BUREAU OF RECLAMATION

Long-Term Operation – Biological Assessment

Chapter 2 – Environmental Baseline

Central Valley Project, California

Interior Region 10 – California-Great Basin

U.S. Department of the Interior

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Mission Statements

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
CCWD	Contra Costa Water District
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
cfs	cubic feet per second
COA	Coordinated Operations Agreement
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
D-1641	Decision 1641
DCC	Delta Cross Channel
Delta	Sacramento–San Joaquin River Delta
DMC	Delta-Mendota Canal
DO	dissolved oxygen
DPS	Distinct Population Segment
DWR	California Department of Water Resources
E/I	export to inflow
EIS	Environmental Impact Statement
EOA	end-of-April
EOS	end-of-September
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FCCL	Fish Conservation and Culture Lab
FERC	Federal Energy Regulatory Commission
FRWD	Freeport Regional Water Diversion
MAF	million acre-feet
MOA	Memorandum of Agreement
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OCAP	Operations Criteria and Plan

OID	Oakdale Irrigation District
PG&E	Pacific Gas and Electric
Reclamation	U.S. Bureau of Reclamation
ROC	reinitiation of consultation
ROD	Record of Decision
RPA	reasonable and prudent alternative
RSFS	Rock Slough Intake and Fish Screen
SJRRP	San Joaquin River Restoration Program
SMP	Suisun Marsh Habitat Management, Preservation and Restoration Plan
SOD	South of Delta
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
TAF	thousand acre-feet
TCCA	Tehama-Colusa Canal Authority
TUCP	Temporary Urgency Change Petition
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
Water Board	State Water Resources Control Board
Water Forum	Sacramento Area Water Forum
WOA	Without Action

Chapter 2 Environmental Baseline

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

The Endangered Species Consultation Handbook (U.S. Fish and Wildlife Service 1998) identifies the ongoing discretionary operations of water supply projects as a new commitment of resources subject to the same approach as for other types of federal Endangered Species Act (ESA) Section 7 analyses, (page 4-30). In August 2019, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) published a final rule updating the ESA Section 7 implementing regulations. *See* 84 *Federal Register* 44976 (August 27, 2019). The August 2019 regulations provide a standalone definition of 'environmental baseline' including additional text "to make it clear that 'environmental baseline' is a separate consideration from the effects of the action." *Id*. at 44978. The final rule clarified that the environmental baseline "refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action." *Id.* at 45016. The definition further states that "[t]he consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline." *Id*. The environmental baseline for this consultation includes not only the effects of all past and present operations of the Central Valley Project (CVP) and State Water Project (SWP), but the future nondiscretionary operations of the CVP and SWP that the agencies must implement to comply with applicable regulatory requirements and contractual obligations, consistent with the ESA.

The duty to avoid jeopardy under Section 7 of the ESA applies to discretionary agency actions. If an agency does not possess the ability to implement measures that inure to the benefit of the protected species, there is no reason or duty to consult. Reclamation does not have discretion to modify the existence of the dams; therefore, effects associated with the continuing existence of those dams are attributed to the environmental baseline. This policy is consistent with the approach taken by other federal agencies, including the Department of the Army (Civil Works and NMFS) (Connor and Spinard 2022). In operating the CVP and SWP, the U.S. Department of the Interior Bureau of Reclamation (Reclamation) and California Department of Water Resources (DWR) have the discretion to store inflow into CVP and SWP reservoirs, subject to nondiscretionary flood control and downstream requirements, release water subject to channel capacities, divert water at CVP and SWP facilities, route water through CVP and SWP control structures, and blend water from different reservoir elevations to manage the available coldwater pool.

In 2019, Reclamation included a Without Action (WOA) scenario in the Environmental Baseline of the 2019 Biological Assessment for the long-term operation of the CVP and SWP. In the WOA scenario, all CVP and SWP facilities exist, but they were not actively operated. Instead, the facilities were configured and gates were positioned to protect the long-term integrity of the structures, regardless of hydrology. Reclamation and DWR selected a day within the historical period of record with high inflow to represent WOA. Reclamation did not attempt to separate nondiscretionary operations for inclusion in the environmental baseline and assumed that all CVP and SWP operations were discretionary parts of the Proposed Action. The intent of the WOA scenario was to help tease out impacts attributable to the effects of existing structures, such as dams, from the effects of the Proposed Action.

For this consultation, Reclamation specifies the nondiscretionary operations of the CVP and SWP and includes those nondiscretionary operations in the environmental baseline. Therefore, the environmental baseline includes the consequences of the existence of CVP and SWP facilities, along with the consequences of any CVP and SWP operations that Reclamation and DWR, respectively, lack the authority to modify. The Proposed Action details how Reclamation and DWR propose to operate the CVP and SWP given the scope of operational discretion.

The environmental baseline condition does not include effects of the Proposed Action. In determining which scenarios would be appropriate to characterize the environmental baseline, Reclamation considered the 2019 Proposed Action adopted in the Record of Decision (ROD), which is currently being implemented, as modified by the Interim Plan Operations. Reclamation determined that the 2019 Proposed Action adopted in the ROD includes various components also included in this current Proposed Action. Thus, the 2019 Proposed Action adopted in the ROD would encompass some of the effects of this Proposed Action and would not be appropriate to inform the environmental baseline condition. The 2019 Proposed Action adopted in the ROD, however, is used in representing the No Action Alternative in the Environmental Impact Statement (EIS) associated with this Biological Assessment. The No Action Alternative represents the current management direction of Reclamation and DWR, as required by the National Environmental Policy Act (NEPA).

Two operational scenarios inform the environmental baseline that, for this Biological Assessment, includes nondiscretionary operations.

- The first scenario is a run-of-river scenario (EXP1) that eliminates all operations, except those needed to provide flood control and to protect existing facilities. EXP 1 depicts conditions without Reclamation exercising discretion to store, divert, or route water. The run-of-river scenario, when examined in the context of the Proposed Action, can be used to determine how the storage, release, diversion, and routing of water in the Proposed Action affects river flows.

- The second scenario is a minimal release operation (EXP3) that uses stored water only to meet nondiscretionary requirements and obligations. That scenario depicts "ongoing agency activities . . . that are not within the agency's discretion to modify." EXP3 is used to describe the effect of nondiscretionary operations on flows below dams and storage in reservoirs where releases are necessary to meet downstream requirements and where water is diverted from the system. This scenario (EXP 3), when examined in the context of the Proposed Action, can be used to determine how the release and diversion water in Proposed Action affects storage.

The Proposed Action subtracting EXP1 or EXP3 scenarios, represents the magnitude of discretionary hydrologic alteration caused by the long-term operation of the CVP to store, release, divert, and route water and the potential range of discretion to operate in a different manner for the conservation of species. The modeling scenarios are intended to provide information that helps separate the environmental baseline from the effects of the Proposed Action. None of the scenarios are the baseline itself; they are analytical tools to help understand the effects of the Proposed Action. Nevertheless, EXP1 and EXP3 together more closely align to the environmental baseline condition because these scenarios do not include the effects of the Proposed Action.

The effects of the Proposed Action are added to the environmental baseline, as shown in Figure 2-1, to evaluate the overall effects on species.

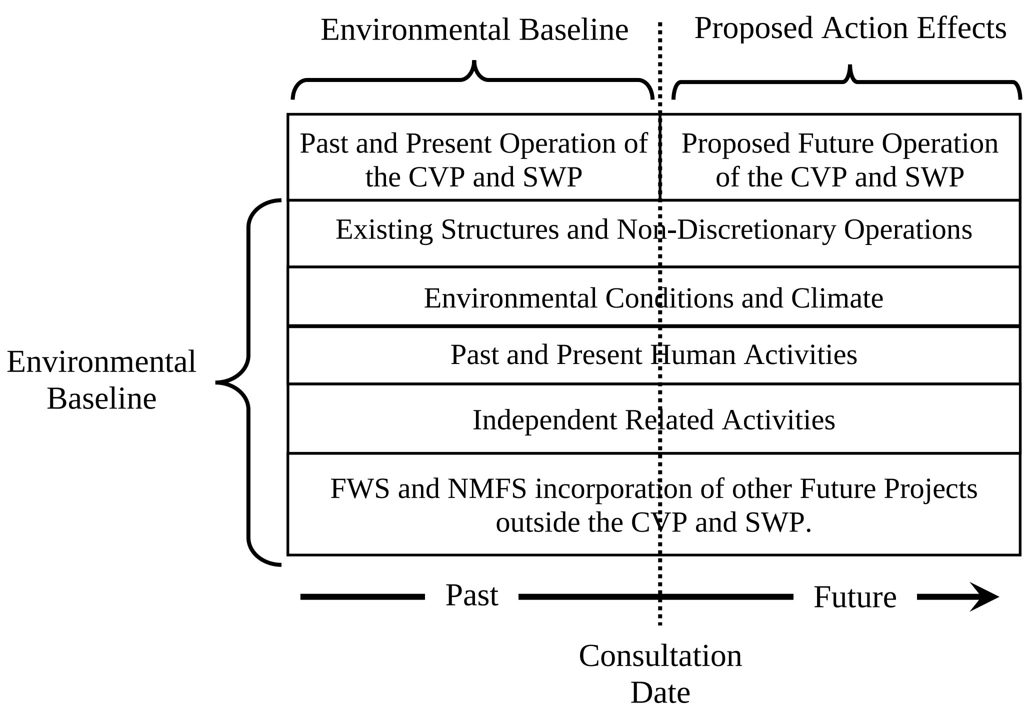

Figure 2-1. Conceptual Model of the Environmental Baseline Role in a Reinitiation of Consultation

Components of the environmental baseline include (1) existing structures and nondiscretionary CVP and SWP operations; (2) environmental conditions and climate, which provides a landscape level description of California hydrology, anticipated climate change, and past periods of drought; (3) past and present operations of the CVP and SWP under prior ESA consultations (e.g., 1992/1993, 2004/2005, 2008/2009, 2019/2020), which become part of the environmental baseline each time Reclamation and DWR consult on long-term operations; (4) past and present human activities, which describe other federal, state, and private actions that have occurred within the action area; (5) independent related activities, which describe Reclamation and DWR activities consulted upon where necessary and implemented separately from the operation of the CVP and SWP.

2.1 Existing Structures and Nondiscretionary Operations

In operating the CVP and SWP, Reclamation and DWR must comply with a myriad of statutory and regulatory requirements, including California water law. Applicable federal law includes the Flood Control Act and regulations imposed by the United States Army Corps of Engineers (USACE), the Clean Water Act, the Central Valley Project Improvement Act (CVPIA), and the Reclamation Act. Under Section 8 of the 1902 Reclamation Act, Reclamation must comply with "any condition imposed by the state on 'control, appropriation, use or distribution of water' in a federal reclamation project that is not inconsistent with clear congressional directives respecting the project."

The State Water Resources Control Board (Water Board) has issued numerous decisions and orders conditioning Reclamation's water right permits and licenses that regulate Reclamation's operation of the CVP and DWR's operation of the SWP. Those terms and conditions are nondiscretionary obligations (including as may be revised or temporarily modified through a temporary urgency change order by the Water Board) and must be complied with in order to exercise diversion and water use rights granted under CVP and SWP water right permits and licenses. One decision in particular, revised 2000 Water Right Decision 1641 (D-1641), affects the operation of numerous CVP and SWP facilities by requiring releases from upstream dams to meet downstream water quality objectives. Operations to meet the requirements of D-1641 are shared between the CVP and SWP under the Coordinated Operations Agreement (COA). However, Reclamation does retain some ability to adjust operations of the CVP to balance the system and meet D-1641 and obligations under the COA with DWR. Reclamation's limited ability to balance the system to meet mandatory requirements obscures a clear separation of discretionary and nondiscretionary operations. Therefore, Reclamation has used several modeling approaches to explore scenarios as explained below that depict to the best of Reclamation's ability that limited ability to adjust operations.

In Appendix E, *Exploratory Modeling*, Reclamation analyzed several modeling runs that depict CVP and SWP operations under different layers of operational assumptions. The primary modeling scenarios included in that appendix are EXP1 – Run-of-River; EXP2 – Maximum Storage; EXP2.5, Maximize Storage – Release Stored Water for Unmet Flow and D-1641 Standards; EXP3 – Minimum Releases from Storage including senior water rights; EXP4 – Excess Flow Diversion; EXP 4.95 – Divert Excess with ESA/CESA Criteria; EXP5 – Storage

Management; and EXP5P – Placeholder for Additional Actions. To illustrate environmental baseline conditions, Reclamation prepared EXP1 and EXP3.

EXP1 identifies hydrologic conditions in the absence of the operation of the projects and provides a basis to measure hydrologic impairment by factors other than the operation of the projects. Under EXP1, the projects release reservoir inflow, subject only to downstream channel capacities. The projects do not store water, and the Sacramento–San Joaquin River Delta (Delta) pumps are not operated in this scenario. Senior water right holders, including refuges with Level 1 water supplies, continue to divert when water is available. EXP1 eliminates any operation of the CVP and SWP, except as needed to bypass inflow and protect downstream infrastructure from damage, thereby providing a basis to help assess the effects of the Proposed Action.

EXP1 is similar to the WOA approach in the prior consultation because both scenarios assume that the projects will not be operated for authorized purposes, except to protect facilities and downstream channels. EXP1, however, assumes a run-of-river operation, instead of operating consistent with a particular high-flow date. Reclamation chose EXP1 because it more closely reflects natural conditions in the river, given the continued existence of project dams. It is also more useful in determining the effects of nondiscretionary operations on river flows, as flows under EXP1 (Run-of-River) can be compared to flows under EXP3 (Minimum Releases from Storage). While EXP1 eliminates the effects of possible discretionary operations from the environmental baseline, it ignores the effects of certain nondiscretionary operations in the environmental baseline. For example, under EXP1, Reclamation and DWR would not operate to the requirements of D-1641 to meet various water quality objectives or with water right permits that require minimum flows for fish below existing dams. Those are regulatory requirements imposed by the Water Board that Reclamation lacks the discretion to unilaterally modify. In EXP1, the projects do not operate to regulatory requirements.

An intermediate step between the two modeling scenarios that best align with the environmental baseline (EXP1 and EXP3), EXP 2 models how much stored water may be available if Reclamation operates to maximum storage with releases limited to inflows. In EXP2, the projects store as much water as possible, but release water to pass-through inflow, which can be used to meet senior water rights, minimum instream flows, and other applicable regulatory requirements, such as Water Board D-1641. By comparing the results of EXP2 and EXP3, the models can be used to show how much stored water is needed to comply with nondiscretionary requirements and obligations.

EXP3 identifies those ongoing operations that are not within the agencies' discretion to modify. In EXP3, Reclamation and DWR not only store and release inflow, but release stored water in the absence of other intervening factors (e.g., Congressional Directive, Temporary Urgency Change Petitions, Voluntary Programs, Board Order, Shortage Provisions) to meet regulatory requirements and senior water rights demands. In this scenario, Reclamation and DWR bypass inflows and make releases from reservoir storage where the flows otherwise in the system are insufficient to meet the following: (1) navigation and minimum instream flow requirements; (2) downstream senior water rights; (3) Exchange Contract demands from San Joaquin flows and Refuge Level 2 demands; and (4) D-1641 and other regulatory requirements. In EXP3, the projects do not operate to deliver water to any water service or repayment contractors for irrigation or municipal and industrial purposes and do not operate the Delta pumps.

EXP3 attempts to model how much water is needed to meet “ongoing agency activities . . . that are not within the agency's discretion to modify,” consistent with the definition of environmental baseline, 50 CFR 402.02. It includes some reasonable assumptions for how the projects would operate to meet certain requirements and obligations. Certain obligations are limited based on which facilities can provide water, e.g., releases on the American River cannot meet demands on the Sacramento River that are upstream of the confluence. Where there is a possibility for multiple facilities (for instance, either Shasta or Folsom) to meet a downstream obligation (such as D-1641), the model (CalSim 3) determines the source of water through rules that attempt to match the reservoir balancing under historical operations. Those rules allow Reclamation to reasonably depict the minimal operations needed to meet nondiscretionary requirements and obligations, although they rarely control. Other modeling assumptions were made because project facilities are not operated to deliver project water to water service contractors. For example, water is not being delivered to Friant Dam water users, so no water is diverted at Friant Dam down the Madera and Friant-Kern Canals, and all releases flow down the San Joaquin River. Those releases effectively alleviate the need for minimum flows under the San Joaquin River Restoration Program.

For both EXP1 and EXP3, Reclamation is not operating the project to deliver CVP water under water service or repayment contracts. Generally, Reclamation’s water service and repayment contracts provide for shortages of project water due to “drought and other physical or natural causes beyond the control of the Contracting Officer; or actions taken by the Contracting Officer to meet current and future legal obligations.” (See, e.g., Westlands Water District, Contract No. 14-06-200-495A-IR1-P, Art. 12(b).) They also recognize that the capacity of the CVP to deliver project pater has been constrained in recent years for various reasons, so the likelihood of the contractor receiving its full amount of project water in any given year is uncertain. *Id*. at Art. 3(b). For contracts that provide for municipal and industrial water supplies, any shortage would be apportioned in accordance with Reclamation’s water shortage policy in effect at the time of the shortage and apportioned among the contractors within the same division or unit.

2.1.1 Clear Creek

Whiskeytown Dam, which forms Whiskeytown Lake, is the only dam on Clear Creek. In all modeling scenarios, Whiskeytown continues to exist, and any effects associated with the existence of the dam are attributed to the environmental baseline. Operational assumptions for Clear Creek are as follows.

In EXP1, Whiskeytown Dam is not operated to store water, and inflow is passed through Whiskeytown Reservoir to Clear Creek. Water is not diverted from Lewiston Dam through the Clear Creek Tunnel to Whiskeytown. Pass-through flows can be used to meet senior water rights and instream flows. The Spring Creek Tunnel is not operated to divert water from Whiskeytown Dam to Keswick Reservoir.

In EXP3, Reclamation operates Whiskeytown to store up to 240 thousand acre-feet (TAF) of water. However, in EXP3, stored water is released to Clear Creek to meet the demands of senior water right holders and minimum flows for fish. Water is not released from Lewiston Dam through the Clear Creek Tunnel to Whiskeytown, and water is not diverted from Whiskeytown Reservoir through the Spring Creek Tunnel to Keswick Reservoir. No stored water is released for delivery to any water service contractor. Additional information about the nondiscretionary operations on Clear Creek are summarized below.

- *Water Board D-1641:* In EXP3, Reclamation operates Whiskeytown Dam in coordination with other CVP and SWP facilities to comply with D-1641's minimum flow requirements near Rio Vista and Delta outflow requirements. CalSim makes reasonable assumptions on when and how much water to release from Whiskeytown to meet D-1641 requirements based on past operations.
- *Conditions of Approval:* In EXP3, Reclamation and DWR operate consistent with Article 6(c) of the COA, as executed in 1986 and amended in 2018. Article 6(c) establishes each party's responsibility for making available storage withdrawals to meet Sacramento Valley in-basin uses based on a set formula. Clear Creek has minimal storage to contribute to these purposes.
- *Minimum Flows for Clear Creek:* Minimum releases for fishery purposes from Whiskeytown Dam to Clear Creek are provided in accordance with the following: (1) a 1960 Memorandum of Agreement (MOA) with California Department of Fish and Wildlife (CDFW); (2) a 1963 release schedule for Whiskeytown Dam that was developed with the USFWS; and (3) water rights permit modification in 2002 that required the bypass or release of water to Clear Creek as provided for in the August 11, 2000 Instream Flow Preservation Agreement executed by Reclamation, USFWS, and CDFW.
- *Exchange Contracts:* Whiskeytown is operated to release water in accordance with two Exchange Contracts that provide for the delivery of up to 14,100 acre-feet of Substitute Water from CVP facilities. Those contractors agreed to forgo diverting Clear Creek water under their riparian water rights in exchange for the Substitute Supply of water.

2.1.2 Sacramento River

Major CVP facilities on the Sacramento River are managed as part of the Shasta Division, which includes Shasta Dam, Lake and Powerplant and Keswick Dam, Lake and Powerplant, and the Sacramento River Division, which includes the Red Bluff Pumping Plant, which diverts water to the Tehama-Colusa Canal, and the Corning Canal, and Black Butte Dam, which is operated by the USACE and releases flood flows into Stony Creek, which flows toward the Sacramento River. In all modeling scenarios, Shasta and Sacramento River Division facilities continue to exist, including Shasta, Keswick, and Black Butte dams. Effects associated with the continued existence of those facilities are attributed to the environmental baseline. Operational assumptions for facilities within the Shasta and Sacramento River divisions are as follows.

In EXP1, inflow is released from Shasta Dam, subject to the release capacity of the dam and downstream channels. Water is not stored in Shasta Reservoir, unless temporarily needed to protect downstream channel capacity. Keswick Dam is operated to release inflow up to release capacity. The Red Bluff Pumping Plant, Corning Canal, and Tehama-Colusa Canal are not operated. Black Butte Dam continues to be operated by USACE in coordination with the Orland Project, but no deliveries are made to CVP water contractors from Black Butte Dam.

In EXP3, Reclamation continues to store water in Shasta Reservoir, but stored water is released to meet the demands of settlement contractors, Level 2 water supplies for NOD Refuges, and nondiscretionary regulatory requirements when bypassed inflows are not sufficient. In addition, as explained above, Reclamation does not divert water through the Spring Creek Tunnel to Keswick Reservoir, and does not operate the Red Bluff Pumping Plant, Corning Canal, or the Tehama-Colusa Canal. Reclamation does not operate any facilities to meet the demands of any water service or repayment contractors. The regulatory requirements and obligations assumed in EXP3 for the Shasta and Sacramento River divisions are summarized below.

- *Flood Control:* In EXP3, Reclamation operates Shasta and Keswick Dams for flood control purposes in accordance with regulating criteria developed by the USACE in 1977.
- *Minimum Flows for Fish:* Under Condition 24 of D-990, Reclamation operates Shasta Dam to bypass or release into the Sacramento River at Keswick Dam fish life flows, as provided in a 1960 MOA with the California Department of Fish and Game (now known as CDFW). In Order 90-05, the Water Board modified the minimum flow requirements initially established in the 1960 MOA. Order 90-5 set the minimum flow below Keswick Dam from September through February to be 3,250 cubic feet per second (cfs) in all but Critically Dry years. EXP3 assumes minimum flows will be provided in accordance with D-990 and Order 90-5.
- *Temperature Objectives Below Keswick Dam:* Order 90-5 requires Reclamation to operate Shasta Dam, Keswick Dam, and the Spring Creek Power Plant, with certain specific exceptions, to meet a daily average water temperature of 56 degrees Fahrenheit (°F) (13 degrees Celsius [°C]) in the Sacramento River at the Red Bluff Diversion Dam during periods when higher water temperatures will be detrimental to the fishery. However, CalSimII is a flow model and does not model water temperature objectives. Additionally, while Reclamation must comply with those water temperature objectives, Order 90-5 allows Reclamation to identify alternative locations for the temperature compliance point if there are factors beyond the reasonable control of Reclamation that prevent meeting 56°F (13°C) at the Red Bluff Diversion Dam after consultation with the CDFW, USFWS, the NMFS, and the U.S. Western Area Power Administration. Water temperature operations at Shasta Dam require operation of the Temperature Control Device located at the dam, and operation of the device is a daily operation that depends on the location of the temperature compliance point, the available coldwater pool in Shasta Reservoir, and other factors. Thus, there is considerable discretion in how to operate Shasta to meet Order 90-5. For those reasons, EXP3 does not assume any operation to comply with Order 90-5’s water temperature objectives.
- *Water Board D-1641:* In EXP3, Reclamation operates Shasta and Keswick dams in coordination with other CVP and SWP facilities to comply with D-1641's minimum flow requirements near Rio Vista and Delta outflow requirements. In EXP3, CalSim 3 makes reasonable assumptions on when and how much water to release from Shasta Reservoir to meet D-1641 requirements based on past operations.

