



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

Refer to NMFS No: WCRO-2021-02725

**February 4, 2022**

Jennifer Cavanaugh  
Environmental Compliance Coordinator  
Natural Resources Conservation Service  
430 G St., #4164,  
Davis, California 95616-5475

*Electronic transmittal only*

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Ricelands Juvenile Salmonid Rearing Technical Guidelines and Management Activity Specifications Research Project

Dear Ms. Cavanaugh:

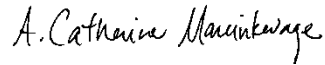
Thank you for your letter of November 2, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for funding the Ricelands Juvenile Salmonid Rearing Technical Guidelines and Management Activity Specifications Research Project. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action.

This biological opinion is based on the biological assessment and supplemental information provided by Natural Resources Conservation Service, University of California at Davis and the NOAA Southwest Fisheries Science Center. Based on the best available scientific and commercial information, the biological opinion concludes that the project is not likely to jeopardize the continued existence of the ESA-listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU), threatened Central Valley spring-run Chinook salmon ESU (*O. tshawytscha*), threatened California Central Valley steelhead distinct population segment (DPS) (*O. mykiss*), or the southern DPS of North American green sturgeon (*Acipenser medirostris*), and it is not likely to destroy or adversely modify the designated critical habitats of Central Valley spring-run Chinook salmon, California Central Valley steelhead, or the southern DPS of North American green sturgeon.



Please contact Kimberly Clements, of my staff, at (916) 930-5646, or via e-mail at [kimberly.clements@noaa.gov](mailto:kimberly.clements@noaa.gov) if you have any questions concerning this consultation, or if you require additional information.

Sincerely,



Cathy Marcinkevage  
Assistant Regional Administrator for  
California Central Valley Office

Enclosure

cc: ARN151422-WCR2021-SA00128

Electronic copy only:

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**Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response**

Ricelands Juvenile Salmonid Rearing Technical Guidelines and Management Activity  
 Specifications Research Project  
 NMFS Consultation Number: WCRO-2021-02725

Action Agency: Natural Resource Conservation Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Sacramento River winter-run Chinook salmon ( <i>Oncorhynchus tshawytscha</i> )	Endangered	Yes	No	NA <sup>1</sup>	NA
Central Valley spring-run Chinook salmon ( <i>O. tshawytscha</i> )	Threatened	Yes	No	Yes	No
California Central Valley steelhead ( <i>O. mykiss</i> )	Threatened	Yes	No	Yes	No
Southern distinct population segment of North American green sturgeon ( <i>Acipenser medirostris</i> )	Threatened	Yes	No	Yes	No

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

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

**Issued By:** *A. Catharine Marcinkevage*  
 Cathy Marcinkevage  
 Assistant Regional Administrator for California Central Valley Office

**Date:** February 4, 2022

<sup>1</sup> "NA" is defined as "Not Applicable."



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## 1. INTRODUCTION

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

### 1.1. Background

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

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

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

### 1.2. Consultation History

November 2020 - The Natural Resource Conservation Service (NRCS) and California Rice Commission (CRC) approached NMFS with an agricultural conservation grant program concept for juvenile salmonid rearing habitat on flooded rice fields. They requested NMFS review the Technical Report titled "Recommendations for Interim Practice Standard: Rearing of Chinook Salmon in Winter-flooded Rice Fields" and provide guidance on permitting the program concept.

January 2021 – In addition to the Technical Report, University of California at Davis (UCD) provided NMFS with a draft Study Plan titled "Refining a practice standard for conservation of salmon that volitionally access winter-flooded rice fields" outlining proposed scientific monitoring in support of program concept on a pilot scale. NMFS provided feedback on both documents and agreed to participate in meetings to provide early technical assistance on permitting the program.

April – July 2021 – NMFS met with NRCS, CRC, and UCD to provide technical assistance on determining an Endangered Species Act (ESA) compliance pathway for the program, including a suggestion to implement the concept on a pilot scale with rigorous monitoring prior to programmatic authorization.

August – September 2021 – NRCS and CRC determined that Section 7 consultation was the appropriate ESA compliance route, and met with NMFS on a weekly (and also ad hoc) basis so that NMFS could provide technical assistance on the development of a biological assessment (BA) as needed. NMFS reviewed and commented on the description of the Project, scientific monitoring, and adaptive management plan.

October 15, 2021 - NRCS submitted the draft BA for the Ricelands Juvenile Salmonid Rearing Technical Guidelines and Management Activity Specifications Research Project (Project) to NMFS for review.

October 18-26, 2021 - NMFS requested additional information upon review of the draft BA, and met with NRCS, CRC, and UCD to obtain sufficient information to initiate consultation.

November 2, 2021 – NRCS requested initiation of Section 7 consultation for the Project, including a final BA, and NMFS determined that the initiation package was complete to initiate formal consultation.

November 3, 2021 - January 13, 2022 – Ongoing clarifications of the Project via meetings and e-mail correspondence.

### **1.3. Proposed Federal Action**

Under the ESA, “action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Under MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not. The NRCS proposes to provide technical and financial assistance to the CRC to test, refine, and quantify benefits of the guidelines in working rice fields in the Sutter Bypass.

#### **1.3.1. Proposed Action Goals**

The CRC, in collaboration with the NRCS, is developing technical guidelines and management activity specifications to use winter flooded rice fields as rearing floodplain habitat for ESA listed natural-origin juvenile salmonids. The Project would be implemented on typical production-scale rice fields in the Sutter Bypass to test and optimize the previously developed draft guidelines and management activities tested on small scale studies (CRC 2021). The specific and measurable biological objectives to be used to meet this goal are as follows:

- Volitional passage of natural-origin juvenile Chinook salmon into the study fields following bypass flooding;
- Estimated infield survival of juvenile Chinook salmon;
- Estimated infield predator relative abundance;
- Volitional passage of juvenile Chinook salmon between individual checks and from the study field to the borrow canal; and
- Safe and timely passage of juvenile Chinook salmon out of the Sutter Bypass.

Rice land manager(s) and/or grower(s) would manage and implement the Project with ongoing coordination with NRCS, CRC, UCD and State/Federal fisheries agencies with the goal of showing the guidelines’ effectiveness to benefit rearing juvenile salmonids and their safeguards to ensure the fields are safely and effectively used as salmonid rearing habitat. Rigorous monitoring efforts will also inform adaptive management decisions to maximize the ability of the

Project to meet these biological objectives, and ultimately the Project's goal. The Project will be implemented during two separate years of sufficient Sutter Bypass inundation to test, refine, and quantify benefits of the guidelines; however, given that the bypass does not flood every year, the Project encompasses 5 water years (2022-2026) to provide for up to 2 years of inundation and associated testing of the guidelines.

While the Project is short-term, the long-term goal for NRCS is to sufficiently advance the guidelines to allow for implementation of a program where growers could enroll under a Practice Specification to implement the guidelines that benefit salmonids rearing on rice fields in bypass floodplains and receive financial reimbursement. Implementation of a NRCS Practice Specification would require a separate ESA Section 7 consultation with NMFS.

### **1.3.2. Project Location**

CRC and UCD, in collaboration with NRCS, would implement the Project each inundation year on rice fields located in the Sutter Bypass, with a maximum annual acreage of approximately 1,000 acres. Two rice farms located in the Sutter Bypass, the Neader and Goose Club properties (Figure 1), have been identified through an outreach and prioritization process with growers to be the test locations for the 2022 flood season (January to March 1 2022).





**Figure 1.** Sutter Bypass action area (light blue shaded area), and 2022 Flood Season Project Locations (red polygons) (CRC 2021).

*Nader Property*

The Nader Property is located in the Sutter Bypass just downstream of the Highway 113 crossing and approximately 6.3 miles downstream of the Tisdale Weir channel and 5 miles upstream of the Feather River confluence with the bypass ( $38^{\circ} 57'06.50''$  N  $121^{\circ} 39'53.47''$  W; Figure 2). The Nader Property fields to be used in the 2022 flood season consist of two hydrologically isolated rice fields of 130 and 126 acres each and span the width of the bypass from the west to the east borrow canals. Each of the two Nader Property fields consists of five individual rice checks.

## Goose Club Property

The Goose Club Property is located in the Sutter Bypass approximately 1 mile downstream of the Feather River confluence with the bypass ( $38^{\circ} 52'33.26''$  N  $121^{\circ} 37'58.55''$  W; Figure 2). The Goose Club Property is approximately 110 acres and is located adjacent to the west borrow canal. The Goose Club property test site consists of one field with six asymmetrical, individual rice checks.



**Figure 2.** 2022 Project Site Locations (red polygons) (CRC 2021).

Because use of the Neader and Goose Club properties is not certain beyond the first year, nor is bypass flooding certain during the 2022 flood season, other rice farms in the Sutter Bypass may be utilized in subsequent years of the study. CRC, in collaboration with NRCS, proposes a similar outreach and prioritization process would occur to ensure potential rice farms utilized in future years are suitable. Suitability would consider multiple conditions, including mandatory field conditions and ranked field conditions, the latter to be used when choosing between locations that all meet the mandatory field conditions. NRCS has provided more information on those conditions in Section 3.2.3 of the BA (CRC 2021).

### 1.3.3. Project Components

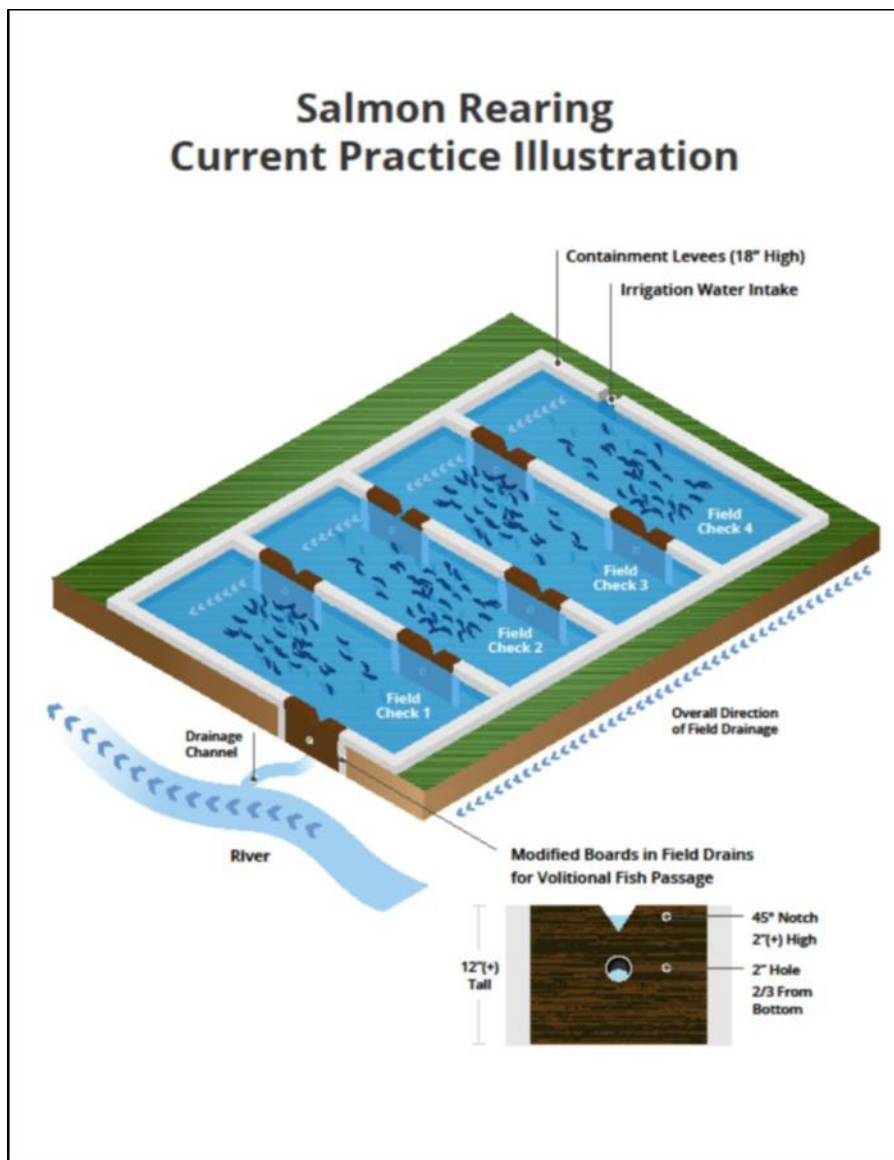
The Project involves habitat management actions associated with preparing and managing selected rice fields (i.e., study fields) to benefit rearing juvenile salmonids, inspections of field conditions, monitoring of juvenile salmonids and water quality parameters, adaptive management, and conservation measures. These components are further described in the following sections.

### **1.3.3.1. Habitat Management Actions**

In collaboration with CRC and UCD, some habitat management actions would be completed by the rice grower/manager (grower) in the study fields. These habitat management actions would require the grower to complete actions to prepare and manage the study fields. The first two management actions, preparing the study fields and pre-flooding, would be completed each year following harvest and prior to bypass inundation, while conditions in the fields are dry and no ESA-listed fish are present in the work areas. The remaining management actions, inspections and field draining, would be completed following bypass flooding.

#### **1.3.3.1.1. Prepare Study Fields for Inundation and Fish Utilization**

Prior to winter flood season, each grower would prepare their study field for inundation and fish utilization. Figure 3 shows the basic components of a study field, including berms, drain boxes, drainage conveyance, and modified boards. Because growers harvest on different schedules, the timing for completion of study field preparation could range from late September to early November, a time period when the fields are dry, and no ESA-listed fish are present in the work areas. More information on field preparation can be found in Section 3.5.1 of the BA (CRC 2021).



**Figure 3.** Diagram of a study field that is divided into four separate sections known as checks. Each of the dark brown sections in the white berms represent drain boxes with the modified boards installed that are designed for volitional fish passage. A close up of the modified board is provided in the lower right corner of the diagram. (CRC 2021).

### 1.3.3.1.2. Pre-flood Study Fields

Each grower would pre-flood their study field (no later than November 25), as a means to initiate fish food production in the study fields prior to bypass flooding. Study fields would be pre-flooded to a depth of 5-6 inches and unmodified boards would be used in the drain boxes to maintain flooding at that sustained depth until the first bypass inundation or until March 1, whichever comes first. Prior to pre-flooding the fields, UCD would install temperature and dissolved oxygen (DO) loggers in each check; however, data would not be downloaded until the bypass floods.



If the Sutter Bypass does not flood for the entire season, pre-flooding would allow for the production of fish food, and growers would release this high production pre-flooded water into the borrow canal on March 1, which would increase the food available for emigrating juvenile salmonids. Pre-flooding may not be possible for some fields in some years due to water supply limitations. If the Sutter Bypass does not flood prior to March 1 in any given year, there would be no volitional passage of natural-origin juvenile Chinook salmon into the fields and, thus, no testing, refinement, or quantification of benefits of the guidelines on natural-origin salmon would occur.

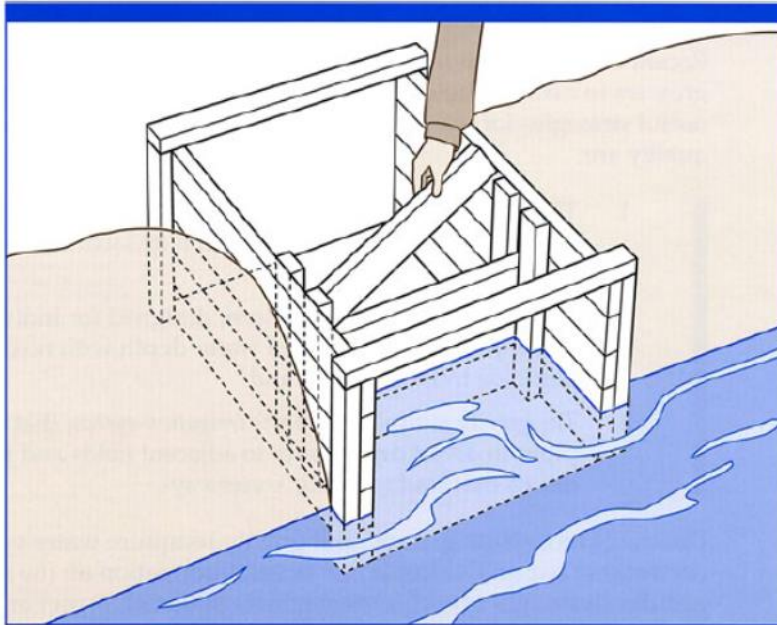
### **1.3.3.1.3. Containment Inspection Following Bypass Flooding**

Once the Sutter Bypass floods, high waters would be allowed to recede to within borders of all field berms (containment) prior to the initiation of daily inspections and biological and water quality monitoring. Bypass flooding is assumed to include the volitional passage of natural-origin juvenile salmon into the study fields. This assumption is based on research conducted in the Sutter Bypass that determined natural-origin juvenile Chinook salmon are entrained within rice fields following a bypass flood event (Cordoleani et al. 2019).

