter-Run ESU | *Oncorhynchus tshawytsch* | NMFS | Endangered | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Chinook salmon, Central Valley Spring-Run ESU | *Oncorhynchus tshawytsch* | NMFS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Steelhead, California Central Valley DPS | *Oncorhynchus mykiss* | NMFS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Green sturgeon, Southern DPS | *Acipenser medirostris* | NMFS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Killer whale, Southern Resident DPS | *Orcinus orca* | NMFS | Endangered | Species: May affect, not likely to adversely affect<br>Critical Habitat: No effect |
| Delta smelt | *Hypomesus transpacificus* | USFWS | Endangered | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Longfin smelt | *Spirinchus thaleichthys* | USFWS | Proposed Endangered | Species: May affect, likely to adversely affect<br>Critical Habitat: Not designated |
| San Joaquin kit fox | *Vulpes macrotis mutica* | USFWS | Endangered | Species: May affect, not likely to adversely affect<br>Critical Habitat: Not designated |
| California least tern | *Sternula antillarum browni* | USFWS | Endangered | Species: May affect, not likely to adversely affect<br>Critical Habitat: Not designated |
| Least Bell's vireo | *Vireo bellii pusillus* | USFWS | Endangered | Species: May affect, likely to adversely affect<br>Critical Habitat: No Effect |
| Western yellow-billed cuckoo | *Coccyzus americanus occidentalis* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: No Effect |
| California red-legged frog | *Rana draytonii* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| California tiger salamander | *Ambystoma californiense* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: No Effect |

| Common and Scientific Names | Scientific Name | Jurisdiction | Status | Effect Determination |
|---|---|---|---|---|
| Giant garter snake | *Thamnophis gigas* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: Not designated |
| Delta green ground beetle | *Elaphrus viridis* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: No Effect |
| Valley elderberry longhorn beetle | *Desmocerus californicus dimorphus* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: No Effect |
| Vernal pool fairy shrimp | *Branchinecta lynchi* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: Likely to adversely affect |
| Vernal pool tadpole shrimp | *Lepidurus packardi* | USFWS | Endangered | Species: May affect, likely to adversely affect<br>Critical Habitat: Not Effect |
| Colusa grass | *Neostapfia colusana* | USFWS | Threatened | Species: May affect, likely to adversely affect<br>Critical Habitat: No effect |
| Solano grass | *Tuctoria mucronata* | USFWS | Endangered | Species: May affect, likely to adversely affect<br>Critical Habitat: No Effect |
| Northwestern pond turtle | *Actinemys marmorata* | USFWS | Proposed Threatened | Species: Not Applicable<br>Critical Habitat: Not Proposed |
| Western spadefoot | *Spea hammondii* | USFWS | Proposed Threatened | Species: Not Applicable<br>Critical Habitat: Not Proposed |

DPS = distinct population segment; ESU = evolutionarily significant unit; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service.

# 7.23 References

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