- *Conditions of Approval - Storage Withdrawals:* In EXP3, Reclamation and DWR operate consistent with Article 6(c) of the COA, as executed in 1986 and amended in 2018. Article 6(c) establishes each party's responsibility for making available storage withdrawals to meet Sacramento Valley in-basin uses based on a set formula.
- *SRS Contracts:* In EXP3, Reclamation operates Shasta Dam to deliver water to the SRS Contractors in accordance with the terms of the contracts. The SRS Contractors divert water directly from the Sacramento River through private facilities at various locations below Shasta Dam. Reclamation administers 132 SRS Contracts that provide for the diversion of approximately 2.09 million acre-feet (MAF) of water annually. The contract total is automatically reduced by 25% in a Shasta Critical Year.
- *Refuge Contracts:* Reclamation administers two agreements that provide for the delivery of up to 151,250 acre-feet annually of water to meet the Level 2 refuge water supply demands of NOD wildlife refuges. Pursuant to Section 3406(d)(4) of CVPIA, Reclamation may temporarily reduce deliveries under these contracts "up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water." In EXP3, Reclamation operates to meet those Level 2 water supplies in accordance with the contracts and CVPIA.

2.1.3 American River

Major CVP facilities on the American River include Folsom Dam, Reservoir and Powerplant, Nimbus Dam, Lake Natoma and Nimbus Powerplant, and the Folsom South Canal. All of those facilities continue to exist in all modeling scenarios, and effects associated with their existence are attributed to the environmental baseline. Operational assumptions for American River Division facilities are discussed below.

In EXP1, Reclamation does not operate Folsom Dam to store, and releases inflow from Folsom Dam, as limited by release capacity and downstream channel capacity. Bypass flows can be used to meet senior water rights and regulatory requirements. The Folsom South Canal is not operated, and water is not diverted down the canal. No deliveries are made to water service or repayment contractors.

In EXP3, Reclamation operates Folsom and Nimbus dams to store and release stored water to meet the demands of senior water right holders and regulatory requirements, but no deliveries are made to water service and repayment contractors. It also assumes that no diversions are made at Nimbus Dam to the Folsom South Canal or to the canal from the Freeport Regional Water Project. Nondiscretionary operations for Folsom Dam are summarized below.

- *Flood Control Manual:* In operating Folsom Reservoir, Reclamation must comply with regulatory requirements imposed by the USACE. In 2017, Reclamation and the USACE completed the Folsom Dam Auxiliary Spillway Project, which is also known as the Joint Federal Project, to improve flood control operations at Folsom. In 2019, the USACE issued a new Water Control Manual, which utilizes forecasted inflow as the criteria for determining flood control releases. EXP3 assumes that Reclamation operates the Joint Federal Project in accordance with the latest USACE manual.

- *Water Board D-893:* EXP3 assumes that Reclamation will comply with minimum flow requirements as provided for in D-893. In that decision, the Water Board set the minimum allowable flows in the lower American River, in the interest of fish conservation, should not ordinarily fall below 250 cfs between January 1 and September 15 or below 500 cfs at other times. Since issuance of D-893, Reclamation has worked with the Sacramento Area Water Forum (Water Forum) to develop new flow standards for the lower American River in 2006 and 2017. However, those flow standards are not required by any law or contract, so they are not incorporated into EXP3.
- *Water Board D-1641:* In EXP3, Reclamation operates Folsom and Nimbus dams to comply with applicable objectives in D-1641. Reclamation operates Folsom Reservoir in coordination with other CVP and SWP facilities to meet those objectives. In EXP3, CalSim II makes reasonable assumptions on when and how much water to release from Folsom Reservoir to meet D-1641 requirements based on past operations.
- *Conditions of Approval - Storage Withdrawals:* As discussed above for Shasta Reservoir, Reclamation and DWR must operate the CVP and SWP in accordance with Article 6(c) of the COA, as executed in 1986 and amended in 2018. Article 6(c) establishes each party's responsibility for making available storage withdrawals to meet Sacramento Valley in-basin uses. EXP3 assumes that Reclamation will operate in accordance with the COA, including the sharing of responsibilities to meet in-basin uses.
- *Water Rights Settlement Contracts:* Reclamation administers five contracts that provide for the diversion of nonproject water by contractors that hold water rights that are senior to those of the United States. In total, those contracts provide for the annual diversion of up to 430,000 acre-feet of water from the American River and up to 81,800 acre-feet of water from the Sacramento River. Reclamation also administers a Memorandum of Understanding with the California Department of Corrections for the annual diversion of up to 5,000 acre-feet of water for Folsom State Prison. Those contracts do not include standard water shortage provisions found in-water service contracts, nor do they include Critical Year shortage provisions, like those found in the SRS Contracts.

2.1.4 Stanislaus River

On the Stanislaus River, Reclamation owns and operates New Melones Dam, which creates New Melones Reservoir, and is part of the Eastside Division, which also includes two nonfederal downstream dams: Tulloch and Goodwin. In all modeling scenarios, all Eastside Division facilities continue to exist and effects associated with their existence are attributed to the environmental baseline. Operational assumptions for New Melones Dam are as follows.

In EXP1, Reclamation passes inflow through New Melones Dam, subject to release capacity at the dam and downstream channel capacity. Those pass-through flows can be used to meet downstream regulatory requirements and senior water rights. New Melones is not operated to store water, and there are no deliveries to water service or repayment contractors.

In EXP3, Reclamation operates New Melones Dam to meet the demands of senior water right holders and regulatory requirements imposed by the USACE and Water Board. In EXP3, Reclamation does not operate New Melones Dam to deliver water to any water service or repayment contractors. Additional nondiscretionary operations are summarized below.

- *Flood Control:* Reclamation operates New Melones Dam in accordance with the water control manual issued by the USACE in 1980 and a flood diagram issued in 1982. The New Melones Reservoir flood control operation is coordinated with the operation of Tulloch Reservoir. The flood control objective is to maintain flood flows at the Orange Blossom Bridge at less than 8,000 cfs. When possible, however, releases from Tulloch Dam are maintained at levels that would not result in long-term downstream flows over 1,500 cfs because of the past reported potential for seepage in agricultural lands adjoining the river associated with flows above this level. Up to 10,000 acre-feet of Tulloch Reservoir storage is set aside for flood control.
- *Dissolved Oxygen Requirements:* Water Board's D-1422 provides that a dissolved oxygen (DO) concentration be maintained in the Stanislaus River as specified in the Water Quality Control Plan (Interim), San Joaquin River Basin 5C, Water Board, June 1971. Water Board's D-1641 also requires Reclamation to maintain a DO concentration in the Stanislaus River as specified in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins. The 2004 San Joaquin Basin 5C Plan (Central Valley Regional Water Quality Control Board) designates the lower Stanislaus River with cold water and spawning beneficial uses, which have a general water quality objective of no less than 7 milligrams per liter DO. EXP3 assumes compliance with the latest DO standards for the Stanislaus River.
- *Salinity and Flow Requirements under D-1641:* Water Board D-1641 requires Reclamation to "maintain the Vernalis agricultural salinity objective specified in Table 2" of D-1641. Those standards are to be met on an *"interim basis… until the Board adopts a further decision in the Bay-Delta Water Rights Hearing assigning responsibility for meeting these objectives."* Water Board D-1641 also requires, *"on an interim basis until the Board adopts a decision assigning permanent responsibility for meeting the water quality objectives,"* that Reclamation ensure that the fish and wildlife objectives for San Joaquin River flow at Airport Way Bridge, Vernalis," as stated in Table 3 of D-1641, is met. However, since the expiration of the San Joaquin River Agreement, there is no viable plan of implementation for Reclamation to solely implement Table 3 flows without contribution from other tributaries.

EXP3 assumes that Reclamation will continue to operate New Melones Reservoir to assist in meeting those two objectives. At the same time, however, Reclamation cannot be solely responsible for these objectives without sacrificing the long-term viability of New Melones Reservoir. For those reasons, EXP3 assumes that Reclamation will operate New Melones Dam to provide the Stanislaus River's contribution to each objective consistent with those assumed in the Stepped Release Plan for New Melones Reservoir.

Senior Water Rights Agreement: In the early 1970s, Reclamation's application for assignment of state water right filings were protested by future in-basin users, senior water rights holders, and CDFW. To resolve the senior water rights' protest, Reclamation entered into a 1972 Agreement and Stipulation with the Oakdale Irrigation District (OID), and South San Joaquin Irrigation District (SSJID). In 1988, the parties executed a new agreement that depended less on actual inflow and more on Reclamation's storage in New Melones Reservoir. The 1988 Agreement and Stipulation commits Reclamation to provide water in accordance with a formula based on inflow and storage of up to 600 TAF each year for diversion at Goodwin Dam by OID and SSJID to meet their demands. In EXP3, Reclamation operates New Melones Dam to provide water to OID and SSJID in accordance with the 1988 Agreement and Stipulation.

2.1.5 San Joaquin River

On the San Joaquin River, Reclamation operates Friant Dam, which creates Millerton Lake and diverts water into the Madera and Friant-Kern Canals for water supply purposes. In all modeling scenarios Friant Dam continues to exist, and effects associated with its existence are attributed to the environmental baseline. Operational assumptions for Friant Dam are as follows.

In EXP1, inflow is passed through Friant Dam to the San Joaquin River. Those inflows can be used to meet regulatory requirements and the demands of contractors that hold or claim senior water rights. Water is not stored in Millerton Lake, and no water is diverted to the Madera or Friant-Kern Canals.

In EXP3, water is stored and released for regulatory requirements, the demands of contractors that claim or hold senior water rights, and Level 2 refuge water supplies for South of Delta (SOD) wildlife refuges. The Madera and Friant-Kern Canals are not operated to deliver water to Friant water users. However, in EXP3 there are no exports from the Delta, so San Joaquin Exchange Contractor demands are met through releases of San Joaquin River water from Friant Dam. The same is true for Level 2 water supplies to SOD wildlife refuges. Stored water is not released down the San Joaquin River to meet the demands of any water service or repayment contractor.

- *Flood Control:* In EXP3, Reclamation operates Friant Dam in accordance with flood control requirements imposed by the USACE in 1980.
- *San Joaquin River Restoration Program Settlement:* In 2006, parties to *NRDC, et al., v. Rodgers, et al.*, executed a stipulation of settlement that called for a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of the Merced River and a self-sustaining Chinook salmon fishery while reducing or avoiding adverse water supply impacts. The San Joaquin River Restoration Program provides for Restoration Flows to be released from Friant Dam to meet Restoration Goals in the San Joaquin River. The settlement-required flow targets for releases from Millerton Lake include six water year types for releases depending upon available water supply as measures of inflow to Millerton Lake. However, the litigation and settlement were primarily driven by historic operation of Friant Dam, which resulted in portions of the San Joaquin River between Friant Dam and the confluence of the Merced River being dry during significant portions of most years. In EXP3, Reclamation is not diverting water at Friant Dam to the Madera and Friant-Kern Canals to meet the demands of Friant water users, so all releases from Millerton Lake are to the San Joaquin River. Thus, the basis for the settlement and Restoration Flows no longer exists in EXP3.
- *Holding Contracts:* The United States has entered into a number of “Holding Contracts” for water supplies from the San Joaquin River. These contracts act as a settlement for certain landowners along the San Joaquin River from Friant Dam to Gravelly Ford that could assert that they hold water rights from the San Joaquin River and that the operation of Friant Dam would impact their use of water for irrigation purposes. Those contracts

require Reclamation to permit water to pass by or through Friant Dam into the San Joaquin River that, when combined with accretions to the river from all sources, will maintain a “live stream” of five cfs at stated “control points” along the San Joaquin River. The furthest downstream control point is located at Gravelly Ford. EXP3 assumes that Reclamation operates Friant Dam to provide a minimum stream flow of five cfs at Gravelly Ford along the San Joaquin River.

- *San Joaquin River Exchange Contract:* In EXP3, Reclamation releases stored water from Friant Dam to the San Joaquin River to meet the demands of San Joaquin River Exchange Contractors. The Second Amended Exchange Contract, executed in 1988, requires Reclamation to provide up to 840 TAF of substitute water in a non-Critical Year and up to 650 TAF of substitute water in a Critical Year. The main source of the substitute supply is the Delta-Mendota Canal (DMC), which conveys water from the Delta, but the source of the substitute supply is not restricted to the DMC. If Reclamation cannot make the substitute supply available from the DMC or another source, Reclamation must make San Joaquin River water available. In EXP3, Reclamation is not operating the Delta pumps or the DMC, so Reclamation cannot make the substitute supply available from the DMC. EXP3 assumes that Exchange Contractor demands, consistent with the terms of the Second Amended Exchange Contract, are met through releases at Friant Dam to the San Joaquin River.
- *San Joaquin River Settlement Contracts:* In EXP3, Reclamation releases water from Friant Dam to the San Joaquin River to meet the Schedule 2 demands of senior water users that executed settlement agreements with the United States in the 1960s. Those settlement contracts typically include the “Shasta Critical” provision to reduce the amount of Schedule 2 water during critical years. They also provide for the delivery of Supplemental Water in addition to Schedule 2 water, but EXP3 does not assume deliveries of supplemental water.
- *Refuge Contracts:* Reclamation administers three agreements that provide for the delivery of up to 271,001 acre-feet of Level 2 water supplies to SOD wildlife refuges. In EXP3, Reclamation releases water from Friant Dam to the San Joaquin River to meet the Level 2 water supplies of SOD wildlife refuges consistent with the terms of the contracts and CVPIA.
- *Friant Division Contracts*: Under paragraph 3.(n), “The United States agrees that it will not deliver to the Exchange Contractors thereunder waters of the San Joaquin River unless and until required by the terms of said contract, and the United States further agrees that it will not voluntarily and knowingly determine itself unable to deliver to the Exchange Contractors entitled thereto from water that is available or that may become available to it from the Sacramento River and its tributaries or the Sacramento-San Joaquin Delta…” However, under future nondiscretionary operations, Reclamation is not operating export facilities.

2.1.6 Delta

Within the Delta, Reclamation and DWR operate facilities that export water out of the Delta and direct the movement of water within the Delta. Major facilities within the CVP's Delta Division include the Delta Cross Channel, the Contra Costa Canal and Pumping Plants, Contra Loma Dam, Martinez Dam, the C.W. "Bill" Jones Pumping Plant (formerly Tracy Pumping Plant), the Tracy Fish Collection Facility, the DMC, and the Delta-Mendota Canal/California Aqueduct Intertie Pumping Plant. Major SWP facilities within the Delta include the Suisun Marsh Salinity Control Gates, Harvey O. Banks Pumping Plant, Clifton Court Forebay, and the John E. Skinner Delta Fish Protective Facility. All Delta facilities continue to exist in all modeling scenarios, and effects associated with their continued existence are attributed to the environmental baseline. Operational modeling assumptions for Delta facilities are as follows.

For the Delta, most operational assumptions are the same in EXP1 and EXP3. Neither the Jones Pumping Plant nor the Banks Pumping Plant are operated to export water from the Delta. Additionally, San Luis Reservoir, which stores water that is exported from the Delta, is not operated. The canals that convey water from the Delta pumps to San Luis Reservoir and beyond are also not operated. Water contractors (both CVP and SWP) located SOD receive a zero allocation. Further assumptions are explained below.

- *Barker Slough Pumping Plant*: DWR operates the Barker Slough Pumping Plant for water supplies to Napa and Solano counties via the North Bay Aqueduct. In both scenarios, DWR does not operate the Barker Slough Pumping Plant.
- *Contra Costa Water District Facilities:* The Contra Costa Water District (CCWD) operates Los Vaqueros Reservoir and pumping and conveyance facilities in the Delta. CCWD's pumping and conveyance system includes the Mallard Slough, Rock Slough, Old River, and Middle River (on Victoria Canal) intakes, and the Contra Costa Canal and shortcut pipeline. In both scenarios, CCWD diverts water under its own water rights for direct use but does not divert water into storage at Los Vaqueros Reservoir. CCWD's facilities are not used to divert CVP water for any purpose.
- *Delta Cross Channel Gates:* The Delta Cross Channel (DCC) is a gated diversion channel in the Sacramento River near Walnut Grove and Snodgrass Slough. When the gates are open, water flows from the Sacramento River through the cross channel to channels of the lower Mokelumne and San Joaquin Rivers toward the interior Delta. In both scenarios, the DCC gates are not operated and are left in the closed position.
- *Suisun Marsh Salinity Control Gates:* The Suisun Marsh Salinity Control Gates, which aid in reducing salinity throughout the Suisun Marsh, are located in the eastern portion of Montezuma Slough approximately 3 miles north of Collinsville. The Suisun Marsh Salinity Control Gates control salinity by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during incoming tides and retaining lower salinity Sacramento River water from the previous ebb tide. In EXP1, the gates are not operated. In EXP3, the gates are operated to meet Water Board D-1641's water quality standards in Montezuma Slough during salinity control season October through May, as necessary in conjunction with upstream releases.

2.1.7 Effects on NOD Storage

The Model Results of the Exploratory Modeling appendix are summarized in Attachment 2 to Appendix E. Attachment 2 analyzes the modeling results for NOD storage (Shasta, Oroville, and Folsom reservoirs), Sacramento and American River flows, Delta inflows and outflows, Delta exports, and deliveries. A summary of the effects of operating for nondiscretionary requirements and obligations under EXP3 follows.

EXP3 can be used to show the effects of nondiscretionary operations of the CVP on storage facilities located on the Sacramento River and American River.

2.1.7.1 Shasta Reservoir Storage

At Shasta Reservoir, end-of-April (EOA) storage is fairly consistent for EXP3 under all water year types, except in Critically Dry years.

For end-of-September (EOS) storage, under EXP3, storage levels decrease progressively from Wet years to Critically Dry years.

The effect of nondiscretionary operations on EOA storage at Shasta Reservoir is almost 800 TAF in a Critically Dry year. The effect of nondiscretionary operations on EOS storage at Shasta Reservoir ranges from about 800 TAF in a Wet year to about 2 MAF in a Critically Dry year. For additional details, refer to Appendix E.

2.1.7.2 Folsom Reservoir Storage

At Folsom Reservoir, a similar pattern to Shasta Reservoir emerges for EOA storage. EOA storage is fairly consistent and differs by no more than 2 TAF across all water year types, except in Critically Dry years. In Critically Dry years, EOA storage drops from 743 TAF to 715 TAF a difference of 28 TAF. That decrease in storage is 14 times greater than the decrease in storage during a Dry year.

EOS storage at Folsom Reservoir decreases progressively from Wet years to Critically Dry years. In a Wet year, EOS storage decreases from 963 TAF to 905 TAF, a decrease of 58 TAF. In a Critically Dry year, EOS storage decreases from 733 TAF to 650 TAF, a decrease of 83 TAF.

Accordingly, the effect of nondiscretionary actions on EOA storage at Folsom Reservoir is 28 TAF, while the effect on EOS storage at Folsom Reservoir ranges from 58 TAF in a Wet year to 83 TAF in a Critically Dry year. For additional details, refer to Appendix E.

2.1.8 Effects on River Flows

The results of EXP3 can be compared to those for EXP1, summarized above, to see how nondiscretionary operations affect river flows in different water year types. In EXP1, the projects do not store any water and pass inflow through dams. Releases are limited to the natural inflow into dams, while diversions are limited to senior water users that divert available flow using their own facilities. The CVP and SWP do not have any usable storage to meet applicable regulatory requirements or contractual demands, and do not operate to meet those demands.

2.1.8.1 Sacramento River

In EXP1, the monthly pattern of flow below Keswick Dam carries the same pattern as inflow into Shasta Reservoir. Below Keswick Dam, the long-term average flows in EXP3 sharply increase in December over the flows in EXP1 due to the simulation of flood control releases. From January through May, the long-term average flows below Keswick Dam in EXP3 decrease below the flows in EXP1. During the temperature management season (June through September) the long-term average flows under EXP3 increase above flows in EXP1 due to reduced inflow and increased releases of stored water for regulatory requirements and settlement contractor demands. In Dry and Critically Dry years, the patterns of flow below Keswick Dam are the same as those for the long-term averages. Downstream of Keswick Dam, at Bend Bridge, the pattern of long-term average flow and flows during Dry and Critically Dry years are similar to those below Keswick Dam.

Further downstream, at Wilkins Slough, the effects of releases at Shasta Reservoir on flows are not as pronounced. For example, flows in December are similar under EXP1 and EXP3. One significant difference is that, under EXP1, long-term average flows fall to zero at Wilkins Slough in July, while flows remain higher in EXP3 due to releases for regulatory requirements and settlement contractor demands. A similar pattern of flow emerges at Wilkins Slough in Dry and Critically Dry years, but river flow also zeros out in parts of June and August.

Downstream of Wilkins Slough, at Verona, Sacramento River flow is influenced by inflow from the Feather River. At Verona, the pattern of long-term average flow for EXP1 and EXP3 remains similar to the pattern of long-term average flow at Wilkins Slough, but the flow does not zero out in July. A similar pattern emerges for flows at Verona in Dry and Critically Dry years, but flows do not zero out in June, July, or August. Further downstream at Hood, Sacramento River flow is influenced by flows from the American River. At Hood, the pattern of long-term average flow for EXP1 and EXP3 remains similar to the pattern of flow at Verona. The same is true for Dry and Critically Dry years.

In sum, the effect of operating Shasta Reservoir on Sacramento River flow is greatest above the confluence with the Feather River. At Wilkins Slough, above that confluence, the Sacramento River runs dry in July in all water year types and in parts of June and August in Dry and Critically Dry years under EXP1. By comparison, under EXP3, operating Shasta to meet nondiscretionary requirements and obligations under EXP3 increases flows at Wilkins Slough in June, July, and August in all water year types to approximately 4,000 cfs.

2.1.8.2 American River

On the American River, under EXP1, the pattern of flow below Nimbus Dam is the same as the pattern of inflow to Folsom Reservoir. In EXP3, long-term average flows and flows in Dry and Critically Dry years spike in November due to Folsom Reservoir flood control releases. In February, flows in EXP3 begin to drop below EXP1, while flows in EXP3 increase above those in EXP1 starting in June due to releases for regulatory requirements and settlement contractors. However, in August and September flows under EXP1 increase above those for EXP3. Downstream of Nimbus Dam, at H Street in Sacramento, a similar pattern emerges for long-term average flows and flows in Dry and Critically Dry years under EXP1 and EXP3.

The effect of operating Folsom Reservoir for nondiscretionary actions under EXP3, as compared to EXP1, are increased flow in November due to flood control releases, decreased flows in the spring, and increased flow in June, July, and August for regulatory requirements and settlement contractors.

2.1.8.3 Effects on Delta Outflow

The results for EXP3 can also be compared to those for EXP1 to determine how continued nondiscretionary operations affect Delta outflow. Delta outflow is the total inflow into the Delta, as measured on the Sacramento River at Freeport and the San Joaquin River at Vernalis plus the combined flow in Old and Middle Rivers and flows through the Yolo Bypass. Average annual inflows for each measuring point decrease slightly from EXP1 to EXP3, as does average annual Delta outflow, which decreases from 23,321 TAF to 21,599 TAF. The same pattern occurs in all water year types. In Wet years, annual outflow decreases from 38,956 TAF to 36,732 TAF, while in Critically Dry years, outflow decreases from 7,718 TAF to 7,490 TAF.

Thus, the continued operation of the CVP and SWP for nondiscretionary purposes, as modeled in EXP3, have little effect on Delta outflow in all water year types. Environmental conditions, like hydrology have a much larger effect on Delta outflow than nondiscretionary operations.

2.2 Environmental Conditions and Climate

Environmental conditions for the Proposed Action include climate change, drought, and hydrology within the action area represented by a 2022 +/- 15 years median climate scenario. A 2022 median climate provides an estimate of warmer conditions based on current trends while reducing the potential for compounding effects in the CalSim III model that yielded results that may be unrealistically impactful to species and water supply.