Once access to the study field is possible, typically a few days following containment, growers, in collaboration with UCD, would inspect the study field to ensure that conditions within the “contained” rice field are adequate for testing of the guidelines. The inspection following containment would be used to ensure: (1) berms are intact and of sufficient height, and (2) drainage boxes and drainage conveyances from the study field to the borrow ditch are free of debris and vegetation. If the post-containment inspection determines that water management of a study field is not possible without completing significant remedial actions (e.g., repair of berms and drainage conveyances), growers will drain the study field and no full season testing of the guidelines would occur in that field.

In addition, UCD would conduct post-containment visual survey inspections for entrained adult salmonids and Southern distinct population segment of North American green sturgeon (sDPS green sturgeon). If adult salmonids or sDPS green sturgeon are observed entrained in the study field, a fish rescue would be completed using guidance from the Fish Rescue Plan (Conservation Measure 12).

Following the inspection and confirmation that the study field is fully contained, and that water can be fully managed, growers would install a modified water flow control board (modified board, Figure 4) in each drain box. Although water flow control boards are commonly used in rice fields to manage water depths within the fields, under baseline conditions growers typically use solid wooden boards of various heights (typically 1-6 inches) to contain water. These unmodified boards are stacked vertically so that growers can control water elevation to a specific depth. Figure 4 shows a typical drain box with boards being inserted to raise the water surface elevation in the upstream check. During testing of the guidelines, a single 12-inch modified board would be used in lieu of regular boards.



**Figure 4.** Example of a drain box between checks in a rice field. The hand shows a person stacking boards on top of each other to control the elevation of water within the rice field under typical conditions (University of California Cooperative Extension 1991).

The modified board would be used to maintain a minimum required depth of 10 inches in the field to allow fish to volitionally egress individual rice checks and the study field. The modified board would include a 2-inch deep by 4-inch wide 45-degree notch (V-notch) at the top of each board and a 2-inch diameter hole positioned below the V-notch approximately 2/3 up from the bottom of the board (Figure 3). To remove sharp edges, the V-notch and 2-inch hole would be chamfered which will create a stream-line flow through each board and minimize potential injury to fish that may brush against the boards as they swim over or through them. All modified boards would be secured to ensure that they remain in place so as to not compromise fish passage.

Once containment is complete and modified boards are installed, the grower would utilize continuous maintenance flows to maintain the minimum depth of 10 inches in the study field until March 1 to ensure adequate passage. The source of maintenance flows would originate from each grower's typical winter water source, which are sourced from direct diversions from the borrow canal or from groundwater pumping. If for any reason, maintenance flows cannot be provided, all testing of the guidelines would be terminated, growers, in collaboration with UCD, would pull the boards, and the study field would drain completely.

#### **1.3.3.1.4. Daily Inspections of the Study Field**

Following containment, UCD will conduct visual inspection of each study field daily. Inspections will include visual checks of all berms, drain boxes, and drainage channels to ensure that berms remain intact and that drain boxes, including the modified board, and drainage conveyance are clear of debris and vegetation.

In addition, surveys for adult salmonids and sDPS green sturgeon would be completed during the daily inspections. If adult salmonids or sDPS green sturgeon are observed in the study field or drainage conveyance during daily inspections, UCD will conduct fish rescues using guidance from the Fish Rescue Plan.

UCD will document results from daily inspections (e.g., blockages, quantities of debris, berm erosion) using data sheets such that trends can be monitored over time. All data collected during daily inspections, including information on entrained adult salmonids and sDPS green sturgeon, would be summarized and sent to NMFS on a weekly basis for review.

If conditions such as berm failures or boards and drainage conveyances clogged with debris are noted during daily inspections, immediate action would be taken to remedy the condition or to terminate all testing of the guidelines and initiate field draining, as further described in Section 3.6 of the BA (CRC 2021). If boards or water conveyances are clogged with floating debris, a simple hand cleaning of debris could be completed by UCD to remedy the problem. If the remedial action requires heavy equipment use where ESA-listed fish could be impacted (i.e., berm failure), the action would not be completed, and all testing of the guidelines would be terminated, and the study field allowed to drain. The one exception to terminating testing and draining the study field is if heavy equipment is needed to clear the terminal drain box or drainage conveyances or repair these areas to ensure adequate fish passage. In these cases, because fish must be allowed to volitionally move off the field, growers would use heavy equipment to complete the remedial action and testing of the guidelines would continue.

#### **1.3.3.1.5. Draining the Study Field**

On March 1, or earlier if habitat conditions degrade, growers would stop any potential inflow and UCD would pull all modified boards to allow the study field to completely drain. Modified boards would be removed by a minimum of 2 personnel, including a qualified biologist, starting with the terminal drain and then moving upstream through each check. Based on previous experiments on the Knaggs Property in Yolo Bypass (Holmes et al. 2021), removing all modified boards (from an 80-acre field) is assumed to take approximately 1 hour to complete. Once all boards are removed, the field would naturally drain starting with the most upstream check to the downstream check. Based on these same previous experiments where an 80-acre field took approximately three days to drain, it is estimated that field drainage would take approximately three to five days. If floodwaters are not back into field containment condition on March 1, the field would be drained immediately upon reasonably feasible field access, which may require ATV travel.

UCD would monitor for stranded fish throughout the field draining process, with a minimum of at least 2 field personnel, including 1 qualified biologist, conducting stranding surveys. Any stranded fish observed would be captured and relocated under guidance of the Fish Rescue Plan.

### **1.3.4. Proposed Monitoring**

#### **1.3.4.1. Water Quality Monitoring**

Prior to pre-flooding of study fields and bypass inundation, an array of temperature and DO loggers would be placed by UCD within the fields. A minimum of two temperature-DO loggers would be installed in each check approximately 10 meters (32.8 feet) from the inlet and outlet structures and in the center of each check. Rebar would be pounded into the sediment, and loggers affixed mid-water column to measure ambient water quality conditions. Temperature and DO data would be logged on a 15-minute time-step. During pre-flood conditions water temperature and DO would be monitored by UCD, but data would not be downloaded until the bypass floods and fields are contained or, if the bypass does not flood, upon discharge of the water on March 1.

Following bypass flooding, UCD would download all temperature-DO data weekly at the outset of flooding and bi-weekly at a pre-selected sentinel check during the month of February to monitor for problematic conditions. For the purposes of this Project, problematic conditions (i.e., thresholds) for juvenile Chinook salmon are defined as temperatures  $>20$  degrees ( $^{\circ}$ ) Celsius (C) and DO levels  $<2.0$  mg/L (daily maximum or minimum, respectively). Should either temperature or DO conditions become problematic for a period  $>3$  days, putatively indicated by consecutive download of weekly and bi-weekly (for the month of February) data exceeding thresholds, UCD, would immediately initiate drainage of the study field.

If temperatures  $>20^{\circ}\text{C}$  or DO levels  $<2.0$  mg/L occur within the last two days of a data download, then another download would occur one to two days following the previous download. After a water quality data download is completed, a review of the data would be initiated on the same day to determine if problematic conditions continue to occur. If data show that thresholds for water temperature or DO have been exceeded for a third consecutive day, UCD would immediately drain the study field.

While these are the defined thresholds for the purposes of this Project, UCD, in collaboration with NMFS, would develop an adaptive management approach, including convening a technical team, to closely monitor water quality conditions on study fields should conditions occur that could result in approaching the proposed water temperature and DO thresholds. This approach would help inform the safeguards necessary to ensure the fields are safely and effectively used as salmonid rearing habitat while testing the guidelines of the Project.

#### **1.3.4.2. Fisheries Monitoring**

Following bypass flooding and containment of the study fields, UCD would monitor natural-origin fish assemblages using seines, fyke nets, and live-car traps. Data from seine, fyke, and live-car trap sampling would be used to calculate population estimates of natural-origin fish and mortality estimates of juvenile Chinook salmon in each check using a modified version of the Lincoln-Petersen method. Live-car traps and tracking of marked hatchery-origin juvenile fall-run Chinook salmon would be used to monitor the movement of juvenile Chinook salmon in the study fields.



#### **1.3.4.2.1. Seine Surveys**

Following bypass flooding and containment of the study fields, natural fish assemblages, including natural-origin juvenile Chinook salmon, would be monitored by UCD using up to three weekly surveys with seines. Seining would occur in accessible habitats within the study fields. Seines would be 1/4-inch knotless mesh 4-5 feet tall by 30-50 feet long with lead-weighted bottom lines and floats on top lines, and a bag for collecting fish. All captured juvenile fish would be immediately placed into clean 5-gallon holding buckets containing fresh water from the location of the seining event, with larger predators kept in separate buckets to avoid predation on salmonids and other smaller fish. Buckets would be kept in the shade as much as possible, and aerators would be placed in buckets. For Chinook salmon, genetic tissue (i.e., caudal fin clip) would be collected prior to release for genetic run identification. All Chinook salmon captured would be counted and measured, and tissue would be collected prior to release for genetic run identification. All other fish species would be counted, measured, and released back into the study field.

#### **1.3.4.2.2. Fyke Netting**

In addition to seining, UCD would also monitor natural fish assemblages, including natural-origin juvenile Chinook salmon, using fyke nets following bypass flooding and containment of the study fields. A 3- by 4-foot opening, one quarter inch knotless nylon mesh fyke net containing 4 galvanized hoops and one throat would be fished overnight up to three times per week within flooded rice fields. The fyke nets will be monitored every morning after soaking overnight. Water depths would not be greater than 4 feet and water velocity would be less than 0.2 m/s. The final chamber of the fyke functions as a live box where all of the fish will be collected. Upon next day collection, all captured juvenile fish would be placed into clean 5-gallon holding buckets containing fresh water from the location of fyke net, with larger predators kept in separate buckets to avoid predation on salmonids and other smaller fish. Buckets would be kept in the shade as much as possible, and aerators would be placed in buckets. All Chinook salmon captured would be counted, measured, and tissue (i.e., caudal fin clip) would be collected prior to release for genetic run identification. All other fish species would be counted, measured, and released back into the study field.

#### **1.3.4.2.3. Live-car Trap Sampling**

Following containment, UCD would place live-car traps at the terminal drain outlet of each field and in each drain box, located between rice checks to monitor fish emigration between checks and out of the field and into the borrow canal. Live-cars would be removable from the live trap frame so that fish would be collected only when the live-cars are in place. Live-car traps would consist of an approximately 3-foot by 3-foot by 5-foot PVC frame with a 3/16-inch extruded plastic mesh on the outside of the box. A lid would be placed on the top of each live box to deter avian and mammal predation. Within the live box would be another, smaller box (2 feet by 2 feet by 2 feet) constructed of 1-inch mesh. This interior box would serve as a refuge for juvenile salmonids in case predatory fish are in the live-car, which is unlikely during modified board operations due to the small size of the holes, but is possible when fish are being monitored after modified boards are pulled during the draining phase. Live-car traps would be sampled daily, and all captured fish would be counted, measured and released downstream of the trap.

Any winter-run, spring-run, and late-fall-run Chinook salmon, as determined by length-at-date criteria, would be measured, weighed, genetic sample collected, and released back into the study field or drainage canal, depending on where it was captured. In addition to a genetic sample being collected, all captured length-at-date fall-run Chinook salmon would also receive a unique mark for their check, which may include a second fin clip, or a passive integrated transponder (PIT) tag to allow for tracking and monitoring while these fish are in the study field.

#### **1.3.4.2.4. Tracking Juvenile Fall-run Chinook Salmon in the Study Fields**

Hatchery-origin juvenile fall-run Chinook salmon would be PIT tagged by UCD and released into the study fields to track fish movement. A PIT tag receiver would be installed and operated on the top of each drain box to track their movement between checks. A PIT tag receiver would also be placed on the terminal box and additional PIT tag antennas would be placed along the gravity-fed conveyance canal that connects study fields to the river or bypass drainage system. The antennae are shaped like a windowpane, slides directly into the rice box, and in previous work was effective at detecting PIT-tagged salmon emigrating rice fields. Operation of this PIT tag array would allow quantification of the egress of juvenile fall-run Chinook salmon tagged and released in the study fields and out through the box infrastructure, in addition to the successful passage of fish through the drainage canal system into the borrow canal.

#### **1.3.4.2.5. Aquatic Predator Studies**

Tethering trials using hatchery-origin, fall-run Chinook salmon would be conducted by UCD to understand relative predation risk posed to salmon by other fish. Tethering involves restraining hatchery-origin juvenile fall-run Chinook salmon in a particular location for a period of time to measure their rate of predation as an indication of natural predation pressure. Trials would be conducted using standard methods outlined for salmonids in California (e.g., Rypel et al. 2007, Michel et al. 2020) in the study fields over both day and night periods to understand diel patterns in relative predation risk. Statistical differences between habitats and time periods would be analyzed using Cox proportional hazards models or logistic regression depending on data structure (Cox 1972).

In addition, as mentioned above under “Fyke Netting”, traps will be installed within study fields up to three times a week to measure natural fish assemblages, which would also include the identification and enumeration of any predatory fish captured. UCD would use this information to estimate predator abundance on study fields.

#### **1.3.4.2.6. Trail Camera Surveys for Avian Predators**

Trail cameras that include motion detection and infrared would be installed by UCD in the corners of each field to track visitation rates of wading avian predators (e.g., egrets, herons, and pelicans). Trail cameras would also be installed in the drainage conveyance by UCD to examine whether avian predators are using these habitats. Photographs from each trail camera would be reviewed to determine the relative level of avian predator visitation rates in each study field.

### 1.3.5. Conservation Measures

NRCS has incorporated conservation measures (CM) into the Project to reduce the potential for effects to ESA-listed fish or critical habitats. These CMs would help mitigate potential environmental effects during implementation of the Project. A summary of CMs are provided in Table 1 below. More information associated with each CM are located in Section 3.7.2 of the BA (CRC 2021).

**Table 1.** Summary of Project Conservation Measures

<b>Number</b>	<b>Title</b>	<b>Summary</b>
CM 1	Project Activity Timing	Proposed Project activities would be timed to avoid or minimize effects to ESA-listed fish.
CM 2	Growers, Monitors, and other Personnel Training	Growers, monitors, and other Project personnel would undergo training and education on applicable environmental rules and regulations and measures necessary to avoid or minimize effects to ESA-listed fish.
CM 3	Complete any Necessary Field Modifications prior to Bypass Inundation	Prior to bypass inundation, rice fields would be inspected and modified, as needed, to reduce potential for fish stranding and ensure volitional passage during field draining.
CM 4	Initial Field Inspection following Containment.	Following containment, an initial inspection of the study field would be completed to ensure that water management can be conducted. All water conveyance routes would be inspected to ensure they are free of debris and vegetation.
CM 5	Daily Field Inspections following Installation of the Modified Board.	Following installation of the modified boards, daily field inspections of the berms, drain boxes, modified boards, and water conveyance routes would be completed. Inspections and remedial actions, if necessary, would be used to ensure that all water conveyance routes are free of debris and vegetation
CM 6	Daily Surveys for Stranded or Entrained Adult Chinook Salmon, sDPS Green Sturgeon, and Steelhead	As part of the daily field inspections, surveys for stranded or entrained adult Chinook salmon, sDPS green sturgeon and steelhead would be conducted in the study field and water conveyance routes. If adult Chinook salmon, sDPS green sturgeon, or steelhead are located within the field or water conveyance, the fish would immediately be rescued and placed into the nearest borrow canal, per the Fish Rescue Plan (see CM 12 for the Fish Rescue Plan).
CM 7	Stranding Surveys during Draining of Fields	During field draining, study fields and water conveyances would be continuously surveyed for ponded water. If ponded water is found, a visual reconnaissance would be completed to determine if fish are stranded. If any fish are stranded during field draining, fish rescues would be completed to capture and move the fish to the borrow canal (see CM 12 for the Fish Rescue Plan).

Number	Title	Summary
CM 8	Water Temperature Monitoring	Temperature loggers that record on a continuous 15-minute time-step would be installed prior to flooding in each check approximately 10 meters (32.8 feet) from the inlet and outlet structure and in the center of each check. If water temperatures >20°C (daily maximum) are recorded for a period greater than three days during containment, the field would be drained, and testing of the guidelines would conclude.
CM 9	Dissolved Oxygen Monitoring	Dissolved oxygen loggers that record on a continuous 15-minute time-step would be installed prior to flooding in each check approximately 10 meters (32.8 feet) from the inlet and outlet structures and in the center of each check. If dissolved oxygen levels <2.0 mg/L (daily minimum) for a period greater than three days during containment, the field would be drained, and testing of the guidelines would conclude.
CM 10	Best Management Practices (BMPs)	BMPs (i.e., Waste Management and Spill Prevention and Response, Erosion and Sedimentation Control, Good Housekeeping and Non-Storm Water Discharge Management, Inspection and Monitoring) would be implemented during operations and maintenance to avoid or minimize impacts to water quality, aquatic habitat, and listed species.
CM 11	Hazards Materials Safety	Standard spill prevention, containment, and response measures would be implemented to address potential hazardous materials releases during implementation of the Proposed Project. Measures would be implemented to ensure all materials placed into the Sutter Bypass are non-toxic.
CM 12	Prepare a Fish Rescue Plan	Prior to installation of the modified boards, UCD would prepare a Fish Rescue Plan for review and approval by NMFS. The Fish Rescue Plan would include measures for fish rescue and salvage, and all necessary minimization measures to reduce potential effects to ESA-listed fish.

### 1.3.6. Adaptive Management

NRCS, in collaboration with CRC and UCD, would utilize adaptive management during implementation of the Project to: (1) ensure potential impacts to ESA-listed fish are minimized while testing the draft technical guidelines, and (2) allow for modification of the guidelines if relevant data arise during implementation that suggest previously documented benefits of the guidelines are not being realized during testing of the guidelines in the Sutter Bypass. Information on specific actions associated with adaptive management are located in Table 2 and Table 3 of the BA (CRC 2021). In addition, NRCS, CRC, and UCD will convene meetings with NMFS on a regular basis during Project implementation to provide updates on daily site inspections (e.g., debris removal), fisheries monitoring activities (e.g., fish presence and habitat utilization), and status of site conditions (e.g., water quality and predation). Establishing frequent communication while testing the guidelines in a dynamic flood controlled system will improve response time if adaptive management measures are taken (CRC 2021).

## **2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT**

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

### **2.1. Analytical Approach**

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

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

The designation(s) of critical habitat for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon use the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a “destruction or adverse modification” analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.

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

## **2.2. Rangewide Status of the Species and Critical Habitat**

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

**Table 2.** Description of species, current Endangered Species Act (ESA) listing classifications (and recovery plans), and summary of species status.

Species	Listing Classification, Federal Register Notice, and Recovery Plans	Status Summary
Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit	Endangered, 70 FR 37160; June 28, 2005 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead (NMFS 2014)	According to the NMFS 5-year species status review (NMFS 2016c), the status of the winter-run Chinook salmon ESU, the extinction risk increased from moderate risk to high risk of extinction since the 2007 and 2010 assessments. Based on the Lindley et al. (2007) criteria, the population was at high extinction risk in 2019. High extinction risk for the population was triggered by the hatchery influence criterion, with a mean of 66% hatchery-origin spawners from 2016 through 2018. Several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and increased hatchery influence. Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability.
Central Valley (CV) spring-run Chinook salmon ESU	Threatened, 70 FR 37160; June 28, 2005 Recovery Plan (NMFS 2014)	According to the NMFS 5-year species status review (NMFS 2016c), the status of the CV spring-run Chinook salmon ESU, until 2015, has improved since the 2010, 5-year species status review, but is still likely to become endangered. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear creeks) trending in the positive direction. However, more recent declines of many of the dependent and independent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Escapement data show a continued overall decline in adult returns from 2014 through 2020 (CDFW 2021).

Species	Listing Classification, Federal Register Notice, and Recovery Plans	Status Summary
California Central Valley (CCV) steelhead Distinct Population Segment (DPS)	Threatened, 71 FR 834; January 5, 2006 Recovery Plan (NMFS 2014)	<p>According to the NMFS 5-year species status review (NMFS 2016c), the status of steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was in danger of extinction. Most natural-origin populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of steelhead has likely been impacted by low population sizes and high numbers of hatchery-origin fish relative to natural-origin fish.</p> <p>Most natural-origin CCV steelhead populations in the Central Valley tributaries are very small, are not well monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change.</p> <p>Run size data from Battle Creek, which is the best population-level data available for steelhead, suggested a 17% decline per year from 2000–2010 (Williams et al. 2016). The USFWS’ Chipps Island midwater trawl dataset indicates that the natural production of steelhead continues to decline, and the majority of steelhead caught are hatchery steelhead (USFWS 2020a). Overall, natural spawning populations of steelhead within the Sacramento tributaries have fluctuated, but show a steady decline over the last decade.</p>
Southern Distinct Population Segment (sDPS) of North American Green Sturgeon	Threatened, 71 FR 17757; April 7, 2006 Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon ( <i>Acipenser medirostris</i> ) (NMFS 2018)	<p>According to the NMFS (2021) 5-year status review and the 2018 final recovery plan (NMFS 2018), some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers, but the species viability continues to be constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The species continues to face a moderate risk of extinction. A recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so species can be evaluated relative to recovery criteria (Mora et al. 2018).</p>



**Table 3.** Description of critical habitat, Listing, and Status Summary.

<b>Critical Habitat</b>	<b>Designation Date and Federal Register Notice</b>	<b>Description</b>
Central Valley spring-run Chinook salmon ESU	September 2, 2005; 70 FR 52488	<p>Critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water mark. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bank full elevation.</p> <p>PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas.</p> <p>Although the current conditions of PBFs for CV spring-run Chinook salmon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.</p>
California Central Valley (CCV) steelhead DPS	September 2, 2005; 70 FR 52488	<p>Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bank full elevation.</p> <p>PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas.</p> <p>Although the current conditions of PBFs for steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.</p>

Critical Habitat	Designation Date and Federal Register Notice	Description
Southern Distinct Population Segment (sDPS) of North American Green Sturgeon	October 9, 2009, 74 FR 52300	<p>Critical habitat includes the stream channels and waterways in the Delta to the ordinary high-water line. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are also included as critical habitat for sDPS green sturgeon.</p> <p>Physical and biological features considered essential to the conservation of the species for freshwater and estuarine habitats include: food resources, substrate type or size, water flow, water quality, migration corridor; water depth, sediment quality.</p> <p>Although the current conditions of PBFs for sDPS green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.</p>

## Current Limiting Factors

The following are current limiting factors for the listed species included in this consultation:

- Major dams blocking access to historical spawning habitat
- Water management/Diversions
- Loss of floodplain rearing habitat from levees and hard bank protection
- Low-flow barriers to passage
- Urbanization and rural development
- Logging
- Grazing
- Agriculture
- Mining – historic hydraulic mining from the California Gold Rush era
- Estuarine modified and degraded (reducing developmental opportunities for juvenile salmonids)
- Predation from non-native species
- Dredging and sediment disposal
- Contaminants
- Fishery related effects
- Hatcheries related effects
- “Natural” factors (e.g. ocean conditions)
- Climate change exacerbating flow and water temperature related impacts

### 2.2.1. Global Climate Change

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Projected warming is expected to affect Central Valley Chinook salmon. Climate change could also result in reduced quantity and quality of freshwater habitat for Central Valley salmonids (Lindley et al. 2007). Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006).

For winter-run Chinook salmon, the embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, so this run is particularly at risk from climate warming. Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2012). Spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Although steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley,

summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F).

Adult sDPS green sturgeon have been observed as far upstream as the Anderson-Cottonwood Irrigation Dam (ACID), which is considered the upriver extent of sDPS green sturgeon passage in the Sacramento River (Heublein et al. 2009). sDPS green sturgeon spawning, however, occurs approximately 30 kilometers (18.6 miles) downriver of ACID where water temperature is higher than at ACID during late spring and summer. If water temperatures increase with climate change, temperatures at spawning locations below ACID may be above tolerable levels for the embryonic and larval life stages of sDPS green sturgeon.

In summary, observed and predicted climate change effects are generally detrimental to the species (NMFS 2011b, Wade et al. 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure et al. 2013).

### **2.3. Action Area**

“Action area” means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area encompasses the entirety of the Sutter Bypass (approximately 15,500 acres), including the ricelands (i.e., large acreages of rice fields), field-specific canals and ditches, and the east and west borrow ditches, from the Butte Sink in the north to the confluence of the Sutter Bypass with the Feather and Sacramento rivers near Verona in the south (Figure 1).

### **2.4. Environmental Baseline**

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

The Project would be located in the Sutter Bypass within California’s Central Valley, which is characterized by a semi-arid Mediterranean climate. Summers are hot and dry, while winters are cool and moist.

Sutter Bypass is part of the Sacramento Flood Control Project that was developed in the early 1900s to divert excessive wintertime flood flows from the Sacramento River through a system of weirs and flood relief structures into a series of leveed flood bypasses. The specific purpose of

the Sacramento Flood Control Project, including the Sutter Bypass, is to help reduce the risk of flooding to communities and agricultural lands in the Sacramento Valley and Sacramento-San Joaquin Delta.

Butte Creek and the Sutter Bypass flows are heavily utilized for agriculture and waterfowl habitat. The Sutter Bypass has several weirs that are used to increase the water height to flood duck hunting land, agricultural fields, or increase flows for water diversions. While there has been a large push by CDFW for screening all diversions within the Sutter Bypass, many remain unscreened and present hazards for juvenile fish rearing and emigrating through.

Sutter Bypass is the uppermost flood bypass within the Sacramento Flood Control Project. It is 51 km (31.6 miles) long and has a surface area of approximately 15,500 acres. Sutter Bypass conveys flood waters from Butte Basin, the Feather River, and the Sacramento River via the Tisdale Bypass, Colusa Weir, and Moulton Weir, each of which is a concrete structure that passes floodwaters by gravity once the Sacramento River reaches the elevation at which flow overtops the weir. The Moulton and Colusa weirs are overtopped when Sacramento River flows exceed 60,000 and 30,000 cubic feet per second (cfs), respectively (Reclamation 2017). The Tisdale Weir is overtopped when Sacramento River flows exceed 23,000 cfs (Reclamation 2017).

Historically, Butte Creek entered the Sacramento River near Colusa at what is now Butte Slough Outfall Gates. Butte Creek now mainly flows to the south through the Sutter Bypass, and the Outfall Gates are only used to maintain water flows at predetermined levels seasonally. When flows in the Sacramento River are high, water flows over the Tisdale weir and into the Sutter Bypass. Moulton and Colusa weirs can overtop from higher in the Sacramento River and into areas higher in the Butte Creek system. When this occurs, fish from the Sacramento River may enter the Sutter Bypass and East Borrow Ditch. The west borrow canal conveys most of the flow, but the east borrow canal remains perennially inundated (Feyrer et al. 2006). The east and west borrow canals are bordered by levees and everything outside of the levees is referred to as the dry side while everything, including the borrow canals, contained within the levees is referred to as the wet side of the Sutter Bypass. However, the east and west borrow canals are heavily impacted by invasive aquatic vegetation which impacts fish passage, nutrient cycling, and water quality (Floodplain Forward 2021), and because they are inundated year-round, likely contain resident predatory fish. The east and west borrow canals can include both adults and juveniles of any of the 4 listed fish species present in the Sutter Bypass. Butte Creek is a natal spawning area for both CV spring-run Chinook salmon and CCV steelhead.

The Sutter Bypass is used as rearing habitat and a migratory corridor for anadromous fish when it is flooded. After floodwaters recede, water temperatures begin to increase and non-native vegetation begins to overgrow. In recent years, this has caused noticeable decreases in oxygen levels and overall water quality, which can reduce the quality of habitat and lead to mortality of fish. An important feature of the Sutter Bypass is the multiple migration pathways through the Sutter Bypass that are available to anadromous fish species.

### **2.4.1. Rice Farming in the Sutter Bypass**

The Project would occur in working rice fields in between growing seasons. Because rice production requires the ability to control and pond water, soils such as clay that have low infiltration rates are necessary to prevent excessive water use. Sutter Bypass soils are made up of Capay Silty Clay and Oswald Clay, which provides ideal rice farming lands. Water availability from the east and west borrow canals and natural flooding provides the water necessary to sustain rice growing within the Sutter Bypass in most years. However, in dry years, some rice growers rely on groundwater as a water source.

Historically, rice fields were burned after the rice was harvested. Beginning in the 1990s, California enacted regulations restricting post-harvest rice stubble burning. This resulted in an increase in winter-flooding of agricultural fields to aid in stubble decomposition. Most Sacramento Valley rice growers flood their fields over winter months (November to March) to facilitate degradation of post-harvest rice stubble (Aghaee and Godfrey 2017). Approximately 300,000 acres of rice fields are intentionally flooded in California each year after fall harvest (Jeffres et al. 2017).

On fields that are intentionally flooded, growers will commonly install water control boards into a number of drain boxes to manage water depths and flows within each check. Growers will typically use solid wooden boards of various heights (typically 1-6 inches) to back up water. These unmodified boards are stacked vertically in each drain box (see Figure 4 above) so that growers can control water elevation to a specific depth, including in some cases to provide shallow flooded waterfowl habitat on their fields for the duration of the winter season.

The timing of rice field drainage in the Sutter Bypass is dependent on flooding events. Although it is optimal for the growers to drain bypass fields by mid-March, to allow for drying and preparation of fields for the next growing season, field drainage can occur from February to late March, or even later in a wet year where the bypass is inundated. Because the timing of draining of rice fields in the Sutter Bypass is variable, and dependent on precipitation cycles in any given year, the baseline condition of these rice fields is also variable. Drainage occurs when farmers remove the boards from all drain boxes and water is allowed to flow to the terminal drain outlet and into a borrow canal.

As conditions permit, seed-bed preparation begins in late March and is completed by mid-April. Fields are typically re-flooded and seeded from April 20 to May 25. Prior to flooding and planting, a corrugated roller is used to ensure a uniform surface across the rice field so that there are no high or low spots in the field. May through October is typically the period of active rice growth and harvest occurs in the fall.

### **2.4.2. Status of the Species in the Action Area**

#### *Presence of Sacramento River Winter-run Chinook Salmon*

Juvenile winter-run Chinook salmon migrate downstream from August through March, and are only likely to enter Sutter Bypass when flows in the Sacramento River exceed approximately 22,000 cfs. When flows exceed this amount, water is diverted into the lower Butte Sink and

Sutter Bypass via overflows from the Tisdale, Colusa, and Moulton weirs (Reclamation 2018). During these flows, the Sutter Bypass can function as a migratory corridor for juvenile winter-run Chinook salmon (Reclamation 2018), though historical CDFW data report they have never been found there in high numbers. The number cannot be accurately determined, as it is dependent on timing of weir overtopping, which generally coincides with a cease in juvenile trapping operations due to high debris flows.