2.2.1 Hydrology

Unimpaired flow into the Delta originates from the Sacramento River and its tributaries (73%), and to a lesser extent from the San Joaquin River and its tributaries (21%). The Cosumnes and Mokelumne Rivers and other smaller tributaries, collectively called the eastside tributaries, contribute 6% of inflows. Upstream dams and diversions (CVP, SWP, and non-project) influence the timing and volume of water flowing into the Delta from rivers and tributaries.

78% of the total annual Delta inflow occurs in winter and spring with inputs of wet season precipitation and snowpack melt from the Sierra Nevada. The summer and fall seasons represent only 22%. The primary origin of precipitation is the seasonal arrival of low-pressure systems from the Pacific Ocean. The wettest (10% exceedance) years provide a total Delta inflow of 49,954 TAF while the driest (90% exceedance) years provide 13,096 TAF. The Delta, lower portion of the Yolo Bypass, and Suisun Marsh are tidally influenced by the Pacific Ocean, although tidal range and influence decrease with increasing distance from the San Francisco Bay (Kimmerer 2004). Tides are mixed semidiurnal with two highs and two lows each day (i.e., one larger magnitude high and low and one lower magnitude high and low).

2.2.2 Climate

The climate in the Delta region is spatially variable but is generally characterized as hot Mediterranean (Kottek et al. 2006). Summers are hot with average summer highs in the upper 80°F (27°C) to lower 90°F (32°C), with little to no precipitation and low humidity. In the Central Valley, during the April through November winter-run Chinook salmon spawning and egg incubation period, the 2000–2022 mean monthly high air temperature at the Redding Municipal Airport ranged from 81°F (27°C) to 111°F (44°C) (National Weather Service 2023).

The climate of the Delta is predicted to change. The Delta is expected to get warmer and drier, while also experiencing sea level rise. Increasing sea level rise will increase saltwater intrusion into the Delta, disrupting marsh and estuary ecosystems and reducing freshwater and terrestrial plant species habitat. Increased salinity also may increase mortality for species that are sensitive to salinity concentrations. Changes in salinity levels may place added stress on other species, reducing their ability to respond to disturbances.

Predicted warmer temperatures will affect the rate of snow accumulation and melting in the snowpack of the Sierra Nevada. The predicted changes in the dynamics of the snowpack will influence the timing, duration, and magnitude of inflow from the Sacramento and San Joaquin River watersheds. For example, with more precipitation falling as rain instead of snow and the snowpack melting earlier, greater peak flows will result during the rainy season and lower flows during the dry season.

Climate projections for the San Francisco Bay-Delta and its watershed indicate that changes will be substantial by midcentury and considerable by the year 2100. Climate models broadly agree that average annual air temperatures will rise by about 36°F (2°C) at midcentury and about 4°C by 2100 if current atmospheric carbon emissions accelerate as currently forecasted (Dettinger et al. 2016). It remains highly uncertain whether annual precipitation in the Bay-Delta watershed will trend wetter or drier (Dettinger 2005; Dettinger et al. 2016). The warmer air temperature projections suggest more precipitation will fall as rain rather than snow and that storms may increase in intensity but will have more dry weather in between them (Knowles and Cayan 2002; Dettinger 2005; Dettinger et al. 2016). The expected consequences are less water stored in spring snowpacks, increased flooding and an associated decrease in runoff for the remainder of the year (Hayhoe et al. 2004). Changes in storm tracks may lead to increased frequency of flood and drought cycles during the twenty-first century (Dettinger et al. 2015).

2.2.3 Drought

California experiences variable climate, and periods of droughts are a recurring feature. Water stored in CVP and SWP reservoirs and groundwater basins mitigate droughts. Multi-year droughts occur when two or more successive years are dry, and reservoirs and groundwater reserves are depleted. Throughout recent recorded history, California has experienced many droughts, such as 1841, 1864, 1924, 1928–1935, 1947–1950, 1959–1960, 1976–1977, 1986–1992, 2006–2010, 2011–2017, 2018 and 2020-2022. Historical data combined with estimates created from indirect indicators such as tree rings suggest that the 1928-34 event may have been the driest period in the Sacramento River watershed since about the mid-1550s.

Partially in response to drought 1986–1992, Congress passed the CVPIA. The CVPIA (Section 3406) dedicated 800,000 acre-feet of CVP project yield for environmental purposes fish, wildlife, and habitat restoration; to protect the waters of the San Francisco Bay/Sacramento–San Joaquin Delta Estuary; and to help meet such obligations such as the ESA. The CVPIA also defined the expected "Central Valley Project yield," based on the 10-delivery capability of the CVP during the 1928–1934 drought period after federal and state fishery, water quality, and other flow and operational requirements existing at the time of its enactment were met. The CVP is still currently operated to meet that yield.

Since the 1987–1992 drought, the regulatory framework for the CVP and SWP water management has changed significantly in terms of new ESA requirements to protect certain fish species, and Water Board water rights decisions governing the water projects' operations in the Delta. These new requirements have decreased CVP yield. Reclamation expects the future to be dryer and hotter and droughts will continue to influence operations. Reclamation's ability to balance conditions during expected future dry conditions, compounded by additional requirements for resources since 1992, has been greatly reduced. This has resulted in a need to request temporary changes to water quality standards to ensure the CVP yield prescribed by Congress.

Over the last decade there have been multiple California Governor proclamations declaring a State of Emergency due to severe drought conditions and directing the Water Board, among other things, to consider modifying requirements for reservoir releases or diversion limitations that were established to implement a water quality control plan. These proclamations stated that such modifications may be necessary to conserve cold water stored in upstream reservoirs that may be needed later in the year to protect salmon and steelhead, to maintain water supply, and to improve water quality. These proclamations were followed by several executive orders continuing the State of Emergency and identifying and expediting actions necessary for state and local agencies and Californians to take to reduce the harmful effects of the drought, including streamlined processing of permits and increased enforcement, conservation, and coordination.

During these drought proclamations, Reclamation and DWR reviewed the ability of the CVP and SWP to meet existing regulatory standards and objectives contained in their water rights permits and licenses, as well as environmental laws and regulations, based on the current and projected hydrology, exceedance forecasts, reservoir levels, etc. This included consideration of the requirements of D-1641, and the USFWS and NMFS Biological Opinions on the Coordinated Long-term Operation of the CVP and SWP. Reclamation and DWR then jointly developed proposed modifications to D-1641 and operations consistent with the Biological Opinions and prepared appropriate documentation to support the permitting and consultation processes. This documentation included preparation of a Temporary Urgency Change Petition (TUCP) for submittal to the Water Board, and federal ESA and California ESA consultation letters and memoranda for exchange with USFWS, NMFS, and CDFW or memoranda to file. For information regarding TUCPs submitted by the Reclamation and DWR during recent droughts, please see the following State Water Board Website, https://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/tucp/index.html. The effectiveness of the actions under the TUCP, Biological Opinions and associated monitoring activities were reviewed and utilized, in light of the species responses, to inform the future responses to drought.

Since December 2013, state and federal agencies that supply water, regulate water quality, and protect fish and wildlife have worked closely to manage resources despite persistent drought conditions. Coordination efforts on periods of drought are expected to continue into the future.

2.2.4 Flooding

Flooding has always been a regular occurrence along the Sacramento River (Thompson 1957) and the San Joaquin River. The climate and geography of the Central Valley combined to produce an area where regular flooding is a natural phenomenon. Under natural conditions, the channels of the Sacramento and San Joaquin Rivers had insufficient capacity to carry the heavy winter and spring flows generated by wet season precipitation and/or snowmelt. Runoff from the Sierra Nevada and the Coast Range would rapidly run off to the valley floor in several rivers. Once flows exceeded channel capacity, the channels overflowed onto the surrounding countryside forming vast floodplains. Hydraulic mining during the gold rush in the 1800s washed mining debris downstream from the Sierra Nevada, and by the late 1800s, millions of cubic yards of material were being washed annually into the Sacramento and San Joaquin Rivers, reducing channel capacity downstream and increasing the instances and magnitude of flooding.

There is little information about floods in the Central Valley prior to the 1850s and most information comes from eyewitness accounts and narratives. In the early 1800s, settlers and Native Americans described the Sacramento and San Joaquin Rivers as “miles wide” during flooding. After 1850, when settlement began in the area, organized records of flooding began. Major floods occurred in the Sacramento River and San Joaquin River Basin in 1862, 1867, 1881, 1890, 1904, 1907, 1909, 1911, 1928, 1955, 1964, 1967, 1969, 1970. 1974, 1983, 1986, 1995, and 1997. The most recent floods—in 1983, 1986, 1995, and 1997—caused extensive damages in both the Sacramento River and San Joaquin River Basins and raised questions about the adequacy of the current flood management systems and land use in the floodplain.

The Jackson Report, completed in 1910 and adopted by both Congress and the California legislature, was the first comprehensive flood plan for the Central Valley. The Jackson Plan was a comprehensive plan for flood protection for the Sacramento Valley that included a system of levees along existing streams, supplemented by weirs and bypasses to convey excess flood flows. Over time, the recommendations of the Jackson Plan have been implemented and led to the current flood protection system. Since the implementation of the Jackson Plan, many projects have been authorized for flood protection in the Sacramento and San Joaquin River Basins including the Sacramento River Flood Control Project, Sacramento River Major and Minor Tributaries Project, Sacramento River Bank Protection Project, Butte Basin Plan of Flood Control, and the Lower San Joaquin River and Tributaries Projects. In addition to projects listed above, several smaller flood control projects have been developed at low elevations in the Sierra Nevada foothills in the San Joaquin River Basin.

In 1920, Colonel Robert Marshall, chief geographer for the United States Geological Survey, proposed a major water storage and conveyance plan to transfer water from Northern California to meet urban and agricultural needs of Central and Southern California. This plan ultimately provided the framework for development of the CVP. Under the Marshall Plan, a dam would be constructed on the San Joaquin River near Friant to divert water north and south to areas in the eastern portion of the San Joaquin Valley and provide flood protection to downstream areas. Construction of the CVP began on October 19, 1937, with the Contra Costa Canal. Construction of Shasta Dam began in 1938 and was completed for full operation in 1949. Friant Dam, on the San Joaquin River, was also completed in 1949. In 1949, Congress passed the American River Act, which authorized the American River Division of the CVP and provided for the construction of Folsom and Nimbus dams, lakes, and powerplants. These authorizations provided a coordinated system for flood protection, water supply, and the optimization of power production.

Despite the improvements in flood protection projects and practices, much of the current levee system in the Central Valley is the same system constructed decades ago. Levees were constructed incrementally, over time, and in response to flooding or to reclaim fertile lands for agriculture. Additionally, the system was not originally designed to provide a high level of protection to the urban areas that have since developed over time and much of the levee system has not undergone any modern engineering upgrades.

2.3 Past and Present Operation of the Central Valley Project and State Water Project

The CVP and SWP historically operate under requirements from the Water Board (water rights and water quality), the USFWS and NMFS (endangered species), and Congress (CVPIA) that are intended to benefit fish and wildlife resources within the Central Valley of California. The SWP must also comply with additional regulatory requirements imposed by CDFW that are intended to benefit aquatic species listed under the California ESA.

This section describes the evolving nature of regulatory efforts imposed on the CVP and SWP to benefit species that are now protected under the federal ESA. The effects from past and present operation of the CVP and SWP under these regulatory requirements, including any resulting take of listed species, are included in the Environmental Baseline.

2.3.1 Regulatory Requirements for Fishery Purposes

To store water behind CVP dams for CVP purposes, Reclamation applied for water rights permits from the Water Board. As part of that process, the Water Board normally requires that a minimum amount of water be released from a dam for fishery purposes. For example, in Decision 893 (1958), the Water Board approved Reclamation's application to store and divert American River water at Folsom Dam. In that decision, the Water Board ordered that the minimum allowable flows in the lower American River, in the interest of fish conservation, should not ordinarily fall below 250 cfs between January 1 and September 15 or below 500 cfs at other times. Another example, in Decision 990 (1961), the Water Board authorized Reclamation to store water behind Shasta Dam for authorized purposes. In Condition 24 of that decision, the Water Board directed Reclamation to bypass or release into the Sacramento River (below Keswick Dam) fish life flows, as provided in a 1960 MOA with CDFW.

The Water Board has also required Reclamation and DWR to comply with applicable water quality plans for the Delta. In 1978, the Water Board issued Decision 1485, which directed Reclamation and DWR to maintain water quality conditions in the channels of the Delta and Suisun Marsh equal to or better than the standards set forth in Table II of D-1485, including specific standards for fish and wildlife. Those standards could be met through reduced exports from the Delta, upstream releases, operation of the DCC gates, or any combination of those measures.

In 1990, the Water Board issued Order 90-5, which modified the minimum flow requirements for the Sacramento River below Keswick Dam that were required by Condition 24 of Decision 990. More specifically, Order 90-5 set the minimum flow below Keswick Dam from September through February to be 3,250 cfs in all but Critically Dry years. Order 90-5 also requires Reclamation to meet specified water quality (temperature) objectives for the "protection of the fishery in the upper Sacramento River." The order requires Reclamation to operate Shasta Dam, Keswick Dam, and the Spring Creek Power Plant to meet a daily average water temperature of 56°F (13°C) in the Sacramento River at Red Bluff Diversion Dam during periods when higher temperatures will be detrimental to the fishery. If there are factors "beyond the reasonable control of [Reclamation]" that prevent meeting 56°F (13°C) at Red Bluff Diversion Dam, then Reclamation may select an alternative temperature compliance point location upstream of the Red Bluff Diversion Dam.

In 2000, the Water Board revised Decision 1641, directing Reclamation and DWR to comply with the objectives set forth in the 1995 Bay-Delta Plan. D-1641 set forth additional protections for fish, including an export to inflow (E/I) ratio, which restricted exports during the winter and spring months when hydrologic conditions are such that exports are not supported by reservoir storage withdrawals. D-1641 also included DO requirements for the Stanislaus and San Joaquin Rivers to benefit salmon species, and the month-long San Joaquin River pulse flow requirement and CVP–SWP export limitation intended to improve river flows and protect outmigrating juvenile salmonids from the San Joaquin River watershed. In addition, the Water Board has issued orders and amended permits to require additional flow and specified water quality (temperature) requirements in CVP-controlled streams for listed salmon.

Congress has also enacted laws to protect aquatic species in the Central Valley. In 1992, Congress enacted CVPIA, which amended the authorized purposes of the CVP and authorized numerous fish, wildlife and conservation measures. Those projects include facility improvement projects (3406(b)(4),(6),(10),(14)); a program with a goal of doubling the number of anadromous fish in Central Valley streams (3406(b)(1)); the management of up to 800 TAF of CVP yield for fish and wildlife purposes (3406(b)(2)); stream restoration projects (3406(b)(12),(13)); and other programs and projects. Reclamation prepared an EIS for CVPIA and issued a ROD on December 7, 2000. Reclamation continues to implement the CVPIA.

A more complete description of applicable regulatory requirements for CVP facilities can be found in Appendix A, *Facilities Description*.

2.3.2 Endangered Species Act Consultations Pursuant to Section 7

Congress enacted the ESA in 1973. Section 4 of the ESA authorizes the USFWS and NMFS to classify species as threatened or endangered, and to designate critical habitat for listed species. 16 USC 1533. Between 1990 and 2006, several aquatic species found in Central Valley streams, the Delta and/or the Pacific Ocean (outside the action area for this consultation) were listed under the ESA as endangered or threatened.

Section 7 of the ESA requires federal agencies to consult with the Services to ensure that actions they fund, authorize, permit, or otherwise carry out will not jeopardize the continued existence of any listed species or adversely modify designated critical habitats (16 United States Code [USC] 1536). The long-term operation of the CVP and SWP is a federal action that require consultation under Section 7 of the ESA. Reclamation and DWR have consulted with USFWS and/or NMFS on the long-term operation of the CVP and SWP several times since 1992. Those consultations have resulted in Biological Opinions, both jeopardy and nonjeopardy, that have been the subject of lengthy litigation in federal courts.

Each of these prior consultations help inform the current environmental baseline for federally listed species and designated critical habitats within the action area and provide data upon which subsequent consultations are based (U.S. Fish and Wildlife Service 1998). As these prior consultations document the status of each of the federally listed species and designated critical habitats at the time of consultation, describes the anticipated effects of the prior Proposed Actions, and finally, the resulting incidental take that was reasonably certain to occur at the time. Refer to the species-specific chapters for incorporation of past data and current status of the federally listed species and designated critical habitats within the action area.

2.3.2.1 1992/1993 National Marine Fisheries Service Consultation

Reclamation first consulted with NMFS on its operation of the CVP following the listing of winter-run Chinook salmon as threatened in 1990. In October 1992, Reclamation prepared an Interim Operations Criteria and Plan (OCAP) and Biological Assessment for CVP operations. On February 13, 1993, NMFS issued a Biological Opinion concluding that proposed operations in 1992 were likely to jeopardize the continued existence of winter-run Chinook salmon, the only species within the action area that was listed at that time. Consequently, NMFS issued a reasonable and prudent alternative (RPA) for operations in 1992, which focused on the Sacramento River below Keswick Dam (where Winter-run Chinook salmon spawn and migrate) and the Delta (through which winter-run Chinook salmon migrate). NMFS' RPA included the following measures: (1) use of conservative February 15 forecasting; (2) a minimum EOS storage requirement at Shasta of 1.9 MAF; (3) a minimum flow of 3,250 cfs below Keswick Dam from October 1 to March 30; (4) temperature requirements for the Sacramento River below Keswick Dam; (5) extended periods for raising the gates at the Red Bluff Diversion Dam; (6) closing of the DCC gates from February 1 to April 30; (7) limiting exports from the Delta to achieve no reverse flows in the western Delta on a 14-day average from February 1 to April 30; and (8) limiting exports to achieve a negative flow in the western Delta of no more than -2,000 cfs on a 14-day average from November 1 to January 31.

Along with their Biological Opinion, NMFS issued an incidental take statement that allowed temperature-dependent egg mortality of 0% to 5% during spawning and incubation periods, 10% to 17% of upstream adult migrants to be taken at the Red Bluff Diversion Dam (depending on gate operations), 3.5% to 32% of outmigrating juvenile winter-run Chinook salmon to be taken at the Red Bluff Diversion Dam (depending on gate operations), and no more than 1% of the estimated number of juvenile winter-run Chinook salmon entering the Delta to be taken at the Delta pumps.

2.3.2.2 2004/2005 Consultation

In the early 2000s, Reclamation had to renew numerous water contracts that were set to expire. Reclamation adopted a dual-track approach to consulting on the contract renewals and operations of the CVP. For contract renewal, Reclamation consulted with USFWS and NMFS on the terms of the contracts and effects on listed species other than aquatic species. To analyze the effects on aquatic species from operating the CVP to deliver water under the proposed contract renewals, Reclamation undertook a much larger consultation on the coordinated CVP and SWP operations. Consequently, Reclamation prepared a new long-term OCAP and Biological Assessment that would support continued operation of the CVP and SWP.

In June 2004, Reclamation transmitted to USFWS and NMFS a long-term OCAP and Biological Assessment for CVP and SWP operations. By this time, Delta smelt, spring-run Chinook salmon and Central Valley steelhead (CV steelhead) had been listed under Section 4 of the ESA and were included in the consultation along with winter-run Chinook salmon. In October 2004, NMFS issued a Biological Opinion concluding that the 2004 OCAP was not likely to jeopardize the continued existence of winter-run Chinook salmon, spring-run Chinook salmon, or CV steelhead and was not likely to adversely modify or destroy their designated critical habitats. Reasonable and prudent measures included spawning gravel augmentation, manage the coldwater supply within Shasta, Folsom, and New Melones Reservoirs and make coldwater releases to provide suitable habitat and to improve and maintain in good working order fish screens at the pumping facilities to minimize entrainment.

On July 30, 2004, USFWS issued a Biological Opinion on the effects of the 2004 OCAP on Delta smelt and listed terrestrial species. That Biological Opinion was voluntarily remanded and superseded by a Biological Opinion issued by USFWS on February 15, 2005. In that 2005 opinion, USFWS concluded that operations under the 2004 OCAP Biological Assessment were not likely to jeopardize the continued existence of Delta smelt or adversely modify or destroy its critical habitat. Reasonable and prudent measures included minimizing the potential for harassment, harm, injury, and mortality to the Delta smelt and to continue to monitor Delta smelt throughout their life history.

On February 16, 2005, USFWS issued its Reinitiation of Formal and Early Section 7 Endangered Species Consultation on the Coordinated Operations of the Central Valley Project and State Water Project and the Operational Criteria and Plan to address potential critical habitat issues.

Both the NMFS' and USFWS' Biological Opinions were challenged in federal court.

2.3.2.3 2008/2009 Consultation

In May 2008, Reclamation transmitted a new Biological Assessment to USFWS and NMFS for the long-term operation of the CVP and SWP. By this time, the Southern Distinct Population Segment (DPS) of green sturgeon had been classified as threatened and was included in the consultation along with winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and Delta smelt. The killer whale had also been listed by this time, and was also included in the consultation, but there was no critical habitat for that species within the action area for the long-term operation consultation.

In December 2008, USFWS issued its Biological Opinion on the coordinated long-term operation of the CVP and SWP. In that opinion, USFWS concluded that operations under the 2008 Long-Term Operation Biological Assessment were likely to jeopardize the continued existence of Delta smelt and adversely modify its critical habitat. USFWS prepared an RPA that included (1) Old and Middle River flow requirements that resulted in export limitations at the Delta pumps to protect adult, larval, and juvenile Delta smelt; (2) outflow requirements during the fall (Fall X2) to provide suitable habitat quality and quantity for Delta smelt; and (3) a requirement to create or restore a minimum of 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh. USFWS included an incidental take statement for take of adult Delta smelt and juvenile/larval Delta smelt. The incidental take limit for adults was the Cumulative Expanded Salvage, which is calculated by multiplying the prior year's Fall Mid-Water Trawl Index by 7.25, which was the Cumulative Salvage Index. For juvenile and larval Delta smelt, the incidental take limit is calculated by multiplying the Juvenile Monthly Salvage Index by the current water year Fall Mid-Water Trawl by 1.5.

In June 2009, NMFS issued its Biological Opinion on the coordinated long-term operation of the CVP and SWP. In that opinion, NMFS concluded that operations under the 2008 Long-Term Operation Biological Assessment were likely to jeopardize the continued existence of winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, southern resident killer whales, and southern DPS of green sturgeon, and adversely modify designated critical habitat for winter-run Chinook salmon, spring-run Chinook salmon and CV steelhead. NMFS prepared an RPA that included over 70 actions and affected operations on Clear Creek (Action Suite I.1), the Sacramento River (Action Suite I.2), the American River (Action Suite II), Stanislaus River (Action Suite III), and the Delta (Action Suite IV), and required Reclamation to development and implement a fish passage pilot program (Action Suite V).

On the Sacramento River, NMFS mandated, among other actions: (1) performance measures for EOS storage at Shasta and temperature compliance points on the Sacramento River; (2) Fall release schedules that were dictated by EOS; (3) Spring release schedules that depended on EOS and forecasted temperature compliance at specified locations on the Sacramento River; (4) a Summer release schedule to be driven by a Temperature Management Plan that ensured the river between Balls Ferry and Bend Bridge would be no greater than 56 degrees Fahrenheit from May 15 to September 30; (5) prescribed gate operations at the Red Bluff Diversion Dam with gates continually open by May 15, 2012; (6) floodplain restoration at the Yolo Bypass; and (7) measures to study and provide fish passage at Shasta Dam (NMFS required similar fish passage actions for Folsom Dam and New Melones Dam).