#### *Presence of Central Valley Spring-run Chinook Salmon*

With the rerouting of Butte Creek, adult CV spring-run Chinook salmon typically enter the East Canal near Verona and travel upstream to Butte Creek through the Sutter Bypass (including the East Borrow Ditch) to get into Butte Creek. Similarly, juvenile CV spring-run Chinook salmon migrating downstream must travel downstream through the Sutter Bypass and East Canal or Butte Slough Outfall Gates to get to the Sacramento River.

Butte Creek CV spring-run Chinook salmon juveniles migrate downstream primarily from December through February, entering the Sacramento River after passing through the Sutter Bypass (some enter the Sacramento River via Butte Slough Outfall Gates). Life history investigations have shown that many juveniles entering the Sutter Bypass remain there for several weeks. The average passage time from January through April for fish that were marked just below the spawning grounds and recaptured in the Sutter Bypass near its confluence with the Sacramento River was 46 days during the 2003-2004 season (Reclamation 2018). This indicates the value of the Sutter Bypass as a nursery for CV spring-run Chinook salmon.

#### *Presence of California Central Valley steelhead*

CCV steelhead use the action area as rearing habitat and as a migration corridor to and from spawning grounds in Butte Creek and other tributaries. They are present within the Butte Creek (and therefore potentially Sutter Bypass) system year-round, either as juveniles rearing or out-migrating, or as adults migrating upstream or downstream. Although there are only limited observations, steelhead are thought to ascend Butte Creek in the late-fall and winter where they proceed to spawn in both the mainstem and tributaries (Reclamation 2018). There is very little information regarding the numbers of steelhead in Butte Creek. Estimating production of steelhead in Butte Creek is complicated because of its hydrologic connections with the Sacramento River. Adult steelhead have been captured in Butte Creek during CDFW trapping efforts for juvenile spring-run Chinook salmon, and the Sutter Bypass is known to be used as rearing habitat by juveniles. As with CV spring-run Chinook salmon, the action area is also used as a migratory corridor for adult CCV steelhead, and for rearing and migration by juvenile CCV steelhead.

#### *Presence of sDPS Green Sturgeon*

Adult and juvenile sDPS green sturgeon may enter the action area during high flow events, though no observations of sDPS green sturgeon have been documented in the action area. Due to the many weirs and fish ladders present in the Sutter Bypass, they are unlikely to be able to make it further upstream from Verona. They may come from the Tisdale Bypass during an

overtopping event or one of the other weirs (Moulton or Colusa) during high flow events. Sturgeon have been documented and rescued from within the Tisdale bypass after high flow events once flows have receded. While sDPS green sturgeon are not expected to be encountered within the action area, it is possible.

### **2.4.3. Status of Critical Habitat within the Action Area**

Critical habitat for winter-run Chinook salmon does not occur within the Sutter Bypass.

All of the waters in the action area are designated critical habitat for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

The PBFs of critical habitat within the action area essential to the conservation of CV spring-run Chinook salmon and CCV steelhead freshwater rearing and freshwater migration corridors. These PBFs include sufficient water quantity and floodplain connectivity to form and maintain physical habitat conditions necessary for salmonid development and mobility, sufficient water quality, food and nutrients sources, natural cover and shelter, migration routes free from obstructions, no excessive predation, adequate forage, holding areas for juveniles and adults, and shallow water areas and wetlands. Habitat within the action area is primarily used for freshwater rearing by CV spring-run Chinook salmon and CCV steelhead juveniles and smolts, and migration by juveniles and adults. The PBFs of critical habitat within the action area essential to the conservation of sDPS green sturgeon include food resources, substrate type or size, water flow, water quality, migration corridors free of passage impediments, and sediment quality. NMFS recognizes that when inundated with Sacramento River flood flows, Sutter Bypass (action area) provides potential rearing habitat for juvenile sDPS green sturgeon.

The substantial degradation of critical habitat over time has diminished the function and condition of the freshwater rearing PBFs for salmonids and sDPS green sturgeon and freshwater migration corridor PBFs for salmonids in the action area. Sutter Bypass (action area) now only has rudimentary functions compared to its historical status. Even though the habitat has been substantially altered and its quality diminished through years of human actions, its value remains high for the conservation of CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. This section describes all factors that have resulted in the current state of critical habitats in the action area, particularly focusing on factors most relevant to the Project.

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs in the Sacramento River and also water impoundments and diversions within the Sutter Bypass, affecting listed salmonids and sDPS green sturgeon in the action area. Overall, water management now reduces natural variability by creating a highly managed system that is incredibly influenced by water diversions used for agriculture, among other purposes. Current agricultural practices require the release of retained waters over the winter in the February to March timeframe, and then fields are typically re-flooded and seeded from April 20 to May 25. The secondary flooding within the Sutter Bypass has caused issues in the past, including completely stopping flows within fish ladders and causing mortality events such as the one that occurred at Weir 1 in 2021 (Kilgour 2021).



High water temperatures can also limit habitat availability for listed salmonids in the Sutter Bypass. High summer water temperatures can exceed 72°F (22.2°C) and create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson et al. 1982). In addition, water diversions for agriculture have reduced in-stream flows to levels where the borrow canals become intermittent and lose flow entirely. These reduced flows frequently result in increased temperatures during the critical summer months, which potentially limit the survival of migrating/spawning adults and juvenile salmonids (Reynolds et al. 1993). The elevated water temperatures compel many salmon juveniles to migrate out quickly and forgo adequate rearing time before summer heat creates temperatures unsuitable for salmonids. Those fish that remain either succumb to the elevated water temperatures or are crowded into river reaches with suitable environmental conditions.

Point and nonpoint sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within, the action area. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (Klimley 2002). Organic contaminants from agricultural discharge, urban and agricultural runoff from storm events, and high heavy metals concentrations may deleteriously affect early life-stage survival of fish in the Sacramento River (USFWS 1995). Principal sources of organic contamination in the Sacramento River are rice field discharges from Butte Slough, Reclamation District 108, Colusa Basin Drain, Sacramento Slough, and Jack Slough (USFWS 1995), as Butte Slough discharges water just north of the Sutter Bypass, it is safe to assume that the organic contamination from agricultural discharge is also present within the action area. Other impacts to adult migration present in the action area include migration barriers, water conveyance factors, and water quality.

#### **2.4.4. Importance of Action Area for Recovery of the Species**

The action area (Sutter Bypass) is a seasonal floodplain rearing and migratory corridor for all juvenile populations of Sacramento basin listed salmonids, and could provide rearing habitat for juvenile sDPS green sturgeon. These habitats are important in smolt growth and survival. Smolt size at ocean entry strongly affects survival during the first year at sea (Williams 2006). The NMFS Recovery Plan (NMFS 2014) identifies management targets for Sutter Bypass, which should include inundation timing, frequency, magnitude, and duration that will maximize the growth and survival of juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead (Recovery Action SAR 1.13); and that the bypass should then be managed to those targets. Local organizations with the support of State and Federal agencies are currently in the process of planning floodplain restoration projects in the bypass, but there are no existing actions currently in place.

The action area is also a migratory corridor for CV spring-run Chinook salmon and CCV steelhead on their upstream migration to Butte Creek spawning grounds. Butte Creek is identified in the NMFS Recovery Plan (NMFS 2014) as having the potential to support a viable population of spring-run Chinook salmon (Core 1 population), and of secondary importance to CCV steelhead (Core 2 population). The Recovery Plan includes the following action (Recovery Action SAR 1.12) for adult salmonids migrating upstream to Butte Creek through the action area: “In an adaptive management context, implement short- and long-term solutions to

minimize the loss of adult Chinook salmon and steelhead in the Sutter-Butte basins”. Existing short-term solutions include monitoring the Sutter-Butte basins during winter and spring for adult salmon presence, and conducting fish rescues as necessary. In the long-term, various effects are in the planning stage to provide and/or improve fish passage through the Sutter Bypass, allowing for improved adult salmonid migration to spawning grounds in Butte Creek or re-entry into the Sacramento River.

The Green Sturgeon Recovery Plan (NMFS 2018) states that the effects of habitat restoration (e.g., channel reconnection and floodplain connectivity) on sDPS green sturgeon recruitment and growth are a research priority (2a), and that beneficial characteristics of tidal wetland and floodplain restoration projects (e.g., forage, depth, flow, turbidity) should be identified to guide future projects. The Project will collect data on temperature, flow, and fish presence in the action area, which will provide information on how it impacts individuals, and ultimately, the sDPS of green sturgeon.

## **2.5. Effects of the Action**

Under the ESA, “effects of the action” are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

NMFS has identified the following potential effects to ESA-listed anadromous fish due to the Project:

- fish passage with modified boards
- migration delays
- stranding
- adult entrainment
- large debris removal
- fish rescue plan
- predation
- water quality
- fisheries monitoring, and
- beneficial effects of floodplain habitat creation

Additionally, there will be adverse effects to designated critical habitat in the action area.

### **2.5.1. Effects of the Proposed Action to ESA-listed Anadromous Fish**

Although juvenile sDPS green sturgeon have never been observed in the action area, there is very little known about rearing, migratory behavior, and general emigration patterns of juvenile sDPS green sturgeon within the Lower Sacramento River region. In addition, fisheries monitoring data in the Sutter Bypass are limited and fishing efforts have primarily focused on

methods to capture and track salmonids. NMFS assumes juvenile sDPS green sturgeon have the potential to become entrained into the Sutter Bypass and onto study fields with high flows during a natural overtopping event. If they remain present in the study fields after floodwaters recede, they would be exposed to similar conditions as juvenile salmonids, and likely experience similar effects as analyzed in detail, below. Effects to adult sDPS green sturgeon are discussed in the “Adult Entrainment” and “Fish Rescue Plan” sections, below.

#### **2.5.1.1. Fish Passage with Modified Boards**

Under the Project, boards modified with a V-notch and 2-inch hole will be installed into each rice check drain box and in the terminal field drain to allow volitional passage for fish that are entrained during bypass flooding to move down stream off of the fields. Each time a fish navigates through a drain box it will navigate via one of two routes, over the modified board using the V-notch, if flows are sufficient, or through the 2-inch hole cut into the board. Each V-notch and 2-inch hole will be chamfered (edges will be cut at an angle) to eliminate the 90-degree sharp edge of each cut to reduce the potential for contact injury. The Project will also provide a continuous flow of water from a dedicated source into the study fields to maintain the minimum 10-inch depth needed to provide a passage route through the boards at all times. Any flow greater than a depth of 10 inches will flow through the notch until it gets to a depth equal to the height of the 12-inch board, and then it will flow over the modified boards to the next rice check drain box in the downstream field.

Similar modified boards have been used in previous rice field rearing studies and results suggest they allow volitional passage of juvenile Chinook salmon (Katz et al. 2014, California Trout et al. 2015). These previous studies noted that fish up to 130 mm length were able to pass the modified boards, including a juvenile steelhead measuring 120 mm in length (Jeffres 2021). However, they do not meet NMFS passage criteria for juvenile salmonids (NMFS 2011a), nor have they been evaluated in laboratory studies to determine the flow dynamics associated with flow through and over the boards.

It is also uncertain if the 2-inch holes will be completely or partially blocked or clogged with debris, minimizing or eliminating passage through the boards. Under the Project, inspections for blockages to volitional passage at the drain boxes and drainage conveyance will be conducted daily. Any debris observed will be cleared by hand, if possible, or with heavy equipment if needed for large debris. Effects associated with use of heavy equipment to remove debris is analyzed under “Large Debris Removal,” below.

Impingement of juvenile ESA-listed fish can occur if flow velocity exceeds their swimming capability, creating injurious contact with the modified boards. Impingement can result in injury to ESA-listed fish if they have direct contact with the boards that can result in abrasions, loss of mucus, loss of scales, damage to integument and internal damage (Stickney 1983, Kelsch and Shields 1996). Impingement can also occur if passage through the 2-inch holes is partially blocked with debris. The potential for and extent of injury to ESA-listed fish is directly related to the water velocities associated with the passage structure and the duration of impingement. NMFS’ juvenile salmonid passage criteria (NMFS 2011a) do not consider situations like

volitional passage through the modified boards, however, it does state that uniform flow distribution should avoid localized areas of high velocity in order to decrease the potential for impingement. Study fields will have uniform continuous water flow and, although velocities have not been recorded in previous studies, the amount of inflow water has been calculated to be low (i.e., less than 1 cfs).

Sufficient water depth is also necessary to allow fish to swim normally and to alleviate any adverse behavioral reaction that would decrease fitness and survival if water is too shallow. The NMFS juvenile salmonid passage criteria identify minimum depths for passage through many different types of infrastructure. However, there is no guidance or criteria directly applicable to floodplains where water tends to be shallower. While the NMFS (2011a) fish passage guidelines do not address retention of juveniles on the floodplain, Section 7.5.2.7 of that document calls out specific water depth requirements for juveniles should be a minimum of 0.5 feet, which is typically in water that moves through a culvert at velocities greater than 2 feet per second. Under the Project, water depths on the study fields will be required to maintain a minimum depth of 10 inches. If continual flow of water onto the study fields is not feasible to maintain the 10-inch minimum depth, the boards will be pulled, allowing the fields to drain and fish to migrate to the drainage conveyance channel (Conservation Measure 5), therefore, reducing the likelihood for effects associated with the lack of sufficient water depth for juvenile ESA-listed fish. To better understand the potential for injury or mortality associated with passage over or through the modified boards due to velocities or with blockage of volitional passage due to debris, monitoring is included in the Project. All juvenile fish passing through each drain box and the terminal box will be collected in a live-car trap and checked on a daily basis. In addition, UCD will PIT tag hatchery-origin juvenile fall-run Chinook salmon to track movement and monitor in-field survival on the study fields. Under adaptive management for the Project (Table 3 of the BA), if the monitoring indicates that juvenile salmonids cannot pass over the V-notch or through the 2-inch holes in a safe manner, NRCS, in collaboration with CRC and UCD, will consider design modifications to passage structures and/or modified boards to improve volitional passage.

Although the Project pilot program will test and refine guidelines, precise safe fish passage conditions through the modified boards and debris blockages remains unknown. Based on best available information and assumptions, NMFS expects that a small portion of juvenile ESA-listed fish would be injured or killed as a result of collisions with infrastructure or impingement during passage.

#### **2.5.1.2. Migration Delays**

Under the Project, modified boards will be installed, which will allow access between the study fields and canal, providing juvenile ESA-listed fish the opportunity to enter and leave. There are limited data available on natural-origin salmonids rearing on rice fields, and field management throughout the bypass varies. More data will be collected to provide more information on juvenile entrainment and outmigration during the Project. Marking (PIT or JSAT tags) and tracking of hatchery-origin fall-run Chinook salmon from the study fields through the Sutter Bypass and into the Sacramento River under the Project, will help to better understand the

potential for delayed river entry to occur with the use of modified boards in place. The Project is expected to minimize the extent of delayed migration.

Under baseline conditions following bypass flooding, Project study fields will be kept flooded for duck hunting or rice straw decomposition by using solid wooden boards (i.e., no V-notches or holes) within drainage boxes to contain the water. Solid boards do not provide volitional passage for juvenile salmonids and water depths will typically be 6 inches or less. Without volitional passage and sufficient water depth, NMFS assumes that any juvenile ESA-listed fish that naturally entrain into rice fields after flood waters recede under baseline conditions would likely result in mortality.

A potential cause of delayed passage is blockage by debris at the modified boards and other infrastructure during the containment period. Passage impediments or barriers can affect juvenile rearing and delay emigration of juvenile ESA-listed fish that are entrained in the study fields, which can impact fitness and survival. To reduce potential for migration delays caused by debris blockage, throughout the entire containment period, a daily inspection of the study fields will be completed. Inspections will include visual checks of all berms, drain boxes, modified boards and drainage channels to ensure that berms remain intact and that drain boxes, modified boards, and drainage conveyances are clear of debris and vegetation. If boards or water conveyances are blocked, debris will be removed to clear any blockage (Conservation Measure 5). Because inspections and associated clearing activities will be completed daily, the longest time period that blockages and associated migration delay to juvenile ESA-listed fish can occur is approximately 24 hours.