In the Delta, NMFS prescribed six RPA actions. In Action IV.1.1, NMFS required modified Delta Cross Cannel gate operations and an evaluation of methods to control access to Georgiana Slough and the Interior Delta to reduce diversion of listed fish from the Sacramento River into the southern or central Delta. In Action IV.1.2, NMFS prescribed controls on the net negative flows toward the export pumps in Old and Middle Rivers to reduce the likelihood that fish would be diverted from the San Joaquin or Sacramento River into the southern or central Delta. In Action IV.1.3, NMFS required a new San Joaquin River inflow (as measured at Vernalis) to combined export (I:E) ratio that restricted exports from April 1 through May 31 as follows: (1) Critically Dry Years: 1:1; (2) Dry Years: 2:1, (3) Below Normal Years: 3:1; (4) Above Normal

Years: 4:1; and (5) Wet Years: 4:1. This RPA not only reduced exports, but required that Reclamation attempt to find additional flows for the San Joaquin River.

NMFS issued an incidental take statement for winter-run Chinook salmon, spring-run Chinook salmon, and CV steelhead, but the amount of take authorized was not quantified in many instances. Specified amounts of take were identified where possible, such as collection of adults, monitoring programs, fish salvage estimates, and unscreened diversions. Where take could not be quantified, NMFS determined that take would be authorized only if Reclamation complied with the requirements of the RPA. For example, take of winter-run Chinook salmon embryos in the Sacramento River was authorized as long as Reclamation complied with RPA Action I.2.3 and met the performance measures included in RPA Action I.2.1. Incidental take limits for all species are set forth in Tables 13-1 to 13-4 of the 2009 Biological Opinion.

The 2008 USFWS Biological Opinion and 2009 NMFS Biological Opinion were challenged in federal court. Initially, both opinions were invalidated by the District Court for the Eastern District of California, however, subsequently upheld.

2.3.2.4 2019/2020 Consultation

In 2016, Reclamation reinitiated consultation with USFWS and NMFS on the long-term operation of the CVP and SWP following several years of drought and due to new information developed since issuance of the last Biological Opinions in 2008 and 2009. Once again, the consultation included Delta smelt, winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and the southern DPS of green sturgeon. It also included the killer whale, but there was no critical habitat in the action area for that species. In January 2019, Reclamation transmitted to USFWS and NMFS a Biological Assessment for the reinitiation of consultation (ROC) on CVP and SWP operations through the year 2030. Following further discussions with the fish agencies, Reclamation transmitted a final Proposed Action to USFWS and NMFS on October 11, 2019.

The Proposed Action included several new management actions intended to improve conditions for federally listed fish while also providing water supply benefits. At Shasta Reservoir, Reclamation developed measures to improve EOS storage, a new tiered approach to Summer Cold Water Pool Management, and associated performance metrics. On the American River, Reclamation proposed to implement the 2017 Flow Management Standard, prepared in coordination with the Water Forum. In the Delta, Reclamation proposed an updated Old and Middle River flow management regime and new performance objectives that utilize Cumulative Loss Thresholds and Single-Year Loss Thresholds for natural and hatchery winter-run Chinook salmon and natural CV steelhead, and a Delta smelt supplementation program. On the Stanislaus River, Reclamation proposed to operate New Melones Reservoir in accordance with a new Stepped Release Plan. For each division of the CVP, Reclamation proposed numerous conservation measures, including costly restoration projects.

On October 21, 2019, NMFS issued a Biological Opinion for CVP and SWP operations. In that opinion, NMFS concluded that the long-term operation of the CVP and SWP was not likely to jeopardize the continued existence of winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, or southern DPS of green sturgeon and was not likely to destroy or adversely modify their critical habitats. NMFS prepared an incidental take statement that addressed take of winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and southern DPS of green sturgeon. Where possible, NMFS identified the amount or extent of incidental take by listed species, life history stage, stressor, and location within the action area. Where it was impossible to quantify the amount or extent of anticipated incidental take, NMFS relied on an ecological surrogate, as it did in 2009. For example, NMFS defined the take limit for winter-run Chinook salmon eggs and fry in terms of consecutive years of temperature-dependent mortality and egg-to-fry survival, which were based on anticipated temperature-dependent mortality and egg-to-fry survival under the Shasta Reservoir Cold Water Pool Management Plan. For the Stanislaus River, allowable take was exceeded if flow releases to the Stanislaus River, as measured at Goodwin Dam, decrease to levels lower than the Stepped Release Plan. A full description of the incidental take limits can be found throughout Section 13.3 of NMFS' 2019 Biological Opinion.

On October 21, 2019, the USFWS issued a final Biological Opinion for CVP and SWP operations, concluding that the long-term operation of the CVP and SWP was not likely to jeopardize the continued existence of Delta smelt and was not likely to destroy or adversely modify designated critical habitat for Delta smelt. USFWS included an incidental take statement in its Biological Opinion. The agency anticipated that injury and mortality of individual Delta smelt would occur as a result of entrainment and whenever habitat conditions in the Delta do not support the successful completion of the species' full life cycle. USFWS relied on ecological surrogates because it was impossible to accurately quantify and monitor the amount or number of individuals that are expected to be incidentally taken as a result of the 2019 Proposed Action. To limit the amount of Delta smelt take, USFWS set forth seasonal limits on negative flows within the Old and Middle Rivers. If those Old and Middle River flow conditions are not maintained, then take of Delta smelt would be exceeded.

On February 20, 2020, following issuance of the 2019 Biological Opinions and completion of an EIS, Reclamation issued a ROD approving long-term operations. The 2019 Biological Opinions and 2020 ROD were challenged in federal court. *See Pac. Coast Fed'n of Fishermen's Ass'n* v. Ross, No. 1:20‒cv‒00431 (E.D. Cal.); *Cal. Natural Resources Agency v. Ross*, No. 1:20-cv-00426 (E.D. Cal.). In those cases, the court granted voluntary remand of the 2019 Biological Opinions and the 2020 ROD without vacatur and approved an Interim Operations Plan for CVP and SWP operations in 2022 and 2023.

2.4 Past and Present Human Activities

The CVP and SWP operate in an environment vastly different from the conditions under which native aquatic species evolved. Past and present human activities have dramatically altered and reshaped the habitat upon which the species addressed in this consultation depend for survival. Past and present actions have produced stressors currently experienced by listed aquatic species. Those actions, as well as others, have reduced and continue to reduce significantly the species' likelihood of survival and recovery.

2.4.1 Water Resource Development

Water storage and diversion in California began in 1772, with a 12-foot-high dam on the San Diego River. The water needs of mining, agriculture, communities, and electricity generation resulted in dams throughout the Sierra Nevada. In 1890, the California Fish and Game Commission first documented concerns with upstream passage and seasonal barriers for Chinook salmon. Around the same time, the Folsom Powerhouse created a stone dam across the American River in 1893 (California Department of Parks and Recreation 2018). On the Sacramento River, the Anderson-Cottonwood Irrigation District constructed a dam near Redding in 1916. Pacific Gas and Electric (PG&E) developed the Pit River in the 1920s for hydroelectricity (Federal Energy Regulatory Commission 2011). On the Stanislaus River, the Oakdale and South San Joaquin Irrigation Districts constructed the original Melones Dam in 1926 to provide water for agriculture. On the San Joaquin River, Mendota Dam diverted irrigation water beginning in 1919 (Central California Irrigation District 2011). These early, non-CVP dams and diversions blocked fish passage and reduced downstream flows during the irrigation season. Since the 1850s, declining numbers of California's anadromous salmonids have been attributed, in large part, to dams (Yoshiyama et al. 1998). Dams disrupt natural hydrologic patterns and impair sediment transport, channel morphology, substrate composition, and water quality (including temperature and turbidity) within downstream reaches (Spence et al. 2008).

Dams block salmonid access to a portion of their spawning habitat, and for some species, most of their spawning habitat. Historical winter-run Chinook salmon and green sturgeon spawning habitat may have extended up into the three major branches of the Upper Sacramento River above the current location of Shasta Dam; the Upper Sacramento River, the Pit River, and the McCloud River. For CV steelhead, the California Advisory Committee on Salmon and Steelhead Trout (1988) estimated that access to as much as 95% of all spawning habitat in the Central Valley has been lost.

Starting in the 1930s, the "rim dams" were constructed around the valley, which blocked higher elevation spawning habitat for salmonids. Examples include Shasta Dam on the Sacramento River; Folsom Dam on the American River; Oroville Dam on the Feather River; Englebright, New Bullards Bar, and Daguerre Point Dams on the Yuba River; New Melones Dam on the Stanislaus River; New Don Pedro Dam on the Tuolumne River; and New Exchequer Dams on the Merced River. Construction of major CVP facilities began in 1938 with breaking of ground for Shasta Dam on the Sacramento River near Redding in Northern California. Over the next five decades, the CVP was expanded into a system of 20 dams and reservoirs that together can hold nearly 12 MAF of water. DWR began construction of Oroville Dam in 1961. On non-CVP and non-SWP streams, local districts have constructed dams and diversion facilities. Examples include Ward Dam on Mill Creek; Deer Creek Irrigation Diversion Dam on Deer Creek; Comanche Dam on the Mokelumne River; Durham Mutual Diversion on Butte Creek; La Grange Diversion Dam on the Tuolumne River; Crocker-Huffman Dam on the Merced River; and New Hogan Dam on the Calaveras River. Currently, in California's Central Valley, dams block access to more than 80% of historical salmonid spawning areas (Yoshiyama et al. 1998; Lindley et al. 2006).

2.4.1.1 Hydrologic Alteration

Dams in the Central Valley reduce flows in the winter and spring by storing snowmelt and precipitation inflows for later release. Releases in the summer and fall for downstream agricultural, municipal, and industrial water supplies add to the flow in rivers. Operations at reservoir-related dams often affect downstream reaches by impairing flow timing and volume. These effects impair salmonid habitat and affect salmonid migration, spawning, and rearing within the affected reaches.

There are over 3,000 known water diversions in the Central Valley for riparian water rights holders, water districts, and CVP and SWP water users (California Department of Fish and Wildlife 2001). These diversions reduce the flow in California rivers, reducing available spawning area, dewatering redds, and stranding juvenile salmonids. A large percentage of the natural historical inflow to Central Valley watersheds and the Delta is now diverted for industrial and domestic uses and agriculture. From 2011 to 2015, an average of 37% of precipitation in the Sacramento and San Joaquin River hydrologic regions was consumed as applied water for urban and irrigated agriculture uses (California Department of Water Resources 2019).

In addition to surface water diversion, groundwater withdrawals may impair stream habitat by lowering groundwater levels. This may impair volume, extent, timing, and temperature of surface flows. From 2011 to 2015, groundwater extraction in California increased from 12.1 to 22.9 MAF per year (California Department of Water Resources 2019).

The reduced flow variability has also shifted water temperatures. If warm surface water from the reservoir is released, dams may increase downstream water temperatures, particularly in summer, when flows are lowest. Lower base flows and warm-water releases can reduce the amount of available habitat, increase the metabolic demands of fishes, and disrupt fish migration patterns (Olden and Naiman 2010). Warm water can also facilitate the spread of disease (Okamura et al. 2011; Kocan et al. 2009). Most large dams, however, release cold water from the bottom of reservoirs. Cold water releases that maintain or increase downstream base flows will usually reduce water temperatures in summer and fall (Huang et al. 2011; Yates et al. 2008), effectively shifting coldwater rearing habitat for juvenile anadromous salmonids from headwaters to below reservoirs (Ward and Stanford 1983). Coldwater releases are often crucial for sustaining remnant salmonid populations.

2.4.1.2 Morphological Processes (Regulating Flows for Flood Control)

Dams block the flow transport of sediment from upstream to downstream, resulting in an alluvial sediment deficit. The reduction in coarse sediment supply can lead to downstream streambeds incising and becoming coarser or armored, hindering excavation of redds by spawning salmonids. Dams have also trapped fine sediment, which otherwise could have entered the Delta (Wright and Schoellhamer 2004), thus contributing—along with other factors such as increases in invasive aquatic vegetation (Hestir et al. 2016) and declining wind speed (Bever et al. 2018)—to a long-term reduction in turbidity for Delta smelt (e.g., Nobriga et al. 2008). In addition to the reduction of sediment supply, recruitment of large woody material to the river channel and floodplain has also declined due to a reduction in bank erosion and blockage of wood transport by dams.

Reduced streamflows have contributed to decreased recruitment of gravel, decreased recruitment of large woody debris, and reduced geomorphic work downstream of dams. Stable year-round flows have resulted in diminished natural channel formation, altered foodweb processes, and slowed regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Mount 1995), caused spawning gravels to become embedded, and decreased channel widths due to channel incision, all of which has decreased the available spawning and rearing habitat below dams. Also, fine sediment from side channels that is normally flushed out by more frequent and larger flows can accumulate in gravel, reducing spawning success of salmonids.

2.4.1.3 Diversions and Entrainment

In 1997, there were at least 3,356 diversions taking water from the Sacramento and San Joaquin Rivers, their tributaries, and the Delta (Herren and Kawasaki 2001). Over 98% of these diversions were unscreened or inadequately screened (Herren and Kawasaki 2001). The 1992 passage of CVPIA included construction of new screens, rehabilitation and replacement of existing screens, and relocation of diversions. Since the start of CVPIA's Anadromous Fish Screen Program, Reclamation and USFWS have provided funding for 35 fish screen projects, which have screened a total of 5,412 cfs of diversions. All diversions greater than 100 cfs are screened on the Sacramento River.

2.4.2 Historical Habitat Isolation and Alteration

Since 1900, approximately 95% of historical freshwater wetland habitat in the Central Valley floodplain has been lost, typically through the construction of levees and draining for agriculture or residential uses (Hanak et al. 2011). Human expansion has occurred over vast areas in the Delta and Sacramento and San Joaquin Valleys between the 1850s and the early 1930s, completely transforming their physical structure (Thompson 1957, 1965; Suisun Ecological Workgroup 2001; Whipple et al. 2012; Whipple 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.

2.4.2.1 Gold and Gravel Mining

Significant gold and gravel mining in the Sacramento River watershed has further degraded aquatic habitats by decreasing the availability and recruitment of suitable spawning gravels. Hydraulic gold mining began in mid-1800, with an estimated 5,000 miles of mining canals and flumes established by 1859 (Lufkin 1996). Around 1.5 billion cubic yards of debris were sluiced into streams. For over 100 years, around 1.5 billion cubic yards of hydraulic mining debris moved through California's rivers and the Delta (Lufkin 1996). Fine sediments settle in between spawning gravels, reducing hyporheic flow and the movement of required DO to developing salmonid eggs. This process contributed to decreased salmonid populations in the 1800s and early 1900s; however, the direct effect no longer occurs, as fine sediments from hydraulic mining are moving past the Golden Gate Bridge (James 2004). Persistent effects from the genetic bottlenecks and physical alterations remain.

2.4.2.2 Disconnected Floodplains and Drained Tidal Wetlands

Floodplains are areas inundated by overbank flow, typically during the winter and spring peak flows. Inundation can last for up to several months. Floodplains can provide conditions that support higher biodiversity and productivity relative to conditions in river channels (Tockner and Stanford 2002; Jeffres et al. 2008). Floodplains also create important habitat for rearing and migrating fish; migratory waterfowl; and amphibians, reptiles, and mammals native to the Central Valley. Historically, CV Chinook salmon juveniles reared for up to 3 months on inundated floodplains, growing rapidly prior to ocean entry (Sommer et al. 2001).

Between the 1850s and 1930s over 300,000 acres of tidal marshes in the Delta were diked, drained, and converted to agriculture (Atwater et al. 1979). In addition, fill associated with past development has resulted in the loss of approximately 79% of tidal marsh habitat and approximately 90% of all tidal wetlands in the San Francisco Bay (California State Coastal Conservancy et al. 2010). Thus, the complex, shallow, and dendritic marshlands were replaced by simplified, deep, and less vegetated 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).

In the Central Valley, 95% of historical floodplain wetland has disappeared (Katz et al. 2017). The decline in, and disconnection from, floodplain habitat and the food it produces has been linked to native fish population declines (Jassby et al. 2003). The degradation and simplification of aquatic habitat in the Central Valley has also greatly reduced the resiliency of Chinook salmon to respond to additional stressors (National Marine Fisheries Service 2016b). Further, important ongoing development stressors (e.g., urban and agricultural development) continue to affect wetlands in California, and stream-associated salt marsh and wetland habitat have shown declining health and function due to urbanization effects (California Natural Resources Agency 2010).

2.4.2.3 Levees

The development of California’s agricultural industry and water conveyance system has resulted in the construction of armored, riprap levees on more than 1,100 miles of channels and diversions to increase channel elevations and flow capacity of the channels (Mount 1995). As part of the Sacramento River Flood Control Project, USACE constructed levees in the lower Sacramento River Basin. Revetments and bank armoring caused channel narrowing and incision and prevented natural channel migration. Levees have also isolated former floodplains from the river channel, preventing access for rearing for juvenile salmonids.

Many of these levees use riprap to armor the bank. Constructing and armoring levees changes bank configuration and reduces cover (Stillwater Sciences 2006). Constructed levees protected with rock revetment generally create nearshore hydraulic conditions characterized by greater depths and faster, more homogeneous water velocities than occur along natural banks. Higher water velocities typically reduce deposition and retention of sediment and woody debris, thereby reducing the shoreline variability. This reduction in variability eliminates the shallow, slow-velocity river margins used by juvenile fish as refuge escape from fast currents, deep water, and predators (Stillwater Sciences 2006).

In addition, the armoring and revetment of stream banks may narrow rivers, reducing the amount of habitat per unit channel length (Sweeney et al. 2004). As a result of river narrowing and deepening, benthic habitat decreases and the number of macroinvertebrates per unit channel length decreases, affecting salmonid food supply.

USACE and local Reclamation districts continue to maintain and improve levees throughout the action area.

2.4.2.4 Land Use

Wildfires

California over the last decade has experienced many record-breaking wildlife fires, which are expected to increase in frequency and magnitude (Moser et al. 2012; Westerling et al. 2011). The Dixie Fire, started on July 14, 2021, is the largest single fire in California history. Human land use, particularly long-term fire suppression has altered the intensity and frequency of wildfire in forested upland and riparian areas (Flitcroft et al. 2015). Recent expansive and destructive timber fires in anadromous watersheds have left behind large amounts of ash, debris, mountainous bare terrain, and mixed stands of dead and scarred trees/vegetation. Resulting effects of fire can lead to local impacts and alteration of freshwater ecological function (Bisson et al. 2003; Bixby et al. 2015). However, recent studies have shown that habitat quality for most life stages of salmon can be compatible with wildfire (Flitcroft et al. 2015; David et al. 2018). Salmonids are adapted to natural disturbance regimes that create dynamic habitat patterns over space and through time. While salmon have evolved with wildfires, fire management practices are anticipated to affect habitat and salmon populations. NMFS, within its 2019 Biological Opinion (File No. WCRO-2018-00288) on Aerial Application of Fire Retardant on National Forest System Land, determined that aerial retardant is likely to be delivered to streams in which federally listed species (including California salmonids) are present, and that aerial retardant can have effects that range from harassment and harm to death.

Marijuana Cultivation

Stressors to salmon from illegal growing marijuana may include habitat fragmentation, agricultural water diversions from rivers and streams, and nonpoint pollutant discharge (i.e., sediment, pesticides, etc.) Illegal marijuana cultivation has grown into a leading threat to salmon and steelhead recovery on smaller creeks throughout California, including those that form part of the Sacramento River watershed. Illegal growers often dam and dewater creek channels to irrigate their marijuana gardens, and commonly use pesticides and fertilizers. Water demand for marijuana cultivation has the potential to divert substantial portions of streamflow (Bauer et al. 2015).

Wastewater Drainage and Contaminants

As described above, historical activities, such as gold mining, have resulted in high concentrations of methylmercury in much of the Central Valley. Many of the more than 500 mercury mines in California have not been remediated and continue to release mercury to the environment (California Department of Fish and Wildlife 2017). Methylmercury is formed from inorganic mercury by microscopic organisms that live in waterbodies and sediments. Inundation of sediments, such as on a floodplain, can increase the methylation of mercury. Methylmercury is a neurotoxin that bioaccumulates and biomagnifies in the aquatic foodweb (Davis et al. 2003). It can also impair the smoltification and subsequent outward migration behavior in juvenile salmon.

Current activities continue to contribute contaminants to Central Valley waterways. For example, from Fong et al. 2016: "Monitoring entities and research studies have detected multiple contaminants occurring simultaneously in Delta water samples (Ensminger et al. 2013; Orlando et al. 2013, 2014). Multiple pesticides are continuously detected in the two primary tributaries to the Delta. For example, 27 pesticides or degradation products were detected in Sacramento River samples, and the average number of pesticides per sample was six. In San Joaquin River samples, 26 pesticides or degradation products were detected, and the average number detected per sample was 9."

High levels of toxicity to aquatic invertebrates were found to originate from urban stormwater pyrethroid pesticide loading to San Francisco Estuary tributaries (Weston et al. 2014, 2015; Brander 2013; Connon et al. 2009; Amweg et al. 2006). Weston and Lydy (2010) detected pyrethroids in all but one of 33 urban runoff samples and observed toxicity over at least a 30 kilometer reach of the American River, and at one site in the San Joaquin River. Pyrethroid pesticides have been identified as a factor possibly contributing to pelagic organism decline because of their increased use in recent years and their high toxicity to aquatic organisms (Fong et al. 2016).

The discharge of contaminants into California waters from urban and agricultural sources will continue into the future. The Central Valley is becoming more urbanized, which increases urban discharges entering waterways. Likewise, regional agriculture will continue to discharge agricultural return flows from irrigation practices into surrounding waterways.

Although conditions in most streams, rivers, and estuaries throughout the State are much improved from 40 years ago, the rate of improvements have slowed over time (San Francisco Estuary Partnership 2015). Contaminants such as polybrominated diphenyl ethers, and copper have declined over time, however many potentially harmful chemicals and contaminants of emerging concern (pharmaceuticals) have yet to be addressed. Legacy pollutants such as mercury and PCBs limit consumption of most fish, and directly and indirectly affect endangered fish populations, as well as their designated critical habitat. In particular, urban stormwater runoff is consistently toxic to fish and stream invertebrates (McIntyre et al. 2014, 2015). The array of toxicity is variously attributed to metals from motor vehicle brake pads; petroleum hydrocarbons from vehicle emissions of oil, grease, and exhaust; and residential pesticide use. Pollutants such as copper, which is a neurobehavioral toxicant in fish, have the potential to cause chemosensory effects changing sensory behaviors (e.g., predator avoidance behavior) in Pacific salmon (Sandahl et al. 2007).

Urban stormwater toxicity has been linked to pre-spawn mortality of coho salmon (Scholz et al. 2011) and significant metabolic changes to early life stages of Chinook salmon (Viant et al. 2006). Juvenile steelhead and Chinook cumulative mortality rates, following exposure to urban stormwater runoff, were 4% to 42% and 0% to 13%, respectively, indicating an intermediate level of sensitivity (French et al. 2022). The degree of impervious surface (Feist et al. 2011) has also been linked to pre-spawn mortality of Coho salmon, and both have been directly linked to effects at the population level (Spromberg and Scholz 2011). Emphasis on wastewater treatment plant upgrades and new legislative requirements (Water Board and U.S. Environmental Policy Act), development and implementation of total maximum daily load (i.e., pathogens, selenium, pesticides, pyrethroids, methylmercury, heavy metals, salts, nutrients) programs, and adoption of new water quality standards (i.e., basin plans), all aid in protecting beneficial uses for aquatic wildlife.

NMFS scientists have investigated the direct and indirect effects of pesticides on individual federally listed species, the foodwebs on which they depend, and at the population level (Baldwin et al. 2009; Laetz et al. 2009; Macneale et al. 2010; Scholz et al. 2012). NMFS has consulted on seven batched pesticide ESA Section 7 consultations, and concluded that chlorpyrifos, diazinon, malathion, carbaryl, carbofuran, methomyl, bensulide, dimethoate, ethroprop, methidathion, naled, phorate, phosmet, 2,4-D, chlorothalonil, diuron, oryzalin, pendimethalin, and trifluralin jeopardize the continued existence of federally listed species and/or adversely modified critical habitat for salmonids across the West Coast Region (National Marine Fisheries Service 2008, 2010, 2011, 2013).

2.4.2.5 Dredging

In addition to the gravel extraction and gold mining activities described above, the Sacramento and San Joaquin Rivers and Delta have been affected by dredging conducted to enhance navigation and to source material for use in constructing levees for reclamation and/or flood control purposes. These actions have had far reaching effects on landforms and channel configuration. Dredging continues in the Delta environment for navigation purposes (i.e., Stockton Deep Water Ship Channel, Sacramento Deep Water Ship Channel, Mare Island) and has been proposed in the South Delta to help address local agricultural water supply issues.

Dredging of river channels in California is not a recent activity and was first proposed in the late 1800s. The California Debris Commission was created in 1893 to address the accumulation of mining debris in the Sacramento River. The commission planned and oversaw dredging operations in the lower Sacramento River, which significantly increased the width and depth of the lower Sacramento River (Whipple et al. 2012). Dredging for purposes of navigation improvements and levee construction have had the effect of homogenizing channels, reducing the complexity of the cross-section profile, and removing longitudinal changed in bed elevation (Whipple et al. 2012). However, these dredging induced changes are thought to have occurred primarily in the Delta as the Sacramento and San Joaquin Rivers are characterized by a natural levee system which limits the width of the river channels. It should be recognized that changes in channel configuration should not be solely attributable to dredging but should be considered in combination with other activities including scouring due to containment of flood flows and snag removal.

Recently conducted environmental evaluations of navigation dredging suggest this dredging activity can result in both indirect and direct adverse effects on aquatic species. Indirect effects may occur as a result of release of suspended contaminants during operation of the dredging equipment as well as decanting water from the dredged material placement sites. Increased turbidity caused by dredging may also adversely affect aquatic species. Direct effects encompass entrainment of aquatic species as dredging equipment is operated, however some species such as juvenile and subadult green sturgeon may be at higher risk of entrainment than other species.

Finally, dredging will remove benthic invertebrates from the channels within the action area, which represents a loss of forage base to outmigrating salmonids and rearing green sturgeon (National Marine Fisheries Service 2016).

2.4.3 Invasive Species Food Web Disruption, Competition, Hybridization, and Predation

2.4.3.1 Striped Bass and Other Nonnative Predators

Aquatic invasive species (both plants and animals) have been shown to have major negative effects on the receiving communities, where they often outcompete native species, reduce species diversity, change community structure, reduce productivity, and disrupt foodweb function by altering energy flow among trophic levels (Cohen and Carlton 1995; Ruiz et al. 2000; Stachowicz and Byrnes 2006). Multiple mechanisms of impact affect species, such as predation and infection (disease and parasitism), and indirectly, such as competition, hybridization, and habitat alterations (Mack et al. 2000; Simberloff et al. 2005). The Delta may be one of the most invaded estuaries in the world based on the number of species, individuals, and biomass, as well as high and accelerating rate of invasion (Cohen and Carlton 1998).

Striped bass were introduced in 1880s to provide a commercial fishery. Now a recreational fishery, striped bass and other introduced species including catfish prey upon listed species. A striped bass population of approximately 1,000,000 individuals could consume 9% of outmigrating winter-run Chinook salmon based on Bayesian population dynamics modeling (Lindley and Mohr 2003). Striped bass are identified by Bennett (2005) as a low potential threat to Delta smelt, though their impact may have already been realized prior to the establishment of fish monitoring surveys in the system (Nobriga and Smith 2020). Nobriga et al. (2013) reported the first estimates of potential striped bass consumption of Delta smelt and found no evidence for a correlation between juvenile Striped Bass abundance and survival of Delta smelt.

High rates of juvenile salmonid predation have been known to occur at diversions and locations where rock revetment has replaced natural riverbank vegetation (Grossman et al. 2013) and near other artificial structures (Sabal et al. 2016). Young salmonids are more susceptible to predation at these locations because predators congregate in areas that provide refuge (Tucker et al. 1998; Williams 2006). Nonnative centrarchids, such as largemouth bass and spotted bass, will opportunistically feed on juvenile salmonids. At the C. W. “Bill” Jones Pumping Plant, for example, adult striped bass likely depend on entrained adult Delta smelt and juvenile Chinook salmon for forage, affecting entrained fishes’ survival and salvage at the Tracy Fish Collection Facility (Bridges et al. 2019).

2.4.3.2 Clams

Two introduced clam species currently affect phytoplankton and zooplankton biomass in the Delta: the freshwater *Corbicula fluminea*, which has been in the Delta and its tributaries since the 1940s, and the estuarine overbite clam *Potamocorbula amurensis*, which has been in San Pablo and Suisun Bays and the west Delta (but not tributaries) since 1986 (Hymanson et al. 1994; Carlton et al. 1990).

The rapid filtration rate of the overbite clam exceeds phytoplankton growth rate (Cloern and Jassby 2012) and has led to the loss of productive summer blooms (Alpine and Cloern 1992). The invasion of *P. amurensis* has also contributed to rapid step-declines in the abundance of important historical foodweb components such as diatoms (Kimmerer 2005; Lucas et al. 2016), *Neomysis* (Kimmerer and Orsi 1996), and *Eurytemora carolleeae* (formerly *E. affinis*) (Kimmerer et al. 2004; Winder and Jassby 2011), which were historically abundant and important prey items for the foodweb and native fish species including Delta smelt (Knutson and Orsi 1983; Feyrer et al. 2003). The decrease in productivity has also led to a shift in the anchovy population to more saline portions of the estuary (Kimmerer 2006). Along with concurrent drought conditions, these changes may have led to shifts in the species composition of the lower trophic foodweb. Diatoms, a large and nutritious food source, have largely been replaced by smaller phytoplankton including cyanobacteria (Lehman et al. 2000). *Pseudodiaptomus forbesi* and other nonnative species replaced the mysids and zooplankton that were historically consumed by fishes (Kimmerer and Orsi 1996; Bouley and Kimmerer 2006; Winder and Jassby 2011).

2.4.3.3 Zooplankton

In addition to the introduction of the overbite clam, many invasive zooplankton species have also become established within the San Francisco Bay Estuary and Delta ecosystem resulting in altered foodwebs that are contributing to food limitation in listed species (Winder and Jassby 2011). Since the invasion of the overbite clam, phytoplankton resources have declined, contributing to a regime shift in the zooplankton community that is now dominated by nonnative species (as reviewed in Brown et al. 2016). Introduced zooplankton species tend to occupy higher trophic level positions than native species, shifting from an herbivorous and omnivorous community toward more predatory species (Kratina et al. 2014).

One major introduced zooplankton predator is *Acartiella sinensis*, which alongside the overbite clam, has restricted the distribution of *P. forbesi* from brackish waters into more freshwater regions by consuming nauplii (Slaughter et al. 2016; Kayfetz and Kimmerer 2017; York et al. 2006). This shift in distribution and decline of *P. forbesi* in the low salinity zone could have important implications for fish species that prey on *P. forbesi* (Bashevkin et al. 2022; Kayfetz and Kimmerer 2017). While *A. sinensis* is consumed by Delta smelt and longfin smelt (Barros et al. 2022; Slater and Baxter 2014), their higher trophic position contributes to a less efficient transfer of energy from one trophic level to another (York et al. 2014).

Native species that were once abundant in fish diets have been replaced by nonnative species. Mysids are important prey items for juvenile longfin smelt and are consumed by Delta smelt and juvenile Chinook salmon (Barros et al. 2022; Slater and Baxter 2014, 2017; MacFarlane and Norton 2002). *Neomysis mercedis* was a dominant food source for multiple species but since the crash of its population due to the invasion of the overbite clam it has been largely replaced by *Hyperacanthomysis longirostris* (Avila and Hartman 2020). *H. longirostris* is considered to be a less valuable prey item due to its smaller size (Feyrer et al. 2003). However, the invasion and dominance of *Limnoithona tetraspina*, which is now the most dominant copepod in the low salinity zone, is considered poor quality prey because of its small size, predator avoidance behavior, and low nutritional value (Bouley and Kimmerer 2006; Kratina and Winder 2015). The dominance of *L. tetraspina* may be facilitating the high abundance of *A. sinensis* and the decline of cyclopoid copepods such as *Acanthocyclops* spp., the latter, which is a prey item for longfin smelt (Bashevkin et al. 2022; Hobbs et al. 2006). *L. tetraspina* was found to be consumed by Delta smelt but usually during July through September, when they were highly abundant and the availability of more preferred prey items were limited (Slater and Baxter 2014). In contrast nonnative *P. forbesi* has replaced the nonnative *E. affinis*, which are nutritionally similar (Kratina and Winder 2015).

2.4.4 Hatcheries

Five hatcheries currently produce Chinook salmon in the Central Valley, and four of these also produce steelhead. Releasing large numbers of hatchery fish can have negative effects on wild populations through competition for space and food, direct predation, and loss of genetic diversity (Moyle 2002). Interbreeding between artificially propagated hatchery and wild individuals can reduce fitness of offspring (Araki et al. 2009). Barnett-Johnson et al. (2008) found that only 10% of fall-run Chinook salmon harvested in the ocean fishery were of natural origin. On the Mokelumne River, approximately 4% of returning adults in the 2004 escapement were found to be of natural origin (Johnson et al. 2012) and the work identified large-scale hatchery production as masking poor natural production and recruitment. These patterns appear throughout the Central Valley, with large proportions of returning adult salmon straying into watersheds without hatcheries (Letvin et al. 2021a, 2021b, 2020).

In 1942, Coleman National Fish Hatchery was established to mitigate the loss of spawning areas due to construction of the Shasta and Keswick dams. Reclamation constructed the Livingston Stone National Fish Hatchery, a sub-station to Coleman National Fish Hatchery, in 1997 to assist in winter-run Chinook salmon recovery. CDFW operates a number of hatcheries for salmon and steelhead, including on the Trinity, Feather, and American Rivers.

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring-run and fall-run Chinook salmon have led to the genetic hybridization of some subpopulations (California Department of Fish and Game 1998). Spring-run Chinook salmon from the Feather River Fish Hatchery have been straying throughout the Central Valley for many years (California Department of Fish and Game 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon, an indication that Feather River Fish Hatchery spring-run Chinook salmon may have fall-run Chinook salmon life history characteristics.

To start to address these interbreeding and hybridization concerns, modern hatcheries are required to develop a Hatchery Genetic Management Plan under Section 4 of ESA. A Hatchery Genetic Management Plan addresses long-range planning and management of the hatchery fish.

2.4.5 Commercial and Sport Harvest

Commercial harvest of salmon began in the 1850s (California Department of Fish and Game 1929) and gill net salmon fisheries became well established in the Lower Sacramento and San Joaquin Rivers by 1860. In 1864, the first Pacific Coast salmon cannery was constructed along the Sacramento River. By its peak in 1882, the Sacramento and San Joaquin Rivers had 20 salmon canneries and processed about 11 million pounds of catch (California Department of Fish and Game 1929). In 1910, there were 10 million pounds of commercial salmon catch; that declined to 4.5 million pounds by 1919 when the last inland cannery closed (California Department of Fish and Game 1929). An estimate of historical abundances of Chinook Salmon in the Central Valley is about one to two million annual spawners (Yoshiyama et al. 1998).

In 1916, ocean harvest at Monterey alone was over 5 million pounds (Yoshiyama et al. 1998). Between 2006 and 2017, the highest total commercial ocean harvest was 3.8 million pounds in 2013, averaging about 1.5 million pounds over that period (California Department of Fish and Wildlife 2016). The ocean commercial harvest at Monterey in 2016 and 2017 was about 150,000 pounds, representing about 25% and 30% of the total ocean commercial harvest, respectively (California Department of Fish and Wildlife 2016). NMFS recently revised harvest rules (National Marine Fisheries Service 2018), which now allows for low harvest rates on winter-run Chinook salmon at low abundances.

2.5 Independent Related Activities

The scope and complexity of agency actions in the Central Valley involve multiple activities with ongoing effects on federally listed species that are consulted upon separately from the long-term operation. These “independent related actions” with their independent section 7 consultations, where warranted, are part of the baseline conditions experienced by federally listed species in certain watersheds and are actions taken under Reclamation and DWR authorities but are not part of the operation of the CVP and SWP to store, release, divert, route, and blend water.

2.5.1 Agricultural Barrier Construction and Local Operations

DWR installs agricultural barriers between March and July to improve water levels and support diversions for Delta water users while operating the SWP. These barriers are constructed in Old River near Tracy 0.5 miles upstream of the Tracy Fish Collection Facility; in Middle River, 0.5 mile upstream of the junction with Victoria Canal; and in Grant Line Canal, about 400 feet upstream of the Tracy Boulevard Bridge. Installation of the barriers begins no earlier than May 1. Prior to June 1, completion of Grant Line Canal and Old River near Tracy Barriers’ installation requires approval from NMFS, USFWS, and CDFW. All barriers are removed by November 30 each year. The agricultural barriers ESA consultations included local operations associated with the barriers. This consultation includes the hydrological alterations associated with the operations of the barriers.

The barriers are installed using large angular rocks and include multiple 48-inch-diameter corrugated metal culverts. The culverts are equipped with flap gates on their upstream ends that can be tidally operated. Tidal operation allows the culverts to be completely closed on ebb tides to retain water upstream of the barriers and opened on flood tides to allow water to flow through them, to upstream. Open culverts allow fish passage until the mean daily water temperature at Mossdale reaches 72°F (22°C) or June 1 if water level maintenance is needed. The remaining culverts would remain open beyond June 1 if water level maintenance is not a concern and the mean daily water temperature at Mossdale is not above 72°F (22°C). Once water level maintenance is needed, culverts would be closed. The barriers’ large center section (weir) is lower than their abutments and allows water on flood tides to pass over them, to upstream. On ebb tides, water flows downstream over the large center section (weir) of the barriers until the upstream water elevation reaches the elevation of the barriers' weir, at which point the barriers behave as low head dams with only minimal river flow passing though the rock.

Incidental take coverage in accordance with the ESA for the hydrological alter of the agricultural barriers is provided by this consultation on long-term operations of the CVP and SWP and is included as part of the Proposed Action.

The following Biological Opinions document the impacts on federally listed species.

- *NMFS 2023 Biological Opinion (File No. WCRO-2022-02869) – Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the South Delta Temporary Barriers Project 2023–2027*
- *USFWS 2023 Biological Opinion (File No. 2023-0004507-S7-001) – Formal Consultation on the South Delta Temporary Barriers Project for 2023-2027, San Joaquin County, California (U.S. Army Corps of Engineers File No. SPK-2001-00121)*

The 2023 NMFS Biological Opinion determined that the temporary barriers will seasonally diminish or degrade designated critical habitat for CV steelhead and the Southern DPS of green sturgeon, as well as habitat for spring-run Chinook salmon and winter-run Chinook salmon in the action area with beneficial effects for the listed fish species migrating through the San Joaquin River basin. The presence and operations of the temporary barriers will also increase the extent of mortality related to predation, delays in migration to the ocean, and exposure to degraded water conditions.

The 2023 USFWS Biological Opinion determined that the South Delta Temporary Barriers Project, as proposed, is not likely to destroy or adversely modify Delta smelt critical habitat and the level of anticipated take is not likely to result in jeopardy to the Delta smelt. However, the construction of the barriers may result in annual adverse effects from increased turbidity, increased underwater noise, physical habitat modification, and creation of temporary predator habitat. These effects are expected to be minor and few Delta smelt are expected to be in this area during construction. The overall effects of construction, operation, and removal on critical habitat would be minimal. Approximately 1.34 acres of potential spawning substrate (primary constituent elements [PCE] #1) would be lost for up to 7 months per year but during a time when most spawning has already occurred and in an area where smelt are unlikely to spawn to due conditions. An additional 2.73 acres of substrate could be modified if sediment removal was required.

2.5.2 Battle Creek Restoration Program and Battle Creek Reintroduction Plan for Winter-run Chinook Salmon

The Battle Creek Salmon and Steelhead Restoration Project is a collaborative effort between Reclamation, PG&E, Water Board, USFWS, NMFS, CDFW, the Federal Energy Regulatory Commission (FERC) and the California Bay Delta Authority, with public participation, including the Greater Battle Creek Watershed Working Group and the Battle Creek Watershed Conservancy.

The purpose of the restoration project is to restore approximately 42 miles of habitat on Battle Creek and an additional six miles of habitat on tributaries to Battle Creek for threatened and endangered salmon and steelhead, while minimizing the loss of clean and renewable energy produced at PG&E's Battle Creek Hydroelectric Project. The restoration project is being accomplished by modifying a portion of the hydroelectric project facilities in three phases (Phases 1A, 1B and 2), including (1) removing diversions dams and constructing fish screens and ladders on other diversion dams to provide safe passage for fish; (2) preventing the mixing of North Fork Battle Creek and South Fork Battle Creek waters, through the construction of powerhouse bypass and tailrace connectors; (3) protecting a State trout hatchery from diseases carried by anadromous fish, through the construction of a fish barrier weir; (4) increasing instream flows, and dedicating water rights for instream purposes at dam removal sites; and (5) implementing adaptive management to ensure fisheries objectives are met.

The following Biological Opinions document the effects on federally listed species.

- *NMFS 2005 Biological Opinion (File No. 151422SWR1008A) – Battle Creek Salmon and Steelhead Restoration Project*
- *USFWS 2005 Biological Opinion (File No. 1-104-F0190) – Battle Creek Salmon and Steelhead Restoration Project, Shasta and Tehama Counties, California*
- *CDFW completed a Battle Creek Winter-Run Chinook Salmon Reintroduction Plan (2016) with more information at https://wildlife.ca.gov/Drought/Projects/Battle-Creek, and is believed to be relying upon 10(a)(1)(A) permits for the Livingston Stone National Fish Hatchery*

The NMFS 2005 Biological Opinion determined, on page 68 and 69, the most significant long-term effect of the Battle Creek Salmon and Steelhead Restoration Project will be to improve overall conditions for listed salmonids by increasing the amount of high-quality habitat available. Minor, short-term adverse effects associated with construction of the Restoration project facilities are addressed by impact avoidance and minimization measures.

The USFWS 2005 Biological Opinion addresses potential effects on terrestrial species.

2.5.3 B.F. Sisk Dam Safety of Dams Modification Project

B.F. Sisk Dam was constructed to create the off-stream San Luis Reservoir, which provides supplemental storage capacity for the CVP and SWP. The B.F. Sisk Dam Safety of Dams Modification Project is a flood safety action currently under construct that would not result in any change to the storage capacity of the Sisk Dam but rather prevent the reservoir from overtopping in the event of dam deformation. Investigations conducted under Reclamation’s Safety of Dam Program identified several sections of the B.F. Sisk Dam sitting above liquefiable and soft soils. The dam could fail during a seismic event if sections of the embankment slump below the water line, or if cracking develops through the embankment. The work will take between eight and 12 years to construct (2022 through 2035).

The following Biological Opinions document the impacts on federally listed species.

- *USFWS 2019 Biological Opinion (File No. 08ESMF00-2019-F-1572-2) Formal Consultation for the B.F. Sisk Safety of Dams Modification Project, Merced County, California*
- *USFWS 2021 Biological Opinion (File No. 08ESMF00-2019-F-1572-R001) Reinitiation of Formal Consultation for the B.F. Sisk Safety of Dams Modification Project, Merced County, California*
- *USFWS 2022 Biological Opinion (File No. 2022-0047090) Reinitiation of Formal Consultation for the B.F. Sisk Safety of Dams Modification Project, Merced County, California*

No effect on federally listed aquatic species in the Delta would occur from construction of this project. USFWS Biological Opinions referenced above addresses potential effects on terrestrial species from construction.

2.5.4 B.F. Sisk Dam Raise and Reservoir Expansion Project

B.F. Sisk Dam Raise and Reservoir Expansion Project would be completed by placing additional fill material on the dam embankment to raise the dam crest an additional 10 feet above the 12-foot embankment raise under development by the B.F. Sisk Dam Safety of Dams Modification Project. The 10-foot embankment raise would support an increase in reservoir storage capacity of 130 TAF. The 10-foot increase in San Luis Reservoir's maximum surface elevation would inundate 445 acres of new land around the shore of the reservoir when the reservoir is full. The Raise and Reservoir Expansion Project will occur in conjunction with the B.F. Sisk Safety of Dams Project, on which the USFWS issued a Biological Opinion and amended Biological Opinions listed in Section 2.5.1.3, *B.F. Sisk Dam Safety of Dams Modification Project*.

- *USFWS December 5, 2022, Biological Opinion (File No. 2023-0012686) Formal Consultation for the B.F. Sisk Dam Raise and Reservoir Expansion Project, Merced County, California*

Operations of the B.F. Sisk Dam associated with the raise and reservoir expansion projects are part of this Proposed Action. Thus, effects resulting from hydrological alteration on federally listed aquatic species in the Delta are addressed by this consultation. The USFWS Biological Opinions referenced above address potential effects on terrestrial species from construction.

2.5.5 Contra Costa Los Vaqueros Reservoir Construction and Phase One Expansion

The CCWD diverts water from the Delta for irrigation and municipal and industrial uses under its contract with Reclamation. Reclamation supplies up to 195,000 acre-feet per year of CVP water for delivery to CCWD's service area including Los Vaqueros Reservoir. CVP water is diverted at CCWD's Old River Intake and new Middle River Intake on Victoria Canal for the Los Vaqueros Reservoir. This water supply is subject to wide variations in salt and organic carbon concentrations, as well as other water quality parameters. During periods when water quality in the Delta at CCWD intakes does not meet CCWD's water quality objectives, CCWD uses higher-quality water stored in Los Vaqueros Reservoir to blend with the directly diverted Delta water. The Contra Costa Los Vaqueros Expansion – Phase 1 was completed in 2012 to expand Los Vaqueros Reservoir. Implementation of the Phase 1 expansion increased reservoir storage from 100 TAF to 160 TAF. The primary purpose of the expansion was to address seasonal water quality degradation while also providing emergency water supply storage, with secondary benefits of recreation and flood management.

The following Biological Opinions document the impacts on federally listed species.

- *NMFS 1993 (File Number not included) Biological Opinion Addressing the Potential Effects on Sacramento River Winter-Run Chinook Salmon from the Bureau of Reclamation's Proposed Los Vaqueros Project, Contra Costa County, California, March 18, 1993*
- *USFWS 1993 (File No. 1-1-93-F-35) Formal Consultation on Effects of the Proposed Los Vaqueros Reservoir Project on Delta Smelt, Contra Costa County, California*
- *NMFS 2010 (File No. 2010/03457) Concurrence Letter on the Los Vaqueros Expansion Project*
- *USFWS 2010 (File No. 81410-2011-I-0001) Concurrence on the Los Vaqueros Expansion Project is Not Likely to Adversely Affect the Delta Smelt (File MP-730 ENV-7.0)*
- *USFWS 2011 (File No. 81420-2009-F-0201-1) Biological Opinion on the Los Vaqueros Reservoir Expansion Project, Contra Costa County, California, February 24, 2011*
- *USFWS 2012 (File No. 81420-2009-F-0201-2) Reinitation of Formal Consultation on the Los Vaqueros Reservoir Expansion Project, Contra Costa County, California, December 1, 2012*
- *USFWS 2015 (File No. 81420-2009-F-0201-3) Reinitation of Formal Consultation on the Los Vaqueros Reservoir Expansion Project, Contra Costa County, California, October 8, 2015*

NMFS and USFWS issued Biological Opinions in 1993 regarding construction and operation of the Los Vaqueros Project. NMFS determined operation of the proposed Project facilities, including the existing Rock Slough intake to divert water delivered under contract by Reclamation was not likely to jeopardize the continued existence of winter-run Chinook salmon or result in the destruction or adverse modification of its critical habitat. NMFS concluded that operation of the project to divert water delivered by Reclamation was expected to have only minimal adverse effects on Shasta Reservoir storage, Reclamation's ability to control upper Sacramento River water temperatures, the diversion of Sacramento River into the Delta, or reverse flow conditions that occur in the Delta. However, operation of the Rock Slough intake and the proposed Project diversion facility on Old River were expected to adversely affect juvenile winter-run Chinook salmon by direct entrainment. Therefore, NMFS included an incidental take statement that provided for the take of entrained and impinged juvenile winter-run Chinook salmon.