If the drain boxes or modified boards become repeatedly blocked (occurring more than once a week at any given location), UCD will contact NMFS to determine if additional actions should occur to remove blockages, or if the boards should be pulled and the study fields allowed to drain. If individual drain boxes or the drainage conveyance channel is blocked with large debris that inhibits volitional passage in-between checks or out of the field, heavy equipment will be deployed to the study field to remove it, with qualified fish biologists on site to ensure the least potential impact to ESA-listed fish. Effects to juvenile ESA-listed fish associated with the use of heavy equipment are addressed under “Debris Removal” below. If there is structural damage to any of the study field berms following containment that results in an inability to manage water in the field or maintain the minimum 10-inch water depth in each field without mechanical repair, the fields will be drained to allow fish to migrate to the drainage conveyance channel and cease testing of the guidelines (Conservation Measure 1).

NMFS expects the modified boards to provide some volitional passage opportunities for juvenile ESA-listed fish, and daily study field inspections and debris removal will maintain passage opportunities.

### 2.5.1.3. Stranding

Under the Project, on March 1, or earlier if habitat conditions degrade, all inflow of water to the study field will be stopped, all boards will be pulled from the drain boxes, and the field will be allowed to completely drain. Juvenile ESA-listed fish have the potential to become stranded on study fields during the draining process. Although specific stranding rates within seasonal bypasses is not well known, studies on natural and managed floodplains have studied the potential for fish, including juvenile Chinook salmon, to become stranded and have determined that some fish stranding occurs during descending limbs of the hydrograph or during individual field draining events (Holmes et al. 2021).

In a 4-year study along the Cosumnes River, researchers examined stranding on restored floodplains and found native fish are adapted to the natural hydrologic regimes of floodplains and rivers and, as such, shallow water habitat emigration is likely to be triggered by environmental cues (e.g., increases in floodplain water temperatures as the water recedes, decreases in water surface elevations) (Moyle et al. 2007). Native fish generally occurred in floodplain habitats from February to April, and emigrated from floodplain habitats rapidly (e.g., approximately one week or less) when daily maximum air temperatures rose from 68°F to 77°F (20°C to 25°C). Stranding was usually associated with the formation of isolated pools. In the event ESA-listed fish are stranded in pools during receding flows, they would be subject to injury or mortality from avian predation, increased competition for resources (such as food), and declining water quality conditions (e.g., elevated water temperatures). If isolated pools dry out completely, all ESA-listed fish stranded in the pools would incur mortality.

Studies on managed floodplains within the Yolo Bypass have monitored the potential for fish to become stranded within various interior landscapes of the bypass. These studies documented some juvenile fish stranding, including relatively small numbers of salmonids, occurring during the descending limbs of the hydrograph, and mostly in isolated earthen ponds or near engineered water control structures in the bypass (Sommer et al. 2005).

NMFS assumes under baseline conditions, that juvenile ESA-listed fish entrained on the study fields after flood waters recede will become permanently stranded due to the lack of volitional passage with solid boards in place.

Under the Project, the installation of modified boards will allow volitional passage and sufficient drainage rates to reduce the potential for stranding to occur. A recent study in rice fields within the Yolo Bypass compared three different drainage practices to determine if it was possible to create hydrologic cues to trigger juvenile salmonid out-migration (Holmes et al. 2021). Researchers found that rapidly draining the fields and not manipulating the inflow during field drainage improved hatchery-origin juvenile Chinook salmon survival, including a decrease in stranding, compared to the slower drain methods. Decreased survival in the slower draining fields was attributed to increased stranding, as well as vulnerability to predation and reduced thermal buffering due to prolonged exposure to shallower water depths. The study concluded that rapid drainage is the best method for successfully draining rice fields after artificially induced

flooding (Holmes et al. 2021). Based on these findings and the size of the study fields in the pilot program, the fields will include rapid draining, estimated to take approximately three to five days.

In the event juvenile ESA-listed fish are stranded on the floodplain, they will be subject to mortality from terrestrial or aquatic fish predation, and physiological stress or even death from declining water quality conditions (e.g., elevated water temperatures and low dissolved oxygen). Under the Project, UCD will monitor the study fields for stranding for the duration of the draining period (Conservation Measure 7). Additionally, under the Project, any depressions in the study fields will be repaired, if necessary, prior to bypass inundation (Conservation Measure 3), which will reduce the potential for ESA-listed fish to be stranded in pools on the fields during draining. However, it is likely some ESA-listed fish would get stranded in the rice fields during the draining process if they did not receive adequate cues. Therefore, NMFS expects that a small number of juvenile ESA-listed fish will experience physiological stress or be killed as a result of stranding during draining activities on the fields with the Project.

If juvenile ESA-listed fish are determined to be stranded, a Fish Rescue Plan will be implemented to minimize potential effects to juvenile ESA-listed fish (Conservation Measure 12). While implementing the Fish Rescue Plan will minimize stranding effects to juvenile ESA-listed fish, the use of nets during capture and relocation efforts can stress, injure or kill juvenile ESA-listed fish. Effects associated with capture and relocation of juvenile ESA-listed fish are analyzed under “Fish Rescue Plan” below.

#### **2.5.1.4. Adult Entrainment**

All ESA-listed adult salmonids and sDPS sturgeon have the potential to be present in the Sutter Bypass during the Project, however, CV spring-run Chinook salmon and CCV steelhead have the greatest potential to occur since they use the bypass as a migration corridor to Butte Creek. To reach their spawning grounds, CV spring-run Chinook salmon and CCV steelhead swim upstream from the Sacramento River through the borrow canals of Sutter Bypass into Butte Slough, which runs into Butte Creek. In addition to CV spring run Chinook salmon and CCV steelhead, adult winter run Chinook salmon and sDPS green sturgeon have the potential to migrate into the bypass and onto the study fields when high water events from the Sacramento River overtop Tisdale Weir and flood into the bypass resulting in false attraction flows. Once floodwaters recede, the study fields will become shallow open water containment areas with solid boards in place at each rice field check until the site can be accessed and replaced with the modified boards. Solid boards do not provide volitional passage for adult fish from the fields back to their migratory corridor in the bypass. Entrainment of ESA-listed adult fish may result in migratory delays or stranding. Following bypass flooding, after flood waters recede, an inspection will be completed prior to installation of the modified boards in part to survey for entrained adult fish (Conservation Measure 4). Because water depths in the field typically range from 10-12 inches, any adult ESA-listed fish entrained in the field will likely be observed. If adult ESA-listed fish (including greater than 1-year old juvenile salmonids or sDPS green

sturgeon) are observed entrained in the fields, the Fish Rescue Plan will be implemented as a remedial action.

The Project also has the potential to entrain ESA-listed adult fish on the study fields in the event of subsequent high-water overtopping events following installation of modified boards or with false attraction flows from continuous flows or during field drainage (less than 1 cfs). Although the boards have been modified to test juvenile fish passage, they do not provide volitional passage for adult fish. Therefore, following installation of the modified boards, daily inspections of the study fields will continue to monitor for entrained adults for the duration of Project implementation (Conservation Measure 6). Any ESA-listed adult fish observed on the study fields following subsequent high flow events will also be rescued and relocated using guidelines from the Fish Rescue Plan. While implementing the plan will minimize stranding effects from entrained ESA-listed adult fish, the use of nets during rescue and relocation efforts can stress, injure or kill adult ESA-listed fish. Effects associated with rescue and relocation of ESA-listed adult fish are analyzed under “Fish Rescue Plan” below. Currently, there have not been any observations for adult fish stranding and associated rescues in rice fields after overtopping events or during field drainage under typical board management practices (see “Environmental Baseline” above), however, fish rescue and relocation is included under the Project, improving survival of adult anadromous ESA-listed fish that are observed in the study fields.

#### **2.5.1.5. Large Debris Removal**

As mentioned above, following bypass flooding, an initial inspection of the field and water conveyance would be completed to ensure that water management can be conducted and that all water conveyance routes are free of debris and vegetation. If water management is not possible (i.e., berm failure), then the study would conclude and the field would be immediately drained. If water management is possible, but upon inspection, volitional passage out of the field is blocked (i.e., small debris, etc.), actions would be implemented immediately to clear the blockage, by hand if possible (Conservation Measure 4). However, heavy equipment (i.e., an excavator) may be needed to clear large debris (i.e., a fallen tree) that is blocking volitional passage at the modified board notch or hole if hand clearing is not successful. Use of heavy equipment could temporarily cause underwater noise and general disturbance, including effects to water quality (i.e., turbidity), immediately adjacent to and downstream from where it is operated. In addition, equipment could come directly into contact with fish, which could result in injury or mortality.

If heavy equipment is required to remove an item that is blocking volitional passage (e.g., a tree) at any of the drain boxes or within the drainage conveyance channel, then the area where work will occur will be isolated using blocking nets (Conservation Measure 10). Prior to placement of blocking nets, a qualified fish biologist will complete a pass through the work area with a seine net to collect and relocate juvenile ESA-listed fish under the Fish Rescue Plan. Effects associated with fish capture and relocation are analyzed in the “Fish Rescue Plan” section below. The qualified fish biologist will remain on site to ensure the least potential impact to juvenile ESA-listed fish throughout the blockage removal. Following any necessary capture and relocation efforts, equipment will be used to remove the debris. After removal of the blockage, if water



management of the study field is still possible (i.e., no structural damage), then guideline testing can continue, as proposed. If not, then the study fields will be drained.

Use of equipment to clear any blockages would result in temporary periods of increased noise levels. Anthropogenic noise can induce startle and alarm responses in fish (Scholik and Yan 2002), causing them to flee an area (Boussard 1981). Thus, increased noise can temporarily disrupt essential behavior patterns such as feeding and predator escapement. In addition, noise emanating from construction activities can temporarily reduce auditory sensitivity of some fish species (Scholik and Yan 2002) and interfere with signals that affect communication, behavior and fitness (Popper and Hastings 2009, Purser and Radford 2011). NMFS expects juvenile ESA-listed fish will be exposed to noise on the study fields during debris removal activities, however these activities would be brief (one to two days). ESA-listed fish exposed to short-term noise could result in modified behavior, injury or reduced fitness.

Fish tend to avoid highly turbid waters. At very high and sustained levels, elevated turbidity can reduce feeding and growth, displace juveniles, cause physiological stress and respiratory impairment and gill damage, reduce tolerance to disease and toxicants, reduce survival, and cause direct mortality (Sigler et al. 1984, Stern 1988, Newcombe and Jensen 1996, Bash et al. 2001, Madej et al. 2007). However, Bash et al. (2001) reported that the primary effect of increased turbidity on juvenile salmonids is irritation of the gills, and that direct lethality is unlikely. Juvenile fish may alter their migratory behavior by moving laterally or downstream to avoid turbid areas (Sigler et al. 1984). NMFS expects that most juvenile ESA-listed fish will actively avoid any elevated turbidity plumes, if possible. For those ESA-listed fish that do not or cannot avoid the turbid water, exposure is expected to be brief (i.e., minutes to hours) and not likely to cause injury or death from reduced growth or physiological stress. Once any ESA-listed fish migrate past the turbid water, normal feeding and migration behaviors are expected to resume.

Operation of power equipment, such as an excavator, in or near aquatic environments increases the potential for toxic substances to enter the aquatic environment and have negative effects on ESA-listed fish species. Spills of toxic substances could negatively affect ESA-listed fish, through injury or death. Effects from a hazardous substance spill that is not completely removed from the environment may remobilize at a later time, such as when heavy rain occurs. The Project includes the development of a hazardous materials spill prevention and countermeasures plan and will comply with the state National Pollutant Discharge Elimination System permit requirements (Conservation Measure 11). The Project includes daily inspections of all heavy equipment for leaks. As identified above, NMFS expects juvenile ESA-listed fish to avoid entering the surrounding area during construction activities. For those ESA-listed fish that do not or cannot avoid contact with hazardous materials if they spill into the water column and disperse across the study fields, exposure is expected to be acute (i.e., sudden but brief) and likely to cause injury or death from physiological stress. The inclusion of conservation measures are likely to reduce the potential for hazardous materials to enter the aquatic environment, thereby reducing the likelihood of exposure to juvenile ESA-listed fish.

Overall, in the event that heavy equipment is operated to remove a blockage to passage between and out of the study fields, the work area will first be isolated. Secondly, a Fish Rescue Plan will be implemented to ensure any juvenile ESA-listed fish captured will be relocated away from the work area to minimize direct contact with equipment resulting in injury or mortality. While implementing the plan will minimize effects to ESA-listed fish by reducing the likelihood of exposure from the heavy equipment activities, the use of nets during capture and relocation efforts can stress, injure or kill juvenile ESA-listed fish. Effects associated with the capture and relocation of ESA-listed juvenile fish are analyzed under “Fish Rescue Plan” below. In addition, any work to clear a blockage will be brief and, thus, expected to result in limited exposure to noise, turbidity, and hazardous material effects for ESA-listed juvenile fish nearby in the study field or downstream. Based on these considerations, effects associated with the use of heavy equipment to remove debris are considered temporary. However, it is expected that a small number of ESA-listed fish will exhibit modified behavior, or be injured or killed by disturbances associated with use of heavy equipment to remove large debris.

#### **2.5.1.6. Fish Rescue Plan**

Fish capture and relocation activities for ESA-listed juvenile fish would occur if any become stranded during study field dewatering, or prior to the use of heavy equipment to remove large debris from blocking volitional passage in the event it occurs between and out of study fields. The capture and relocation of ESA-listed fish associated with the Fish Rescue Plan could induce physiological stress, even when a qualified fish biologist performs the relocation. The use of seine nets during capture and relocation efforts can stress, injure or kill juvenile ESA-listed fish. Mechanisms for these potential effects include loss of mucus and scales, crushing, suffocation, and being gilled in the mesh of the seine nets.

Because of the variability and uncertainty associated with the cohort size of the species, annual variation in the timing of migration, and variability regarding individual habitat use of the action area, the actual number of individuals present in the study field section area during the time the Fish Rescue Plan is implemented, is not known. NMFS expects that a small number of ESA-listed fish will be harassed, injured, or killed in the event fish capture and relocation is needed.

Fish rescue and relocation activities for ESA-listed adult ESA-listed fish would occur if they become entrained on study fields after high water bypass overtopping events. The use of seine nets and additional equipment during rescue and relocation efforts can stress, injure or kill adult ESA-listed fish. Therefore, NMFS expects that a small number of adult ESA-listed fish will be harassed, injured, or killed as a result of rescue and relocation activities.

#### **2.5.1.7. Increased Predation**

The study fields are part of an open system that allows terrestrial and aquatic predators to access the area where juvenile ESA-listed fish will likely occur. Additionally, the study fields are uniform and provide limited habitat complexity for juvenile ESA-listed fish to seek refuge from predation. Under baseline conditions, containment with solids boards in place would concentrate

juvenile ESA-listed fish with avian, mammalian, or fish predators within the study fields. Predatory fish would not be able to pass from one field to another or out of the drainage conveyance with solid boards in place. However, the Project also has the potential to create concentrated conditions where predators can prey on juvenile ESA-listed fish rearing the study fields for prolonged periods of time.

Larger predatory fish would not be able to pass through the two-inch hole or V-notch in the modified boards. As such, most predatory fish will not be able to volitionally move from check to check. Instead, once predatory fish are entrained onto a study field, they will remain in the check to which they were entrained until the modified boards are pulled and the fields are allowed to drain. Therefore, with the modified boards in place, predators can also feed on juvenile ESA-listed fish as they migrate downstream through each check and into the drainage conveyance from the study field to the borrow canal.

All movement of juvenile fish between checks and out of the study field will occur while swimming downstream through a modified board located in each drain box. This can concentrate predatory fish with juvenile ESA-listed fish and create a predation hot spot within each check. Consolidating all fish into two specific locations within each check can increase predation opportunities due to use of the modified boards.