USFWS concluded in its 1993 opinion that the proposed operation of the Los Vaqueros project was not likely to jeopardize the continued existence of Delta smelt and noted that critical habitat for Delta smelt had not been designated. USFWS cited effects from displacement of Delta smelt to less suitable areas due to modification of flow patterns, interference with movement to suitable rearing habitat during filling operations, a minor level of harassment or harm to adults and juveniles due to construction of the new Old River intake, entrainment or impingement at the intake on Old River and otherwise taken in reservoirs, pipelines, and other Los Vaqueros project facilities, and harm and harassment during maintenance activities. Incidental take was provided for all Delta smelt entrained because of the operations of Los Vaqueros project with an annual maximum delivery of 148 TAF.

NMFS and USFWS issued concurrence letters under informal consultation in 2010 regarding the expansion of the Los Vaqueros Reservoir from 100 TAF to 160 TAF. NMFS determined that since there would be no work conducted within the waters of the Delta direct effects associated with the construction were not expected to occur and the only impacts on aquatic fish species would be from the indirect operation of filling the Los Vaqueros Reservoir. NMFS concurred with Reclamation's determination that listed winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and green sturgeon were not likely to be adversely affected by the Los Vaqueros project. NMFS also concurred that critical habitat was not likely to adversely affected for CV steelhead or green sturgeon and noted that critical habitat for winter-run and spring-run Chinook salmon were outside the action area (i.e., south delta).

USFWS also concurred with Reclamation’s determination that the Los Vaqueros expansion project was not likely to adversely affect Delta smelt, which was based on operational criteria, avoidance and minimization measures and because no construction-related effects would occur to perennial and tidal aquatic habitat, insubstantial alteration of outflow to the Delta, diversion would be within those already permitted, effects on Delta hydrodynamics would be minor and CCWD would continue to operate consistent with previous Biological Opinions and permits.

The USFWS 2011 Biological Opinion and the associated 2012 and 2015 amendments address potential effects on terrestrial species.

2.5.6 Contra Costa Rock Slough Intake and Fish Screen

The Rock Slough Intake and Fish Screen (RSFS) facility is located at the junction of the Contra Costa Canal and the Rock Slough. The Contra Costa Canal and the RSFS facility are owned by Reclamation and operated and maintained by the CCWD under contract with Reclamation. The Contra Costa Canal and the RSFS facility are the primary conveyance for CCWD’s untreated water supply. Construction on the RSFS facility began in 2009 and was completed in 2011, in order to comply with requirements of the CVPIA and USFWS 1993 Los Vaqueros Biological Opinion. The purpose of the RSFS is to reduce the entrainment of listed aquatic species. Reclamation and CCWD also undertook the 2019 *Rock Slough Fish Screen Facility Improvements and Transfer of Operation and Maintenance* in order to address operational issues of the facility and the transfer of ownership to CCWD. The Project included improvements to the existing RSFS Facility, various site improvements/adjustments, resolution of adjacent landowner issues, and ongoing routine operations and maintenance of the RSFS and associated appurtenances. Construction of the fish screen and its maintenance are considered as part of the baseline of this consultation. However, the 195 TAF of water diversions at the Rock Slough intake for Los Vaqueros and its resulting hydrological alteration are analyzed in this consultation.

The following Biological Opinions document the impacts on federally listed species.

- *NMFS 1993 (File Number not included) Biological Opinion Addressing the Potential Effects on Sacramento River Winter-Run Chinook Salmon from the Bureau of Reclamation's Proposed Los Vaqueros Project, Contra Costa County, California, March 18, 1993*
- *USFWS 1993 (File No. 1-1-93-F-35) Formal Consultation on Effects of the Proposed Los Vaqueros Reservoir Project on Delta Smelt, Contra Costa County, California*
- *USFWS 2005 (File No. 1-1-04-F-0368) O&M 2005 Biological Opinion on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within South-Central California Area Office*
- *NMFS 2009 (File No. NMFS 2009/03303) Concurrence Letter for Construction of the RSFS, August 20, 2009*
- *USFWS 2009 (File No. 81420-2009-I-1015-1) Endangered Species Act Consultation on the Contra Costa Canal Rock Slough Fish Screen Project, Contra Costa County, California, September 3, 2009*
- *USFWS 2017 (File No. 08FBDT00-2017-F-0072) Amendment of the 2005 Biological Opinion on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within South-Central California Area Office (Service File No. 1-1-04-F-0368) to include the Rock Slough Fish Screen Facility Improvement Project (Bureau of Reclamation File No. 423 ENV 7.00), November 2, 2017*
- *NMFS 2017 (File No. WCR-2017-6161) Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Rock Slough Fish Screen Facilities Improvement Project located in Contra Costa County, California, June 29, 2017*
- *NMFS 2018 Errata (File No. WCR-2017-6161) Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Rock Slough Fish Screen Facilities Improvement Project located in Contra Costa County, California, June 13, 2018*

NMFS and USFWS issued Biological Opinions in 1993 regarding operation of the Los Vaqueros project including diversions at the Rock Slough intake. Both Biological Opinions identified that unscreened diversions would adversely affect Delta smelt and winter-run Chinook salmon. USFWS included a reasonable and prudent measure that required reduction of entrainment losses through screening of the Rock Slough intake and adequate screen cleaning by October 1998. The completion date was later extended to 2003 and then to 2008, with a final extension to 2018.

In 2009, USFWS and NMFS issued Biological Opinions specific to the construction of the RSFS. In the 2009 consultation, USFWS found that Delta smelt would not be affected from the work related to installation of the fish screen. In their 2009 consultation, NMFS determined that winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and green sturgeon were not likely to be adversely affected by construction and would be considered wholly beneficial, since it would reduce direct entrainment and predation.

In 2017, USFWS issued an amendment to the 2005 *Biological Opinion on the Operations and Maintenance Program Occurring on Bureau of Reclamation Lands within South-Central California Area Office*. The USFWS concluded that operation and maintenance required of the RSFS will not result in effects beyond those previously analyzed in earlier documents (*1993 Los Vaqueros Biological Opinion, 2008 Biological Opinion on the Long-Term Operations of the CVP and SWP, 2009 RSFS construction Biological Opinion*). Additionally, in 2017, NMFS issued a Biological Opinion on the Rock Slough Facilities Improvement Project and associated Errata in 2018. The 2017 NMFS Biological Opinion found that the project was not likely to jeopardize listed winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and green sturgeon and provided incidental take for adult salmonid mortality due to rake cleaning, fish exposures to herbicide and pesticide and general disturbance due to ongoing operation and maintenance activities. NMFS issued an erratum in 2018 to the 2017 Biological Opinion to address an error where a conservation measure (in-water work window) was incorrectly included.

2.5.7 Central Valley Project Improvement Act Habitat and Facility Improvements (Competitive Grant Process)

Reclamation and the USFWS complete CVPIA Habitat and Facility Improvements through a competitive grant process that solicits projects through a Notice of Funding Opportunity available at www.grants.gov. The objective of this program is to execute collaborative planning efforts to increase the total salmonid juvenile biomass at Chipps Island, the natural adult production of salmonids, and the spatial diversity of salmonids in the Central Valley. Overall, projects conducted under this program seek to restore and maintain the production of anadromous salmonids and their habitats in the Central Valley of California. Potential actions can include the following.

- Create new side channels and modify existing side channels to create and/or improve rearing habitats for the juvenile life stages of anadromous salmonids in the Central Valley rivers and tributaries
- Place woody material, boulders, and other structures as appropriate, to provide habitat for salmonids
- Create/enhance incrementally inundating floodplain habitat
- Provide spawning habitat/coarse (spawning sized) substrate
- Provide passage to and from disconnected habitats
- Improve facilities by reducing their impact on fish survival and growth rates, such as inclusion of fish screens on diversions, modifications to allow for broader range of operation, increased frequency of operation, or to reduce the incidence of predation at a facility
- Improve growth & survival of fall-run, spring-run, or winter-run Chinook salmon, and CV steelhead
- Conduct pre-and post-project site surveys, and monitoring to document the effectiveness of projects at improving salmonid habitat

- Coordinate activities with a local watershed restoration group or an interagency restoration group consisting of agencies and local stakeholders

Fully completed applications are submitted to Application Review Committee with members from Reclamation, USFWS, other federal and state agencies, and potentially a subcommittee under the Collaborative Science and Adaptive Management Program. Reclamation awarded five projects that submitted applications in 2021 and currently 10 more projects that submitted applications in 2022. Reclamation anticipates completing separate site-specific ESA Section 7 consultations for habitat and facility improvement projects during the duration of the Proposed Action for this consultation.

Prior to the development of the competitive grant program, Reclamation and USFWS implemented a number of activities including removal of the McCormack-Seltzer Dam on Clear Creek, passage at the ACID diversion dam, and tributary efforts under the CVPIA on Battle, Butte, Calaveras, Mill, Deer, and Antelope Creeks.

2.5.8 Central Valley Project Improvement Act Small Fish Screen Program

Reclamation has contributed funding toward the construction of positive barrier fish screens structures and water-diversion and conveyance facilities operated along the Sacramento River. Through the Anadromous Fish Screen Program, as of 2023, there have been 54 fish screens constructed at diversions on the Sacramento River, San Joaquin River, Delta and tributaries, which has resulted in reduced entrainment at those diversions.

Most recently the Meridian Farms Water Company received Reclamation funding toward the construction of screened facilities. Previously existing Meridian Farms Water Company facilities included three unscreened intakes and related conveyance facilities located in Sutter County, along the Sacramento River. Funding of this action contributed to the removal, consolidation, and replacement of unscreened diversions with screened diversions that occurred in two phases. Phase 1 was completed in 2010 and included installation of the new Grimes Diversion and Pumping Plant, installation of associated pipelines and canal modifications, and removal of the old Grimes Diversion and Pumping plant. Phase 2 was completed in 2023 and included installation of the new Meridian Diversion and Pumping Plant, installation of the new Drexler Re-lift Pumping Plant, installation of associated pipelines and canal modifications, and removal of the old Meridian and Drexler Diversion and Pumping Plants.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2013 Biological Opinion (File No. 08ESMF00-2013-F-0108-1) Formal Consultation for the Meridian Farms Fish Screen Phase 2 Project, Sutter County, California*
- *NMFS 2014 Biological Opinion (File No. 151422SWR2008SA00084) Formal Consultation for the Meridian Farms Fish Screen Project, Phase 2, Sutter County, California*

Operation of unscreened diversions may entrain salmonid migrants/out-migrants, green sturgeon, as well as other special status fish species. As such, funding of new diversions and screening is anticipated to provide an overall net benefit to the fisheries resources subjected to impacts from river diversions. These actions are expected to help prevent further loss of the federally listed Chinook salmon, CV steelhead and green sturgeon, while allowing for continued delivery of water for agricultural purposes.

2.5.9 Central Valley Project Improvement Act Spawning and Rearing Habitat Restoration

Through CVPIA, Reclamation has augmented spawning and rearing habitat for listed species in CVP tributaries. Between 1997 and 2008, over 195,000 tons of gravel have been placed in the Sacramento, Stanislaus, and American River tributaries. Since 2016, a number of spawning and rearing side channel restoration sites on the American and Sacramento Rivers have been implemented. In the lower American River, roughly 24 acres have been devoted to gravel augmentation, while approximately 50 acres have focused on side channel creation. In the Sacramento River, roughly 4 acres have been devoted to ongoing gravel augmentation launching sites, while approximately 20 acres have been devoted to side channel creation. As a result of these actions, Reclamation has improved spawning and rearing habitat for ESA-listed salmonids in these tributaries.

The following Biological Opinions document the impacts on federally listed species.

- American River
    - *USFWS 2016 Letter of Concurrence (File No. 08FBDT00-2016-I-0198) – Programmatic Informal Consultation on the Lower American River Anadromous Fish Habitat Restoration Project*
    - *NMFS 2015 Biological Opinion (File No. WCR-2015-2703) – Lower American River Anadromous Fish Habitat Restoration Program*
- Sacramento River
    - *USFWS 2016 Letter of Concurrence (File No. 08FBDT00-2016-I-0166) – Programmatic Informal Consultation on the Upper Sacramento River Anadromous Fish Habitat Restoration Project*
    - *NMFS 2015 Biological Opinion (File No. WCR-2015-2725) – Upper Sacramento River Anadromous Fish Habitat Restoration Programmatic*
    - *USFWS 2020 Letter of Concurrence (File No. 08FBDT00-2020-I-2016) – Informal Consultation on the East Sand Slough Side Channel Project*
    - *NMFS 2020 Coverage under the NOAA RC's Central Valley Office Programmatic Approach, Biological Opinion (Project No. SPK-2018-01011) – East Sand Slough Side Channel Project*
- Stanislaus River
    - *NMFS 2020 Coverage under the NOAA RC's Central Valley Office Programmatic Approach, Biological Opinion (Project No. SPK-2004-00280) – Goodwin Canyon Spawning Gravel Placement Project*

The USFWS 2016 and 2020 informal consultations on the American and Sacramento River addresses potential effects on terrestrial species.

The NMFS 2015 Biological Opinion on the American River determined that temporary construction impacts may adversely affects juvenile CV steelhead. Incidental take was identified for temporary impacts associated from construction activities to CV steelhead. The results of the Proposed Action will ultimately enhance all three PCEs of critical habitat for CV steelhead and spring-run Chinook salmon contained in the action area. The NMFS 2015 Biological Opinion on the Sacramento River determined that some potential effects of the implementation of the project are expected to result in incidental take of listed anadromous fish in the action area, although negative effects are expected to be minimal. Most significant immediate and long-term effects of the habitat restoration projects will be to improve overall conditions for listed salmonids, and likely green sturgeon, by increasing and improving spawning and rearing habitat.

2.5.10 Delta Cross Channel Improvement Project

The DCC gate facility is more than 65 years old, and its gates rely on Reclamation operators to travel to the facility to change their position. When the gates are open, they provide a critical diversion for freshwater reaching the CVP and SWP south Delta export facilities. The gates are closed to prevent scouring near the facility during high flows, reduce salinity intrusion in the western Delta, and protect Sacramento River federally listed and nonlisted salmonids. As a commitment in Reclamation’s preferred alternative, described in the 2020 ROD, Reclamation is currently developing alternatives to modify and improve the existing DCC Gate Facility to operate the gates in more flexible manner for water quality management and fish protection actions (such as diurnal operations). Additional long-term goals are to increase the operational life of the facility, address safety issues, decrease ongoing operation and maintenance costs, maintain and improve safety of recreational boaters, and improve ease of operation with remote operated gates.

Reclamation anticipates completing a separate site-specific ESA Section 7 consultation for the DCC Improvement Project during the duration of the Proposed Action for this consultation. Reclamation understands that this project has independent utility. The USFWS 2019 Biological Opinion included the DCC Improvement Project programmatically and addressed potential effects on terrestrial species.

2.5.11 Oroville Reservoir and Feather River

The Oroville Complex (Oroville Dam and related facilities, including the Feather River Fish Hatchery) is located on the Feather River in Butte County, California, approximately 70 miles north of Sacramento. Oroville Dam, Lake Oroville, and related facilities occupy 41,100 acres in the foothills of the Sierra Nevada. The Oroville Complex was developed as part of the SWP and is operated for the storage and delivery of water, flood management, power generation, water quality improvement in the Delta, and enhancement of recreation, fish, and wildlife.

DWR has been operating the Oroville Complex under a FERC license and is currently undergoing a relicensing process (FERC Project No. 2100-134). Section 7 consultations were completed for Relicensing of the Oroville Facilities and Biological Opinions were issued by both USFWS, on April 6, 2007, and NMFS, on December 5, 2016. Because the effects of operation of the Oroville facilities were considered in the consultations with FERC, they are not addressed in the Long-term Operation Biological Opinion.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2007 Biological Opinion for the Oroville Facilities Relicensing Project, Butte County, California (USFWS File No. 1-1-07-F-0049, FERC File No. 2100)*
- *NMFS 2016 Biological Opinion (WCR-2015-3218), and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response and Fish and Wildlife Coordination Act Recommendations for Relicensing the Oroville Facilities Hydroelectric Project, Butte County, California (FERC Project No. 2100-134)*

2.5.12 Freeport Regional Water Diversion

The Freeport Regional Water Diversion (FRWD) is a screened intake facility and pumping plant constructed on the Sacramento River to divert water. The FRWD was designed to divert up to 185 million gallon per day. The construction of the diversion also included a 5-7ft diameter pipeline to convey water 15 miles to the Folsom South Canal and 17 miles from the Canal to the Mokelumne Aqueduct. The fish screen, at the interface of the intake structure and the Sacramento River, is approximately 175 feet long and has a minimum depth of 10 feet, and is designed to meet an approach velocity of 0.2 feet per second and a screen slot size of 1.75 millimeters. This criterion, negotiated between Freeport Regional Water Authority and USFWS is to protect Delta smelt, as it exceeds NMFS' design criteria for juvenile salmonids.

Construction of the screened intake facility, pumping plant and pipeline and its maintenance are considered as part of the baseline of this consultation. However, the 185 million gallons per day of water diversions at the FRWD and its resulting hydrological alteration are analyzed in this consultation.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2004 Biological Opinion (1-1-04-F-0224) – Freeport Regional Water Project*
- *NMFS 2004 Biological Opinion (151422SWR01SA5822) – Freeport Regional Water Project*

The NMFS 2004 Biological Opinion anticipated construction activities may cause short-term exposure of juveniles and adults to increased sound pressure levels, turbidity, or suspended sediment, or cause entrainment and stranding of juveniles within the project cofferdam. These activities are expected to result in temporary disruptions in the feeding, sheltering, and migratory behavior of adult and juvenile salmon and steelhead. Fish screen operation or maintenance is generally expected to operate to NMFS criteria, with the exception of sweeping velocity. Juvenile fish exposure to the screen during routine operation or maintenance may cause some injury or death due to impingement or entrainment.

The USFWS 2004 Biological Opinion analyzed the construction, maintenance, and effects of operation at the diversion, along with terrestrial effects of CVP water deliveries to FRWD. This Biological Opinion anticipated that the construction of the FRWD would result in the permanent loss of shallow water habitat, increased predation and the entrainment and impingement of Delta smelt at the screened intake facility due to water diversions. USFWS concluded that “all Delta smelt inhabiting up to I 85 million gallons per day may be harmed, harassed, injured, or killed as a result of the operation and maintenance of the fish screen/intake facility” (U.S. Fish and Wildlife Service 2004:125).

2.5.13 Georgiana Slough Non-physical Barrier

DWR, in coordination with Reclamation, will seasonally install and operate a salmonid migratory barrier at Georgiana Slough each year to reduce entrainment into the central and south Delta of emigrating juvenile winter-run Chinook salmon and spring-run Chinook salmon encountering the Sacramento River–Georgiana Slough junction. Operation of the salmonid migratory barrier should improve the seasonally averaged survival probability to Chipps Island compared with survival probability if the salmonid barrier were not in operation. In-water construction and barrier installation are generally completed between September and October and removed between May and July. Barrier operations and efficacy monitoring occur between November and May of each year. Barrier operations and monitoring details are defined in the Georgiana Slough Migratory Barrier Operations and Monitoring Plans.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2022 Biological Opinion (2022-0012599-S7-001) – Georgiana Slough Salmonid Migratory Barrier Project*
- *NMFS 2022 Biological Opinion (WCR-2022-00411) – Georgiana Slough Salmonid Migratory Barrier Project*

The Georgiana Slough Non-physical Barrier Project will result in primarily beneficial effects but will also result in temporary adverse effects on salmonids, green sturgeon and their habitats. Adverse effects include behavioral impacts from vibratory pile driving, such as potential delays in migration. However, these effects are expected to be minor in scope, affecting a limited number of fish and during annual in-water construction. The Georgiana Slough Non-physical Barrier (i.e., Bio-Acoustic Fish Fence) is designed to allow water to enter the Georgiana Slough channel, while also serving as a deterrent to juvenile salmonids that would enter the channel during downstream migration. Barrier operations are expected to improve abundance, fitness, and survival of listed juvenile salmonids by deterring the fish from entering the interior Delta through Georgiana Slough. Salmonids that become entrained in the interior Delta experience increases in migration time, increases in predation risk, and reduced fitness due to exposure to degraded water quality. By keeping the juvenile salmonids in the mainstem of the Sacramento River, they are more likely to survive to Chipps Island, and ultimately enter the Pacific Ocean. With increased juvenile survival to the ocean, it is likely that these fish will return to their natal river as spawning adults. The Georgiana Slough Non-physical Barrier Project will increase the likelihood of survival and recovery of listed salmonids. Adult salmonids are not expected to experience delays migrating upstream to spawn during barrier operations.

The Georgiana Slough Non-physical Barrier Project should have minimal effects on the designated critical habitats for winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and southern DPS of green sturgeon. Georgiana Slough Non-physical Barrier Project is only anticipated to result in only a temporary disturbance of the channel substrate as the barrier will be completely removed from the channel, including all piers, concrete anchors, and pilings.

There will be an impediment to free migratory movement of fish within the designated critical habitats for salmonids and green sturgeon. The impediment to free migration is intentional and is part of the purpose. The barrier is designed to deter listed juvenile salmonids from entering Georgiana Slough and subsequently the waters of the Delta interior, including the central and southern Delta. By doing so, it limits access to critical habitats within Georgiana Slough and the interior Delta and the PBFs within them. The barrier is temporary with full removal by the end of September 2030. Thereafter, there will be no impediment to migration. The barrier will temporarily impact designated critical habitat physical and biological features for listed salmonids and sturgeon, including food resources, water quality (contaminants during construction), migratory corridors, and rearing areas. There will be no impediment to migration following removal of Georgiana Slough Non-physical Barrier.

2.5.14 Conservation Hatcheries

2.5.14.1 Livingston Stone National Fish Hatchery

The Livingston Stone National Fish Hatchery, located in the upper Sacramento River, was constructed by Reclamation in 1997 for the explicit purpose of propagating Sacramento River winter-run Chinook Evolutionary Significant Unit (ESU) salmon to assist in its recovery. Adult fish, known as broodstock, are captured at the Keswick Dam and transferred to Livingston Stone National Fish Hatchery for spawning. The first winter-run Chinook salmon was released in April 1998. Each year the hatchery produces approximately 200,000 juvenile winter-run Chinook salmon for release into the upper Sacramento River. This conservation hatchery includes an integrated-recovery supplementation program and a captive broodstock program. Reclamation provides USFWS with funding for operations and maintenance.

Starting in 2006, the Livingston Stone National Fish Hatchery also houses a refugial population of Delta smelt for the University of California Davis Fish Conservation and Culture Lab (FCCL) to reduce the risks of extinction for this threatened species.

In 2017, USFWS requested an enhancement permit from NMFS for a hatchery and genetic management plan for the Livingston Stone National Fish Hatchery, which describes the biologically based artificial propagation management strategies that ensure the conservation and recovery of winter-run Chinook salmon.

The following ESA documentation records the effects on federally listed species.

- *NMFS 2017 Biological Opinion for the issuance of an ESA Section 10(a)(1)(A) enhancement permit to the USFWS for implementation of two Hatchery and Genetic Management Plans at Livingston Stone National Fish Hatchery (WCR-2016-4012)*
- *September 29, 2017, section 10(a)(1)(A) permit 16477; issued to the USFWS authorizing continued operations of the hatchery programs at Livingston Stone National Fish Hatchery; Section 10(a)(1)(A) permit 16477 is set to expire on December 31, 2027*

The NMFS 2017 Biological Opinion anticipated that stressors from the propagation management strategies could reduce the abundance, productivity, and diversity of winter-run Chinook salmon. Concerning pathogens and disease, NMFS noted that "increased transmission or amplification of disease is not expected to result from releasing juvenile winter-run Chinook salmon from the LSNFH. Juvenile winter-run Chinook salmon released from LSNFH have been notably healthy and free of disease problems." Adverse stressors are offset by the overall purpose of enhancing the natural population of winter-run Chinook salmon in the Upper Sacramento River Basin. NMFS described that spring-run Chinook salmon and CV steelhead from Broodstock collection, via rotary screw trap. Also, Southern Resident killer whales could benefit slightly from hatchery production of winter-run Chinook salmon due to an increased forage base of salmon, which is their principal prey item.

2.5.14.2 University of California Davis Fish Conservation and Culture Laboratory

Since 1996, the FCCL has been a part of the Biological and Agricultural Engineering Department of the University of California Davis. Reclamation and DWR are the primary funding sources for the FCCL. The two main goals of the refuge population (annually, approximately 32,000 adults) at the FCCL are to maintain a population in captivity that is as genetically close to as possible to the wild population, and to provide a safeguard against extinction. The FCCL has closed the life cycle of Delta smelt meaning that they can produce new generations of fish at their facility with or without the addition of new wild spawners and keep enough progeny alive to repeat the process for multiple generations.

The following ESA documentation records the effects on federally listed species.

- *USFWS Permit Native Threatened Species – Recovery Threatened Wildlife 2018 (TE027742-6)*
- *USFWS 2018 Biological Opinion (File No. 08FBDT00-2018-F-0360) Programmatic Biological Opinion on the Amendment of Recovery Permit for U.C. Davis Fish Conservation and Culture Laboratory (TE-027742-6) Pursuant to Section 10(a)(l)(A) of the Endangered Species Act for Actions Involving the Use of Cultured Delta Smelt During Contained Study in the Natural Environment*

The USFWS 2018 Biological Opinion anticipated that the release of cultured Delta smelt into areas where wild Delta smelt reside could adversely affect the wild population by increased inbreeding, reduced fitness, and loss of genetic diversity (adaptive potential) over time. However, the recovery permit (*TE027742-6)* is not likely to jeopardize the continued existence of the Delta smelt. USFWS also noted that the information collected and reported by permittees will support recovery efforts, and thus the species' survival, as this information is used to inform future management and recovery actions.

2.5.14.3 U.S. Fish and Wildlife Service Fish Technology Center and Estuarine Research Station

USFWS is planning on designing and constructing a Fish Technology Center and to study Delta smelt and other imperiled species as part of a larger Delta Research Station located near Rio Vista, California. The Fish Technology Center is envisioned to operate as a stand-alone facility for maintaining a refugial population of Delta smelt and for propagation research, conservation, and study of other imperiled fishes. Research would include focus on methods of marking and recapturing fish, appropriate life stage for release, success of captive-reared fish in the wild, and techniques for producing the volume of fish necessary for supplementation in the wild. Currently, construction of the Fish Technology Center is at the 35% design review phase.

The following ESA documentation records the effects on federally listed species.

- *USFWS 2017 Intra-Service Biological Opinion and Conference Opinion on the Delta Research Station: Fish Technology Center and Estuarine Research Station (08FBDT00-2017-F-0101)*
- *NMFS 2017 Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the proposed Delta Research Station project. (WCR-2017-6715)*

The NMFS 2017 Biological Opinion anticipated that the project will not directly affect any listed salmonoids as the proposed in water work is limited to the summer and fall months when the salmonoids are not present in the action area. The project is likely to directly affect green sturgeon due to the presence of the species within the action area during the in-water work. The size and duration of the project lead NMFS to determine that the overall impacts to the green sturgeon will not result in impacts likely to jeopardize the continued existence of this species. No critical habitat is likely to be destroyed or adversely modified by the Proposed Action.

The USFWS 2017 Biological Opinion anticipated the project would have temporary construction-related adverse effects on Delta smelt and longfin smelt and result in permanent loss of shallow water habitat. USFWS noted that the "Estuarine Research Station would provide modem facilities for science and research efforts and would reduce operational costs and foster scientific collaboration for the benefit of delta fisheries, including Delta smelt."

2.5.15 Production Hatcheries

2.5.15.1 Coleman National Fish Hatchery

The Coleman National Fish Hatchery was constructed in 1942 adjacent to Battle Creek, and currently propagates three salmonid stocks; fall-run Chinook salmon, late-fall Chinook salmon and steelhead. The Coleman National Fish Hatchery serves to partially mitigate the negative effects of the construction of Shasta Dam. Fish produced at the Coleman National Fish Hatchery contribute to the commercial and recreational fishing industry in California. The fall-run and late-fall Chinook salmon propagation program is operated as an integrated-harvest type program that is intended to mitigate for the harvest in the Sacramento River sport fishery and the sport and commercial ocean fisheries.

The following Biological Opinions and recovery permits document the effects on federally listed species.

- *NMFS 2014 Biological Opinion (File No. 151422SWR2000SA5806) Coleman National Fish Hatchery Complex Artificial Propagation Programs*
- *NMFS Section 10 Enhancement Permit for the take of listed species associated with monitoring program (Permit 1415)*
- *NMFS Section 10 Enhancement Permit for the take of listed species associated with monitoring program (Permit 1027)*

The NMFS 2014 Biological Opinion anticipated that listed salmonids could be adversely affected by failure of broodstock collection and holding facilities (i.e., flow reductions, flooding, and overcrowding), entrainment into hatchery water intakes, reduced battle creek flows from hatchery water withdrawals, decreased water quality from discharge of hatchery effluent, artificial spawning, handling, stress, delayed passage, injury, or mortality due to broodstock congregation and collection, genetic effects and lose of population diversity, increased potential for disease, increased competition and density-dependence effects, and finally, increased predation. However, over all Coleman National Fish Hatchery steelhead program increases the abundance of the threatened CV steelhead DPS.

2.5.15.2 Nimbus Hatchery

The Nimbus Fish Hatchery is operated by CDFW under a cooperative agreement with Reclamation. The purpose of Nimbus Hatchery is to provide fall-run Chinook salmon for harvest in ocean (commercial and recreational) and freshwater recreational fisheries, as well as hatchery and natural area escapement to the lower American River. Hatchery production mitigates for the loss of salmonid spawning and rearing habitat and resulting natural production caused by the construction of Nimbus Dam on the American River. The Nimbus Dam was constructed as part of the CVP and the Nimbus Fish Hatchery was constructed to mitigate for the loss of approximately 72% of the historic salmon habitat spawning area for fall-run Chinook Salmon above the dam.

There are no existing Section 7(a)(2) consultations associated with this facility, but CDFW is currently in the process of applying for a Section 10(a)(1)(A) permit, and as part of that application, a Draft Hatchery and Genetic Management Plan for Nimbus Hatchery fall-run Chinook salmon.

2.5.16 Head of Old River Scour Hole Predation Reduction Project

As a commitment in Reclamation's 2020 ROD, Reclamation is currently developing alternatives to modify the scour hole located at the head of Old River to increase the survival of downstream-migrating juvenile CV steelhead and spring-run Chinook salmon in the San Joaquin River by reducing the predation intensity they encounter at this site. The main goal of the project is to improve habitat conditions through permanent modifications of channel geometry. Reclamation awarded a contract in 2021 for the development of alternatives, design, cost estimates and environmental compliance for this project. Currently, four structured decision-making meetings have occurred with various resource agencies (USFWS, NMFS, CDFW) and other interested parties regarding the potential options and the objectives that were identified as being important for the implementation of this plan.

Reclamation anticipates completing a separate site-specific ESA Section 7 consultation for the Head of Old River Scour Hole Predation Reduction Project during the duration of the Proposed Action for this consultation. Reclamation understands that this project has independent utility.

The 2019 NMFS Biological Opinions included this action programmatically. NMFS expected "benefits most likely accruing to CV steelhead and CV spring-run Chinook salmon entering the Delta from the San Joaquin River" (2019 NMFS Biological Opinion, pg. 599) from this project. NMFS, within its 2019 Biological Opinion, assessed the response to listed salmonids from predator hot spot removal and short-term effects from potential construction.

2.5.17 Monitoring

Reclamation and DWR undertake monitoring to inform long-term operations associated with this Proposed Action. Monitoring is necessary to determine and help avoid and minimize the effects of the Proposed Action, including minimizing anticipated incidental take and informing specific real-time actions. The adaptive management process described for the Proposed Action is based on the continuation of monitoring programs both upstream and in the Delta. The information obtained from these programs is used in making real-time decisions regarding project operations. Incidental take for these monitoring programs has been previously authorized under individual ESA Section 10 permits or separate ESA Section 7 consultation. If there are additional monitoring activities that are not subject to existing or subsequent ESA Section 7 consultation and that may adversely affect listed species or their designated critical habitat, reinitiation of this consultation will likely be required to address those effects. Monitoring activities associated with all other aspects of the Proposed Action will require subsequent approvals as described in the Proposed Action and will be subject to subsequent consultations if those activities may affect listed species or designated critical habitat.

The following monitoring programs are necessary to adaptively manage project operations and are either directly related to management of releases (e.g., temperature and flow), or are a necessary component the salmon and smelt decision process used to manage Delta operations (e.g., DCC gates and export pumping).

- California Department of Fish and Wildlife. 2023. NMFS State 4(d) Rule for Research Programs. #26021. *Renew: Upper Sacramento River Basin Salmon and Steelhead Assessment.* January 1, 2023–December 31, 2023.
- California Department of Fish and Wildlife. 2023. NMFS State 4(d) Rule for Research Programs. #26002. *Renew: Sacramento River Basin Salmon and Steelhead Assessment. Upper Sacramento River Basin Adult Salmon and Steelhead Counts and Spawning Stock Surveys* January 1, 2023–December 31, 2023.
- California Department of Fish and Wildlife. 2021. NMFS Section 10(a)(1)(A) Permit 1440-3R. *Renew: Interagency Ecological Program (IEP): long-term fish, zooplankton and aquatic monitoring and research program in the San Francisco Bay-Delta Region.* March 30, 2021–December 31, 2025.

- California Department of Fish and Wildlife. 2021. NMFS Section 10(a)(1)(A) Permit 14808-4M. *Renew: Central Valley Salmon and Steelhead Monitoring*. January 1, 2021–December 31, 2025.
- California Department of Fish and Wildlife. 2021. NMFS Section 10(a)(1)(A) Permit 18181-4R. *Renew: Salmon and Steelhead Monitoring and Rescue and Relocation of ESA-listed Fishes in California's Central Valley.* January 1, 2021–December 31, 2025.
- Cramer Fish Science. 2022. NMFS Section 10(a)(1)(A) Permit 25856. *Stanislaus River O. mykiss juvenile Population and Life History Composition Census*. January 1, 2022–December 31, 2026.
- Cramer Fish Science. 2022. NMFS State 4(d) Rule for Research Programs. #24188. *Renew: Restored Side Channel Habitat Utilization by Juvenile Chinook Salmon on the Lower American River.* April 14, 2022. January 1, 2023–December 31, 2023.
- National Marine Fisheries Service, Southwest Fisheries Science Center. 2022. NMFS Section 10(a)(1)(A) Permit 17299-4R. *Central Valley research to study survival, movement, habitat use and physiological capacity of Chinook salmon and steelhead and their predators in the Sacramento River basin.* January 1, 2022–December 31, 2026.
- U.S. Fish and Wildlife Service. 2021. NMFS Section 10(a)(1)(A) Permit 1415-5R. *Multiple Projects conducted by the US Fish and Wildlife Services' Red Bluff Fish and Wildlife Office.* March 30, 2021–December 31, 2025.
- U.S. Fish and Wildlife Service. 2021. NMFS Section 10(a)(1)(A) Permit 13791-7R. *USFWS Long-term Delta Juvenile Fish Monitoring Program, Delta Littoral Habitat Study, Liberty Island and Cache Slough Complex, IEP Gear Efficiency Evaluation, Enhanced Delta Smelt Monitoring, Tissue Collection of Winter-run Sized Juvenile Salmon.* January 1, 2021–December 31, 2025.
- U.S. Fish and Wildlife Service. 2022. NMFS Section 10(a)(1)(A) Permit 17428-4R. *Monitor Juvenile Salmonids in the American River (Sacramento County, California) and Stanislaus River (San Joaquin County, California).* September 30, 2022–December 31, 2027.
- U.S. Bureau of Reclamation. 2023. *Formal Consultation on the Sacramento Deepwater Ship Channel Food Study Pre-Project Monitoring Project.* July 23, 2021–December 31, 2025.
- U.S. Bureau of Reclamation. 2022. *Formal Consultation on the 2022-2026 Effect of Managed Flow and Food Subsidies on the Availability and Quality of Delta Smelt Habitat and Prey Project (BDO-400 2.2.1.06).* April 11, 2022–December 31, 2026.
- U.S. Bureau of Reclamation. 1997. *Formal Endangered Species Consultation and Conference on Field Sampling Activities of the Interagency Ecological Program for the Sacramento–San Joaquin Estuary*. Amended August 11, 1998. Amended September 20, 2012.

2.5.18 Red Bluff Pumping Plant and Fish Passage Improvement Project

Red Bluff Diversion Dam is located on the Sacramento River approximately two miles southeast of Red Bluff, California. Completed in the mid-1960s, the diversion dam raised the water surface of the Sacramento River enabling gravity diversion into Tehama-Colusa Canal Authority's (TCCA) canal system. As required by the 2009 NMFS Biological Opinion, in 2011, the dam gates were permanently placed in the open position for free migration of fish while ensuring continued water deliveries by way of the Red Bluff Pumping Plant.

In August 2012, Reclamation completed, the Fish Passage Improvement Project at the Red Bluff Diversion Dam, which solves the dual concerns of providing fish passage at Red Bluff Diversion Dam while ensuring reliable water deliveries to the TCCA service area. The Fish Passage Improvement Project consisted of construction of a positive barrier fish screen structure, forebay, pumping plant, switchyard, canal, and siphon to reduce or eliminate reliance on the Red Bluff Diversion Dam. The fish screen was designed to comply with NMFS and CDFW criteria for salmon and steelhead fry. It is generally accepted that these criteria for salmonids are also protective of green sturgeon.

Construction of the screened intake facility, pumping plant and its maintenance are considered as part of the baseline of this consultation. However, the diversion of water at the Red Bluff Diversion Dam and its resulting hydrological alteration are analyzed in this consultation.

The following ESA documentation records the effects on federally listed species.

- *NMFS 2009 Biological Opinion (2009/00554) – Red Bluff Pumping Project*

NMFS 2009 Biological Opinion expected that the Fish Passage Improvement Project will result in short-term and temporary construction-related impacts that will injure, harm, and possibly kill mainly juveniles, but possibly larvae/post-larvae and fry life stages, of the federally listed salmonids and southern DPS of green sturgeon and remove or alter their habitat. While resulting in temporary adverse effects, NFMS anticipated the Fish Passage Improvement Project "would provide operational flexibility to Red Bluff Diversion Dam for adult and juvenile listed species and provide reliable water delivery to TCCA" (National Marine Fisheries Service 2022:55).

2.5.19 San Joaquin River Restoration Program

The San Joaquin River Restoration Program is a multi-agency effort to restore self-sustaining fish populations to the San Joaquin River, focusing on threatened spring-run Chinook salmon. The restoration area stretches for 150 miles of the San Joaquin River, from the base of Friant Dam to the confluence with the Merced River. The San Joaquin River Restoration Program was established in late 2006 to implement the Stipulation of Settlement in *NRDC et al. v. Kirk Rodgers et al*. Authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Public Law 111-11).

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2012 Biological Opinion (File No. 08ESMF00-2012-F-0125)- Formal Consultation and Conference Report Under Section 7(a)(2) of the Endangered Species Act on the San Joaquin River Restoration Program*

- *NMFS 2012 Biological Opinion (File No. 151422SWR2010SA00360) - Programmatic Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response and Fish and Wildlife Coordination Act Recommendations for the San Joaquin River Restoration Program*

The NMFS 2012 Biological Opinion documents that the described proposed project, the San Joaquin River Restoration Program, is not likely to adversely affect winter-run Chinook salmon, spring-run Chinook salmon, CCV steelhead and Southern DPS green sturgeon. The potential impacts that may occur will occur primarily to CCV steelhead once they occupy the restoration area. These potential impacts occur primarily from construction, flow management and monitoring actions. All actions that would potentially affect listed species will undergo subsequent ESA consultation.

NMFS has also determined that the action, as proposed, is not likely to destroy or adversely modify critical habitat for these species. Designated critical habitat for CV spring-run Chinook salmon does not occur within the action area. Critical habitat for CV steelhead does not occur within the restoration area. Impacts on designated critical habitat for CV steelhead could occur from construction and flow manipulation related to water recapture facilities on the lower San Joaquin River. Best management practices, conservation measures, and water-diversion screening criteria will be incorporated into modifications to existing diversions or building of new diversions to reduce potential impacts on critical habitat.

Implementation of the San Joaquin River Restoration Program Preferred Alternative C1 as described in the NMFS 2012 Biological Opinion is not likely to jeopardize the continued existence of winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, or southern DPS of green sturgeon. NMFS has also determined that the action, as proposed, is not likely to destroy or adversely modify critical habitat for these species.

The USFWS 2012 Biological Opinion addresses potential effects on terrestrial species.

2.5.20 Shasta Temperature Control Device Performance Evaluation

The purpose of the Shasta Temperature Control Device Performance Evaluation was to study whether there were problems or limitations with the function of the Shasta Dam Temperature Control Device under low storage conditions. Reclamation convened a technical team in 2021 consisting of members from Reclamation, NMFS, and the Western Area Power Association to identify problems and limitations of the Shasta Dam Temperature Control Device.

Warm-water leakage through the Temperature Control Device middle gates was identified as a structural limitation to the function of the device. A report (*Shasta Temperature Control Device Performance Evaluation)* outlines potential study topics that may improve operational efficiency that were discussed during the four technical team meetings that took place in 2021. Development of the *Shasta Temperature Control Device Performance Evaluation* report used existing data and did not include any field data collection efforts. Reclamation will evaluate necessary potential actions and/or modifications to the device; any future actions that have beneficial or adverse effects on federally listed species associated with the evaluation will be subject to separate and independent future ESA Section 7 consultation.

2.5.21 Suisun Marsh Preservation Agreement

Reclamation and DWR address salinity impacts on fish and wildlife in the Suisun Marsh related to long-term operation of the CVP and SWP through the 2015 Suisun Marsh Preservation Agreement. Public Law 99-546 identifies that Reclamation and DWR will share the implementation cost of the Suisun Marsh Preservation Agreement. The agreement was signed by DWR, CDFW, Suisun Resource Conservation District, and Reclamation.

Operations of the Suisun Marsh Facilities constructed pursuant to the Suisun Marsh Preservation Agreement and resulting hydrological alteration is included in this consultation. However, Reclamation expects the operation of the Suisun Marsh Facilities will be part of the Suisun Marsh Habitat Management, Preservation and Restoration Plan Biological Opinions, upon its next reinitiation of consultation.

2.5.22 Suisun Marsh Habitat Management, Preservation and Restoration Plan

The Suisun Marsh Habitat Management, Preservation and Restoration Plan (SMP) is a comprehensive plan designed to address the various conflicts regarding use of marsh resources, with the focus on achieving an acceptable multi-stakeholder approach to the restoration of tidal wetlands and the management of managed wetlands and their functions. The SMP addresses habitats and ecological process, public and private land use, levee system integrity, and water quality through restoration and managed wetland activities. The SMP is intended to guide near-term and future actions related to restoration of tidal wetlands and managed wetland activities.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2013 Biological Opinion (File No. 0SESMF00-2012-F-0602)- Transmittal of Final Biological Opinion on the Proposed Suisun Marsh Habitat Management, Preservation, and Restoration Plan and the Project-Level Actions in Solano County, California*
- *NMFS 2013 Biological Opinion (File No. 2012-02390)- Suisun Marsh Long-Term Habitat Management, Preservation, and Restoration Plan*

The USFWS SMP Biological Opinion described the tidal wetland restoration actions, specifically levee breaching, initially would result in the establishment of tidal open water habitat. Tidal wetland vegetation would establish as sediment accrues over time. Effects of tidal marsh restoration will be dispersed in space and time. As the restored area evolves into a functioning, vegetated tidal wetland, it is expected to provide permanent suitable and sustainable habitat for federally listed species in Suisun Marsh. Specifically, as the restored area evolves into a functioning tidal marsh, it is expected to provide indirect benefits to fish species through increased exports of nutrients and food to adjacent open water areas. SMP restoration activities would benefit the actual or available primary productivity of Suisun Marsh as a whole by increasing nutrient exchange and nutrient turnover rates. Restoration activities would include the construction of habitat levees that include benches or berms, which would provide opportunities for the establishment of high marsh/upland transition habitat. Ground-disturbing activities, such as levees maintenance and dredging, may result in the harassment, harm, injury, or death of federally listed species within Suisun Marsh. Also, there could be a temporary loss of foraging habitat as a result of construction-related activities throughout the Marsh. The USFWS SMP

Biological Opinion anticipates the harassment of 10 Delta smelt in 20 acres of tidal sloughs, annually.

The NMFS 2013 Biological Opinion also documented that over the 30-year term of the SMP, 5,000 to 7,000 acres within the action area will be restored to tidal marsh and this component is anticipated to provide significant long-term benefits to winter-run Chinook salmon and green sturgeon critical habitat in the action area. The Biological Opinion also anticipated that the SMP's long-term benefits from the restoration of tidal wetlands are expected to provide listed anadromous salmonids and green sturgeon some increased resistance to climate change. The NMFS 2013 Biological Opinion anticipated that listed anadromous salmonid smolts and green sturgeon may be harmed or killed by managed wetland operations and levee breeching in Suisun Marsh. The number of affected salmonids is expected to be small over the 30-year term of the SMP (between 50 and 500 juvenile salmonids from the unscreened diversions and up to 20 steelhead and five green sturgeon from poor water quality).

2.5.23 Tracy Fish Collection Facility Improvement Program

Reclamation conducts studies and physical modifications at the Tracy Fish Collection Facility to improve fish survival and improve facility efficiency, reducing mortality through the facility, fish hauling, and release operations through the Tracy Fish Facility Improvement Program. Activities include predation studies and piscivorous predator control, improvement of hydrologic monitoring and telemetry systems, holding-area improvements including fish-count automation and tank aeration and screening, improvement of data management, as well as aquaculture facility maintenance, operation, and improvements. Tracy Fish Collection Facility studies are established at annual multi-agency meetings of the Tracy Tech Advisory Team with written reports on the Tracy Fish Facility Improvement Program website. The program would improve the Tracy Fish Collection Facility to reduce loss by (1) improving the existing debris removal systems at each trash removal barrier, screen, and fish barrier; (2) improving the fish-handling systems and holding tanks for system reliability by incorporating proven technologies; (3) incorporating remote operation into the design and modernization of the facility, such as automation for the purpose of reducing loss; and (4) installing predation control systems that include mechanical options such as carbon dioxide injectors and operational options. Facility improvements will improve survival of fish salvaged and potentially reduce the loss factors to allow for additional certainty on Old and Middle River management with low impacts from salvaging salmonids.

Reclamation anticipates completing a separate site-specific ESA Section 7 consultation for the remaining Tracy Fish Collection Facility Improvement Program components at some point in the duration of the Proposed Action for this consultation.

2.5.24 Tidal Habitat Restoration

The 2008 and 2019 USFWS Biological Opinion's on the long-term operation included an RPA for DWR to implement a program to create or restore 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh. 2,000 acres of tidal habitat restoration has been constructed by DWR of the total 8,000 acres thus far. All of the below tidal restoration projects have completed site-specific formal consultation.