Birds are known to prey on juvenile salmonids in winter-flooded rice fields, as the ricelands are part of the winter habitat of bird populations in the Pacific flyway (Elphick 2008, Holmes et al. 2021). They are more likely to prey on juvenile salmonids in rice fields than adjacent riverine environments, and shallow waters make ESA-listed fish easy to prey upon. Previous studies have shown that flooded rice fields become avian predation hotspots in dry years while inundated aquatic habitat is limited in the regional landscape (Katz et al. 2013, Sommer et al. 2020). In wetter years, avian predation is greatly reduced because the birds have more areas to hunt for food (Sommer et al. 2020). Although less common, it is also possible for mammalian predators (e.g., otters) to prey on ESA-listed fish in the study fields. The number of ESA-listed fish susceptible to mammalian predation is not well documented.

While it is possible for predatory fish to hold in the area downstream of the drain boxes, their ability to prey upon juveniles ESA-listed fish swimming through the modified boards may be lessened because the large open area below the drain boxes will allow fish to swim in different directions once through the modified boards. In addition, live-car traps will be installed at the downstream side of the drain box which will reduce the potential for predation while testing the guidelines during the pilot program. Effects to juvenile ESA-listed fish associated with live-car traps are analyzed under “Fisheries Monitoring” below. It is also possible for mammals and avian predators to hunt near the drainage boxes where the ESA-listed fish would pass through. However, as mentioned above, juvenile ESA-listed fish will likely disperse as they swim through the hole and not congregate in the area of each drain box, reducing the potential for predation.

Juvenile ESA-listed fish in the study fields will also have the ability to pass through the terminal drainage box to enter into the drainage conveyance. Due to the placement of a modified board in

the terminal drainage box, juvenile ESA-listed fish can leave the study field and enter into the drainage conveyance, but cannot swim back into the study field once in the drainage conveyance. Drainage conveyances will vary in lengths, depths and widths for each study field but generally consist of a relatively small channel that connects the terminal drain box to the borrow canal. Predatory fish can use attraction flows from the study field to move from the borrow canal into the drainage conveyance or simply lie-in-wait in the borrow canal at the confluence of the drainage conveyance to more easily access juvenile ESA-listed fish. According to previous studies, relatively few predatory fish are expected to volitionally pass into the study fields during flooding, however, the borrow canal likely includes a significant year-round population of predatory fish (Feyrer et al. 2006).

Predation of juvenile ESA-listed fish will likely occur in the drainage conveyance as they move from the study field to the borrow canal. Since the drainage conveyance channels are relatively shallow and narrow, mammalian predators such as otters and raccoons can easily access fish as they swim through the channels to the borrow canal. Avian predators can also easily access the drainage conveyance where fish can be concentrated and would be able to locate prey in the shallow water. Potential effects to juvenile ESA-listed fish by avian predators may be less in years when the entire Sutter Bypass is inundated and multiple fields can be inhabited by bird populations in the Pacific Flyway.

Under baseline conditions, juvenile ESA-listed fish are expected to use study fields when the bypass floods. As such, these ESA-listed fish could also be subjected to predation within the shallow rice fields, in particular without volitional passage with solid boards in place. Although juvenile ESA-listed fish rearing on the study fields will have been exposed to greater amounts of predation under the baseline, encouraging rearing on these fields for an extended duration of time even with modified boards in place can expose juvenile ESA-listed fish to prolonged predation and have unknown long-term effects that have yet to be determined.

Based on these considerations, some juvenile ESA-listed fish can be preyed upon by avian, mammalian, or fish predators. More information will need to be collected to better understand predation effects while testing the guidelines. The Project includes several measures to study predation during testing of the guidelines. In-field monitoring of predatory fish using seines, fyke nets, live-car traps, and conducting tethering experiments using hatchery-origin fall-run Chinook salmon would be used to calculate predation rates on ESA-listed juvenile salmonids. Trail cameras will also be installed to document the presence of avian predators in the field and in the drainage conveyance. NMFS expects that a small amount of juvenile ESA-listed fish will be injured or killed as a result of predation associated with testing the guidelines during the pilot program.

#### **2.5.1.8. Water Quality**

As previously mentioned, after the bypass floods, high waters would recede to within borders of all study fields (i.e., containment). Modified boards would be used to maintain a minimum depth of 10 inches in the study field and allow for fish to leave the field when they desire. The grower

would use continuous maintenance flows until March 1 to ensure adequate passage and water quality conditions within the study field. The source of maintenance flows would originate from each grower's typical winter water source, which are sourced from direct diversions from the borrow canal or from groundwater pumping. If, for any reason, continuous maintenance flows cannot be provided, all testing of the guidelines would be terminated, modified boards would be pulled, and the study field would be allowed to drain completely.

To ensure juvenile ESA-listed fish entrained on study fields are not subjected to elevated water temperatures or low DO levels for multiple days, temperature loggers that record on a continuous 15-minute time-step would be installed within each check, approximately 10 meters (32.8 ft) from the inlet and outlet structure and in the center of each check. If water quality deteriorates on the study fields, ESA-listed fish will most likely be able to move volitionally away from areas with poor water quality as well as migrate off the study fields into the borrow canal, thereby reducing the potential for prolonged exposure to poor water quality conditions. Following bypass flooding, all temperature and DO data would be downloaded weekly at the outset of flooding through March 1. Additional temperature and DO data will be downloaded twice a week at a preselected sentinel check during the month of February when air temperatures start to rise. Previous research has shown that water temperature and DO conditions are similar in adjacent and nearby winter-flooded rice fields; thus, a sentinel approach captures general conditions of nearby fields.

The Project includes actions to alleviate poor water quality conditions if they occur. Poor water quality conditions are defined by the Project as when "water temperatures  $>20^{\circ}\text{C}$  or DO levels  $<2.0\text{ mg/L}$ " are recorded (daily maximum or minimum, respectively) for a period greater than three days during containment, upon which time the study fields would be allowed to drain, and testing of the guidelines would conclude (Conservation Measures 8, 9). If poor water quality conditions occur within the last two days of a weekly data download, then another download would occur within one to two days following the previous download. After an additional water quality data download is completed, a review of the data would be initiated on the same day to determine if poor water quality conditions continue to occur. If data show that thresholds for water temperature or DO have been exceeded for a third consecutive day, UCD would immediately drain the study field. Poor water quality conditions could occur throughout the time period in between data downloads, however, those conditions are unlikely based on previous studies (Cordoleani et al. 2019, 2020, 2021).

Based on three years of study within the Sutter Bypass, water temperatures in the interior portion of the bypass remain below  $20^{\circ}\text{C}$  through March 1 (Cordoleani et al. 2019, 2020, 2021). Maximum daily water temperatures first warmed to above  $20^{\circ}\text{C}$  during the warmest part of the day in mid-March within the wetland habitats, but the daily mean generally remained under  $17.5^{\circ}\text{C}$  through at least mid-March (Cordoleani et al. 2021). Several studies suggest the optimal temperatures for juvenile Chinook salmon growth occurs within the  $17.2\text{-}20^{\circ}\text{C}$  range (Marine and Cech 2004, Myrick and Cech 2004). Water temperatures greater than  $20^{\circ}\text{C}$  could result in sub-lethal effects such as slowed growth, delayed smoltification, desmoltification, and extreme physiological changes that can result in disease and increased predation (Myrick and Cech 2004).

Additional water quality concerns with impounding water on study fields include creating low DO conditions within the study fields. Based on 3 years of study within the Sutter Bypass, the DO in the drainage canals remained at 5 mg/L or higher during February and March (Cordoleani et al. 2019, 2020, 2021). Cordoleani et al. (2021) found that in wetland habitats within the bypass, which are comparable to rice fields, the mean DO was as low as 0 mg/L by late February, but there were large diurnal fluctuations in daily DO such that maximum DO was at least as high as 5 mg/L on most days. During the winter of 2016-2017, another study demonstrated similar findings on rice fields in both Yolo and Sutter bypasses as well as on the Willow Bend remnant floodplain along the eastern bank of the Sacramento River (Katz et al. 2017). Field and laboratory studies have found that avoidance reactions in juvenile salmonids consistently occur at concentrations of 5 mg/L and lower, and there is some indication that avoidance is triggered at concentrations as high as 6 mg/L Washington State Department of Ecology (WDOE 2002). These studies also found that when DO concentrations fall below a daily minimum of 5-6 mg/L they can result in sub-lethal effects such as slowed growth and significant changes to swim behavior.

According to the US Environmental Protection Agency, juvenile salmonid mortality begins to occur when dissolved oxygen concentrations are below 3 mg/L for periods longer than 3.5 days (USEPA 1986). A summary of various field study results by WDOE (2002) reports that significant mortality occurs in natural waters when DO concentrations fluctuate in the range of 2.5 - 3 mg/L. According to one short-term (1 - 4 hours) exposure study in warm water (20°C to 21°C), salmonids may require daily minimum oxygen levels to remain above 2.6 mg/L to avoid significant (50%) mortality (Burdick et al. 1954). From these and other types of studies, WDOE (2002) concluded that juvenile salmonid mortality can be avoided if daily minimum dissolved oxygen concentration remains above 3.9 mg/L, and the monthly or weekly average of minimum concentrations remains above 4.6 mg/L.

Lastly, stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may negatively affect salmonid and sturgeon reproductive success and survival rates (Dubrovsky et al. 1998, Daughton 2003). Many questions relating to the long-term effects of pesticides and herbicides used on agricultural fields on the Sutter Bypass remain unanswered. NMFS assumes that the juvenile ESA-listed fish rearing on the study fields would have been exposed to greater amounts of these chemicals under baseline conditions (solid boards in). However, encouraging rearing on these fields for an extended duration of time even with modified boards in place could also expose juvenile ESA-listed fish to chemicals for prolonged amounts of time and have unknown long-term effects.

Under baseline conditions, juvenile ESA-listed fish have access to the rice fields when the bypass floods. As such, these ESA-listed fish could be subjected to adverse water quality conditions within the shallow rice fields with solids boards in place during bypass flooding. If juvenile ESA-listed fish cannot migrate off of rice fields under baseline conditions, NMFS assumes these individuals would be subjected to adverse conditions resulting in mortality. While potential effects associated with changes or exposure to water quality due to water impoundment are assumed to be similar to those under some baseline conditions, juvenile ESA-listed fish may

not be able to avoid these conditions with the installation of the modified boards. Additionally, there are still some uncertainties with previous studies concerning water temperature and DO concentration tolerance levels as well as exposure to chemicals while juvenile ESA-listed fish are present within the study fields. Therefore, NMFS expects a small portion of juvenile ESA-listed fish will be injured or killed while subjected to poor water quality conditions as a result of the Project. Proposed monitoring and adaptive management will better inform effects associated with water quality conditions on juvenile ESA-listed fish during the pilot program.

Although ESA-listed adult fish are unlikely to become stranded within the study fields, CV spring-run Chinook salmon and CCV steelhead are likely to be present in the adjacent bypass borrow canal since it is the primary migration corridor to Butte Creek spawning grounds. Water released from the study fields during the drainage process will flow through the drainage conveyance channel downstream in the borrow canal as a result of the Project. As mentioned above, if poor water quality conditions occur, water will be drained from the study fields prior to March 1, which would expose any migrating adults present downstream in the borrow canal to water temperatures  $>20^{\circ}\text{C}$  or DO levels  $<2.0$  mg/L. As with juvenile ESA-listed fish, exposure to high water temperatures and low DO can result in injury or mortality to adult ESA-listed fish.

Under baseline conditions, the timing of rice field drainage in the Sutter Bypass is dependent on flooding events. Drainage occurs when farmers remove the boards from all drain boxes and water is allowed to flow to the terminal drain outlet and into a borrow canal. It is optimal for the growers to drain bypass fields by mid-March, to allow for drying and preparation of fields for the next growing season, however, field drainage can occur between February and late March, or even later in a wet year if the bypass becomes inundated. Because the timing of draining of rice fields in the Sutter Bypass is variable, and dependent on precipitation cycles in any given year, the baseline condition of these rice fields is also variable.

The exposure to poor water quality conditions for adult ESA-listed fish present in the borrow canal as a result of drainage practices with the Project are expected to be similar to the baseline condition, temporary (three to five days), and likely to improve when water released from the study fields mixes with water in the borrow canal where conditions are likely to be more suitable. Poor water quality conditions may also exist under the baseline condition on flooded rice fields in the action area and the timeframe for adult ESA-listed fish to be exposed to these conditions is likely similar to the Project (on or before March 1). Based on these considerations, any adult ESA-listed fish exposed to high water temperature and low dissolved oxygen in the borrow canal would be localized, temporary, and likely similar to baseline conditions. Therefore, NMFS anticipates a minimal effect on adult ESA-listed fish associated with exposure to poor water quality conditions as a result of the Project.

#### **2.5.1.9. Fisheries Monitoring**

An important aspect of the Project is the associated monitoring to document both beneficial and negative effects on ESA-listed fish. Most monitoring also has associated effects as discussed below. No adults are expected to be encountered during normal monitoring activities. Adults are

not expected to be present within the monitoring area during normal sampling activities. All fisheries monitoring would not occur until after inspection of study fields following natural bypass overtopping. Observed adults would be rescued and relocated, reducing the potential for adult ESA-listed fish to be captured in fisheries sampling gear.

#### **2.5.1.9.1. Effects of Seining, Fyke Netting, Live-Car Trap Sampling, and Associated Handling**

Seine sampling would be performed up to three times weekly within inundated fields to monitor for the presence of juvenile ESA-listed fish. Beach seining is a commonly used capture method for juvenile salmonids within the Central Valley. The USFWS has been using beach seining to monitor salmonids throughout the Delta for their Delta Juvenile Fish Monitoring Program (DJFMP) since the 1970s, and incidental mortalities of juvenile fish have remained low through the years, generally no more than 1-2 fish per species per year, with the number of seine hauls being in the hundreds (USFWS APPS reporting for 13791).

Fyke net sampling would also be performed up to three times weekly within inundated fields to monitor for the presence of juvenile ESA-listed fish as well as predatory fish. Fyke netting is a commonly used capture method for juvenile salmonids within the Central Valley. Fish captured within fyke nets experience less stress than other captured methods and are usually released unharmed (NMFS 2013). Incidental mortalities of juvenile ESA-listed fish are also likely low with this sampling method. However, ESA-listed fish are vulnerable to predation if the nets remain unchecked for long periods of time. UCD would check the fyke trap the following morning each time the nets are set up in the study fields.

Live-car trapping would occur passively at all times, and traps would be checked daily. Live-cars have active flow passing through them, so while capture is of minimal concern, predation is more likely to negatively affect juvenile ESA-listed fish with this trap method. The addition of a mesh predator exclusion box within should allow a respite for smaller fish to shelter from larger predatory fish, and is expected to reduce predation within the live-car.

All juvenile ESA-listed fish captured during seining, fyke netting, and live-car trap operations would be measured and weighed. After processing, all juvenile fish would be released to the general location in which they were captured or downstream of the trap. Handling would only be performed by biologists who have experience with ESA-listed fish capture and handling to minimize potential stress, injury, or mortality to juveniles. All fish processing would be completed using water taken directly from where seining and fyke netting was conducted or live trap was located to reduce stress from changes in temperature or DO. All juvenile fish would be released immediately after measurements were recorded and genetic samples collected.

Physical handling is known to be stressful to ESA-listed fish and could cause injury or death (Sharpe et al. 1998). Stress and the potential for injury or death to ESA-listed fish also increases rapidly from handling if the water temperature exceeds 18°C (64.4°F) or DO is below saturation (NMFS 2013). Improper handling can also result in injury or death. Improperly handled fish are



also more susceptible to developing diseases, which can lead to delayed mortality. Some of the injuries that can lead to disease are the loss of mucus, loss of scales, damage to integument and internal damage (Stickney 1983, Kelsch and Shields 1996). Although stress may increase the potential for vulnerability, after the fish is released, the recovery is thought to be fairly rapid, and residual effects from handling are typically minor and short-lived (Sharpe et al. 1998).