- Bradmoor Island and Arnold Slough Restoration Project (approximately 476 and 141 of restored tidal acres)
    - NMFS 2020 Letter of Concurrence (WCRO-2012-00005, ID-2231) *Review of Bradmoor Island and Arnold Slough Restoration Project (Corps File No. SPN-2018-00115) pursuant to the July 3, 2013 Biological Opinion and Incidental Take Statement for the Suisun Marsh Habitat Management, Preservation, and Restoration Plan*
    - USFWS 2020 Biological Opinion (08FBDT00-2020-F-0211) *Formal Consultation on the Bradmoor Island and Arnold Slough Restoration Projects, Solano County, California (Corps File No. SPN-2018-00115) and Appending to the June 10, 2013, Formal Programmatic Biological Opinion on the Proposed Suisun Marsh Habitat Management, Preservation, and Restoration Plan and the Project-Level Actions (Service File No. 08ESMF00-2012-F-0602-2)*
- Decker Island Restoration Project (approximately 140 of restored tidal acres)
    - NFMS 2016 Letter of Concurrence (File No. WCR-2016-6023) *Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Decker Island Tidal Habitat Restoration Project (Horseshoe Bend)*
    - 2018 USFWS Biological Opinion (File No. 08FBDT00-2017-F-0042) *Biological Opinion on Decker Island Tidal Habitat Restoration Project, Solano County, California*
- Lookout Slough Restoration Project (approximately 3,164 of restored tidal acres)
    - NMFS 2018 Programmatic Biological Opinion (File No.) *NAME.* Appended on Aug 25, 2020, via email
    - USFWS 2020 Biological Opinion (File No. 08FBDT00-2020-F-0181) *Formal Consultation on the Lookout Slough Tidal Habitat Restoration and Flood Improvement Project, Solano and Yolo Counties, California [Corps File No. 408 Permission Section (19477)]*
    - USFWS 2021 Biological Opinion (File No. 08FBDT00-2020-F-0181-R001) *Reinitiation of Formal Consultation on the Lookout Slough Tidal Habitat Restoration and Flood Improvement Project, Solano and Yolo Counties, California [Corps File No. 408 Permission Section (19477)]*
- Lower Yolo Ranch Restoration Project (approximately 1,681 of restored tidal acres)
    - USFWS 2019 Biological Opinion (File No. 08FBDT00-2019-F-0276) *Formal Consultation on the Lower Yolo Restoration Project, Yolo County, California (Corps File No. SPK-2010-01035)*

    - NMFS 2019 Letter of Concurrence (File No. WCRO- 2019-02338) *Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Lower Yolo Bypass Restoration Project*

- Prospect Island Restoration Project (approximately 1,600 of restored tidal acres)

    - NMFS 2018 Letter of Concurrence (File No. WCR-2018-9356) *Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Prospect Island Tidal Restoration Project (SPK-2013-00085)*

    - USFWS 2018 Biological Opinion (File No. 08FBDT00-2018-F-0069) *Formal Consultation on the Prospect Island Tidal Restoration Project, Solano County, California (U.S. Army Corps of Engineers File No. SPK-2013-00085)*

Incidental take associated with the proposed monitoring activities for Prospect Island could result in the harm or mortality of 10 larval, 1 juvenile, and 1 adult Delta smelt, annually.

- Tule Red Restoration Project (approximately 420 of restored tidal acres)

    - NMFS 2016 Letter of Consistency (File No. WCR-2012-2390) *National Marine Fisheries Service's review of the Tule Red Tidal Restoration Project (Corps File No. 2014-00131S) pursuant to the July 3, 2013 Biological Opinion and Incidental Take Statement for the Suisun Marsh Habitat Management, Preservation, and Restoration Plan*

    - USFWS 2016 Biological Opinion (File No. 08FBDT00-2016-F-0071) *Formal Consultation on the Tule Red Tidal Restoration Project, Solano County, California (U.S. Army Corps of Engineers File No. 2014-00131S) and Appending to the June 10, 2013, Formal Programmatic Biological Opinion on the Proposed Suisun Marsh Habitat Management, Preservation, and Restoration Plan and the Project-Level Actions (Service File No. 08ESMF00-2012-F-0602-2)*

- Wings Landing Restoration Project (267.02 of restored tidal acres)

    - NMFS 2016 Letter of Consistency (File No. WCRO-2012-00005, ID-1760) *Wings Landing Tidal Restoration Project (Corps File No. SPN-2018-00344)*

    - USFWS 2020 Biological Opinion (File No. 08FBDT00-2016-F-0071) *Formal Consultation on the Wings Landing Tidal Habitat Restoration Project, Solano County, California (Corps File No. SPN-2018-00344)*

- Winter Island Restoration Project (approximately 384.4 of restored tidal acres)

    - NMFS 2019 Concurrence Letter (File No. WCRO-2019-00046) *Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Winter Island Tidal Habitat Restoration Project (Corps File No. 2017-00146)*

    - USFWS 2019 Biological Opinion (File No. 08FBDT00-2019-F-0079) *Biological Opinion for the Winter Island Tidal Habitat Restoration Project, Contra Costa County, California (Corps File No. SPN-2017-00146)*

- Yolo Flyway Farms Restoration Project (approximately 278 of restored tidal acres)

    - NMFS 2016 Letter of Concurrence (File No. WCRO-2016-5863) *Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Yolo Flyway Farms Restoration Project, Yolo County, California*

    - USFWS 2017 Biological Opinion (File No. 08FBDT00-2016-F-0101) *Formal Consultation on the Yolo Flyway Farms Restoration Project, Sacramento County, CA*

The overall primary purpose of these restoration projects is to protect, restore, and enhance intertidal and associated subtidal habitat to benefit listed fishes, including Delta smelt, through increased foodweb production. Restoration projects result in short-term construction-related effects and may result in permanent habitat loss for upland terrestrial species. However, as the restored areas evolve over time into a functioning tidal marsh, restoration projects are expected to provide benefits through increased exports of nutrients and food to adjacent open water, and potentially provide potential physical Delta smelt rearing habitat.

2.5.25 Trinity River Restoration Program

The Trinity River Restoration Program is a partnership comprised of federal and California State agencies, Hoopa Valley and Yurok Tribes, and Trinity County, California. These entities work collaboratively with stakeholders to restore the Trinity River between Lewiston Dam and the confluence of the North Fork Trinity River, California to mitigate impacts of the Trinity River Division of the CVP on anadromous fish populations in the Trinity River by successfully implementing the 2000 Trinity River ROD and achieving Congressionally mandated restoration goals. The long-term goals are to (1) restore the form and function of the Trinity River; (2) restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and (3) to facilitate full participation by dependent tribal, commercial, and sport fisheries through enhanced harvest opportunities.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2000 Biological Opinion (File No. 1-1-00-F-0125) - (1) Reinitiation of Formal Consultation on the Effects of Long-term Operation of the Central Valley Project and State Water Project as Modified by Implementing the Preferred Alternative in the Draft Environmental Impact Statement/Environmental Impact Report for the Trinity River Mainstem Fishery Restoration Program. (2) Request for Consultation on the Implementation of this Alternative on the Threatened Northern Spotted Owl, Northern Spotted Owl Critical Habitat, and the Endangered Bald Eagle within the Trinity River Basin and where applicable, Central Valley reservoirs.*

- *NMFS 2000 Biological Opinion (No file Number) - Biological Opinion for the Trinity River Mainstem Fishery Restoration EIS and Its Effects on Southern Oregon/Northern California Coast Coho Salmon, Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, and Central Valley Steelhead*

The NMFS 2000 Biological Opinion anticipated Trinity River Restoration Program would result minor, short-lived adverse effects on juvenile coho salmon because of the gravel supplementation project, and result in highly beneficial improvements in river system and habitat conditions allowing naturally produced anadromous salmonid populations, including coho salmon, to greatly increase. Trinity River Coho salmon were expected to benefit from increases in suitable habitat due to increased survival of associated freshwater life history stages and resulting production of smolts. These benefits are expected to substantially contribute toward the achievement of management goals for these fish. The NMFS 2000 Biological Opinion also anticipated potential indirect adverse effects on Central Valley listed species in the upper Sacramento River due to implementation of the Proposed Action are temperature-related stress and mortality below Keswick Dam during the winter-run Chinook salmon spawning and incubation season (April through September).

The USFWS 2000 Biological Opinion for the Trinity River Restoration Program concluded that adverse effects on Delta smelt and Sacramento splittail will occur as a result of implementation of an average annual reduction of 240 TAF of Trinity River water from being diverted into the Sacramento River Basin. The implementation could result in an upstream (eastward) movement of X2 in any month between February 1 through June 30.

Reclamation will consult on the CVP facilities in the Trinity River Basin separately and concurrently with this consultation on the CVP and SWP facilities in the Central Valley and Delta. An aquatic Biological Assessment specific to the Trinity River Division will be prepared. The separate consultation is being conducted for the Trinity River Division because there are different species in the action area, a different regulatory office overseeing the ESA consultation, specific tribal interests, and additional interested parties and watershed management groups (i.e., Trinity Management Council) as compared to the Central Valley and Delta.

2.5.26 Lower Klamath River Long-Term Plan

Lower Klamath River Long-Term Plan provides supplemental flows from mid-August to late September, from Lewiston Dam to prevent a disease outbreak in the lower Klamath River in years when the flow in the lower Klamath River is projected to be less than 2,800 cfs. Supplemental flows come from water stored in Trinity Reservoir. The Lower Klamath River Long-Term Plan consists of three different flow-augmentation components to be implemented as needed in a phased approach, based on environmental and biological conditions. The three components include (1) a preventive base-flow release that targets increasing the base flow of the lower Klamath River to 2,800 cfs from mid-August to late September to improve environmental conditions; (2) a preventive pulse flow to be used as a secondary measure to alleviate continued poor environmental conditions and signs of Ich infection in the lower Klamath River; and (3) a contingency volume, to be used on an emergency basis as a tertiary treatment to avoid a significant die-off of adult salmon when the first two components are not successful at meeting their intended objectives. An adaptive management approach that incorporates real-time environmental and biological monitoring would be used to determine whether and when to implement any or all of these three flow-augmentation components. Reclamation signed a ROD for the Lower Klamath River Long-Term Plan on April 20, 2017, and is authorized by Section 2 of the 1955 Trinity River Division Act.

Reclamation consulted with NMFS on the potential effects of the Lower Klamath River Long-Term Plan on listed fish species. NMFS concluded consultation with the issuance of a programmatic Biological Opinion which includes stipulations for annual reinitiating of consultation as well as annual assessment, coordination, monitoring, and reporting. The Biological Opinion provided a determination that the project would not jeopardize the existence of any listed fish species, while the annual consultation process is expected to culminate in an individual Biological Opinion that will include an incidental take statement.

The following Biological Opinions document the effects on federally listed species:

2.5.27 Water Contracts

This consultation addresses the long-term operations of the CVP and SWP, including the delivery of water under existing water contracts. In the Proposed Action, Reclamation describes its proposed operation to deliver water for water supply purposes under existing contracts and for other authorized purposes. Effects on federally listed species and designated critical habitat by operating the CVP and SWP to deliver water under these contracts are addressed. Reclamation is not proposing to renew, execute, or amend any water contracts in the Proposed Action.

Most of the water service contracts were converted to repayment contracts in 2020 and 2021 pursuant to Section 4011 of the Water Infrastructure and Improvements for the Nation Act (Pub. L. No. 114-322, 130 Stat. 1628 (2016)). Section 4011 of the WIIN Act required the Secretary to convert any water service contract to a repayment contract if the contractor requested conversion. As such, Reclamation determined that the WIIN Act conversions were not discretionary actions that required consultation under Section 7 of the ESA. The converted repayment contracts provide for the continued delivery of the same amount of water for the same purposes.

Reclamation previously consulted separately with USFWS and NMFS on the renewal and execution of individual contracts, primarily in 2004 and 2005. Consistent with the CVPIA Biological Opinion, Reclamation undertook a two-track process to analyze effects from executing and implementing water contracts, including water service and settlement contracts. Reclamation analyzed the effects of operating the CVP to deliver water under water contracts (contract implementation) on listed aquatic species as part of long-term operations in 2004/2005, 2008/2009, and 2019/2020. Through separate consultations, Reclamation consulted on the renewal/execution of the contracts and any effects on nonaquatic species. The contract renewal/execution consultations addressed the diversion of Sacramento River water by water contractors at prescribed diversion points and times for the use of that water on a specified land area (the contractors' service area).

The following is a non-exhaustive list of Section 7 consultations documenting effects on federally listed species.

- *NMFS 2005 (File No. 151422SWR03SA8377:MET) Letter from Rodney R. McInnis, Regional Administrator, NMFS to Michael J. Ryan, NCAO Area Manager, Reclamation Concerning the Renewal of 145 Sacramento River Settlement Contracts*
- *USFWS 2005 (File No. 1-1-05-I-0699) Conclusion of Informal Consultation on the Renewal of 138 Sacramento River Settlement Contracts, and Request for Supplemental Information on the Colusa Drain Mutual Water Company contract renewal*
- *USFWS 2005 (File No. 1-1-05-I-1165) Conclusion of Informal Consultation on the Renewal of the City of Redding and Anderson-Cottonwood Irrigation Districts Sacramento River Settlement Contracts*
- *USFWS 2005 (File No. 1-1-05-I-0699) Conclusion of Informal Consultation on the Renewal of the Natomas Central Mutual Water Company Sacramento River Settlement Contract*
- *USFWS 2015 Reinitiation of Section 7 Consultations for the Renewal of 138 Sacramento River Settlement Contracts (Service File No. 1-1-05-1-0699); (2) the Long-Term Renewal of Water Service contracts in the Delta-Mendota Canal Unit (Service File No. 1-1-04-1-0707); (3) the Natomas Central Mutual Water Company Sacramento River Settlement Contract (Service File No. 1-1-05-1-0699); and (4) the City of Redding and the Anderson-Cottonwood Irrigation District Sacramento River Settlement Contracts (Service File No. 1-1-05-1-1165) (File MP-152 ENV-7.00)*
- *NMFS 2005 (File No. 151422SWR04SA9134:JSM) Letter from Rodney R. McInnis, Regional Administrator, NMFS to Kathy Wood, SCAO Chief Resources Manager, NMFS Concerning the Renewal of the Delta-Mendota Canal Unit Contracts*
- *USFWS 2005 (File No. 1-1 -04-1-0707) Conclusion of Consultation on Long-Term Renewal of Water Service Contracts in the Delta-Mendota Canal Unit*
- *NMFS 2005 (File No. 151422SWR04SA9164:HLB) Letter from Rodney R. McInnis, Regional Administrator, NMFS to Michael J. Ryan, NCAO Area Manager, Reclamation Concerning the Renewal of Water Service Contracts Within the Sacramento River Division of the CVP*
- *USFWS 2004 (File No. 1-1-04-F-0227) Conclusion of Informal Consultation on Long-Term Renewal of Sixteen Water Service Contracts in the Shasta, Trinity, and Sacramento River Divisions*
- *USFWS 2004 (File No. 1-1-04-12949) Conclusion of Informal Consultation on Long-Term Renewal of Six Water Service Contracts in the Shasta, Trinity, and Sacramento River Divisions*
- *USFWS 2005 (File No. 1-1-04-1-2978) Conclusion of Informal Consultation on Long-Term Renewal of the Proberta Water Service Contract in the Sacramento River Division*
- *USFWS 2005 (File No. 1-1-04-0721) Conclusion of Informal Consultation on Long-Term Renewal of Five Water Service Contracts in the Sacramento River Division*

- *NMFS 2014 (File No. WRC-2013-74) Letter from William W. Stelle, Jr., Regional Administrator, NMFS to Drew Lessard, CCAO Area Manager, Reclamation Concerning a 40-Year Water Service Contract for El Dorado County Water Agency Within the American River Division*

The USFWS Biological Opinions and letters of concurrences addressed potential effects on terrestrial species.

2.5.28 Water Temperature Modeling Platform

The Water Temperature Modeling Platform project is intended to modernize the analytical tools that support activities and decision-making for water temperature management in CVP reservoirs for fishery species protection in downstream river reaches. The focus of the project is to enhance modeling capabilities to predict summer and fall water temperature prediction through facilities operations specifically designed for temperature management such as the Shasta Dam Temperature Control Device and Folsom Dam Temperature Shutters with effective performance measure reporting functions.

The Water Temperature Modeling Platform project includes a collaborative process and is supported by the Modeling Technical Committee; an open forum that meets quarterly for collaboration on project development and progress review. Reclamation collaborated with the Delta Stewardship Council to conduct two rounds of scientific peer reviews for the project to provide independent feedback to further improve the outcome and support the transparency of the project. Information on the Water Temperature Modeling Platform is available at: https://www.usbr.gov/mp/bdo/cvp-wtmp.html.

2.5.29 Water Transfer Program

Water transfers and exchanges are an integral part of CVP water operations, particularly in drought years, as long as transfers can occur consistent with state and federal laws governing water transfers. The hydrological alteration associated with water transfers are included in this consultation. Section 3405(a) of the CVPIA authorizes the transfer of all or a portion of a CVP contractors contracted water supply to any other California water user or water agency, state or federal agency, Indian Tribe, or private nonprofit organization for project purposes or any purpose recognized as beneficial under State law. CVP water transfers are subject to the conditions prescribed in Section 3405(a), 1993 Interim Guidelines for Implementation of Water Transfers, and the Department of the Interior Final CVPIA Administrative Proposal on Water Transfers (1998).

The Accelerated Water Transfers Program allows water transfer and/or exchange agreements between CVP contractors that had historically occurred before enactment of CVPIA to be acknowledged by Reclamation. These types of transfers are often referred to as a reallocation of contract supply within a basin and are generally considered consistent with Section 3405(a)(1)(m) of the CVPIA.

In July of 2013, Reclamation signed a ROD for a water transfer program that may provide for the transfer and/or exchange of up to 150,000 acre-feet of substitute water from the Exchange Contractors in non-critical years to several potential users over a 25-year time frame (water service years 2014–2038). Distribution of this water depends on the CVP's annual water supply allocation, with more water going to west side San Louis & Delta-Mendota Water Authority contractors in lower allocation years.

Reclamation signed a ROD in 2014 executing a 10-year program to make water available for transfer from upstream of the Delta contractors to CVP water service contractors south of the Delta serviced by the Delta export facilities. This program makes up to 250,000 acre-feet available largely from senior water contractors on the Sacramento River for export south of the Delta. The program expires in 2025 and Reclamation anticipates preparing a new environmental impact statement in the near future to consider continuing the transfer program beyond 2025. In 2019, Reclamation completed a consultation on effects on listed species following litigation. Subsequently, Reclamation signed a new ROD for this transfer program in October of 2019 and an amended ROD in May 2021.

Water transfers are described in greater detail in the Draft Technical Information for Preparing Water Transfers, which can be found online at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Water-Transfers/Files/Draft_WTWhitePaper_20191203.pdf.

The following actions to make water available for transfer are not a part of this Proposed Action.

- Cropland Idling/Crop Shifting Transfers: Water from idling cropland or growing lower-water-use crops. The seller reduces surface water diversion from their normal operations.
- Groundwater Substitution Transfers: Water from reducing surface water diversions and replacing that like amount water with groundwater pumping.
- Reservoir Storage Release: Water from seller releasing stored water from their reservoir (non-CVP/SWP reservoirs) in excess of what would be released annually under their normal operations (e.g., reservoir storage targets, historical operation patterns, instream flow requirement, conveyance losses, refill, and other downstream obligations).

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2019 Biological Opinion (File No. 0SESMF00-2019-F-0619-1) Formal Consultation on the Long-Term Water Transfers Project (2019–2024)*
- *USFWS 2021 Memorandum (File No. 08ESMF00-2019-F-0619-2) Response to Notification of Minor Corrections Regarding the Formal Consultation on the Long-Term Water Transfers Project, 2019–2024 (08ESMF00-2019-F-0619-1)*

The USFWS Biological Opinions and letters of concurrences addressed potential effects on terrestrial species.

2.5.30 Wilkins Slough Flow Relief

Due to historical navigation criteria many of the diversions on the Sacramento River were designed around a 5,000 cfs minimum flow near Wilkins Slough. This program is a focus within the CVPIA Small Fish Screen program to provide grants to senior water right holders within this area to install new diversions and screens that would operate at the lower flows, which would allow Reclamation to have greater flexibility in managing Sacramento River flows and temperatures for both water users and wildlife, including listed salmonids (Northern California Water Association 2014).

2.5.31 Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project

To assist in recovering some of the hundreds of thousands of acres of floodplain that were disconnected from Central Valley streams starting in the 1800s, Reclamation and DWR are currently in the process of modifying infrastructure at Fremont Weir to increase access to floodplain habitat in the Yolo Bypass for juvenile salmonids. These modifications will also increase the ability of adult salmon and sturgeon to migrate from the Yolo Bypass to the Sacramento River. One of these modifications, commonly referred to as the Big Notch Project, includes the removal of a section of the Fremont Weir, the installation of gates, and the construction of a control building and pedestrian bridge for the purposes of increasing adult salmon and sturgeon migration through the Yolo Bypass. The Big Notch Project is currently under construction with an anticipated completion date of fall, 2024.

The Yolo Bypass is an important physical feature affecting river hydrology during high-flow events in the Sacramento River watershed. The bypass is a 59,280-acre engineered floodplain that conveys flood flows from the Sacramento River, Feather River, American River, Sutter Bypass, and western tributaries and drains (Harrell and Sommer 2003). The leveed bypass protects Sacramento and other nearby communities from flooding during high-water events and can convey up to 80% of flow from the Sacramento basin during flood events (Sommer et al. 2001). Most water enters the Yolo Bypass by spilling over the Fremont and Sacramento weirs and returns to the Sacramento River in the Delta approximately 5 miles upstream of Rio Vista. The Yolo Bypass floods seasonally in approximately 60% of years (Sommer et al. 2001). Reclamation and DWR are currently partnering to reconnect floodplain habitat and improve fish passage in the Yolo Bypass, the largest contiguous floodplain remaining in the Central Valley.

The following Biological Opinions document the effects on federally listed species.

- *USFWS 2019 Biological Opinion (File No. 08FBDT00-2019-F-0061) – Biological Opinion on the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project, Yolo County, California (BDO-400, ENV-7.00)*
- *NMFS 2019 Biological Opinion (File No. WCR-2019-11447)– Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project*

The NMFS 2019 Biological Opinion documented negative effects on listed species include elevated levels of noise from pile driving and turbidity from construction experienced as they migrate through the Sacramento River part of the action area during the roughly seven-month construction period, and injury/mortality related to fish salvage and relocation efforts carried out in conjunction with dewatering the construction area. Operation of the project is expected to provide improved habitat connectivity for ESA-listed fish species to migrate between the Sacramento River and the Yolo Bypass. This enhanced habitat connectivity is expected to improve the ability of anadromous fish to access the Yolo Bypass, resulting in increased growth and decreased stranding events, thereby reducing the necessity and frequency of non–project-related fish rescue efforts (by CDFW), increasing individual fitness and survival, and, potentially, contributing to increased spawning success upstream of the Yolo Bypass. In addition, the hydraulically operated bottom-hinged gate of the fish passage structure takes roughly 60 minutes to fully close, providing fish with ample time to get out of the gate's path of travel. All maintenance activities would be conducted during the nonflood season when listed species are not expected to be present on the Yolo Bypass floodplain. Incidental take was represented by ecological surrogates.

The USFWS 2019 Biological Opinion addresses potential adverse effects on terrestrial species. Within its opinion, USFWS concurs with Reclamation's determination that the project may affect but is not likely to adversely affect Delta smelt. Delta smelt do not occur in the proposed construction area, and the Delta smelt that occupy the southern Yolo Bypass may benefit from increased winter flows from Yolo Bypass into Cache Slough and increased food productivity due to the increased floodplain inundation during winter months.

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