Potential stress, injury, and mortality of captured and handled juvenile ESA-listed fish during fish monitoring operations would be lessened by using qualified biologists to handle all ESA-listed fish and using water taken directly from the area where the fish has been captured. Despite protective measures, monitoring activities will require handling and processing, therefore, harassment, injury, and mortality of a small number of juvenile ESA-listed fish is expected.

#### **2.5.1.9.2. Effects from Fin-Clip Marking and Genetic Tissue Sampling**

All natural-origin juvenile Chinook salmon captured during seining, fyke netting, or in live car traps would be fin clipped to provide a tissue sample for genetic run identification to confirm run-type. Juvenile length-at-date fall-run Chinook salmon could also receive a second (partial) fin clip based on which check within the field it was captured as a means to track their movements through and out of the study field. The second and partial clip would be made in either the anal or adipose fin and would be made in such a way that the fish is clearly marked for later visual identification.

If fish grow faster or slower than expected, their length-at-date run identification can prove inaccurate when confirmed genetically. Length-at-date fall-run Chinook salmon could be genetically identified to be an ESA-listed species that was not the target species to be fin-clipped.

The potential for unintentional fin-clipping of winter-run Chinook salmon is less likely due to the larger size difference between winter-run and fall-run Chinook salmon. However, it is possible that spring-run Chinook salmon could be unintentionally fin-clipped, even though they are not intended to be tagged as part of the Project.

The effects of tissue sampling ESA-listed salmonids for genetic testing may include harassment, injury from handling, and damaged fins resulting in infection and delayed mortality. However, wounds caused by partial fin-clips generally heal quickly (NMFS 2013). Numerous studies have examined the effects of fin clipping on growth, survival, and behavior. The mortality rate typically depends on which fin is clipped. Increase mortality has been observed when pectoral, dorsal, or anal fins are clipped (Nicola and Cordone 1973). Although study results are somewhat variable, clipping fins does not generally affect fish growth (Brynildson and Brynildson 1967, Gjerde and Refstie 1988).

Tissue sampling juvenile winter-run and spring-run Chinook salmon during live-car trapping operations could result in stress and injury, which can lead to delayed mortality. These potential effects would be lessened by using qualified biologists to handle all fish, only taking fin clips from juvenile fish which appear to be in good condition and allowing the fish to fully recover before being released. Marking and tissue sampling activities are expected to cause harassment,

injury, and mortality to a small number of juvenile winter-run Chinook salmon and CV spring-run Chinook salmon.

### **2.5.1.9.3. Effects of Combined Fisheries Monitoring Methods**

The Project incorporates a variety of stressors on individual fish (capture, handle, fin-clip, tissue sample, and release). While each of the proposed methods have effects that are generally temporary, all carry a small risk of injury or death. When used in combination, those effects have the potential to accumulate and cause increased stress, increased risk of injury, and an increased risk of death.

Above, we discussed each separate method of monitoring and the associated risk, most carrying a small chance of mortality. When combined, each small chance of mortality, stressors, and injury can easily compound and make the risk of mortality for each fish higher than with any single activity alone. Therefore, effects due to fisheries monitoring are expected to result in harassment, harm from reduced fitness or survival, injury, and death for a small number of individual juvenile ESA-listed fish.

### **2.5.1.10. Beneficial Effects of Floodplain Habitat Creation**

In order to maximize food web productivity and to jump start fish food production, pre-flooding with the use of solid boards would be initiated in the study fields prior to bypass flooding. Modified boards would then be installed to retain water in the study fields following a flooding event in the Sutter Bypass. Modified boards would remain in place until the first bypass inundation or until March 1, whichever comes first. If the bypass does not flood for the entire season, pre-flooding would occur so that the highly productive prey-rich water could be released into the borrow canal on March 1 to benefit emigrating juvenile ESA-listed fish present in the floodplains. Two considerations are noted in section 6.2.10 of the BA: (1) growers initiate field preparation beginning in late September to early November and will have all fields drained by March 1 and (2) emigrating Butte Creek juvenile spring-run Chinook salmon are known to occur in the Sutter Bypass during this time. Also, pre-flooding may not be possible for some fields in some years due to water supply limitations.

Once the bypass is flooded and modified boards are in place in the study fields, increased food web production would be expected to continue based on ongoing management of the study fields. While maintenance flows continue to pass through the study fields, a continuous discharge of food-rich water from the fields would continue to flow into the borrow canal. On March 1, or when the study fields are drained, a final, large pulse of high production prey items would be released into the borrow canal.

The BA describes a “slow it down, spread it out, warm it up” approach which uses the modified boards to maintain inundation of the fields to increase food production. These increased inundation times have been shown to increase food web production on managed rice fields (Schemel et al. 2004, Sommer et al. 2004, Ahearn et al. 2006), which also resulted in increased growth rates for caged hatchery-origin juvenile fall-run Chinook salmon in previous studies

(Katz et al. 2017, Holmes et al. 2021). The BA refers to studies that showed how extensive the food web expands in the photic zone created by shallow floodplain habitat. These conditions enhance phytoplankton and drift invertebrate biomass, and zooplankton growth. Similar active management has shown to benefit food production, as demonstrated by the Knaggs Ranch experiments, which resulted in abundant plankton production on flooded rice fields after weeks of inundation (Katz et al. 2017, Sommer et al. 2020). Zooplankton densities in managed agricultural floodplains in Yolo Bypass were greater in density compared to samples taken from waters in the adjacent Sacramento River. The increased prey availability is expected to benefit rearing juvenile ESA-listed fish present in the action area by improving their fitness, health, and ability to avoid predators.

Since it has been shown that growth rates are high for Chinook salmon rearing in rice fields due to greatly increased prey abundance, NMFS expects the increase in food production to result in increased growth of juvenile ESA-listed fish that rear in floodplain habitat created in the study fields. In addition, UCD will mark (JSAT tags) and track how increased growth from hatchery-origin juvenile fall-run Chinook salmon rearing on study fields will correlate to improved survival to ocean entry.

### **2.5.2. Effects of the Proposed Action to Critical Habitat**

The action area is located within CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon critical habitat. CV spring-run Chinook salmon and CCV steelhead PBFs that occur within the action area are freshwater migration corridors and freshwater rearing sites. The sDPS green sturgeon PBFs that occur within the action area include food resources, water flow, water quality, migratory corridor, and sediment quality.

#### **2.5.2.1. Water Quality Effects to Critical Habitat with Floodplain Habitat Creation**

The use of the modified boards to hold shallow water and create floodplain habitat on the study fields would result in inundation of a portion of the bypass (action area) for a longer period of time. The shallow water habitat on the study fields will be supplemented with a continuous inflow of water from a dedicated source to maintain water elevations and provide flow over boards for volitional passage.

Under baseline conditions, water quality conditions in the action area can fluctuate and result in low DO levels and elevated temperature swings, especially in shallow water areas like the study fields. Fluctuations in water quality on the study fields would also occur under the Project, which can significantly reduce the quality of the rearing and migratory corridor PBFs for salmonids and food resources and migratory corridor PBFs for sDPS green sturgeon. If poor water quality conditions occur (i.e., daily maximum water temperatures  $>20^{\circ}\text{C}$  or daily minimum DO levels  $<2.0\text{ mg/L}$ ) for a period greater than three days during containment, the study fields would be drained, and testing of the guidelines would conclude (Conservation Measures 8, 9). Poor water quality conditions could occur throughout the time period in between data downloads, however, those conditions are unlikely based on previous studies (Cordoleani et al. 2019, 2020, 2021).

In addition, water quality conditions on the study fields could deteriorate under the Project if flows are too slow while fields are draining (three to five days) during the migration period. Potential impacts to these PBFs with exposure to poor water quality include reduced benthic invertebrate production, disrupted migration, and/or displacement (resulting in susceptibility to increased predation).

The borrow canal also serves as a migratory corridor PBF for salmonids and sDPS green sturgeon. As mentioned and defined above, if poor water quality conditions occur, water will be released from the study fields prior to March 1, and drained into the borrow canal. This can result in poor water quality traveling into adjacent and downstream migratory corridor PBFs for salmonids and sDPS green sturgeon. These conditions would be temporary (three to five days), and likely to improve when water released from the study fields mixes with water in the borrow canal where conditions are likely to be more suitable.

The Project will provide prolonged inundation in the study fields via the modified boards and continuous inflows. Water quality parameters on the fields, drainage conveyance, and borrow canal may not be ideal at times, and if poor water quality conditions occur, there could be temporary and localized adverse effects to critical habitat for salmonids and sDPS green sturgeon. Although long-term water quality parameters in the action area are not fully understood, without the Project, critical habitat in the study fields would not be passable due to solid boards in place. Since the critical habitats in the action area would be inundated and accessible, the Project is expected to benefit the rearing and migratory corridor PBFs for salmonids; and, food resources, water quality, water flow and migratory corridor PBFs for sDPS green sturgeon.

#### **2.5.2.2. Turbidity and Sedimentation Effects to Critical Habitat**

Proposed fisheries monitoring methods, emergency debris removal actions, and installation of modified boards may result in turbidity and sedimentation disturbances to rearing and migratory corridor PBFs for salmonids; and, food resources and migratory corridor PBFs for sDPS green sturgeon in the action area. The methods used for fisheries monitoring are expected to have temporary increases in turbidity and suspended sediment levels within the study fields and areas immediately downstream due to seine pulling, walking through wetted fields, and other associated activities. The use of heavy equipment to remove fish passage blockages (e.g., trees) from the study fields or drainage conveyance channel may result in similar turbidity and sedimentation effects within the vicinity of the work being performed in the study field or drainage conveyance. Likewise, the removal of solid boards from each individual drain box and installation of modified boards may also cause temporary increases in turbidity and suspended sediment levels within the study fields at these locations and areas immediately downstream.

The deposition of sediment is expected to temporarily reduce localized food availability and feeding efficiency due to the natural substrate being coated with a new layer of sediment. Short-term increases in turbidity and suspended sediment levels is expected to negatively impact rearing habitat and migratory corridor PBFs for salmonids; and, food resources, migratory

corridor, and sediment quality PBFs for sDPS green sturgeon temporarily through reduced availability of food and reduced feeding efficiency, which support juvenile growth and foraging opportunity.

Proposed monitoring, debris removal, and modified board installation will cause intermittent small-scale increases in turbidity through the duration of the Project. While small increases in turbidity may cause short-term, localized disturbances to rearing habitat and migratory corridor PBFs for salmonids; and, food resources and migratory corridor PBFs for sDPS green sturgeon on the study fields, effects are not expected to cause any long-term impacts to critical habitat for salmonids and sDPS sturgeon in the action area.

### **2.5.2.3. Beneficial Effects to Critical Habitat with Floodplain Habitat Creation**

The Project would result in temporary and small-scale benefits to the rearing habitat PBF for salmonids; and, the food resources PBF for sDPS green sturgeon by creating seasonally inundated floodplain habitat. Increasing the inundation period of the rice fields allows for the growth of invertebrates and zooplankton. This provides increased foraging opportunity, which improves the rearing and food resources PBFs in the action area.

## **2.6. Cumulative Effects**

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

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

### **2.6.1. Agriculture Practices and Water Diversions**

Agricultural practices within the action area are expected to continue and may degrade cover and water quality through the cumulative loss of riparian habitat due to bank stabilization projects, uncontrolled run-off, or the discharge of return flows with poor water quality. Agricultural run-off is expected to introduce contaminants such as herbicides, pesticides, petroleum products and other contaminants into the action area waterways. These potential activities and associated stressors are ongoing and expected to continue into the future. However, the extent of the effects from these activities is uncertain. It is not possible to predict the extent of the effects future non-Federal activities will have in the action area.

Existing and future non-Federal water withdrawals, diversions, and transfers within the action area may entrain, injure, or kill individual fish at unscreened, improperly screened, or poorly maintained diversions.

Activities that affect the flows in the Sutter Bypass, in particular the borrow ditches, are expected to continue. This includes DWR's management of water elevation, discharge from water diversions, and water withdrawal and discharges from agriculture which may strand fish or cause migratory delays.

### **2.6.2. Levee Maintenance**

Levee maintenance and bank protection activities can reduce floodplain connectivity, change substrate size, and decrease riparian habitat and shaded riverine aquatic cover.

## **2.7. Integration and Synthesis**

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

SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon have experienced significant declines in abundance and available habitat in the California Central Valley relative to historical conditions. The status of the species and critical habitat and environmental baseline sections (2.2 and 2.4) discuss the current range-wide status of these ESUs/DPSs and the current baseline conditions found in the Sutter Bypass, respectively, where the Project is to occur. Sections 2.2 and 2.4 discuss the vulnerability of listed species and critical habitat to climate change projections in the California Central Valley. In light of the predicted impacts of climate change, Central Valley salmonids are likely to be negatively affected by warmer temperatures (Lindley et al. 2007), especially those that spend the summer in freshwater.

### **2.7.1. Summary Status of SR winter-run Chinook salmon ESU**

The SR winter-run Chinook salmon ESU consists of only one population that is confined to the Sacramento River in California. The NMFS (2016b) 5-year Status Review of the SR winter-run Chinook salmon ESU demonstrated that the winter-run Chinook salmon ESU has further declined, and that continued loss of historical habitat and the degradation of remaining habitat continue to be major threats to the SR winter-run Chinook salmon ESU. NMFS concluded that winter-run ESU remains at high risk of extinction.

In recent years, efforts towards SR winter-run Chinook salmon recovery have been implemented, such as habitat improvements in Battle Creek and Yolo Bypass, and reintroduction into Battle Creek and the McCloud River (NMFS 2021b). However, the winter-run Juvenile Production

Estimate for brood year 2021 is significantly lower than previous years, due to factors such as low egg-to-fry survival, caused primarily by warm water temperatures and thiamine deficiency complex (NMFS 2022). The SR winter-run Chinook salmon ESU continues to be one of the most at-risk endangered species because it is composed of just one population that is a fraction of its historical size (NMFS 2021b).

As a single population, individuals using the action area and impacted by the Project are part of that population. Recovery of the population through threat abatement efforts and recovery actions should be considered a high priority. Given the susceptibility of the population to impacts, protection and enhancement of habitat for this population would be beneficial to the ESU.

### **2.7.2. Summary Status of CV spring-run Chinook salmon ESU and Designated Critical Habitat**

Historically, the majority of CV spring-run Chinook salmon in the Central Valley were produced in the Southern Sierra Nevada Diversity Group, which have since been extirpated (Lindley et al. 2007). Of 18 or 19 total historic independent populations of CV spring-run Chinook salmon distributed among four diversity groups, only three are extant (Mill, Deer, and Butte creeks) and they represent the Northern Sierra Nevada diversity group.

At the time of the NMFS (2016b) 5-year status review, the status of the CV spring-run Chinook salmon ESU had improved since the 2010 5-year status review. The improved status was primarily due to extensive restoration and increases in spatial structure with historically extirpated populations (Battle and Clear creeks) trending in the positive direction.

However, more recent declines of many of the dependent and independent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought, warm ocean conditions, and reorganization of coastal marine food webs are likely increasing the ESU's extinction risk. Escapement and total population abundance of CV spring-run Chinook salmon in the Central Valley has declined since the 2012-2016 drought. For example, escapement was significantly lower in 2017 (1,591 fish) and 2020 (3,242 fish) than the average escapement over the last 10 years (9,913 fish) (CDFW 2021).

Straying of FRFH spring-run Chinook salmon has also impacted some CV spring-run Chinook salmon populations. These conditions are likely to persist in future years, which will put additional pressure on the populations of CV spring-run Chinook salmon already experiencing depressed numbers.

Overall, the current status of CV spring-run Chinook salmon is similar to the 2016 status review, however the ESU's extinction risk may have increased, and is likely to increase over the next few years if there are not significant habitat and flow improvements.

### **2.7.3. Summary Status of CCV steelhead DPS and Designated Critical Habitat**

The 2016 status review (NMFS 2016a) concluded that overall, the status of CCV steelhead appears to have changed little since the 2011 status review and that CCV steelhead should

remain listed as threatened, as the DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Further, there is still a general lack of data on the status of wild steelhead populations. There are some encouraging signs, as several hatcheries in the Central Valley (such as Mokelumne River) have experienced increased returns of steelhead over the last few years. There has also been a slight increase in the percentage of wild steelhead in salvage at the south Delta fish facilities, and the percent of wild fish in those data remains much higher than at Chipps Island.

#### **2.7.4. Summary Status of sDPS green sturgeon**

The sDPS green sturgeon includes only one continuous spawning population located in the Upper Sacramento River. The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites in just a few locations (NMFS 2021a). The risk of extinction is still considered to be moderate, because although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices. There is a strong need for additional information regarding sDPS green sturgeon, especially concerning a robust abundance estimate, a greater understanding of their biology, and further information about their micro- and macro-habitat ecology.

#### **2.7.5. Summary Status of the Environmental Baseline and Cumulative Effects**

Listed salmonids primarily use the action area as a migration corridor and for rearing habitat. Within the action area, the PBFs of freshwater rearing and migration corridor for CV spring-run Chinook salmon and CCV steelhead have been transformed from historic floodplain habitat to a highly leveed system under varying degrees of constraint of riverine erosional processes and flooding, as well as controlled water releases upstream of Sutter Bypass. The change in the ecosystem as a result of halting the lateral migration of the river channel, the loss of floodplains, the removal of wetlands, riparian vegetation, and in-stream woody material have led to loss and alteration of rearing and migrating habitat through reduced flows, increased water temperatures, and limited prey abundance. These changes have likely affected the functional ecological processes that are essential for growth and survival of salmonids in the action area.

The PBFs of sDPS green sturgeon critical habitat include food resources, water quality, water flow, migratory corridor, and sediment quality. Habitat alterations mentioned above for salmonids similarly affect sDPS green sturgeon PBFs. Juvenile and subadult sDPS green sturgeon are not known to occupy Sutter Bypass but could potentially rear in the action area with the prolonged inundation of the rice fields. The Green Sturgeon Recovery plan lists the Sutter Bypass as an area where adult stranding should be reduced, and improvement of volitional passage at Sutter Bypass (Recovery Action 1b) (NMFS 2018).

The Cumulative Effects section of this opinion describes how continuing or future effects, such as the discharge of point and non-point source chemical contaminants discharges and increased urbanization affect the species in the action area. These actions typically result in habitat fragmentation, and conversion of complex nearshore aquatic habitat to simplified habitats that incrementally reduces the carrying capacity of migratory corridors.



### **2.7.6. Summary of Project Effects to Listed Species**

During Project implementation, some behavioral effects, as well as injury or death to individual fish, are likely to result. Study fields would be flooded when migrating adult and juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS green sturgeon are likely to be present, providing an increase in prey availability, but also subjecting individuals to poor water quality conditions and increased predation risk. In addition, during debris removal activities, turbidity is likely to increase, as well as physical disturbance. However, with the implementation of avoidance and minimization measures, impacts would be minimized and affect a low number of listed species. Survival of adult and juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS green sturgeon is expected to increase due to fish rescue activities.

SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS green sturgeon individuals may use the action area for rearing. Juveniles of these species would be susceptible to increased predation and decreased water quality. The proportion of the populations that will use the action area is unknown, since the spatial distribution of fish that rear in the bypass by the different fish species and life stages is unknown. Juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS green sturgeon may benefit from increased prey abundance from the prolonged inundation of the rice fields. However, it is certain that the Project increases the risk to rearing juvenile or migrating adult SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead and sDPS green sturgeon, resulting in adverse effects.

### **2.7.7. Summary of Project Effects to Critical Habitat**

The action area is within the critical habitat designation for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The relevant PBFs of the designated critical habitats for listed CV spring-run Chinook salmon and CCV steelhead are migratory corridors and rearing habitat, and the PBFs for sDPS green sturgeon habitat are food resources, water quality, water flow, migratory corridor, and sediment quality.

Based on the effects of the Project described previously in this opinion, the impacts are expected to improve and degrade designated critical habitat for and CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The quality of the current conditions of the PBFs in the action area are poor compared to historical conditions. In particular, levees, riprapping, dams, and removal of wetland and riparian vegetation have greatly diminished the value of the aquatic habitat in the action area by decreasing the quantity of rearing habitat, food resources via food-web degradation, and complexity and diversity of habitat forms necessary for holding and rearing (floodplain availability).

The Project would increase the amount of CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon rearing habitat and migratory corridors in the action area with prolonged rice field inundation, as discussed in the Effects of the Action section. These effects would last for a seasonal period of up to approximately three months (December 1 to March 1). The Project would increase the period of inundation on the study fields and would greatly increase the amount of available prey. However, it would also increase predation risk and water quality

impacts, resulting in both beneficial and adverse impacts to critical habitat for the above listed species (see Section 2.5.).

### **2.7.8. Summary of Risk to the DPS/ESU for each Species and Critical Habitat**

Small numbers from the multiple populations of CV spring-run in the Sacramento River Basin, CCV steelhead, the single population of SR winter-run Chinook salmon, and the sDPS green sturgeon that use the Sutter Bypass as non-natal rearing habitat are expected to be affected by the Project. The Salmonid Recovery Plan (NMFS 2014) identifies floodplain habitat as important for salmonid rearing as it contributes to higher juvenile growth rates and presumably higher ocean survival. The Green Sturgeon Recovery Plan (NMFS 2018) identifies the need to evaluate access to floodplain habitat for sDPS green sturgeon recruitment and growth. Non-natal rearing areas have potential for high recovery value, because they provide improved growing conditions, particularly during high winter flow events on the Sacramento River. Although the Sutter Bypass is not known to support a large number of salmonids or sDPS green sturgeon, the non-natal rearing habitat has the potential to provide important habitat for growth and rearing of juveniles of the ESUs/DPSs.

Even though there are long-term and short-term impacts to the listed ESUs/DPSs, the impacts are expected to be offset by the beneficial effects. Furthermore, the action area is a small fraction of the available habitat supporting the listed ESUs/DPSs. Therefore, when combining the adverse and beneficial effects associated with this Project, the environmental baseline and the cumulative effects, and taking into account the status of the species affected by the Project, the Project is not expected to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild, nor appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

### **2.8. Conclusion**

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon, or destroy or adversely modify designated critical habitats for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

### **2.9. Incidental Take Statement**

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly

disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering.” “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

### **2.9.1. Amount or Extent of Take**

In the opinion, NMFS determined that incidental take of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon is reasonably certain to occur due to the implementation of the Project. These include installation of modified boards, maintenance, fisheries monitoring, and draining of the fields. Because of the proposed timing of the Project, juveniles are expected to be present, but actual numbers of fish adversely affected by the Project are expected to be low. A small number of adults may be exposed to the Project while migrating up- or downstream.

While individual fish will be present in the action area, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the Project. This is due to the variability and uncertainty associated with the response of listed species to the effects of the Project, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates those elements of the Project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of incidental take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of temporary disturbance to fish and habitat during Project implementation, including fisheries monitoring and rescue activities and changes to water quality and flow. The appropriate surrogate is the total affected area, which is a maximum of 1,000 acres per year (including the 256-acre Neader Property and 110-acre Goose Club Property) for up to 2 years within water years 2022 through 2026.

The physical and behavioral impacts to fish that result from disturbance to fish and habitat are described below. NMFS anticipates that incidental take during Project implementation will be limited to the following forms:

1. Harassment, injury, or death to juvenile and adult SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are expected during fisheries monitoring and rescue activities, from December 1 to March 1. Capture and handling activities will subject fish to harm (resulting in reduced survival) or injury from increased predation when relocated.
2. Harm to juvenile and adult SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon from December 1 to March 1, when the rice fields are exposed to warm temperatures and low flows, resulting in water temperatures >20°C or

DO levels <2.0 mg/L for multiple days. These conditions will affect the behavior of listed fish, including migration delays and displacement, which are reasonably certain to result in increased predation risk resulting in decreased survival, decreased feeding resulting in reduced growth, and increased competition. If conditions persist for an extended time, it would result in death due to asphyxiation and desiccation.

3. Injury or death due to increased predation to juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon during draining activities or when poor water quality conditions occur (warm water temperatures, low DO, low flow resulting in shallow water). These conditions reduce juvenile fitness and mobility, making them susceptible to predation by avian or other predators.
4. Injury or death of a low number of juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon is expected to result from impingement when flow velocity exceeds the swimming capability of a fish, or blockages due to debris that creates injurious contact with the modified boards.
5. Harm and mortality to juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon is expected due to stranding (resulting in reduced survival) in the rice fields, when the boards are pulled and water is released downstream at the end of the season.
6. Harm (modified behavior and reduced fitness), injury, and mortality of juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon is anticipated due to temporary disturbances with use of heavy equipment on study fields.

A small proportion of juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon rearing in the action area, and a small number of adults are expected to be subjected to the incidental take described above. Incidental take will be exceeded if the amount of habitat disturbance (1,000 acres per year for up to 2 years within water years 2022-2026), or water quality thresholds (water temperatures >20°C or DO levels <2.0 mg/L for greater than three days), described as the ecological surrogates, is exceeded.

### **2.9.2. Effect of the Take**

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

### **2.9.3. Reasonable and Prudent Measures**

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

1. NRCS shall minimize impacts to listed species and their critical habitats from Project specific activities.

2. NRCS shall take measures to ensure implementation of the fisheries monitoring in section 3.5.2 of the BA, and adaptive management as detailed in section 3.6 in the BA.

#### **2.9.4. Terms and Conditions**

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The NRCS or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
  - a. NRCS shall provide a copy of this opinion to the NMFS-approved supervising biologist(s) and all other contractors involved in the Project, for education, information, and implementing all requirements and obligations included in this opinion.
  - b. Fish rescue operations shall be conducted according to the specifications provided in the NMFS-approved Fish Rescue Plan.
  - c. The NMFS-approved supervising biologist(s) shall oversee all aspects of fish handling, including fish monitoring and rescue activities.
  - d. During draining of the study fields, a qualified fish biologist shall be present on site to make observations, and capture/relocate fish if they become entrapped in the dewatered area.
  - e. Prior to trained fish biologists working onsite, a list of biologist names and credentials (e.g. resumes) shall be provided to and approved by NMFS.
  - f. No fisheries monitoring activities shall occur when poor water quality conditions exist (water temperatures  $>20^{\circ}\text{C}$  or DO levels  $<2.0\text{ mg/L}$ ).
  - g. NRCS shall convene a Water Quality Team to evaluate water temperature and dissolved oxygen conditions observed on the study fields if water quality thresholds (water temperatures  $>20^{\circ}\text{C}$  or DO levels  $<2.0\text{ mg/L}$  for greater than three days) are approached (when water temperature  $>18^{\circ}\text{C}$  or DO  $<6\text{ mg/L}$ ). The Water Quality Team shall include representatives from NMFS and UCD.
  - h. Water velocities shall be measured at the V-notch and 2-inch holes in order to determine what velocities (in feet per second) juvenile salmonids are exposed to during volitional passage at modified boards. Measurements shall be taken (at least weekly) that would provide the range of velocities that persist in the study field.
  - i. If volitional passage is not feasible for juvenile fish through or over the modified boards, the boards shall be re-modified with discussion and agreement with NMFS. This could include increasing the size of the V-notches and/or holes.
2. The following terms and conditions implement reasonable and prudent measure 2:
  - a. NRCS shall provide a summary report to NMFS by November 1 of each year of implementation. The summary report shall include each biological objective, how the objective would be monitored, the metric for measurement, the goal, the intervention

threshold for determining if a management response is necessary, and the potential management response as listed in Table 3 under Adaptive Management of the BA. While reporting on these objectives, NRCS shall include:

- i. Number and size of fish observed in the study fields during fisheries monitoring.
  - ii. Number of tagged fish (PIT and JSAT).
  - iii. Survival results of the tag studies: number of fish and percent of total tagged.
  - iv. Number of juvenile, greater than 1-year old juvenile, and adult ESA-listed fish rescued and relocated under the Fish Rescue Plan.
- b. NRCS shall identify future rice field study site locations at least 30 days prior to the start of seasonal Project activities for each Project implementation year. This information can be sent electronically to [ccvo.consultationrequests@noaa.gov](mailto:ccvo.consultationrequests@noaa.gov).
- c. Any observed injured or dead fish shall be reported to NMFS within 24 hours of observation.

Electronically to the NMFS CCVO at [ccvo.consultationrequests@noaa.gov](mailto:ccvo.consultationrequests@noaa.gov)

Or mailed to:

Cathy Marcinkevage  
Assistant Regional Administrator  
National Marine Fisheries Service  
California Central Valley Office  
650 Capitol Mall, Suite 5-100  
Sacramento CA 95814  
FAX: (916) 930-3629  
Phone: (916) 930-3600

## 2.10. Conservation Recommendations

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

1. NRCS should use biodegradable lubricants and hydraulic fluid in equipment and vehicles. The use of petroleum alternatives can greatly reduce the risk of contaminants directly or indirectly entering the aquatic ecosystem.
2. NRCS should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid and sDPS sturgeon habitat restoration projects within the Central Valley.

3. NRCS should identify ways to provide and/or improve adult fish passage through the Sutter Bypass, allowing for improved adult salmonid migration to spawning grounds in Butte Creek or re-entry into the Sacramento River.

## **2.11. Reinitiation of Consultation**

This concludes formal consultation for the Ricelands Juvenile Salmonid Rearing Technical Guidelines and Management Activity Specifications Research Project.

Under 50 CFR 402.16(a): “Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action.”

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

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

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

### 3.1. Essential Fish Habitat Affected by the Project

The geographic extent of freshwater EFH for Pacific salmon in the California Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers et al. (1998), and for the action area within the Sutter Bypass includes the Sacramento-Stone Corral hydrologic unit (HUC 18020104) as well as the western portions of the Honcut Headwaters-Lower Feather hydrologic unit (HUC 18020159). SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CV fall-run Chinook salmon and late fall-run Chinook salmon, are species managed under the Pacific Coast Salmon FMP and occur in these two units. Habitat Areas of Particular Concern (HAPCs) that may be either directly or indirectly adversely affected include complex channels and floodplain habitats.

### 3.2. Adverse Effects on Essential Fish Habitat

The effects of the Project on Pacific salmon EFH will be similar to those discussed in the Effects of the Action section (2.5) for Chinook salmon. Based on the information provided, NMFS concludes that the Project would adversely and beneficially affect EFH for federally managed Pacific salmon. Adverse and beneficial effects to the complex channels and floodplain habitat HAPC for Pacific salmon EFH (including fall and late fall-run Chinook salmon) are appreciably similar to effects to critical habitat for ESA-listed Chinook salmon, therefore no additional discussion is included. Listed below are the adverse effects on EFH reasonably certain to have occurred and/or occur in the future as a result of the Project:

1. Installation of modified boards  
Lack of habitat complexity  
Degraded water quality  
Turbidity
2. Floodplain Habitat Creation  
Increase in aquatic macroinvertebrate production (Beneficial)  
Increase in available habitat (Beneficial)
3. Fisheries Monitoring and Heavy Debris Removal  
Noise  
Sedimentation  
Turbidity

### 3.3. Essential Fish Habitat Conservation Recommendations

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

1. NRCS should work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the Sutter Bypass.



2. To support floodplain HAPCs, NRCS should promote the restoration of degraded floodplains and wetlands, and the reconnection of migration channels and the Sacramento River to disconnected floodplains and wetlands whenever possible.

Fully implementing these EFH conservation recommendations would protect up to 1,000 acres of designated EFH within the action area each year, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

### **3.4. Statutory Response Requirements**

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

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

### **3.5. Supplemental Consultation**

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

## **4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW**

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

### **4.1. Utility**

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are NRCS. Other interested users could include the CRC and UCD. Individual copies of this opinion were

provided to the NRCS. The document will be available within two weeks at the [NOAA Library Institutional Repository](#). The format and naming adheres to conventional standards for style.

#### 4.2. Integrity

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

#### 4.3. Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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